

High-Precision Fuel Flow Meters

FP/FX/FZ Series Detectors

FM/DF Series Display Units



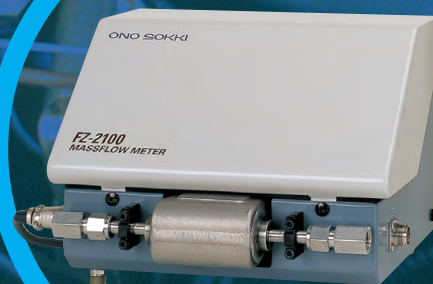
FP Series



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

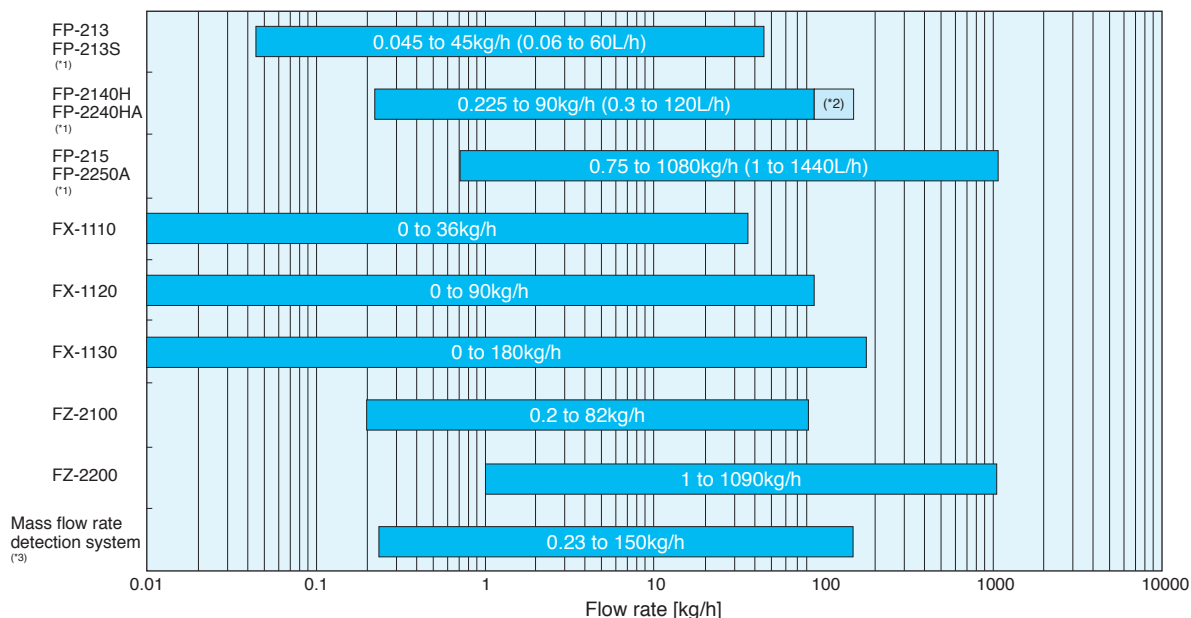
High-Precision Fuel Flow Meter Series that Support Automobile Energy Conservation Countermeasures

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

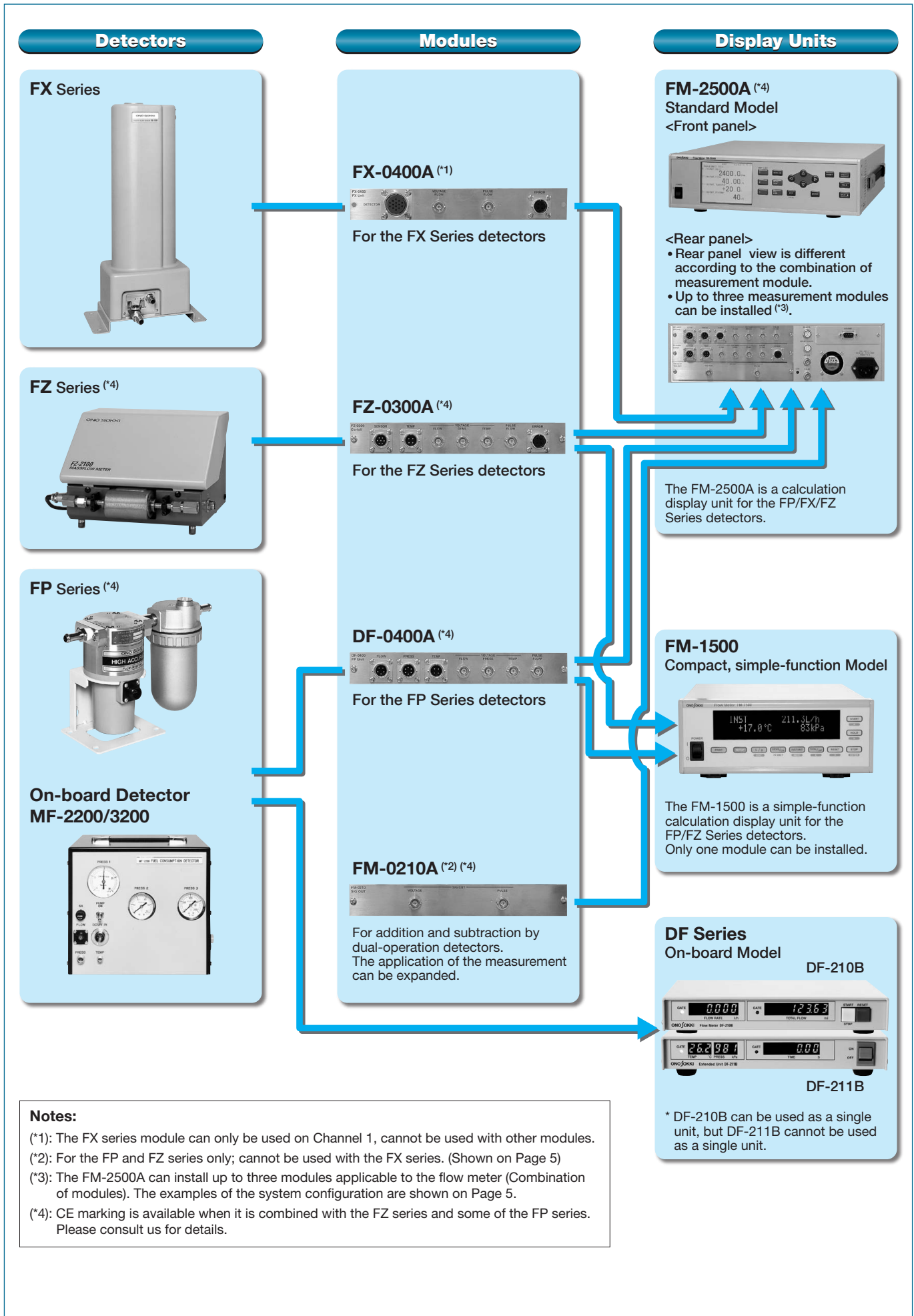
- FP Series Detectors**
 - Volumetric flow measurement
 - Capable of long-term continuous flow rate measurement
 - Also be measurable for on-board measurement applications
- FX Series Detectors**
 - Gravity flow measurement
 - Capable of performing measurement from zero flow (ultra-wide range)
 - Can 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): The values are those converted into mass flow rate 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



