

High-Precision Fuel Flow Meters

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



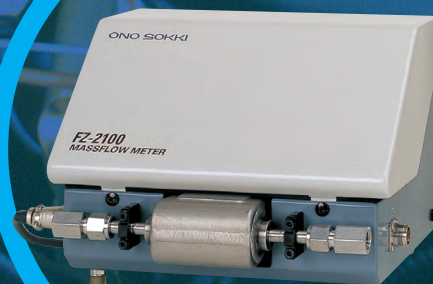
FP Series



FX Series



FM-2500A



FZ Series

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.

ONOSOKKI

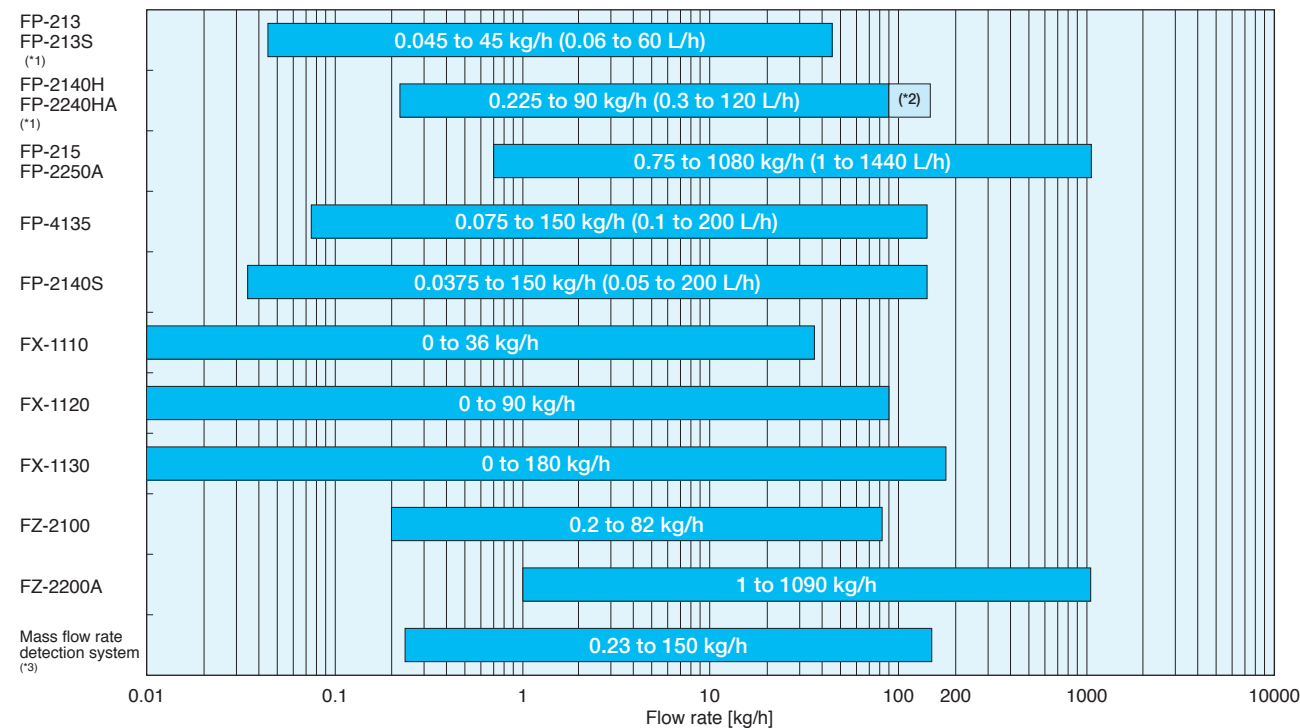
High-Precision Fuel Flow Meter Series that Support Automobile Energy Conservation Countermeasures

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

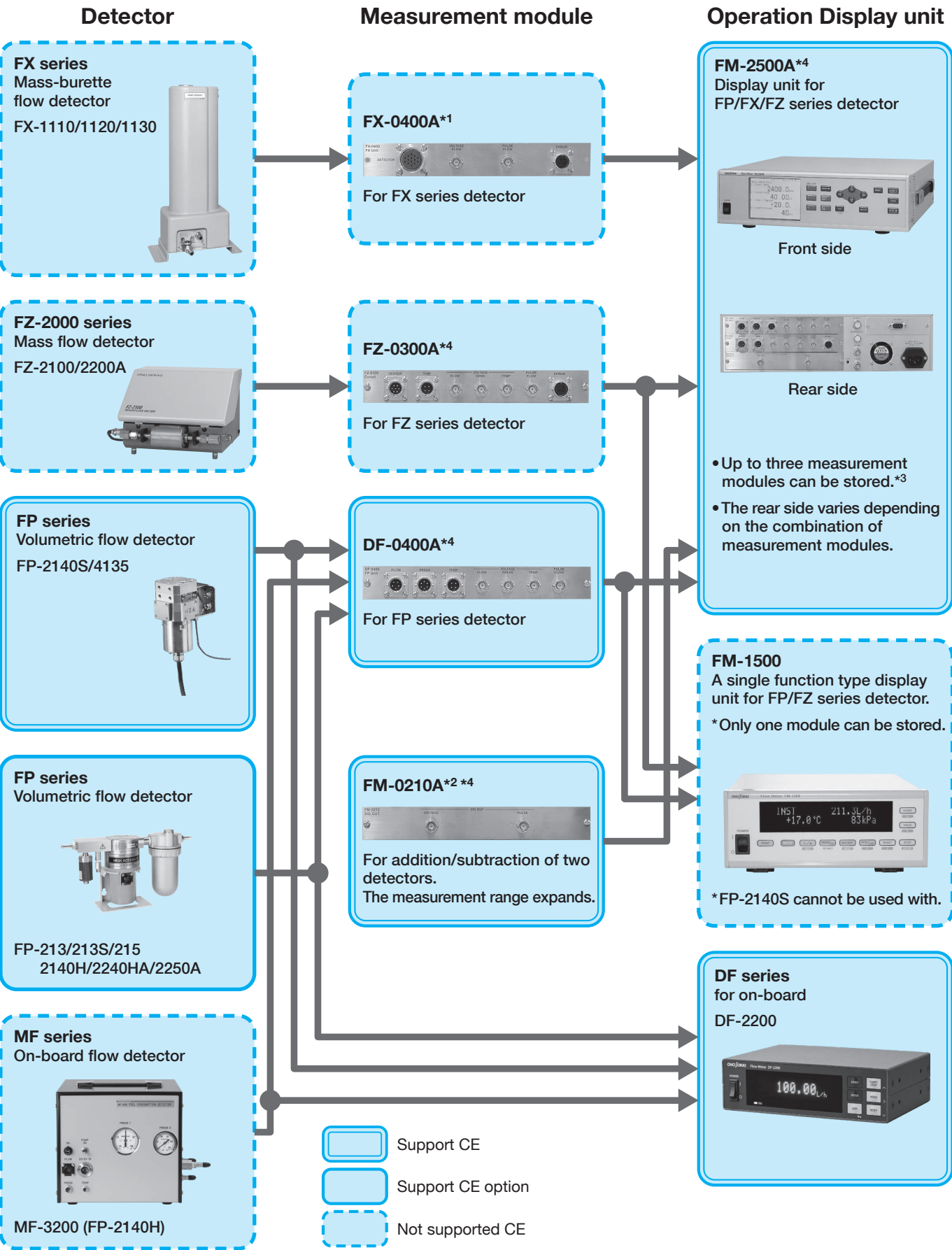
- FP Series Detectors**
 - Volumetric flow measurement
 - Capable of long-term continuous flow rate measurement
 - Capable of on-board measurement
- FX Series Detectors**
 - Gravity flow measurement
 - Capable of performing measurement from zero flow (ultra-wide range)
 - Can perform continuous measurement up to a maximum of 1000 g (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): The values are those converted into mass flow rate at a density of 0.75 g/cm³.
(*2): applies when the 0.225 to 150 kg/h (0.3 to 200 L/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



