

Guard Lock Safety-door Switch D4JL

World's Top* Holding Force of 3,000 N

*For plastic models, as of May 2005

- Two safety circuits and two monitor contacts provide an array of monitoring patterns.
- Standard gold-clad contacts enable use with ordinary loads and microloads.
- Models with trapped keys prevent workers from being locked in hazardous work areas.
- Models with rear release buttons allow people to unlock the Switch and escape if they are locked into hazardous areas.
- IP67 degree of protection

Note: Be sure to read the "Safety Precautions" on page 19 and the "Precautions for All Safety Door Switches".



NEW

Features

Plastic Guard Lock Safety-door Switches Rank Among the Strongest in the World

A holding force of 3,000 N makes these Switches suitable for large, heavy doors.

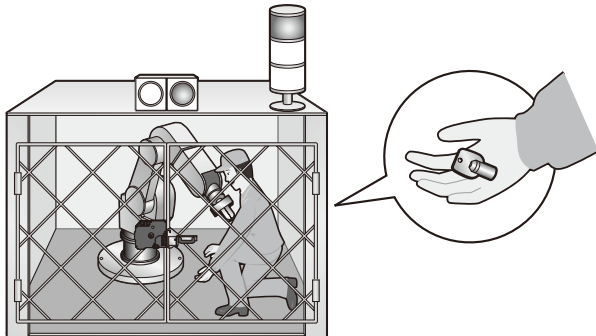


Models with Trapped Keys (See page 5 for a list of models.)

OMRON also offers Trapped Key Switches (on mechanical lock models only).

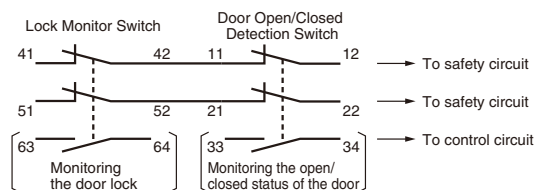
As long as a person has the trapped key when he enters a hazardous area, he does not have to worry about somebody locking the door and trapping him inside. The door can be opened only by supplying power to the solenoid and then turning the trapped key to unlock the D4JL.

There are thirty different types of trapped keys available for use in applications with adjacent hazardous areas.



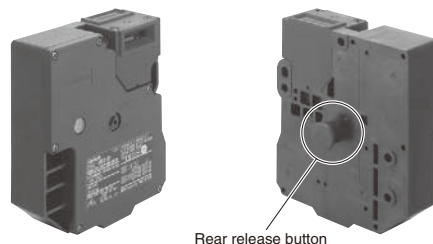
Two Safety Circuits and Two Monitor Contacts

The D4JL has two safety circuits. It also has two contacts to separately monitor the open/closed status of the door and the status of the lock.

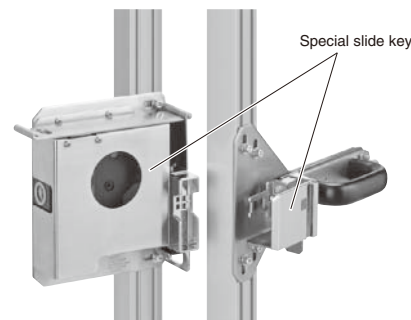


Models with Rear Release Buttons (See page 4 for a list of models.)

A Switch with a rear release button allows the door to be unlocked from inside a hazardous area in an emergency. OMRON also offers Switches with Special Slide Keys. Refer to the "D4NS-SK/D4JL-SK" for details.



Rear release button



Special slide key

Model Number Structure

■ Model Number Legend

Switches

D4JL-□□□□-□□-□□
 1 2 3 4 5 6 7

1. Conduit Size

- 1: Pg13.5
- 2: G1/2
- 3: 1/2-14NPT (See note 2.)
- 4: M20

2. Built-in Switch

- N: 2NC/1NO slow-action contacts plus 2NC/1NO slow-action contacts
- P: 2NC/1NO slow-action contacts plus 3NC slow-action contacts
- Q: 3NC slow-action contacts plus 2NC/1NO slow-action contacts
- R: 3NC slow-action contacts plus 3NC slow-action contacts

3. Head Material

- F: Plastic

4. Door Lock and Release

- A: Mechanical lock/24-VDC solenoid release
- G: 24-VDC Solenoid lock/Mechanical release

5. Indicator

- C: 24 VDC (green LED indicator)
- D: 24 VDC (orange LED indicator)

6. Release Key Type

- 5: Special release key (See note 3).
- 6: Special release key plus rear release button (See note 3).
- 7: Trapped key

7. Trapped Key Type

- 01 to 30: 30 types (See note 4.)

Note: 1. A 24-VDC solenoid lock cannot be combined with a trapped key.

A 24-VDC solenoid lock cannot be combined with a special release key and rear release button.

- 2. Models with M20 conduits come with an M20 to 1/2-14NPT Adaptor.
- 3. Release keys are provided.
- 4. Thirty types of trapped keys can be manufactured. Specify the trapped key type in numerical order starting from 01 when ordering.

Operation Keys

D4JL-K□
 1

1. Operation Key Type

- 1: Horizontal mounting
- 2: Vertical mounting

Ordering Information

■ Switches (Operation Keys are sold separately.)

Standard Models

Release key type	Indicator	Lock and release types	Contact configuration (door open/closed detection switch and lock monitor switch contacts)	Conduit opening	Model
Special release key	Green	Mechanical lock Solenoid release	2NC/1NO+2NC/1NO	PG13.5	D4JL-1NFA-C5
				G1/2	D4JL-2NFA-C5
				1/2-14NPT	D4JL-3NFA-C5
				M20	D4JL-4NFA-C5
			2NC/1NO+3NC	PG13.5	D4JL-1PFA-C5
				G1/2	D4JL-2PFA-C5
				1/2-14NPT	D4JL-3PFA-C5
				M20	D4JL-4PFA-C5
			3NC+2NC/1NO	PG13.5	D4JL-1QFA-C5
				G1/2	D4JL-2QFA-C5
				1/2-14NPT	D4JL-3QFA-C5
				M20	D4JL-4QFA-C5
		Solenoid lock Mechanical release	2NC/1NO+2NC/1NO	PG13.5	D4JL-1RFA-C5
				G1/2	D4JL-2RFA-C5
				1/2-14NPT	D4JL-3RFA-C5
				M20	D4JL-4RFA-C5
			2NC/1NO+3NC	PG13.5	D4JL-1NFG-C5
				G1/2	D4JL-2NFG-C5
				1/2-14NPT	D4JL-3NFG-C5
				M20	D4JL-4NFG-C5
			2NC/1NO+3NC	PG13.5	D4JL-1PFG-C5
				G1/2	D4JL-2PFG-C5
				1/2-14NPT	D4JL-3PFG-C5
				M20	D4JL-4PFG-C5
			3NC+2NC/1NO	PG13.5	D4JL-1QFG-C5
				G1/2	D4JL-2QFG-C5
				1/2-14NPT	D4JL-3QFG-C5
				M20	D4JL-4QFG-C5
			3NC+3NC	PG13.5	D4JL-1RFG-C5
				G1/2	D4JL-2RFG-C5
				1/2-14NPT	D4JL-3RFG-C5
				M20	D4JL-4RFG-C5
	Orange	Mechanical lock Solenoid release	2NC/1NO+2NC/1NO	PG13.5	D4JL-1NFA-D5
				G1/2	D4JL-2NFA-D5
				1/2-14NPT	D4JL-3NFA-D5
				M20	D4JL-4NFA-D5
			2NC/1NO+3NC	PG13.5	D4JL-1PFA-D5
				G1/2	D4JL-2PFA-D5
				1/2-14NPT	D4JL-3PFA-D5
				M20	D4JL-4PFA-D5
			3NC+2NC/1NO	PG13.5	D4JL-1QFA-D5
				G1/2	D4JL-2QFA-D5
				1/2-14NPT	D4JL-3QFA-D5
				M20	D4JL-4QFA-D5
			3NC+3NC	PG13.5	D4JL-1RFA-D5
				G1/2	D4JL-2RFA-D5
				1/2-14NPT	D4JL-3RFA-D5
				M20	D4JL-4RFA-D5
		Solenoid lock Mechanical release	2NC/1NO+2NC/1NO	PG13.5	D4JL-1NFG-D5
				G1/2	D4JL-2NFG-D5
				1/2-14NPT	D4JL-3NFG-D5
				M20	D4JL-4NFG-D5
			2NC/1NO+3NC	PG13.5	D4JL-1PFG-D5
				G1/2	D4JL-2PFG-D5
				1/2-14NPT	D4JL-3PFG-D5
				M20	D4JL-4PFG-D5
			3NC+2NC/1NO	PG13.5	D4JL-1QFG-D5
				G1/2	D4JL-2QFG-D5
				1/2-14NPT	D4JL-3QFG-D5
				M20	D4JL-4QFG-D5
			3NC+3NC	PG13.5	D4JL-1RFG-D5
				G1/2	D4JL-2RFG-D5
				1/2-14NPT	D4JL-3RFG-D5
				M20	D4JL-4RFG-D5

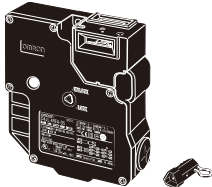
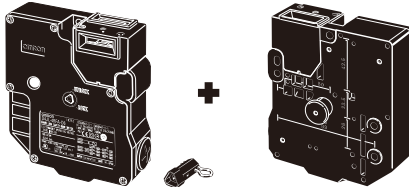
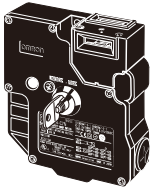
Models with Rear Release Buttons

Release key type	Indicator	Lock and release types	Contact configuration (door open/closed detection switch and lock monitor switch contacts)	Conduit opening	Model
Special release key	Green	Mechanical lock Solenoid release	2NC/1NO+2NC/1NO	PG13.5	D4JL-1NFA-C6
				G1/2	D4JL-2NFA-C6
				1/2-14NPT	D4JL-3NFA-C6
				M20	D4JL-4NFA-C6
			2NC/1NO+3NC	PG13.5	D4JL-1PFA-C6
				G1/2	D4JL-2PFA-C6
				1/2-14NPT	D4JL-3PFA-C6
				M20	D4JL-4PFA-C6
			3NC+2NC/1NO	PG13.5	D4JL-1QFA-C6
				G1/2	D4JL-2QFA-C6
				1/2-14NPT	D4JL-3QFA-C6
				M20	D4JL-4QFA-C6
			3NC+3NC	PG13.5	D4JL-1RFA-C6
				G1/2	D4JL-2RFA-C6
				1/2-14NPT	D4JL-3RFA-C6
				M20	D4JL-4RFA-C6
	Orange		2NC/1NO+2NC/1NO	PG13.5	D4JL-1NFA-D6
				G1/2	D4JL-2NFA-D6
				1/2-14NPT	D4JL-3NFA-D6
				M20	D4JL-4NFA-D6
			2NC/1NO+3NC	PG13.5	D4JL-1PFA-D6
				G1/2	D4JL-2PFA-D6
				1/2-14NPT	D4JL-3PFA-D6
				M20	D4JL-4PFA-D6
			3NC+2NC/1NO	PG13.5	D4JL-1QFA-D6
				G1/2	D4JL-2QFA-D6
				1/2-14NPT	D4JL-3QFA-D6
				M20	D4JL-4QFA-D6
			3NC+3NC	PG13.5	D4JL-1RFA-D6
				G1/2	D4JL-2RFA-D6
				1/2-14NPT	D4JL-3RFA-D6
				M20	D4JL-4RFA-D6

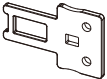

Models with Trapped Keys

Release key type	Indicator	Lock and release types	Contact configuration (door open/closed detection switch and lock monitor switch contacts)	Conduit opening	Model
Trapped key (See note.)	Green	Mechanical lock Solenoid release	2NC/1NO+2NC/1NO	PG13.5	D4JL-1NFA-C7-01
				G1/2	D4JL-2NFA-C7-01
				1/2-14NPT	D4JL-3NFA-C7-01
				M20	D4JL-4NFA-C7-01
			2NC/1NO+3NC	PG13.5	D4JL-1PFA-C7-01
				G1/2	D4JL-2PFA-C7-01
				1/2-14NPT	D4JL-3PFA-C7-01
				M20	D4JL-4PFA-C7-01
			3NC+2NC/1NO	PG13.5	D4JL-1QFA-C7-01
				G1/2	D4JL-2QFA-C7-01
				1/2-14NPT	D4JL-3QFA-C7-01
				M20	D4JL-4QFA-C7-01
			3NC+3NC	PG13.5	D4JL-1RFA-C7-01
				G1/2	D4JL-2RFA-C7-01
				1/2-14NPT	D4JL-3RFA-C7-01
				M20	D4JL-4RFA-C7-01
	Orange		2NC/1NO+2NC/1NO	PG13.5	D4JL-1NFA-D7-01
				G1/2	D4JL-2NFA-D7-01 (See note 2.)
				1/2-14NPT	D4JL-3NFA-D7-01
				M20	D4JL-4NFA-D7-01
			2NC/1NO+3NC	PG13.5	D4JL-1PFA-D7-01
				G1/2	D4JL-2PFA-D7-01 (See note 2.)
				1/2-14NPT	D4JL-3PFA-D7-01
				M20	D4JL-4PFA-D7-01
			3NC+2NC/1NO	PG13.5	D4JL-1QFA-D7-01
				G1/2	D4JL-2QFA-D7-01 (See note 2.)
				1/2-14NPT	D4JL-3QFA-D7-01
				M20	D4JL-4QFA-D7-01
			3NC+3NC	PG13.5	D4JL-1RFA-D7-01
				G1/2	D4JL-2RFA-D7-01 (See note 2.)
				1/2-14NPT	D4JL-3RFA-D7-01
				M20	D4JL-4RFA-D7-01

Note: 1. Thirty types of trapped keys can be manufactured. Specify the trapped key type in numerical order starting from 01 when ordering.
2. Models with Korean S-mark certification.

