STEP1 Clamp Set and Sensor Head Selection

For plastic piping/tubing

1. Select the clamp set based on the outer diameter of the piping.

2. Select the corresponding sensor head.

Target pipe diameter		A Clamp set			B Sensor head			Rated flow range
Pipe outer diameter*	Installable range	Appearance	Model	Weight	Appearance	Model	Weight	
ø3 mm 0.12"	ø2.7 to 3.7 0.11" to 0.15"		FD-XC1R1	Approx. 50 g		FD-XS1	Approx. 230 g	0 to 1000 mL/min
1/8" (3.18 mm)								
ø4 mm 0.16"	ø3.5 to 4.5 0.14" to 0.18"		FD-XC1R2	Approx. 50 g				
ø6 mm 0.24"	ø5.5 to 6.5 0.22" to 0.26"		FD-XC8R1	Approx. 55 g		FD-XS8	Approx. 250 g	0 to 3000 mL/min
1/4"(6.35 mm)	ø5.9 to 6.9 0.23" to 0.27"		FD-XC8R2	Approx. 60 g				
ø8 mm 0.31"	ø7.5 to 8.5 0.30" to 0.33"		FD-XC8R3	Approx. 60 g				0 to 8000 mL/min
3/8"(9.53 mm)	ø9.0 to 10.0 0.35" to 0.39"		FD-XC20R1	Approx. 75 g		FD-XS20	Approx. 260 g	0 to 15 L/min
ø10 mm 0.39"	ø9.5 to 10.5 0.37" to 0.41"		FD-XC20R2	Approx. 80 g				
ø12 mm 0.47"	ø11.5 to 12.5 0.45" to 0.49"		FD-XC20R3	Approx. 80 g				0 to 20 L/min
1/2"(12.7 mm)	ø12.2 to 13.2 0.48" to 0.52"		FD-XC20R4	Approx. 80 g				

* The dimensions in inch are not Nominal dimensions B of JIS/ANSI standards. 1 inch = 25.4 mm

For metal piping

1. Select the clamp set based on the outer diameter of the piping.

2. Select the corresponding sensor head.

Target pipe diameter			A Clamp set			B Sensor head			Rated flow range
Pipe outer diameter*	A name	Installable range	Appearance	Model	Weight	Appearance	Model	Weight	
ø3 mm 0.12"	—	ø2.8 to 5.5 mm 0.11" to 0.22"		FD-XC1M	Approx. 190 g		FD-XS1	Approx. 230 g	0 to 1000 mL/min
1/8" (3.18 mm)	—								
ø4 mm 0.16"	—								
ø6 mm 0.24"	—	ø5.5 to 8.3 mm 0.22" to 0.33"		FD-XC8M	Approx. 210 g		FD-XS8	Approx. 250 g	0 to 3000 mL/min
1/4"(6.35 mm)	—								
ø8 mm 0.31"	—								0 to 8000 mL/min
3/8"(9.53 mm)	—	ø8.3 to 10.8 mm 0.33" to 0.43"		FD-XC20M1	Approx. 240 g		FD-XS20	Approx. 260 g	0 to 15 L/min
ø10 mm 0.39"	—								
ø10.5 mm 0.41"	6A								
ø12 mm 0.47"	—	ø10.8 to 14 mm 0.43" to 0.55"		FD-XC20M2	Approx. 250 g				0 to 20 L/min
1/2"(12.7 mm)	—								
ø13.8 mm 0.54"	8A								

* The dimensions in inch are not Nominal dimensions B of JIS/ANSI standards. 1 inch = 25.4 mm

STEP2 Controller Selection

Controllers

Type	Appearance	Model	Control output	External input	Analog current output	Network Compatibility	Cable	Weight (with cable)
DIN-rail mount type, main unit		**FD-XA1**	2 outputs (selectable NPN/ PNP)	2 inputs	1 output	IO-Link	7-core loose wires cable, 2 m 6.6'	Approx. 210 g
DIN-rail mount type, expansion unit Up to 7 expansion units per main unit		**FD-XA2**			—	NU Series • EtherNet/IP® • CC-Link • DeviceNet® • EtherCAT®	4-core loose wires cable, 2 m 6.6'	Approx. 180 g
Panel mount type, main unit		**FD-XA5**			1 output	IO-Link	7-core loose wires connector cable included, 2 m 6.6'	Approx. 210 g

Network Communication Unit, Multi-Output Unit (select as needed)

Contact your local KEYENCE representative for more details

Network Communication Unit **NU** Series

Multi-output unit **FS-MC8N/P** Controller settings can be saved and written

STEP3 Optional Parts Selection (if needed)

