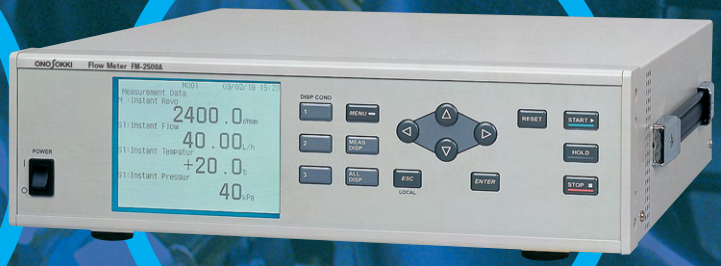
High-Precision Fuel Flow Meters

FP/FX/FZ Series Detectors
FM/DF Series Display Units



FP Series: For flow rate measurement in bench tests and actual running tests.

FX Series: For high-accuracy performance tests of flow rates starting from near-zero.

FZ Series: For continuous measurement of mode fuel consumption, etc.

We supply a wide range of high-precision flow meters for advanced automobile development and testing. Select the flow meter that best meets your test purpose needs.

ONO SOKKI

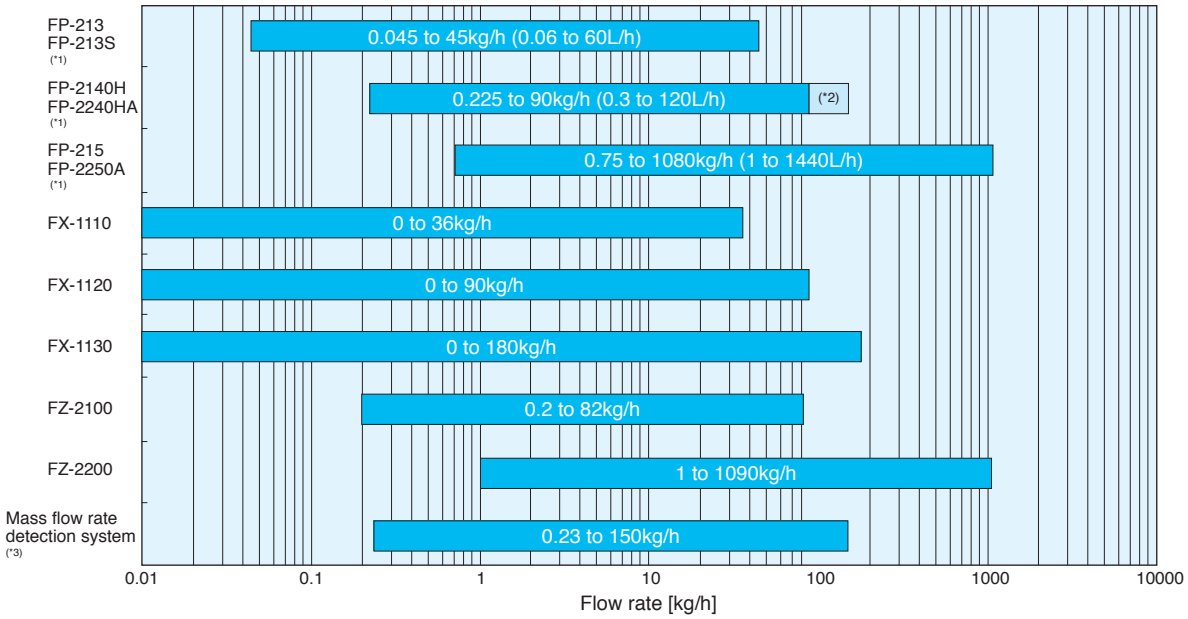
High-Precision Fuel Flow Meter Series that Support Automobile Energy Conservation Countermeasures

The global warming phenomenon is one of several global environmental conservation problems that need to be tackled, and the further reduction of fuel consumption is one of the important issues currently being addressed. At Ono Sokki, we have been manufacturing automobile-related measuring and control instruments for over the past half century. With regard to the measurement of fuel consumption, which is an important factor in automobile measurement applications, we have endeavored to develop and manufacture various types of measuring instruments that meet the needs of our customers, and to further increase measurement accuracy. There are three series of flow detectors, the FP, FX, and FZ Series, and we also provide the FM and DF Series display units to enable you to select the optimum combination for your test purpose needs.

Features

FP Series Detectors	• Volumetric flow measurement • Capable of long-term continuous flow rate measurement • Also be measurable for on-board measurement applications
FX Series Detectors	• Gravity flow measurement • Capable of performing measurement from zero flow (ultra-wide range) • Can perform continuous measurement up to a maximum of 1000g (FX-1130) • Simple configuration with minimal pressure loss
FZ Series Detectors	• Mass flow measurement • Capable of long-term continuous measurement without being affected by temperature or pressure • Density measurement enabled

FP/FX/FZ Series Detectors Measurement Range Comparison Chart



Note:
(*1): With the FP Series, the values are those converted to mass flow at a density of 0.75g/cm³.
(*2): ▭ applies when the 0.225 to 150kg/h (0.3 to 200L/h) range has been selected as an option.
(*3): The measurement range is the range given for the mass flow rate detection system on Page 12.

Configuration Diagram

Detectors | **Modules** | **Display Units**

FX Series

FZ Series (*4)

FP Series (*4)

On-board Detector MF-2200/3200

FX-0400A (*1)

For the FX Series detectors

FZ-0300A (*4)

For the FZ Series detectors

DF-0400A (*4)

For the FP Series detectors

FM-0210A (*2) (*4)

For addition and subtraction by dual-operation detectors.
The application of the measurement can be expanded.

FM-2500A (*4)
Standard Model

<Front panel>

<Rear panel>
(3 channels of the modules are installed.)

The FM-2500A is a calculation display unit for the FP/FX/FZ Series detectors.

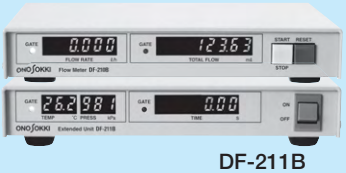
Measurement modules can be installed for up to 3 channels (*3).

FM-1500
Compact, simple-function Model

The FM-1500 is a simple-function calculation display unit for the FP/FZ Series detectors.
Only one module can be installed.

DF Series
On-board Model

DF-210B



DF-211B

* The DF-211B cannot be used as a single unit.

Notes:

(*1): The FX series module can only be used on Channel 1, cannot be used with other modules.

(*2): For the FP and FZ series only; cannot be used with the FX series. (Shown on Page 5)

(*3): The FM-2500A allows connection to its rear panel a maximum of three modules applicable to the flow meter. The examples of system configuration are shown on Page 5.

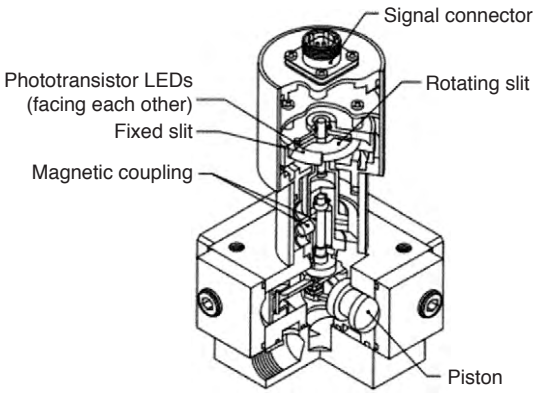
(*4): CE marking is available when it is combined with the FZ series and some of the FP series. Please consult us for details.

FP Series Volumetric Flow Detectors

Measurement accuracy: Within ±0.2% of the reading (FP-2140H/2240HA)

The piston method is used for volumetric flow rate detection, and there are three measurement flow ranges: 0.06 to 60L/h, 0.3 to 120L/h, and 1 to 1440L/h depending on the model. The flow rate ratio of 1:400 or more enables a wide measurement range. If the application is measurement of engine fuel consumption, measurement can be performed for minute quantities such as during idling, through to the large quantities generated under high-speed, high-load engine conditions.
The detector is compact and light weight, and, as it can be easily mounted in a vehicle, it is ideal not only for test bench fuel consumption measurement, but also for measurement of fuel consumption during actual running tests.

The Detection Principle



Four pistons are arranged radially in the flow detection unit, and move back and forth repeatedly according to the flow of fluid from the inlet to the outlet. The pistons are rotated by the crankshaft, and their movement is transmitted to the magnetic-coupled rotation detection unit. The rotary encoder mounted on the rotation detection unit generates pulse signals in accordance with the amount of piston movement.