Release key position	Front	Front and rear release button	Front
Release key type	Special release key	Special release key	Trapped key
Switch appearance			

Operation Keys

Type	Model
Horizontal mounting 	D4JL-K1
Vertical mounting 	D4JL-K2

Specifications

■ Standards and EC Directives

Conforms to the following EC Directives

- Machinery Directive
- Low Voltage Directive
- EN 1088
- EN 60204-1
- GS-ET-19
- CCC

Certified Standards

Certification body	Standard	File No.
TÜV Product Service	EN 60947-5-1 (certified direct opening)	Consult your OMRON representative for details.
UL (See note 1.)	UL 508, CSA C22.2 No.14	
CQC (CCC)	GB14048.5	2005010305167533
KOSHA (See note 2.)	EN60947-5-1	2005-196

Note: 1. CSA C22.2 No. 14 was certified by UL.
2. Only certain models have been certified.

■ Certified Standard Ratings

TÜV (EN 60947-5-1)

Item	Utilization category	AC-15	DC-13
Rated operating current (Ie)		3 A	0.27 A
Rated operating voltage (Ue)		240 V	250 V

Note: Use a 10-A fuse type gI or gG that conforms to IEC 60269 as a short-circuit protection device. This fuse is not built into the Switch.

UL/CSA (UL 508, CSA C22.2 No. 14)

A300

Rated voltage	Carry current	Current (A)		Volt-amperes (VA)	
		Make	Break	Make	Break
120 VAC	10 A	60	6	7,200	720
240 VAC		30	3		

Q300

Rated voltage	Carry current	Current (A)		Volt-amperes (VA)	
		Make	Break	Make	Break
125 VDC	2.5 A	0.55	0.55	69	69
250 VDC		0.27	0.27		

Solenoid Coil Characteristics

Item	Type	24 VDC
Rated operating voltage (100% ED)		24 VDC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$
Current consumption		Approx. 200 mA
Insulation		Class F (130°C max.)

Indicator Characteristics

Item	Type	LED	
Rated voltage	24 VDC	24 VDC	24 VDC
Current consumption	Approx. 1 mA	Approx. 8 mA	Approx. 8 mA
Color (LED)	Orange	Green	Green

■ Characteristics

Degree of protection (See note 2.)		IP67 (EN60947-5-1) (This applies for the Switch only. The degree of protection for the key hole is IP00.)
Durability (See note 3.)	Mechanical	1,000,000 operations min. (trapped key: 10,000 operations min., rear release button: 3,000 operations min.)
	Electrical	500,000 operations min. (3-A resistive load at 250 VAC) (See note 4.)
Operating speed		0.05 to 0.5 m/s
Operating frequency		30 operations/minute max.
Direct opening force (See note 5.)		60 N min. (EN60947-5-1)
Direct opening travel (See note 5.)		15 mm min. (EN60947-5-1)
Holding force (See note 6.)		3,000 N min.
Contact resistance		25 mΩ max. (per contact)
Minimum applicable load (See note 7.)		1-mA resistive load at 5 VDC (N-level reference value)
Rated insulation voltage (U _i)		300 V (EN60947-5-1)
Rated frequency		50/60 Hz
Protection against electric shock		Class II (double insulation)
Pollution degree (operating environment)		3 (EN60947-5-1)
Impulse withstand voltage (EN60947-5-1)	Between terminals of same polarity	2.5 kV
	Between terminals of different polarity	4 kV
	Between other terminals and non-current carrying metallic parts.	6 kV
Insulation resistance		100 MΩ min. (at 500 VDC)
Contact gap		2 × 2 mm min.
Vibration resistance	Malfunction	10 to 55 Hz, 0.75-mm single amplitude
Shock resistance	Destruction	1,000 m/s ² min.
	Malfunction	80 m/s ² min.
Conditional short-circuit current		100 A (EN60947-5-1) (See note 8.)
Conventional free air thermal current (I _{th})		10 A (between terminals 12 and 41), 3 A (between all other terminals) (EN60947-5-1)
Ambient operating temperature		–10 to +55°C (with no icing)
Ambient operating humidity		95% max.
Weight		Approx. 650 g (D4JL-4NFA-C7-01)

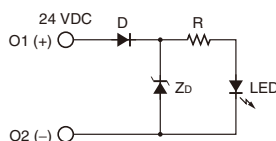
Note: 1. The above values are initial values.

2. The degree of protection is tested using the method specified by the standard (EN60947-5-1). Confirm that sealing properties are sufficient for the operating conditions and environment beforehand. Although the switch box is protected from dust or water penetration, do not use the D4JL in places where foreign material may enter through the key hole on the head, otherwise Switch damage or malfunctioning may occur.
3. The durability is for an ambient temperature of 5 to 35°C and an ambient humidity of 40% to 70%. For further conditions, consult your OMRON sales representative.
4. Do not pass a 3-A, 250-VAC load through more than two circuits.
5. These figures are minimum requirements for safe operation.
6. This figure is based on the GS-ET-19 evaluation method.
7. This value will vary with the switching frequency, environment, and reliability level. Confirm that correct operation is possible with the actual load beforehand.
8. Use a 10-A fuse type gI or gG that conforms to IEC 60269 as a short-circuit protection device.

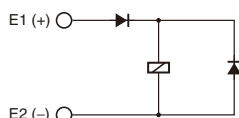
Connections

Internal Circuit Diagram

Indicator



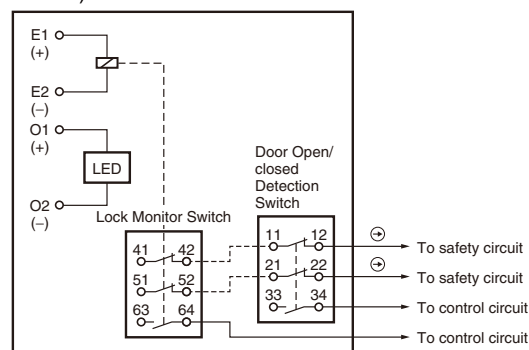
Solenoid



Circuit Connection Example

(Examples for the D4JL-□NF□-□)

- Terminals 11-42 and terminals 21-52 are connected internally and so connect terminals 12-41 and 22-51 for safety-circuit input. (GS-ET-19).



- Direct opening contacts used as safety-circuit input are indicated with the \ominus mark. Terminals 11-12 and terminals 21-22 are direct opening contacts.
- Do not connect the indicator directly to direct opening contacts. If indicator is connected in parallel with direct opening contacts, a short-circuit current may flow in the event that the indicator is damaged, causing equipment to malfunction.
- Do not switch standard loads for more than 2 circuits at the same time. Otherwise, the level of insulation may decrease.
- The solenoid terminals have polarity (E1: + and E2: -). Confirm the polarity before wiring.

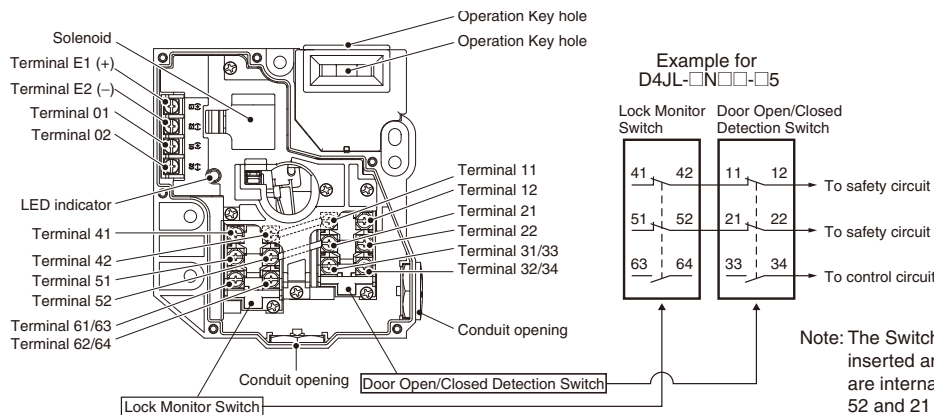
Contact Forms

Indicates conditions where the Key is inserted and the lock is applied. Terminals 42-11 and terminals 52-21 are connected internally (as per BIA GS-ET-19).

Model	Contacts (door open/closed detection and lock monitor)	Contact forms		Operating pattern	Remarks
		Lock monitor	Door open/ closed detection		
D4JL-□NF□-□	2NC/1NO+2NC/1NO				NC contacts 11-12 and 21-22 have a certified direct opening mechanism (\ominus). The terminals 41-12, 51-22, 33-34, and 63-64 can be used as unlike poles.
D4JL-□PF□-□	2NC/1NO+3NC				NC contacts 11-12 and 21-22 have a certified direct opening mechanism (\ominus). The terminals 41-12, 51-22, 33-34, and 61-62 can be used as unlike poles.
D4JL-□QF□-□	3NC+2NC/1NO				NC contacts 11-12, 21-22 and 31-32 have a certified direct opening mechanism (\ominus). The terminals 41-12, 51-22, 31-32, and 63-64 can be used as unlike poles.
D4JL-□RF□-□	3NC+3NC				NC contacts 11-12, 21-22, and 31-32 have a certified direct opening mechanism (\ominus). The terminals 41-12, 51-22, 31-32, and 61-62 can be used as unlike poles.

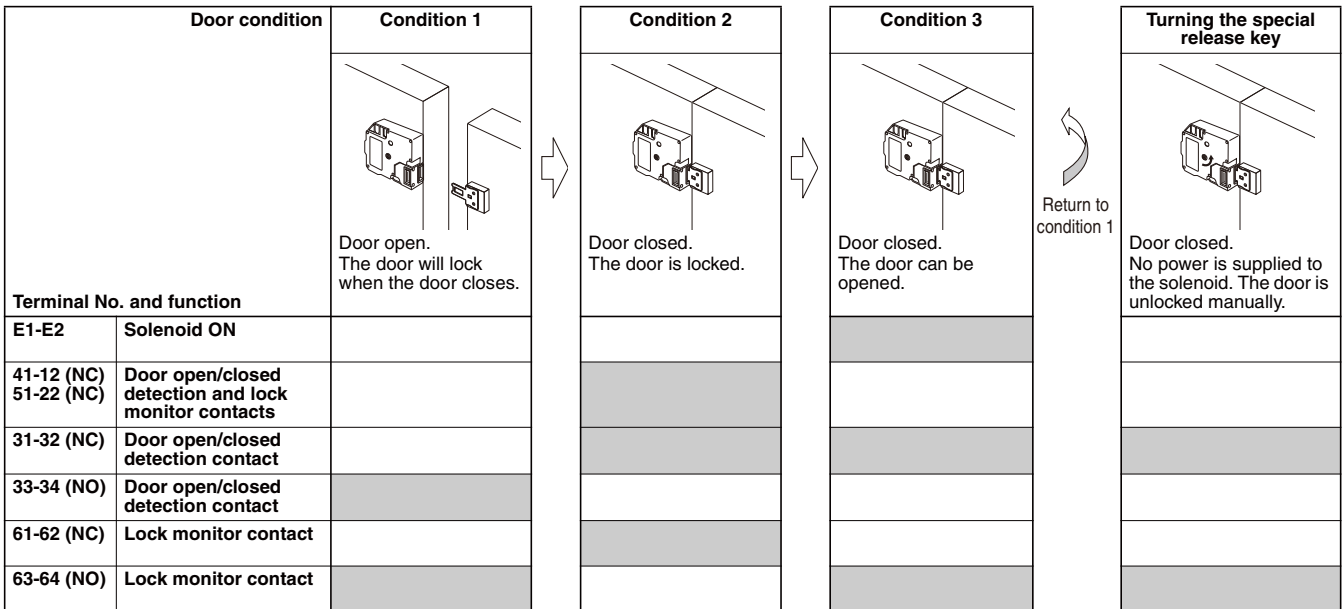
Nomenclature

■ Structure of D4JL-□□□A-5 and D4JL-□□□G-□5

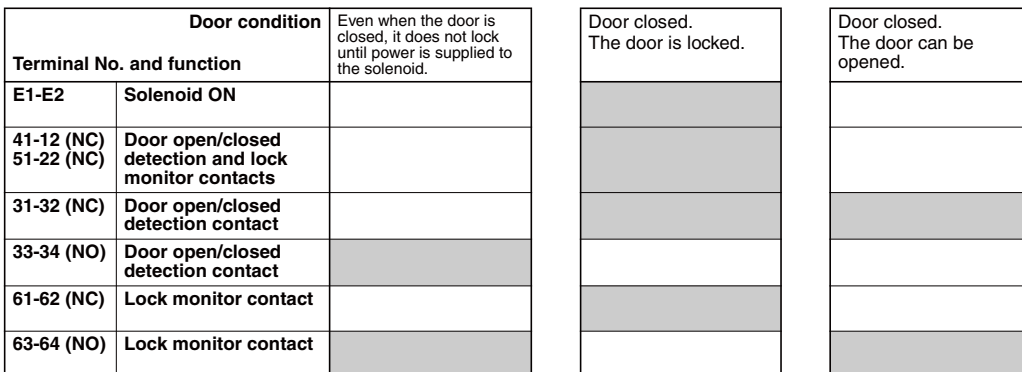


■ Operating Cycle Examples for Standard Models

D4JL-□□□A-5 (Mechanical Lock Models with Special Release Keys)



D4JL-□□□G-□5 (Solenoid Lock Models with Special Release Keys)



The shaded areas indicate the contact is closed and power is supplied to the solenoid.

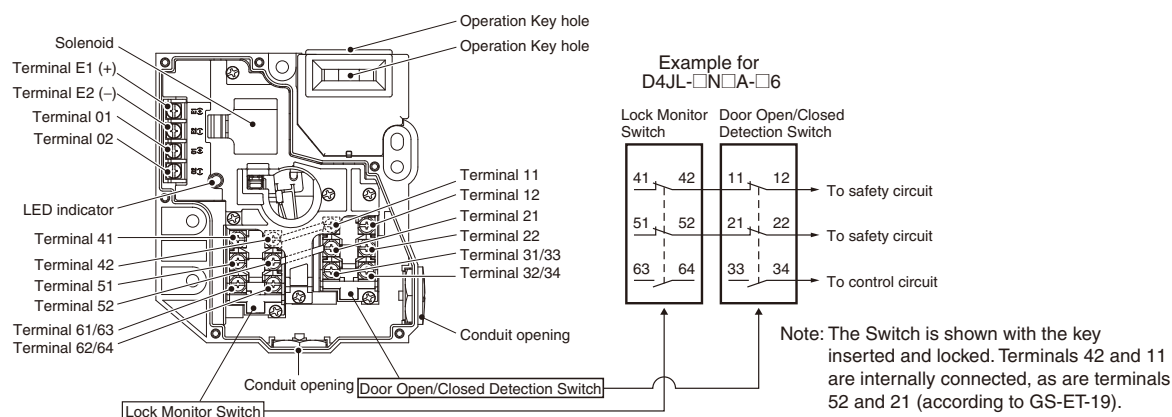
Door open/closed detection and lock monitor contacts: Can be used in safety circuits because of the direct opening mechanisms.

