

# Safety Mat

*FF-SM Series*

based on a fiber optic technology

## FEATURES

- Meets applicable parts of US ANSI B11.19.1990, ANSI/RIA 15.06-1992 standards, OSHA 1910.212, 1910.217 regulations and European EN 1760-1 standard for Pressure Sensitive Protective Devices
- Permanent self-checking electronic designed in compliance with the requirements of the EN 954-1 standard for **Category 4 Electrosensitive Protective Devices**
- Sensor based on a fiber optic technology for a positive light operating mode and designed in compliance with the requirements of the EN 954 - 1 standard for Category 3 protective devices
- Standard sizes in mm / ft:
  - 500 mm x 750 mm / 1.64 ft x 2.46 ft,
  - 500 mm x 1000 mm / 1.64 ft x 3.28 ft,
  - 500 mm x 1500 mm / 1.64 ft x 4.92 ft,
  - 750 mm x 750 mm / 2.46 ft x 2.46 ft,
  - 750 mm x 1000 mm / 2.46 ft x 3.28 ft,
  - 750 mm x 1500 mm / 2.46 ft x 4.92 ft,
  - 1000 mm x 1000 mm / 3.28 ft x 3.28 ft,
  - 1000 mm x 1500 mm / 3.28 ft x 4.92 ft
- Several safety mats can be connected in series
- Number of operations > 10 million
- Shock and overload resistance
- Sensor: IP 67 / NEMA 6 control unit: IP 65 / NEMA 4
- Highly resistant to chemical agent and oils
- Supply voltage: 120 Vac, 240 Vac & 24 Vdc
- Response time: 0.025 s
- Test input
- LED status indicators

## TYPICAL APPLICATIONS

- Presence sensing device for the control of dangerous areas such as robot areas, automotive transfer lines
- Additional protection for optoelectronic trip devices

**INRS**

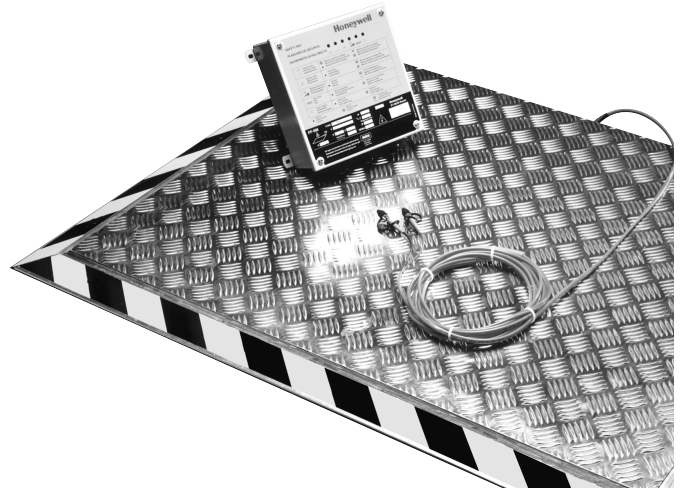
CE

C **SP**® US**Category 3**  
EN 954-1

Mat

**Category 4**  
EN 954-1

Control unit



The FF-SM safety mat is a pressure sensitive protective device designed in compliance with the requirements of the EN 1760 - part 1 European standard for the detection of operators inside a dangerous zone. The sensor uses an infrared modulated light source spread by a fiber optic cable and operates in the light operated mode for a positive safety: the presence of a load greater than the 30 kg / 66.14 lbs detection capability causes a bending of the fiber optic cable on the whole of the sensing surface. The loss in signal resulting from this bending de-energizes the output relays of the control unit and stops the dangerous movement of the machine. The fiber optic technology is totally immune to electromagnetic disturbances and it allows longer connections than electrical wires. Several safety mats can be connected in series and monitored by one single control unit.

