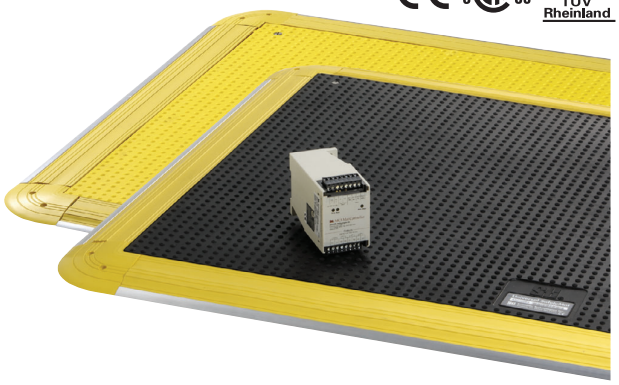
Safety Mat/Safety Mat Controller

UM/MC3

CSM_UM_MC3_DS_E_2_1

New Safety Mat That Is Easy to Install and Maintain

- Meets Safety Category 3 (EN954-1) requirements when used in combination with a dedicated controller.
- Simple connection allows multiple mats to be joined together.
- A wide variety of mat sizes are available.
- Obtained EN1760-1 and EN954-1 (Cat.3) certification.
- Complies with North American safety standards, including ANSI/RIA15.06-1999.



⚠ Be sure to read the *"Safety Precautions"* on page 10.

Model Number Structure

Model Number Legend

Safety Mat

UM□□□-□-□

1 2 3 4 5

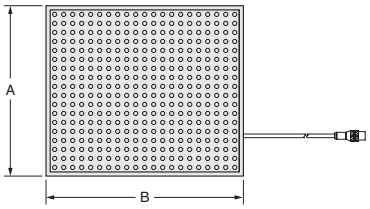
1. Color
None : Black
Y : Yellow

2. Unit of Length
None : Inch
M : Millimeter

3. Cable Length
5 : 5 m
10 : 10 m

4. Safety Mat Dimension A

5. Safety Mat Dimension B



Ordering Information

Safety Mat Controller

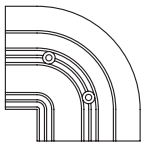
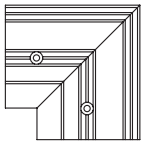
Safety outputs	Auxiliary outputs	Rated voltage	Terminal block type	Model
SPDT-NO	SPDT-NC	24 VDC	Screw terminals	**MC3**

Safety Mat

Dimensions		Black	Yellow
A (mm)	B (mm)	Model	Model
300	300	**UMM5-0300-0300**	**UMYM5-0300-0300**
400	400	**UMM5-0400-0400**	**UMYM5-0400-0400**
500	250	**UMM5-0500-0250**	**UMYM5-0500-0250**
500	400	**UMM5-0500-0400**	**UMYM5-0500-0400**
500	500	**UMM5-0500-0500**	**UMYM5-0500-0500**
500	1500	**UMM5-0500-1500**	**UMYM5-0500-1500**
600	400	**UMM5-0600-0400**	**UMYM5-0600-0400**
750	250	**UMM5-0750-0250**	**UMYM5-0750-0250**
750	500	**UMM5-0750-0500**	**UMYM5-0750-0500**
750	750	**UMM5-0750-0750**	**UMYM5-0750-0750**
750	1500	**UMM5-0750-1500**	**UMYM5-0750-1500**
1000	500	**UMM5-1000-0500**	**UMYM5-1000-0500**
1000	750	**UMM5-1000-0750**	**UMYM5-1000-0750**
1000	1000	**UMM5-1000-1000**	**UMYM5-1000-1000**
1000	1250	**UMM5-1000-1250**	**UMYM5-1000-1250**
1000	1500	**UMM5-1000-1500**	**UMYM5-1000-1500**

Note: The actual lengths of the Safety Mat are 12 mm longer in both dimension A and dimension B.

