Safety Precautions

Always read this section before use.

Design & selection

⚠WARNING

■ Use this product in accordance with the specifications.
- Use for applications, or at load currents, voltages, temperatures, impacts or sites excluded from the specifications could result in damage or malfunctions.

■ Do not use oxygen, corrosive or combustible gas, or toxic fluid for this product.

■ Do not use this product in explosive atmosphere.
- The pressure switch is not explosion proof. Never use in an explosive gas atmosphere as explosions or fires could result.

■ Avoid installing this product in a sealed control box or indoors.
- If the fluid should leak due to any trouble, the pressure in the sealed chamber could change and create a hazardous state. Use this product in the control box having safety device to control internal pressure, or indoors with no pressure differential from the outside.

■ Power supply voltage
Use the product within the specified power supply voltage. The product could rupture or burn if voltage exceeding the working range is applied or if an AC power supply (100 VAC) is applied.

■ Load short circuit
Do not short-circuit the load. Failure to observe this could result in rupture or burning.

■ Incorrect wiring
Avoid incorrect wiring such as wrong polarity of power source, etc. Failure to observe this could result in rupture or burning.

⚠CAUTION

■ Applicable fluid
When using applicable fluid other than air; nitrogen gas, etc., oxygen deficiency could be caused. Observe the following instructions.
- Use this product in well ventilated locations.
- Ventilate the work area when nitrogen gas is being used.
- Inspect piping regularly, so nitrogen gas piping does not leak.
- Non-corrosive gas means substances such as nitrogen or carbon dioxide contained in air and inert gases such as argon or neon.
- When using this product for compressed air containing water or oil, use PPD3-S (stainless steel diaphragm sensor specifications) with increased corrosion resistance.

■ If this product is used for vacuum suction confirmation, care must be taken for following matters.
- When applying positive pressure for vacuum break onto the product, check that it does not exceed the specified proof pressure.

■ Working environment
- Avoid using this product where vibration or impact exceeding 100 m/s^2 could be applied.
- Check the temperature of fluid being measured and the environmental temperature in piping.
- When using a type that does not have the corresponding degree of protection, do not use where it may come into contact with water or oil.

■ Determine the setting taking error caused by accuracy and temperature characteristics into consideration.

■ Take care when using this product for an interlock circuit.
- When using the pressure switch for an interlock signal required high reliability, provide a double interlock by installing a mechanical protection function or a switch (sensor) other than a pressure switch as a safeguard against failure.
  Regularly inspect and confirm that the interlock activates correctly.

(Recommended values)

Model No.	Degree of protection
PPD3-D	IP40
PPE (-A)/PPD3-S	IP65

■ Response time is affected by working pressure and load volume. If reproducibility with stable response time is required, install a regulator in the proceeding stage.

■ Take the following countermeasures to prevent malfunction caused by noise.
- Install a line filter in the AC power supply line.
- Do not share power with components such as an inverter, motor, etc., that cause noise.
- Use a surge suppressor, such as CR or diode on the inductive load (solenoid valve, relay, etc.) and remove noise when generated.
- When using a device such as a switching regulator or inverter motor that could generate noise near the sensor, be sure to ground the device frame ground (F.G.) terminal.
- Separate wiring to the device of proportional control by electrical signal from strong magnetic fields.
- Connect wiring to device of proportional control by electrical signal with a shield wire.
- Ground the shield wire on the power supply side.

■ When releasing secondary control pressure, such as an air blowing, to the atmosphere, pressure could fluctuate depending on piping conditions and flow conditions. Test the product under actual working conditions, or contact CKD before using this method.

■ When selecting dryer, air filter, oil mist filter or regulator, select a device with a flow rate higher than that used by device of proportional control by electrical signal.

■ CE-compliance working conditions
The standard for the immunity for industrial environments applied to CE conforming product is EN61000-6-2, but the following requirements must be satisfied in order to conform to this standard.
Conditions
- The assessment of this product is performed by using a cable pairing a power supply line and a signal line, treating this cable as a signal line.
- This product is not equipped with surge immunity. Implement surge protection measures on the system side.

