

# Digital Mass Flow Controller **CMQ-V Series**

New advances in finely honed control capability!  
Superior high-speed control (300ms) with an  
enhanced variety of functions.



# The Ultra Fast $\mu$ F Sensor, Combined with Advanced Actuator Control Technology

300ms\* high-speed control can be used for low differential pressure work. Selectable control range, power circuit isolation (an industry first), and emphasis on usability.  
 (\*700ms for the MQV0050/0200/0500/1000J and K)

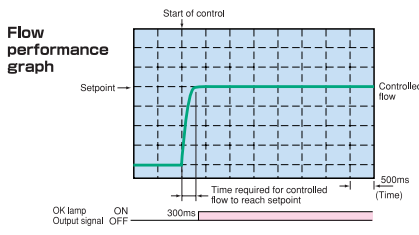
The CMQ-V Series features high performance digital gas mass flow controllers that incorporate the ultra small  $\mu$ F (Micro Flow<sup>®</sup>) sensor developed by Yamatake, a pioneer in MEMS (micro electromechanical systems) flow sensors. The CMQ-V uses  $\mu$ F sensor output and advanced PID control technology to drive a proportional actuator.



These models offer superb high-speed control, operation at low differential pressure, and a wide flow rate control range to meet the most demanding application needs. With a wide variety of models available, the CMQ-V is perfect for numerous applications.

## Advantage 1 Advanced 300ms high-speed controllability

Achieves 300ms high-speed control (700ms for the MQV0050/0200/0500/1000J and K). The CMQ-V offers exceptionally fast response from no flow to the stable setpoint flow rate, and after setpoint changes. This high-speed response to changes in primary gas pressure can minimize the effects on secondary flow.



## Advantage 2 Reliable control

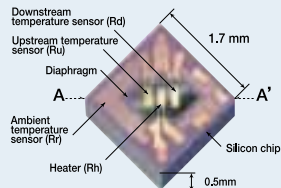
Standard model  
 Accuracy:  $\pm 0.5\%$  FS  
 Repeatability:  $\pm 0.25\%$  FS

High accuracy model (standard gas model only)  
 Accuracy:  $\pm 1.0\%$  SP  
 Repeatability:  $\pm 0.5\%$  SP

Control range: 1 to 100% FS  
 Note: For detailed specifications, refer to page 3. % SP refers to deviation from the setpoint.

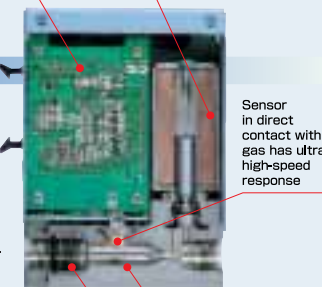
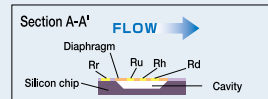
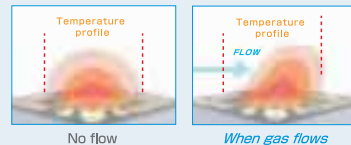
Digital circuitry for high degree of actuator control  
 Proportioning solenoid valve with wide rangeability

## Structure and features of the $\mu$ F sensor



### Principle of measurement

When there is no gas flow, the temperature distribution around the heater is symmetric. When the gas starts to flow from Ru to Rd, the temperature at Ru upstream decreases and the temperature at Rd downstream increases, thus causing a distortion of the symmetry in temperature distribution. The temperature difference between Ru and Rd is used to calculate the mass flow rate (flow rate  $\times$  density).



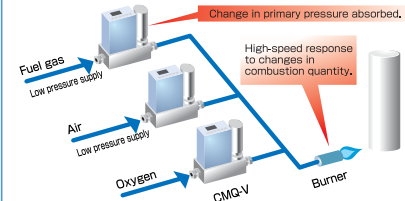
Sensor in direct contact with gas has ultra high-speed response  
 Advanced rectification structure suitable for wide rangeability  
 Straight flow path with low pressure loss

## Advantage 3 Operation at low differential pressure is a standard feature

The CMQ-V Series offers a low differential pressure control of less than 50kPa as a standard specification, making it suitable for low pressure supply applications, such as fuel gas supply.

### Optimum for low pressure gas control applications

Ex.: production of halogen lamps, backlights, fluorescent lamps, etc.



Note: Controllable gas flow rate differs depending on pressure and type of gas.