Features

- Wide measurement range thanks to a flow rate ratio of 1:400 or more
- Capable of compensating for errors caused by pulsating or backflow by means of a function for judging the direction of rotation
- High reproducibility and high-speed response result in superb reliability
- Capable of simultaneous measurement of temperature and pressure during flow rate measurement (FP-2240HA/2250A)

Detector Specification

Item \ Model Name		FP-213S	FP-213	FP-2140H	FP-2240HA	FP-215	FP-2250A
Measurement parameters	Flow rate	Yes	Yes	Yes	Yes	Yes	Yes
	Temperature	—	—	—	Yes	—	Yes
	Pressure				Yes		Yes
Applicable fluids	Gasoline	Yes	Yes	Yes	Yes	Yes	Yes
	Light oil	Yes	Yes	Yes	Yes	Yes	Yes
	Kerosene	Yes	Yes	Yes	Yes	Yes	Yes
	Standard petroleum oils	—(*1)	Yes	Yes	Yes	Yes	Yes
	Alcohol fuels	Option	Option	Option	Option	Option	Option
Measurement range	Flow rate	0.06 to 60L/h (1 to 1000mL/min, 0.02 to 16.7mL/s)		0.3 to 120L/h(*2) (5 to 2000mL/min, 0.08 to 33.3mL/s)		1 to 1440L/h (20 to 24000mL/min, 0.3 to 400mL/s)	
	Temperature	—	—	—	0 to +99.9°C	—	0 to +99.9°C
	Pressure				0 to 980kPa		0 to 980kPa
Accuracy	Flow rate	Within ±0.5% of reading (over the entire 0.06 to 60L/h range)	Within ±0.0009L/h (from 0.06 to 0.18L/h) Within ±0.5% of reading (from 0.18 to 60L/h)	Within ±0.2% of reading (over the entire 0.3 to 120L/h range)		Within ±0.018L/h (from 1 to 3.6L/h) Within ±0.5% of reading (from 3.6 to 1440L/h)	
	Temperature	—	—	—	Pt 100Ω Class B	—	Pt 100Ω Class B
	Pressure				±0.5% of F.S.		±0.5% of F.S.
Pressure loss		0.01kPa or less (excluding filter pressure loss)	8kPa or less(*3) (at 40L/h, for gasoline)	2kPa or less(*3) (at 60L/h, for gasoline)		7.5kPa or less(*3) (at 500L/h, for light oil)	
Minimum resolution		0.01mL		0.1mL		1mL	
Maximum pressure		980kPa	980kPa(*4)			3.4MPa(*4)	980kPa(*4)
Operating temperature range		0 to +60°C	0 to +65°C(*4)				
Filter		EH-106 provided as standard		EH-1050 provided as standard		Provided as standard	
Weight		Approx. 2.5kg (including filter)	Approx. 2kg (including filter)	Approx. 5kg (including filter)	Approx. 6kg (including filter)	Approx. 14kg (including separately-attached filter)	
Outer dimensions		See (1) on Page 14	See (2) on Page 14	See (3) on Page 14	See (4) on Page 14	See (5) on Page 14	See (6) on Page 14

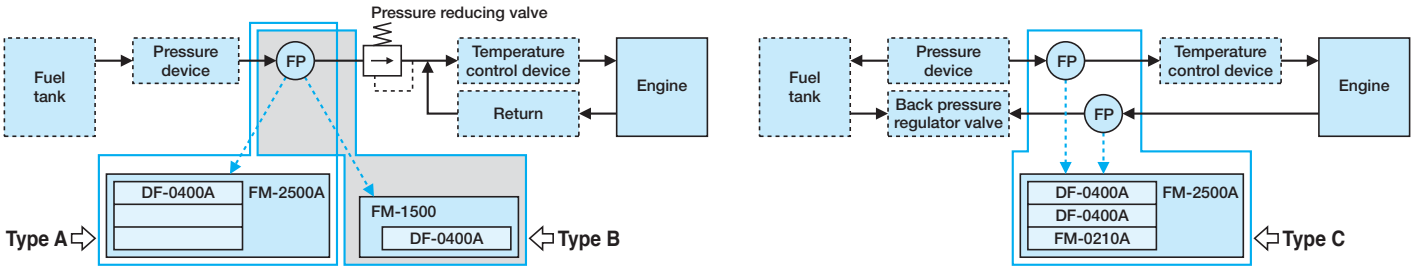
(*1): Please consult us for details.
(*2): 0.3 to 200L/h, 0.3 to 300L/h flow rate measurement range can also be provided. Please consult us for details.
(*3): If the inlet pressure is lower than the pressure loss and if the outlet is open to the atmosphere, the instantaneous flow rate may be varied.
(*4): Please consult us if you require specifications other than those given above.

FM-2500A/1500 Display Unit Specification

Item \ Model Name			FM-2500A (FM-2500A + DF-0400A)				FM-1500 (FM-1500 + DF-0400A)			
Applicable flow detectors			FP-213S, FP-213, FP-2140H, FP-2240HA, FP-215 or FP-2250A							
Applicable revolution detectors			MP-9100, MP-981 or LG-916 (*9)				—			
Displayed items and number of digits	Time measurement	Sectional total time (*1)	0.00 to 9999999s (max. 7 digits)							
		Total time (*1)								
	Revolution measurement	Revolution speed	0.0r/min (max. 7 digits)				—			
		Sectional total average revolution speed (*2)								
		Sectional total revolution	0 to 9999999 REV (max. 7 digits)							
		Total average revolution speed (*3)	0.0r/min (max. 7 digits)							
		Total revolution	0 to 9999999 REV (max. 7 digits)							
	Pressure measurement	Pressure	0 to 9999kPa (max. 4 digits)							
	Temperature measurement	Temperature	±0.0 to 999.9°C (max. 4 digits)							
	Flow rate measurement (max. 7 digits) (*6) (*7)	Applicable detectors	FP-213S/213	FP-2140H/2240HA	FP-215/2250A	Units	FP-213S/213	FP-2140H/2240HA	FP-215/2250A	Units
		Instantaneous flow rate	0.000	0.00	0.0	mL/s, mL/min,L/h, g/s, g/min, kg/h	0.000	0.00	0.0	L/h, kg/h
		Sectional total flow rate (*1)	0.000 to 9999999	0.00 to 9999999	0.0 to 9999999	mL, g, L, kg	0.000 to 9999999	0.00 to 9999999	0.0 to 9999999	mL, g
		Total flow rate (*1)								
		Sectional total average flow rate (*4)	Same as for instantaneous flow rate							
		Total average flow rate (*5)	Same as for instantaneous flow rate				—			
		Instantaneous in-cylinder injection	0.000	0.00	0.0	mm³/st, mg/st				
		Sectional total average in-cylinder injection								
		Total average in-cylinder injection								
Measurement time		Instantaneous	Can be specified within the range of 1 to 10seconds. (in 1-second increments)				1-second			
		Total	Up to the start time to stop time, specified in the total measurement mode.							
Total measurement mode		Manual	Total from the start to stop signal specified on the panel or by an external signal (communications or remote box the FM-0200).							
		Flow rate setting method	Total time/revolutions from the start signal up to the specified total flow rate.				Total time from the start signal up to the specified total flow rate.			
		Time setting method	Total flow rate/revolutions from the start signal up to the specified total time.				Total flow rate from the start signal up to the specified total time.			
		Revolution setting method	Total flow rate/time from the start signal up to the specified total revolutions.				—			
Voltage output (*8)		Flow rate	0 to 10V/Low to High (Low and High values are variable.)				0 to 10V/0 to F.S. (F.S. value is selectable from 100/200/300/500/1000/1500 (kg/h, L/h).)			
		Pressure					0 to 10V/0 to F.S. (F.S. value is selectable from 200/500/980/1000 (kPa).)			
		Temperature					0 to 10V/0 to 100°C			
Pulse output		Pulse output	FP-213S/213: Selectable from Direct/0.001/0.01 (mL/P, g/P) FP-2140H/2240HA: Selectable from Direct/0.01/0.1 (mL/P, g/P) FP-215/2250A: Selectable from Direct/0.1/1 (mL/P, g/P)							
		Output specification	Frequency range: 0 to 100kHz, Output H level: 2.4V or more, L level: 0.8V or less							
Outer dimensions			See (11) on Page 15.				See (12) on Page 15.			

(*1) Total value can be displayed up to 7 digits. The position of the decimal point moves to the right or left depending on the number of decimal positions of the value.
(*2) Sectional total average revolution speed = Sectional total revolution / sectional total time
(*3) Total average revolution speed = Total revolution / total time
(*4) Sectional total average flow rate = Sectional total flow rate / sectional total time
(*5) Total average flow rate = Total flow rate / total time
(*6) Displayed value of mass flow rate is converted at density / temperature / temperature correction coefficient specified in advance. The conversion by actual measurement density is available when simultaneous measurement with the FZ series continuous mass flow meter is performed. (only the FM-2500A)
(*7) The position of the decimal point in the above table is when the encoder pulse is set at "120P/R x multiplier 10" or "1200P/R (option)". If the setting at "120P/R" is selected, the decimal point moves to the right to increase one digit. If the setting at "1200P/R x multiplier 10" is selected, the decimal point moves to the left to decrease one digit.
(*8) Update interval of voltage output: 0.1 seconds, accuracy: ±0.1%/F.S.
(*9) The MP-9100 can be connected via the MX-0xx series, MP-981 and LG-916 can be connected via the MX-8000 series cable.

