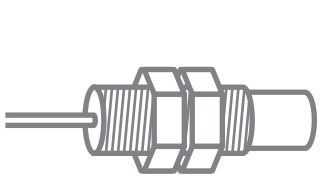
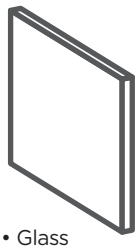
Detection

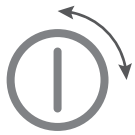
2 Part

Capacitive Proximity Sensor
Metal Body Round
KCR(P) Series

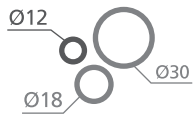




- Glass
- Liquid
- Wood
- Plastic
- Paper
- Metal

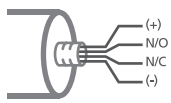


Convenient application setting with adjustable volume.



Primally, lineup M12, M18 and M30.

Every size is possible Metal & Plastic body.



A body has two output for variety applications. (N/O+N/C)

Durable metal body against external shock.

Enhanced waterproof design

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺

	SERIES	KCR : Capacitive Round		KCP : Capacitive Round Plastic	
❶	**Distance**	E : 2mm L : 10mm	G : 4mm P : 15mm	H : 5mm	K : 8mm
❷	**Size**	4 : Ø12	5 : Ø18	6 : Ø30	
❸	**Output**	1 : NPN N/O (3 wire) 5 : N/O (2 wire)	2 : NPN N/C (3 wire) 6 : N/C (2 wire)	3 : PNP N/O (3 wire) 7 : NPN N/O+N/C (4 wire)	4 : PNP N/C (3 wire) 8 : PNP N/O+N/C (4 wire)
❹	**Power**	1 : 10 ~ 30VDC	5 : 20 ~ 240VAC		
❺	**Cable Outlet**	Standard* : 2m Cable	3 : M12 connector		

* Standard specification is not appeared in part number description

Guide to Selection

Size	●3	●5	■7	●8	●12	●■18	■25	●■30	●32	■34	■40	■80
Available					O	O		O				
Sensing Distance	0.8mm	1mm	1.5mm	2mm	3mm	4mm	5mm	7mm	8mm	10mm	12mm	15mm
Available				O		O	O		O	O		O
Sensing Distance	20mm	22mm	25mm	30mm	40mm	50mm	70mm					
Available												
Output	NPN N/C	NPN N/O	PNP N/C	NPN N/O	N/C	N/O	NPN N/O+N/C		PNP N/O+N/C		Analog	NAMUR
Available	O	O	O	O	O	O	O		O			
Connector	2m Cable			M8 Connector			M12 Connector			Screw Terminal		
Available	O						O					
Power	7.7-9VDC		10-30VDC		15-30VDC		10-60VDC		20-240VAC		20-240VAC/DC	
Available			O						O			

General Specification

Detectable Object	Conductive Material (Metal, Wood, Water...)
Differential Travel	4% to 20% of sensing distance
Indicators	LED
Cable Outlet	Standard : 2m Cable 3 : M12 connector
Protection Circuits	Load short-circuit protection, Surge suppressor, Reverse polarity protection
Ambient Temperature	Operating/Storage : −25 to 70°C (with no icing)
Ambient Humidity	Operating/Storage : 35% to 95% (with no icing)
Temperature Influence	Max. ±10% of sensing distance at 23°C in the temperature range of −25 to 70°C
Voltage Influence	Max. ±1% of sensing distance at rated voltage in the rated voltage ±15% range
Insulation Resistance	Min. 50 MΩ (at 500 VDC) between current-carrying parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions
Shock Resistance	Destruction : 500 m/s^2 10 times each in X, Y, and Z directions
Materials	KCR : Nickel copper plate KCS : Plastic
Degree of Protection	IP67

Characteristics

		DC 3/4 wire	AC 2 wire
Supply Voltage		1 : 10 ~ 30VDC	5 : 20 ~ 240VAC
Current Consumption		Max. 15mA	
Leakage Current		-	Max. 2.2mA
Voltage Drop		Residual voltage : Max. 2V Load current : Max. 200 mA	Load current : 5 to 300 mA
Operation Mode	3wire	1 : NPN N/O, 2 : NPN N/C, 3 : PNP N/O, 4 : PNP N/C	5 : N/O, 6 : N/C
	4wire	7 : NPN N/O+N/C, 8 : PNP N/O+N/C	
Dielectric Strength		1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case	4,000 VAC, 50/60 Hz for 1 minute between current carry parts and case
Maximum Switching Frequency		50Hz	15Hz

Capacitive Proximity Sensor
Metal Body Round
KCR(P) Series

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M12 Round Metal body 3-Wire(DC)	E : 2mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCR E411	50Hz
			2 : NPN N/C			KCR E421	
			3 : PNP N/O			KCR E431	
			4 : PNP N/C			KCR E441	
	G : 4mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCR G411	50Hz
			2 : NPN N/C			KCR G421	
			3 : PNP N/O			KCR G431	
			4 : PNP N/C			KCR G441	
	E : 2mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCR E411 3	50Hz
			2 : NPN N/C			KCR E421 3	
			3 : PNP N/O			KCR E431 3	
			4 : PNP N/C			KCR E441 3	
	G : 4mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCR G411 3	50Hz
			2 : NPN N/C			KCR G421 3	
			3 : PNP N/O			KCR G431 3	
			4 : PNP N/C			KCR G441 3	
M18 Round Metal body 3, 4-Wire(DC)	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCR H511	50Hz
			2 : NPN N/C			KCR H521	
			3 : PNP N/O			KCR H531	
			4 : PNP N/C			KCR H541	
			7 : NPN N/O+N/C			KCR H571	
			8 : PNP N/O+N/C			KCR H581	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCR K511	50Hz
			2 : NPN N/C			KCR K521	
			3 : PNP N/O			KCR K531	
			4 : PNP N/C			KCR K541	
			7 : NPN N/O+N/C			KCR K571	
			8 : PNP N/O+N/C			KCR K581	
	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCR H511 3	50Hz
			2 : NPN N/C			KCR H521 3	
			3 : PNP N/O			KCR H531 3	
			4 : PNP N/C			KCR H541 3	
			7 : NPN N/O+N/C			KCR H571 3	
			8 : PNP N/O+N/C			KCR H581 3	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCR K511 3	50Hz
			2 : NPN N/C			KCR K521 3	
			3 : PNP N/O			KCR K531 3	
			4 : PNP N/C			KCR K541 3	
			7 : NPN N/O+N/C			KCR K571 3	
			8 : PNP N/O+N/C			KCR K581 3	

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M30 Round Metal body 3, 4-Wire(DC)	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCR L611	50Hz
			2 : NPN N/C			KCR L621	
			3 : PNP N/O			KCR L631	
			4 : PNP N/C			KCR L641	
			7 : NPN N/O+N/C			KCR L671	
			8 : PNP N/O+N/C			KCR L681	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCR P611	50Hz
			2 : NPN N/C			KCR P621	
			3 : PNP N/O			KCR P631	
			4 : PNP N/C			KCR P641	
			7 : NPN N/O+N/C			KCR P671	
			8 : PNP N/O+N/C			KCR P681	
	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCR L611 3	50Hz
			2 : NPN N/C			KCR L621 3	
			3 : PNP N/O			KCR L631 3	
			4 : PNP N/C			KCR L641 3	
			7 : NPN N/O+N/C			KCR L671 3	
			8 : PNP N/O+N/C			KCR L681 3	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCR P611 3	50Hz
			2 : NPN N/C			KCR P621 3	
			3 : PNP N/O			KCR P631 3	
			4 : PNP N/C			KCR P641 3	
			7 : NPN N/O+N/C			KCR P671 3	
			8 : PNP N/O+N/C			KCR P681 3	
M18 Round Plastic body 3, 4-Wire(DC)	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCP H511	50Hz
			2 : NPN N/C			KCP H521	
			3 : PNP N/O			KCP H531	
			4 : PNP N/C			KCP H541	
			7 : NPN N/O+N/C			KCP H571	
			8 : PNP N/O+N/C			KCP H581	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCP K511	50Hz
			2 : NPN N/C			KCP K521	
			3 : PNP N/O			KCP K531	
			4 : PNP N/C			KCP K541	
			7 : NPN N/O+N/C			KCP K571	
			8 : PNP N/O+N/C			KCP K581	

Capacitive Proximity Sensor
Metal Body Round
KCR(P) Series

Product Selection

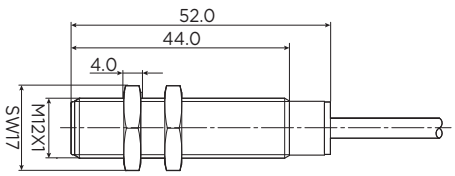
Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M18 Round Plastic body 3, 4-Wire(DC) 	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCP H511 3	50Hz
			2 : NPN N/C			KCP H521 3	
			3 : PNP N/O			KCP H531 3	
			4 : PNP N/C			KCP H541 3	
			7 : NPN N/O+N/C			KCP H571 3	
			8 : PNP N/O+N/C			KCP H581 3	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCP K511 3	50Hz
			2 : NPN N/C			KCP K521 3	
			3 : PNP N/O			KCP K531 3	
			4 : PNP N/C			KCP K541 3	
			7 : NPN N/O+N/C			KCP K571 3	
			8 : PNP N/O+N/C			KCP K581 3	
M30 Round Metal body 3, 4-Wire(DC)	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCP L611	50Hz
			2 : NPN N/C			KCP L621	
			3 : PNP N/O			KCP L631	
			4 : PNP N/C			KCP L641	
			7 : NPN N/O+N/C			KCP L671	
			8 : PNP N/O+N/C			KCP L681	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCP P611	50Hz
			2 : NPN N/C			KCP P621	
			3 : PNP N/O			KCP P631	
			4 : PNP N/C			KCP P641	
			7 : NPN N/O+N/C			KCP P671	
			8 : PNP N/O+N/C			KCP P681	
	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCP L611 3	50Hz
			2 : NPN N/C			KCP L621 3	
			3 : PNP N/O			KCP L631 3	
			4 : PNP N/C			KCP L641 3	
			7 : NPN N/O+N/C			KCP L671 3	
			8 : PNP N/O+N/C			KCP L681 3	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KCP P611 3	50Hz
			2 : NPN N/C			KCP P621 3	
			3 : PNP N/O			KCP P631 3	
			4 : PNP N/C			KCP P641 3	
			7 : NPN N/O+N/C			KCP P671 3	
			8 : PNP N/O+N/C			KCP P681 3	

Dimension

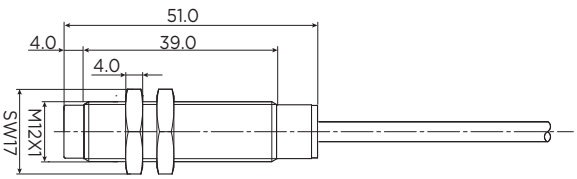
(mm)

KCR(P) Ø12

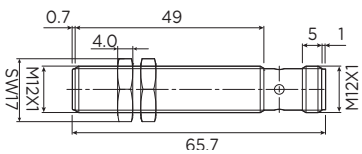
Flush



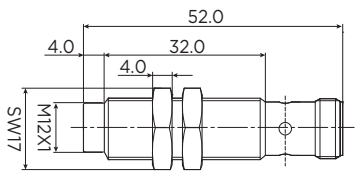
Non flush



M12 connector Flush

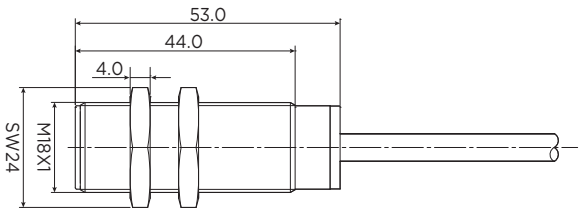


M12 connector Non flush

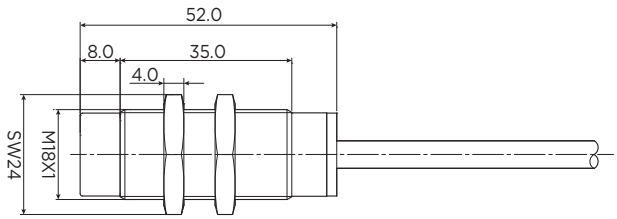


KCR(P) Ø18

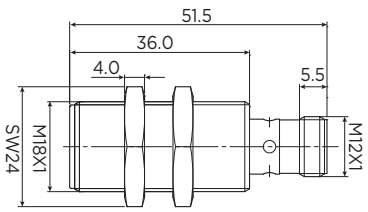
Flush



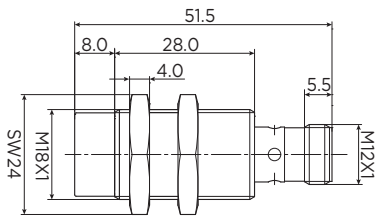
Non flush



M12 connector Flush



M12 connector Non flush



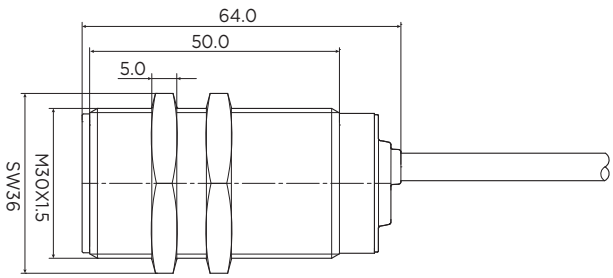
Capacitive Proximity Sensor
Metal Body Round
KCR(P) Series

Dimension

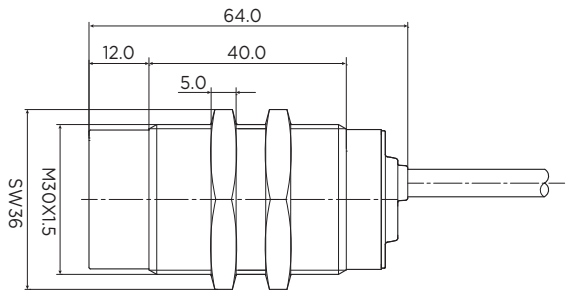
(mm)

KCR(P) Ø30

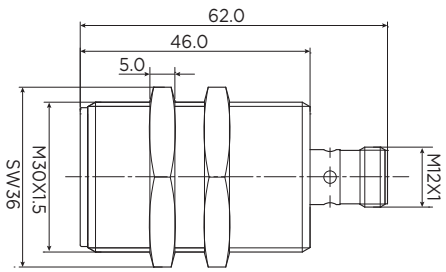
Flush



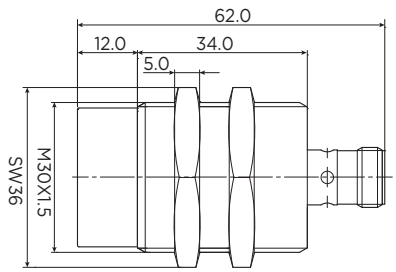
Non flush



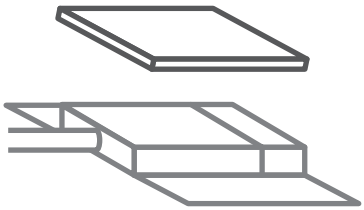
M12 connector Flush



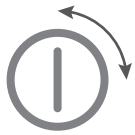
M12 connector Non flush



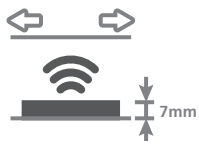
Capacitive Proximity Sensor
Square
KCS Series



- Glass
- Liquid
- Wood
- Plastic
- Paper
- Metal



Convenient Application setting with adjustable volume.



The best fit size for flat and narrow space with 7mm high.

It is possible to install on the metal surface.

Built-in Amplifier

Enhanced waterproof design

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺

	SERIES	KCS : Capacitive Square			
❶	**Distance**	L : 10mm			
❷	**Size**	F : 7 Rectangular*	G : 34 Rectangular		
❸	**Output**	1 : NPN N/O (3 wire)	2 : NPN N/C (3 wire)	3 : PNP N/O (3 wire)	4 : PNP N/C (3 wire)
❹	**Power**	1 : 10 ~ 30VDC			
❺	**Cable Outlet**	Standard** : 2m Cable			

* F : 7 Rectangular Model in under development
** Standard specification is not appeared in part number description

Guide to Selection

Size	●3	●5	■7	●8	●12	●■18	■25	●■30	●32	■34	■40	■80
Available			□							□		
Sensing Distance	0.8mm	1mm	1.5mm	2mm	3mm	4mm	5mm	7mm	8mm	10mm	12mm	15mm
Available										○		
Sensing Distance	20mm	22mm	25mm	30mm	40mm	50mm	70mm					
Available												
Output	NPN N/C	NPN N/O	PNP N/C	NPN N/O	N/C	N/O	NPN N/O+N/C		PNP N/O+N/C		Analog	NAMUR
Available	○	○	○	○								
Connector	2m Cable			M8 Connector			M12 Connector			Screw Terminal		
Available	○											
Power	7.7-9VDC		10-30VDC		15-30VDC		10-60VDC		20-240VAC		20-240VAC/DC	
Available			○									

Capacitive Proximity Sensor
Square
KCS Series

General Specification

Detectable Object	Conductive Material (Metal, Wood, Water...)
Differential Travel	4% to 20% of sensing distance
Indicators	LED
Cable Outlet	Standard : 2m Cable
Protection Circuits	Load short-circuit protection, Surge suppressor, Reverse polarity protection
Ambient Temperature	Operating/Storage : −25 to 70°C (with no icing)
Ambient Humidity	Operating/Storage : 35% to 95% (with no icing)
Temperature Influence	Max. ±10% of sensing distance at 23°C in the temperature range of −25 to 70°C
Voltage Influence	Max. ±1% of sensing distance at rated voltage in the rated voltage ±15% range
Insulation Resistance	Min. 50 MΩ (at 500 VDC) between current-carrying parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions
Shock Resistance	Destruction : 500 m/s^2 10 times each in X, Y, and Z directions
Materials	Plastic
Degree of Protection	IP67

Characteristics

	DC 3wire			
Supply Voltage	1 : 10 ~ 30VDC			
Current Consumption	Max. 10mA			
Voltage Drop	Residual voltage : Max. 1.5 V Load current : Max. 200 mA.			
Operation Mode	1 : NPN N/O	2 : NPN N/C	3 : PNP N/O	4 : PNP N/C
Dielectric Strength	1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case			
Maximum Switching Frequency	30Hz			

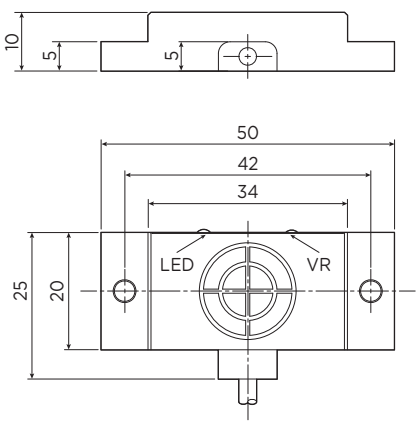
Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
34 Square 3-Wire(DC)	L : 10mm	G : 34 rectangular Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KCS LG11	30Hz
			2 : NPN N/C			KCS LG21	
			3 : PNP N/O			KCS LG31	
			4 : PNP N/C			KCS LG41	

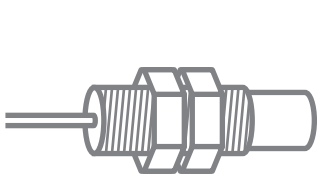
Dimension

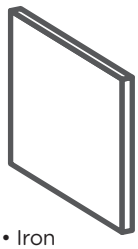
(mm)

KCS LG



Inductive Proximity Sensor
Round-Standard Type
KPR Series



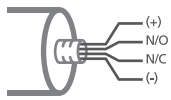


- Iron
- Aluminum
- Copper
- Stainless
- Brass

Never mind to install in flat and narrow space with M3, M5 size.

Durable M8, M12 connector against vibration and shock.

Enhanced waterproof design



A body has two output for variety applications. (N/O+N/C)

Wide power supply and combination AC/DC power.

High-speed Detection with a response frequency of 2.5kHz (M3 Size)

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺

	SERIES	KPR : Inductive proximity Round		
❶	**Distance**	A : 1mm G : 4mm P : 15mm	B : 1mm H : 5mm	E : 2mm K : 8mm	F : 3mm L : 10mm
❷	**Size**	1 : Ø3 4 : Ø12	2 : Ø5 5 : Ø18	3 : Ø8 6 : Ø30	
❸	**Output**	1 : NPN N/O (3 wire) 5 : N/O (2 wire)	2 : NPN N/C (3 wire) 6 : N/C (2 wire)	3 : PNP N/O (3 wire) 7 : NPN N/O+N/C (4 wire)	4 : PNP N/C (3 wire) 8 : PNP N/O+N/C (4 wire)
❹	**Power**	1 : 10 ~ 30VDC	2 : 7.7 ~ 9VDC*	5 : 20 ~ 240VAC	6 : 20 ~ 240VAC/DC
❺	**Cable Outlet**	Standard** : 2m Cable	2 : M8 connector	3 : M12 connector	

* NUMAR(7.7 ~ 9VDC) model is under development.
** Standard specification is not appeared in part number description

Guide to Selection

Size	●3	●5	■7	●8	●12	●■18	■25	●■30	●32	■34	■40	■80
Available	○	○		○	○	○		○				
Sensing Distance	0.8mm	1mm	1.5mm	2mm	3mm	4mm	5mm	7mm	8mm	10mm	12mm	15mm
Available	○	○		○	○	○	○		○	○		○
Sensing Distance	20mm	22mm	25mm	30mm	40mm	50mm	70mm					
Available												
Output	NPN N/C	NPN N/O	PNP N/C	NPN N/O	N/C	N/O	NPN N/O+N/C		PNP N/O+N/C		Analog	NAMUR
Available	○	○	○	○	○	○	○		○			
Connector	2m Cable			M8 Connector			M12 Connector			Screw Terminal		
Available	○			○			○					
Power	7.7-9VDC		10-30VDC		15-30VDC		10-60VDC		20-240VAC		20-240VAC/DC	
Available			○						○		○	

General Specification

Detectable Object	Ferrous metal (The sensing distance decreases with non-ferrous metal.)
Differential Travel	Max. 15% of sensing distance
Indicators	LED
Cable Outlet	Standard : 2m Cable 2 : M8 connector 3 : M12 connector
Protection Circuits	Load short-circuit protection, Surge suppressor, Reverse polarity protection
Ambient Temperature	Operating/Storage : −25 to 70°C (with no icing)
Ambient Humidity	Operating/Storage : 35% to 95% (with no icing)
Temperature Influence	Max. ±10% of sensing distance at 23°C in the temperature range of −25 to 70°C
Voltage Influence	Max. ±1% of sensing distance at rated voltage in the rated voltage ±15% range
Insulation Resistance	Min. 50 MΩ (at 500 VDC) between current-carrying parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions
Shock Resistance	Destruction : 1,000 m/s^2 10 times each in X, Y, and Z directions
Case Material	Stainless(M3, M5 type only) / Nickel copper plated
Degree of Protection	IP67

Characteristics

			DC 3/4 wire	DC 2 wire	AC/DC 2 wire	AC 2 wire
Supply Voltage			1 : 10 ~ 30VDC 3 : 15 ~ 30VDC		6 : 20 ~ 250VAC/DC	5 : 20 ~ 240VAC
Current Consumption			Max. 10mA	Max. 0.8mA		-
Leakage Current			-	-		Max. 1mA
Voltage Drop			Residual voltage : Max. 2V Load current : Max. 200 mA	Residual voltage : Max. 4V Load current : 3 to 100 mA	Residual voltage : Max. 5V for DC power Load current : 3 to 100 mA	Load current : 5 to 300 mA
Operation Mode		3wire	1 : NPN N/O, 2 : NPN N/C, 3 : PNP N/O, 4 : PNP N/C	5 : N/O, 6 : N/C		
		4wire	7 : NPN N/O+N/C, 8 : PNP N/O+N/C			
Dielectric Strength			1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case		4,000 VAC, 50/60 Hz for 1 minute between current carry parts and case	
Maximum Switching Frequency	**M3**	**Flush**	2500Hz	-	-	-
	M5	**Flush**	2500Hz	-	-	-
	M8	**Flush**	2000Hz	-	-	-
		Non flush	1500Hz	-	-	-
	M12	**Flush**	1500Hz	800Hz	-	20Hz
		Non flush	1000Hz	500Hz	-	
	M18	**Flush**	1000Hz	500Hz	AC : 15Hz DC : 50Hz	20Hz
		Non flush	800Hz	300Hz		
	M30	**Flush**	500Hz	300Hz	AC : 15Hz DC : 50Hz	20Hz
		Non flush	300Hz	200Hz		

Inductive Proximity Sensor
Round-Standard Type
KPR Series

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M3 Round 3-Wire(DC) 	A : 1 mm	1 : M3 (Smooth Barrel) Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR A111	2,500Hz
			2 : NPN N/C			KPR A121	
			3 : PNP N/O			KPR A131	
			4 : PNP N/C			KPR A141	
M5 Round 3-Wire(DC) 	B : 1mm	2 : M5 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR B211	2,500Hz
			2 : NPN N/C			KPR B221	
			3 : PNP N/O			KPR B231	
			4 : PNP N/C			KPR B241	
	B : 1mm	2 : M5 Flush	1 : NPN N/O	1 : 10-30VDC	2 : M8 connector	KPR B211 2	2,500Hz
			2 : NPN N/C			KPR B221 2	
			3 : PNP N/O			KPR B231 2	
			4 : PNP N/C			KPR B241 2	
M8 Round 3-Wire(DC)	E : 2mm	3 : M8 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR E311	2,000Hz
			2 : NPN N/C			KPR E321	
			3 : PNP N/O			KPR E331	
			4 : PNP N/C			KPR E341	
	F : 3mm	3 : M8 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR F311	1,500Hz
			2 : NPN N/C			KPR F321	
			3 : PNP N/O			KPR F331	
			4 : PNP N/C			KPR F341	
	E : 2mm	3 : M8 Flush	1 : NPN N/O	1 : 10-30VDC	2 : M8 connector	KPR E311 2	2,000Hz
			2 : NPN N/C			KPR E321 2	
			3 : PNP N/O			KPR E331 2	
			4 : PNP N/C			KPR E341 2	
	F : 3mm	3 : M8 Non flush	1 : NPN N/O	1 : 10-30VDC	2 : M8 connector	KPR F311 2	1,500Hz
			2 : NPN N/C			KPR F321 2	
			3 : PNP N/O			KPR F331 2	
			4 : PNP N/C			KPR F341 2	
	E : 2mm	3 : M8 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR E311 3	2,000Hz
			2 : NPN N/C			KPR E321 3	
			3 : PNP N/O			KPR E331 3	
			4 : PNP N/C			KPR E341 3	
	F : 3mm	3 : M8 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR F311 3	1,500Hz
			2 : NPN N/C			KPR F321 3	
			3 : PNP N/O			KPR F331 3	
			4 : PNP N/C			KPR F341 3	

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M12 Round 3-Wire(DC)	E : 2mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR E411	1,500Hz
			2 : NPN N/C			KPR E421	
			3 : PNP N/O			KPR E431	
			4 : PNP N/C			KPR E441	
	G : 4mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR G411	1,000Hz
			2 : NPN N/C			KPR G421	
			3 : PNP N/O			KPR G431	
			4 : PNP N/C			KPR G441	
	H : 5mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR H411	800Hz
			2 : NPN N/C			KPR H421	
			3 : PNP N/O			KPR H431	
			4 : PNP N/C			KPR H441	
	E : 2mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR E411 3	1,500Hz
			2 : NPN N/C			KPR E421 3	
			3 : PNP N/O			KPR E431 3	
			4 : PNP N/C			KPR E441 3	
	G : 4mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR G411 3	1,000Hz
			2 : NPN N/C			KPR G421 3	
			3 : PNP N/O			KPR G431 3	
			4 : PNP N/C			KPR G441 3	
	H : 5mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR H411 3	400Hz
			2 : NPN N/C			KPR H421 3	
			3 : PNP N/O			KPR H431 3	
			4 : PNP N/C			KPR H441 3	

Inductive Proximity Sensor
Round-Standard Type
KPR Series

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M18 Round 3,4-Wire(DC)	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR H511	1,000Hz
			2 : NPN N/C			KPR H521	
			3 : PNP N/O			KPR H531	
			4 : PNP N/C			KPR H541	
			7 : NPN N/O+N/C			KPR H571	
			8 : PNP N/O+N/C			KPR H581	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR K511	800Hz
			2 : NPN N/C			KPR K521	
			3 : PNP N/O			KPR K531	
			4 : PNP N/C			KPR K541	
			7 : NPN N/O+N/C			KPR K571	
			8 : PNP N/O+N/C			KPR K581	
	L : 10mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR L511	500Hz
			2 : NPN N/C			KPR L521	
			3 : PNP N/O			KPR L531	
			4 : PNP N/C			KPR L541	
	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR H511 3	1,000Hz
			2 : NPN N/C			KPR H521 3	
			3 : PNP N/O			KPR H531 3	
			4 : PNP N/C			KPR H541 3	
			7 : NPN N/O+N/C			KPR H571 3	
			8 : PNP N/O+N/C			KPR H581 3	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR K511 3	800Hz
			2 : NPN N/C			KPR K521 3	
			3 : PNP N/O			KPR K531 3	
			4 : PNP N/C			KPR K541 3	
			7 : NPN N/O+N/C			KPR H571 3	
			8 : PNP N/O+N/C			KPR H581 3	
	L : 10mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR L511 3	500Hz
			2 : NPN N/C			KPR L521 3	
			3 : PNP N/O			KPR L531 3	
			4 : PNP N/C			KPR L541 3	

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M30 Round 3, 4-Wire(DC)	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR L611	500Hz
			2 : NPN N/C			KPR L621	
			3 : PNP N/O			KPR L631	
			4 : PNP N/C			KPR L641	
			7 : NPN N/O+N/C			KPR L671	
			8 : PNP N/O+N/C			KPR L681	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPR P611	300Hz
			2 : NPN N/C			KPR P621	
			3 : PNP N/O			KPR P631	
			4 : PNP N/C			KPR P641	
			7 : NPN N/O+N/C			KPR P671	
			8 : PNP N/O+N/C			KPR P681	
	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR L611 3	500Hz
			2 : NPN N/C			KPR L621 3	
			3 : PNP N/O			KPR L631 3	
			4 : PNP N/C			KPR L641 3	
			7 : NPN N/O+N/C			KPR L671 3	
			8 : PNP N/O+N/C			KPR L681 3	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPR P611 3	300Hz
			2 : NPN N/C			KPR P621 3	
			3 : PNP N/O			KPR P631 3	
			4 : PNP N/C			KPR P641 3	
			7 : NPN N/O+N/C			KPR P671 3	
			8 : PNP N/O+N/C			KPR P681 3	

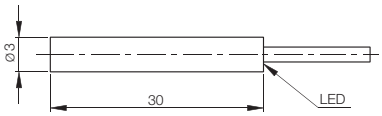
Inductive Proximity Sensor
Round-Standard Type
KPR Series

Dimension

(mm)

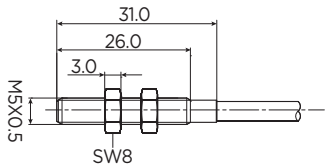
KPR Ø3

Flush

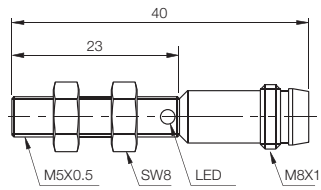


KPR Ø5

Flush

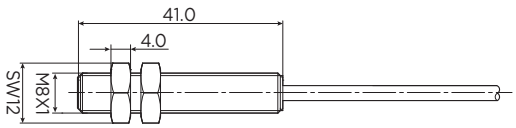


M8 connector Flush

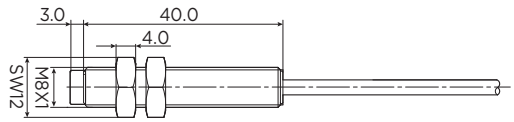


KPR Ø8

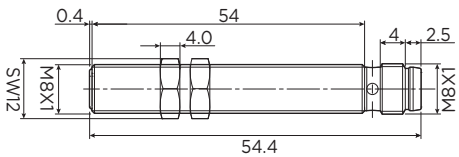
Flush



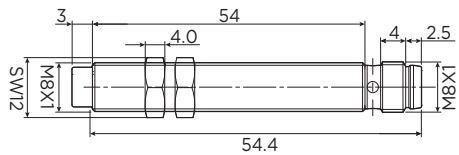
Non flush



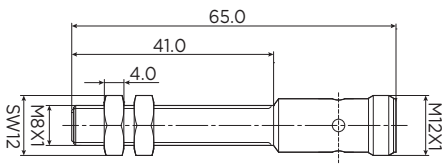
M8 connector Flush



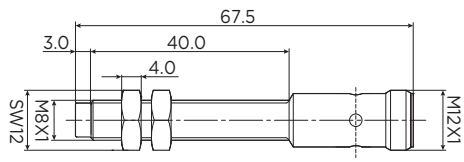
M8 connector Non flush



M12 connector Flush



M12 connector Non flush

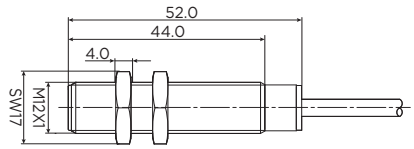


Dimension

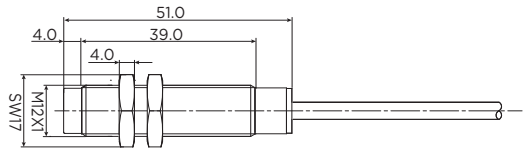
(mm)

KPR Ø12

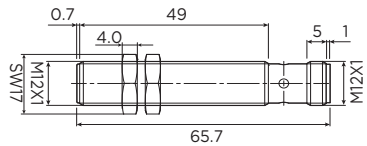
Flush



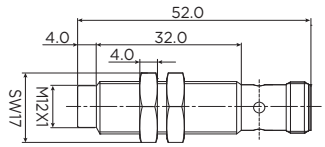
Non flush



M12 connector Flush

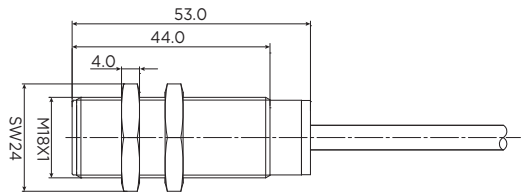


M12 connector Non flush

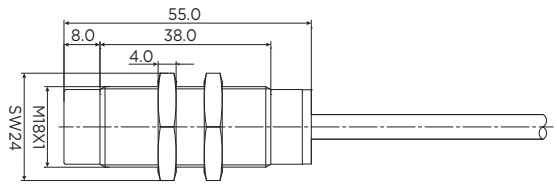


KPR Ø18

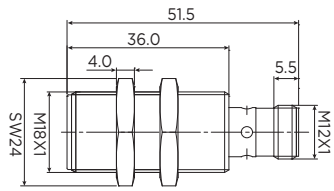
Flush



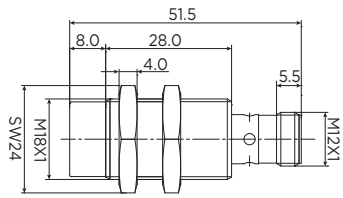
Non flush



M12 connector Flush

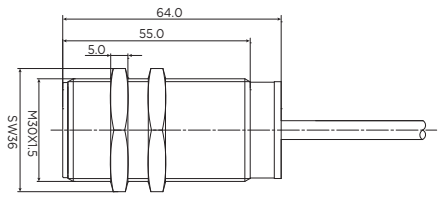


M12 connector Non flush



KPR Ø30

Flush



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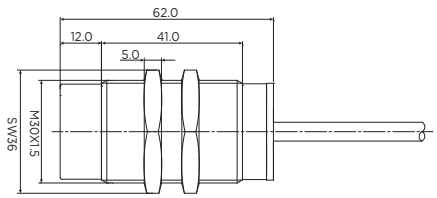
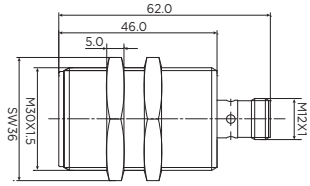
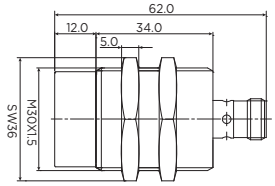


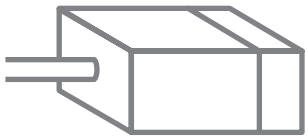
M12 connector Flush

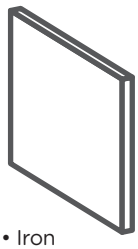


M12 connector Non flush



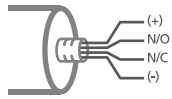
Inductive Proximity Sensor
Square-Standard Type
KPS Series





- Iron
- Aluminum
- Copper
- Stainless
- Brass

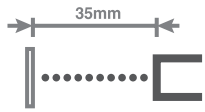
Variety connetor types help to easy install.



A body has two output for variety applications. (N/O+N/C)

Wide power supply and combination AC/DC power.

