Instruction Manual

Model DT400G
Dust Monitor

IM 11K1B1-01E

YOKOGAWA
Yokogawa Electric Corporation

IM 11K1B1-01E
1st Edition

Introduction

The DT400G dust monitor is a process instrument designed to detect solid particles in gas. The integral unit is made of converter, detector and sensor. The DT400G has a wide variety of applications, including continuous monitoring of the amount of dust contained in exhaust gas.

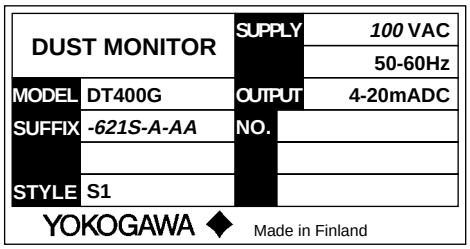
Before use, read this manual thoroughly to enable the instrument to be used to its fullest capabilities.

The topics and information that need your special attention when handling the product are given in the text of this manual along with cautionary notes, which are classified into the categories WARNING or CAUTION, depending on the importance of the information. For safety reasons or to avoid possible damage to your equipment, strictly adhere to every cautionary note that appears in this manual. The cautionary word "WARNING," which also appears on the product itself, is indicated together with the alert symbol shown below:

Example of a notation of a WARNING alert symbol indicated on the product

1. Specifications Cross-check

Upon arrival of the purchased product, carefully unpack it and make sure it is completely free from any damage that may have occurred during transport. It is shipped in strict conformance to the purchaser's specifications such as the adaptable type of power supply and the method of installation. By way of precaution, confirm that the delivered DT400G dust monitor is exactly the same model as you ordered. When confirming the specifications, refer to the model number and suffix code indicated on the nameplate attached to the instrument. For a description of the model number and suffix code, refer to Section 1.2 (page 1-4).



Example of Nameplate

2. Contents of This Manual

This instruction explains how to install the DT400G dust monitor, connect the pipe and wires, and carry out inspection and maintenance. Accordingly, it is advisable that all personnel who are technically concerned with the instrument, including system designers, persons in charge of attaching the piping and wiring, operation managers and maintenance personnel, read this manual.

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Contents

1. Overview

This chapter discusses the following topics.

- Product overview
- Standard specifications
- Model number and related codes
- External views

1.1 Product Overview

● **Applications and Features**

Powder and granular materials are used in a broad range of industries. In the manufacturing of china and porcelains, ceramics, cement, fine chemicals, pharmaceuticals, and food for example, powder and granular materials are treated as semi-finished products or the raw materials of the products. When gases used in such a process are exhausted from the system, powder and granular materials (dust) are recovered. In each industry segment that emits combustion flue gases, dust is recovered from the emitted gases in order to prevent atmospheric pollution.

For dust recovery, an emission gas treatment system such as a bag filter or electrostatic dust collector is used. For effective treatment of emission gas, such as keeping the specified value of the dust concentration in emission gas below the specified value, it is essential to perform continuous on-line monitoring of the dust concentration in the gas after emission from the gas treatment plant. The DT400G dust monitor uses a triboelectrification detection method, involving only minimal fluctuations in the output due to dust deposition. Furthermore, the monitor can be air-purged to prevent any conductive substance from depositing between the direct insertion sensor and the duct walls. This design permits the DT400G to operate even in a harsh environment, offering superb reliability and maintainability for continuous monitoring of dust. The monitor's sensor and converter have an integrated design for easy mounting on a welded socket or a flange.

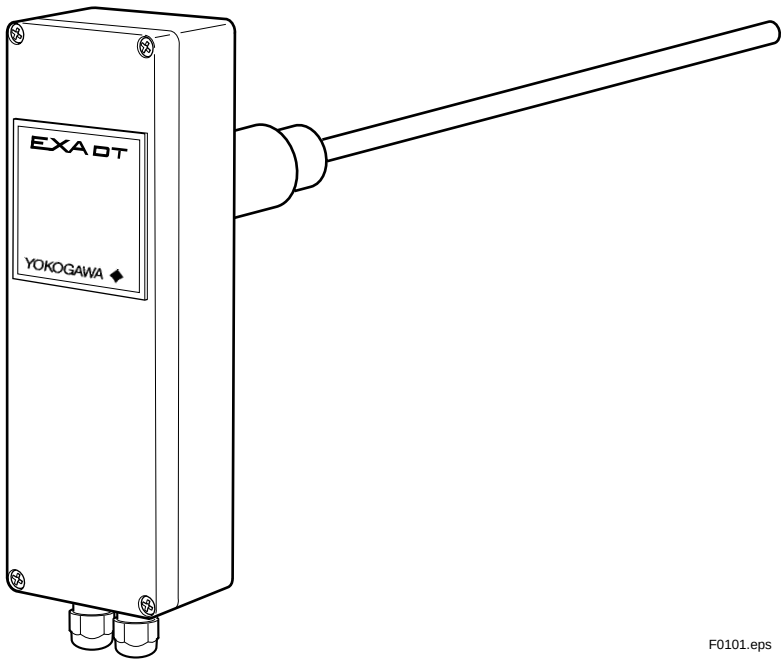

Figure 1.1 DT400G Dust Monitor

● Measuring Principle

When two solid particles come into contact with each other, charge transfer takes place between them. This charge transfer is known as the principle of triboelectrification or contact electrification and the DT400G utilizes this principle. More specifically, charge transfer occurs when particles in a gas stream collide with (or pass nearby) the sensor probe, producing an electric current. The DT400G amplifies this current to convert it into its output current. The electric current produced by frictional electricity is subject to the effects of the following factors:

- Amount of the particles' electrostatic charge and a change in the polarity
- Particle size
- Velocity of particles
- Components of particles

The behaviors of these factors vary widely depending on the object of measurement and their effects are in no way uniform. In the case of fixed-position measurement in a particular plant however, measurement conditions, such as the components of particles, are almost constant and therefore the effects are usually marginal. Dust concentration is also constant in the case of gases emitted from a bag filter, cyclone or electrostatic dust collector.

A current-mode input signal obtained at the detector block is transferred to the converter block, where the signal is converted to a 4-20 mA DC analog output signal. The converter block outputs an alarm contact signal at a desired level, in addition to the analog output signal.

1.2 Specifications

Measurement Objects: Solid particles contained in gas

Composition of particle: Unlimited

Particle size: 0.3 μm or larger

Measurement range: 0.1 mg/m^3 to 1 kg/m^3

Measurement Principle: Friction electrostatic detection

Process Conditions:

Temperature : Maximum of 200°C

Pressure: Maximum of 200 kPa

Gas flow speed: Minimum of 4 m/s (max. of 30 m/s)

Humidity: Maximum of 40 vol%

Input surge voltage: 100 V maximum (the converter may be damaged at surge voltages of 500 V or higher)

Note: See Section 2.1 for a case where the DT400G is installed in downstream of an electric dust collector.

Measurement Range: Flexible (however, the lower range limit must be zero).

Note: The measurement range is set in amplification factors (gain and bias) for the converter input. (The measurement range does not directly represent the concentration of dust. If the absolute value of the dust concentration needs to be observed, the relationship between the output value and dust concentration must be obtained by laboratory analyses or the like.)

Analog Output Signal: 4 to 20 mA DC (isolated, load resistance of 600 Ω)

Contact Output Signal (for high-limit alarm):

Contact capacity: 3 A at 240 V AC, or 3 A at 30 V DC.

Note: When the analog and contact output signals are connected using the same cable, the capacity is 3 A at 30 V DC.

Setting range: 5 to 100% of the measurement range

Contact configuration: One make (normally opened) or break (normally closed) contact.

Note: The relay is energized upon alarm.

Damping Time Constant: 1 to 30 seconds, variable

Ambient Conditions:

Temperature: –20 to 45°C

Humidity: 95% RH or less (non-condensing)

Vibration: 5 m/s^2 (0.5G) or less

Storage Conditions:

Temperature: –20 to 70°C

Humidity: 95% RH or less (non-condensing)

Structure:

Converter: Integrated with sensor probe; jet-proof in compliance with Japanese Industrial Standard (JIS)

Sensor: Direct-insertion sensor

Materials:

Sensor probe: Stainless steel (JIS SUS316L equivalent)

Insulation of sensor: PEEK, PTFE

Converter casing: Aluminum die cast

Coating: Grey (DIN RAL7001) polyester resin coating

Power Supply: 90 to 100 V AC ±10%, 50/60 Hz; or 180 to 250 V AC ±10%, 50/60 Hz

Power Consumption: 3 VA

Wiring Connection: 2 ports

DIN Pg11 port for power cable: With cable gland (applicable cable diameter: 6 to 10 mm)

DIN Pg9 port for output signals: With cable gland (applicable cable diameter: 5 to 8 mm)

Note: Use the same cable for wiring the analog and contact output signals.

Air Purge:

Connection: One Rc 1/4 port

Air supply: Clean, dry air equivalent to instrument air, at a pressure of at least (process pressure +50 kPa) for continuous purge

Air consumption: 10 to 50 Nl/min

Mounting: Mounted to the dedicated socket for welding, or flange mounted

Note: The size of a duct onto which the 500-mm long sensor probe can be installed, is approximately 650 to 4000 mm.