Equipment Configuration Examples



Types A and B: This is the standard system configuration when one detector is used.

Type C: A detector is installed at both the supply and return sides, and the difference is used to measure the fuel consumption. Separate standalone displays can also be used for the supply and return sides.

The FM-0210A in Type C is an addition/subtraction module for two detectors. (Each type of A,B or C is delineated by —. (FP) indicates a detector.)

FP Series Flow Detectors

FP-213S

Small flow rate, low pressure loss type

- Measurement range: 0.06 to 60L/h
- Range ability: 1/1000
- Accuracy within ±0.5% of reading
- Low pressure loss (10 Pa or less), ideal for measuring the amount of fuel consumption of motorcycles and heating equipments

FP-213

Small flow rate type

- Measurement range: 0.06 to 60L/h
- Range ability: 1/1000
- Accuracy within ±0.5% of reading (0.18 to 60L/h)

FP-2140H

Standard flow rate type

- Measurement range: 0.3 to 120L/h
- Range ability: 1/400
- Accuracy within ±0.2% of reading

FP-2240HA

Simultaneous measurement of standard flow rate, temperature and pressure type

- Measurement range: 0.3 to 120L/h
- Range ability: 1/400
- Accuracy within ±0.2% of reading
- Simultaneous measurement of temperature and pressure

FP-215

Large flow rate type

- Measurement range: 1 to 1440L/h
- Range ability: 1/1440
- Accuracy within ±0.5% of reading (3.6 to 1440L/h)
- Ideal for measuring the flow rate of engines used in buses, trucks, and other large vehicles, as well as marine engines

FP-2250A

Simultaneous measurement of standard flow rate, temperature and pressure type

- Measurement range: 1 to 1440L/h
- Range ability: 1/1440
- Accuracy within ±0.5% of reading (3.6 to 1440L/h)
- Simultaneous measurement of temperature and pressure
- Ideal for measuring the flow rate of engines used in buses, trucks, and other large vehicles, as well as marine engines

MF Series On-Board Flow Detectors (Incorporating the FP-2140H)

The MF series fuel flow detectors are one unit type with small and light weight for on-board measurement. The MF series can measure fuel flow rate in combination with the FM series or the DF series.

MF-2200: For gasoline engines; measures the flow rate of in-tank type electronic fuel injected system engines. (Cannot be used for return less engine.)

MF-3200: For diesel engines. (Excluding in-tank fuel pump type vehicle)

MF-2200

MF-3200

Features

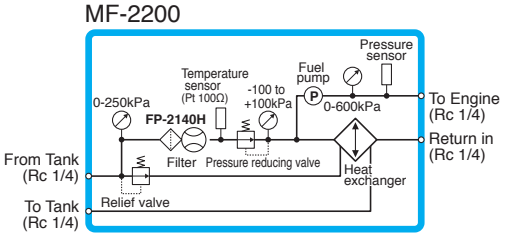
- High accuracy within ±0.2% of reading.
- Compact size and light weight enabled by the use of component blocks.
- A fuel cooling function is provided as standard.
- Simultaneous measurement of temperature and pressure together with the flow rate.

Specification

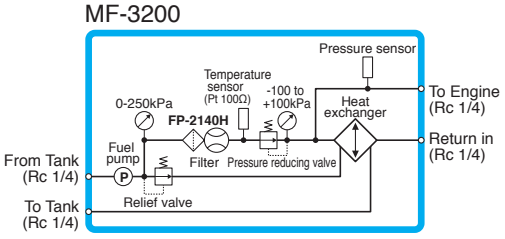
Item \ Model Name		MF-2200	MF-3200
Measurement parameters		Flow rate, Temperature or Pressure	
Flow detector used		FP-2140H	
Applicable fluids		Gasoline	Light oil
Measurement range	Flow rate	0.3 to 120L/h	
	Pressure	0 to 980kPa	
	Temperature	0 to +99.9°C	
Measurement accuracy	Flow rate	Within ±0.2% of reading	
	Pressure	±0.5% of F.S.	
	Temperature	Pt 100Ω Class B	
Return processing		Pressure control system (using a precision pressure reducing valve)	
Operating temperature range		0 to +65°C (both the temperature of the fluid and the ambient temperature)	
Weight		Approx. 15kg	
Outer dimensions		260 (W) x 243 (H) x 243 (D)mm	

Configuration Diagrams

MF-2200



MF-3200



DF-200 Series On-Board Flow Meters

The DF series are compact, light weight, thin profile vehicle-mounted flow meters for use with the FP series detectors and the MF series detectors.
The DF-210B measures instantaneous flow rates and total flow rates.
The DF-211B is an extension unit for the DF-210B and measures total time, temperature, and pressure.

DF-210B

DF-211B

Options

DF-021A Battery Box

The DF-021A is a portable battery box that uses dry batteries.
Batteries used: Size C, 8 batteries
Battery life (when alkaline manganese batteries used):
Approx. 8 hours when the DF-210B is used on its own.
Approx. 4 hours when the DF-210B and DF-211B are used at the same time.
Weight: Approx. 1.2kg (including batteries)

DF-022 Remote Box

The DF-022 provides remote START, STOP, and RESET switches for accumulative measurement.

DF-024/025 Protective Heat-Resistant Mounting Units

These heat-resistant units prevent exposure to heat generated by the sun when the DF-210B and DF-211B are mounted on a vehicle dashboard.

DF-024: Two-stacking type (DF-210B + 211B, DF-210B + 021A)
DF-025: Three-stacking type (DF-210B + 211B + 021A)

Specification

Item \ Model Name		DF-210B	DF-211B (*1)
Applicable flow detectors		MF-2200, MF-3200, FP-213S, FP-213, FP-2140H, FP-2240HA, FP-215 or FP-2250A	
Display device		Green LEDs	
Displayed items and number of digits	Instantaneous flow rate (*2)	0.00L/h (max. 5 digits)	—
	Total flow rate (*2)	0.0mL (max. 7 digits)	
	Total time	—	0.00s (max. 7 digits)
	Temperature		0.0°C (max. 3 digits)
	Pressure		0kPa (max. 3 digits)
Voltage output	Instantaneous flow rate (*3)	0 to 10V/0 to 100L/h, 0 to 10V/0 to 1000L/h, ±0.5% F.S.	—
	Temperature	—	0 to 10V/0 to +100°C ±0.5% F.S.
	Pressure		0 to 10V/0 to 980kPa ±0.5% F.S.
Pulse output	Flow rate (*2)	0.01mL/pulse or 0.1mL/pulse TTL level, duty approx. 1:1	—
Measurement time	Instantaneous flow rate	1-second, automatically repeated	
	Total flow rate	Total from start signal to stop signal specified on the panel or remote box (DF-022)	
	Total time	—	Total from start signal to stop signal specified on the panel or remote box (DF-022)
Data memory function (*4)		Provided	—
Power requirement		10 to 15VDC, approx. 4VA	
Operating temperature range		0 to +40°C	
Weight		Approx. 1kg	
Accessories		DC power cable (3.5m): 1	Cable to connect the DF-210B and the DF-211B (15cm) DC power cable (15cm), for remote use (15cm)
Outer dimensions		See (7) on Page 14	

(*1): The DF-211B is required when the detector is the MF-2200/3200 or the FP-2240HA/2250A.

(*2): The position of the decimal point for the "Instantaneous flow rate" and "Total flow rate" measurement parameters and the pulse output are applicable when the MF-2200/3200/FP-2140H/2240HA detector is used. When the FP-213S/213 is used, the value must be multiplied by 0.1. When the FP-215/2250A is used, the value must be multiplied by 10.

(*3): For analog output, the specification is 0 to 10V/0 to 100L/h when the MF-2200/3200/FP-213S/213/2140H/2240HA is used, and 0 to 10V/0 to 1000L/h when the FP-215/2250A is used. The scale of analog output can be modified.

(*4): When the power is off, total flow rate values can be stored in the memory backup battery.

