

# Compact Heavy Duty Limit Switches FM/FR/FZ/FX



Compact limit switches with snap-action contacts and positive break according to BS/EN60947-5-1

- Bifurcated contacts for low resistance and high reliability – suitable for switching low-level electronic currents
- Double-break contacts with electrically separate NO and NC circuits in conformity with VDE 0660 part 206
- 10A 500VAC/600VDC rated
- Turret head position rotatable in 90° increments
- Centre-position indicator arrow – lever actuators
- Wide range of actuators
- Single and dual cable entry models
- Removable contact block for ease of wiring
- Metal or plastic housing options
- IP65 according to BS EN 60947-1
- FM and FR dimensions in accordance with EN50047 with dual fixing centres: 20 and 22mm
- UL and CUL approved



## Options and ordering codes

	<b>FM</b>	<b>5</b>	<b>01</b>	<b>7</b>
Compact metal housing	<b>FM</b>			-
Compact plastic housing	<b>FR</b>			7
Dual-entry metal housing	<b>FZ</b>			71
Dual-entry plastic housing	<b>FX</b>			
Snap-action contacts, 1NO + 1NC		<b>5</b>		
Slow-action, break before make 1NO + 1NC		<b>6</b>		
Slow-action, make before break 1NO + 1NC		<b>7</b>		
Slow-action contacts, 2NC		<b>9</b>		
Slow-action contacts, 2NO		<b>10</b>		
Snap-action contacts, 2NC		<b>11</b>		
Slow-action contacts, break before make 2NC + 1NO		<b>20</b>		
Slow-action contacts, 3NC		<b>21</b>		
Slow-action contacts, break before make 1NC + 2NO		<b>22</b>		
Snap-action contacts, 2NO + 2NC		<b>2</b>		
			-	
			<b>38</b>	
			<b>VFL313</b>	
			<b>VFL353</b>	
			<b>VFL354</b>	

Please note: Positive break applies to the NC contacts of types 5, 6, 7, 9, 11, 20, 21 and 22 only.

## Contact ratings

BS/EN 60947-5-1		
AC15 – Control of AC electromagnetic loads > 72VA sealed – replaces AC11	230VAC	6A
	400VAC	4A
	500VAC	1A
DC13 – Control of DC electromagnetic loads where the time taken to reach 95% of the rated current is equal to 6 times the power of the load (where P ≤ 50W) – replaces DC11		
	24VDC	6A
	125VDC	1.1A
	250VDC	0.4A

## Terminal connections

Standard contacts: NO: 13–14      NC: 21–22  
Terminal screws: M3.5 with rising cable clamps.

Note: The positive break of the type 5 contact block applies to the NC contacts only. Connections to safety circuits should NOT be made using the NO contacts.

To ensure positive breaking of the contacts, exceed the pre-travel by 1.5mm or 25° according to the model. Maximum screw tightening torque 0.8Nm (8KgcM)

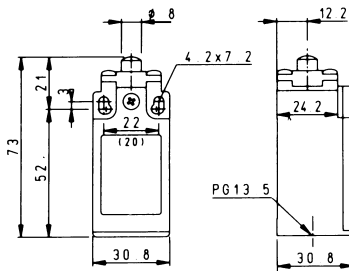
# Compact Heavy Duty Limit Switches FM/FR/FZ/FX continued



## Specification

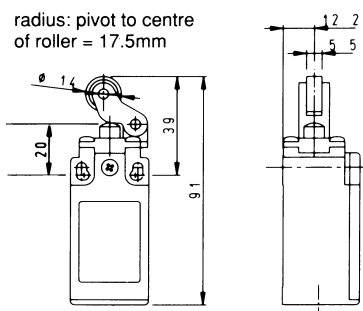
Rated thermal current I <sub>th</sub>	10A
Rated working voltage	500VAC/600VDC
Maximum operating frequency	6000/hour
Mechanical life	>20 million operations
Contact form	1NO + 1NC
Initial contact resistance	<25 mOhms
Contact gap	>2.5mm (2 x 1.25mm conforming to VDE 0660 part 206)
Contact material	silver
Dielectric strength	2000VAC, 50/60Hz for 1 minute between open contacts 2000VAC, 50/60Hz for 1 minute between current-carrying parts and ground
Protection rating	IP65
Ambient operating temperature	-25 to +80 deg. C
Ambient humidity	95% R.H.
Maximum wire size	2 x 1.5mm <sup>2</sup> flexible, 2 x 2.5mm <sup>2</sup> solid
Housing material	FM/FZ: die-cast metal alloy, FR/FX: self-extinguishing, glass-reinforced, thermoplastic resin
Conduit entry	PG 13.5