Weight: Approx. 2.2 kgf (excluding the flange)

Dimensions: 81×252×690 mm (W×H×D)

Characteristics

Accuracy of electric circuit: ±5%

1.3 Model and Suffix Code

Model	Suffix Code	Option Code	Specification
DT400G	· · · · · · · · · ·	· · · · · ·	Dust monitor
Output signal	-6 · · · · · · · ·	· · · · · ·	4 to 20 mA DC
Power supply	2 · · · · · · · ·	· · · · · ·	200 V AC, 50/60 Hz
	5 · · · · · · · ·	· · · · · ·	100 V AC, 50/60 Hz
Sensor length	1 · · · · · · · ·	· · · · · ·	500 mm
Sensor material	S · · · · · · · ·	· · · · · ·	JIS SUS316L equivalent
Mounting	-W · · · · · · · ·	· · · · · ·	Socket mounted (provided with welding socket)
	-A · · · · · · · ·	· · · · · ·	Flange mounted (ANSI class 150, 2.5 inch RF equivalent)
	-P · · · · · · · ·	· · · · · ·	Flange mounted (JPI class 150, 2.5 inch RF equivalent)
	-J · · · · · · · ·	· · · · · ·	Flange mounted (JIS 5K, 65A (2.5 inch) FF equivalent)
—	-AA · · · · · · · ·	· · · · · ·	Always -AA

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1.4 Dimensions

● **Welding Socket Mounting Model**

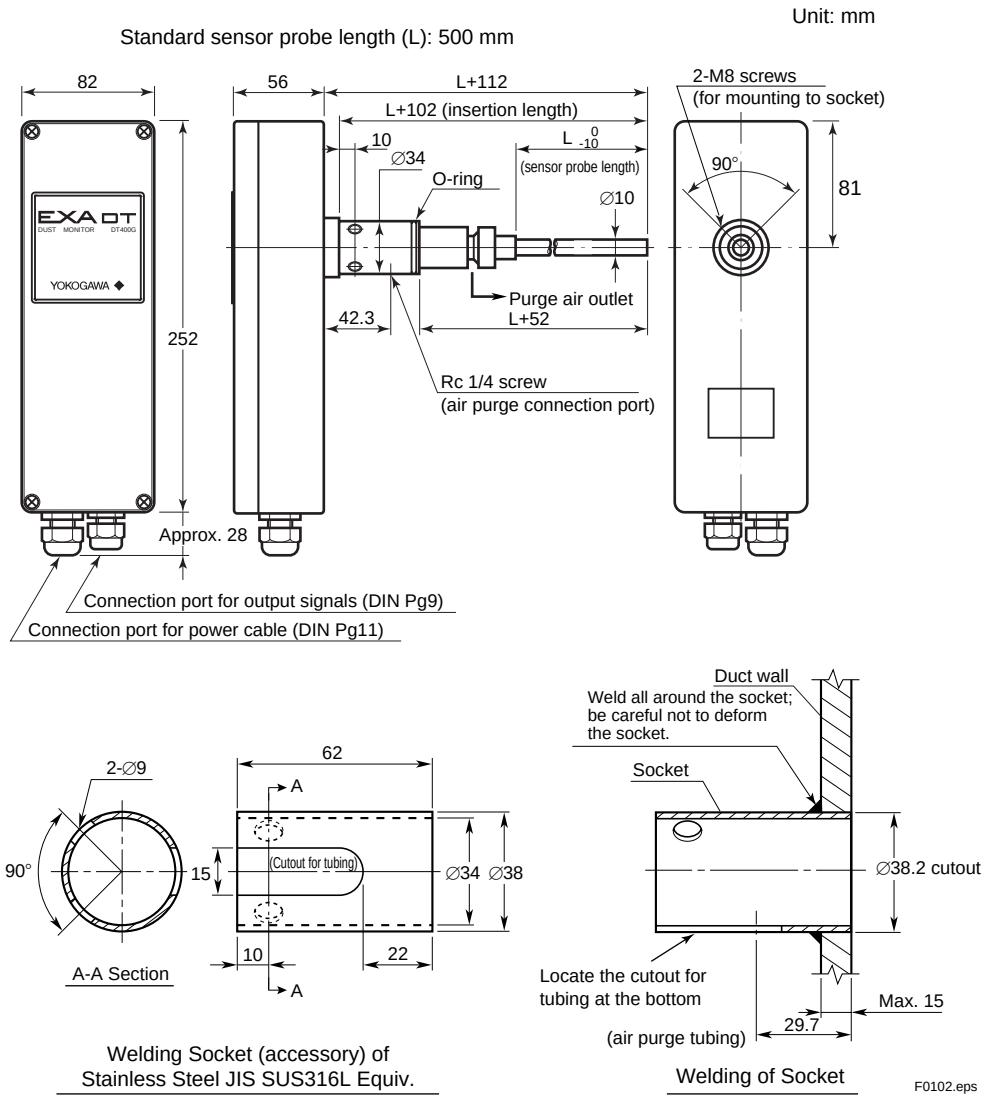
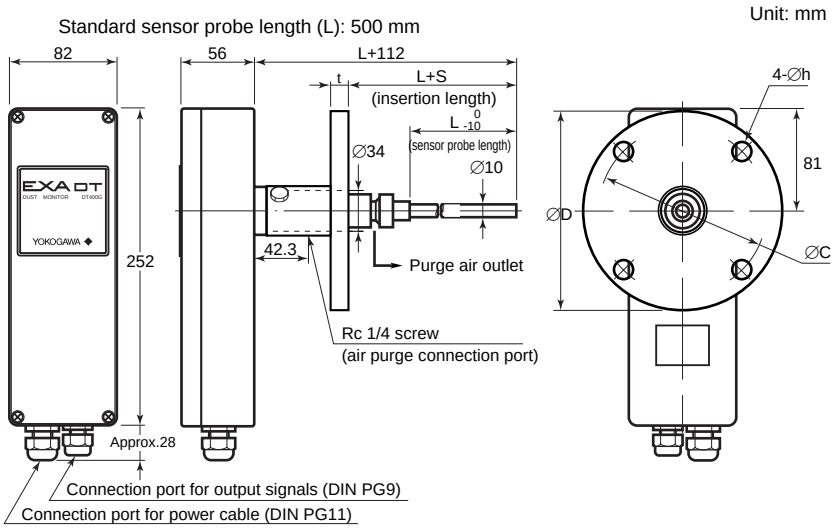


Figure 1.2 Dimensions of DT400G Dust Monitor (Welding Socket Mounting Model)

● Flange Mounting Model



			Flange				
Model and Suffix Code	**L**	**S**	**Flange Specification**	**D**	**C**	**h**	**t**
DT400G-6 ☐ 1S-A-AA	500	20	ANSI class 150, 2.5-inch RF	177.8	139.7	19.1	22.4
DT400G-6 ☐ 1S-P-AA	500	20	JPI class 150, 2.5-inch RF	178.0	139.7	19.0	22.5
DT400G-6 ☐ 1S-J-AA	500	28	JIS 5K, 65A (2.5-inch) FF	155.0	130.0	15.0	14.0

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Figure 1.3 Dimensions of DT400G Dust Monitor (Flange Mounting Model)

2. Installation

The DT400G is designed for indoor installation or installation in an outdoor location free from splashes of rainwater and direct sunlight.

This chapter explains how to install the DT400G in the following order of topics.

- Selection of installation location
- Machining of inlet for sensor probe
- Installation of DT400G

2.1 Selection of Installation Location

The DT400G is designed for mounting on a duct with a width of 650 to 4000 mm (when the standard probe length is 500 mm) or other alternative locations. Install the DT400G in a location where optimal measurement can be carried out and inspection and maintenance is easy. When selecting an installation location, make sure it also satisfies the measuring and ambient environmental conditions described in Section 1.2. In addition, the installation location must meet the following requirements.

· **Availability of Typical Dust Concentration**

The most suitable location along a duct is where there is no flowmeter or valve that may disturb the gas flow and where the duct is straight and the length is adequate in comparison with the inside width of the duct. (Ideally, the straight portion should be no less than five times the length of the width. Locate the probe inlet in a position one-third the length of the straight portion from the downstream edge and two-thirds the length from the upstream edge.)

Note: Insert the sensor probe into the inlet so that it is perpendicular to the stream of gas. The DT400G can be positioned in such a manner that its sensor probe is level or facing downward at an angle up to 90°C.

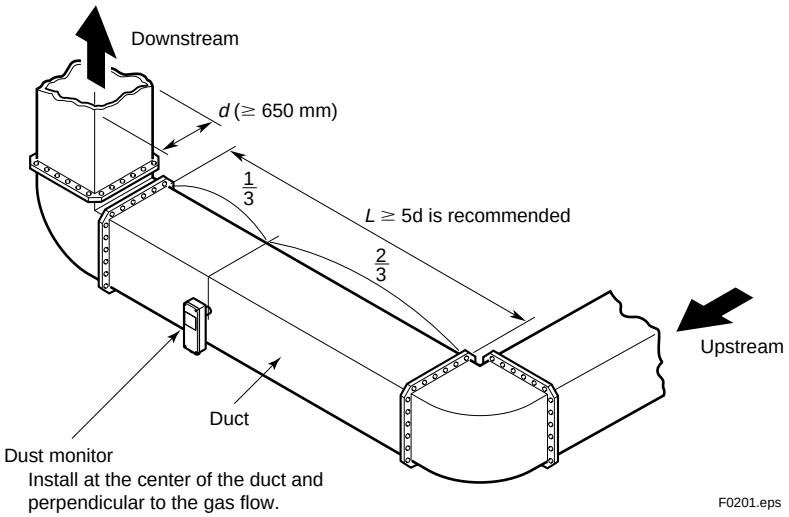

Figure 2.1 Installation of Dust Monitor on Streight Part of Duct

· **No Noise Effects**

Make sure the output signal will not be affected by noise arising from plant equipment or other structures. In an electrostatic dust collector is used, locate the DT400G at least 20 m away from the dust collector. When monitoring such dust collectors as a bug filter, locate the DT400G in the upstream of the blower. When mounting the DT400G on a non-conductive structure, shield the structure with a conductive material (see Section 3.4).

· **Minimal Vibration**

For reasons of sensor structure, avoid installing the DT400G in a location exposed to mechanical vibration at a level greater than 5 m/s^2.