Door open/closed detection contact: Can be used to confirm whether the key is inserted and to monitor the open/closed status of a door.

Lock monitor contact: Can be used to confirm whether power is supplied to the solenoid and to monitor whether or not a door can be opened or closed.

Note: The door open/closed detection and lock monitor contact configuration depends on the model.

■ Structure of D4JL-□□□A-□6



■ Operating Cycle Examples for Models with Rear Release Buttons

D4JL-□□□A-□6 (Mechanical Lock Models with Special Release Keys and Rear Release Buttons)

Door condition	Condition 1	Condition 2	Condition 3	Turning the special release key	Pressing the rear release button
	 Door open. The door will lock when the door closes.	 Door closed. The door is locked.	 Door open. The door can be opened.	 Door closed. No power is supplied to the solenoid. The door is unlocked manually.	 Door closed. No power is supplied to the solenoid. The door is unlocked manually.
Terminal No. and function					
E1-E2	Solenoid ON				
41-12 (NC) 51-22 (NC)	Door open/closed detection and lock monitor contacts				
31-32 (NC)	Door open/closed detection contact				
33-34 (NO)	Door open/closed detection contact				
61-62 (NC)	Lock monitor contact				
63-64 (NO)	Lock monitor contact				

The shaded areas indicate the contact is closed and power is supplied to the solenoid.

Door open/closed detection and lock monitor contacts: Can be used in safety circuits because of the direct opening mechanisms.

Door open/closed detection contact:

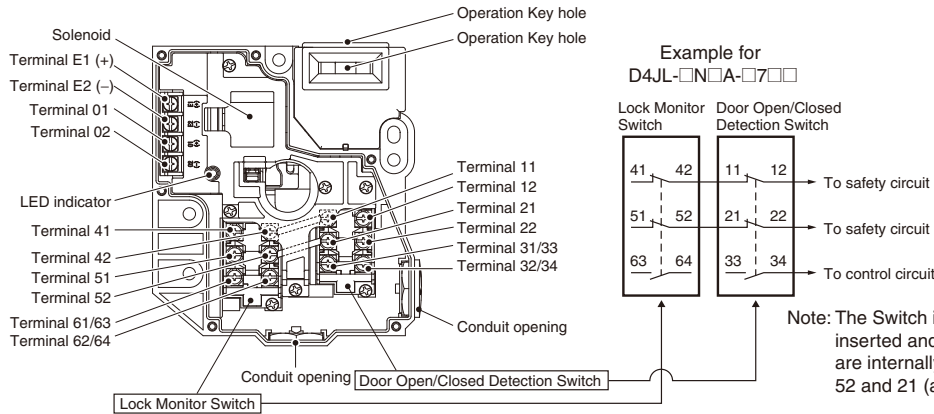
Can be used to confirm whether the key is inserted and to monitor the open/closed status of a door.

Lock monitor contact:

Can be used to confirm whether power is supplied to the solenoid and to monitor whether or not a door can be opened or closed.

Note: The door open/closed detection and lock monitor contact configuration depends on the model.

■ Structure of D4JL-□□□A-□7-□□



■ Operating Cycle Examples for Models with Trapped Keys

D4JL-□□□A-□7-□□ (Models with Trapped Keys)

Door condition	Condition 1	Condition 2	Condition 3	Condition 4	Condition 5	Condition 6	
							Return to condition 1
Terminal No. and function							
E1-E2	Solenoid ON						
41-12 (NC) 51-22 (NC)	Door open/closed detection and lock monitor contacts						
31-32 (NC)	Door open/closed detection contact						
33-34 (NO)	Door open/closed detection contact						
61-62 (NC)	Lock monitor contact						
63-64 (NO)	Lock monitor contact						

The shaded areas indicate the contact is closed and power is supplied to the solenoid.

Door open/closed detection and lock monitor contacts: Can be used in safety circuits because of the direct opening mechanisms.

Door open/closed detection contact:

Can be used to confirm whether the key is inserted and to monitor the open/closed status of a door.

Lock monitor contact:

Can be used to confirm whether power is supplied to the solenoid and to monitor whether or not a key can be removed.

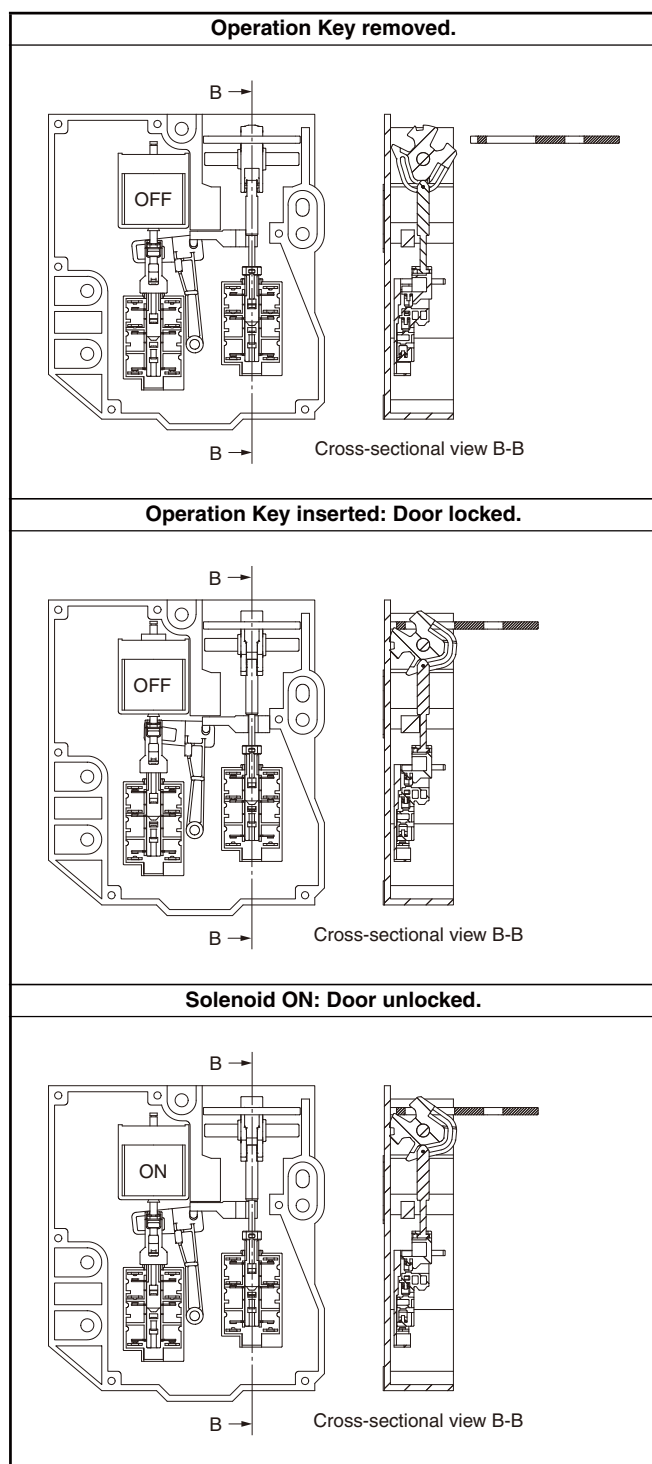
Note: 1. Door open/closed detection and lock monitor contact configuration depends on the model.

2. If power is supplied to the solenoid, the door cannot be unlocked until the Key is turned to the left and removed.

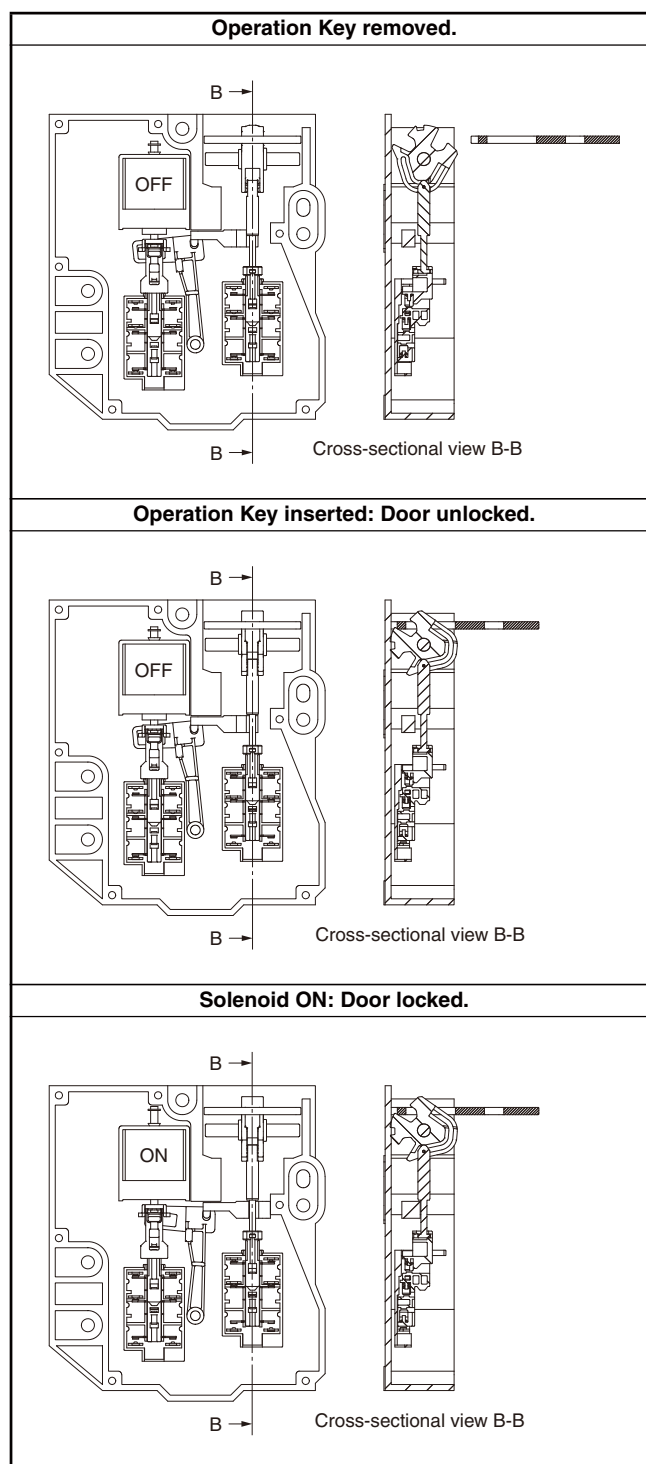
Operation Method

■ Operation Principles

Mechanical Lock Models

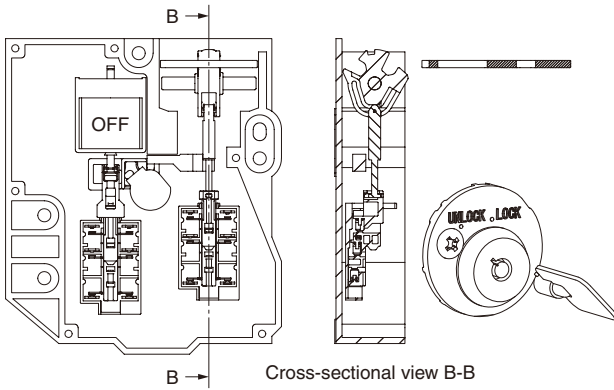


Solenoid Lock Models

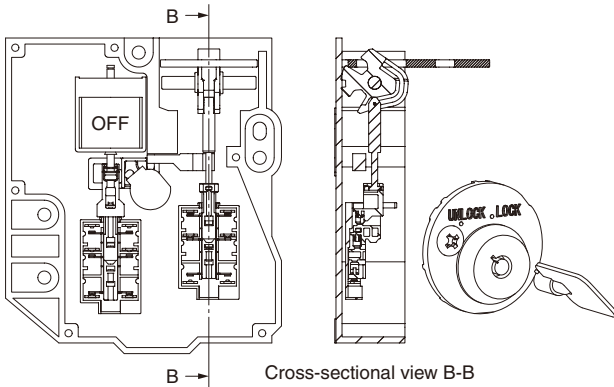


Trapped Key Models

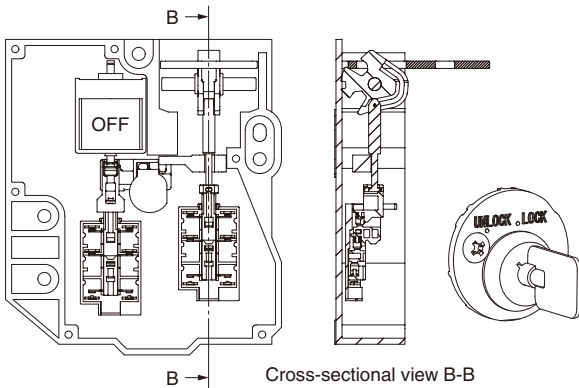
(1) Operation Key removed, solenoid OFF, and trapped key removed.



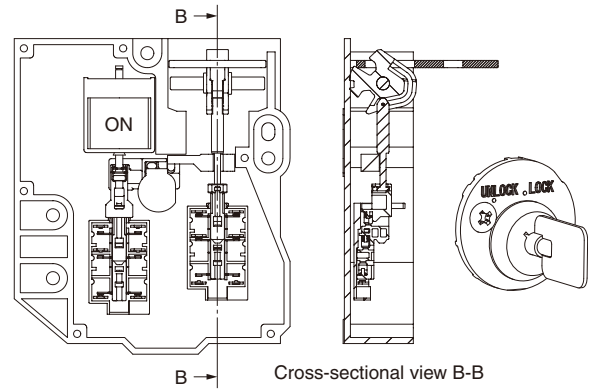
(2) Operation Key inserted, solenoid OFF, and trapped key removed. Status: Door unlocked.



