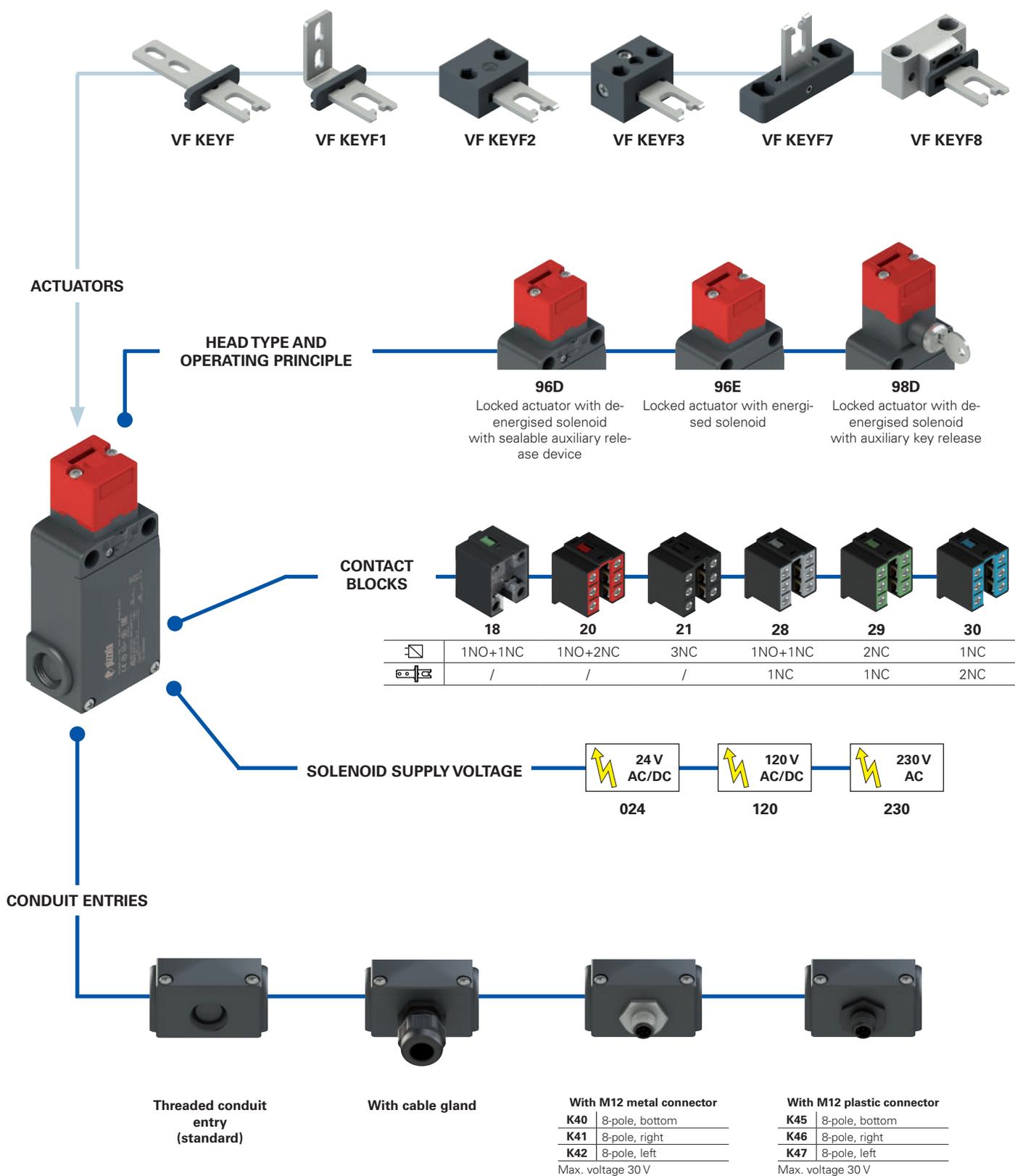


Selection diagram



● product option  
 → Sold separately as accessory



**Code structure** **Attention!** The feasibility of a code number does not mean the effective availability of a product. Please contact our sales office.

article options options  
**FS 1896D024-F1GM2K40V34**

Contact block		
	Contacts activated by the solenoid 	Contacts activated by the actuator 
<b>18</b>	1NO+1NC	/
<b>20</b>	1NO+2NC	/
<b>21</b>	3NC	/
<b>28</b>	1NO+1NC	1NC
<b>29</b>	2NC	1NC
<b>30</b>	1NC	2NC

Auxiliary release options (only for articles FS **98D**)	
	The key can be removed in locked and unlocked actuator position (standard)
<b>V34</b>	The key can be removed only in the locked position of the actuator
<b>V70</b>	Key release with triangular key with spring return.
<b>V73</b>	Key release with triangular key, no spring return.

Head type and operating principle	
<b>96D</b>	locked actuator with de-energised solenoid with sealable auxiliary release device
<b>96E</b>	locked actuator with energised solenoid
<b>98D</b>	locked actuator with de-energised solenoid with auxiliary key release

Solenoid supply voltage	
<b>024</b>	24 Vac/dc (-10% ... +25%).
<b>120</b>	120 Vac/dc (-15% ... +20%)
<b>230</b>	230 Vac (-15% ... +10%)

Pre-installed cable glands or connectors	
	no cable gland or connector (standard)
<b>K23</b>	cable gland for cables Ø 6 ... 12 mm
...	.....
<b>K40</b>	M12 metal connector, 8-pole
...	.....
<b>K45</b>	M12 plastic connector, 8-pole
...	.....

