Fujikin

*FINE series PURE®*

*Flow Control System*

# FCS® Pressure Series

# Towards the New Horizon

Fujikin's FCS® (Flow Control System) Series
leads the way in flow control technology.

- *Fluctuations in the supply pressure have little effect on the control flow rate.*
- *Quick response time of 0.5 msec or less.*
- *Equipped with the Multi Gas / Multi Range (MGMR) function.*
- *Can be mounted in any attitude or position.*
  *(Free mounting position)*
- *Incorporates flow rate self-diagnosis function.*


Developed to enhance stability and repeatability during etch and deposition, the most critical steps in semiconductor wafer manufacturing, the FCS® differs dramatically from conventional mass flow controllers (MFC) in its very theory of operation.

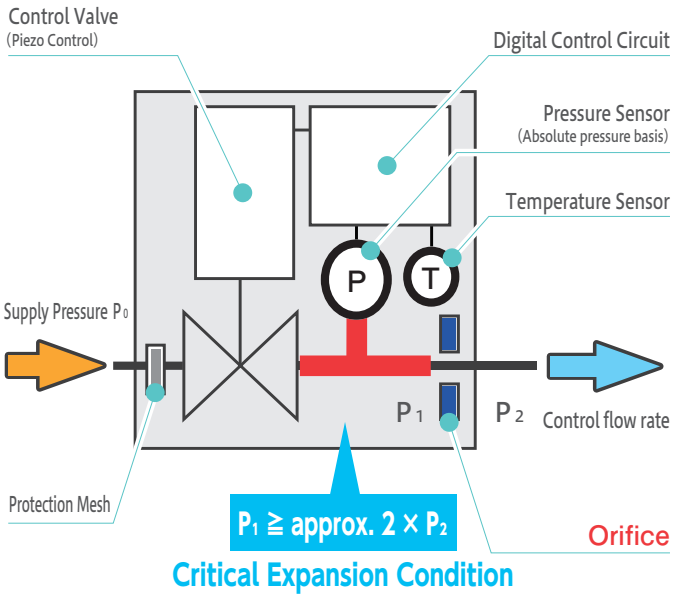
By developing the FCS® around non-conventional methods, highly accurate flow control is achieved – accuracy that is impossible to achieve with traditional pressure-based MFCs.

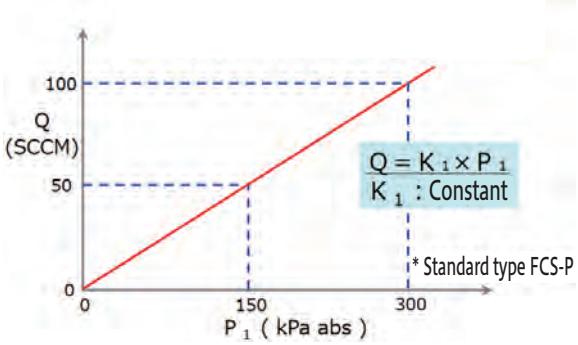
The FCS® overcomes unstable process variations such as pressure fluctuations (hunting) and crosstalk in gas supply systems and provides an unlimited amount of flow control stability.

In addition, the high accuracy of the FCS® matches the state-of-the-art in semiconductor manufacturing and is therefore one of the FCS®'s most appealing features.

The FCS® promises the highest level of performance.

## Basic Structure and Operating Principle of FCS®



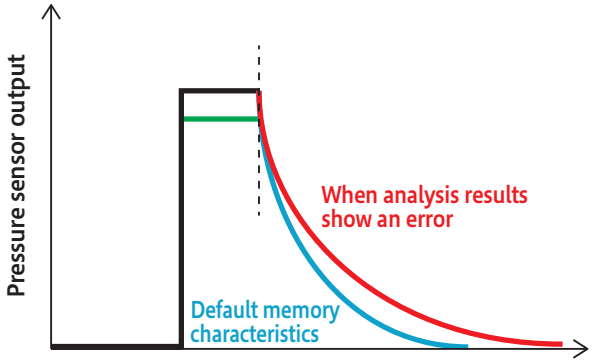

When orifice downstream pressure $P_2$ is 1 kPa or less

$P_1$ = 2 kPa abs. → Flow rate: 10 SCCM
$P_1$ = 20 kPa abs. → Flow rate: 100 SCCM
$P_1$ = 200 kPa abs. → Flow rate:1000 SCCM

## Flow Rate Self-diagnosis Function

Memorizes pressure drop characteristics. ▶ Compares with the normal state (default values). ▶ Analyzes failures and estimates the cause of failure.

**Pressure Drop Characteristics.**




### Default Memory

After the control flow rate is set to the specified value by the FCS-P itself, the control valve is closed, and the characteristics between the pressure sensor output and time are saved in the CPU. (The initial reference characteristics memory: $N_2$ gas is the default.)