Mounting / Installation / adjustment

⚠ WARNING

■ Avoid incorrect connection.
- An incorrect connection may cause a fatal error not only to this product but also peripheral devices.

■ DC power not insulated from AC primary side may damage the product and power supply, so an electric shock could occur. Do not use the product in this case.

⚠ CAUTION

■ Do not use the product where the product is exposed to direct sunlight or may come in contact with water or oil.

■ Flush air pipe connected to device of proportional control by electrical signal before connecting. Prevent pipe from catching tips of sealing tape when piping.

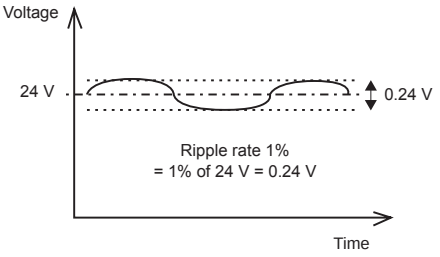
■ Correct pressure control is not possible if the exhaust port is plugged. Release this port into the atmosphere.

■ Use proper torque to tighten the pipes when connecting them.
- To prevent air leak and to protect threads from damage.
- First tighten the screw by hand to prevent damage to screw threads, then use a tool.

Port thread	Tightening torque N·m
M3	0.3 to 0.6
M5	1 to 1.5
Rc1/8	3 to 5
Rc1/8 (resin)	1 to 1.5

■ Care must be taken for protection of body and lead wire.
- Do not bump or drop the main unit, or apply excessive bending or tensile force to the lead wire because the lead could be disconnected.
- Connect and wire bending-resistant material, such as robot wire material, for the movable sections.

■ Wiring
- Turn the power OFF before wiring this product. Discharge static electricity from personnel or tools before and during work.
- Use a stabilized noise-free power supply with a ripple rate of 1% or less.



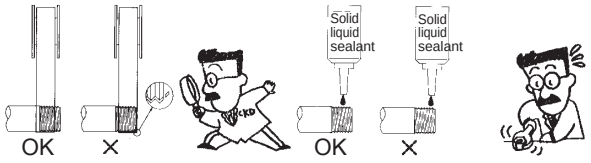
- Turn the power ON and OFF at the quick rising and falling edges of voltage.
  If the rated voltage is not reached, the sensor could malfunction. In some cases, the sensor could not recover after the rated voltage is reached. Reset the power in that case. Even if the rated voltage drops temporarily, shout down the power once, then turn ON the power again. If the power-supply voltage drops below the rated voltage even temporarily,
- Install the product and wiring as far away as possible from noise source such as a strong electric line. Take separate measures against surge generated from inductive loads that enters the power wire.
- Do not start the control unit, machinery and equipment immediately after wiring. Unpredicted signals could be output due to inadvertently set values. Conduct an energized test with controls and machine devices stopped, and set target switch data.

■ Stop the machinery and equipment and confirm safety before setting switch outputs.

■ Operate the keys with fingertips. Sharp instruments, such as knife or screwdriver, contacting a plastic film on the operation section could damage the film and compromise its protective functions.

■ Open the package in a clean room.
- The products are wrapped in an antistatic sheet before packaged in a box. If you install the product in a clean room, we recommend you to take it out of the box outside the clean room before you bring it in and to unwrap in the clean room.

■ Piping work
- For the push-in fitting, use the recommended tube, and perform piping work to the push-in fitting assembly after the brushing.
  * Recommended tube: Conforming tube O. D. 6 mm manufactured by CKD F-1506, U-9506 and others.
- For the screw-in fitting, wind sealing tape or apply a sealant, and screw in without tightening excessively. Apply a wrench to the metal section when tightening. (resin section only for PPE, PPD3-R*A-6)
- Wrap sealing tape from threads starting 2 mm inside from the end of piping threads.
  * If sealing tape protrudes from pipe threads, it could be cut when screwed in. This could cause the tape to enter the component and lead to faults.



