

ACTIVAL+™

Standalone Model

Motorized Two-Way Valve with Flanged-End Connection (ANSI Class 125 / A126 Class B)

■ General

ACTIVAL+™ Model FVY51_FJ is a series of motorized two-way valves with flanged-end connection. Rotary valve and actuator are integrated in a single unit.

In combination with the functions of a control valve, Model FVY51_FJ measures and controls flow. Model FVY51_FJ thus enables to control temperature for air conditioning by controlling chilled/hot water volume and to measure chilled/hot water flow.

For such a high functionality, compact size and simple installation of Model FVY51_FJ are incomparable.

Model FVY51_FJ is operated by the following control signal.

1. 4–20 mA DC input
 2. 2 to 10 V input
- Both provide proportional control in combination with a single loop controller (e.g., Model SDC35/SDC36)

Flow data stored in Model FVY51_FJ is retrieved via RS-485 communication (Modbus protocol). The retrieved flow data is effective for energy-saving facility operation.



■ Features

- Compact and lightweight:
Rotary valve actualizes small body and light weight.
- Valve and actuator integrated in a single unit.
- NEMA 4X and IP54 enclosure rating
(Waterproof connectors are required to assure NEMA 4X and IP54)
- Valve for chilled/hot water control applicable to large Cv value, high rangeability, and low leakage.
- Durable actuator with low power consumption.
- Flow control/position control operation selectable:
For flow control, flow characteristic is selectable (equal percentage or linear). For position control, flow characteristic is equal percentage.
- Model FVY51_FJ holds flow data effective for maintenance and energy-saving facility operation. The data is retrieved via RS-485 communication (Modbus protocol).
- In combination with the optional Display Panel (Model QY5010S2000) and the insertion-type temperature sensor (Model TY7830) or the temperature sensor for pipe surface (Model TY7820), pressure, temperature, and flow can be displayed on the Display Panel.

Note: The display panel, the insertion-type pipe temperature sensor, and the temperature sensor for pipe surface should be ordered separately.

IMPORTANT:

Do not use the data measured by this product for charging or dealing purposes.

Safety Precautions

Please read instructions carefully and use the product as specified in this manual. Be sure to keep this manual nearby for quick reference.

Restrictions on Use

This product was developed, designed, and manufactured for general air conditioning use.

Do not use the product in a situation where human life may be at risk or for nuclear applications in radiation controlled areas. If you wish to use the product in a radiation controlled area, please contact Azbil Corporation.

Particularly when the product is used in the following applications where safety is required, implementation of fail-safe design, redundant design, regular maintenance, etc., should be considered in order to use the product safely and reliably.

- Safety devices for protecting the human body
- Start/stop control devices for transportation machines
- Aeronautical/aerospace machines

For system design, application design, instructions for use, or product applications, please contact Azbil Corporation.

Azbil Corporation bears no responsibility for any result, or lack of result, deriving from the customer's use of the product.

Recommended Design Life

It is recommended that this product be used within the recommended design life.

The recommended design life is the period during which you can use the product safely and reliably based on the design specifications.

If the product is used beyond this period, its failure ratio may increase due to time-related deterioration of parts, etc.

The recommended design life during which the product can operate reliably with the lowest failure ratio and least deterioration over time is estimated scientifically based on acceleration tests, endurance tests, etc., taking into consideration the operating environment, conditions, and frequency of use as basic parameters.

The recommended design life of this product is 10 years.

The recommended design life assumes that maintenance, such as replacement of the limited life parts, is carried out properly.

Refer to the section on maintenance in this manual.

Warnings and Cautions

 **WARNING** Alerts users that improper handling may cause death or serious injury.

 **CAUTION** Alerts users that improper handling may cause minor injury or material loss.

Signs

 Notifies users that specific actions are prohibited to prevent possible danger. The symbol inside  graphically indicates the prohibited action. (For example, the sign on the left means that disassembly is prohibited.)

 Instructs users to carry out a specific obligatory action to prevent possible danger. The symbol inside  graphically indicates the actual action to be carried out. (For example, the sign on the left indicates general instructions.)

WARNING

 When handling or transporting any heavy product (more than 39.7 lb (18 kg)), carefully move the product with a handtruck or the like, or with 2 or more people. Careless lifting or accidental dropping of the product may result in injury or product damage.

CAUTION

 Provide a circuit protector (e.g., a fuse or circuit breaker) for the power source. Failure to do so may cause a short circuit leading to fire or device failure.

 Do not freeze this product. Doing so may damage the valve body and cause leakage.

 When piping this product, be sure there is no foreign matter in the pipes. If foreign matter remains in the pipes, the product may break down.

 Install, wire, and use this product under the conditions specified by this manual. Failure to do so may cause fire or device failure.

 Use full face gaskets for flat face flanges. Failure to do so may damage the flanges or cause leakage outside of the valve.

 When installing this product, hold it in the proper position and securely fasten it to the pipes. Excessive tightening or improper installation position may damage the valve.

|  CAUTION | |
|---|--|
|  | After installation, make sure no fluid leaks from the valve-pipe connections. Improper piping may cause fluid leakage outside of the valve. |
|  | Do not put a load or weight on this product. Doing so may damage the product. |
|  | Installation and wiring of the actuator must be performed by personnel qualified to do instrumentation and electrical work. Mistakes in installation or wiring may cause fire or electric shock. |
|  | Before wiring or maintenance, be sure to turn off the power to this product. Failure to do so may result in electric shock or device failure. |
|  | All wiring must comply with applicable codes and ordinances. Otherwise there is a danger of fire. |

|  CAUTION | |
|---|--|
|  | For wiring, strip the insulation from cables as specified in this manual. If the length of exposed wire is longer than specified, it may cause electric shock or short circuit between adjacent terminals. If it is too short, it may not make proper contact. |
|  | Use crimp terminals with insulation for connections to the product terminals. Failure to do so may cause short circuit leading to fire or device failure. |
|  | Tighten the terminal screws with the specified torque. Insufficient tightening of the terminal screws may cause fire or overheating. |
|  | After wiring or maintenance, be sure to reattach the terminal cover. Failure to do so may result in electric shock. |
|  | Do not carelessly touch this product when it is used to control hot water. Doing so may result in burns, because the product reaches a high temperature. |

Note:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

IMPORTANT:

In case an Azbil Corporation product fails, you are required to provide your Equipment with safety design such as fool-proof design*¹, and fail-safe design*² (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance*³, fault tolerance*⁴, or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.
 *2. A design that is safe even if the device fails.
 *3. Avoidance of device failure by using highly reliable components, etc.
 *4. The use of redundancy.

IMPORTANT:

- Install the product to a pipe so that they are electrically connected at the same potential. If the valve and the pipe are electrically isolated, noise might be generated, causing incorrect measurement and control of flow.
- When installing the product with flange gasket, do not use the rubber gasket or the gasket that goes inside the pipe. Doing so might cause incorrect measurement and control of flow.
- This product is applicable only to chilled/hot water control. If the product is used to control any other medium such as brine or air, flow rate cannot be measured or controlled.
- Install the valve so that the flow direction of process fluid agrees with the arrow indicated on the valve body. If the flow direction is opposite to the arrow, correct measurement and control of flow is not assured.
- Do not loosen the yoke fixing screws or the actuator fixing screws. Loose fixing screws lower flow measuring accuracy. Note that the actuator mounting position onto the valve cannot be changed.
- Flow measuring accuracy in the subsection Measuring range and accuracy shown later is for the valve sensor measuring 44.6 to 62.6 °F (7 to 17 °C) and 113 to 149 °F (45 to 65 °C) ranges, 29 to 261 psig pipe pressure, and 4.35 to 43.5 psi differential pressure. Without these ranges, the flow rate measuring accuracy might decrease.
- To keep flow measuring accuracy, control the quality of process fluid (water), and do not allow rust or foreign object inside the valve. Rust or foreign object inside the valve lowers flow measuring accuracy.
- Thermally insulate the valve, and do not allow the process fluid to freeze. Frozen process fluid around the valve sensor might damage the valve sensor and cause error output.

■ Model Numbers

Model FVY51_FJ is the model for the valve and actuator integrated into a single unit.
The model number label is attached to the yoke.

| Base model Number | Actuator / Valve | | Actuator | | Valve | Generation | Description |
|-------------------|------------------|-------------------|----------|-------|-------------------|-------------------|---|
| | Control signal | Rating / Material | Type | Fixed | Nominal size / Cv | | |
| FVY51 | | | | | | | Motorized two-way valve with flanged-end connection (Flow measuring and controlling functioned) |
| | 3 | | | | | | 4 to 20 mA DC input, pulse output, RS-485 communication (Modbus protocol) |
| | 4 | | | | | | 2 to 10 V DC input, pulse output, RS-485 communication (Modbus protocol) |
| | | F | | | | | ANSI Class 125 / A126 Class B |
| | | | J | | | | NEMA 4X and IEC IP54 protected and standard torque type actuator with terminal block |
| | | | | 00 | | | Fixed |
| | | | | | 21 | | 1" / 10 Cv value |
| | | | | | 22 | | 1" / 16 Cv value |
| | | | | | 41 | | 1½" / 25 Cv value |
| | | | | | 42 | | 1½" / 40 Cv value |
| | | | | | 51 | | 2" / 65 Cv value |
| | | | | 61 | | 2½" / 95 Cv value | |
| | | | | 81 | | 3" / 125 Cv value | |

Notes:

- This product has acquired the following UL/cUL certification.
UL60730-1/-2-14, CAN/CSA E60730-1:15 / -2-14:13
Rated impulse voltage : 330 V (Over Voltage Category I), Control pollution degree: 4 (3 for the inside of actuator), Type of action: 1.AB
Use the class 2 power supply.
UL50E
Type 4 Enclosure
- Only the actuator is certified with the UL/cUL above.

■ Specifications

For weight, refer to the table shown in the section **Dimensions**.