Notes:

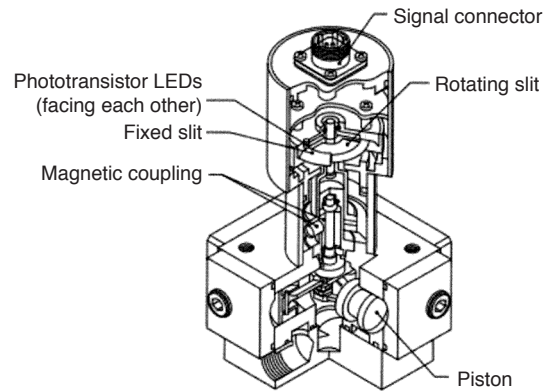
- (*1): The FX series module can only be used on Channel 1, cannot be used with other modules.
- (*2): For the FP and FZ series only; cannot be used with the FX series. (Shown on Page 5)
- (*3): The FM-2500A can install up to three modules applicable to the flow meter (Combination of modules). The examples of the 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.

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.

The flow rate ratio of 1:400 or more enables a wide range measurement. If the application is measurement of engine fuel consumption, it can be performed from minute quantities during idling to the large quantities generated under high-speed, high-load engine conditions.

As the detector is compact and light weight, 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



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 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)

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.

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		—	—	—	—	—	—
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 $\pm 0.5\%$ of reading (over the entire 0.06 to 60L/h range)	Within $\pm 0.0009\text{L/h}$ (from 0.06 to 0.18L/h) Within $\pm 0.5\%$ of reading (from 0.18 to 60L/h)	Within $\pm 0.2\%$ of reading (over the entire 0.3 to 120L/h range)		Within $\pm 0.018\text{L/h}$ (from 1 to 3.6L/h) Within $\pm 0.5\%$ of reading (from 3.6 to 1440L/h)	
	Temperature		—	—	—	Pt 100Ω Class B	—	Pt 100Ω Class B
	Pressure		—	—	—	$\pm 0.5\%$ of F.S.	—	$\pm 0.5\%$ 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	
Operating 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.

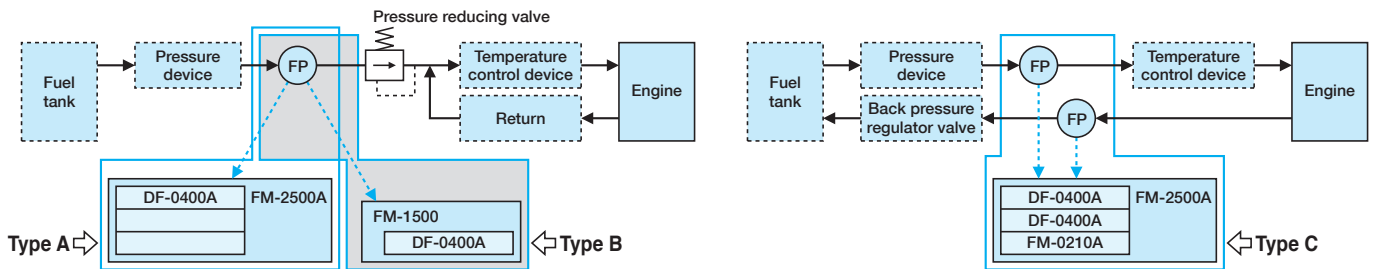
(4): Please consult us if you require specifications other than those given above.

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-9200 ^{(*)9}										
Measurement parameter and number of digits	Time measurement	Sectional time ^{(*)1}	0.00 to 9999999s (max. 7 digits)									
		Total time ^{(*)1}										
	Revolution measurement	Revolution speed	0.0r/min (max. 7 digits)									
		Sectional 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 average flow rate ^{(*)4}		Same as for instantaneous flow rate										
Total average flow rate ^{(*)5}		Same as for instantaneous flow rate										
In-cylinder injection		0.000	0.00	0.0	mm ³ /st, mg/st	—						
Measurement time	Instantaneous	Can be specified within the range of 1 to 10 seconds. (in 1-second increments)				1-second						
	Total	Total from 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 (FM-0200)).										
	Flow rate setting method	Total time/revolutions from the start signal to the specified total flow rate.				Total time from the start signal to the specified total flow rate.						
	Time setting method	Total flow rate/revolutions from the start signal to the specified total time.				Total flow rate from the start signal to the specified total time.						
	Revolution setting method	Total flow rate/time from the start signal to the specified total revolutions.				—						
Voltage output ^{(*)8}	Flow rate	0 to 10V/Low to High (Low and High values can be optionally specified.)				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 average revolution speed = Sectional total revolution / sectional time
- (*)3 Total average revolution speed = Total revolution / total time
- (*)4 Sectional average flow rate = Sectional total flow rate / sectional time
- (*)5 Total average flow rate = Total flow rate / total time
- (*)6 Displayed value of mass flow rate is the value 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-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. 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 —. indicates a detector.)