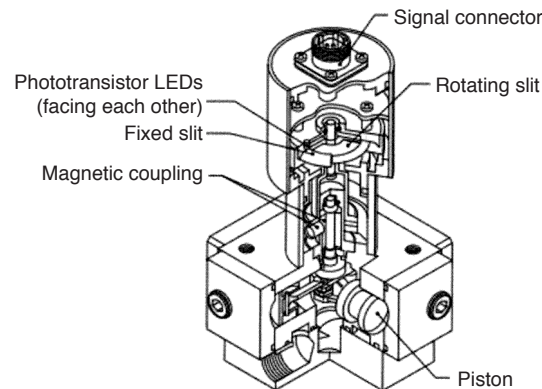
*1: Modules for FX series detectors can only be used in the top slot. It cannot be used in combination with other measurement modules.
*2: It is for FP/FZ series detectors. Cannot be used for FX series detectors. (See P.5)
*3: It can be combined with the same three measurement modules or other measurement modules. (Up to three units.) Refer to the configuration example for combination.
*4: It can support CE by combining some of the FP series detectors with the FM-2500A.

Features

- Wide measurement range thanks to a flow rate ratio (range ability 1/400 or more)
- Capable of compensating for errors caused by pulsating or backflow by means of a function for judging the rotation direction
- 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/FP-4135)

* Pressure measurement with FP-4135 is an option.

- High resistance to the environment. (FP-4135)

The Detection Principle

Four pistons are arranged radially in the flow detection unit, and move back and forth repeatedly due 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.

Detector Specification

Item	Model Name	FP-213S	FP-213	FP-2140H	FP-2240HA	FP-2140S	FP-4135	FP-215	FP-2250A
Measurement parameters	Flow rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Temperature	—	—	—	Yes	—	Yes	—	Yes
	Pressure	—	—	—	Yes	—	Option	—	Yes
Applicable fluids	Gasoline	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Light oil	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Kerosene	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Standard ⁽¹⁾ petroleum oils	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Alcohol fuels	Option	Option	Option	Option	Option	Yes	Option	Option
	Biofuel	Option	Option	Option	Option	Option	Yes	Option	Option
Measurement range	Flow rate	0.06 to 60 L/h (1 to 1000 mL/min)		0.3 to 120 L/h ⁽²⁾ (5 to 2000 mL/min)		0.05 to 200 L/h (0.8 to 3333 mL/min)	0.1 to 200 L/h (1.7 to 3333 mL/min)	1 to 1440 L/h (17 to 24000 mL/min)	
	Temperature	—	—	—	0 to +99.9 °C	—	-30 to +100 °C	—	0 to +99.9 °C
	Pressure	—	—	—	0 to 980 kPa	—	—	—	0 to 980 kPa
Accuracy	Flow rate	Within ±0.5 % of reading (over the entire measurement range)	Within ±0.0009 L/h (from 0.06 to 0.18 L/h) Within ±0.5 % of reading (from 0.18 to 60 L/h)	Within ±0.2 % of reading (over the entire measurement range)				Within ±0.018 L/h (from 1 to 3.6 L/h) Within ±0.5 % of reading (from 3.6 to 1440 L/h)	
	Temperature	—	—	—	Pt 100 Ω Class B	—	Pt 100 Ω class A	—	Pt 100 Ω Class B
	Pressure	—	—	—	±0.5 % of F.S.	—	—	—	±0.5 % of F.S.
Minimum resolution	Flow rate	0.01 mL/0.01 L/h		0.1 mL/0.1 L/h		0.01 mL/0.01 L/h	0.01 mL/0.01 L/h	1 mL/1 L/h	
	Temperature	—	—	—	0.1 °C	—	0.1 °C	—	0.1 °C
	Pressure	—	—	—	1 kPa (DF-2200: 0.1 kPa)	—	—	—	1 kPa (DF-2200: 0.1 kPa)
Operating range	Flow rate	Same as the measurement range							
	Fluid pressure	980 kPa	980 kPa ⁽⁴⁾			980 kPa	8 MPa	3.4 MPa ⁽⁴⁾	980 kPa ⁽⁴⁾
	Fluid temperature	0 to 60 °C	0 to 65 °C			0 to 50 °C	-30 to +100 °C	0 to 65 °C	
	Operating temperature range	0 to 60 °C	0 to 65 °C			0 to 60 °C	-30 to +100 °C ⁽⁶⁾	0 to 65 °C	
Pressure loss		0.01 kPa or less (excluding filter pressure loss)	8 kPa or less ⁽³⁾ (at 40 L/h, for gasoline)	2 kPa or less ⁽³⁾ (at 60 L/h, for gasoline)		0.01 kPa or less ⁽³⁾ (excluding filter pressure loss)	4 kPa or less ⁽³⁾ (60 L/h, gasoline)	7.4 kPa or less ⁽³⁾ (at 500L/h, for light oil)	
Filter		EH-106A provided as standard		EH-1050 provided as standard			Filter is built-in	Provided as standard	
Weight		Approx. 2.5 kg (including filter)	Approx. 2.0 kg (including filter)	Approx. 4.5 kg (including filter)	Approx. 5.0 kg (including filter)	Approx. 9.0 kg (including filter)	Approx. 2.4 kg (including signal processing part)	Approx. 14 kg (including separately-attached filter)	Approx. 15 kg (including separately-attached filter)
Connector diameter		IN : Rc 1/4 OUT: Rc 1/8		IN : Rc 3/8 OUT: Rc 3/8			IN : Rc 1/4 ⁽⁵⁾ OUT: Rc 1/4 ⁽⁵⁾	IN : Rc 1/2 OUT: Rc 1/2	
Outer dimensions		See outer dimensions for each (page 14 and 15).							

(*)1: Please consult us for details.

(*)2: 0.3 to 200 L/h, 0.3 to 300 L/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.

(*)5: Optional joint is available. Please consult us for details.

(*)6: The operating temperature range of the signal processing part of FP-4135 is 0 to +70 °C.

FM-2500A/1500/DF-2200 Display Unit Specification * There is a description of common specification on P.16.