## Standard actuator options – FM and FR series



### Actuator type 01 Piston plunger

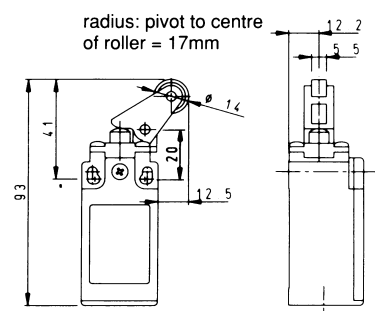
Operating force min.	OF	820g
Pre-travel	PT	2mm
Over-travel	OT	4mm
Movement differential	MD	1mm
Operating point	OP	19mm
Operating speed max.	OS	0.5m/s



### Actuator type 02 One-way roller – top actuated

Operating force min.	OF	615g
Pre-travel	PT	2.9mm
Over-travel	OT	5.6mm
Movement differential	MD	1.6mm
Operating point	OP	36.1mm
Operating speed max.	OS	1m/s using a 30° cam

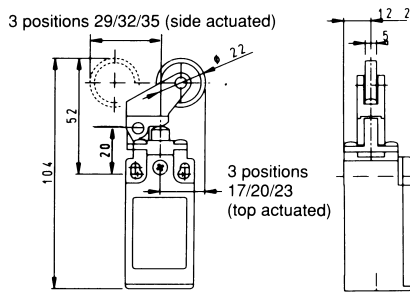
Note: plastic roller only



### Actuator type 05 One-way roller – side actuated

Operating force min.	OF	615g
Pre-travel	PT	2.9mm
Over-travel	OT	5.6mm
Movement differential	MD	1.6mm
Operating point	OP	–
Operating speed max.	OS	1m/s using a 30° cam

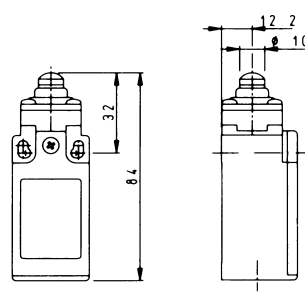
Note: plastic roller only



### Actuator type 07 One-way roller adjustable 3 positions top actuated 3 positions side actuated

Operating force min.	OF	410g
Pre-travel	PT	5mm
Over-travel	OT	8mm
Movement differential	MD	2.8mm
Operating point	OP	47mm
Operating speed max.	OS	1m/s using a 30° cam

Note: plastic roller only  
radius: pivot to centre of roller = 28mm



### Actuator type 08 Sealed piston plunger

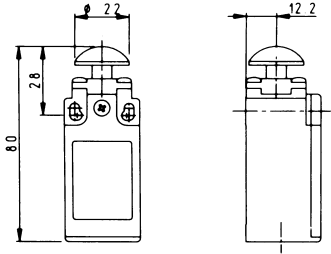
Operating force min.	OF	820g
Pre-travel	PT	2mm
Over-travel	OT	4mm
Movement differential	MD	1mm
Operating point	OP	30mm
Operating speed max.	OS	0.5m/s

Also available: Actuator type 10. Piston plunger with M12 mounting bush on the turret. Characteristics as for type 08 except: OP=34mm.

# Compact Heavy Duty Limit Switches FM/FR/FZ/FX continued

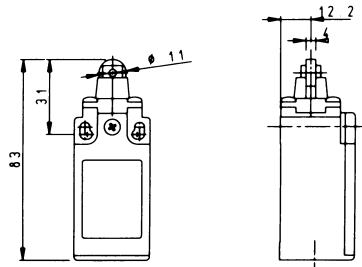


## Standard actuator options – FM and FR series continued



**Actuator type 14**  
**Mushroom head plunger (red plastic)**

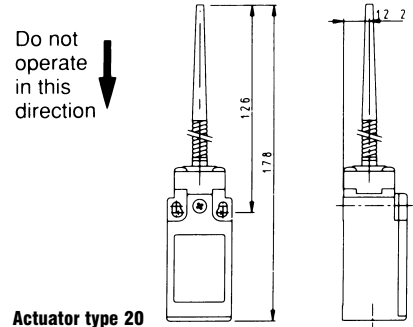
OF	820g
PT	2mm
OT	4mm
MD	1mm
OP	26mm
OS	0.5m/s