### Flow Rate Self Diagnosis

When the gas used in the default memory is flown, the FCS-P is triggered by the flow rate diagnosis start signal and starts adjusting the control flow rate to the specified value. Then the control valve is closed, the characteristics between the pressure sensor output and time are compared with the default memory characteristics, and diagnosis results are obtained.

**If an error is detected in the diagnosis results, an alarm ("diagnosis result error") is issued.**

For example, if there is a clogging, the diagnosis result shows positive.

# FCSP7300 series


- **Possible to monitor the supply pressure based on the response time!**
- **Response time is 500 mm/sec or less!**
- **Multi Gas / Multi Range (MGMR) supported!**

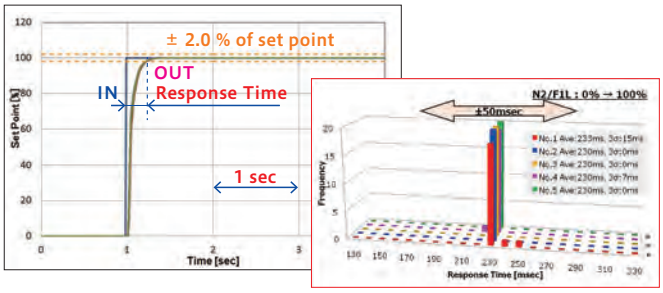
## General Specifications

| | |
|---|---|
| Flow Rate Range ($N_2$ Equivalent) | 10 SCCM – 4 SLM |
| Flow Rate Accuracy | ≦ ±1.0% S.P. (Setting signal: 10 to 100% [when controlling differential pressure: 10 to 19.7%]) |
| | ≦ ±0.1% F.S. (Setting signal: 1 to 10% [when controlling differential pressure: 4 to 10%]) |
| Response Time ($N_2$)* | ≦500 msec |
| Supply Pressure (F.S. Flow Rate) | 250 – 898.7 kPaG |
| Downstream Pressure | ≦200 Torr |
| Permissible Operating Temperature Range | 0 – 50 °C |
| Communication System | DeviceNet™, EtherCAT® |

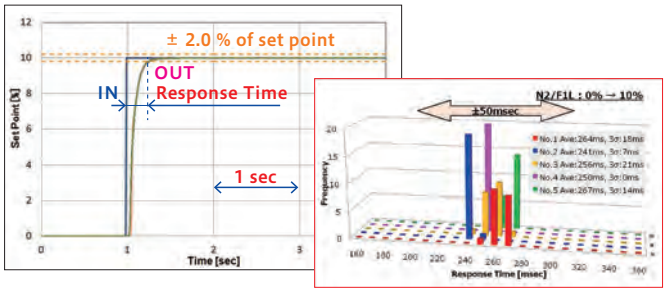
* Within 500 msec to reach to ±2.0% of the setting value (Setting value: 10 to 100%)
Note 1: Flow rates (SCCM, SLM) are converted to values at 0°C and 101.3 kPa abs (1 atm) for calibration.
Note 2: Supported ranges and usable gases are limited. Check each time as required.
Note 3: When using RS485, please contact Fujikin.

## Response Time

N2 gas/1,000 SCCM F.S.: 0% ⇒ 100% response waveform

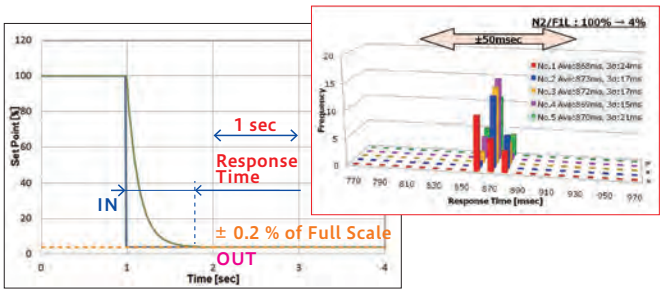



N2 gas/1,000 SCCM F.S.: 0% ⇒ 10 % response waveform




**Within ±50 msec of actual value, variation (3σ)**

N2 gas/1,000 SCCM F.S.: 100 % ⇒ 4 % response waveform




## Flow Rate Range
### (N2 Equivalent)

- Multi Gas / Multi Range (MGMR) supported (Full scale flow rate turn-down: 50%)
- Flow rate range (BIN): Total 9 types / Full scale flow rate 10 SCCM to 4 SLM [N2 equivalent])

| Bin Size | N2 | Flow Rate Range |
|---|---|---|
| Bin1 | 10 – 20 SCCM | 10 SCCM, 20 SCCM |
| Bin2 | 21 – 40 SCCM | 30 SCCM, 40 SCCM |
| Bin3 | 41 – 80 SCCM | 43 SCCM, 50 SCCM, 65 SCCM, 80 SCCM |
| Bin4 | 81 – 160 SCCM | 100 SCCM, 110 SCCM, 130 SCCM, 160 SCCM |
| Bin5 | 161 – 300 SCCM | 200 SCCM, 210 SCCM, 260 SCCM, 300 SCCM |
| Bin6 | 301 – 600 SCCM | 400 SCCM, 450 SCCM, 500 SCCM, 600 SCCM |
| Bin7 | 601 – 1000 SCCM | 850 SCCM, 1000 SCCM |
| Bin8 | 1001 – 2000 SCCM | 1300 SCCM, 1600 SCCM, 2000 SCCM |
| Bin9 | 2001 – 4000 SCCM | 2400 SCCM, 3000 SCCM, 4000 SCCM |