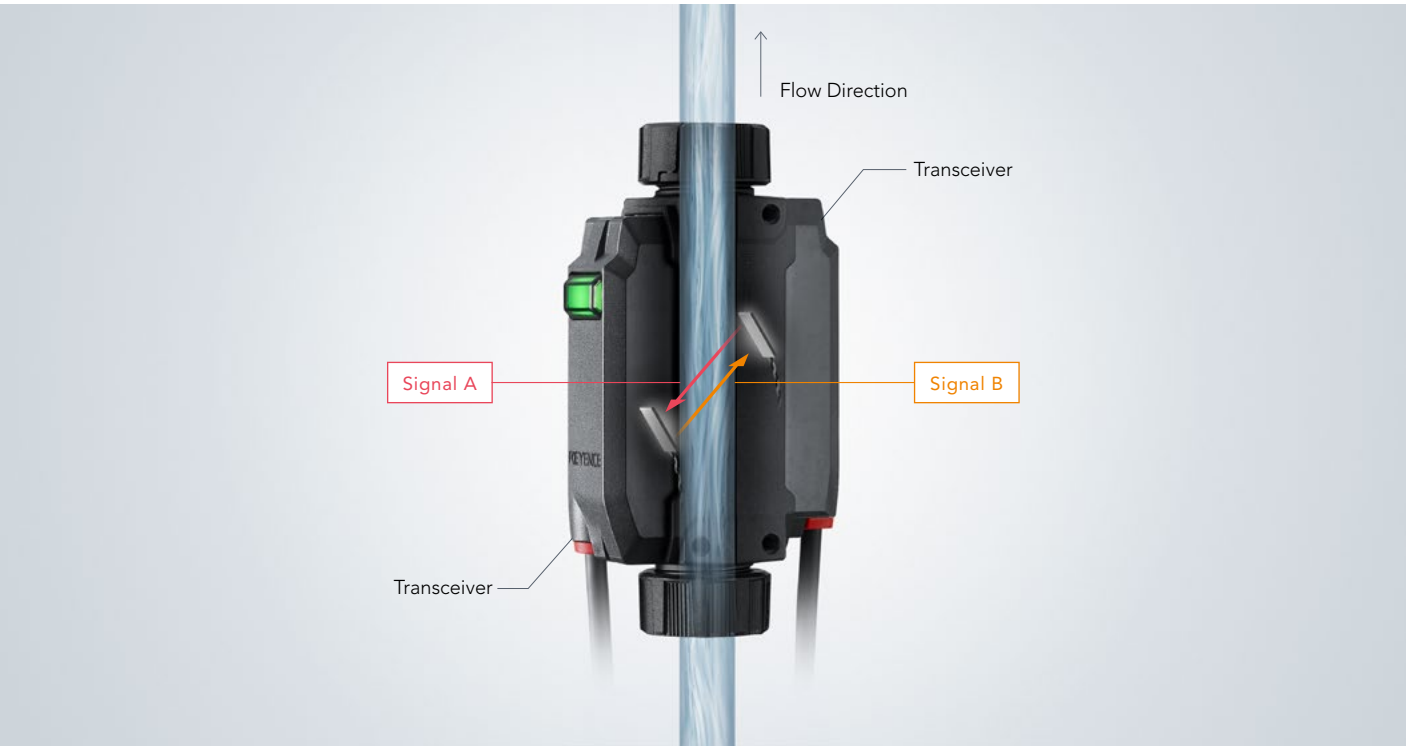
Installation

Type	Appearance	Model	For use with	Description	Weight
Securing bracket for plastic clamp set		**OP-88294**	FD-XC1R1/XC1R2 FD-XC8R1/XC8R2/XC8R3 FD-XC20R1/XC20R2/XC20R3/ XC20R4	For securing the plastic clamp set to a jig, etc. Use when clamping to a soft plastic tube.	Approx. 55 g
Metal clamp set mounting bracket		**OP-88297**	FD-XC1M/XC8M	For securing the metal clamp set to a jig, etc. Use with metal piping with an outer diameter of ø8.3 mm 0.33" or less if heavy vibration or shocks occur in the installation area.	Approx. 60 g
PEEK screw set		**OP-88295**	FD-XC1R1/XC1R2 FD-XC8R1/XC8R2/XC8R3 FD-XC20R1/XC20R2/XC20R3/ XC20R4/OP-88294	Use if the chemical resistance of the SUS screws included with the plastic clamp sets (FD-XCxRx) or plastic clamp securing brackets (OP-88294) is a concern.	Approx. 3 g
DIN securing bracket (for main unit)		**OP-88311**	FD-XA1	Allows attachment without a DIN rail.	Approx. 15 g
End unit (for expansion)		**OP-26751**	FD-XA1/XA2	Secure main and expansion units when mounted together on a DIN rail. Always use when connecting multiple units. (Pack of 2)	Approx. 15 g

Wiring

Type	Appearance	Model	For use with	Description	Weight
Sensor head-controller extension cable, 2 m 6.6'		**OP-88292**	FD-XS1/XS8/XS20	A cable that further extends the 2 m 6.6' cable between the sensor head's relay amp and the controller. Connectors are on both ends. * The cable between the relay amp and controller can be extended up to 12 m 39.4' long.	Approx. 110 g
Sensor head-controller extension cable, 5 m 16.4'		**OP-88293**			Approx. 240 g
Loose wires/ M12 adapter		**OP-88296**	FD-XA1/XA5 cables, or cables with cross sectional area 0.14 to 0.34 mm² 0.0002 to 0.0005 in² and outer diameter ø3.5 to 6 mm 0.14" to 0.24"	A connector that converts loose wires to a M12 4-pin connector. Useful for connecting to IO-Link compatible master units.	Approx. 12 g

Operating Principles

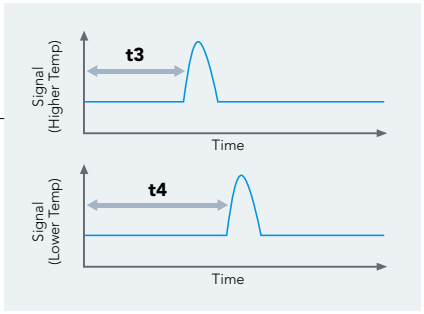


Delta TOF

Conventional ultrasonic flow sensors monitor flow by measuring the time it takes for an ultrasonic pulse to travel from a transmitting element to a receiving element. As the flow rate increases, the signal is accelerated and the transmission time decreases. This transmission time can then be directly correlated to the instantaneous flow rate. The FD-X Series improves upon this method by simultaneously monitoring two signals (one moving in the direction of flow and one moving against the direction of flow). By doing this, the readings remain consistent and stable regardless of external factors such as clogging or temperature changes.

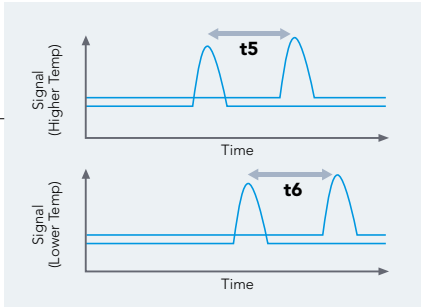
Basic Principle

The duration of the pulse is easily influenced by external factors.



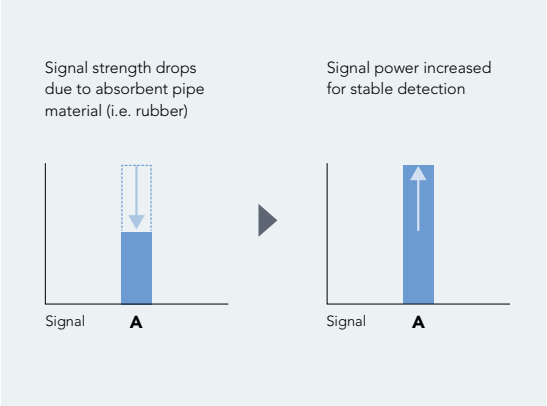
Delta TOF

External factors do not affect detection as the time difference between signals A and B remains the same.