**Actuator type 15**  
**Roller piston plunger**

OF	820g
PT	2mm
OT	4mm
MD	1mm
OP	29mm
OS	0.3m/s using a 30° cam

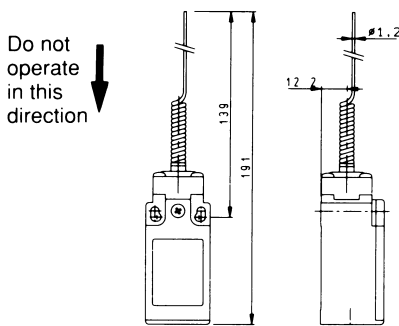
Notes: FM515  $\phi$  12mm metal roller as standard,  
FR515  $\phi$  11mm plastic roller as standard.  
For FR with  $\phi$  12mm metal roller: FR5151



**Actuator type 20**  
**Sealed coil spring with flexible rod**

OF	100g at $\frac{2}{3}$ the length of the actuator
PT	18°
OT	—
MD	10°
OP	—
OS	1m/s

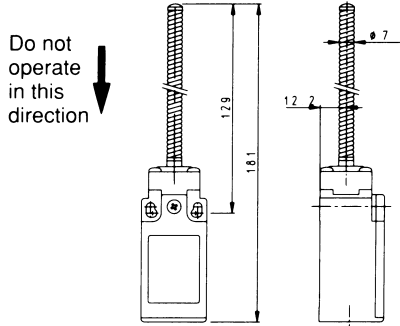
Notes: Not suitable for safety circuits.  
Not suitable for use with contact blocks 20, 21 or 22



**Actuator type 21**  
**Sealed coil spring with cat's whisker**

OF	70g at $\frac{2}{3}$ the length of the actuator.
PT	18°
OT	—
MD	10°
OP	—
OS	1m/s

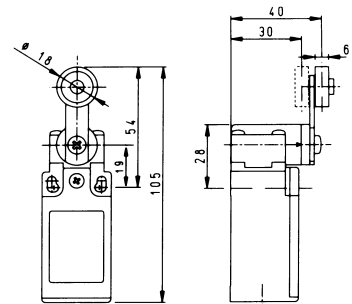
Notes: Not suitable for safety circuits  
Not suitable for use with contact blocks 20, 21 or 22



**Actuator type 25**  
**Sealed coil spring**

OF	185g at $\frac{2}{3}$ the length of the actuator
PT	18°
OT	—
MD	10°
OP	—
OS	1m/s

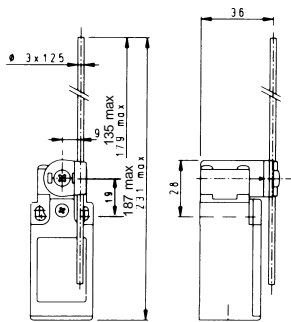
Notes: Not suitable for safety circuits  
Not suitable for use with contact blocks 20, 21 or 22



**Actuator type 31**  
**Roller-lever**

OF	1000gcm
PT	30°
OT	45°
MD	13°
OP	—
OS	1.5m/s using a 30° cam

Notes: 1.  $\phi$ 18mm plastic roller as standard,  $\phi$ 20mm metal roller actuator part no.: 311.  
2. Lever position adjustable over 360° in 10° increments.

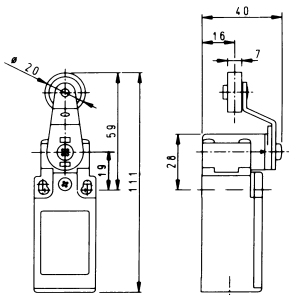


**Actuator type 50**  
**Adjustable steel rod**

OF	1000gcm
PT	30°
OT	45°
MD	13°
OP	—
OS	1.5m/s

Note: Lever position adjustable over 360° in 10° increments.

**Also available: Actuator type 69. Adjustable glass-fibre rod  $\phi$ 6x200mm. Characteristics as for type 50, but not suitable for safety circuits.**



**Actuator type 51**  
**Roller-lever with large offset**

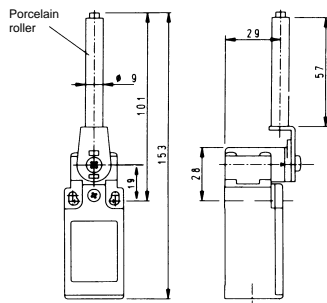
OF	1000gcm
PT	30°
OT	45°
MD	13°
OP	—
OS	1.5m/s using a 30° cam

Notes: 1. Plastic roller as standard, metal roller actuator part no.: 511. 2. Lever position adjustable over 360° in 10° increments.

