

Limit Touch Switch NL



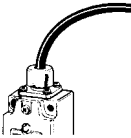
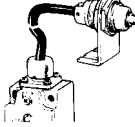
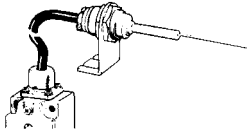
Object Actuates Switch and Turns Built-in Monitor Indicator ON

- Solid-state switch activates the moment its actuator comes in contact with the object.
- Detects minute displacement or lightweight objects with minimal operating force.
- Built-in LED indicator ensures easy operation monitoring.
- DC models provide versatile functions in combination with the S3D2 Sensor Controller.



Ordering Information

List of Models

Series	Power supply voltage	Built-in antenna model		Separate antenna model		
		Model	Model	Model	Model	Model
		Features • Provides sufficient OT (overtravel). • Antenna tip withstands bending.	• Ensures high-precision positioning control. • OT of 5-mm max. (overtravel)	• Antenna with 3-m extension cable is available for narrow spaces where conventional limit switches cannot be used.		
		Antenna Coil spring 	Plunger 	No antenna 	Plunger with antenna 	Coil spring with antenna 
		Model	Model	Model	Model	Model
NL1	12 VDC	NL1-C	NL1-P	NL1-S	NL1-SP	NL1-SC
NL2	24 VDC	NL2-C	NL2-P	NL2-S	NL2-SP	NL2-SC
NL3	100 VAC	NL3-C (see note 2)	NL3-P (see note 2)	---	---	---
	200 VAC	NL3-C (see note 2)	NL3-P (see note 2)	---	---	---
Antenna only		NL1-C ANTENNA ASSY (see note 3)	---	---	---	NL1-SC ANTENNA (see note 4)

- Note:**
1. Each model is provided with a standard 1-m cable.
 2. Specify the power supply voltage when ordering the NL3-C□ or NL3-P□.
 3. Same for NL1, NL2, and NL3 (set including coil spring and head).
 4. Same for NL1 and NL2 (coil spring only).

Specifications

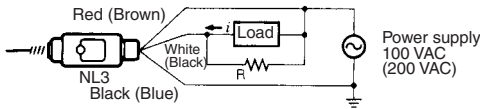
■ Characteristics

Item	NL1	NL2	NL3
Degree of protection	IP60		
Supply voltage (operating voltage)	12 VDC	24 VDC	100 VAC or 200 VAC
Rated frequency	---		50/60 Hz
Sensitivity	Grounded object: Contact resistance of 3 kΩ max. Non-grounded object: Antenna-to-ground capacitance of 100 pF min.		
Current consumption	8 mA	15 mA	---
Leakage current	---		Circuit: 2 mA; Antenna: 1 mA (see note 1)
Response time	5 ms max.		20 ms max.
Output signal	Voltage output model: 30 mA at 12 VDC with output impedance of 4.7 kΩ	Current output model: 24 VDC (directly switching resistive load of 170 mA max.)	Thyristor output model: 100 or 200 VAC (directly switching resistive load of 30 to 300 mA) (see note 2)
Insulation resistance	0 V (black lead wire) is connected to casing		100 MΩ min. at 500 VDC between current-carrying and non-current-carrying metal parts
Dielectric strength	0 V (black lead wire) is connected to casing		1,500 VAC at 50/60 Hz for 1 min between current-carrying and non-current-carrying metal parts
Pollution degree (operating environment)	Level 3 (IEC947-5-1)		
Protection against electric shock	Class II		
Proof tracking index (PTI)	175		
Switch category	D (IEC335)		
Vibration resistance	Malfunction: 10 to 55 Hz, 1.5-mm double amplitude		
Shock resistance	Malfunction: Approx. 200 m/s ² min.		
Ambient temperature	Operating: -10°C to 60°C (with no icing)		
Ambient humidity	90% max.		
Weight	Approx. 370 g (NL□-C, -P) Approx. 550 g (NL□-S) Approx. 680 g (NL□-SP, -SC)		

- Note:**
- The NL3 has a capacitor and resistor for the protection of the built-in SCR. Therefore, the NL3 has leakage current.
 - The NL3 requires a current of 30 mA for circuit protection. If the load current is less than 30 mA, connect the bleeder resistance R in parallel with the load as shown below so that the total current of the load circuit will be 30 to 300 mA. Obtain R from the following formula.

$$R \text{ (k}\Omega\text{)} = \frac{V}{30 - i}$$

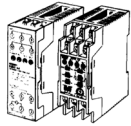
Make sure that the permissible power of the resistor is sufficient.