Note: It is virtually impossible for vibration to affect the measured value.

· **No Splashes of Rainwater, Direct Sunlight or Abnormal Temperature Rises due to Heat Radiation from Equipment**

The DT400G may be installed outdoors. However, avoid installing the monitor in a location exposed to direct sunlight or heat radiated from equipment, in order to prevent the temperature of the main unit's casing from rising above 50°C.

Note: The DT400G can be operated within an ambient temperature range of –20°C to 45°C.

If the part of the duct assigned for the probe inlet is covered with insulating material that is likely to contribute to a temperature rise in the casing, remove the insulating material around the probe inlet in an area approximately 40 cm wide across the inlet.

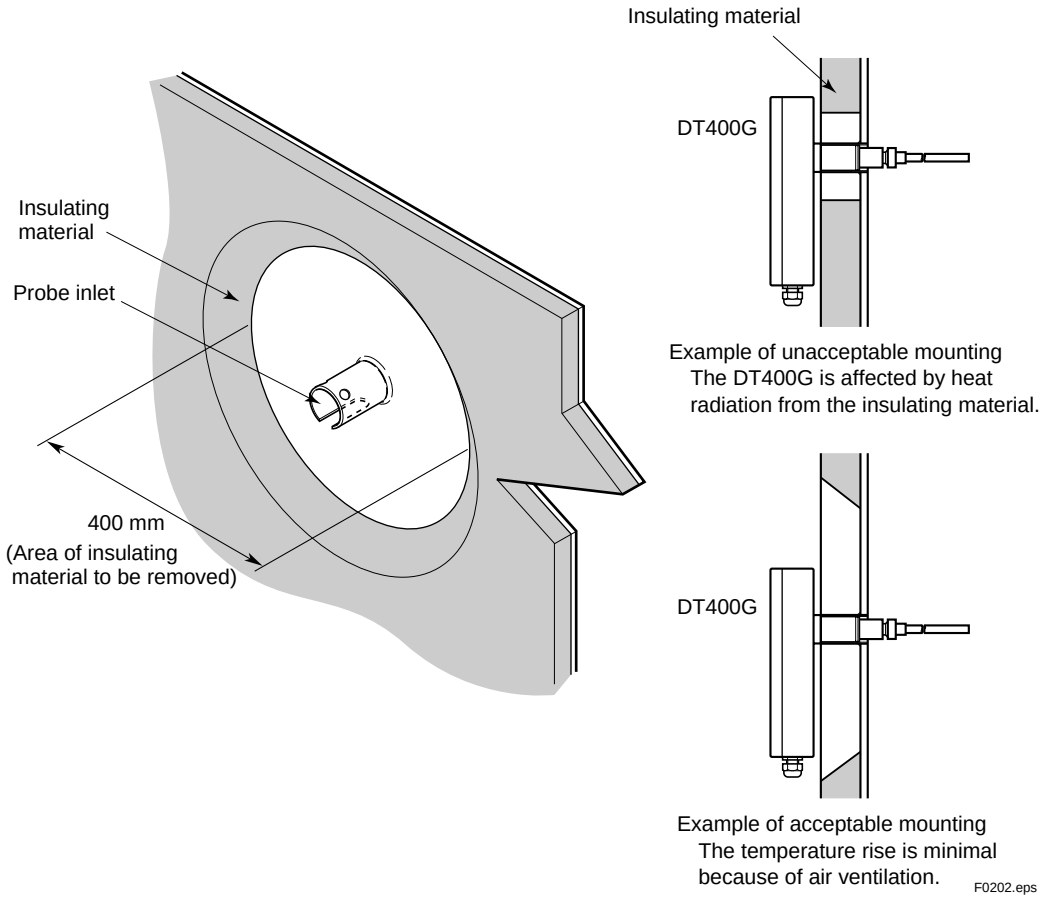

Figure 2.2 Measures to Take When the Temperature of the DT400G's Casing Is Likely to Rise due to Insulating Material

· **Ease of Inspection and Maintenance**

The DT400G dust monitor must be detached for cleaning the sensor probe, however some maintenance works such as replacement of the fuse may be carried out without detaching the dust monitor. For safe operation of these maintenance works, a sufficient maintenance space as shown below is required (See Figure 2.3).

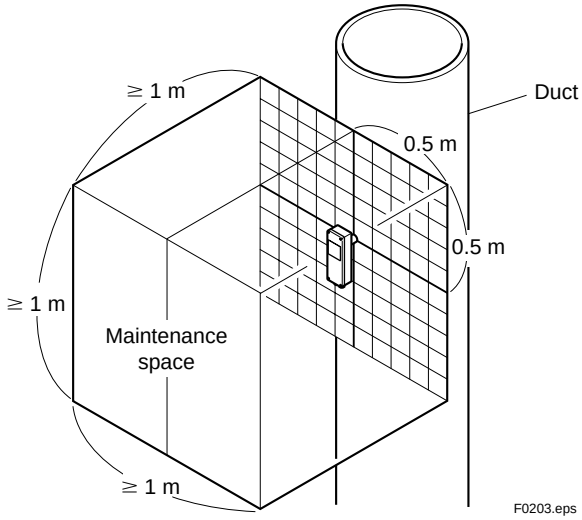

Figure 2.3 Maintenace Space at Installation Location of DT400G Dust Monitor

2.2 Machining of Probe Inlet

The DT400G is designed for mounting on a socket or flange attached to an inlet on a duct or other alternative facility. Equip the inlet with a socket or flange that complies with the specifications of the DT400G. At this point, make sure the DT400G's casing and the duct are in electrical continuity.

● When Mounting to Socket

Use the socket that comes with the DT400G for installation. Weld this socket paying attention to the following precautions.

- The standard insertion length of the sensor probe is 602 mm. Determine the depth of the socket inside the duct so that the tip of the sensor probe is positioned at the center of the duct. If there is no way that the tip can reach the center of the duct, insert the sensor probe as far as possible into the duct.
- For welding the socket, cut out a 38.2-mm diameter hole on the duct or pipe. (The socket's outer diameter is 38.0 mm.)
- Weld all around the socket (stainless steel JIS SUS316L). Make sure there are no spots not welded. Be careful not to deform the socket while welding. Be careful about the orientation of the socket. When installing the dust monitor on a vertical plane, place the cutout for air tubing at the bottom.

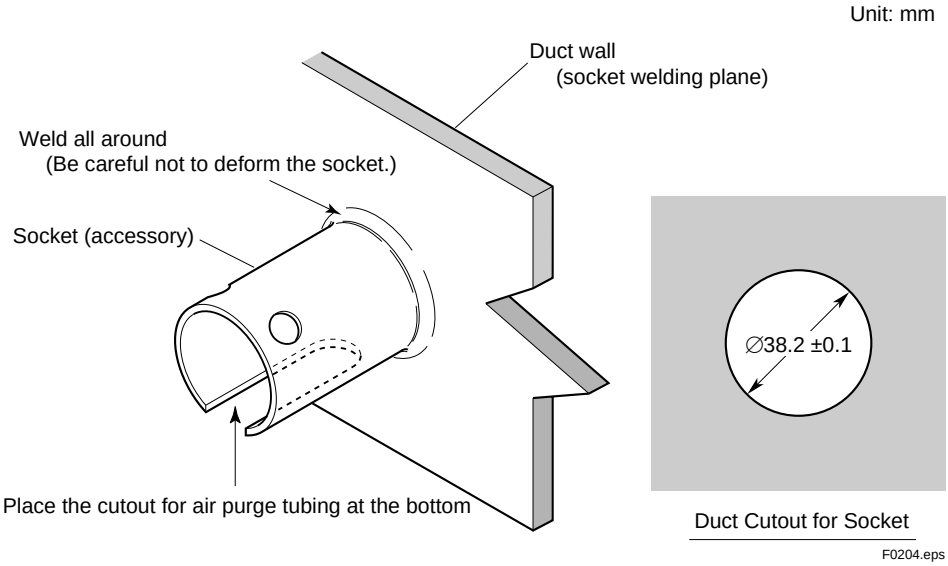

Figure 2.4 Connection Port for Socket Mounting Model

● **When Mounting to Flange**

Prepare the DT400G with a flange that meets the specified standard. Prepare the tie-in flange at the connection port of the duct or pipe. Note that the standard sensor probe insertion length varies depending on the flange specification.