Enhanced waterproof design



Provides Long-distance Detection. (Maximum 35mm)

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺

	SERIES	KPS : Inductive Proximity Square		
❶	**Distance**	H : 5mm P : 15mm	J : 7mm Q : 20mm	K : 8mm S : 25mm	L : 10mm V : 35mm
❷	**Size**	A : 18 Square	B : 25 Square	C : 30 Square	D : 40 Square
❸	**Output**	1 : NPN N/O (3 wire) 5 : N/O (2 wire)	2 : NPN N/C (3 wire) 6 : N/C (2 wire)	3 : PNP N/O (3 wire) 7 : NPN N/O+N/C (4 wire)	4 : PNP N/C (3 wire) 8 : PNP N/O+N/C (4 wire)
❹	**Power**	1 : 10 ~ 30VDC	5 : 20 ~ 240VAC	6 : 20 ~ 240VAC/DC	
❺	**Cable Outlet**	Standard* : 2m Cable	3 : M12 connector		

* Standard specification is not appeared in part number description

Guide to Selection

Size	●3	●5	■7	●8	●12	●■18	■25	●■30	●32	■34	■40	■80
Available						□	□	□			□	
Sensing Distance	0.8mm	1mm	1.5mm	2mm	3mm	4mm	5mm	7mm	8mm	10mm	12mm	15mm
Available							○	○	○	○		○
Sensing Distance	20mm	22mm	25mm	35mm	40mm	50mm	70mm					
Available	○		○	○								
Output	NPN N/C	NPN N/O	PNP N/C	NPN N/O	N/C	N/O	NPN N/O+N/C		PNP N/O+N/C		Analog	NAMUR
Available	○	○	○	○	○	○	○		○			
Connector	2m Cable			M8 Connector			M12 Connector			Screw Terminal		
Available	○						○					
Power	7.7-9VDC		10-30VDC		15-30VDC		10-60VDC		20-240VAC		20-240VAC/DC	
Available			○						○		○	

General Specification

Detectable Object	Ferrous metal (The sensing distance decreases with non-ferrous metal.)
Differential Travel	Max. 15% of sensing distance
Indicators	LED
Cable Outlet	Standard : 2m Cable 3 : M12 connector (KPS Q, KPS V only)
Protection Circuits	Load short-circuit protection, Surge suppressor, Reverse polarity protection
Ambient Temperature	Operating/Storage : −25 to 70°C (with no icing)
Ambient Humidity	Operating/Storage : 35% to 95% (with no icing)
Temperature Influence	Max. ±10% of sensing distance at 23°C in the temperature range of −25 to 70°C
Voltage Influence	Max. ±1% of sensing distance at rated voltage in the rated voltage ±15% range
Insulation Resistance	Min. 50 MΩ (at 500 VDC) between current-carrying parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions
Shock Resistance	Destruction : 1,000 m/s^2 10 times each in X, Y, and Z directions

Characteristics

			DC 3/4 wire	DC 2 wire	AC/DC 2 wire	AC 2 wire
Supply Voltage			1 : 10 ~ 30VDC 3 : 15 ~ 30VDC	4 : 10 ~ 60VDC	6 : 20 ~ 250VAC/DC	5 : 20 ~ 240VAC
Current Consumption			Max. 10mA	Max. 0.8mA		-
Leakage Current			-	-		Max. 1mA
Voltage Drop			Residual voltage : Max. 1V Load current : Max. 100 mA	Residual voltage : Max. 4V Load current : 3 to 100 mA	Residual voltage : Max. 5V for DC power Load current : 3 to 200 mA	Load current : 5 to 200 mA
Operation Mode		3wire	1 : NPN N/O, 2 : NPN N/C, 3 : PNP N/O, 4 : PNP N/C	5 : N/O, 6 : N/C		
		4wire	7 : NPN N/O+N/C, 8 : PNP N/O+N/C			
Dielectric Strength			1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case		4,000 VAC, 50/60 Hz for 1 minute between current carry parts and case	
Maximum Switching Frequency	**18sq**	**Flush**	1000Hz	800Hz	20Hz	20Hz
		Non flush				
	25sq	**Flush**	700Hz	600Hz	20Hz	20Hz
		Non flush				
	30sq	**Flush**	500Hz	500Hz	20Hz	20Hz
		Non flush				
	40sq	**Flush**	150Hz	150Hz	20Hz	20Hz
		Non flush				

Inductive Proximity Sensor
Square-Standard Type
KPS Series

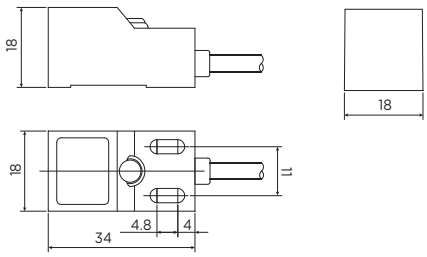
Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
18 Square 3-Wire(DC) 	H : 5mm	A : 18sq Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPS HA11	1,000Hz
			2 : NPN N/C			KPS HA21	
			3 : PNP N/O			KPS HA31	
			4 : PNP N/C			KPS HA41	
	K : 8mm	A : 18sq Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPS KA11	1,000Hz
			2 : NPN N/C			KPS KA21	
			3 : PNP N/O			KPS KA31	
			4 : PNP N/C			KPS KA41	
25 Square 3-Wire(DC) 	J : 7mm	B : 25sq Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPS JB11	700Hz
			2 : NPN N/C			KPS JB21	
			3 : PNP N/O			KPS JB31	
			4 : PNP N/C			KPS JB41	
	L : 10mm	B : 25sq Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPS LB11	700Hz
			2 : NPN N/C			KPS LB21	
			3 : PNP N/O			KPS LB31	
			4 : PNP N/C			KPS LB41	
30 Square 3-Wire(DC) 	L : 10mm	C : 30sq Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPS LC11	500Hz
			2 : NPN N/C			KPS LC21	
			3 : PNP N/O			KPS LC31	
			4 : PNP N/C			KPS LC41	
	P : 15mm	C : 30sq Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPS PC11	500Hz
			2 : NPN N/C			KPS PC21	
			3 : PNP N/O			KPS PC31	
			4 : PNP N/C			KPS PC41	
40 Square 3-Wire(DC) 	Q : 20mm	D : 40sq Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPS QD11 3	150Hz
			2 : NPN N/C			KPS QD21 3	
			3 : PNP N/O			KPS QD31 3	
			4 : PNP N/C			KPS QD41 3	
	V : 35mm	D : 40sq Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPS VD11 3	150Hz
			2 : NPN N/C			KPS VD21 3	
			3 : PNP N/O			KPS VD31 3	
			4 : PNP N/C			KPS VD41 3	

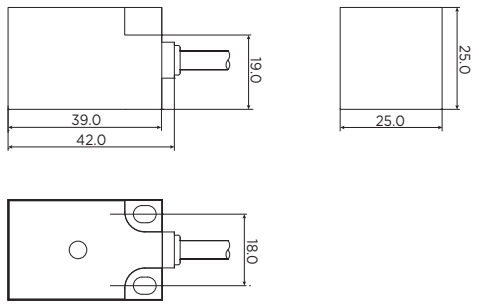
Dimension

(mm)

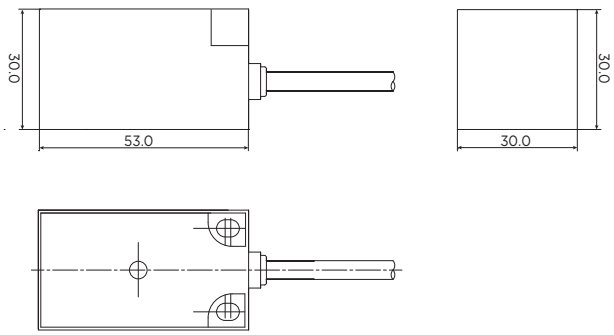
KPS 18sq



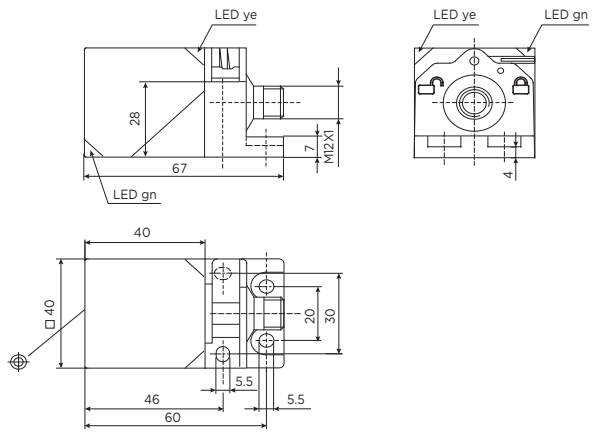
KPS 25sq



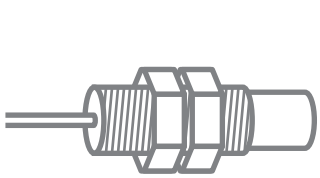
KPS 30sq

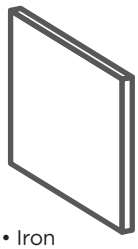


KPS 40sq



Inductive Proximity Sensor
Round-Long Distance
KPRD Series

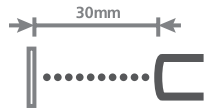




- Iron
- Aluminum
- Copper
- Stainless
- Brass

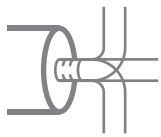
Enhanced waterproof design

Durable M8, M12 connector against vibration and shock.



Long-distance Detection at up to 30 mm enables secure mounting with reduced problems due to workpiece collisions.

Twice or three times that of oil-resistant vinyl chloride



Approximately twice that of vinyl chloride.

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺

	SERIES	KPRD : Inductive Proximity Long sensing round		
❶	**Distance**	G : 4mm R : 22mm	K : 8mm V : 30mm	N : 12mm	P : 15mm
❷	**Size**	3 : Ø8	4 : Ø12	5 : Ø18	6 : Ø30
❸	**Output**	1 : NPN N/O (3 wire) 5 : N/O (2 wire)	2 : NPN N/C (3 wire) 6 : N/C (2 wire)	3 : PNP N/O (3 wire)	4 : PNP N/C (3 wire)
❹	**Power**	1 : 10 ~ 30VDC	2 : 7.7 ~ 9VDC*	6 : 20 ~ 240VAC/DC	
❺	**Cable Outlet**	Standard** : 2m Cable	3 : M12 connector		

* NUMAR(7.7 ~ 9VDC) model is under development.
** Standard specification is not appeared in part number description

Guide to Selection

Size	●3	●5	■7	●8	●12	●■18	■25	●■30	●32	■34	■40	■80
Available				○	○	○		○				
Sensing Distance	0.8mm	1mm	1.5mm	2mm	3mm	4mm	5mm	7mm	8mm	10mm	12mm	15mm
Available						○			○		○	○
Sensing Distance	20mm	22mm	25mm	30mm	40mm	50mm	70mm					
Available		○		○								
Output	NPN N/C	NPN N/O	PNP N/C	NPN N/O	N/C	N/O	NPN N/O+N/C		PNP N/O+N/C		Analog	NAMUR
Available	○	○	○	○	○	○						
Connector	2m Cable			M8 Connector			M12 Connector			Screw Terminal		
Available	○			○			○					
Power	7.7-9VDC		10-30VDC		15-30VDC		10-60VDC		20-240VAC		20-240VAC/DC	
Available			○								○	

General Specification

Detectable Object	Ferrous metal (The sensing distance decreases with non-ferrous metal.)
Differential Travel	Max. 15% of sensing distance
Indicators	LED
Cable Outlet	Standard : 2m Cable 3 : M12 connector
Protection Circuits	Load short-circuit protection, Surge suppressor, Reverse polarity protection
Ambient Temperature	Operating/Storage : −25 to 70°C (with no icing)
Ambient Humidity	Operating/Storage : 35% to 95% (with no icing)
Temperature Influence	Max. ±10% of sensing distance at 23°C in the temperature range of −25 to 70°C
Voltage Influence	Max. ±1% of sensing distance at rated voltage in the rated voltage ±15% range
Insulation Resistance	Min. 50 MΩ (at 500 VDC) between current-carrying parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions
Case Material	Nickel copper plated
Shock Resistance	Destruction : 1,000 m/s^2 10 times each in X, Y, and Z directions

Characteristics

<table>
<tr><th colspan="4"></th><th>DC 3/4 wire</th><th>DC 2 wire</th><th>AC/DC 2 wire</th><th>AC 2 wire</th></tr>
<tr><td colspan="4">Supply Voltage</td><td colspan="2">1 : 10 ~ 30VDC 3 : 15 ~ 30VDC</td><td>6 : 20 ~ 250VAC/DC</td><td>5 : 20 ~ 240VAC</td></tr>
<tr><td colspan="4">Current Consumption</td><td>Max. 10mA</td><td>Max. 0.8mA</td><td></td><td>-</td></tr>
<tr><td colspan="4">Leakage Current</td><td>-</td><td>-</td><td></td><td>Max. 1mA</td></tr>
<tr><td colspan="4">Voltage Drop</td><td>Residual voltage : Max. 2V
Load current : Max. 200 mA</td><td>Residual voltage :
Max. 4V
Load current :
3 to 100 mA</td><td>Residual voltage :
Max. 5V for DC power
Load current :
3 to 100 mA</td><td>Load current :
5 to 300 mA</td></tr>
<tr><td colspan="3" rowspan="2">Operation Mode</td><td>3wire</td><td>1 : NPN N/O, 2 : NPN N/C,
3 : PNP N/O, 4 : PNP N/C</td><td colspan="3" rowspan="2">5 : N/O, 6 : N/C</td></tr>
<tr><td>4wire</td><td>7 : NPN N/O+N/C, 8 : PNP N/O+N/C</td></tr>
<tr><td colspan="4">Dielectric Strength</td><td colspan="2">1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case</td><td colspan="2">4,000 VAC, 50/60 Hz for 1 minute between current carry parts and case</td></tr>
<tr><td rowspan="6">Maximum Switching Frequency</td><td>M8</td><td>Non flush</td><td colspan="2">600Hz</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">M12</td><td>Flush</td><td colspan="2">800Hz</td><td>500Hz</td><td>-</td><td rowspan="2">20Hz</td></tr>
<tr><td>Non flush</td><td colspan="2">400Hz</td><td>200Hz</td><td>-</td></tr>
<tr><td rowspan="2">M18</td><td>Flush</td><td colspan="2">500Hz</td><td>300Hz</td><td rowspan="2">AC : 20Hz
DC : 50Hz</td><td rowspan="2">20Hz</td></tr>
<tr><td>Non flush</td><td colspan="2">300Hz</td><td>150Hz</td></tr>
<tr><td rowspan="2">M30</td><td>Flush</td><td colspan="2">400Hz</td><td>200Hz</td><td rowspan="2">AC : 20Hz
DC : 50Hz</td><td rowspan="2">20Hz</td></tr>
<tr><td>Non flush</td><td colspan="2">22mm : 200Hz
30mm : 75Hz</td><td>100Hz</td></tr>
</table>

Inductive Proximity Sensor
Round-Long Distance
KPRD Series

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M8 Round 3-Wire(DC)	G : 4mm	3 : M8 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRD G311	600Hz
			2 : NPN N/C			KPRD G321	
			3 : PNP N/O			KPRD G331	
			4 : PNP N/C			KPRD G341	
	G : 4mm	3 : M8 Non flush	1 : NPN N/O	1 : 10-30VDC	2 : M8 connector	KPRD G311 2	600Hz
			2 : NPN N/C			KPRD G321 2	
			3 : PNP N/O			KPRD G331 2	
			4 : PNP N/C			KPRD G341 2	
	G : 4mm	3 : M8 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRD G311 3	600Hz
			2 : NPN N/C			KPRD G321 3	
			3 : PNP N/O			KPRD G331 3	
			4 : PNP N/C			KPRD G341 3	
M12 Round 3-Wire(DC)	G : 4mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRD G411	800Hz
			2 : NPN N/C			KPRD G421	
			3 : PNP N/O			KPRD G431	
			4 : PNP N/C			KPRD G441	
	K : 8mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRD K411	400Hz
			2 : NPN N/C			KPRD K421	
			3 : PNP N/O			KPRD K431	
			4 : PNP N/C			KPRD K441	
	G : 4mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRD G411 3	800Hz
			2 : NPN N/C			KPRD G421 3	
			3 : PNP N/O			KPRD G431 3	
			4 : PNP N/C			KPRD G441 3	
	K : 8mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRD K411 3	400Hz
			2 : NPN N/C			KPRD K421 3	
			3 : PNP N/O			KPRD K431 3	
			4 : PNP N/C			KPRD K441 3	

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M18 Round 3-Wire(DC)	K : 8mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRD K511	500Hz
			2 : NPN N/C			KPRD K521	
			3 : PNP N/O			KPRD K531	
			4 : PNP N/C			KPRD K541	
	N : 12mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRD N511	300Hz
			2 : NPN N/C			KPRD N521	
			3 : PNP N/O			KPRD N531	
			4 : PNP N/C			KPRD N541	
	K : 8mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRD K511 3	500Hz
			2 : NPN N/C			KPRD K521 3	
			3 : PNP N/O			KPRD K531 3	
			4 : PNP N/C			KPRD K541 3	
	N : 12mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRD N511 3	300Hz
			2 : NPN N/C			KPRD N521 3	
			3 : PNP N/O			KPRD N531 3	
			4 : PNP N/C			KPRD N541 3	
M30 Round 3-Wire(DC)	P : 15mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRD P611	400Hz
			2 : NPN N/C			KPRD P621	
			3 : PNP N/O			KPRD P631	
			4 : PNP N/C			KPRD P641	
	V : 30mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRD V611	200Hz
			2 : NPN N/C			KPRD V621	
			3 : PNP N/O			KPRD V631	
			4 : PNP N/C			KPRD V641	
	P : 15mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRD P611 3	400Hz
			2 : NPN N/C			KPRD P621 3	
			3 : PNP N/O			KPRD P631 3	
			4 : PNP N/C			KPRD P641 3	
	V : 30mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRD V611 3	200Hz
			2 : NPN N/C			KPRD V621 3	
			3 : PNP N/O			KPRD V631 3	
			4 : PNP N/C			KPRD V641 3	

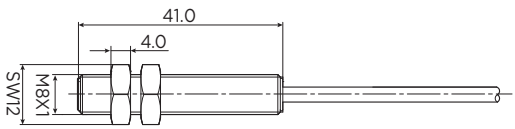
Inductive Proximity Sensor
Round-Long Distance
KPRD Series

Dimension

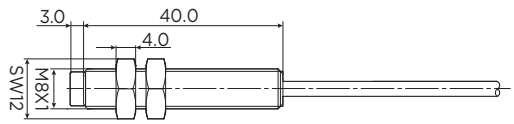
(mm)

KPRD Ø8

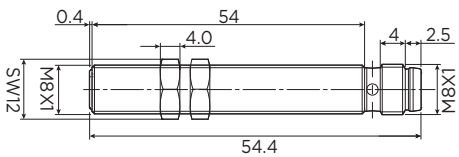
Flush



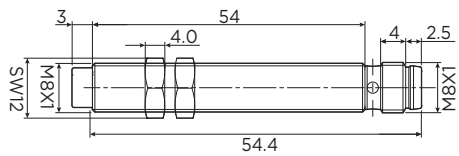
Non flush



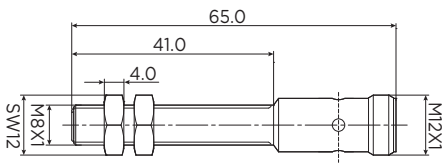
M8 connector Flush



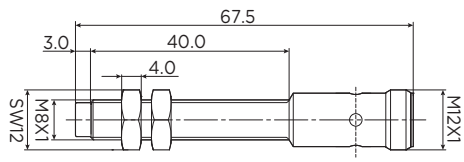
M8 connector Non flush



M12 connector Flush

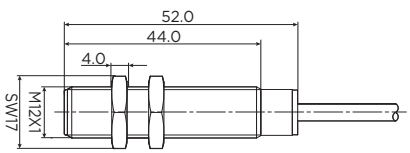


M12 connector Non flush

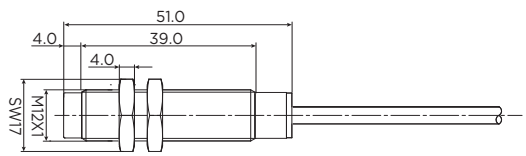


KPRD Ø12

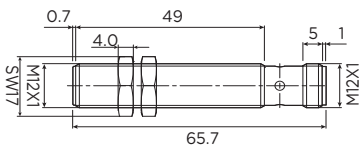
Flush



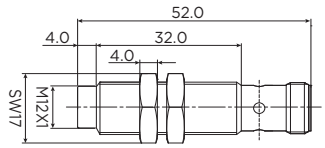
Non flush



M12 connector Flush



M12 connector Non flush

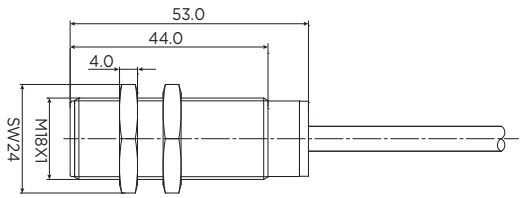


Dimension

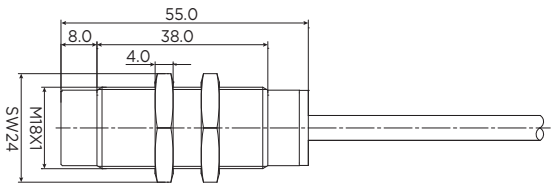
(mm)

KPRD Ø18

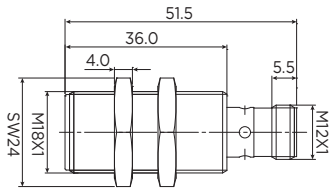
Flush



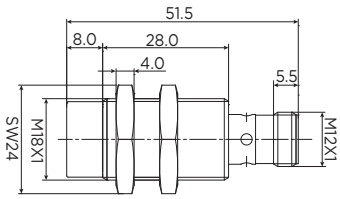
Non flush



M12 connector Flush

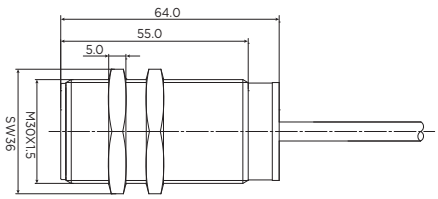


M12 connector Non flush

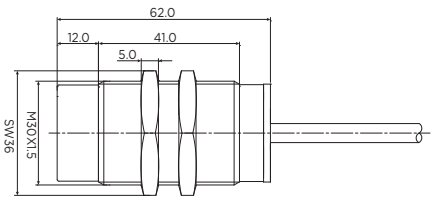


KPRD Ø30

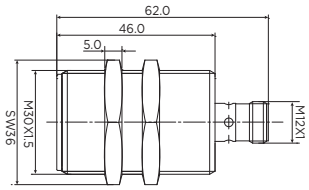
Flush



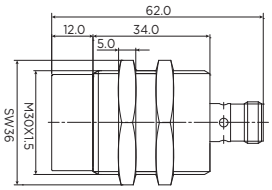
Non flush



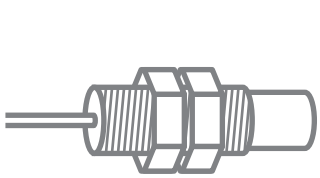
M12 connector Flush

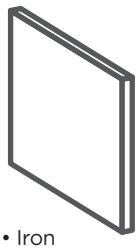


M12 connector Non flush



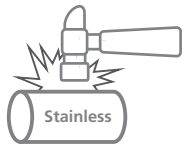
Inductive Proximity Sensor
Round-All Metal Body
KPRM Series



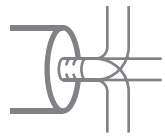


- Iron
- Aluminum
- Copper
- Stainless
- Brass

Allowing installation onto lines that require cleaning.



All Stainless body withstands cleaning agents at features high resistance to corrosion.



Approximately twice that of vinyl chloride.

Twice or three times that of oil-resistant vinyl chloride

Enhanced waterproof design

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺

	SERIES	KPRM : Inductive Proximity Metal head round			
❶	**Distance**	E : 2mm K : 8mm	G : 4mm L : 10mm	H : 5mm P : 15mm	
❷	**Size**	4 : Ø12	5 : Ø18	6 : Ø30	
❸	**Output**	1 : NPN N/O (3 wire)	2 : NPN N/C (3 wire)	3 : PNP N/O (3 wire)	4 : PNP N/C (3 wire)
❹	**Power**	1 : 10 ~ 30VDC			
❺	**Cable Outlet**	Standard* : 2m Cable	3 : M12 connector		

* Standard specification is not appeared in part number description

Guide to Selection

Size	●3	●5	■7	●8	●12	●■18	■25	●■30	●32	■34	■40	■80
Available					○	○		○				
Sensing Distance	0.8mm	1mm	1.5mm	2mm	3mm	4mm	5mm	7mm	8mm	10mm	12mm	15mm
Available				○		○	○		○	○		○
Sensing Distance	20mm	22mm	25mm	30mm	40mm	50mm	70mm					
Available												
Output	NPN N/C	NPN N/O	PNP N/C	NPN N/O	N/C	N/O	NPN N/O+N/C		PNP N/O+N/C		Analog	NAMUR
Available	○	○	○	○								
Connector	2m Cable			M8 Connector			M12 Connector			Screw Terminal		
Available	○						○					
Power	7.7-9VDC		10-30VDC		15-30VDC		10-60VDC		20-240VAC		20-240VAC/DC	
Available			○									

General Specification

Detectable Object	Ferrous metal (The sensing distance decreases with non-ferrous metal.)
Differential Travel	Max. 15% of sensing distance
Indicators	LED
Cable Outlet	Standard : 2m PUR cable 3 : M12 connector
Protection Circuits	Load short-circuit protection, Surge suppressor, Reverse polarity protection
Ambient Temperature	Operating/Storage : −30 to 85°C (with no icing)
Ambient Humidity	Operating/Storage : 35% to 95% (with no icing)
Temperature Influence	Max. ±10% of sensing distance at 23°C in the temperature range of −25 to 70°C
Voltage Influence	Max. ±1% of sensing distance at rated voltage in the rated voltage ±15% range
Insulation Resistance	Min. 50 MΩ (at 500 VDC) between current-carrying parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions
Case Material	Stainless
Shock Resistance	Destruction : 1,000 m/s^2 10 times each in X, Y, and Z directions

Characteristics

	DC 3wire			
Supply Voltage	1 : 10 ~ 30VDC			
Current Consumption	Max. 10mA			
Voltage Drop	Residual voltage : Max. 2V Load current : Max. 200 mA			
Operation Mode	1 : NPN N/O	2 : NPN N/C	3 : PNP N/O	4 : PNP N/C
Dielectric Strength	1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case			
Maximum Switching Frequency	300Hz (KPRM Ø30 : 150Hz)			

Inductive Proximity Sensor
Round-All Metal Body
KPRM Series

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M12 Round 3-Wire(DC)	E : 2mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRM E411	300Hz
			2 : NPN N/C			KPRM E421	
			3 : PNP N/O			KPRM E431	
			4 : PNP N/C			KPRM E441	
	G : 4mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRM G411	300Hz
			2 : NPN N/C			KPRM G421	
			3 : PNP N/O			KPRM G431	
			4 : PNP N/C			KPRM G441	
	E : 2mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRM E411 3	300Hz
			2 : NPN N/C			KPRM E421 3	
			3 : PNP N/O			KPRM E431 3	
			4 : PNP N/C			KPRM E441 3	
	G : 4mm	4 : M12 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRM G411 3	300Hz
			2 : NPN N/C			KPRM G421 3	
			3 : PNP N/O			KPRM G431 3	
			4 : PNP N/C			KPRM G441 3	
M18 Round 3-Wire(DC)	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRM H511	300Hz
			2 : NPN N/C			KPRM H521	
			3 : PNP N/O			KPRM H531	
			4 : PNP N/C			KPRM H541	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRM K511	300Hz
			2 : NPN N/C			KPRM K521	
			3 : PNP N/O			KPRM K531	
			4 : PNP N/C			KPRM K541	
	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRM H511 3	300Hz
			2 : NPN N/C			KPRM H521 3	
			3 : PNP N/O			KPRM H531 3	
			4 : PNP N/C			KPRM H541 3	
	K : 8mm	5 : M18 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRM K511 3	300Hz
			2 : NPN N/C			KPRM K521 3	
			3 : PNP N/O			KPRM K531 3	
			4 : PNP N/C			KPRM K541 3	

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M30 Round 3-Wire(DC)	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRM L611	150Hz
			2 : NPN N/C			KPRM L621	
			3 : PNP N/O			KPRM L631	
			4 : PNP N/C			KPRM L641	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRM P611	150Hz
			2 : NPN N/C			KPRM P621	
			3 : PNP N/O			KPRM P631	
			4 : PNP N/C			KPRM P641	
	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRM L611 3	150Hz
			2 : NPN N/C			KPRM L621 3	
			3 : PNP N/O			KPRM L631 3	
			4 : PNP N/C			KPRM L641 3	
	P : 15mm	6 : M30 Non flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRM P611 3	150Hz
			2 : NPN N/C			KPRM P621 3	
			3 : PNP N/O			KPRM P631 3	
			4 : PNP N/C			KPRM P641 3	

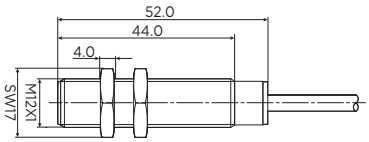
Inductive Proximity Sensor
Round-All Metal Body
KPRM Series

Dimension

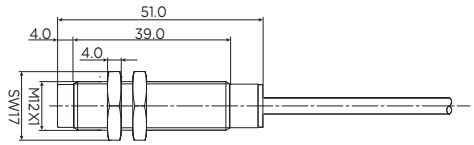
(mm)

KPRM Ø12

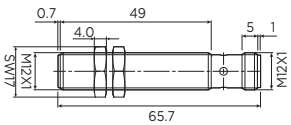
Flush



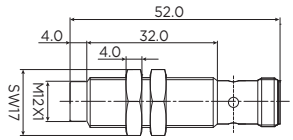
Non flush



M12 connector Flush

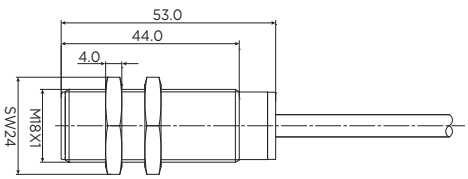


M12 connector Non flush

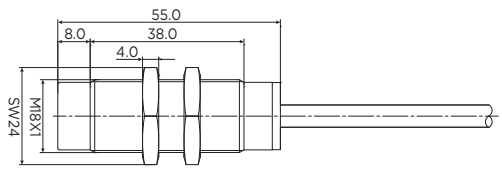


KPRM Ø18

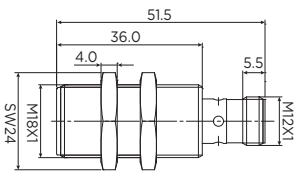
Flush



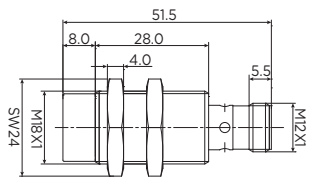
Non flush



M12 connector Flush

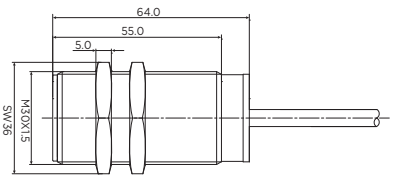


M12 connector Non flush

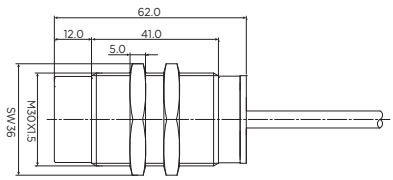


KPRM Ø30

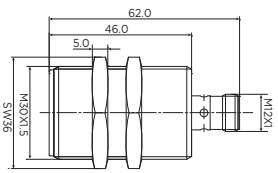
Flush



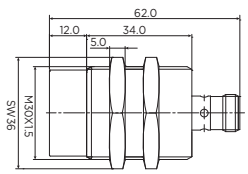
Non flush



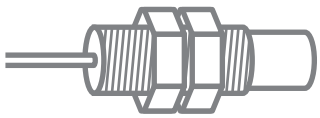
M12 connector Flush

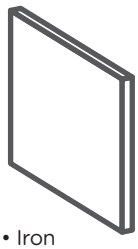


M12 connector Non flush



Inductive Proximity Sensor
Round-Tefron coated
KPRT Series

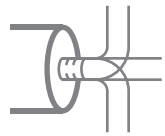




- Iron
- Aluminum
- Copper
- Stainless
- Brass

The best choice for the welding machine.

Enhanced waterproof design



Approximately twice that of vinyl chloride.

Twice or three times that of oil-resistant vinyl chloride

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺

	SERIES	KPRT : Inductive Proximity Tefron round			
❶	**Distance**	F : 3mm	H : 5mm	L : 10mm	
❷	**Size**	4 : Ø12	5 : Ø18	6 : Ø30	
❸	**Output**	1 : NPN N/O (3 wire)	2 : NPN N/C (3 wire)	3 : PNP N/O (3 wire)	4 : PNP N/C (3 wire)
❹	**Power**	1 : 10 ~ 30VDC			
❺	**Cable Outlet**	Standard* : 2m Cable	3 : M12 connector		

* Standard specification is not appeared in part number description

Guide to Selection

Size	●3	●5	■7	●8	●12	●■18	■25	●■30	●32	■34	■40	■80
Available					○	○		○				
Sensing Distance	0.8mm	1mm	1.5mm	2mm	3mm	4mm	5mm	7mm	8mm	10mm	12mm	15mm
Available					○		○			○		
Sensing Distance	20mm	22mm	25mm	30mm	40mm	50mm	70mm					
Available												
Output	NPN N/C	NPN N/O	PNP N/C	NPN N/O	N/C	N/O	NPN N/O+N/C		PNP N/O+N/C		Analog	NAMUR
Available	○	○	○	○								
Connector	2m Cable			M8 Connector			M12 Connector			Screw Terminal		
Available	○						○					
Power	7.7-9VDC		10-30VDC		15-30VDC		10-60VDC		20-240VAC		20-240VAC/DC	
Available			○									

Inductive Proximity Sensor
Round-Tefron coated
KPRT Series

General Specification

Detectable Object	Ferrous metal (The sensing distance decreases with non-ferrous metal.)
Differential Travel	Max. 15% of sensing distance
Indicators	LED
Cable Outlet	Standard : 2m PUR cable 3 : M12 connector
Protection Circuits	Load short-circuit protection, Surge suppressor, Reverse polarity protection
Ambient Temperature	Operating/Storage : −30 to 85°C (with no icing)
Ambient Humidity	Operating/Storage : 35% to 95% (with no icing)
Temperature Influence	Max. ±10% of sensing distance at 23°C in the temperature range of −25 to 70°C
Voltage Influence	Max. ±1% of sensing distance at rated voltage in the rated voltage ±15% range
Insulation Resistance	Min. 50 MΩ (at 500 VDC) between current-carrying parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions
Shock Resistance	Destruction : 1,000 m/s^2 10 times each in X, Y, and Z directions

Characteristics

			DC 3wire			
Supply Voltage			1 : 10 ~ 30VDC			
Current Consumption			Max. 15mA			
Voltage Drop			Residual voltage : Max. 2V Load current : Max. 200 mA			
Operation Mode			1 : NPN N/O	2 : NPN N/C	3 : PNP N/O	4 : PNP N/C
Dielectric Strength			1,000 VAC, 50/60 Hz for 1 minute between current carry parts and case			
Maximum Switching Frequency	M12	Flush	800Hz			
	M18	Flush	800Hz			
	M30	Flush	500Hz			

Product Selection

Model	Sensing Distance	Shape	Output	Power	Cable Outlet	Part Number	Response Frequency
M12 Round Tefron coating 3-wire(DC) 	F : 3mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRT F411	800Hz
			2 : NPN N/C			KPRT F421	
			3 : PNP N/O			KPR TF431	
			4 : PNP N/C			KPRT F441	
	F : 3mm	4 : M12 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRT F411 3	800Hz
			2 : NPN N/C			KPRT F421 3	
			3 : PNP N/O			KPRT F431 3	
			4 : PNP N/C			KPRT F441 3	
M18 Round Tefron coating 3-wire(DC) 	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRT H511	1000Hz
			2 : NPN N/C			KPRT H521	
			3 : PNP N/O			KPRT H531	
			4 : PNP N/C			KPRT H541	
	H : 5mm	5 : M18 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRT H511 3	1000Hz
			2 : NPN N/C			KPRT H521 3	
			3 : PNP N/O			KPRT H531 3	
			4 : PNP N/C			KPRT H541 3	
M30 Round Tefron coating 3-wire(DC) 	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	Standard : 2m Cable	KPRT L611	500Hz
			2 : NPN N/C			KPRT L621	
			3 : PNP N/O			KPRT L631	
			4 : PNP N/C			KPRT L641	
	L : 10mm	6 : M30 Flush	1 : NPN N/O	1 : 10-30VDC	3 : M12 connector	KPRT L611 3	500Hz
			2 : NPN N/C			KPRT L621 3	
			3 : PNP N/O			KPRT L631 3	
			4 : PNP N/C			KPRT L641 3	

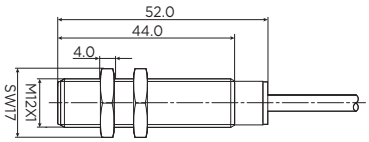
Inductive Proximity Sensor
Round-Tefron coated
KPRT Series

Dimension

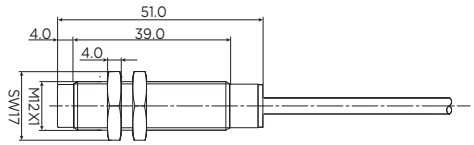
(mm)

KPRT Ø12

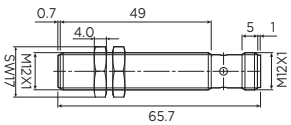
Flush



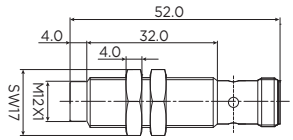
Non flush



M12 connector Flush

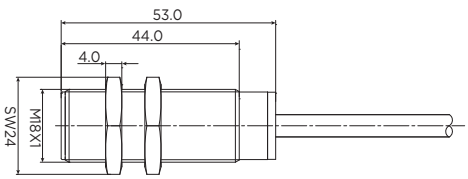


M12 connector Non flush



KPRT Ø18

Flush



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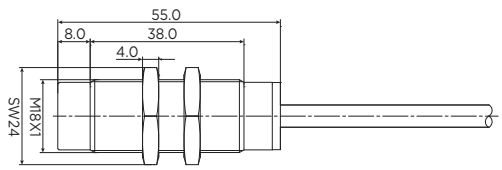
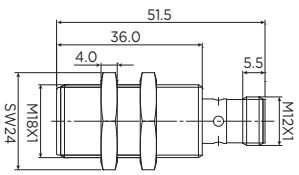
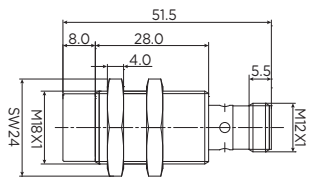


M12 connector Flush

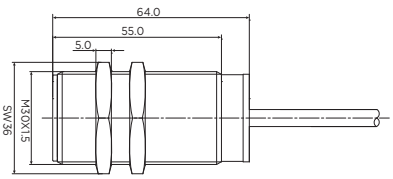


M12 connector Non flush

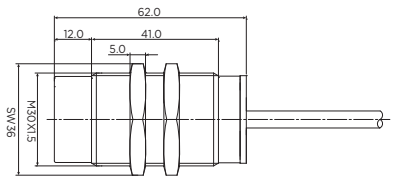


KPRT Ø30

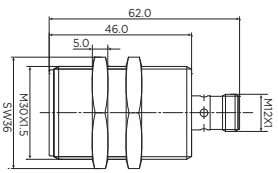
Flush



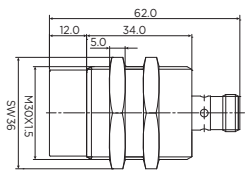
Non flush



M12 connector Flush



M12 connector Non flush



Technical Data
Proximity Sensor

Overview

Proximity Sensor includes all sensors that perform non-contact Detection in comparison to sensors, such as limit switches, that detect objects by physically contacting them. Proximity Sensors convert information on the movement or presence of an object into an electrical signal. There are three types of Detection systems that do this conversion : systems that use the eddy currents that are generated in metallic detectable objects by electromagnetic induction, systems that detect changes in electrical capacity when approaching the detectable object, and systems that use magnets and reed switches.

Features

(1) Proximity Sensors detect an object without touching it, and they therefore do not cause abrasion or damage to the object.
Devices such as limit switches detect an object by contacting it, but Proximity Sensors are able to detect the presence of the object electrically, without having to touch it.

(2) No contacts are used for output, so the Sensor has a longer service life (excluding sensors that use magnets).
Proximity Sensors use semiconductor outputs, so there are no contacts to affect the service life.

(3) Unlike optical Detection methods, Proximity Sensors are suitable for use in locations where water or oil is used.
Detection takes place with almost no effect from dirt, oil, or water on the object being detected.

(4) Proximity Sensors provide high-speed response, compared with switches that require physical contact.
For information on high-speed response, refer to Explanation of Terms on glossary page.

(5) Proximity Sensors are not affected by colors.
Proximity Sensors detect the physical changes of an object, so they are almost completely unaffected by the object's surface color.

(6) Unlike switches, which rely on physical contact, Proximity Sensors are affected by ambient temperatures, surrounding objects, and other Sensors. Both Inductive and Capacitive Proximity Sensors are affected by interaction with other Sensors. Because of this, care must be taken when installing them to prevent mutual interference Care must also be taken to prevent the effects of surrounding metallic objects on Inductive Proximity Sensors, and to prevent the effects of all surrounding objects on Capacitive Proximity Sensors.

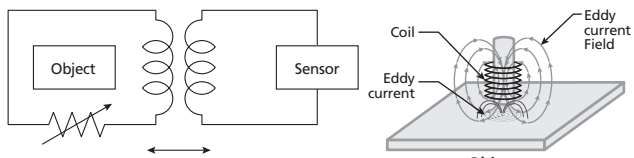
Operating Principles

Principle of Inductive Sensors

Inductive Proximity Sensors detect magnetic loss due to eddy currents that are generated on a conductive surface by an external magnetic field. An AC magnetic field is generated on the Detection coil, and changes in the impedance due to eddy currents generated on a metallic object are detected.

