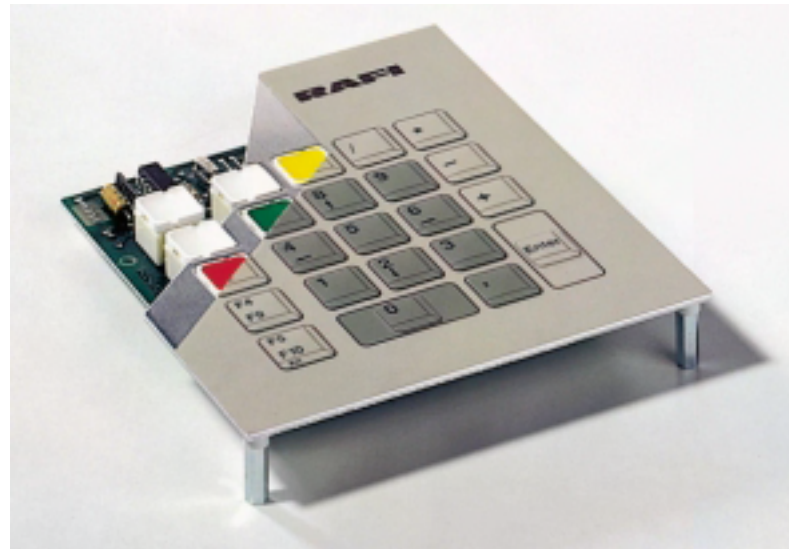




**THE DATASHEET OF**  
**5.46.011.036/0710**





## General data

RF 15 (15 x 15 mm) and RF 19 (19 x 19 mm) with distinct key click, for use under an overlay or with RK 90 keycaps. Can be fully illuminated.

## Content

<b>RF 15 short-travel keyswitch</b>	<b>4 - 26</b>
RF 15 short-travel keyswitch, non-illuminated	4 - 28
RF 15 short-travel keyswitch, fully illuminated with 2 LEDs	4 - 29
RF 15 short-travel keyswitch, 1 LED spot-illumination	4 - 30
<b>RF 15 N short-travel keyswitch</b>	<b>4 - 32</b>
RF 15 N short-travel keyswitch, non-illuminated	4 - 35
<b>RF 15 R short-travel keyswitch</b>	<b>4 - 36</b>
RF 15 R low short-travel keyswitch, non-illuminated	4 - 39
RF 15 R high short-travel keyswitch, non-illuminated	4 - 39
RF 15 R low short-travel keyswitch, 1 LED spot-illumination	4 - 40
RF 15 R high short-travel keyswitch, 1 LED spot-illumination	4 - 41
<b>RF 15 H short-travel keyswitch</b>	<b>4 - 42</b>
RF 15 H short-travel keyswitch, non-illuminated	4 - 44
RF 15 H short-travel keyswitch, fully illuminated	4 - 45
<b>RF 15 signal indicator</b>	<b>4 - 46</b>
RF 15 signal indicator, fully illuminated, 1 LED	4 - 48
<b>RF 19 short-travel keyswitch</b>	<b>4 - 50</b>
RF 19 short-travel keyswitch, non-illuminated	4 - 53
RF 19 short-travel keyswitch, fully illuminated with 2 LEDs	4 - 54
RF 19 short-travel keyswitch, 1 LED spot-illumination	4 - 55
<b>RF 19 short-travel keyswitch, 1 NC + 1 NO</b>	<b>4 - 56</b>
RF 19 short-travel keyswitch, non-illuminated	4 - 58
<b>RF 19 H short-travel keyswitch</b>	<b>4 - 60</b>
RF 19 H keyswitch, non-illuminated	4 - 63
RF 19 H short-travel keyswitch, fully illuminated	4 - 64

4

RF

**Content**

<b>RF 19 signal indicator</b>	<b>4 - 66</b>
RF 19 signal indicator, 1/2 x 1-module	4 - 68
RF 19 signal indicator, 1/2 x 2-module	4 - 68
RF 19 signal indicator, 1 x 1-module	4 - 69
RF 19 signal indicator, 1 x 2-module	4 - 69
<b>RF special accessories</b>	<b>4 - 70</b>
Extension plunger for RF 15 N, round head	4 - 70
Extension plunger for RF 15 N, round head, with recess for LED	4 - 71
Keycap for RF 15, snap-on, for overall height 12.5 mm	4 - 71
Spacers, round, for RF 15, RF 19	4 - 72
Spacers, triangular, for RF 15, RF 19	4 - 73
LED spacer for RF 15 N	4 - 74

**4****RF**

## Specifications LED

### 3 mm LED

(valid for 25 °C)	Red LED	Green LED	Yellow LED
Max. forward current $I_F$ :	30 mA	30 mA	20 mA
Current reduction from: $T_0 = 50\text{ °C}$ :	approx 0.5 mA/°C	approx 0.5 mA/°C	approx 0.2 mA/°C
Wavelength typ:	635 nm	565 nm	586 nm
Forward voltage $U_{F/I_F}$ typ:	2 V/10 mA	2 V/10 mA	2 V/10 mA
Reverse voltage $U_{R/I_F}$ typ:	5 V/100 µA min.	5 V/100 µA min.	5 V/100 µA min.
Ambient temperature, operating:	- 20 °C ... + 80 °C	- 20 °C ... + 80 °C	- 20 °C ... + 80 °C
	Blue LED	Red low-current LED	
Max. forward current $I_F$ :	20 mA	30 mA	
Current reduction from: $T_0 = 50\text{ °C}$ :	approx 0.6 mA/°C	approx 0.5 mA/°C	
Wavelength typ:	470 nm	645 nm	
Forward voltage $U_{F/I_F}$ typ:	2.7 V/10 mA	1.6 V/1 mA	
Reverse voltage $U_{R/I_F}$ typ:	5V/100 µA min.	5 V/100 µA min.	
Ambient temperature, operating:	- 20 °C ... + 80 °C	- 20 °C ... + 80 °C	

### 2 mm LED

(valid for 25 °C)	Red LED	Green LED	Green LED superbright
Max. forward current $I_F$ :	30 mA	30 mA	30 mA
Current reduction from: $T_0 = 50\text{ °C}$ :	0.5 mA/°C	0.5 mA/°C	-
Light current $f_v/I_F$ typ:	-	-	-
Wavelength typ:	637 nm	569 nm	510-545 nm
Forward voltage $U_{F/I_F}$ typ:	1.8 V/20 mA	2.1 V/10 mA	3.5 V/20 mA
Reverse voltage $U_{R/I_F}$ typ:	5 V/100 µA min.	5 V/100 µA min.	-
Ambient temperature, operating:	- 55 °C ... + 100 °C	- 40 °C ... + 100 °C	-30 °C ... + 100 °C
	Yellow LED	White LED	Blue LED
Max. forward current $I_F$ :	50 mA	25 mA	30 mA
Current reduction from: $T_0 = 50\text{ °C}$ :	0.8 mA/°C	-	-
Light current $f_v/I_F$ typ:	250 mlm/20 mA	-	-
Wavelength typ:	590 nm	-	464-485 nm
Forward voltage $U_{F/I_F}$ typ:	1.9 V/20 mA	3.6 V/20 mA	3.6 V/20 mA
Reverse voltage $U_{R/I_F}$ typ:	5 V/100 µA min.	-	-
Ambient temperature, operating:	-40 °C ... + 100 °C	- 20 °C ... + 80 °C	- 20 °C ... + 80 °C
	Multi-colour LED		
Max. forward current $I_F$ :	30 mA		
Current reduction from: $T_0 = 50\text{ °C}$ :	approx 0.6 mA/°C		
Light current $f_v/I_F$ typ:	-		
Wavelength typ:	635/565 nm		
Forward voltage $U_{F/I_F}$ typ:	2 V/10 mA		
Reverse voltage $U_{R/I_F}$ typ:	-		
Ambient temperature, operating:	- 20 °C ... + 80 °C		

4

RF

Calculating the series resistor:

$$R_V = \frac{U_B - U_F}{I_F}$$

Rated power of series:

$$P_V = I_F^2 \times R_V$$

Example for 5 Volt:

$$R_V = \frac{5V - 2.0 V}{0.02 A} = 150 \Omega (= \text{standard value})$$

### RF 15 short-travel keyswitch



### General data

Low-profile keyboards with RF 15 components should be designed with a 19.05 mm grid. With this grid, frame webs remain free between the individual keys. The overlay can be glued onto these frame webs; we recommend area embossing over the keys for the overlays.

### Technical data

4

#### General information

Colour of lens see order block  
Recommended key grid 19.05 mm

#### Dimensions

Length 15 mm  
Width 15 mm  
Overall height 9.7 mm

#### Mechanical design

Mounting soldering into PCB  
Terminals contacts tin-plated,  
fix contact Ag plated

Contact system snap-action contact  
Contact arrangement 1 NO  
Contact materials Au/Ag  
Illumination spot-/fully illuminated  
LED colour see order block  
LED type see order block

#### Mechanical characteristics

Operating force max. 2 ... 3 N  
Operating travel 0.5 mm  
Switching travel 0.5 mm  
Robustness min. with through-plated PCB  
100 N

#### Electrical characteristics

Rated voltage min. Au: 0.02 V, Ag: 3 V  
Rated voltage max. Au: 42 V, Ag: 50 V  
Rated current min. Au: 0.01 mA, Ag: 0.1 mA  
Rated current max. Au: 100 mA, Ag: 250 mA

Rated power max. (ohmic load) Au: 2 W, Ag: 12.5 W  
Contact resistance when new max. 100 mΩ  
Contact resistance acc. to life max. 3 Ω  
Insulation resistance 10<sup>9</sup> Ω  
ESD strength (underneath overlay) 15 kV  
Bouncing time max. 5 ms

#### Other specifications

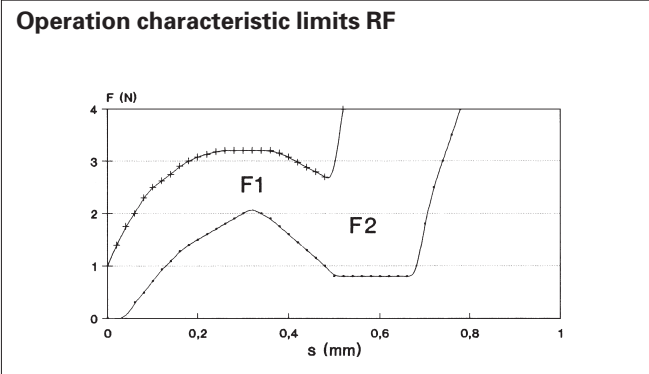
Ambient temp. operating min. -25 °C  
Ambient temp. operating max. +70 °C  
Storage temperature min. -40 °C  
Storage temperature max. (product) +80 °C  
Storage temperature max. (in tube) +50 °C  
Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
Operating life min. 1000000  
Soldering time max. 2.5 sec.  
Soldering temperature max. 250 °C  
Flammability of materials UL 94 HB

RF



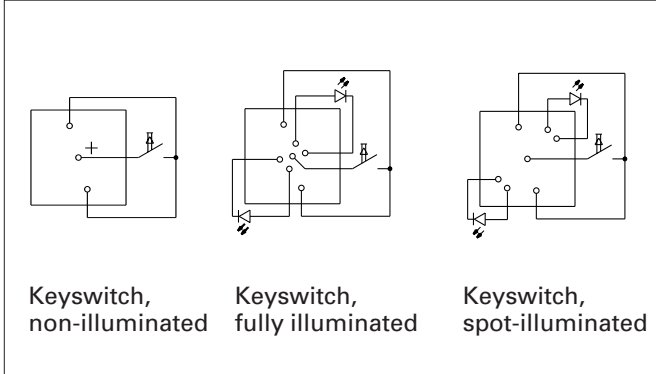
# RF short-travel keyswitches

## Force/Travel Diagram – Keyswitch RF 15

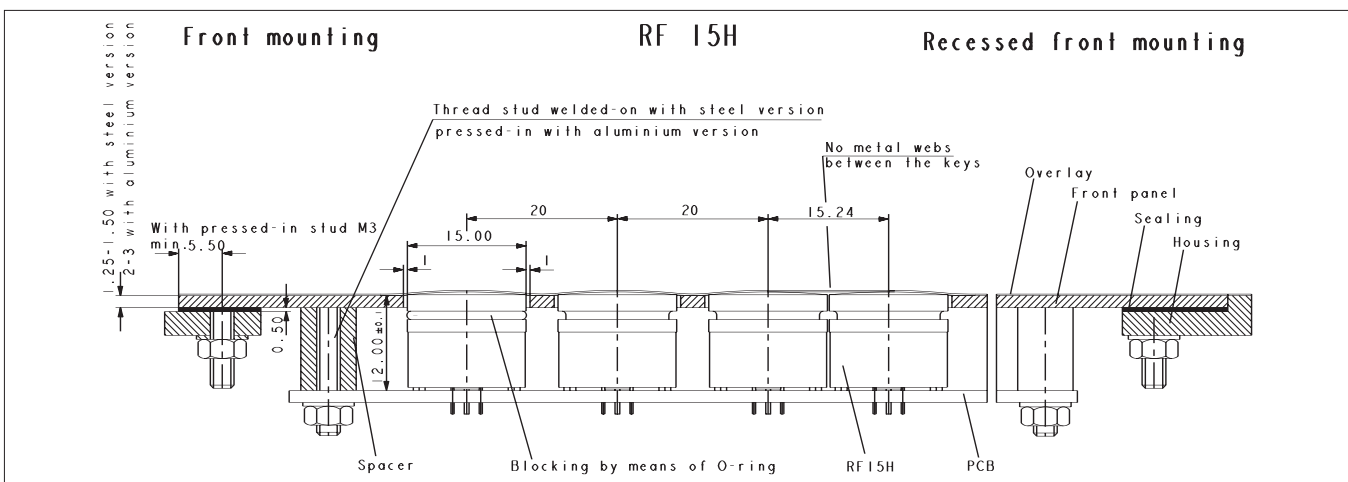


F 1 = Max. operating force  
 F 2 = Force at contact  
 F 2 is max. 55% of F 1

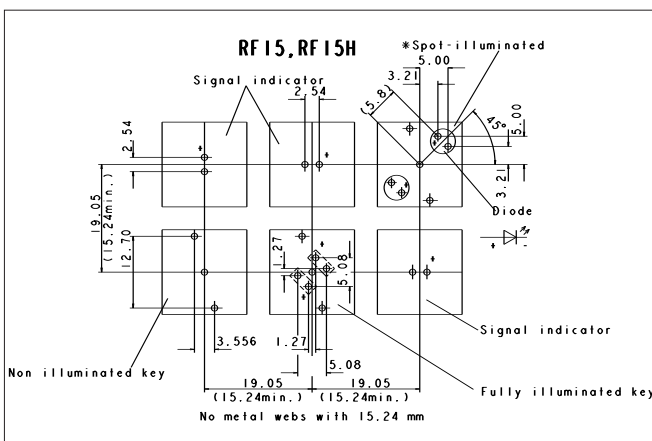
## Circuit Diagram – Keyswitch RF 15



## Dimensional Drawing RF 15

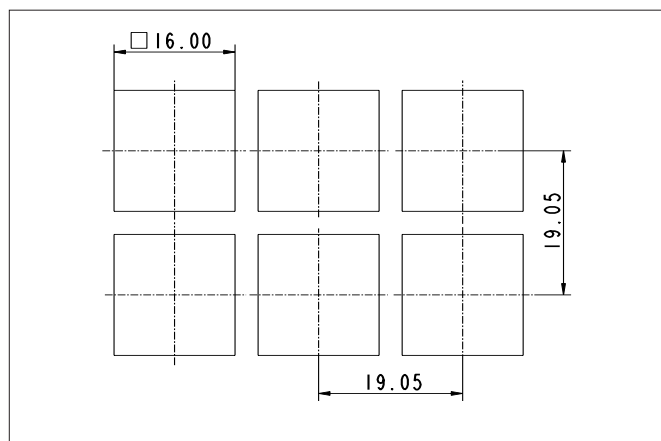


## Hole Pattern RF 15

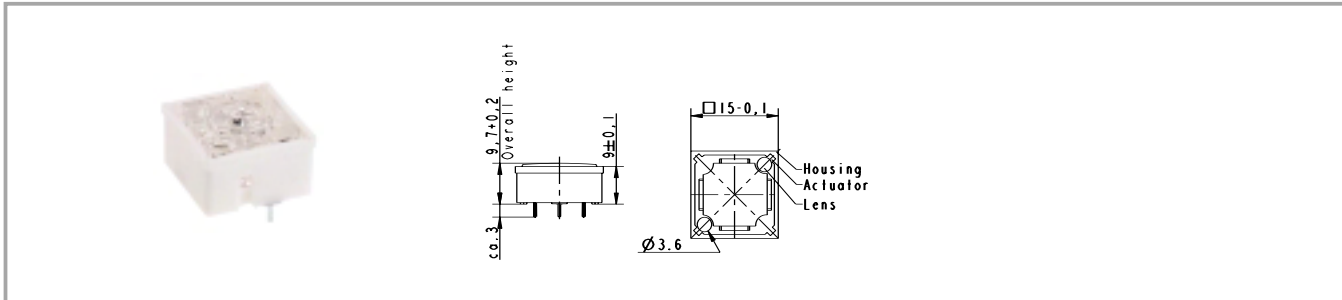


View on component side, all hole diameters 1,1 ±0,1 mm

## Hole Pattern – Front Panel



### RF 15 short-travel keyswitch, non-illuminated



Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	not illuminated	transparent			<b>3.14.100.001/0000</b>
Ag	not illuminated	transparent			<b>3.14.100.006/0000</b>