## Advantage 4 Broad lineup of models

The lineup includes models with or without integrated display, and models for standard gas, for hydrogen/helium, and for special gases. Select the optimum model for your application needs.



## Advantage 5 Wide range of standard functions

The CMQ-V Series comes with a multitude of standard functions such as flow rate indication and totalizing. Without the need to process software like a PLC, the CMQ-V handles a wide range of applications with ease.

### Major functions

- Flow rate indication
- Flow rate totalizing
- Valve open/close indication
- OK flow rate indicator/output
- Indication of amperage to valve
- Flow rate unit and decimal point location change
- Up to 8 preset setpoints
- Valve forced open/closed
- Automatic valve shut-off
- Gas type changeover
- Gas type selection (freely change gas conversion factor)
- Selectable control range
- SP ramp setting
- Slow start option
- Control dead zone setting
- External switch input (for SP change, gas type changeover and range changeover)
- Event output (abnormal flow rate, operation mode)
- Alarm output

Six easy-to-operate buttons, superior indication function, and SP change even in control run mode.



## Advantage 6 A variety of available input and output signals



Voltage signal (0–5Vdc and 1–5Vdc)  
 Current signal (4–20mA and 0–20mA) (Selectable by setting)  
 Switch between 3 inputs and between 2 event outputs  
 RS-485 communications (optional)  
 Dedicated port for connection to a PC

## Advantage 7 Can be connected to a regular 24Vdc power supply

The internal power supply circuit of this device is isolated from its analog circuits. When multiple CMQ-Vs are controlled by PLC analog input/output, even if the analog module of the PLC is not isolated between channels, a common power supply can be used. Even without individual power supplies, there is no negative effect from surrounding circuits. An AC adapter (100 to 240Vac) is also available by separate purchase.



## Advantage 8 Engineered for flexible installation

On models with an integrated display, the display direction can be changed 180 degrees.