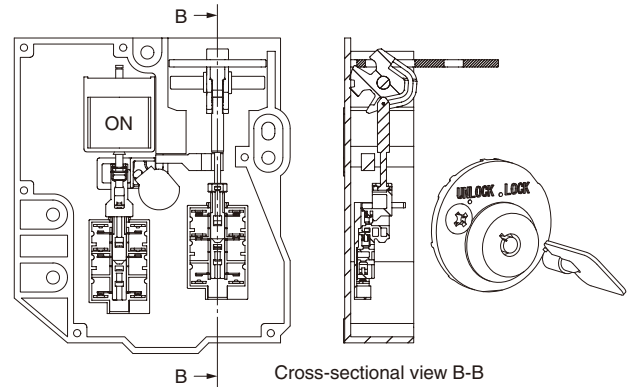
(3) Operation Key inserted, solenoid OFF, and trapped key inserted. Status: Door locked and trapped key cannot be removed.



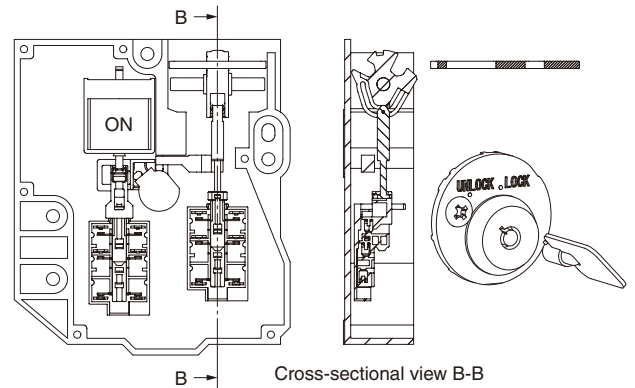
(4) Operation Key inserted, solenoid ON, and trapped key inserted. Status: Door locked and trapped key can be removed.



(5) Operation Key inserted, solenoid ON, and trapped key removed. Status: Door unlocked.



(6) Operation Key removed, solenoid ON, and trapped key removed.



Dimensions

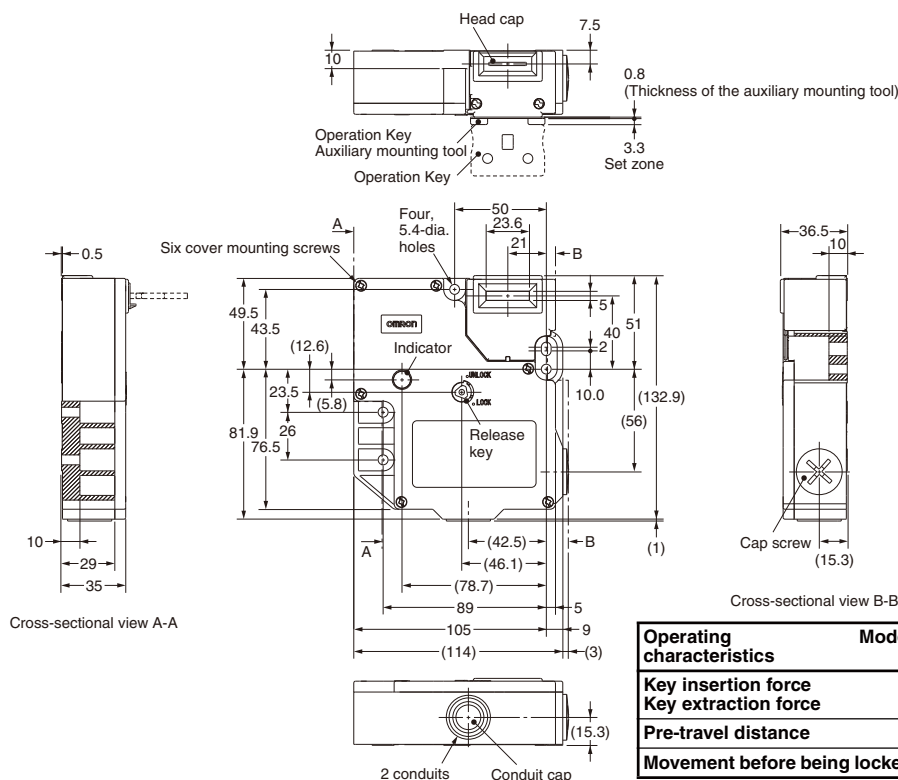
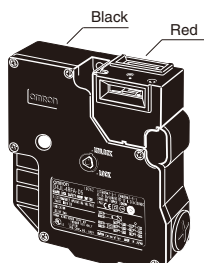
Note: All units are in millimeters unless otherwise indicated.

■ Dimensions and Operating Characteristics

Switches

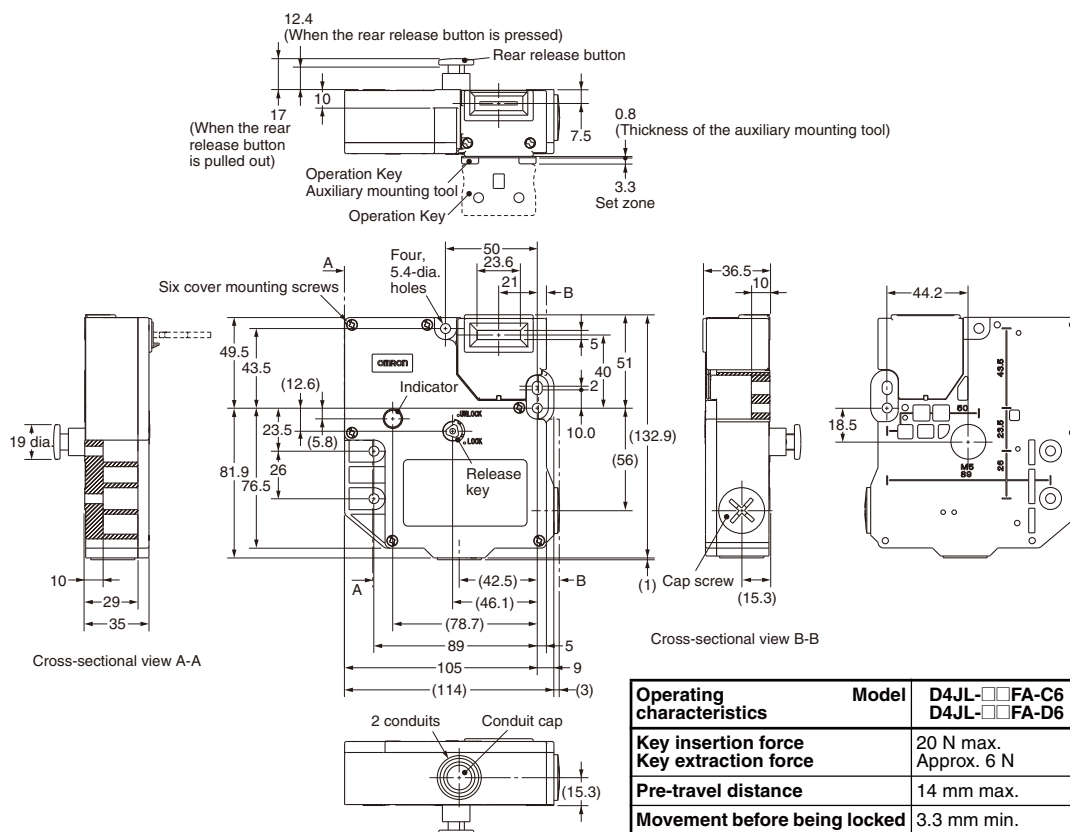
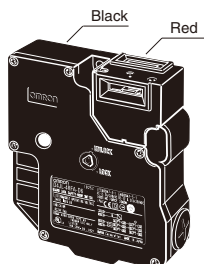
D4JL-□□F□-C5

D4JL-□□F□-D5

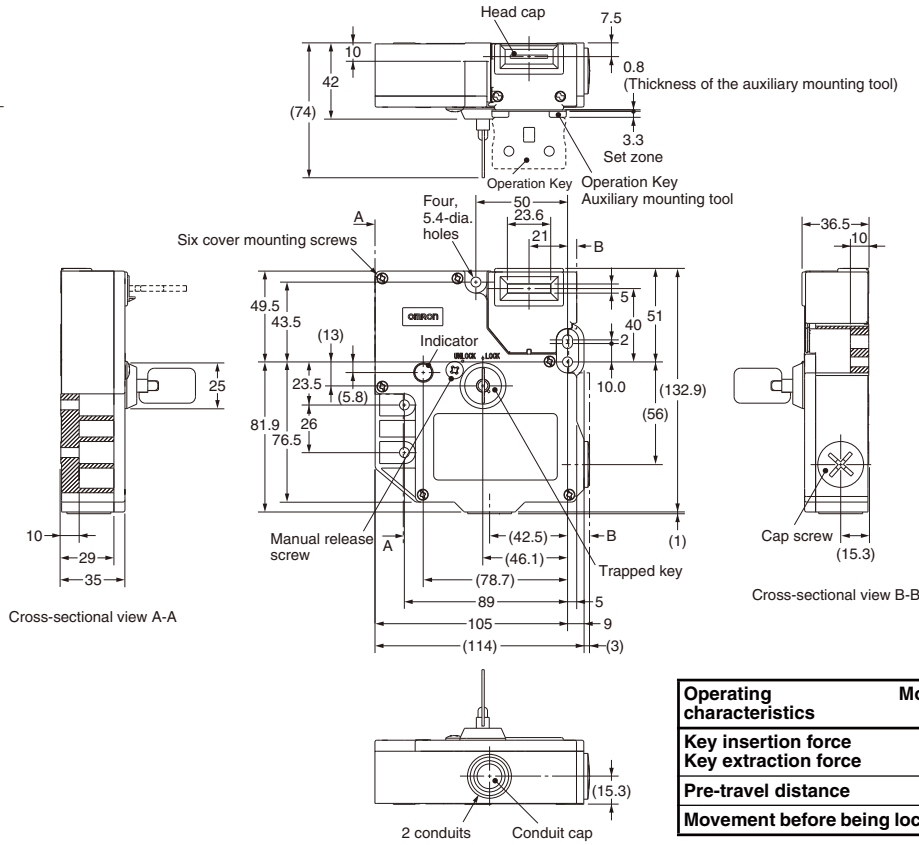
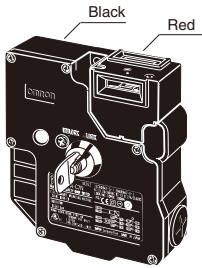


D4JL-□□FA-C6

D4JL-□□FA-D6



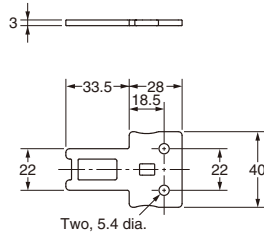
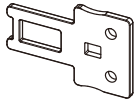
D4JL-□□FA-C7
D4JL-□□FA-D7



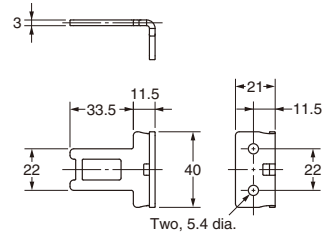
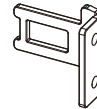
Operating characteristics	Model	D4JL-□□FA-C7 D4JL-□□FA-D7
Key insertion force		20 N max.
Key extraction force		Approx. 6 N
Pre-travel distance		14 mm max.
Movement before being locked		3.3 mm min.

Operation Keys

D4JL-K1



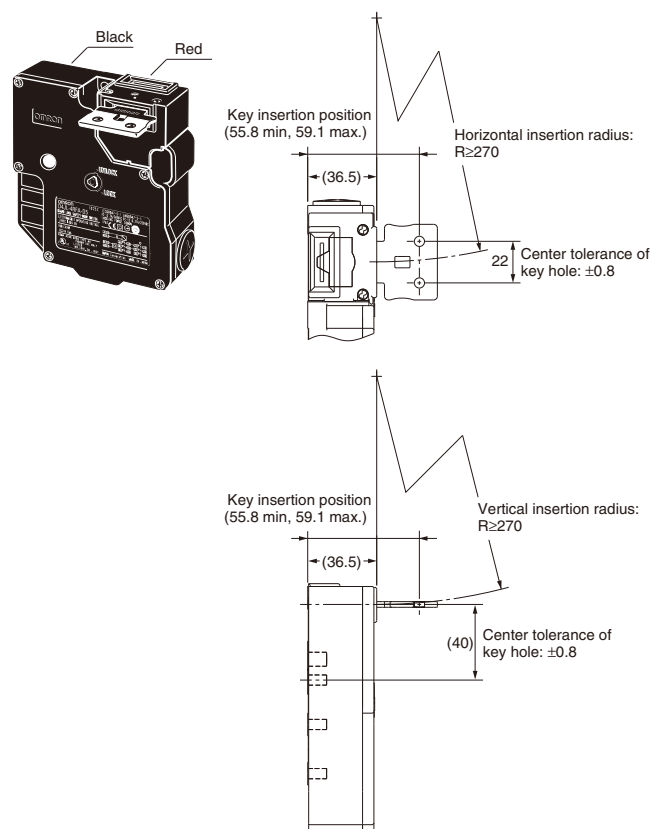
D4JL-K2



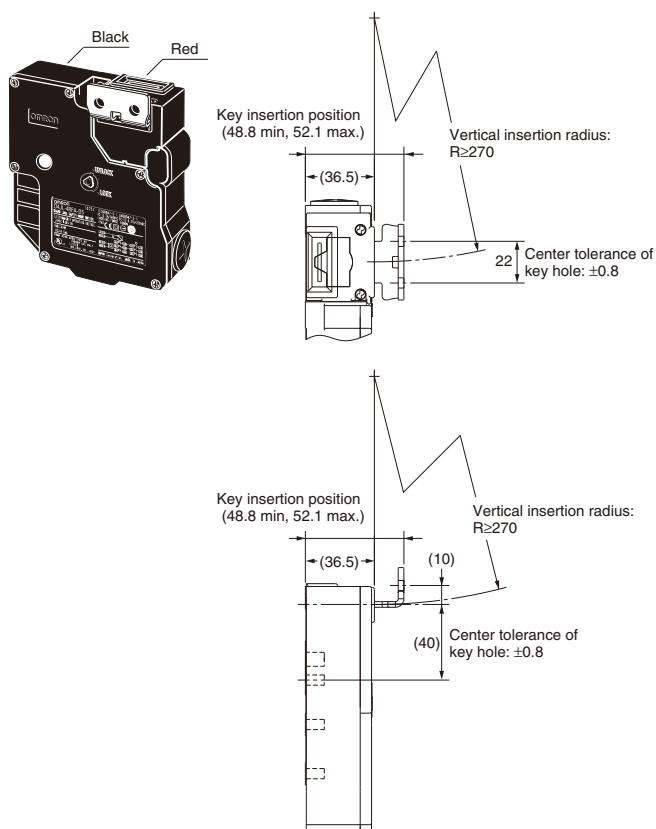
Note: Unless otherwise specified, a tolerance of ± 0.8 mm applies to all Switch dimensions and a tolerance of ± 0.4 mm applies to Operation Key dimensions.