Technical data see page 4 - 26

**Accessories:**

Keycap for RF 15, snap-on, for overall height 12.5 mm: 5.46.654.059/0227

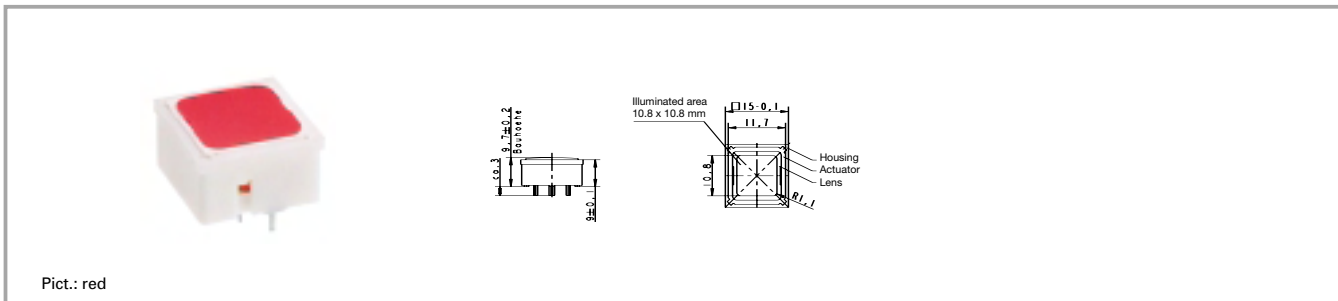
Other keycaps see chapter RK90

4

RF

## RF short-travel keyswitches

### RF 15 short-travel keyswitch, fully illuminated with 2 LEDs



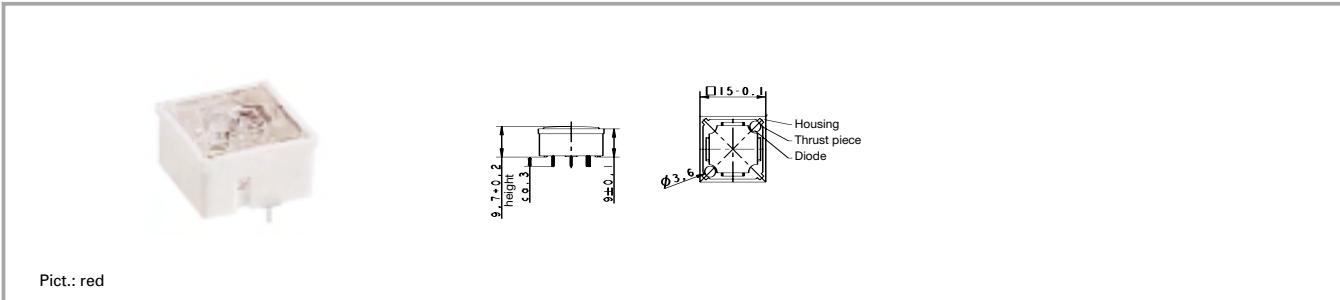
Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	fully illuminated 2 LEDs	red	red	2 mm	<b>3.14.200.011/0000</b>
Au	fully illuminated 2 LEDs	green	green	2 mm	<b>3.14.200.012/0000</b>
Au	fully illuminated 2 LEDs	yellow	yellow	2 mm	<b>3.14.200.013/0000</b>
Au	fully illuminated 2 LEDs	orange	yellow	2 mm	3.14.200.014/0000
Au	fully illuminated 2 LEDs	blue	blue	2 mm	3.14.200.015/0000
Ag	fully illuminated 2 LEDs	red	red	2 mm	<b>3.14.200.021/0000</b>
Ag	fully illuminated 2 LEDs	green	green	2 mm	<b>3.14.200.022/0000</b>
Ag	fully illuminated 2 LEDs	yellow	yellow	2 mm	<b>3.14.200.023/0000</b>
Ag	fully illuminated 2 LEDs	orange	yellow	2 mm	3.14.200.024/0000
Ag	fully illuminated 2 LEDs	blue	blue	2 mm	3.14.200.025/0000

Technical data see page 4 - 26

4

RF

### RF 15 short-travel keyswitch, 1 LED spot-illumination



Pict.: red

Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	spot illumination 1 LED	opaque white	blue	3 mm	3.14.100.030/0000
Au	spot illumination 1 LED	transparent	red	3 mm	<b>3.14.100.031/0000</b>
Au	spot illumination 1 LED	transparent	green	3 mm	<b>3.14.100.032/0000</b>
Au	spot illumination 1 LED	transparent	yellow	3 mm	<b>3.14.100.033/0000</b>
Ag	spot illumination 1 LED	opaque white	blue	3 mm	3.14.100.040/0000
Ag	spot illumination 1 LED	transparent	red	3 mm	<b>3.14.100.041/0000</b>
Ag	spot illumination 1 LED	transparent	green	3 mm	<b>3.14.100.042/0000</b>
Ag	spot illumination 1 LED	transparent	yellow	3 mm	<b>3.14.100.043/0000</b>

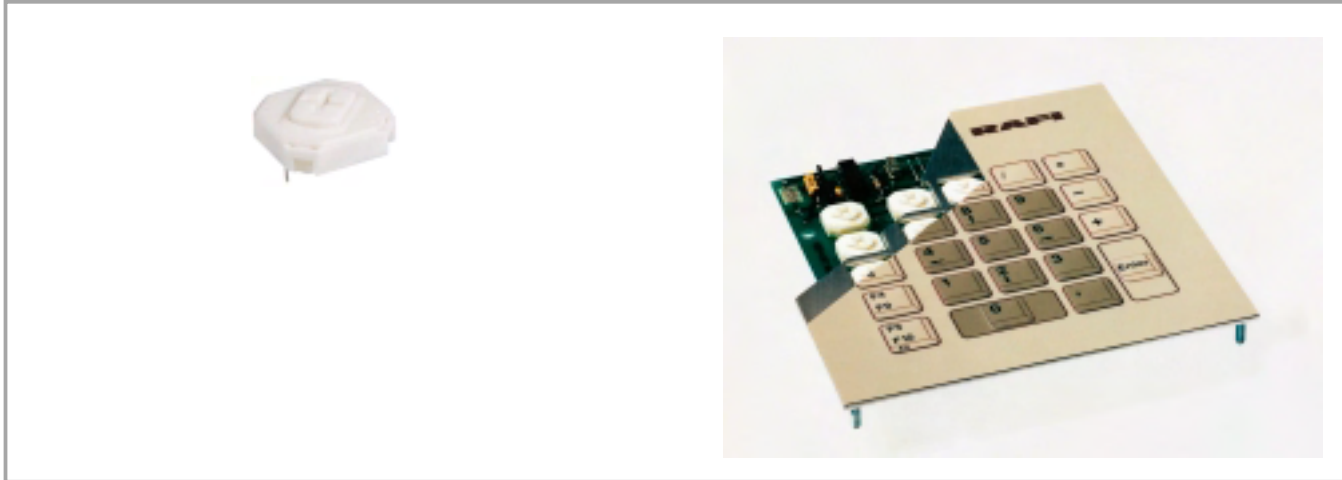
Technical data see page 4 - 26

Double-spot LED illumination available on request.

4

RF

### RF 15 N short-travel keyswitch



### General data

The RF 15N keyswitch provides a minimum overall height of 6.2 mm. The overall height can be varied by extension plungers which are inserted into the cross-like notches on the actuator tops.

LEDs can only be arranged separately next to the keyswitches up to an overall height of 10 mm (i.e. without plunger or with small plunger).

Keyswitches with overall heights of 12 mm or more can be provided with a maximum of 2 LEDs which are inserted into the recesses of the keyswitch housing. LEDs of keyswitches with overall heights of 12.5 mm or more should be placed onto LED spacers in order to obtain satisfactory illumination.

### Technical data

#### General information

Colour of lens see order block  
Recommended key grid 19.05 mm

#### Dimensions

Length 15 mm  
Width 15 mm  
Overall height 6.2 mm

#### Mechanical design

Mounting soldering into PCB  
Terminals contacts tin-plated, fix contact Ag plated  
Contact system snap-action contact  
Contact arrangement 1 NO  
Contact materials Au/Ag  
Illumination external 3 mm LED possible if height  $\geq$  12 mm

#### Mechanical characteristics

Operating force max. 2 ... 3 N  
Operating travel 0.5 mm  
Switching travel 0.5 mm  
Robustness min. with through-plated PCB 100 N

#### Electrical characteristics

Rated voltage min. Au: 0.02 V, Ag: 3 V  
Rated voltage max. Au: 42 V, Ag: 50 V  
Rated current min. Au: 0.01 mA, Ag: 0.1 mA  
Rated current max. Au: 100 mA, Ag: 250 mA  
Rated power max. (ohmic load) Au: 2 W, Ag: 12.5 W

Contact resistance when new max. 100 m $\Omega$   
Contact resistance acc. to life max. 3  $\Omega$   
Insulation resistance 10<sup>9</sup>  $\Omega$   
ESD strength (underneath overlay) 15 kV  
Bouncing time max. 5 ms

#### Other specifications

Ambient temp. operating min. -25 °C  
Ambient temp. operating max. +70 °C  
Storage temperature min. -40 °C  
Storage temperature max. (product) +80 °C  
Storage temperature max. (in tube) +50 °C  
Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
Operating life min. 1000000  
Soldering time max. 2.5 sec.  
Soldering temperature max. 250 °C  
Flammability of materials UL 94 HB

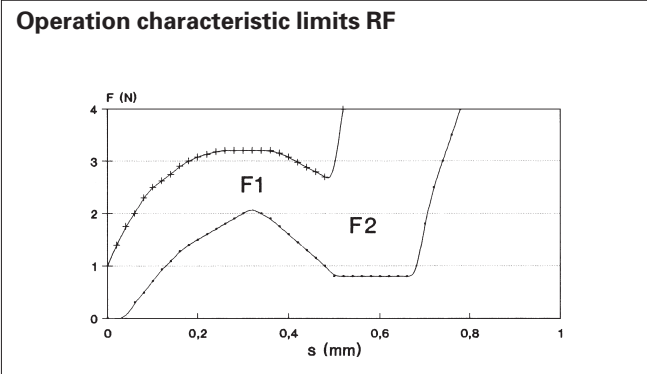
4

RF



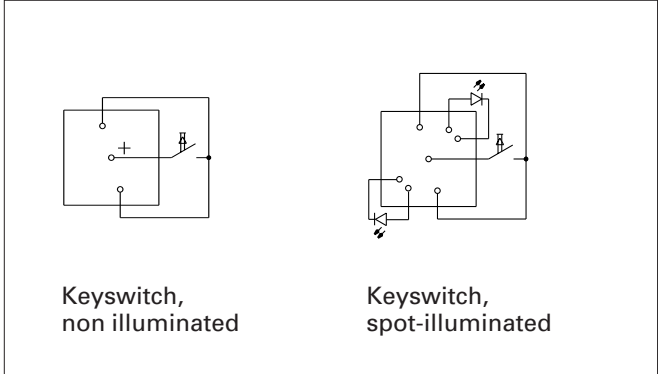
# RF short-travel keyswitches

## Force/Travel Diagram – Keyswitch RF 15 N

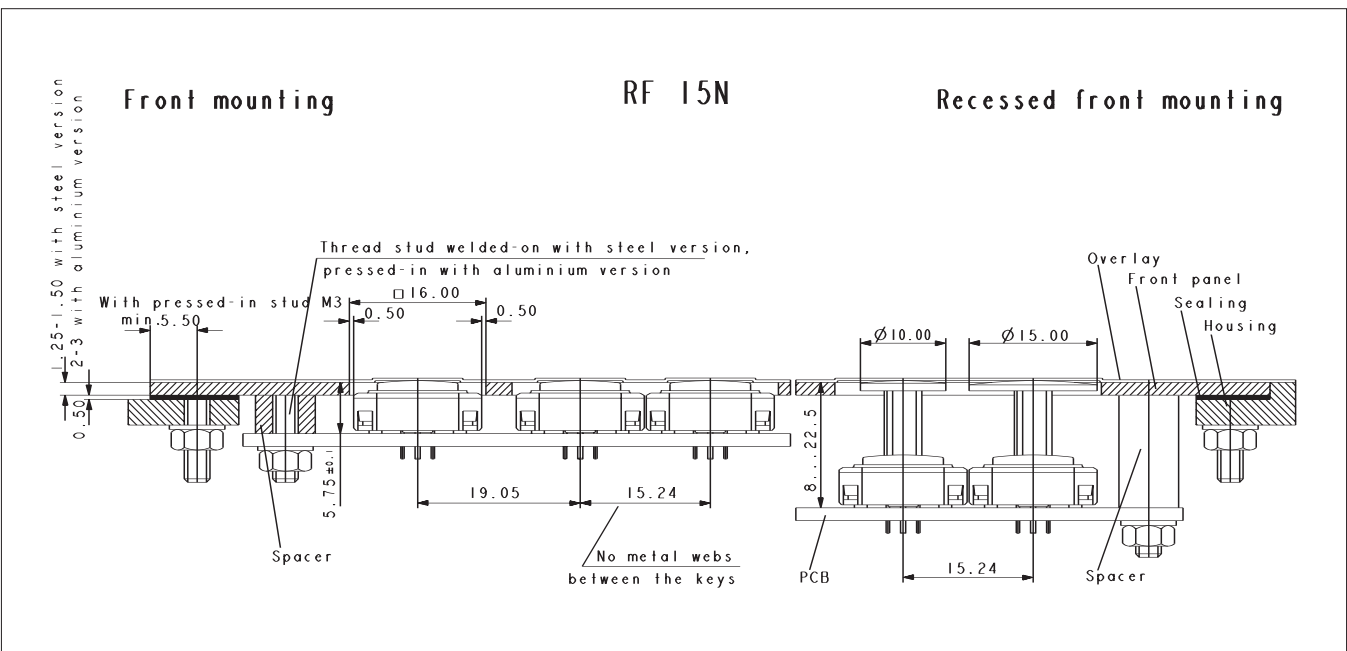
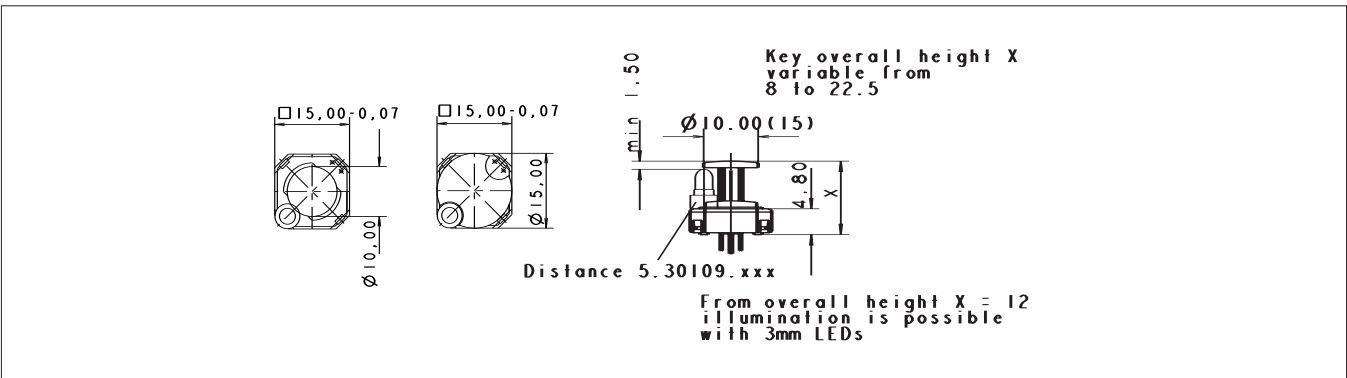


F 1 = Max. operating force  
 F 2 = Force at contact  
 F 2 is max. 55% of F 1

## Circuit Diagram – Keyswitch RF 15 N

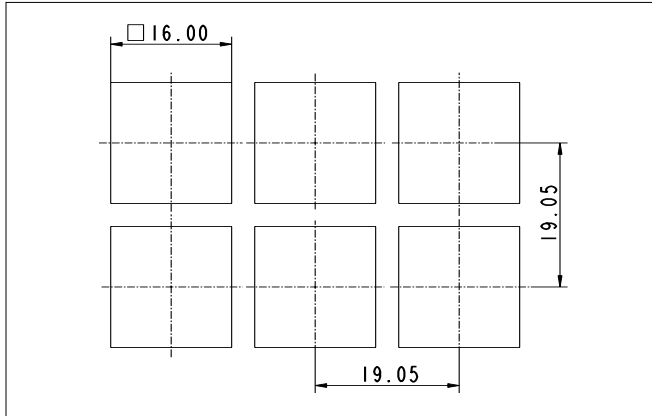


## Dimensional Drawings RF 15 N

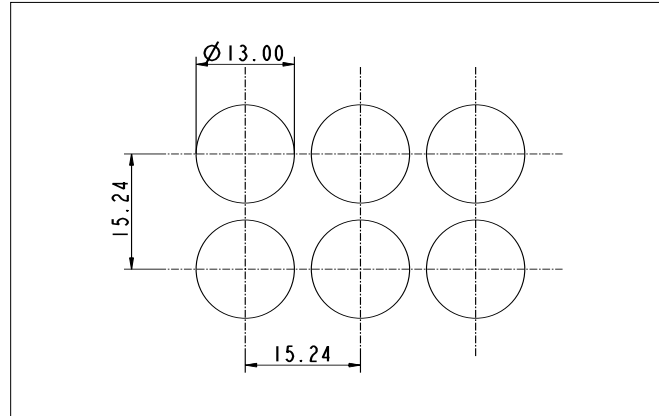


### Hole Patterns – Front Panel RF 15 N

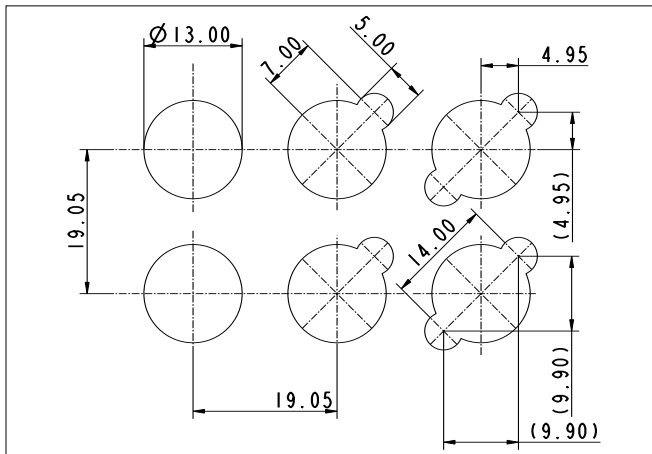
RF 15 N without plunger



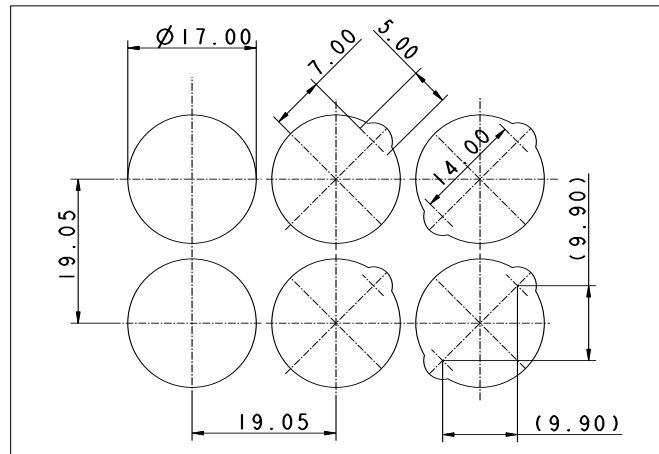
RF 15 N with plunger  $\varnothing$  10 mm, non-illuminated