Connections

S3D2 Sensor Power Supply

The use of the S3D2 is recommended for supplying 12 VDC to the NL2 (or 24 VDC to the NL2) and converting the output of the NL into relay or open collector output in versatile timing control. The NL3 does not require a sensor power supply.

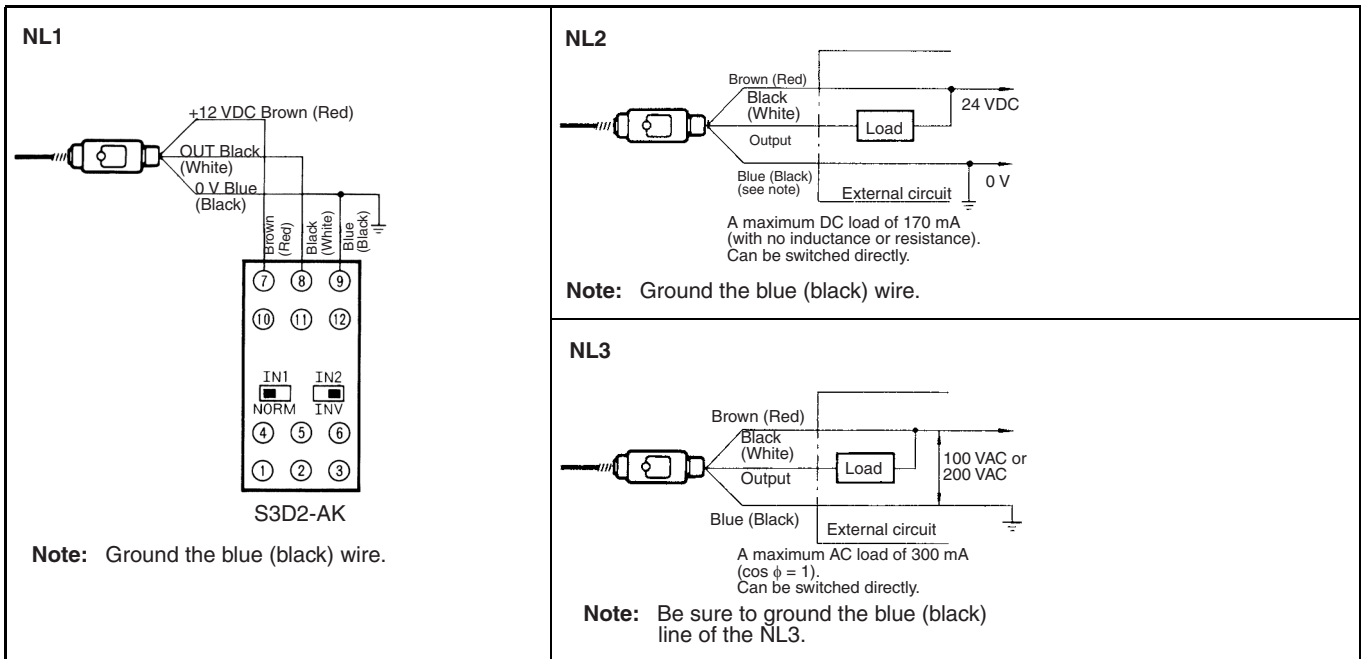


S3D2 Controller Unit

Model	Sensor Power Supply	Function	Power supply voltage
NL1	S3D2-AK	Basic operation	100 to 240 VAC
	S3D2-BK	Memory and timer operation	
	S3D2-CK	Timer operation	
NL2	S3D2-AKD	Basic operation	24 VDC
	S3D2-CKD	Timer operation	

Be sure to wire the cable correctly according to the color of each lead wire. Do not wire power lines or high-tension lines alongside the cable.

The use of S3D2 is recommended as a power supply to the NL1. Contact your OMRON representative for the datasheet of the S3D2.