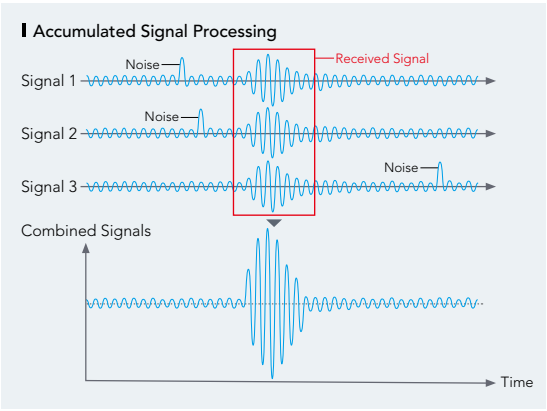
Automatic Power Control

The stable transmission of the ultrasonic signal is imperative for consistent and reliable detection. To ensure stability on a large variety of pipe material, the FD-X Series utilizes an Automatic Power Control function, which identifies signal strengths and adjusts accordingly. This ensures stable detection on everything from steel pipes to rubber hoses.



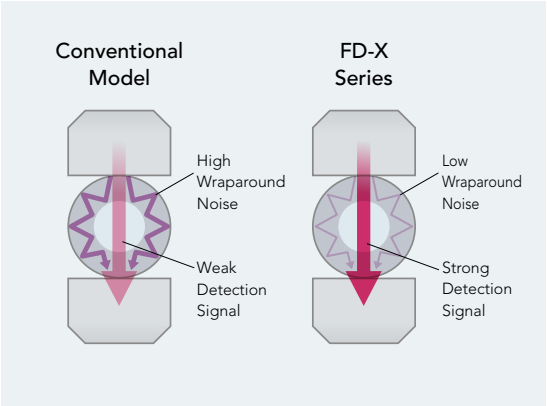
Accumulated Signal Processing

By utilizing a unique signal processing methodology, the FD-X Series bases its detection on not just one signal transmission but multiple signal transmissions. This allows the unit to combine signals and completely ignore any external noise.



Guided Wave Technology

The effects of noise generated by the ultrasonic detection signal can be detrimental to stable detection. To prevent this, the FD-X Series has adopted several innovative noise reducing techniques, including guided wave technology, which prevents the signal from wrapping around the pipe and hampering detection.



FD-X (Standard)

Sensor head model			FD-XS1			FD-XS8			FD-XS20					
Supported pipe materials			Metal pipes, Plastic pipes (soft/hard)*1											
Supported fluids			Liquids (water, oil, adhesive, grease, chemical solutions, etc.)*1											
Supported fluid temperature (Pipe surface temperature)			0°C (no freezing on the pipe surface) to 100°C 32°F to 212°F											
Supported diameter	Plastic pipe/tube attachment	Clamp set model	FD-XC1R1		FD-XC1R2	FD-XC8R1	FD-XC8R2	FD-XC8R3	FD-XC20R1	FD-XC20R2		FD-XC20R3	FD-XC20R4	
		Outer diameter of pipe	ø3 0.12"	1/8"(3.18 mm)	ø4 0.16"	ø6 0.24"	1/4"(6.35 mm)	ø8 0.31"	3/8"(9.53 mm)	ø10 0.39"		ø12 0.47"	1/2"(12.7 mm)	
		Attachable range	ø2.7 to 3.7 0.11" to 0.15"		ø3.5 to 4.5 0.14" to 0.18"	ø5.5 to 6.5 0.22" to 0.26"	ø5.9 to 6.9 0.23" to 0.27"	ø7.5 to 8.5 0.27" to 0.33"	ø9.0 to 10.0 0.35" to 0.39"	ø9.5 to 10.5 0.37" to 0.41"		ø11.5 to 12.5 0.45" to 0.49"	ø12.2 to 13.2 0.48" to 0.52"	
	Metal pipe attachment*2	Clamp set model	FD-XC1M			FD-XC8M			FD-XC20M1			FD-XC20M2		
		Outer diameter of pipe	ø3 0.12"	1/8"(3.18 mm)	ø4 0.16"	ø6 0.24"	1/4"(6.35 mm)	ø8 0.31"	3/8"(9.53 mm)	ø10 0.39"	ø10.5 0.41"	ø12 0.47"	1/2"(12.7 mm)	ø13.8 0.54"
		A designation	—	—	—	—	—	—	—	—	6A	—	—	8A
		Attachable range	ø2.8 to 5.5 0.11" to 0.22			ø5.5 to 8.3 0.22" to 0.33"			ø8.3 to 10.8 0.33" to 0.43"			ø10.8 to 14 0.43" to 0.55"		
Rated flow range			0 to 1000 mL/min			0 to 3000 mL/min		0 to 8000 mL/min	0 to 15.00 L/min			0 to 20.00 L/min		
Zero cut flow rate*3 (variable, default)			20 mL/min			40 mL/min			0.10 L/min (standard), 40 mL/min (high resolution*7)					
Display resolution (Displayed on controller)	Instantaneous flow rate		0.1/1/10 mL/min						0.001/0.01/0.1 L/min (standard), 0.1/1/10 mL/min (high resolution*7)					
	Shot amount		0.001/0.01/0.1/1 mL						0.001/0.01/0.1 L (standard), 0.001/0.01/0.1/1 mL (high resolution*7)					
Repeatability *4	Plastic pipe/tube attachment	Response time: 50 ms*5 F.S.	±0.6%			±0.1%								
		Response time: 500 ms	Instantaneous flow rate	±6 mL/min			±3 mL/min		±8 mL/min	±15 mL/min			±20 mL/min	
			Instantaneous flow rate	±1.9 mL/min			±1.0 mL/min		±2.6 mL/min	±4.7 mL/min			±6.3 mL/min	
	Metal pipe attachment	Response time: 50 ms*5 F.S.	±1%			±0.3%			±0.15%					
			Instantaneous flow rate	±10 mL/min			±9 mL/min		±12 mL/min	±23 mL/min			±30 mL/min	
		Response time: 500 ms	Instantaneous flow rate	±3.2 mL/min			±2.9 mL/min		±3.8 mL/min	±7.2 mL/min			±9.5 mL/min	
Hysteresis			Variable											
Integrated unit display (displayed on controller)			0.1/1/10/100/1000/10000 mL						0.01/0.1/1/10/100 L (standard), 0.1/1/10/100/1000/10000 mL (high resolution*7)					
Display method			Status indicator											
Environmental resistance	Enclosure rating		IP65/IP67 (IEC60529), IP68G (JIS C0920) *6											
	Ambient temperature		0 to 60°C (No freezing) 32 to 140°F			-10 to 60°C (No freezing) 14 to 140°F								
	Ambient humidity		35% to 85% RH (No condensation)											
	Vibration resistance		10 to 55 Hz, double amplitude 1.5 mm 0.06", 2 hours each for X, Y, Z direction											
	Shock resistance		50 G 11 ms 3 times each for X, Y, Z direction											
Material	Sensor head		Head body: PPS/PPSU, in-cable amplifier: PPS, cable: PVC, controller connector: PPS/PBT/POM											
	Clamp set	For plastic pipe	Body, fixing screw: PPS, detection surface: special rubber, pipe support rubber: FKM, sensor head fixing screw: SUSXM7											
		For metal pipe	Metal: SUS304/SUSXM7, detection surface: special rubber, clamp support rubber: FKM, sensor head fixing screw: SUSXM7											