FP Series Flow Detectors

<p>FP-213S</p> 	<p>Small flow rate, low pressure loss type</p> <ul style="list-style-type: none"> • Measurement range: 0.06 to 60L/h • Range ability: 1/1000 • Accuracy within $\pm 0.5\%$ of reading • Low pressure loss (10 Pa or less), ideal for measuring the amount of fuel consumption of motorcycles and heating equipments 	<p>FP-213</p> 	<p>Small flow rate type</p> <ul style="list-style-type: none"> • Measurement range: 0.06 to 60L/h • Range ability: 1/1000 • Accuracy within $\pm 0.5\%$ of reading (0.18 to 60L/h)
<p>FP-2140H</p> 	<p>Standard flow rate type</p> <ul style="list-style-type: none"> • Measurement range: 0.3 to 120L/h • Range ability: 1/400 • Accuracy within $\pm 0.2\%$ of reading 	<p>FP-2240HA</p> 	<p>Standard flow rate, simultaneous measurement of temperature and pressure type</p> <ul style="list-style-type: none"> • Measurement range: 0.3 to 120L/h • Range ability: 1/400 • Accuracy within $\pm 0.2\%$ of reading • Simultaneous measurement of temperature and pressure
<p>FP-215</p> 	<p>Large flow rate type</p> <ul style="list-style-type: none"> • Measurement range: 1 to 1440L/h • Range ability: 1/1440 • Accuracy within $\pm 0.5\%$ 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 	<p>FP-2250A</p> 	<p>Large flow rate, simultaneous measurement of temperature and pressure type</p> <ul style="list-style-type: none"> • Measurement range: 1 to 1440L/h • Range ability: 1/1440 • Accuracy within $\pm 0.5\%$ 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 is a small and light weight on-board type fuel flow meter that incorporates FP-2140H. 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-controlled fuel injected system engines. (Cannot be used for returnless engine.)

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



MF-2200

MF-3200

Features

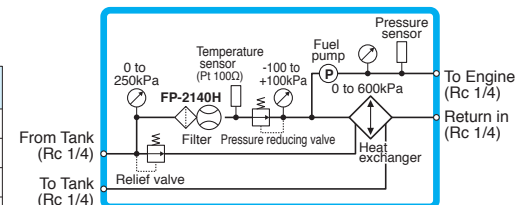
- High accuracy within $\pm 0.2\%$ of reading.
- Compact size and light weight enabled by the use of component blocks.
- A fuel cooling function is provided as standard.
- Simultaneous measurement of temperature and pressure together with the flow rate.

Specification

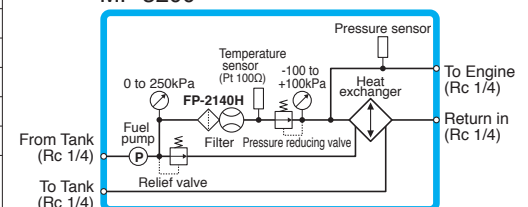
Item	Model Name	MF-2200	MF-3200
Measurement parameters		Flow rate, Temperature or Pressure	
Flow detector used		FP-2140H	
Applicable fluids		Gasoline	Light oil
Measurement range	Flow rate	0.3 to 120L/h	
	Pressure	0 to 980kPa	
	Temperature	0 to +99.9°C	
Measurement accuracy	Flow rate	Within $\pm 0.2\%$ of reading	
	Pressure	$\pm 0.5\%$ of F.S.	
	Temperature	Pt 100 Ω 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) \times 243 (H) \times 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 total measurement.

DF-024/025 Thermal Insulation Unit

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	
Measurement parameter 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), cable 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 by backup battery.

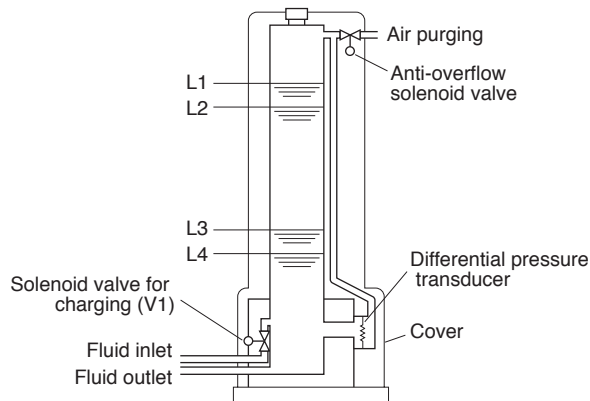
High accuracy: Within $\pm 0.2\%$ of the reading $\pm 0.01\%$ of F.S. (FX-1100 Series)
 This high-precision flow detector is ideal for engine performance tests.