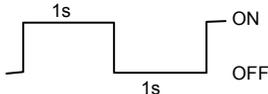
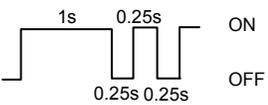
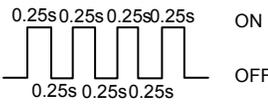
● Valve and actuator (as a single unit) specifications

| Item | | Specification | |
|--------------------------|---|---|--|
| Environmental conditions | Rated operating conditions | Ambient temperature | -4 to 122 °F (-20 to 50 °C) (Do not allow the process fluid to freeze.) |
| | | Ambient humidity | 5 to 95 % RH |
| | | Vibration | 16.1 fps ² (4.9 m/s ²) for 10 to 150 Hz |
| | | Shock | 16.1 fps ² (4.9 m/s ²) |
| | Transport/storage conditions (in package) | Ambient temperature | -4 to 158 °F (-20 to 70 °C) |
| | Ambient humidity | 5 to 95 % RH | |
| | Vibration | 64.3 fps ² (19.6 m/s ²) for 10 to 150 Hz | |
| Installation locations | | Indoor (salt air, corrosive gas, flammable gas, and organic solvent must be avoided.) Outdoor (Use the outdoor cover etc. to be ordered separately. Direct sunlight, salt air, corrosive gas, flammable gas, and organic solvent must be avoided.) | |
| Installation orientation | | Installable in any position ranging from upright to sideways (90° tilted.) * The valve sensor must face upward when tilted. * Always install in upright position outdoors. | |
| Manual operation | | Available | |
| Insulation resistance | Between the case and terminal | Min. 5 MΩ (50 V DC) | |
| Dielectric strength | Between the case and terminal | 250 V AC for 1 min, leakage current 5 mA or less | |
| Position for shipment | | 100 % (fully open) preset at factory. | |

● Valve specifications

| Item | Specification | | | | |
|------------------------------|--|-------------------------------|-----|---------|-------------------|
| Model | Two-way valve with flanged-end connection | | | | |
| Body pressure rating | ANSI Class 125 | | | | |
| End connection | ANSI Class 125 bolt pattern flanges, flat face flange (FF) | | | | |
| Size, Cv, Close-off ratings | Model number | Nominal size | | Cv | Close-off ratings |
| | | Inch | DN | | |
| | FVY51_FJ0021 | 1" | 25 | 10 | 145 psi |
| | FVY51_FJ0022 | 1" | 25 | 16 | 145 psi |
| | FVY51_FJ0041 | 1½" | 40 | 25 | 145 psi |
| | FVY51_FJ0042 | 1½" | 40 | 40 | 145 psi |
| | FVY51_FJ0051 | 2" | 50 | 65 | 145 psi |
| | FVY51_FJ0061 | 2½" | 65 | 95 | 145 psi |
| FVY51_FJ0081 | 3" | 80 | 125 | 145 psi | |
| Materials | Body | Gray cast iron (A126 Class B) | | | |
| | Plug and stem | Stainless steel | | | |
| | Seat ring | Heat-resistant PTFE | | | |
| | Gland packing | Inorganic fiber | | | |
| | Gasket | Expansion graphite sheet | | | |
| Applicable fluid | Chilled/hot water | | | | |
| Allowable fluid temperature* | 32 °F to 176 °F (0 °C to 80 °C Non-freezing) * Frozen process fluid around the valve sensor may damage or may cause output error. | | | | |
| Flow characteristics | Equal percentage | | | | |
| Rangeability | 100 : 1 | | | | |
| Seat leakage | Class IV (0.01 % of rated Cv value) | | | | |
| Paint | Gray | | | | |
| Actuator to be combined | Integrated with the valve | | | | |

● Actuator specifications

| Item | | Specification | |
|--|--|---|---|
| Power supply | | 24 V AC± 15 %, 50 Hz/60 Hz | |
| Power consumption | | 8 VA | |
| Timing | | 63 ± 5 sec (50 Hz) / 53 ± 5 sec (60 Hz) | |
| Control signal | Model FVY513 | 4 to 20 mA DC input (Input impedance: 250 Ω) | |
| | Model FVY514 | 2 to 10 V DC input (Input impedance: 500 kΩ) | |
| DI ^{*1} (Cooling/heating switch) | Input type | Potential free (dry) contact input | |
| | Voltage, current | 12 V DC, 5 mA | |
| Pulse output ^{*2} (Totalized energy output Totalized flow output) | Output type | Open collector output | |
| | Contact rating | 30 V DC, Max. 60 mA | |
| | Pulse rate | 3.4 Hz or lower | |
| Temperature sensor input | | Pt100 RTD, 3-wire | |
| Communication (Modbus protocol) | Transmission system | RS-485 | |
| | Transmission speed | 4800 bps | |
| | Connection | Multi-drop (1 to 31 max.) | |
| | Transmission distance | Max. 1640 ft (500 m) | |
| Communication (Display Panel) | Transmission system | AP-bus (RS-485 communication) | |
| | Transmission speed | 4800 bps | |
| | Transmission distance | Max. 164 ft (50 m) | |
| Materials | Case | Die cast aluminum | |
| | Top cover, terminal cover | Polycarbonate resin | |
| | Yoke | Steel plate (bright chromate finish) | |
| Position indication | | Pointer of the actuator shows the position (0 % to 100 %). Visible from the forward, backward, and downward position. Position and flow can be indicated on the optional Display Panel. | |
| Enclosure rating | | NEMA 4X, IEC IP54 | |
| Wire connection | Power, control signal, DI, pulse output | M3.5 screw terminal connection | |
| | Temperature sensor (Pt100 input) | 6-pin (3-pin × 2) connector | |
| | RS-485 communication | 6-pin (3-pin × 2) connector | |
| | Display Panel | 4-pin connector | |
| Operation status indicator LED | | 1 red LED | |
| | Status | LED indication | |
| | Normal | Repetition of 1-second ON → 1-second OFF. |  |
| | Major alarm | Continuous ON. | |
| | Minor alarm | Repetition of 1-second ON → 0.25-second OFF → 0.25-second ON → 0.25-second OFF. |  |
| Communication error (and minor alarm) | Repetition of 0.25-second ON → 0.25-second OFF |  | |

Notes:

- *1 Heating and cooling modes are switched over by DI (open/closed contact). Heating and cooling modes are also switched over by setting the Display Panel (Model QY5010S2000). Refer to **AB-7497-U Instruction Manual of ACTIVAL + Standalone Model** for details.
- *2 Totalized energy or totalized pulse rate for the pulse output is selectable by setting the Display Panel (Model QY5010S2000).
- *3 Pulse rate is set with the Display Panel (Model QY5010S2000). Refer to **AB-7497-U Instruction Manual of ACTIVAL + Standalone Model** for details.
- *4 In combination with 2 temperature sensors (Pt100 RTD, 3-wired), Model FVY51_ _J is applicable to simplified energy calculation.
- *5 Flow measuring data and device data are output in Modbus protocol via RS-485 communication. Refer to **AB-7497-U Instruction Manual of ACTIVAL + Standalone Model** for details.

● Measuring range and accuracy

IMPORTANT:

Flow measuring accuracy shown in the below is for the valve sensor measuring 44.6 to 62.6 °F (7 to 17 °C) and 113 to 149 °F (45 to 65 °C) ranges, 29 to 261 psi pipe pressure, and 4.35 to 43.5 psi differential pressure. Without these ranges, the flow rate measuring accuracy might decrease.

(1/2)

| Item | | Specification | | | |
|----------------|-------------------------------------|---------------|--------------|----------|---------------|
| Flow measuring | Setting range | Model number | Nominal size | Cv value | Max. set flow |
| | | FVY51_FJ0021 | 1" | 10 | 30 GPM |
| | | FVY51_FJ0022 | 1" | 16 | 48 GPM |
| | | FVY51_FJ0041 | 1½" | 25 | 75 GPM |
| | | FVY51_FJ0042 | 1½" | 40 | 120 GPM |
| | | FVY51_FJ0051 | 2" | 65 | 195 GPM |
| | | FVY51_FJ0061 | 2½" | 95 | 285 GPM |
| | | FVY51_FJ0081 | 3" | 125 | 375 GPM |
| Flow measuring | Measuring accuracy (Factory preset) | | | | |

Notes:

- *1 ΔPv is differential pressure between valve inlet pressure (Pvin) and outlet pressure (Pvout).
- *2 Flow measuring accuracy above may change depending on the conditions including valve positions, differential pressure, etc.

(2/2)

| Item | | Specification | | | | |
|--|-----------------------|--|--|----------|----------|----------|
| Valve sensor ³ | Pressure measuring | Measuring range | 0 to 145 psi ⁴ | | | |
| | | Accuracy | ± 0.5 %FS (factory preset) ⁵ | | | |
| | Temperature measuring | Measuring range | 14 to 212 °F (-10 to 100 °C) | | | |
| | | Accuracy | ± 1.8 °F (± 1 °C) (factory preset) ⁶ (within 32 to 176 °F (0 to 80 °C) measuring range, at -13 to 104 °F (25 to 40 °C) temperature difference between measuring temperature and ambient temperature) | | | |
| Temperature measuring of Pt100 input | Accuracy ⁷ | Conversion accuracy: ± 0.72 °F at 32 to 176 °F (± 0.4 °C at 0 to 80 °C) ambient temperature ± 1.08 °F at -4 to 32 °F (± 0.6 °C at -20 to 0 °C) ambient temperature Error due to wiring length: ± 0.27 °F at 49.2 ± 49.2 ft (± 0.15 °C at 15 ± 15 m) in the 32 to 176 °F (0 to 80 °C) measuring range | | | | |
| Energy calculation ⁸ (with two temperature sensors (Pt100 input) connected) | Accuracy | Temperature difference b/w supply and return water | Flow measuring accuracy ⁹ | | | |
| | | | ± 5 %RD | ± 7 %RD | ± 1 %FS | ± 3 %FS |
| | | ΔT = 9.0 °F (5 °C) | ± 25 %RD | ± 27 %RD | ± 21 %FS | ± 23 %FS |
| | | ΔT = 18 °F (10 °C) | ± 15 %RD | ± 17 %RD | ± 11 %FS | ± 13 %FS |
| | ΔT = 27 °F (15 °C) | ± 12 %RD | ± 14 %RD | ± 8 %FS | ± 10 %FS | |

Notes:

- *3 Valve sensor is the temperature and pressure sensors mounted onto the valve (Model FVY51_ _J), measuring valve surface temperature and inlet and outlet flow pressure.
- *4 When you test the withstand pressure, up to 232 psi pressure can be applied to the valve sensor.
- *5 The above pressure measuring accuracy is for the 44.6 to 149 °F (7 to 65 °C) flow temperature. If the flow temperature is out of the 44.6 to 149 °F (7 to 65 °C), the valve sensor flow measuring accuracy may decrease.
- *6 For accurate measuring of flow temperature, thermal insulation is required.
- *7 Overall accuracy is calculated based on the sensing accuracy of the temperature sensors connected, the conversion accuracy, and the error due to wiring length.
- *8 Energy calculation accuracy is calculated from the flow measuring accuracy at 1.8 °F (1 °C) measuring error of the temperature difference.
- *9 The flow measuring accuracy in the table corresponds to the data shown in the above flow measuring accuracy graph.