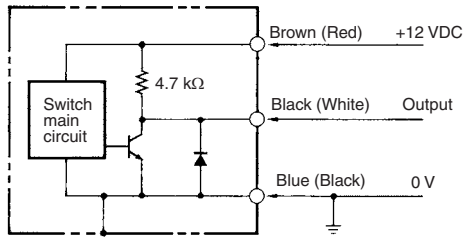


- Note:**
1. The lead wire colors of the NL have been changed in compliance with the latest applicable JIS standards. Colors in parentheses are previous ones.
 2. The figures in the S3D2 illustration indicate the terminal numbers of the socket.
 3. Use a three-conductor cable with a minimum thickness of 0.75 mm to connect the NL and the Sensor Power Supply or other devices with no built-in contacts. The cable can be extended up to 100 m on condition that the cable is wired in an independent conduit.

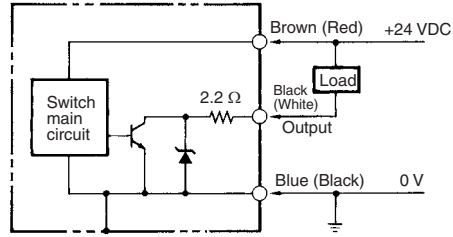
Output Circuit

Note: The lead wire colors of the NL have been changed in compliance with the latest applicable JIS standards. Colors in parentheses are previous ones.

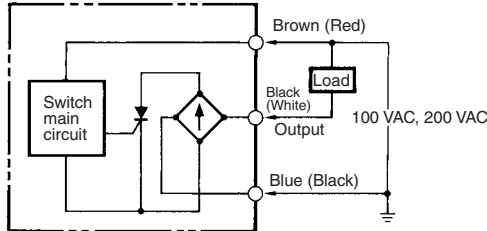
NL1



NL2

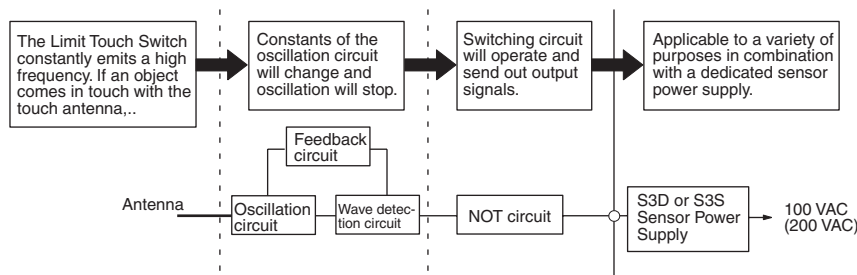


NL3

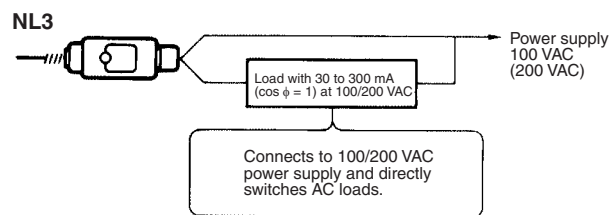
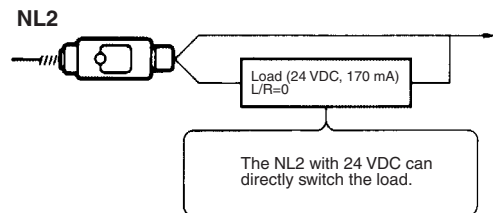
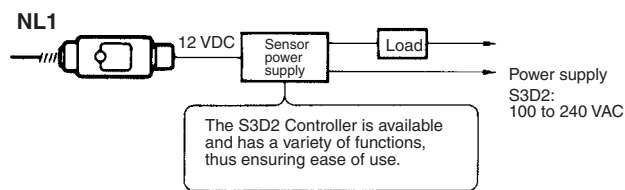


Note: The 0-V power supply side will be connected to the casing if the model is the NL1 or NL2.