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 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 $\pm 0.2\%$ of reading, $\pm 0.01\%$ 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
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: $\phi 6$ External diameter: $\phi 9$ Hose nipple (for both IN and OUT)	R1/2 Internal diameter: $\phi 12$ External diameter: $\phi 16$ 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 Series



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-9200 ^{(*)8}				
Measurement parameter and number of digits	Time measurement	Sectional time ^{(*)1}	0.00 to 9999999s (max. 7 digits)				
		Total time ^{(*)1}					
	Revolution measurement	Revolution speed	0.0r/min (max. 7 digits)				
		Sectional average revolution speed ^{(*)2}					
		Sectional total revolution					
		Total average revolution speed ^{(*)3}					
		Total revolution					
		Total revolution					
	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 average flow rate ^{(*)4}		Same as for instantaneous flow rate					
Total average flow rate ^{(*)5}							
In-cylinder injection							
Sectional average in-cylinder injection	0.00		0.0		mm ³ /st, mg/st		
Average in-cylinder injection							
Measurement time	Instantaneous	Can be specified within the range of 1 to 10 seconds (in 1-second increments).					
	Total	Total from 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 (FM-0200)).					
	Flow rate setting method	Total time/revolutions from the start signal to the specified total flow rate.					
	Time setting method	Total flow rate/revolutions from the start signal to the specified total time.					
	Revolution setting method	Total flow rate/time from the start signal to the specified total revolutions.					
Alarm output		Overflow (L1 level): Monitor display and external contact output Low fluid surface (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 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 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 average revolution speed = Sectional total revolution / sectional time

(*)3 Total average revolution speed = Total revolution / total time

(*)4 Sectional average flow rate = Sectional total flow rate / sectional time

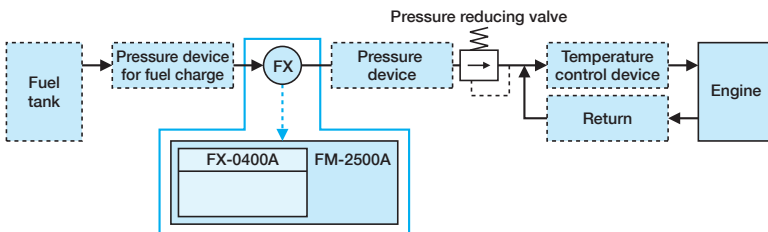
(*)5 Total average flow rate = Total flow rate / total time

(*)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: ±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



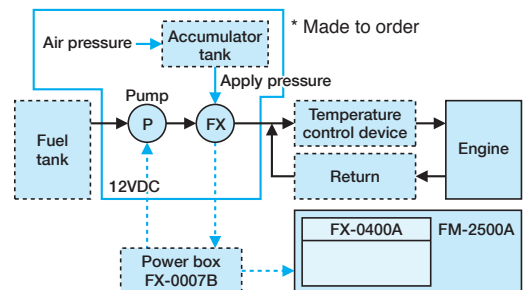
Type A

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.)

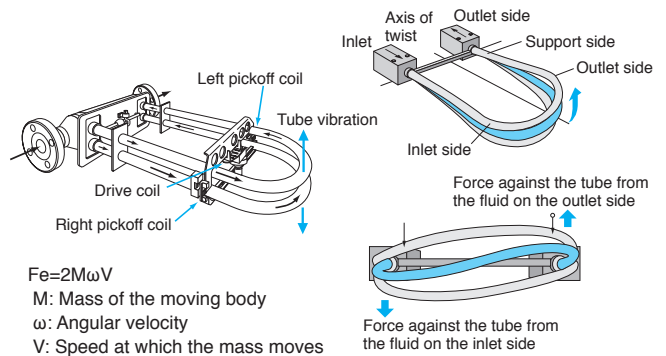
Measurement accuracy: Within $\pm 0.1\%$ of the reading
 High response, high-precision detectors for the continuous measurement of mode tests, etc.

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.

Features

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

The Detection Principle



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.

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/cm ³	0 to 1453L/h at 0.75g/cm ³
	Maximum flow rate	108kg/h	2180kg/h
	Density (*2)	0 to 1g/cm ³	
Accuracy	Flow rate	$\pm 0.1\%$ of reading at 2 to 82kg/h $\pm(0.002\text{kg/h}/\text{flow rate}) \times$ within 100% of reading at 0.2 to 2kg/h	$\pm 0.1\%$ of reading at 27 to 1090kg/h $\pm(0.027\text{kg/h}/\text{flow rate}) \times$ within 100% of reading at 1 to 27kg/h
	Density	$\pm 0.0005\text{g}/\text{cm}^3$	
	Density reproducibility	$\pm 0.0002\text{g}/\text{cm}^3$	
	Density temperature characteristic	$\pm 0.000015\text{g}/\text{cm}^3/^\circ\text{C}$	
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

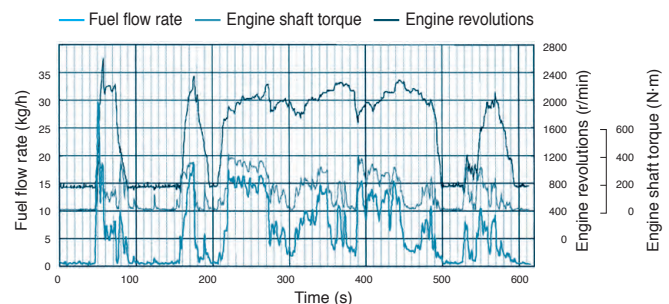
(*1): Can also be used with CNG and LPG gases (option). Please consult us for details.