■ Data in Model FVY51_FJ

| | |
|-------------|---|
| Flow data | Following items are displayed on Display Panel (Model QY5010S2000): Actual flow, supply water temperature, return water temperature, valve inlet pressure, valve outlet pressure, actual flow (% in bar graph), actual valve position (% in bar graph) |
| | Following items are retrieved via RS-485 communication (Modbus protocol): Control setting value, actual valve position, actual flow, set flow, supply water temperature, return water temperature, valve inlet pressure, valve outlet pressure, instantaneous energy, totalized flow, totalized energy, cool/heat status, point status ^{*1} |
| Device data | Following items are retrieved via RS-485 communication (Modbus protocol): Model number, date of manufacture, version of hardware, version of software, serial number, power-ON time, operating time, operating level, number of operations, number of reverse, range, device status ^{*2} |

Notes:

*1 Point status indicates an error of analog data. Refer to **AB-7497-U Instruction Manual of ACTIVAL + Standalone Model** for details.

*2 Device status indicates the status of this product. Refer to **AB-7497-U Instruction Manual of ACTIVAL + Standalone Model** for details.

■ Wire Specifications

| | | | | |
|--|--|---|-----------------|-----------------------------|
| Power | | AWG 14–18 (0.75 to 2.0 mm ²) | — | M3.5 screw connection |
| Control signal, DI (Cooling/heating switch signal), pulse output | | AWG 16–18 (0.75 to 1.25 mm ²) | 164 ft (50 m) | M3.5 screw connection |
| Display Panel | | AWG 22 x 4-core (0.3 mm ²) | 164 ft (50 m) | 4-pin connector |
| Temperature sensor (Pt100 input) | Temperature sensor for pipe surface (Pipe sensor) | 3-core cable assembled with the sensor | 98 ft (30m) | 6-pin (3-pin × 2) connector |
| | Insertion-type pipe temperature sensor | AWG 22 x 3-core (0.3 mm ²) | 98 ft (30m) | |
| RS-485 communication | | AWG 16–24 x 2- pairs of shielded twist pair cable / 1 pair of shielded twist pair and conductor cable ^{*2} (0.2 to 1.25 mm ²) | 1640 ft (500 m) | 6-pin (3-pin × 2) connector |

Notes:

*1 Total length of the product - relay terminal block wiring and the relay terminal block - load (device in connection).

*2 Recommended cable: Belden's Model 3106A/3107A/9842

■ Options

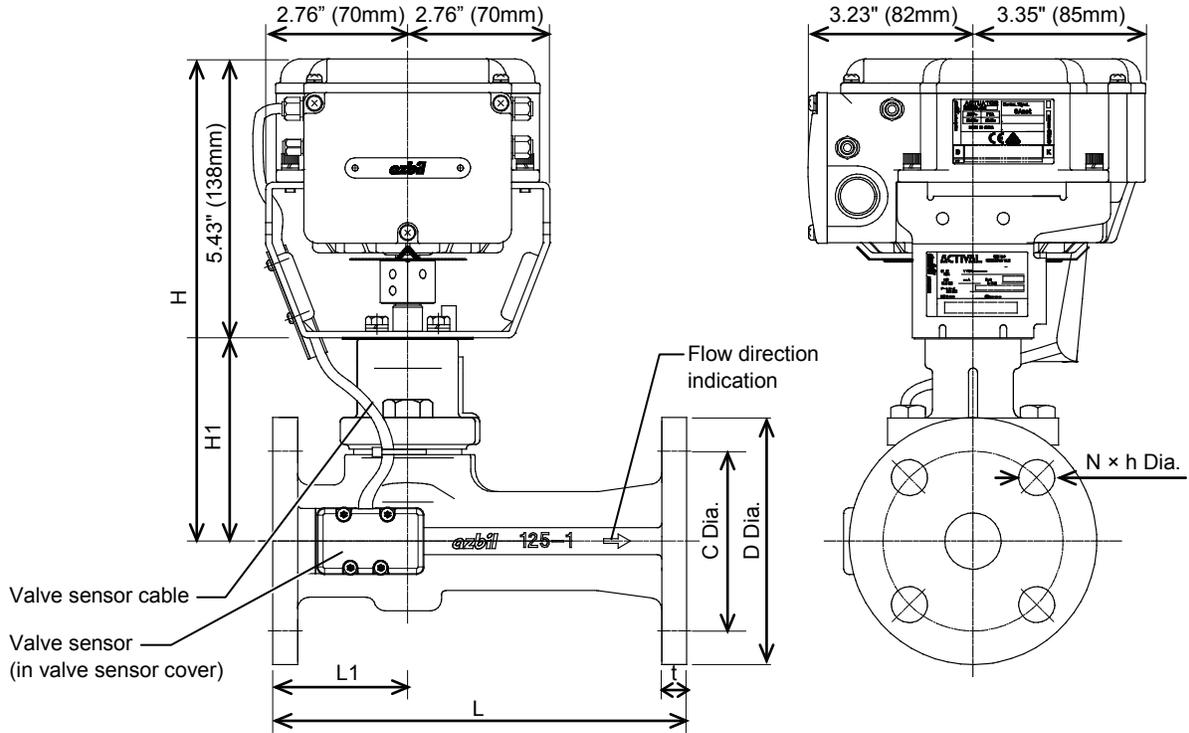
Separately order the following optional parts if needed.

| | | | |
|--|-------------------|--|--|
| Display Panel Model QY5010S2000* | | Data displaying device for Model FVY51_FJ series | For the specifications of Display Panel, refer to AB-7496-U Specifications/ Instructions of Display Panel . |
| Temperature sensor for pipe surface (Pipe sensor) | Model TY7820Z0P01 | Total length: 19.7 ft (1.5 m) | For the specifications of the pipe sensor, refer to AB-6923 Specifications/ Instructions of Temperature Sensor for Pipe Surface . |
| | Model TY7820Z0P05 | Total length: 65.6 ft (5 m) | |
| | Model TY7820Z0P10 | Total length: 131.2 ft (10 m) | |
| | Model TY7820Z0P30 | Total length: 393.7 ft (30 m) | |
| Insertion-type pipe temperature sensor Model TY783 | | For the specifications of the insertion type pipe temperature sensor, refer to AB-5429 Specifications/Instructions of Pipe Temperature Sensor . | |

Note:

* Order Display Panel (Model QY5010S2000) and connect it to the product (Model FVY51_FJ). Display Panel is required to set the product.

■ Dimensions



| Model number | Valve size | L (in) | L1 (in) | H (in) | H1 (in) | D (in) | C (in) | t (in) | φh (in) | N | Weight (lb) |
|--------------|------------|--------|---------|--------|---------|--------|--------|--------|---------|---|-------------|
| FVY51_FJ002_ | 1" | 7.24 | 2.36 | 8.98 | 3.54 | 4.33 | 3.15 | 0.44 | 0.63 | 4 | 16.8 |
| FVY51_FJ004_ | 1½" | 6.5 | 3.25 | 9.49 | 4.06 | 4.92 | 3.91 | 0.71 | 0.63 | 4 | 20.9 |
| FVY51_FJ005_ | 2" | 7.01 | 3.5 | 9.65 | 4.21 | 5.91 | 4.72 | 0.79 | 0.75 | 4 | 25.4 |
| FVY51_FJ006_ | 2½" | 7.48 | 3.54 | 10.31 | 4.88 | 7.09 | 5.51 | 0.79 | 0.75 | 4 | 35.3 |
| FVY51_FJ008_ | 3" | 7.99 | 3.94 | 10.35 | 4.92 | 7.48 | 6 | 0.87 | 0.75 | 4 | 44.1 |

Figure 1. Dimensions

■ Parts Identification

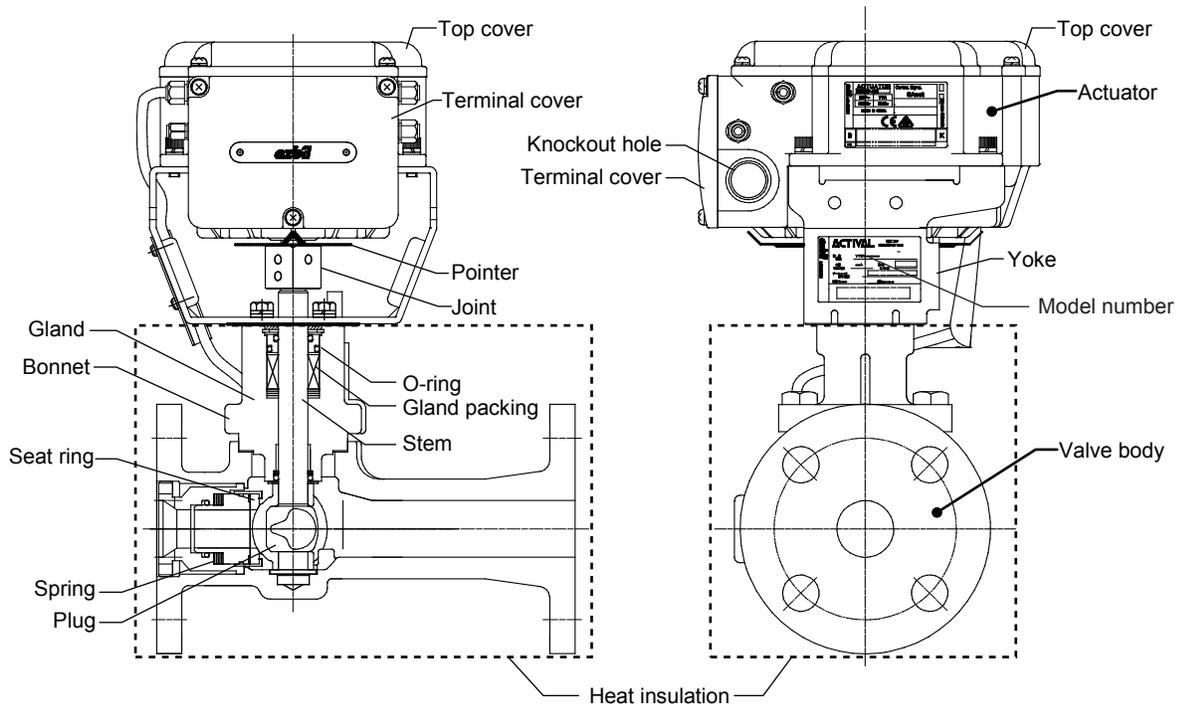


Figure 2. Parts identification: Valve details

● Actuator details (Connectors, ports, terminals, and LED)