FX Series Gravity Flow Detectors

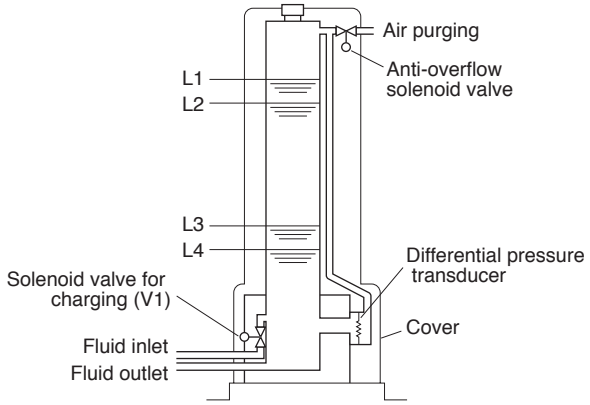
High accuracy: Within ±0.2% of the reading ±0.01% of F.S. (FX-1100 Series)
This high-precision flow detector is ideal for engine performance tests.

The FX series flow detectors are capable of measuring the instantaneous flow and total flow directly from gravity of the fuel. The high accurate differential pressure transducer at the bottom of the FX series detects the changes of the pressure which comes from the fuel consumption. No need to consider the density variations caused by temperature. Therefore, measurement can be performed from near-zero flow rates and these flow detectors are ideal for engine performance tests.

Features

- High-accuracy flow rate measurement over a wide range
- Built-in air purging function to counteract the mixing in air bubbles
- Alarm function against overflows and low fluid levels
- Density corrections due to changes in the temperature are no longer required.
- Increased pressure and pressure feed are available as options.

The Detection Principle



If the fluid level falls below L3, the pressure signal generated by the detector causes the solenoid valve V1 to open and more fluid to flow in. When the fluid level reaches L2, valve V1 closes. Measurement of the flow rate starts after the specified time for the surface of the fluid to reach the fixed level has elapsed. As the fluid level falls from L2 as it is being consumed, the output from the differential pressure transducer changes in accordance with the gravity of the consumed fluid, and the gravity flow rate is obtained from this changed amount. Alarms are generated if the fluid reaches the L1 overflow level or falls to the L4 insufficient fluid level.

Detector Specification

Item \ Model Name	FX-1110	FX-1120	FX-1130
Applicable fluids	Gasoline, Light oil, Kerosene or Alcohol fuels (option)		
Measurement range	0 to 10g/s (0 to 36kg/h)	0 to 25g/s (0 to 90kg/h)	0 to 50g/s (0 to 180kg/h)
Accuracy (*1)	Within ±0.2% of reading, ±0.01% of F.S.		
Instantaneous flow rate resolution	0.001g/s	0.01g/s	
Total flow rate resolution	0.01g		0.1g
Maximum total quantity (single fill operation)	200g	500g	1000g
Maximum pressure	196kPa		
Operating temperature range (*2)	0 to +40ºC (with no freezing)		
Open-atmosphere processing	Solenoid valve for overflow protection		
Inlet, outlet, and return joints	R3/8 Internal diameter: ø6 External diameter: ø9 Hose nipple (for both IN and OUT)	R1/2 Internal diameter: ø12 External diameter: ø16 Hose nipple (for both IN and OUT)	
Weight	Approx. 13kg		
Outer dimensions	See (8) on Page 14		

(*1) If the temperature changes rapidly during measurement, the above accuracy cannot be guaranteed.
(*2) Vapor may be produced in this temperature range, and may prevent normal measurement.

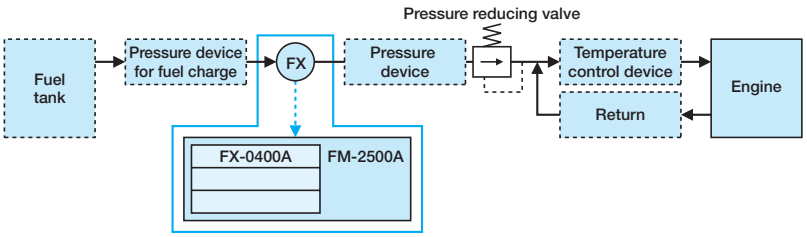
FX-1100 Sereis

FM-2500A Display Unit Specification

Item \ Model Name			FM-2500A (FM-2500A + FX-0400A)			
Applicable flow detectors			FX-1110, FX-1120 or FX-1130			
Applicable revolution detectors			MP-9100, MP-981 or LG-916 (*8)			
Displayed items and number of digits	Time measurement	Sectional total time (*1)	0.00 to 9999999s (max. 7 digits)			
		Total time (*1)				
	Revolution measurement	Revolution speed	0.0r/min (max. 7 digits)			
		Sectional total average revolution speed (*2)				
		Sectional total revolution	0 to 9999999 REV (max. 7 digits)			
		Total average revolution speed (*3)	0.0r/min (max. 7 digits)			
		Total revolution	0 to 9999999 REV (max. 7 digits)			
	Flow rate measurement (max. 7 digits) (*6)	Applicable detectors	FX-1110	FX-1120	FX-1130	Units
		Instantaneous flow rate	0.000	0.00		mL/s, g/s
			0.0	0		mL/min, g/min
			0.00	0.0		kg/h
			0.00			L/h
		Sectional total flow rate (*1)	0.00 to 9999999		0.0 to 9999999	mL, g, L, kg
		Total flow rate (*1)				
		Sectional total average flow rate (*4)	Same as for instantaneous flow rate			
		Total average flow rate (*5)				
		Instantaneous in-cylinder injection	0.00	0.0		mm³/st, mg/st
		Sectional total average in-cylinder injection				
		Total average in-cylinder injection				
Measurement time		Instantaneous	Can be specified within the range of 1 to 10seconds (in 1-second increments).			
		Total	Up to the start time to stop time, specified in the total measurement mode.			
Total measurement mode		Manual	Total from the start to stop signal specified on the panel or by an external signal (communications or remote box the FM-0200).			
		Flow rate setting method	Total time/revolutions from the start signal up to the specified total flow rate.			
		Time setting method	Total flow rate/revolutions from the start signal up to the specified total time.			
		Revolution setting method	Total flow rate/time from the start signal up to the specified total revolutions.			
Alarm output			Overflow (L1 level): Monitor display and external contact output Low fluid (L4 level): Monitor display and external contact output			
Fluid fill operation control		Setting range for the time for the fluid surface to reach the fixed level	2 to 99s			
		Setting range for the fluid level	0 to 95%			
Voltage output (*7)		Flow rate	0 to 10V/Low to High (Low, High values are variable.)			
Pulse output		Pulse output (no output during charging)	FX-1110: Selectable from 0.001/0.01 (mL/P, g/P) FX-1120: Selectable from 0.01/0.1 (mL/P, g/P) FX-1130: Selectable from 0.1/1 (mL/P, g/P)			
		Output specification	Frequency range: 0 to 100kHz, Output H level: 2.4V or more, L level: 0.8V or less			
Outer dimensions			See (11) on Page 15.			

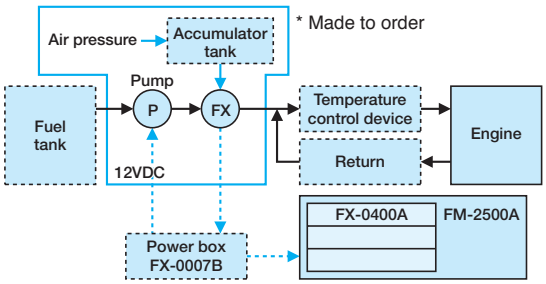
(*1) Total value can be displayed up to 7 digits. The position of the decimal point moves to the right or left depending on the number of decimal positions of the value.
(*2) Sectional total average revolution speed = Sectional total revolution / sectional total time
(*3) Total average revolution speed = Total revolution / total time
(*4) Sectional total average flow rate = Sectional total flow rate / sectional total time
(*5) Total average flow rate = Total flow rate / total time
(*6) Displayed value of volumetric flow is converted at density / temperature / temperature correction coefficient specified in advance.
(*7) Update interval of voltage output: 0.1 seconds, accuracy: ±0.1%/F.S.
(*8) The MP-9100 can be connected via the MX-0xx series cable, the MP-981 and the LG-916 can be connected via the MX-8000 series cable.

Equipment Configuration Examples



Type A
This is the standard system configuration when one detector is used.
(When fuel supply pressure is applied.)
(This type is delineated by —. (FX) indicates a detector.)

* The only one FX-0400A module can be installed on the FM-2500A.



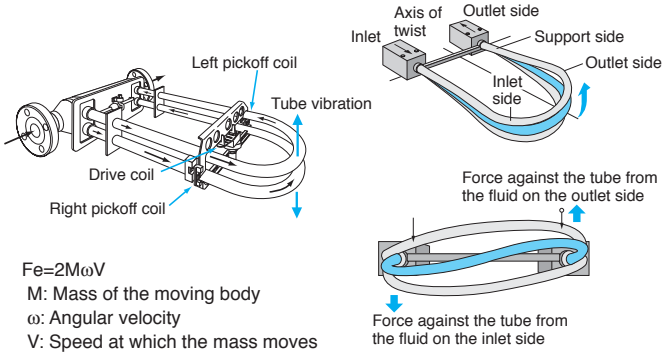
Increased pressure type:
An accumulator tank is used to enable an increase in pressure.
Use this method when fuel cannot be supplied due to reasons such as not being able to install the detector in a high position.
(The FX-0007B power box is an option.)

