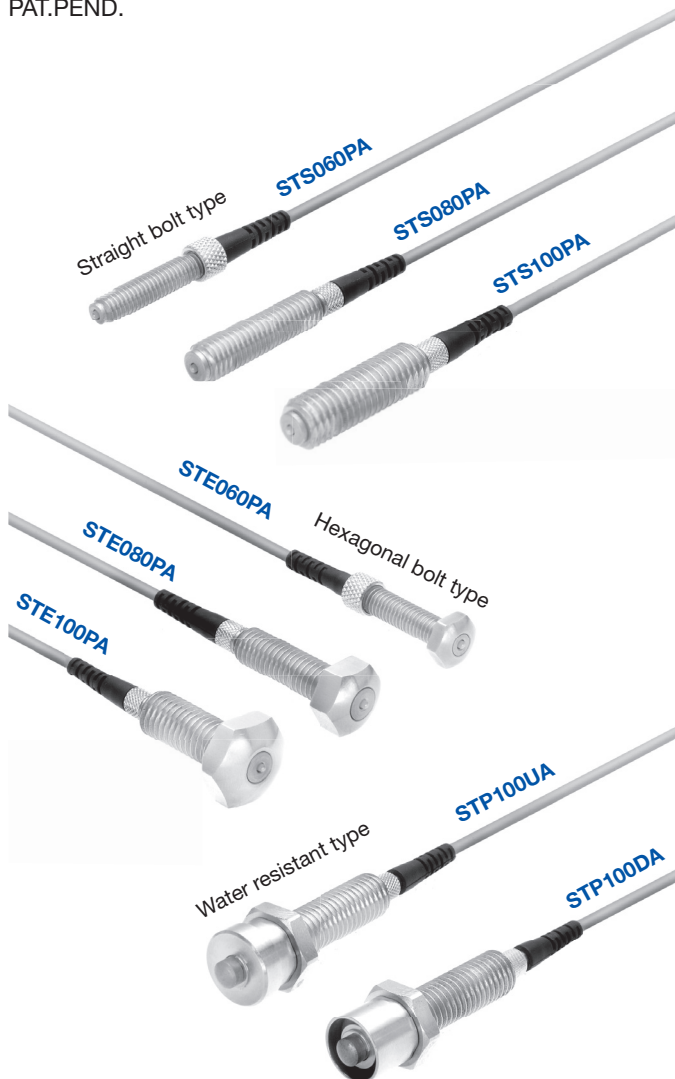


Stopper Bolt with a Built-in Switch

STS / STE / STP

Seating check, plunger type
Straight touch type

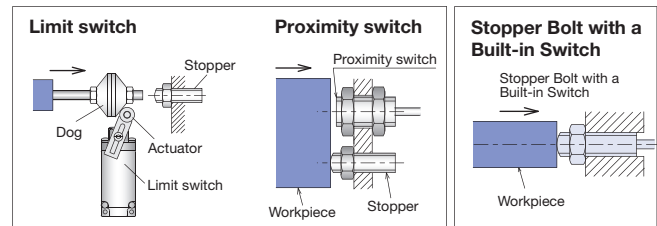
PAT.PEND.



- **2 tasks with 1 device.**
Housing a high-accuracy built-in switch in a stopper bolt

Realization of compact machine size by reducing the number of parts.

Differences from conventional switches



No need of dogs and stopper bolts → Compact machine design

- **Maintenance cost is greatly reduced by applying cartridge type**

- When replacing the switch because of breakdown, no need for detaching the stopper bolt or adjusting the position of it, thereby simplifying the maintenance procedure.
- No need to visit customer sites for repair
- Install stopper bolt and adjust the position before installing the built-in type switch to avoid the twisting of the cable.