- Make the pipe length of approx. 1 m, and take caution not to apply tensile force or impact on the piping. For the longer tube, by its own weight and vibration/impact, unexpected tensile strength is produced. In order not to apply a weight, fix and relay the tube to the machine device in the middle of the piping.

■ Avoid connecting the output for a relay contact, operation switch, or other component output in parallel with the PLC to the product's output, or short-circuiting the input terminal of the PLC to which this product is connected with the power supply cable's minus side to test the input device. This product's output circuit could be damaged.

Mounting / Installation / adjustment

⚠ CAUTION

■ Some models have a push-in fitting for the measured pressure port. Check the perpendicularity of the tube side, and check that there are no scratches, indents, or dirt near the end. Air and compressed air are measured. Check that water and dirt do not enter the tube during piping.

During use & maintenance

⚠ WARNING

■ Do not apply overcurrent.

- If overcurrent flows to the pressure switch due to a load short-circuit, etc., the pressure switch will be damaged and could also ignite. Provide an overcurrent protection circuit, such as a fuse, for the output wire and power cable as needed.

⚠ CAUTION

■ Do not disassemble the products.

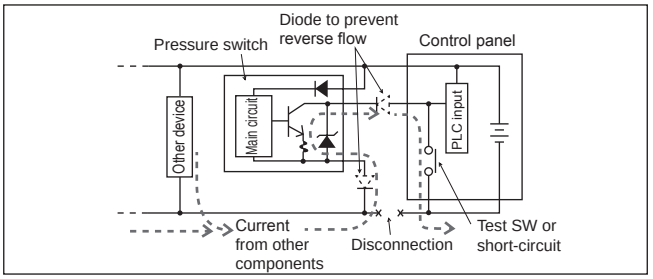
- The product could be damaged or its performance compromised if it is disassembled. CKD does not guarantee performance after disassembly. Remove the entire installation section (pressurized port section) when replacing or moving the product.

■ Stop machinery and equipment, then check the safety before operating the product.

■ With PPD3-S, pressure is detected 200 times per second, but this display is updated 4 times a second, and cannot track fast pressure changes. The switch could therefore start operating at quickly changing pressure even when the display does not indicate the switch setting.

■ The case is made of resin. Do not use solvent, alcohol or detergent in cleaning, or resin could absorb it. There is a risk of affecting the resin. Wipe off dirt with a rag soaked in a diluted neutral detergent solution and wrung out well.

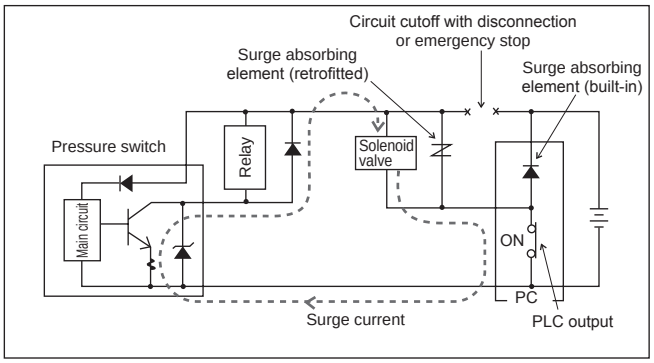
■ Pay attention to reverse currents caused by disconnected wires and wiring resistance.
When other devices, including pressure switches, are connected to the same power supply as the pressure switch, and the output cable and power cable's minus side are short-circuited or the power supply's minus side is disconnected to check operation of the input device from the control panel, reverse current could flow to the pressure switch's output circuit and cause damage.



Take countermeasures as followings to prevent damages caused by reverse current.

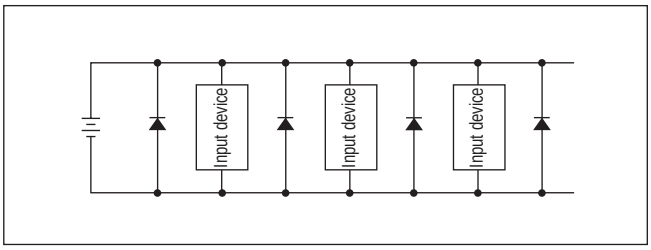
(1) Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.
(2) Limit the number of devices connected to the same power supply as the pressure switch.
(3) Insert a diode in series with the pressure switch's output cable to prevent reversal of current.
(4) Insert a diode in serial with the pressure switch's power cable minus side to prevent reversal of current.