The sensor is designed in compliance with the requirements of the EN 954 - 1 European standard for Category 3 Pressure Sensitive Protective Devices. A load distributor forms part of the sensor mechanics and protects the sensing surface from damage caused by the falling of heavy objects (such as a 5 kg / 11 lbs steel sphere being dropped from a 1 m / 3.3 ft height). Due to the mechanical structure of the sensor, the safety mat is resistant to occasional overloads caused by fork lift trucks, and features an exceptional life expectancy when used in normal conditions.

The available industrial coatings provide excellent chemical resistance and sealing Sensor: IP 67 / NEMA 6, and control unit: IP 65 / NEMA 4.

*(1) Note: The 30 kg / 66.14 lbs sensitivity is suitable for adult detection only (15 kg / 33.07 lbs is the sensitivity for children detection).*

### **WARNING**

#### MISUSE OF DOCUMENTATION

- The information presented in this product sheet (or catalogue) is for reference only. DO NOT USE this document as system installation information.
- Complete installation, operation and maintenance information is provided in the instructions supplied with each product.

**Failure to comply with these instructions could result in death or serious injury.**

The control unit complies with the requirements of the EN 954-1 European Standard for Category 4 safety related parts of control systems and is based on a permanent self-checking principle.

The control unit is equipped with 2 safety relays with guided contacts which can be directly used to stop the dangerous movement. However, most of the time, additional relaying (or «Final Switching Devices» - FSD) between the control unit outputs and the machine control circuitry is necessary.

For this reason, the use of an emergency stop relay module is recommended. This relay module must integrate a start and re-start interlock facility for a correct installation of the safety mat as required by the EN 1760-1 European standard.

A test input is also available on the control unit. The test input is used to set the equipment in an alarm condition. It provides the ability to regularly check the correct operation of the interface relays.

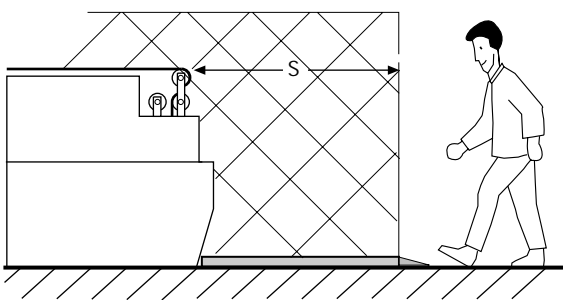
LED indicators provide useful information on the equipment status during installation and operation.

**Safety Distances**

The safety mat must be dimensioned and positioned so access to the dangerous zone is impossible without actuating the sensing zone. The EN 999 standard or ANSI B11.19 1990 provides a formula for calculating the minimum distance between the dangerous zone and the edge of the safety mat for ground level trip devices.

To prevent access to dangerous sides of machinery not protected by safety mats, install additional hard guarding and/or safety protection type products.

**Floor Mounting safety distance formula:**



Ensure hard guarding protection is installed on the rear face and on both sides.

Europe (EN 999)

$$S \geq 1600 (t1 + t2) + 1200 \text{ (mm)}$$

$$\text{or } S \geq 63 (t1 + t2) + 47.3 \text{ (in)}$$

US (ANSI B11.19 1990)

$$Ds \geq 63 (t1 + t2) + C \text{ (in)} \quad S = Ds$$

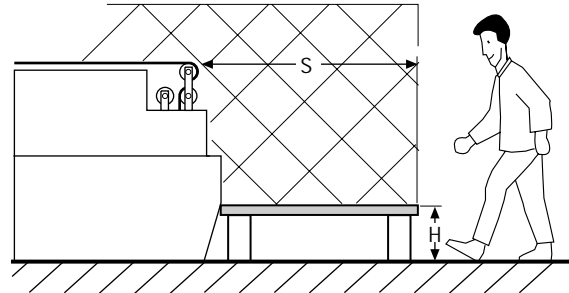
where C is an additional safety distance (see local Health and Safety Regulations for this value).

*Ds: minimum safety distance (mm / in)*

*t1: Global response time of the safety mat (0.025 s)*

*t2: Stopping time of the machine, application dependent (s)*

**Step mounting safety distance formula:**



Ensure hard guarding protection is installed on the rear face and on both sides.