(*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-9200 ⁽⁷⁾					—	
Measurement parameter and number of digits	Time measurement	Sectional time ⁽¹⁾	0.00 to 9999999s (max. 7 digits)					—
		Total time ⁽¹⁾						
	Revolution measurement	Revolution speed	0.0r/min (max. 7 digits)					—
		Sectional average revolution speed ⁽²⁾						
		Sectional total revolution						
		Total average revolution speed ⁽³⁾						
		Total revolution						
	Temperature measurement	Temperature	±0.0 to 999.9°C (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 average flow rate ⁽⁴⁾		Same as for instantaneous flow rate						
Total average flow rate ⁽⁵⁾		Same as for instantaneous flow rate						
In-cylinder injection		0.0000	0.00	mm ³ /st, mg/st	—			
Sectional average in-cylinder injection								
Average in-cylinder injection								
Density measurement	Density	0.0000 g/cm ³ (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			
	Total (flow rate/time)	Total from start to stop, specified in the total measurement mode.						
Total measurement mode	Manual	Total from start to stop signal specified on the panel or by an external signal (communications or remote box (FM-0200)).						
	Flow rate setting method	Total time/revolutions from the start signal to the specified total flow rate.			Total time from the start signal to the specified total flow rate.			
	Time setting method	Total flow rate/revolutions from the start signal to the specified total time.			Total flow rate from the start signal to the specified total time.			
	Revolution setting method	Total flow rate/time from the start signal to the specified total revolutions.			—			
Voltage output ⁽⁶⁾	Flow rate	0 to 10V / Low to High (Low and High values can be optionally specified.)			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 100°C			
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 average revolution speed = Sectional total revolution / sectional time

(3) Total average revolution speed = Total revolution / total time

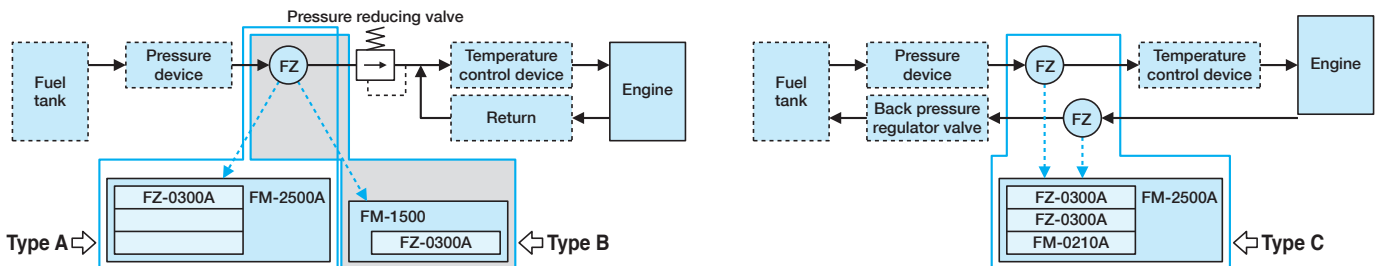
(4) Sectional average flow rate = Sectional total flow rate / sectional time

(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-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 —. (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 $\pm 0.35\%$ 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 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/cm ³
	Normal volumetric flow rate	0.3 to 200L/h
	Maximum flow rate	225kg/h (300L/h at 0.75g/cm ³)
	Density (*1)	0 to 1g/cm ³
Accuracy	Flow rate	Within $\pm 0.35\%$ of reading at 0.3 to 200L/h
	Density accuracy	$\pm 0.0005\text{g/cm}^3$
	Density reproducibility	$\pm 0.0002\text{g/cm}^3$
	Density temperature characteristic	$\pm 0.000015\text{g/cm}^3/\text{°C}$
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.

LPG Mass Flow Rate Detection System

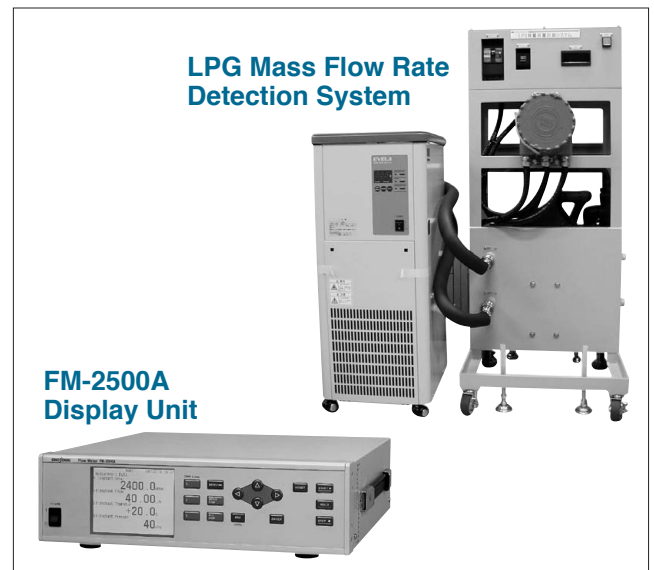
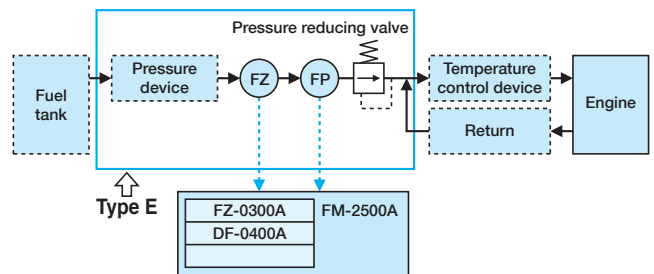
This system uses the FZ-2100 mass flow detector for high-accuracy detection of the mass of an LPG flow rate.

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/cm ³
	Temperature	-20 to +55°C
Accuracy	Flow rate	$\pm 0.1\%$ of reading at 2 to 60kg/h $\pm (0.002 \text{ kg/h/flow rate}) \times 100\%$ of reading at 2kg/h or less
	Density	$\pm 0.0005\text{g/cm}^3$
	Temperature	Pt100Ω Class B
Pressure loss	Approx. 100kPa at 82kg/h	
Operating temperature range (*1)	0 to +40°C	
Weight	Approx. 200kg	

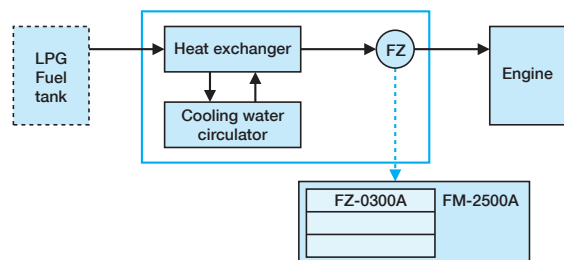
(*1) Please consult us for temperature and density that exceed the above ranges.