RF 15 N with plunger  $\varnothing$  10 mm, illuminated



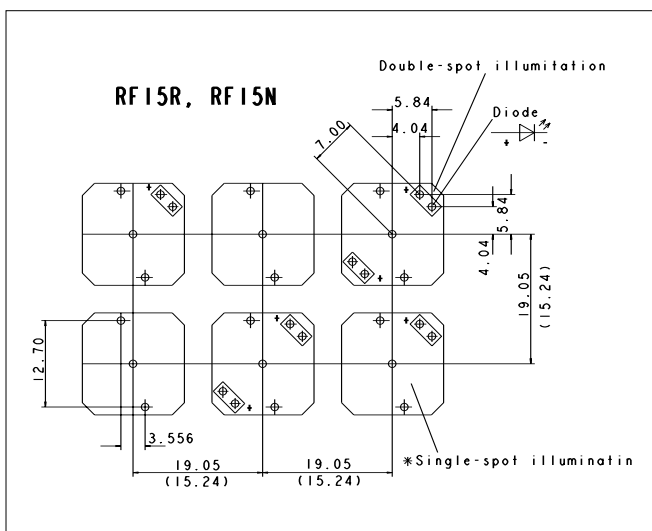
RF 15 N with plunger  $\varnothing$  15 mm, illuminated



4

### Hole Pattern RF 15 N

RF



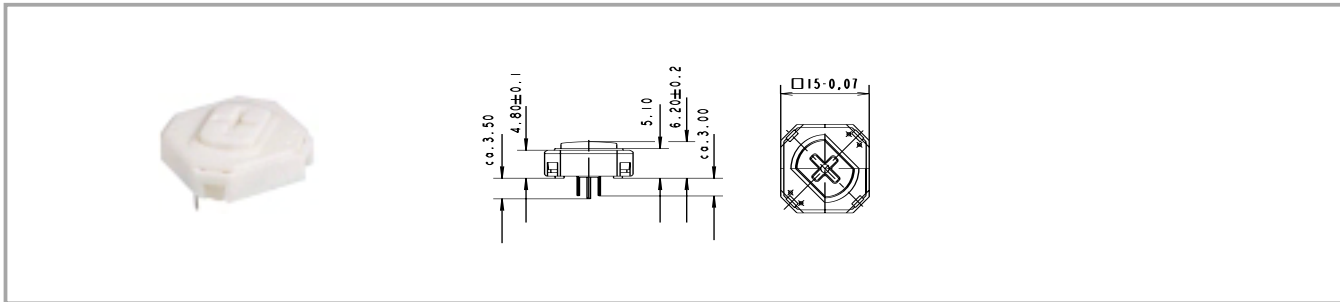
View on component side  
All hole diameters  $1.1 \pm 0.1$  mm  
PCB layout Keyswitch 1/400" grid

## RF short-travel keyswitches

### Accessories RF 15 N short-travel keyswitch

Description	Photo	Order no.	Page
LED yellow, 3mm		1.90.690.103/0000	
LED spacer for RF 15 N, Ø 5 mm, spacing length 2.2 mm, light grey, for use with overall height of 12.5 mm		5.30.109.010/0756	
Extension plunger for RF 15 N, Ø 10 mm, overall height 22.5 mm		<b>5.46.011.028/0710</b>	
Extension plunger for RF 15 N, Ø 15 mm, overall height 22.5 mm		<b>5.46.017.028/0710</b>	

### RF 15 N short-travel keyswitch, non-illuminated



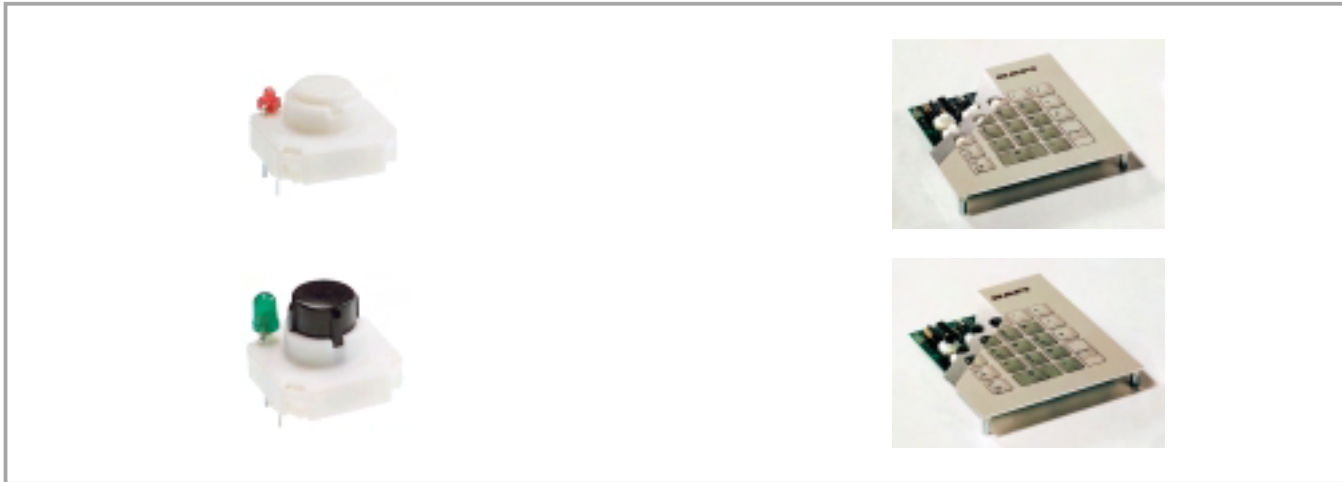
Contact materials	Illumination	Recommended key grid	Overall height	Order no.
Au	external 3 mm LED possible if height	19.05 mm	6.2 mm	<b>3.14.100.601/0000</b>
Ag	external 3 mm LED possible if height	19.05 mm	6.2 mm	<b>3.14.100.606/0000</b>

Technical data see page 4 - 32

4

RF

### RF 15 R short-travel keyswitch



### General data

The round actuator of the RF 15 R keyswitch requires round front panel cut-outs. These make it possible to use a narrow keyboard grid of only 15.24 mm with sufficiently large frame webs between the individual keys. We recommend area embossing over the actuators for the overlay.

### Technical data

4

#### General information

Recommended key grid 15.24 mm

#### Dimensions

Length 15 mm  
Width 15 mm  
Overall height 9,7/12,5 mm

#### Mechanical design

Mounting soldering into PCB  
Terminals contacts tin-plated, fix contact Ag plated

Contact system snap-action contact  
Contact arrangement 1 NO  
Contact materials Au/Ag  
Illumination spot illumination  
LED colour see order block  
LED type see order block

#### Mechanical characteristics

Operating force max. 2 ... 3 N  
Operating travel 0.5 mm  
Switching travel 0.5 mm  
Robustness min. with through-plated PCB 100 N

#### Electrical characteristics

Rated voltage min. Au: 0.02 V, Ag: 3 V  
Rated voltage max. Au: 42 V, Ag: 50 V  
Rated current min. Au: 0.01 mA, Ag: 0.1 mA  
Rated current max. Au: 100 mA, Ag: 250 mA  
Rated power max. (ohmic load) Au: 2 W, Ag: 12.5 W

Contact resistance when new max. 100 mΩ  
Contact resistance acc. to life max. 3 Ω  
Insulation resistance 10<sup>9</sup> Ω  
ESD strength (underneath overlay) 15 kV  
Bouncing time max. 5 ms

#### Other specifications

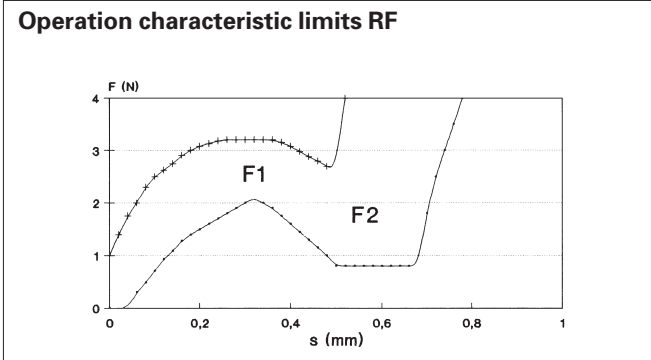
Ambient temp. operating min. -25 °C  
Ambient temp. operating max. +70 °C  
Storage temperature min. -40 °C  
Storage temperature max. (product) +80 °C  
Storage temperature max. (in tube) +50 °C  
Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
Operating life min. 1000000  
Soldering time max. 2.5 sec.  
Soldering temperature max. 250 °C  
Flammability of materials UL 94 HB

RF



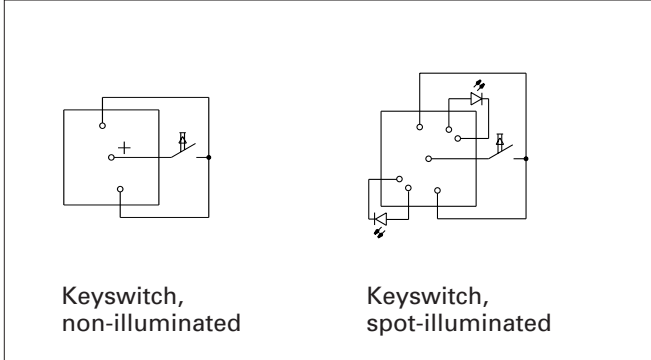
# RF short-travel keyswitches

## Force/Travel Diagram – Keyswitch RF 15 R

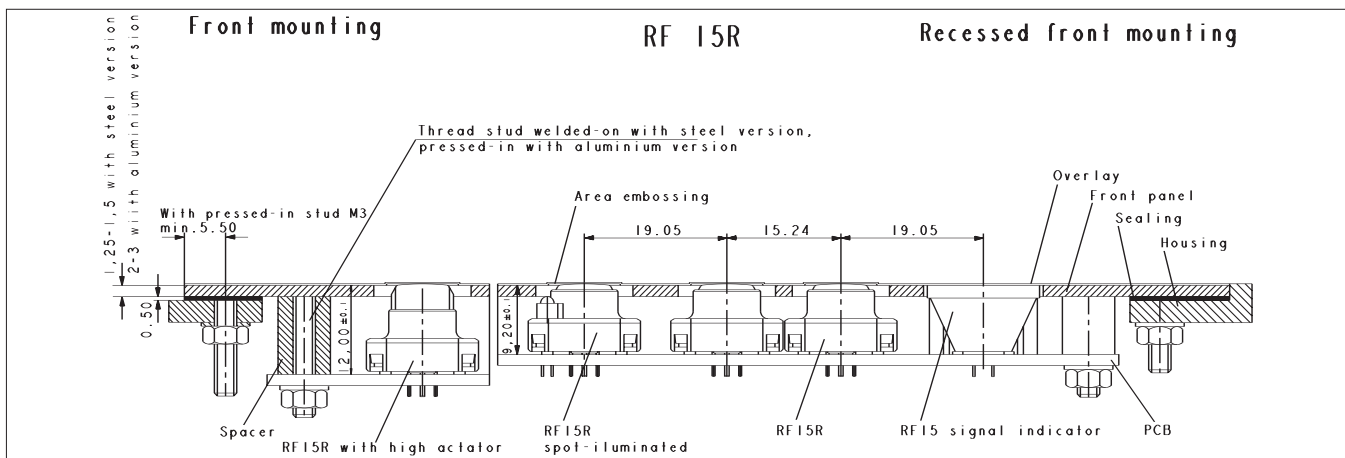


F 1 = Max. operating force  
 F 2 = Force at contact  
 F 2 is max. 55% of F 1

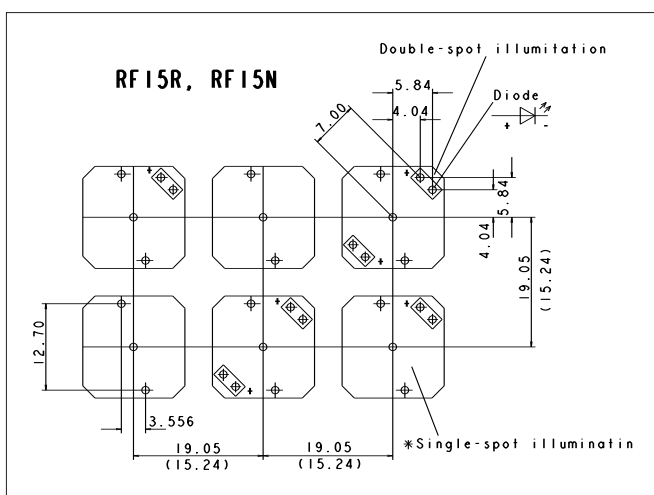
## Circuit Diagram – Keyswitch RF 15 R



## Dimensional Drawing RF 15 R



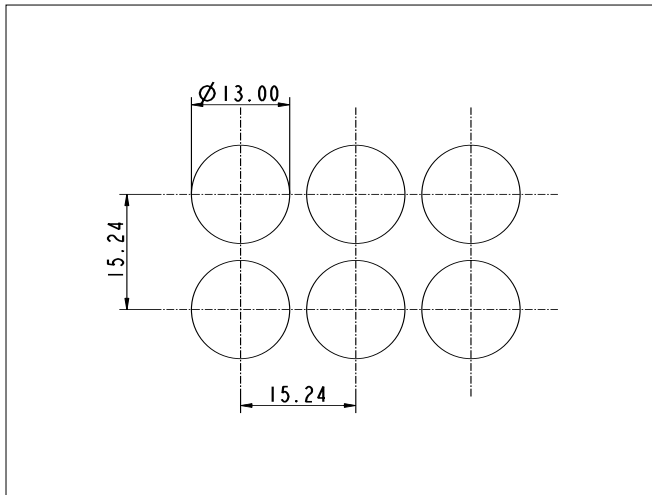
## Hole Pattern RF 15 R



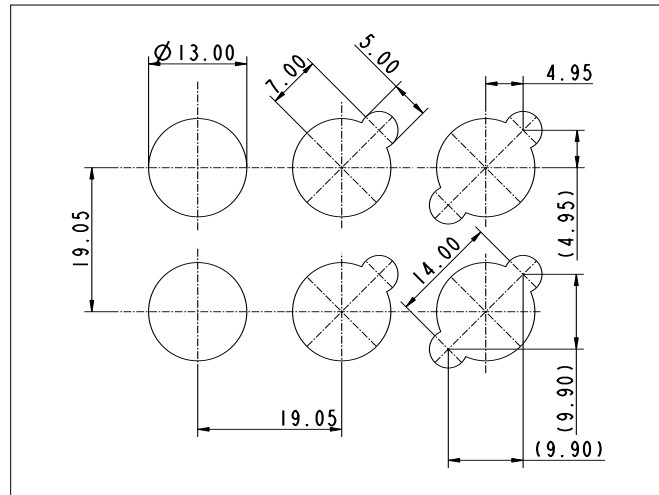
View on component side  
 All hole diameters 1,1 ±0,1 mm  
 PCB layout Keyswitch 1/400" grid

### Hole Pattern – Front Panel RF 15 R

RF 15 R, non-illuminated



RF 15 R, illuminated

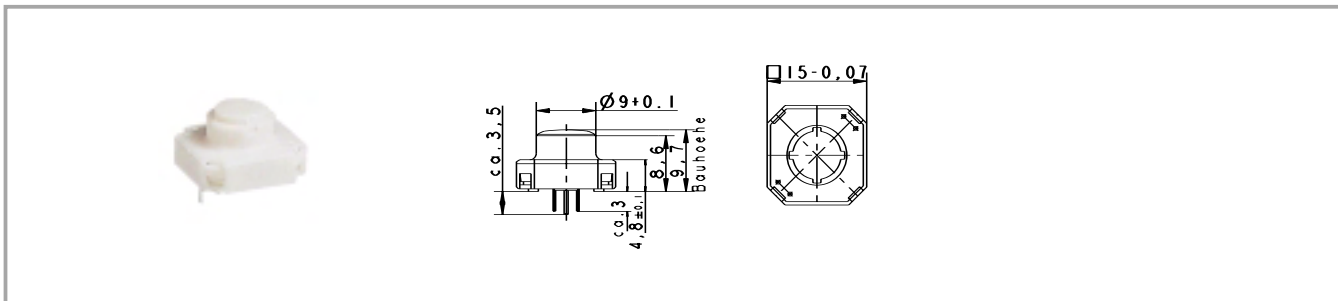


4

RF

## RF short-travel keyswitches

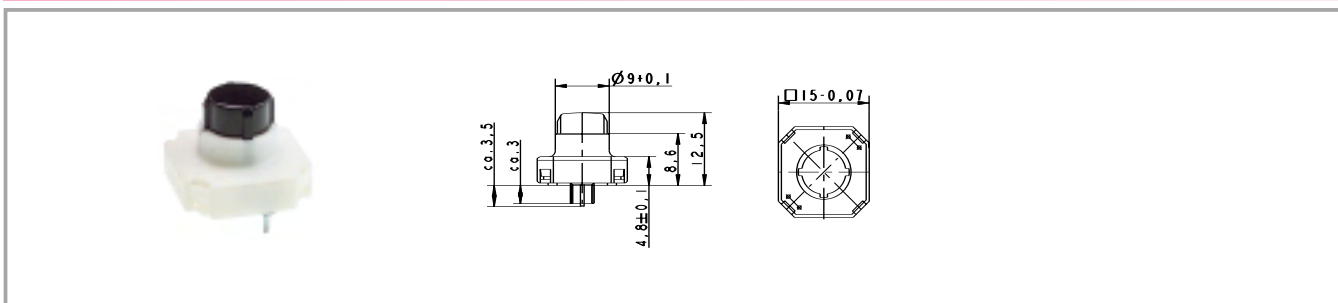
### RF 15 R low short-travel keyswitch, non-illuminated



Contact materials	Overall height	Illumination	LED type	LED colour	Order no.
Au	9.7 mm	not illuminated			<b>3.14.100.501/0000</b>
Ag	9.7 mm	not illuminated			<b>3.14.100.506/0000</b>

Technical data see page 4 - 36

### RF 15 R high short-travel keyswitch, non-illuminated



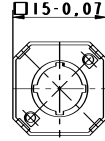
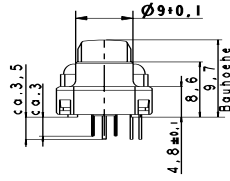
Contact materials	Overall height	Illumination	LED type	LED colour	Order no.
Au	12.5 mm	not illuminated			<b>3.14.100.801/0000</b>
Ag	12.5 mm	not illuminated			<b>3.14.100.806/0000</b>

Technical data see page 4 - 36

4

RF

### RF 15 R low short-travel keyswitch, 1 LED spot-illumination



Pict.: red

Contact materials	Overall height	Illumination	LED type	LED colour	Order no.
Au	9.7 mm	spot illumination 1 LED	2 mm	red	<b>3.14.100.531/0000</b>
Au	9.7 mm	spot illumination 1 LED	2 mm	green	<b>3.14.100.532/0000</b>
Au	9.7 mm	spot illumination 1 LED	2 mm	yellow	<b>3.14.100.533/0000</b>
Ag	9.7 mm	spot illumination 1 LED	2 mm	red	3.14.100.541/0000
Ag	9.7 mm	spot illumination 1 LED	2 mm	green	3.14.100.542/0000
Ag	9.7 mm	spot illumination 1 LED	2 mm	yellow	3.14.100.543/0000

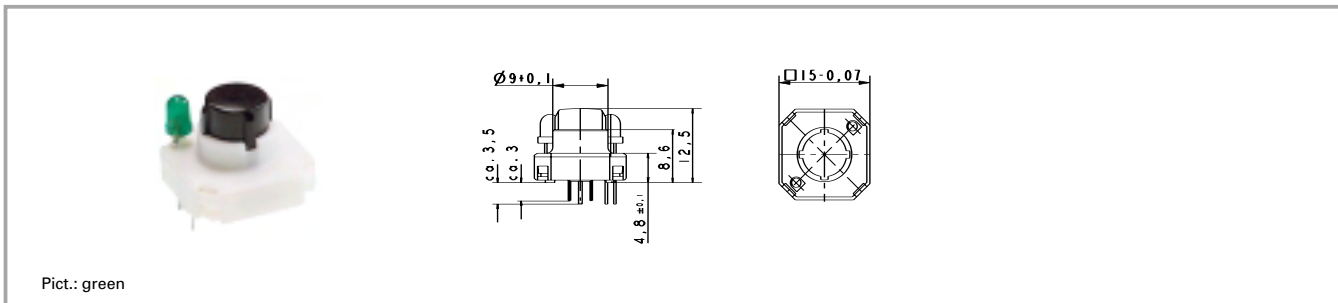
Technical data see page 4 - 36

Versions with 2 LEDs available on request.