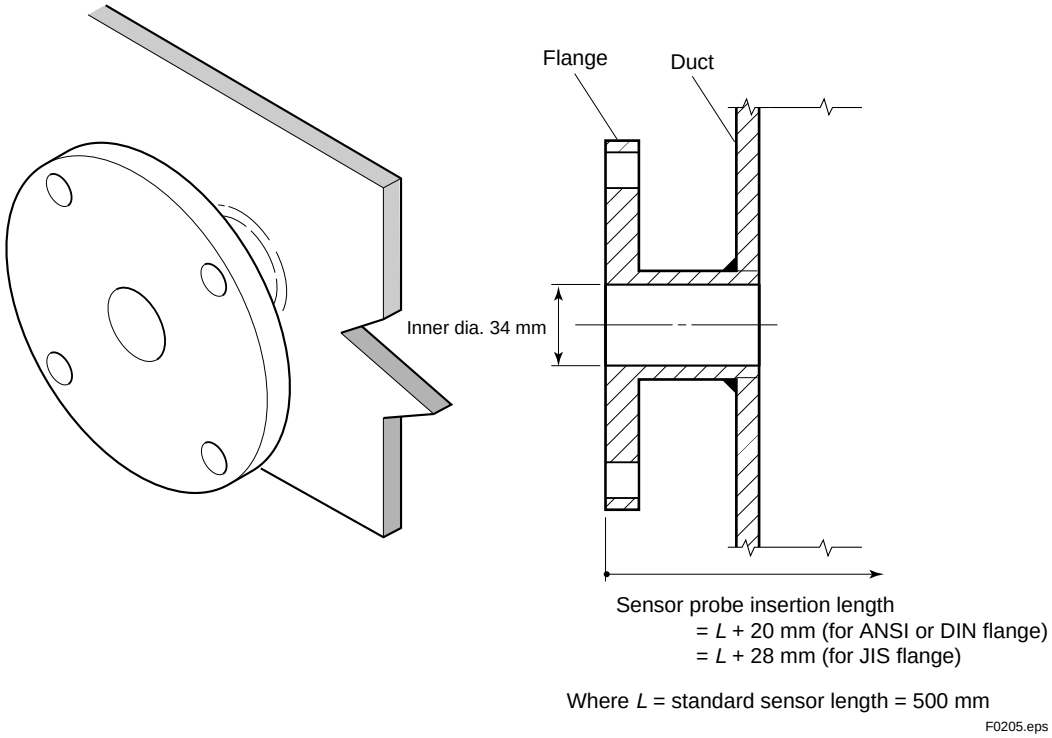

Figure 2.5 Connection Port for Flange Mounted Model

● **Thermal Insulation for Preventing Condensation When measuring high-temperature gas.**

A drop of water on the insulated part of the sensor probe will prevent correct measurement. If the process gas is cooled down around the sensor connection port when measuring high-temperature and high-humidity gas, be sure to purge the air in order to prevent condensation at the neck of the sensor connection flange. If there is a possibility of the ambient temperature decreasing to 0°C or less, provide thermal insulation at the neck of the connection flange.

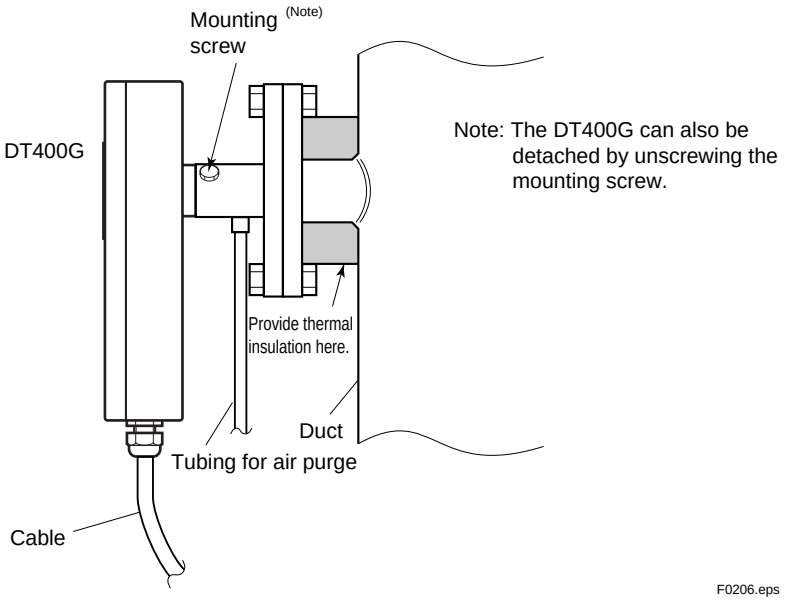

Figure 2.6 Termal Installation for Preventing Condensation

2.3 Installing the DT400G

When installing the DT400G, check the position in which the "purge cone" of the sensor probe is fixed.

- When the DT400G is air-purged: Allow a gap of 0.5 to 1.0 mm between the purge cone and the insulating material.

  Note: If air-purging of the DT400G is to be continuous at a pressure higher than the specified value in an application (dust pressure) the amount of air consumption may be controlled by adjusting the gap of the purge cone.

- When the DT400G will not be air-purged: Bring the purge cone into close contact with the insulating material.

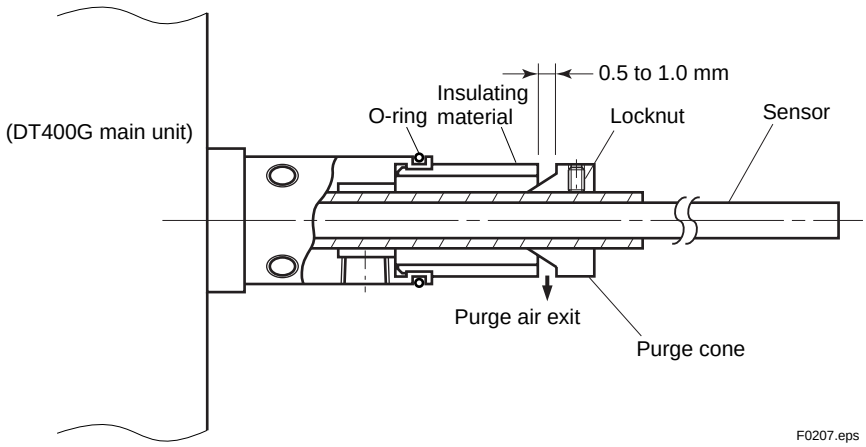

Figure 2.7 Position in which the Purge Cone Is Fixed

Securely fix the DT400G onto a socket or flange on the probe inlet. When fixing the DT400G onto a socket, use the supplied two M8-size bolts. When fixing the DT400G onto a flange, use bolts having a size that conforms to the flange specifications.

Be careful not to damage the O-ring when mounting the DT400G onto a socket.

CAUTION

If the gas to be measured is flowing constantly through a duct where the DT400G is mounted, air-purge the monitor as instructed in subsection 4.2.2. If you leave the monitor exposed to the gas for a prolonged period without air-purging the monitor, the resistance of the insulated part of the sensor probe will decrease. This may result in a failure of the monitor to start smoothly.

3. Piping and Wiring

Before operating the DT400G, the pipe for air purge and wires for output signals must be connected.

This chapter explains how to connect the pipe and wires to DT400G in the following order of topics.

- Connecting the pipe for air purge
- Connecting the wires for the power supply
- Connecting the wires for the output signals
- Grounding of a duct or other alternative facilities where the DT400G is mounted

3.1 Connecting the Pipe for Air Purge

As a rule, the insulated part of the sensor probe should be air-purged before the DT400G is put into use. Air purge is mandatory if any of the following cases apply:

- The concentration of dust in a gas is extremely high and the resistance of the insulated part of the sensor probe is likely to decrease due to dust accumulation.
- The gas temperature at the probe inlet is likely to drop, resulting in condensation.

Note that clean air, such as air specified for instruments, must be used for air purge. (If air is not available, use gas such as nitrogen instead.)

Note: For reasons of the measurement principle, any dust accumulating on the insulated part of the sensor probe can cause malfunction. The purpose of air purge is to prevent such dust accumulation. Care must be taken since an air purge with air containing moisture or oil mist causes the same phenomenon as dust accumulation.

Air purge is normally carried out by continuously supplying air to the DT400G with a pressure of approximately 50 kPa higher than that of the gas being measured. If the effect of air purge is inadequate, due to the presence of moisture in the gas being measured, the DT400G may require air purge at a higher pressure. For air purge, use an air source with a sufficiently large capacity. (The normal rate of air consumption is 10 to 50 Nl/min.)

When connecting the pipe to the DT400G for air purge, note the following.

- The DT400G may be removed during inspection or maintenance. When connecting the pipe to the DT400G, use a one-touch connector and/or a pipe made of flexible material to ensure easy maintenance.
- Install a stop valve or pressure-reducing valve in a position as close as possible to the DT400G.
- Connect a pipe with an inside diameter of 6 to 8 mm to the DT400G. Note that the pipe connection of the DT400G is Rc1/4-threaded.

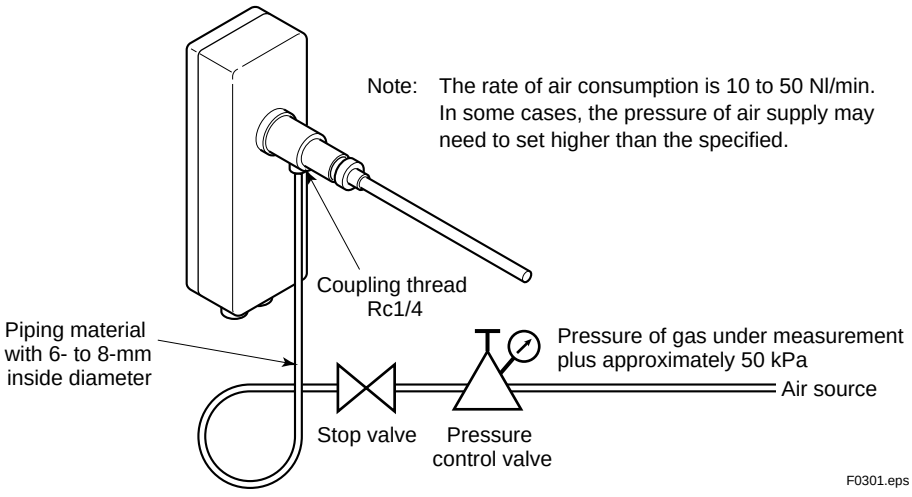

Figure 3.1 Method of Piping for Air Purge

If air purge need not be carried out, attach a blind plug to the pipe connection.

3.2 Connecting the Wires for the Power Supply

CAUTION

The DT400G has no power switch. For reasons of safety during inspection and maintenance, install a double-pole switch in the power line.

CAUTION

Since the DT400G may be removed for inspection or maintenance, allow each cable to have a sufficient margin of length.

Connect a power supply that conforms to the voltage and frequency in the specifications of the DT400G. For wiring, use a two-core shielded cable of a 6- to 10-mm outside diameter with the nominal cross-section of the conductor being at least 1.5 mm^2. Lead the cable from the power supply through the DT400G's cable connection fitted with a Pg11 cable gland into the DT400G's inner assembly. Then, connect the cable to the L1 terminal (non-grounded side) and N terminal (grounded side). Connect the cable's shield wire to the PE terminal. Note that the terminals of the DT400G are designed for connection with bar-type terminal lugs.