Specifications

Standard gas model

Model No.	MQV9200	MQV9500	MQV0002	MQV0005	MQV0020	MQV0050 (B,C)	MQV0050 (J,K)	MQV0200	MQV0500
Valve type	Proportional solenoid valve								
Valve operation	Normally closed when de-energized (N.C.)								
Standard full-scale flow rate (Note 1)	200mL/min (standard)	0,500L/min (standard)	2,00L/min (standard)	5,00L/min (standard)	20,0L/min (standard)	50,0L/min (standard)	200L/min (standard)	500L/min (standard)	
Gas types	Air/nitrogen (N <sub>2</sub> ), oxygen (O <sub>2</sub> ), argon (Ar), carbon dioxide (CO <sub>2</sub> ), city gas 13A (LNG: 45MJ/m <sup>3</sup> ), city gas 13A (LNG: 46MJ/m <sup>3</sup> ), methane 100% (CH <sub>4</sub> ), propane 100% (C <sub>3</sub> H <sub>8</sub> ), butane 100% (C <sub>4</sub> H <sub>10</sub> ), (Note 10) Note that gas must be dry, without corrosive components (chlorine, sulfur, acid). It must also be clean, without dust or oil mist. (Note 12)								
Control	1 to 100% FS (see Table 1 below)								
Valve output update cycle	5ms								
Response (at std. differential pressure)	0.3s for SP ±2% FS (typ.)								
Accuracy (Note 2) (at standard temperature and differential pressure; Q is flow rate)	(1) Std. model: ±0.5% FS (0% FS ≤ Q ≤ 50% FS) ±1% FS (50% FS < Q ≤ 100% FS) (2) High accuracy model: ±0.2% FS (0% FS ≤ Q < 20% FS) ±1% SP (20% FS ≤ Q ≤ 100% FS) (Note 3)								
Repeatability	(1) Std. model: ±0.25% FS (0% FS ≤ Q ≤ 50% FS) ±0.5% FS (50% FS < Q ≤ 100% FS) (2) High accuracy model: ±0.1% FS (0% FS ≤ Q < 20% FS) ±0.5% SP (20% FS ≤ Q ≤ 100% FS) (Note 3)								
Pressure	Standard differential pressure (Note 4): 200kPa Inlet pressure: 200kPa(gauge) Outlet pressure: 0kPa(gauge) 150kPa Inlet pressure: 150kPa(gauge) Outlet pressure: 0kPa(gauge) 200kPa Inlet pressure: 200kPa(gauge) Outlet pressure: 0kPa(gauge) 20kPa Inlet pressure: 20kPa(gauge) Outlet pressure: 0kPa(gauge) 200kPa Inlet pressure: 200kPa(gauge) Outlet pressure: 0kPa(gauge)								
Required differential pressure (Note 5)	50kPa, 5kPa, 50kPa, 5kPa, 50kPa, 100kPa, 10kPa, 100kPa, 150kPa								
Operating differential pressure range (Note 6)	300kPa max.								
Pressure resistance (max. inlet pressure)	1MPa (gauge)								
Temp.	Operating temp.: -10 to +60°C								
Humidity	Operating humidity: 10 to 90% RH (no condensation allowed)								
Flow rate setup	Setup method: (1) Key input, (2) External analog input, (3) Dedicated PC loader connection, (4) RS-485 communications (3-wire type)								
External analog input	Input range: 0-5Vdc / 1-5Vdc / 0-20mAdc / 4-20mAdc (selectable)								
Totalizing function	Display range: 0.00 to 999,999.99L, 0.0 to 9,999,999.9L, 0 to 99,999,999L, 0.000 to 99,999,999m <sup>3</sup> , 0.00 to 999,999.99m <sup>3</sup>								
Analog output	Output type: Instantaneous flow rate (PV) or flow rate setpoint (SP) selectable Output scale: 0 to full scale flow rate (scale changeable) Output range: 0-5Vdc / 1-5Vdc / 0-20mAdc / 4-20mAdc (selectable)								
Alarm/event output	Number of outputs: Alarm: 1, Event: 2 Output rating: 30Vdc, 30mA max. (open collector non-insulated output) Totalizer pulse rate: 1 pulse/0.01L, 1 pulse/0.1L, 1 pulse/1L, 1 pulse/0.001m <sup>3</sup> , 1 pulse/0.01m <sup>3</sup>								
External switching input	Input type, number of inputs: External 3-way switching inputs: 1, External contact inputs (2-way switching): 3. Ext. device circuit type: Non-voltage contact, or open collector								
Communications	System: (1) Dedicated PC loader connection (Note 8) (2) RS-485 communications (3-wire system) (Note 9) Transmission rate: 2400, 4800, 9600, 19200, 38400bps (19200bps only for PC loader connection)								
Power	Rating: 24Vdc, current consumption 300mA max. Allowable power voltage range (ripple 5% max.): 21.6 to 26.4Vdc Isolation: Power circuit is isolated from input/output circuit.								
Matl. of gas-contacting parts	SUS316, Teflon, Viton								
Connection method	Rc 1/4", 1/4" Swl, 1/4" VCR, 9/16-18 UNF, Rc 1/2", 1/2" Swl, 3/8" VCR, 3/4-16 UNF								
Mounting orientation	Horizontal. Note that the display panel must not face down.								
Weight	Approx. 1.2kg								
Standards compliance	EN61326:1997/A1:1998/A2:2001/A3:2003								

Notes for pages 03-04  
 1. L/min (standard) indicates the volumetric flow rate (L/min) converted to 20°C, one atmosphere (1 atm). The reference temperature can be changed to 0°C, 25°C, or 35°C. The controllable flow rate range varies according to the gas type. See Table 1.  
 2. Accuracy information applies to air/nitrogen or oxygen (oxygen gas model). For accuracy with other gases, contact Yamatake Corporation.  
 3. ±x% SP indicates how accurately the controlled flow rate matches the flow rate setpoint.  
 4. Temperature and pressure during calibration.  
 5. Differential pressure required to control the full-scale flow rate. (Conditions: outlet pressure = 0kPa (gauge)).  
 6. Operation is possible even below the required differential pressure, but the controllable flow rate range is narrower. For details on the relationship between differential pressure and flow rate when the valve is fully open, refer to the user's manual, CP-SP-1204E (standard gas model) or CP-SP-1205E (hydrogen/helium gas model).  
 7. Maximum operating differential varies according to power supply voltage.  
 8. A dedicated PC loader package (sold separately) is required.

9. Applies only to models with the optional RS-485 communications function.  
 10. When used with ammonia, acetylene, or ethylene oxide gas, select a special gas model (with EPDM seal). For ammonia, be sure to use under dry conditions with a dewpoint of -20°C or less. In addition, do not use a special gas model with gases other than the above gases and nitrogen. Doing so may degrade the O-ring sealing characteristics. The special gas model is set for air/nitrogen use before factory shipment. Before using the model, set the gas type temperature and pressure conversion factor (CF). Contact Yamatake Corporation for the conversion factor.  
 11. May also be used for mixed gases containing hydrogen or helium (excluding corrosive gases or gases within explosive limits). For details, contact Yamatake Corporation.  
 12. Prevent foreign matter from entering the device, if rust, water droplets, oil mist, or dust in the piping enters the device, measurement error or damage to the device might result. If there is a possibility of foreign matter entering the device, provide an upstream filter, strainer or mist trap capable of eliminating foreign matter 0.1µm or greater in diameter, and be sure to periodically inspect and replace the filter.