Europe (EN 999)

$$S \geq 1600 (t1 + t2) + (1200 - 0.4 H) \text{ (mm)}$$

$$\text{or } Ds \geq 63 (t1 + t2) + (47.3 - 0.4 H) \text{ (in)} \quad S = Ds$$

*S: minimum safety distance (mm / in)*

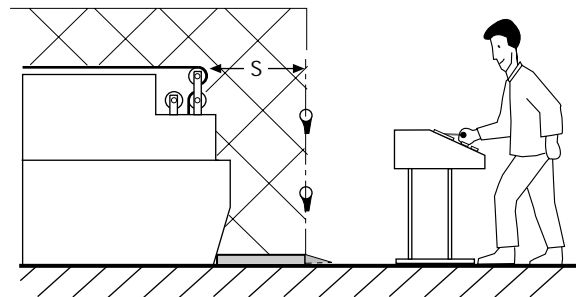
*t1: global response time of the safety mat (0.025 s)*

*t2: stopping time of the machine, application dependent (s)*

*H: height of the platform (mm / in)*

**Combined protective devices**

If a safety mat is used with a safety light curtain or multiple safety single beam devices, the minimum safety distance between the dangerous zone and the safety beams or the edge of the safety mat should be calculated using the following formula:



Ensure hard guarding protection is installed on the rear face and on both sides.

Europe (EN 999)

$$S \geq 1600 (t1 + t2) + 850 \text{ (mm)}$$

$$\text{or } S \geq 63 (t1 + t2) + 33.5 \text{ (in)}$$

*S: minimum safety distance (mm / in)*

*t1: response time of the multiple safety single beam device (s)*

*t2: stopping time of the machine, application dependent (s)*

FF-SM

### LED status indicators

The 4 LED's available on the front panel have the following meaning:

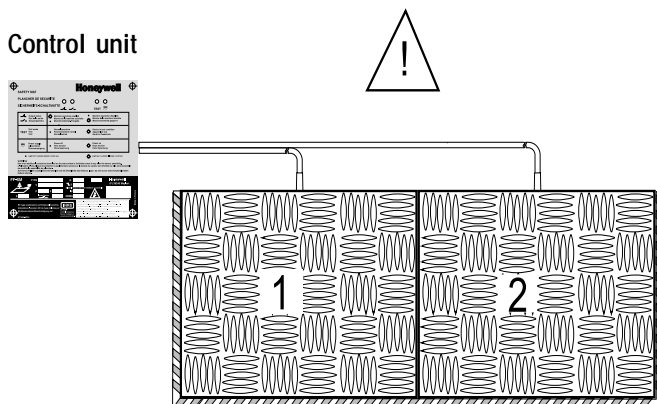
 Output status	 Machine operation enabled	 Machine operation disabled
<b>TEST</b> Test	 Normal operation	 Device in test condition
 Power supply	 Power off	 Power on

● Light off      ☀ Light on

### Area controlled by several safety mats run by a single control unit

The fiber optic technology allows the connection in series of up to **4 mats** to cover a larger detection zone while using a single channel control unit. The following applications can be performed:

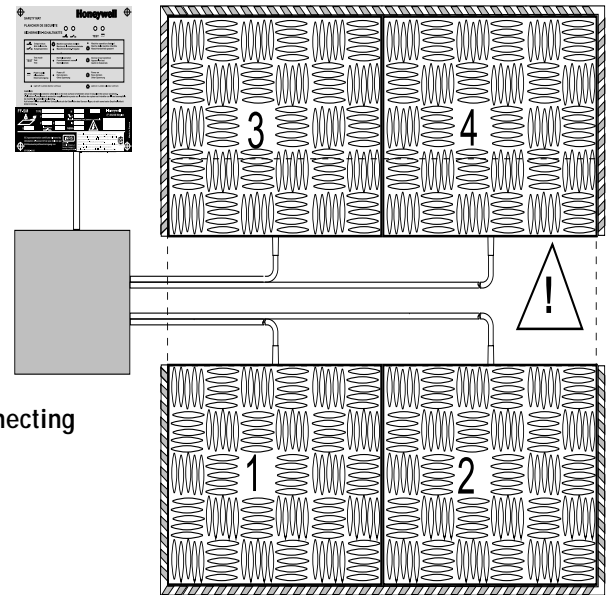
- Protection of a single zone with several mats run by a single control unit:



Connection in series of 2 safety mats can be done inside the control unit box.