# Compact Heavy Duty Limit Switches FM/FR/FZ/FX continued

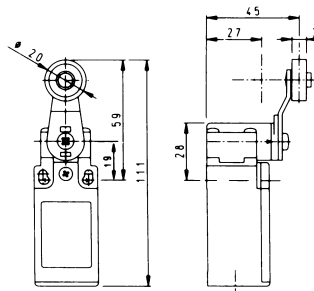


## Standard actuator options – FM and FR series continued



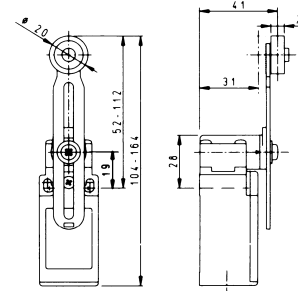
**Actuator type 53**  
**Porcelain roller-lever**

OF 615gcm  
PT 30°  
OT 45°  
MD 13°  
OP –  
OS –  
Note: Lever position adjustable over 360° in 10° increments.



**Actuator type 54**  
**Roller-lever with small offset**

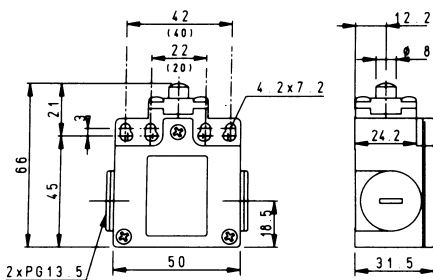
OF 1000gcm  
PT 30°  
OT 45°  
MD 13°  
OP –  
OS 1.5m/s using a 30° cam  
Notes: 1. Plastic roller as standard, metal roller actuator part no.: 541. 2. Lever position adjustable over 360° in 10° increments.



**Actuator type 55**  
**Adjustable roller-lever**

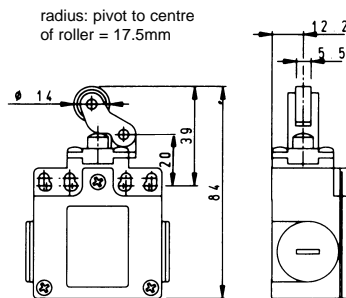
OF 1000gcm  
PT 30°  
OT 45°  
MD 13°  
OP –  
OS 1.5m/s using a 30° cam  
Notes: 1. Plastic roller as standard, metal roller actuator part no.: 551. 2. Lever position adjustable over 360° in 10° increments.

## Standard actuator options – FZ and FX series



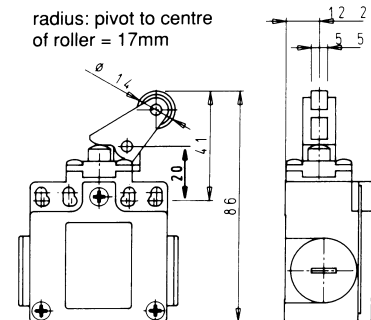
**Actuator type 01**  
**Piston plunger**

OF 820g  
PT 2mm  
OT 4mm  
MD 1mm  
OP 19mm  
OS 0.5m/s



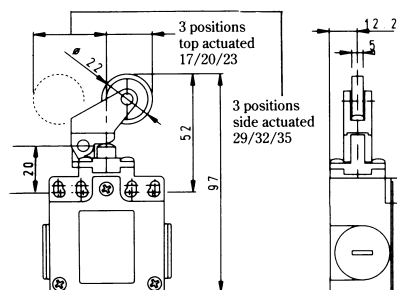
**Actuator type 02**  
**One-way roller – top actuated**

OF 615g  
PT 2.9mm  
OT 5.6mm  
MD 1.6mm  
OP 36.1mm  
OS 1m/s using a 30° cam  
Note: plastic roller only



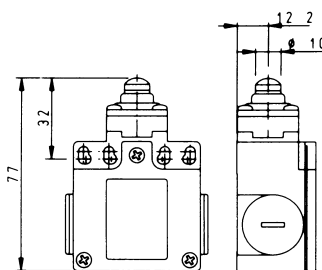
**Actuator type 05**  
**One-way roller – side actuated**

OF 615g  
PT 2.9mm  
OT 5.6mm  
MD 1.6mm  
OP –  
OS 1m/s using a 30° cam  
Note: plastic roller only



**Actuator type 07**  
**One-way roller adjustable**  
**3 positions top actuated**  
**3 positions side actuated**

OF 410g  
PT 5mm  
OT 8mm  
MD 2.8mm  
OP 47mm  
OS 1m/s using a 30° cam  
Note: Plastic roller only radius: pivot to centre of roller = 28mm