For the complete list of possible combinations please contact our technical department.

Actuators	
	without actuator (standard)
<b>F</b>	straight actuator VF KEYF
<b>F1</b>	angled actuator VF KEYF1
<b>F2</b>	jointed actuator VF KEYF2
<b>F3</b>	jointed actuator adjustable in two directions VF KEYF3
<b>F7</b>	jointed actuator adjustable in one direction VF KEYF7
<b>F8</b>	universal actuator VF KEYF8

Threaded conduit entry	
<b>M2</b>	M20x1.5 (standard)
	PG 13.5

Contact type	
	silver contacts (standard)
<b>G</b>	silver contacts with 1 µm gold coating
<b>G1</b>	silver contacts, 2.5 µm gold coating (not for contact blocks 20, 21, 28, 29, 30)



### Main features

- Technopolymer housing, three conduit entries
- Protection degree IP67
- 6 contact blocks available
- 6 stainless steel actuators available
- 3 solenoid supply voltages available
- Versions with auxiliary release device or turnable lock
- Operation with energised or de-energised solenoid

### Quality marks:



IMQ approval:	CA02.03808
UL approval:	E131787
CCC approval:	2020970305002281
EAC approval:	RU C-IT.YT03.B.00035/19

### Technical data

#### Housing

Housing made of glass fibre reinforced technopolymer, self-extinguishing, shock-proof and with double insulation:	<input type="checkbox"/>
Three knock-out threaded conduit entries:	M20x1.5 (standard)
Protection degree:	IP67 acc. to EN 60529 with cable gland of equal or higher protection degree

#### General data

SIL (SIL CL) up to:	SIL 3 acc. to EN 62061
Performance Level (PL) up to:	PL e acc. to EN ISO 13849-1
Interlock with mechanical lock, coded:	type 2 acc. to EN ISO 14119
Coding level:	low acc. to EN ISO 14119
Safety parameters:	
$B_{10D}$ :	4,000,000 for NC contacts
Mission time:	20 years
Ambient temperature:	-25°C ... +60°C
Max. actuation frequency:	600 operating cycles/hour
Mechanical endurance:	800,000 operating cycles
Max. actuation speed:	0.5 m/s
Min. actuation speed:	1 mm/s
Maximum force before breakage $F_{1max}$ :	1100 N (head 96), 900 N (head 98) acc. to EN ISO 14119
Max. holding force $F_{Zh}$ :	846 N (head 96), 692 N (head 98) acc. to EN ISO 14119
Maximum clearance of locked actuator:	4.5 mm
Released actuator extraction force:	30 N
Tightening torques for installation:	see page 379
Wire cross-sections and wire stripping lengths:	see page 399

#### Solenoid

Duty cycle:	100% ED (continuous operation)
Solenoid inrush power:	20 VA 0.1 s (24 V) 18 VA 0,1 s (120 V) 18 VA 0,1 s (230 V)
Solenoid consumption:	4 VA
Average overall consumption:	10 VA
Solenoid protection 24 V:	fuse 500 mA, delayed
Solenoid protection 120 V:	fuse 315 mA, delayed
Solenoid protection 230 V:	fuse 160 mA, delayed

**Notes:** Calculate the power supply using the average overall consumption. Please consider the solenoid inrush power in order to avoid intervention of overload-protection in case of electronic power supply.

#### In compliance with standards:

IEC 60947-5-1, IEC 60947-1, IEC 60204-1, EN ISO 14119, EN ISO 12100, IEC 60529, IEC 61000-6-2, IEC 61000-6-3, EN IEC 63000, BG-GS-ET-15, UL 508, CSA 22.2 N. 14.

#### Approvals:

EN 60947-5-1, UL 508, CSA 22.2 N. 14, GB/T14048.5

#### Compliance with the requirements of:

Machinery Directive 2006/42/EC, EMC Directive 2014/30/EU, RoHS Directive 2011/65/EU.

#### Positive contact opening in conformity with standards:

IEC 60947-5-1, EN 60947-5-1.

**⚠ If not expressly indicated in this chapter, for correct installation and utilization of all articles see the instructions given on pages 377 to 392.**

### Electrical data

### Utilization category

without connector	Thermal current ( $I_{th}$ ):	10 A	Alternating current: AC15 (50-60 Hz)			
	Rated insulation voltage (U):	500 Vac 600 Vdc	$U_e$ (V)	250	400	500
	Rated impulse withstand voltage ( $U_{imp}$ ):	400 Vac 500 Vdc (contact blocks 20, 21, 28, 29, 30)	$I_e$ (A)	6	4	1
	Conditional short circuit current: Protection against short circuits: Pollution degree:	6 kV 4 kV (contact blocks 20, 21, 28, 29, 30) 1000 A acc. to EN 60947-5-1 type aM fuse 10 A 500 V 3	Direct current: DC13	$U_e$ (V)	24	125
with M12 connector, 8-pole	Thermal current ( $I_{th}$ ):	2 A	$I_e$ (A)	3	0.55	0.3
	Rated insulation voltage (U):	30 Vac 36 Vdc	Alternating current: AC15 (50-60 Hz)			
	Protection against short circuits: Pollution degree:	type gG fuse 2 A 500 V 3	$U_e$ (V)	24	Direct current: DC13	
			$I_e$ (A)	2		