Hydrogen gas model

Model No.	MQV9500	MQV0005	MQV0010	MQV0050	MQV0200	MQV0500	MQV1000
Valve type	Proportional solenoid valve						
Valve operation	Normally closed when de-energized (N.C.)						
Standard full-scale flow rate (Note 1)	0,500L/min (standard)	5,00L/min (standard)	10,00L/min (standard)	50,0L/min (standard)	200L/min (standard)	500L/min (standard)	1000L/min (standard)
Gas types	Hydrogen (H <sub>2</sub> ), helium (He). (Note 11) The gas must be dry and not contain corrosive components (chlorine, sulfur, acid). It must also be clean, without dust or oil mist. (Note 12)						
Control	1 to 100% FS (see separate Table 1)						
Valve output update cycle	5ms						
Response (at std. differential pressure)	0.3s for SP ±2% FS (typ.)						
Accuracy (at standard temperature and differential pressure; Q is flow rate)	±0.5% FS (0% FS ≤ Q ≤ 40% FS) ±1.0% FS (40% FS < Q ≤ 80% FS) ±2.0% FS (80% FS < Q ≤ 100% FS)						
Repeatability	±0.25% FS (0% FS ≤ Q ≤ 40% FS) ±0.5% FS (40% FS < Q ≤ 100% FS)						
Pressure	Standard differential pressure (Note 4): 200kPa. Inlet pressure: 200kPa (gauge). Outlet pressure: 0kPa (gauge). Required differential pressure (Note 5): Hydrogen: 20kPa Helium: 40kPa Hydrogen: 20kPa Helium: 150kPa Hydrogen: 20kPa Helium: 40kPa Hydrogen: 100kPa Helium: 180kPa Hydrogen: 40kPa Helium: 80kPa Operating differential pressure range (Note 6): 300kPa max.						
Pressure resistance (max. inlet pressure)	1MPa (gauge)						
Temp.	Operating temp.: -10 to +60°C						
Humidity	Operating humidity: 10 to 90% RH (no condensation allowed)						
Flow rate setup	Setup method: (1) Key input, (2) External analog input, (3) Dedicated PC loader connection, (4) RS-485 communications (3-wire type)						
External analog input	Input range: 0-5Vdc / 1-5Vdc / 0-20mAdc / 4-20mAdc (selectable)						
Totalizing function	Display range: 0.00 to 999,999.99L, 0.0 to 9,999,999.9L, 0 to 99,999,999L, 0.000 to 99,999,999m <sup>3</sup> , 0.00 to 999,999.99m <sup>3</sup>						
Analog output	Output type: Instantaneous flow rate (PV) or flow rate setpoint (SP), selectable Output range: 0-5Vdc / 1-5Vdc / 0-20mAdc / 4-20mAdc (selectable)						
Alarm/event output	Number of outputs: Alarm: 1, Event: 2 Output rating: 30Vdc, 30mA max. (open collector non-insulated output) Totalizer pulse rate: 1 pulse/0.01L, 1 pulse/0.1L, 1 pulse/1L, 1 pulse/0.01m <sup>3</sup> , 1 pulse/0.1m <sup>3</sup>						
External switching input	Input type, number of inputs: External 3-way switching inputs: 1, External contact inputs (2-way switching): 3. Ext. device circuit type: Non-voltage contact, or open collector						
Communications	System: (1) Dedicated PC loader connection (Note 8) (2) RS-485 communications (3-wire system) (Note 9) Transmission rate: 2400, 4800, 9600, 19200, 38400bps (19200bps only for PC loader connection)						
Power	Rating: 24Vdc, current consumption 300mA max. Allowable power voltage range (ripple 5% max.): 21.6 to 26.4Vdc Isolation: Power circuit is isolated from input/output circuit.						
Matl. of gas-contacting parts	SUS316, Teflon, Viton						
Connection method	Rc 1/4", 1/4" Swl, 1/4" VCR, 9/16-18 UNF, Rc 1/2", 1/2" Swl, 3/8" VCR, 3/4-16 UNF						
Mounting orientation	Horizontal. Note that the display panel must not face down.						
Weight	Approx. 1.2kg						
Standards compliance	EN61326:1997/A1:1998/A2:2001/A3:2003						