With Operation Key Inserted

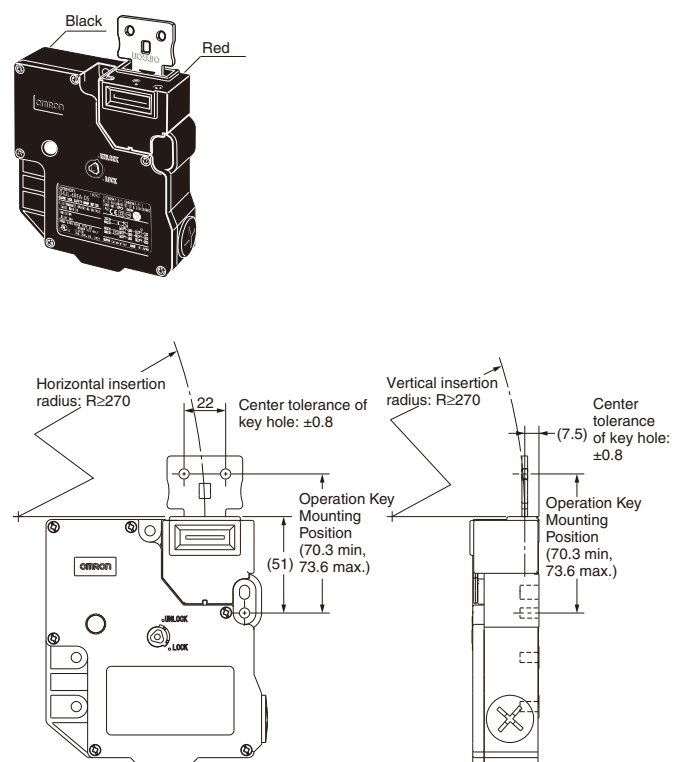
D4JL+D4JL-K1 (with Front-inserted Operation Key)



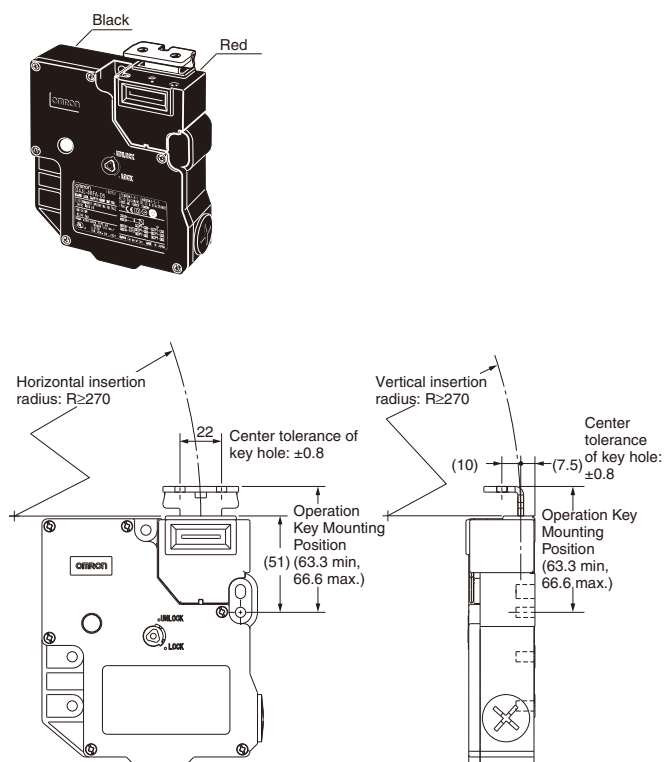
D4JL+D4JL-K2 (with Front-inserted Operation Key)



D4JL+D4JL-K1 (with Top-inserted Operation Key)



D4JL+D4JL-K2 (with Top-inserted Operation Key)

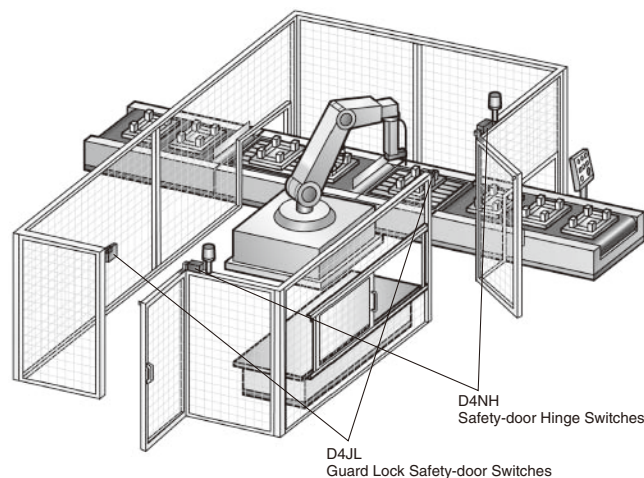
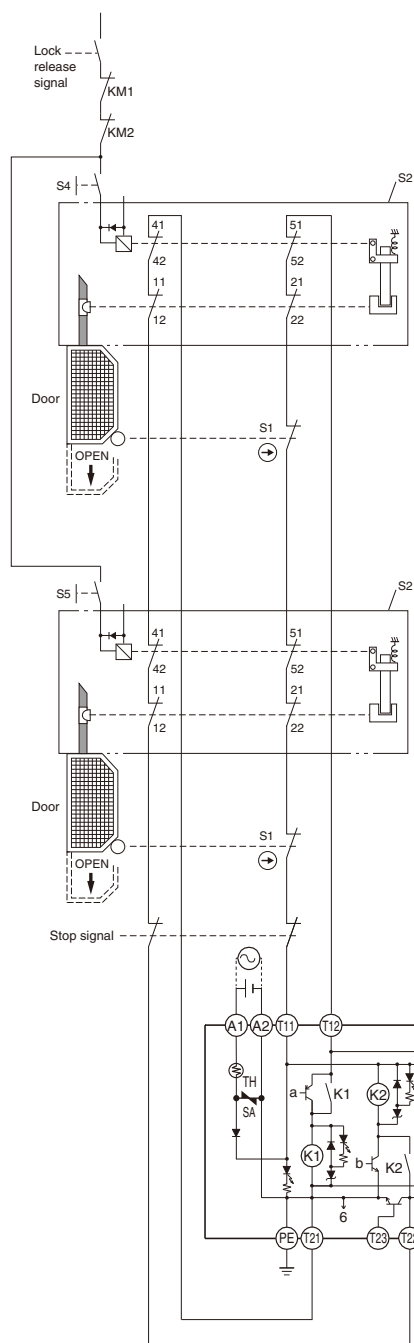


Application Examples

G9SA-321-T□ (24 VAC/VDC) + D4JL-□□□A-□□ (Mechanical Lock Models)/Manual Reset

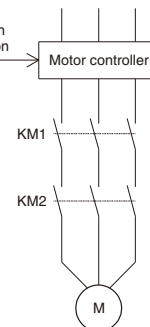
Application Example

Stopping a Robot on a Conveyor Line



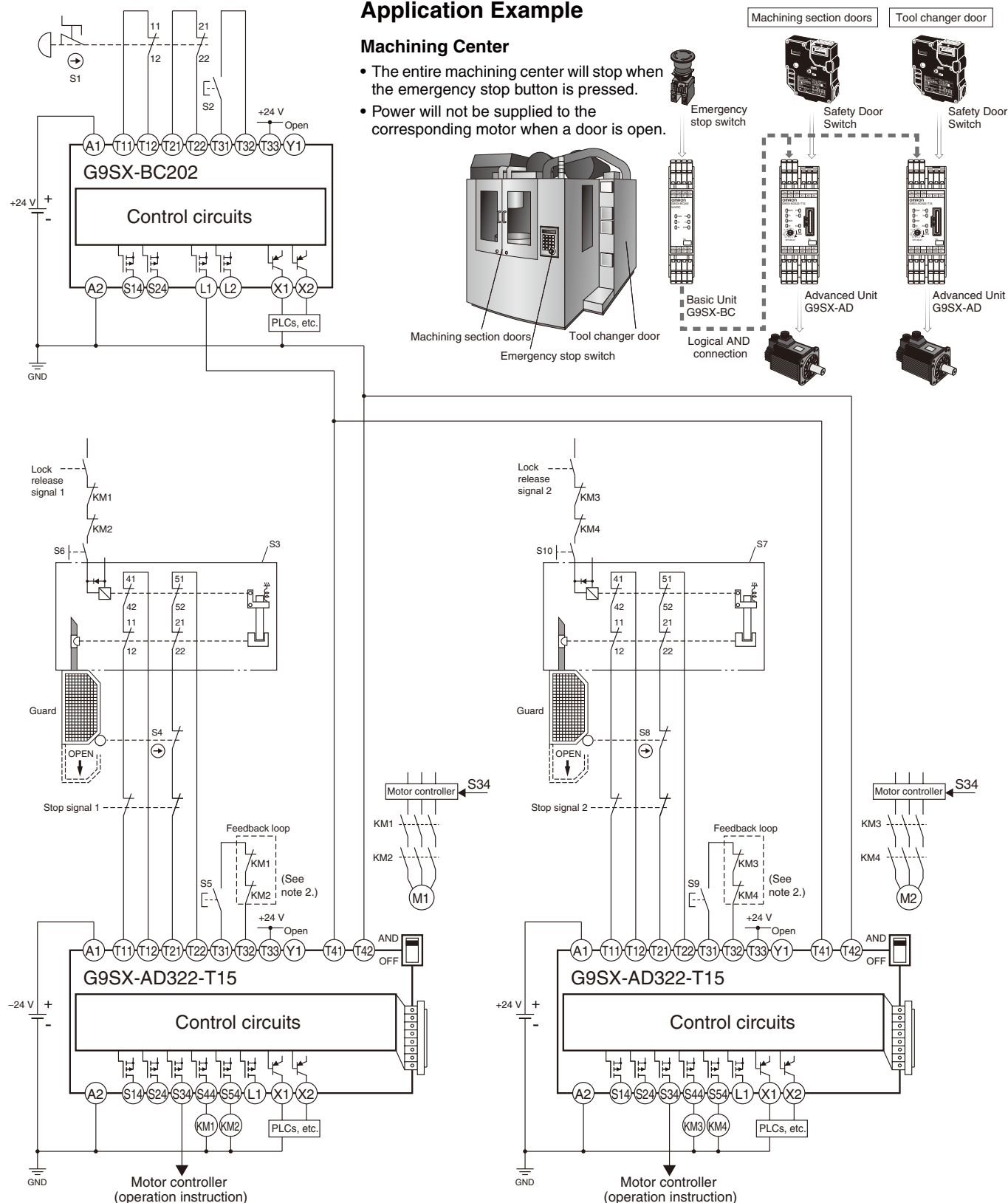
- S1: Safety-door Switch with direct opening contact
 S2: Guard Lock Safety-door Switch
 S3: Reset switch
 S4 and S5: Lock release switches
 KM1 and KM2: Magnetic contactors
 M: 3-phase motor

- Note:** 1. This circuit conforms to EN954-1 Safety Category 3.
 2. When the release button is pressed on rear release models, the solenoid contacts are turned OFF.
 3. With Trapped Key Models, the door will not lock when it is closed with the trapped key removed.



G9SX-AD322-T15 (24 VDC) + D4JL-□□□A-□□ (Mechanical Lock Models)/Manual Reset
Application Example
Machining Center

- The entire machining center will stop when the emergency stop button is pressed.
- Power will not be supplied to the corresponding motor when a door is open.



- S1: Emergency stop switch
 S3 and S7: Guard Lock Safety-door Switches
 S2, S5, and S9: Reset switches
 S6 and S10: Lock release switches
 S4 and S8: Safety-door Limit Switches with direct opening contacts
 KM 1, KM 2, KM3, and KM4: Magnetic contactors
 M1 and M2: 3-phase motors

Safety Precautions

Refer to the "Precautions for All Switches" and "Precautions for All Safety Door Switches".

⚠ DANGER

Injury may occasionally occur. Always check to make sure that the safety functions operate correctly before using the machine. The safety functions may not operate correctly because of wiring mistakes, setting mistakes, or Switch malfunction, causing some machines to continue operating in situations where they should be stopped.



Injury may occasionally occur. If the machine is used with the release key in the UNLOCK position, the electromagnetic lock may not operate, causing some machines to continue operating in situations where they should be stopped. Be sure to put the release key in the LOCK position before using the machine. Also, check the condition of the lock and safety circuits.



Injury may occasionally occur. When the electromagnetic lock function or Switch function is damaged, some machines may continue operating in situations where they should be stopped. Do not use the electromagnetic lock function of the Switch in place of a door lock. Always provide a lock separate from the Switch, attach a warning seal to prevent people from using excessive force to open the door when it is locked, or provide an indicator lamp to show the locked/unlocked status of the door.



⚠ CAUTION

Electric shock may occasionally occur.
Do not use metal connectors or metal conduits.



■ Precautions for Safe Use

Installation Environment

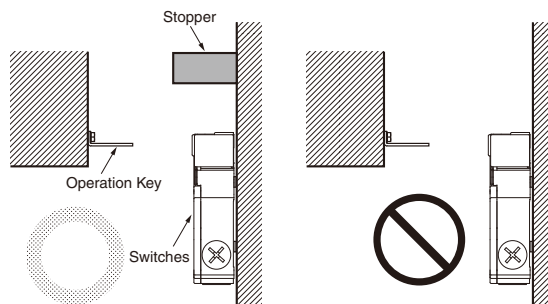
- Do not use the Switch submerged in oil or water or in locations continuously subject to splashes of oil or water. Doing so may result in oil or water entering the Switch. (The IP67 degree of protection of the Switch specifies the amount of water penetration after the Switch is submerged in water for a certain period of time.)