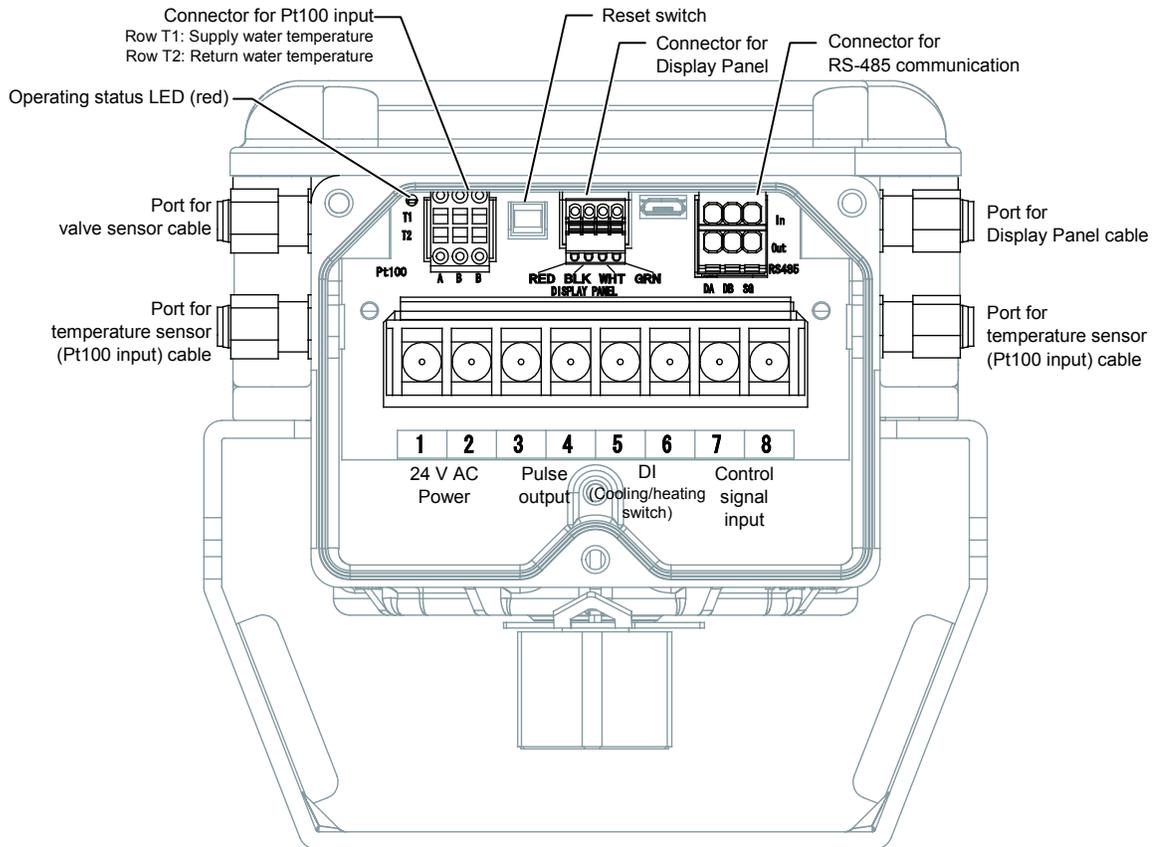


Figure 3. Parts identification: Actuator details

■ Installation

● Precautions for installation

|  WARNING | |
|---|---|
|  | When handling or transporting any heavy product (more than 39.7 lb (18 kg)), carefully move the product with a handtruck or the like, or with 2 or more people. Careless lifting or accidental dropping of the product may result in injury or product damage. |

|  CAUTION | |
|---|---|
|  | Do not freeze this product. Doing so may damage the valve body and cause leakage. |
|  | When piping this product, be sure there is no foreign matter in the pipes. If foreign matter remains in the pipes, the product may break down. |
|  | Install, wire, and use this product under the conditions specified by this manual. Failure to do so may cause fire or device failure. |
|  | Use full face gaskets for flat face flanges. Failure to do so may damage the flanges or cause leakage outside of the valve. |

| IMPORTANT: | |
|--|--|
| <ul style="list-style-type: none"> • This product requires straight pipe runs (valve diameter × 2 long) on the inlet and outlet sides for accurate flow measuring. • When installing the product with flange gasket, do not use the rubber gasket or the gasket that goes inside the pipe. Doing so might cause incorrect measurement and control of flow. • Install the product to a pipe so that they are electrically connected at the same potential. If the valve and the pipe are electrically isolated, noise might be generated, causing incorrect measurement and control of flow. | |

- Model FVY51_FJ is the valve and actuator integrated into a single unit. Do not combine the valve with any other actuator, or do not combine the actuator with any other valve.
- To remove foreign objects inside the pipes, install a strainer with 40 or more meshes on the inflow side of each valve. If the strainers cannot be installed on the inflow side of each valve, install it on the pipe diverting sections (sections diverting from main piping system to sub piping system).
- Install the product so that the flow direction of process fluid agrees with the arrow indicated on its valve body.
- Do not install the product nearby a steam coil, pressurized hot-water coil, or any high heat source. High temperature radiation might cause malfunction of its actuator.

● Installation location

IMPORTANT:

- The top and the terminal covers might be corroded by chemicals and organic solvent or their vapor. Do not expose the product to such substances/vapor.
- Although the product can be used in high humidity environments (max. 95 % RH), do not immerse the actuator in water.
- Although the product can be used outdoors, be sure not to expose the product to direct sunlight. Provide the outdoor cover (optional) to install outdoors.

- Install the product in a position allowing easy access for maintenance and inspection. 12" (305 mm) clearance on top of and around the actuator, 24" (610 mm) clearance on the front are required, as shown in Fig. 4. When installing the product in a ceiling space, provide an access hole within the 20" (508 mm) radius of the product. And, place a drain pan under the valve.
- Do not mount the product on a pipe where water hammer occurs, or where solid objects including slug may accumulate.

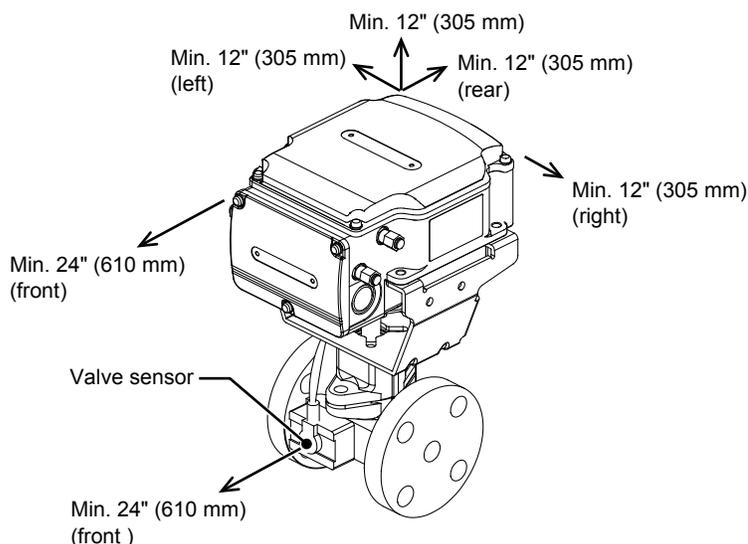


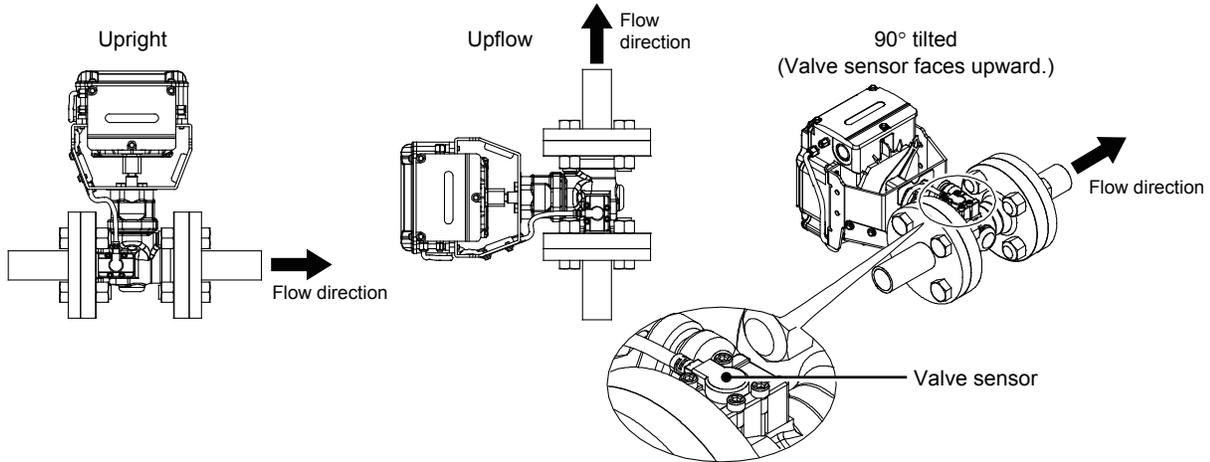
Figure 4. Clearance for maintenance

● **Mounting position**

Model FVY51_FJ can be mounted in any position ranging from upright to sideways (90° tilted). Note that Model FVY51_FJ must be installed with the valve sensor vertically positioned above the valve body when being tilted. It is also installable on the vertical upflow pipe. (See Fig. 5.) However, Model FVY51_FJ must be installed always in upright position outdoors.

Do not mount Model FVY51_FJ; with its actuator vertically below the valve, on a vertical downflow pipe, or with the valve sensor facing downward.