Note: When connecting the shield wire to the PE terminal, equip the wire end with a bar-type terminal lug.

Ground the PE terminal on the power-supply side according to the JIS Class D grounding procedure (grounding resistance: 100Ω maximum).

Note: The DT400G main unit and the duct on which the monitor is mounted are in electrical continuity. Should the measured value be adversely affected by the method of two-point grounding at the duct (see Section 3.4) and the PE terminal, remove either of the two grounding lines.

3.3 Connection of Wires for the Output Signals

This section discusses the wiring necessary to transmit analog output signals and alarm contact signals to each device.

Wire the analog output and alarm contact signals of the DT400G using a single cable. Use a cable with an outside diameter of 5- to 8-mm, comprising two shielded twisted-pair wires with the nominal cross-section of the conductor being at least 0.5 mm^2. If only the analog output signal is used and it is unlikely to be affected by noise (as the signal is wired at a location distant from the power line), it is not always necessary to use twisted-pair wires.

Insert the cable through the cable connection fitted with a Pg9 cable gland into the internal assembly of the DT400G. Connect the core wires of the analog output signal to the +Iout (positive side) and -Iout (negative side) terminals. Also, connect the core wires of the alarm contact signal to the COMM and NC terminals (for an open contact upon alarm output) or to the COMM and NO terminals (for a closed contact upon alarm output). Ground the shielded wires of the cable on the equipment side.

Note: According to the rules of wiring for the power supply, equip the wire ends of the cable with bar-type terminal lugs and allow the cable to have a sufficient margin of length.

CAUTION

The output signal may be mixed with electric noise if the cable swings. If the cable is likely to be affected by wind, for example, secure it in position at main points.

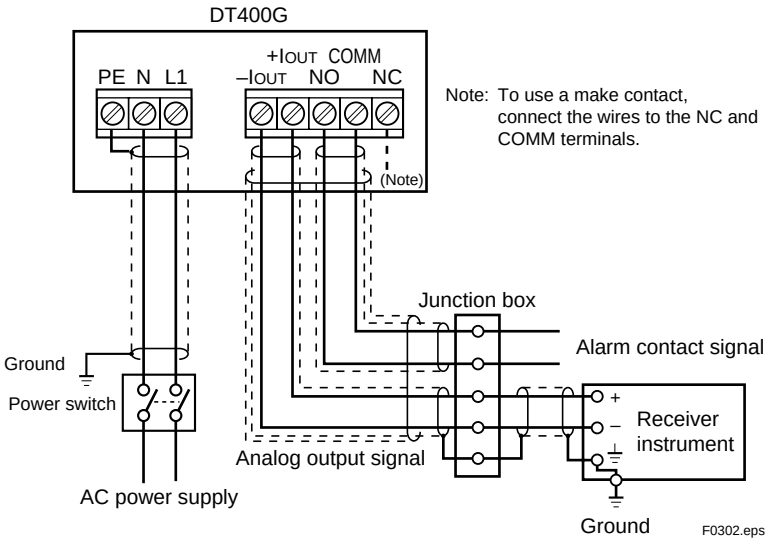

Figure 3.2 Wiring Diagram

3.4 Grounding the Duct

WARNING

When such equipment as an electrostatic dust collector is used, be sure to ground both the duct and the DT400G. Otherwise, there may be a danger of electrical shock due to high-potential static electricity.

If a duct or other alternative facility where the DT400G is mounted is charged with electricity, the electricity will serve as noise, possibly affecting the signal under measurement. Ground the duct where the DT400G is mounted, as well as other nearby structures, in order to prevent the duct from being charged with electricity. If the duct or such structures are made of non-conductive material, cover as widely as possible the peripherals where the DT400G is to be mounted using conductive material, and ground the material (see Figure 3.3).

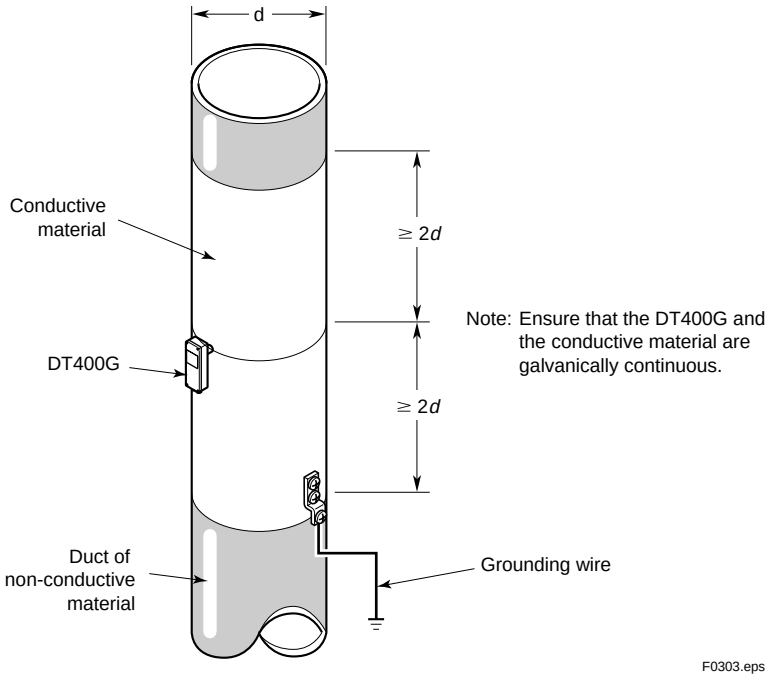

Figure 3.3 Grounding of Duct

4. Operation

The ranges and other parameters of the DT400G must be configured before you start operation.

This chapter explains how to operate the DT400G, including preparations, in the following order of topics.

- Components and their functions
- Preparation for operation
- Regular operation

4.1 Components and Their Functions

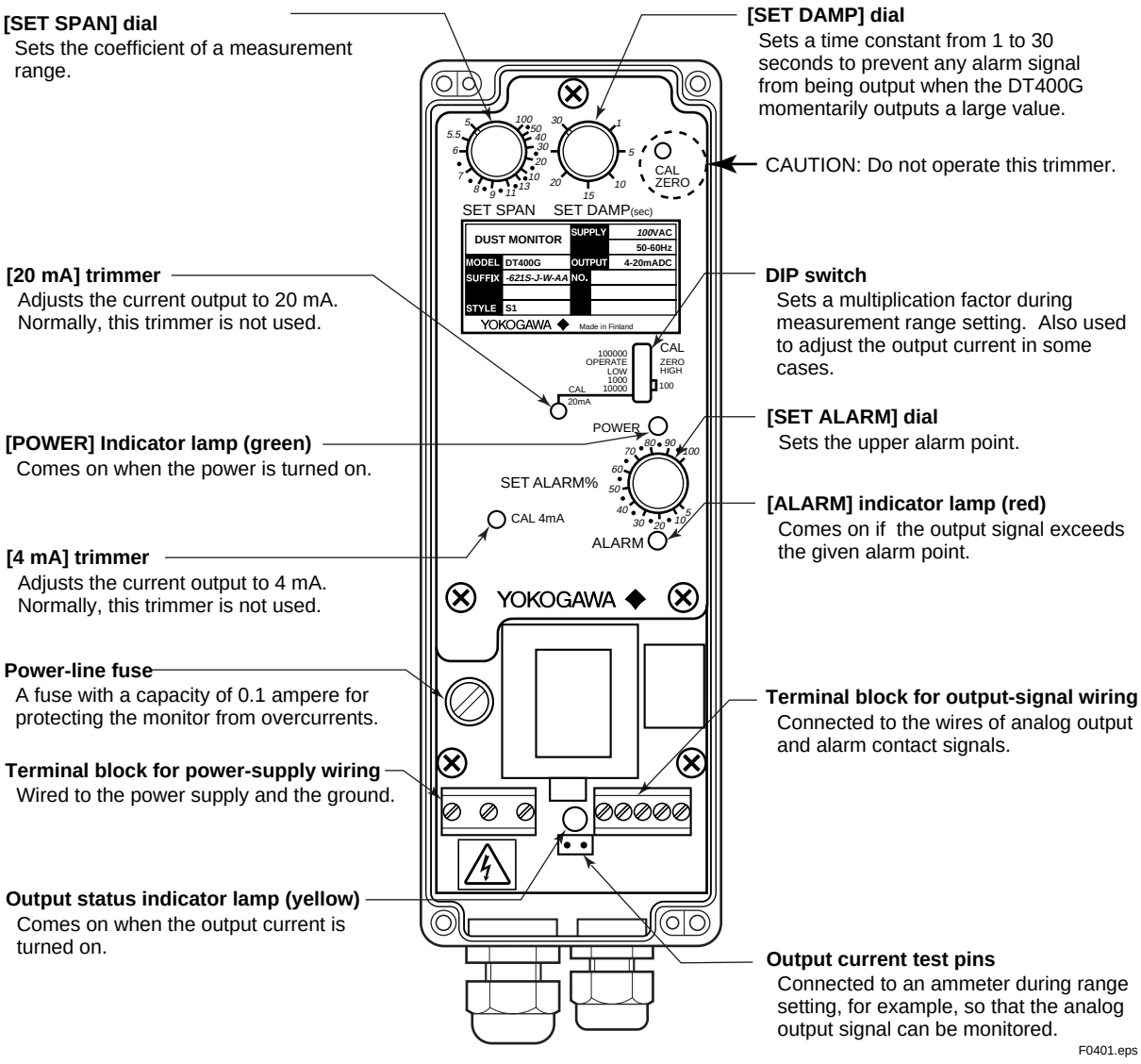

Figure 4.1 Components of the DT400G and Their Functions

4.2 Preparation for Operation

Before you start operating the DT400G, carry out the following tasks.