- Protection of several zones with several mats run by a single control unit:

### Control unit

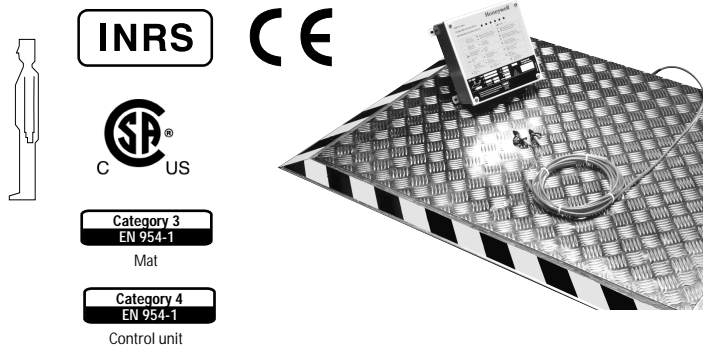


### Connecting box

Connection in series of more than 2 safety mats must be done inside an additional connecting box.

# FF-SM

- Pressure sensitive device in compliance with the requirements of the EN 1760-1 standard
- Control unit in compliance with the requirements of the EN 954-1 standard for Category 4 equipment
- Sensor unit based on a fiber optic technology and designed in compliance with the requirements of the EN 954-1 standard for Category 3 equipment
- Meets applicable parts of ANSI/RIA/OSHA regulations



Dimensions in millimeters / inches, meters / feet, weights in kg / lbs

Features	Compliance
	<b>Europe:</b> Compliance with EN 1760-1 standard <b>US:</b> ANSI B11.19.1990, ANSI/RIA 15.06-1992 standards, OSHA 1910.212, 1910.217 regulations
<b>Sensor unit</b>	Category 3 according to EN 954-1 standard ≥ 30 kg / 66.14 lbs
Detection sensitivity	Tested up to 10 million with a ø80 mm/75 kg / 3.15 in/165 lbs stamp applied on 1 point
Number of operations	50 Joules (energy released by the falling of a 5 kg / 11 lbs sphere dropped from 1 m / 3.28 ft)
Shock resistance	Maximum static load: 1000 N/cm <sup>2</sup> (resist to fork lift trucks)
Overload resistance	Aluminium bulb plate: welding splash resistant (3 mm / 0.11 in thickness)
Quality of coating	Nitrile checker: oil resistant (5 mm / 0.2 in thickness)
Chemical resistance	Oils / Diluted bases / Usual cleaning liquids
Operating temperature	0 °C to 55 °C / 32 °F to 131 °F
Connection to the control unit	A fiber optic cable equipped with 2 ST connectors (5 m / 16.4 ft) cable length, PVC sheath
Connection in series	Up to 4 mats per control unit
Sealing	IP 67 / NEMA 6
Fixing on the reference floor	Laid on the reference floor and maintained by edges, or embedded in the reference floor
Weight	Aluminium: 27 kg/m <sup>2</sup> / 5.5 lbs/ft <sup>2</sup> • Nitrile: 23 kg/m <sup>2</sup> / 4.6 lbs/ft <sup>2</sup>
<b>Control unit</b>	Category 4 according to EN 954-1 standard
Supply voltage	120 Vac (+ 10%, - 20%), 240 Vac (+10%, -20%), 24 Vdc (±15%)
Frequency	50 to 60 Hz
Power consumption	6 VA / 9 W
Global response time	0.025 s (safety mat included)
Connection	Snap-in clips for electrical wires - ST connectors for fiber optic cables
Electrical noise immunity	according to IEC 801-4: level IV (Vac) or level III (Vdc) according to IEC 801-3: level III (Vac & Vdc)
Outputs	2 NO +1 NC (2 safety relays with guided contacts, 2A/250 Vac, 10 mA mini.)
Functions	Test input
Sealing	IP 65 / NEMA 4
Fixing	4 M5 screws
Weight	3,6 kg / 7.93 lbs