Principle of Operation



Classification by Series and Features

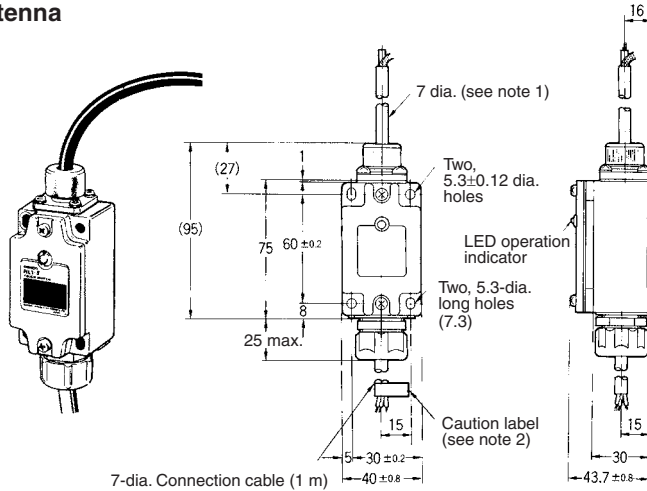


Separated Antenna Models

Note: The dimensions provided for the NL1-SP, NL2-SP, NL1-SC, and NL2-SC are the external dimensions for the antennas. The casing dimensions of these models are all the same as those for the coil spring or plunger models.

No Antenna

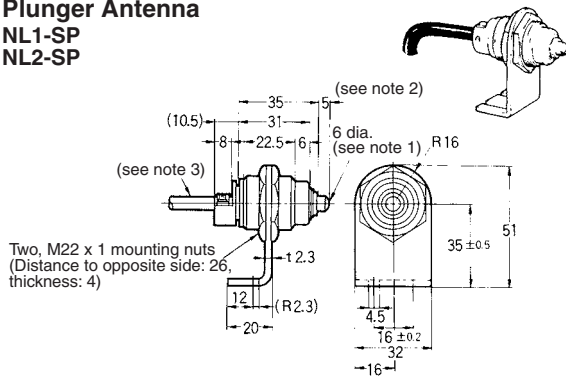
NL1-S
NL2-S



- Note:**
1. Make sure that the shape of the antenna is suitable to the application. Use the plunger antenna or coil spring antenna as shown below for the NL1-S or NL2-S.
 2. Use after removing the caution label.
 3. A standard 3-m high-frequency coaxial cable is provided. Models with 1- or 2-m connection cables are available as well.
 4. Do not cut or extend the connecting cable.

Plunger Antenna

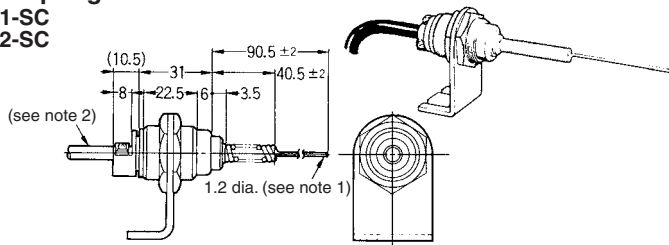
NL1-SP
NL2-SP



- Note:**
1. The stainless-steel plunger antenna allows a maximum OT (overtravel) of 5 mm.
 2. This position is the FP (free position) of the plunger.
 3. A standard 3-m high-frequency coaxial cable is provided. Models with 1- or 2-m connection cables are available as well.
 4. Do not apply a force greater than 9.8 N to the plunger.
 5. Do not cut or extend the connecting cable.