Wiring

- Do not switch circuits for two or more standard loads (250 VAC, 3 A) at the same time. Doing so may adversely affect insulation performance.
- Do not use screws longer than 9 mm when using metal connectors. Otherwise it may result in electric shock.
- Do not use metal conduits. Damage to the conduit opening may result in an improper seal or electric shock.
- Do not use metal connectors or metal conduits when using 1/2-14NPT connectors. Damage to the conversion adapter may result in an improper seal or electric shock.
- Always attach the cover after completing wiring and before using the Switch. Do not supply power when the cover is not attached. Electric shock may occur if the Switch is used without the cover attached.

Installation

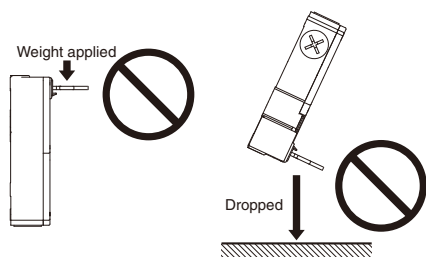
- Make sure the Switch is mounted securely to prevent it from falling off. Otherwise injury may result.
- Do not use the Switch as a stopper. Be sure to install a stopper as shown in the following illustration when mounting the Switch and adjust the stopper so that the Operation Key is within the setting zone.



■ Precautions for Correct Use

Operation Key

- Use only the designated Operation Key. The Head has been designed so that operation is not possible with a screwdriver or other tools. Using anything other than the designated Operation Key may damage the Switch or affect machine safety.
- Do not operate the Switch with anything other than the special OMRON Operation Key, otherwise the Switch may break or the safety of the system may not be maintained.
- Do not impose excessive force on the Operation Key while the Key is inserted into the Switch or drop the Switch with the Operation Key inserted. Doing either of these may deform the Key or break the Switch.

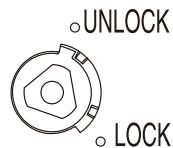


Switch Contacts

The Switch contacts can be used with either standard loads or microloads. Once the contacts have been used to switch a load, however, they cannot be used to switch smaller loads. The contact surfaces will become rough once they have been used and contact reliability for smaller loads may be reduced.

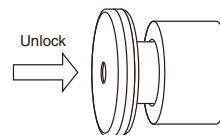
Release Key

- The release key is used to unlock the Switch in case of emergency or if the power supply to the Switch stops.
- If the release key setting is changed from LOCK to UNLOCK using an the enclosed release key, the lock will be released and the safety door can be opened (mechanical lock models only).
- After setting the release key to UNLOCK to, for example, change the head direction or perform maintenance, be sure to return it to the LOCK setting before resuming operation.
- The release key is set in the unlock position at the factory for the D4JL-□□□A-□5 and D4JL-□□□A-□6 and in the lock position for the D4JL-□□□G-□5 and D4JL-□□□A-□7-□□.
- If the release key is set to UNLOCK when the Switch is used for the door of a machine room to ensure the safety of people performing adjustment work inside, the door will not be locked when the door is closed and no power will be supplied to the equipment.
- Do not use the release key to start or stop machines.
- The auxiliary lock must be released using the release key only by authorized personnel.
- Do not impose a force exceeding 1 N·m on the release key screws. The release key may be damaged and may not operate properly.
- To prevent the release key from being used by unauthorized personnel, set it to LOCK and seal it with sealing wax.



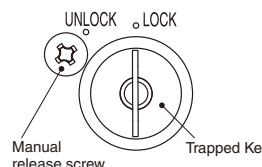
Rear Release Button

- The rear release button is used for emergency escapes when someone locks a worker in the work area (hazardous area).
- The door can be unlocked by pressing the rear release button.
- After the rear release button is used to unlock the door, pull the button out to restore it to its original state. If the button is left pressed in, the door will not lock when the door is closed and power will not be supplied to the equipment.
- Mount the Switch so that the rear release button can be operated by a worker inside the work area (hazardous area).



Trapped Key

- The trapped key is released when power is supplied to the solenoid. Turn the trapped key to the UNLOCK position and remove the key to unlock the door. The door cannot be unlocked solely by supplying power to the solenoid. As long as a worker has the trapped key with him when he enters the work area (hazardous area), he cannot be locked inside by another worker.
- Do not impose a force exceeding 1 N·m when operating the key. Otherwise, the Switch may be damaged and may not operate properly.

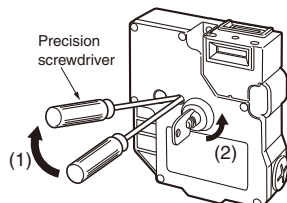


Attaching a Cover

- Make sure the release key is set to the LOCK position before covering the D4JL.
- When attaching a cover, be sure that the seal rubber is in place and that there is no foreign material present. If the cover is attached with the seal rubber out of place or if foreign material is stuck to the rubber, a proper seal will not be obtained.
- Do not use any screws to connect the cover other than the specified ones. The seal characteristics may be reduced.
- Use one of the following methods when covering a Trapped Key Switch.
 - When the Operation Key is removed (door open):
Cover with the trapped key removed (UNLOCK).
 - When the Operation Key is inserted (door closed):
Cover with the trapped key inserted (LOCK).

Manual Release

- Manual release is used to unlock the Switch when power cannot be supplied to the solenoid, such as when power is interrupted or the equipment is being repaired.
- 1. Use a Phillips screwdriver to remove the manual release screw. Use a precision screwdriver to press down the lever inside the Switch far enough to release the trapped key.
- 2. The door is unlocked when the trapped key is turned to the UNLOCK position and removed.
- Do not use manual release to stop machines.
- After the Switch has been manually released, re-install the manual release screw in its proper position on the Switch using the specified torque.



Hinged Doors

If the Switch is mounted too close to the hinge, the force imposed on the lock will be much larger than for locations far from the hinge and the lock may be damaged. Mount the Switch close to the handle.

Solenoid Lock Models

The solenoid lock locks the door only when power is supplied to the solenoid. The door will be unlocked if the power supply to the solenoid stops. Therefore, do not use the solenoid lock models for machines that may be operating and dangerous even after the machine stops operating.

Mounting Methods

Tightening Torque

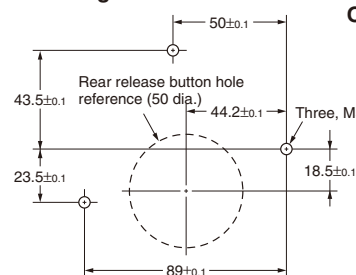
Be sure to tighten each screw of the Switch properly. Loose screws may result in malfunction.

Type	Tightening torque
Terminal screw	0.6 to 0.8 N·m
Cover mounting screw	0.7 to 0.9 N·m
Manual release screw	0.6 to 0.8 N·m
Operation Key mounting screw	2.4 to 2.8 N·m
Switch mounting screw	3.2 to 3.8 N·m
Connector	1.8 to 2.2 N·m (except 1/2-14NPT) 1.4 to 1.8 N·m (for 1/2-14NPT)
Cap screw	1.3 to 1.7 N·m

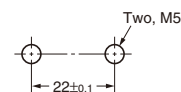
Switch and Operation Key Mounting

- Mount the Switch and Operation Key securely to the applicable tightening torque with M5 screws and washers.

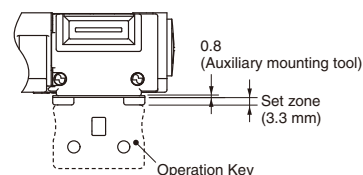
Mounting Holes for Switches



Mounting Holes for Operation Keys



- Do not operate the Switch with anything other than the special OMRON Operation Key. Otherwise, the Switch may be damaged and the safety of the system may not be maintained.
- Ensure that the alignment offset between the Operation Key and the key hole does not exceed ± 0.8 mm. If the Operation Key is offset or at an angle, accelerated wear or damage to the Switch may result.
- When inserting the Operation Key, install the provided mounting auxiliary tool in the key hole and use the tool to position the key in the key hole center and set zone.
- Remove the mounting auxiliary tool from the Switch after the Operation Key is properly inserted.
- Observe the specified insertion radius for the Operation Key and insert it in a direction perpendicular to the key hole.



- Do not impose excessive force on the Operation Key while the Key is inserted into the Switch or drop the Switch with the Operation Key inserted. Doing either of these may deform the Key or break the Switch.
- Attach the enclosed cap head to any Operation Key hole that is not used.

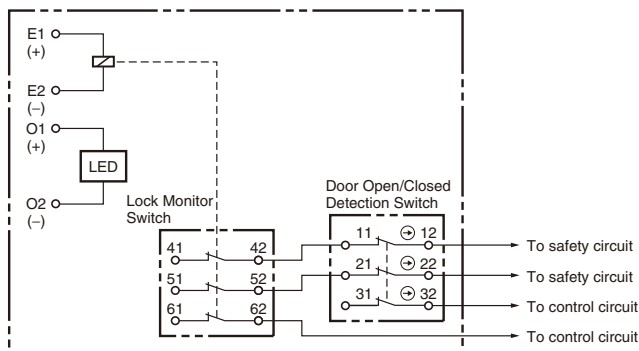
Securing Doors

When the door is closed (with the Operation Key inserted), the Operation Key may exceed the set zone because of, for example, the door's own weight, machine vibration, or the door cushion rubber. Then, when an attempt is made to open the door, it may result in damage or malfunction. Also, it may not be possible to unlock the Switch if there is weight placed on the Operation Key. Do not rely on the Switch to substitute for a door locking device. Secure the door with a stopper so that the Operation Key remains within the set zone.

Wiring

Circuit Connection Example

- Direct opening contacts used for safety circuit inputs are indicated with the \ominus mark. Terminals 12-41 and terminals 22-51 have direct opening contacts.
- Connect the indicators in parallel to the auxiliary circuits or terminals E1 and E2. Do not connect the indicators in parallel with the direct opening contact. If the indicators are broken, a short-circuit current may flow, causing equipment to malfunction.
- Do not switch circuits for two or more standard loads at the same time. Doing so may adversely affect insulation performance.
- The 24-VDC solenoid terminals have polarity (E1: +, E2: -). Confirm the polarity before wiring.
- The contact ON/OFF timing for Switches is not synchronized. Confirm performance before application.

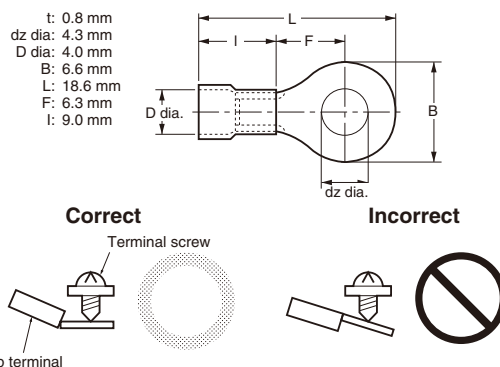


Wiring

- Do not wire the Switch while power is being supplied. Doing so may result in electric shock.
- Do not let particles, such as small pieces of lead wire, enter the switch body when wiring.
- Make sure that the wiring does not hide the LED indicator when wiring E1/E2 or O1/O2.
- When connecting to the terminals via insulating tube and M3.5 crimp terminals, arrange the crimp terminals so that they do not rise up onto the case or the cover.
- Applicable lead wire size: AWG22 to AWG18 (0.3 to 0.75 mm²). Use lead wires of an appropriate length. Not doing so may result in excess length causing the cover to rise and not fit properly.
- Do not pull on the lead wires with excessive force. Doing so may disconnect them.
- Do not push crimp terminals into gaps in the case interior. Doing so may cause damage or deformation of the case.

Recommended Crimp Terminals

Manufacturer	Model
J.S.T. Mfg Co.	FN1.25-M4 (F Type) N1.25-M4 (Straight Type)



Processing the Conduit Opening

- Connect a recommended connector to the opening of the conduit and tighten the connector to the proper torque. The case may be damaged if excessive tightening torque is applied.
- When using a 1/2-14NPT conduit, wind sealing tape around the conduit end of the connector so that the enclosure will conform to IP67.
- Make sure that the outer diameter of the cable connected to the connector is correct.
- Attach a conduit cap to the unused conduit opening when wiring and tighten it to a suitable torque. The conduit cap is provided with the Switch.

Recommended Connectors

Use a connector with a screw section not exceeding 9 mm. Otherwise, the screws will protrude into the case interior. The connectors given in the following table have connectors with screw sections not exceeding 9 mm. Use the following connectors to ensure conformance to IP67.

Size	Manufacturer	Model	Applicable cable diameter
G1/2	LAPP	ST-PF1/2 5380-1002	6.0 to 12.0 mm
PG13.5	LAPP	ST-13.5 5301-5030	6.0 to 12.0 mm
M20	LAPP	ST-M20 × 1.5 5311-1020	7.0 to 13.0 mm
1/2-14NPT	LAPP	ST-NPT1/2 5301-6030	6.0 to 12.0 mm

Use LAPP connectors together with Seal Packing (JPK-16, GP-13.5, or GPM20), and tighten to the applicable torque. Seal Packing is sold separately.

- LAPP is a German manufacturer.
- For a 1/2-14NPT conduit, use the above connector after attaching the provided Adaptor to the Switch and wrapping it with sealing tape.

Other Precautions

- A Guard Lock Safety-door Switch will heat when power is supplied to the solenoid. Do not touch these Switches.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Precautions for All Safety Door Switches

Note: Refer to the *Safety Precautions* section for each Switch for specific precautions applicable to each Switch.

CAUTION

Do not insert the Operation Key when the door is open.
The machine may operate, possibly causing injury.