*1 Liquid must allow for the passage of an ultrasonic pulse, as well as not contain large air pockets or excessive bubbles. Readings may become unstable depending on the type of pipe. *2 When using stainless steel or iron pipes, the ideal pipe wall thickness is as follows, FD-XS1: approx. 0.5 mm 0.02", FD-XS8: approx. 1 mm 0.04", FD-XS20: approx. 1 0.04" to 2 mm 0.08". FD-X signal strength and stability will decrease as the thickness of the pipe wall increases or decreases from the suggested size. *3 The zero cut flow rate can be changed in the settings. When using the unit with a low flow rate range, perform an origin adjustment when the fluid is not moving if you change the zero cut flow rate. *4 This specification is valid when the flow velocity distribution is stable. This value does not take into account the effects of pulsation or fluctuations in flow velocity distribution due to facility factors. Convert the F.S. (full scale value) listed in the table according to the rated flow range. *5 The longer the response time is set, the more repeatability is improved. As a guideline, use √ (50 ms/response time) times. *6 The connector part of the sensor head cable is IP65 / IP67. *7 Only controllers with serial numbers beginning with "G" (FD-XA1/XA2/XA5) are supported.

Shot amount repeatability (Typical values) * Plastic pipe/tube attachment

Sensor head model			FD-XS1			FD-XS8			FD-XS20			
Plastic pipe/tube attachment	Clamp set model		FD-XC1R1		FD-XC1R2	FD-XC8R1	FD-XC8R2	FD-XC8R3	FD-XC20R1	FD-XC20R2	FD-XC20R3	FD-XC20R4
	Diameter of pipe		ø3 0.12"	1/8"(3.18 mm)	ø4 0.16"	ø6 0.24"	1/4"(6.35 mm)	ø8 0.31"	3/8"(9.53 mm)	ø10 0.39"	ø12 0.47"	1/2"(12.7 mm)
	Shot time	50 ms	±0.005 mL			±0.003 mL		±0.004 mL	±0.006 mL		±0.008 mL	
		1 s	±0.015 mL			±0.008 mL		±0.012 mL	±0.019 mL		±0.023 mL	
		10 s	±0.044 mL			±0.024 mL		±0.036 mL	±0.057 mL		±0.071 mL	
Metal pipe attachment	Clamp set model		FD-XC1M			FD-XC8M			FD-XC20M1			FD-XC20M2
	Diameter of pipe		ø3 0.12"	1/8"(3.18 mm)	ø4 0.16"	ø6 0.24"	1/4"(6.35 mm)	ø8 0.31"	3/8"(9.53 mm)	ø10 0.39"	6A(10. 5 mm)	ø12 0.47"	1/2"(12.7 mm)	8A(13.8 mm)
	Shot time	50 ms	±0.007 mL			±0.008 mL			±0.009 mL			±0.012 mL		
		1 s	±0.021 mL			±0.025 mL			±0.027 mL			±0.036 mL		
		10 s	±0.063 mL			±0.075 mL			±0.083 mL			±0.112 mL		

*1 Repeatability of the shot amount is the typical value for water, response time of 50 ms, no zero cut flow rate setting and after origin adjustment. *2 Variations due to facility factors (such as pulsation, valve control, liquid pooling, change in flow velocity distribution) are not taken into account in this value.

Controller

Model		FD-XA1	FD-XA2	FD-XA5
Type		DIN rail type, main unit	DIN rail type, expansion unit	Panel type, main unit
Display method		Output indicator, 4-digit 7 segment display, OLED, Stability level display		
Display refresh frequency		Instantaneous flow: approx. 5 times/second, Discharge amount/Accumulated flow approx. 30 times/second		
Response time		50 ms/100 ms/500 ms/1 s/2.5 s/5 s/10 s/30 s/60 s (selectable, default: 500 ms)		
Integration data storage interval		Written to the memory every 10 seconds		
Memory back up*1		EEPROM (data storage period: more than 10 years, number of data rewritable times: 1 million times or more)		
Detection mode (selectable)	ch.1	Instantaneous flow rate mode/Area mode/Pulse output (+) mode/Integrated flow mode/Shot mode		
	ch.2	Instantaneous flow rate mode/Area mode/Pulse output (-) mode/Shot mode/Error output mode/Bubble alert mode/Error + bubble alert mode		
Input/output	Output ch.1/2	NPN/PNP setting switch Open collector output: 30 V or lower, main unit: 50 mA or lower/ch.*2/expansion unit: 20 mA or lower/ch., residual voltage: 2 V or lower		
	Analog output	4-20 mA/0-20 mA (selectable) load resistance: 500 ohms or lower	—	4-20 mA/0-20 mA (selectable) load resistance: 500 ohms or lower
	External input 1/2	Flow rate zero input/shot sampling input/integrated flow reset input/zero shift input (selectable) Short circuit current: NPN 1 mA or lower/PNP 2 mA or lower, input time: 20 ms or longer		
Network support		IO-Link*3	Supports NU Series	IO-Link*3
Power source	Power supply voltage	20 to 30 VDC including 10% ripple (P-P), Class 2		
	Current consumption	195 mA or lower (including the sensor head, excluding the load current)	185 mA or lower (including the sensor head, excluding the load current)	195 mA or lower (including the sensor head, excluding the load current)
Protection circuit		Power supply reverse connection protection, power surge protection, output short circuit protection, output surge protection		
Addition of expansion units		Up to 7*4 per main unit		—
Environmental resistance	Ambient temperature	-10 to +50°C 14 to 122°F (No freezing)		
	Ambient humidity	35% to 85% RH (No condensation)		
	Vibration resistance	10 - 55 Hz, double amplitude 1.5 mm 0.06", 2 hours each for X, Y, Z direction		
	Shock resistance	100 m/s² 328.1'/s² (approx. 10 G) 16 ms pulse, 1000 times each for X, Y, Z direction		
Material		Main body case/front sheet: PC Key top: POM Cable: PVC		

*1 Internal data from full time recording can be read via USB (Ver.2.0) communication. *3 20 mA or lower/ch when adding expansion units. *3 IO-Link: Specification v1.1/COM2 (38.4 kbps) is supported. If the end of the cable needs to be an M12 connector when supporting IO-Link communication, connect an M12 conversion connector (OP-88296) to the cable. *4 Refer to the Instruction Manual for the number of connected units to N-bus devices.