# Ultra Compact
# FCS-P


- *Achieves the width of 10.2mm and supports the increase in the number of gas systems.*
- *Flow rate accuracy: ±1.0 % S.P. (Multi Gas / Multi Range)*
- *Response time is 500 msec or less!*

## General Specifications

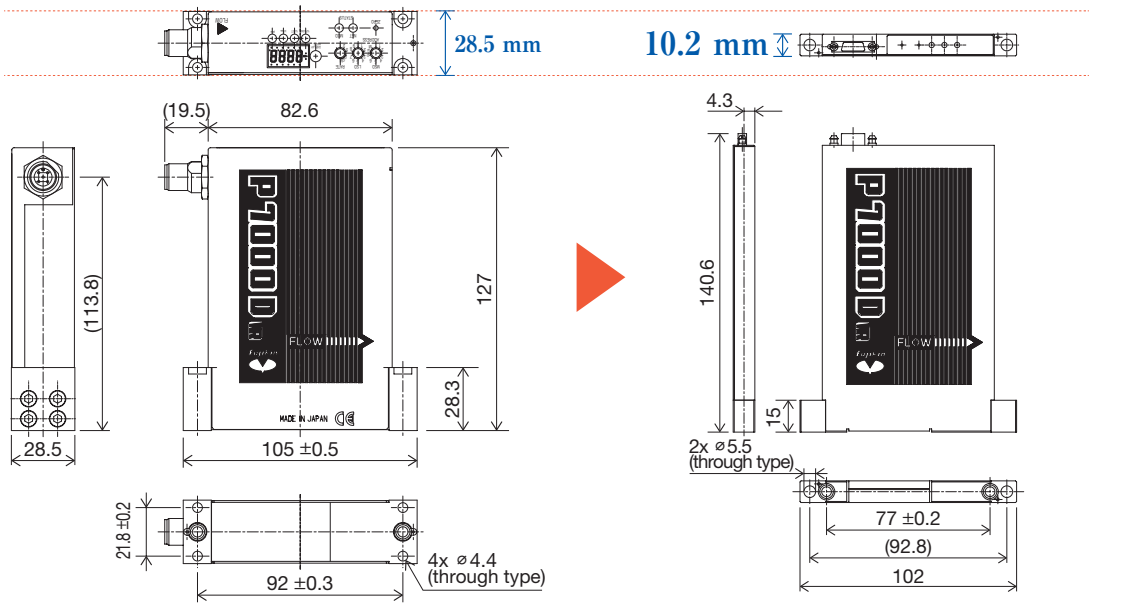
| | | |
|---|---|---|
| Flow Rate Range ($N_2$ Equivalent) | | 10 – 1300 SCCM |
| Flow Rate Accuracy | Standard Type | ≦ ±1.0% S.P. (Setting signal: 10 to 100% [when controlling differential pressure: 10 to 19.7%]) |
| | | ≦ ±0.1% F.S. (Setting signal: 1 to 10% [when controlling differential pressure: 4 to 10%]) |
| | Low Pressure (B) Type | ≦ ±1.0% S.P. (Setting signal: 20 to 100% [when controlling differential pressure: 20 to 45.1%]) |
| | | ≦ ±0.2 % F.S. (Setting signal: 2 to 20 % [when controlling differential pressure: 10 to 20%]) |
| Response Time ($N_2$ rising characteristics)* | | ≦500 msec |
| Supply Pressure (F.S. Flow Rate) | Standard Type | 250 – 898.7 kPaG |
| | Low Pressure (B) Type | 50 – 898.7 kPaG |
| Downstream Pressure | | ≦200 Torr |
| Permissible Operating Temperature Range | | 0 – 50 °C |
| Communication System | | DeviceNet™, EtherCAT® |

* Within 500 msec up to ±2% S.P. of the setting value or ±0.2% F.S. (whichever is larger).
Note 1: Flow rates (SCCM, SLM) are converted to values at 0°C and 101.3 kPa abs (1 atm) for calibration.

## Size Comparison

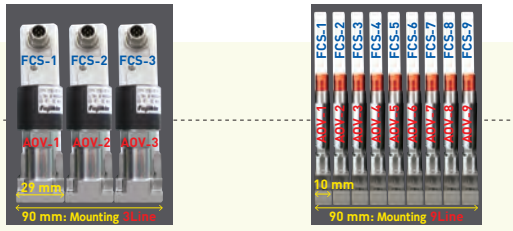
Conventional product — 1.125 inch FCS® [P7300series]

Ultra compact — 2/5(0.4) inch FCS® [Ultra Compact FCS-P]




### Comparison of Mounted Gas Lines

The compact FCS-P has
**three times larger number of gas lines**
compared with the conventional 1.125-inch FCS®.