■ Care must be taken for surge current flow-round.
When the power is shared with inductive loads that create surge current such as pressure switches, solenoid valves or relays, if the circuit is closed with inductive loads activated, surge current could lead to the output circuit, causing damages. When the pressure switch power is shared with an inductive load that generates surges, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, surge current could enter the output circuit and cause damage depending on where the surge absorbing element is installed.



Take the following countermeasures as followings to prevent damages caused by reverse current.

(1) Separate the power supply for the output system comprising the inductive load, such as the solenoid valve and relay, and the input system, such as the pressure switch.
(2) If separate power supplies cannot be used, directly install a surge absorption element for all inductive loads. Remember that the surge absorbing element connected to the PLC, etc. protects only that device.
(3) Connect a surge absorption element to the following places on the power wiring as shown below as a measure against disconnections in unspecific areas.



When the devices are connected to a connector, the output circuit could be damaged by the above phenomenon if the connector is disconnected while the power is ON. Turn the power OFF before connecting or disconnecting the connector.

Electronic pressure switch PPE Series

Design & selection

⚠WARNING

■ Check the internal drop voltage.

- When using with a voltage less than specified voltage, the pressure switch may be activated correctly, but the load may not function correctly. Check the load's working voltage, and check that the following expression is satisfied:

  Power supply voltage – internal voltage drop > load working voltage

■ Care must be taken for leakage current.

- Even when the 2-wire pressure switch is OFF, current (leakage current) flows to operate the internal circuit (1 mA or less).

  Load working current > leakage current

  If the above expression is not satisfied, the switch may be interpreted as ON even when it is OFF, and operation fail. Use the 3-wire PPD if specifications are not met. If n units are connected in parallel, the current that flows to the load increases n-fold.

Mounting / Installation / adjustment

⚠CAUTION

■ Handling the product

- When installing the product, hold the body section so that impact is not applied to the body or excessive stress is not applied to the lead wire.
- Do not disassemble or dismantle the product. The product could be damaged or its performance compromised if it is disassembled. CKD does not guarantee performance after disassembly.

■ Load short circuit protection circuit

- If the load is inadvertently short-circuited, the internal load short-circuit protection circuit is activated and the switch remains OFF. Fix wiring, then turn power OFF, or short-circuit the PPE's brown and blue lines to recover normal switch operations.

■ The main body and fitting connection rotate, but this section should not repeatedly rotate during use.

■ The degree of protection is equivalent to IP65, and this product must not be used in an environment where it could come in contact with water above the protective level specified in IP65. Check that cutting oil and coolant do not come in contact.

[Cautions on installation]

■ Driver

Use a flat head screwdriver corresponding to the trimer groove (0.5 W × 2.3 L × 0.5 D) or a cross-point screwdriver for 1 bit to set the trimmer.