### Ordering information

• SAFETY MAT

FF-SM 05

Coating:  
1: aluminium  
2: nitrile

Dimensions:

075050: 0750 mm<sup>2</sup> x 0500 mm<sup>2</sup> / 2.46 ft<sup>2</sup> x 1.64 ft<sup>2</sup>  
 100050: 1000 mm<sup>2</sup> x 0500 mm<sup>2</sup> / 3.28 ft<sup>2</sup> x 1.64 ft<sup>2</sup>  
 150050: 1500 mm<sup>2</sup> x 0500 mm<sup>2</sup> / 4.92 ft<sup>2</sup> x 1.64 ft<sup>2</sup>  
 075075: 0750 mm<sup>2</sup> x 0750 mm<sup>2</sup> / 2.46 ft<sup>2</sup> x 2.46 ft<sup>2</sup>  
 100075: 1000 mm<sup>2</sup> x 0750 mm<sup>2</sup> / 3.28 ft<sup>2</sup> x 2.46 ft<sup>2</sup>  
 150075: 1500 mm<sup>2</sup> x 0750 mm<sup>2</sup> / 4.92 ft<sup>2</sup> x 2.46 ft<sup>2</sup>  
 100100: 1000 mm<sup>2</sup> x 1000 mm<sup>2</sup> / 3.28 ft<sup>2</sup> x 3.28 ft<sup>2</sup>  
 150100: 1500 mm<sup>2</sup> x 1000 mm<sup>2</sup> / 4.92 ft<sup>2</sup> x 3.28 ft<sup>2</sup>

• CONTROL UNIT

FF-SMC100T

Supply voltage: E: 120 Vac / G: 240 Vac / 2: 24 Vdc

- If the control unit is installed on a flexible structure submitted to vibrations, the use of anti-vibration dampers FF-SMZ646095 is necessary.  
 - Secure the installation by fixing the safety mat with the recommended FF-SMZTAPE double-sided adhesive tape.

Also refer to the accessory section.