Other methods include Aluminum-detecting Sensors, which detect the phase component of the frequency, and All-metal Sensors, which use a working coil to detect only the changed component of the impedance. There are also Pulse-response Sensors, which generate an eddy current in pulses and detect the time change in the eddy current with the voltage induced in the coil.

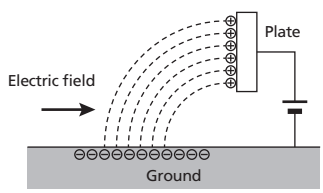
The detectable object and Sensor form what appears to be a transformer-like relationship.



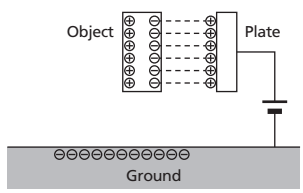
The transformer-like coupling condition is replaced by impedance changes due to eddy-current losses

The impedance changes can be viewed as changes in the resistance that is inserted in series with the detectable object.

Principle of Capacitive Sensors



<Figures1>



<Figures2>

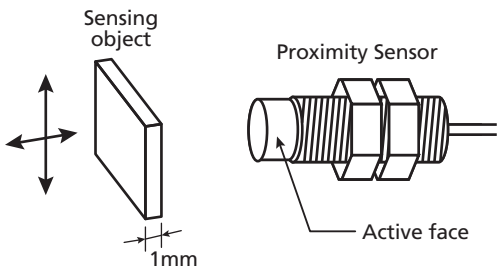
Capacitive Proximity Sensors detect changes in the capacitance between the detectable object and the Sensor. The amount of capacitance varies depending on the size and distance of the detectable object. An ordinary Capacitive Proximity Sensor is similar to a capacitor with two parallel plates, where the capacity of the two plates is detected. One of the plates is the object being measured (with an imaginary ground), and the other is the Sensor's sensing surface. The changes in the capacity generated between these two poles are detected.

The objects that can be detected depend on their dielectric constant, but they include resin and water in addition to metals.

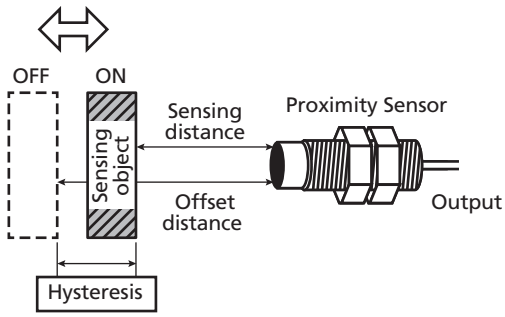
Technical Data
Proximity Sensor

Usage Guidance

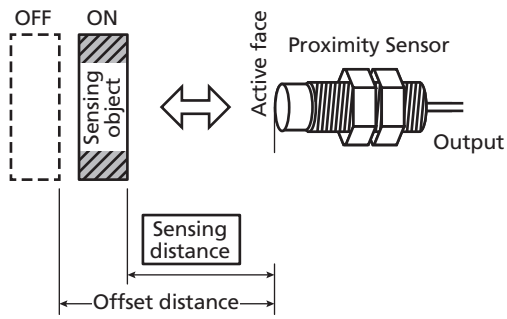
Standard Object
• A detectable object that serves as a reference for measuring basic performance, and that is made of specified materials and has a specified shape and dimensions.



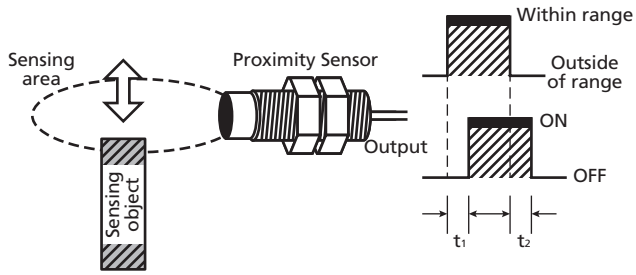
Differential Travel
• With respect to the distance between the standard detectable object and the Sensor, the difference between the distance at which the Sensor operates and the distance at which the Sensor resets.



Sensing Distance
• The distance from the reference position (reference surface) to the measured operation (reset) when the standard detectable object is moved by the specified method.

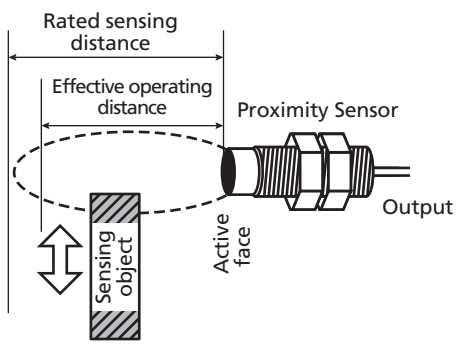


Response Time
• t1 : The interval from the point when the standard detectable object moves into the sensing area and the Sensor activates, to the point when the output turns ON.
• t2 : The interval from the point when the standard detectable object moves out of the Sensor sensing area to the point when the Sensor output turns OFF.



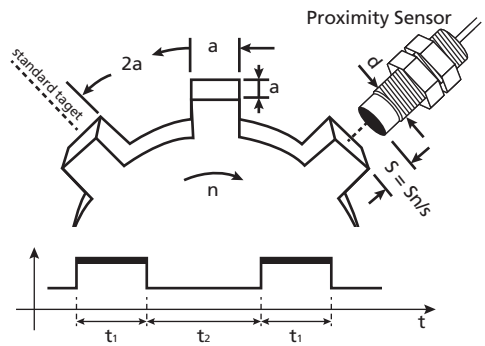
Effective Operating Distance
• The distance from the reference surface that allows stable use, including the effects of temperature and voltage, to the (standard)detectable object transit position.

• This is approximately 70% to 80% of the normal (rated) sensing distance.



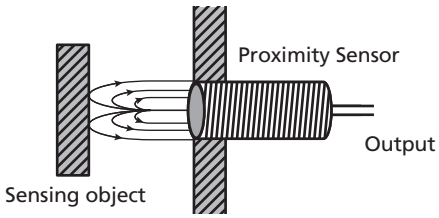
Response Frequency
• The number of Detection repetitions that can be output per second when the standard detectable object is repeatedly brought into proximity.

• See the accompanying diagram for the measuring method.



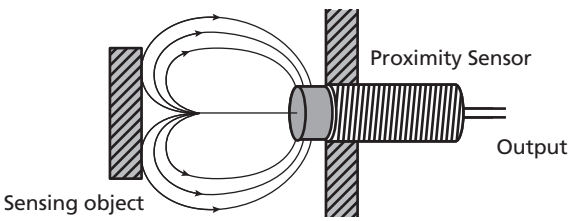
Flush

- With a FlushSensor, magnetic flux is concentrated in front of the Sensor and the sides of the Sensor coil are covered with metal.
- The Sensor can be mounted by embedding it into metal.



Non flush

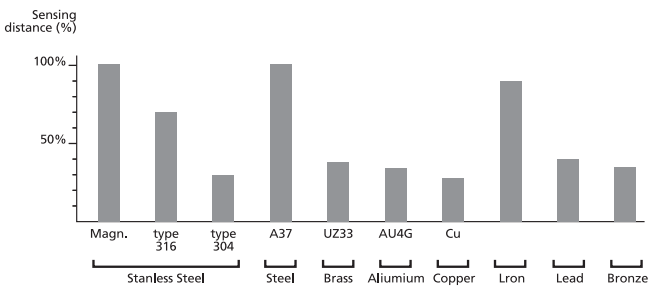
- With an Non flush Sensor, magnetic flux is spread widely in front of the Sensor and the sides of the Sensor coil are not covered with metal.
- This model is easily affected by surrounding metal objects (magnetic objects), so care must be taken in selecting the mounting location.



Interpreting Engineering Data

Effects of Detectable object Size and Material

Distance Table by Material



- It shows changes in the sensing distance due to material of the detectable object. Refer to this data when using the same Sensor to detect various different detectable objects

Leakage Current Characteristics

- In contrast with contact-type limit switches, which have physical contacts, leakage cur-rent in a 2-wire Proximity Sensor is related to an electrical switch that consists of transis-tors and other components. This graph indi-cates the leakage current characteristics caused by transistors in the output section of the Sensor.
- Generally speaking, the higher the voltage, the larger the leakage current. Because leak-age current flows to the load connected to the Proximity Sensor, care must be taken to select a load that will not cause the Sensor to operate from the leakage current.
- Be careful of this factor when replacing a limit switch, micro-switch, or other switch with a Proximity Sensor.

Residual Voltage Characteristics

- Similar to leakage current characteristics, re-sidual voltage is something that occurs due to electrical switches that are comprised of tran-sistors and other components. For example, whereas the voltage in a normally open switch should be 0 V in the ON state, and the same as the power supply voltage in the OFF state, residual voltage refers to a certain level of voltage remaining in the switch. Be careful of this factor when replacing a limit switch, micro-switch, or other switch with a Proximity Sensor.

General Precautions

For precautions on individual products, refer to the Safety Precautions in individual product information.

⚠ WARNING

- These products cannot be used in safety devices for presses or other safety devices used to protect human life.
- These products are designed for use in applications for sensing workpiecs and workers that do not affect safety.

Precautions for Safe use

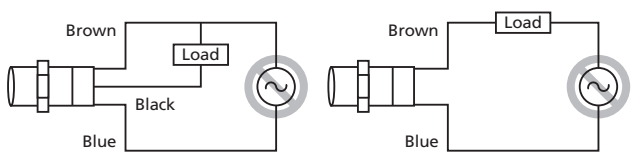
- To ensure safety, always observe the following precautions.

Wiring Instruction

Power Supply Voltage

Do not use a voltage that exceeds the operating voltage range. Applying a voltage that is higher than the operating voltage range, or using an AC power supply (100 VAC or higher) for a Sensor that requires a DC power supply may cause explosion or burning.

(1) DC 3-Wire NPN Output Sensors **(2) DC 2-Wire Sensors**



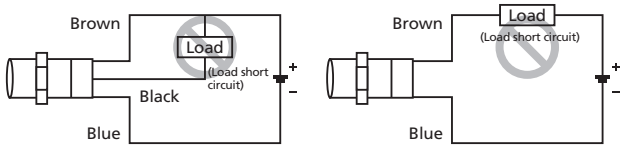
Technical Data
Proximity Sensor

Wiring Instruction

Load short-circuiting
• Do not short-circuit the load. Explosion or burning may result.

• The load short-circuit protection function operates when the power supply is connected with the correct polarity and the power is within the rated voltage range.

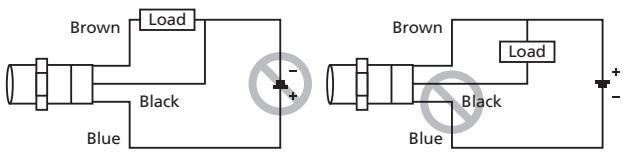
(1) DC 3-Wire NPN Output Sensors **(2) DC 2-Wire Sensors**



• Even with the load short-circuit protection function, protection will not be provided when a load short circuit occurs if the power supply polarity is not correct.

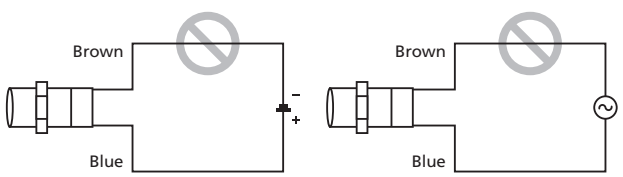
Incorrect Wiring
Be sure that the power supply polarity and other wiring is correct. Incorrect wiring may cause explosion or burning.

DC 3-Wire NPN Output Sensors



Cable outlet without a Load
If the power supply is connected directly without a load, the internal elements may explode or burn. Be sure to insert a load when connecting the power supply.

(1) DC 2-Wire Sensors **(2) AC 2-Wire Sensors**



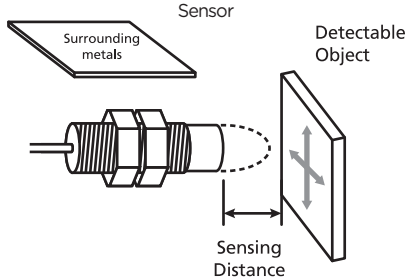
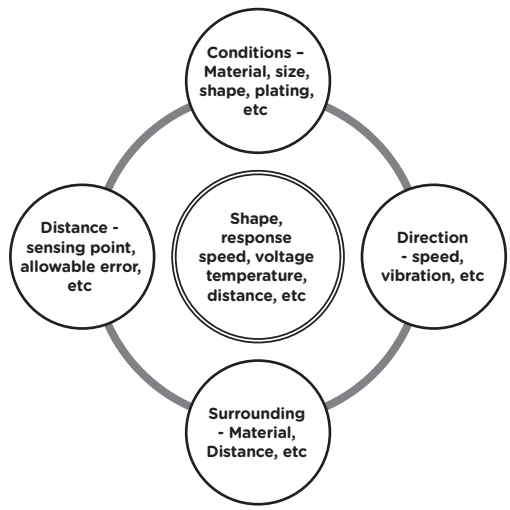
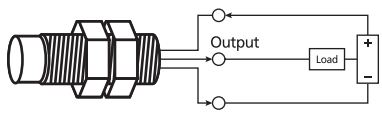
• Even with the load short-circuit protection function, protection will not be provided if both the power supply polarity is incorrect

Operating Environment
Do not use the Sensor in an environment where there are explosive or combustible gases.

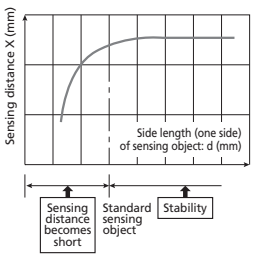
Precaution for Safe use

The following conditions must be considered to understand the conditions of the application and location as well as the relation to control equipment.

Model Selection

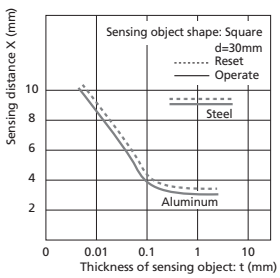
Item	Check points		
Detectable object and operating condition of Proximity Sensor	Check the relation between the detectable object and the Proximity Sensor  		
Electrical conditions	Verify the electrical conditions of the control system to be used and the electrical performance of the Proximity Sensor. 		
	Power supply	DC (voltage fluctuation, current capacity value) AC (voltage fluctuation, frequency, etc.)	- Selecting the power supply type [DC/DC/AC]
	Load	Resistive load - Non-contact control system Inductive load - Relay, solenoid, etc. • Steady-state current, inrush current • Operating, reset voltage (current) Lamp load • Steady-state current, inrush current Open/close frequency	- Selecting the power supply type [DC/DC/AC] - Control output Maximum current (voltage) - Leakage current - Residual load voltage

Size of Detectable object



In general, if the object is smaller than the standard detectable object, the sensing distance decreases.
Design the setup for an object size that is the same or greater than the standard detectable object size from the graphs showing the detectable object size and sensing distance. When the size of the standard detectable object is the same or less than the size of the standard detectable object,select a sensing distance with sufficient leeway.

Thickness of Detectable object



The thickness of ferrous metals (iron, nickel, etc.) must be 1 mm or greater.
For non-magnetic metal, a sensing distance equivalent to a magnetic body can be obtained when the coating thickness is 0.01 mm or less.
When the coating is extremely thin and is not conductive, such as a vacuum deposited film, Detection is not possible.
Influence of Plating If the detectable object is plated, the sensing distance will change (see the table below).

Effect of Plating (Typical)

Thickness and base material of plating	Detectable performance (%)
Non plating steel(Fe)	100
Zn 5 to 15 μm	90 to 120
Cd 5 to 15 μm	100 to 110
Ag 5 to 15 μm	60 to 90
Cu 10 to 20 μm	70 to 95
Cu 5 to 15 μm	-
Cu (5 to 10 μm) + Ni (10 to 20 μm)	70 to 95
Cu (5 to 10 μm) + Ni (10 μm) + Cr (0.3 μm)	70 to 95

Mutual Interference

Mutual interference refers to a state where a Sensor is affected by magnetism (or static capacitance) from an adjacent Sensor and the output is unstable. One means of avoiding interference when mounting Proximity Sensors close together is to alternate Sensors with different frequencies. The model tables indicate whether different frequencies are available. Please refer to the tables. When Proximity Sensors with the same frequency are mounted together in a line or face-to-face, they must be separated by a minimum distance. For details, refer to Mutual Interference in the Safety Precautions for individual Sensors.

Power Reset Time

A Sensor is ready for Detection within 100 ms after turning ON the power. If the load and Sensor are connected to separate power supplies, design the system so that the Sensor power turns ON first.

Turning OFF the Power

An output pulse may be generated when the power is turned OFF, so design the system so that the load or load line power turns OFF first.

Influence of Surrounding Metal

The existence of a metal object other than the detectable object near the sensing surface of the Proximity Sensor will affect Detection performance,increase the apparent operating distance, degrade temperature characteristics, and cause reset failures. For details, refer to the influence of surrounding metal table in Safety Precautions for individual Sensors. Particularly the distance m that separates a metal surface that faces the Sensor's sensing surface will influence performance, such as shortening the sensing distance. The values in the table are for the nuts provided with the Sensors.Changing the nut material will change the influence of the surrounding metal.

Power Transformers

Be sure to use an insulated transformer for a DC power supply. Do not use an auto-transformer (single-coil transformer).

Precautions for AC 2-Wire/DC 2-Wire Sensors Surge Protection

Although the Proximity Sensor has a surge absorption circuit, if there is a device (motor, welder, etc.) that causes large surges near the Proximity Sensor, insert a surge absorber near the source of the surges.

Influence of Leakage Current

Even when the Proximity Sensor is OFF, a small amount of current runs through the circuit as leakage current.For this reason, a small current may remain in the load (residual voltage in the load) and cause load reset failures. Verify that this voltage is lower than the load reset voltage (the leakage current is less than the load reset current) before using the Sensor.

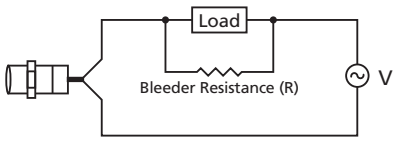
Using an Electronic Device as the Load for an AC 2-Wire Sensor

When using an electronic device, such as a Timer, some types of devices use AC half-wave rectification. When a Proximity Sensor is connected to a device using AC half-wave rectification, only AC halfwave power will be supplied to the Sensor. This will cause the Sensor operation to be unstable. Also, do not use a Proximity Sensor to turn the power supply ON and OFF for electronic devices that use DC halfwave rectification. In such a case, use a relay to turn the power supply ON and OFF, and check the system for operating stability after connecting it.

Countermeasures for Leakage Current (Examples)

AC 2-Wire Model

Connect a bleeder resistor to bypass the leakage current flowing in the load so that the current flowing through the load is less than the load reset current. When using an AC 2-Wire Sensor, connect a bleeder resistor so that the Proximity Sensor current is at least 10 mA, and the residual load voltage when the Proximity Sensor is OFF is less than the load reset voltage.



Calculate the bleeder resistance and allowable power using the following equation.

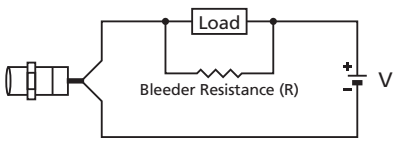
$$R \leq \frac{V}{10 - 1}(k\Omega) \qquad P > \frac{V^2}{R}(mW)$$

P : Watts of bleeder resistance (the actual number of watts used should be several times this number)
I : Load current (mA)

It is recommend that leeway be included in the actual values used.For 100 VAC, use 10 kΩ or less and 3 W (5 W) or higher, and for 200 VAC, use 20 kΩ or less and 10 W (20 W) or higher. If the effects of heat generation are a problem, use the number of watts in parentheses ( ) or higher.

DC 2-Wire Model

Connect a bleeder resistor to bypass the leakage current flowing in the load, and design the load current so that (leakage current) × (load input impedance) < reset voltage.

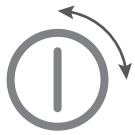


Calculate the bleeder resistance and allowable power using the following equation.

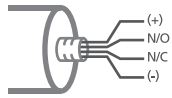
$$R \leq \frac{V}{iBR - iL}(k\Omega) \qquad P > \frac{V^2}{R}(mW)$$

P : Watts of bleeder resistance (the actual number of watts used should be several times this number)
iBR : Leakage current of Proximity Sensor (mA)
iL : Load reset current (mA)
It is recommend that leeway be included in the actual values used.For 12 VDC, use 15 kΩ or less and 450 mW or higher, and for 24 VDC, use 30 kΩ or less and 0.1 W or higher.

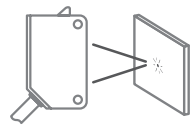
Photo Electric Sensor
KE Series



Sensitivity adjustable



N/O + N/C output



Optional for red beam

Reverse Cable outlet protection
Short circuit protection

Enhanced waterproof design

Part Number Description

SERIES ❶ ❷ ❸ ❹

	SERIES	KER	Ø18 Round type	KES KESB	32X20 mm Mini Ractangular type Red Beam type
❶	**Sensing Distance**	KER	F : 10m (Emitter + Receiver type) E : 3m (Retro reflective) C : 600mm (Diffuse reflective)	KES(B)	F : 10m (Emitter + Receiver type) E : 3m (Retro reflective) D : 800mm (Diffuse reflective) A : 150mm (Backgound suppression)
❷	**Output**	7 : NPN N/O + N/C (4 wire)	8 : PNP N/O + N/C (4 wire)		
❸	**Cable Outlet**	Standard* : 2m Cable	2 : M8 pig tail connector	3 : M12 connector	
❹	**Power**	1 : 10 ~ 30VDC			

*Standard specification is not appeared in part number description

General Specification

Light Source (Wave Length)	Infrared LED (850 nm), Red optional
Power Supply Voltage	10 to 30 VDC±10% including 10% (p-p) max. ripple
Output Type	N/O + N/C Output (NPN / PNP)
Circuit Protection	Protection from reversed power supply Cable outlet , output short-circuit, mutual interference, and reversed output Cable outlet
Sensitivity	Adjustable
Response Time	Operation or reset : Max. 1 ms
Ambient Illumination	Incandescent lamp : Max. 3,000 lx
(Receiver Side)	Sunlight : Max. 10,000 lx
Ambient Temperature	Operating : −25°C to 55°C/Storage : −40°C to 70°C (with no icing)
Ambient Humidity	Operating : 35% to 85%/Storage : 35% to 95% (with no icing)
Dielectric Strength	1,000 VAC, 50/60 Hz for 1 min between charged parts and case
Vibration Resistance	Destruction : 10 to 55 Hz, 1.5-mm double amplitude or 300 m/s^2 for 2 hours each in X, Y, and Z directions
Shock Resistance	Destruction : 500 m/s^2 3 times each in X, Y, and Z directions
Indicator Operation	LED on : Power on / Object detecting , LED Flickering : Object is in unclear range. LED off : Power off / No object detecting
Accessories	Instruction manual (The Reflector and Mounting Bracket are not provided with any of the above models.) Screw for potencial meter

Photo Electric Sensor
KE Series

Characteristics

KER Series

Sensing Method	Emitter + Receiver	Retro reflective	Diffuse reflective
Sensing Distance	10m	3 m	600mm
Operating Spot	1.2m	350mm	10mm
Current Consumption	Emitter : Max. 20 mA Receiver : Max.25 mA	Max.15 mA	
Maximum Response Frequency	200Hz(5ms)		
Material	Nickel plated copper, PMMA		
Maximum Response Frequency	200Hz(5ms)		
Cable Outlet	Standard : 2m Cable, 3 : M12 4-pin connector		
Control Output – **Load Current**	Max. 200mA		
Control Output – **Residual Voltage**	Load current 0 ~ 10 mA : Max. 1 V Load current 10 ~ 200 mA : Max. 2 V		
Degree of Protection	IP67		

KES(B) series

Sensing Method	Emitter + Receiver	Retro reflective	Diffuse reflective
Sensing Distance	10m	3 m	150mm (Background suppression) 800mm
Operating Spot	1.2m	350mm	10mm
Current Consumption	Emitter : Max. 20 mA Receiver : Max. 25 mA	Max. 15 mA	
Maximum Response Frequency	0.5ms		
Material	PC, PMMA		
Maximum Response Frequency	0.5ms		
Cable Outlet	Standard : 2m Cable, 2 : M8 pig tail connector		
Control Output – **Load Current**	Max. 100mA		
Control Output – **Residual Voltage**	Load current 0 ~ 10 mA : Max. 1 V Load current 10 ~ 100 mA : Max. 2 V		
Degree of Protection	IP65		

Product Selection

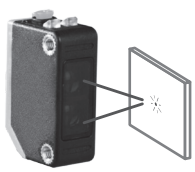
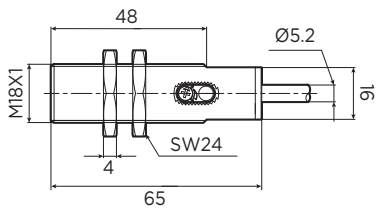
Model	Sensing Distance	Output	Power	Connector	Part Number
KER 4-wire(DC)	F : 10m (Emitter + Receiver)	7 : NPN N/O + N/C	1 : 10-30 VDC	Standard : 2m Cable	KER F71
	E : 3m (Retro diffuse)				KER E71
	C : 600mm (Diffuse reflective)				KER C71
	F : 10m (Emitter + Receiver)	7 : NPN N/O + N/C	1 : 10-30 VDC	3 : M12 connector	KER F71 3
	E : 3m (Retro diffuse)				KER E71 3
	C : 600mm (Diffuse reflective)				KER C71 3
KES 4-wire(DC)	F : 10m (Emitter + Receiver)	7 : NPN N/O + N/C	1 : 10-30 VDC	Standard : 2m Cable	KES F71
	E : 3m (Retro diffuse)				KES E71
	D : 800mm (Diffuse reflective)				KES D71
	A : 150mm (Diffuse reflective Background suppression)				KES A71
	F : 10m (Emitter + Receiver)	7 : NPN N/O + N/C	1 : 10-30 VDC	2 : M8 pig tail connector	KES F71 2
	E : 3m (Retro diffuse)				KES E71 2
	D : 800mm (Diffuse reflective)				KES D71 2
	A : 150mm (Diffuse reflective Background suppression)				KES A71 2
KESB (Red Beam Type) 4-wire(DC)	F : 10m (Emitter + Receiver)	7 : NPN N/O + N/C	1 : 10-30 VDC	Standard : 2m Cable	KES BF71
	E : 3m (Retro diffuse)				KES BE71
	D : 800mm (Diffuse reflective)				KES BD71
	A : 150mm (Diffuse reflective Background suppression)				KES BA71
	F : 10m (Emitter + Receiver)	7 : NPN N/O + N/C	1 : 10-30 VDC	2 : M8 pig tail connector	KES BF71 2
	E : 3m (Retro diffuse)				KES BE71 2
	D : 800mm (Diffuse reflective)				KES BD71 2
	A : 150mm (Diffuse reflective Background suppression)				KES BA71 2

Photo Electric Sensor
KE Series

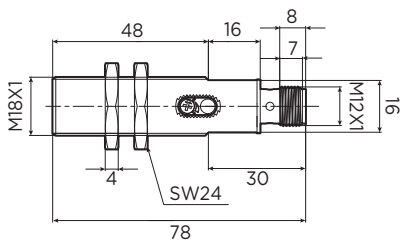
Dimension (mm)

KER

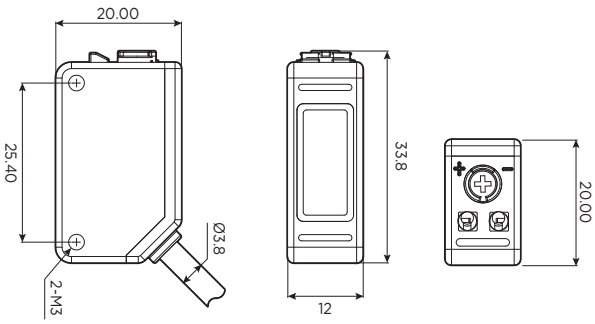
Flush



M12 connector Flush

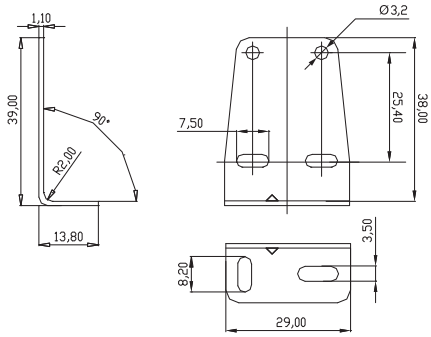


KES(B)

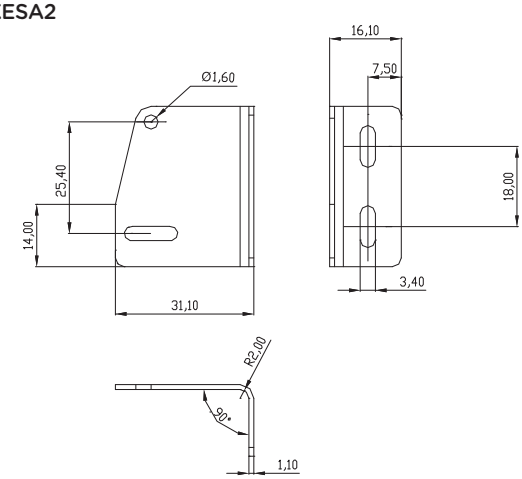


KES(B) Bracket

KESA1



KESA2



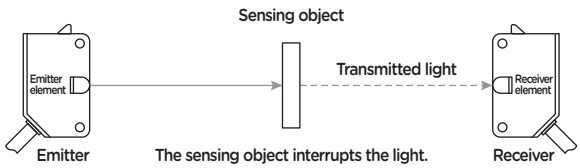
Technical Data
Photo Electric Sensor

Overview

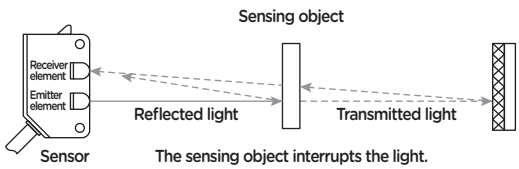
What Are Photoelectric Sensors?
Photoelectric Sensors detect objects, changes in surface conditions, and other items through a variety of optical properties.A Photoelectric Sensor consists primarily of an Emitter for emitting light and a Receiver for receiving light. When emitted light is interrupted or reflected by the detectable object, it changes the amount of light that arrives at the Receiver. The Receiver detects this change and converts it to an electrical output. The light source for the majority of Photoelectric Sensors is infrared or visible light (generally red, or green/blue for identifying colors).

Photoelectric Sensors are classified as shown in the figure below

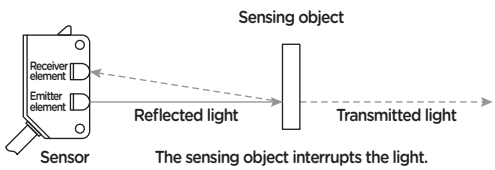
Through-beam Sensors



Retro reflectice Sensors



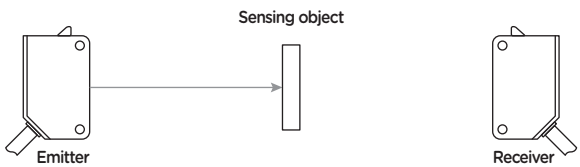
Diffuse reflectice Sensors



Operating Principles

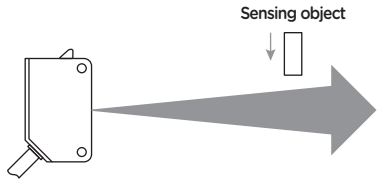
1) Through-beam Sensors

- Stable operation
- Long sensing distances ranging(Max.20m) from several centimeters to several tens of meters.
- Sensing position unaffected by changes in the detectable object path.
- Operation not greatly affected by detectable object gloss, color, or inclination.



2) Diffuse reflective Sensors

It has wide sensing range but shorter sensing distance since light source is diffused after passing the lens.

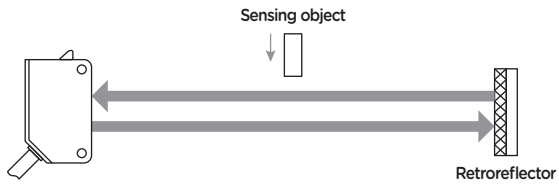


Features

- Sensing distance ranging(Max.several meters).
- Easy mounting adjustment.
- The intensity of reflected light and operating stability vary with the conditions (e.g., color and smoothness) on the surface of the detectable object

3) Retro reflective Sensors

Retro reflective type uses mirrors (reflectors) with high light radiant in order to detect a target by comparing difference of light amount determined by the presence of target between the sensor and reflector.



BGS (Background Suppression)

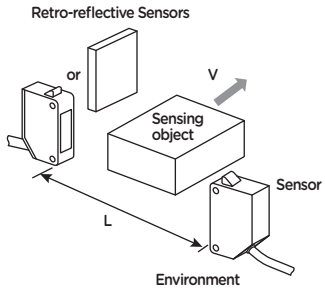
The BGS function prevents any background object (i.e., the conveyor) beyond the set distance from being detected.
(1) Objects with extremely low reflectance and objects that are darker than black paper.
(2) Objects like mirrors that return virtually all light back to the Emitter.
(3) Uneven, glossy surfaces that reflect a lot of light but disperse the light in random directions.
Reflected light may return to the Receiver momentarily for item (3) due to detectable object movement. In that case, an OFF delay timer or some other means may need to be employed to prevent chattering.

Usage Guidance

Model Selection

Checkpoints for Through-beam and Retro reflective Sensors

Detactable object
1. Size and shape
   (vertical x horizontal x height)
2. Transparency (opaque, semi-transparent, transparent)
3. Velocity V (m/s or units/min.)

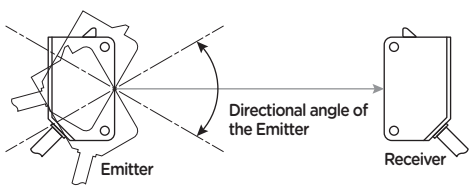


Sensor
1. Sensing distance (L)
2. Restrictions on size and shape
   a) Sensor
   b) Retroreflector
      (for Retro reflective Sensors)
3. Need for side-by-side mounting
   a) No. of units
   b) Mounting pitch
   c) Need for staggered mounting
4. Mounting restrictions (angling, etc.)

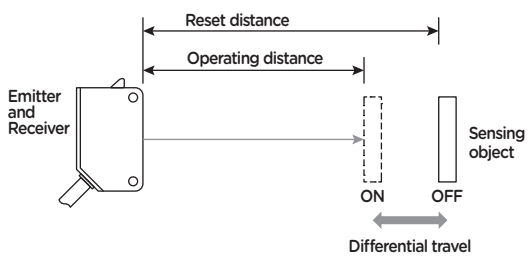
Environment
1. Ambient temperature
2. Presence of splashing water, oil, or chemicals
3. Others

HOW TO INSTALL

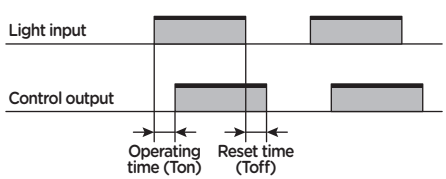
Directional angle
The angle where operation as a Photoelectric Sensor is possible.



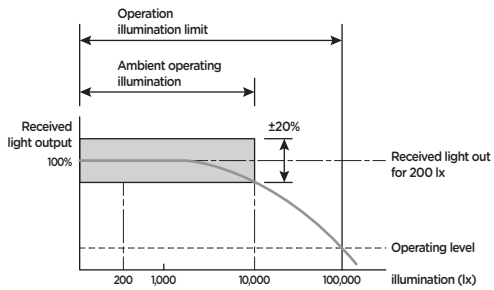
Differential travel
The difference between the operating distance and the reset distance.



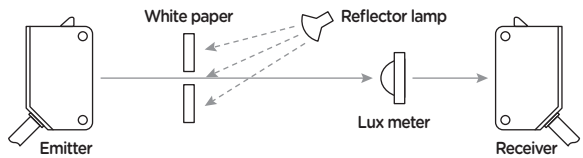
Response time
The delay time from when the light input turns ON/OFF until the control output operates or resets.
In general for Photoelectric Sensors, the operating time (Ton) ≒ reset time (Toff).



The ambient operating illumination is expressed in terms of the Receiver surface illuminance and is defined as the illuminance
when there is a ±20% change with respect to the value at a light reception output of 200 lx.

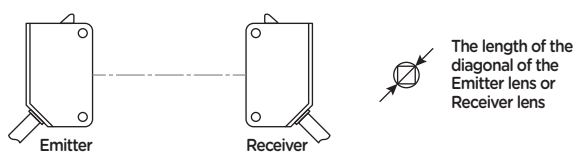


Received illumination

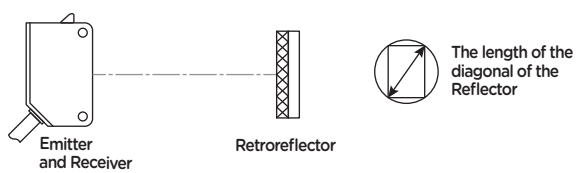


Standard Detectable object
The standard detectable object for both Through-beam Sensors and Retro-reflective Sensors is an opaque rod with a diameter larger than the length of a diagonal line of the optical system.
For Diffuse-reflective Sensors, the standard detectable object is a sheet of white paper larger than the diameter of the emitted beam.

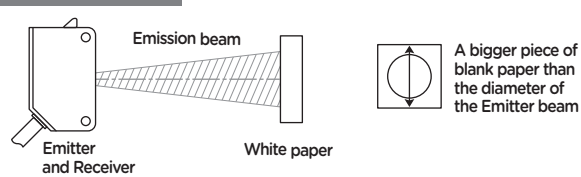
Through-beam Sensors



Retro-reflectice Sensors



Diffuse-reflectice Sensors



General Precautions

For precautions on individual products, refer to the Safety Precautions in individual product information.

⚠ WARNING

- These products cannot be used in safety devices for presses or other safety devices used to protect human life.
- These products are designed for use in applications for sensing workpiecs and workers that do not affect safety.

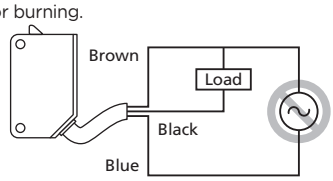
Precautions for Safe use

- To ensure safety, always observe the following precautions.

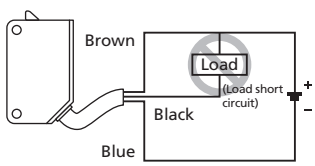
Safety Precautions
Be sure to abide by the following precautions for the safe operation of the Sensor.

Wiring Instruction

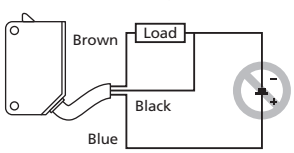
Power Supply Voltage
Do not use a voltage that exceeds the operating voltage range. Applying a voltage that is higher than the operating voltage range, or using an AC power supply (100 VAC or higher)for a Sensor that requires a DC power supply may cause explosion or burning.

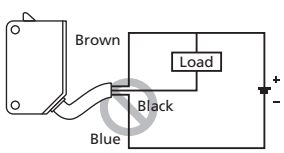


Load short-circuiting
- Do not short-circuit the load. Explosion or burning may result.
- The load short-circuit protection function operates when the power supply is connected with the correct polarity and the power is within the rated voltage range.



Incorrect Wiring
Be sure that the power supply polarity and other wiring is correct. Incorrect wiring may cause explosion or burning.
DC 3/4-Wire NPN Output Sensors





Precaution for Safe use

Settings
Power Reset Time
The Sensor is ready to operate 100 ms after the Sensor is turned ON. If the load and Sensor are connected to independent power supplies respectively, be sure to turn ON the Sensor before turning the load ON.