FZ Series Mass Flow Detectors

Measurement accuracy: Within ±0.1% of the reading
High response, high-precision detectors for the continuous measurement of mode tests, etc.

The FZ series flow detectors use the principle of the Coriolis force which is generated when the movement of a mass and rotation occur simultaneously. They are capable of high-accuracy, continuous measurement of mass flow, and are ideal for applications such as measuring the amount of fuel consumption in mode tests, and fuel consumption behavior when the speed is accelerated or decelerated.

The Detection Principle



Fe=2MωV
M: Mass of the moving body
ω: Angular velocity
V: Speed at which the mass moves

The fluid that entered from the inlet passes through the tube and goes out through the outlet. With this flow meter, the application of its inherent vibration to the tube causes a movement equivalent to the angular velocity, thereby generating a Coriolis force. As shown in the figures above, since the tube for which the Coriolis force is being generated generates a twist proportional to the mass flow rate, the mass flow rate is calculated from the amount of this twist.

Features

- Continuous measurement without being affected by temperature, pressure, or density
- High measurement accuracy (up to a ratio of 40:1 within ±0.1% of reading accuracy)
- Density measurement enabled
- The case provided with each detector is capable of purging internal air.

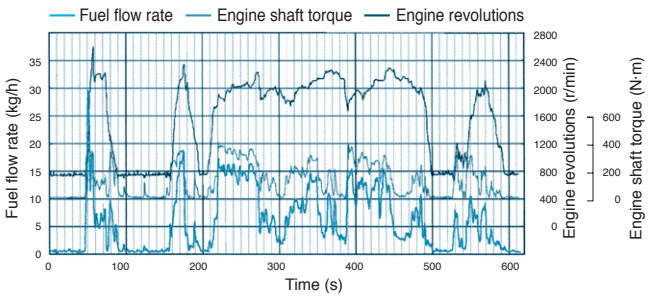
Detector Specification

Item \ Model Name		FZ-2100	FZ-2200
Measurement parameters		Flow rate, Temperature or Density	
Applicable fluids (*1)		Gasoline, Light oil, Kerosene, Water, Standard petroleum oils, or Alcohol fuels (option)	
Measurement range	Normal mass flow rate	0.2 to 82kg/h	1 to 1090kg/h
	Normal volumetric flow rate	0 to 109L/h at 0.75g/cm³	0 to 1453L/h at 0.75g/cm³
	Maximum flow rate	108kg/h	2180kg/h
	Density (*2)	0 to 1g/cm³	
Accuracy	Flow rate	±0.1% of reading at 2 to 82kg/h ±(0.002kg/h/flow rate) x within 100% of reading at 0.2 to 2kg/h	±0.1% of reading at 27 to 1090kg/h ±(0.027kg/h/flow rate) x within 100% of reading at 1 to 27kg/h
	Density	±0.0005g/cm³	
	Density reproducibility	±0.0002g/cm³	
	Density temperature characteristic	±0.000015g/cm³/°C	
Pressure loss (when measuring gasoline)		Approx. 100kPa at 82kg/h	Approx. 100kPa at 1090kg/h
Withstand pressure		10MPa	
Operating temperature range (*2)		0 to +40°C	
Weight		Approx. 12kg	Approx. 9kg
Outer dimensions		See (9) on Page 15	See (10) on Page 15

(*1): Can also be used with CNG and LPG gases (option). Please consult us for details.
(*2): Please consult us for temperatures and densities that exceed the above ranges.

FZ-2100 Detector

Example of actual fuel mass flow rate data at the North American transient test mode

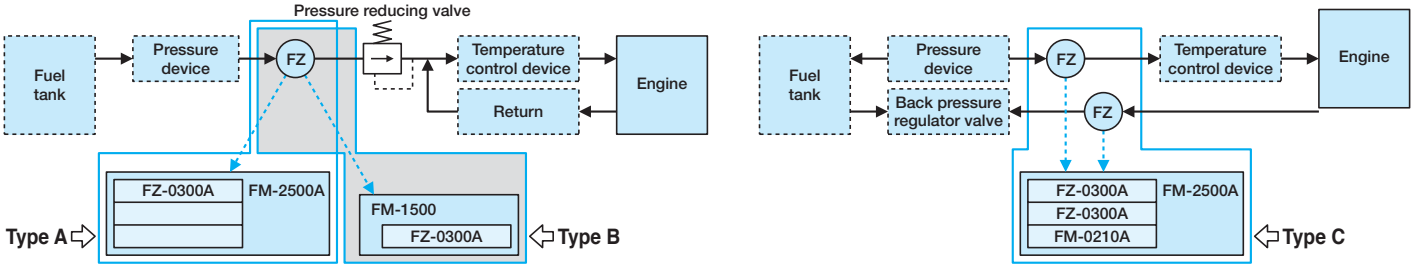


FM-2500A/1500 Display Unit Specification

Item \ Model Name			FM-2500A (FM-2500A + FZ-0300A)			FM-1500 (FM-1500 + FZ-0300A)		
Applicable flow detectors			FZ-2100 or FZ-2200					
Applicable revolution detectors			MP-9100, MP-981 or LG-916 (*7)			—		
Displayed items and number of digits	Time measurement	Sectional total time (*1)	0.00 to 9999999s (max. 7 digits)					
		Total time (*1)						
	Revolution measurement	Revolution speed	0.0r/min (max. 7 digits)			—		
		Sectional total average revolution speed (*2)						
		Sectional total revolution	0 to 9999999 REV (max. 7 digits)					
		Total average revolution speed (*3)	0.0r/min (max. 7 digits)					
		Total revolution	0 to 9999999 REV (max. 7 digits)					
	Temperature measurement	Temperature	±0.0 to 999.9ºC (max. 4 digits)					
	Flow rate measurement (max. 7 digits)	Applicable detectors	FZ-2100	FZ-2200	Units	FZ-2100	FZ-2200	Units
		Instantaneous flow rate	0.0000	0.00	mL/s, mL/min, L/h, g/s, g/min, kg/h	0.0000	0.00	L/h, kg/h
		Sectional total flow rate (*1)	0.0000 to 9999999	0.00 to 9999999	mL, g, L, kg	0.0000 to 9999999	0.00 to 9999999	mL, g
		Total flow rate (*1)						
		Sectional total average flow rate (*4)	Same as for instantaneous flow rate					
		Total average flow rate (*5)	Same as for instantaneous flow rate			—		
		Instantaneous in-cylinder injection	0.0000	0.00	mm^2/st, mg/st			
		Sectional total average in-cylinder injection						
		Total average in-cylinder injection						
	Density measurement	Density	0.0000 g/cm^3 (5 digits)					
		Converted temperature setting	0.0 to 999.9ºC (density calculation performed for the three specified temperature points)			0.0 to 999.9ºC (density calculation performed for the one specified temperature point)		
Measurement time		Instantaneous	Can be specified within the range of 1 to 10 seconds. (in 1-second increments)			1-second		
		Total (flow rate/time)	Up to the start time to stop time, specified in the total measurement mode.					
Total measurement mode		Manual	Total up to the start to stop signal specified on the panel or by an external signal (communications or remote box the FM-0200).					
		Flow rate setting method	Total time/revolutions from the start signal up to the specified total flow rate.			Total time from the start signal up to the specified total flow rate.		
		Time setting method	Total flow rate/revolutions from the start signal up to the specified total time.			Total flow rate from the start signal up to the specified total time.		
		Revolution setting method	Total flow rate/time from the start signal up to the specified total revolutions.			—		
Voltage output (*6)		Flow rate	0 to 10V / Low to High (Low and High values are variable.)			0 to 10V / 0 to F.S. (F.S. value is selectable from 100/200/300/500/1000/1500 (kg/h, L/h))		
		Density				0 to 10V / 0 to 1g/cm^3		
		Temperature				0 to 10 V/ 0 to 100ºC		
Pulse output		Pulse output	FZ-2100: Selectable from 0.001/0.01 (mL/P, g/P) FZ-2200: Selectable from 0.1/1 (mL/P, g/P)					
		Output specification	Frequency range: 0 to 100kHz, Output H level: 2.4V or more, L level: 0.8V or less					
Outer dimensions			See (11) on Page 15			See (12) on Page 15.		