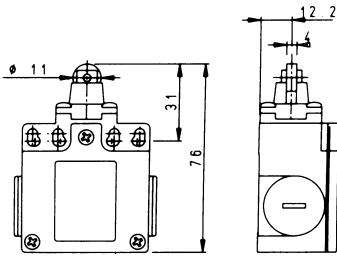
**Actuator type 08**  
**Sealed piston plunger**

OF 820g  
PT 2mm  
OT 4mm  
MD 1mm  
OP 30mm  
OS 0.5m/s

# Compact Heavy Duty Limit Switches FM/FR/FZ/FX continued

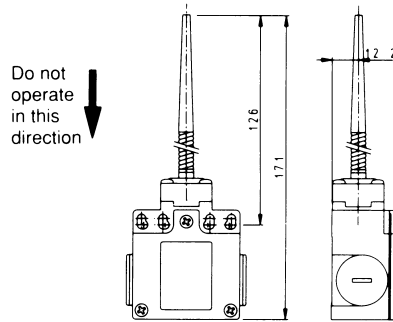


## Standard actuator options – FZ and FX series continued



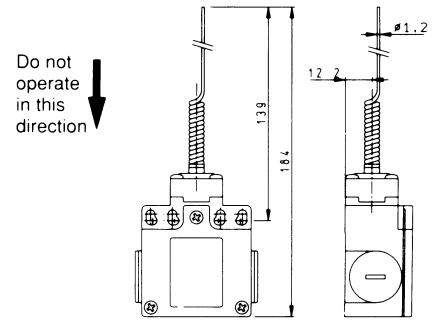
### Actuator type 15 Roller piston plunger

- OF 820g
  - PT 2mm
  - OT 4mm
  - MD 1mm
  - OP 29mm
  - OS 0.3m/s using a 30° cam
- Note: FZ515 ø12mm metal roller as standard.  
Note: FX515 ø11mm plastic roller as standard.  
Note: For FX with ø12mm metal roller: FX5151



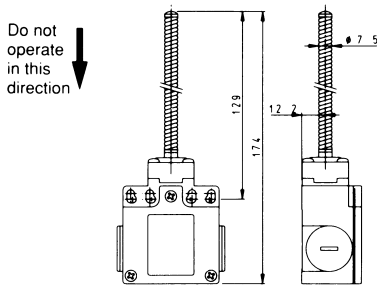
### Actuator type 20 Sealed coil spring with flexible rod

- OF 100g at 2/3 the length of the actuator
  - PT 18°
  - OT –
  - MD 10°
  - OP –
  - OS 1m/s
- Notes: Not suitable for safety circuits  
Not suitable for use with contact blocks 20, 21 or 22



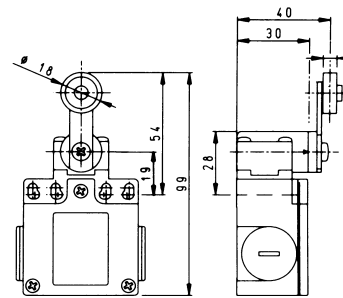
### Actuator type 21 Sealed coil spring with cat's whisker

- OF 70g at 2/3 the length of the actuator
  - PT 18°
  - OT –
  - MD 10°
  - OP –
  - OS 1m/s
- Notes: Not suitable for safety circuits  
Not suitable for use with contact blocks 20, 21 or 22



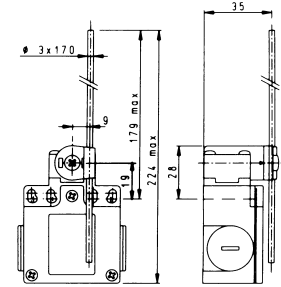
### Actuator type 25 Sealed coil spring

- OF 185g at 2/3 the length of the actuator
  - PT 18°
  - OT –
  - MD 10°
  - OP –
  - OS 1m/s
- Notes: Not suitable for safety circuits  
Not suitable for use with contact blocks 20, 21 or 22



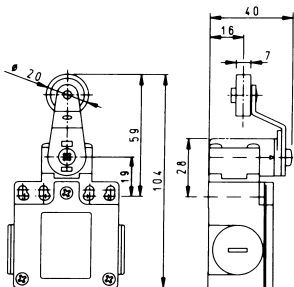
### Actuator type 31 Roller-lever

- OF 1000gcm
  - PT 30°
  - OT 45°
  - MD 13°
  - OP –
  - OS 1.5m/s using a 30° cam
- Notes: 1. ø18mm plastic roller as standard, ø20mm metal roller actuator part no.: 311  
2. Lever position adjustable over 360° in 10° increments.