Cable outlets
- Secure the connector cover by hand. Do not use any pliers, other-wise the connector may be damaged.
- The proper tightening torque range is between 0.3 and 0.4 N • m. Be sure to tighten the connector securely, otherwise the specified degree of protection may not be maintained or the connector may be disconnected due to vibration.

Mounting
Sensor Mounting
Use M3 screws to mount the sensor and tighten each screw to a maximum torque of 0.5 N • m.

Cables
Part of the cable is coated and may wrinkle when bent.
Observe the following precautions when handling the cable because it is made of the same polyvinyl chloride (PVC) material as the cables for standard Sensors.
- Do not subject the cable to mechanical movement in oily environments

The sheath will lose its elasticity and harden over time. The cable may break as a result and cause faulty operation, or there may be damage to the sheath that leads to a short circuit.

Distribution Box
Metal Body
KDM series

Part Number Description

SERIES	❶	❷	❸	❹

	SERIES	KDM	Metal Distribution Box		
❶	Number of Sockets	Standard* : 8 Sockets			
❷	Connector Dimension	Standard* : M12		8 : M8	
❸	Led Indicator	1 : NPN N/O	3 : PNP N/O	7 : NPN N/O+N/C	8 : PNP N/O+N/C
❹	Main Connector	Standard* : M23			

* Standard specification is not appeared in part number description

General Specification

Model Output Type	KMD 1	KMD3	KMD7	KMD8
Number of Core	4 - Core		5 - Core	
Output Configration	1 : NPN N/O	3 : PNP N/O	7 : NPN N/O+N/C	8 : PNP N/O+N/C
Supply Voltage	Max. 125VAC/DC or 24VDC			
Power Indicator	GREEN LED			
Number of Sockets	8			
Number of Signals Per Sockets	2			
Status(Signal) Indicators	YELLOW LED			
Supply Current	Max. 4A per contact			
Combined Current	Pre-wired cable : Max. 12A, M23 Connector : Max. 10A			
Housing Material	Zinc-Nickel plated			
Protection Degree	IP67			
Temperature Range	-20 ~ 80°C			
Resistance	Good resistance against chemicals and oils. For corrosive media it should be individually specified according to the requirement.			

Product Selection

Model	Cable Outlet For Sensors/Actuators	Output Configration	Part Number	Main Cable Outlet	Locking Sockets	Supply Power
	M12 port 4-core	1 : NPN N/O	KDM 1	M23	Threaded M12	125VAC/DC or 24VDC
		3 : PNP N/O	KDM 3			
	M12 port 5-core	7 : NPN N/O+N/C	KDM 7	M23	Threaded M12	125VAC/DC or 24VDC
		8 : PNP N/O+N/C	KDM 8			

Accessories - Plug Connector

Straight field-attachable connector	Angled field-attachable connector	Straight pre-wired connector
		
KDMC1	KDMC2	KDMC3

I/O Connector
KQS, KQJ series

Part Number Description

SERIES ❶ ❷ ❸ ❹

SERIES	KQS	Kacon I/O connector straight	
	KQA	Kacon I/O connector angled	
❶ Led Indicator	Standard* : No Indicator	L : LED Indicator	
❷ Connector Type	1 : Male	2 : Female	
❸ Connector Size	2 : M8	3 : M12	
❹ Number of Pin/Core	3 : 3pin/core	4 : 4 pin/core	5 : 5pin/core

* Standard specification is not appeared in part number description

Product Selection

Model	Indicator	Connector Type	Connector Size	Number of Pin	Part Number	Ambient Temperature	Rated Current/ Voltage
I/O Connector Straight - M8 	Standard : No Indicator	1 : Male	2 : M8	3 : 3 Pin	KQS 123	-25 ~ 85°C	4A/250V
				4 : 4 Pin	KQS 124		
I/O Connector Straight - M8 	Standard : No Indicator	2 : Female	2 : M8	3 : 3 core	KQS 223	-25 ~ 85°C	4A/250V
				4 : 4 core	KQS 224		
I/O Connector Straight - M12 	Standard : No Indicator	1 : Male	3 : M12	3 : 3 Pin	KQS 133	-25 ~ 85°C	4A/250V
				4 : 4 Pin	KQS 134		
				5 : 5 Pin	KQS 135		
	L : LED Indicator with transparent case			3 : 3 Pin	KQS L133	-25 ~ 85°C	4A/250V
				4 : 4 Pin	KQS L134		
				5 : 5 Pin	KQS L135		
I/O Connector Straight - M12 	Standard : No Indicator	2 : Female	3 : M12	3 : 3 core	KQS 233	-25 ~ 85°C	4A/250V
				4 : 4 core	KQS 234		
				5 : 5 core	KQS 235		
	L : LED Indicator with transparent case			3 : 3 core	KQS L233	-25 ~ 85°C	4A/250V
				4 : 4 core	KQS L234		
				5 : 5 core	KQS L235		

I/O Connector
KQS, KQJ series

Product Selection

Model	Indicator	Connector Type	Connector Size	Number of Pin	Part Number	Ambient Temperature	Rated Current/ Voltage
I/O Connector Angled - M8 	Standard : No Indicator	1 : Male	2 : M8	3 : 3 Pin	KQA 123	-25 ~ 85°C	4A/250V
				4 : 4 Pin	KQA 124		4A/60V
I/O Connector Angled - M8 	Standard : No Indicator	2 : Female	2 : M8	3 : 3 core	KQA 223	-25 ~ 85°C	4A/250V
				4 : 4 core	KQA 224		4A/60V
I/O Connector Angled - M12 	Standard : No Indicator	1 : Male	3 : M12	3 : 3 Pin	KQA 133	-25 ~ 85°C	4A/250V
				4 : 4 Pin	KQA 134		
				5 : 5 Pin	KQA 135		
I/O Connector Angled - M12 	Standard : No Indicator	2 : Female	3 : M12	3 : 3 core	KQA 233	-25 ~ 85°C	4A/250V
				4 : 4 core	KQA 234		
				5 : 5 core	KQA 235		

KACON
Rotary ENCODER

CE

General Incremental Encoders

Ø28

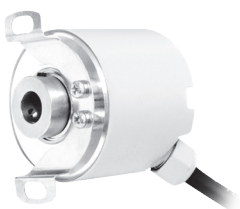
Ø38

Ø50

Incremental encoder is widely automation field wherever it need to have control the motion. KRE series has got wide range of resolution up to 2500ppr and various size from Ø28 to Ø50 for most of general purpose motion applications.

KACON is strongly recommend to use KRE series When you think about cost and reliable performance.

Waterproof Incremental Encoders



Ø38 IP69K

Ø50 IP65

KRW/KNM Incremental encoder is developed for outstanding performance in mechanical shock-resistance and Waterproof. Also It is workable at 100N radial roads to fit various industrial circumstance.

KRW/KNM incremental encoder will extend your application performance in tough environments conditions.

Special purpose Encoders (Under developments)

Ø25 ~ Ø40H

Stainless Housing

25bit Multi turn

The effort of innovation is never stop in KACON. And it will show you the most advanced encoder models such as 25 bit Multi turn encoders, large hollow shaft Encoders and Stainless housing encoders.

If you have any problem with you motion control, please concern KACON.
KACON will provide you right solution in time

KACON Rotary Encoder

Part Number Description

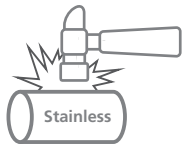
SERIES ❶ ❷ ❸ ❹ ❺

SERIES	KR (IP54) KRW(IP65/IP67)						
	Under Development	KNM	(IP69K Waterproof)				
		KNP	(High Resolution)				
		KRS	(Stainless)				
		KRA	(Absolute)				
		KRH	(Large Hollow shaft)				
❶ **Shape**	Shaft	Ø28	Ø38	Ø40	Ø50	Ø58	
	Hollow Shaft	Ø38	Ø40	Ø50	Ø58		
	Semi Hollow Shaft	Ø38					
❷ **Shaft**	Ø4	Ø5		Ø6		Ø8	Ø10
	Ø12	Ø13		Ø14		Ø15	Ø16
❸ **Resolution**	10 ~ 30,000						
❹ **Output**	Push-Pull (Totempole) NPN Open Collector Line Drive (RS422)						
❺ **Power**	5 - 30VDC	10 - 30VDC		5VDC (Line drive output / Absolute)			

* Standard specification is not appeared in part number description

Incremental ENCODER

KR Series



Stainless shaft

Waterproof rubber or
cable locker for cable outlet

Reverse Cable outlet
protection
Short circuit protection

Part Number Description

KR ❶ ❷ ❸ ❹ - ❺

❶ **Shape**	2 : Ø28 Shaft A : Ø38 Hollow Shaft	3 : Ø38 Shaft C : Ø50 Hollow Shaft	5 : Ø50 Shaft
❷ **Shaft Size**	Ø28 Shaft 4 : Ø4, 5 : Ø5		Ø50 Shaft 8: Ø8
	Ø38 Shaft 6 : Ø6		Ø50 Hollow Shaft 8: Ø8
	Ø38 Hollow Shaft 8 : Ø8, 6 : Ø6		
❸ **Output**	1 : Push-Pull	2 : NPN Open Collector	3 : Line Drive (RS422)
❹ **Power**	1 : 5 ~ 30VDC	2 : 5VDC (Line drive output only)	
❺ **Resolution**	Ø28 : 50, 100, 200, 300, 360, 500, 600		
	Ø38 / Ø50 : 10 ,20 ,30 ,40 ,50 ,60 ,70 ,80 ,90 ,100 ,200 ,300 ,360 ,400 ,500 ,512 ,600 ,800 , 1000 ,1024 ,1200 ,2000 ,2500		

Incremental ENCODER
KR Series

General Specification

Shape	Ø28 Shaft	Ø38 Shaft/Hollow Shaft	Ø50 Shaft/Hollow Shaft
Maximum Operating Speed	6000 rpm	6000 rpm	6000 rpm
Maximum Load Capacity	5N (axial), 10N (radial)	25N (axial), 50N (radial)	30N (axial), 60N (radial)
Shock Resistance	30G/11ms	50G/11ms	50G/11ms
Vibration Resistance	6G 10 ~ 2000HZ	10G 10 ~ 2000HZ	10G 10 ~ 2000HZ
Life Time (bearing)	10^9 revolution	10^9 revolution	10^9 revolution
Starting Torque	< 0.01 Nm	< 0.01 Nm	< 0.01 Nm
Body Material	AL-alloy UNI9002-5	AL-alloy UNI9002-5	AL-alloy UNI9002-5
Housing Material	AL-alloy UNI9002-5	AL-alloy UNI9002-5	AL-alloy UNI9002-5
Ambient Temperature	-20 ~ 80°C (with no icing)	-20 ~ 80°C (with no icing)	-20 ~ 80°C (with no icing)
Storage Temperrature	-35 ~ 85°C (with no icing)	-35 ~ 85°C (with no icing)	-35 ~ 85°C (with no icing)
Cable Outlet	Axial 2m Cable	2m Cable (Radial / Axial)	2m Cable (Radial / Axial)
Weight	100g	135g	155g
Protection Degree	IP50	IP54	IP54

Characteristics

Output	Push-Pull (Totem pole)	NPN Open Collector	RS422(Line Drive)
Supply Voltage (VDC)	5 ~ 30VDC	5 ~ 30VDC	5VDC
Power Consumption (no load)	125mA	80mA	80mA
Maximum Load Current	±80mA	± 50mA	± 50mA
Pulse Frequency	Max. 300kHz	Max. 300kHz	Max. 300kHz
Signal At High	Min. Ub-1.5V	Min. Ub- 70%*	Min. Ub-3.4V
Signal At Low	Max. 0.8V	Max. 0.4V	Max. 0.4V
Rise Timetr	Max. 1μs	Max. 1μs**	Max. 200ns
Fall Time Tf	Max. 1μs	Max. 1μs**	Max. 200ns

(*) High signal level of NPN Open collector is depends on the pull up resistor. 4.7kΩ is recommended resistance.
(**) Fall and Rise time of NPN Open collector is depends on pull up resistor and cable length.

Terminal configuration

Push-Pull / NPN Open Collector Output

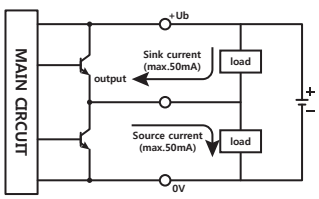
Signal	0V	+Ub	+A		+B		+Z		Shield
Color	White (WH)	Brown (BN)	Green(GN)		Gray (GY)		Blue (BU)		Sliver

RS422(Line Drive) output

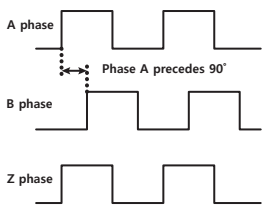
Signal	0V	+Ub	+A	-A	+B	-B	+Z	-Z	Shield
Color	White (WH)	Brown (BN)	Green(GN)	Yellow(YE)	Gray (GY)	Pink(PK)	Blue (BU)	Red (RD)	Sliver

Output Circuit

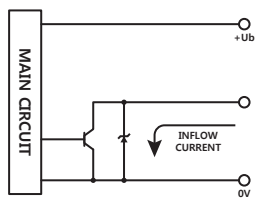
(1) Push-Pull Output



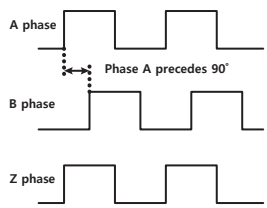
Output Phase



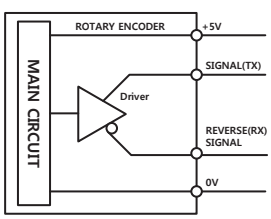
(2) NPN Open Collector Output



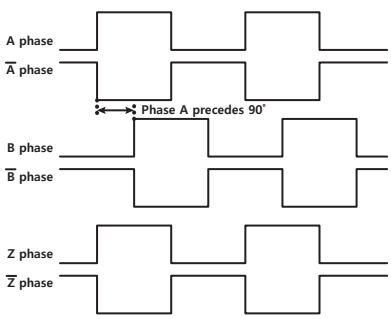
Output Phase



(3) Line-driver Output



Output Phase



Incremental ENCODER
KR Series

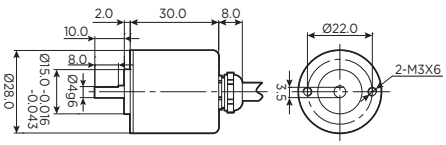
Product Selection

Model	Shape	Shaft	Resolution (P/R)	Output	Power	Part Number
	Shaft 2 : Ø28	5 : Ø5	100	1 : Push-Pull	1 : 5-30VDC	KR 2511-100
			200			KR 2511-200
			300			KR 2511-300
			360			KR 2511-360
			500			KR 2511-500
			600			KR 2511-600
	Shaft 3 : Ø38	6 : Ø6	100	1 : Push-Pull	1 : 5-30VDC	KR 3611-100
			200			KR 3611-200
			300			KR 3611-300
			360			KR 3611-360
			500			KR 3611-500
			600			KR 3611-600
			1000			KR 3611-1000
			1024			KR 3611-1024
	Hollow Shaft A : Ø38	6 : Ø6	100	1 : Push-Pull	1 : 5-30VDC	KR A611-100
			200			KR A611-200
			300			KR A611-300
			360			KR A611-360
			500			KR A611-500
			600			KR A611-600
			1000			KR A611-1000
			1024			KR A611-1024
	Shaft 5 : Ø50	8 : Ø8	100	1 : Push-Pull	1 : 5-30VDC	KR 5811-100
			200			KR 5811-200
			300			KR 5811-300
			360			KR 5811-360
			500			KR 5811-500
			600			KR 5811-600
			1000			KR 5811-1000
			1024			KR 5811-1024
	Hollow Shaft C : Ø50	8 : Ø8	100	1 : Push-Pull	1 : 5-30VDC	KR C811-100
			200			KR C811-200
			300			KR C811-300
			360			KR C811-360
			500			KR C811-500
			600			KR C811-600
			1000			KR C811-1000
			1024			KR C811-1024

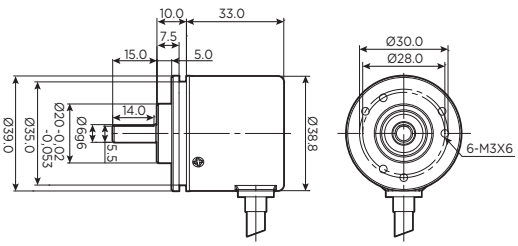
Dimension

(mm)

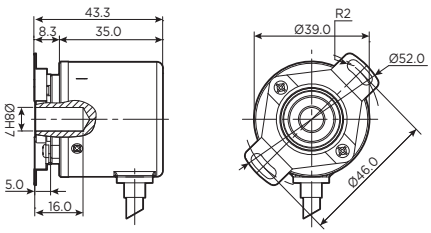
KR Ø28 Shaft



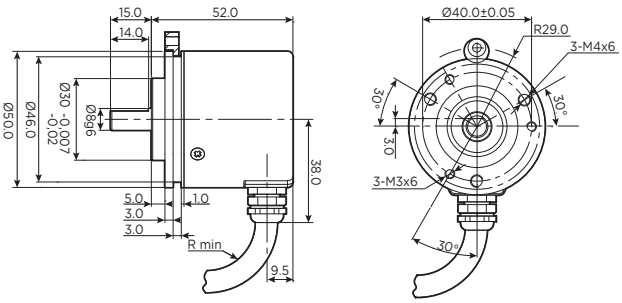
KR Ø38 Shaft



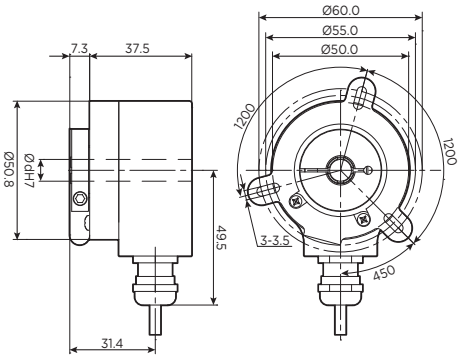
KR Ø38 Hollow Shaft



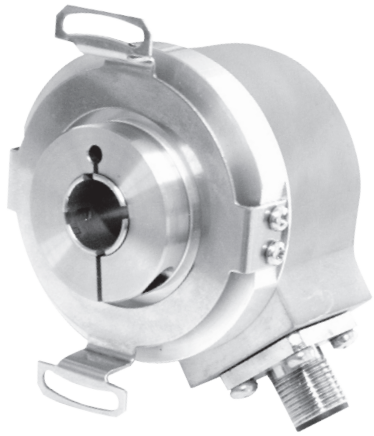
KR Ø50 Shaft

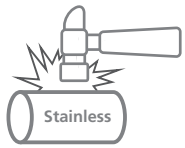


KR Ø50 Hollow Shaft



Incremental ENCODER
Waterproof Model
KRW Series





Stainless shaft

Waterproof rubber or
cable locker for cable outlet

Reverse Cable outlet
protection
Short circuit protection

Improved hosing for better shock
resistance
(2 times higher than others)

Side pre-wired cabling
design for saving
space & installation effort

Enhanced waterproof
design

Part Number Description

SERIES ❶ ❷ ❸ ❹ ❺ ❻ - ❼

	SERIES	KRW : IP65	KRWP : IP67		
❶	**Shape**	4 : Ø40 Shaft	5 : Ø50 Shaft	B : Ø40 Hollow Shaft	C : Ø50 Hollow Shaft
❷	**Mounting Type**	Ø40 Shaft	Standard : Ø20 Clamping flange wih synchro flange ditch		
		Ø40 Hollow Shaft	Standard : Double wing Bracket / P : Single wing Bracket / L : Long single wing bracket		
		Ø50 Shaft	Standard : Ø50.8 Synchro flange /B : Ø58 Sychro flange / C : Ø58 Clamping flange		
		Ø50 Hollow Sahft	Standard : Double wing Bracket (Ø60mm) / L : Long single wing bracket / D : 63.5 Square flange		
❸	**Shaft Size**	Ø40 Shaft	6 : Ø6		
		Ø40 Hollow Shaft	8 : Ø8, 6 : Ø6		
		Ø50 Shaft	8 : Ø8, 6 : Ø6(10mm), 6L : Ø6(15mm), 10 : Ø10(20mm) , 12 : Ø12 (20mm)		
		Ø50 Hollow Sahft	8 : Ø8, 6 : Ø6, 10 : Ø10 , 12 : Ø12, 14 : Ø14, 15 : Ø15		
❹	**Output**	1 : Push-Pull	2 : NPN Open Collector (Ø50 only)		3 : Line Drive (RS422)
❺	**Power**	1 : 10 ~ 30VDC	2 : 5VDC (Line drive output only)		
❻	**Cable Outlet**	Standard : 2m Cable	1 : M12 5pin	2 : M12 8pin	3 : M23 12pin
❼	**Resolution**	10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 360, 400, 500, 512, 600, 800, 1000, 1024, 2000, 2048, 2500, 3600, 4000, 4096, 5000			

General Specification

Shape	Ø40 Shaft/Hollow Shaft	Ø50 Shaft/Hollow Shaft
Maximum Operating Speed	6000rpm	IP65 12000 rpm IP67 6000 rpm
Maximum Load Capacity	60N (axial), 100N (radial)	40N (axial), 80N (radial)
Shock Resistance	50G / 11ms	50G / 11ms
Vibration Resistance	10G 10 ~ 2000HZ	10G 10 ~ 2000HZ
Life Time (Bearing)	10^9 revolution	10^9 revolution
Starting Torque	< 0.08 Nm	IP65 < 0.01 Nm IP67 < 0.05 Nm
Body Material	AL-alloy UNI9002-5	AL-alloy UNI9002-5
Housing Material	Zn-alloy	AL-alloy UNI9002-5
Ambient Temperature	-20 ~ 85°C (with no icing)	-40 ~ 85°C (with no icing)
Storage Temperature	-25 ~ 100°C (with no icing)	-45 ~ 90°C (with no icing)
Weight	110g	400g
Protection Degree	IP65	IP65 / IP67

Characteristics

Output	Push-Pull (Totem pole)	NPN Open Collector	RS422(Line Drive)
Supply Voltage (VDC)	10 ~ 30VDC	10 ~ 30VDC	5VDC
Power Consumption (no load)	125mA	80mA	80mA
Maximum Load Current	± 80mA	± 50mA	± 50mA
Pulse Frequency	Max. 300kHz	Max. 300kHz	Max. 300kHz
Signal At High	Min. Ub -1.5V	Min. Ub -70%*	Min. Ub -3.4V
Signal At Low	Max. 0.8V	Max. 0.4V	Max. 0.4V
Rise Timetr	Max. 1μs	Max. 1μs**	Max. 200ns
Fall Time Tf	Max. 1μs	Max. 1μs**	Max. 200ns

(*) High signal level of NPN Open collector is depends on the pull up resistor. 4.7kΩ is recommended resistance.
(**) Fall and Rise time of NPN Open collector is depends on pull up resistor and cable length.

Incremental ENCODER
Waterproof Model
KRW Series

Terminal configuration

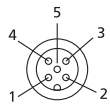
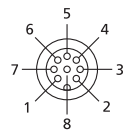
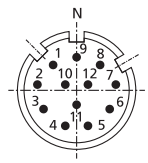
Push-Pull / NPN Open Collector Output

Signal	0V	+Ub	+A		+B		+Z		Shield
Color	White (WH)	Brown (BN)	Green(GN)		Gray (GY)		Blue (BU)		Sliver
Pin code(5-pin)	1	2	3		4		5		

RS422(Line Drive) output

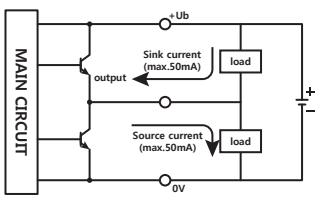
Signal	0V	+Ub	+A	-A	+B	-B	+Z	-Z	Shield
Color	White (WH)	Brown (BN)	Green(GN)	Yellow(YE)	Gray (GY)	Pink(PK)	Blue (BU)	Red (RD)	Sliver
Pin code (8-pin)	1	2	3	4	5	6	7	8	
Pin code (12-pin)	10	12	5	6	8	1	3	4	

Top view of pin plug

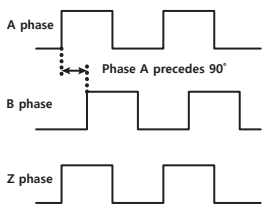
Connector type	M12 connector 5pin	M12 connector 8pin	M23 connector 12pin
Pin plug			

Output Circuit

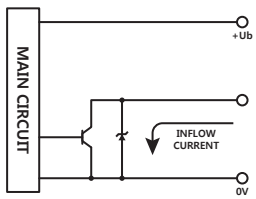
(1) Push-Pull Output



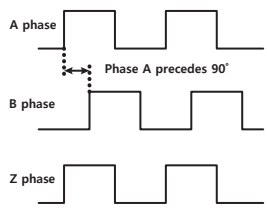
Output Phase



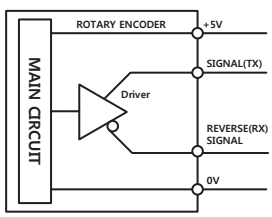
(2) NPN Open Collector Output



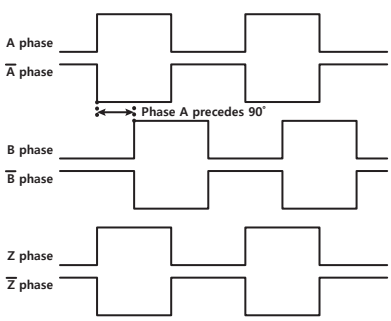
Output Phase



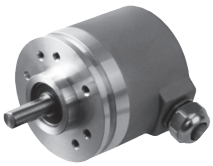
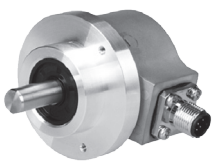
(3) Line-driver Output



Output Phase



Product Selection

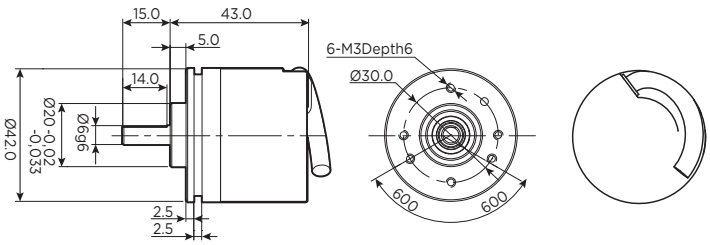
Shape	Mounting	Shaft	Output	Power	Cable	Resolution (P/R)	Part Number
4 : Ø40 Shaft 	Standard : Ø20 Clamping flange	6 : Ø6	1 : Push-Pull	1 : 10-30VDC	Standard : 2m Cable	100	KRW 4611-100
						200	KRW 4611-200
						300	KRW 4611-300
						360	KRW 4611-360
						500	KRW 4611-500
						512	KRW 4611-512
						600	KRW 4611-600
						1000	KRW 4611-1000
						1024	KRW 4611-1024
B : Ø40 Hollow Shaft 	Standard : Double wing bracket	8 : Ø8	1 : Push-Pull	1 : 10-30VDC	Standard : 2m Cable	100	KRW B811-100
						200	KRW B811-200
						300	KRW B811-300
						360	KRW B811-360
						500	KRW B811-500
						512	KRW B811-512
						600	KRW B811-600
						1000	KRW B811-1000
						1024	KRW B811-1024
5 : Ø50 Shaft 	Standard : Ø50.8 Synchro flange	8 : Ø8	1 : Push-Pull	1 : 10-30VDC	Standard : 2m Cable	100	KRW 5811-100
						200	KRW 5811-200
						300	KRW 5811-300
						360	KRW 5811-360
						500	KRW 5811-500
						512	KRW 5811-512
						600	KRW 5811-600
						1000	KRW 5811-1000
						1024	KRW 5811-1024
C : Ø50 Hollow Shaft 	Standard : Double wing bracket (Ø60mm)	8 : Ø8	1 : Push-Pull	1 : 10-30VDC	Standard : 2m Cable	100	KRW C811-100
						200	KRW C811-200
						300	KRW C811-300
						360	KRW C811-360
						500	KRW C811-500
						512	KRW C811-512
						600	KRW C811-600
						1000	KRW C811-1000
						1024	KRW C811-1024

Incremental ENCODER
Waterproof Model
KRW Series

Dimension

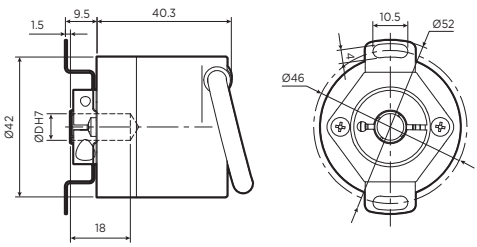
(mm)

KRW Ø40 Shaft

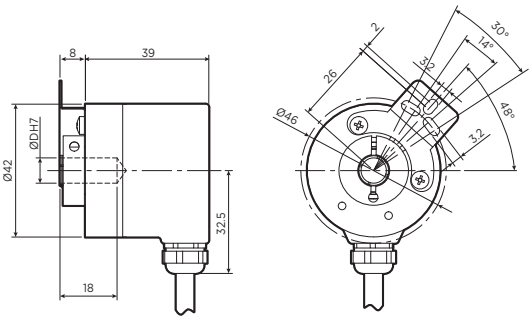


KRW Ø40 Hollow Shaft

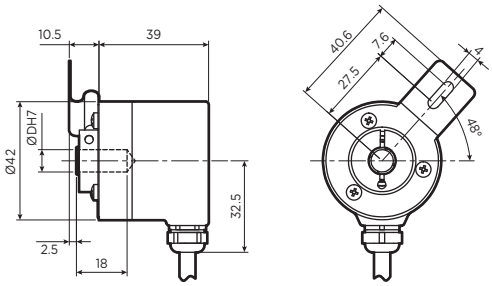
Double wing bracket



Single wing bracket



Long single wing bracket

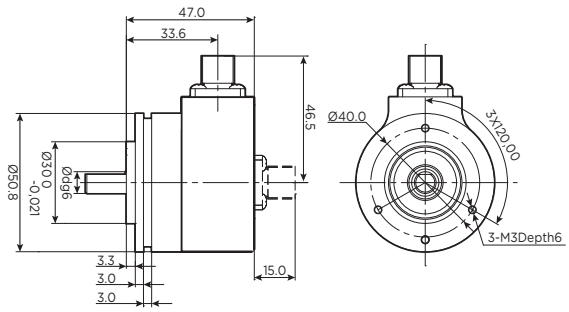


Dimension

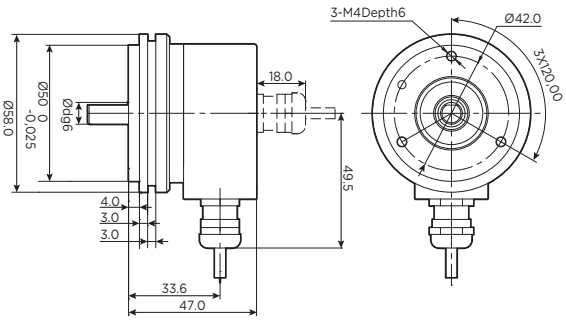
(mm)

KRW Ø50 Shaft

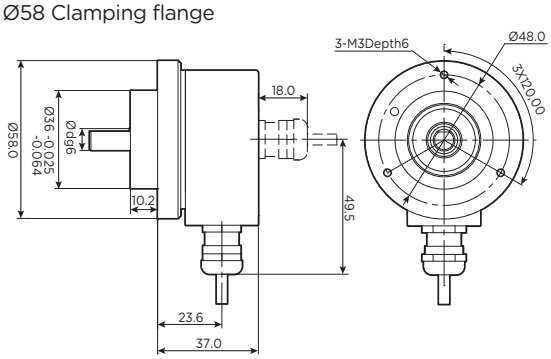
Ø50.8 Synchro flange



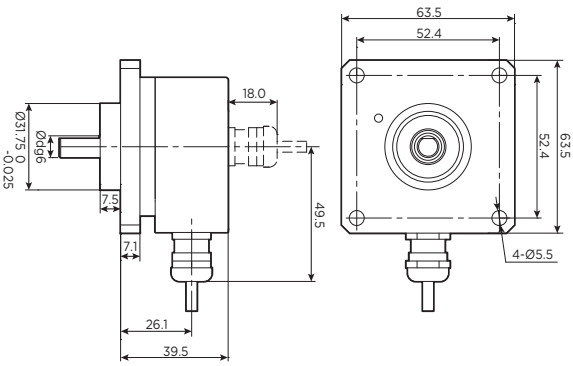
Ø58 Synchro flange



Ø58 Clamping flange

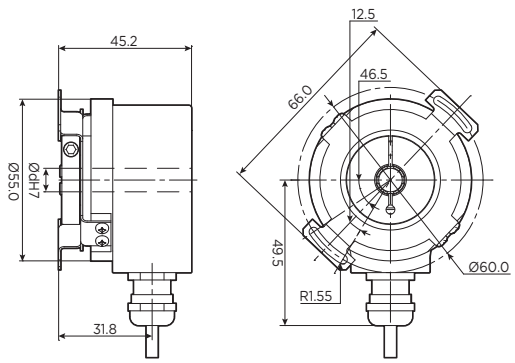


Ø63.5 Square flange

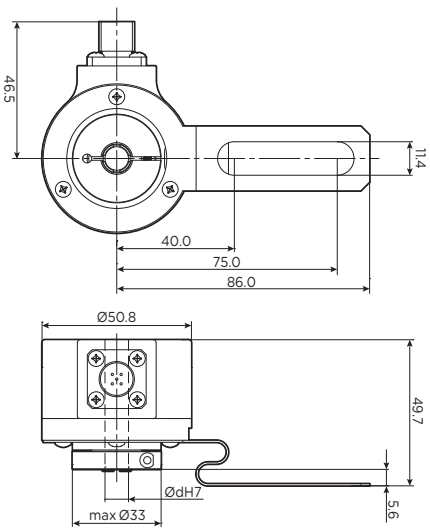


KRW Ø50 Hollow Shaft

Double wing bracket (Ø60mm)



Long single wing bracket



Metal coupling for Encoders

KP Series

Part Number Description

KP - ❶

	Model	KP : Ø25 Alluminum metal coupling			
❶	**Shaft Size**	5	6	8	10

General Specification

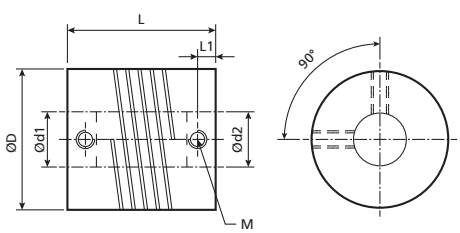
Twisting Moment	1.8 N.m
Maximum Speed	8000 rpm
Screw	M : M4
Material	Al-alloy

Product Selection

	Shaft hole size		
Model	Ød1	Ød2	**Part number**
KP	5	5	KP55
		6	KP56
		8	KP58
		10	KP510
	6	6	KP66
		5	KP65
		8	KP68
		10	KP610
	8	5	KP85
		6	KP86
		10	KP810
	10	10	KP1010
		5	KP105
		6	KP106
		8	KP108

Dimension

(mm)



D : Ø25

L : 25

L1 : 3.55

Technical Data
KACON Rotary Encoder Series

General

Encoders are sensors that generate digital signals in response to movement. Both shaft encoders, which respond to rotation, and linear encoders, which respond to motion in a line, are available. When used in conjunction with mechanical conversion devices, such as rack-and-pinions, measuring wheels, or spindles, shaft encoders can also be used to measure linear movement, speed, and position.

Encoders are available with a choice of outputs. Incremental encoders generate a series of pulses as they move. These pulses can be used to measure speed, or be fed to a counter to keep track of position. Absolute encoders generate multi-bit digital words that indicate actual position directly.

Encoders can be used in a wide variety of applications. They act as feedback transducers for motor-speed control, as sensors for measuring, cutting and positioning, and as input for speed and rate controls. Some examples are listed below

- Door control devices
- Robotics
- Lens grinding machines
- Plotters
- Testing machines
- Ultrasonic welding
- Converting machinery
- Assembly machines
- Labeling machines
- x/y indication
- Analysis devices
- Drilling machines
- Mixing machines
- Medical equipment

Operating Principle

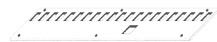
Encoders can use either optical or magnetic sensing technology. Optical sensing provides high resolutions, high operating speeds, and reliable, long life operation in most industrial environments. Magnetic sensing, often used in such rugged applications as steel and paper mills, provides good resolution, high operating speeds, and maximum resistance to dust, moisture, and thermal and mechanical shock.

Optical Encoders

Optical encoders use a glass disk with a pattern of lines deposited on it, a metal or plastic disk with slots (in a rotary encoder), or a glass or metal strip (in a linear encoder). Light from an LED shines through the disk or strip onto one or more photodetectors, which produce the encoder's output. An incremental encoder has one or more of these tracks, while an absolute encoder has as many tracks as it has output bits.

Incremental Disk

Absolute Disk



Linear Scale

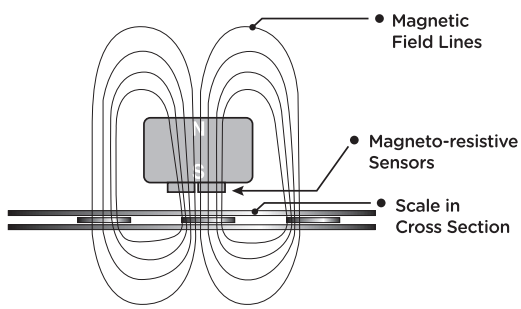
Magnetic Encoders

Magnetic sensing technology is very resistant to dust, grease, moisture, and other contaminants common in industrial environments, and to shock and vibration. There are several types of magnetic sensors.

Variable reluctance sensors detect changes in the magnetic field caused by the presence or movement of a ferromagnetic object. The simplest variable-reluctance rotary sensor, often called a magnetic pickup, consists of a coil wound around a permanent magnet. This generates a voltage pulse when a gear tooth moves past it. Rugged, reliable, and inexpensive, this sensor is used mostly to measure speed, as it does not work unless the target is moving past the sensor face at about 180 inches per second or faster.

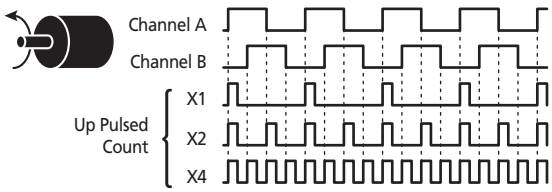
Another type of sensor uses a permanent magnet and a Hall effect or magnetoresistive device to produce a change in either voltage or electrical resistance in the presence of ferromagnetic material, which can be in the form of a gear tooth (in a rotary encoder) or a metal band with slots (in a linear encoder). This type of sensor will work down to zero speed, and is available in both rotary and linear forms.

Another type of magnetic sensor uses a magnetoresistive device to detect the presence or absence of magnetized "stripes", either on the rim of a drum or on a nonmagnetic strip.



Inductive Principle

Absolute vs. Incremental Coding



The difference between incremental and absolute encoders is analogous to the difference between a stop watch and a clock.
A stop watch measures the incremental time that elapses between its start and stop, much as an incremental encoder will provide a known number of pulses relative to an amount of movement. If you knew the actual time when you started the watch, you can tell what time it is later by adding the elapsed time value from the stop watch. For position control, adding incremental pulses to a known starting position will measure the current position.
When an absolute encoder is used, the actual position will constantly be transmitted, just as a clock will tell you the current time.

Incremental Coding

Incremental encoders provide a specific number of equally spaced pulses per revolution (PPR) or per inch or millimeter of linear motion. A single channel output is used for applications where sensing the direction of movement is not important. Where direction sensing is required, quadrature output is used, with two channels 90 electrical degrees out of phase; circuitry determines direction of movement based on the phase relationship between them. This is useful for processes that can reverse, or must maintain net position when standing still or mechanically oscillating. For example, machine vibration while stopped could cause a unidirectional encoder to produce a stream of pulses that would be erroneously counted as motion. The controller would not be fooled when quadrature counting is used.