- **Improve the availability ratio of the machine and cut-down maintenance time (MTTR)**

Standard product name

unit:mm

Shape	Standard product name	Output mode	Size	Protective structure	with LED	Cartridge name
Straight bolt type	STS060P A/B	A : Normally open B : Normally close	M6×1	IP65 *1	STS060P A/B- L	KS21PA/KS21PB
	STS080P A/B		M8×1.25		STS080P A/B- L	KS23PA/KS23PB
	STS100P A/B		M10×1.5		STS100P A/B- L	KS23PA/KS23PB
Hexagonal bolt type	STE060P A/B		M6×1		STE060P A/B- L	KS21PA/KS21PB
	STE080P A/B		M8×1.25		STE080P A/B- L	KS23PA/KS23PB
	STE100P A/B		M10×1.5		STE100P A/B- L	KS23PA/KS23PB
Water resistant type	STP080U A/B		M8×1.25	IP67	STP080U A/B- L	KS30A/KS30B
	STP100U A/B		M10×1.5		STP100U A/B- L	
	STP080D A/B		M8×1.25		STP080D A/B- L	
	STP100D A/B		M10×1.5		STP100D A/B- L	

e.g. STS060PA, STS060PB

-L : LED indicator (120mm from the switch)
Add "-L" after cartridge name for LED type
e.g.) KS21PA -L

unit:mm

Common specification

Switch structure	Dry contact
Output mode	A: Normally open / B: Normally close
Signal point	0.3 from stopper surface
Stroke	0.7
Repeatability	Both On→Off, Off→On/ 0.01 (At operating speed 50~200mm/min)*1
Movement differential	0
Contact life time	10 million (See before 3-4)
Contact force	STS, STE: 2N STP: 4N
Contacting part material	SUS HRc40~50
Hardness of the stopper surface	SUS HRc40~50

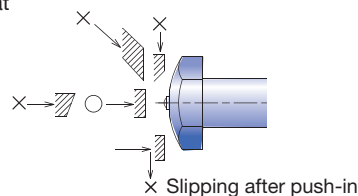
*1 Operating speed slower than 10mm/min is not recommended.

Withstand load	5000N
Impact resistance	0.4J
Cable (Refer to P2-4)	Standard length 2m Oil resistant $\phi 2.8$ / 2 cores, Tensile strength 30N, minimum bending R7 Cable protector (Detachable)
Operating temperature range	0°C~80°C (Ice-free)*2
Temperature drift	0
Oscillation	10~55Hz total amplitude 1.5 for X,Y,Z each direction
Impact	300m/s ² for X,Y,Z each direction
Contact rating	DC5V~DC24V 10mA (MAX20mA) Resistance load
Standard accessory	Two fixing nuts and a toothed washer

*2 The sealed waterproof structure, when used under temperature (below 5°C) causes delay in return.

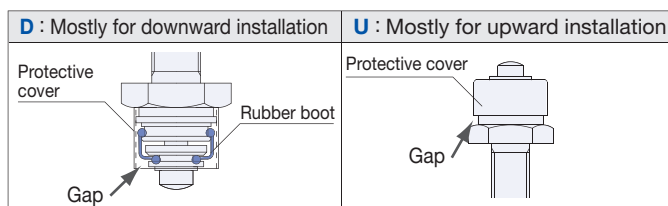
How to use

Make contact with the object at right angle
(with deflection angle $\pm 3^\circ$)



Protective covers

The protective cover protects rubber boot from damage caused by metal cuttings etc. and prevents impairment of water- and dust-resistant property. Choose the suitable cover according to switch mounting direction so that the metal cuttings and coolant can't enter from the gaps (See the drawings below and also refer to P6-7).



For metal cuttings and coolant

Protective cover is strongly recommended to avoid damage from cuttings and coolant when the switch is used in machining environment. In addition, an extra cover is recommended to avoid direct hit by high-pressure coolant or heavy cuttings.

Screw / nut tightening torque

	Screw / Nut	Tightening torque	Applicable models
Machine Components with a Built-in Switch	M6×1	8N·m	ST
	M8×1.25	20N·m	
	M10×1.5	35N·m	
Stopper-Mini	M10×0.75	10N·m	STM

Circuit diagram

No LED	with LED
<p>Normally open (NO)</p> <p>Normally close (NC)</p>	<p>Normally open (NO)</p> <p>with LED (Normally Off)</p> <p>Normally close (NC)</p> <p>with LED (Normally On)</p>

Electrical specification / circuit diagram. (Refer to P2-1)

CL type interface unit cannot be used with LED.

When using the switches with LED option, limit the current below 10mA.

Instruction for cartridge installation

- Anti-loosening agent is applied to the screw of the built-in cartridge. And the screw is not tightened on delivery. Tighten the screw by fingers activating the anti-loosening agent.
- Do not tighten the screw by pliers. It may cause damage to the switch.
- The cartridge is thin. Handle it carefully.
- When installing the cartridge type switches, give consideration to enough space to replace the cartridge.