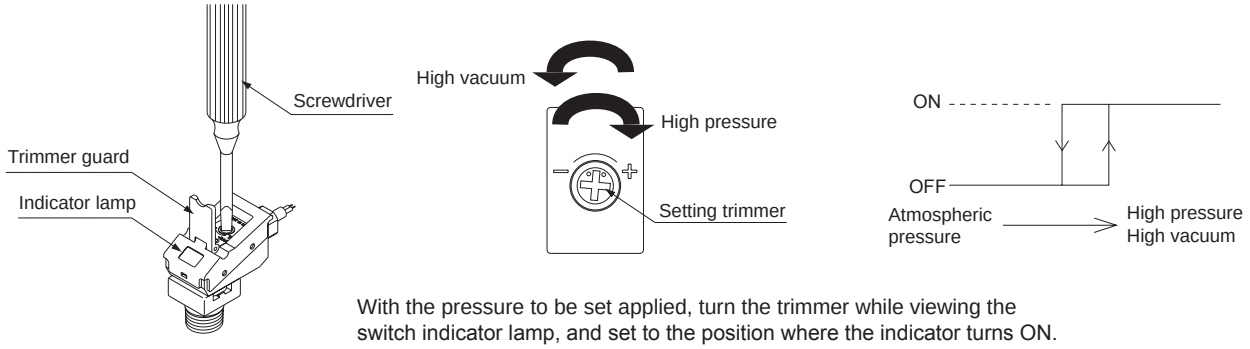
■ Trimmer

The rotation range of the trimmer is 240 degree. The trimmer could be damaged if turned any further or if turned forcibly.

■ Opening and closing the trimmer cover

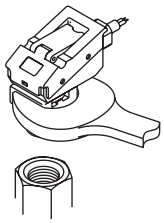
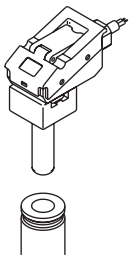
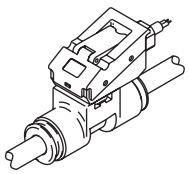
Use a flat head screwdriver to open the trimmer cover and set the trimmer. After setting, press the trimmer cover with a finger and completely close it. The degree of protection (IP65) is not satisfied if the cover is not completely closed.

Setting pressure and switch operations



With the pressure to be set applied, turn the trimmer while viewing the switch indicator lamp, and set to the position where the indicator turns ON.

Connection

PPE-□-6	PPE-□-H6-B	PPE-□-H6
		
Use sealing tape or sealant, and catch a wrench against the square section (13 mm) of the R1/8 fitting to install. (Precautions) • The tightening torque is 1.0 to 1.5 N·m or less. Resin parts may be damaged if tightened too far.	Insert the CKD 6 mm tube push-in fitting and use. (Precautions) • Securely insert the plug section, and check that the plug is not dislocated. If the plug is not fully inserted, it could be dislocated or air could leak. • Use the applicable push-in fitting. GW Series GWJ Series	Insert the 6 mm tube into the two push-in fittings. (Precautions) • Use the designated tube and plastic plug. Tube outer diameter precision Nylon, soft nylon tube : Within ±0.1 mm Polyurethane tube : Within +0.1 mm Urethane tube : Within -0.2 mm and with hardness of 93° and over. • Securely insert the tube to the tube end, and make sure that the tube cannot be pulled off. If the tube is not fully inserted, it could be dislocated or air could leak. • Cut the tube with a dedicated cutter, and cut at a right angle.

Electronic pressure sensor analog output PPE-☐A Series

Design & selection

⚠WARNING

■ Wiring
Turn the power OFF before wiring this product. Discharge static electricity charged in human body, tool or equipment before and during operation.
Connect and wire bending-resistant material, such as robot wire material, for the movable sections.

■ Installation
Install this product and wiring as far as possible from noise source such as a strong electric line.
Take separate countermeasures against surge that enter the power wire.

■ Power supply voltage
Use the product within the specified power supply voltage. The product could rupture or burn if voltage exceeding the working range is applied or if an AC power supply (100 VAC) is applied.

■ Load short circuit
Do not short-circuit the load. Failure to observe this could result in rupture or burning.

■ Incorrect wiring
Avoid incorrect wiring such as wrong polarity of power source, etc. Failure to observe this could result in rupture or burning.

■ Connecting load
When connecting an inductive load such as relay or solenoid valve, a surge voltage is generated when the switch is turned OFF. Directly connect a diode onto all inductive loads in the same power circuit.

■ Connecting load
The output impedance of the analog output section is 1 kΩ. If the impedance of the connecting load is small, output error increases. Check error with the impedance of the connecting load before using.