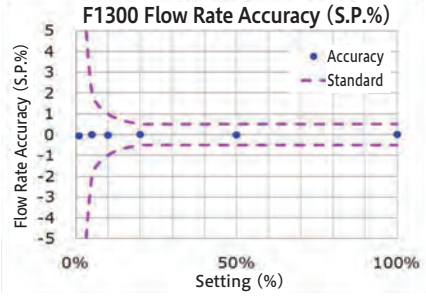



1.125 inch FCS® — 3 LINE

Ultra Compact FCS-P — 9 LINE

## Flow Rate Accuracy

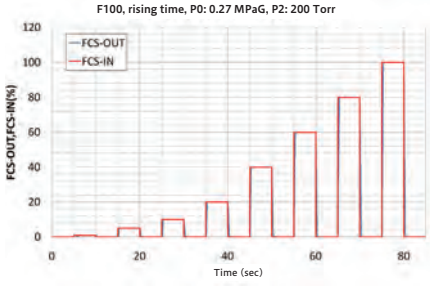
F1300 Flow Rate Accuracy (S.P.%)



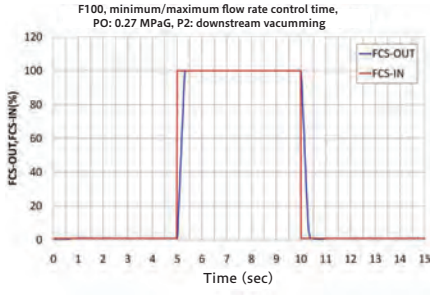

Flow rate accuracy specifications:
Within ±0.5% S.P. (Setting signal: 20 to 100%)
Within ±0.1% F.S. (Setting signal: 1 to 20 %)
Setting signal: 1 %, 5 %, 10 %, 20 %, 50 %, 100 %

## Response Time

F100, rising time, P0: 0.27 MPaG, P2: 200 Torr




F100, minimum/maximum flow rate control time, PO: 0.27 MPaG, P2: downstream vacumming



# FCSP8000 series

2021
18th Cho-Monodzukuri Grand Award for Parts Machinery & Robot Component Award


- ***Range ability: 1000:1***
- ***Guarantees the flow rate accuracy of ±1.0% S.P.!***

## General Specifications

| | |
|---|---|
| Flow Rate Range ($N_2$ Equivalent) | 3.3 SCCM – 3.2 SLM |
| | [Small flow rate range: 3.3 to 160 SCCM, Large flow rate range: 160 SCCM to 3.2 SLM] |
| Flow Rate Accuracy | ≦±1.0 % S.P. (8 SCCM – 3.2 SLM) |
| | ≦±0.1 % F.S. (3.3 – 8 SCCM) |
| Response Time ($N_2$ rising characteristics)* | ≦ 0.5 sec (≦ 2.0 sec 5% F.S. or less) |
| Response Time ($N_2$ falling characteristics)* | ≦ 1.0 sec (5 to 100% F.S.) ≦ 2.0 sec (less than 5% F.S.) |
| Supply Pressure (F.S. Flow Rate) | 250 – 898.7 kPaG |
| Downstream Pressure | ≦400 Torr |
| Permissible Operating Temperature Range | 0 – 50 °C |
| Communication System | DeviceNet™ |

* Within 0.5 sec up to ±2% S.P. of the setting value or ±0.05 % F.S. (whichever is larger).
Note 1: Flow rates (SCCM, SLM) are converted to values at 0°C and 101.3 kPa abs (1 atm) for calibration.

# Auto Pressure Controller

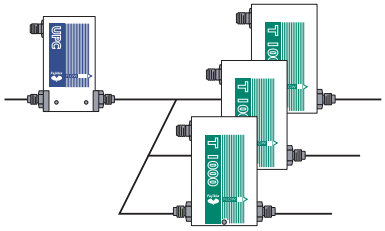

## Operating Principle

The UPC® Series controllers keep the pressure constant using a built-in pressure sensor.

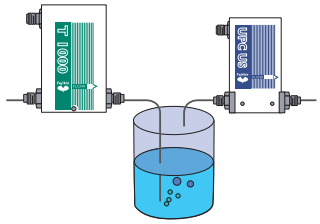
## Application

- Any pressure can be set using an electrical signal.
- Connecting a UPC® Series controller to the upstream side of a Mass Flow Controller (MFC) makes extremely stable flow control possible.
- When two or more MFCs are connected in one line and a rapid change in gas flow rate occurs on one of them, the other MFCs may sometimes be affected.
  This can be prevented by using a UPC® Series controller (downstream pressure controller).
- The UPCUS® (upstream pressure controller) keeps constant the internal pressure of the liquid source tank of an MO-CVD system, for example, to improve the vaporization stability in amount of a liquid source.
- Can be used as a controller for cooling wafer rear surfaces.
- High temperature type (for max. 150 ° C and max. 250 ° C) and a model with a flow monitor are also available from the product lineup.