Protective covers (Old Type)

unit:mm

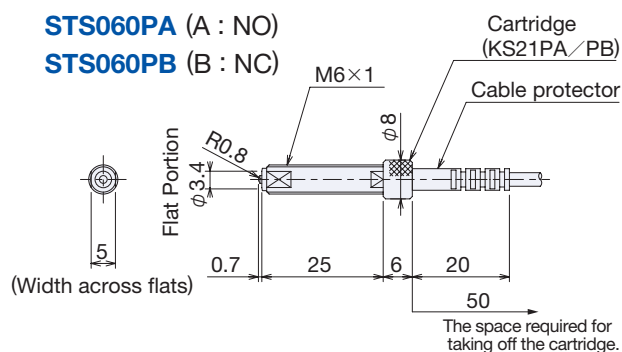
Standard product name	Output mode	Size	Protective structure	Cartridge name
STS060 A/B	A : Normally open	M6	IP40	KS21A / KS21B
STS080 A/B		M8		KS23A / KS23B
STS100 A/B		M10		KS21A / KS21B
STE060 A/B	B : Normally close	M6		KS21A / KS21B
STE080 A/B		M8		KS23A / KS23B
STE100 A/B		M10		KS23A / KS23B

Outer dimension

Straight bolt

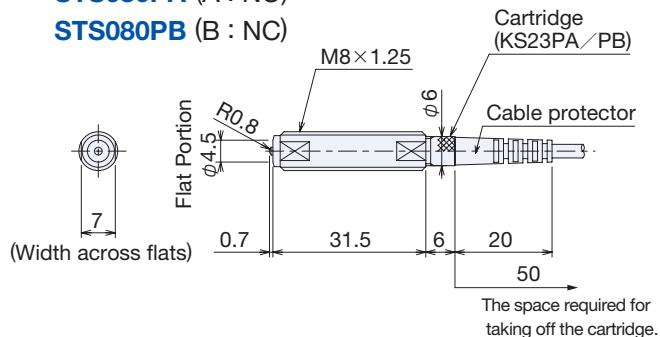
STS060PA (A : NO)

STS060PB (B : NC)



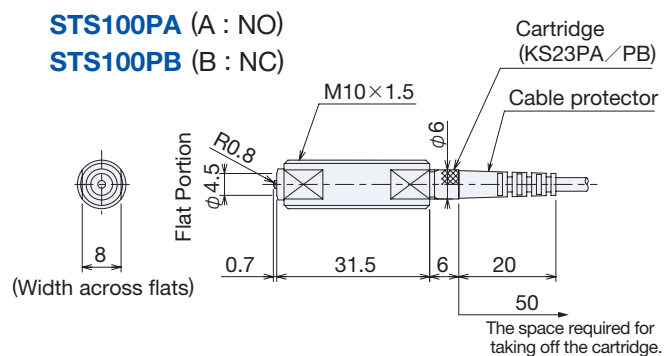
STS080PA (A : NO)

STS080PB (B : NC)

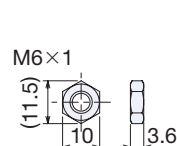
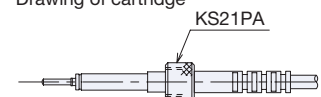


STS100PA (A : NO)

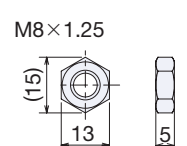
STS100PB (B : NC)