When more resolution is needed, it's possible for the counter to count the leading and trailing edges of the pulse train from one channel, which doubles (×2) the number of pulses counted for one rotation or inch of motion. Counting both leading and trailing edges of both channels will give 4× resolution.

An incremental encoder's output indicates motion. To determine position, its pulses must be accumulated by a counter. The count is subject to loss during a power interruption or corruption by electrical transients. When starting up, the equipment must be driven to a reference or home position to initialize the position counters.

Some incremental encoders also produce another signal known as the "marker," "index," or "Z channel." This signal, produced once per revolution of a shaft encoder or at precisely-known points on a linear scale, is often used to locate a specific position, especially during a homing sequence.

Absolute Coding

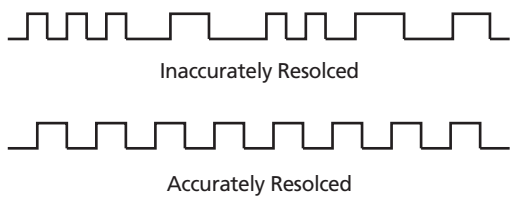
An absolute encoder generates digital words that represent the encoder's actual position, as well as its speed and direction of motion. If power is lost, its output will be correct whenever power is restored. It is not necessary to move to a reference position as with incremental type encoders. Electrical transients can only produce transient data errors, usually too brief to effect the dynamics of a control system.

An absolute encoder's resolution is defined as the number of bits in its output word. This output can be in straight binary or in gray code, which produces only a singlebit change at each step to reduce errors.

Single vs. Multi-Turn

In a single-turn encoder, the output codes are repeated for every revolution of the encoder's shaft. There is no data provided to indicate if the encoder had made one revolution—or 1000 revolutions. With multi-turn absolute encoders, the output is unique for each shaft position, through every rotation, up to 4096 revolutions.

Resolution and Accuracy



Resolution is the number of measuring segments or units in one revolution of an encoder shaft or one inch or mm of a linear scale. Shaft encoders are available with resolutions up to 10,000 pulses per revolution (PPR) directly, and 40,000 PPR by edge-Detection of the A and B channels, while linear encoders are available with resolutions measured in microns. The bottom line is, the selected encoder must have resolution equal to or better than that required by the application. But resolution is not the whole story.

Accuracy and resolution are different, and it is possible to have one without the other. This figure shows a distance X divided into 24 increments or "bits." If X represents 360° of shaft rotation, then one revolution has been resolved into 24 parts.

While there are 24 bits of resolution, the 24 parts are not uniform. This transducer could not be used to measure position, velocity or acceleration with any accuracy.

On the other hand, in this figure the distance X is
divided into 24 equal parts. Each increment represents exactly 1/24 of a revolution. This transducer operates with accuracy as well as resolution. Accuracy, however, can be independent of resolution. A transducer may have a resolution of only two parts per revolution, yet its accuracy could be ±6 arc seconds.

System Effects on Accuracy and Repeatability

System Accuracy : An encoder's performance is typically stated as resolution, rather than accuracy of measurement. The encoder may be able to resolve movement into precise bits very accurately, but the accuracy of each bit is limited by the quality of the machine motion being monitored. For example, if there are deflections of machine elements under load, or if there is a drive screw with 0.1 inch of play, using a 1000 count-per-turn encoder with an output reading to 0.001 inch will not improve the 0.1 inch tolerance on the measurement. The encoder only reports position; it cannot improve on the basic accuracy of the shaft motion from which the position is sensed.

Note : Given a particular machine design, some errors in measuring motion such as mechanical backlash and errors in leadscrews or gearing systems, can be electronically compensated by some of the more advanced motion controllers.

System Repeatability : Repeatability is the tolerance to which the controlled machine element can be repeatedly positioned to the same point in its travel. Repeatability is generally less than system resolution, but somewhat better than system accuracy. 10,000 pulses per turn can be generated from a 2500 cycle, twochannel encoder. Typically with a Dynapar encoder, this 4× signal will be accurate to better than ±1 count.

Encoder Communications

The output of an incremental encoder is a stream of pulses on one or two channels, while the output of an absolute encoder is a multi-bit word. This can be transmitted in either parallel or serial form.

Parallel Output

Parallel output makes all output bits available simultaneously. It may be provided as straight binary or transformed into gray code. Gray code produces only a single-bit change at each step, which can reduce errors. The table on page 6 shows an example of conversion between straight binary and gray code.

Some parallel-output encoders also can accept inputs from the outside—output latching commands, for example, and direction sense setting. The advantage of parallel output is that it's fast : all the data is available in real time, all the time. Disadvantages include bulky (and expensive) cables and limited cable length. Most encoders come with cables a meter or two long, but a parallel output using differential output and Flushcabling can be extended to 100 m using a thicker cable, at a reduction in speed. Open-collector (sinking or sourcing) outputs can go roughly a third that far.

Serial Output

The alternative to parallel output is to encode it and send it in serial form. There are several dedicated serial buses available, as well as standard industrial buses. Tradeoffs among these include bandwidth, update rate, hardware requirements, wire count, proprietary vs nonproprietary nature, and availability. The table below summarizes the major differences.

Decimal	Gray Code	Binary	Decimal	Gray Code	Binary
0	0000	0000	8	1100	1000
1	0001	0001	9	1101	1001
2	0011	0010	10	1111	1010
3	0010	0011	11	1110	1011
4	0110	0100	12	1010	1100
5	0111	0101	13	1011	1101
6	0101	0110	14	1001	1110
7	0100	0111	15	1000	1111

Dedicated Serial Interfaces				
	HIPERFACE®	SSI + Sine / Cos	EnDat®	BiSS
Open Protocol	No	No (License available)	No	Yes
Cable outlet	RS-485 : Bus or Point-to-Point Analog : Point-to-Point	Point-to-Point	Point-to-Point	Bus or Point-to-Point
Analog Signals Required	Yes	Yes	No	No
Transmission Mode (Digital)	Bidirectional, asynchronous	Unidirectional, synchronous	Bidirectional, synchronous	Bidirectional, synchronous
Digital Data Transmission Rate	38.4 kBaud	1.5 MHz	4 MHz	10 MHz
Cable Length Compensation	No	No	Yes	Yes
Protocol Length Adjustable	No	No	Yes	Yes
No. of Wires	8	6–8	6 to 12	6
Hardware Compatible	← →			
Alarm/Warning Bit	No	Definable	Yes	Definable

Technical Data
KACON Rotary Encoder Series

SSI® (Synchronous Serial Interface)

Synchronous Serial Interface is an all-digital point-to-point interface popular in Europe. It provides unidirectional communication at speeds up to 1.5 MHz and uses a four-wire cable (plus two wires for power).

Some encoders also provide a 1 V p-p sin/cos output for real-time control, since the on-demand absolute encoder data can come in too slowly for many control loops.

Data rate depends on both resolution and cable length, as shown.

Cable Length	Data Rate
50 m	400 kHz
100 m	300 kHz
200 m	200 kHz
400 m	100 kHz

EnDat®

EnDat (Encoder Data) is a proprietary protocol developed by Heidenhain. Like SSI, it is synchronous, with clock signals fed to the encoder by the controller. EnDat can carry more information than SSI, because it provides for internal memory in the encoder that can be read and written to by the controller. This data can include encoder diagnostics, identification, and alarm status. In addition, the controller can set the encoder's zero reference point, which aids in equipment setup. As with SSI, EnDat encoders transmit absolute position data on demand. Depending on version EnDat can include an analog 1 V p-p sin/cos output that electronics in the controller interpolate to derive incremental data for real-time control. EnDat uses a six- to twelve-conductor cable up to 150 m long,

HIPERFACE®

HIPERFACE is a proprietary protocol developed by Max Stegmann GmbH. It uses an eight-wire cable (two for data, two for power and four for 1Vp-p sin/cos) and has two channels : One carries 1 V p-p sin/cos incremental data, while the other is a bidirectional RS-485 link. Absolute position data is transmitted via the RS-485 link at power-up, and the system is incremental after that.

HIPERFACE can access the encoder's memory area for manufacturer's data, status, alarm information, and so on. In addition, the controller can write to certain memory areas, and can set the absolute zero position.

BiSS

BiSS (Bidirectional Synchronous Serial interface), is an open protocol and is the newest of the encoder interfaces. It takes a somewhat different path : BiSS sends full absolute position data whenever the controller polls the encoder, rather than just at startup. It allows easy recovery from momentary data dropouts during operation. Since it is an all-digital system, it eliminates the cost of A/D converters needed in drive systems that connect to encoders using some proprietary protocols. It is hardware-compatible with SSI, requiring only software changes.

BiSS uses four data lines, one pair carrying data from the encoder and one carrying clock data to it, plus two power conductors.

BiSS can address internal registers in the encoder that can be read by and written to by the master with data about the encoder itself (identification, device data, resolution, etc.). It can also carry other digital data (temperature, acceleration, etc.) and transmit it to the master on demand, without interfering with real-time operation.

BiSS, like HIPERFACE, can be connected either point-to-point or via a bus.

Industrial Bus Interfaces

Three general-purpose industrial buses are commonly used with encoders.

DeviceNet™

Based on the Controller Area Network (CAN), this system's basic trunkline-dropline topology provides separate twisted-pair wires for both signal and power distribution, enabling 24 VDC devices to be powered directly from the bus. End-toend network distance varies with data rate and cable size.

Profibus

This open communication standard developed by the European Community (European Common Standard EC50170), comes in two variations : FMS, which is used for upper level cell-to-cell communication, and Profibus DP, which is optimized for data transfer with local field devices like valves, drives and encoders. There are specific device profiles defined, including one for encoders. DP is good for applications that require high speed transmission of fairly large amounts of information (512 bits of input data and 512 bits of output data over 32 nodes in 1 ms).

Interbus®

Designed by Phoenix Contact in the mid '80s, Interbus is the longest-standing open industrial network. A true token ring topology, Interbus is actually divided into two buses. The remote bus is an RS-485 transmission medium with length capabilities up to 13 km. The local or peripheral bus enables Cable outlet of up to eight devices within a 10 m range.

Bus Network Comparison

	DeviceNet	Profibus	Interbus
Topology	Linear (trunkline/dropline)	Linear (trunkline/dropline)	Closed Loop
Communication System	Master/Slave	Multimaster (Producer/ Consumer)	Master/Slave
Data Exchange	Polled, Change of State, Cyclic	Polled	Polled
Max. Length	500 m	1200 m (w/ repeaters)	13 km
Max. Nodes	64	126	512
Data Packet	0–8 bytes	244 bytes	Flexible
Transmission Speed	125 Kbps @ 500 m 250 Kbps @ 250 m 500 Kbps @ 100 m	9.6 Kbps to 12 Mbps	500 Kbps
Transmission Media	2-wire twisted pair with 2-wire bus power cable w/drain wire	2-wire twisted pair w/shield	Local : 3-pair twisted w/drain Remote : 5-pair twisted w/drain

Applications

Linear/Straight-Line Measuring with Shaft Encoders

Through mechanical means, usually racks and pinions or leadscrews, rotary encoders can measure straight-line or linear motion. Calibrating the number of pulses per unit of measure involves selecting the proper transducer and may include a separate calibration step.

Measuring Length with Leadscrews

The relationship between resolution, lead screw pitch, and PPR is shown below.

$$\text{Resolution} = \frac{\text{Lead}}{\text{PPR}} = \frac{1}{\text{PPR} \times \text{Pitch}}$$

$$\text{PPR} = \frac{\text{Lead}}{\text{Resolution}} = \frac{1}{\text{Resolution} \times \text{Pitch}}$$

The table below shows some examples. Note that the PPR of an encoder can be doubled or quadrupled by counting the rising and falling edges of one or both output channels, so a 1000 PPR encoder with a 4× multiplication will act like a 4000 PPR encoder.

Encoder PPRs and Servo Resolutions for Typical Leadscrew Applications

Servo Resolution	Encoder PPR and Logic Multiplier		
	0.5-in. Lead (2 pitch)	0.25-in. Lead (4 pitch)	0.2-in. Lead (5 pitch)
0.0001 in.	1250 × 4	625 × 4	500 × 4
0.00005 in.	2500 × 4	1250 × 4	1000 × 4
0.0005 in.	250 × 4	250 × 2	200 × 2
0.00025 in.	500 × 4	250 × 4	200 × 4
0.0002 in.	625 × 4	625 × 2	500 × 2
0.001 mm	3175 × 4 (special)	3175 × 2	1270 × 4
0.002 mm	3175 × 2	3175 × 1	635 × 4
0.01 mm	635 × 2	635 × 1	508 × 1
0.005 mm	635 × 4	635 × 2	508 × 2

Examples :

1. An incremental encoder is required on a milling machine to provide a digital readout display. The display must read directly in ten thousandths of an inch. The travel is regulated by a 10-pitch precision leadscrew, which moves the bed 1/10th inch for every revolution of the leadscrew. Using the formulas,

$$\text{PPR} = \frac{1}{\text{Resolution} \times \text{Pitch}} = \frac{1}{0.0001 \times 10}$$

Alternatively,

$$\text{PPR} = \frac{\text{Lead}}{\text{Resolution}} = \frac{0.1}{0.0001} = 1000$$

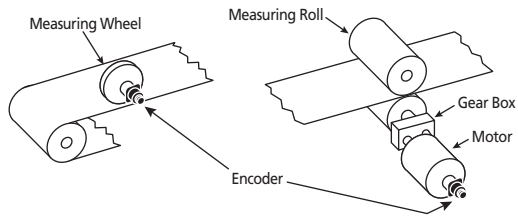
So the encoder must have 1000 PPR, whichever way we calculate it. If we like, we could also use a 500 PPR encoder with a 2× logic multiplier.

2. To measure 10 inches of travel to 0.01 inch resolution : Total count = 1000; Resolution = 0.01 inch. If the encoder makes one full turn over the total travel, a 1000 PPR encoder can satisfy this requirement. At full travel, the encoder and counter will read 9.99, which is within the stated tolerance of 0.01 inch.

Measuring Length with Wheels and Rolls

An encoder can also measure linear distance using a measuring wheel or roll. The table below gives the calibration constant, K, that must be set on the counter or tach readout in order to give the display resolution desired.

Examples :



TYPE 1 **TYPE 1**

Length	Application	
Display Resolution	Type 1 Measuring Wheel	Type 2 Measuring Roll
1 Foot	$K = \frac{C}{12N}$	$K = \frac{0.2618D}{GN}$
1 Inch	$K = \frac{C}{N}$	$K = \frac{3.1416D}{GN}$
0.1 Inch	$K = \frac{10C}{N}$	$K = \frac{31.416D}{GN}$
0.01 Inch	$K = \frac{100C}{N}$	$K = \frac{314.6D}{GN}$
1 Meter	$K = \frac{M}{N}$	$K = \frac{0.079796D}{GN}$
1 Decimeter	$K = \frac{10M}{N}$	$K = \frac{0.797966D}{GN}$
1 Centimeter	$K = \frac{100M}{N}$	$K = \frac{7.97966D}{GN}$
1 Millimeter	$K = \frac{1000M}{N}$	$K = \frac{79.796D}{GN}$
0.1 Millimeter	$K = \frac{10,000M}{N}$	$K = \frac{797.966D}{GN}$

Examples :

In a Type 2 application we wish to display feet to the nearest 1 foot.

From the table above :

$$K = \frac{0.2618D}{GN}$$

If G = 2.6, N = 1, D = 9.15,

$$K = \frac{0.2618 \times 9.15}{2.6 \times 1} = 0.92133$$

Ratio Calibration

In some cases, the desired display is the ratio of two inputs, A and B. This table shows how to calculate the calibration factor, K, for the A and B inputs to the counter to give the desired display resolution.

WHERE : G = Gear Ratio (increases rpm of encoder in relation to rpm of roll)
N = Encoder pulses per revolution
D = Roll diameter in inches
C = Measuring wheel circumference in inches

Ratio	Application	
Display Resolution	Type 1	Type 2
.001	$K = \frac{5C}{N}$	$K = \frac{15.708D}{GN}$
.0001	$K = \frac{50C}{N}$	$K = \frac{157.08D}{GN}$

Examples :

Assume that both inputs are Type 2 and you want a 0.001-in. display resolution.

Input A

$$K = \frac{15.708D}{GN}$$

K = 17.0 in
N = 12
G = 3.5

Input B

$$K = \frac{15.708D}{GN}$$

K = 19.2 in
N = 12
G = 2.8

Then :

$$K_A = \frac{15.708 \times 17.0}{12 \times 3.5} = 6.3580$$

$$K_B = \frac{15.708 \times 19.2}{12 \times 2.8} = 8.9760$$

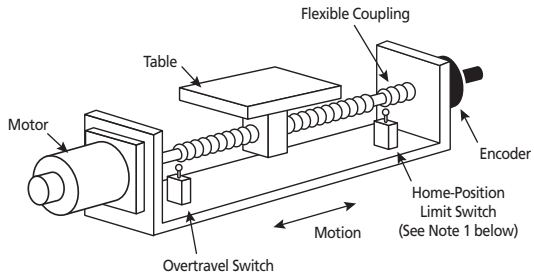
Establishing Reference Position

Reference Pulse

An incremental encoder's reference pulse (sometimes called a Marker or Index Pulse) occurs at a precisely-known point in a 360° revolution of a shaft encoder or along a linear scale. A unique position can be identified by using the reference- pulse output only, or by logically relating the reference pulse to the A and B data channels. Thus it is most frequently used in positioning and motion control applications as an electronic starting point of known position from which counting or position tracking begins.

In long travel or multiple turns of the encoder, the reference pulse is sometimes used by the control to initiate an electronic check on the total count received from the encoder. For example, each time a reference pulse is received by the control, the total count received from channels A and B should be an even multiple of the encoder's pulses per revolution.

Ballscrew Position Table Example



In motion control encoder applications, a PLC, CNC, or motion controller will usually command a sequence of moves with each axis of a positioning system to bring the table to the same starting position before beginning a task. The following is a typical automatic referencing and backlash compensation sequence for establishing a home position through the use of an encoder marker pulse.

1. If the Home Switch is open (indicating a position on the positive side of home) when the command is received, the axis is accelerated in the negative direction at the JOG ACCELERATION rate and moved at the FAST JOG VELOCITY until the Home Switch closes.

Note that a mechanical home-position limit switch is usually not repeatably accurate enough for this application. The encoder reference or proximity sensor has much greater repeat accuracy and is therefore a better reference point to establish a starting point for subsequent measurements. The home limit switch is used to signal the control that the next marker pulse signal received is "Home" in multi-turn encoder applications.

2. The axis is stopped at the JOG ACCELERATION rate.

3. The axis is accelerated in the positive direction at the JOG ACCELERATION rate and moved at the FAST JOG VELOCITY until the Home Switch opens.

4. The axis is accelerated in the negative direction at the JOG ACCELERATION rate and moved at the SLOW JOG VELOCITY until the Home Switch closes and an encoder marker pulse is sensed by the control (in that order).

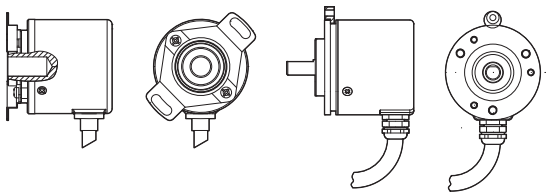
5. The axis is stopped at the JOG ACCELERATION rate.

Transducer Operating Speed

All transducers have inherent mechanical and electronic speed limitations, and exceeding them may result in incorrect data or premature failure. The maximum operating speed for a given application will be the maximum electronic operating speed of the encoder and the electronics to which it is connected, or the encoder's maximum mechanical RPM specification, whichever is less.

Mechanical Installation

Encoders are available in (below, l to r) shaft, hub shaft, and hollow shaft configurations.



The method of coupling the encoder to the machine is important because of possible errors or stresses which can be introduced. Take care not to exceed the rated shaft loading, both radial and axial.

Common causes of difficulty are end thrust, misalignment, and belt or gear thrust. Backlash or modulation in the coupling can cause errors in position indication. The smallest misalignment can result in high radial loads, which lead to premature bearing failure. To prevent this, use a flexible coupling that compensates for the misalignment between the shaft of the encoder and the machine. Generally, the greater the misalignment, the quicker the coupling will fail. When selecting the coupling determine how long it will last under operating misalignment, and the effect of this misalignment on shafts and bearings. This will yield better results than just choosing a coupling solely on the basis of how much misalignment it will take. A coupling will last indefinitely if there is no misalignment.

Encoders usually require a precision instrument coupling to prevent errors caused by backlash and to prevent damage to shaft and bearings. Specifically, do not use fingered motor couplings with rubber spacers.

Timing Belts

Use Series XL timing belts. Reliable long-life encoder performance is achievable provided the belt is installed in accordance with the manufacturer's instructions.

Belt Tension : The belt's positive grip eliminates the need for high initial tension. A properly tensioned belt will last longer, cause less wear on encoder bearings, and operate more quietly.

General Precautions

For precautions on individual products, refer to the Safety Precautions in individual product information.

⚠ WARNING

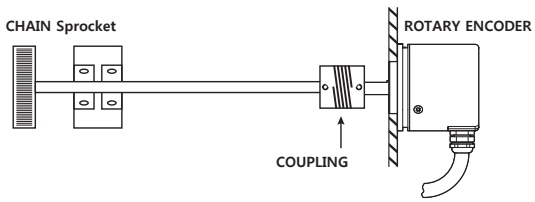
- These products cannot be used in safety devices for presses or other safety devices used to protect human life.
- These products are designed for use in applications for sensing workpiecs and workers that do not affect safety.

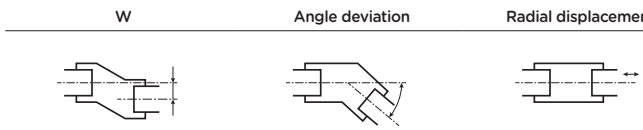
Precautions for Safe use

- To ensure safety, always observe the following precautions.

Precaution for Safe use

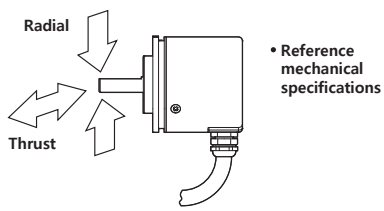
The Rotary Encoder consists of high-precision components. Dropping the Encoder may damage it. Exercise sufficient caution when handling the Encoder. Do not allow water or oil to splash on the Encoder. When connecting with a chain timing belt and gears, hold the shaft with a bearing and use a coupling to join to the Encoder.



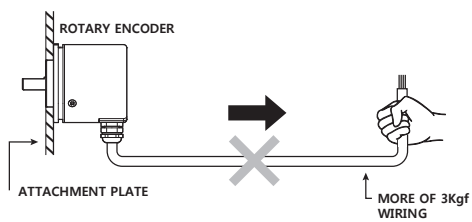


When using a coupling, do not exceed the following permitted values.

Make sure that an excessive load is not placed on the shaft when the gears engage.



When inserting the coupling into the shaft, do not tap it with a hammer or apply any other type of shock.
When attaching or detaching the coupling, do not bend, compress, or pull excessively on the coupling.
If connecting the cable after securing the Encoder, do not pull on the cable. Also do not apply shock to the Encoder or shaft.



When extending the cable, check the cable type and response frequency. Wire resistance and capacitance between wires may amplify residual voltage and cause waveform distortions.
If the cable is extended, it is recommended to use a line-driver output. Regardless of the output type, only lengths of 30 m or less.
To avoid inductive noise, keep the cabling as short as possible (particularly when inputting to an IC).

When the cable length is extended, the output waveform startup time is lengthened and it affects the phase difference characteristics of phases A and B.

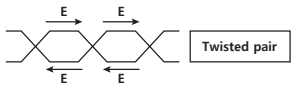
Extending the cable length not only changes the startup time, but also increases the output residual voltage.

Preventing Counting Errors

Spurious pulses due to vibration may cause counting errors if the shaft is stationary near the rise or fall of the signal.
Using an up/down counter can prevent the counting of error pulses.

Extending the Cable When Using a Line-driver Output

Be sure to use shielded twisted-pair cable when extending the cable for a line-driver output,
and use an RS-422A Receiver for the receiver side.
The structure of twisted-pair cable is suitable for RS422 transmission. By twisting the two outputs as shown in the following diagram, electromotive force occurring in the wires is reciprocally canceled, and the noise element of normal mode is eliminated.



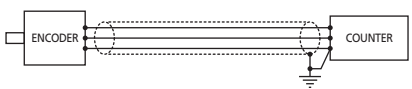
When using a line-driver output, a power supply of 5 VDC is needed for the Encoder.
The voltage will drop approximately 1 V per 100 m of cable.

Wiring Instruction

The most frequent problems encountered in transmitting an encoder's signal(s) to the receiving electronics are signal distortion and electrical noise. Either can result in gain or loss of encoder counts. Many problems can be avoided with good wiring and installation practices. The following descriptions and recommendations are presented as general guidelines and practices for field-installed equipment.

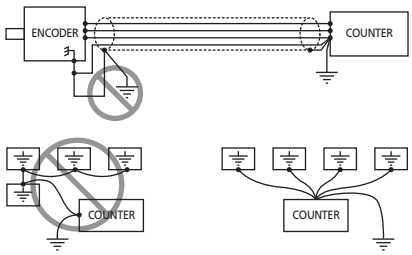
Protecting Signals from Radiated and Conducted Noise

Take reasonable care when connecting and routing power and signal wiring on a machine or system. Radiated noise from nearby relays (relay coils should have surge suppressors), transformers, other electronic drives, etc. may be induced into the signal lines causing undesired signal pulses. Likewise, the encoder may induce noise into sensitive equipment lines adjacent to it.

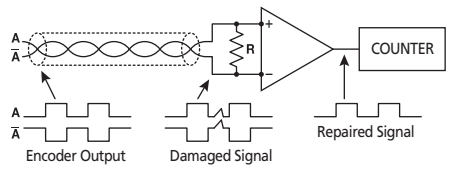


Route machine power and signal lines separately. Signal lines should be Flush, twisted and routed in separate conduits or harnesses spaced at least 12 inches from power leads. Power leads are defined here as transformer primary and secondary leads, motor armature leads and any 120 VAC or above control wiring for relays, fans, thermal protectors, etc.

Maintain continuity of wires and shields from the encoder through to the controller, avoiding the use of terminals in a junction box. This helps to minimize radiated and induced noise problems and ground loops.



In addition, operation may be influenced by transients in the encoder power supply. Typically, encoder power should be regulated to within ±5%, and it should be free of induced transients.



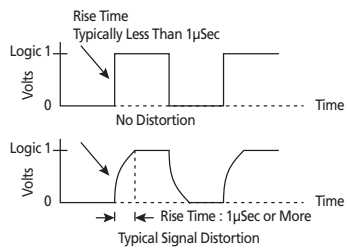
Signal distortion can be eliminated by complementary encoder signals (line drivers), used with differential receivers (line receivers or comparators) at the instrument end, as shown here.

Grounding requirements, conventions and definitions are contained in the National Electrical Code. Local codes will usually dictate the particular rules and regulations that are to be followed concerning system safety grounds.

Signal Distortion

The majority of signal transmission problems involve electrical noise. Severity of the problem increases with transmission distance. Good shielding practice, as described previously, should be observed.

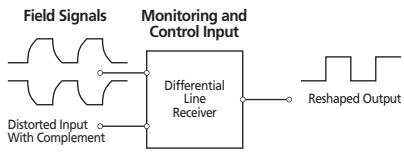
The primary cause of signal distortion is cable length, or more specifically, cable capacitance.



Generally, the receiving electronics will respond to an input signal that is either logical "0" or logical "1". The region between logical 0 and logical 1 is undefined, and the transition through this region must be very rapid (less than about 1 microsecond). As the leading edge of the waveform is distorted, the transition time increases. At some point, the receiver becomes unstable and encoder counts may be gained or lost.

To minimize distortion, low capacitance cable (typically less than 40 picofarads per foot) should be used. The longer the cable, the greater the potential for signal distortion. Beyond some cable length, the signal must be "reshaped" before it can be used reliably.

Squarewave distortion is not usually significant for cable lengths less than about 50 feet (capacitance up to about 1000 picofarads). Encoders supplied with differential line drivers are recommended for applications with cable length requirements of hundreds of feet.



Greater assurance of signal integrity is best achieved when an encoder with line driver outputs is used in conjunction with a line receiver.

Micro Switch

Z15 Series

Part Number Description

Z15 - ❶ ❷ B

❶ Description	G : Standard	H : High Sensitive (Only 060, 08)		
❷ Head Type	01 : Push Plunger	010 : Pin Push Plunger	10 : Short Push Plunger	03 : Long Push Plunger
	030 : Roller Plunger	031 : Cross Roller Plunger	05 : Lever	052 : Roller Lever
	063 : Hinge Short Lever	062 : Hinge Short Lever	061 : Hinge Long Lever	06 : Hinge Long Lever
	060 : Hinge Long Lever (Only H)	08 : Hinge Long Lever (Only H)	09 : Hinge Roller Short Lever	091 : Cross Hinge Roller Short Lever
	092 : Directional Roller Lever	07 : Hinge Roller Long Lever	73 : Hinge Roller Long Lever (Plastic Roller)	

General Specification

Contact Form			1N/O + 1N/C				
Contact Material			Ag alloy				
Contact & Contact Distance			Z15G : 0.5mm		Z15H : 0.25mm		
Insulation Resistance			100MΩ 500VDC				
Contact Resistance			Max. 50mΩ				
Coatact Ratings	Non-Inductive	Resistance Load		15A(10) 125VAC 15A(10) 250VAC 10A 500VAC		15A 8VDC 15A 14VDC 6(2)A 30VDC	0.5A 125VDC 0.25A 250VDC
			Norminal Open (N/O)			Norminal Close (N/C)	
		Lamp Load	1.5A 125VAC 1.25A 250VAC 0.75A 500VAC	1.5A 8VDC 1.5A 14VDC 1.5A 30VDC	0.5A 125VDC 0.25A 250VDC	3A 125VAC 2.5A 250VAC 1.5A 500VAC	3A 8VDC 3A 14VDC 3A 30VDC	0.5A 125VDC 0.25A 250VDC
	Inductive	Inductive Load		15(10)A 125VAC 15(10)A 250VAC 6A 500VAC		15A 8VDC 10A 14VDC 5(1)A 30VDC 0.05A 125 VDC 0.03A 250VDC		
			Norminal Open (N/O)			Norminal Close (N/C)		
		Motor Load	2.5A 125VAC 1.5A 250VAC 0.75A 500VAC	2.5A 8VDC 2.5A 14VDC 2.5(1)A 30VDC	0.05A 125VDC 0.03A 250VDC	5A 125VAC 3A 250VAC 1.5A 500VAC	5A 8VDC 5A 14VDC 5(1)A 30VDC	0.05A 125VDC 0.03A 250VDC
Maximum Inrush Current			Norminal Open (N/O)			Norminal Close (N/C)		
			15A			30A		

- The values in the blanks are ratings of Z15H type switch. The Z15H type switch has AC ratings of 125 V and 250 V.
- The aforementioned values are steady-state current values.
- The inductive load has a power factor of 0.4 or more (AC), and a time constant of 7m/s or less (DC).
- The inrush current is ten times larger than steady-state current in the lamp load, and six times, in the motor load.

Operating Speed		0.01mm/sec ~ 0.5m/sec
Dielectric Strength		2000VAC 1 Minute
Life Cycle	Electrical	Min. 500,000
	Mechanical	Min. 20,000,000
Vibration Resistance		10Hz ~ 55Hz Durable amplitude 1.5mm
Shock Resistance	Malfunctional	Max. 30G
	Destruction	Max. 100G
Ambient Temperature		-25°C ~ +80°C(with no icing)
Ambient Humidity		35% ~ 85% RH
Tightening Torque		1.2N·m (12.24kgf·cm)

☞ This is the case for the push-button type (The values are for the actuator for the lever type).
In the types other than the push-button type, the mechanical life is 10 million times, and the operating error is 1 ms or less.

Detection

Micro Switch

Z15 Series

Product Selection

	Part Number	Head Type	OF	RF	PT	OT	ME	MD	FD	OP	KS
	Z15G - 01B	Push Plunger	250 ~ 350gf (2.45 ~ 3.43N)	114gf (1.12N)	0.4 mm	0.13 mm		0.05 mm		15.9 ± 0.4 mm	Z4G1P01B
	Z15G - 010B	Pin Push Plunger	250 ~ 350gf (2.45 ~ 3.43N)	114gf (1.12N)	0.4 mm	0.16 mm		0.05 mm		28.2 ± 0.5 mm	Z4G1P03B
	Z15G - 10B	Short Push Plunger	250 ~ 350gf (2.45 ~ 3.43N)	114gf (1.12N)	0.4 mm	0.16 mm		0.05 mm		21.5 ± 0.5 mm	Z4G1P09B
	Z15G - 03B	Long Push Plunger	250 ~ 350gf (2.45 ~ 3.43N)	114gf (1.12N)	0.4 mm	5.5 mm		0.05 mm		21.8 ± 0.8 mm	Z4G1P05B
	Z15G - 030B	Roller Plunger	250 ~ 350gf (2.45 ~ 3.43N)	114gf (1.12N)	0.4 mm	3.58 mm		0.05 mm		33.4 ± 1.2 mm	Z4G1P07B
	Z15G - 031B	Cross Roller Plunger	250 ~ 350gf (2.45 ~ 3.43N)	114gf (1.12N)	0.4 mm	3.58 mm		0.05 mm		33.4 ± 1.2 mm	

Product Selection

	Part Number	Head Type	OF	RF	PT	OT	ME	MD	FD	OP	KS
	Z15G - 05B	Lever	141 gf (1.38N)	14gf (0.14N)		1.6 mm		1.3 mm	20.6 mm	17.4 ± 0.8 mm	Z4G1R01B
	Z15G - 052B	Roller Lever	141 gf (1.38N)	14gf (0.14N)		1.6 mm		1.3 mm	31.8 mm	28.6 ± 0.8 mm	Z4G1R03B
	Z15G - 063B	Hinge Short Lever	160 gf (1.57N)	28gf (0.27N)		2.0 mm		1.0 mm	24.8 mm	19.0 ± 0.8 mm	Z4G1R05B
	Z15G - 062B	Hinge Short Lever	95 gf (0.95N)	18gf (0.18N)		4.2 mm		0.95 mm	26.2 mm	19.0 ± 0.8 mm	
	Z15G - 061B	Hinge Long Lever	80gf (0.78N)	15.5gf (0.15N)		4.8 mm		1.12 mm	27.2 mm	19.0 ± 0.8 mm	
	Z15G - 06B	Hinge Long Lever	70gf (0.69N)	14gf (0.14N)		5.6 mm		1.27 mm	28.2 mm	19.0 ± 0.8 mm	Z4G1L01B

Micro Switch

Z15 Series

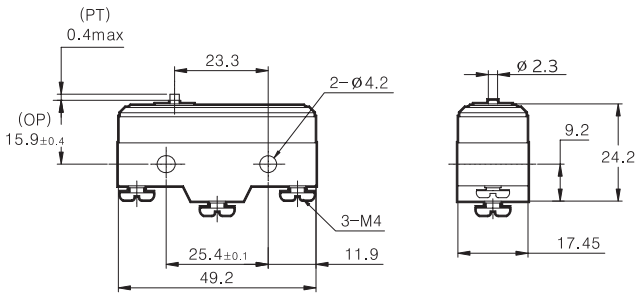
Product Selection

	Part Number	Head Type	OF	RF	PT	OT	ME	MD	FD	OP	KS
	Z15H - 060B	Hinge Long Lever	6gf (58.8 mN)	0.5gf (4.90N)	19.8 mm	10.0 mm		2.0 mm		19.8 ± 1.6 mm	
	Z15H - 08B	Hinge Long Lever	4gf (39.2N)	0.3gf (2.94N)	10.0 mm	6.0 mm		3.0 mm		20.0 ± 1.0 mm	Z4G1P05B
	Z15G - 09B	Hinge Roller Short Lever	160gf (1.57N)	42g (0.41N)		2.4 mm		0.5 mm	32.5 mm	30.2 ± 0.4 mm	Z4G1L07B
	Z15G - 091B	Cross Hinge Roller Short Lever	170gf (1.67N)	42gf (0.41N)	2.4 mm	0.51 mm			33.3 mm	31.0 ± 0.4 mm	
	Z15G - 092B	Directional Roller Lever	170 gf (1.67N)	42gf (0.41N)	2.4 mm	0.51 mm			43.6 mm	41.3 ± 0.8 mm	
	Z15G - 07B	Hinge Roller Long Lever	100 gf (0.98N)	22gf (0.22N)	4.0 mm	1.02 mm			36.5 mm	30.2 ± 0.8 mm	Z4G1L03B
	Z15G - 073B	Hinge Roller Long Lever (Plastic Roller)	100 gf (0.98N)	21gf (0.21N)	4.0 mm	1.6 mm			47.5 mm	41.2 ± 0.8 mm	

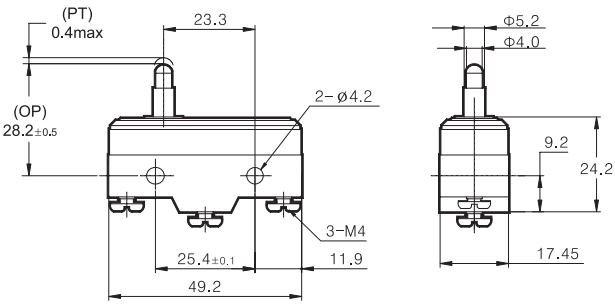
Dimension

(mm)

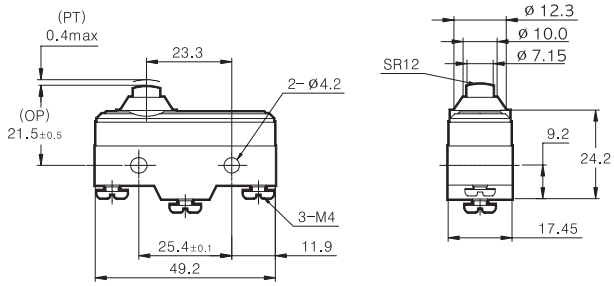
Z15G - 01B



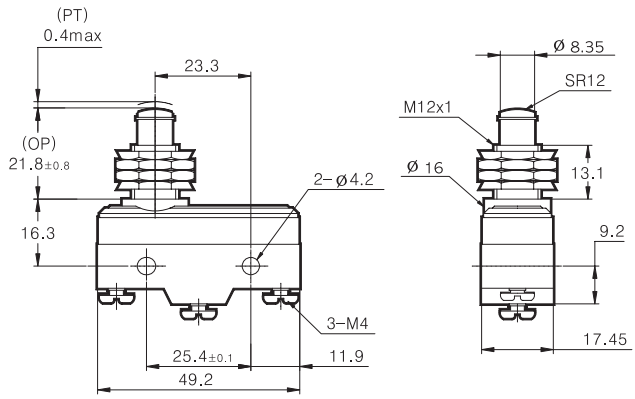
Z15G - 010B



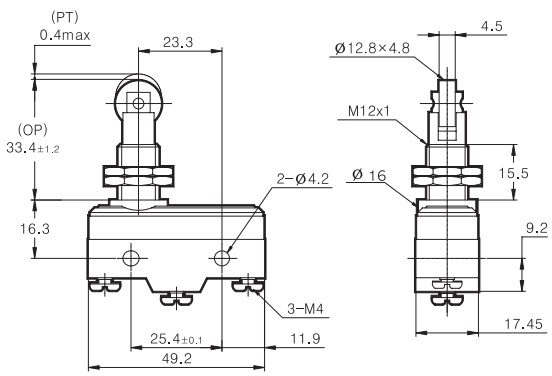
Z15G - 10B



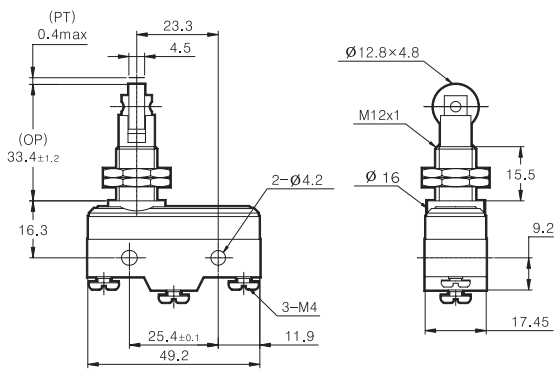
Z15G - 03B



Z15G - 030B



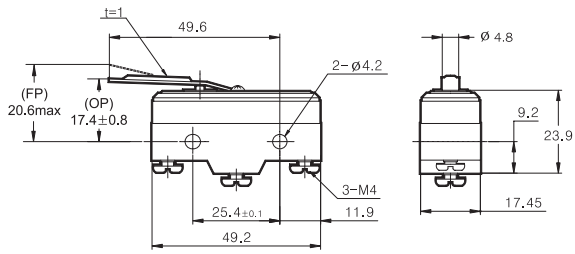
Z15G - 031B



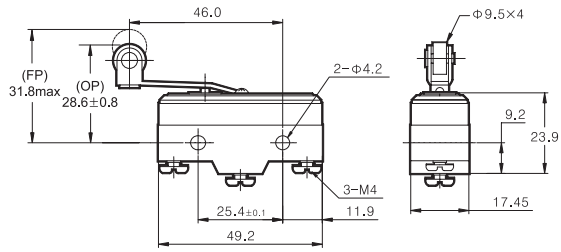
Dimension

(mm)