(*1) Total value can be displayed up to 7 digits. The position of the decimal point moves to the right or left depending on the number of decimal positions of the value.
(*2) Sectional total average revolution speed = Sectional total revolution / sectional total time
(*3) Total average revolution speed = Total revolution / total time
(*4) Sectional total average flow rate = Sectional total flow rate/ sectional total time
(*5) Total average flow rate = Total flow rate/ total time
(*6) Update interval of voltage output: 0.1 seconds, accuracy: ±0.1%/F.S.
(*7) The MP-9100 can be connected via the MX-0xx series cable, the MP-981 and the LG-916 can be connected via the MX-8000 series cable.

Equipment Configuration Examples



Types A and B: This is the standard system configuration when one detector is used.

Type C: A detector is installed at both the supply and return sides, and the difference is used to measure the fuel consumption. (Please consult us when using this type.)

The FM-0210A in Type C is an addition/subtraction module for two detectors.
(Each type of A,B or C is delineated by —. (FZ) indicates a detector.)

Mass Flow Rate Measurement Systems (Applications)

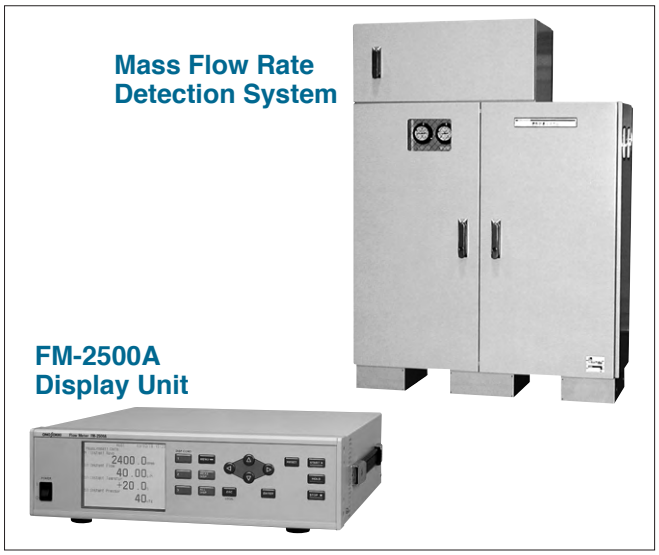
Mass Flow Rate Detection System

This system uses two detectors, the FP-2140H volumetric flow detector and the FZ-2200 mass flow detector. High-accuracy volumetric flow rate measurement values are converted using density measurement values and displayed as mass values.

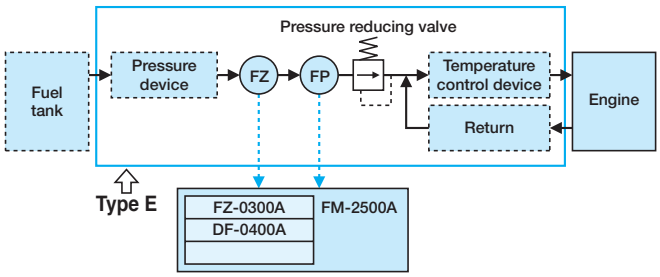
- Continuous measurement without being affected by temperature, pressure or density
- Wide measurement range (up to a ratio of 1000: 1 within ±0.35% of reading accuracy)
- Density measurement enabled
- A function for removing air bubbles to enable the supply of bubble-free fuel is provided.
- A device for initial air purging when workpieces are replaced is provided.

Item		Specification
Measurement parameters		Flow rate, Temperature or Density
Applicable fluids		Gasoline, Light oil, Kerosene, Standard petroleum oils or Alcohol fuels (option)
Measurement range	Normal mass flow rate	0.23 to 150kg/h at 0.75g/cm³
	Normal volumetric flow rate	0.3 to 200L/h
	Maximum flow rate	225kg/h (300L/h at 0.75g/cm³)
	Density (*1)	0 to 1g/cm³
Accuracy	Flow rate	Within ±0.35% of reading at 0.3 to 200L/h
	Density accuracy	±0.0005g/cm³
	Density reproducibility	±0.0002g/cm³
	Density temperature characteristic	±0.000015g/cm³/°C
Pressure loss		—
Operating temperature range (*1)		0 to +40°C
Weight		Approx. 200kg (including a solenoid valve controller)

(*1) Please consult us for temperature and densities that exceed the above ranges.



Mass Flow Rate Detection System (delineated by —)

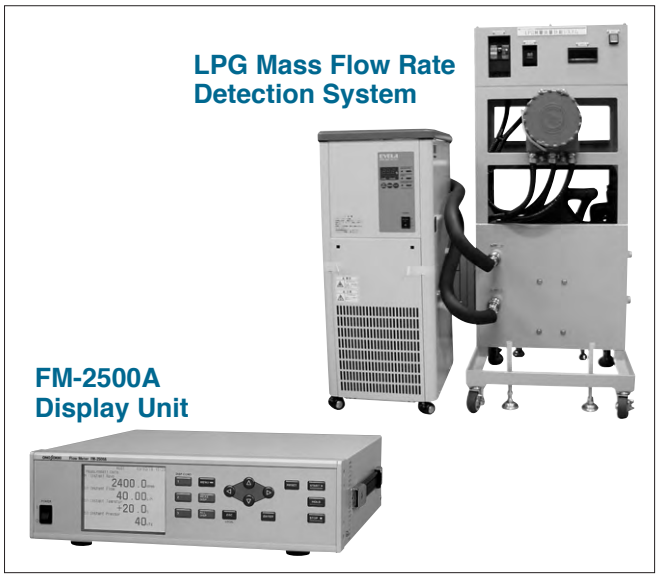


LPG Mass Flow Rate Detection System

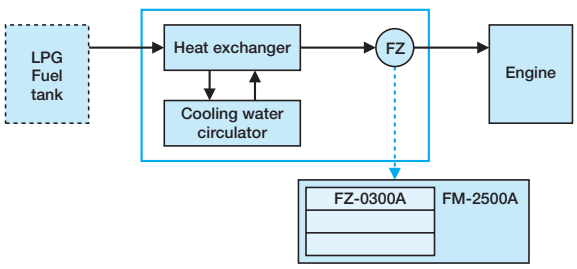
This system uses the FZ-2100 mass flow detector for high-accuracy detection of the mass of an LPG flow rate.

Item		Specification
Measurement parameters		Flow rate, Temperature or Density
Measurement range	Mass flow rate	0.2 to 60kg/h
	Density (*1)	0 to 1.0g/cm³
	Temperature	-20 to +55°C
Accuracy	Flow rate	±0.1% of reading at 2 to 60kg/h ±(0.002 kg/h/flow rate) x 100% of reading at 2kg/h or less
	Density	±0.0005g/cm³
	Temperature	Pt100Ω Class B
Pressure loss		Approx. 100kPa at 82kg/h
Operating temperature range (*1)		0 to +40°C
Weight		Approx. 200kg

(*1) Please consult us for temperature and density that exceed the above ranges.



LPG Mass Flow Rate Detection System (delineated by —)



Flow Meter Peripheral Devices

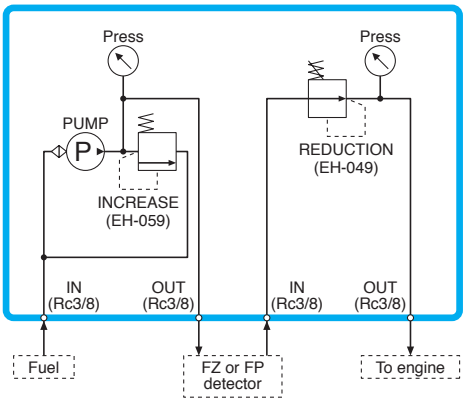
MF-113 Pressure Increase & Reduction Unit

The MF-113 is used to increase the pressure at the fuel supply side and to reduce the pressure at the detector output side.

Applicable fluids : Gasoline, light oil or kerosene
Maximum flow rate : Approx. 100L/h
Pressure increase adjustment range: 50 to 200kPa
Pressure reduction adjustment range: 20 to 70kPa
Withstand pressure : 200kPa
Joint : Hose nipple
R3/8 Internal diameter: ø6mm
External diameter: ø9mm
(for both IN and OUT on the pressure increase and reduction sections)
Power supply : 12VDC, approx. 3A
Weight : Approx. 13kg
Outer dimensions : 305 (W) x 332 (H) x 305 (D) mm

Example of use

MF-113



EH-049 Regulator Valve / EH-059 Relief Valve

Item \ Model Name	EH-049	EH-059
Settable pressure range	20 to 70kPa	50 to 200kPa
Withstand pressure	0.8Mpa or less	
Operating temperature range	0 to +70°C	
Connector fitting diameter	Rc1/4 (for both IN and OUT)	
Body material	Aluminum	
Weight	500g	

Compatible Filters and Filter Elements

Item \ Compatible detectors		For FP-213S/213	For FP-2140H/2240HA	For FP-215/2250A
For models with standard specification	Filter	EH-106	EH-1050	* (See Note)
	Element	Provided together with the filter unit	EH-015 (one set for 5 pieces)	
For models that can detect alcohol fuels	Filter	—	EH-107A	
	Element		* (See Note)	

* Note: Please contact us for details.