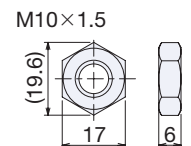
Drawing of cartridge



Material: SUS304



Material: SUS304

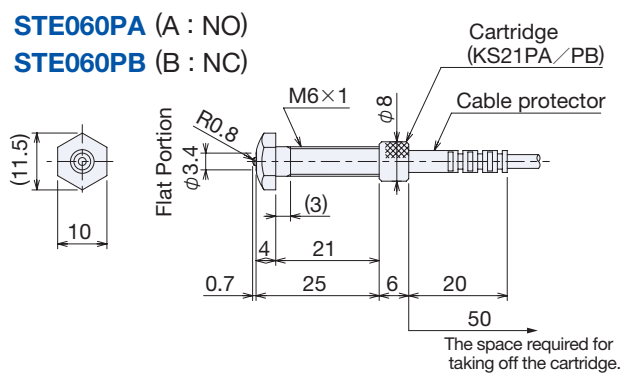


Material: SUS304

Hexagonal bolt type

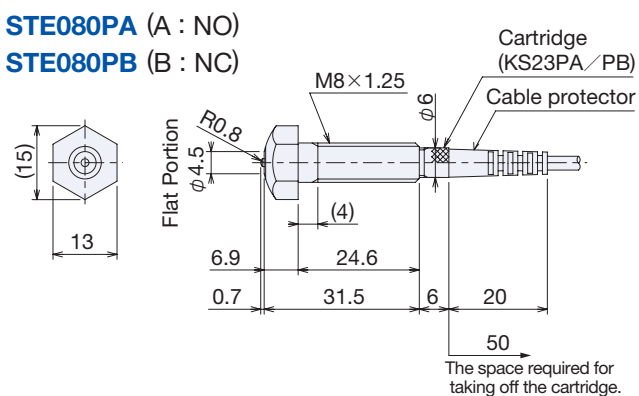
STE060PA (A : NO)

STE060PB (B : NC)



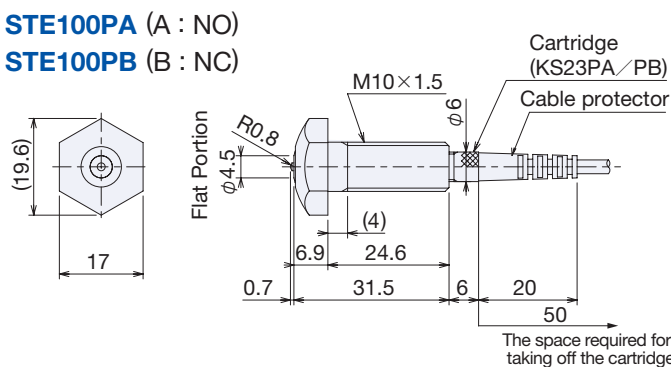
STE080PA (A : NO)

STE080PB (B : NC)

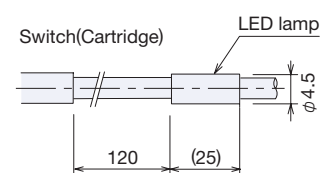


STE100PA (A : NO)

STE100PB (B : NC)



(-L: LED indicator)



Outer dimension

Water-resistant type (IP67)

with upward protective cover

STP080UA (A : NO)

STP080UB (B : NC)

STP100UA (A : NO)

STP100UB (B : NC)

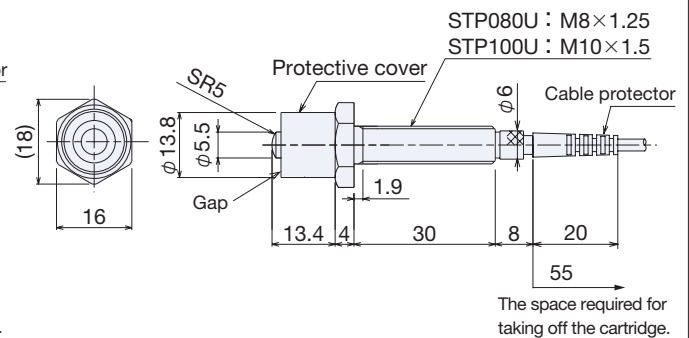
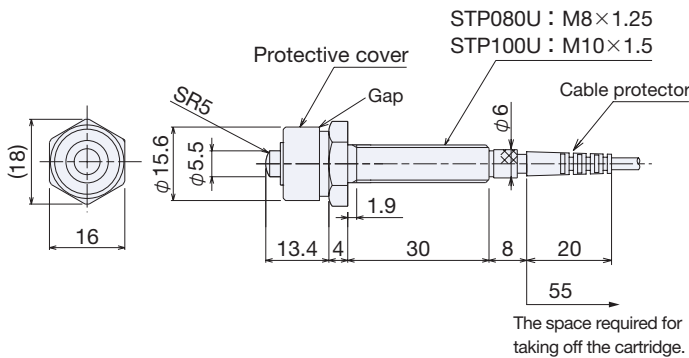
with downward protective cover