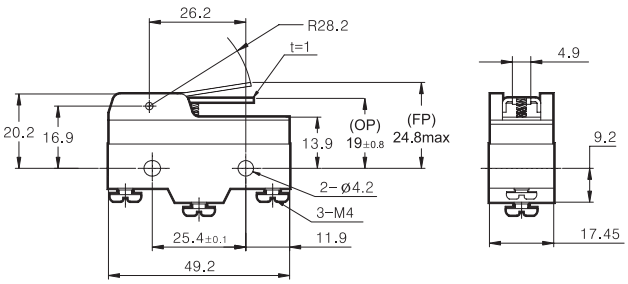
Z15G - 05B



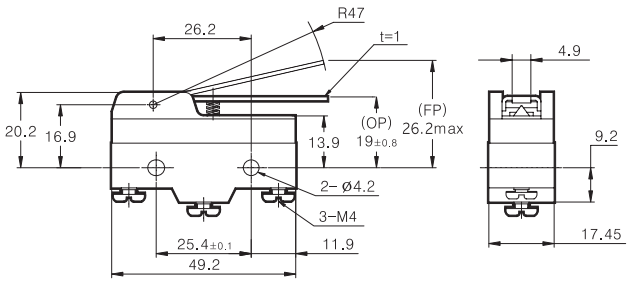
Z15G - 052B



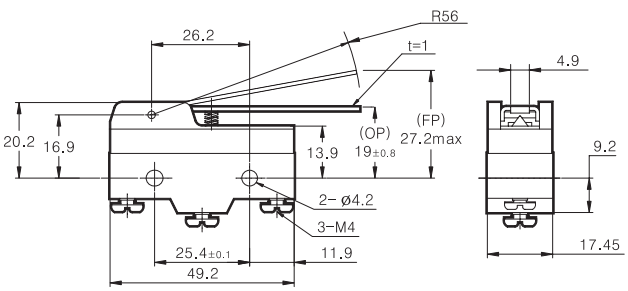
Z15G - 063B



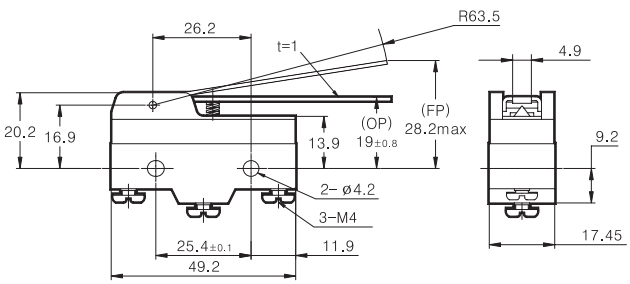
Z15G - 062B



Z15G - 061B

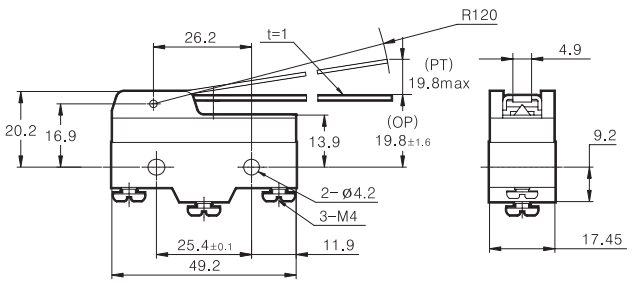


Z15G - 06B

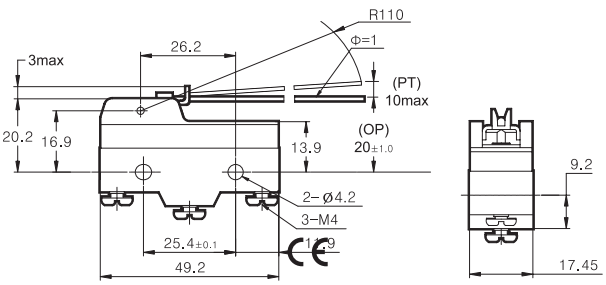


Dimension

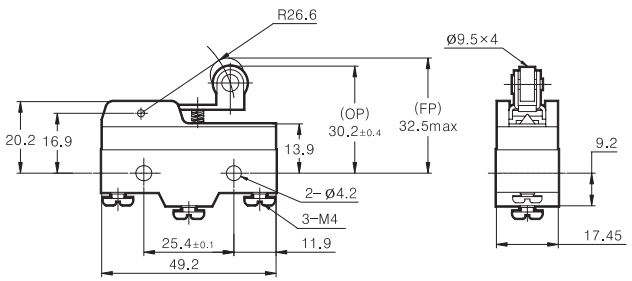
Z15H - 060B



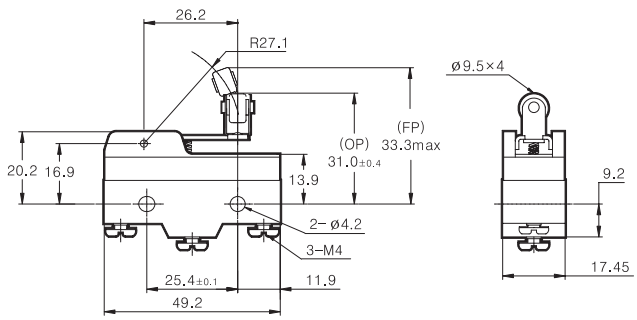
Z15H - 08B



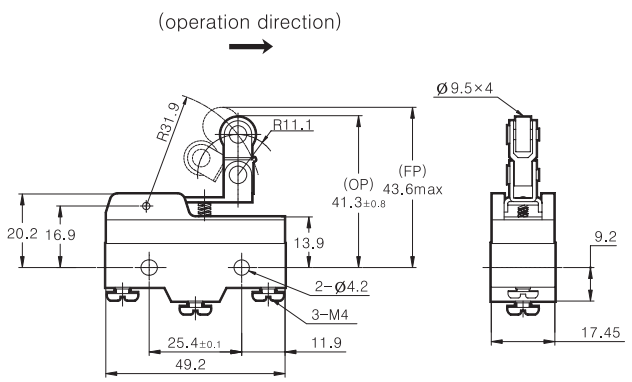
Z15G - 09B



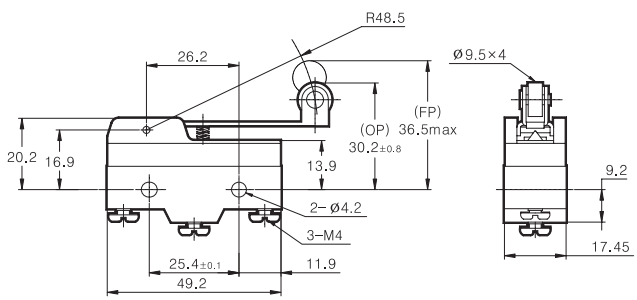
Z15G - 091B



Z15G - 092B



Z15G - 07B



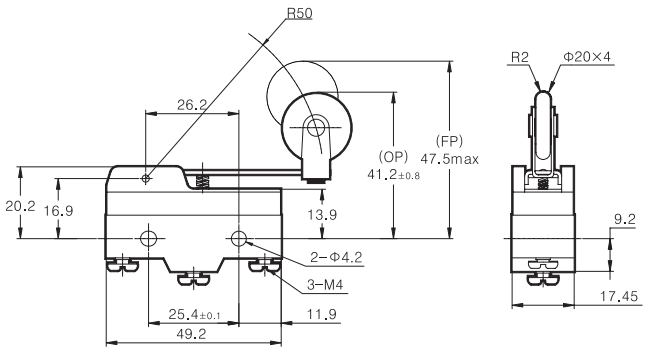
Micro Switch

Z15 Series

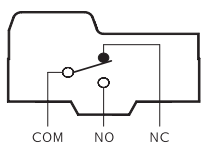
Dimension

(mm)

Z15G-073B

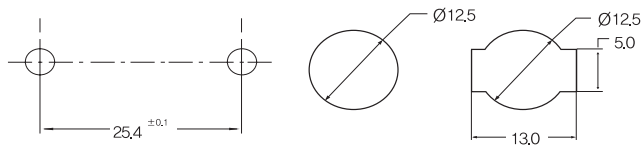


Diagram

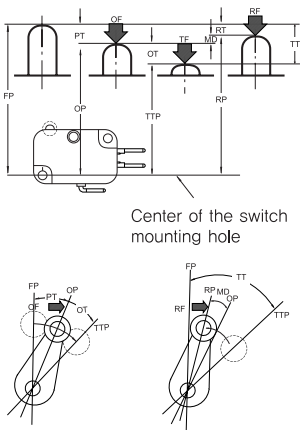


COM : Common Terminal
NO : Norminal Open Terminal
NC : Norminal Close Terminal

Panel Cut Out



Glossary

Operating characteristics	Category	Abbr.	Term	Unit	Definition
	Force	Force required for operation	OF	g, kg g-mm	Force on the actuator required for the motion from the free position to the operating position
		Restoring force	RF	g, kg g-mm	Force on the actuator required for the motion from the operating limit position to the restoring position
		Force required for entire motion	TF	g, kg g-mm	Force on the actuator required for the motion from the operating position to the operating limit position
	Motion	Motion to the operating position	PT	mm, deg	Distance or angle from the free position of the actuator to the operating position
		Motion after operation	OT	mm, deg	Distance or angle from the operating position of the actuator to the operating limit position
		Hysteresis distance	MD	mm, deg	Distance or angle from the operating position of the actuator to the restoring position
		Total motion	TT	mm, deg	Distance or angle from the free position of the actuator to the operating limit position
	Position	Free position	FP	mm, deg	The position of the operating part when no force is applied from outside
		Operating position	OP	mm, deg	The position of the actuator when the external force is applied to the actuator and the moving contact reverses from the free position
		Restoring position	RP	mm, deg	The position of the actuator when the external force to the actuator is reduced and the moving contact reverses from the operating position to the free position
		Operating limit position	TTP	mm, deg	The position of the actuator when the actuator reaches the actuator stop position

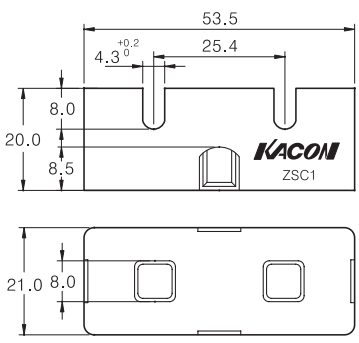
Center of the switch mounting hole

Option

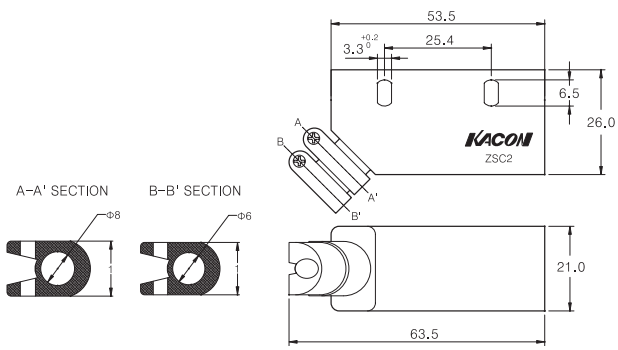
(mm)

SAFETY COVER

ZSC1



ZSC2



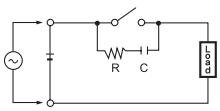
Micro Switch
Z15 Series

Electrical Caution

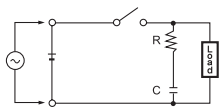
● **Electrical conditions**
- •Check the rating because the contact has different breaking capacities for AC and DC.
- •For microvoltage and microcurrent, use the contact for microload.
- •Check the inrush current, steady-state current and inrush time.
- •Measure the contact resistance at DC 6 V ~ DC 8 V and 1A
  (Comply with the voltage drop method for the microcurrent).
- •The difference between the steady-state current and inrush current may vary according to the load type. Check the inrush current value.

● **The ratings are based on the following conditions.**
- •Inductive load: power factor 0.4 or more (AC), time constant 7 ms or less (DC)
- •Lamp load: Inrush current≥10× Steady-state current
- •Motor load: Inrush current≥6× Steady-state current

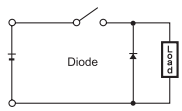
● **Notes for the circuit**
- •In the inductive load breaking circuit, the surge and inrush current at the opening/closing of the circuit may cause contact problems.
  Therefore, it is desirable to insert a protection circuit as follows.



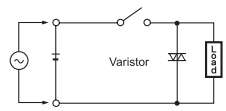
Normally used for DC circuits.
A resistor of several ohms is required.
When used for AC circuit, the load must be small.
R: 10 Ω ~ 100 Ω
C: 0.05 ~ 0.1 uF



Used both for AC and DC circuits.
R: 10 Ω
C: 0.1 ~ 0.2 uF

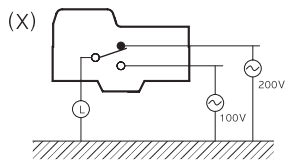


Used only for DC circuits.
Select a diode with sufficient margin to the inverse withstand voltage.



Used both for AC and DC circuits.
Select a varistor that is 1.5 times higher than the power supply voltage.

- •Do not connect different polarities and types of power to one switch contact.
- •Do not apply the voltage between contacts (This causes the mixed contact and contact weld)



● **Application to the electronic circuits (low voltage and current)**

1.The micro switch generates bouncing and chattering between contacts when it is switched on/off.
This causes troubles, including noises and wrong pulses, to the electronic circuits or acoustic devices.

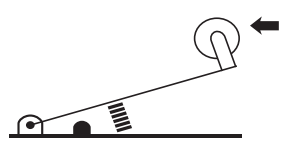
2.When bouncing and chattering cause problems, studies are required to provide an absorption circuit in addition to the CR circuit.

3.In the areas that require high contact reliability, the Ag contacts, which have been widely used, are hardly used.
Au contacts have high performances for microvoltage and microcurrent.

Mechanical Caution

● **Mechanical conditions**
- •Select the actuator according to the operating method.
- •Do not apply excessive force to the actuator.
- •Check the switching speed and frequency.
  1) If the switching speed is too slow and unstable, poor contact or contact weld may occur.
  2) If the switching speed is too high, switching may not be completed.

● **Precautions**
- •The operating method, cam or dog type, frequency, motion after switching significantly influence the prodvvuct life and accuracy. Use the cams or dogs that have general shapes.
- •Do not allow the load to one side of the switch actuator, and prevent the partial wear.
- •Adjust the actuator so that it does not pass beyond OT.
  The proper operating stroke is 70% ~ 100 % of the standard OT.
- •If OT passes beyond the limit, it may cause failure.
- •Use the switch considering the characteristics of the actuator.
  In the case of the roller arm lever, do not apply force in the arrowed direction in the figure.
- •Avoid the modification of the operating position by processing the actuator.

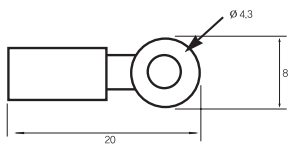


Mounting Caution

● **Environment**
- •If the switch is not waterproof and sealed, do not use the product in the environment where oil or water scatters or bursts. Use the protective cover to avoid direct exposure to the liquid. A limit switch is more proper for this case than the standard switch.
- •Contact us when using the limit switch outside or with special cutting oil so that the deterioration of the switch material is expected.
- •Place the switch on the place where it is not directly exposed to the processing waste or dusts. Protect the actuator and switch body from the cutting waste or foreign matters.
- •Do not use the switch in the temperature and air conditions other than specified. The allowable ambient temperature varies according to the product type (Check the product specifications). In the case of abrupt thermal change, the heat impact deforms the switch and causes failure.
- •When mounting the switch in the place where operating errors or accidents may happen in the normal operator or equipment conditions, additional measures are required.

● **The panel mounting type**
- •Use M4 screws for fixing. Mount the product firmly using flat or spring washers. The proper tightening torque is 12 ~ 15 kgf·cm (1.18 ~ 1.47 N·m).
- •The proper tightening torque for the hexagonal nut of the actuator is 50 kgf·cm (4.9 N·m).
- •When mounting the panel mounting pushbutton type on the side using screws, remove the hexagonal nuts from the actuator part.
- •For the connection with lead terminals, use crimp terminals at a tightening torque of 8 ~ 12 kgf·cm (0.78 ~ 1.18 N·m). (Recommended wire spec.: VCT 1.25 mm^2 twowire, three-wire)

● **The drip-proof type**
- •Do not soak the product in oil because this product is not completely oil-tight.
- •Avoid using this product in the condition where temperature abruptly changes.



☞ Specifications and materials can change without prior notice.

Micro Switch

V Series

Part Number Description

V ❶ 15F - ❷ C

❶ Description	No mark : Standard	V : Special (Only 01)		
❷ Head Type	01 : Push Plunger	06 : Lever	070 : Round Lever	060 : Long Lever
	07 : Roller Long Lever	08: Short Lever	09 : Roller Short Lever	

VAP - ❶ ❷

❶ Button Size	10 : Ø10	13 : Ø13	18 : Ø18	
❷ Button Color	R : Red	G : Green	Y : Yellow	K : Black

General Specification

Contact Form			1N/O + 1N/C		
Contact Material			Ag alloy		
Contact & Contact Distance			0.5mm		
Insulation Resistance			100MΩ 500VDC		
Contact Resistance			50mΩ		
Contact Ratings			Norminal Open		Norminal Close
	Non-Inductive	Resistive Load	15A 125VAC 10A 250VAC	10A 8VDC 5A 14VDC 2A 30VDC 0.5A 125VDC 0.25A 250VDC	15A 125VAC 15A 250VAC	15A 8VDC 15A 14VDC 10A 30VDC 0.6A 125VDC 0.3A 250VDC
		Lamp Load	1.5A 125VAC 1.0A 250VAC	1.5A 8VDC 1.5A 14VDC 1.0A 30VDC 0.1A 125VDC 0.05A 250VDC	3A 125VAC 2A 250VAC	4A 8VDC 4A 14VDC 4A 30VDC 0.1A 125VDC 0.05A 250VDC
	Inductive	Inductive Load	10A 125VAC 6A 250VAC	8A 8VDC 4A 14VDC 1.5A 30VDC 0.05A 125VDC 0.03A 250VDC	10A 125VAC 10A 250VAC	10A 8VDC 10A 14VDC 6A 30VDC 0.6A 125VDC 0.3A 250VDC
		Motor Load	2A 125VAC 1A 250VAC	2.5A 8VDC 2.5A 14VDC 1.5A 30VDC 0.05A 125VDC 0.04A 250VDC	4A 125VAC 3A 250VAC	6A 8VDC 6A 14VDC 4A 30VDC 0.1A 125VDC 0.05A 250VDC
Minimum Inrush Current			Norminal Open 15A		Norminal Close 30A	

•The aforementioned values are steady-state current values.
•The inductive load has a power factor of 0.4 or more (AC), and a time constant of 7 m/s or less (DC).
•The inrush current is ten times larger than steady-state current in the lamp load, and six times, in the motor load.

Operating Speed		0.1mm/sec ~ 0.5m/sec
Dielectric Strength		1,500VAC 1 Minute
Life Cycle	Electrical	Min. 100,000
	Mechanical	Min. 1,000,000
Vibration Resistance		10 ~ 55Hz(durable amplitude 1.5mm)
Shock Resistance		30G
Ambient Temperature		-25°C ~ +80°C (with no icing)Z
Ambient Humidity		35% ~ 80% RH

☞ The material and the specification of the product can be changed without notice for better quality.

Product Selection

	Color	Part Number	Contact Form	Contact & Contact Distance	PT	MD	OT	OP
	Black	V15F - 01C	1N/O + 1N/C	0.5 mm	1.7 mm Maximum	0.4 mm Maximum	0.8 mm Minimum	14.7 ± 0.6 mm
	Black	V15F - 06C	1N/O + 1N/C	0.5 mm	3.2 mm Maximum	1.2 mm Maximum	1.2 mm Minimum	15.3 ± 1.2 mm
	Black	V15F - 070C	1N/O + 1N/C	0.5 mm	3.2 mm Maximum	1.2 mm Maximum	1.2 mm Minimum	15.5 ± 1.2 mm
	Black	V15F - 060C	1N/O + 1N/C	0.5 mm	7.5 mm Maximum	2.2 mm Maximum	2.2 mm Minimum	15.3 ± 2.6 mm
	Black	V15F - 07C	1N/O + 1N/C	0.5 mm	3.2 mm Maximum	1.2 mm Maximum	1.2 mm Minimum	20.7 ± 1.2 mm
	Black	V15F - 08C	1N/O + 1N/C	0.5 mm	1.6 mm Maximum	0.5 mm Maximum	0.8 mm Minimum	15.3 ± 0.8 mm
	Black	V15F - 09C	1N/O + 1N/C	0.5 mm	1.6 mm Maximum	0.5 mm Maximum	0.8 mm Minimum	20.7 ± 0.8 mm
	Black	VV15F - 01C	1N/O + 1N/C	0.5 mm	1.6 mm Maximum	0.4 mm Maximum	0.8 mm Minimum	14.7 ± 0.6 mm

Micro Switch

V Series

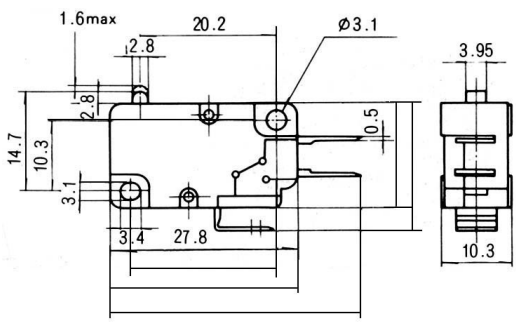
Product Selection

	Button Color	Part Number	Contact Form	Contact & Contact Distance	PT	MD	OT	OP
	Red Green	VAP - 10R VAP - 10G	1N/O + 1N/C	0.5 mm	1.6 mm Maximum	0.4 mm Maximum	0.8 mm Minimum	14.7 ± 0.6 mm
	Red Green Yellow Blue Black	VAP - 13R VAP - 13G VAP - 13Y VAP - 13B VAP - 13K	1N/O + 1N/C	0.5 mm	1.6 mm Maximum	0.4 mm Maximum	0.8 mm Minimum	14.7 ± 0.6 mm
	Red Green Yellow Blue Black	VAP - 18R VAP - 18G VAP - 18Y VAP - 18B VAP - 18K	1N/O + 1N/C	0.5mm	1.6 mm Maximum	0.4 mm Maximum	0.8 mm Minimum	14.7 ± 0.6 mm

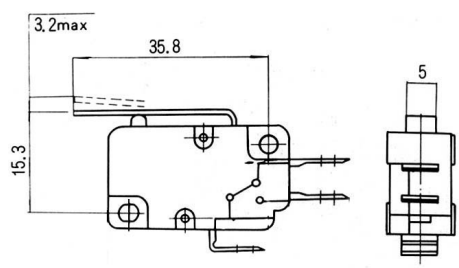
Dimension

(mm)

V15F - 01C



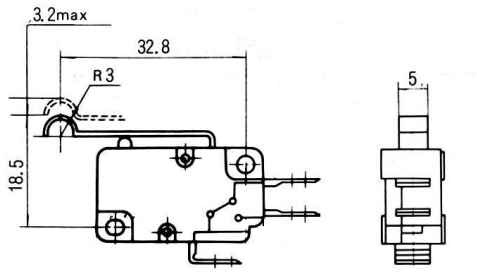
V15F - 06C



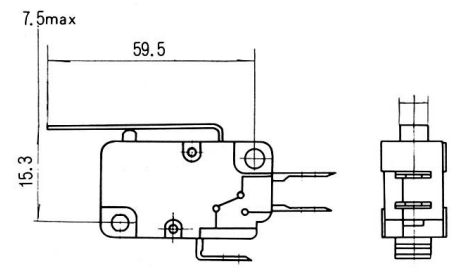
Dimension

(mm)

V15F-070C



V15F-060C



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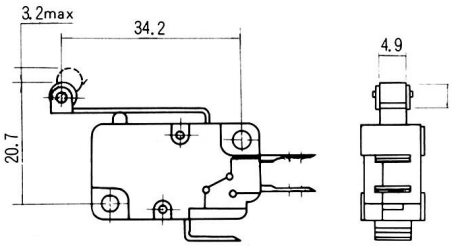
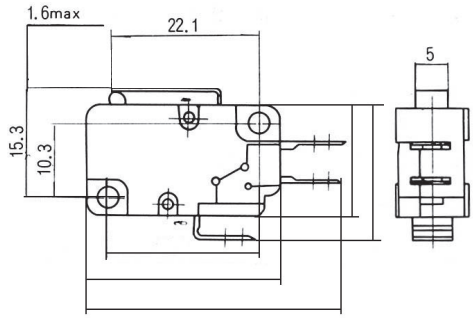


V15F-08C



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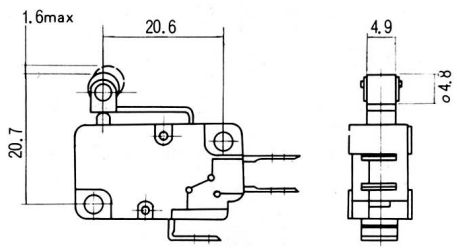

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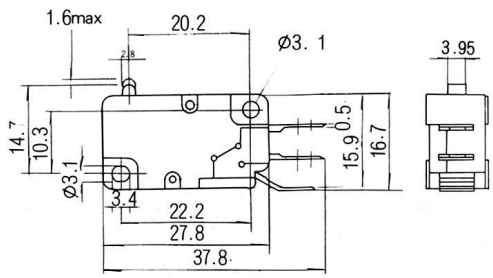
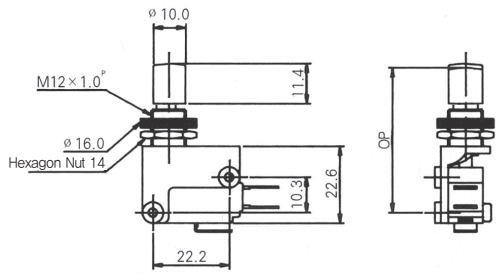
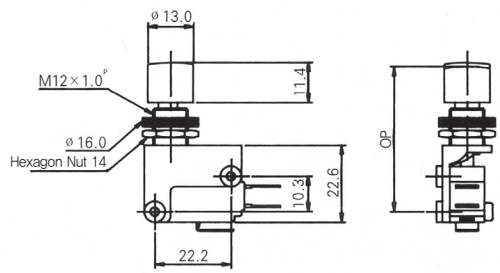


VAP-10



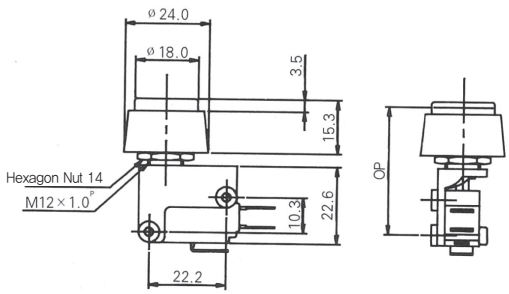
VAP-13



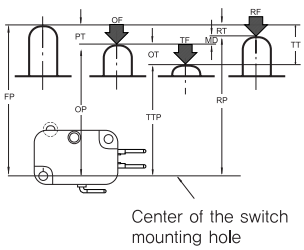
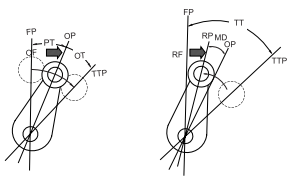
Micro Switch
V Series

Dimension (mm)

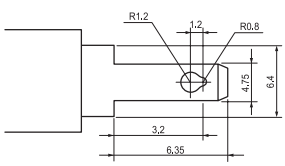
VAP-18



Glossary

Operating characteristics	Category	Abbr.	Term	Unit	Definition
	Force	Force required for operation	OF	g, kg g-mm	Force on the actuator required for the motion from the free position to the operating position
		Restoring force	RF	g, kg g-mm	Force on the actuator required for the motion from the operating limit position to the restoring position
		Force required for entire motion	TF	g, kg g-mm	Force on the actuator required for the motion from the operating position to the operating limit position
	Motion	Motion to the operating position	PT	mm, deg	Distance or angle from the free position of the actuator to the operating position
		Motion after operation	OT	mm, deg	Distance or angle from the operating position of the actuator to the operating limit position
		Hysteresis distance	MD	mm, deg	Distance or angle from the operating position of the actuator to the restoring position
		Total motion	TT	mm, deg	Distance or angle from the free position of the actuator to the operating limit position
	Position	Free position	FP	mm, deg	The position of the operating part when no force is applied from outside
		Operating position	OP	mm, deg	The position of the actuator when the external force is applied to the actuator and the moving contact reverses from the free position
		Restoring position	RP	mm, deg	The position of the actuator when the external force to the actuator is reduced and the moving contact reverses from the operating position to the free position
		Operating limit position	TTP	mm, deg	The position of the actuator when the actuator reaches the actuator stop position

Terminal



☞ Quick Connect Tab #187 / Soldering t=0.5

Limit Switch

ZXL Series

Part Number Description

ZXL - ❶ ❷

❶ Head Type	301 : Push Plunger	706 : Ø50 Adjustable Roller Lever - Aluminum	
	302 : Roller Plunger	726 : Ø50 Adjustable Roller Lever - Rubber	
	303 : Ball Plunger	717 : Yoke Roller Lever	
	702 : Roller Lever	727 : Yoke Roller Lever	
	703 : Adjustable Roller Lever	737 : Yoke Roller Lever	
	713 : Adjustable Roller Short Lever	747 : Yoke Roller Lever	
	704 : Adjustable Rod Lever	901 : Spring Rod	
	705 : Ø50 Roller Lever -Aluminum	902 : Spring Wire	
	725 : Ø50 Roller Lever - Rubber		
❷ Indicator Lamp	No mark : Standard (No Indicator)	D : LED Lamp (12 ~ 24VDC / AC)	A : Neon Lamp (100 ~ 240VAC)

General Specification

Contact Form		1N/O + 1N/C
Contact Material		Ag alloy / 24K gold plated
Rated Current		12A 250VAC·resistance load
Insulation Resistance		Min. 100MΩ 500VDC Insulation resistance
Contact Resistance		Max. 15mΩ
Dielectric Strength		2,200VAC·50/60Hz 1 Minute
Life Cycle	Mechanical	Min. 10,000,000
	Electrical	Min. 1,000,000
Operation Speed		1mm ~ 1m/sec
Vibration Resistance		10 ~ 55Hz Dual wave length 1.5mm
Shock Resistance	Malfunction	1,000m/s² Max. approx. 100G
	Destruction	300m/s² Max. approx. 30G
Degree Of Protection		IP67
Ambient Temperature		-10 ~ +80°C·(with no icing)
Ambient Humidity		Max. 95%RH
Housing Material		Aluminum die-casting
Weight		Approx. 270g

Limit Switch

ZXL Series

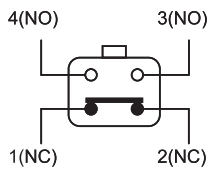
Performance And Specification

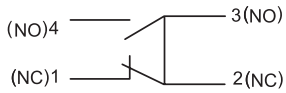
	Non-Inductive		Inductive	
Rated Voltage	Resistance Load	Lamp Load	Motor Load	Inductive Load
125VAC	16A	5A	8A	16A
250VAC	12A	3A	5A	12A
500VAC	10A	2.5A	2.5A	10A
30VDC	8A	6A	6A	8A
125VDC	1A	0.3A	0.3A	1A
250VDC	0.5A	0.2A	0.2A	0.5A

Contact Block

ZXL-101	ZXL-102	ZXL-103
24K gold plated Contact	12 ~ 24VAC/DC LED Lamp	100 240VAC NEON Lamp

Internal Circuit Drawing





Product Selection

	Indicator Lamp	Part Number	Head Type	OF	RF	PT	OT	MD	TT	OP	TTP
	Standard LED Lamp Neon Lamp	ZXL - 301 ZXL - 301D ZXL - 301A	Push Plunger	2,720gf (26.67N)	910gf (8.92N)	1.7mm	6.4mm	1mm	-	34 ± 0.8 mm	29.5 mm
	Standard LED Lamp Neon Lamp	ZXL - 302 ZXL - 302D ZXL - 302A	Roller Plunger	2,720gf (26.67N)	910gf (8.92N)	1.7mm	5.6mm	1mm	-	44 ± 0.8 mm	39.5 mm
	Standard LED Lamp Neon Lamp	ZXL - 303 ZXL - 303D ZXL - 303A	Ball Plunger	2,720gf (26.67N)	910gf (8.92N)	1.7mm	4mm	1mm	-	44.5 ± 0.8 mm	41 mm
	Standard LED Lamp Neon Lamp	ZXL - 702 ZXL - 702D ZXL - 702A	Roller Lever	1,360gf (13.34N)	227gf (2.23N)	15±5° mm	80°	12°	100°		
	Standard LED Lamp Neon Lamp	ZXL - 703 ZXL - 703D ZXL - 703A	Adjustable Roller Lever	1,360gf (13.34N)	227gf (2.23N)	15±5° mm	80°	12°	100°		

Limit Switch
ZXL Series

Product Selection

	Indicator Lamp	Part Number	Head Type	OF	RF	PT	OT	MD	TT	OP	TTP
	Standard LED Lamp Neon Lamp	ZXL - 713 ZXL - 713D ZXL - 713A	Adjustable Roller Short Lever	1,360gf (13.34N)	227gf (2.23N)	15±5° mm	80°	12°	100°		
	Standard LED Lamp Neon Lamp	ZXL - 704 ZXL - 704D ZXL - 704A	Adjustable Rod Lever	142gf (13.34N)	28gf (0.27N)	15±5° mm	80°	12°	100°		
	Standard LED Lamp Neon Lamp	ZXL - 705 ZXL - 705D ZXL - 705A	Ø50 Roller Lever - Aluminum	1,360gf (13.34N)	227gf (2.23N)	15±5° mm	80°	12°	100°		
	Standard LED Lamp Neon Lamp	ZXL - 725 ZXL - 725D ZXL - 725A	Ø50 Roller Lever - Rubber	1,360gf (13.34N)	227gf (2.23N)	15±5° mm	80°	12°	100°		
	Standard LED Lamp Neon Lamp	ZXL - 706 ZXL - 706D ZXL - 706A	Ø50 Adjustable Roller Lever - Aluminum	1,360gf (13.34N)	227gf (2.23N)	15±5° mm	80°	12°	100°		
	Standard LED Lamp Neon Lamp	ZXL - 726 ZXL - 726D ZXL - 726A	Ø50 Adjustable Roller Lever - Rubber	1,360gf (13.34N)	227gf (2.23N)	15±5° mm	80°	12°	100°		

Product Selection

	Indicator Lamp	Part Number	Head Type	OF	RF	PT	OT	MD	TT	OP	TTP
	Standard LED Lamp Neon Lamp	ZXL - 717 ZXL - 717D ZXL - 717A	York Roller Lever	1,200gf (11.8N)	50±5°	50±5°	35°				
	Standard LED Lamp Neon Lamp	ZXL - 727 ZXL - 727D ZXL - 727A	York Roller Lever	1,200gf (11.8N)	50±5°	50±5°	35°				
	Standard LED Lamp Neon Lamp	ZXL - 737M ZXL - 737MD ZXL - 737MA	York Roller Lever	1,200gf (11.8N)	50±5°	50±5°	35°				
	Standard LED Lamp Neon Lamp	ZXL - 747 ZXL - 747D ZXL - 747A	York Roller Lever	1,200gf (11.8N)	50±5°	50±5°	35°				
	Standard LED Lamp Neon Lamp	ZXL - 901 ZXL - 901D ZXL - 901A	Spring Rod	150gf (1.47N)		20±10 mm					
	Standard LED Lamp Neon Lamp	ZXL - 902 ZXL - 902D ZXL - 902A	Spring Wire	150gf (1.47N)		20±10 mm					

Limit Switch

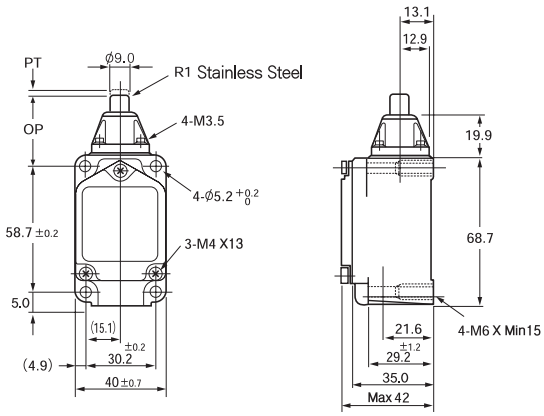
ZXL Series

Dimension

(mm)