Mass Flow Rate Detection System (delineated by —)



LPG Mass Flow Rate Detection System (delineated by —)



Flow Meter Peripheral Devices

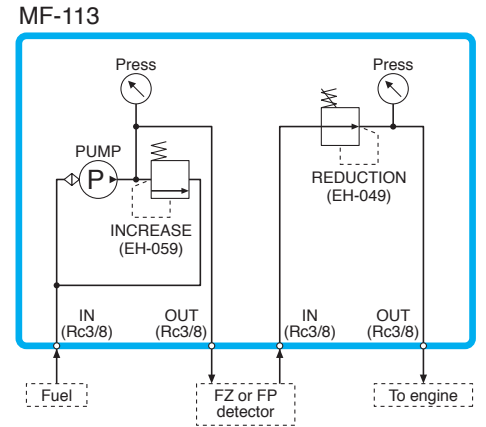
MF-113 Pressure Increase & Reduction Unit



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: ϕ 6mm
 - External diameter: ϕ 9mm
 - (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 (not including protruded section)

Example of use



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		Max. 0.8MPa	
Operating temperature range		0 to +70°C	
Connector fitting diameter		Rc1/4 (for both IN and OUT)	
Body material		Aluminum	
Weight		Approx. 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 Element: Provided together with the filter unit	EH-1050 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, 5μ m)
- **EH-106**
980kPa withstand pressure, element provided with the main unit (sintered metal, 5μ m)
* Only an element cannot be provided.
- **EH-107A**
980kPa withstand pressure, element provided (stainless steel wire mesh, 5μ m)

MF-015 Automatic Air Purging Tank

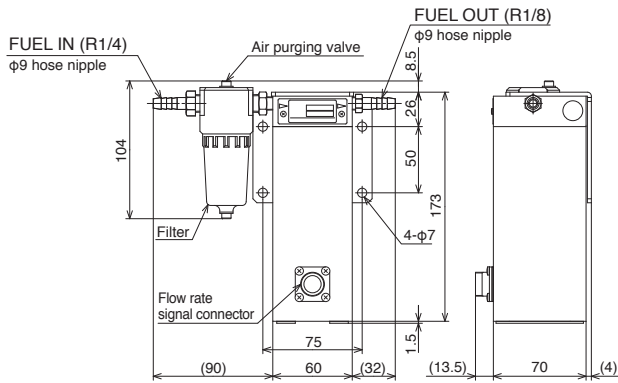


The MF-015 is an automatic air purging tank that uses a precision float valve. When fluid enters the flow line, the air is automatically purged to the atmosphere.

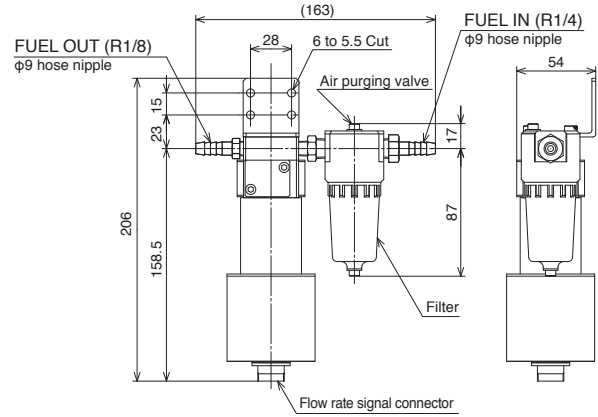
- Applicable fluids : Gasoline, light oil or kerosene
- Maximum flow rate: Approx. 100L/h
- Tank capacity : 0.7L
- Withstand pressure : 200kPa
- Joint : Hose nipple
 - R1/4 Internal diameter: ϕ 6mm
 - External diameter: ϕ 9mm
 - (for both IN and OUT)
- Weight : Approx. 1.8kg
- Outer dimensions : ϕ 93 (W) x 197 (H) mm (not including protruded section)