STP080DA (A : NO)

STP080DB (B : NC)

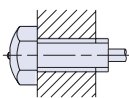
STP100DA (A : NO)

STP100DB (B : NC)

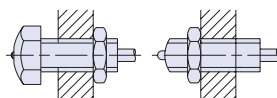


How to fix the sensor

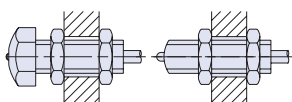
Simply screw in
(No need for position setting)



Screw in to the mounting hole
and apply a lock nut



Insert the switch in the mounting
hole and apply two fixing nuts*



* Level 2 bracket screws, please note the increase of impact resistance.

Impact-resistance calculation

Inertia collision

$$E = 1/2mv^2$$

m : Mass kg

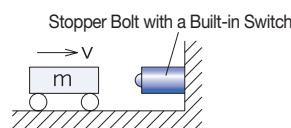
v : Speedm/s

Vertical free fall

$$E = mgh$$

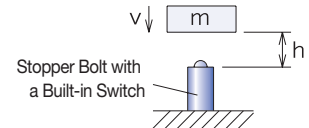
g : Gravitational acceleration 9.8m/s²

h : Dropping height m



e.g.)

m	v	$mv^2/2$ [J]
80	0.1	0.4
320	0.05	0.4
80	0.05	0.1

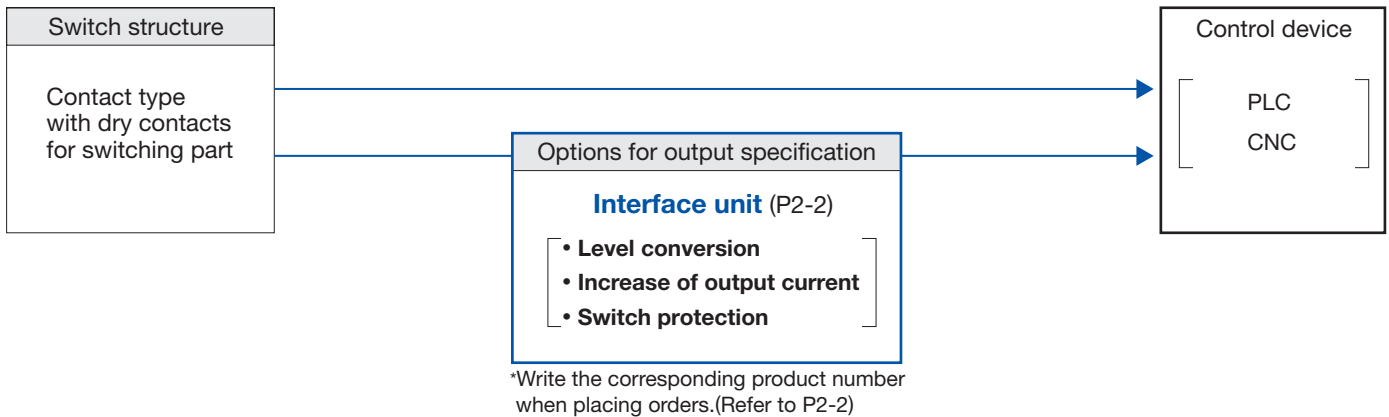


e.g.)

m	h	$v = \sqrt{2gh}$	mgh [J]
0.4	0.05	1	0.2
0.4	0.1	1.4	0.4

Contact type with dry contacts for switching part

Block diagram



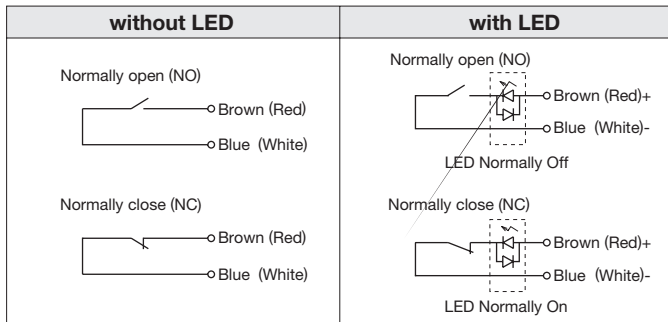
Specification

Contact rating	DC+5V~DC+24V 10mA (MAX20mA) Resistance load (Switch without LED,DC1V-24V possible)
Insulation resistance	More than 100MΩ with DC250V Megger
Output mode	A : Normally open or B : Normally close

Refer to P6-3 about how to use switches under the condition of AC100V-200V.