### Sensor unit

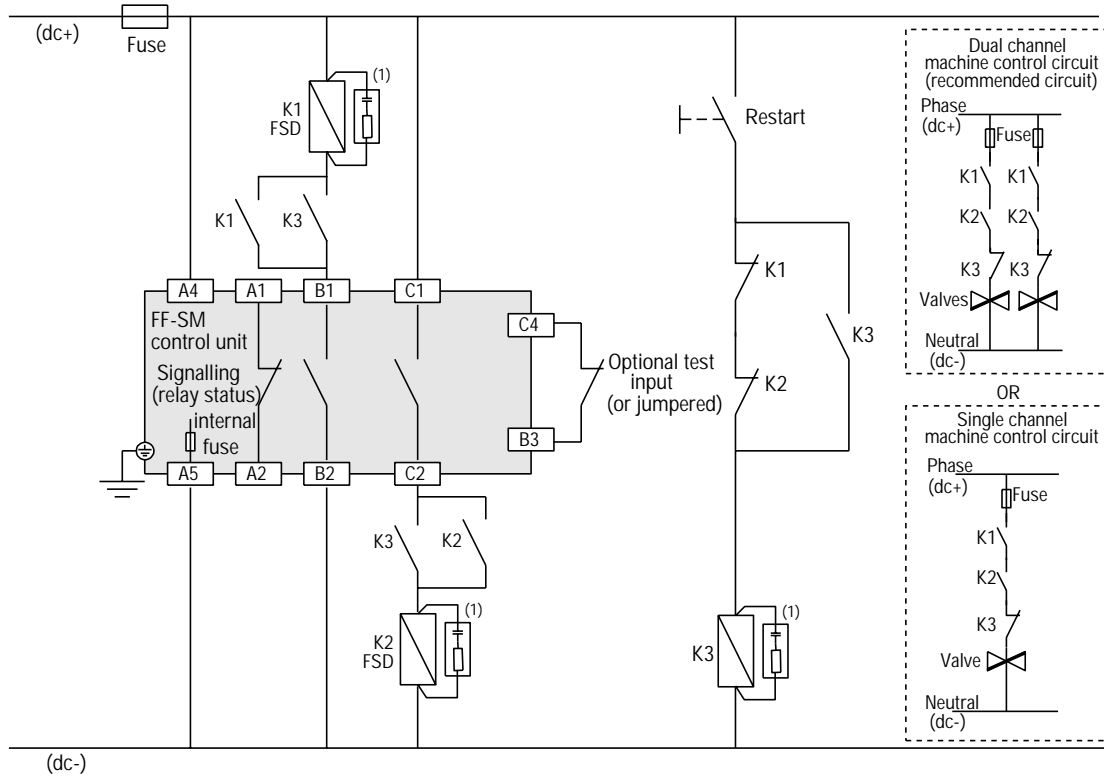
References	a (mm <sup>2</sup> / ft <sup>2</sup> )	b (mm <sup>2</sup> / ft <sup>2</sup> )
FF-SM075050-□05	750 / 2.46	500 / 1.64
FF-SM100050-□05	1000 / 3.28	500 / 1.64
FF-SM150050-□05	1500 / 4.92	500 / 1.64
FF-SM075075-□05	750 / 2.46	750 / 2.46
FF-SM100075-□05	1000 / 3.28	750 / 2.46
FF-SM150075-□05	1500 / 4.92	750 / 2.46
FF-SM100100-□05	1000 / 3.28	1000 / 3.28
FF-SM150100-□05	1500 / 4.92	1000 / 3.28

Control unit

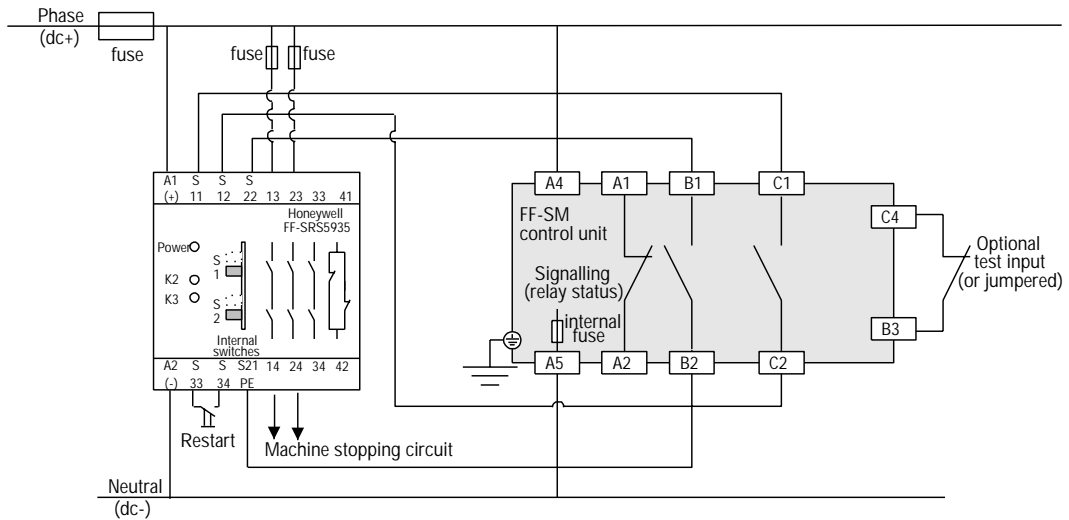
1 : Cable gland for the power line (PG11)  
 2 and 3 : Cable glands for fiber optic cables (PG16)  
 4 : Cable gland for signals (PG16)