Item		Model Name	FM-2500A	FM-1500	DF-2200					
Applicable flow detectors		FP-213/213S	Yes	Yes	Yes					
		FP-2140H	Yes	Yes	Yes					
		FP-2240HA	Yes	Yes	Yes					
		FP-215	Yes	Yes	—					
		FP-2250A	Yes	Yes	—					
		FP-4135	Yes	Yes	Yes					
		FP-2140S	Yes	—	Yes					
		MF-3200	Yes	Yes	Yes					
Applicable revolution detectors		MP-9100	Yes	—	—					
		MP-981	Yes	—	—					
		LG-9200	Yes	—	—					
Measurement parameter and number of digits	Time measurement	Interval integration time ^{(*)1}	0.00 to 9999999 s (max. 7 digits)							
		Integration time ^{(*)1}	0.00 to 9999999 s (max. 7 digits)							
		Revolution speed	0.0 r/min (max. 7 digits)	—	—	—				
		Interval average revolution speed ^{(*)2}	0.0 r/min (max. 7 digits)	—	—	—				
		Interval integration revolution speed	0 to 9999999 REV (max. 7 digits)	—	—	—				
		Average revolution speed ^{(*)3}	0.0 r/min (max. 7 digits)	—	—	—				
		Integration revolution speed	0 to 9999999 REV (max. 7 digits)	—	—	—				
	Pressure measurement	Pressure	0 to 9999 kPa (max. 4 digits)		0 to 9999.9 kPa					
	Temperature measurement	Temperature	±0.0 to 999.9 °C (max. 4 digits)							
	Flow rate measurement ^{(*)6,*)7}	Display digit		FM-2500A	FM-1500	DF-2200	Display item	Unit	FM-2500A	FM-1500
FP-4135		—	0.01 to 9999999	0.01 to 9999999	0.01 to 9999999.9	Instantaneous flow	mL/s, mL/min, g/s, g/min	Yes	Yes	—
FP-213S		120P/R	0.01 to 9999999	0.01 to 9999999	0.01 to 9999999.9		L/h, kg/h	Yes	—	Yes
FP-213		1200P/R	0.001 to 9999999	0.001 to 9999999	0.001 to 9999999.9	Interval integration flow	mL, g	Yes	Yes	—
FP-2140H		120P/R	0.1 to 9999999	0.1 to 9999999	0.1 to 9999999.9	^{(*)1}	L, kg	Yes	—	Yes
FP-2240HA		1200P/R	0.01 to 9999999	0.01 to 9999999	0.01 to 9999999.9	Integration flow ^{(*)1}	mL, g	Yes	Yes	—
FP-2140S		1440P/R	0.01 to 9999999	0.01 to 9999999	0.01 to 9999999.9		L, kg	Yes	—	—
FP-215		120P/R	1 to 9999999	1 to 9999999	—	Interval average flow ^{(*)4}	mL/s, mL/min, g/s, g/min	Yes	Yes	—
FP-2250A		1200P/R	0.1 to 9999999	0.1 to 9999999	—		L/h, kg/h	Yes	—	—
						Average flow ^{(*)5}	mL, g	Yes	—	—
							L, kg	Yes	—	—
						Injection amount	mm³/st, mg/st	Yes	—	—
						Interval average injection amount	mm³/st, mg/st	Yes	—	—
						Average injection amount	mm³/st, mg/st	Yes	—	—
Measurement time	Instantaneous	Can be specified within the range of 1 to 10 seconds. (in 1-second increments)		1-second		Can be specified to 500ms or 1 s.				
	Integration	Integration from start time to stop time, specified in the integration measurement mode.								
Integration measurement mode	Manual	Integration from the start to stop signal specified on the panel or by an external signal (communications or remote box (FM-0200))								
	Flow rate setting method	Integration time/revolutions from the start signal to the specified integration flow rate.			Integration time from the start signal to the specified integration flow.					
	Time setting method	Integration flow rate/revolutions from the start signal to the specified integration time.			Integration flow from the start signal to the specified integration time.					
	Revolution setting method	Integration flow rate/time from the start signal to the specified integration revolutions.			—					
Voltage output	Flow rate	0 to 10 V/Low to High (Low and High values can be optionally specified.)			0 to 10 V/0 to F.S. (F.S. value is selectable from 100/200/300/500/1000 /1500 (kg/h, L/h).)		Voltage output: 0 to 10 V Range setting: 0 to 60/100/120/200/300 (unit: L/h and kg/h)			
	Pressure	0 to 10 V/Low to High (Low and High values can be optionally specified.)			0 to 10 V/0 to F.S. (F.S. value is selectable from 200/500/980/1000 (kPa).)		Voltage output: 0 to 10 V Range setting: selectable from 200/500 /980/1000 kPa (input: 0 to +5 V)			
	Temperature	0 to 10 V/Low to High (Low and High values can be optionally specified.)			0 to 10 V/0 to 100 °C		Voltage output: 0 to 10 V Range setting: selectable from 0 to 100, -50 to 100 °C			
Pulse output	Pulse output	Output items: instantaneous flow rate, pulse output: 0.001/0.01/0.1 (mL/P or g/P) and direct								
	Output specification	Output H level: + 2.4 V or more Output L level: + 0.8 V or less						Output HIGH level: 4.5 V or more Output LOW level: 0.4 V or less		

(*)1: Integration 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: Interval average revolution speed = Interval integration revolution / interval time

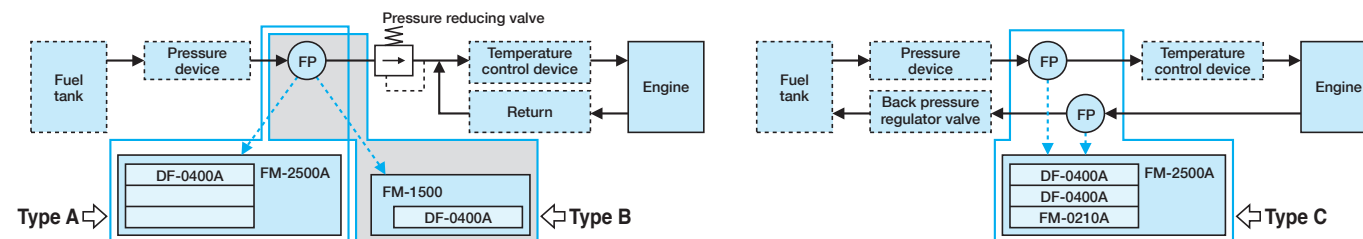
(*)3: Average revolution speed = Integration revolution / integration time

(*)4: Interval average flow = Interval integration flow / interval time

(*)5: Average flow = Integration flow / integration 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.

(*)7: By selecting the encoder pulse setting to be multiplied by 10 for the display digit, it is possible to increase the number of digits after the decimal point by one digit. (Excluding FP-2140S, FP-4135).

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 <ul style="list-style-type: none"> Measurement range: 0.06 to 60 L/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 <ul style="list-style-type: none"> Measurement range: 0.06 to 60 L/h Range ability: 1/1000 Accuracy: within ± 0.5 % of reading (0.18 to 60 L/h)
FP-2140H 	Standard flow rate type <ul style="list-style-type: none"> Measurement range: 0.3 to 120 L/h Range ability: 1/400 Accuracy: within ± 0.2 % of reading 	FP-2240HA 	Standard flow rate, simultaneous measurement of temperature and pressure type <ul style="list-style-type: none"> Measurement range: 0.3 to 120 L/h Range ability: 1/400 Accuracy: within ± 0.2 % of reading Simultaneous measurement of temperature and pressure
FP-215 	Large flow rate type <ul style="list-style-type: none"> Measurement range: 1 to 1440 L/h Range ability: 1/1440 Accuracy: within ± 0.5 % of reading (3.6 to 1440 L/h) Ideal for measuring the flow rate of engines used in buses, trucks, and other large vehicles, as well as marine engines 	FP-2250A 	Large flow rate, simultaneous measurement of temperature and pressure type <ul style="list-style-type: none"> Measurement range: 1 to 1440 L/h Range ability: 1/1440 Accuracy: within ± 0.5 % of reading (3.6 to 1440 L/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
FP-2140S 	Low pressure loss & ultra wide range, high accuracy and high resolution type <ul style="list-style-type: none"> Measurement range: 0.05 to 200 L/h Accuracy: within ± 0.2 % of reading Range ability: 1/40000 Low pressure loss (10 Pa or less) 	FP-4135 	On-board type <ul style="list-style-type: none"> Measurement range: 0.1 to 200 L/h Accuracy: within ± 0.2 % of reading Range ability 1/2000 Operating temperature: -30 to +100 °C Corresponding to standard alcohol

DF-2200 On-board Flow Meter

This is a small flow rate display for FP series detector and MF series detector.