Circuit diagram

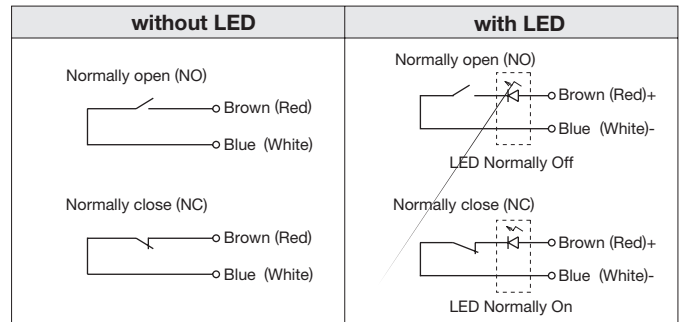
High-accuracy MT-Touch Switch 1-signal type (Old wire color)



When using the switches with LED option, limit the current below 10mA.

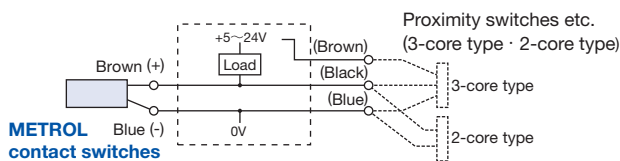
CS-Touch Switch and others
(Other sensors 1-signal types)

(Old wire color)

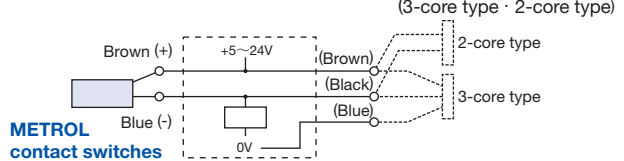


How to replace currently using proximity switches (3-core and 2-core type) with METROL (2-core type)

NPN output



PNP output



Interface unit

Electrical specification

Power supply voltage	DC24V $\pm 10\%$ (Full-wave rectification with ripple 5% or less)
Power consumption	30mA
Input	One contact signal
Output	Transfer output (in-phase or inverted output)
Operating temperature range	0°C~50°C

- When using the switches (except MT-Touch Switch) with the interface unit, the option for the LED attached on the switch is not available.
- The diode is attached in parallel to the LED for MT-Touch Switch for the cases where the switch is used with the interface unit.
- No diode is attached to the switches except for MT-Touch Switch.

Characteristics

1) Protection for the dry contacts from inrush current

- The interface unit is not needed, when using the switches under the contact rating. The switch side of the interface unit has high-frequency alternating current control and it reduces the influence of sparks and chattering caused by vibration.
- Being separated from I/O circuit, the dry contacts of the switches remain intact from sudden inrush current.

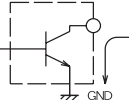
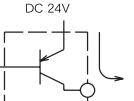
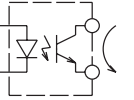
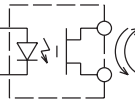
2) Increase the output current (except photo coupler type)

- Enable to drive a relay or similar devices directly.
- When driving a relay by this unit, the repetitive accuracy would be lowered due to delay of the relay.

3) Level conversion unit

- Level conversion (normally close to normally open, normally open to normally close)

Output specification

Product name		CL-1N	CL-1P	CL-1FT	CL-1F	CL-1FH
Output method		NPN-TR	PNP-TR	Photo coupler	Photo Mos relay	
Diagram						
Output level		0V sink	24V source	No-voltage floating output		
Output capacity		DC24V 100mA 350mW		DC30V 20mA 120mW	AC/DC60V 100mA 240mW	AC/DC200V 100mA 240mW
Operating time	Delay	100μsec (Representing value)			500μsec(Representing value)	
	Spread	20~100μsec			10~20μsec	

Outer dimension

Terminal layout

In-phase output: 1, 4, 5, 8, 9, 12, 13, 14

Inverted output: 1, 4, 5, 8, 9, 12, 13, 14

Switch input: (-) DC24V (+)

[BOTTOM VIEW]

No terminal block is provided. Refer to the following.