Correct mounting positions



Incorrect mounting positions

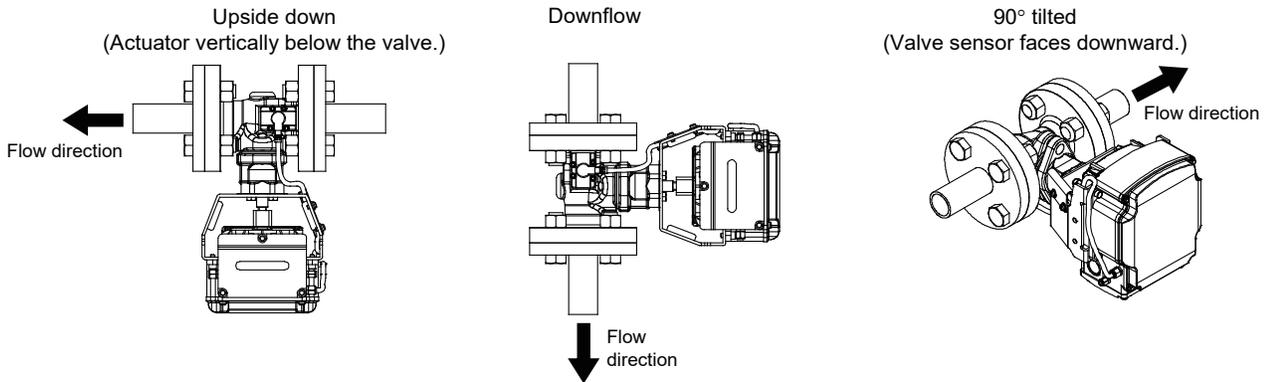


Figure 5. Mounting position

● Piping

⚠ CAUTION



When installing this product, hold it in the proper position and securely fasten it to the pipes. Excessive tightening or improper installation position may damage the valve.

IMPORTANT:

Do not put force on the valve sensor or its cable to prevent failure.

- Check that the model number of the product is what you ordered. The model number is shown on the label attached to the yoke.
- Install a bypass pipe and gate valves on the inflow, outflow, and bypass sides. Also, install a strainer with 40 or more meshes on the inflow side.
- When installing the product to the pipes, do not allow any object, such as chips, to get inside a pipe or the valve. The valve cannot fully close, or the valve seat may get damaged causing fluid leakage, due to an object jammed inside the valve.
- When piping, do not apply too much sealing material, such as solidifying liquid and tape, to the pipe connection sections so that these materials flow into the valve. The valve cannot fully close, or the valve seat may get damaged causing fluid leakage, due to the sealing material jammed inside the valve.
- Before activating the product, fully open (in 100 % position) the valve and flush the pipes (with the product installed) at the maximum flow rate to remove all the foreign objects. (Factory preset position: 100 %)

⚠ CAUTION



After installation, make sure no fluid leaks from the valve-pipe connections. Improper piping may cause fluid leakage outside of the valve.



Do not put a load or weight on this product. Doing so may damage the product.

● Heat insulation

Apply heat insulation to the valve, as  and  shown in Fig. 2. Do not apply it to the yoke or the actuator. If the heat insulation is inappropriate, temperature measuring accuracy may decrease. If the yoke and/or the actuator are covered with insulation material, the pointer cannot be checked or may be distorted.

When cutting the insulation material that covers the valve, be sure not to damage the valve sensor cable.

● Factory preset position

The actuator shaft is positioned at 100% (in fully open position) for shipment. The shaft is thus completely turned clockwise, and the pointer points at '100'. (See Fig. 6.)

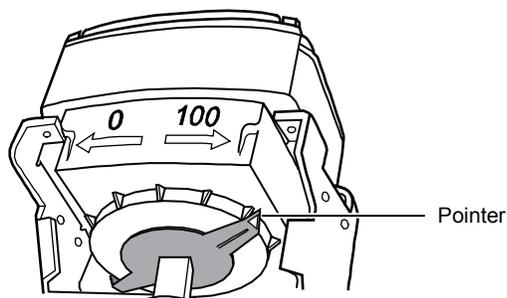


Figure 6. Pointer position for shipment

● **Manually opening/closing Model FVY51_FJ**

IMPORTANT:

- Manually opening/closing the product with the power (24 V AC) applied might damage the actuator.
- To manually open/close the product, do not turn the joint beyond the fully open (100)/closed (0) mark.
- To manually open/close the product, slowly turn the joint. If shock is sent to the actuator, the actuator might get damaged.
- Do not touch the pin with a wrench (tool) when manually opening/closing the product.

Disconnect the power from Model FVY51_FJ before manual operation. As shown in Fig. 7, from the front of the actuator, hold the joint using a tool such as a wrench, and turn the joint slowly toward the set position.

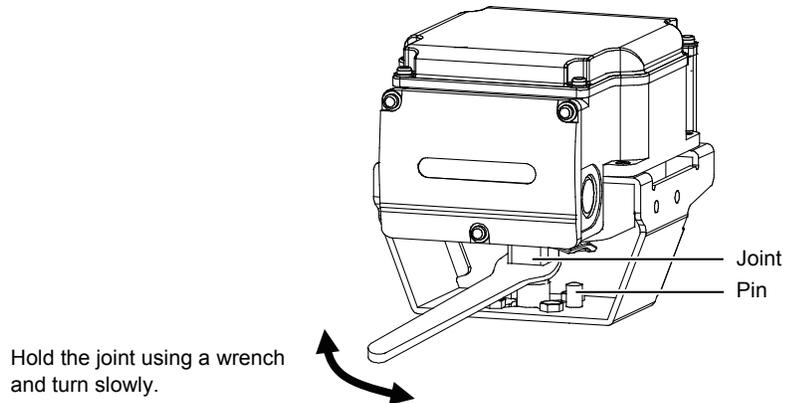


Figure 7. Manual operation

■ **Wiring**

|  CAUTION | |
|---|--|
|  | Provide a circuit protector (e.g., a fuse or circuit breaker) for the power source. Failure to do so may cause a short circuit leading to fire or device failure. |
|  | Install, wire, and use this product under the conditions specified by this manual. Failure to do so may cause fire or device failure. |
|  | Installation and wiring of the actuator must be performed by personnel qualified to do instrumentation and electrical work. Mistakes in installation or wiring may cause fire or electric shock. |
|  | Before wiring, be sure to turn off the power to this product. Failure to do so may result in electric shock or device failure. |
|  | All wiring must comply with applicable codes and ordinances. Otherwise there is a danger of fire. |
|  | For wiring, strip the insulation from cables as specified in this manual. If the length of exposed wire is longer than specified, it may cause electric shock or short circuit between adjacent terminals. If it is too short, it may not make proper contact. |
|  | Use crimp terminals with insulation for connections to the product terminals. Failure to do so may cause short circuit leading to fire or device failure. |
|  | Tighten the terminal screws with the specified torque. Insufficient tightening of the terminal screws may cause fire or overheating. |
|  | After wiring, be sure to reattach the terminal cover. Failure to do so may result in electric shock. |

IMPORTANT:

- The product is designed for 24 V AC power supply voltage.
Do not apply any other power voltage (e.g., 120 V AC, 240 V AC) to the product.
- To prevent damage, cover the terminals except when connecting/disconnecting wires.
- Do not leave any refuse including metal chips inside the actuator after cutting a knockout and after connecting the wires.

● **To keep NEMA 4X, Type 4 Enclosure, and IEC IP54 protection**

In order to maintain NEMA 4X, Type 4 Enclosure, and IEC IP54 performance, use waterproof connectors etc. when the product is used in high humidity environment or outdoor.

- Close the terminal cover and top cover firmly. (Screw tightening torque: 7.08 lbf•in (0.8 Nm))
- Apply a waterproofing treatment for the knockout holes. (In order to satisfy the Type 4 Enclosure requirements, use the UL listed conduit fittings that are equivalent to Type 4 or more stringent.)
- Use waterproof connectors to pull out the cables.
Select suitable connectors from the table below according to diameter of the cables.
- If cables are connected by cable glands, use waterproof plica tubes etc.

| Model number | Applicable cables |
|--|---|
| 83104346-003 | 0.28" Dia. to 0.35" Dia. (7 mm Dia. to 9 mm Dia.) |
| 83104346-004 | 0.35" Dia. to 0.43" Dia. (9 mm Dia. to 11 mm Dia.) |
| 83104346-005 | 0.43" Dia. to 0.51" Dia. (11 mm Dia. to 13 mm Dia.) |
| 83104098-001 (Pipe-insertion type temperature sensor) | 0.16" Dia. to 0.24" Dia. (4 mm Dia. to 6 mm Dia.) |

● **Wiring procedure**

- 1) To lead the wires into the terminals, open a knockout for a wiring port. Two knockouts are provided on the bilateral sides of the actuator terminals. Select a knockout according to the conduit mounting direction, and open the hole by lightly knocking the knockout using a screwdriver.
- 2) Unscrew the 3 setscrews (M4 × 10) of the terminal cover and remove the terminal cover, as shown in Fig. 9.

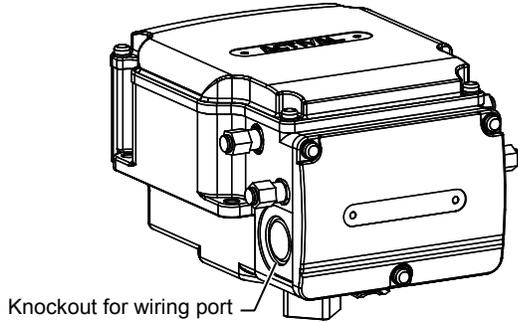


Figure 8. Knockout for wiring port

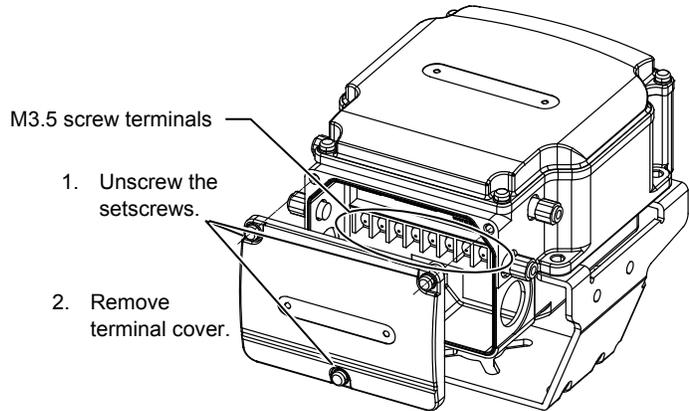


Figure 9. Terminal cover removal

- 3) Refer to Figs. 3 and 10 and correctly connect the wires to the M3.5 screw terminals. Note that the wires of the temperature sensor, Display Panel, and RS-485 communication lines are connected to the connectors.