Trims

Appearance	Name	Model	Remarks
	Ramp Trim with Yellow PVC Cover (1.22 m)	**UMRT4**	Installed on the perimeter of the Safety Mat. Each Trim is composed of two parts, an aluminum base and a PVC Cover. Possible to install cables inside.
	Ramp Trim with Yellow PVC Cover (2.44 m)	**UMRT8**	
	Joining Trim (1.22 m)	**UMJS4**	The Joining Trims join the Safety Mats when two or more Safety Mats are being combined. In addition to joining the Safety Mats, the Joining Trims preserve the Safety Mat's sensitivity at the joints.
	Joining Trim (2.44 m)	**UMJS8**	
	Aluminum Ramp Trim (2.44 m)	**UMAL**	Installed on the perimeter of the Safety Mat.
	Molded Outside Corner	**UMOC**	Installed at the outside corners of the Safety Mat combining with Ramp Trims with Yellow PVC Cover.
	Molded Inside Corner	**UMIC**	Installed at the inside corners when two or more Safety Mats combining with Ramp Trims with Yellow PVC Cover are being combined.

Accessories

Appearance	Name	Model	Remarks
	Distribution Box (for six mats)	**UMDB-6 (Available soon)**	Used to connect to two or more Safety Mats to the single MC3 Safety Mat Controller.
	Y Connector	**UM-Y-2-1**	Used to connect two Safety Mats to the single MC3 Safety Mat Controller.
	Panel-mount Connector	**UMPMC**	Distributes to individual lines to connect the Safety Mat to a MC3 Safety Mat Controller.
	Extension Cable (3 m)	**UMEC-03**	This cable is used to extend a cable.
	Extension Cable (5 m)	**UMEC-05**	
	Extension Cable (10 m)	**UMEC-10**	
	Extension Cable (15 m)	**UMEC-15**	

Note: For trims and accessories required for the Safety Mat system configuration, see "**Installation**" on **page 4**.

Specifications

Ratings

Safety Mat Controller

Power input

Item / Model	MC3
Power voltage	24 VDC
Operating voltage range	-15% to +15% of rated supply voltage
Power consumption ✻	3 W max.

✻ Power consumption of loads is not included.

Switch

Item / Model	MC3
Rated load	6A at 250 VAC/6A at 24 VDC (resistance load) 5A at 250 VAC/2A at 24 VDC (inductive load)
Rated carry current	6 A

Characteristics

Safety Mat

Item / Model	UM
Detection method	Pressure sensing method
Detection weight	30 kg min.
Material	PVC (Polyvinyl Chloride)
Ambient operating temperature	-37 to 66°C (with no icing or condensation)
Degree of protection	IP67
Weight	Approx. 28 kg/m^2

Safety Mat Controller

Item / Model		MC3
Response time		30 ms max.
Safety input		Four-wire Safety Mat only Mat can be connected in series (27.9 m^2 max.)
Safety output		SPDT-NO
Auxiliary output		SPDT-NC
Insulation resistance		20 MΩ min. (at 500 VDC)
Dielectric strength	Between different poles of outputs	1,800 VAC, 50/60 Hz for 1 min.
	Between power supply and output	
Vibration resistance		Malfunction: 10 to 55 Hz, 0.15 mm single amplitude
Mechanical shock resistance		Malfunction: 98 m/s^2
Durability	Mechanical	10,000,000 cycles min.
	Electrical	100,000 cycles min. (rated load, switching frequency: 360 cycles/hour)
Ambient operating temperature		0 to 55°C (with no icing or condensation)
Ambient operating humidity		0% to 90% RH
Degree of protection		IP20
Terminal tightening torque		0.5 N·m
Weight		Approx. 360 g

Installation

Using Trim Pieces

Ramp Trim with Yellow PVC Cover: UMRT4/UMRT8
Secures the edges of the Safety Mats to the floor.
It is composed of two parts with an aluminum base and a PVC Cover.

Joining Trim: UMJS4/UMJS8
The Joining Trims join the Safety Mats when two or more Safety Mats are being combined.
In addition to joining the Safety Mats, the Joining Trims preserve the Safety Mat's sensitivity at the joints.