▮ FD-XE (E-type for clog detection) [See pages 26-29]

Sensor head model			FD-XS1E			FD-XS8E			FD-XS20E					
Supported pipe materials			Metal pipes, Plastic pipes (soft/hard)*1											
Supported fluids			Liquids (water, oil, adhesive, grease, chemical solution, etc.)*1											
Supported fluid temperature (Pipe surface temperature)			0°C (no freezing on the pipe surface) to 100°C 32°F to 212°F											
Supported diameter	Plastic pipe/tube attachment	Clamp set model	FD-XC1R1		FD-XC1R2	FD-XC8R1	FD-XC8R2	FD-XC8R3	FD-XC20R1	FD-XC20R2		FD-XC20R3	FD-XC20R4	
		Outer diameter of pipe	ø3 mm 0.12"	1/8" (3.18 mm)	ø4 mm 0.16"	ø6 mm 0.24"	1/4" (6.35 mm)	ø8 mm 0.31"	3/8" (9.53 mm)	ø10 mm 0.39"		ø12 mm 0.47"	1/2" (12.7 mm)	
		Attachable range	ø2.7 to 3.7 mm 0.11" to 0.15"		ø3.5 to 4.5 mm 0.14" to 0.18"	ø5.5 to 6.5 mm 0.22" to 0.26"	ø5.9 to 6.9 mm 0.23" to 0.27"	ø7.5 to 8.5 mm 0.30" to 0.33"	ø9.0 to 10.0 mm 0.35" to 0.39"	ø9.5 to 10.5 mm 0.37" to 0.41"		ø11.5 to 12.5 mm 0.45" to 0.49"	ø12.2 to 13.2 mm 0.48" to 0.52"	
	Metal pipe attachment*2	Clamp set model	FD-XC1M			FD-XC8M			FD-XC20M1			FD-XC20M2		
		Outer diameter of pipe	ø3 mm 0.12"	1/8" (3.18 mm)	ø4 mm 0.16"	ø6 mm 0.24"	1/4" (6.35 mm)	ø8 mm 0.31"	3/8" (9.53 mm)	ø10 mm 0.39"	ø10.5 mm 0.41"	ø12 mm 0.47"	1/2" (12.7 mm)	ø13.8 mm 0.54"
		A designation	—	—	—	—	—	—	—	—	6A	—	—	8A
		Attachable range	ø2.8 to 5.5 mm 0.11" to 0.22"			ø5.5 to 8.3 mm 0.22" to 0.33"			ø8.3 to 10.8 mm 0.33" to 0.43"			ø10.8 to 14 mm 0.43" to 0.55"		
Maximum rated flow rate			1000 mL/min			3000 mL/min		8000 mL/min	15.00 L/min			20.00 L/min		
Zero cut flow rate*3 (variable, default)			50 mL/min			50 mL/min			0.15 L/min					
Display resolution (Displayed on controller)	Instantaneous flow		1/10 mL/min						0.01/0.1 L/min					
Repeatability			Response time 50 ms: ±20% of RD Response time 500 ms: ±15% of RD											
Hysteresis			Variable											
Display method			Status indicator											
Environmental resistance	Enclosure rating		IP65/IP67 (IEC60529), IP68G (JIS C0920)*4											
	Ambient temperature		0 to 60°C 32 to 140°F (No freezing)			-10 to 60°C 14 to 140°F (No freezing)								
	Ambient humidity		35% to 85% RH (No condensation)											
	Vibration resistance		10 to 55 Hz, double amplitude 1.5 mm 0.06", 2 hours each for X, Y, Z direction											
	Shock resistance		50 G 11 ms 3 times each for X, Y, Z direction											
Material	Sensor head		Head body: PPS/PPSU, relay amplifier: PPS, cable: PVC, controller connector: PPS/PBT/POM											
	Clamp set	For plastic pipe/tube	Body, fixing screw: PPS, detection surface: special rubber, pipe support rubber: FKM, sensor head fixing screw: SUSXM7											
		For metal pipe	Metal: SUS304/SUSXM7, detection surface: special rubber, clamp support rubber: FKM, sensor head fixing screw: SUSXM7											

*1 Liquid must allow for the passage of an ultrasonic pulse, as well as not contain large air pockets or excessive bubbles. Readings may become unstable depending on the type of pipe.
*2 When using stainless steel or iron pipes, the ideal pipe wall thickness is as follows, FD-XS1E: approx. 0.5 mm 0.02", FD-XS8E: approx. 1 mm 0.04", FD-XS20E: approx. 1 0.04" to 2 mm 0.08". FD-X signal strength and stability will decrease as the thickness of the pipe wall increases or decreases from the suggested size.
*3 The zero cut flow rate can be changed in the settings. When using the unit with a low flow rate range, perform an origin adjustment when the fluid is not moving if you change the zero cut flow rate.
*4 The connector part of the sensor head cable is IP65 / IP67.