4

RF

**RF 15 R high short-travel keyswitch, 1 LED spot-illumination**



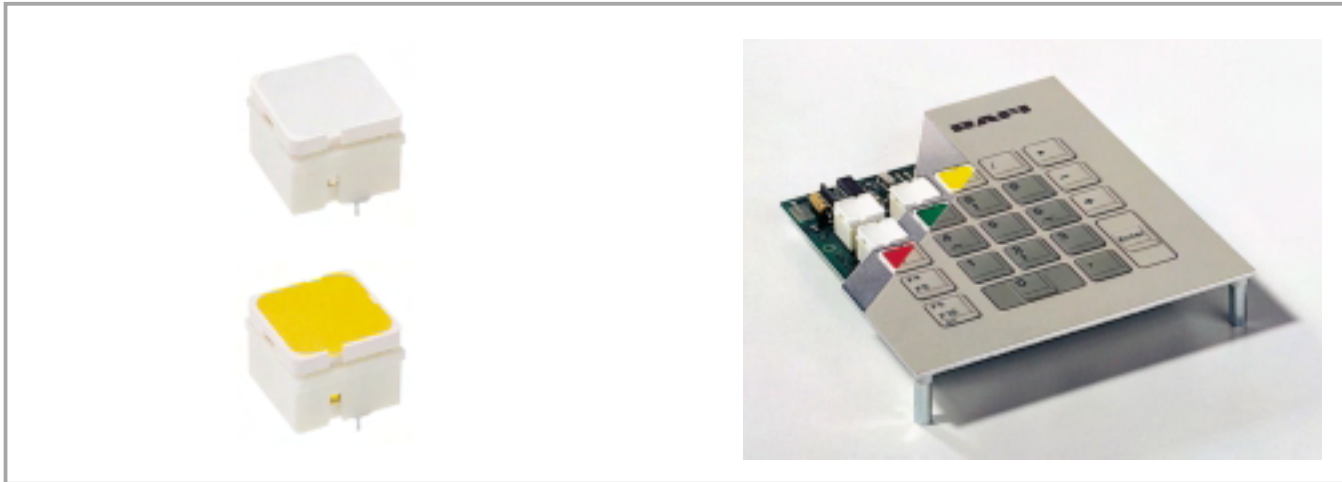
Pict.: green

Contact materials	Overall height	Illumination	LED type	LED colour	Order no.
Au	12.5 mm	spot illumination 1 LED	3 mm	blue	3.14.100.830/0000
Au	12.5 mm	spot illumination 1 LED	3 mm	red	3.14.100.831/0000
Au	12.5 mm	spot illumination 1 LED	3 mm	green	3.14.100.832/0000
Au	12.5 mm	spot illumination 1 LED	3 mm	yellow	3.14.100.833/0000
Ag	12.5 mm	spot illumination 1 LED	3 mm	blue	3.14.100.840/0000
Ag	12.5 mm	spot illumination 1 LED	3 mm	red	3.14.100.841/0000
Ag	12.5 mm	spot illumination 1 LED	3 mm	green	3.14.100.842/0000
Ag	12.5 mm	spot illumination 1 LED	3 mm	yellow	3.14.100.843/0000

Technical data see page 4 - 36

Versions with 2 LEDs available on request.

### RF 15 H short-travel keyswitch



### General data

#### Application notes:

The RF 15 H key has an overall height of 12.5 mm and can be fully illuminated. When designing membrane keyboards, we recommend using a key grid of at least 19.05 mm and a 0.13 mm overlay with area embossing over the keys. You can use the O-ring (accessory) to block the key and use it as an indicator field or blank spaceholder.

### Technical data

4

#### General information

Colour of lens see order block  
Recommended key grid 20 mm

#### Dimensions

Length 15 mm  
Width 15 mm  
Overall height 12.5 mm

#### Mechanical design

Mounting soldering into PCB  
Terminals see order block  
Contact system snap-action contact  
Contact arrangement 1 NO  
Contact materials Au/Ag  
Illumination not illuminated / fully illuminated / see order block  
LED colour see order block  
LED type see order block

#### Mechanical characteristics

Operating force max. 2 ... 3 N  
Operating travel 0.5 mm  
Switching travel 0.5 mm  
Robustness min. with through-plated PCB  
100 N

#### Electrical characteristics

Rated voltage min. Au: 0.02 V, Ag: 3 V  
Rated voltage max. Au: 42 V, Ag: 50 V  
Rated current min. Au: 0.01 mA, Ag: 0.1 mA  
Rated current max. Au: 100 mA, Ag: 250 mA

Rated power max. (ohmic load) Au: 2 W, Ag: 12.5 W  
Contact resistance when new max. 100 mΩ  
Contact resistance acc. to life max. 3 Ω  
Insulation resistance 10<sup>9</sup> Ω  
ESD strength (underneath overlay) 15 kV  
Bouncing time max. 5 ms

#### Other specifications

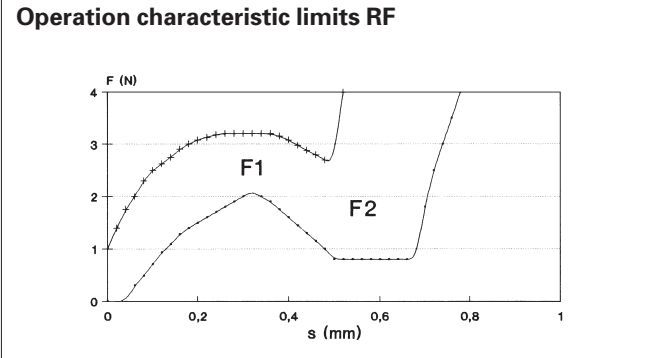
Ambient temp. operating min. -25 °C  
Ambient temp. operating max. +70 °C  
Storage temperature min. -40 °C  
Storage temperature max. (product) +80 °C  
Storage temperature max. (in tube) +50 °C  
Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
Operating life min. 1000000  
Soldering time max. 2.5 sec.  
Soldering temperature max. 250 °C  
Flammability of materials UL 94 HB

RF



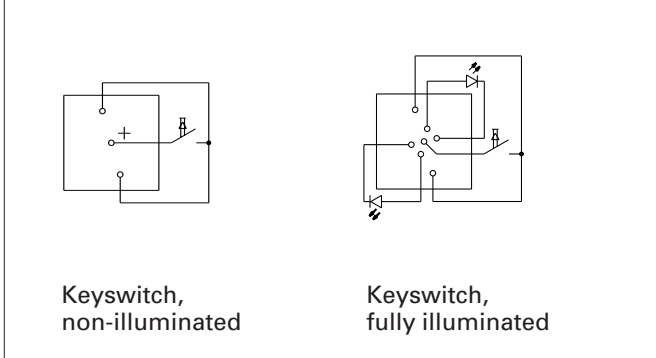
# RF short-travel keyswitches

## Force/Travel Diagram – Keyswitch RF 15 H

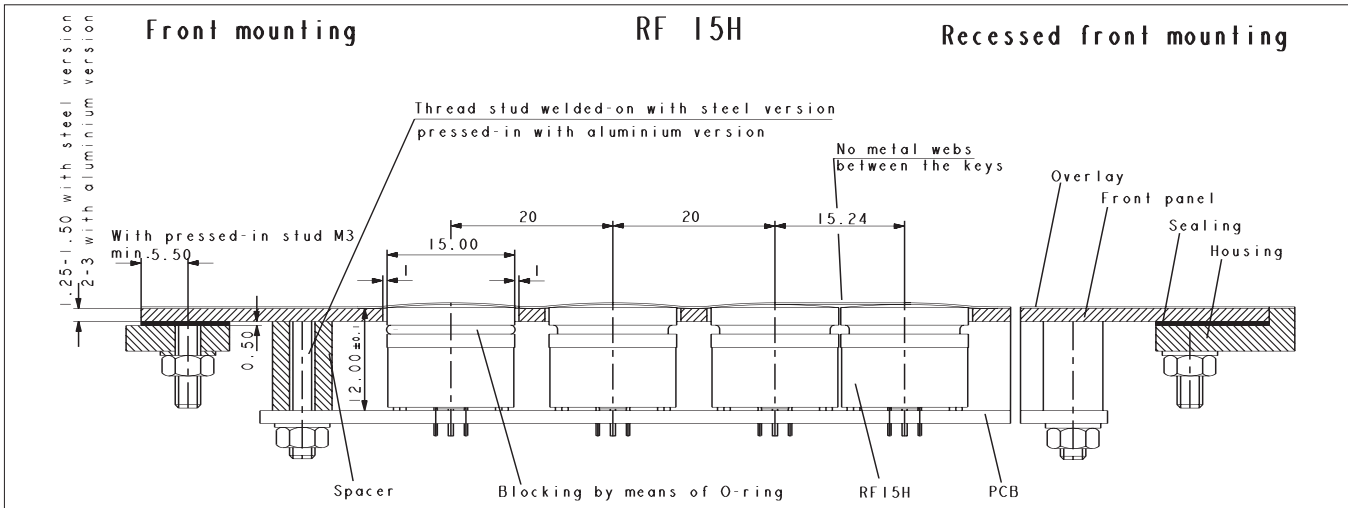


F 1 = Max. operating force  
 F 2 = Force at contact  
 F 2 is max. 55% of F 1

## Circuit Diagram – Keyswitch RF 15 H

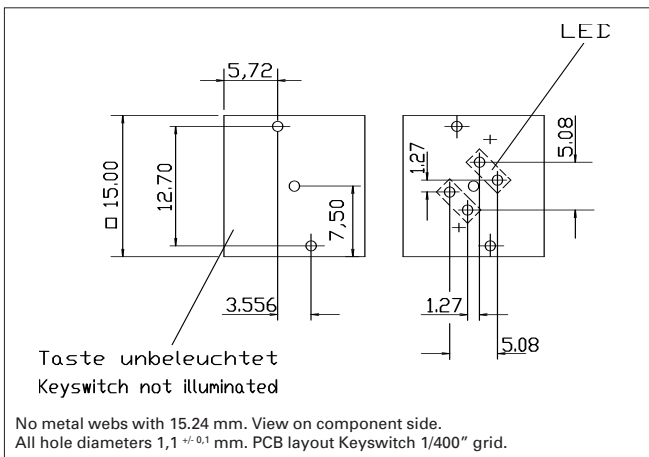


## Dimensional Drawing

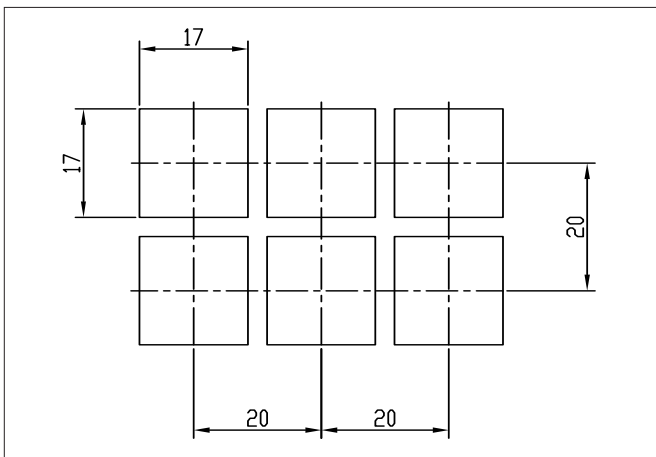


4

## Hole Pattern



## Hole Pattern – Front Panel

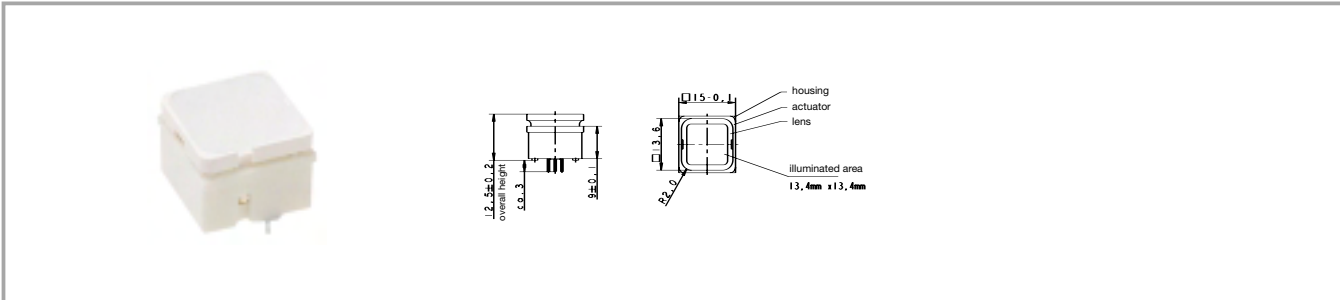


RF

### Accessories RF 15 H short-travel keyswitch

Description	Photo	Order no.	Page
O-ring, black, for blocking the operating stroke		5.30.120.009/0100	

### RF 15 H short-travel keyswitch, non-illuminated



Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	not illuminated	white			<b>3.14.100.702/0000</b>
Ag	not illuminated	white			<b>3.14.100.707/0000</b>

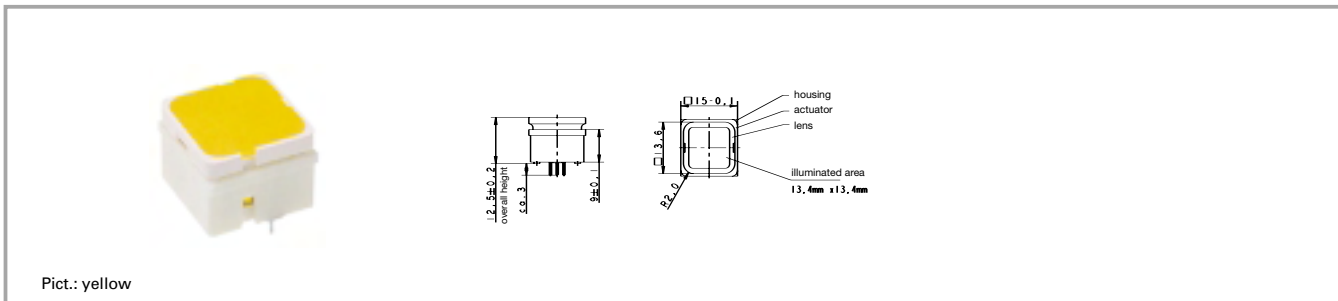
Technical data see page 4 - 42

4

RF

## RF short-travel keyswitches

### RF 15 H short-travel keyswitch, fully illuminated



Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	fully illuminated 2 LEDs	red	red	2 mm	<b>3.14.200.731/0000</b>
Au	fully illuminated 2 LEDs	green	green	2 mm	<b>3.14.200.732/0000</b>
Au	fully illuminated 1 LED	green	green super bright	3 mm	<b>3.14.200.736/0000</b>
Au	fully illuminated 2 LEDs	yellow	yellow	2 mm	<b>3.14.200.733/0000</b>
Au	fully illuminated 1 LED	white	white	3 mm	<b>3.14.200.735/0000</b>
Au	fully illuminated 2 LEDs	orange	yellow	2 mm	<b>3.14.200.738/0000</b>
Au	fully illuminated 1 LED	blue	blue	3 mm	<b>3.14.200.739/0000</b>
Au	fully illuminated 2 LEDs	white	multi colour	3 mm	3.14.100.734/0000
Ag	fully illuminated 2 LEDs	red	red	2 mm	<b>3.14.200.741/0000</b>
Ag	fully illuminated 2 LEDs	green	green	2 mm	<b>3.14.200.742/0000</b>
Ag	fully illuminated 1 LED	green	green super bright	3 mm	<b>3.14.200.746/0000</b>
Ag	fully illuminated 2 LEDs	yellow	yellow	2 mm	<b>3.14.200.743/0000</b>
Ag	fully illuminated 1 LED	white	white	3 mm	<b>3.14.200.745/0000</b>
Ag	fully illuminated 2 LEDs	orange	yellow	2 mm	<b>3.14.200.748/0000</b>
Ag	fully illuminated 1 LED	blue	blue	3 mm	<b>3.14.200.749/0000</b>
Ag	fully illuminated 2 LEDs	white	multi colour	3 mm	3.14.100.744/0000

Technical data see page 4 - 42

When using the keyswitches with multicolour LEDs the illumination colour can be varied from red to green by change of polarity. Due to the frequency of the polarity-changes the colours red, green, yellow as well as all secondary colours from these are possible.