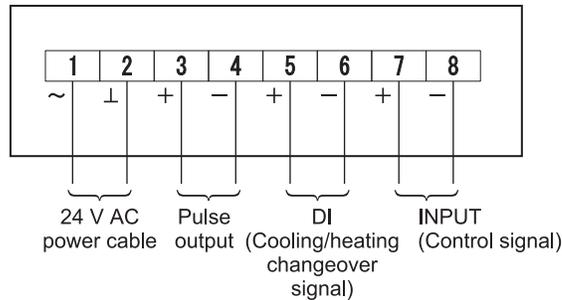


Figure 10. Terminals arrangement

- 4) Separate the power supply line from the signal lines. Do not lead the power supply line through the wiring port (knockout) for the signal lines since the power supply line may generate noise causing operation error and failure.
- 5) Connect the wires of each line. After connecting the wires, lightly pull them from the wiring ports so that minimum wire slack remains inside the actuator. Too long wire slack inside the actuator may block the terminal cover to close or may hold down the reset switch and interrupt the operation. See Fig. 3 for the location of the reset switch.

- 6) Tighten the seal connectors of the wiring ports. On the wiring ports for Display Panel cable and temperature sensor (Pt100 input) cable, tighten the seal connectors until the clearance between the wiring port and the seal connector becomes narrower than 0.04" (1 mm). Cable may get twisted as you tighten the seal connector. In such a case, loosen and remove the seal connector and untwist the cable, then re-tighten the seal connector.

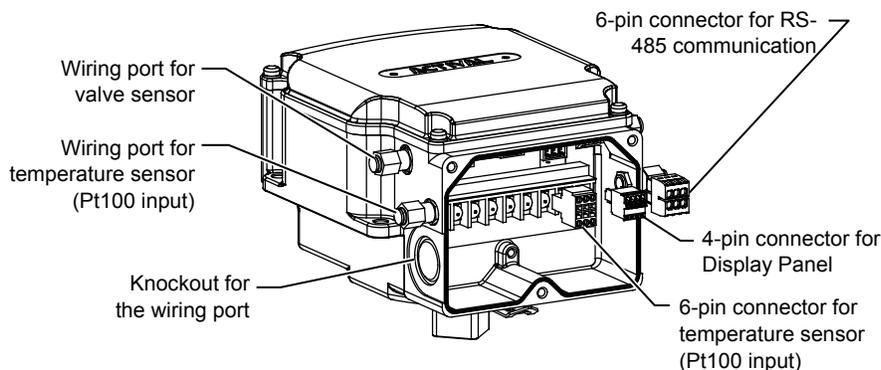


Figure 11. Connectors for the temperature sensor, Display Panel, and RS-485 communication

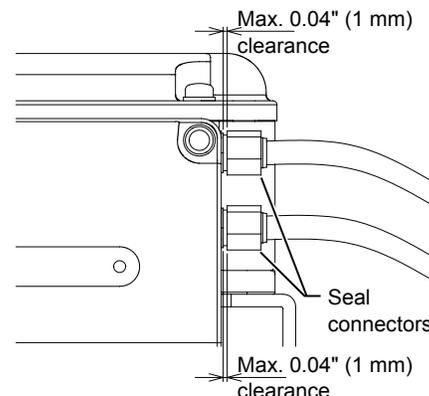


Figure 12. Clearance for seal connector connection

● Wires connection of the temperature sensor (Pt100 input)

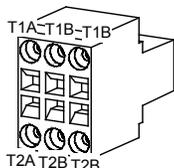


Figure 13. 6-pin connector for temperature sensor (Pt100 input)

| Terminal | Wire color* | | Description |
|----------|-------------------------------------|--|------------------------------------|
| | Temperature sensor for pipe surface | Insertion-type pipe temperature sensor | |
| T1A | Red | Red | Pt100 A (supply water temperature) |
| T1B | White | Black | Pt100 B (supply water temperature) |
| T1B | White | White | Pt100 B (supply water temperature) |
| T2A | Red | Red | Pt100 A (return water temperature) |
| T2B | White | Black | Pt100 B (return water temperature) |
| T2B | White | White | Pt100 B (return water temperature) |

Note: * Wire color of the insertion-type pipe temperature sensor shown in the above table is the wire colors of the recommended cable.

- 1) Pass the 3-core cable of the temperature sensor (Temperature sensor for pipe surface/Insertion-type pipe temperature sensor) through the actuator port for the temperature sensor (Pt100 input). (See Fig. 3 for the location of the port.) Use AWG 18–22 x 3-core cable or equivalent for the insertion-type pipe temperature sensor.

- 2) Strip the wire sheath. Strip length is 0.28" (7 mm) (See Fig. 14.)

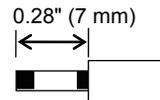


Figure 14. Wire sheath strip length

- 3) Unplug the 6-pin connector for temperature sensor (Pt100 input) from the actuator socket, and connect the sheath stripped wires (3-core cable of the temperature sensor (Pt100 input)) to the connector. Insert a slotted screwdriver (with 0.1" x 0.02" (2.5 x 0.4 mm) blade tip) into a square hole of the connector for clamp release. The screwdriver successfully releasing the clamp remains the inserted position. Insert the stripped wire into a circular hole (terminal), and then pull out the screwdriver. Make sure that all the wires are completely connected by lightly pulling the wires.

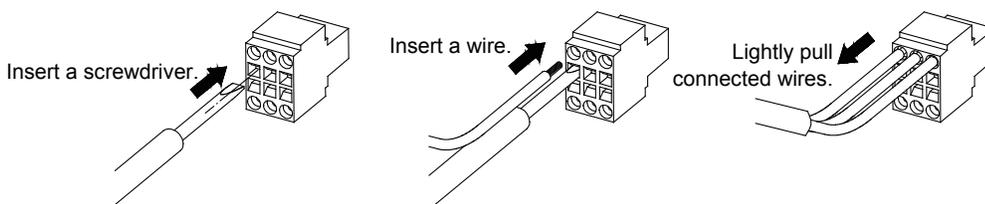


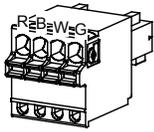
Figure 15. Wires connection to the 6-pin connector for the temperature sensor

- 4) Plug the connector into the actuator socket.

Note:

Completely plug the connector into the actuator socket. Incompletely plugged connector might become unplugged due to vibration.

● Wires connection of Display Panel



R: RED
B: BLK
W: WHT
G: GRN

| Terminal | Wire color* | Description |
|----------|-------------|-------------|
| RED | Red | 12 V DC |
| BLK | Black | 0 V |
| WHT | White | AP-bus (+) |
| GRN | Green | AP-bus (-) |

Figure 16. 4-pin connector for Display Panel

Note: * Wire color of the Display Panel shown in the above table is the wire colors of the recommended cable.

- 1) Pass the 4-core cable of Display Panel through the actuator port for Display Panel. (See Fig. 3 for the location of the port.)
- 2) Strip the wire sheath. Strip length is 0.31" (8 mm). (See Fig. 14.)
- 3) Unplug the 4-pin connector for Display Panel from the actuator socket, and connect the sheath stripped wires to the connector. Hold down a clamp release button using a slotted screwdriver, insert the stripped wire into a terminal, and then release the button. Make sure that all the wires are completely connected by lightly pulling out the wires.

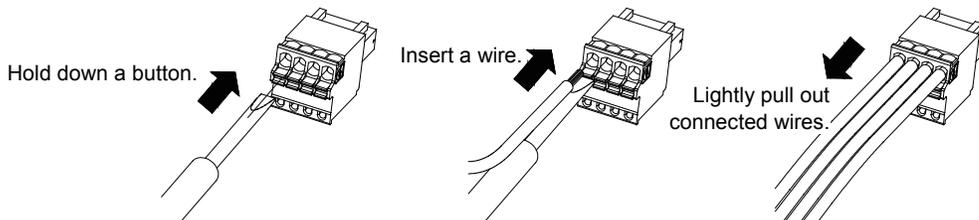


Figure 17. Wires connection to the 4-pin connector for Display Panel

- 4) Plug the connector into the actuator socket.

Note:

Completely plug the connector into the actuator socket. Incompletely plugged connector might become unplugged due to vibration.

● Wires connection of RS-485 communication

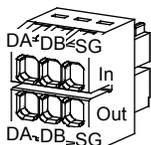


Figure 18. 6-pin connector for RS-485 communication

| Terminal | Description |
|----------|-------------|
| In DA | DA |
| In DB | DB |
| In SG | SG |
| Out DA | DA |
| Out DB | DB |
| Out SG | SG |

- 1) Pass the cable of RS-485 communication through the actuator wiring port (knockout).
- 2) Strip the wire sheath. Strip length is 0.28" (7 mm).
- 3) Unplug the 6-pin connector for RS-485 communication from the actuator socket, and connect the sheath stripped wires to the connector. Insert a slotted screwdriver (with 0.1" x 0.02" (2.5 x 0.4 mm) blade tip) into a pocket on the top/bottom of the connector for clamp release. The screwdriver successfully releasing the clamp remains the inserted position. Insert the stripped wire into a terminal, and then pull out the screwdriver. Make sure that all the wires are completely connected by lightly pulling out the wires.

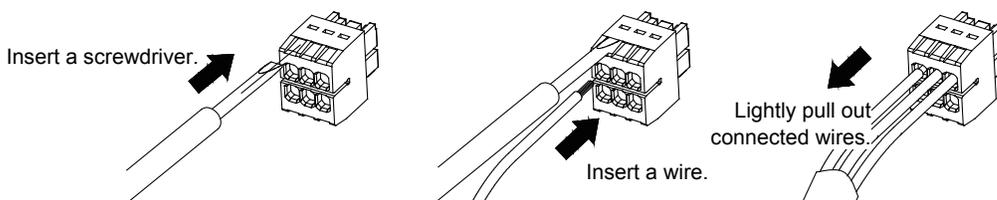


Figure 19. Wires connection to the 6-pin connector for RS-485 communication

- 4) Plug the connector into the actuator socket.