▮ Controllers (E-type for clog detection) [See pages 26-29]

Model		FD-XA1E	FD-XA2E	FD-XA5E
Type		DIN rail type, main unit	DIN rail type, expansion unit	Panel type, main unit
Display method		Output indicator, 4-digit 7 segment display, OLED, Stability level display		
Display refresh frequency		Approximately 5 times/second		
Response time		50 ms/100 ms/500 ms (selectable, default: 500 ms)		
Memory back up		EEPROM (data storage period: more than 10 years, number of data rewritable times: 1 million times or more)		
Detection mode	ch.1	Instantaneous flow rate mode		
	ch.2	Error output mode		
Input/output	Output	NPN/PNP selectable Open collector output: 30 V or lower, main unit: 50 mA or lower/ch.*1/expansion unit: 20 mA or lower/ch., residual voltage: 2 V or lower		
	External input	Flow rate zero input/zero shift input (switchable) Short circuit current: NPN 1 mA or lower/PNP 2 mA or lower, input time: 20 ms or longer		
Network support		—	Supports NU Series	—
Power source	Power supply voltage	20 to 30 VDC including 10% ripple (P-P), Class 2		
	Current consumption	185 mA or lower (including the sensor head, excluding the load current)		
Protection circuit		Power supply reverse connection protection, power surge protection, output short circuit protection, output surge protection		
Addition of expansion units		Up to 7*2 per main unit		—
Environmental resistance	Ambient temperature	-10 to +50°C 14 to 122°F (No freezing)		
	Ambient humidity	35% to 85% RH (No condensation)		
	Vibration resistance	10 to 55 Hz, double amplitude 1.5 mm 0.06", 2 hours each for X, Y, Z direction		
	Shock resistance	100 m/s² 328.1'/s² (approx. 10 G) 16 ms pulse, 1000 times each for X, Y, Z direction		
Material		Main body case/front sheet: PC, Key top: POM, Cable: PVC		

*1 20 mA or lower/ch when adding expansion units.
*2 Consult the manual for the number of serially-connectable devices to the N-bus.

Multi-Output Unit

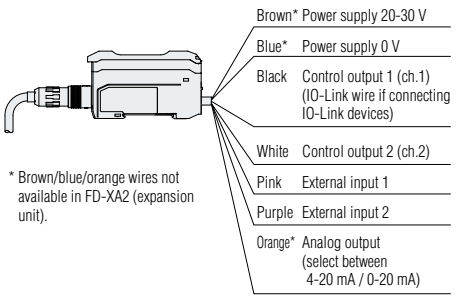
Model		FS-MC8N / FS-MC8P
Model	NPN output	**FS-MC8N**
	PNP output	**FS-MC8P**
Number of inputs and outputs		Separate control output: 8, common output: 1, common input: 1
Response time		Depends on the response time settings of the connected expansion units
Unit expansion		Up to 8 expansion units can be connected. (However, each dual output type will be treated as 2 expansion units.) Allowable passing current: 1200 mA or less
Indicators		STATUS indicator (green and red two-color display) MEMORY indicator (orange) LOCK indicator (orange)
Separate control outputs, common output	NPN output	NPN open-collector, 30 V or less, 20 mA or less per output, residual voltage: 1.4 V or less
	PNP output	PNP open-collector, 30 V or less, 20 mA or less per output, residual voltage: 1.6 V or less
External input time		Input time of the connected expansion units +11 ms
Protection circuit		Protection against reverse power connection, reverse output connection, output overcurrent, and output surge
Power supply	Power supply voltage*1	10 to 30 VDC (including 10% ripple (P-P) or less), class 2 or LPS
	Power consumption*2	690 mW or less (when used as a solitary unit) (26 mA or less at 24 V/38 mA or less at 12 V [excluding the load current])
Environmental resistance	Ambient temperature	-20°C to +55°C -4°F to +131°F (no freezing)
	Vibration resistance	10 to 55 Hz; double amplitude 1.5 mm 0.06" ; 2 hours each for X, Y, and Z axes
	Shock resistance	500 m/s² 1640.4'/s²; 3 times each for X, Y, and Z axes
Case material		Main unit and cover: polycarbonate
Weight		Approx. 110 g

*1 Match the rated power supply voltage of the expansion units to be connected to expand the system.
*2 The power consumption including the loads when the maximum number of units are connected is 38 W max.

I/O Circuit Diagrams

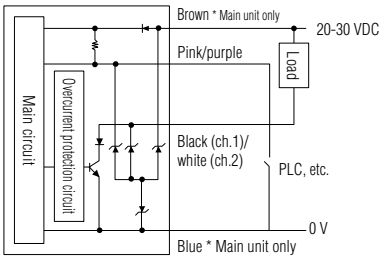
Controller

FD-XA1/XA2/XA5

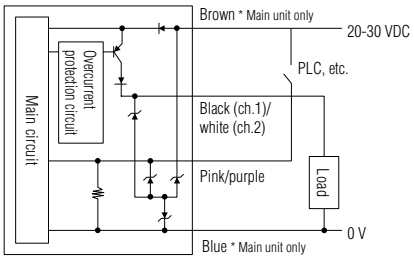


* Brown/blue/orange wires not available in FD-XA2 (expansion unit).

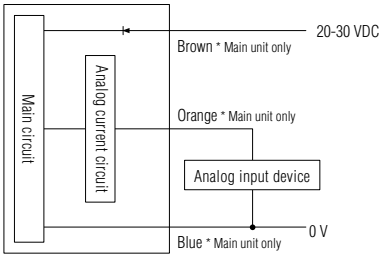
When using in NPN mode



When using in PNP mode

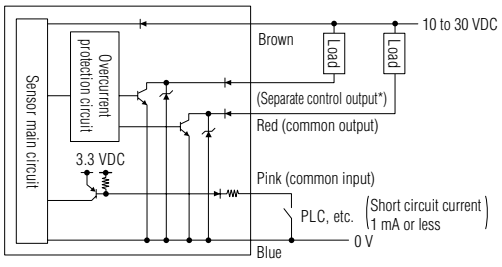


Analog output circuit diagram



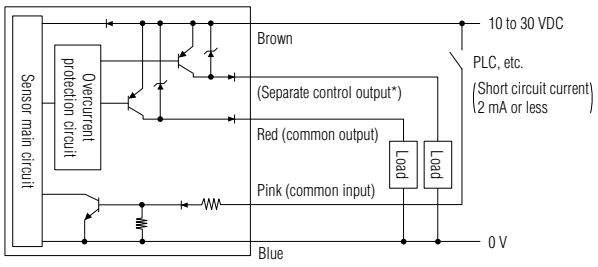
Multi-Output Unit

FS-MC8N

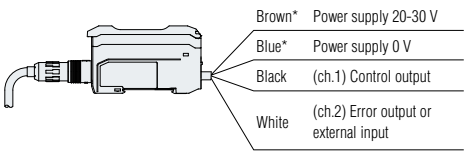


* Black, white, orange, yellow, green, purple, gray, pink / purple

FS-MC8P



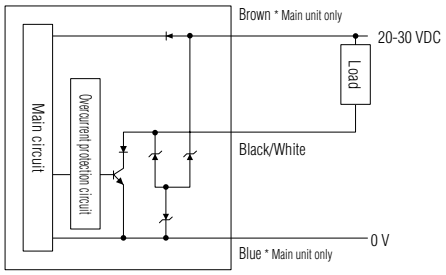
FD-XA1E/XA2E/XA5E



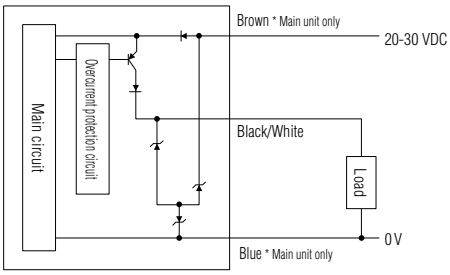
* No brown or blue wires in the FD-XA2E (expansion unit).