Table 1. Control flow rate range and setting/display resolutions (factory settings) (Units: L/min (standard), but mL/min (standard) for the CMQV9200) (Notes 14, 15, 16)

Standard gas model

Gas type	MQV9200		MQV9500		MQV0002		MQV0005		MQV0020		MQV0050 (B,C)		MQV0050 (J,K)		MQV0200		MQV0500	
	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution
Air, nitrogen	2 to 200	1	0.024 to 0.500	0.002	0.02 to 2.00	0.01	0.04-5.00	0.02	0.2 to 20.0	0.1	0.4 to 50.0	0.2	0.4 to 50.0	0.2	2 to 200	1	4 to 500	2
Oxygen	2 to 200	1	0.024 to 0.500	0.002	0.02 to 2.00	0.01	0.04-5.00	0.02	0.2 to 20.0	0.1	0.4 to 50.0	0.2	0.4 to 50.0	0.2	2 to 200	1	4 to 500	2
Argon	2 to 200	1	0.024 to 0.500	0.002	0.02 to 2.00	0.01	0.04-5.00	0.02	0.2 to 20.0	0.1	0.4 to 50.0	0.2	0.4 to 50.0	0.2	2 to 200	1	4 to 500	2
Carbon dioxide	1.0 to 120	0.5	0.023 to 0.300	0.001	0.01 to 1.20	0.005	0.03-3.00	0.01	0.10 to 12.0	0.05	0.3 to 30.0	0.1	0.3 to 30.0	0.1	1 to 120	0.5	4 to 400	2
City gas 13A (LNG: 45MJ/m <sup>3</sup> )	2 to 200	1	0.024 to 0.500	0.002	0.02 to 1.80	0.01	0.04-5.00	0.02	0.2 to 20.0	0.1	0.4 to 50.0	0.2	0.4 to 50.0	0.2	2 to 180	1	4 to 400	2
City gas 13A (LNG: 46MJ/m <sup>3</sup> )	2 to 200	1	0.024 to 0.500	0.002	0.02 to 1.80	0.01	0.04-5.00	0.02	0.2 to 20.0	0.1	0.4 to 50.0	0.2	0.4 to 50.0	0.2	2 to 180	1	4 to 400	2
Methane 100%	2 to 200	1	0.024 to 0.500	0.002	0.02 to 2.00	0.01	0.04-5.00	0.02	0.2 to 20.0	0.1	0.4 to 50.0	0.2	0.4 to 50.0	0.2	2 to 200	1	4 to 500	2
Propane 100%	0.8 to 80.0	0.2	0.023 to 0.180	0.001	0.02 to 1.80	0.01	0.03-1.80	0.01	0.2 to 16.0	0.1	0.2 to 16.0	0.1	0.2 to 16.0	0.1	0.6 to 60.0	0.2	2 to 200	1
Butane 100%	0.4 to 50.0	0.2	0.012 to 0.120	0.001	0.01 to 1.20	0.005	0.04-4.00	0.02	0.1 to 10.00	0.05	0.1 to 10.00	0.05	0.4 to 40.0	0.2	2 to 180	1		

Hydrogen gas model

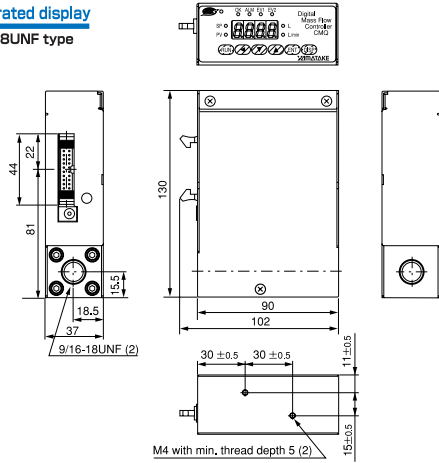
Gas type	MQV9500		MQV0005		MQV0010		MQV0050		MQV0200		MQV0500		MQV1000	
	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution	Control flow rate range	Setting/display resolution
Hydrogen	0.024 to 0.500	0.002	0.04 to 5.00	0.02	0.10 to 10.00	0.05	0.4 to 50.0	0.2	2 to 200	1	4 to 500	2	10 to 1000	5
Helium	0.024 to 0.500	0.002	0.04 to 5.00	0.02	0.10 to 10.00	0.05	0.4 to 50.0	0.2	2 to 200	1	4 to 500	2	10 to 1000	5

Notes for pages 03-04  
 13. When the gas type of MQV9500 is set to butane 100%, the flow rate display unit is mL/min.  
 14. Control range can be optionally set at 1% intervals from 10 to 100% FS.  
 15. For the MQV9200/9500/0002/0005, the flow rate display unit can be either L/min or mL/min.  
 16. The decimal point position on the flow rate display can be moved forward or backward by one digit.