Example of calculation

(PPE-☐A output impedance: Ro = 1 kΩ
Load internal impedance: Rx = 1 MΩ

$$\text{Output value} = \left(1 - \frac{Ro}{Ro + Rx}\right) \times 100\%$$

$$= \left(1 - \frac{1\ k\Omega}{1\ k\Omega + 1\ M\Omega}\right) \times 100\% \Rightarrow \text{Error in the output value approx. 0.1\%}$$

Mounting / Installation / adjustment

⚠CAUTION

■ When installing the product, hold the body section so that impact is not applied to the body or excessive stress is not applied to the lead wire.

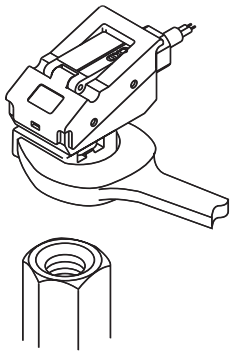
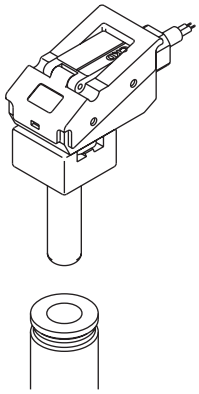
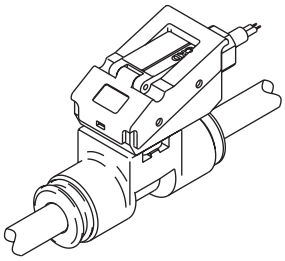
■ When applying positive pressure for vacuum break onto the product to check vacuum suction, check that it does not exceed the specified proof pressure.

■ Do not disassemble or dismantle the product. The product could be damaged or its performance compromised if it is disassembled.
CKD does not guarantee performance after disassembly.

■ The main body and fitting connection rotate, but this section should not repeatedly rotate during use.

■ The degree of protection is equivalent to IP65, and this product must not be used in an environment where it could come in contact with water above the protective level specified in IP65. Check that cutting oil and coolant do not come in contact.

[Connection]

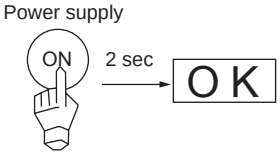
PPE-□A-6	PPE-□A-H6-B	PPE-□A-H6
		
Use sealing tape or sealant, and catch a wrench against the square section (13 mm) of the R1/8 fitting to install. (Precautions) • The tightening torque is 1.0 to 1.5 N·m or less. Resin parts may be damaged if tightened too far.	Insert the CKD 6 mm tube push-in fitting and use. (Precautions) • Securely insert the plug section, and check that the plug is not dislocated. If the plug is not fully inserted, it could be dislocated or air could leak. • Use the applicable push-in fitting. GW Series GWJ Series	Insert the 6 mm tube into the two push-in fittings. (Precautions) • Use the designated tube and plastic plug. Tube outer diameter precision Nylon, soft nylon tube : Within ±0.1 mm Polyurethane tube : Within +0.1 mm Urethane tube : Within -0.2 mm and with hardness of 93° and over. • Securely insert the tube to the tube end, and make sure that the tube cannot be pulled off. If the tube is not fully inserted, it could be dislocated or air could leak. • Cut the tube with a dedicated cutter, and cut at a right angle.

Electronic pressure switch PPD3-S

Design & selection

⚠CAUTION

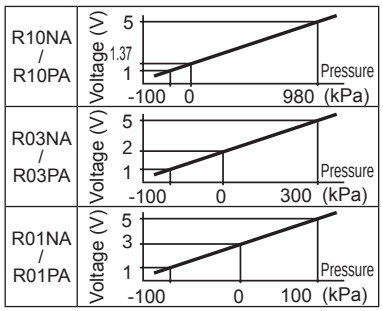
■ This product self-diagnoses the internal circuit immediately after power is turned ON, so pressure is not detected immediately. Set the control circuit so signals are ignored for 2 seconds after power is turned ON.