**Features approved by IMO**

Rated insulation voltage (U<sub>i</sub>): 500 Vac  
400 Vac (for contact blocks 20, 21, 28, 29, 30)

Conventional free air thermal current (I<sub>th</sub>): 10 A

Protection against short circuits: type aM fuse 10 A 500 V

Rated impulse withstand voltage (U<sub>imp</sub>): 6 kV  
4 kV (for contact blocks 20, 21, 28, 29, 30)

Protection degree of the housing: IP67

MV terminals (screw terminals): 3

Pollution degree: AC15

Utilization category: 400 Vac (50 Hz)

Operating voltage (U<sub>e</sub>): 3 A

Operating current (I<sub>e</sub>):

Forms of the contact element: Zb, Y+Y+X, Y+Y+Y, Y+X+X

Positive opening contacts on contact blocks 18, 20, 21, 28, 29, 30

In compliance with standards: EN 60947-1, EN 60947-5-1, fundamental requirements of the Low Voltage Directive 2014/35/EU.

Please contact our technical department for the list of approved products.

**Features approved by UL**

Electrical Ratings: Q300 pilot duty (69 VA, 125-250 V dc)  
A600 pilot duty (720 VA, 120-600 V ac)

Environmental Ratings: Types 1, 4X, 12, 13

Use 60 or 75 °C copper (Cu) conductor and wire size range 12, 14 AWG, stranded or solid. The terminal tightening torque of 7.1 lb in (0.8 Nm).

Please contact our technical department for the list of approved products.

**Wiring diagram for M12 connectors**

Contact block 18 1NO+1NC		Contact block 20 1NO+2NC		Contact block 21 3NC		Contact block 28 1NO+2NC		Contact block 29 3NC		Contact block 30 3NC	
M12 connector, 8-pole		M12 connector, 8-pole		M12 connector, 8-pole		M12 connector, 8-pole		M12 connector, 8-pole		M12 connector, 8-pole	
Contacts	Pin no.	Contacts	Pin no.	Contacts	Pin no.	Contacts	Pin no.	Contacts	Pin no.	Contacts	Pin no.
A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2
NC	3-4	NC	3-4	NC	3-4	NC	3-4	NC	3-4	NC	3-4
NO	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6
		NO	7-8	NC	7-8	NO	7-8	NC	7-8	NC	7-8

### Operating principle

The operating principle of these safety switches allows three different operating states:

**state A**: with inserted and locked actuator

**state B**: with inserted but not locked actuator

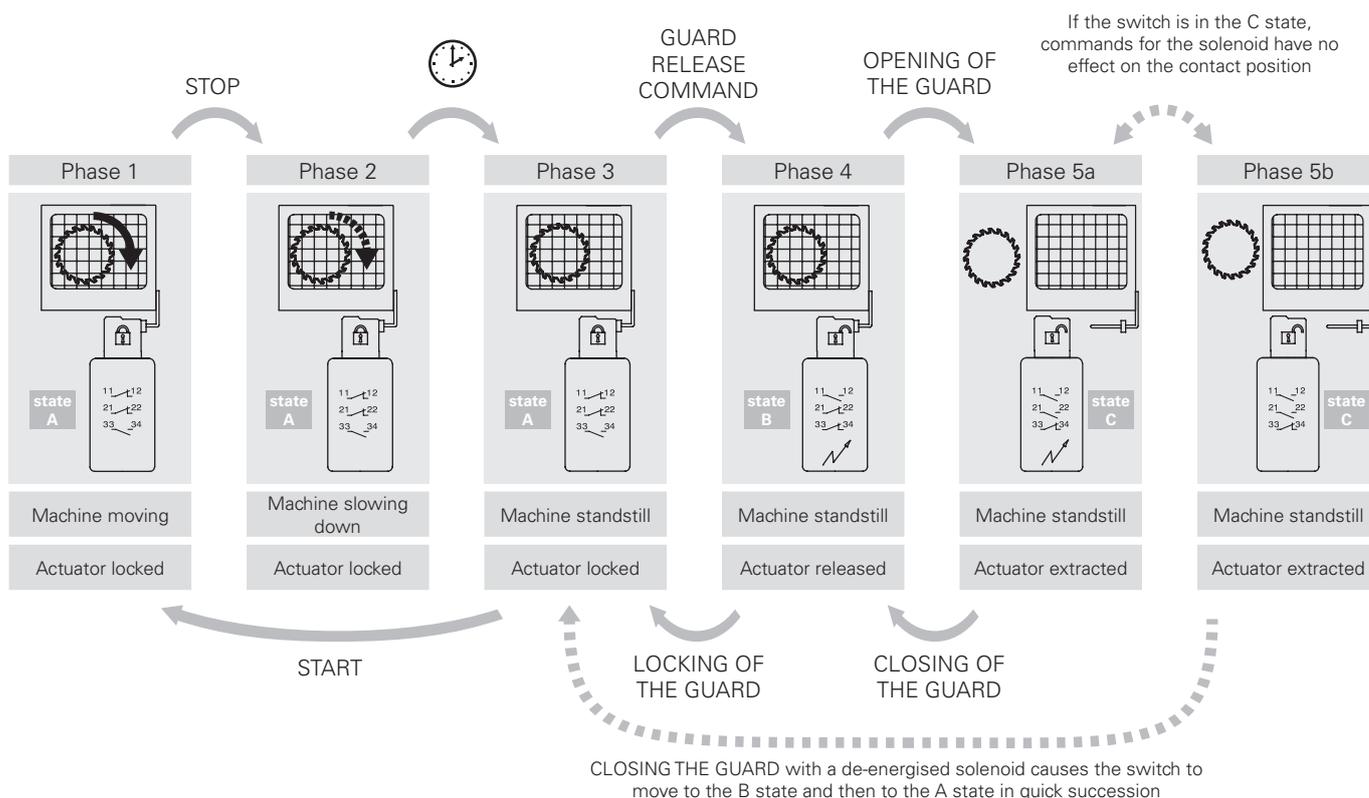
**state C**: with extracted actuator

All or some of these states can be monitored by means of electrical contacts with positive opening by selecting the appropriate contact blocks. In detail, contact blocks that have electric contacts marked with the symbol of the solenoid () are switched in the transition between the state A and state B, while the electric contacts marked with the symbol of the actuator () are switched between state B and state C.

It is also possible to choose between two operating principles for the actuator locking:

- **Operating principle D**: locked actuator with de-energised solenoid. The actuator is released by applying the power supply to the solenoid (see example of the operating phases).
- **Operating principle E**: locked actuator with energised solenoid. The actuator is released by switching off the power supply to the solenoid. This version should only be used under certain conditions, since a power failure at the system will result in the immediate opening of the guard.

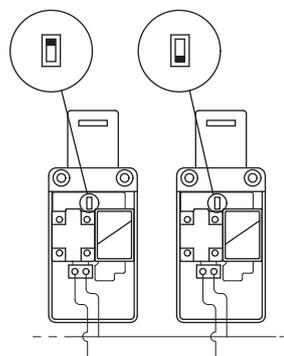
### Example: operating phases with FS 2896D024-F1 (switch with operating principle D)



### Installation of two or more switches connected to the same power supply

#### 24 V AC/DC versions only

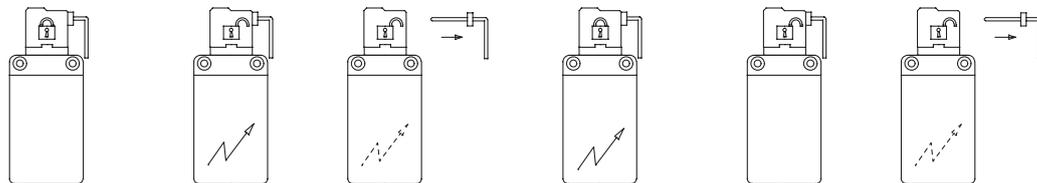
- This operation is intended to reduce the effects of the combined solenoid inrush currents on the power supply and should only be executed if necessary and with great care.
- Switch off the power supply.
- Open the switch cover.
- Loosen the two screws that secure the black plastic protective cover of the solenoid to the switch body and remove the plastic protective cover.
- Use a pin to set the selector switch so that each switch has a different combination (see figure at the side). If more than two switches are installed, repeat the combinations for any next set of two switches.
- Reposition the black plastic protective cover and tighten the two screws with a torque of 0.8 Nm.





## Contact positions related to switch states

Operating state	Operating principle D locked actuator with de-energised solenoid			Operating principle E locked actuator with energised solenoid		
	state A	state B	state C	state A	state B	state C
Actuator	Inserted and locked	Inserted and released	Extracted	Inserted and locked	Inserted and released	Extracted
Solenoid	De-energised	Energised	-	Energised	De-energised	-



<b>FS 18</b> ..... 1NO+1NC controlled by the solenoid		11 — 12	11 — 12	11 — 12	11 — 12	11 — 12	11 — 12
		23 — 24	23 — 24	23 — 24	23 — 24	23 — 24	23 — 24
<b>FS 20</b> ..... 1NO+2NC controlled by the solenoid		11 — 12	11 — 12	11 — 12	11 — 12	11 — 12	11 — 12
		21 — 22	21 — 22	21 — 22	21 — 22	21 — 22	21 — 22
		33 — 34	33 — 34	33 — 34	33 — 34	33 — 34	33 — 34
<b>FS 21</b> ..... 3NC controlled by the solenoid		11 — 12	11 — 12	11 — 12	11 — 12	11 — 12	11 — 12
		21 — 22	21 — 22	21 — 22	21 — 22	21 — 22	21 — 22
		31 — 32	31 — 32	31 — 32	31 — 32	31 — 32	31 — 32
<b>FS 28</b> ..... 1NO+1NC controlled by the solenoid 1NC controlled by the actuator		11 — 12	11 — 12	11 — 12	11 — 12	11 — 12	11 — 12
		21 — 22	21 — 22	21 — 22	21 — 22	21 — 22	21 — 22
		33 — 34	33 — 34	33 — 34	33 — 34	33 — 34	33 — 34
<b>FS 29</b> ..... 2NC controlled by the solenoid 1NC controlled by the actuator		11 — 12	11 — 12	11 — 12	11 — 12	11 — 12	11 — 12
		21 — 22	21 — 22	21 — 22	21 — 22	21 — 22	21 — 22
		31 — 32	31 — 32	31 — 32	31 — 32	31 — 32	31 — 32
<b>FS 30</b> ..... 1NC controlled by the solenoid 2NC controlled by the actuator		11 — 12	11 — 12	11 — 12	11 — 12	11 — 12	11 — 12
		21 — 22	21 — 22	21 — 22	21 — 22	21 — 22	21 — 22
		31 — 32	31 — 32	31 — 32	31 — 32	31 — 32	31 — 32