Options

DF-0223 Remote box

This is a remote switch for START / STOP / RESET at integration measurement.

CT-0676 Light Shielding Hood

This is designed to protect the body from heat caused by sunlight when mounted on vehicle.

DF-2200



Specification

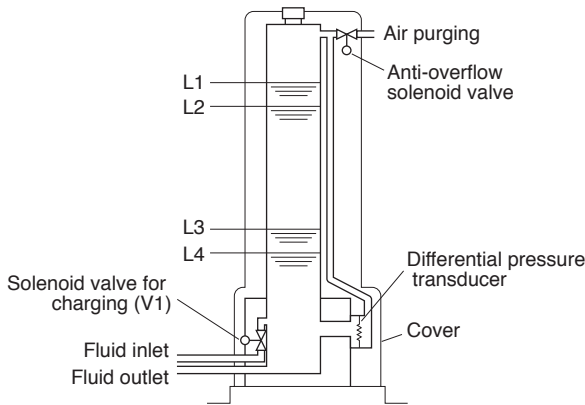
Item	Model Name	DF-2200
Applicable detector	FP-4135, FP-213/213S, FP-2140H, FP-2240HA, FP-2140S, MF-3200	
Display method	Fluorescent display tube 11.45 mm x 69.85 mm (2-stage display)	
Display item and digit number	Integration flow	0.000 to 999999.9 • When the display value reaches its maximum, change and display the decimal point. • The decimal point is variable according to the weight per selected pulse. • When the multiplication is ON, add one decimal digit to the above values.
	Instantaneous flow	0.0000 to 99999.9 • The decimal point is variable according to the weight per selected pulse. • When the multiplication is ON, add one decimal digit to the above values.
	Pressure	0.0 to 9999.9 (kPa)
	Temperature	± 0.0 to 999.9 (°C)
	Integration time	0.00 to 99999.9 (s) • If the number of digits of the value is insufficient, the decimal place is rounded up to display.
Output section	Voltage output	Instantaneous flow Voltage output: 0 to 10 V Range setting: 0 to 60/100/120/200/300 (unit: L/h and kg/h) Update period: 10 ms (standard)/1 ms (option) • Average indexation settings (Standard): $1 \leq N \leq 1000$ (initial value N=30) (Option): $1 \leq N \leq 10000$ (initial value N=300)
		Temperature Voltage output: 0 to 10 V Range setting: select from 0 to 100, -50 to 100 °C Update period: 100 ms • Average indexation settings $1 \leq N \leq 10$ (initial value N=2)
	Pressure	Voltage output: 0 to 10 V Range setting: select from 200/500/980/1000 kPa (for input: 0 to +5 V) Update period: 10 ms/1 ms (option) • Average indexation settings (Standard): $1 \leq N \leq 100$ (initial value N=20) (Option): $1 \leq N \leq 10000$ (initial value N=200)
		Pulse output The number of output pulse: 0.001/0.01/0.1 (mL/Pulse or g/Pulse) and direct Minimum pulse duration: approx. 1 μ s, Output item: instantaneous flow Output waveform: square wave duty 50 % High level: +4.5 V or more Low level: +0.4 V or less
	CAN output	Protocol: conforms to CAN Ver. 2.0B Bus data format: Endian: Big Endian (Motorola) ID: 0x721 (initial value) 0x001 to 0x7FF Variable Termination resistor: ON/OFF function Baud rate: 125 kbps/250 kbps/500 kbps/1 Mbps Output update cycle: select from OFF/1 Hz/2 Hz/5 Hz/10 Hz/20 Hz/100 Hz/1 kHz (option) Output item: instantaneous flow (L/h)/temperature (°C)/pressure (kPa)/integration flow (L) (option)/ integration time (s) (option)
Function section	RS-232C (option)	
	Instantaneous flow average	
	Instantaneous flow analog output	
	Indexation average	
	Backward flow correction	
	Density temperature correction function (convert into weight)	
	Output calibration (CAL)	
	Factor	
	Power source	
	Current consumption	
General specification	Operating environment	
	Altitude	
	Operating temperature range	
	Storage temperature range	
	Operating humidity range	
	Storage humidity range	
	Outer dimensions	
	Weight	
	Safety	
	Conforming standard	
Option software		DF-0221: Auto stop function DF-0224: DA/CAN high speed output function (an option to make the output speed higher from 10 ms to 1 ms.) DF-0225: CAN integrated value output function

FX Series Gravity Flow Detectors

Features

- High-accuracy flow rate measurement over a wide range
- Built-in air purging function to counteract the mixing 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.
- Measurement accuracy: within the combined range of $\pm 0.2\%$ of reading value and $\pm 0.01\%$ of F.S.

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 10 g/s (0 to 36 kg/h)	0 to 25 g/s (0 to 90 kg/h)	0 to 50 g/s (0 to 180 kg/h)
Accuracy (*1)		Within the combined range of ±0.2 % of reading value and ±0.01 % of F.S.		
Instantaneous flow resolution		0.001 g/s	0.01 g/s	
Integration flow resolution		0.01 g		0.1 g
Maximum integration amount (single fill operation)		200 g	500 g	1000 g
Operating maximum pressure		196kPa		
Operating temperature range (*2)		0 to +40 °C (with no freezing)		
Open-atmosphere processing		Solenoid valve for overflow protection		
Inlet, outlet, and return joints		R3/8 Internal diameter: φ6 External diameter: φ9 Hose nipple (for both IN and OUT)	R1/2 Internal diameter: φ12 External diameter: φ16 Hose nipple (for both IN and OUT)	
Weight		Approx. 13 kg		
Outer dimensions		See (9) on Page 15		

(*)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 series



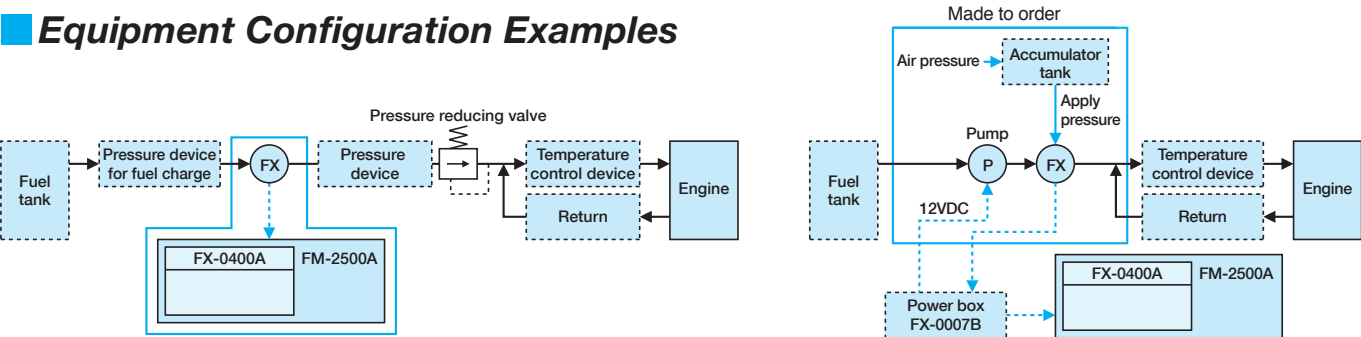
FM-2500A Display Unit Specification

* There is a description of common specification on P.16.