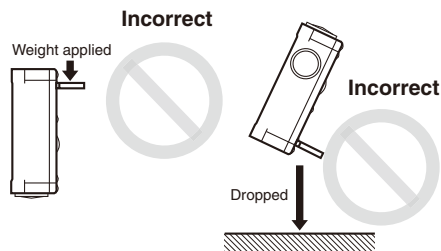
■ Precautions for Safe Use

- Do not use the Switch in atmospheres containing explosive or flammable gases.
- Although the switch body is protected from the ingress of dust or water, avoid the ingress of foreign substance through the key hole on the head. Otherwise, accelerated wear, breaking, or malfunction may result.
- The durability of the Switch varies considerably depending on the switching conditions. Always confirm the usage conditions by using the Switch in an actual application, and use the Switch only for the number of switching operations that its performance allows.
- Do not use the Switch in a starting circuit. (Use the Switch for safety confirmation signal purposes.)
- Connect a fuse in series with the Switch to protect it from short-circuit damage. The value of the breaking current of the fuse must be calculated by multiplying the rated current by 150% to 200%. When using the Switch for an EN rating, use a 10-A fuse of type gI or gG that complies with IEC 60269.
- Mount the Operation Key so that it will not come into contact with persons in the area when the door is opened and closed. Injury may result.
- Do not drop the Switch. Doing so may prevent the Switch from functioning to its full capability.
- Do not under any circumstances disassemble or modify the Switch. Doing so may cause malfunction.

■ Precautions for Correct Use

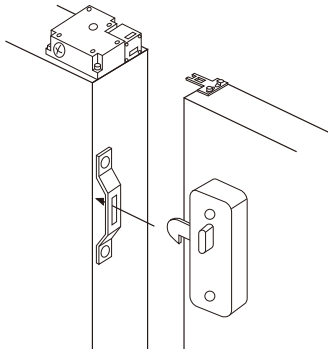
Operation Key

- Use only the designated Operation Key. The Head has been designed so that operation is not possible with a screwdriver or other tools. Using anything other than the designated Operation Key may damage the Switch or affect machine safety.
- Do not operate the Switch with anything other than the special OMRON Operation Key, otherwise the Switch may break or the safety of the system may not be maintained.
- Do not impose excessive force on the Operation Key while the Key is inserted into the Switch or drop the Switch with the Operation Key inserted. Doing either of these may deform the Key or break the Switch.



Securing the Door

If the closed door (with the Operation Key inserted) pulls the Operation Key past the operating/lock position (i.e., the set zone) because of, for example, the door's own weight, machine vibration, or the door cushion rubber, the Switch may be damaged. Also, with a magnetic lock, it may not be possible to unlock the Switch if there is weight placed on the Operation Key. Secure the door with a stopper so that the Operation Key remains within the set zone.



Operating Environment

- Safety Door Switches are designed for use indoors. Using a Switch outdoors may damage it.
- Do not use the Switch in locations where toxic gases, such as H_2S , SO_2 , NH_3 , HNO_3 , and Cl_2 , may be present, or in locations that are subject to high temperature or high humidity. Doing so may damage the Switch due to contact failure or corrosion.

Do not use the Switch in the following locations:

- Locations subject to severe temperature changes
- Locations subject to high temperatures or condensation
- Locations subject to severe vibration
- Locations where the interior of the Protective Door may come into direct contact with cutting chips, metal filings, oil, or chemicals
- Locations where the Switch may come into contact with thinner or detergents
- Locations where explosive or flammable gases are present

Storing Switches

Do not store Switches in locations where toxic gases, such as H_2S , SO_2 , NH_3 , HNO_3 , and Cl_2 , may be present, or in locations that are subject to excessive dirt, excessive dust, high temperature, or high humidity.

Other Precautions

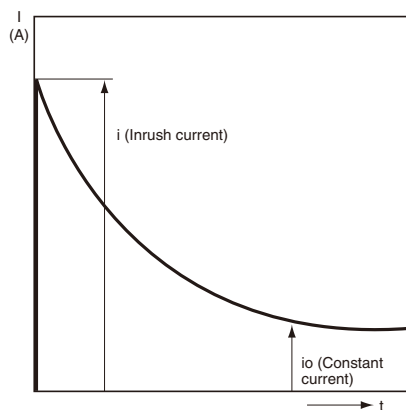
- When attaching a cover, be sure that the seal rubber is in place and that there is no foreign material present. If the cover is attached with the seal rubber out of place or if foreign material is stuck to the rubber, a proper seal will not be obtained.
- Perform maintenance inspections periodically.
- Use the Switch with a load current that does not exceed the rated current.
- Do not use any screws to connect the cover other than the specified ones. The seal characteristics may be reduced.

Precautions for All Switches

Note: Refer to the Safety *Precautions* section for each Switch for specific precautions applicable to each Switch.

■ Precautions for Safe Use

- If the Switch is to be used as a switch in an emergency stop circuit or in a safety circuit for preventing accidents resulting in injuries or deaths, use a Switch with a direct opening mechanism, use the NC contacts with a forced release mechanism, and set the Switch so that it will operate in direct opening mode.
For safety, install the Switch using one-way rotational screws or other similar means to prevent it from easily being removed. Protect the Switch with an appropriate cover and post a warning sign near the Switch to ensure safety.
- Do not perform wiring while power is being supplied. Wiring while the power is being supplied may result in electric shock.
- Keep the electrical load below the rated value.
- Be sure to evaluate the Switch under actual working conditions after installation.
- Do not touch the charged Switch terminals while the Switch has carry current, otherwise an electric shock may be received.
- If the Switch has a ground terminal, be sure to connect the ground terminal to a ground wire.
- The durability of the Switch greatly varies with switching conditions. Before using the Switch, be sure to test the Switch under actual conditions. Make sure that the number of switching operations is within the permissible range.
If a deteriorated Switch is used continuously, insulation failures, contact welding, contact failures, Switch damage, or Switch burnout may result.
- Maintain an appropriate insulation distance between wires connected to the Switch.
- Some types of load have a great difference between normal current and inrush current. Make sure that the inrush current is within the permissible value. The greater the inrush current in the closed circuit is, the greater the contact abrasion or shift will be. Consequently, contact welding, contact separation failures, or insulation failures may result. Furthermore, the Switch may become broken or damaged.



- The user must not attempt to repair or maintain the Switch and must contact the machine manufacturer for any repairs or maintenance.
- Do not attempt to disassemble or modify the Switch. Doing so may cause the Switch to malfunction.
- Do not drop the Switch. Doing so may result in the Switch not performing to its full capability.

Wiring

Pay the utmost attention so that each terminal is wired correctly. If the terminal is wired incorrectly, the Switch will not function. Furthermore, not only will the Switch have a negative influence on the external circuit, the Switch itself may become damaged or burnt.

Mounting

- Do not modify the Actuator, otherwise the operating characteristics and performance of the Actuator will change.
- Do not enlarge the mounting holes of the Switch or modify the Switch, otherwise insulation failures, housing damage, or human accidents may result.
- Do not apply oil, grease, or other lubricants to the moving parts of the Actuator, otherwise the Actuator may not operate correctly. Furthermore, ingress of oil, grease, or other lubricants inside the Switch may reduce sliding characteristic or cause failures in the Switch.
- Mount the Switch and secure it with the specified screws tightened to the specified torque along with flat and spring washers.
- Be sure to wire the Switch so that the conduit opening is free of metal powder or any other impurities.
- If glue or bonding agent is applied, make sure that it does not adhere to the movable parts or enter the Switch, otherwise the Switch may not work correctly or cause contact failure. Some types of glue or bonding agent may generate a gas that may have a negative influence on the Switch. Pay the utmost attention when selecting the glue or locking agent.
- Some models allow changes in the head direction. When changing the head of such a model, make sure that the head is free of any foreign substance. Tighten each screw of the head to the rated torque.
- Be sure to take measures so that no foreign material, oil, or water will enter the Switch through the conduit opening. Be sure to attach a connector suitable for the cable thickness and tighten the connector securely to the rated torque.
- Do not impose shock or vibration on the Actuator while it is fully pressed. Otherwise, the Actuator will partially abrade and an actuation failure may result.

■ Precautions for Correct Use

Switch Operation

- The Switch in actual operation may cause accidents that cannot be foreseen from the design stage. Therefore, the Switch must be practically tested before actual use.
- When testing the Switch, be sure to apply the actual load conditions together with the actual operating environment.
- All the performance ratings in this catalog are provided under the following conditions unless otherwise specified.

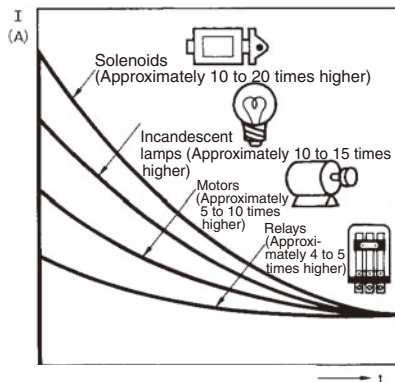
Inductive load: A minimum power factor of 0.4 (AC) or a maximum time constant of 7 ms (DC)

Lamp load: An inrush current 10 times higher than the normal current

Motor load: An inrush current 6 times higher than the normal current

1. Ambient temperature: 5°C to 35°C
2. Ambient humidity: 40% to 70%.

Note: An inductive load causes a problem especially in DC circuitry. Therefore, it is essential to know the time constants (L/R) of the load.



Mechanical Conditions for Switch Selection

- An Actuator suitable for the operating method must be selected. Ask your OMRON representative for details.
- Check the operating speed and switching frequency.
 1. If the operating speed is extremely low, switching of the movable contact will become unstable, thus resulting in incorrect contact or contact welding.
 2. If the operating speed is extremely high, the Switch may break due to shock. If the switching frequency is high, the switching of the contacts cannot keep up with the switching frequency. Make sure that the switching frequency is within the rated switching frequency.
- Do not impose excessive force on the Actuator, otherwise the Actuator may become damaged or not operate correctly.
- Make sure that the stroke is set within the suitable range specified for the model, or otherwise the Switch may break.

Electrical Characteristics for Switch Selection

Electrical Conditions

- The switching load capacity of the Switch greatly varies between AC and DC. Always be sure to apply the rated load. The control capacity will drastically drop if it is a DC load. This is because a DC load has no current zero-cross point, unlike an AC load. Therefore, if an arc is generated, it may continue comparatively for a long time. Furthermore, the current direction is always the same, which

results in contact relocation, whereby the contacts easily stick to each other and do not separate when the surfaces of the contacts are uneven.

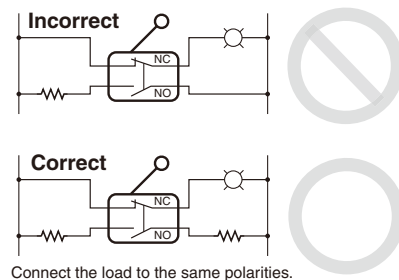
- If the load is inductive, counter-electromotive voltage will be generated. The higher the voltage is, the higher the generated energy will be, which will increase the abrasion of the contacts and contact relocation load conditions. Be sure to use the Switch within the rated conditions.
- If the load is a minute voltage or current load, use a Switch designed for minute loads. The reliability of silver-plated contacts, which are used by standard Switches, will be insufficient if the load is a minute voltage or current load.

Connections

- With a Za contact form, do not connect a single Switch to two power supplies that are different in polarity or type.

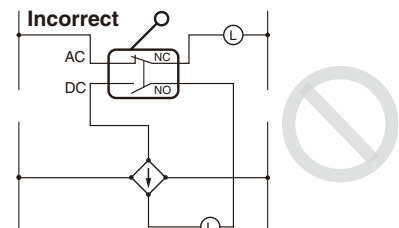
Power Connection Examples

(Connection of Different Polarities)

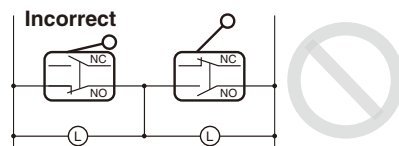


Incorrect Power Connection Example

(Connection of Different Power Supplies)
There is a risk of AC and DC mixing.



- Do not use a circuit that will short-circuit if a fault occurs, otherwise the charged part may melt and break off.



- Application of Switch to a Low-voltage, Low-current Electronic Circuit

1. If bouncing or chattering of the contacts results and causes problems, take the following countermeasures.
 - (a) Insert an integral circuit.
 - (b) Suppress the generation of pulses from the contact bouncing or chattering of the contacts so that it is less than the noise margin of the load.
2. Conventional silver-plated contacts are not suitable for this application, in which particularly high reliability is required. Use gold-plated contacts, which are ideal for handling minute voltage or current loads.
3. The contacts of the Switch used for an emergency stop must be normally closed with a positive opening mechanism.

- To protect the Switch from damage due to short-circuits, be sure to connect in series a quick-response fuse with a breaking current 1.5 to 2 times larger than the rated current to the Switch. When complying with EN certified ratings, use a 10-A IEC 60269-compliant gI or gG fuse.

Contact Protection Circuits

Using a contact protection circuit to increase the contact durability, prevent noise, and suppress the generation of carbide or nitric acid. Be sure to apply the contact protection circuit correctly, otherwise adverse results may occur.

The following tables shows typical examples of contact protection circuits. If the Switch is used in an excessively humid location for switching a load that easily generates arcs, such as an inductive load, the arcs may generate NO_x, which will change into HNO₃ when it reacts with moisture. Consequently, the internal metal parts may corrode and the Switch may fail. Be sure to select the best contact protection circuit from the following table.