Panasonic: HC2-SFD-S

Omron: PYF-08A

Connecting diagram with electrical load

CL-1N

CL-1P

CL-1FT

CL-1F/CL-1FH

Connection diagram (Plural switches)

When connecting plural switches to one plug-in type interface unit, refer to the diagram below.

It is available only for the switches without LED.

- Make sure no noise and inductive source.
- Overall length of the sensor side cables should be in 100mm.

Precautions

- 1) Do not connect the load exceeding the output rating specified for each model. Since the switching parts and interface elements may be damaged due to the flow of current in excess of the rating caused by noise or surge induction, place the switch at an adequate distance from any power lines or other sources of noise.
- 2) As a rule of thumb, connect one switch to one unit.
- 3) Select the installation location of I/F unit so that the cable length between the switch and the I/F unit should not exceed 20m .
- 4) Since the I/F unit is not water-proof, protect it from moisture such as water and oil.
- 5) In case of using Normally-open type switch with a LED indicator, I/F unit can be used only when the LED is normally OFF and turns ON in operation. Similarly, for Normally-Close type switch, the unit can be used only when the LED is normally ON and turns OFF in operation.
- 6) This I/F unit is especially designed for the METROL switches, do not use this I/F unit with the switch from other manufacturers.

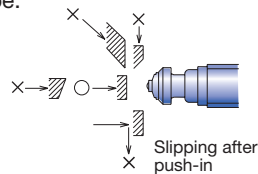
Common warnings and precautions

Electrical

- Use under the specified contact rating.
- Chattering may occur when opening and closing the circuit with dry contacts regardless of whether the switch has a snap action mechanism. Take the first signal as a judgment signal.
- In adverse condition such as using a magnet coil for inductive load and over current may occur, regardless of whether the switch has dry contacts or is contact-less using interface unit with built-in surge protection unit is recommended(Refer to P2-2).
- When using the switch with LED, keep the current below 10mA.

How to use

- When using the plunger type with plain bearing, make contact with the detected object at right angle (with deflection angle $\pm 3^\circ$). For sliding, rotating, angled, offset objects, use ball bearing type or contacting ball type.



- When the plunger is pushed straight by the detected object, do not allow the object to abruptly slide away, as it will cause the plunger to snap back. Note that this may cause failure of the bearing and built-in switching part.
- Because offset distance (misalignment with axis of the plunger) should be shorter than 5mm, the maximum diameter for detecting surface is 10mm for the plunger type with plain bearing.
- In case the detected surface is angled or ragged, note that the switch may fail to operate properly or cause malfunction.
- If the contacting part is worn away depending on conditions, the signal point becomes different. When designing the detected objects, give consideration to its angle, chamfer and roughness so that the contacting part holds up longer. (Mainly for sliding touch type)

Operating environment

- Use in the environment in where cuttings and dust don't prevent switch movement.
- Choose protective cover option in case cutting may damage the rubber boot.
- An extra cover is recommended to avoid direct hit by high-pressure coolant or heavy cuttings.

Contacting part material

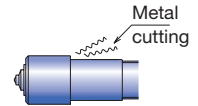
- Even though hardened stainless steel is used as the material of the contacting part or stopper surface (for Stopper Bolt with a Built-in Switch series), they are oxidized and may gather rust under certain conditions.

Rubber for protective structure (boot, seal, O-ring)

- Rubbers for some products are intended for water-soluble cutting oil (Alkaline). For oily, chlorine-base, coolants and other chemicals, consult METROL for assistance.
- The rubber material for High-accuracy MT-Touch Switch and CS-Touch Switch is for both oily and water-soluble coolants.

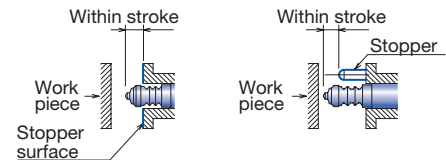
Installation

- Ensure that the threaded part of the switch is not bent during installation.
- When using fixing screws, do not tighten the screws with excessive force. That may distort the switch shape or restrict the movement of the plunger. If the fixing screws are damaged, the switch can be stuck and difficult to be detached.
- When the switch with a protective cover is installed horizontally, an extra cover is needed separately to prevent coolant or cuttings from entering inside and getting piled up on the switch.