## Limits of use

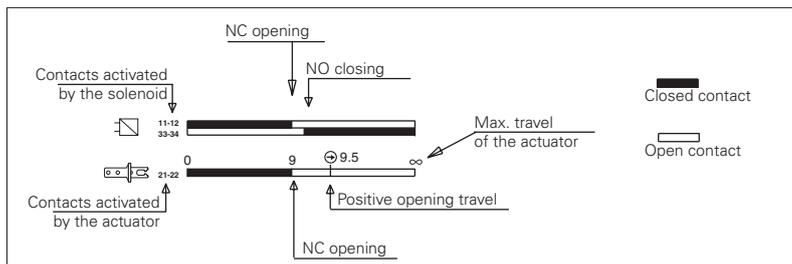
Do not use where dust and dirt may penetrate in any way into the head and deposit there. Especially not where powder, shavings, concrete or chemicals are sprayed. Adhere to the EN ISO 14119 requirements regarding low level of coding for interlocks. Do not use in environments with presence of explosive or flammable gas. In these cases, use ATEX products (see dedicated Pizzato catalogue).

Attention! These switches alone are not suitable for applications where operators may physically enter the dangerous area, because an eventual closing of the door behind them could restart the machine operation. In these cases the actuator entry locking device VF KB1 shown on page 146 must be used.

	Operating principle D, with sealable auxiliary release device, without actuator	Operating principle E, without actuator	Operating principle D, with auxiliary key release, without actuator
Contact type:			
Contact block			
18	L FS 1896D024-M2   1NO+1NC 	FS 1896E024-M2   1NO+1NC 	FS 1898D024-M2   1NO+1NC 
20	L FS 2096D024-M2   1NO+2NC 	FS 2096E024-M2   1NO+2NC 	FS 2098D024-M2   1NO+2NC 
21	L FS 2196D024-M2   3NC 	FS 2196E024-M2   3NC 	FS 2198D024-M2   3NC 
28	L FS 2896D024-M2   1NO+2NC 	FS 2896E024-M2   1NO+2NC 	FS 2898D024-M2   1NO+2NC 
29	L FS 2996D024-M2   3NC 	FS 2996E024-M2   3NC 	FS 2998D024-M2   3NC 
30	L FS 3096D024-M2   3NC 	FS 3096E024-M2   3NC 	FS 3098D024-M2   3NC 
Actuating force	30 N (40 N )		

Legend: With positive opening according to EN 60947-5-1, interlock with lock monitoring acc. to EN ISO 14119

## How to read travel diagrams



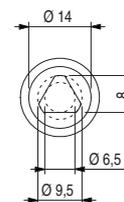
### IMPORTANT:

The state of the NC contact refers to the switch with inserted actuator and locked lock. In **safety applications**, actuate the switch **at least up to the positive opening travel** shown in the travel diagrams with symbol . Actuate the switch **at least with the positive opening force**, reported in brackets below each article, next to the actuating force value.

## Auxiliary key release with triangular key



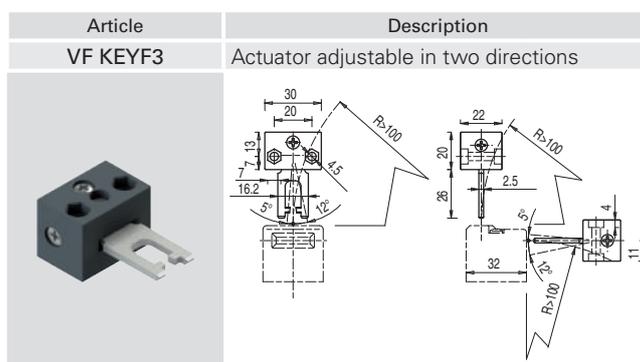
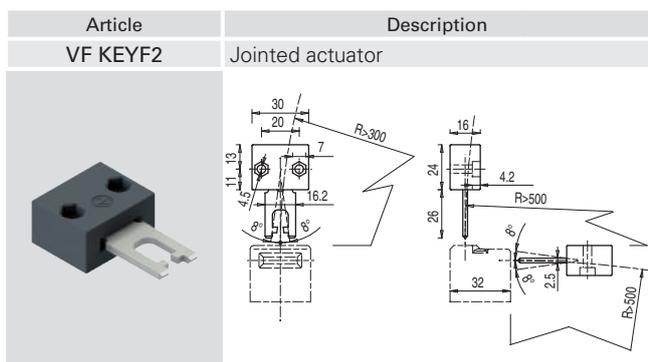
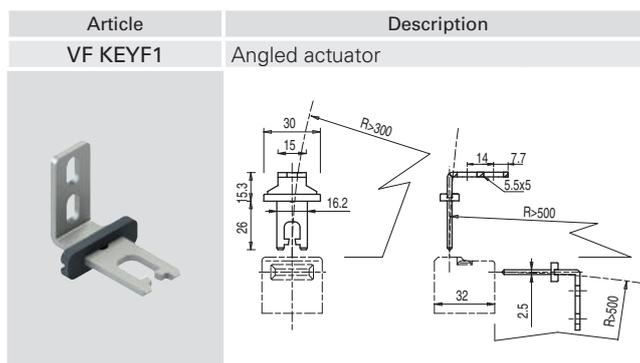
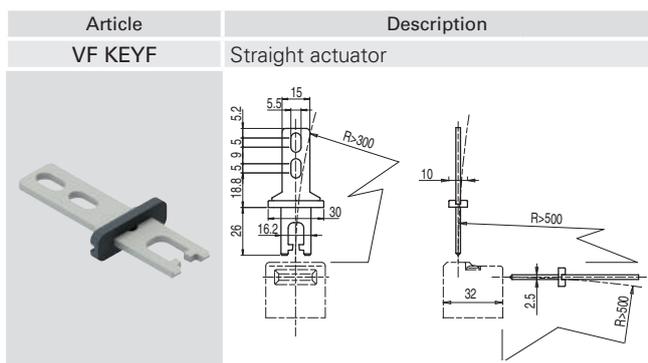
Articles with the V70 and V73 option have an auxiliary key release with a triangular key that meets DIN 22417 standards. This type of lock can be used in situations where the switch must only be unlocked using the corresponding triangular key, a tool which is not usually available. There are two versions of the triangular key release: with a spring return (option V70) and without a spring return (option V73).