Pressure control of gas supply system



Internal pressure control of MO material source tank



## ⟨Part Number Designation⟩

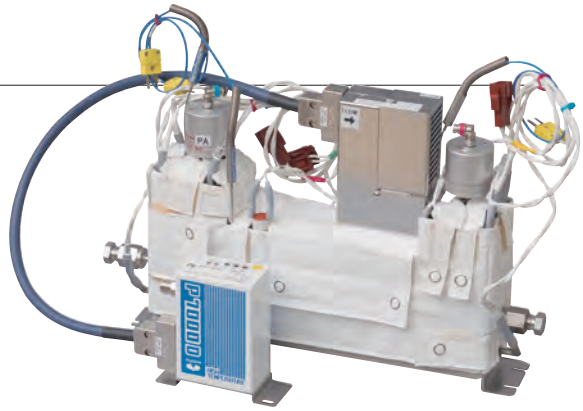
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| UPC | Analog I/O<br>Downstream pressure control | – | 4J2C | Face-to-face dimension: 124 mm<br>Piping height: 12.7 mm | – | C150 | Full scale pressure range: 150 kPa abs. | L | Control valve Cv value: 0.0055 |

## General Specifications

| Model Number | UPC® (Downstream pressure controller) | | UPCUS® (Upstream pressure controller) |
|---|---|---|---|
| Pressure Range | F.S. 13.3 kPa abs. (100 Torr) | F.S. 150/300/500 kPa abs. | |
| Control Pressure Range | 1 - 100 % | 1 - 100 % *1 | |
| Control Valve Cv Value | ——— | L type: 0.0055 / M Type: 0.011 / H Type: 0.03 | |
| Pressure Adjusting Accuracy (After auto zeroing) | 1 - 40 %: ±0.2 % F.S.<br>40 - 100 %: ±0.5 % S.P. | F.S.150 kPa abs. [1 - 40 %: ±0.2 % F.S., 40 - 100 %: ±0.5 % S.P.]<br>F.S.300/500 kPa abs. [1 - 20 %: ±0.1 % F.S., 20 - 100 %: ±0.5 % S.P.] | |
| Maximum Pressure | 200 kPaG | 1 MPaG | |
| Permissible Operating Temperature Range | 0 - 50 °C (Accuracy guaranteed temperature range: 15 – 35° C) *2 | | |
| Pressure Setting / Output Signal | Analog: 0.1 - 10 VDC/0 - 10 VDC (Supply power voltage: ±15 VDC)<br>Digital: DeviceNet™ | Analog: 0.05 – 5 VDC/0 – 5 VDC (Supply power voltage: ±15 VDC)<br>Digital: DeviceNet™ | |

*1: Control range: The pressure control range of the UPCUS® changes under different conditions. Please consult Fujikin for more information.
*2: Options available for temperature specifications of 50 °C. Please consult Fujikin for more information.

# FCS® & FALVS® for High Temperature Service

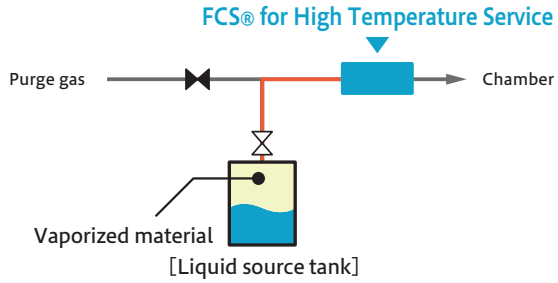


2015
12th Cho-Monodzukuri Grand Award for Parts
(Encouragement Award)

2011
6th Monodzukuri
(Shared Prize and Special Prize)

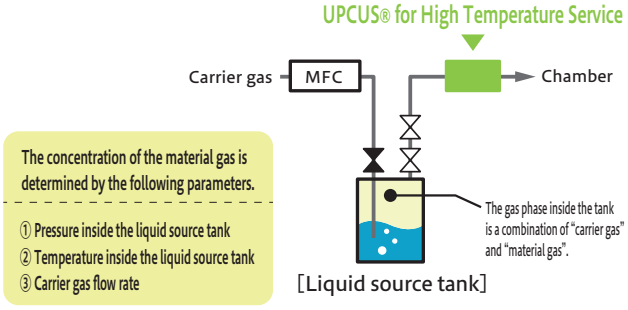
## FCS® for High Temperature Service

FCS® for High Temperature Service controls the flow rate of vapor generated in a tank.