- Inspection of the state of installation
- Supply of purge air
- Supply of power
- Setting of measurement range
- Setting of alarm points
- Setting of damping action

4.2.1 Inspection of the State of Installation

Check that all the specifications are completely satisfied with the installation of the DT400G. Also check that the DT400G wiring and piping have been correctly connected. Especially, make sure the following are true.

- The DT400G is securely mounted onto the probe inlet and is free from effects of strong mechanical vibration. In addition, the short tubing of the probe inlet is adequately heat-insulated and the main unit's casing is not exposed to direct sunlight that causes an abnormal temperature rise or subject to heat radiated from other equipment.
- The duct or other alternative facilities where the DT400G is mounted is reliably grounded.
- Wires are correctly connected to the terminals of the DT400G. In addition, the cables are securely fixed by cable glands so as to prevent any corrosive gas or moisture from entering the monitor.
- The air-purge piping and each cable connected to the DT400G have a sufficient margin of length necessary for maintenance.

4.2.2 Supply of Purge Air

Using the pressure control valve, adjust the supply pressure of purge air as noted below. Then, fully open the stop valve.

- Supply pressure = Pressure of gas under measurement + approximately 50 kPa

4.2.3 Supply of Power

Turn on the power switch installed in the power line to feed power to the DT400G.

When the power is turned on, the green POWER indicator lamp on the monitor comes on. It takes approximately 30 minutes for the DT400G to reach steady-state operation.

4.2.4 Setting of Measurement Range

The magnitude of current resulting from frictional electricity detected by the DT400G varies as the properties of dust under measurement differ. Consequently, the output signal level may not always be the same even though the dust concentration remains the same. Setting the measurement range of the DT400G involves two tasks:

- Determining the steady-state level of a 4-20 mA DC signal; and
- Evaluating the dust concentration relative to the 4-20 mA DC signal, as necessary.

When setting the measurement range, you may need to examine the output signal level. As a rule, prepare an ammeter for checking the output signal level. No ammeter is necessary however, if the output signal level can be easily identified as a consequence of a receiving meter being installed nearby, or by any other means.

The measurement range corresponding to the 4-20 mA DC signal is determined by the coefficient set with the SET SPAN dial and the multiplication factor set with the DIP switch. This subsection explains in order, the steps of how to set the measurement range.

● **Connecting an Ammeter for Monitoring the Output Signal**

If an ammeter is available, connect it to the DT400G. Remove the cover on the DT400G's casing. The test pins for connection to the ammeter are located near the terminal block for external wiring.


WARNING


Danger of electric shock

A high-tension current is flowing through the conductive parts and terminals of the power-supply wiring. In addition, there may be high voltage across the conductors and terminals of the contact-signal wiring. DO NOT under any circumstances touch these parts, as doing so may result in serious injury or death due to electric shock. Also check the safety of equipment for connecting the ammeter to the DT400G to avoid electric shock by accidental contact.

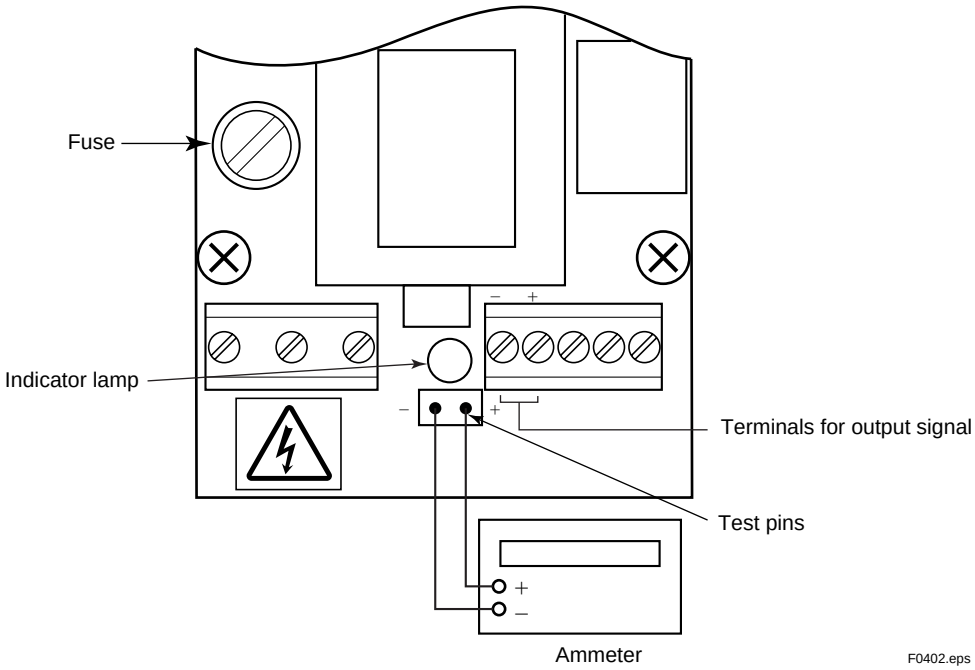

Figure 4.2 Connection of Ammeter for Monitoring the Output Signal

When connecting the ammeter, make sure the yellow indicator lamp is lit. If not, short-circuit the positive and negative terminals of the analog output signal to ensure that the lamp comes on. The indicator lamp goes out when the ammeter is connected to the test pins, indicating that the output signal can now be monitored with the ammeter.

● Checking the 4mA and 20mA Trimmers

The operations described in the following steps are used to ensure that the DT400G outputs a 4-20 mA DC signal according to the given measurement range. These operations are normally unnecessary however, as the trimmers are preadjusted at the factory before shipment. If it is necessary for the trimmers to be checked (and adjusted), follow the steps given below.

- First check the 4mA trimmer in an atmosphere where no dust particles exist. Set switch 5 to the OFF (ZERO) position. Among all other switches, only set switch 6 to the ON position or the desired measurement range may be selected.
- Make sure the ammeter reads 4 mA. To adjust the reading, slowly turn the 4mA trimmer with a flat-blade screwdriver.
- Next, check the 20mA trimmer by only setting switches 1, 3 and 6 to the ON position.

  Note: It is not always necessary to check the 20mA trimmer in an atmosphere containing no dust particles.

- Turn the SET SPAN dial to adjust its pointer to the scale value "10."
- Make sure the ammeter reads 20 mA. To adjust the reading, slowly turn the 20mA trimmer with a flat-blade screwdriver.
- Configure the DIP switch back to its original settings (switch 1 = OFF; switch 5 = ON).

This completes the checking (adjustment) of the 4-mA and 20-mA trimmers. The following operations should be used only when the concentration of dust in the gas under measurement is at a steady-state level.

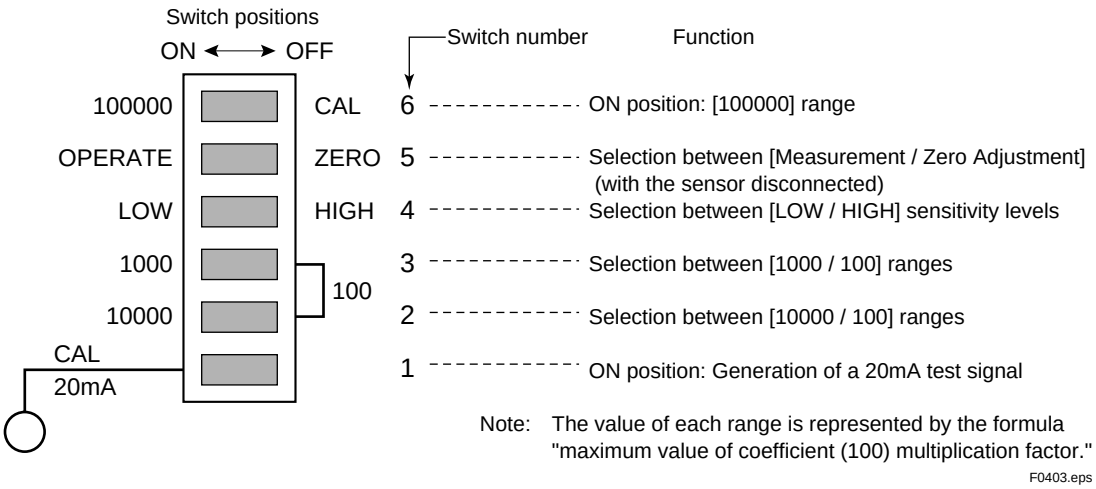

Figure 4.3 Functions Assigned to the DIP Switch

● Adjusting the Multiplication Factor

Check the ammeter reading. If the reading is found to be in the state of overshooting, change the multiplication factor so that the reading falls within the 4-20 mA range. Figure 4.4 shows the relationship between DIP switch settings and multiplication factors.