Selected ch.2 function = output

When using in NPN mode

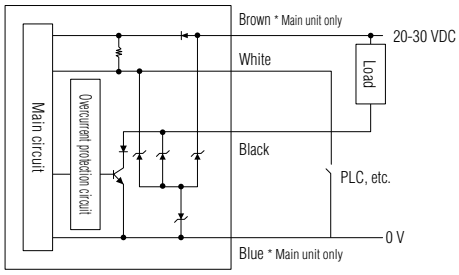


When using in PNP mode

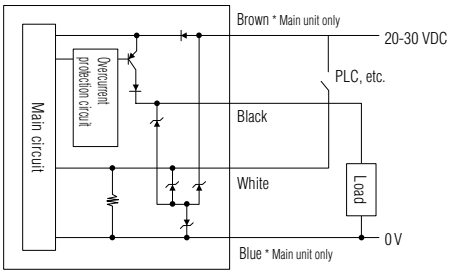


Selected ch.2 function = input

When using in NPN mode

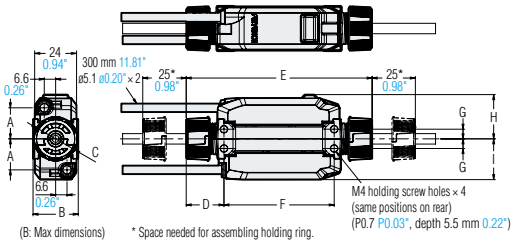


When using in PNP mode



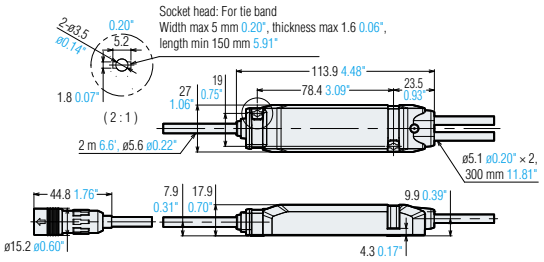
Sensor head

FD-XS1/XS8/XS20/XS1E/XS8E/XS20E + plastic piping clamp set

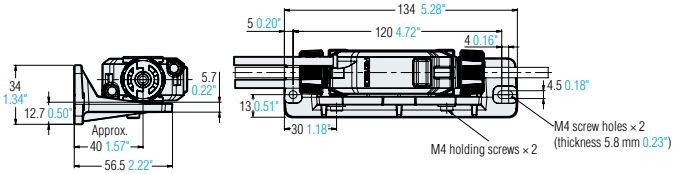


Sensor head	Clamp set	A	B	C	D	E	F	G	H	I
FD-XS1	FD-XC1R1	14.6 0.57"	24.6 0.97"	ø22 0.87"	21.3 0.84"	106 4.17"	63.4 2.50"	4 0.16"	22.2 0.87"	20.2 0.80"
	FD-XC1R2	15 0.59"	24.6 0.97"	ø22 0.87"	21.3 0.84"	106.5 4.19"	63.9 2.52"	4.4 0.17"	22.6 0.89"	20.6 0.81"
FD-XS8	FD-XC8R1	17.9 0.70"	26 1.02"	ø25.5 1.00"	21.4 0.84"	106.1 4.18"	63.4 2.50"	5.6 0.22"	25.5 1.00"	23.5 0.93"
	FD-XC8R2	18 0.71"	26 1.02"	ø25.5 1.00"	21.4 0.84"	106.3 4.19"	63.6 2.50"	5.7 0.22"	25.6 1.01"	23.6 0.93"
	FD-XC8R3	18.9 0.74"	26 1.02"	ø25.5 1.00"	21.4 0.84"	107.3 4.22"	64.6 2.54"	6.6 0.26"	26.5 1.04"	24.5 0.96"
FD-XS20	FD-XC20R1	22.4 0.88"	30 1.18"	ø29.5 1.16"	21.5 0.85"	112.8 4.44"	69.9 2.75"	7.3 0.29"	30 1.18"	28 1.10"
	FD-XC20R2	22.7 0.89"	30 1.18"	ø29.5 1.16"	21.5 0.85"	113.3 4.46"	70.4 2.77"	7.6 0.30"	30.3 1.19"	28.3 1.11"
	FD-XC20R3	23.7 0.93"	30 1.18"	ø29.5 1.16"	21.5 0.85"	114.4 4.50"	71.5 2.81"	8.6 0.34"	31.3 1.23"	29.3 1.15"
	FD-XC20R4	24 0.94"	30 1.18"	ø29.5 1.16"	21.5 0.85"	114.8 4.52"	71.9 2.83"	8.9 0.35"	31.6 1.24"	29.6 1.16"

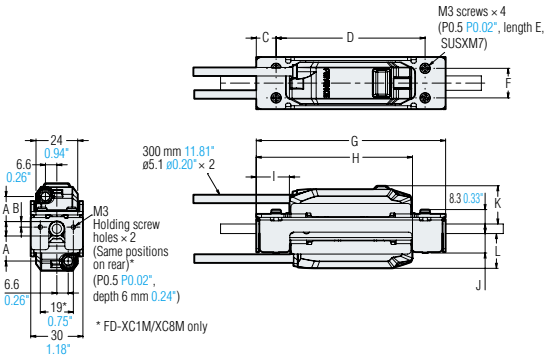
Relay amplifier



FD-XS1/XS8/XS20 securing bracket installed (optional, sold separately, OP-88294)