## UPCUS® for High Temperature Service

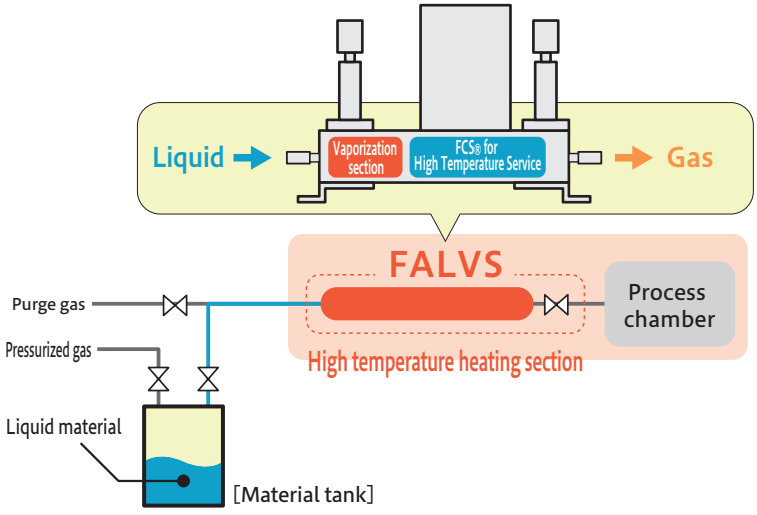
Used for bubbling supply and precisely controls the pressure inside the tank.




## FALVS®

The FALVS® (Fujikin Advance Liquid Vaporize System) is a system designed to vaporize a liquid material and to precisely control the vapor flow rate with the FCS® for High Temperature Service.

- **Vaporizes 100% at the vaporization section. The FCS® for High Temperature Service controls the flow rate of vaporized material.**
  - ・Prevents reliquefaction or solidification (precipitation) of material.
  - ・Particle free
- **Realizes no carrier gas.**
  - ・Reduces costs and environmental loads.
- **Achieves highly accurate flow control.**
  - ・Improved process reliability
  - ・Compact



# FFMS
## Flow Measurment System


- *Prevention of process problems!*
- *Checking repeatability of a mass flow controller!*

# IGS®

2005
Prime Minister's Prize
1st Monodzukuri Nippon Grand Awards
(Excellence Award)


- *Downsizing!*
- *Improved installation and maintenance workability!*

# Part Number Designation

## FCSP7302

**FCS P7302 D W2 L - T5 - 4CW2 - F300 / N2 - B5 D ****

FLOW CONTROL SYSTEM

① Series
- D: DeviceNet™
- E: EtherCAT®

② Communication
- W2: Wide range 200 Torr

③ Control range
- None: Provided
- L: Not provided

④ LCD display PO sensor
- None: 15 – 35 °C
- T5: 15 – 50 °C

⑤ Accuracy guaranteed temperature range
- 4CW2: 1.125, Wseal®
  Seal pitch: 92 mm
- 4CC2: 1.125, Cseal
  Seal pitch: 92 mm

⑥ Fitting type, face-to-face dimension or seal pitch
- F300: 300 SCCM
- F4L: 4 SLM

⑦ Full scale
- Chemical formula

⑧ Gas name
- B1: 10-20 SCCM
- B2: 21-40 SCCM
- B3: 41-80 SCCM
- B4: 81-160 SCCM
- B5: 161-300 SCCM
- B6: 301-600 SCCM
- B7: 601-1000 SCCM
- B8: 1001-2000 SCCM
- B9: 2001-4000 SCCM
- ($N_2$ Equivalent)

⑨ Bin No.
- D**:
- E**:

  Numerals are entered in "**".

⑩ Function

**FCS P7302 E W2 - 4TW1 - F20 B / N2 - B1 E ****

FLOW CONTROL SYSTEM

① Series
- E: EtherCAT®

② Communication
- W2: Wide range 200 Torr or less

③ Control range
- 4TW1: 10 mm, OneWseal®
  Seal pitch: 77 mm

④ Fitting type, face-to-face dimension or seal pitch
- F20: 20 SCCM
- FIL: 1 SLM

⑤ Full scale
- None: Standard Type
- B: Low Pressure Type

⑥ Pressure range
- Chemical formula

⑦ Gas name
- B1: 10-20 SCCM
- B2: 21-40 SCCM
- B3: 41-80 SCCM
- B4: 81-160 SCCM
- B5: 161-300 SCCM
- B6: 301-600 SCCM
- B7: 601-1000 SCCM
- ($N_2$ Equivalent)

⑧ Bin No.
- E**:

  Numerals are entered in "**".