Outer Dimensions

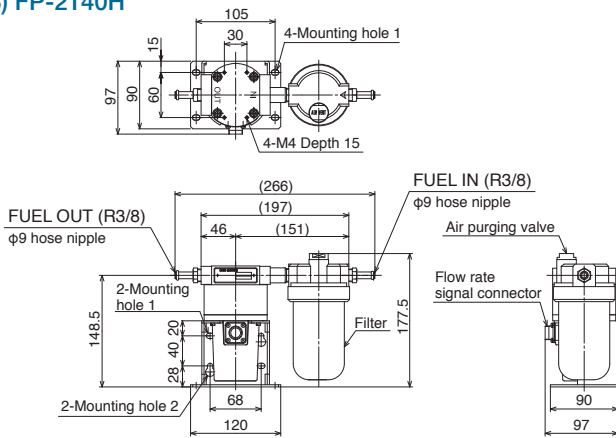
(1) FP-213S



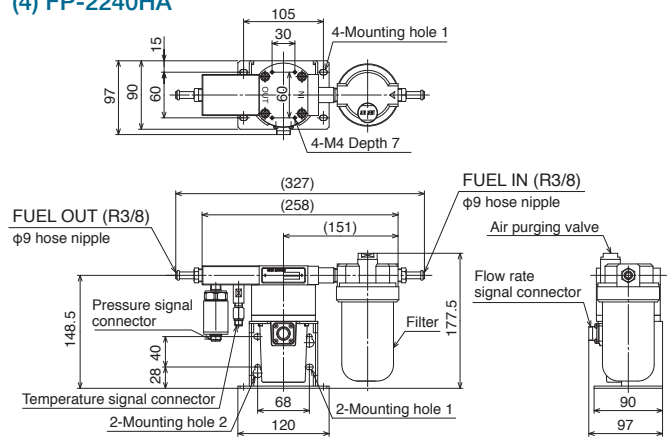
(2) FP-213



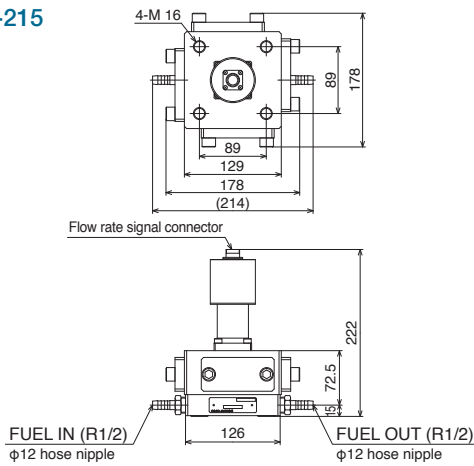
(3) FP-2140H



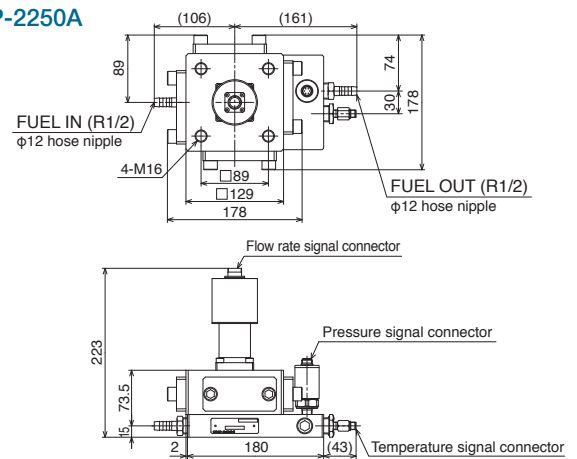
(4) FP-2240HA



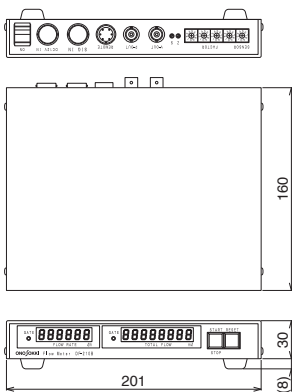
(5) FP-215



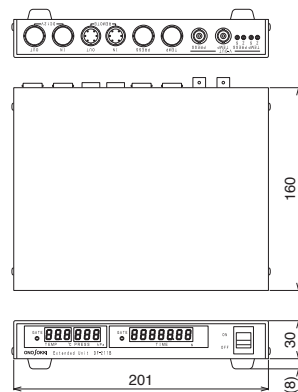
(6) FP-2250A



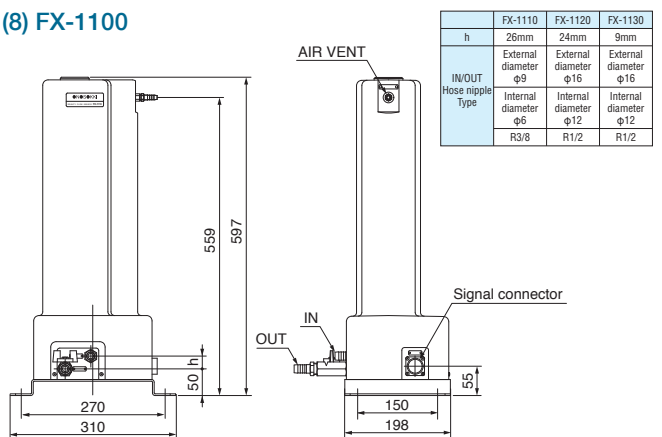
(7) DF-210B



DF-211B

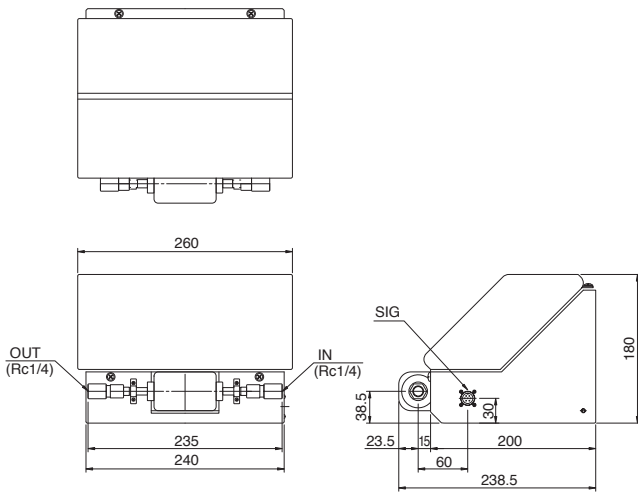


(8) FX-1100

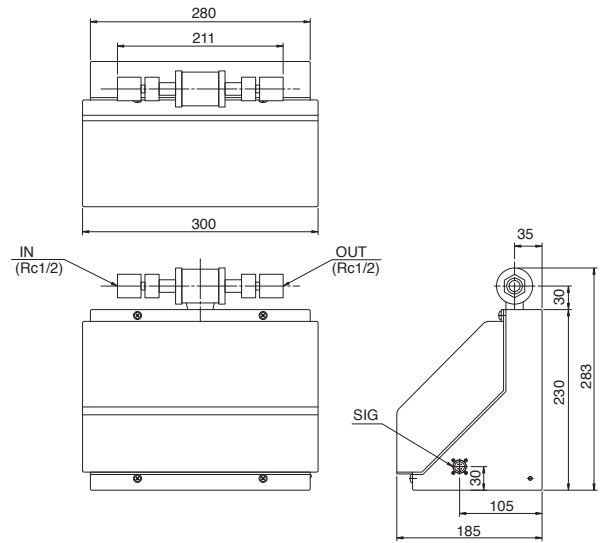


	FX-1110	FX-1120	FX-1130
h	26mm	24mm	9mm
External diameter	φ9	φ16	φ16
Internal diameter	φ6	φ12	φ12
IN/OUT Hose nipple Type	R3/8	R1/2	R1/2