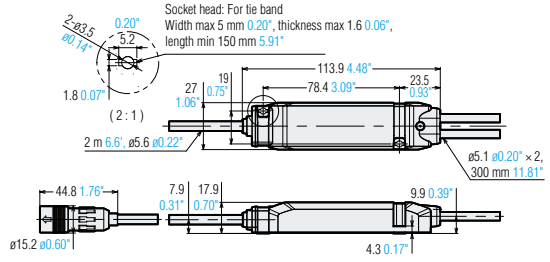


FD-XS1/XS8/XS20/XS1E/XS8E/XS20E + metal piping clamp set

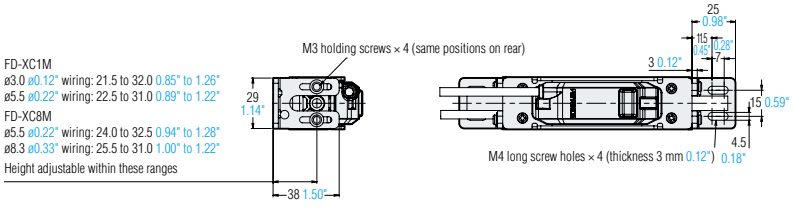


Sensor head	Clamp set	A	B	C	D	E	F	G	H	I	J	K	L
FD-XS1	FD-XC1M	12.7 0.50"	2.2 0.09"	10.8 0.43"	79.9 3.15"	20 0.79"	16 0.63"	102.5 4.04"	83.5 3.29"	22 0.87"	10.7 0.42"	20.3 0.80"	18.3 0.72"
FD-XS8	FD-XC8M	14.4 0.57"	4.2 0.17"	11.4 0.45"	85.7 3.37"	23 0.91"	17 0.67"	108.9 4.29"	89.4 3.52"	19.1 0.75"	11.2 0.44"	22 0.87"	20 0.79"
FD-XS20	FD-XC20M1	17.3 0.68"	—	11.9 0.47"	95.8 3.77"	26 1.02"	17.5 0.69"	119.5 4.70"	94.4 3.72"	19.7 0.78"	11.4 0.45"	24.9 0.98"	22.9 0.90"
	FD-XC20M2	17.3 0.68"	—	11.4 0.45"	98.8 3.89"	30 1.18"	18 0.71"	121.5 4.78"	93.9 3.70"	19.2 0.76"	12.9 0.51"	24.9 0.98"	22.9 0.90"

Relay amplifier

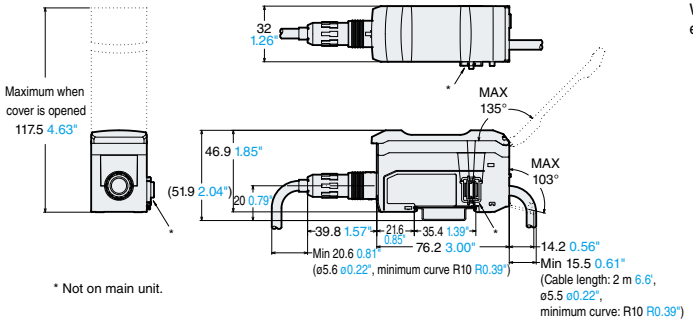


FD-XS1/XS8 securing bracket installed (optional, sold separately, OP-88297)

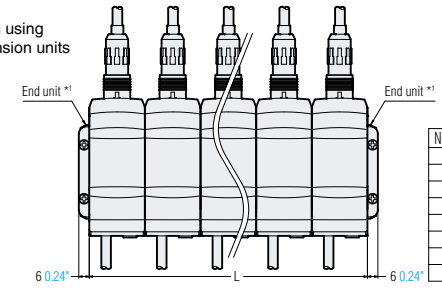


Controller

DIN rail mount type **FD-XA1/XA1E** (main unit) **/XA2/XA2E** (expansion unit)



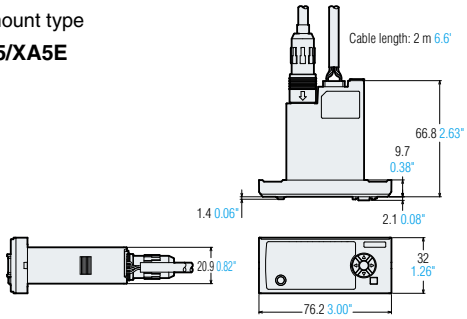
When using expansion units



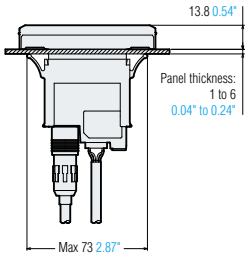
No. of expansion units	L
1	32 1.26"
2	64 2.52"
3	96 3.78"
4	128 5.04"
5	160 6.30"
6	192 7.56"
7	224 8.82"
8	256 10.08"

*1 When using expansion units, be sure to use the end units (sold separately)

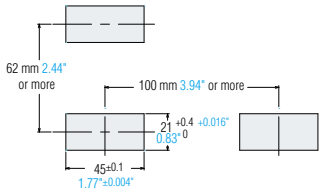
Panel mount type
FD-XA5/XA5E



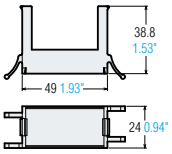
Assembled on panel



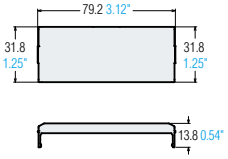
Panel cutting dimensions



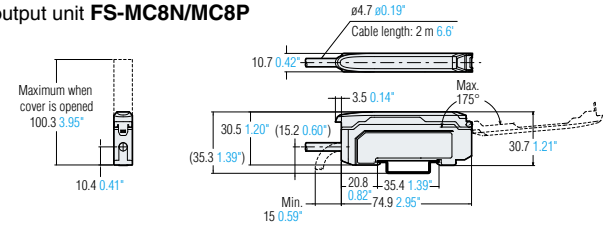
Panel mounting accessory



Protective cover

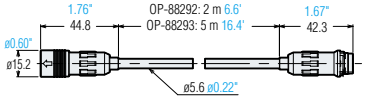


Multi-output unit **FS-MC8N/MC8P**

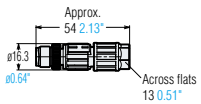


Optional cables

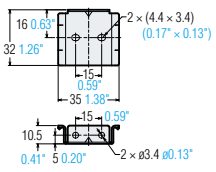
Sensor head-Controller extension cable
OP-88292/88293



Loose wires-M12 adapter connector
OP-88296



DIN amplifier securing bracket (for main unit)
OP-88311



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