⑩ Function

## FCSP8502

**FCS P8502 D W4 - 4CC2 - F3200 / N2 - D****

FLOW CONTROL SYSTEM

① Series
- D: DeviceNet™
- E: EtherCAT®

② Communication
- W4: Wide range 400 Torr

③ Control range
- None: 15 – 50 °C

④ Accuracy guaranteed temperature range
- 4CC2: 1.125, Cseal
  Seal pitch: 92 mm

⑤ Fitting type, face-to-face dimension or seal pitch
- F3200: 3200 SCCM
- F160: 160 SCCM

⑥ Full scale
- Chemical formula

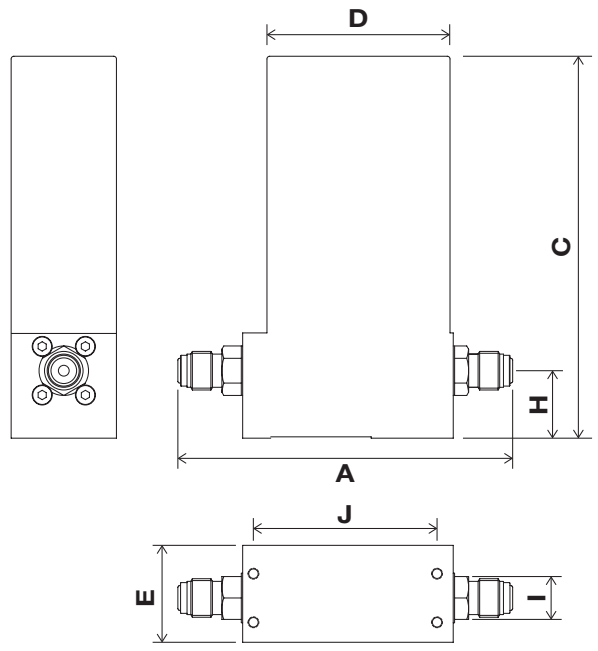
⑦ Gas name
- D**:
- E**:

  Numerals are entered in "**".

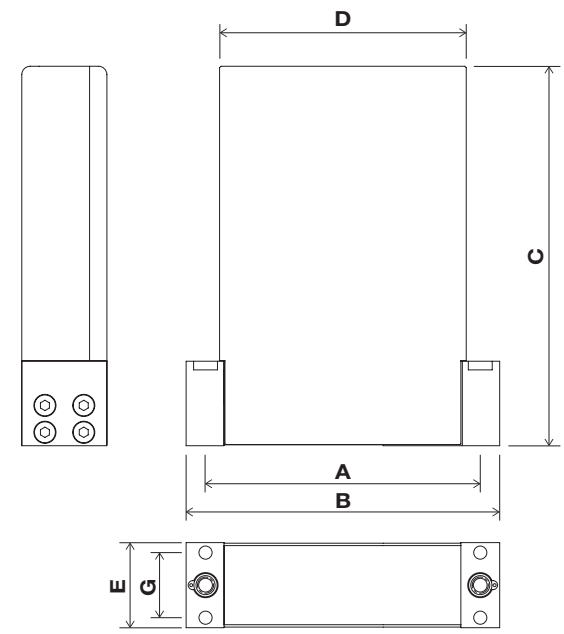
⑧ Function

# Dimensions

**Connection: UJR Type**




**Connection: Wseal®/Cseal Type**




### UJR Type

| Model Number | A | C | D | E | H | I | J |
|---|---|---|---|---|---|---|---|
| P7000 (WR) | 124 | 141.5 | 67.8 | 39 | 25 | 25 | 68 |
| UPC® | 106/124 | 128 | 70.5 | 28.1 | 25 | 18 | — |

### 1.5Wseal® Type

| Model Number | A | B | C | D | E | G |
|---|---|---|---|---|---|---|
| P7000 (WR) | 79.8 | 93 | 141.5 | 67.8 | 39 | 30 |
| UPC® | 79.8 | 93 | 128 | 70.5 | 39 | 30 |

### 1.125Wseal® Type

| Model Number | A | B | C | D | E | G |
|---|---|---|---|---|---|---|
| P7000/P8000 | 92 | 105 | 127 | 82.6 | 28.5 | 21.8 |
| UPC®/UPCUS® | 92 | 105 | 128 | 70.5 | 28.5 | 21.8 |

### 1.125Cseal Type

| Model Number | A | B | C | D | E | G |
|---|---|---|---|---|---|---|
| P8000 | 92 | 105 | 127 | 83 | 28.5 | 21.8 |