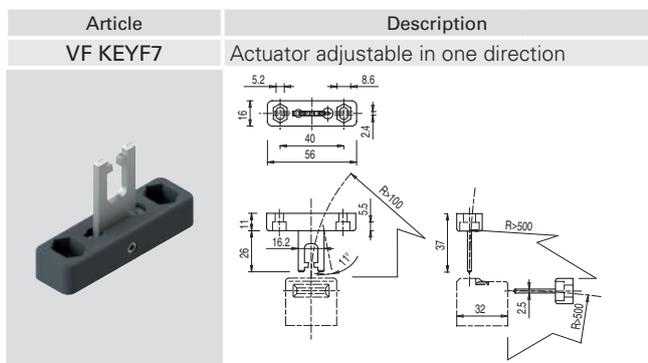
## Stainless steel actuators

**IMPORTANT:** These actuators can be used only with items of the FD, FP, FL, FC, and FS series (e.g. FS 1896D024-M2).  
Low level of coding acc. to EN ISO 14119.

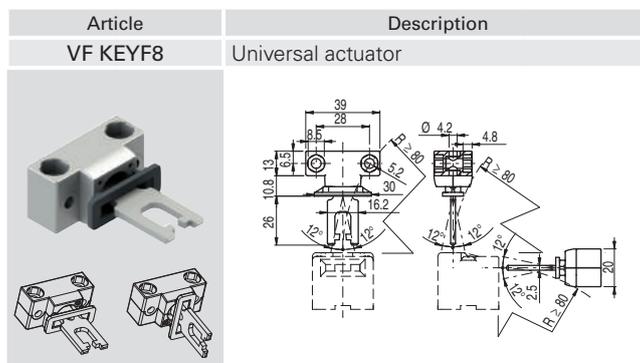


The actuator can flex in four directions for applications where the guard alignment is not precise.

Actuator adjustable in two directions for guards with reduced dimensions.

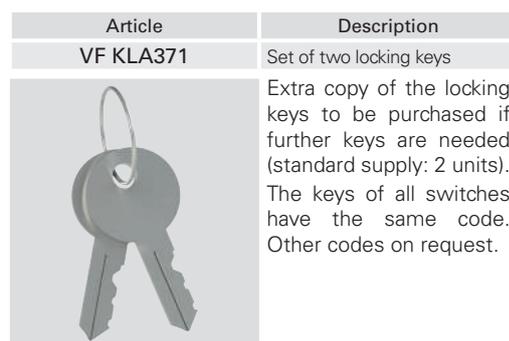
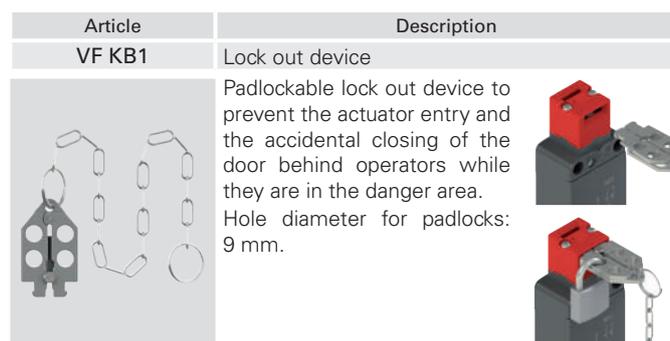


Actuator adjustable in one direction for guards with reduced dimensions.



Jointed actuator for guards with poor alignment, adjustable in two dimensions for small doors; can be mounted in various positions. The metal fixing body has two pairs of bore holes; it is provided for rotating the working plane of the actuator by 90°.

## Accessories



## Description



These switches are used on machines where the hazardous conditions remain for a while, even after the machines have been switched off, for example because of mechanical inertia of pulleys, saw disks, parts under pressure or with high temperatures. Thus, the switches can also be used if individual guards are only to be opened under certain conditions.