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-9200 ^(*)					
Measurement parameter and number of digits	Time measurement	Interval integration time ^(*)	0.00 to 9999999 s (max. 7 digits)					
		Integration time ^(*)						
	Revolution measurement	Revolution speed	0.0 r/min (max. 7 digits)					
		Interval average revolution speed ^(*)						
		Interval integration revolution speed	0 to 9999999 REV (max. 7 digits)					
		Average revolution speed ^(*)	0.0 r/min (max. 7 digits)					
		Integration revolution	0 to 9999999 REV (max. 7 digits)					
	Flow rate measurement (max. 7 digits) ^(*)	Applicable detectors	FX-1110	FX-1120	FX-1130	Units		
		Instantaneous flow	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	
		Interval integration flow ^(*)	0.00 to 9999999		0.0 to 9999999		mL, g, L, kg	
		Integration flow ^(*)						
		Interval average flow ^(*)	Same as for instantaneous flow					
Average flow ^(*)								
Injection amount								
Interval average injection amount	0.00	0.0		mm³/st, mg/st				
Average injection amount								
Measurement time		Instantaneous	Can be specified within the range of 1 to 10 seconds (in 1-second increments).					
		Integration	Integration from the start time to stop time, specified in the integration measurement mode.					
Integration measurement mode		Manual	Integration from the start to stop signal specified on the panel or by an external signal (communications or remote box (FM-0200)).					
		Flow rate setting method	Integration time/revolutions from the start signal to the specified integration flow rate.					
		Time setting method	Integration flow rate/revolutions from the start signal to the specified integration time.					
		Revolution setting method	Integration flow rate/time from the start signal to the specified integration revolutions.					
Alarm output			Overflow (L1 level): Monitor display and external contact output Low fluid surface (L4 level): Monitor display and external contact output					
Voltage output ^(*)		Flow rate	0 to 10 V/Low to High (Low, High values can be optionally specified.)					
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 100 kHz, Output H level: +2.4 V or more, L level: +0.8 V or less					
Outer dimensions			See (12) on Page 15.					

(*)1 Integration 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 Interval average revolution speed = Interval integration revolution / interval time
(*)3 Average revolution speed = Integration revolution / integration time
(*)4 Interval average flow = Interval integration flow / interval time
(*)5 Average flow = Integration flow / integration time
(*)6 Displayed value of volumetric flow is the value converted at density / temperature / temperature correction coefficient specified in advance.
(*)7 Update interval of voltage output: 0.1 seconds, accuracy: $\pm 0.1\%$ /F.S.
(*)8 The MP-9100 can be connected via the MX-0xx series cable, the MP-981 and the LG-9200 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:

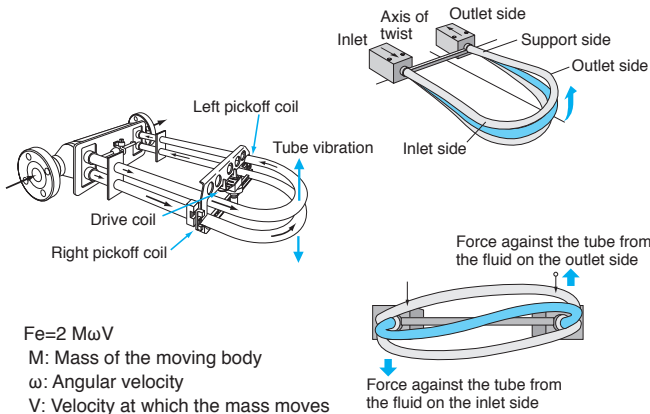
An accumulator tank is used to enable an increase in pressure.
Use this method when fuel cannot be supplied due to reasons such as not being able to install the detector in a high position.
(The FX-0007B power box is an option.)

Features

- Continuous measurement without being affected by temperature, pressure, and density
- High measurement accuracy (up to range ability 1/40 within ±0.1 % of reading accuracy)
- Density measurement enabled
- The case for purging internal air is provided to each detector.

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 with Coriolis force generates a twist proportional to the mass flow rate, the mass flow rate is calculated from the amount of this twist.

The Detection Principle



Detector Specification

Item	Model Name	FZ-2100	FZ-2200A
Measurement parameters		Flow rate, Temperature, and Density	
Applicable fluids ^(*)		Gasoline, Light oil, Kerosene, Water, Standard petroleum oils, or Alcohol fuels (option)	
Measurement range	Normal mass flow rate	0.2 to 82 kg/h	1 to 1090 kg/h
	Normal volumetric flow rate	0.27 to 109 L/h at 0.75 g/cm ³	1.33 to 1453 L/h at 0.75 g/cm ³
	Maximum flow rate	108 kg/h	2180 kg/h
	Density ^(*)	0 to 1 g/cm ³	
Accuracy	Flow rate	±0.1 % of reading at 2 to 82 kg/h ±(0.002 kg/h/flow rate) × within 100 % of reading at 0.2 to 2 kg/h	±0.1 % of reading at 27 to 1090 kg/h ±(0.027 kg/h/flow rate) × within 100 % of reading at 1 to 27 kg/h
	Density	±0.0005 g/cm ³	
	Density reproducibility	±0.0002 g/cm ³	
	Density temperature characteristic	±0.000015 g/cm ³ /°C	
Pressure loss (when measuring gasoline)		Approx. 100 kPa at 82 kg/h	Approx. 100 kPa at 1090 kg/h
Withstand pressure		10 MPa	
Operating temperature range ^(*)		0 to +40 °C	
Weight		Approx. 12 kg	Approx. 9 kg
Outer dimensions		See (10) on Page 15	See (11) on Page 15

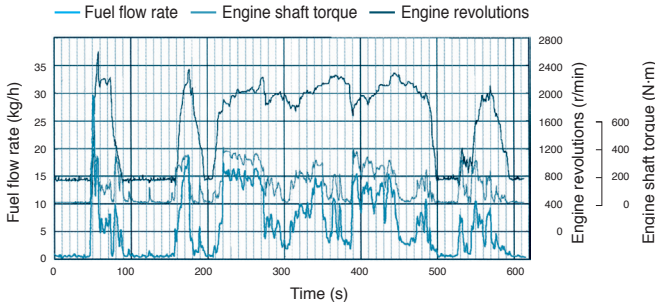
(*)1: Can also be used with CNG and LPG gases (option). Please consult us for details.

(*)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

* There is a description of common specification on P.16.