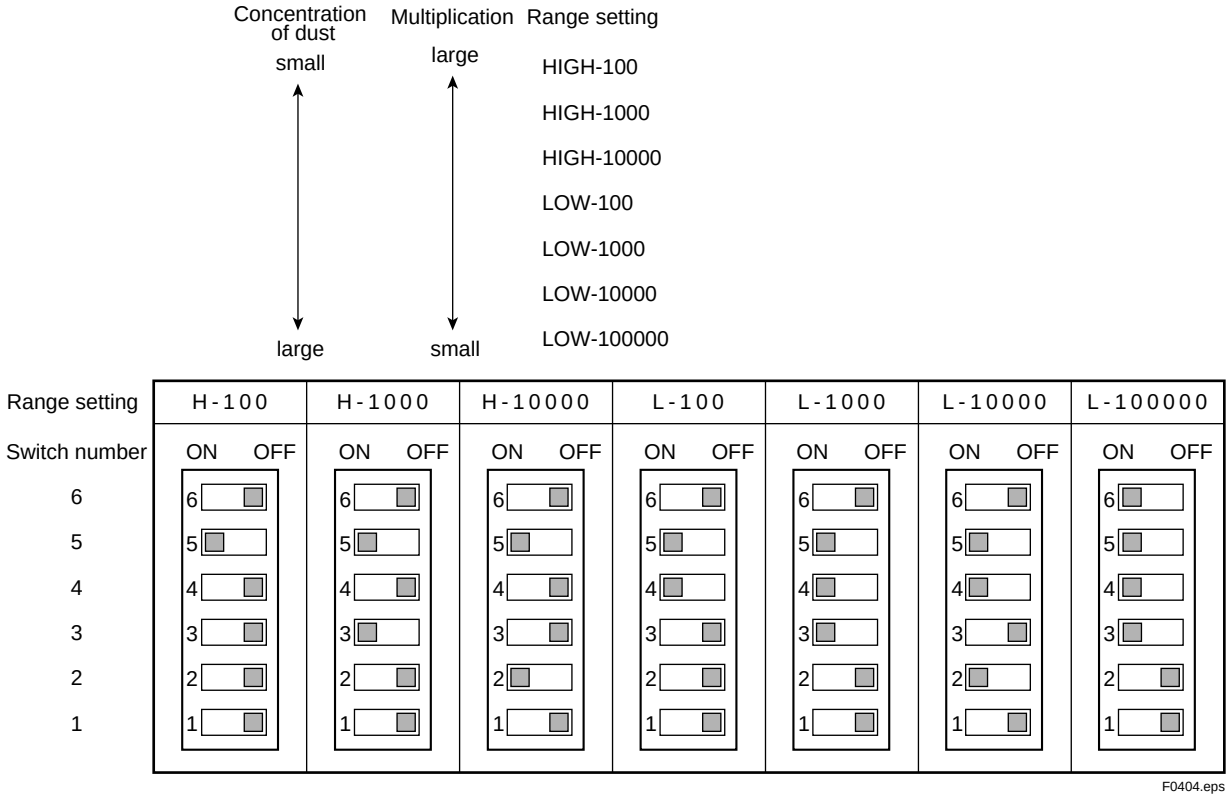

Figure 4.4 The relationship between DIP switch settings and multiplication factors

● Determining the Measurement Range

Determine the measurement range with reference to the state of monitor operation (such as the span of change in dust concentration). In normal application*, it is advisable that normal-state dust concentration be adjusted close to 20% (7.2-mA output) of the span of the output signal.

* For example, the normal-state dust concentration is used as a reference level so that the DT400G outputs an alarm signal when the concentration rises by some extent above the reference level.

Note: The span recommended above (where the maximum level of the 20-mA output is five times the normal-state level) is not always optimal. Increase or decrease the span, as necessary, according to each individual state of operation. Be careful however, since increasing the span too much will result in instability of the output signal in a normal condition.

To adjust the measurement range, use the SET SPAN dial. Turn the dial until the ammeter gives your desired reading. The upper limit of the range at this point is a value obtained by multiplying the current setpoint of the dial (i.e., the coefficient indicated by the pointer) by the multiplication factor set with the DIP switch (see Figure 4.4). The lower limit of the range is fixed to 0. Consequently, if a value of 25 is set as the coefficient and a value of H-100 as the multiplication factor, for example, the resulting measurement range is represented as "0-2500."

Note: If there are two ways of determining the same measurement range, choose the way that uses a larger multiplication factor. For example, consider the case of a 0 to 6000 range where the multiplication factor can be either H-100 or H-1000. In that case, set the coefficient to 6 and the multiplication factor to H-1000.

Although the measurement range serves as an index of sensitivity for the input current, its values themselves do not have any particular significance. If it is necessary to define the relationship between the output signal and the dust concentration, evaluate the dust concentration so it corresponds to the measurement range (output signal).

● Evaluating the Dust Concentration for the Measurement Range

· Knowing the concentration of dust in the gas under measurement by manual analysis

Make sure the ammeter reading is stable (pointing close to a value equivalent to the steady-state level of the output signal). Then, check the concentration of dust in the gas under measurement. If you want the dust concentration to correspond to the measurement range (output signal level) as precisely as possible, evaluate the concentration by using the manual gravimetric analysis method (compliant to JIS Z8808).

After checking the dust concentration, determine the range of the dust concentration. The dust concentration range can be determined in two ways:

- Allowing the dust concentration to correspond to the preset measurement range; and
- Correcting the measurement range so that it corresponds to the desired dust concentration range.

· **Allowing the dust concentration to correspond to the preset measurement range**

From the relationship between the steady-state output signal and dust concentration, calculate the dust concentration for an output level of 20 mA. For example, if the dust concentration when the ammeter reading is 7.2 mA (20% of the span of the output signal) is 41 mg/m^3, then the dust concentration for 100% of the output signal's span is 205 g/m^3. Thus, the dust concentration range is defined as 0-205 mg/m^3.

Note: The output signal versus dust concentration relationship is not always constant (or proportional) over the entire range of span. If you need to precisely know the relationship between these two parameters, take samples from two or more points of the span.

If you want a dust concentration range whose limits contain fractions to be corrected into a dust concentration range consisting of whole-number limits, such as 0-200 mg/m^3, correct the preset measurement range.

· **Correcting the measurement range so that it corresponds to the desired dust concentration range**

Determine by calculation the upper limit of the post-correction measurement range. Then, set the coefficient and multiplication factor of the upper limit using the SET SPAN dial and DIP switch, respectively.

Calculation should be carried out with such data items as the steady-state dust concentration, the upper limit of the dust concentration range (i.e., dust concentration for a 20-mA output level), and the current measurement range. Then, calculate using the following equation.

$$\text{Upper limit of post-correction measurement range} = A_0 \times m_d / m_m \times (I_m - 4) / 16$$

where

A_0 = Upper limit of the current measurement range

m_d = Upper limit of the dust concentration range being set

m_m = Measured dust concentration

I_m = Output signal level when the dust concentration is measured

Set the DT400G to the value (coefficient (multiplication factor) obtained by calculation. The coefficient can be a value from 5 to 100 and should be set with the SET SPAN dial. The multiplication factor should be set with the DIP switch. By referring to Figure 4.4, configure the DIP switch so that the multiplication factor matches the value in question, from among 100, 1000, 10000, 100000 and 1000000. If there are two ways in determining the same measurement range, choose the way that uses a larger multiplication factor (which means lower sensitivity and thereby higher dust concentration).

- Example of Calculation -

If you measure (by manual analysis) dust concentration for an output signal level of 7.2 mA, you will obtain 41 mg/m^3. At this point, the upper limit of the preset measurement range is 1300. Now, assuming you change the upper limit so that the dust concentration range is 0-100 mg/m^3 for the output signal range of 4-20 mA DC, then the following calculation holds true.

Upper limit of post-correction measurement range =

$$1300 \times 100 / 41 \times (7.2 - 4) / 16 \fallingdotseq 634$$

According to this result of calculation, set the DIP switch to the multiplication factor of 100 and the SET SPAN dial to the coefficient of 6.3 to 6.4.

Note: If the size of dust particles and the amount and polarity of static charge change as the amount of dust changes, the amount of dust may not correctly correspond to the output signal level.

4.2.5 Setting the Alarm Points

A contact signal (NO or NC contact) for the upper-limit alarm is available from the DT400G. The alarm point that can be defined is a value from 5% to 100% of the span of the analog output signal. Determine the output signal level (or dust concentration level) at which you want the alarm to be raised, convert it to a percentage of the span (16 mA) of the output signal, and set the value with the SET ALARM dial. For example, set 40% if you want the alarm point to be an output signal level of 10.4 mA (6.4 mA in terms of a span value).

4.2.6 Setting of Damping Action

The output signal may fluctuate greatly for a moment if disturbed by noise or if a significant change occurs temporarily in the dust concentration. Setting a damping action means a specific time constant is set into the DT400G to prevent any alarm signal from arising in that situation. Set a time constant from 1 to 30 seconds by turning the SET DAMP dial.

4.3 Steady-state Operation

Proceed to steady-state operation after making sure there is no problem with the DT400G during start-up.

Before going into steady-state operation, make sure the cover is securely attached to the DT400G main unit. Moisture or corrosive gas entering into the DT400G may result in malfunction.

This section discusses the following topics concerning the handling of the DT400G during steady-state operation.

- Examination of operating condition (carried out only at the beginning of operation)
- Shutdown
- Restart

4.3.1 Examining the Operating Condition

At the beginning of operation, examine the following points to ensure that the DT400G continues to operate in its optimum condition.

● **Effects of External Noise, Etc.**

If the DT400G is being affected by noise to such a degree that normal operation becomes problematic, first make sure the DT400G is installed and wired correctly as instructed by this manual. Then, take appropriate noise countermeasures.

● **State of Dust Accumulation**

Accumulation of a large amount of dust on the sensor probe of the DT400G may adversely affect its normal operation. If the measured value is found to be abnormal, remove the DT400G and examine the state of dust contamination of the sensor probe. If the cause of the abnormal measured value is dust accumulation, clean the sensor probe periodically. If you are using the DT400G in a high-temperature or moist gas atmosphere, also examine the effectiveness of air purge. If the amount of dust accumulating on the outlet of purge air is found to be gradually increasing, adjust the gap at the purge-air outlet (see Section 2.3) or increase the supply pressure of purge air. If condensation is observed around the probe inlet, it is advisable that heat insulation measures be taken.

4.3.2 Shutdown

To shut down the DT400G, turn off the power switch installed in the power line. If the DT400G will not be used for a prolonged period, only turn off the power switch without turning off the air-purge line. The air-purge line need not be left turned on if there is no flow of gas to be measured (provided that the ambient humidity is not too high).