- **EH-1050**
  980kPa withstand pressure, element provided (paper, 5μm)
- **EH-106**
  980kPa withstand pressure, element provided with the main unit (sintered metal, 5μm)
  * Only an element cannot be provided.
- **EH-107A**
  980kPa withstand pressure, element provided (stainless steel wire mesh, 5μm)

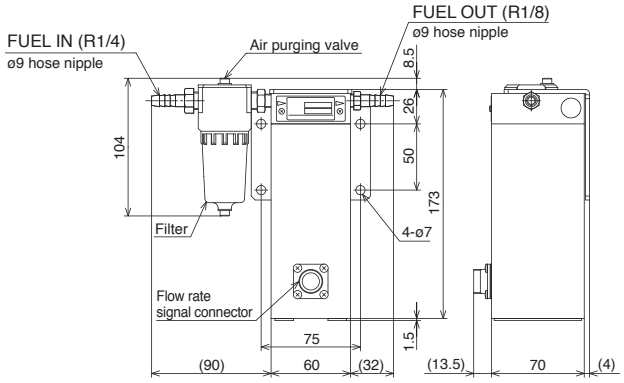
MF-015 Automatic Air Purging Tank

The MF-015 is an automatic air purging tank that uses a precision float valve. When fluid enters the flow line, the air is automatically purged to the atmosphere.

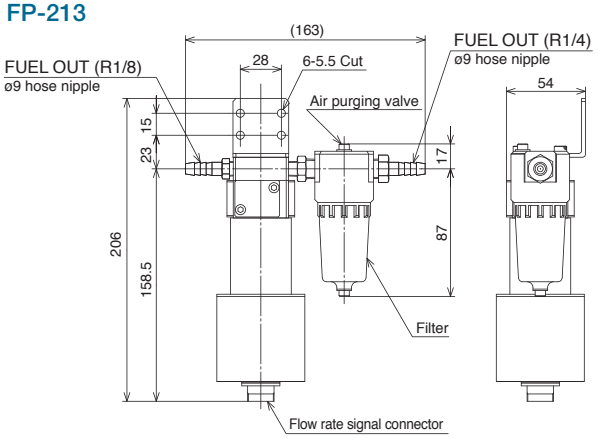
Applicable fluids : Gasoline, light oil or kerosene
Maximum flow rate : Approx. 100L/h
Tank capacity : 0.7L
Withstand pressure : 200kPa
Joint : Hose nipple
R1/4 Internal diameter: ø6mm
External diameter: ø9mm
(for both IN and OUT)
Weight : Approx. 1.8kg
Outer dimensions : ø93 (W) x 212 (H) mm