FF-SM

### Wiring diagram with safety relays



### Wiring diagram with Honeywell safety module



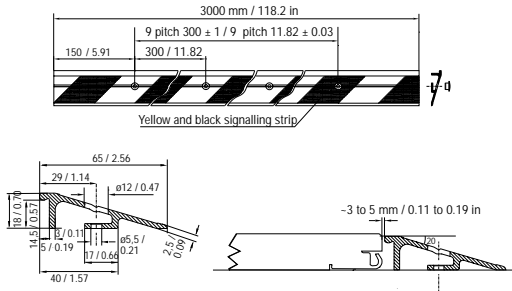
(1) RC (220 Ω + 0.22 μF) for ac interfaces or varistors for dc interfaces  
 FSD: Final Switching Device

Note: The start and restart interlock facility and the cross-monitored Final Switching Devices may be provided by a safety relay module from the FF-SR Series.

## Accessories FF-SM

Dimensions in millimeters / inches, meters / feet

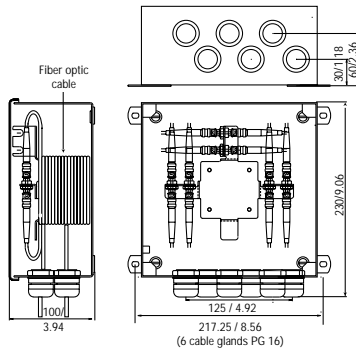
### • FF-PSZS1030



### Edges

If the safety mat is laid on the reference floor, then the EN 1760-1 standard makes the use of edges all around the accessible periphery of the sensing zone mandatory. They prevent people from stumbling over the safety mats and keep them in position. The edges are delivered per 3 m / 9.84 ft and must be cut to the right length according to the application.

### • FF-SMZBOX:

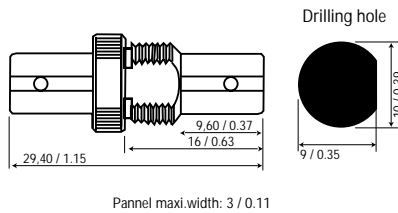


**Connecting box** (delivered without cable-to-cable connector) For a reliable installation, it is recommended to use the connecting box for the connection in series of several mats. It allows the connection in series of 2 to 4 mats to the control unit via a cable extension. The connecting box is equipped with a cable drum to absorb the excess cable, it improves the IP sealing of connectors (dust proof - IP 60) and protects them from mechanical damages.

#### Notes:

- Connection in series of 2 safety mats can be made inside the control unit box if no cable extension is required.

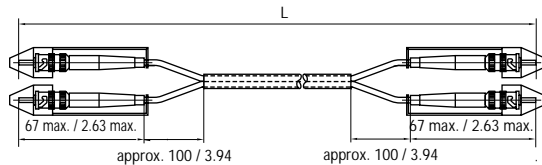
### • FF-SMZ175196:



### Kit of 2 cable-to-cable connectors

This kit of 2 ST cable-to-cable connectors must be used for the interconnection of optical cables. 2 cable-to-cable connectors are necessary for the connection of a mat to the control unit via a cable extension, and one cable-to-cable connector is necessary for the connection in series of 2 mats to the control unit. (Example: Order 2 kits of cable-to-cable connectors for the connection in series of 3 mats to the control unit via a cable extension).

### • FF-SMZFOC□□:

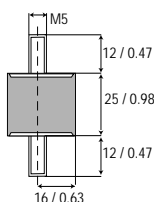


### Cable extensions (delivered without cable-to-cable connector)

Each mat is pre-wired with a fiber optic cable. If the control unit is installed at a greater distance, the use of a cable extension is necessary.

Reference	L (m / ft)
FF-SMZFOC02	2 / 6.56
FF-SMZFOC05	5 / 16.4
FF-SMZFOC10	10 / 32.8
FF-SMZFOC20	20 / 65.6

### • FF-SMZ646095



### Kit of 4 antivibration dampers with 8 HM5 nuts for the control unit

### • FF-SMZTAPE

### Sellotape 0485 double-sided adhesive tape:

0.4 mm / 0.016 in thickness and 30 m / 98.36 ft length, to secure the mats installation