Versions with mode 1 and 3 (safety outputs active when guard closed and locked) are interlocks with guard locking acc. to ISO 14119; the product is labelled with the symbol shown.



## Maximum safety with a single device

# PL e + SIL 3

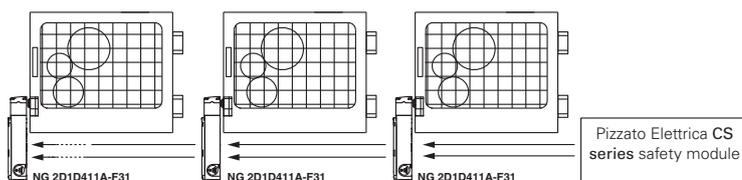
The NG series switches are constructed with redundant electronics. As a result, the maximum PL e and SIL 3 safety levels can still be achieved through the use of a single device on a guard. This avoids expensive wiring in the field and allows faster installation. Inside the control cabinet, the two electronic safety outputs must be connected to a module suitable for managing devices with solid state outputs, or to a safety PLC.

## Series connection of several switches

One of the most important features of the NG series is the possibility of connecting up to 32 sensors in series, while still maintaining the maximum safety levels PL e laid down in EN 13849-1 and SIL 3 acc. to EN 62061.

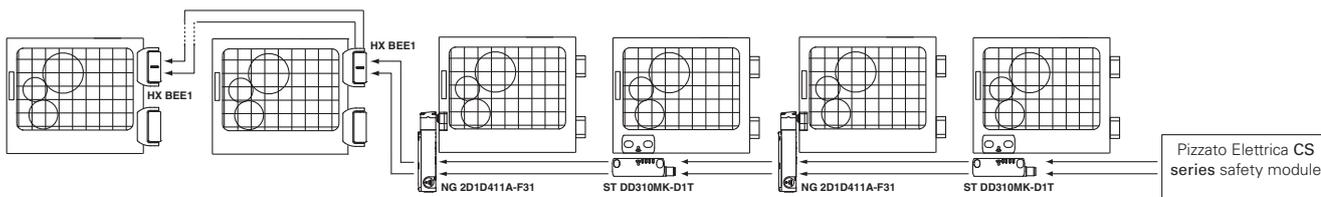
This connection type is permissible in safety systems which have a safety module at the end of the chain that monitors the outputs of the last NG switch.

The fact that the PL e safety level can be maintained even with 32 sensors connected in series demonstrates the extremely secure structure of each single device.



## Series connection with other devices

The NG series features two safety inputs and two safety outputs, which can be connected in series with other Pizzato Elettrica safety devices. This option allows the creation of safety chains containing various devices. For example, stainless steel safety hinges (HX BEE1 series), transponder sensors (ST series) and door lock sensors (NG series) can be connected in series while still maintaining the maximum PL e and SIL 3 safety levels.

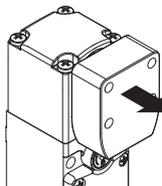


## RFID actuators with high coding level



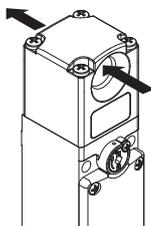
The NG series is provided with an electronic system based on RFID technology to detect the actuator. This allows to provide each actuator with different coding and makes it impossible to tamper with a device by using another actuator of the same series. Millions of different coding combinations are possible for the actuators. They are therefore classified as high level coded actuators, according to EN ISO 14119.

## Holding force of the locked actuator



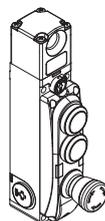
**9750 N** The strong interlocking system guarantees a maximum actuator holding force of  $F_{1max} = 9750 \text{ N}$ . This is one of the highest values currently available on the market today, making this device suitable for heavy-duty applications.

## Dustproof



The switch is provided with a through hole for inserting the actuator. Thanks to this unique feature, any dust that enters the actuator hole can always come out on the opposite side instead of remaining inside. Moreover, the lock pin is provided with a diaphragm seal, making the system suitable for critical environments with a high level of dust.

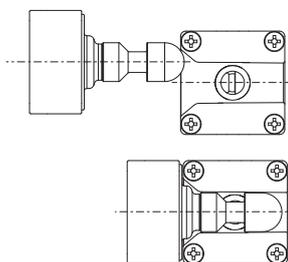
## Integrated control devices



The switch is also available with elevated cover. Control devices such as buttons, emergency stop buttons, indicator lights or selectors can thereby be attached directly to the switch together with corresponding contact blocks.

The result is a compact solution with direct access to control devices without needing to install them separately on the switch panel or in their own housing. The devices can be illuminated and, thanks to the PUSH-IN spring-operated connections, wiring is quick and intuitive.

## Centring



The switch is provided with a wide centring inlet for the actuator pin. This solution makes it easier to align the actuator and the opening hole on the head during installation. Moreover, this solution drastically reduces the probability of a collision between the switch and the actuator, making it possible to install the device even on inaccurately closing doors.

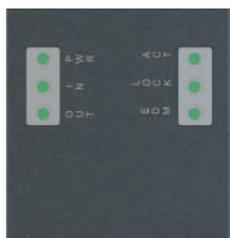
## Push-in spring-operated connections



The switch is provided with a PUSH-IN type spring-operated connection system on the inside. This technology allows wiring to be performed quickly and easily, as the wire just needs to be inserted into the appropriate hole in order to establish the electrical connection and automatically secure the wire. This operation can be performed with rigid or flexible wires with a crimped wire-end sleeve and requires no tools. Release is obtained by pressing the appropriate wire-releasing button.