4

RF

### RF 15 signal indicator



### Technical data

#### General information

Colour of lens see order block  
 Recommended key grid 19.05 mm

#### Dimensions

Length 15 mm  
 Width 15 mm  
 Overall height 9.7 mm

#### Mechanical design

Mounting soldering into PCB  
 Illumination fully illuminated 1 LED  
 LED colour see order block  
 LED type 2 mm

#### Other specifications

Ambient temp. operating min. -25 °C  
 Ambient temp. operating max. +70 °C

Storage temperature min. -40 °C  
 Storage temperature max. (product) +80 °C  
 Storage temperature max. (in tube) +50 °C  
 Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
 Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
 Soldering time max. 2.5 sec.  
 Soldering temperature max. 250 °C  
 Flammability of materials UL 94 HB

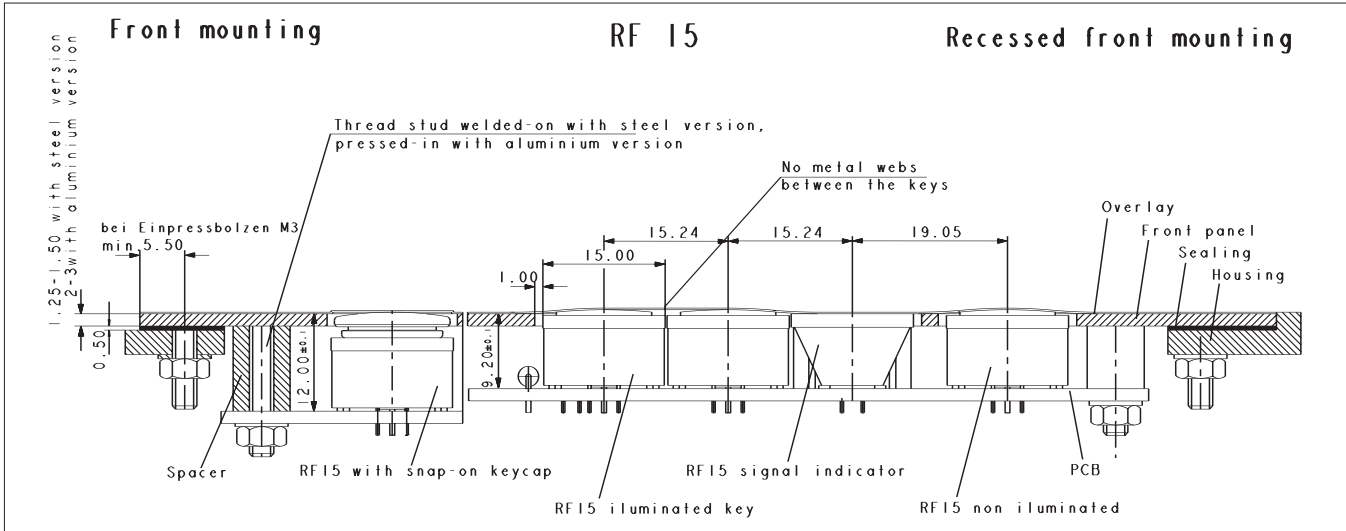
4

RF

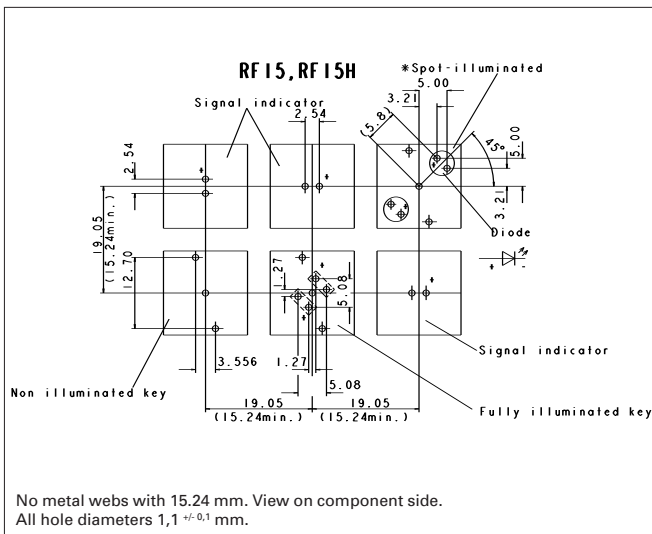


# RF short-travel keyswitches

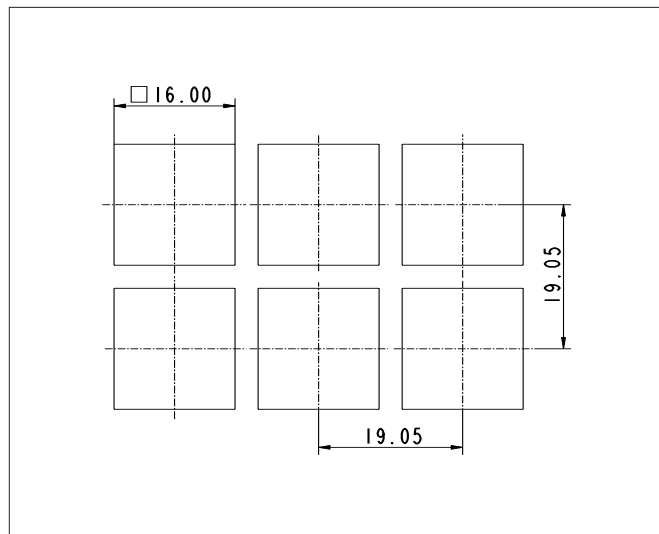
## Dimensional Drawing Signal Indicator RF 15



### Hole Pattern



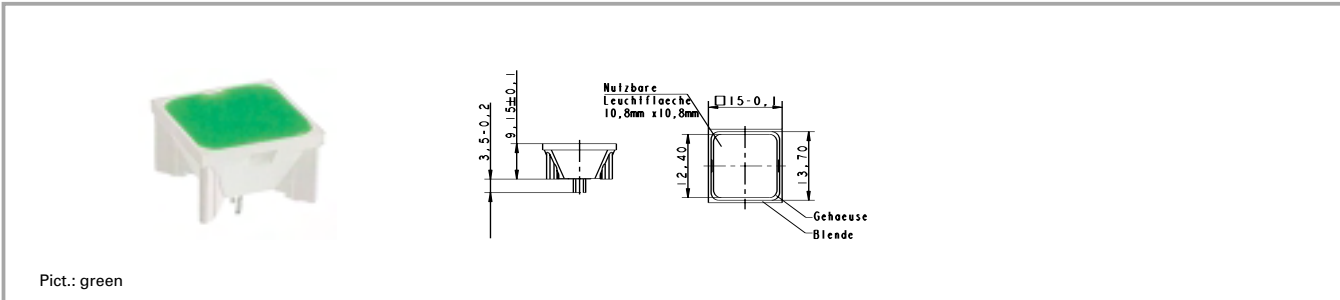
### Hole Pattern – Front Panel



4

RF

### RF 15 signal indicator, fully illuminated, 1 LED



Pict.: green

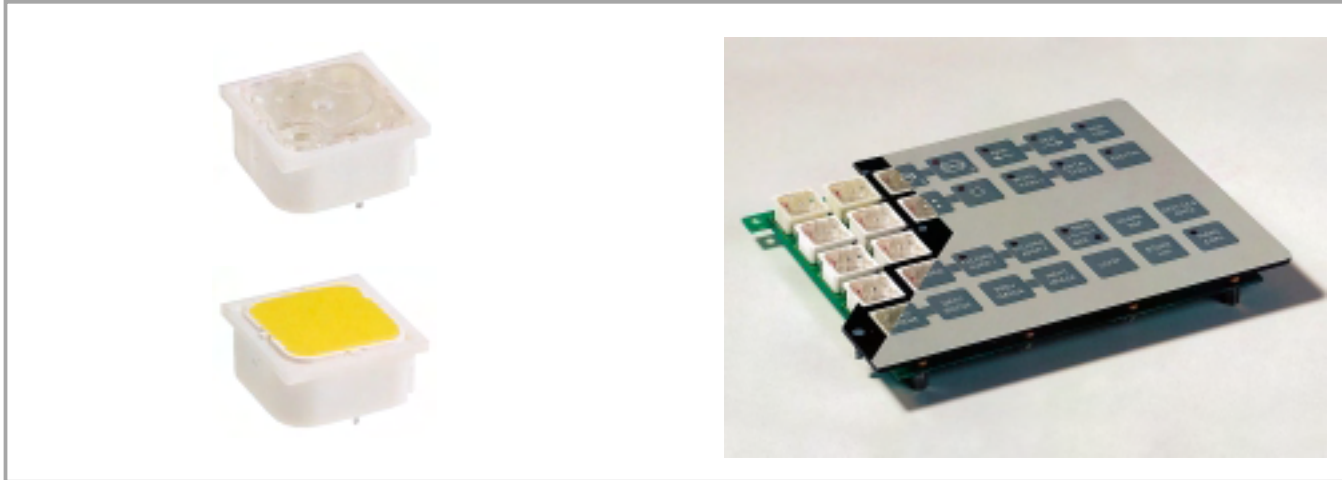
Overall height	Illumination	Colour of lens	LED colour	LED type	Order no.
9.7 mm	fully illuminated 1 LED	red	red	2 mm	<b>3.14.200.051/0000</b>
9.7 mm	fully illuminated 1 LED	green	green	2 mm	<b>3.14.200.052/0000</b>
9.7 mm	fully illuminated 1 LED	yellow	yellow	2 mm	<b>3.14.200.053/0000</b>
9.7 mm	fully illuminated 1 LED	orange	yellow	2 mm	3.14.200.054/0000
9.7 mm	fully illuminated 1 LED	blue	blue	2 mm	3.14.200.055/0000

Technical data see page 4 - 46

4

RF

### RF 19 short-travel keyswitch



### General data

#### Application notes:

RF 19 keys offer a large actuation area. When designing low-profile keyboards with a grid of  $\geq 23$  mm, frame webs remain free between the individual keys.

The overlay can be glued onto these frame webs; we recommend area embossing over the keys for the overlay.

### Technical data

4

#### General information

Colour of lens see order block  
Recommended key grid 23 mm

#### Dimensions

Length 19.05 mm  
Width 19.05 mm  
Overall height 9.7 mm

#### Mechanical design

Mounting soldering into PCB  
Terminals contacts tin-plated, fix contact Ag plated snap-action contact

Contact system 1 NO  
Contact arrangement Au/Ag  
Contact materials spot-/fully illuminated  
Illumination see order block  
LED colour see order block  
LED type see order block

#### Mechanical characteristics

Operating force max. 2 ... 3 N  
Operating travel 0.5 mm  
Switching travel 0.5 mm  
Robustness min. with through-plated PCB 100 N

#### Electrical characteristics

Rated voltage min. Au: 0.02 V, Ag: 3 V  
Rated voltage max. Au: 42 V, Ag: 50 V  
Rated current min. Au: 0.01 mA, Ag: 0.1 mA  
Rated current max. Au: 100 mA, Ag: 250 mA

Rated power max. (ohmic load) Au: 2 W, Ag: 12.5 W  
Contact resistance when new max. 100 m $\Omega$   
Contact resistance acc. to life max. 3  $\Omega$   
Insulation resistance 10<sup>9</sup>  $\Omega$   
ESD strength (underneath overlay) 15 kV  
Bouncing time max. 5 ms

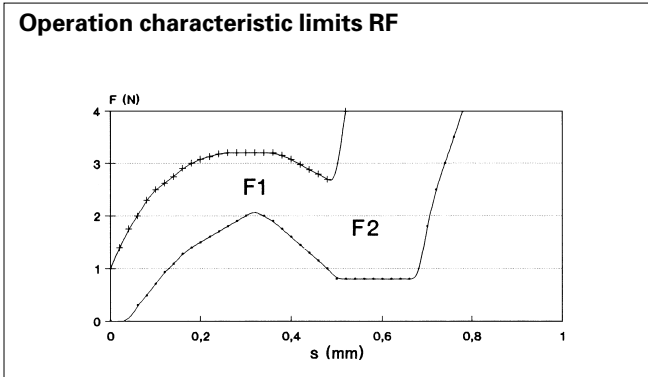
#### Other specifications

Ambient temp. operating min. -25 °C  
Ambient temp. operating max. +70 °C  
Storage temperature min. -40 °C  
Storage temperature max. (product) +80 °C  
Storage temperature max. (in tube) +50 °C  
Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
Operating life min. 1000000  
Soldering time max. 2.5 sec.  
Soldering temperature max. 250 °C  
Flammability of materials UL 94 HB

RF

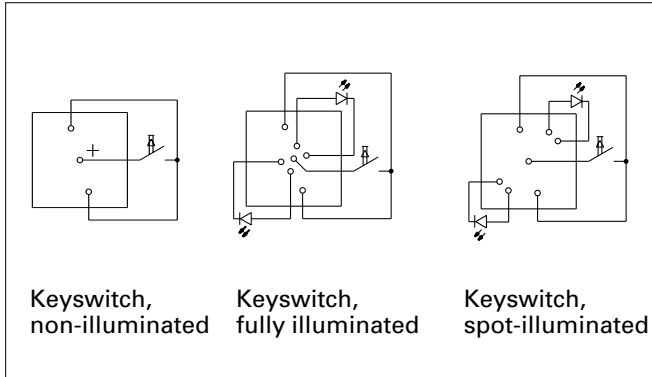
# RF short-travel keyswitches

## Force/Travel Diagram – Keyswitch RF 19



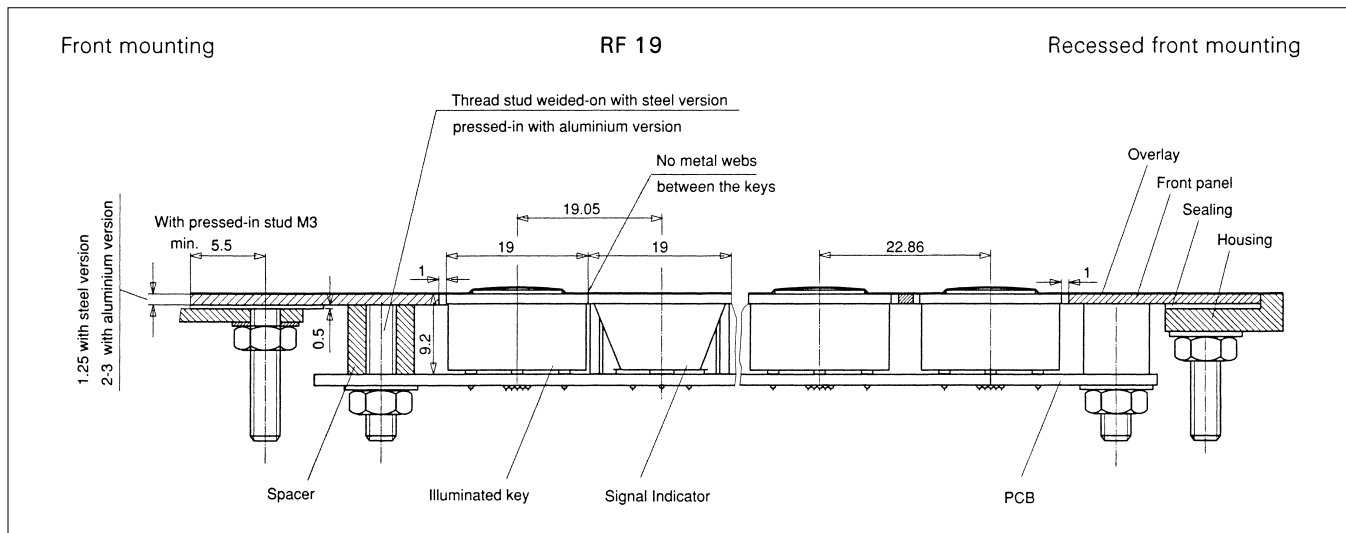
F 1 = Max. operating force  
 F 2 = Force at contact  
 F 2 is max. 55% of F 1

## Circuit Diagram – Keyswitch RF 19



Keyswitch, non-illuminated      Keyswitch, fully illuminated      Keyswitch, spot-illuminated