4.3.3 Restart

There is nothing in particular that needs to be done before restarting the DT400G. If the DT400G has not been in use for a prolonged period however, make sure there are no abnormalities with the sensor probe before you restart the DT400G. When there are no abnormalities with the DT400G, it will come into steady-state operation in approximately 30 minutes after power-on.

5. Inspection and Maintenance

WARNING

If the DT400G is installed in the downstream of an electrostatic dust collector, there is a danger of serious injury or death from electric shock due to high-potential static electricity. Carry out maintenance without disconnecting the grounding line that was connected when the DT400G was installed. If the DT400G is not yet grounded with a grounding line, ground it before you start maintenance.

This chapter explains inspection and maintenance carried out to repair or replace worn-out or deteriorated parts and thereby maintain the DT400G in its optimal operating condition.

CAUTION

When inspecting and maintaining the DT400G, remove it from where it is installed. Be careful not to inflict severe impact to the monitor during inspection and maintenance, otherwise it may be damaged.

5.1 Periodic Maintenance

If the sensor probe is contaminated with a large amount of dust or significantly worn out by dust, the output signal level for the same dust concentration may differ from the level when the DT400G was initially put into operation. To be able to revert to the initial output signal level, the sensor probe must be cleaned or the measurement range must be reset. Do not disassemble such components as the printed circuit board from the internal unit of the DT400G; otherwise, the DT400G may fail to operate correctly.

5.1.1 Cleaning the Sensor Probe

If the sensor probe tends to gather a significant amount of dust, it is advisable that the probe be cleaned periodically. If dust accumulation is not very serious, its effect on the output signal is in most cases negligible; therefore, it is not necessary to clean the sensor probe frequently.

Remove dust on the sensor probe with a dry cloth. For correct and normal measurement, keep the insulation resistance of the purge-air outlet at a high level. To ensure this, completely remove contaminants from the outlet. When cleaning the sensor probe, also remove dust that has accumulated on the probe inlet.

5.1.2 Correcting (Resetting) the Measurement Range

The sensor probe may be worn out by dust contained in the gas under measurement. Although wear in the sensor probe may not directly lead to the inability to measure, the level of current arising from frictional electricity may change, affecting the output signal. If you need to know precise dust concentration, correct (or reset) the measurement range according to your degree of necessity. Correct (reset) the measurement range according to the procedure of measurement range setting discussed in subsection 4.2.4. If the wear on the sensor probe is extreme, it must be replaced.

5.2 Replacing Parts

In order to keep the DT400G serviceable over a prolonged period, you must replace parts that are worn out or have deteriorated as a result of the gas under measurement.

5.2.1 Replacing the O-rings

The O-ring that needs replacement is the one that prevents leakage of the gas under measurement from the probe inlet. If the O-ring is found to be damaged in any way, such as scratches, or cracks or permanent deformity due to deterioration, replace it.

Note: O-rings are also used in the DT400G main unit and on the contact surfaces of the sensor probe, though they are not visible from outside. Ask Yokogawa Electric Corporation for replacement of these O-rings.

5.2.2 Replacing the Fuse

As a rule, the fuse in the internal unit of the DT400G need not be replaced until it is blown. It is advisable however, that the fuse be replaced at a fixed interval (2 to 4 years, for example) if you do not want it to blow during regular operation. Turn off the power switch in the power line before you replace the fuse. Use a replacement fuse conforming to the given specifications (250 V/0.1 A).

5.2.3 Replacing the Sensor Probe

Even if the sensor probe becomes worn, it does not fall into a state of being totally unable to take measurements. If wear of the sensor probe is extreme however, replace the whole sensor assembly. Determine the time of replacement on a case-by-case basis, by judging from what degree of correction has been made to the measurement range set when the DT400G was first put into use, whether the sensor probe is still adequately rigid, and so on. Yokogawa Electric should be asked to carry out any replacement of the sensor assembly.

6. Troubleshooting

This chapter explains measures that should be taken when the output signal gives abnormal readings. Note that not all anomalies are due to failure (disorder or malfunction) in the DT400G. Some of them may be due to a change in the physical properties (types of components, the flow velocity, etc.) of the gas being measured. If such a change is likely, first check for the following.

●Causes of Failure and Corrective Actions

State of Failure	Cause	Corrective Action
The output signal overshoots toward the 20mA side.	・Air purge is not effective. ・Condensation occurs at the probe inlet.	・Check that the gap at the purge-air exit is as specified. If the exit is contaminated with dust, increase the purge pressure (remove the dust on the exit). ・Take appropriate heat insulation measures.
The output signal gives abnormal readings.	・The purge-air exit is contaminated with dust. ・The sensor probe is in a state of insulation failure because of inappropriate purge air (e.g., contains moisture). ・The gas under measurement has entered the purge-air piping, causing an insulation failure in the sensor probe.	・Clean the exit (see subsection 5.1.1). ・Use normal, dry purge air. ・Set the pressure relatively higher and continue air purge for a while. (If contaminants still remain in the piping, contact Yokogawa Electric for assistance.)
The output signal does not stabilize.	・The flow velocity of the gas under measurement is not constant. ・The humidity of the gas under measurement changes.	・Change the measurement point to a position in the straight portion of the duct where the flow of gas is regular. ・If the change occurs constantly, check if measuring the gas is practicable at all.
The output signal becomes disturbed momentarily.	・The wiring is inappropriate and therefore picks up noise. ・There is equipment nearby serving as a source of noise.	・Check the states of grounding and wiring and correct a problem if there is any. ・Take measures for protecting the DT400G from the source of noise.
There is no output signal.	・The fuse is blown or there is something wrong with the wiring connections. ・There is something wrong with the electric circuit components.	・Turn off the power switch temporarily if the green indicator lamp is unlit. Then, examine the wiring connections and check if the fuse has blown. ・Request repair to be carried out by Yokogawa Electric.

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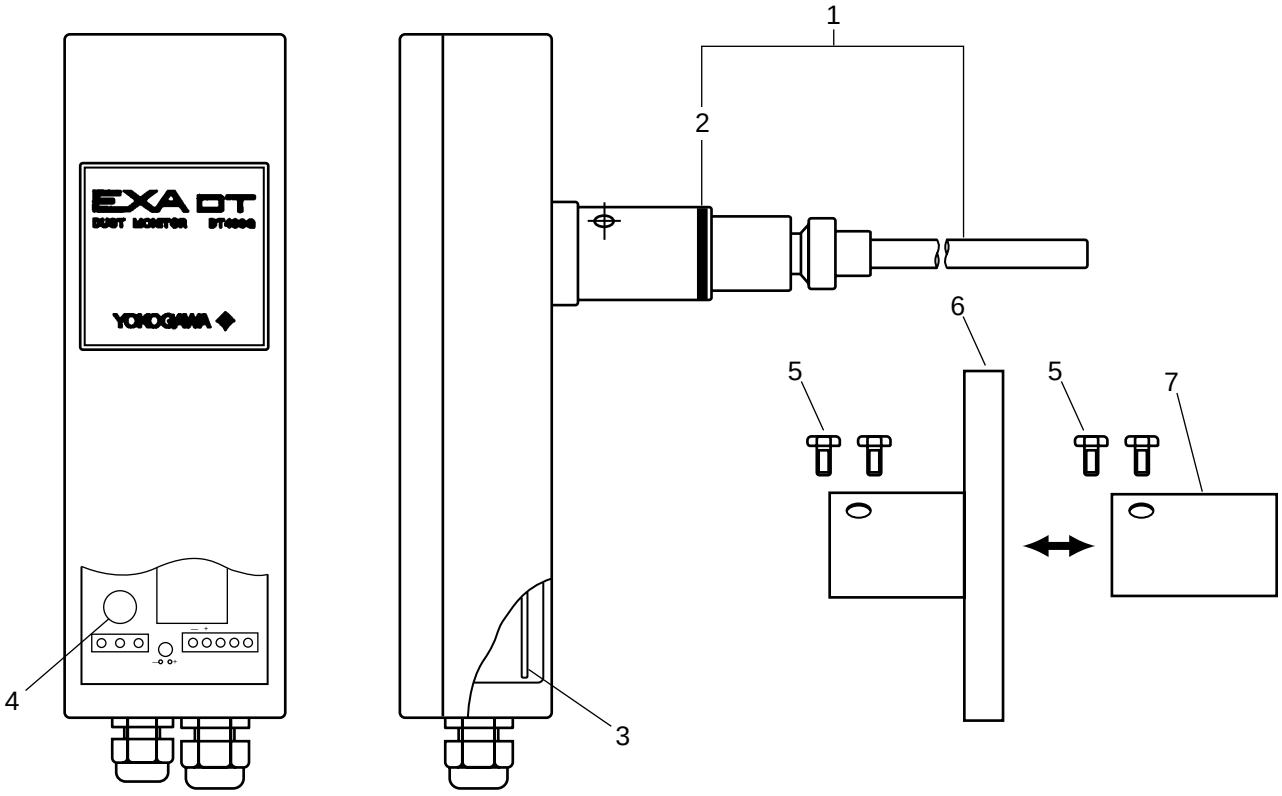
<<iPartDirect>> <<Note>>

Customer Maitenance Parts List

DT400G
Dust Monitor

EXA DT



Item	Part No.	Qty	Description
1	K9359AC	1	Sensor Assembly
2	L9817AG	1	O-Ring
3		1	Amplifier Assembly
	K9359AP		for 100V AC Power Supply
	K9359AQ		for 200V AC Power Supply
4	A1084EF	1	Fuse
5	L9800TC	2	Bolt
6		1	Flange Assembly
	K9359AF		(JIS)
	K9359AG		(ANSI)
	K9359AH		(JPI)
7	K9359BD	1	Socket

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