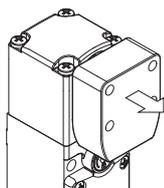


### Six LEDs for immediate diagnosis



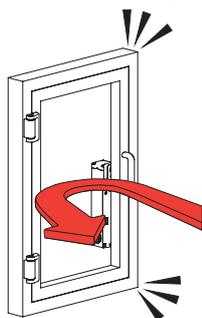
As the LEDs have been designed for quick immediate diagnosis, the status of each input and output is highlighted by one specific LED. This makes it possible to quickly identify the interruption points in the safety chain, which device is released, which door is opened and any errors inside the device. All of this at a glance, without needing to decode complex flashing sequences.

### Holding force of the unlocked actuator



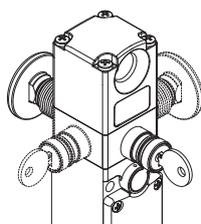
The inside of each switch features a device which holds the actuator in its closed position. Ideal for all those applications where several guards are unlocked simultaneously, but only one is actually opened. The device keeps all the unlocked guards in their position with a retaining force of approx. 30 N, stopping any vibrations or gusts of wind from opening them.

### Function for protecting against recoil forces



If a guard is closed too quickly or with so much force that the recoil would cause it to open again, a special function in the NG switch prevents locking. This function prevents the immediate locking of the guard if the lock signal is applied. This protects the switch against recoil forces that occur during instantaneous locking. This serves to protect the switch from damage and forces the operator to close the guard more gently.

### Key release device and escape release button



The key release device (auxiliary release) is used to permit unlocking of the actuator only by personnel in possession of the key. The device also functions with no power supply and, once actuated, prevents the guard from being locked.

The escape release button allows actuator release and immediate opening of the guard. Generally used in machines

within which an operator could inadvertently become trapped, it faces towards the machine interior, to allow the operator to exit even in the event of a power failure. The button has two stable states and can be freely extended in length with suitable extensions (see accessories). Both devices can be positioned on the four sides of the switch. As a result, it can be installed both towards the interior and towards the exterior of the machine.

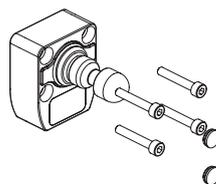
### Three safety output actuation modes

**MODE 1**  
**MODE 2**  
**MODE 3**

The device is available with 3 different actuation modes for safety outputs:

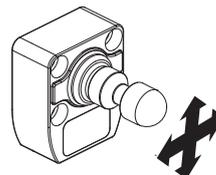
- mode 1: safety outputs active with inserted and locked actuator, for machines with inertia;
- mode 2: safety outputs active with inserted actuator, for machines without inertia;
- mode 3: a first safety output active with actuator inserted and locked and a second safety output active with actuator inserted, for special applications.

### Protection against tampering



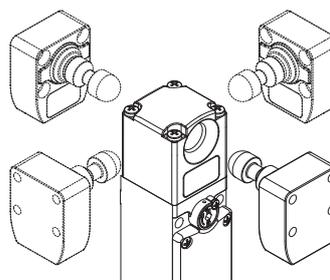
Each actuator of the NG series is supplied with four protection caps. Not only do the caps prevent dirt from accumulating and simplify cleaning, they also block access to the fastening screws of the actuator. As a result, standard screws can be used instead of tamper-proof screws.

### Jointed actuator for inaccurately closing guards



All NG series actuators are articulated, thereby allowing the actuator pin to be safely guided into the switch through the centring hole. As a result, the actuator and switch do not need to be precisely aligned during installation. In addition, the device can thereby be used on guards with a minimum actuation radius of 150 mm without the actuation pin needing to be angled.

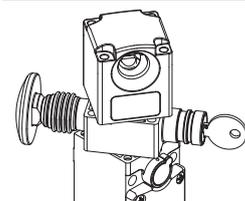
### Head and devices with variable orientation



The system can be variably configured by loosening the 4 screws on the head.

The key release device and the escape release button can also be rotated and secured independently of one another in steps of 90°. The device can thus assume 16 different configurations.

### Non-detachable head and release devices



The head and the release device can be rotated but cannot be detached from each other. This makes the switch more secure since the problem of incorrect assembly by the installer cannot occur; in addition, the risk of damage is lower (loss of small parts, penetration of dirt, etc.).

### High protection degree

**IP69K**  
**IP67**

These devices are designed to be used in the toughest environmental conditions and they pass the IP67 immersion test acc. to EN 60529. They can therefore be used in all environments where maximum protection degree of the housing is required. Due to their special design, these devices are suitable for use in equipment subjected to cleaning with high pressure hot water jets. These devices meet the IP69K test requirements according to ISO 20653 (water jets with 100 bar and 80°C).

### External device monitoring

**EDM**

On request, the switch can be supplied with EDM function (External Device Monitoring). In this case, the switch itself checks the proper function of the devices connected to the safety outputs. These devices (usually relays or safety contactors) must send a feedback signal to the EDM input, which checks that the received signal is consistent with the state of the safety outputs.