Outer Dimensions

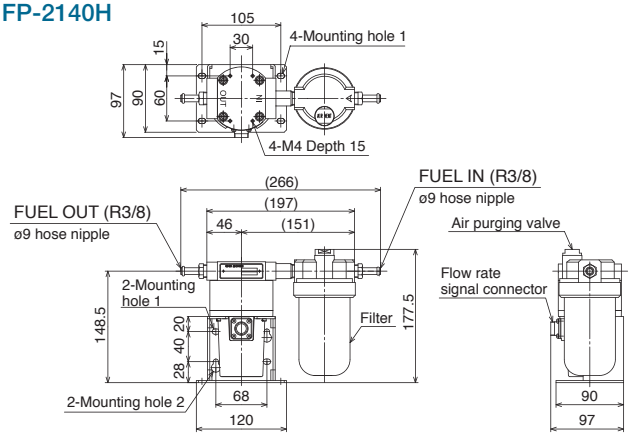
(1) FP-213S



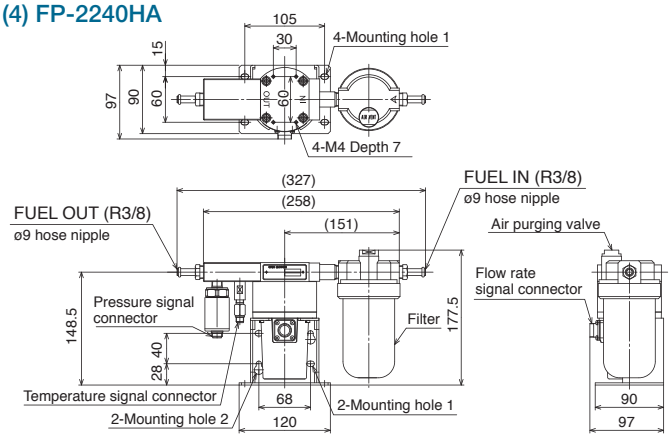
(2) FP-213



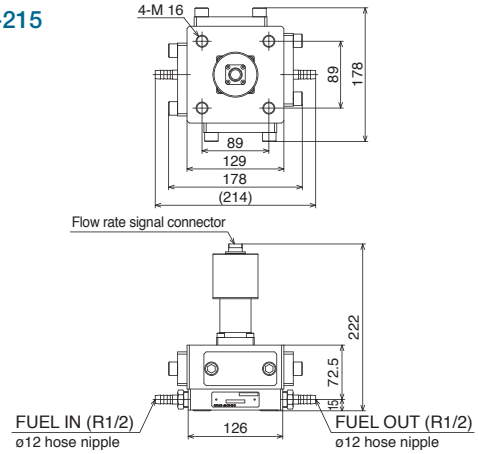
(3) FP-2140H



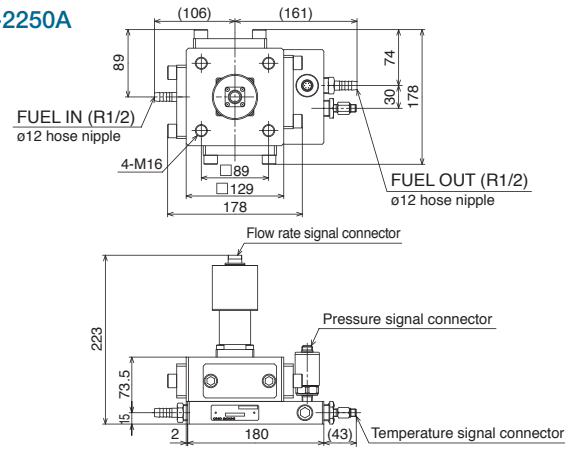
(4) FP-2240HA



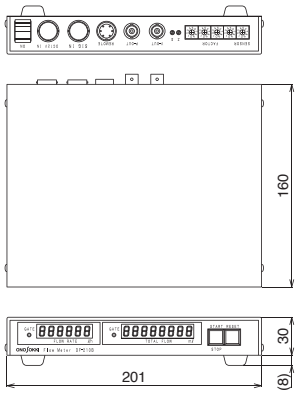
(5) FP-215



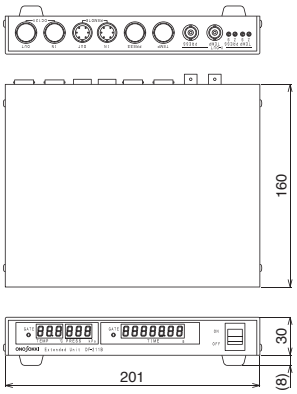
(6) FP-2250A



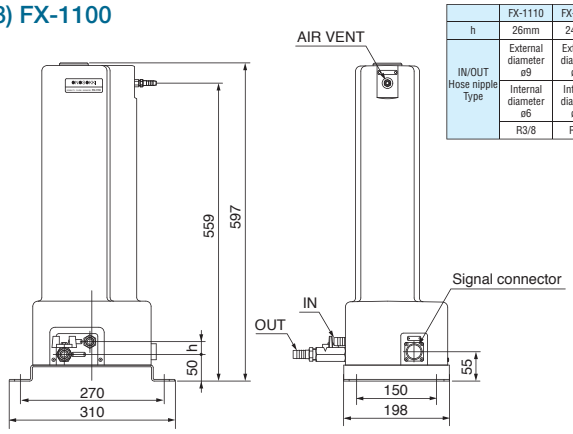
(7) DF-210B



DF-211B



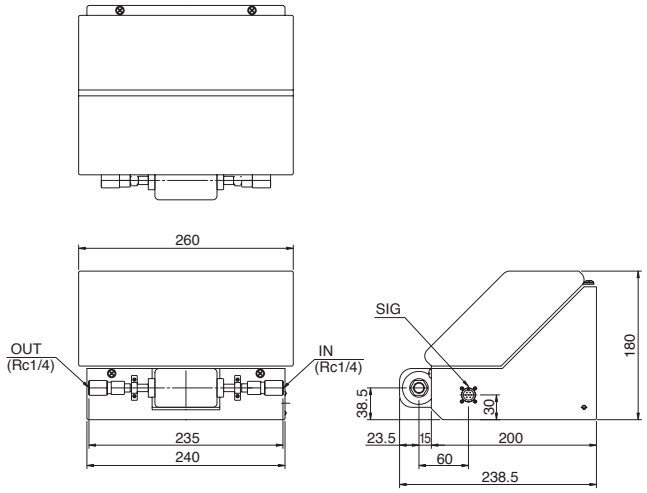
(8) FX-1100



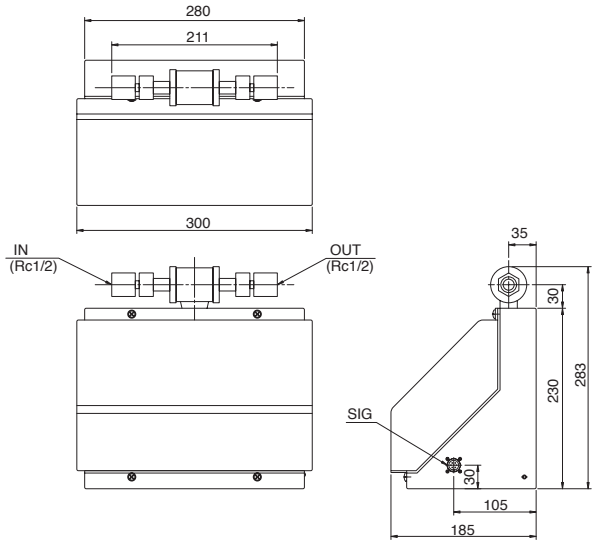
	FX-1110	FX-1120	FX-1130
h	26mm	24mm	9mm
IN/OUT Hose nipple Type	External diameter ø9	External diameter ø16	External diameter ø16
	Internal diameter ø6	Internal diameter ø12	Internal diameter ø12
	R3/8	R1/2	R1/2

Unit: mm

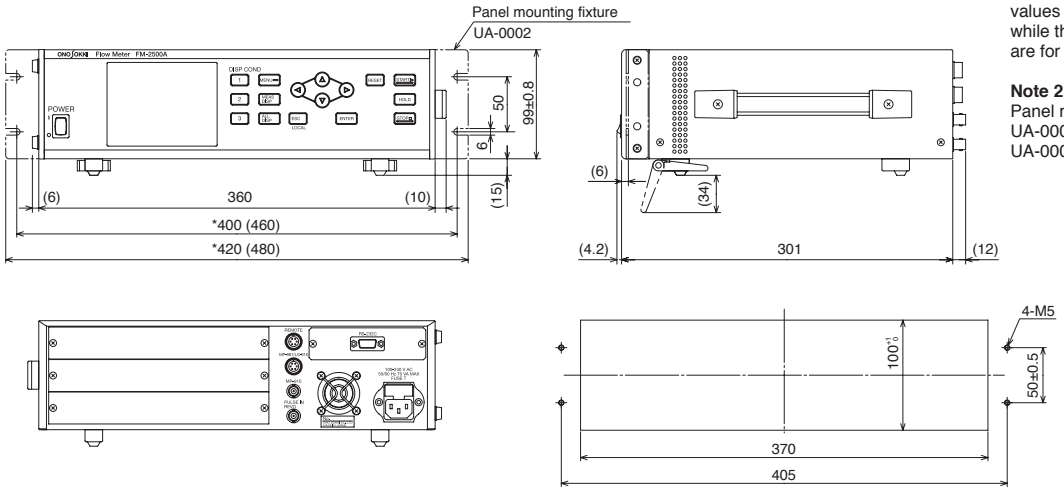
(9) FZ-2100



(10) FZ-2200



(11) FM-2500A

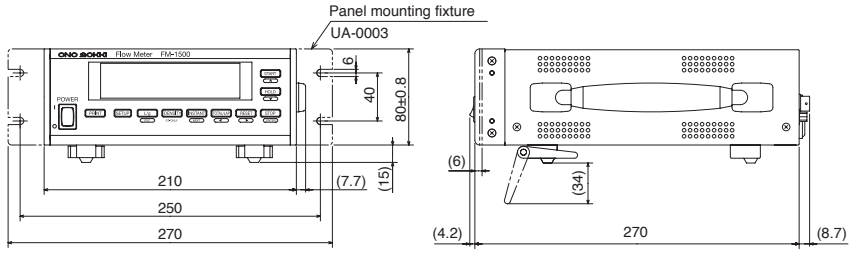


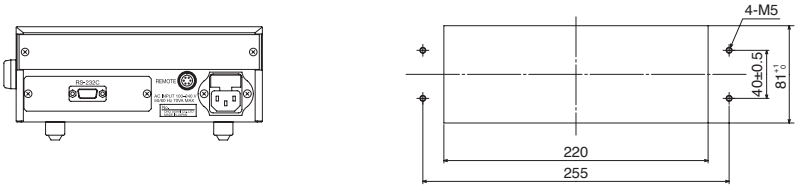
Panel cutout dimensions

Note 1:
The dimensions with the "⋆" mark are the values for the panel cutout dimensions while the values within the parentheses ( ) are for 480-mm rack.

Note 2:
Panel mounting fixture model names
UA-0001: For 480-mm rack
UA-0002: For panel mounting

(12) FM-1500

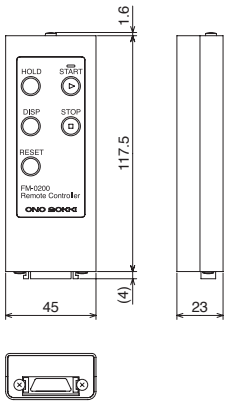




Panel cutout dimensions

Note:
Panel mounting fixture model name: UA-0003

(13) FM-0200 Remote box



FM-2500A/1500 Display Unit Common Specification (*1)

Item \ Model Name			FM-2500A (*2)	FM-1500
Display			LCD with CFL backlight, 320 x 240 dots	Fluorescent display tube (20 characters x 2 lines), 5 x 8 dots
Interface (*3)	Remote (*4)	Commands	Start, Stop, Hold, Reset or Display	
		Input levels	H: +2.4 to 15V, L: +0.8V or less	
	RS-232C (*5)		Communication method: asynchronous full-duplex mode, data length: 8bits Baud rate (*6): 9600, 19200, 38400, 57600, 115200bps	
	GPIB		Option (model name: FM-0263)	
	Digital input/output		Option (model name: FM-0361)	—
Memory function	Measurement memory	Capacity	300 addresses	
		Capture timing	Automaticlly saved when Hold or Stop, automatic increment of addresses from 001 to 300	
	Memory backup	Memory capacity	1Mbyte (SRAM)	
		Data backup period	Approx. 1.5 months (at 25°C) Battery: coin-type vanadium lithium secondary battery	
General specification	Environmental condition	Storage temperature/ humidity range	-20 to +60°C, 10 to 90% RH (with no condensation)	
		Operating temperature/ humidity range	0 to +40°C, 10 to 90% RH (with no condensation)	
	Weight		Approx. 7kg (When measurement modules are installed in 3 channels.)	Approx. 4.2kg
	Power requirement	Power requirement	100 to 240VAC ±10%, 50/60Hz	
		Maximum current consumption	40VA or less External fuse: 2A	30VA or less External fuse: 2A
	Insulation resistance		10MΩ or more (500VDC rated power supply)	
	Withstand voltage		1500VAC for one minute	
	Compatible shock-resistance standard		JIS C 0041:1999 (peak acceleration: 300m/s^2, shock application period: 18ms)	
	Compatible vibration-resistance standard		JIS C 0040:1999 (vibration acceleration: 10m/s^2, vibration frequency range:10 to 150Hz)	
	Compatible standard		IEC/EN61010-1: 2001 (2nd Edition)	

(*1): The above specifications are specifications that are common to the FM-2500A and FM-1500 (Pages 5/9/11). Moreover, " – " indicates specifications that are not included with the FM-1500.
(*2): CE marking is available when it is combined with the FZ series and some of the FP series. Please consult us for details.
(*3): Only one interface unit can be installed. The RS-232C interface cannot be used if a GPIB interface is installed.
(*4): The model name of Remote Box is the FM-0200, and the outer dimensions are given on Page 15.
(*5): With the FM-1500, the DPU-414 digital printer (option) can be used to print out measured values. (RS-232C interface)
(*6): Baud rate of the FM-1500: 9600bps

- CE marking is available depending on the model. Please consult us for details.
- Signal cables between fuel flow detectors and displaying units are sold separately.
- The FM-1500 cannot be compatible with the FX-series detector.

ONO SOKKI

• Outer appearance and specifications are subject to change without prior notice.
URL: http://www.onosokki.co.jp/English/english.htm

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