# FCS®-Thermal Series

## Product Line-UP

| Series | | | Mass Flow Controller | | | | |
|---|---|---|---|---|---|---|---|
| | | |  |  |  |  |  |
| Features | | | PI Function Model<br>•Equipped with built-in pressure sensor<br>•Insensitive to sudden pressure fluctuations (Pressure insensitive)<br>•With MGMR function<br>•Corrosion resistant Hastelloy sensor<br>•Flow rate accuracy: Within ±1.0 % S.P. | MGMR Model<br>•MGMR (Multi Gas / Multi Range) function<br>•Corrosion resistant Hastelloy sensor<br>•Flow rate accuracy: Within ±1.0 % S.P. | Standard Digital Model<br>•Flow rate accuracy: ±1.0 % F.S.<br>•All flow rate areas: Response time ≦ 1 sec<br>•24V drive model<br>•Supports special specifications | High Flow Rate Model<br>•Max. flow rate 1000 SLM (1000 SLM: Limited to certain gases)<br>•Flow rate accuracy: ±1.0 % F.S.<br>•Response time: ≦ 3 sec | High Temperature Model<br>•50 – 80 °C (Please consult Fujikin for use at temperatures above 80 °C.) |
| Series Name | | | FCS-T1000MP | FCS-T1000Z | FCS-T1000F | FCS-T1200F<br>FCS-T1500F | FCS-T1000M (Z) F-HT<br>FCS-T1200MF-HT |
| Flow Rate Range ($N_2$ Equivalent) | | | 10 SCCM – 50 SLM | 10 SCCM – 50 SLM | 10 SCCM – 50 SLM | 51 – 1000 SLM | 10 SCCM – 200 SLM |
| Seal Material | | | Metal | Metal Rubber | Metal Rubber | Metal Rubber | Metal |
| Flow Rate Accuracy | | | ±1.0 % S.P. (25–100 %)<br>±0.25 % F.S. (2–25 %) | ±1.0 % S.P. (25–100 %)<br>±0.25 % F.S. (2–25 %) | ±1.0 % F.S. | ±1.0 % F.S. (T1200)<br>±2.0 % F.S. (T1500) | ±1.0 % S.P. (25–100 %) (T1000MZF)<br>±0.25 % F.S. (2–25 %) (T1000MZF)<br>±1.0 % F.S. (2–100 %) (T1000MF, T1200MF) |
| Response Time | | | ≦1 sec | ≦1 sec | ≦1 sec | ≦3 sec | ≦1 sec (10 SCCM-50 SLM)<br>≦3 sec (51-150 SLM) |
| PI Function | | | PI | | | | |
| MGMR Function | | | MGMR | MGMR | MR MG ※1 | | |
| Communication System | Analog *2 | ±15V drive (0 – 5 VDC) | ±15V drive (0 – 5 VDC) | ±15V drive (0 – 5 VDC) | ±15V drive (0 – 5 VDC) | ±15V drive (0 – 5 VDC) | ±15V drive (0 – 5 VDC) |
| | | +24V drive (0 – 5 VDC) | | +24V drive (0 – 5 VDC) | +24V drive (0 – 5 VDC) | +24V drive (0 – 5 VDC) For rubber type only | +24V drive (0 – 5 VDC) For T1000 only |
| | | +24V drive (4 – 20 mA) | | +24V drive (4 – 20 mA) | +24V drive (4 – 20 mA) | +24V drive (4 – 20 mA) For rubber type only | +24V drive (4 – 20 mA) For T1000 only |
| | Digital *3 | RS485 | RS485 | RS485 | RS485 | RS485 | RS485 |
| | | DeviceNet™ | DeviceNet™ | DeviceNet™ | DeviceNet™ | DeviceNet™ | DeviceNet™ For T1000MF only |
| | | EtherCAT® | EtherCAT® For metal type only | EtherCAT® | EtherCAT® | EtherCAT® | EtherCAT® |
| | | PROFIBUS | | | PROFIBUS | | |
| | | CC-Link | | | CC-Link | CC-Link | CC-Link |
| Fittings | Union Gasket Type (UJR Type) | | 1/4 UJR | 1/4 UJR | 1/4 UJR | 3/8 UJR (T1200)<br>1/2 UJR (T1500) | 1/4 UJR (T1000M)<br>3/8 UJR (T1200MF) |
| | Double Compression Ring Type (F900 Type) | | – | 1/4 F900 | 1/4 F900 | 3/8 F900 (T1200)<br>1/2 F900 (T1500) | 1/4 F900 (T1000M)<br>3/8 F900 (T1200MF) |
| | Integrated System Type (IGS® Type) | | 1.5 Wseal®<br>1.125 Wseal®<br>1.125 Cseal | 1.5 Wseal®<br>1.125 Wseal®<br>1.125 Cseal | 1.5 Wseal®<br>1.125 Wseal®<br>1.125 Cseal | — | 1.5 Wseal®<br>1.125 Wseal®<br>1.125 Cseal |
| Surface Finish | | | EP | EP For metal type only | EP For metal type only | EP For metal type only | EP Option |
| Compatible with RoHS | | | RoHS | RoHS | RoHS | RoHS | RoHS |
| Mass Flow Meter | | | | Mass Flow Meter | Mass Flow Meter | Mass Flow Meter | Mass Flow Meter For T1000 only |

*1: MR specifications: Changeable to 1/3 flow of the specified full scale flow. MG specifications: Up to four kinds of gases and flow rates can be registered.
*2: Analog interface: D-sub 9 pin Note that TM39 HRS-made HR10A-7R-6P UPC® or UPCUS® has half pitch 20 P.
*3: Digital interface: For RS485 communications, FCS-T1000 Series has RJ11 connector; FCS-T2000 Series has RJ45 connector.

Note 1: External leak rate: Metal seal: $1\times10^{-11}$ Pa·m³/sec He, Rubber Seal: $1\times10^{-7}$ Pa·m³/Sec He
Note 2: Please consult Fujikin for use under other conditions.
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## MEMO


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