Typical Examples of Contact Protection Circuits

Circuit example		Applicable current		Features and remarks	Element selection
		AC	DC		
CR		*See remarks.	Yes	*Load impedance must be much smaller than the CR circuit impedance when using the Switch for an AC voltage.	Use the following as guides for C and R values: C: 1 to 0.5 μ F per 1 A of contact current (A) R: 0.5 to 1 Ω per 1 V of contact voltage (V) These values depend on various factors, including the load characteristics. Confirm optimum values experimentally. Capacitor C suppresses the discharge when the contacts are opened, while the resistor R limits the current applied when the contacts are closed the next time. Generally, use a capacitor with a low dielectric strength of 200 to 300 V. For applications in an AC circuit, use an AC capacitor (with no polarity).
		Yes	Yes	The operating time of the contacts will be increased if the load is a Relay or solenoid. Connecting the CR circuit in parallel to the load is effective when the power supply voltage is 24 or 48 V and in parallel to the contacts when the power supply voltage is 100 to 200 V.	
Diode		No	Yes	The energy stored in the coil reaches the coil as current via the diode connected in parallel, and is dissipated as Joule heat by the resistance of the inductive load. This type of circuit increases the release time more than the CR type.	Use a diode having a reverse breakdown voltage of more than 10 times the circuit voltage, and a forward current rating greater than the load current.
Diode + Zener diode		No	Yes	This circuit effectively shortens the reset time in applications where the release time of a diode circuit is too slow.	Use a Zener diode with a low breakdown voltage.
Varistor		Yes	Yes	This circuit prevents a high voltage from being applied across the contacts by using the constant-voltage characteristic of a varistor. This circuit also somewhat increases the reset time. Connecting the varistor across the load is effective when the supply voltage is 24 to 48 V, and across the contacts when the supply voltage is 100 to 240 V.	---

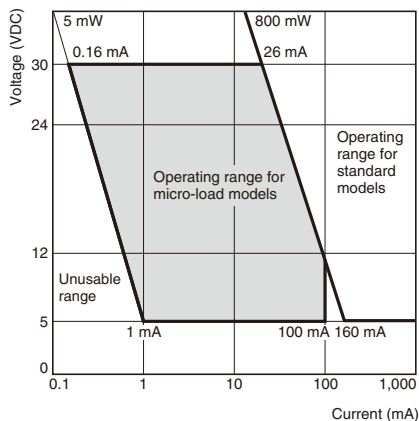
Do not use the following types of contact protection circuit.

<p>This circuit arrangement is very effective for diminishing arcing at the contacts when breaking the circuit. However, since electrical energy is stored in C (capacitor) when the contacts are open, the current from C flows into the contacts when they close. This may lead to contact welding.</p>	<p>This circuit arrangement is very useful for diminishing arcing at the contacts when breaking the circuit. However, since the charging current to C flows into the contacts when they are closed, contact welding may occur.</p>
---	--

Although it is thought that switching a DC inductive load is more difficult than a resistive load, an appropriate contact protection circuit can achieve almost the same characteristics.

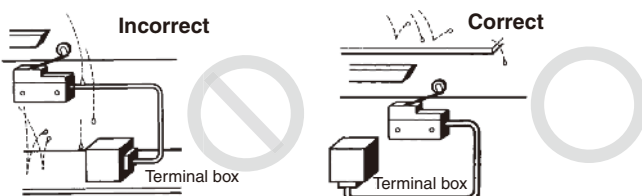
Using Switches for Microloads

Contact failure may occur if a Switch for a general load is used to switch a microload circuit. Use Switches in the ranges shown in the diagram below. However, even when using microload models within the operating range shown here, if inrush current occurs when the contact is opened or closed, it may increase contact wear and so decrease durability. Therefore, insert a contact protection circuit where necessary. The minimum applicable load is the N-level reference value. This value indicates the malfunction reference level for the reliability level of 60% (λ_{60}) (JIS C5003). The equation, $\lambda_{60} = 0.5 \times 10^{-6} / \text{operations}$ indicates that the estimated malfunction rate is less than 1/2,000,000 operations with a reliability level of 60%.

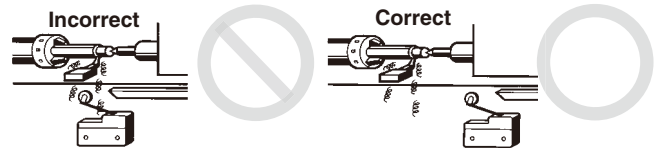


Operating Environment

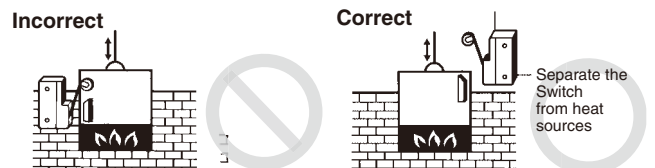
- The Switches are designed for use indoors. Using a Switch outdoors may cause it to malfunction.
- Do not use the Switch submerged in oil or water, or in locations continuously subject to splashes of water. Doing so may result in oil or water entering the Switch interior.
- Confirm suitability (applicability) in advance before using the Switch where it would be subject to oil, water, chemicals, or detergents. Contact with any of these may result in contact failure, insulation failure, earth leakage faults, or burning.
- Do not use the Switch in the following locations:
 - Locations subject to corrosive gases
 - Locations subject to severe temperature changes
 - Locations subject to high humidity, resulting in condensation
 - Locations subject to severe vibration
 - Locations subject to cutting chips, dust, or dirt
 - Locations subject to high humidity or high temperature
- Use protective covers to protect Switches that are not specified as waterproof or airtight whenever they are used in locations subject to splattering or spraying oil or water, or to accumulation of dust or dirt.



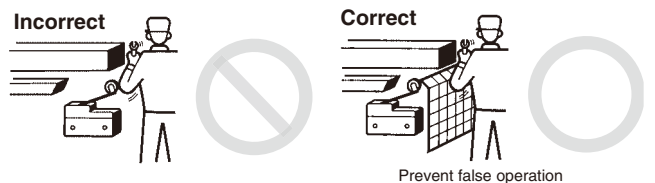
- Be sure to install the Switch so that the Switch is free from dust or metal powder. The Actuator and the Switch casing must be protected from the accumulation of dust or metal powder.



- Do not use the Switch in locations where the Switch is exposed to steam or hot water at a temperature greater than 60°C.
- Do not use the Switch under temperatures or other environmental conditions not within the specified ranges. The rated permissible ambient temperature range varies with the model. Refer to the *Specifications* in this catalog. If the Switch is exposed to radical temperature changes, the thermal shock may deform the Switch and the Switch may malfunction.



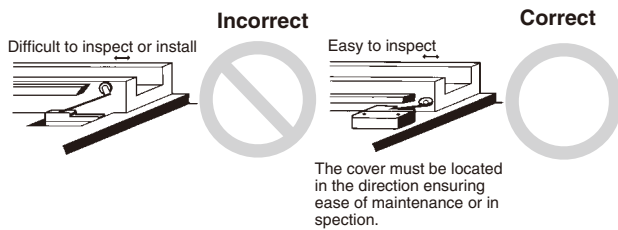
- Be sure to protect the Switch with a cover if the Switch is in a location where the Switch may be actuated by mistake or where the Switch is likely cause an accident.



- Make sure to install the Switch in locations free of vibration or shock. If vibration or shock is continuously imposed on the Switch, contact failure, malfunction, or decrease in service life may be caused by abrasive powder generated from the internal parts. If excessive vibration or shock is imposed on the Switch, the contacts may malfunction or become damaged.
- Do not use the Switch with silver-plated contacts for long periods if the switching frequency of the Switch is comparatively low or the load is minute. Otherwise, sulfuric film will be generated on the contacts and contact failures may result. Use the Switch with gold-plated contacts or use a Switch designed for minute loads instead.
- Do not use the Switch in locations with corrosive gas, such as sulfuric gas (H_2S or SO_2), ammonium gas (NH_3), nitric gas (HNO_3), or chlorine gas (Cl_2), or high temperature and humidity. Otherwise, contact failure or corrosion damage may result.
- If the Switch is used in locations with silicone gas, arc energy may create silicon dioxide (SiO_2) on the contacts and a contact failure may result. If there is silicone oil, silicone sealant, or wire covered with silicone close to the Switch, attach a contact protection circuit to suppress the arcing of the Switch or eliminate the source of silicone gas generation.

Regular Inspection and Replacement

- If the Switch is normally closed with low switching frequency (e.g., once or less per day), a reset failure may result due to the deterioration of the parts of the Switch. Regularly inspect the Switch and make sure that the Switch is in good working order.
- In addition to the mechanical durability or electrical durability of the Switch described previously, the durability of the Switch may decrease due to the deterioration of each part, especially rubber, resin, and metal. Regularly inspect the Switch and replace any part that has deteriorated to prevent accidents from occurring.
- If the Switch is not turned ON and OFF for a long period of time, contact reliability may be reduced due to contact oxidation. Continuity failure may result in accidents (i.e., the switch may not turn ON due to increased contact resistance.)
- Be sure to mount the Switch securely in a clean location to ensure ease of inspection and replacement. The Switch with operation indicator is available, which is ideal if the location is dark or does not allow easy inspection or replacement.



Storage of Switch

- When storing the Switch, make sure that the location is free of corrosive gas, such as H_2S , SO_2 , NH_3 , HNO_3 , or Cl_2 , or dust and does not have a high temperature or humidity.
- Be sure to inspect the Switch before use if it has been stored for three months or more.

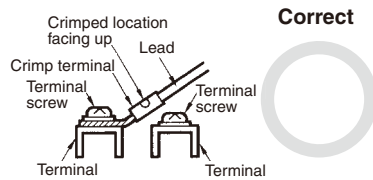
Typical Problems, Probable Causes, and Remedies

Problem	Probable cause	Remedy
Mechanical failure	1. The Actuator does not operate. 2. The Actuator does not return. 3. The Actuator has been deformed. 4. The Actuator is worn. 5. The Actuator has been damaged.	The shape of the dog or cam is incorrect.
		The contacting surface of the dog or cam is rough.
		The Actuator in use is not suitable.
		The operating direction of the Actuator is not correct.
		The operation speed is excessively high.
		Excessive stroke.
		The rubber or grease hardened due to low temperature.
		The accumulation of sludge, dust, or cuttings.
		Dissolution, expansion, or swelling damage to the rubber parts of the driving mechanism.
	There is a large deviation in operating position (with malfunctioning involved).	Damage to and wear and tear of the internal movable spring.
		Wear and tear of the internal mechanism.
		The loosening of the mounting screws causing the position to be unstable.
	The terminal part wobbles. (The mold part has been deformed.)	Overheating due to a long soldering time.
		The Switch has been connected to and pulled by thick lead wires with excessive force.
		High temperature or thermal shock resulted.
Failures related to chemical or physical characteristics	Contact chattering	Vibration or shock is beyond the rated value.
		Shock has been generated from a device other than the Switch.
		Too-slow operating speed.
	Oil or water penetration	The sealing part has not been tightened sufficiently.
		The wrong connector has been selected and does not conform to the cable.
		The wrong Switch has been selected.
		The terminal part is not molded.
		The Switch has been burnt or carbonated due to the penetration of dust or oil.
	Deterioration of the rubber part	The expansion and dissolution of the rubber caused by solvent or lubricating oil.
		Cracks due to direct sunlight or ozone.
		Damage to the rubber caused by scattered or heated cuttings.
	Corrosion (rusting or cracks)	The oxidation of metal parts resulted due to corrosive solvent or lubricating oil.
		The Switch has been operated in a corrosive environment, near the sea, or on board a ship.
		The electrical deterioration of metal parts of the Switch resulted due to the ionization of cooling water or lubricating oil.
		The cracking of alloyed copper due to rapid changes in temperature.
Failures related to electric characteristics	No actuation. No current breakage. Contact welding	Inductive interference in the DC circuit.
		Carbon generated on the surface of the contacts due to switching operations.
		A short-circuit or contact welding due to contact migration.
		Contact welding due to an incorrectly connected power source.
		Foreign materials or oil penetrated into the contact area.

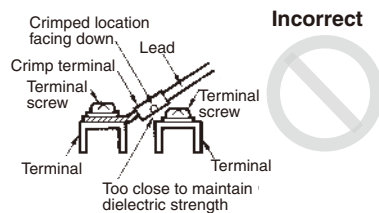
Other

- The standard material for the Switch seal is nitrile rubber (NBR), which has superior resistance to oil. Depending on the type of oil or chemicals in the application environment, however, NBR may deteriorate, e.g., swell or shrink. Confirm performance in advance.
- The correct Switch must be selected for the load to ensure contact reliability. Refer to *Precautions* for microloads in individual product information for details.
- Wire the leads as shown in the following diagram.

Correct Wiring



Incorrect Wiring





WARNING

This catalog is a guide to help customers select the proper safety products. Observe the following items when choosing products, select the right products for your devices or equipment, and develop a safety-related system to fully utilize product functions.

Setting Up a Risk Assessment System

The items listed in this catalog must be used properly in terms of product location as well as product performance and functionality. Part of the process of selecting and using these products should include the introduction and development of a risk assessment system early in the design development stage to help identify potential dangers in your equipment that will optimize safety product selection. A badly designed risk assessment system often results in poor choices when it comes to safety products.

- Related International Standards:
ISO 14121 Principles of Risk Assessment

Safety Policy

When developing a safety system for the devices and equipment that use safety products, make every effort to understand and conform to the entire series of international and industrial standards available, such as the examples given below.

- Related International Standards:
ISO 12100 Basic Concepts, General Principles for Design
IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Role of Safety Products

Safety products have functions and mechanisms that ensure safety as defined by standards. These functions and mechanisms are designed to attain their full potential within safety-related systems. Make sure you fully understand all functions and mechanisms, and use that understanding to develop systems that will ensure optimal usage.

- Related International Standards:
ISO 14119 Interlocking Devices Associated with Guards-Principles for Design and Selection

Installing Safety Products

Make sure that properly educated and trained engineers are selected to develop your safety-related system and to install safety products in devices and equipment.

- Related International Standards:
ISO 12100 Basic Concepts, General Principles for Design
IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Observing Laws and Regulations

Safety products should conform to pertinent laws, regulations, and standards, but make sure that they are used in accordance with the laws, regulations, and standards of the country where the devices and equipment incorporating these products are distributed.

- Related International Standards:
IEC 60204 Electrical Equipment of Machines

Observing Usage Precautions

Carefully read the specifications and precautions listed in this catalog for your product as well as all items in the Operating Manual packed with the product to learn usage procedures that will optimize your choice. Any deviation from precautions will lead to unexpected device or equipment failure not anticipated by safety-related systems or fire originating from equipment failure.

Transferring Devices and Equipment

When transferring devices and equipment, be sure to keep one copy of the Operating Manual and pack another copy with the device or equipment so the person receiving it will have no problem operating it.

- Related International Standards:
ISO 12100 Basic Concepts, General Principles for Design
IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Read and Understand This Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS, OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Disclaimers

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the product may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased product.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

ERRORS AND OMISSIONS

The information in this catalog has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

PERFORMANCE DATA

Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

COPYRIGHT AND COPY PERMISSION

This catalog shall not be copied for sales or promotions without permission.

This catalog is protected by copyright and is intended solely for use in conjunction with the product. Please notify us before copying or reproducing this catalog in any manner, for any other purpose. If copying or transmitting this catalog to another, please copy or transmit it in its entirety.