Item			Model Name			FM-2500A (FM-2500A + FZ-0300A)			FM-1500 (FM-1500 + FZ-0300A)		
Applicable flow detectors			FZ-2100 or FZ-2200A								
Applicable revolution detectors			MP-9100, MP-981 or LG-9200 ^(*)				—				
Measurement parameter and number of digits	Time measurement	Interval integration time ^(*)	0.00 to 9999999 s (max. 7 digits)								
	Revolution measurement	Integration time ^(*)									
		Revolution speed									
		Interval average revolution speed ^(*)	0.0r/min (max. 7 digits)				—				
		Interval integration revolution	0 to 9999999 REV (max. 7 digits)								
		Average revolution speed ^(*)	0.0r/min (max. 7 digits)								
		Integration revolution	0 to 9999999 REV (max. 7 digits)								
	Temperature measurement	Temperature	±0.0 to 999.9 °C (max. 4 digits)								
	Flow rate measurement (max. 7 digits)	Applicable detectors	FZ-2100	FZ-2200A	Units	FZ-2100	FZ-2200A	Units			
		Instantaneous flow	0.0000	0.00	mL/s, mL/min, L/h, g/s, g/min, kg/h	0.0000	0.00	L/h, kg/h			
		Interval integration flow ^(*)	0.0000 to 9999999	0.00 to 9999999	mL, g, L, kg	0.0000 to 9999999	0.00 to 9999999	mL, g			
		Integration flow ^(*)									
		Interval average flow ^(*)	Same as for instantaneous flow rate								
		Average flow ^(*)	Same as for instantaneous flow rate								
		Injection amount									
		Interval average injection amount	0.0000	0.00	mm³/st, mg/st	—					
	Density measurement	Average injection amount									
Density		0.0000 g/cm³ (5 digits)									
Converted temperature setting		0.0 to 999.9 °C (density calculation performed for the three specified temperature points)			0.0 to 999.9 °C (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					
		Integration (flow/time)	Integration from start to stop, specified in the integration measurement mode.								
Integration measurement mode		Manual	Integration from start to stop signal specified on the panel or by an external signal (communications or remote box (FM-0200)).								
		Flow rate setting method	Integration time/revolutions from the start signal to the specified integration flow rate.			Integration time from the start signal to the specified integration flow rate.					
		Time setting method	Integration flow rate/revolutions from the start signal to the specified integration time.			Integration flow rate from the start signal to the specified integration time.					
		Revolution setting method	Integration flow rate/time from the start signal to the specified integration revolutions.			—					
Voltage output ^(*)		Flow rate	0 to 10 V / Low to High (Low and High values can be optionally specified.)			0 to 10 V / 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 1 g/cm³					
		Temperature				0 to 10 V/ 0 to 100					
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 100 kHz, Output H level: +2.4 V or more, L level: +0.8 V or less								
Outer dimensions			See (12) on Page 15			See (13) on Page 15					

(*)1 Integration 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 Interval average revolution speed = Interval integration revolution / interval time

(*)3 Average revolution speed = Integration revolution / interval time

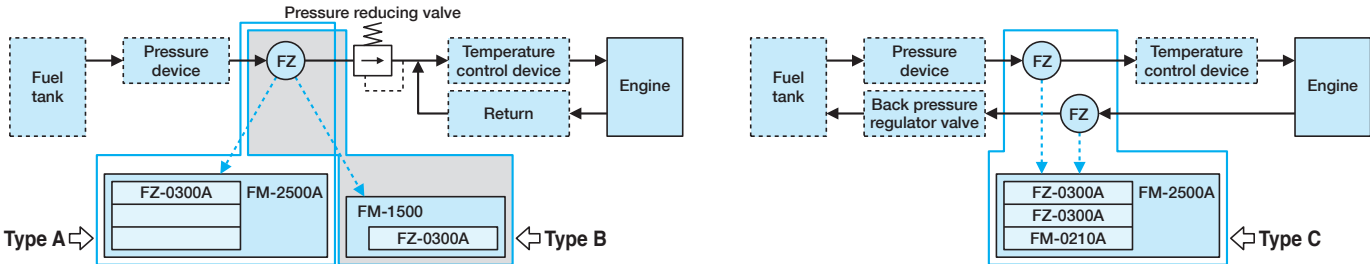
(*)4 Interval average flow = Interval integration flow / interval time

(*)5 Average flow = Integration flow / integration 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-9200 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 considering purchasing 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 —. indicates a detector.)

Mass Flow Rate Measurement Systems (Applications)

Mass Flow Rate Detection System

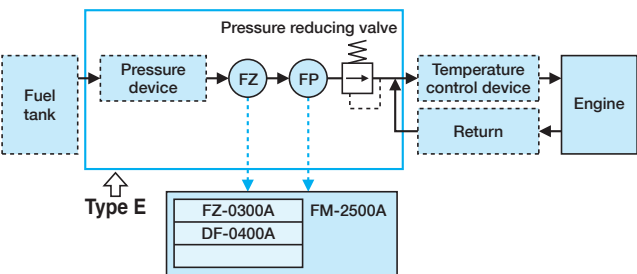
This system uses two detectors, the FP-2140H volumetric flow detector and the FZ-2200A mass flow detector. Volumetric flow rate measurement values are converted with high accuracy using density measurement values and displayed as mass values.

- Continuous measurement without being affected by temperature, pressure or density
- Wide measurement range (up to range ability 1/1000 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 mechanism purging initial air at the time of workpiece replacement is provided.

Item		Specification
Measurement parameters		Flow rate, Temperature, and Density
Applicable fluids		Gasoline, Light oil, Kerosene, Standard petroleum oils or Alcohol fuels (option)
Measurement range	Normal mass flow rate	0.23 to 150 kg/h at 0.75 g/cm ³
	Normal volumetric flow rate	0.3 to 200 L/h
	Maximum flow rate	225 kg/h (300 L/h at 0.75 g/cm ³)
	Density (*1)	0 to 1 g/cm ³
Accuracy	Flow rate	Within ± 0.35 % of reading at 0.3 to 200 L/h
	Density accuracy	± 0.0005 g/cm ³
	Density reproducibility	± 0.0002 g/cm ³
	Density temperature characteristic	± 0.000015 g/cm ³ /°C
Pressure loss		—
Operating temperature range (*1)		0 to +40 °C
Weight		Approx. 200 kg (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 —)



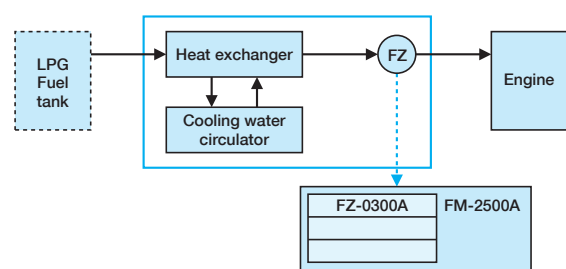
LPG Mass Flow Rate Detection System

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, and Density
Measurement range	Mass flow rate	0.2 to 60 kg/h
	Density (*1)	0 to 1.0 g/cm ³
	Temperature	-20 to +55 °C
Accuracy	Flow rate	± 0.1 % of reading at 2 to 60 kg/h $\pm (0.002 \text{ kg/h/flow rate}) \times 100$ % of reading at 2 kg/h or less
	Density	± 0.0005 g/cm ³
	Temperature	± 1 °C $\pm 0.005 \times$ reading value °C
	Pressure loss	Approx. 100 kPa at 82 kg/h
Operating temperature range (*1)		0 to +40 °C
Weight		Approx. 200 kg

(*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-3200 Automotive Flow Detector (using FP-2140H)

MF-3200 flow detection system is an in-vehicle type detection system using FP-2140H for the detecting section. Fuel flow rate is measured by combination with FM series and DF series flow indicator.

Used for only diesel engines (other than in-tank fuel pump cars).

* Please contact us separately for other than diesel engine.