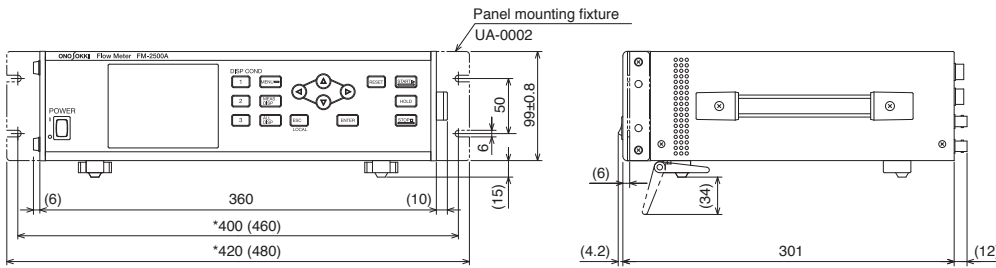
(9) FZ-2100



(10) FZ-2200

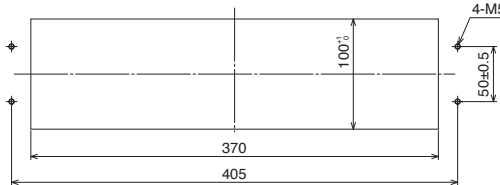
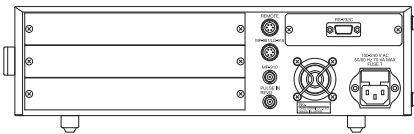


(11) FM-2500A



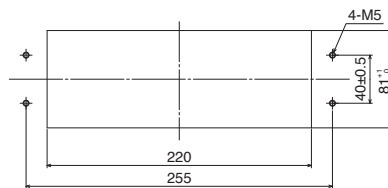
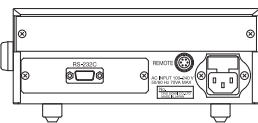
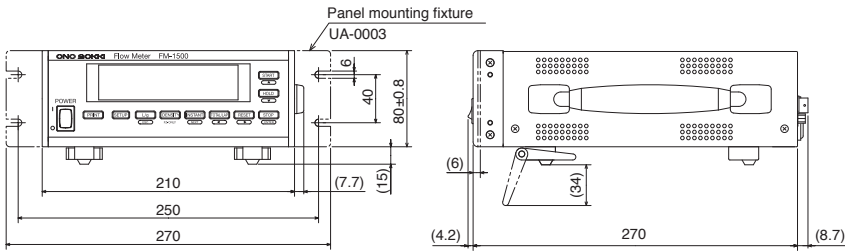
Note 1:
The dimensions with the “*” mark are the values for the panel cutout dimensions while the values within the parentheses () are for 480mm rack.

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



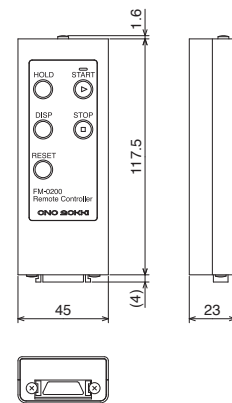
Panel cutout dimensions

(12) FM-1500



Panel cutout dimensions

(13) FM-0200 Remote box



Note:
Panel mounting fixture model name: UA-0003

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

Model Name			FM-2500A (*2)	FM-1500	
Item					
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		
		Input levels	H: +2.4 to 15V, L: +0.8V or less		
	RS-232C (*5)		Communication method: Asynchronous full-duplex mode, data length: 8 bits 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	Automatically 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 three measurement modules are installed.)	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 voltage)		
	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): 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 (13).

(*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



WORLDWIDE ONO SOKKI CO., LTD.

1-16-1 Hakusan, Midori-ku, Yokohama, 226-8507, Japan
Phone : +81-45-935-3918 Fax : +81-45-930-1808
E-mail : overseas@onosokki.co.jp

*Outer appearance and specifications are subject to change without prior notice.

URL: <http://www.onosokki.co.jp/English/english.htm>

U.S.A.

Ono Sokki Technology Inc.
2171 Executive Drive, Suite 400,
Addison, IL. 60101 U.S.A.
Phone : +1-630-627-9700
Fax : +1-630-627-0004
E-mail : info@onosokki.net
<http://www.onosokki.net>

THAILAND

Ono Sokki (Thailand) Co., Ltd.
1/293-4 Moo.9 T.Bangphud A.Pakkred,
Nonthaburi 11120, Thailand
Phone : +66-2-584-6735
Fax : +66-2-584-6740
E-mail : sales@onosokki.co.th

INDIA

Ono Sokki India Private Ltd.
Plot No.20, Ground Floor, Sector-3,
IMT Manesar Gurgaon-122050,
Haryana, INDIA
Phone : +91-124-421-1807
Fax : +91-124-421-1809
E-mail : osid@onosokki.co.in

P.R.CHINA

Ono Sokki Shanghai Technology Co., Ltd.
Room 506, No.47 Zhengyi Road, Yangpu
District, Shanghai, 200433, P.R.C.
Phone : +86-21-6503-2656
Fax : +86-21-6506-0327
E-mail : admin@shonosokki.com