Note:

Completely plug the connector into the actuator socket. Incompletely plugged connector might become unplugged due to vibration.

● **Wires connection of control signal, DI (Cooling/heating switch signal), pulse output**

- 1) Pass the cable of control signal/DI/pulse output through a wiring port on the other side of the port for power supply cable.
- 2) Use 4- or 6-core cable for connecting the wires of the multiple signal lines.

● **Precautions for connection**

1. RS-485 communication (See Figs. 25 and 26.):
 - Connect the wires of RS-485 communication cable to the connector unplugged from the actuator socket. After connecting the wires to the connector, plug the connector into the socket.
 - Do not use terminators.
 - Do not connect between the terminals DA and DB.
 - Single-point ground is required for one side of the shielded cable.
 - Connect SG wire for stable communication link.
 - To daisy-chain the communication line, connect the wires of the receiving line to the terminals In DA, In DB, and In SG. Connect the wires of the sending line to the terminals Out DA, Out DB, and Out SG.
2. Pulse output (See Figs. 27 and 28.):
 - Apply 30 V DC or lower voltage (on '+V' shown in Fig. 27).
 - Do not directly connect the DC power to the pulse output terminal.
 - To use a magnetic counter with a relay coil, refer to Fig. 28 and connect a protection diode to the input of the magnetic counter.
3. Temperature sensor for pipe surface:
 Since the 3-core cable of the temperature sensor for pipe surface has small diameter, the seal connector pre-assembled with the product is not enough to ensure the NEMA 4X, IEC IP54 protection. Caulk the seal connector or apply the tape to seal the connector.
4. Insertion-type pipe temperature sensor:
 Use the seal connector Part No. 83104098-001 for the cable of the insertion-type pipe temperature sensor (AWG 18–22 x 3-core or equivalent.)
5. Internal isolation:
 Only the pulse output and the RS-485 communication are internally isolated. Isolator therefore is required to connect a non-isolated device to the control signal input and DI (Cooling/heating switch signal) of the product.

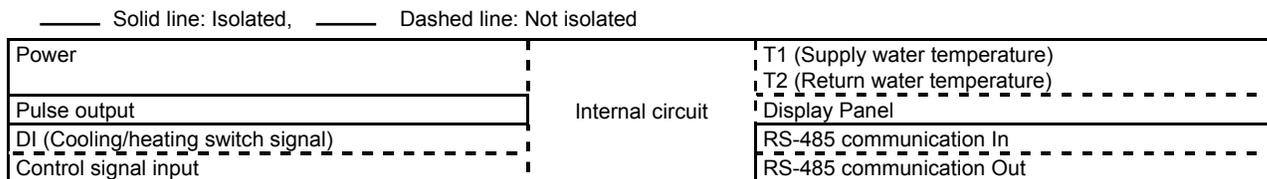


Figure 20. Internal isolation

6. Single transformer with two products (See Fig. 21.):
 Connect the lines from the terminal 1 of each product to the transformer with the same polarity. Connect the lines from the terminal 2 of each product the same way. If the terminals (of the product and the transformer) with different polarities are connected, the products may get damaged.

7. Single controller with multiple 4 to 20 mA input type products (See Figs. 22 and 23.):
 4 to 20 mA control signal input is not isolated from the power, and the 4 to 20 mA input impedance is 250 Ω. For connecting a controller, the relations among the input impedance of this product, the output load resistance of the controller, and the output load resistance and input impedance of an isolator (if necessary) must meet the following formula.

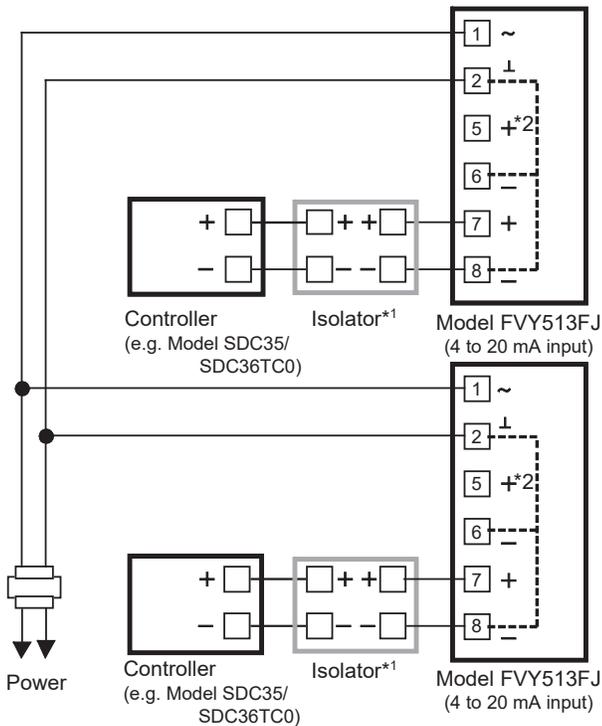
$$\text{Applicable load resistance} > \text{Total input impedance}$$

To operate the two products with a single controller for example, refer to Fig. 22 for the two products powered by a single transformer, and refer to Fig. 23 for the two products separately powered by the two transformers. To connect a single transformer, be sure to connect an isolator to the 4 to 20 mA input terminal of the second product. The products will malfunction without the isolator.

8. Single controller with multiple 2 to 10 V input type products (See Figs. 24.):
 2–10 V control signal input is not isolated from the power.

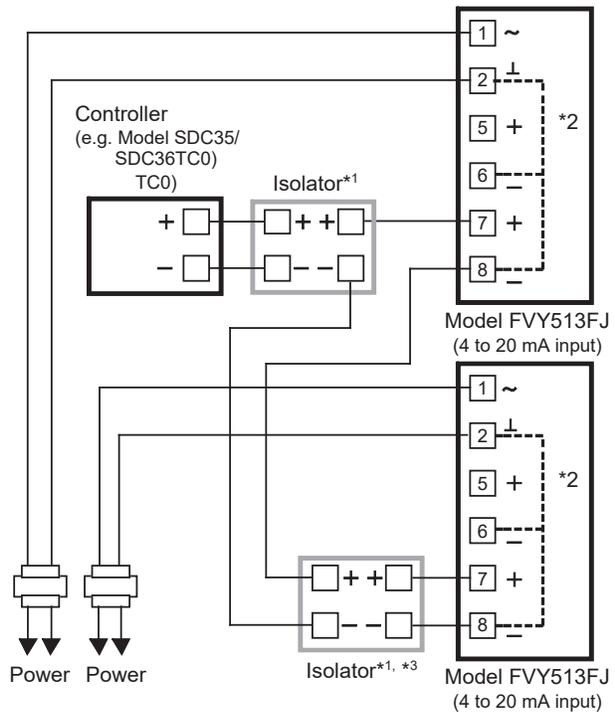
To operate the two products with a single controller for example, the two products must be powered by a single transformer.

● Connection examples



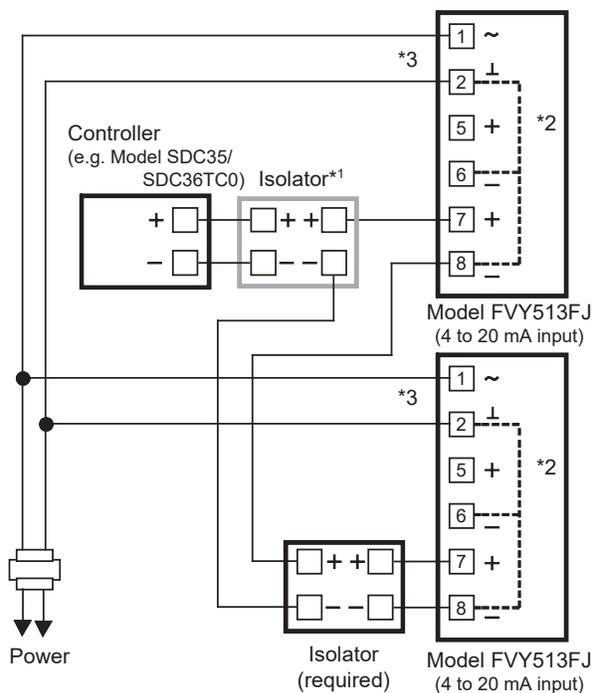
- Notes:
- *1 Provide an isolator for the controller not internally isolated.
 - *2 Terminals 2, 6, and 8 of the product are internally connected.

Figure 21. Connection example: Two Model FVY513FJ with a single transformer



- Notes:
- *1 Provide an isolator for the controller not internally isolated.
 - *2 Terminals 2, 6, and 8 of the product are internally connected.
 - *3 - No isolator provided for the 4 to 20 mA input of the first product
 - Less than 500 Ω applicable load resistance of the controller
 Provide an isolator for the second product if both of the above conditions fit your connection.

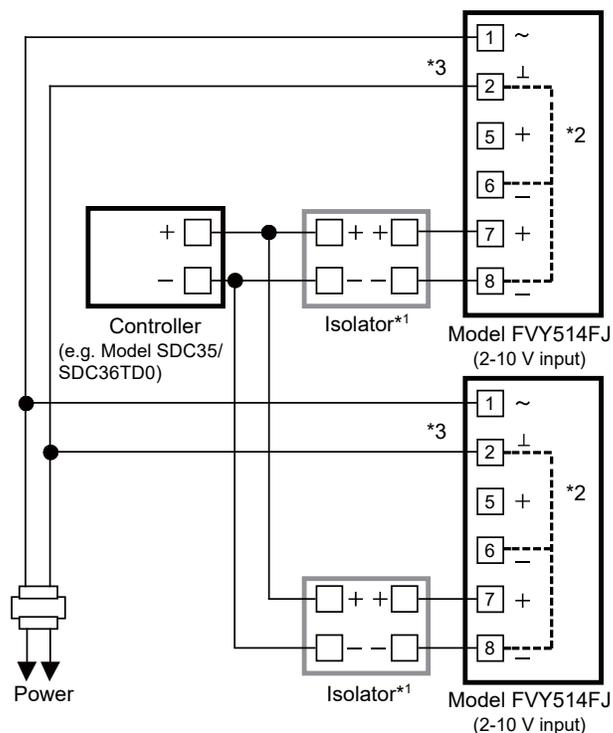
Figure 22. Connection example: Two Model FVY513FJ with a single controller and two transformers for each Model FVY513FJ



Notes:

- *1 Provide an isolator for the controller not internally isolated.
- *2 Terminals 2, 6, and 8 of the product are internally connected.
- *3 Refer to **6. Single transformer with two products in the Precautions for connection** section.