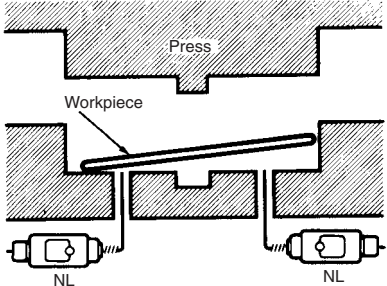
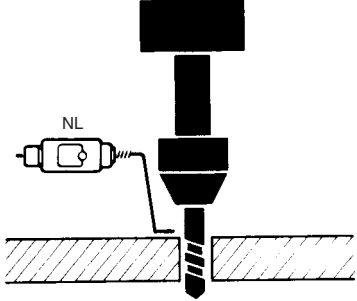
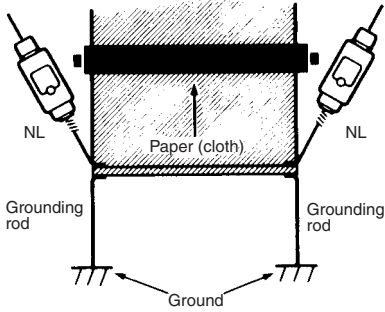
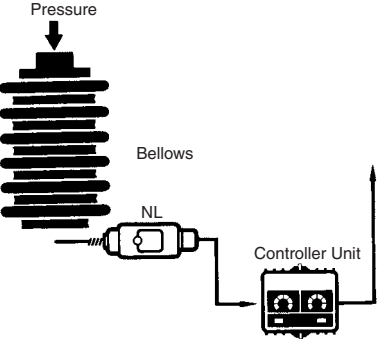
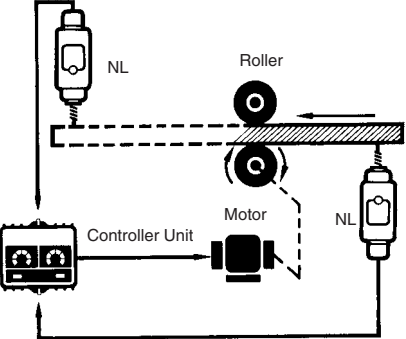
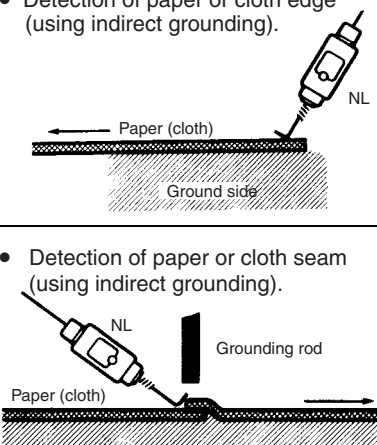
Coil Spring Antenna

NL1-SC
NL2-SC



- Note:**
1. The coil spring antenna is movable in any direction. Make sure that the angle of the antenna is within 30° to the FP (free position) after the antenna comes into contact with the object.
 2. A standard 3-m high-frequency coaxial cable is provided. Models with 1- or 2-m connection cables are available as well.
 3. Do not cut or extend the connecting cable.
 4. The antenna is replaceable. Contact your OMRON representative for details.

Application Examples

<ul style="list-style-type: none"> • Detection of press completion position. • Detection of mistakes in workpiece setting or removal. • Detection of minute workpieces.  <p>The diagram shows a cross-section of a press machine. A workpiece is being processed between two dies. Two NL switches are positioned to detect the workpiece's position at different stages of the press cycle.</p>	<ul style="list-style-type: none"> • Drill positioning. • Material positioning.  <p>The diagram shows a drill bit positioned above a workpiece. An NL switch is attached to the drill's shaft to detect the correct vertical position before drilling.</p>	<ul style="list-style-type: none"> • Detection of workpiece edges.  <p>The diagram shows a rectangular workpiece on a table. Two NL switches are positioned to detect the edges of the workpiece. Grounding rods are used to provide a reference ground level for the switches.</p>
<ul style="list-style-type: none"> • Displacement detection and control.  <p>The diagram shows a bellows mechanism. Pressure is applied to the top of the bellows, causing it to expand or contract. An NL switch is connected to the bellows to detect its displacement. The switch is connected to a Controller Unit, which provides feedback for control.</p>	<ul style="list-style-type: none"> • Thickness control of rolling plates.  <p>The diagram shows a rolling mill with two rollers. A plate is being rolled between them. An NL switch is positioned to detect the thickness of the plate. The switch is connected to a Controller Unit, which is also connected to a Motor that adjusts the pressure between the rollers.</p>	<ul style="list-style-type: none"> • Detection of paper or cloth edge (using indirect grounding). • Detection of paper or cloth seam (using indirect grounding).  <p>Two diagrams illustrate indirect grounding. The top diagram shows a paper or cloth edge being detected by an NL switch. The bottom diagram shows a seam in the paper or cloth being detected by an NL switch and a grounding rod.</p>

Precautions

Refer to the "Precautions for All Switches" on page 17 and "Precautions for General-purpose Limit Switches (Including Multiple Limit Switches, Mechanical Touch Switches, High-precision Switches, Touch Switches, On-site Flexible Switches; Not Including Safety Switches)" on page 23.

CAUTION

Make sure that the antenna does not come into contact with the human body, otherwise an electric shock may be received.