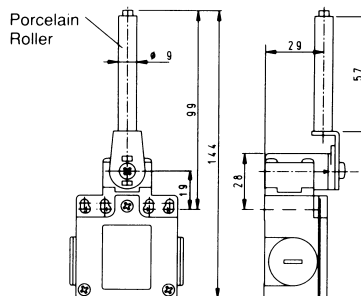
### Actuator type 50 Adjustable steel rod

- OF 1000gcm
  - PT 30°
  - OT 45°
  - MD 13°
  - OP –
  - OS 1.5m/s
- Note: Lever position adjustable over 360° in 10° increments.



### Actuator type 51 Roller-lever with large offset

- OF 1000gcm
  - PT 30°
  - OT 45°
  - MD 13°
  - OP –
  - OS 1.5m/s using a 30° cam
- Notes: 1. Plastic roller as standard, metal roller actuator part no.: 511. 2. Lever position adjustable over 360° in 10° increments.



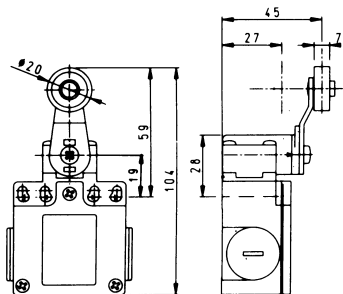
### Actuator type 53 Porcelain roller-lever

- OF 615gcm
  - PT 30°
  - OT 45°
  - MD 13°
  - OP –
  - OS –
- Note: Lever position adjustable over 360° in 10° increments.

# Compact Heavy Duty Limit Switches FM/FR/FZ/FX continued



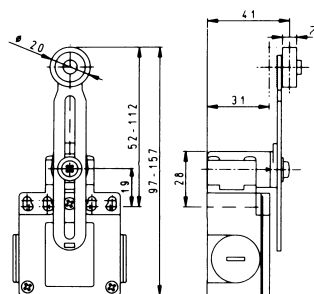
## Standard actuator options – FZ and FX series continued



### Actuator type 54 Roller-lever with small offset

OF 1000gcm  
PT 30°  
OT 45°  
MD 13°  
OP –  
OS 1.5m/s using a 30° cam

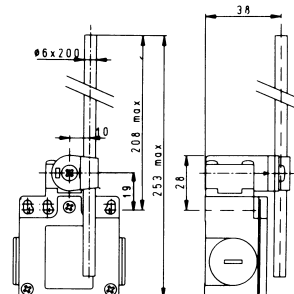
Notes: 1. Plastic roller as standard, metal roller actuator part no.: 541. 2. Lever position adjustable over 360° in 10° increments.



### Actuator type 55 Adjustable roller-lever

OF 1000gcm  
PT 30°  
OT 45°  
MD 13°  
OP –  
OS 1.5m/s using a 30° cam

Notes: 1. Plastic roller as standard, metal roller actuator part no.: 551. 2. Lever position adjustable over 360° in 10° increments.



### Actuator type 69 Adjustable glass-fibre rod

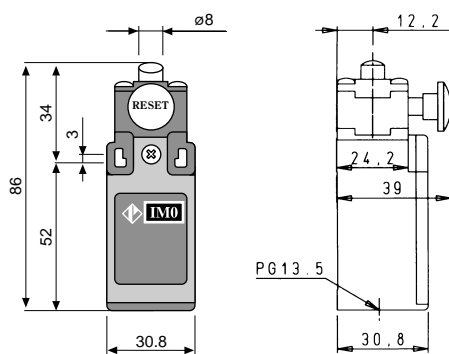
OF 1000gcm  
PT 30°  
OT 45°  
MD 13°  
OP –  
OS 1.5m/s

Notes: 1. Not suitable for safety circuits 2. Lever position adjustable over 360° in 10° increments.

## Standard switches with reset buttons

Examples – many other types available – for reset button, add suffix – 7 to standard part numbers

Operation – once contacts have changed-over and latched, the reset button must be operated for the contacts to change back

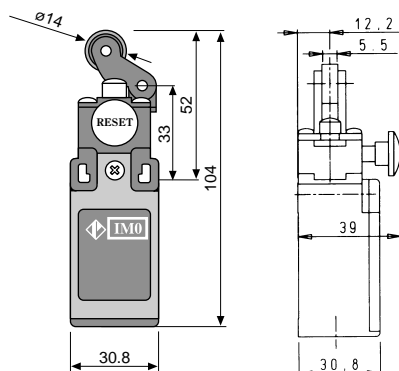


FR 501-7

### Piston plunger

Pre-travel 2mm  
Additional travel beyond the operating point until the mechanism latches 2mm