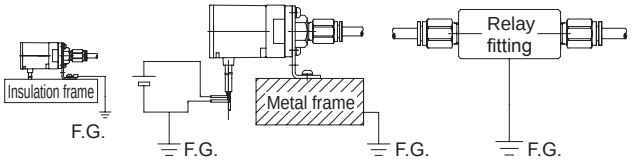
■ This product's overcurrent protection turns the output OFF when an overcurrent is detected. However, the output is repeatedly turned ON for a short time at a set cycle. This causes power supply voltage to fluctuate and may adversely affect peripheral devices.

■ When using this product for compressed air containing water or oil, use PPD3-S (stainless steel diaphragm sensor specifications) with increased corrosion resistance.

[Analog output voltage waveform]

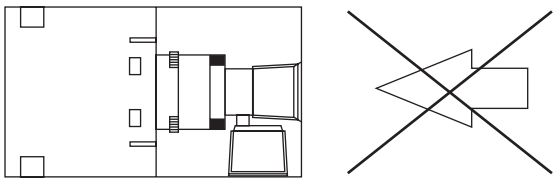


■ Install PPD3-S on a frame or panel connected to the frame ground F.G., and if necessary, directly connect from PPD3-S port to F.G. When leading fluids in from an external device, connect via a relay fitting connected to F.G. (To provide safety when using conductive fluids)



■ PPD3-S power supply is a DC stabilized power supply completely isolated from the AC primary side. Connect either the + side or - face of the power to the F.G. A variable resistor (voltage limit 40 V) is connected between the internal power circuit and port installation section of this PPD3-S to prevent dielectric breakdown of the sensor. Do not conduct withstand voltage or insulation resistance tests between the PPD3-S's internal power supply circuit and port installation section. Disconnect the PPD3-S wiring if this kind of test must be done. An excessive potential difference between the PPD3-S power supply and port installation section could burn internal parts.
After installing, connecting, and wiring the PPD3-S, electrical welding of the device or frame, or short-circuit accidents, etc., could cause welding current, excessive high voltage caused by welding, or surge voltage, etc, to run through the wiring, ground wire, or fluid path connected between the above devices. This could damage wires or devices.
Conduct any work such as electrical welding after removing this device and disconnecting all electric wires connected to the F.G.

■ Care must be taken for entry of water and drain.
PPD3-S has a stainless steel diaphragm pressure sensor that cannot be damaged by water. However, when vacuum is broken after checking vacuum suction, drainage in the water and air could collide with the pressure sensor. The **water's inertia** could damage the pressure sensor and prevent the correct pressure from being indicated.
If water or drainage could enter, connect a thin pipe to the PPD3-S, or install an orifice midway.
Take special care when using the back ports on PPD3-S 6B port.
In addition, this has a ø1 built-in orifice inside the pressure port.



Take special care when using the back ports on the 6B if water of drainage could enter.

Mounting / Installation / adjustment

⚠CAUTION

■ Check the pressure range.
If the pressure switch for low pressure range is incorrectly used for high pressure applications, this product could be ruptured or damaged, and a large amount of air could leak, posing a hazard.

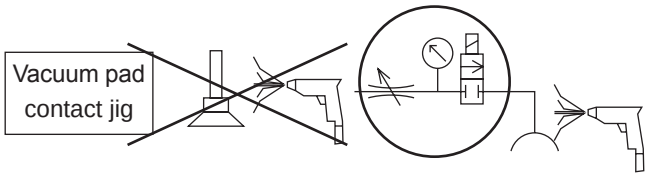
High pressure | P10 > P01 > V01 / R10 > R03 > R01 | Vacuum

■ Switch data can be set to values that exceed the rating range, or to unrealistic values, but operation and accuracy at such values are not guaranteed. Confirm that settings enable the target operation. Ensure the following difference between data A and B to stabilize operation:

Operation mode	Difference of min. digit
Hysteresis operation	1% F.S.
Window operation	3% F.S.

Do not set as follows (Data A = Data B / ON point = OFF point)

■ Avoid air blow
The high pressure near the nozzle could back flow and exceed the product proof pressure. This could result in rupture or damage. Lower the pressure of compressed air to less than the proof pressure, or shield the flow path when blowing air.