For the switches without stopper

- Do not excessively press the plunger to the stroke end. It may cause malfunction due to impact.
- If there is possibility to press the plunger to the stroke end, install a separate stopper to prevent malfunction.



For cartridge type switches

- Tighten the cartridge firmly by fingers. Do not use pliers to fix it. That may cause malfunction.
- The cartridge is thin. Handle it carefully.
- When installing the cartridge type switches, give consideration to enough space to replace the cartridge.

Screw / nut tightening torque Screw / Nut

	Screw / Nut	Tightening torque	Applicable models
PT-Touch Switch	M5×0.5	1N·m	PT
MT-Touch Switch	M8×0.5	4N·m	P085DB
	M10×0.5	8N·m	P10
	M14×0.5	10N·m	P10DH
CS-Touch Switch	M5×0.5	2N·m	CSJ055
	M6×0.75	4N·m	CS067
	M8×0.75	7N·m	CSP087
	M10×0.5	8N·m	CSM
	M21×1	12N·m	CSH
Machine Components with a Built-in Switch	M6×0.5	2N·m	ST BP SP
	M6×1	8N·m	
	M8×1.25	20N·m	
	M10×1.5	35N·m	
Stopper-Mini	M10×0.75	10N·m	STM

Cables and cable protection

Type of cable

Cabtyre cable

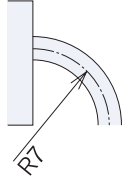
Cabtyre cables are used as robot cables without any safety compromise since the working voltage and current are low, though cabtyre cables are not applicable to UL, CSA, EN or other safety standards.

Specification

Conductor material	Copper-tin alloy, tight winding
Conductor resistance	1Ω/m (per 1 core)
Sheath material	PVC (Non-migrating styrene, oil-resistant, alkaline-resistant)
Minimum bending radius	7mm
Outer diameter	$\phi 3$ (2-core) $\phi 3.5$ (3-core) $\phi 4$ (2-core for dry contact type, 3-core for contact-less type and 5-core for dry contact type) $\phi 5$ (s-core, 3-core) $\phi 5.5$ (5-core)
Sheath color	Black : 2 cores, 3 cores for normally close Gray : 2 cores, 3 cores for normally open (Excludes MT-Touch Switch Series)

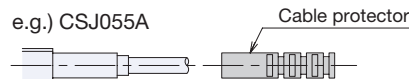
Handling instruction

- 1) Do not pull or twist the cable with excessive force. Max.30N (3kgf)
- 2) Water-resistance →P6-7
- 3) When extending cable length, use cabtyre cable having a cross-section area of at least 0.02mm².
- 4) The minimum bending radius is 7mm.



Cable protector (Depending on products)

e.g.) CSJ055A



Core-wire cable

For CS-Touch Switch CSM short type (P4-7) and stopper-mini type (P5-16)

Specification: $\phi 0.6$ AWG 30 (0.05mm²) Tensile strength 15N

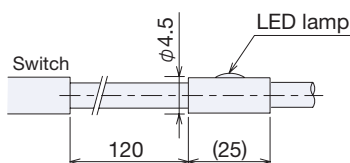
Cross-section area / weight(Including sheath / 1m)

$\phi 2.8$	2-core	AWG 26	(0.151mm ²)	10g
$\phi 3.5$	3-core	AWG 28	(0.096mm ²)	15g
$\phi 4$	2-core	AWG 30	(0.063mm ²)	16g
$\phi 4$	3-core	AWG 28	(0.096mm ²)	19g
$\phi 4$	5-core	AWG 28	(0.096mm ²)	21g
$\phi 5$	2-core	AWG 30	(0.063mm ²)	26g
$\phi 5$	4-core	AWG 30	(0.063mm ²)	32g
$\phi 5$	3-core	AWG 30	(0.063mm ²)	26g
$\phi 5.5$	5-core	AWG 30	(0.063mm ²)	33g

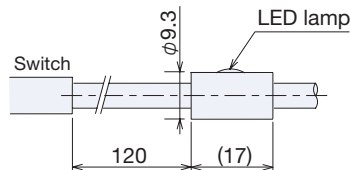
Outer dimension

L : Tubular type

Cable $\phi 3$ or smaller



Cable $\phi 4$



Cable $\phi 5$