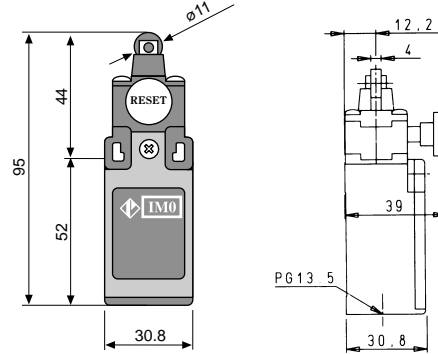
radius: pivot to centre of roller = 17.5mm



FR 502-7

### One-way roller – top actuated

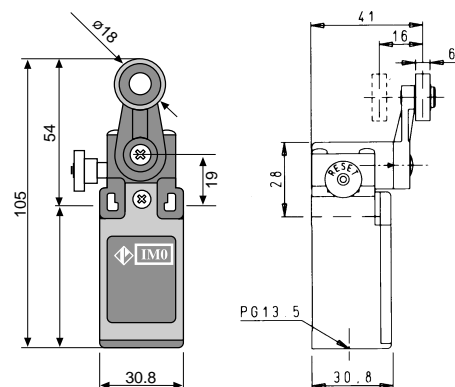
Pre-travel 2.9mm  
Additional travel beyond the operating point until the mechanism latches 2.3mm



FR 515-7

### Roller piston plunger

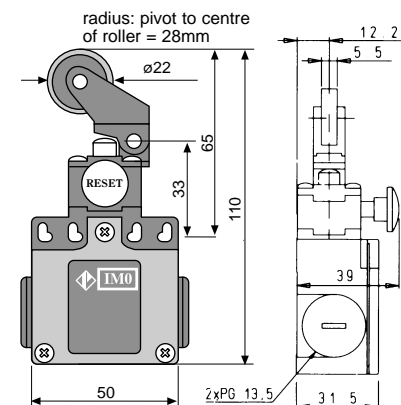
Pre-travel 2mm  
Additional travel beyond the operating point until the mechanism latches 2mm



FR 530-7

### Roller-lever

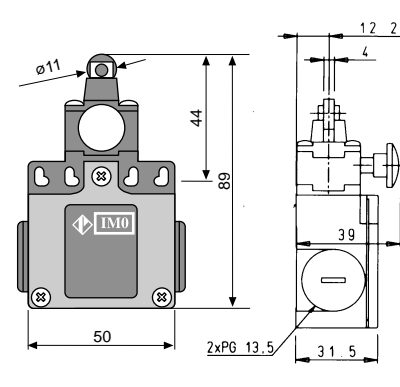
Pre-travel 30°  
Additional travel beyond the operating point until the mechanism latches 25°



FX 507-7

### One-way roller – adjustable

3 positions top actuated  
3 positions side actuated  
Pre-travel 5mm  
Additional travel beyond the operating point until the mechanism latches 3.4mm



FX 515-7

### Roller piston plunger

Pre-travel 2mm  
Additional travel beyond the operating point until the mechanism latches 2mm

# Compact Heavy Duty Limit Switches FM/FR/FZ/FX continued



## Glossary

The following is a glossary of terms in specifying actuator characteristics:

### Operating force (OF)

The force applied to the actuator required to operate the switch contacts.

### Releasing force (RF)

The value to which the force on the actuator must be reduced to allow the contacts to return to the normal position.

### Total force (TF)

The force applied to the actuator required to reach the stopper from the free position.

### Free position (FP)

The initial position of the actuator when there is no external force applied.

### Operating position (OP)

The position of the actuator at which the contacts snap to the operated contact position measured with respect to the centres of the mounting holes.

### Releasing position (RP)

The position of the actuator at which the contacts snap from the operated contact position to their normal position.

### Total travel position (TTP)

The position of the actuator when it reaches the limit of travel – must not be exceeded.

### Pretravel (PT)

The distance or angle through which the actuator moves from the free position to the operating position.

### Overtravel (OT)

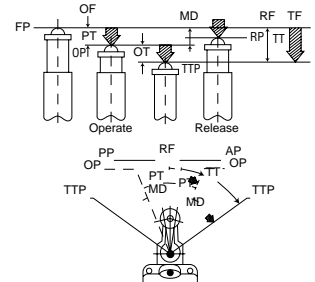
The distance or angle of the actuator movement beyond the operating position.

### Movement differential (MD)

The distance or angle from the operating position to the releasing position.