## Dimensional Drawing



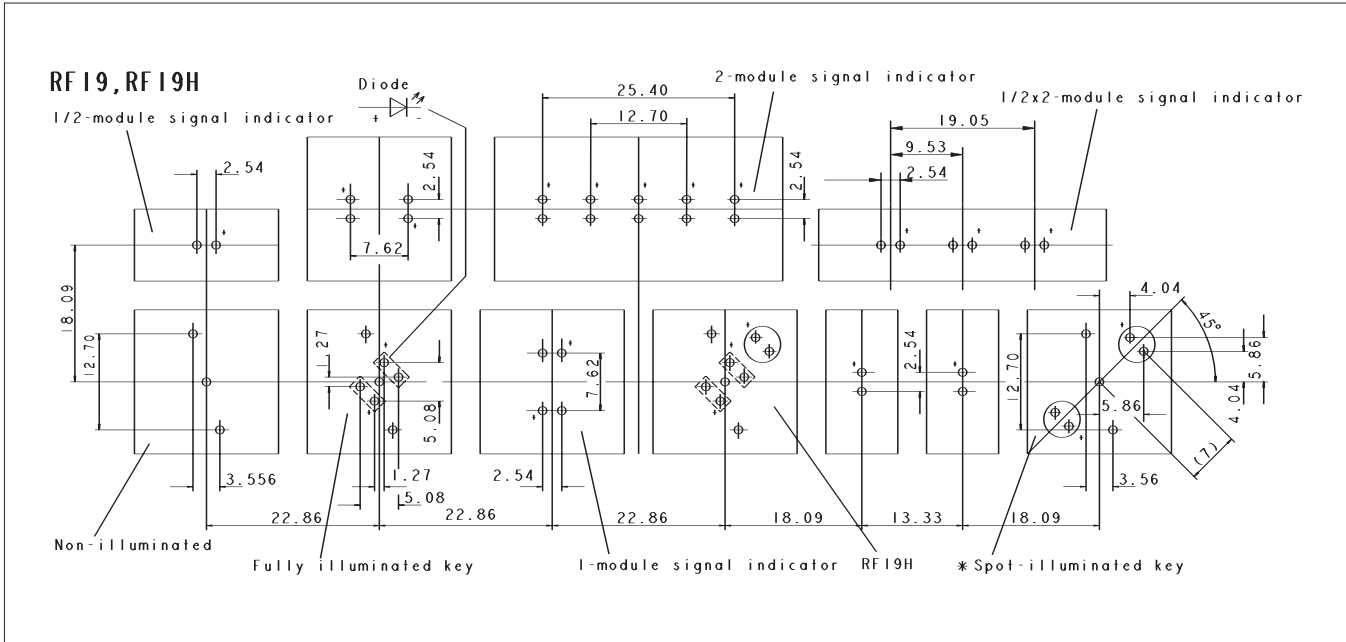
4

RF



## RF short-travel keyswitches

### Hole Patterns RF 19

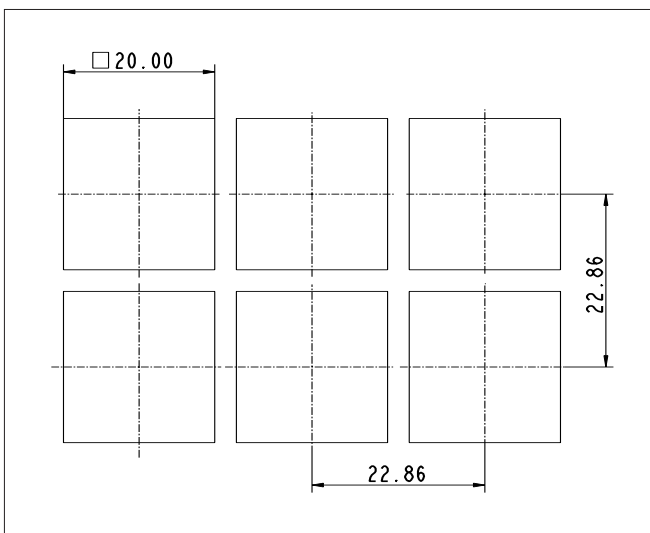


\* The LED may be positioned either on the left-hand or right-hand side.  
 Standard version: LED on left-hand side  
 View on component side, all hole diameters 1,1 +/- 0,1 mm

### Hole Patterns – Front Panel RF 19

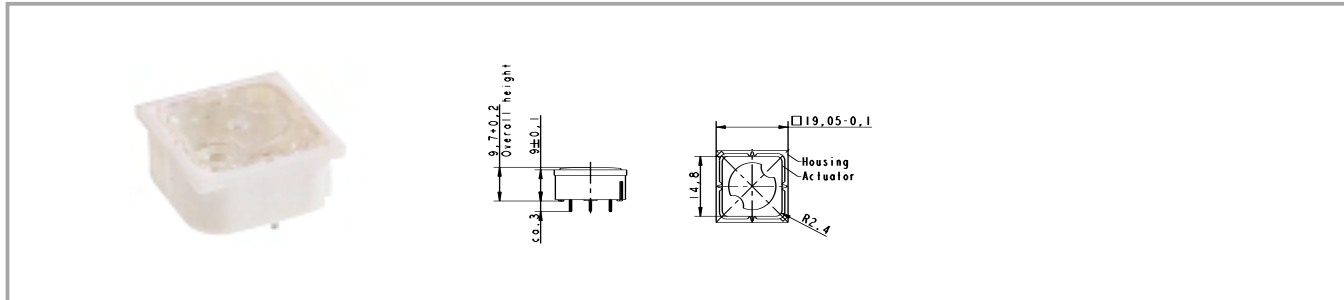
4

RF



# RF short-travel keyswitches

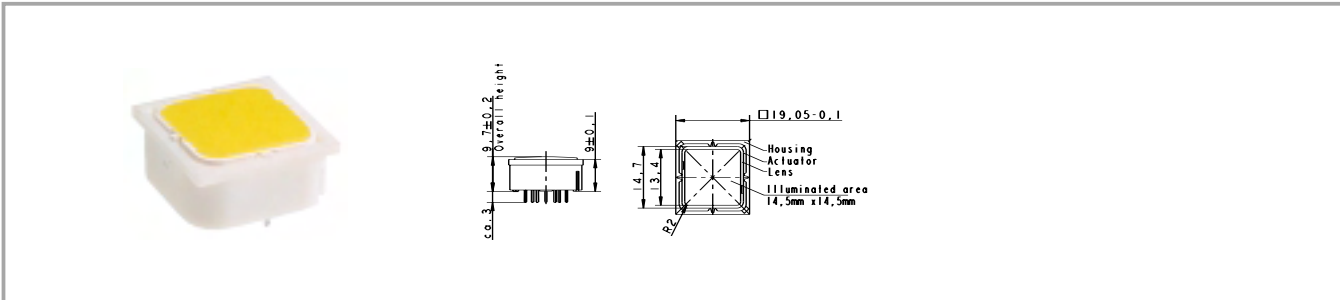
## RF 19 short-travel keyswitch, non-illuminated



Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	not illuminated	transparent			<b>3.14.001.001/0000</b>
Ag	not illuminated	transparent			<b>3.14.001.006/0000</b>

Technical data see page 4 - 50

### RF 19 short-travel keyswitch, fully illuminated with 2 LEDs



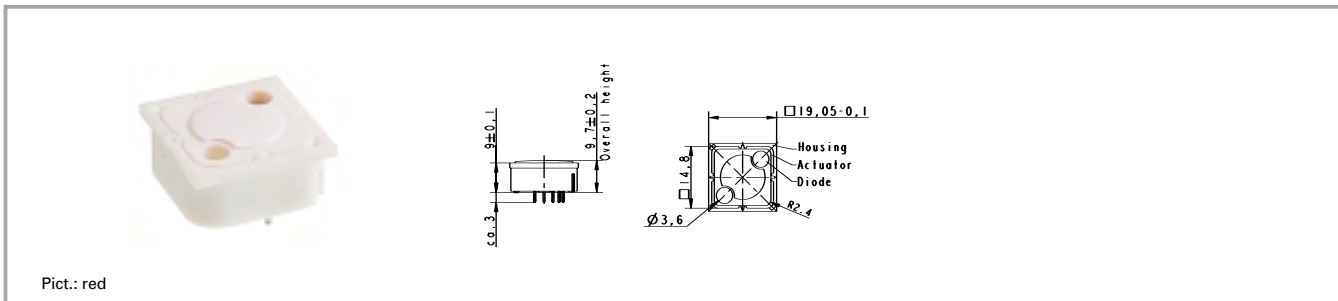
Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	fully illuminated 2 LEDs	red	red	2 mm	<b>3.14.002.011/0000</b>
Au	fully illuminated 2 LEDs	green	green	2 mm	<b>3.14.002.012/0000</b>
Au	fully illuminated 2 LEDs	yellow	yellow	2 mm	<b>3.14.002.013/0000</b>
Au	fully illuminated 2 LEDs	orange	yellow	2 mm	3.14.002.014/0000
Au	fully illuminated 2 LEDs	blue	blue	2 mm	3.14.002.015/0000
Ag	fully illuminated 2 LEDs	red	red	2 mm	3.14.002.021/0000
Ag	fully illuminated 2 LEDs	green	green	2 mm	3.14.002.022/0000
Ag	fully illuminated 2 LEDs	yellow	yellow	2 mm	3.14.002.023/0000
Ag	fully illuminated 2 LEDs	orange	yellow	2 mm	3.14.002.024/0000
Ag	fully illuminated 2 LEDs	blue	blue	2 mm	3.14.002.025/0000

Technical data see page 4 - 50

4

RF

RF 19 short-travel keyswitch, 1 LED spot-illumination



Pict.: red

Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	spot illumination 1 LED	opaque white	blue	3 mm	3.14.001.030/0000
Au	spot illumination 1 LED	transparent	red	3 mm	<b>3.14.001.031/0000</b>
Au	spot illumination 1 LED	transparent	green	3 mm	<b>3.14.001.032/0000</b>
Au	spot illumination 1 LED	transparent	yellow	3 mm	<b>3.14.001.033/0000</b>
Ag	spot illumination 1 LED	opaque white	blue	3 mm	3.14.001.040/0000
Ag	spot illumination 1 LED	transparent	red	3 mm	<b>3.14.001.041/0000</b>
Ag	spot illumination 1 LED	transparent	green	3 mm	<b>3.14.001.042/0000</b>
Ag	spot illumination 1 LED	transparent	yellow	3 mm	<b>3.14.001.043/0000</b>

Technical data see page 4 - 50

Versions with 2 LEDs available on request.

### RF 19 short-travel keyswitch, 1 NC + 1 NO



### Technical data

#### General information

Recommended key grid 23 mm

#### Dimensions

Length 19.05 mm  
 Width 19.05 mm  
 Overall height 9.7 mm

#### Mechanical design

Mounting soldering into PCB  
 Terminals contacts tin-plated, fix contact Ag plated  
 Contact system bridge contact  
 Contact arrangement 1 NC + 1 NO  
 Contact materials Au/Ag  
 Illumination none

#### Mechanical characteristics

Operating force max. 2 ... 3 N  
 Operating travel 0.5 mm  
 Switching travel 0.5 mm  
 Robustness min. with through-plated PCB  
 100 N

#### Electrical characteristics

Rated voltage min. Au: 0.02 V, Ag: 3 V V  
 Rated voltage max. Au: 42 V, Ag: 50 V V  
 Rated current min. Au: 0.01 mA, Ag: 0.1 mA mA  
 Rated current max. Au: 100 mA, Ag: 250 mA mA  
 Rated power max. (ohmic load) Au: 2 W, Ag: 12.5 W

Contact resistance when new max. 100 mΩ  
 Contact resistance acc. to life max. 3 Ω  
 Insulation resistance 2 x 10<sup>6</sup> Ω  
 ESD strength (underneath overlay) 15 kV  
 Bouncing time max. 5 ms

#### Other specifications

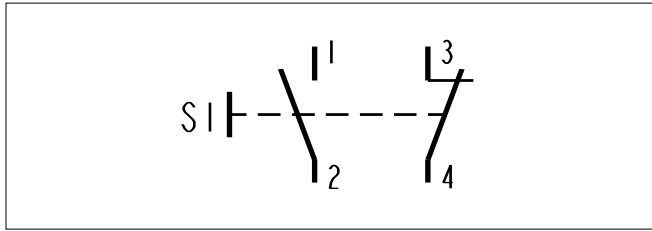
Ambient temp. operating min. -25 °C  
 Ambient temp. operating max. +70 °C  
 Storage temperature min. -40 °C  
 Storage temperature max. (product) +80 °C  
 Storage temperature max. (in tube) +50 °C  
 Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
 Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
 Operating life min. 100000  
 Soldering time max. 5 sec.  
 Soldering temperature max. 265 °C  
 Flammability of materials UL 94 HB

4

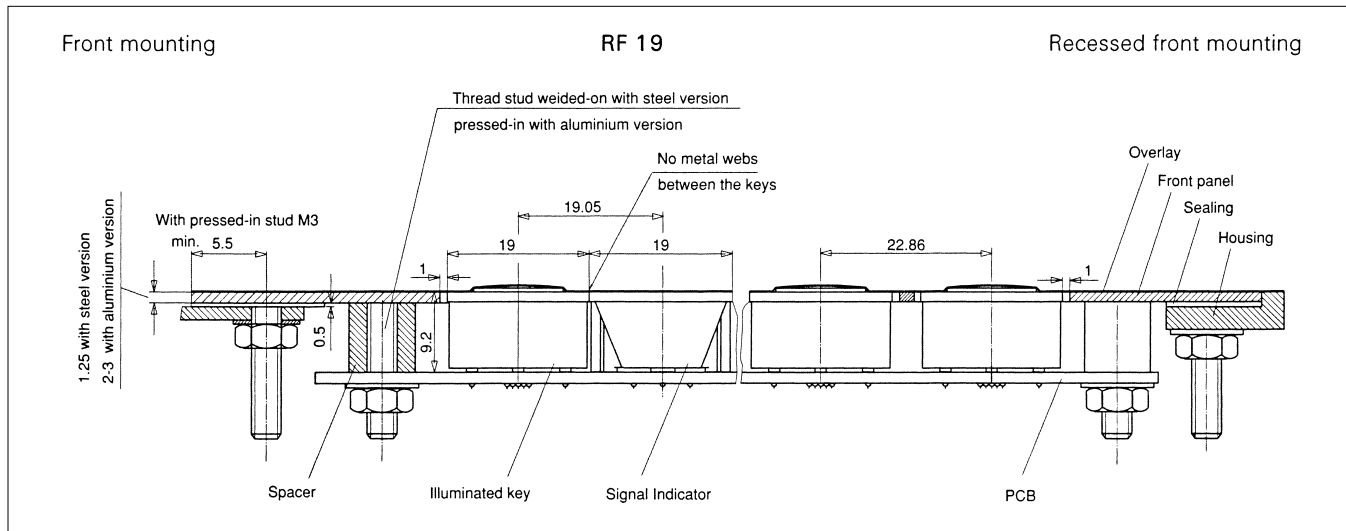
RF

# RF short-travel keyswitches

## Circuit Diagram

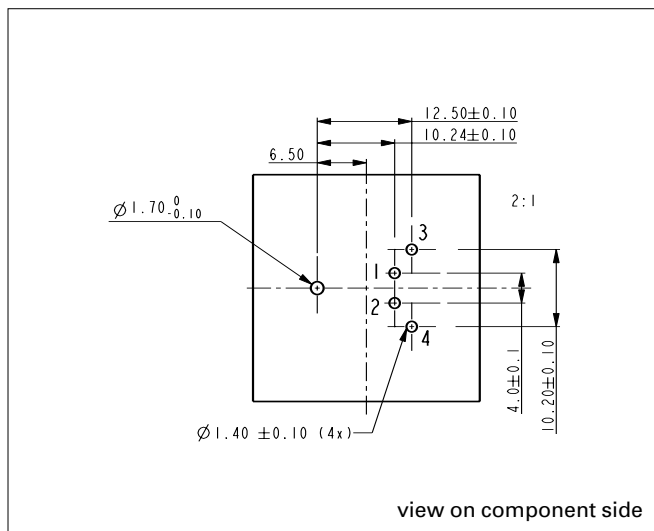


## Dimensional Drawing

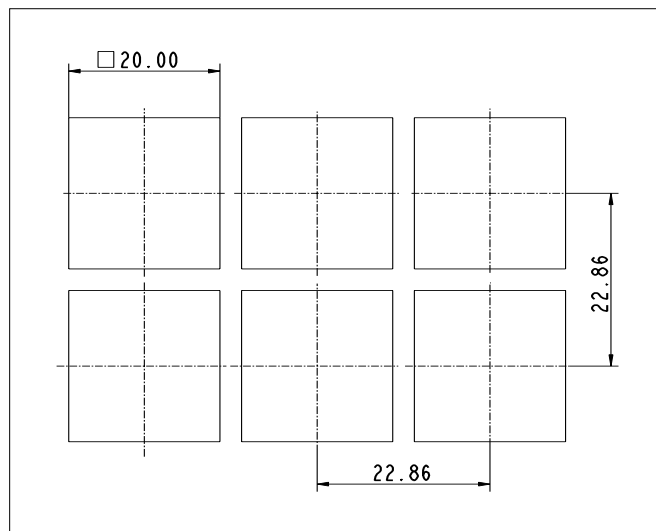


4

## Hole Pattern

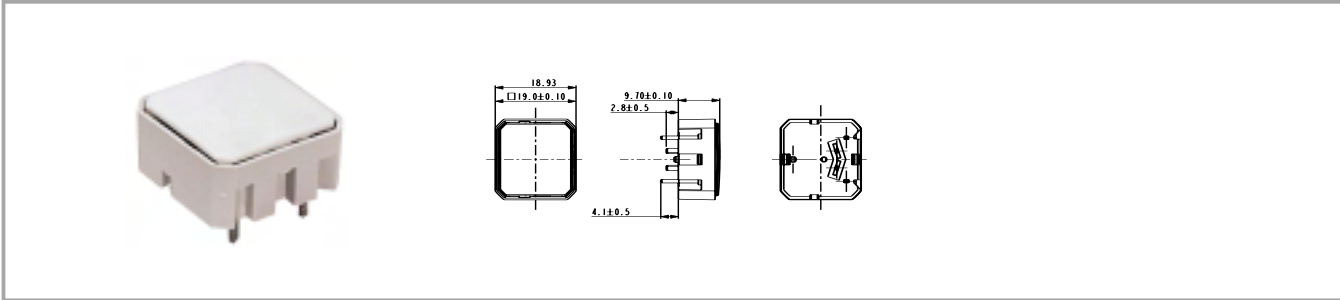


## Hole Pattern – Front Panel



RF

### RF 19 short-travel keyswitch, non-illuminated



Contact materials	Contact arrangement	Illumination	Colour of lens	Order no.
Au	1 NC + 1 NO	not illuminated	opaque white	1.16.000.991/0000
Ag	1 NC + 1 NO	not illuminated	opaque white	1.16.000.990/0000

Technical data see page 4 - 56

4

RF

### RF 19 H short-travel keyswitch



### General data

#### Application notes:

The RF 19H key has an overall height of 12.5 mm and can be fully illuminated. When designing membrane keyboards, we recommend using a key grid of at least 23 mm and a 0.13 mm overlay with area embossing over the keys. You can use the O-ring (accessory) to block the key and use it as an indicator field or blank spaceholder.