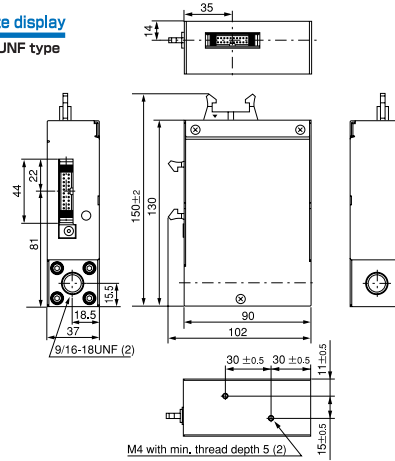


Standard gas model: MQV9200/9500/0002/0005/0020/0050B,C  
 Hydrogen/helium gas model: MQV9500/0005/0010/0050/0200B,C

**With integrated display**  
 Ex.: 9/16-18UNF type

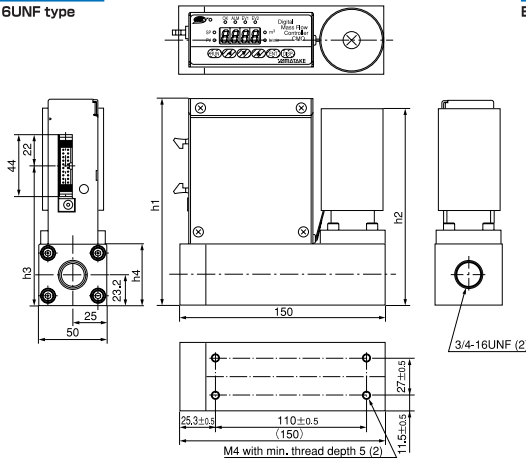


**With separate display**  
 Ex.: 9/16-18UNF type

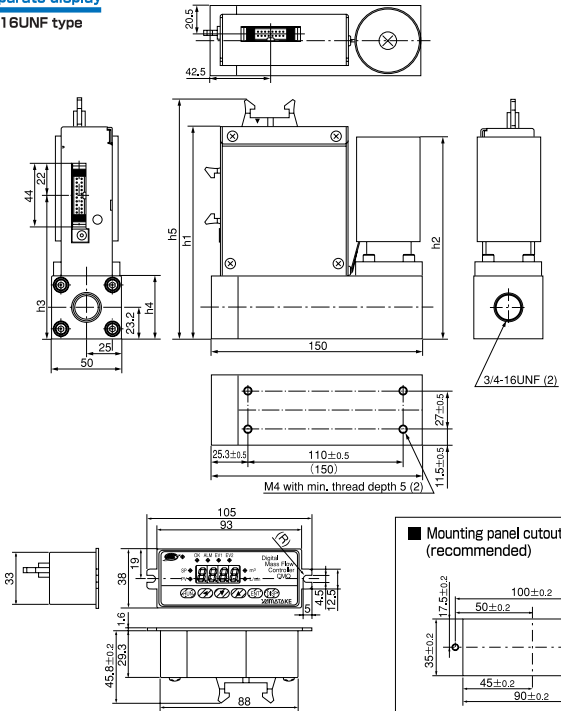


Standard gas model: MQV0050/0200/0500J,K  
 Hydrogen/helium gas model: MQV0500/1000J,K

**With integrated display**  
 Ex. 3/4-16UNF type



**With separate display**  
 Ex. 3/4-16UNF type



The "h" dimensions for the above diagrams

	h1	h2	h3	h4	h5
CMQ-V0050J,K/CMQ-V0200J,K	151	145	102	45	172
Hydrogen/helium: CMQ-V0500/1000					
CMQ-V0500J,K	152	146	103	46	173

**⚠ RESTRICTIONS ON USE**

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment. Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.



Specifications are subject to change without notice.

**Yamatake Corporation**  
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