■ Remove humidity, dirt and contamination from the installation location. Select a flat installation surface. Any warp or bumps on the installation surface could damage the case or compromise protective functions. Excessive tightening of installation screws can result in similar damage.
- After installation, do not bump the case or use the case as step. Even if there is no apparent external damage, this remains as stress that gradually forms cracks and further damage.

■ Precautions for PPD3-S (sensor integrated) Series
- The product may be prone to damage when in a state of being unpacked or being installed. The protective functions are effective when the product is correctly installed, wired and piped. Provide protection so that water and other substances do not come in contact until installation is completed.
- Wire and pipe the product after fixing it at the installation site. Check surrounding safety and that water and other substances do not come in contact before starting wiring. Continue to provide protection after the product is connected. (The current could leak at the connection section, and water could run along the cable and enter the case.)
- The atmospheric introduction port for atmospheric pressure is treated as a key point in ensuring this product's protective performance. Use the following tube, and release the end into the atmosphere in a dry environment with no barometric pressure differences.
Recommended tube: Soft nylon tube model No. FH-3224
Urethane tube model No. U-9532, U-9504

[IMPORTANT] Never apply pressure to atmospheric inlet port.

■ If the atmospheric inlet port is pressurized, protective performance could be lost, and the case could rupture or pop off. Leave this port set at atmospheric pressure. Separate piping for atmospheric release port from other pressurized air piping by using different tube diameters or colors. Take sufficient countermeasures to prevent pressurized air from being applied.
- Even when protective performance is not required, if this product is installed in a humid environment with large temperature variation, dew condensation in the case is prevented by taking these measures. (Dew is fatal to the electric circuit.)
- Note that if this product is connected in a control panel, pressurized to a positive pressure or negative pressure within a dry environment, the pressure difference could affect indicator accuracy.
- This product is intended to protect from city water. Protection performance cannot be guaranteed for hot water, oil, coolant (nonwater soluble, water soluble), solvent, acid, alkaline, or chemicals, etc. These substances could cause solvent cracks to form on in the case's resin parts, the gasket to swell, the adhesive to melt and separate, and other problems. Note that if water that gets on the product freezes, the case could be damaged and protective performance could be lost. Please be careful.

■ The degree of protection is equivalent to IP65, and this product must not be used in an environment where it could come in contact with water above the protective level specified in IP65. Check that cutting oil and coolant do not come in contact.

During use & maintenance

⚠CAUTION

■ This product has O-ring seals and threaded fittings. A slight amount of air leaks (1 cm^3/min. ANR or less) is tolerated.
When using applicable fluid other than air; nitrogen gas, etc., oxygen deficiency could be caused. Observe the following instructions.
- Use this product in well ventilated locations.
- Ventilate the work area when nitrogen gas is being used.
- Inspect piping regularly, so nitrogen gas piping does not leak.

■ Fluids that could corrode the gas contact area material (*1) or flammable, explosive, or toxic fluids could damage the sensor or main body. Do not use those fluids.

■ Confirm that fluid being measured does not freeze (resulting in expansion or contraction of volume), contents do not solidify and stick due to drying, solid contents do not form sediments or accumulate, accumulated fluid does not decompose and that the product is not clogged by dirt. When using inductive fluids, fluid staying in the middle of piping at low pressure ranges may cut off the pressure or cause negative pressure generation, preventing proper measurement. Fluids such as water or oil drainage could result in a water hammer caused by the fluid's inertial pressure, or a sudden pressure rise such as a surge pressure when the valve is turned ON and OFF, etc. Before installing, use a highly responsive pressure sensor and check that these do not exceed the proof pressure even instantly. Pressure exceeding the proof pressure could damage the sensor or body.

■ For safety, be sure to turn power OFF before connecting the sensor-separated sensor.

*1 Wetted section material

Model No.	Material
PPD3-S	SUS630, FKM, aluminum

Note: The fitting material is included for models with push-in fittings (PPD3-S-6HD, PPD3-S-6HT).

Fitting	NBR, brass (nickeling)