Figure 23. Connection example: Two Model FVY513FJ with a single controller and a single transformer



Notes:

- *1 Provide an isolator for the controller not internally isolated.
- *2 Terminals 2, 6, and 8 of the product are internally connected.
- *3 Refer to **6. Single transformer with two products in the Precautions for connection** section.

Figure 24. Connection example: Two Model FVY514FJ with a single controller

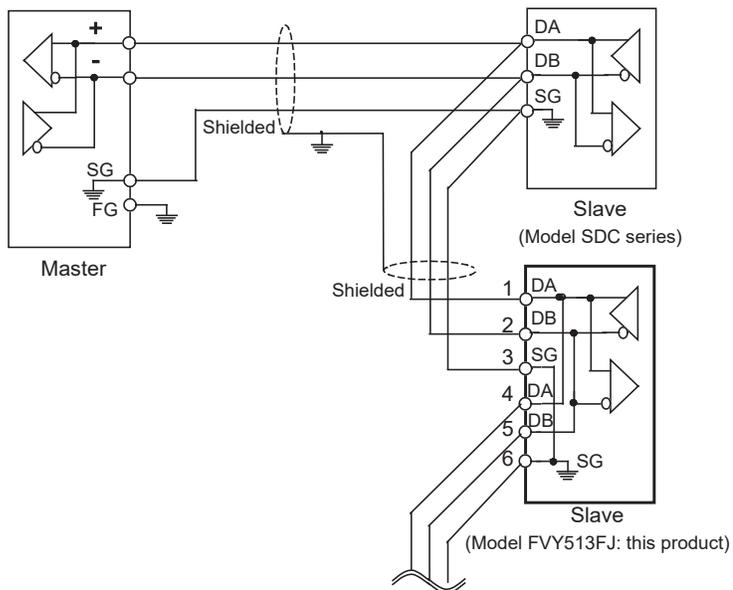


Figure 25. Connection example: 3-wire RS-485 communication

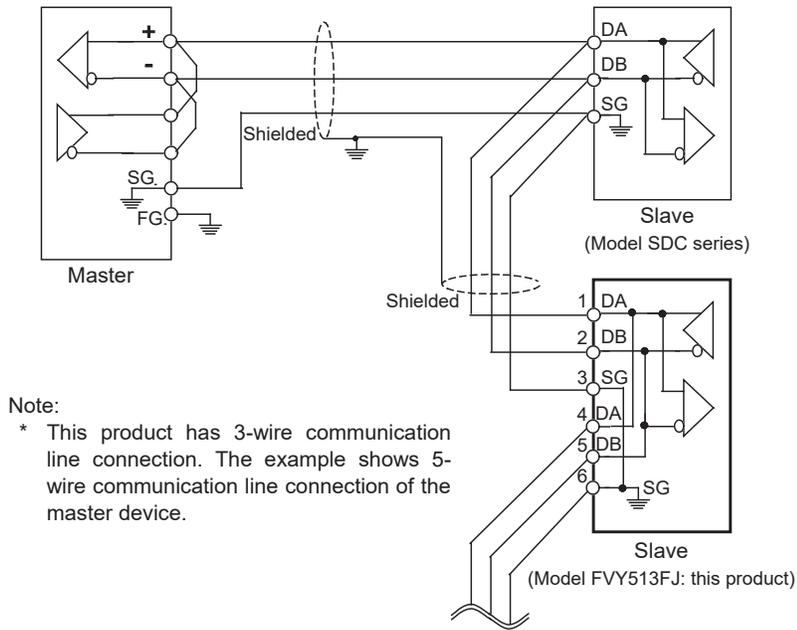


Figure 26. Connection example: 5-wire RS-485 communication

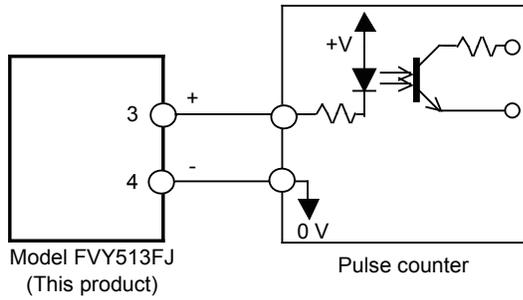


Figure 27. Connection example: Totalizing pulse output (open collector output)

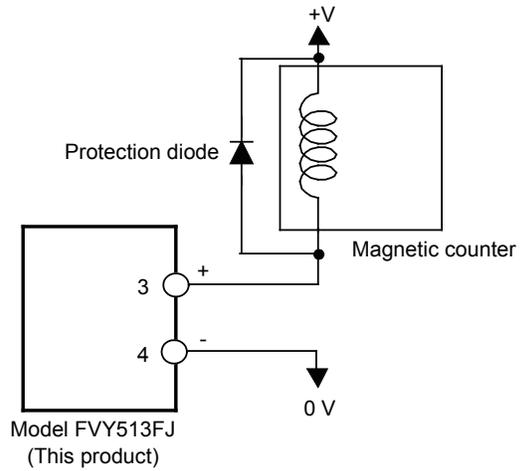


Figure 28. Connection example: Magnetic counter with relay coil

■ Inspection and Troubleshooting

|  CAUTION | |
|---|---|
|  | Do not put a load or weight on this product. Doing so may damage the product. |
|  | Before doing maintenance, be sure to turn off the power to this product. Failure to do so may result in electric shock or device failure. |
|  | After maintenance, be sure to reattach the terminal cover. Failure to do so may result in electric shock. |
|  | Do not carelessly touch this product when it is used to control hot water. Doing so may result in burns, because the product reaches a high temperature. |

- Inspect the product according to Table 1.
- Be sure to check the flow measuring accuracy according to Flow measuring accuracy in Table 1. Flow measuring accuracy is very essential for this product used for energy management, energy-saving application, etc. (To inspect flow measuring accuracy, optional Display Panel is required.)
- Manually open/close the product at least once a month if it is left in inactive state for a long period.
- Visually inspect the fluid leakage of the valve and the actuator operations every six months. If any of the problems described in **AB-7497-U Instruction Manual of ACTIVAL + Standalone Model (Chapter 4. Troubleshooting)** are found, take corresponding actions shown in that manual.
If your problem is not solved by the corresponding action, please contact our salesperson/serviceperson.

Table 1. Inspection items and details

| Inspection item | Inspection interval | Inspection detail |
|---------------------------|---------------------|---|
| Visual inspection | Semiannual | <ul style="list-style-type: none"> • Fluid leakage from the gland and the flange face • Loosened bolts • Valve and actuator damages |
| Operating status | Semiannual | <ul style="list-style-type: none"> • Unstable open/close operation • Abnormal noise and vibration • Abnormal differential pressure across valve (Pvin-Pvout) in fully closed/open position. |
| Routine inspection | Any time | <ul style="list-style-type: none"> • Fluid leakage to the outside • Abnormal noise and vibration • Unstable open/close operation • Valve hunting |
| Flow measuring accuracy*1 | Any time (annual) | <ul style="list-style-type: none"> • Measuring accuracy of differential pressure across valve: Measure the valve inlet pressure and outlet pressure when they are equal and check the values measured by the valve sensor. If difference of the values is ± 0.44 psig, flow measuring accuracy satisfies the factory preset accuracy. Situation of inlet pressure equal to outlet pressure → No flow across the valve in open position e.g, when supply pump is OFF, or when hand valves on the inflow and/or outflow sides of the valve are/is fully closed. • Valve position detecting accuracy: Select the position control*2, and check the position of the actuator pointer when 50 % position signal is input. If the pointer points out of 0.39" (1 cm) range from the 50 % scale (the center of the lower setscrew of the terminal cover), product replacement is required. See Fig. 34. |

Notes:

*1 Simplified inspection of flow measuring accuracy is illustrated above. For accurate inspection, a reference flow meter is required. Note that you cannot field-calibrate or field-adjust flow measuring accuracy.

*2 To select the position control, refer to **AB-7497-U Instruction Manual of ACTIVAL + Standalone Model**.

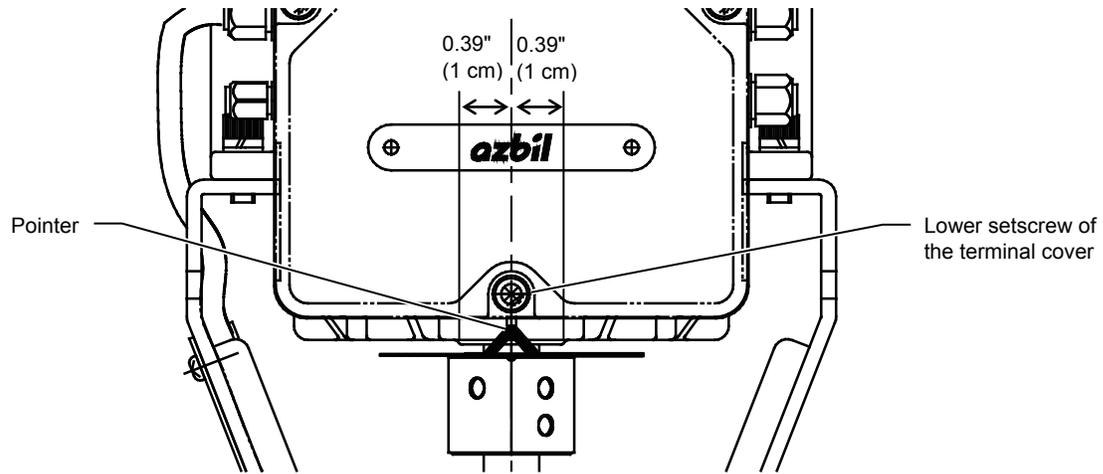


Figure 29. Check of the valve position detecting accuracy

■ Disposal

Dispose of this product as industrial waste in accordance with your local regulations.

Do not reuse all or any part of the product.

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This product complies with the following harmonised standards of the Electromagnetic Compatibility Directive (EMCD) and the Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment Directive (RoHSD).

EMCD: EN 61000-6-2

EN 61000-6-4

RoHSD: EN 50581

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