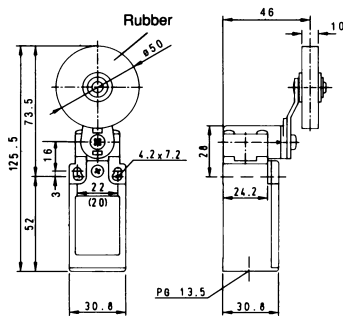
### Total travel (TT)

The sum of the pretravel and overtravel expressed by distance or angle.

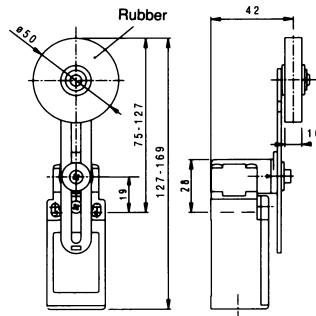


## Lift-style switches

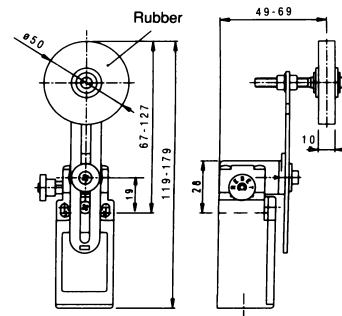
### EXAMPLES



**FR538 or FR938 + VFLE543**  
**FM538 or FM938 + VFLE543**  
**Turret type 38** (without reset button)  
**Lever type VFLE543** (fixed position roller)  
Pre-travel = 30°



**FR538 or FR938 + VFLE553**  
**FM538 or FM938 + VFLE553**  
**Turret type 38** (without reset button)  
**Lever type VFLE553** (single adjustment roller)  
Pre-travel = 30°



**FR538-71 + VFLE554** **FM538-71 + VFLE554**  
**Turret type 38-71** (early trip point with reset button)  
**Lever type VFLE554** (dual adjustment roller)  
Pre-travel = 30°  
Additional travel to latching point -0°/+8°

- Three lever options, all with or without manual reset button.
- FZ and FX models also available with a choice of turret and lever.
- Age-resistant and oil-resistant rubber rollers.
- Lever position adjustable over 360° in 10° increments.
- Head rotatable in 90° increments.
- Glass-reinforced thermoplastic resin models (FR and FX) double insulated for electrical safety.

- Die-cast metal alloy models (FM and FZ) include earth terminal.
- Note: Types with reset button have non-removable contact block due to interlocking with reset mechanism.

FR538-71 formerly FR581

# Compact Heavy Duty Limit Switches

## FM/FR/FZ/FX continued



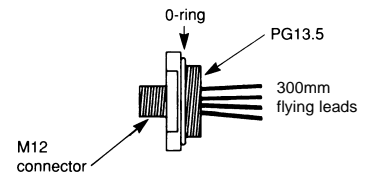
### Replacement contact blocks

<b>B5</b>	1NO+1NC 13 21 14 22	Positive break <i>Snap action</i> standard contact block	Zb
<b>B6</b>	1NO+1NC 13 21 14 22	Positive break <i>Slow action</i> break before make	Zb
<b>B7</b>	1NO+1NC 13 21 14 22	Positive break <i>Slow action</i> make before break	Zb
<b>B9</b>	2NC 11 21 12 22	Positive break <i>Slow action</i> , contacts 11-12, 21-22 open at the same time	Zb
	<b>B14</b>	Positive break <i>Slow action</i> , contacts 11-12 open first, further actuator travel causes contacts 21-22 to open	
<b>B10</b>	2NO 13 23 14 24	<i>Slow action</i> , contacts 13-14, 23-24 close at the same time	Zb
	<b>B15</b>	<i>Slow action</i> , contacts 13-14 close first, further actuator travel causes contacts 23-24 to close	
<b>B2</b>	2NO+2NC 13 21 43 31 14 22 44 32	<i>Snap action</i> , double pole	

### Plug and socket limit switches

All FR/FM/FZ/FX series limit switches can be converted to a plug-in style by the addition of an adaptor.

**Part number**  
**8R4D26E03C3003**



The adaptor is screwed into the limit switch and the four flying leads connected to the four terminals of the contact block.

Suitable 4-wire plug leads are available.

Ratings 250VAC/300VDC

3A

IP67

### Cable glands

Cable glands are available to enable standard multi-core cables to be connected without the use of conduit.

Two sizes are possible:

Part number **VFPG13.5** Cable size  $\varnothing$ 9-12mm

Part number **VFPG13.5/6** Cable size  $\varnothing$ 6-9mm