Correct Use

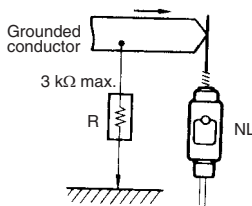
Antenna Grounded through Sensing Object (Size of Sensing Object)

Grounded Object

If the sensing object is the following grounded conductor, its size will not affect the operation of the NL. Check for the presence of insulators sticking to the sensing object or the corrosion of the sensing object, however, so that the ground resistance will not exceed 3 kΩ.

Contact with Grounded Conductor

The sensing object is equivalently grounded through ground resistor R.



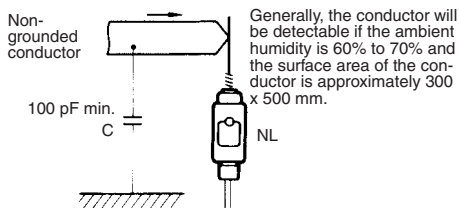
R: 3 kΩ max.
The sensing object must not come into contact with the human body.

Non-grounded Object

If the sensing object is the following non-grounded conductor, the NL will operate if the capacitance between the sensing object and the ground is 100 pF or more. The larger the surface area of the sensing object is, the higher its capacitance will be. The shorter the distance between the sensing object and the ground is, the higher the capacitance will be. Furthermore, the capacitance greatly varies with the ground condition (e.g., dry sand, concrete, or wet soil).

Contact with Non-grounded Conductor

The sensing object is equivalently grounded through capacitor C.



C: 100 pF min.

Conditions of Sensing Object

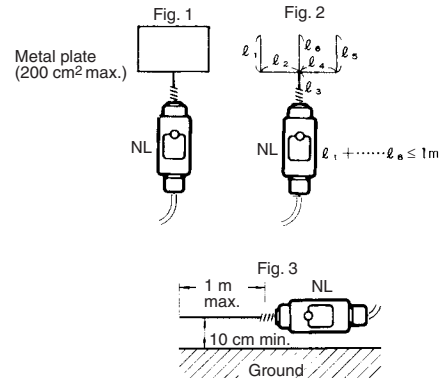
The detection of conductors (e.g., iron, stainless steel, aluminum, and brass objects) poses no particular problem. A conductor coated with paint cannot be detected, however, because there is no electrical continuity between the antenna and the conductor.

Non-conductive objects (e.g., plastic, ceramic, glass, and cloth objects) can be detected by grounding them indirectly.

Antenna

Shape and Extension

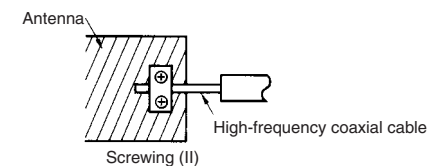
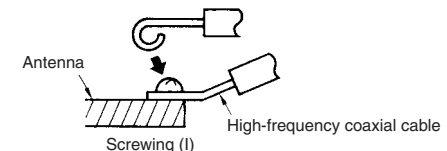
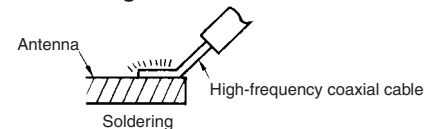
If a metal plate is used as an antenna by connecting it to the built-in or separated antenna of the NL, the surface area of the metal plate must be 200 cm² maximum. The antenna can be extended, provided that the total length of the antenna is 1 m maximum and that the bottom of the antenna is at least 10 cm away from the ground. Refer to the illustrations below.



Antenna Connection

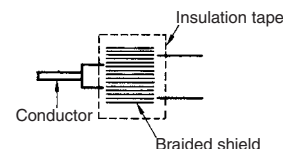
To connect a suitable antenna to the high-frequency coaxial cable of the NL□-S, perform the following steps.

Connecting Conductor to Antenna



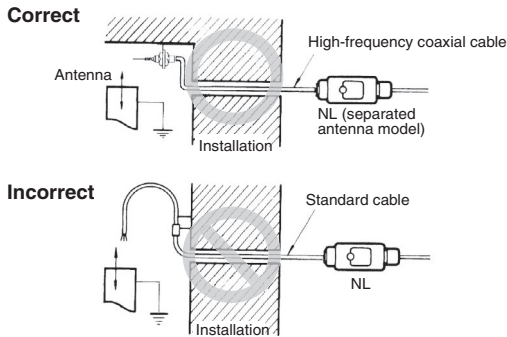
Braided Shield

The shield is connected to the casing of the NL. Pay the utmost attention so that the conductor connected to the antenna will not come into contact with the shield. Secure the shield with insulation tape.