### Technical data

4

#### General information

Colour of lens see order block  
Recommended key grid 24 mm

#### Dimensions

Length 19.05 mm  
Width 19.05 mm  
Overall height 12.5 mm

#### Mechanical design

Mounting soldering into PCB  
Terminals contacts tin-plated, fix contact Ag plated  
Contact system snap-action contact  
Contact arrangement 1 NO  
Contact materials Au/Ag  
Illumination spot-/fully illuminated  
LED colour see order block  
LED type see order block

**Mechanical characteristics**  
Operating force max. 2 ... 3 N  
Operating travel 0.5 mm  
Switching travel 0.5 mm  
Robustness min. with through-plated PCB 100 N

#### Electrical characteristics

Rated voltage min. Au: 0.02 V, Ag: 3 V  
Rated voltage max. Au: 42 V, Ag: 50 V  
Rated current min. Au: 0.01 mA, Ag: 0.1 mA  
Rated current max. Au: 100 mA, Ag: 250 mA

Rated power max. (ohmic load) Au: 2 W, Ag: 12.5 W  
Contact resistance when new max. 100 mΩ  
Contact resistance acc. to life max. 3 Ω  
Insulation resistance 10<sup>9</sup> Ω  
ESD strength (underneath overlay) 15 kV  
Bouncing time max. 5 ms

#### Other specifications

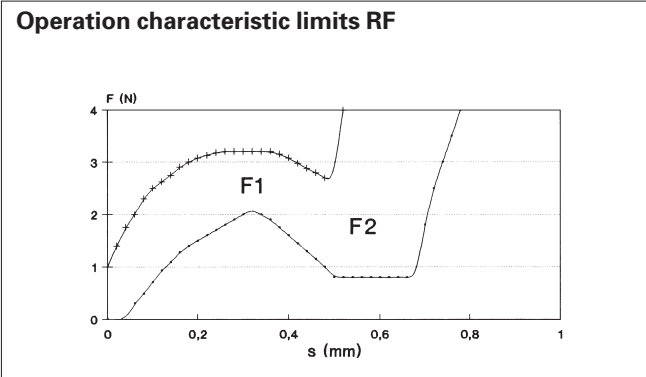
Ambient temp. operating min. -25 °C  
Ambient temp. operating max. +70 °C  
Storage temperature min. -40 °C  
Storage temperature max. (product) +80 °C  
Storage temperature max. (in tube) +50 °C  
Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
Operating life min. 1000000  
Soldering time max. 2.5 sec.  
Soldering temperature max. 250 °C  
Flammability of materials UL 94 HB

RF



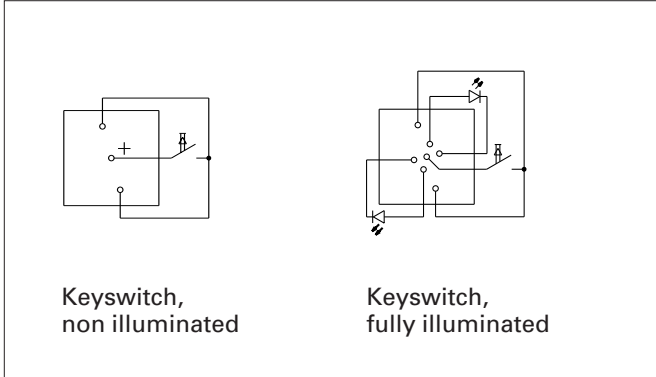
# RF short-travel keyswitches

## Force/Travel Diagram – Keyswitch RF 19 H

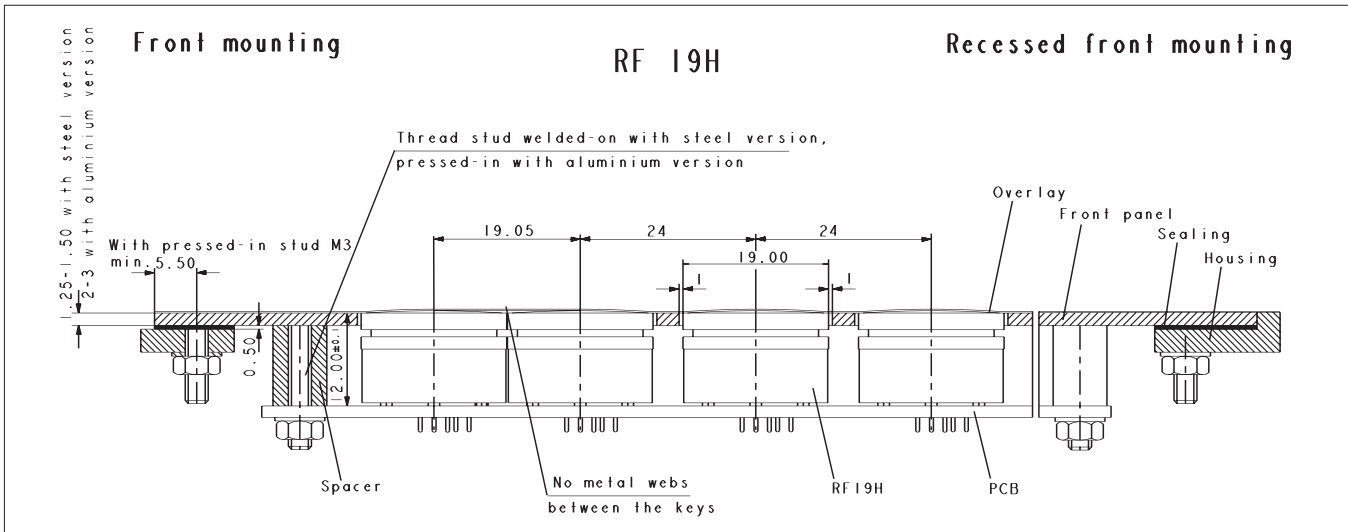


F 1 = Max. operating force  
 F 2 = Force at contact  
 F 2 is max. 55% of F 1

## Circuit Diagram – Keyswitch RF 19 H



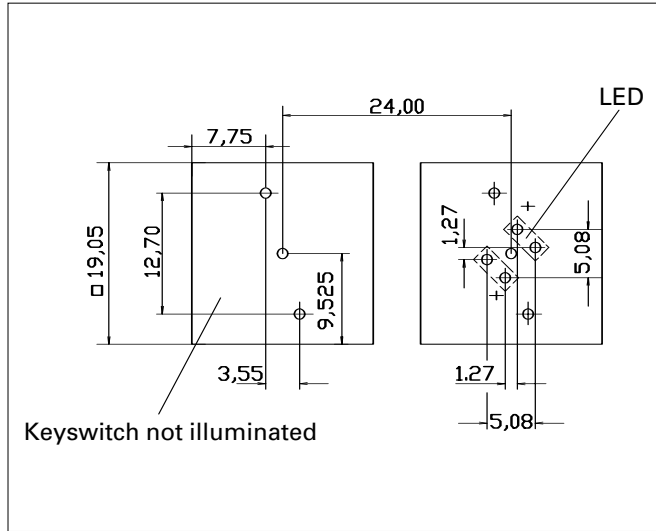
## Dimensional Drawing



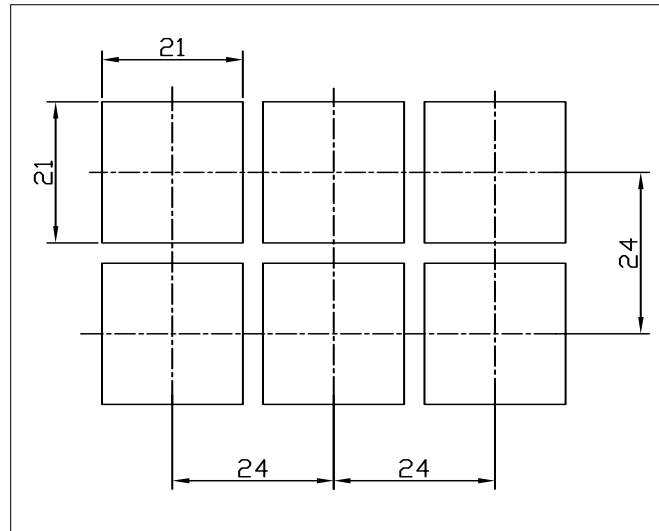
4

RF

### Hole Pattern RF 19 H



### Hole Pattern – Front Panel RF 19 H



\* The LED may be positioned either on the left-hand or right-hand side.  
Standard version: LED on left-hand side  
View on component side, all hole diameters  
1,1 +/- 0,1 mm

4

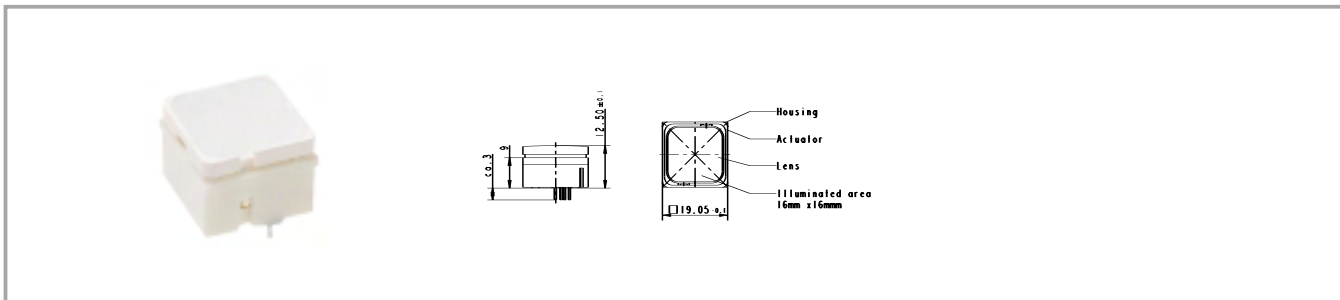
RF

## RF short-travel keyswitches

### Accessories RF 19 H short-travel keyswitches

Description	Photo	Order no.	Page
O-ring, black, 17.0 x 1.5, for blocking RF 19H keys		5.30.125.003/0100	

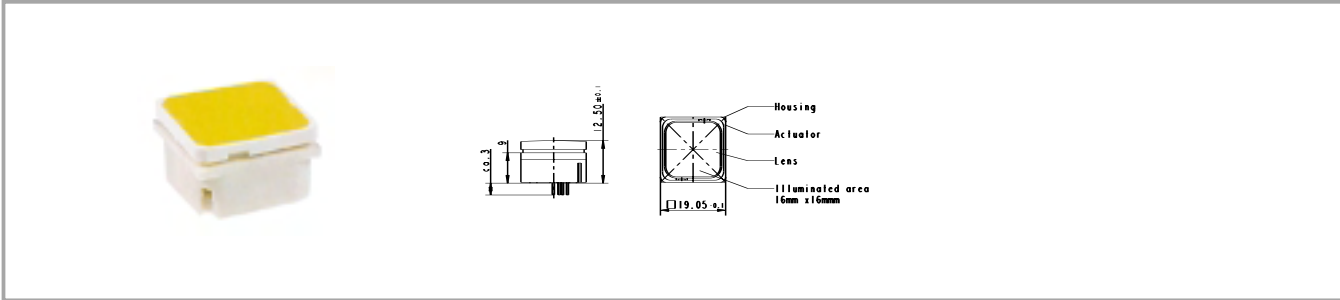
### RF 19 H keyswitch, non-illuminated



Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	not illuminated	white			3.14.001.501/0000
Ag	not illuminated	white			3.14.001.506/0000

Technical data see page 4 - 60

### RF 19 H short-travel keyswitch, fully illuminated



Contact materials	Illumination	Colour of lens	LED colour	LED type	Order no.
Au	fully illuminated 2 LEDs	red	red	2 mm	3.14.002.613/0000
Au	fully illuminated 2 LEDs	green	green	2 mm	3.14.002.632/0000
Au	fully illuminated 1 LED	green	green super bright	3 mm	3.14.002.633/0000
Au	fully illuminated 2 LEDs	yellow	yellow	2 mm	3.14.002.653/0000
Au	fully illuminated 1 LED	white	white	3 mm	3.14.002.684/0000
Au	fully illuminated 2 LEDs	orange	yellow	2 mm	3.14.002.673/0000
Au	fully illuminated 2 LEDs	white	multi colour	3 mm	3.14.001.672/0000
Au	fully illuminated 1 LED	blue	blue	3 mm	3.14.002.683/0000
Ag	fully illuminated 2 LEDs	red	red	2 mm	3.14.002.623/0000
Ag	fully illuminated 2 LEDs	green	green	2 mm	3.14.002.642/0000
Ag	fully illuminated 1 LED	green	green super bright	3 mm	3.14.002.643/0000
Ag	fully illuminated 1 LED	blue	blue super bright	3 mm	3.14.002.688/0000
Ag	fully illuminated 2 LEDs	yellow	yellow	2 mm	3.14.002.663/0000
Ag	fully illuminated 1 LED	white	white	3 mm	3.14.002.689/0000
Ag	fully illuminated 2 LEDs	orange	yellow	2 mm	3.14.002.678/0000
Ag	fully illuminated 2 LEDs	white	multi colour	3 mm	3.14.001.682/0000

Technical data see page 4 - 60

When using the keyswitches with multicolour LEDs the illumination colour can be varied from red to green by change of polarity. Due to the frequency of the polarity-changes the colours red, green, yellow as well as all secondary colours from these are possible.

### RF 19 signal indicator



### Technical data

#### General information

Colour of lens see order block  
 Recommended key grid 23/x mm

#### Dimensions

Length see order block  
 Width see order block  
 Overall height 9.15 mm

#### Mechanical design

Mounting soldering into PCB  
 Illumination see order block  
 LED colour see order block  
 LED type see order block

#### Other specifications

Ambient temp. operating min. -25 °C  
 Ambient temp. operating max. +70 °C  
 Storage temperature min. -40 °C  
 Storage temperature max. (product) +80 °C  
 Storage temperature max. (in tube) +50 °C  
 Resistance to constant environment according to IEC 600 68-2-3 and 2-30  
 Resistance at variable environment according to IEC 600 68-2-14 and 2-33  
 Soldering time max. 2.5 sec.  
 Soldering temperature max. 250 °C  
 Flammability of materials UL 94 HB

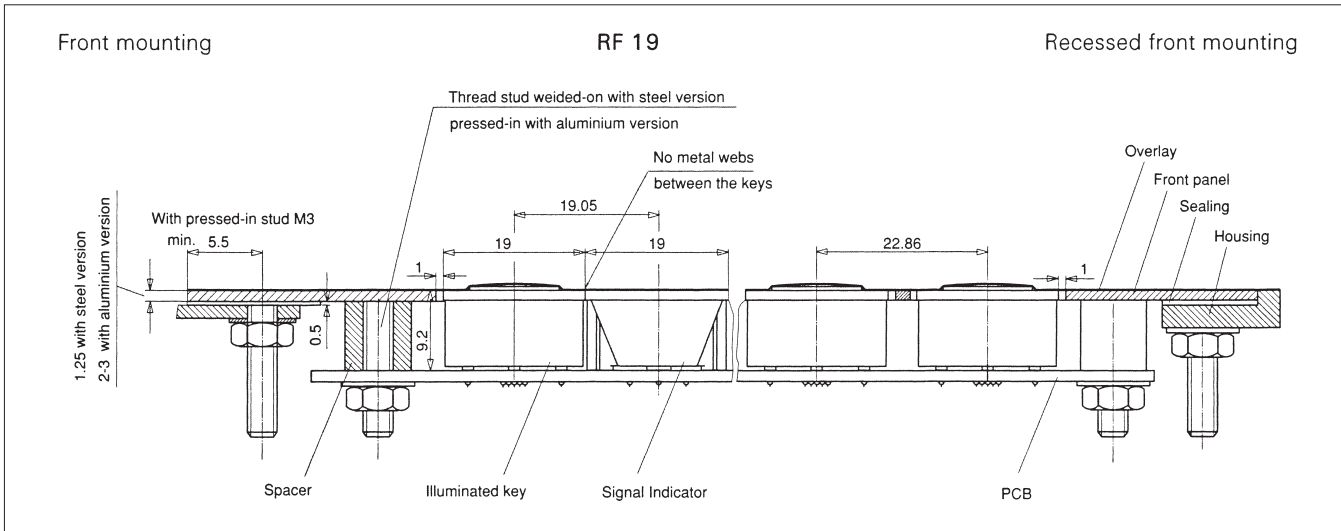
4

RF

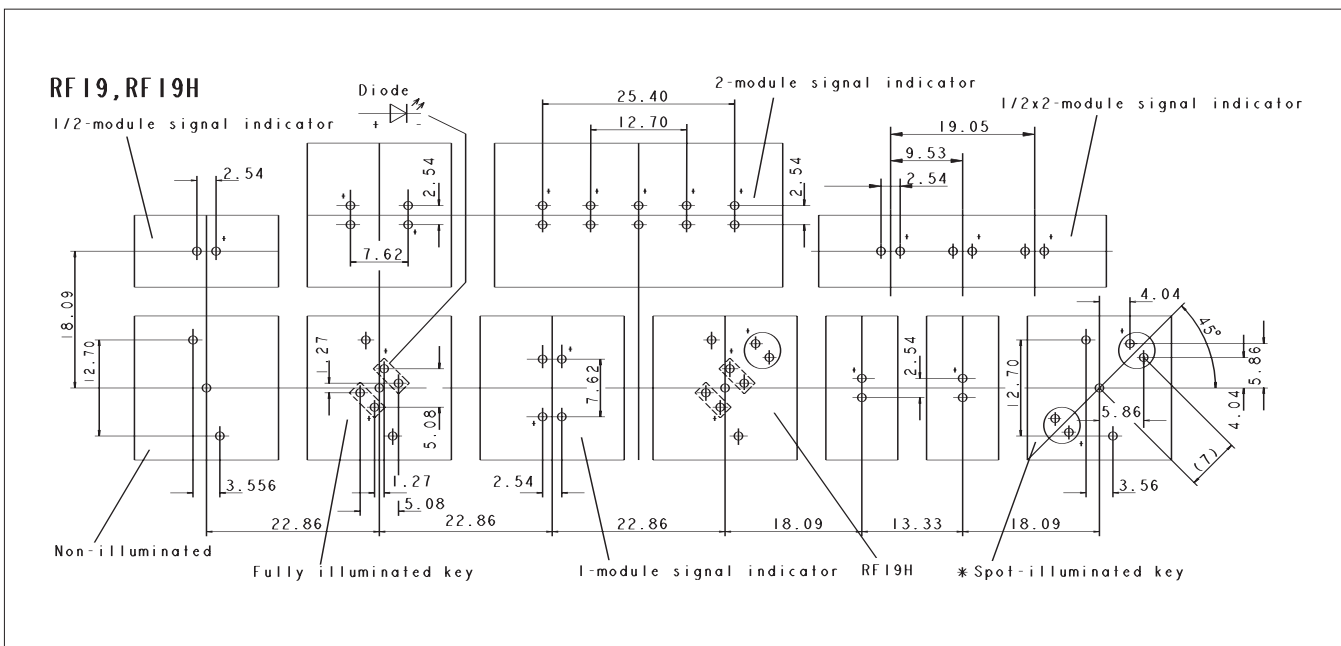


# RF short-travel keyswitches

## Dimensional Drawing Signal Indicator RF 19



## Hole Patterns RF 19



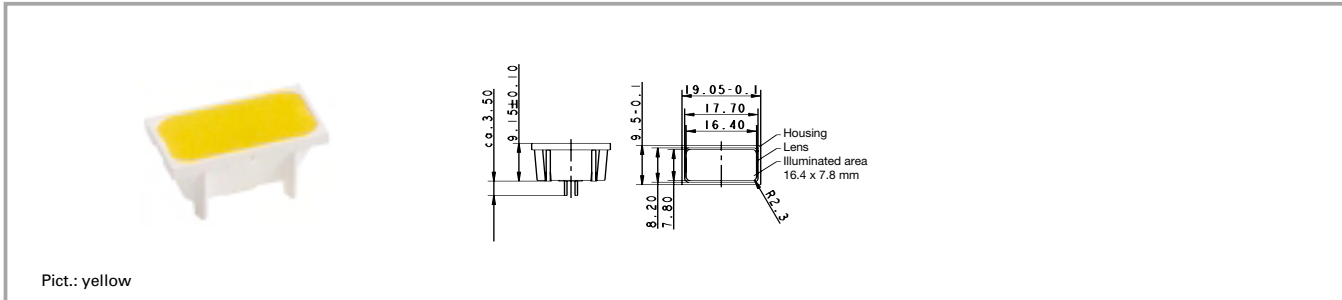
\* The LED may be positioned either on the left-hand or right-hand side.  
 Standard version: LED on left-hand side  
 View on component side, all hole diameters 1,1 +/- 0,1 mm