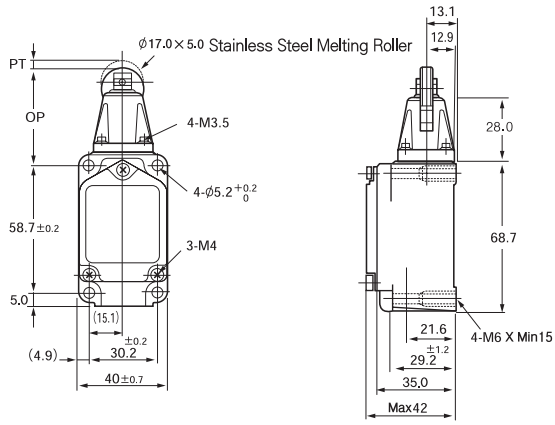
Push Plunger

ZXL - 301



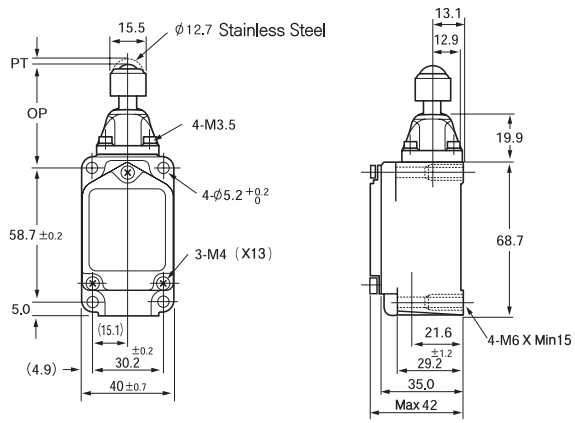
Roller Plunger

ZXL - 302



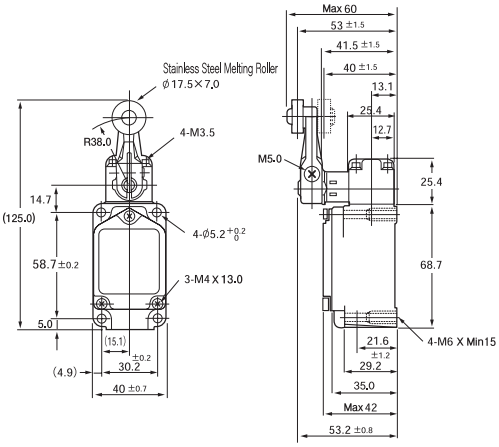
Ball Plunger

ZXL - 303



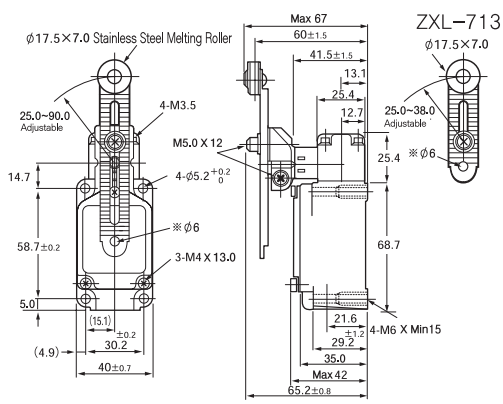
Roller Lever

ZXL - 702



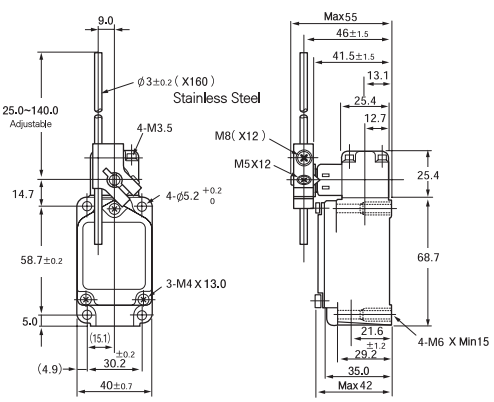
Adjustable Roller Lever

ZXL - 703, 713



Adjustable Rod Lever

ZXL - 704

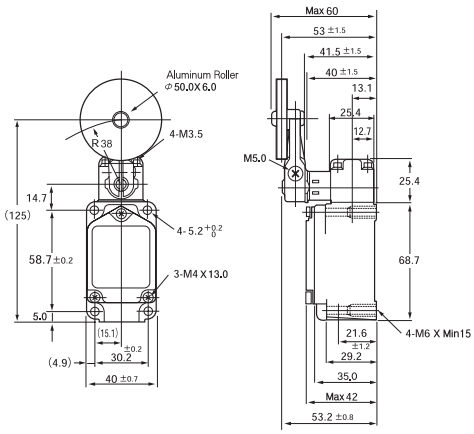


Dimension

(mm)

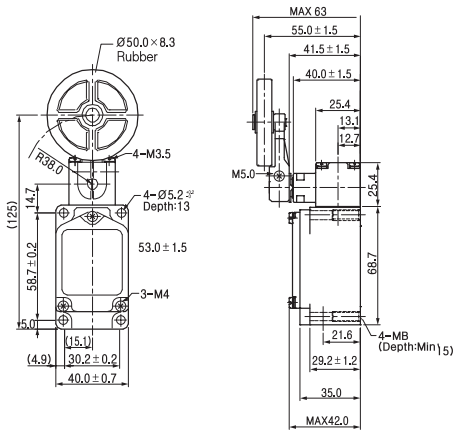
Ø50Roller Lever - Aluminum

ZXL - 705



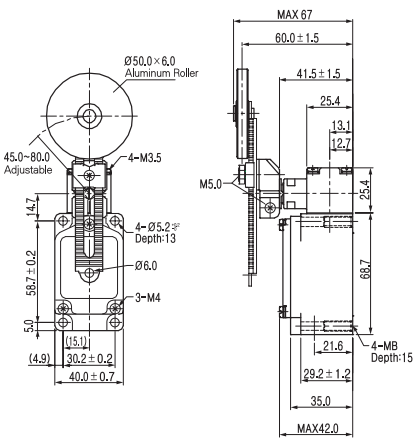
Ø50Roller Lever - Rubber

ZXL - 725



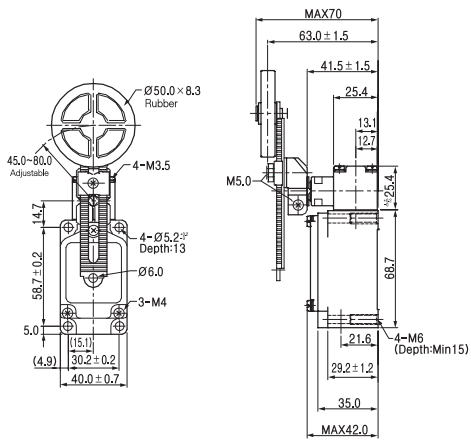
Ø50Adjustable Roller Lever - Rubber

ZXL - 706



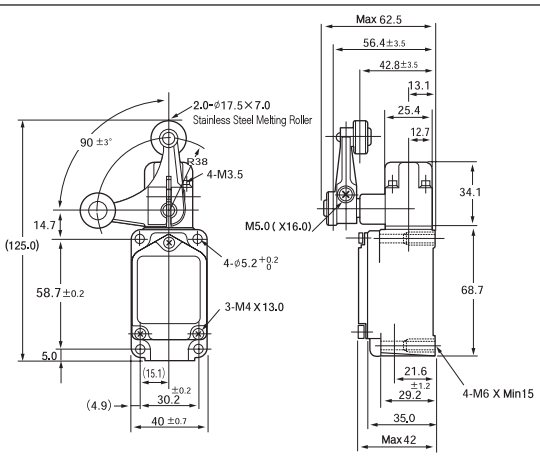
Ø50Adjustable Roller Lever - Rubber

ZXL - 726



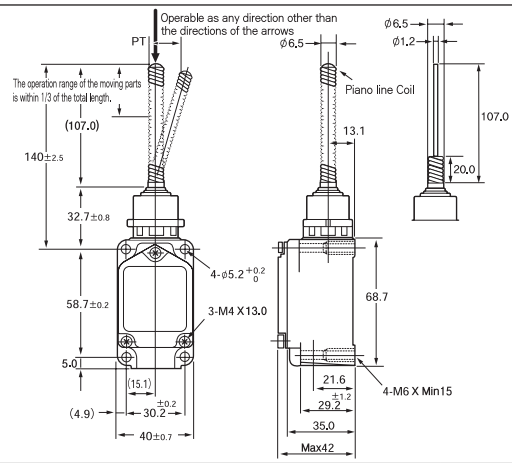
York Roller Lever

ZXL - 717, 727, 737, 747



Spring Wire

ZXL - 901, 902



Limit Switch

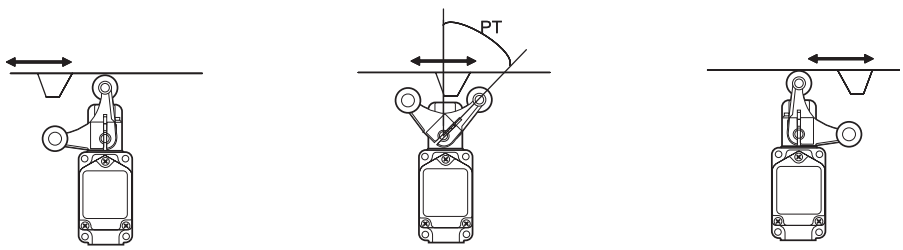
ZXL Series

The York Roller Lever

ZXL-717	ZXL-727	ZXL-737	ZXL-747

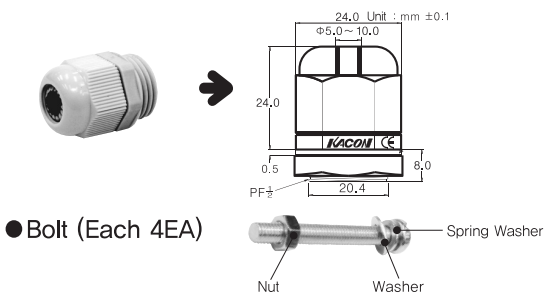
The Operation Of The Built - In Switch In A Accordance With The Movement Of The York

NC current application	NO current application	NO current application



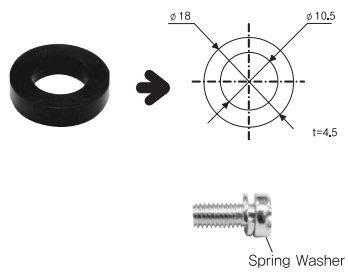
Basic Accessories

PG 13.5A



[M5X40mm]

Rubber Packing



[M6X14mm]

Basic Accessories

Indicator Lamp \ Item	Rated Voltage	Rated Current	Order code
Neon lamp	100 ~ 240VAC	0.6 ~ 2mA	AC Load : ZXL - ☐ A
LED lamp	12 ~ 24VAC/DC	Approx. 1mA	DC Load : ZXL - ☐ D

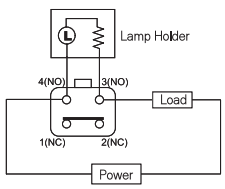
- There are two types of lamps: Neon and LED lamps.
- The circuit check and fault detection are easy because the switch operation status is easily checked outside.
- The user can change the mode of operation status indication by changing the lamp holder mounting direction by 180°(up or down) inside the indicator lamp cover.
- Additional wiring is not required for the lamp terminals because the spring attached to the indicator lamp cover comes in contact with the terminal screw of the built-in switch.

Operation Indicator Lamp Direction Shift

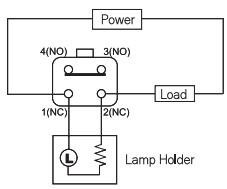
- The LED type does not require the change of polarity because it has a built-in rectifier.
- The indicator lamp cover is formed by coating transparent resin on the Al die casting material, and can be used in the place with cutting oil. In addition, the operation status (ON in operation or non-operation) can be checked outside.
- This is ideal for the places where checking the passage of products is difficult on the conveyor line.
- The factory setting is “ON in operation”.
- For the use with ON in non-operation, shift the LED downward as in the figure.

Indication Lamp Wiring And Circuit Diagram

Internal Wiring Diagram

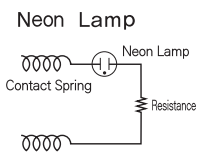


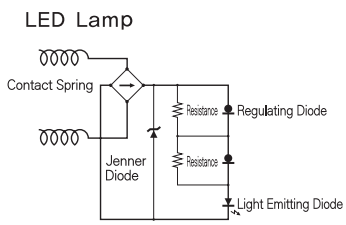
Lights on when in non-operation
[Lamp ON when NC ON]



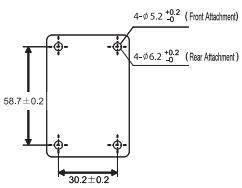
Lights on when in operation
[Lamp ON when NO ON]

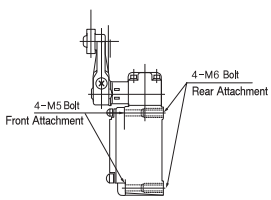
Internal Circuit Drawing





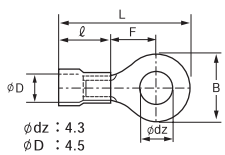
Mounting





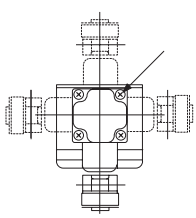
Fastening bolt is shipped together with the product.

Pressurized Terminal In Use

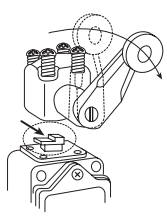


ϕdz : 4.3
ϕD : 4.5
B : 8.5
L : 21.0
F : 7.8
ℓ : 9.0 (mm)

How To Change The Attached Direction Of The Head Part

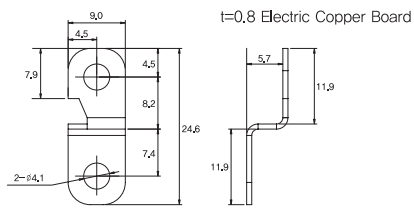


The head position can be changed in four directions by loosening four bolts.



The arrowed internal parts must rotate in the same direction as the head part rotation.

Short Bar, Available On Separate Orders



If the shorting terminal is used as in the figure, the switch can be the single pole double throw type.

Limit Switch

ZXM Series

Part Number Description

ZXM - ❶ ❷

❶ Head Type	301 : Push Plunger	726 : Ø50 Adjustable Roller Lever - Rubber	
	302 : Roller Plunger	901 : Spring Rod	
	312 : Cross Roller Plunger	902 : Spring Wire	
	702 : Roller Lever	903 : Spring Rod - Plastic Tip	
	703 : Adjustable Roller Lever	923 : Spring Rod - Metal Tip	
	704 : Adjustable Rod Lever		
❷ Indicator Lamp	No mark : Standard (No Indicatior)	D : LED Lamp (12 ~ 24VDC/AC)	A : Neon Lamp (80 ~ 240VAC)

General Specification

Contact Form		1N/O + 1N/C
Contact Material		Ag alloy/24K Au Plate
Rated Current		6A 250VAC · Resistance load
Insulation Resistance		Min. 100MΩ 500VDC Insulation resistance
Contact Resistance		Max. 25mΩ
Dielectric Strength		1,500VAC· 50/60Hz 1 Minute
Life Cycle	Mechanical	Min. 1,000,000
	Electrical	Min. 300,000
Vibration Resistance		10 ~ 55Hz dual wave length 1.5mm
Shock Resistance	Malfunction	98m/s^2· Max. 10G
	Destruction	294m/s^2· Max. 30G
Degree Of Protection		IP65
Ambient Temperature		-20 ~ +60°C· (with no icing)
Ambient Humidity		Max. 90%RH
Weight		Approx. 130 ~ 190g

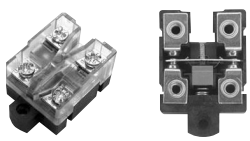
Regular

Rated Voltage	Non-Inductive				Inductive			
	Resistive Load		Lamp Load		Motor Load		Inductive Load	
	NC(A)	NO(A)	NC(A)	NO(A)	NC(A)	NO(A)	NC(A)	NO(A)
125VAC 250VAC 500VAC	6		1.5	0.7	2	1	3	
	6		1	0.5	1.5	0.8	3	
	2		0.75	0.35	0.75	0.4	0.75	
30VDC 125VDC 250VDC	5		3		3		4	
	0.4	0.2	-		-		-	

Contact Block

ZXM-101

24K Au Plate



Indication Lamp Name Plate

ZXM-102 12 ~ 24VAC/DC LED Lamp

ZXM-103 80 ~ 240VAC Neon Lamp

Product Selection

	Indicator Lamp	Part Number	Head Type	OF	RF	PT	MD	OT	TT
	Standard LED Lamp Neon Lamp	ZXM - 301 ZXM- 301D ZXM - 301A	Push Plunger	900gf (8.83N)	150gf (1.47N)	1.5mm	0.7mm	4mm	5.5mm
	Standard LED Lamp Neon Lamp	ZXM - 302 ZXM - 302D ZXM - 302A	Roller Plunger	900gf (8.83N)	150gf (1.47N)	1.5mm	0.7mm	4mm	5.5mm
	Standard LED Lamp Neon Lamp	ZXM - 312 ZXM - 312D ZXM - 312A	Cross Roller Plunger	900gf (8.83N)	150gf (1.47N)	1.5mm	0.7mm	4mm	5.5mm
	Standard LED Lamp Neon Lamp	ZXM - 702 ZXM - 702D ZXM - 702A	Roller Lever	600gf (5.88N)	150gf (0.49N)	20°	10°	75°	95°
	Standard LED Lamp Neon Lamp	ZXM - 703 ZXM - 703D ZXM - 703A	Adjustable Roller Lever	800gf (7.84N) ~ 342gf (3.35N)	50gf (0.49N) ~ 21gf (0.21N)	20°	10°	75°	95°
	Standard LED Lamp Neon Lamp	ZXM - 704 ZXM - 704D ZXM - 704A	Adjustable Rod Lever	800gf (7.84N) ~ 230gf (1.99N)	50gf (0.49N) ~ 12gf (0.12N)	20°	10°	75°	95°

Limit Switch

ZXM Series

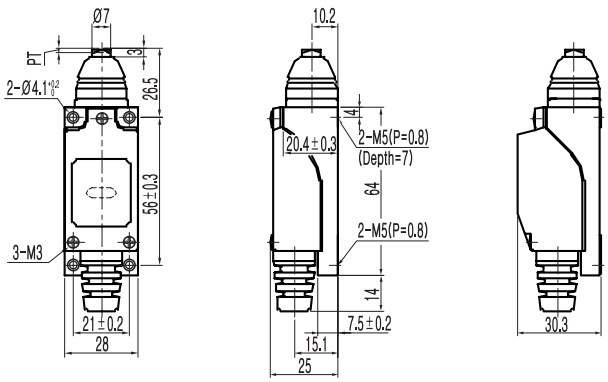
Product Selection

	Indicator Lamp	Part Number	Head Type	OF	RF	PT	MD	OT	TT
	Standard LED Lamp Neon Lamp	ZXM-726 ZXM-726D ZXM-726A	Ø50 Adjustable Roller Lever Type	800gf (7.84N) ~ 342gf (3.35N)	50gf (0.49N) ~ 21gf (0.21N)	20°	10°	75°	95°
	Standard LED Lamp Neon Lamp	ZXM-901 ZXM-901D ZXM-901A	Spring Rod	90gf (0.88N)		30°		20°	50°
	Standard LED Lamp Neon Lamp	ZXM-902 ZXM-902D ZXM-902A	Spring Wire	90gf (0.88N)		30°		20°	50°
	Standard LED Lamp Neon Lamp	ZXM-903 ZXM-903D ZXM-903A	Spring Rod-Plastic Tip	90gf (0.88N)		30°		20°	50°
	Standard LED Lamp Neon Lamp	ZXM-923 ZXM-923D ZXM-923A	Spring Rod-Metal Tip	90gf (0.88N)		30°		20°	50°

Dimension

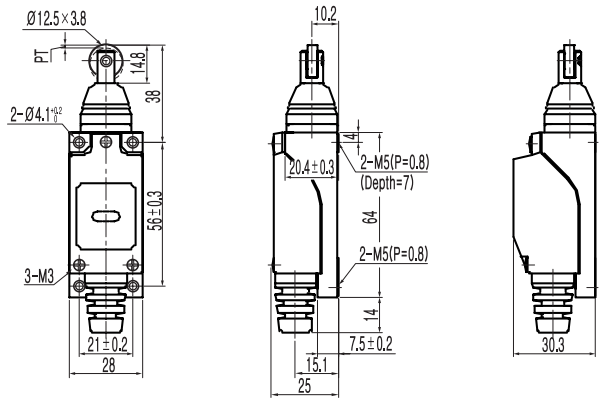
(mm)

Push Plunger
ZXM-301



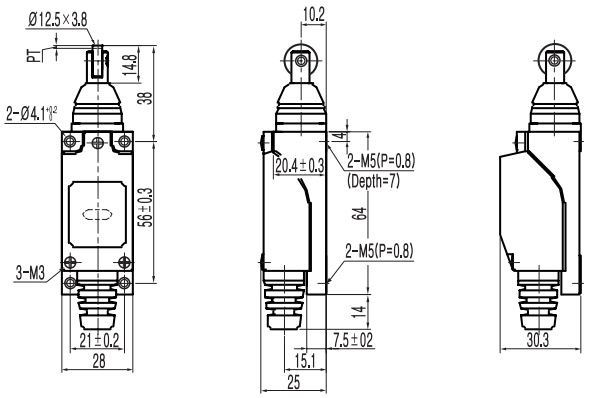
Standard Type with Neon / LED Type

Roller Plunger
ZXM-302



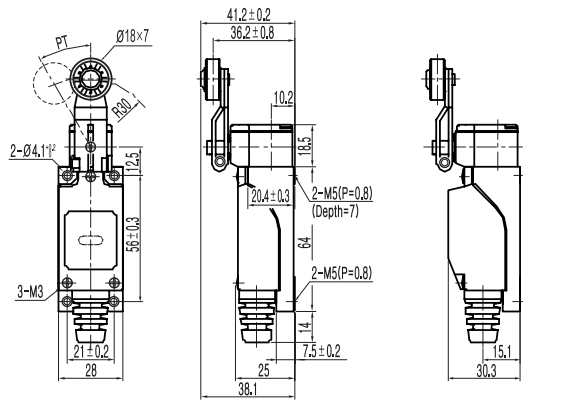
Standard Type with Neon / LED Type

Cross Roller Plunger
ZXM-312



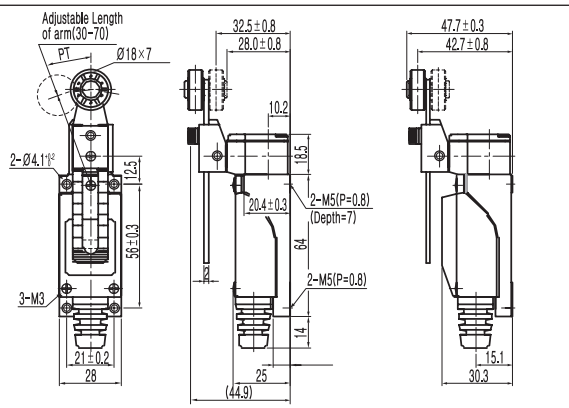
Standard Type with Neon / LED Type

Roller Lever
ZXM-702



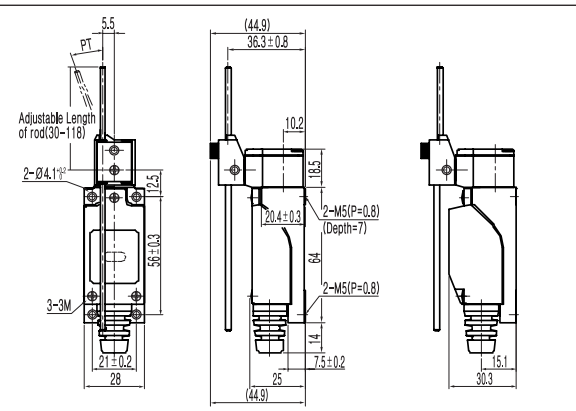
Standard Type with Neon / LED Type

Adjustable Roller Lever
ZXM-703



Standard Type with Neon / LED Type

Adjustable Rod Lever
ZXM-704



Standard Type with Neon / LED Type

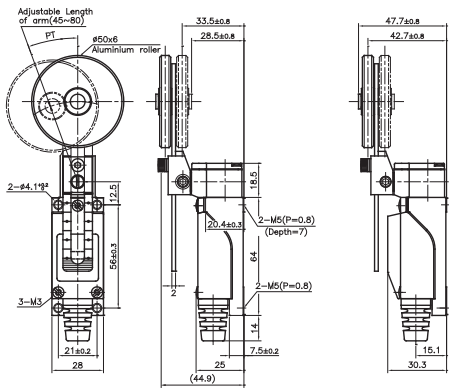
Limit Switch

ZXM Series

Dimension

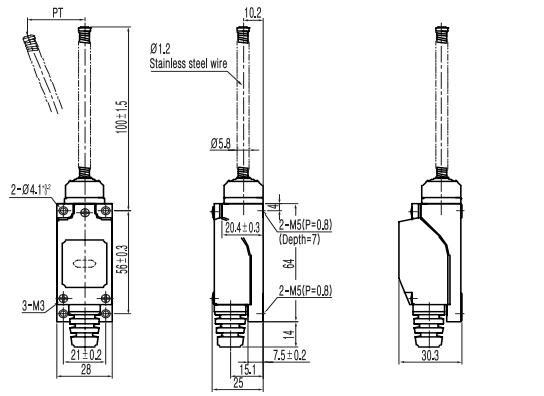
(mm)

Ø50 Adjustable Roller Lever Type
ZXM-726



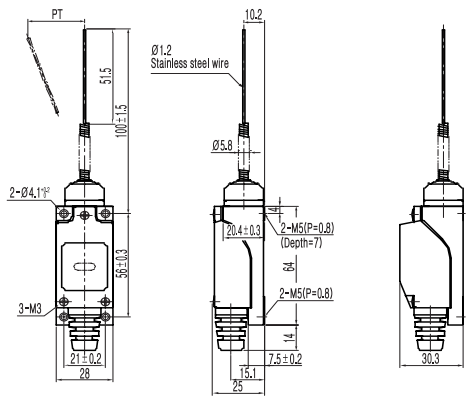
Standard Type with Neon / LED Type

Spring Rod
ZXM-901



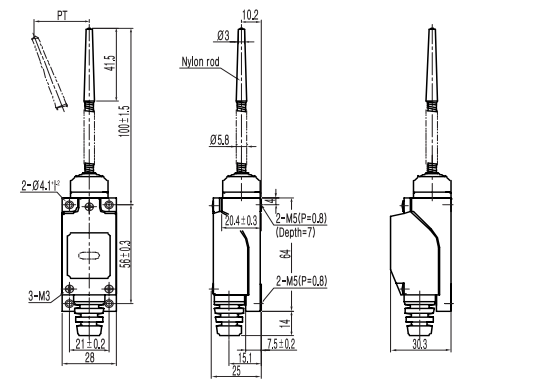
Standard Type with Neon / LED Type

Spring Wire
ZXM-902



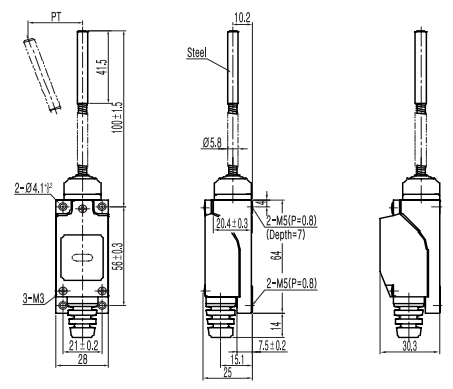
Standard Type with Neon / LED Type

Spring Rod-Plastic Tip
ZXM-903



Standard Type with Neon / LED Type

Spring Rod-Metal Tip
ZXM-923



Type with Neon / LED Type

Operation indicator lamp Ratings

Item / Indicator Lamp	Rated voltage	Rated current	Order code
NEON lamp	80 ~ 240VAC	0.2 ~ 1.5mA	AC load: ZXM - □A
LED lamp	12 ~ 24VDC	0.5 ~ 1.5mA	DC load: ZXM - □D

- There are two types of lamps: Neon and LED lamps.
- The circuit check and fault detection are easy because the switch operation status is easily checked outside.
- This is ideal for the places where checking the passage of products is difficult on the conveyor line.
- The LED type has the + or - polarity. Pay attention to the polarity, which is indicated inside.
- The lens section of the indicator lamp cover ensures sufficient brightness with its diffusible resin diamond cut structure.
- The waterproof performance is excellent because the indicator lamp and cover are formed together.

Operation indicator lamp direction shift

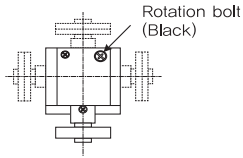
- The lamp terminal does not require additional wiring, because it is connected via the spring in the indicator cover and the built-in switch terminal bolts.
- The indicator lamp can be selected between the modes of “ON in operation” and “ON in nonoperation”.
- The indicator lamp can be shifted by removing the lamp holder inside the cover using tools including drivers.

Lamp holder removal | ON in operation | ON in non–operation

- The user can change the mode of operation status indication by changing the lamp holder mounting direction by 180°(up or down) inside the indicator lamp cover.
- The factory setting is “ON in operation”

Head mounting

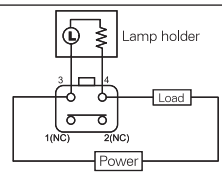
In the lever type, the head can be placed in one of four directions at 90° rotation interval.



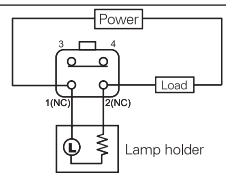
To change the head direction, loosen the black bolt on the top of the head, rotate the head, and tighten the bolt again.

Operation indicator lamp wiring and circuit diagram

Internal wiring



ON in non-operation
[Lamp ON when NC ON]

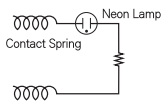


ON in operation
[Lamp ON when NO ON]

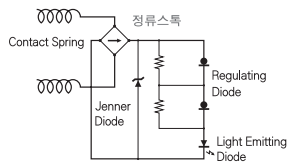
☞ Caution: Use the same power supply for terminals / Connect the same polarity for terminals 1 and 4, and 2 and 3.

Diagram

NEON Lamp

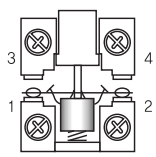


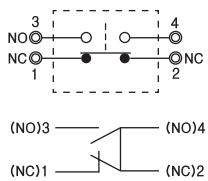
LED Lamp



Built-in switch circuit diagram

24K Au Plate

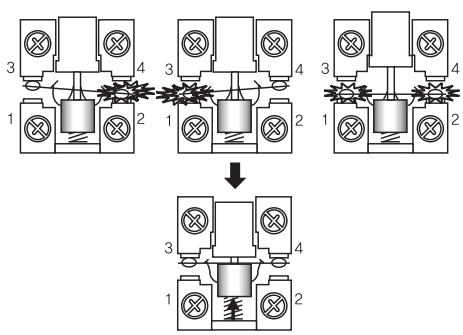




Direct contact opening ⇨ Direct Openning

1. The device is safe with the mechanism that cuts off the circuit when the switch contact weld occurs.
2. If the contact weld appears, the plunger directly pushes up the movable terminal to forcefully separate the NC contact and cut off the circuit.
3. The direct opening function is for the Nc contact only.
4. The plunger continues to push the movable terminal during operation, and the circuit is not cut off by mechanical impact.

Welding



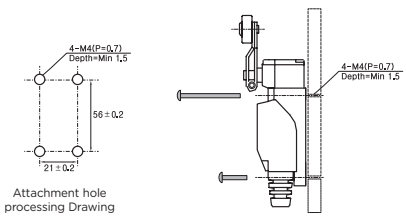
Contact weld After direct opening

Limit Switch
ZXM Series

Mounting on the panel

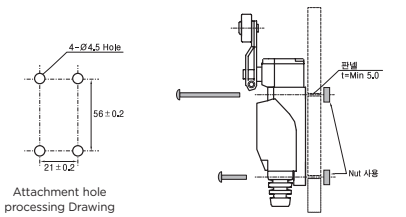
1. This product can be mounted on the front or rear.
2. Before the installation of the product, determine its position so that the OT of the actuator is proper.
   ⇨ An excessive OT leads to a decrease in the product life due to the strong wear and fatigue
3. After determining the mounting position, refer to the following types to process the panel.
4. Be sure to use spring washers for the mounting bolts so that the product will not be removed by vibration or impact.

Type 1. Front Attached - Direct Tap Processing on the panel



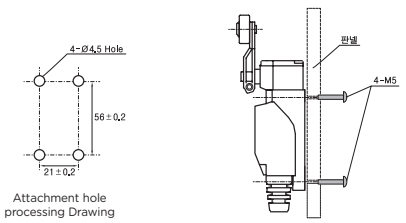
Attachment hole processing Drawing

Type 2. Front Attachment - Direct hole processing on the panel



Attachment hole processing Drawing

Type 3. Rear Attachment - Using M5 Tap of the product



Attachment hole processing Drawing

☞ The bolts and nuts above are shipped together with the product.

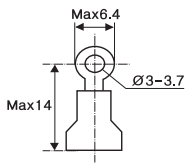
Wires

1. The proper size of wires that pass through the wiring lead-out (NBR) is Ø6.6 ~ Ø8.5.
2. The use of VCTF cable is desirable.
3. The following table shows the specifications of the VCTF cable. Refer to the table for cable selection.

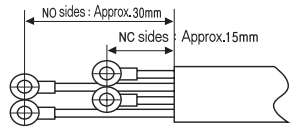
Small Line Number	Conductor (L)	Completed outer diameter (I)
2 wire	0.75mm² 1.25mm² 2.0mm²	Ø6.6mm Ø7.4mm Ø8.0mm
3 wire	0.75mm² 1.25mm² 2.0mm²	Ø7.0mm Ø7.8mm Ø8.5mm
4 wire	0.75mm² 1.25mm²	Ø7.6mm Ø8.5mm

VCTF : The cable for 300 V or less indoor small appliances, which is manufactured by insulating stranded copper wires with PVC.

4. When wiring the switch terminals, do not directly connect the lead wire to the terminal, but use the O-type clamp terminal with insulation shielding.
5. After wiring, be sure to mount the cover before applying the power. Otherwise, it may lead to an electric shock.



Clamp terminal specifications



O-terminal wiring reference

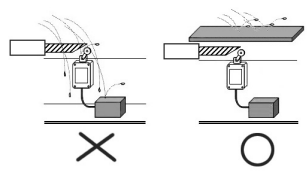
Tightening torque

When mounting the product, excessive force for bolts or nuts may damage the product. Observe the following tightening torques.

Front Attachment	M4- Max. 12kgf.cm / 1.2N.m
Rear Attachment	M5- Max. 19.6kgf.cm / 2.0N.m
Switch Terminal	M3- Max. 4.9kgf.cm / 0.5N.m

Environment

- Do not use the product under water or oil, nor in the environment where it is influenced by oil or water because this product is not completely oiltight.
- Do not use the product in the places where there are risks of fire and corrosion.
- Actual conditions may affect the product reliability including the guaranteed life and tightness.



- Front attachment-M4×35 2EA, M4×20 2EA

- Rear Attachment-M5×10 4EA

Limit Switch

ZXG Series

Part Number Description

ZXG - ❶

❶ Head Type	301 : Push Plunger	507 : Roller Lever
	311 : Short Push Plunger	517 : Roller Short Lever
	321 : Long Push Plunger	527 : Directional Roller Lever
	302 : Roller Plunger	537 : Directional Roller Short Lever
	312 : Cross Roller Plunger	902 : Spring Wire
	501 : Hinge Lever	903 : Spring Rod - Plastic Tip
	511 : Hinge Short Lever	923 : Spring Rod - Metal Tip

☞ This model is under development. Please contact to local agent for order.