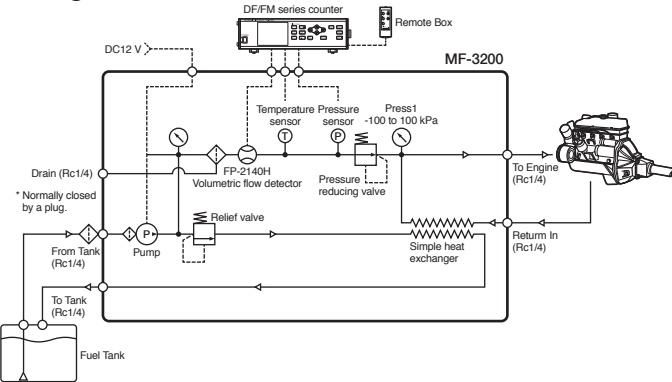


MF-3200

Features

- High accuracy within ± 0.2 % (reading value)
- Reduction in size and weight by blocking each component
- Fuel cooling function is provided as standard equipment.
- Temperature and pressure can be measured simultaneously with flow rate measurement.

Configuration



Specifications

Item	Model Name	MF-3200
Measurement items		Flow rate, temperature, pressure
Used flow rate detector		FP-2140H
Measurement item		Light oil
Measurement range	Flow rate	0.3 to 120 L/h
	Pressure	0 to 980 kPa
	Temperature	0 to +99.9 °C
Measurement accuracy	Flow rate	Within ± 0.2 % of reading value
	Pressure	± 0.5 %F.S.
	Temperature	Pt100 Ω class B
Return processing		Pressure control method (Using the precise pressure reducing valve)
Operating temperature range		0 to +65 °C (both liquid and ambient)
Weight		Approx. 15 kg
Outer dimensions		260 (W) \times 243 (H) \times 243 (D) mm

EH-049 Regulator Valve / EH-059 Relief Valve

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

Compatible Filters and Filter Elements

Compatible detectors		For FP-213S/213	For FP-2140H/2240HA	For FP-215/2250A
For models with standard specification	Filter	EH-106A	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**
980 kPa withstand pressure, element provided (paper, 5 μ m)
- **EH-106A**
980 kPa withstand pressure, element provided with the main unit (sintered metal, 5 μ m)
* Only an element cannot be provided.
- **EH-107A**
980 kPa withstand pressure, element provided (stainless steel wire mesh, 5 μ m)

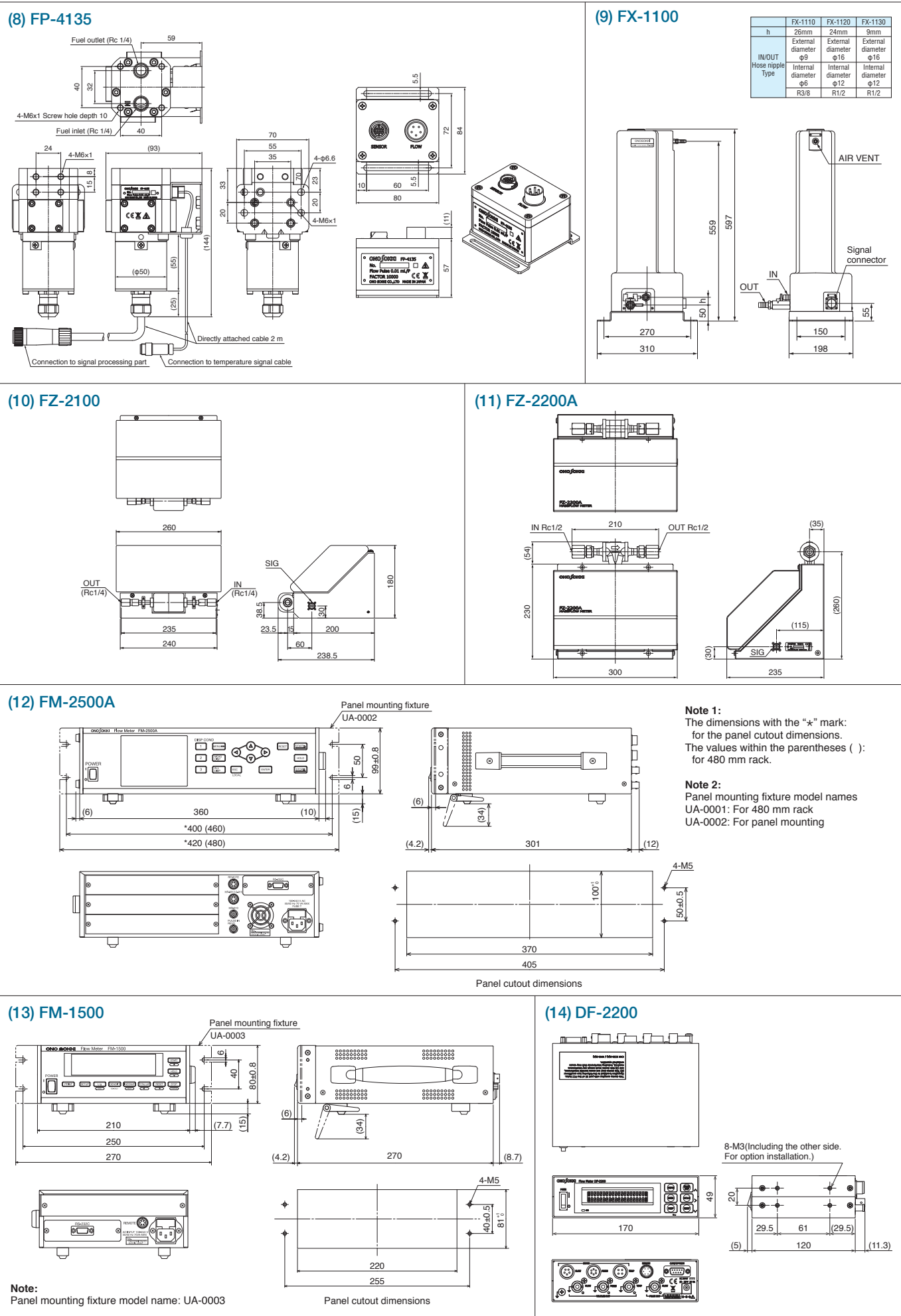
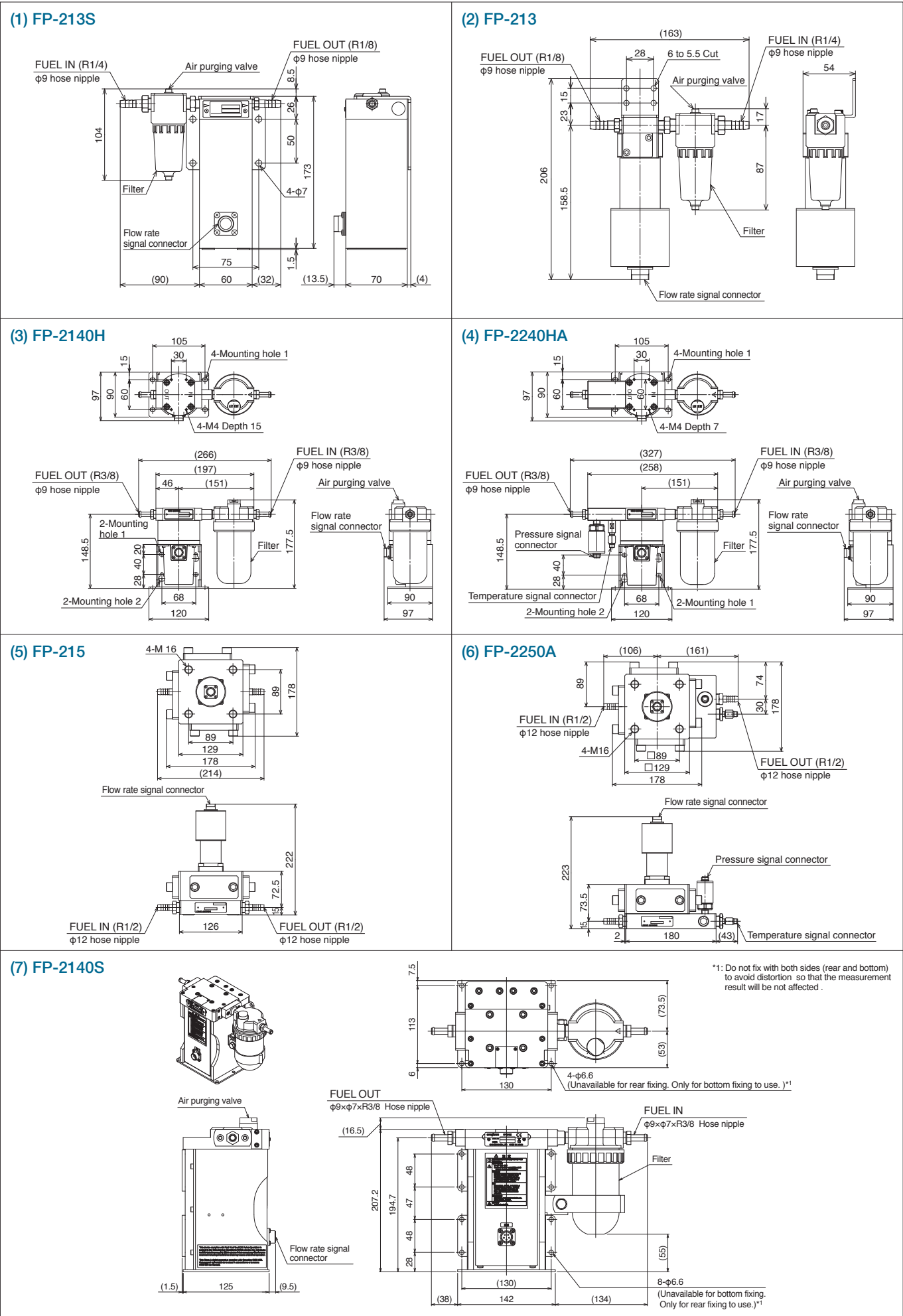
MF-015 Automatic Air Purging Tank