Front panel cut-out = outer keyswitch size + 1 mm

4

RF

### RF 19 signal indicator, 1/2 x 1-module

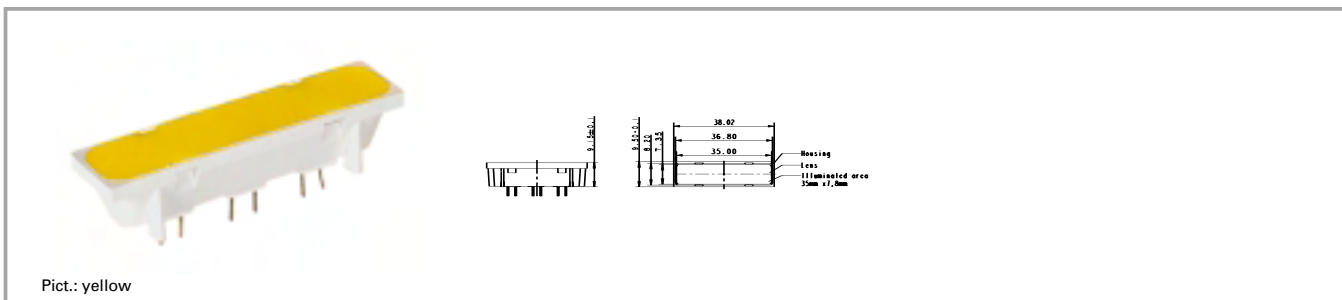


Pict.: yellow

Illumination	Colour of lens	LED colour	LED type	Order no.
fully illuminated 1 LED	red	red	2 mm	<b>3.14.002.061/0000</b>
fully illuminated 1 LED	green	green	2 mm	<b>3.14.002.062/0000</b>
fully illuminated 1 LED	yellow	yellow	2 mm	<b>3.14.002.063/0000</b>
fully illuminated 1 LED	orange	yellow	2 mm	3.14.002.064/0000

Technical data see page 4 - 66

### RF 19 signal indicator, 1/2 x 2-module



Pict.: yellow

Illumination	Colour of lens	LED colour	LED type	Order no.
fully illuminated 3 LEDs	red	red	2 mm	3.14.002.908/0000
fully illuminated 3 LEDs	green	green	2 mm	3.14.002.909/0000
fully illuminated 3 LEDs	yellow	yellow	2 mm	3.14.002.910/0000
fully illuminated 3 LEDs	orange	yellow	2 mm	3.14.002.911/0000

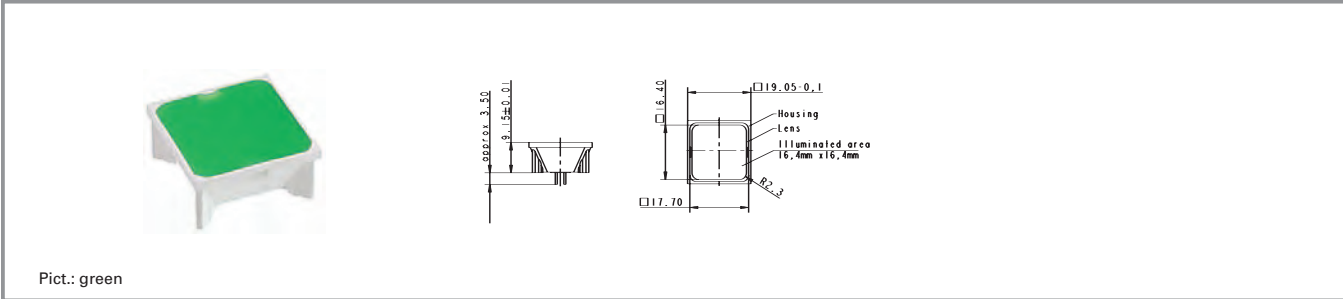
Technical data see page 4 - 66

4

RF

## RF short-travel keyswitches

### RF 19 signal indicator, 1 x 1-module

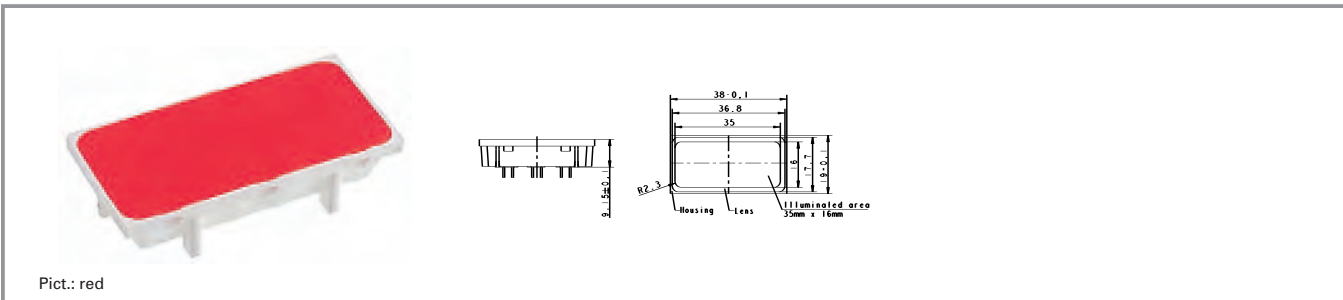


Pict.: green

Illumination	Colour of lens	LED colour	LED type	Order no.
fully illuminated 2 LEDs	red	red	2 mm	<b>3.14.002.051/0000</b>
fully illuminated 2 LEDs	green	green	2 mm	<b>3.14.002.052/0000</b>
fully illuminated 2 LEDs	yellow	yellow	2 mm	<b>3.14.002.053/0000</b>
fully illuminated 2 LEDs	orange	yellow	2 mm	3.14.002.054/0000
fully illuminated 2 LEDs	blue	blue	2 mm	3.14.001.659/0000

Technical data see page 4 - 66

### RF 19 signal indicator, 1 x 2-module



Pict.: red

Illumination	Colour of lens	LED colour	LED type	Order no.
fully illuminated 5 LEDs	red	red	2 mm	<b>3.14.002.071/0000</b>
fully illuminated 5 LEDs	green	green	2 mm	<b>3.14.002.072/0000</b>
fully illuminated 5 LEDs	yellow	yellow	2 mm	<b>3.14.002.073/0000</b>
fully illuminated 5 LEDs	orange	yellow	2 mm	3.14.002.074/0000

Technical data see page 4 - 66

4

RF



## RF short-travel keyswitches

### RF special accessories



Pict.: light grey

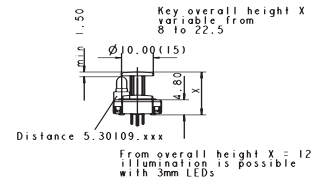
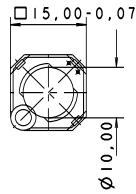


round and triangular versions

### Extension plunger for RF 15 N, round head



Pict.: light grey



Length	Width	Overall height	Diameter	Colour	Order no. complete
		9 mm	10 mm		<b>5.46.011.036/0710</b>
		9.7 mm	10 mm		<b>5.46.011.030/0710</b>
		12.5 mm	10 mm		<b>5.46.011.037/0710</b>
		13 mm	10 mm		<b>5.46.011.038/0710</b>
		22.5 mm	10 mm		<b>5.46.011.028/0710</b>

Length of plunger = Overall height - 4.25 mm.

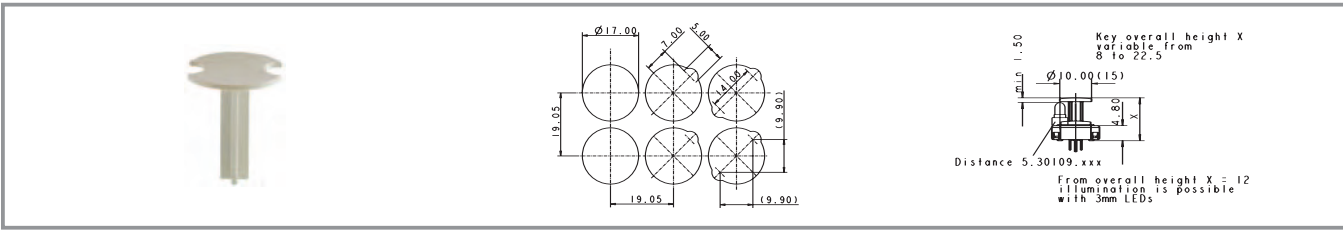
4

RF



## RF short-travel keyswitches

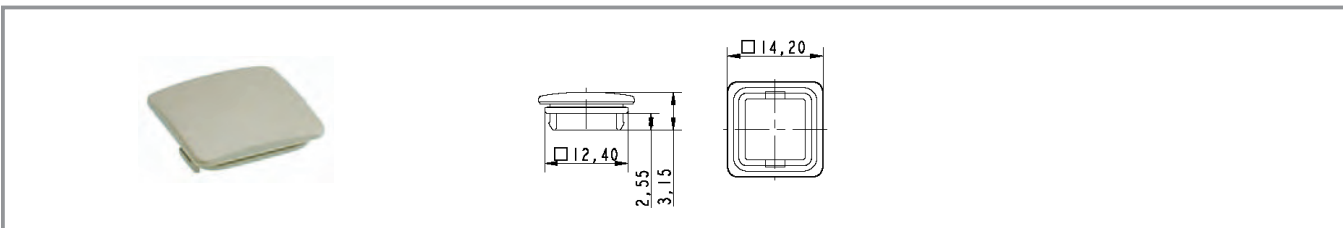
### Extension plunger for RF 15 N, round head, with recess for LED



Length	Width	Overall height	Diameter	Colour	Order no. complete
		9 mm	15 mm		<b>5.46.017.036/0710</b>
		9.7 mm	15 mm		<b>5.46.017.030/0710</b>
		12.5 mm	15 mm		<b>5.46.017.037/0710</b>
		13 mm	15 mm		<b>5.46.017.038/0710</b>
		22.5 mm	15 mm		<b>5.46.017.028/0710</b>

Length of plunger = Overall height - 4.25 mm.

### Keycap for RF 15, snap-on, for overall height 12.5 mm

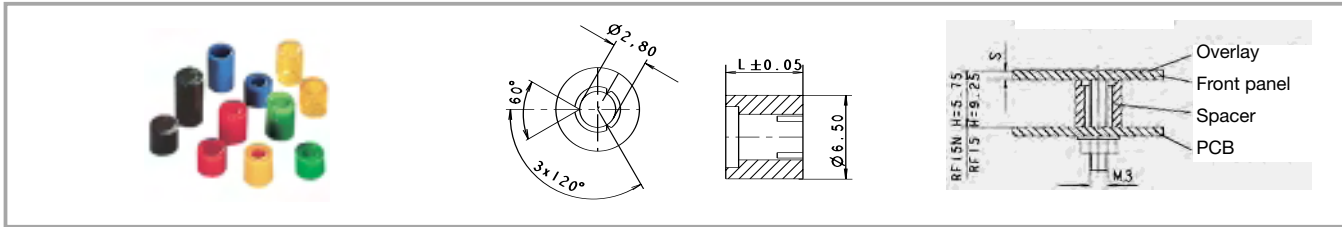


Length	Width	Overall height	Diameter	Colour	Order no. complete
14.2 mm	14.2 mm	12.5 mm		beige	5.46.654.059/0227

4

RF

### Spacers, round, for RF 15, RF 19



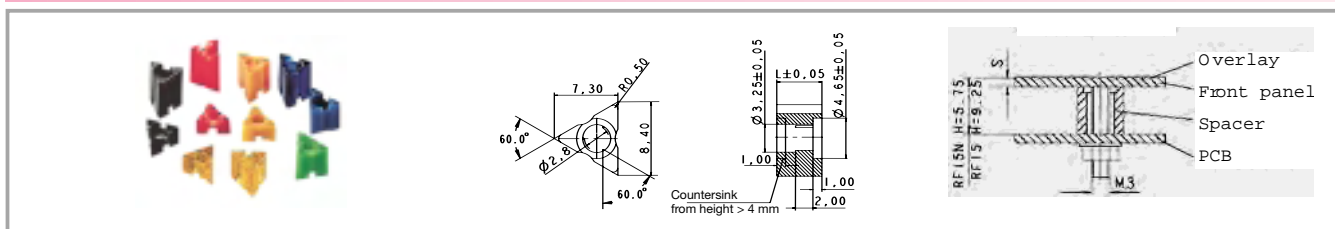
Length	Width	Overall height	Diameter	Colour	Order no. complete
4 mm				green	<b>5.30.759.025/0000</b>
4.25 mm				blue	<b>5.30.759.026/0000</b>
4.50 mm				red	<b>5.30.759.027/0000</b>
4.75 mm				blue transparent	<b>5.30.759.028/0000</b>
5 mm				black	<b>5.30.759.029/0000</b>
5.25 mm				yellow orange transparent	<b>5.30.759.030/0000</b>
5.50 mm				yellow	<b>5.30.759.031/0000</b>
5.75 mm				green	<b>5.30.759.032/0000</b>
6 mm				blue	<b>5.30.759.033/0000</b>
6.25 mm				red	<b>5.30.759.034/0000</b>
6.50 mm				blue transparent	<b>5.30.759.035/0000</b>
6.75 mm				black	<b>5.30.759.036/0000</b>
7 mm				yellow orange transparent	<b>5.30.759.037/0000</b>
7.25 mm				yellow	<b>5.30.759.038/0000</b>
7.50 mm				green	<b>5.30.759.039/0000</b>
7.75 mm				blue	<b>5.30.759.040/0000</b>
8 mm				red	<b>5.30.759.041/0000</b>
8.25 mm				blue transparent	<b>5.30.759.042/0000</b>
10.00 mm				black	<b>5.30.759.043/0104</b>

Required spacer length = Overall height of key - front panel thickness - 0.5 mm (area embossing).

4

RF

## Spacers, triangular, for RF 15, RF 19



Length	Width	Overall height	Diameter	Colour	Order no. complete
2.50 mm				blue	<b>5.30.759.094/0000</b>
2.75 mm				red	<b>5.30.759.095/0000</b>
3 mm				blue transparent	<b>5.30.759.096/0000</b>
3.25 mm				black	<b>5.30.759.097/0000</b>
3.50 mm				yellow orange transparent	<b>5.30.759.098/0000</b>
3.75 mm				yellow	<b>5.30.759.099/0000</b>
4 mm				green	<b>5.30.759.100/0000</b>
4.25 mm				blue	<b>5.30.759.101/0000</b>
4.50 mm				red	<b>5.30.759.102/0000</b>
4.75 mm				blue transparent	<b>5.30.759.103/0000</b>
5 mm				black	<b>5.30.759.104/0000</b>
5.25 mm				yellow orange transparent	<b>5.30.759.105/0000</b>
5.50 mm				yellow	<b>5.30.759.106/0000</b>
5.75 mm				green	<b>5.30.759.107/0000</b>
6 mm				blue	<b>5.30.759.108/0000</b>
6.25 mm				red	<b>5.30.759.109/0000</b>
6.50 mm				blue transparent	<b>5.30.759.110/0000</b>
6.75 mm				black	<b>5.30.759.111/0000</b>
7 mm				yellow orange transparent	<b>5.30.759.112/0000</b>
7.25 mm				yellow	<b>5.30.759.113/0000</b>
7.50 mm				green	<b>5.30.759.114/0000</b>
7.75 mm				blue	<b>5.30.759.115/0000</b>
8 mm				red	<b>5.30.759.116/0000</b>

4

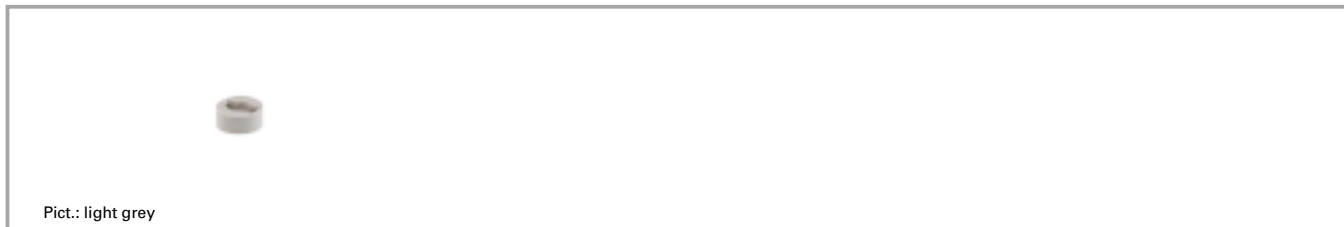
RF

## RF short-travel keyswitches

Length	Width	Overall height	Diameter	Colour	Order no. complete
8.25 mm				blue transparent	5.30.759.117/0000
10.00 mm				black	5.30.759.124/0000
10.25 mm				yellow orange transparent	5.30.759.125/0000

Required spacer length = Overall height of key - front panel thickness - 0.5 mm (area embossing).

### LED spacer for RF 15 N





Length	Width	Overall height	Diameter	Colour	Order no. complete
2.2 mm		12.5 mm	5 mm	light grey	5.30.109.010/0756
12 mm		22.5 mm	5 mm	black	5.30.109.019/0105

4





RF

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