General Specification

Contact Form		1N/O + 1N/C
Contact Material		Ag alloy / 24K Au Plate
Rated Current		10A 250VAC·resistance load
Insulation Resistance		Min. W 100MΩ 500VDC Insulation resistance
Contact Resistance		Max. 15mΩ
Dielectric Strength		2,000VAC·50/60Hz 1 Minute
Life Cycle	**Mechanical**	Min. 10,000,000
	Electrical	Min. 200,000
Vibration Resistance		10 ~ 55Hz dual wave length 1.5mm
Shock Resistance	**Malfunctional**	98m/s² Max. 10G
	Destruction	294m/s² Max. 30G
Degree Of Protection		IP64
Ambient Temperature		-20 ~ +60°C (with no icing)
Ambient Humidity		Max. 95% RH
Weight		Approx. 60g

Rated voltage(V)	Non-Inductive				Inductive			
	Resistance load		Lamp load		Motor load		Inductive load	
	NC(A)	NO(A)	NC(A)	NO(A)	NC(A)	NO(A)	NC(A)	NO(A)
125VAC	10		3	1.5	5	2.5	10	
250VAC	10		2.5	1.25	3	1.5	10	
500VAC	3		1.5	0.75	1.5	0.75	2.5	
30VDC	6		3	1.5	5	2.5	5	
125VDC	0.5		0.4	0.4	0.05	0.05	0.05	
250VDC	0.25		0.2	0.2	0.03	0.03	0.03	

Limit Switch

ZXG Series

Product Selection

	Part Number	Contact Form	Degree of Protection	Head Type	OF	RF	PT	MD	OT	OP
	ZXG-301	1N/O + 1N/C	IP64	Push Plunger	600gf (5.88N)	100gf (0.98N)	2.0mm	0.8mm	0.8mm	30 ±0.8mm
	ZXG-311	1N/O + 1N/C	IP64	Short Push Plunger	600gf (5.88N)	100gf (0.98N)	2.0mm	0.8mm	0.6mm	21.8 ±0.8mm
	ZXG-321	1N/O + 1N/C	IP64	Long Push Plunger	600gf (5.88N)	100gf (0.98N)	2.0mm	0.8mm	5.0mm	4.4 ±1.2mm
	ZXG-302	1N/O + 1N/C	IP64	Roller Plunger	600gf (5.88N)	100gf (0.98N)	2.0mm	0.8mm	0.8mm	33.3 ±1.2mm
	ZXG-312	1N/O + 1N/C	IP64	Cross Roller Plunger	600gf (5.88N)	100gf (0.98N)	2.0mm	0.8mm	0.8mm	33.3 ±1.2mm
	ZXG-501	1N/O + 1N/C	IP64	Hinge Lever	150gf (1.47N)	40gf (0.39N)	13.5mm	3.2mm	4.0mm	25 ±2.0mm
	ZXG-511	1N/O + 1N/C	IP64	Hinge Short Lever	220gf (2.16N)	60gf (0.59N)	8.5mm	2.0mm	2.5mm	25 ±1.3mm

Product Selection

	Part Number	Contact Form	Degree of Protection	Head Type	OF	RF	PT	MD	OT	OP
	ZXG-507	1N/O + 1N/C	IP64	Roller Lever	180gf (1.77N)	50gf (0.49N)	11.0mm	2.4mm	3.0mm	40 ±1.9mm
	ZXG-517	1N/O + 1N/C	IP64	Roller Short Lever	240gf (2.35N)	80gf (0.78N)	6.5mm	1.5mm	2.0mm	40 ±1.6mm
	ZXG-527	1N/O + 1N/C	IP64	Directional Roller Lever	200gf (1.96N)	60gf (0.59N)	11.0mm	2.4mm	3.0mm	50 ±2.0mm
	ZXG-537	1N/O + 1N/C	IP64	Directional Roller Short Lever	280gf (2.75N)	100gf (0.98N)	6.5mm	1.5mm	2.0mm	50 ±1.6mm
	ZXG-902	1N/O + 1N/C	IP64	Spring Wire	120gf (1.18N)		25mm		11mm	36mm
	ZXG-903	1N/O + 1N/C	IP64	Spring Rod - Plastic Tip	120gf (1.18N)		25mm		11mm	36mm
	ZXG-923	1N/O + 1N/C	IP64	Spring Rod - Metal Tip	120gf (1.18N)		25mm		11mm	36mm

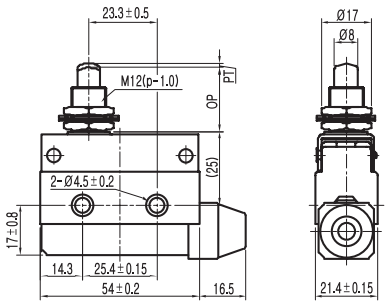
Limit Switch

ZXG Series

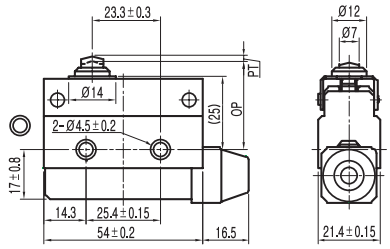
Dimension

(mm)

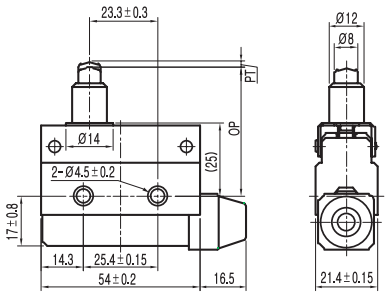
Push Plunger
ZXG-301



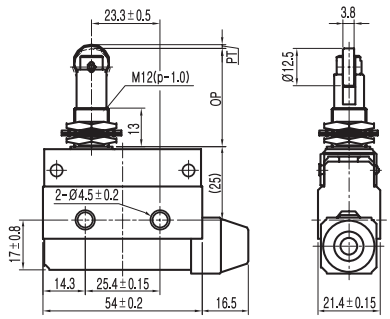
Short Push Plunger
ZXG-311



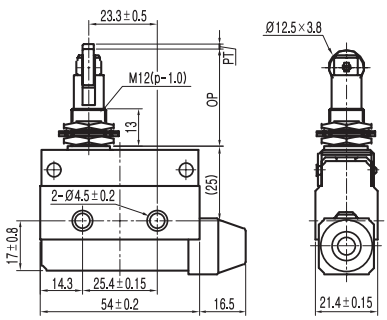
Long Push Plunger
ZXG-321



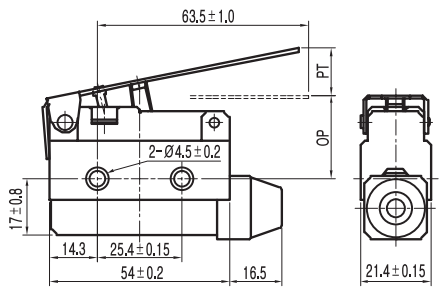
Roller Plunger
ZXG-302



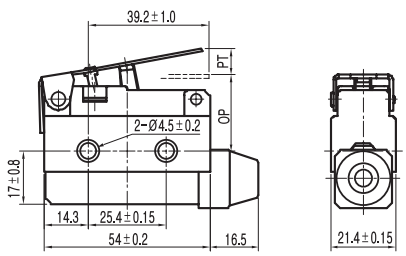
Cross Roller Plunger
ZXG-312



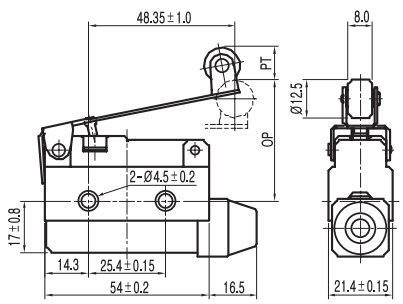
Hinge Lever
ZXG-501



Hinge Short Lever
ZXG-511



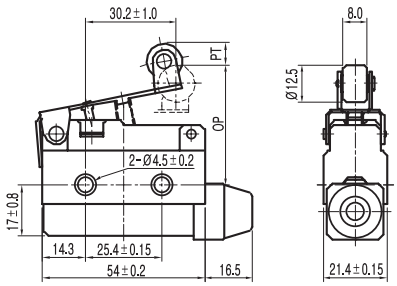
Roller Lever
ZXG-507



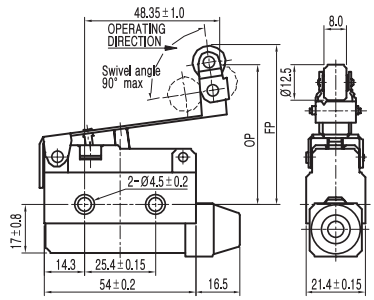
Dimension

(mm)

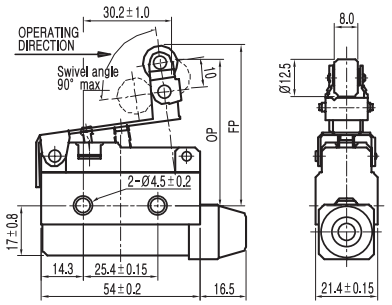
Roller Short Lever
ZXG-517



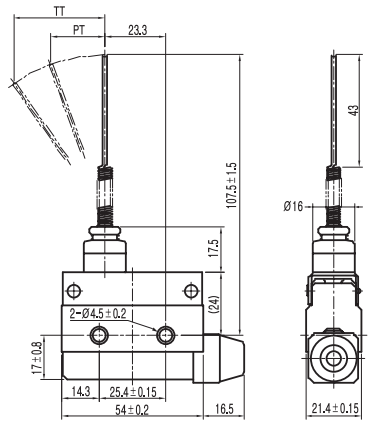
Directional Roller Lever
ZXG-527



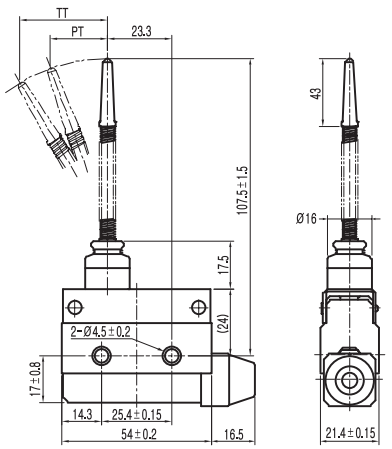
Directional Roller Short Lever
ZXG-537



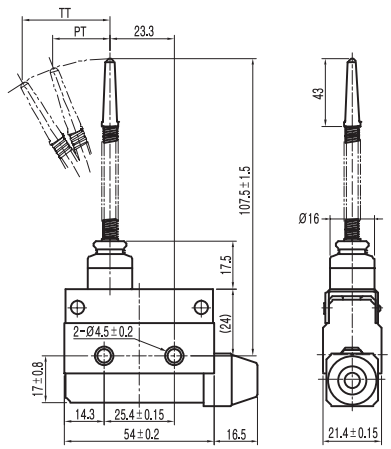
Spring Wire
ZXG-902



Spring Rod-Plastic Tip
ZXG-903



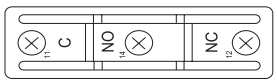
Spring Rod-Metal Tip
ZXG-923



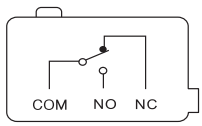
Limit Switch

ZXG Series

Contact Types

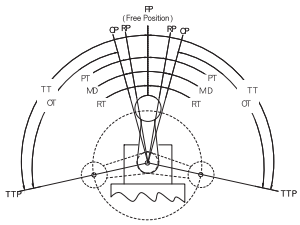


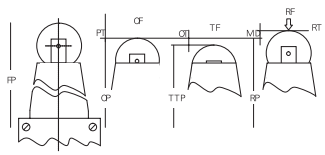
COM Terminal NO Terminal NC Terminal



Glossary

Lever type **plunger**

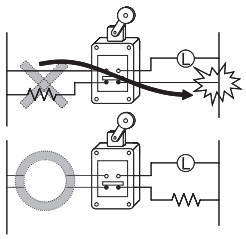




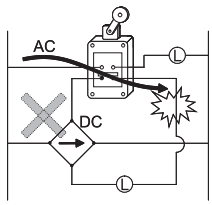
Category	Term	Abbr.	Definition
Force	Force required for operation	OF	Force on the actuator required for the motion from the free position (FP) to the operating position (OP)
	Restoring force	RF	Force on the actuator required for the motion from the operating limit position (TTP) to the restoring position (RP)
	Force required for entire motion	TF	Force on the actuator required for the motion from the operating position (OP) to the operating limit position (TTP)
Motion	Motion to the operating position	PT	Distance or angle from the free position of the actuator (FP) to the operating position (OP)
	Motion after operation	OT	Distance or angle from the operating position of the actuator (OP) to the operating limit position (TTP)
	Hysteresis distance	MD	Distance or angle from the operating position of the actuator (OP) to the restoring position (RP)
	Total motion	TT	Distance or angle from the free position of the actuator (FP) to the operating limit position (TTP)
Position	Free position	FP	The position of the operating part when no force is applied from outside
	Operating position	OP	The position of the actuator when the external force is applied to the actuator and the contact reverses from the free position
	Restoring position	RP	The position of the actuator when the external force to the actuator is reduced and the moving contact reverses from the operating position (OP) to the free position (FP)
	Operating limit position	TTP	The position of the actuator when the actuator reaches the actuator stop position

Caution

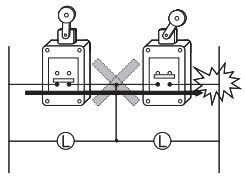
1. Note the following for the circuit wiring for the limit switch.



Make sure that the wrong polarity is not connected to both ends of the contact (A and B contacts). An abnormal switch operation may lead to fire.

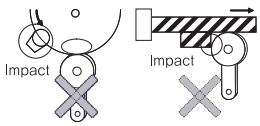


Make sure that the wrong polarity is not connected to both ends of the contact (A and B contacts). An abnormal switch operation may lead to fire or damage to the product.

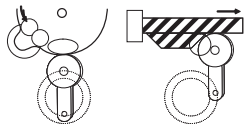


Do not use the circuit that continues the closed status upon the occurrence of abnormality. There is a risk of a short circuit at the conduction part.

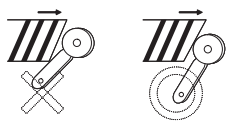
2. Note the following for determining the positions of the dog and switch.



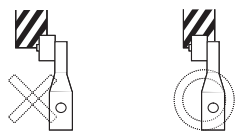
If the dog that conducts rotational or straight motion has a sharp edge, it may lead to the damage to the switch, operating error and reduced life.



Design the dog in the circled or leaned shape so that there will be no impact on the friction surface.



If the dog comes in contact with the switch lever, it may be damaged or its life may be shortened. Determine the operating position so that it will not touch the lever.



The partial contact between the dog and roller may cause operating errors or damage. Position the dog on the center of the roller.

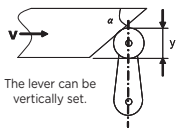
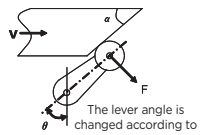
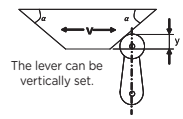
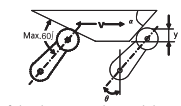
3. Note the following for designing the dog.

The relationships among the dog velocity (V), angle (**α**) and actuator shape should be fully considered.
The proper dog angle (**α**) is 30° ~ 45°, and the proper operating velocity (V) is 0.5 m/s or less.
When the dog angle (**α**) exceed 45°, a fast dog velocity may damage the switch head.

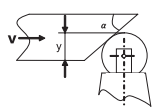
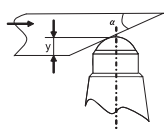
Limit Switch
ZXG Series

Caution

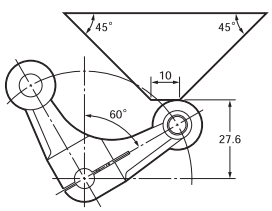
1) Roller Lever Type Actuator

Status	Dog Velocity(V)	Dog Design	Dog Angle(α) and Velocity(V)
When the dog does not pass beyond the actuator	V≤0.5m/s (Normal)	 The lever can be vertically set.	α / V Maximum(m/s) / y 30° / 0.4 / 0.8(TT) 45° / 0.25 60° / 0.1 60° ~ 90° / 0.05 ※ The y value can reach up to 80 % of TT.
	0.5≤V≤2m/s (High Speed)	 The lever angle is changed according to the dog angle.	α / α / V Maximum(m/s) / y 45° / 45° / 0.5 / 0.5 ~ 0.8 50° / 40° / 0.6 / 0.5 ~ 0.8 60° ~ 55° / 30° ~ 35° / 1.3 / 0.5 ~ 0.7 75° ~ 65° / 15° ~ 25° / 2 / 0.5 ~ 0.7 ※ The y value is the ratio to TT. The values in the table show that the dog can move within the range of 50 ~ 80 % and 50 ~ 70 % of TT.
When the dog passes beyond the actuator	V≤0.5m/s	 The lever can be vertically set.	α / V Maximum(m/s) / y 30° / 0.4 / 0.8(TT) 45° / 0.25 60° / 0.1 60° ~ 90° / 0.05 ※ The y value can reach up to 80 % of TT.
	0. 5m/s≤V	 If the dog passes beyond the actuator with a relatively high speed, design the rear of the dog in a gentle slope (15 - 30).	α / α / V Maximum(m/s) / y 45° / 45° / 0.5 / 0.5 ~ 0.8 50° / 40° / 0.6 / 0.5 ~ 0.8 60° ~ 55° / 30° ~ 35° / 1.3 / 0.5 ~ 0.7 75° ~ 65° / 15° ~ 25° / 2 / 0.5 ~ 0.7 ※ The y value is the ratio to TT. The values in the table show that the dog can move within the range of 50 ~ 80 % and 50 ~ 70 % of TT.

2) Plunger Type Actuator

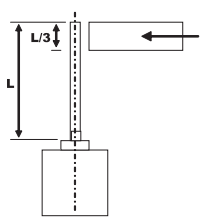
Head Type	Dog velocity (V)	Dog design	Dog Angle(α) and Velocity(V)
Roller Plunger Type	0.25≤V≤0.5m/s		When the dog passes beyond the actuator, the dog shapes in front and rear directions can be the same, but the abrupt dog slope is not desirable.
Ball Plunger Type	0.25≤V≤0.5m/s		α / V Maximum(m/s) / y 30° / 0.25 / 0.6 ~ 0.8 20° / 0.5 / 0.5 ~ 0.7 ※ The Y value means 60 ~ 80% or 50 ~ 70% of the total travel.

3) Yoke Type Actuator



Design the dog shape so that the dog does not come in contact with the opposite roller lever when the actuator rotates (reversing).

4) Spring Rod Type Actuator

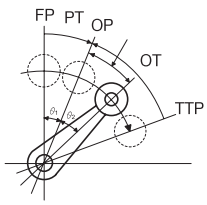


Design the special dog so that it will reach 1/3 of the actuator length (total spring load length) L.

Caution

4. Stroke setting based on the dog movement

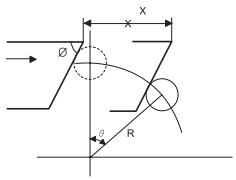
If the stroke setting for the limit switch is based on the dog movement, instead of on the actuator angle, the proper stroke of the limit switch is as follows.



Proper stroke:

PT+{standard OT×(0.7 ~ 1.0)}

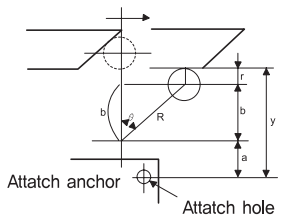
In angle, this is **θ1+θ2**.



The dog movement X that corresponds to the proper stroke:

$$X = R\sin\theta + \frac{R(1-\cos\theta)}{\tan\alpha}(mm)$$

α : Dog angle
θ : Proper stroke angle
R : Actuator length
X : Dog movement



The y value, which is the length between the reference mounting position and the dog bottom surface, which corresponds to the proper stroke:

y = a + b + r (mm)

a : Length between the reference mounting position and the actuator center
b : R**cos**θ
r : Roller radius
Y : Length from the reference mounting position and the dog bottom surface

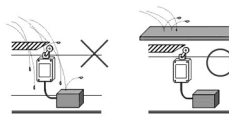
5. Roughness of the dog surface

The proper roughness of the dog surface is ▽▽▽(6.3 S), and the suitable quenching level is HV450.
Applying the grease (Molybdenum disulfide) to the contacting surface between the actuator and dog can reduce the friction and ensure smooth contact operation.

Limit Switch
ZXG Series

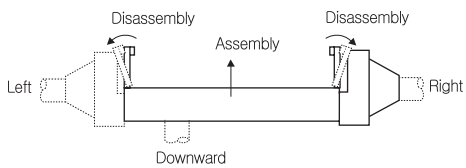
Terminal protection cover

- The terminal protection cover is made from durable plastic. Excessive force may deform or damage the product.
- The terminal protection cover can be removed or mounted using a (-) shaped driver.
- The proper size of wires that pass through the wiring lead-out (NBR) is Ø6.6 ~ Ø8.5.
- The purpose of the terminal protection cover is to prevent electric shock. Be sure to mount it before use.
- Do not use the product in or in contact with oil, because this product is not completely oil-tight. Contact our main office for the waterproof treatment for the terminal.
- Do not use this product in special environments (e.g., organic solvent, acid, alkali and cutting oil)



Terminal protection cover assembly/disassembly

1. Use a (-) driver and push the terminal protection cover in the arrowed directions to remove it.
2. After the wires are connected to terminal bolts, they can be led out to the left, right or downward directions.
3. The terminal protection cover can also be mounted in the user's desired direction (left or right).
4. The assembly is completed by pushing the terminal protection cover in the arrowed assembly direction until the click sound is heard.



Terminal mold type (IP64)

- The terminal part is waterproof (epoxy resin filling) (IP64) and heat-resistant.
- The product is provided with wires connected.
- Specify the wire length and lead-out direction in the order
- All general type products can be produced.

Tightening torque

The application of excessive force to bolts or nuts may lead to the damage to the product. Use the following tightening torque.

Side	M4 - Maximum 12kgf.cm / 1.2N.m
Body (Nut)	M4 - Maximum 12kgf.cm / 1.2N.m
Switch terminal	M3.5 - Maximum6kgf.cm 06N.m

Wires

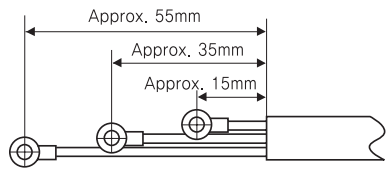
- The proper size of wires that pass through the wiring lead-out (NBR) is Ø6.6 ~ Ø?8.
- The use of VCTF cable is desirable.

■Wire specifications

No. of wire	Conductor (L)	Entire diameter (I)
2	0.75mm²	Ø6.6mm
	1.25mm²	Ø7.4mm
	2.0mm²	Ø8.0mm
3	0.75mm²	Ø7.0mm
	1.25mm²	Ø7.8mm

※VCTF: The cable for 300 V or less indoor small appliances, which is manufactured by insulating stranded copper wires with PVC.

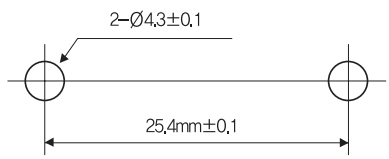
- When wiring the switch terminals, use the O-type crimp terminal with insulation shielding.



Mounting

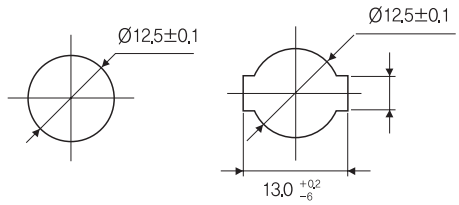
1. Side mounting

Process holes, and use M4 bolts to fix the product. The proper tightening torque is 12 kgf·cm/1.2 N·m.



2. Panel mounting (ZXG-301, 302 and 312)

After processing the panel as follows, and use the M12 hexagonal nuts attached to the product to fix it with a tightening torque of 50 kgf·cm/5.1 N·m or less.



Limit Switch

ELN Series

Part Number Description

ELN - ❶

❶ Head Type	03 : Push Plunger	030 : Roller Plunger	031 : Cross Roller Plunger	09 : Roller Lever Plunger

General Specification

Contact Form			1N/O + 1N/C		
Contact Material			Ag alloy		
Contact & Contact Distance			0.5mm		
Insulation Resistance			100MΩ 500VDC		
Contact Resistance			Max. 50mΩ		
Contact Rating	Non-Inductive	Resistance Load	15 125VAC 15 250VAC 2 500VAC	15A 8VDC 15A 14VDC 6A 30VDC 0.4A 125VDC 0.2A 250VDC	
			Norminal Open	Norminal Close	
		Lamp Load	1.5A 125VAC 1.25A 250VAC 0.5A 500VAC	1.5A 8VDC 1.5A 14VDC 1.5A 30VDC 0.4A 125VDC 0.2A 250VDC	3A 125VAC 2.5A 250VAC 0.8A 500VAC	3A 8VDC 3A 14VDC 3A 30VDC 0.4A 125VDC 0.2A 250VDC
	Inductive	Motor Load	5A 125VAC 3A 250VAC 0.8A 500VAC	10A 8VDC 5A 14VDC 3A 30VDC 0.05A 125VDC 0.03A 250VDC	
		Inductive Load	15A 125VAC 15A 250VAC 2A 500VAC	15A 8VD 10A 14VDC 5A 30VDC 0.05A 125VDC 0.03A 250VDC	
Maximum Inrush Current			Norminal Open	Norminal Close	
			15A	30A	

·The above figure means the normal current.
·The Inductive load has the power factor of 0.4 or above (AC) and a correction factor of 7m/s or lower (DC).
·The lamp load generates approx. 10 times more inrush current, while the motor load generates 6 times more.

Dielectrle Strength		2,000VAC 1 minute
Life Cycle	Electrical	Min. 100,000
	Mechanical	Min. 1,000,000
Vibration Resistance		10Hz ~ 55Hz Dual wave length 1.5mm
Shock Resistance	Malfunction	Max. 20G
	Destruction	Max. 200G
Degree Of Protection		Center Attachment type : IP65, Diagonal Attachment type : IP68
Ambient Temperature		-25°C ~ +80°C (with no icing)
Ambient Humidity		35% ~ 85% RH

☞ The above specification and the material can be changed without notice for the improvement of the quality.

Limit Switch

ELN Series

Product Selection

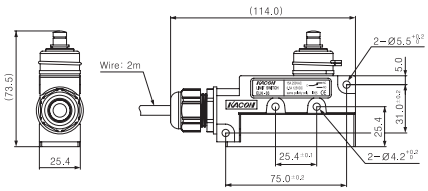
	Part Number	Head Type	Contact Form	Contact & Contact Distance
	ELN-03	Push Plunger	1N/O +1N/C	0.5mm
	ELN-030	Roller Plunger	1N/O +1N/C	0.5mm

	Part Number	Head Type	Contact Form	Contact & Contact Distance
	ELN-031	Cross Roller Plunger	1N/O +1N/C	0.5mm
	ELN-09	Roller Lever Plunger	1N/O +1N/C	0.5mm

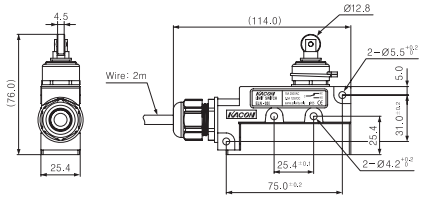
Dimension

(mm)

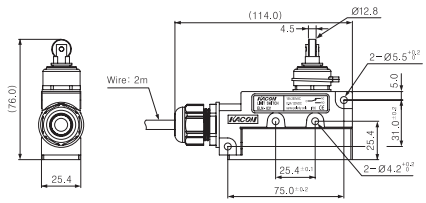
Push Plunger
ELN-03



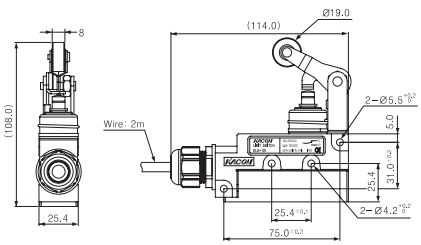
Roller Plunger
ELN-030



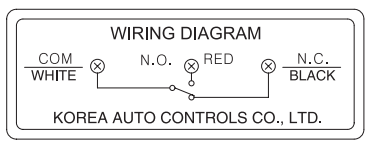
Cross Roller Plunger
ELN-031

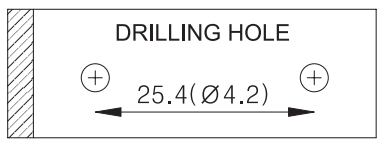


Roller Lever Plunger
ELN-09



Wiring Diagram And Attachment Processing Drawing





Limit Switch

E1Z4 Series

Part Number Description

E1Z4 - ❶ K1

❶ Head Type	P1 : Push Plunger	P2 : Roller Plunger	L1 : Roller Lever Plunger

Contact Part

Contact Form			1N/O + 1N/C			
Contact Material			Ag alloy			
Contact & Contact Distance			0.5mm			
Insulation Resistance			100MΩ 500VDC			
Contact Resistance			Max. 50mΩ			
Contact Ratings	Non-Inductive	Resistance Load		15A 125VAC 15A 250VAC 2A 500VAC	15A 8VDC 15A 14VDC 6A 30VDC 0.4A 125VDC 0.2A 250VDC	
		Lamp Load	Norminal Open		Norminal Close	
			1.5A 125VAC 1.25A 250VAC 0.5A 500VAC	1.5A 8VDC 1.5A 14VDC 1.5A 30VDC 0.4A 125VDC 0.2A 250VDC	3A 125VAC 2.5A 250VAC 0.8A 500VAC	3A 8VDC 3A 14VDC 3A 30VDC 0.4A 125VDC 0.2A 250VDC
	Inductive	Motor Load		5A 125VAC 3A 250VAC 0.8A 500VAC	10A 8VDC 5A 14VDC 3A 25VDC 0.05A 125VDC 0.03A 250VDC	
		Inductive Load		15A 125VAC 15A 250VAC 2A 500VAC	15A 8VD 10A 14VDC 5A 30VDC 0.05A 125VDC 0.03A 250VDC	
Maximum Inrush Current			Norminal Open		Norminal Close	
			15A		30A	

·The above figure means the normal current.
·The Inductive load has the power factor of 0.4 or above (AC) and a correction factor of 7m/s or lower (DC).
·The lamp load generates approx. 10 times more inrush current, while the motor load generates 6 times more.

General Specification

Dielectrle Strangth		2,000VAC 1 minute
Life Cycle	Electrical	Min. 100,000
	Mechanical	Min. 1,000,000
Vibration Resistance		10Hz ~ 55Hz Dual wave length 1.5mm
Shock Resistance	Malfunction	Max. 20G
	Destructive	Max. 100G
Degree Of Protection		IP67
Ambient Temperature		-25°C ~ +80°C (with no icing)
Ambient Humidity		35% ~ 85% RH
Tightening Torque		1.2N·m (12.24kgf·cm)

☞ The above specification and the material can be changed without notice for the improvement of the quality.

Limit Switch

E1Z4 Series

Operation Characteristics

characteristics \ model	E1Z4P1K1	E1Z4P2K1	E1Z4L1K1
OF	1000g	350g	680g
RF	220g	114g	170g
PT	2.0mm	0.5mm	4.5mm
MD	0.1mm	0.1mm	0.4mm
OT	5.0mm	3.6mm	5.5mm
TTP	7.0mm	4.1mm	10mm

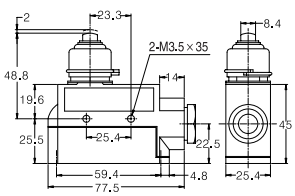
Product Selection

	Part Number	Head Type	Contact Form	Contact & Contact Distance	OF	RF	PT	MD	OT	TTP
	E1Z4P1K1	Push Plunger	1N/O + 1N/C	0.5 mm	1,000g Maximum	220g Maximum	2.0mm Maximum	0.1mm Maximum	5.0mm Minimum	7.0mm Minimum
	E1Z4P2K1	Roller Plunger	1N/O + 1N/C	0.5 mm	350g Maximum	114g Maximum	0.5mm Maximum	0.1mm Maximum	3.6mm Minimum	4.1mm Minimum
	E1Z4L1K1	Roller Lever Plunger	1N/O + 1N/C	0.5 mm	680g Maximum	170g. Maximum	4.5mm Maximum	0.4mm Maximum	5.5mm Minimum	10mm Minimum

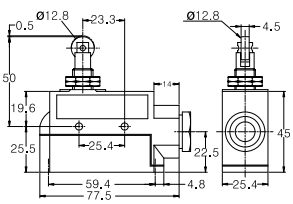
Dimension

(mm)

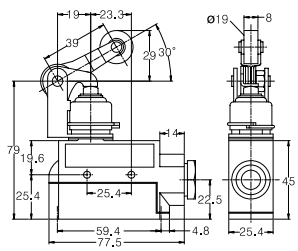
Plunger
E1Z4P1K1



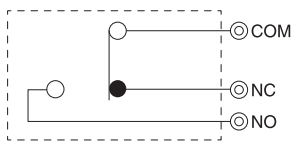
Roller Plunger
E1Z4P2K1



Roller Lever Plunger
E1Z4L1K1



Diagram



☞ The above specification and the material can be changed without notice for the improvement of the quality.

Waterlevel Switch & Leak Detector

FLR Series

Part Number Description

FLR - ❶ ❷

❶ Description	202 : Socket / 3pole	203 : Socket & Panel / 3pole	302 : Socket / 2pole
	201 : Panel / 3pole	261 : 5Pole Panel Mounting (option)	
❷ Sensitivity	B: General Sensitivity	C : High Sensitivity	

HS - ❶ A

❶ Poles	3 : 3Pole	5 : 5Pole (option)

General Specification

Recede type							
Mounting		**Socket**		**Socket+Panel**		**Socket**	
Poles		FLR - 202B	FLR - 202C	FLR - 203B	FLR - 203C	FLR - 302C	
		3 pole	3 pole	3 pole	3 pole	2 pole	
Sensitivity	**Operating**	5kΩ	25kΩ	5kΩ	25kΩ	0 Sensitivity : 5kΩ	50 Sensitivity : 70kΩ
	Return	15kΩ	35kΩ	15kΩ	35kΩ	0 Sensitivity : 50kΩ	50 Sensitivity : 200kΩ
Purpose		General sensitivity	High sensitivity	General sensitivity	High sensitivity	Leak detection	
Supply Voltage		220AVC					
Rated Current		5A 250VAC					
Dieletric Strength		2,000VAC 1 minute					
Insulation Resistance		100MΩ 500VDC					

Exposure type			
		FLR - 201B	FLR - 261B (option)
Poles		3 pole	5 pole
Sensitivity	**Operating**	5kΩ	
	Return	15kΩ	
Purpose		General Sensitivity	
Supply Voltage		220/110VAC	
Rated Current		5A 250VAC	
Dieletric Strength		2,000VAC 1 minute	
Insulation Resistance		100MΩ 500VDC	
Tightening Torque		0.8N·m (8.16kgf·cm)	

☞ The specification and material of the product can be changed without notice for higher quality.

Waterlevel Switch & Leak Detector

FLR Series

Product Selection

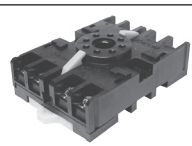
	Type	Sensitivity	
		General	High
	3 Pole Socket	FLR - 202B	FLR - 202C
	2 Pole Socket		FLR - 302C
	3 Pole Panel Mounting	FLR - 201B	

	Type	Sensitivity	
		General	High
	3 Pole Socket +Panel	FLR - 203B	FLR - 203C

Resistance is lowered by water leakage, leak detection zone is wet the internal relay (Terminal 3-4 is closed between state), it is deenergized in alarm.
3-4 between terminal are open to stop the leak, leak detection zone dries, warning I returned to the normal state from the information.
The power is turned OFF, 3-4 between terminal is closed, you will alarm.

Power status	Leak Detection	Indicator (red)	Alarm contacts (terminals 3-4)
Power On	Detection	OFF	ON
	Non-detection	Blinking	OFF
Power Off	Power Off	OFF	ON

	Type	2 Pole	3 Pole	4 Pole	5 Pole
	Electrode Holder	HS - 2A	HS - 3A	HS- 4A	HS- 5A

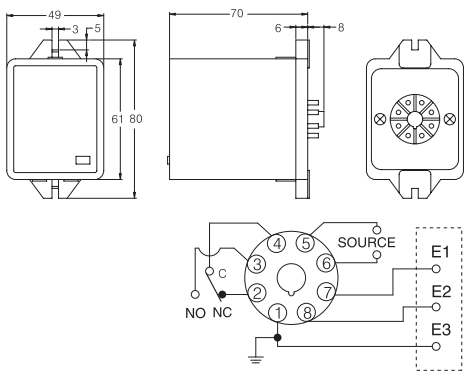
	Type	3 Pole	5 Pole
	Socket	K2CF08K K2CF08 (203 socket) K2BF08 (203 panel)	

	Type	5 Pole,Panel Mounting	FLR - 261B (option)
			

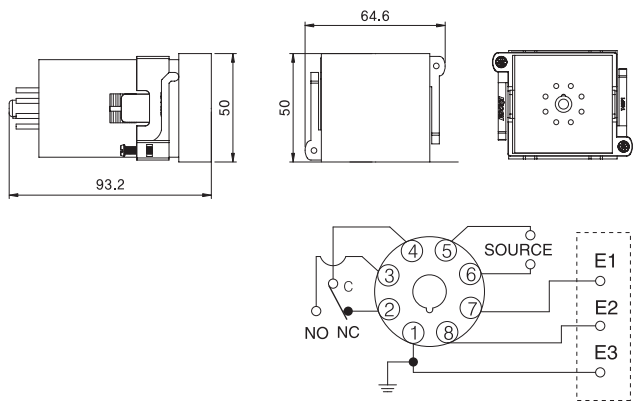
Dimension & Diagram

(mm)

FLR-202B / FLR-202C



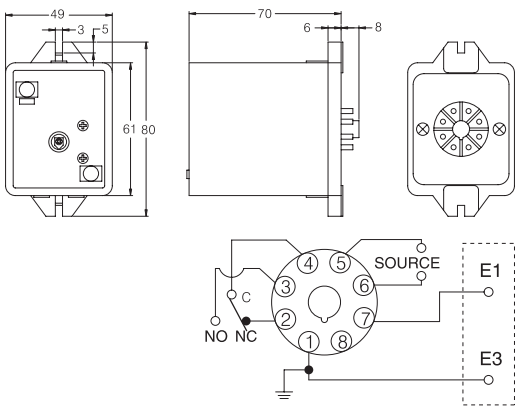
FLR-203B / FLR-203C



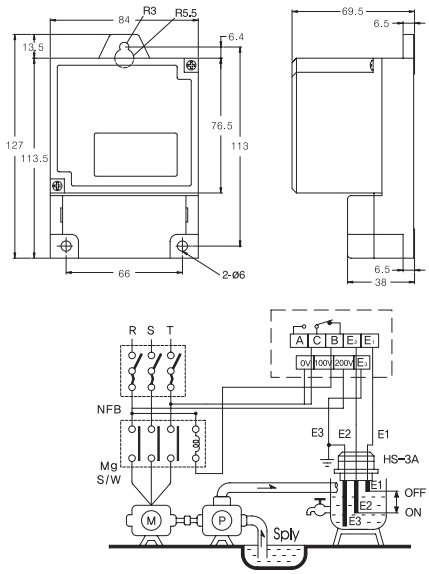
Dimension & Diagram

(mm)

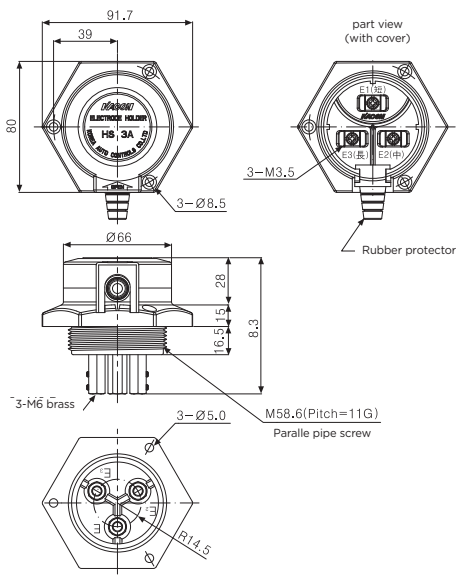
FLR-302C

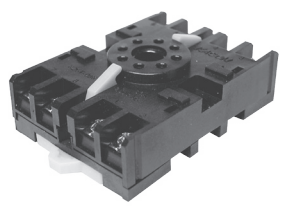


FLR-201B



HS-3A





FLR socket

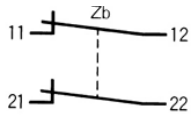
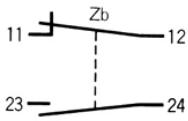
Actuator Safety Switch

ZXS Series

Part Number Description

ZXS - ❶ ❷

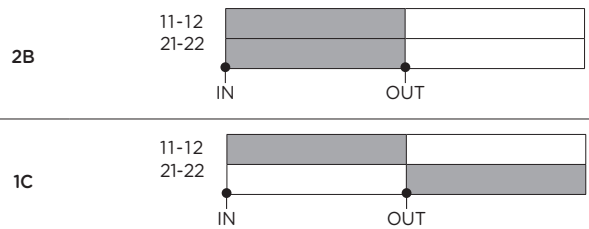
❶ Contact arrangement

2B	2N/C	
1C	1N/O + 1N/C	

❷ Actuator

H (Horizontal Type)		Steel
V (Vertical Type)		Steel
A (Adjustable Type)		Steel+Plastic

The Contact Operating Chart



: Contact Closed

: Contact Open

IN : Actuator insertion position

OUT : Actuator release position

Specification

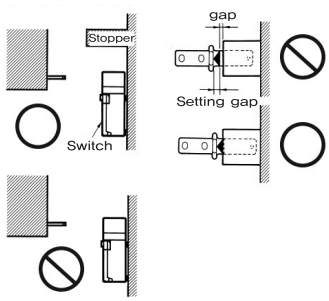
Contact Form		2N/C, 1N/O + 1N/C
Contact Material		Ag Alloy / 24K Au Plate
Rated Current (Resistance Load)		3A 240VAC
Insulation Resistance		100MΩ 500VDC
Contact Resistance		Max. 15mΩ
Life Cycle	Mechanical	Min. 10,000,000
	Electrical	Min. 300,000 Apply Rated Current
Maximum Rated Voltage		600V
Dielectric Strength		1,500VAC 50/60Hz 1 minute
Vibration Resistance		10 ~ 55Hz Durable Amplitude 1.5mm
Degree of Protection		IP65 (Contact Part) / IP00(Operation Key Part)
Ambient Temperature		-20 ~ 80℃ (With no icing)
Ambient Humidity		90%RH

Caution

- Do not use the product in, nor in the environment influenced by, water or oil. Water or oil may penetrate inside (The protection standard IP67 tests the product in the water for a specific time and checks the water penetration).
- The switch body is protected against dusts and water, but the head is not. Do not allow the entrance of foreign matters because it may be a cause of early wear and damage.
- After wiring, be sure to mount the cover before use. Otherwise, it may cause an electric shock.

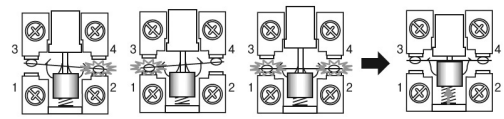
● Stopper installation

Do not use the body as a stopper.
Be sure to mount a stopper and make it within the operating key setting area for the edge of the operation key to be separated from the head part.



● **Forced open circuit operation**

When the contact weld appears, the plunger pushes the terminals back to forcefully separate the NC contact.



Dimension

● **Proper tightening torque**

Loosened screws are the cause of early faults. Tighten the screws with a proper torque.

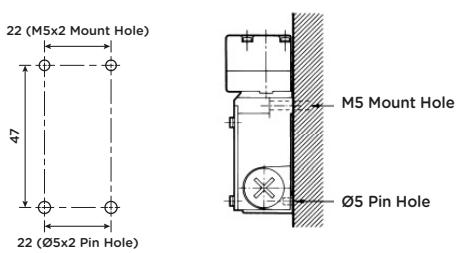
Type	Proper torque
Terminal screw / Earth terminal included	0.59 ~ 0.78N.m
Cover mounting screws*1	1.18 ~ 1.37N.m
Head mounting screw	0.78 ~ 0.98N.m
Body mounting screws*2	4.90 ~ 5.88N.m
Key mounting screws	2.35 ~ 2.75N.m
Connector	1.77 ~ 2.16N.m
Screw Cap	1.27 ~ 1.67N.m

• 1. Three-lead-in type: 0.78 ~ 0.88 N·m

• 2, Use the M5 screws.

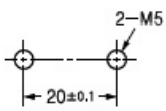
Tighten bolts with a torque of 4.90 ~ 5.88 N·m, and countersunk head screws with a torque of 2.35 ~ 2.75 N·m.

● **Mount Cut Dimensions**

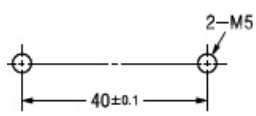


● **Operation Key Mount**

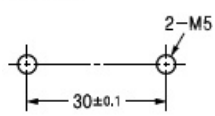
Horizontal Mount Type



Vertical Mount Type



Adjustable Type



Mount the switch body and operation key with screws or equivalent so that they are not easily removed, to ensure safety.

More reliable interface between
human and machines.

Machines and engineers sharing senses.