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. 100 L/h
Tank capacity : 0.7 L
Withstand pressure : 200 kPa
Joint : Hose nipple
R1/4 Internal diameter : $\phi 6$ mm
External diameter : $\phi 9$ mm
(for both IN and OUT)
Weight : Approx. 1.8 kg
Outer dimensions : $\phi 93$ (W) \times 197 (H) mm
(not including protruded section)

Outer Dimensions



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

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 DISP	
	RS-232C (*5)	Input levels	H: +2.4 to 15V, L: +0.8 V or less	
			Communication method: Asynchronous full-duplex mode, data length: 8 bits	
	GPIO		Baud rate (*6): 9600, 19200, 38400, 57600, 115200 bps	
Memory function	Digital input/output		Option (model name: FM-0361)	
	Measurement memory	Capacity	300 addresses	
	Memory backup	Capture timing	Automatically saved when Hold or Stop, automatic increment of addresses from 001 to 300	
		Memory capacity	1 Mbyte (SRAM)	
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. 7 kg (When three measurement modules are installed.)	Approx. 4.2 kg
	Power requirement	Power requirement	100 to 240 VAC ±10 %, 50/60 Hz	
	Maximum current consumption		40 VA or less	30 VA or less
	Insulation resistance		10 MΩ or more (500 VDC rated power voltage)	
	Withstand voltage		1500 VAC for one minute	
	Compatible shock-resistance standard		JIS C 0041:1999 (peak acceleration: 300 m/s ² , shock application period: 18 ms)	
	Compatible vibration-resistance standard		JIS C 0040:1999 (vibration acceleration: 10 m/s ² , vibration frequency range: 10 to 150 Hz)	
	Compatible standard		IEC/EN61010-1: 2001 (2nd Edition) / CE marking	—

(*1): 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 GPIO interface is installed.

(*4): The model name of Remote Box is the FM-0200.

(*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: 9600 bps

Product list

FP/FX/FZ series detector

Item	Model	Specification
FP series	FP-213	0.06 to 60 L/h
	FP-213S	Capable of compensating for pressure errors of FP-213
	FP-2140H	0.3 to 120 L/h
		0.3 to 200 L/h (remodel)
	FP-2240HA	FP-2140H + temperature/pressure detector
	FP-215	1 to 1440 L/h
	FP-2250A	FP-215 + temperature/pressure detector
	FP-4135	On-Board volumetric flow detector
FX series	FP-2140S	Servo type flow detector
	FX-1110	0 to 10 g/s (0 to 36 kg/h)
	FX-1120	0 to 25 g/s (0 to 90 kg/h)
	FX-1130	0 to 50 g/s (0 to 180 kg/h)
FZ series	FZ-2100	0.2 to 82 kg/h
	FZ-2200A	1 to 1090 kg/h

On-board flow detector

Item	Model	Specification
MF series	MF-3200	For light oil vehicle

DF-2200 series

Item	Model	Specification
DF series	DF-2200	On-board flow detector
	DF-0221	Auto-stop function
	DF-0222	RS-232C communication function
	DF-0223	Remote box
	DF-0224	High speed output function
	DF-0225	Output function of CAN integration value
	PS-P200023A	AC adapter
	—	Battery cable for AC adapter 2m
	CT-0673	Panel mounting fixture
	CT-0675	Protection plate
	CT-0676	Light shielding hood

Peripheral device for flow detector

Item	Model	Specification
Automatic air purging tank	MF-015	Tank capacity: approx.0.7 L

FM series display unit and storage modules

Item	Model	Specification
Digital flow meter	FM-2500A	For FP/FX/FZ series detector
	FM-1500	For FP/FZ series detector
Measurement module	DF-0400A	Dedicated for FP series detector
	FX-0400A	Dedicated for FX series detector
	FZ-0300A	Dedicated for FZ series detector
Module for result of addition/subtraction	FM-0210A	For FP/FZ series detector, dedicated for FM-2500A
GP-IB board	FM-0263	For FM-2500A/1500
DI/DO board	FM-0361	For FM-2500A
Remote box	FM-0200	For FM-2500A/1500

Signal cable between the FP series detector and display units

Signal cable			For between detector and display unit	
Object	Model	Length	Detector model	
For flow rate	FP-0011	5 m	FP-213/213S/2140H/2240HA/215/2250A	
	FP-0012	10 m		
	FP-0014	20 m		
	FP-0015	5 m		
	FP-0016	10 m	FP-2140S/4135	
	FP-0017	20 m		
For temperature	FP-0025	5 m	FP-2240HA/2250A/4135	
	FP-0026	10 m		
	FP-0027	20 m		
For pressure	FP-0035	5 m	FP-2240HA/2250A/4135	
	FP-0036	10 m		
	FP-0037	20 m		

Signal cable for connecting the FX series detector with display units

Object	Model	Length	FX-1110/1120/1130	
For flow rate	FX-0021	5 m	FX-0400A (Measurement module for FM-2500A storage)	
	FX-0022	10 m		
	FX-0023	20 m		

Signal cable for connecting the FZ series detector with the display units

Object	Model	Length	FZ-2100/2200A	
For flow rate	FZ-0011	5 m	FZ-0300A (Measurement module for FM-2500A/1500 storage)	
	FZ-0012	10 m		
	FZ-0013	20 m		

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