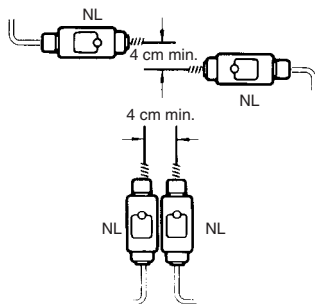
If the antenna cable needs to be extended, use the separated antenna model. Do not use a standard cable in place of the high-frequency coaxial cable.

Antenna in Parallel to Object



If more than one NL is used in parallel or side-by-side, make sure that the distance between the antennas is at least 4 cm.

Maintenance



Make sure that the antenna is free of oil, dust, or rust, otherwise the antenna may not operate.

Do not use the NL in places where water or oil (especially water-soluble oil) is frequently sprayed to the NL or antenna, otherwise the NL may malfunction.

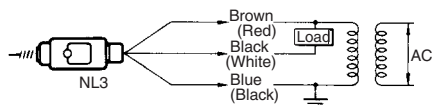
Grounding

In order to maintain the operational reliability of the NL, be sure to ground the blue (black) wire of the power cable.

The blue (black) lead wire of the connection cable will be connected to the casing internally if the model is the NL1 or NL2. The NL1 or NL2 does not operate with the service power supply of the PC (Programmable Controller) because the negative end of the service power supply is not grounded. The noise immunity performance of the PC will be degraded if the negative end of the service power supply is grounded.

Provided that single-phase 200 V is supplied to the NL3, if one phase is grounded, the power supply will be short-circuited and a machinery breakdown will result. Use an isolating transformer and ground the secondary side of the transformer instead.

In the above case, be sure to ground the secondary side, otherwise the NL may not operate.



Note: The lead wire colors of the NL have been changed in compliance with the latest applicable JIS standards. Colors in parentheses are previous ones.

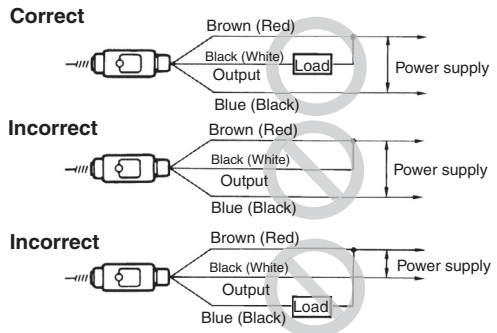
Others

Do not disassemble the NL, otherwise the internal wiring will be damaged and the NL will fail to operate.

Make sure that the conduit opening is free of foreign materials or cuttings.

The sealing of the NL uses nitrile butadien rubber (NBR), which is highly oil resistive. If exposed to some types of oil or chemical indoors or outdoors, however, the NBR may deteriorate. Contact your OMRON representative for details.

Make sure that the load is connected according to the connection diagram. The internal circuit of the NL will break due to mistakes in wiring or load short-circuiting.

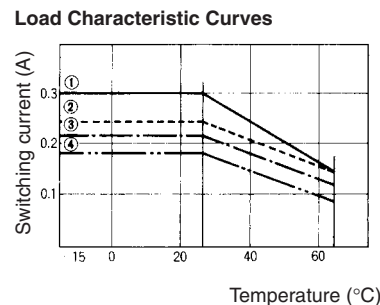


Note: The lead wire colors of the NL have been changed in compliance with the latest applicable JIS standards. Colors in parentheses are previous ones.

Remove the warning label on the end of the connection cable before wiring.

Load Switching

The NL3 switches AC loads. The maximum switching load varies with the ambient temperature as shown in the following graph of load characteristic curves.



- Note:**
- Load ① is an inductive load with a maximum repetitive operation rate of once per 5-minute period or resistive load.
 - Load ② is an inductive load with a maximum repetitive operation rate of 3 times per minute.
 - Load ③ is an inductive load with a maximum repetitive operation rate of 30 times per minute.
 - Load ④ is an inductive load with a maximum repetitive operation rate of 300 times per minute.
 - Except for the resistive load, the characteristic curves cover repetitive operations in an ON-to-OFF ratio of 1:1. If the OFF period is extremely short in actual application, use 80% of the above values.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

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