Aluminum Ramp Trim: UMAL
Secures the edges of the Safety Mat to the floor.
The Aluminum Ramp Trim is hollow, so cable can be routed through it.

Molded Outside Corner: UMOC
Used together with the Ramp Trim with Yellow PVC Cover (UMRT4/UMRT8) to secure the external corners of the Safety Mats to the floor.

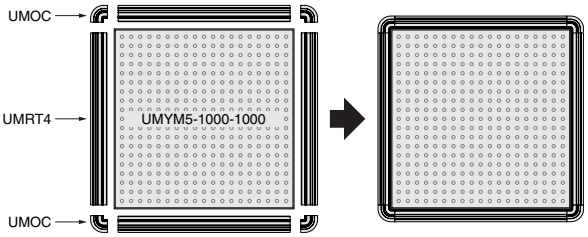
Molded Inside Corner: UMIC
Used together with the Ramp Trim with Yellow PVC Cover (UMRT4/UMRT8) to secure the internal corners of the Safety Mats to the floor.

Note: 1. The Aluminum Ramp Trim or Ramp Trim with Yellow PVC Cover must be cut to fit the size of the Safety Mats being used.
Furthermore, when the Safety Mat's wiring is being routed through the Aluminum Ramp Trim or Ramp Trim with Yellow PVC Cover, it will be necessary to cut or notch the Aluminum Ramp Trim or Ramp Trim with Yellow PVC Cover for cable access.
Refer to the Safety Mat Instruction Sheet for details on cutting or notching the Aluminum Ramp Trim or Ramp Trim with Yellow PVC Cover.
2. The Joining Trim must be cut to fit the size of the Safety Mats being used.
3. The Ramp Trim with Yellow PVC Cover and Molded Corner must be anchored to the floor to secure the Safety Mats. It is also necessary to drill holes in the Trim to anchor it.
Refer to the Safety Mat Instruction Sheet for details on drilling holes in the Trim and Molded Corner and anchoring it to the floor.

Safety Mat Configuration

The Safety Mats are secured by anchoring the Ramp Trim with Yellow PVC Cover and Molded Corner to the floor.
Before ordering, confirm the number of Ramp Trim with Yellow PVC Cover and Molded Corner pieces that will be needed.

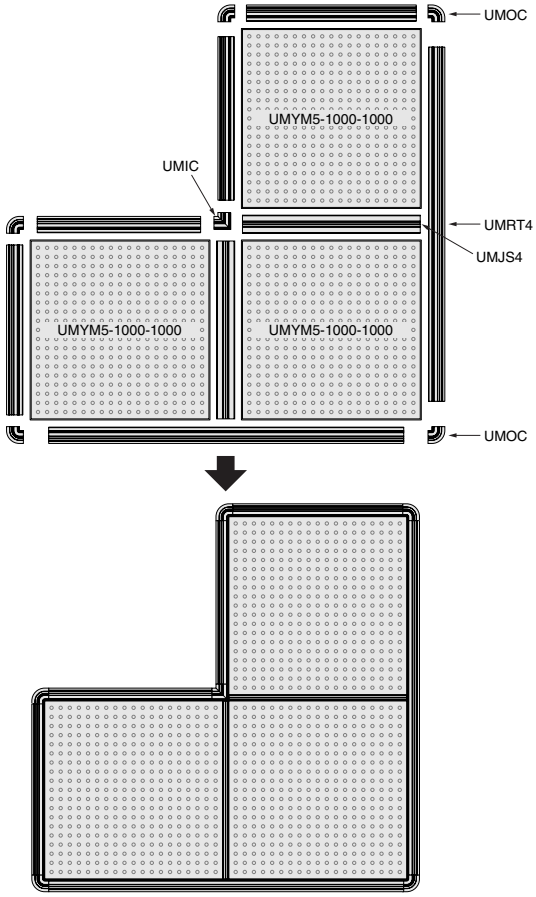
Example 1: Using a Single Safety Mat



In this case, the perimeter of the Safety Mat is about 4 m and the following pieces are required:
The example above consists of the following components:

UMYM5-1000-1000 Safety Mat	: 1 piece
UMRT4 Ramp Trim with Yellow PVC Cover (1.22 m)	: 4 pieces
UMOC Molded Outside Corner	: 4 pieces

Example 2: Using three Safety Mats

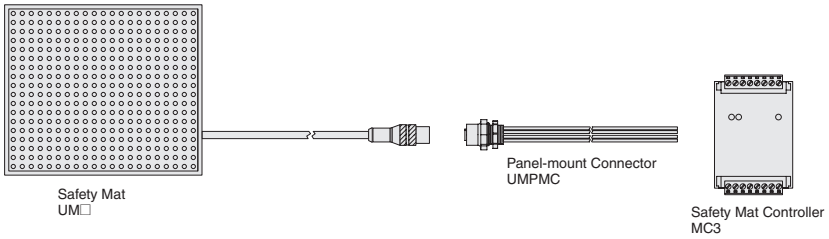


In this case, the perimeter of the Safety Mat is about 8 m, the joint between the Safety Mats is 2-m long, and the following pieces are required:
The example above consists of the following components:

UMYM5-1000-1000 Safety Mat	: 3 pieces
UMRT4 Ramp Trim with Yellow PVC Cover (1.22 m)	: 8 pieces
UMJS4 Joining Trim (1.22 m)	: 2 pieces
UMOC Molded Outside Corner	: 5 pieces
UMIC Molded Inside Corner	: 1 piece

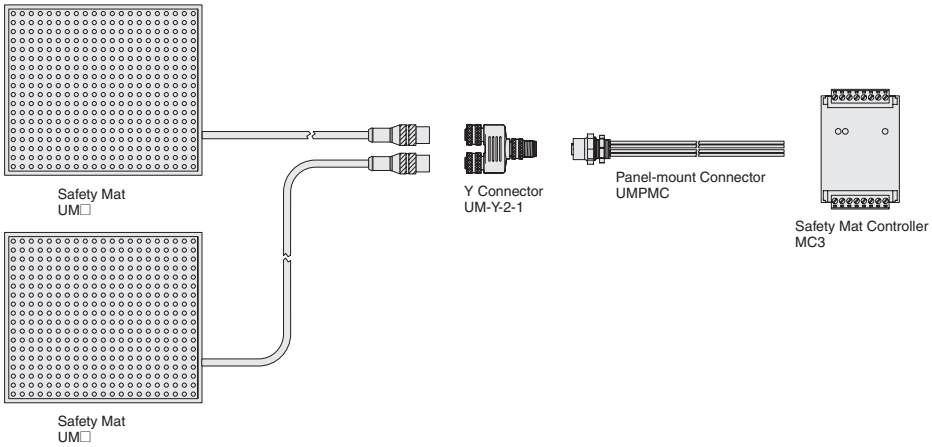
Wiring of Safety Mat and Safety Mat Controller

Example 1: Using a Single Safety Mat



Note: You can cut a Safety Mat's cable and wire it to the MC3 Safety Mat Controller without using UMPMC.

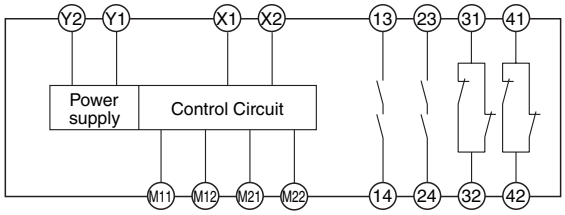
Example 2: Using Two Safety Mats



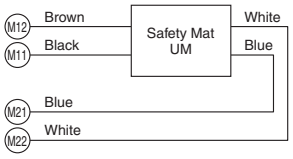
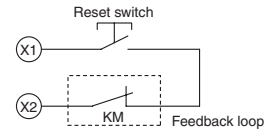
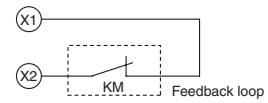
Contact your dealer for other wiring combinations.

Connections

Internal Connection



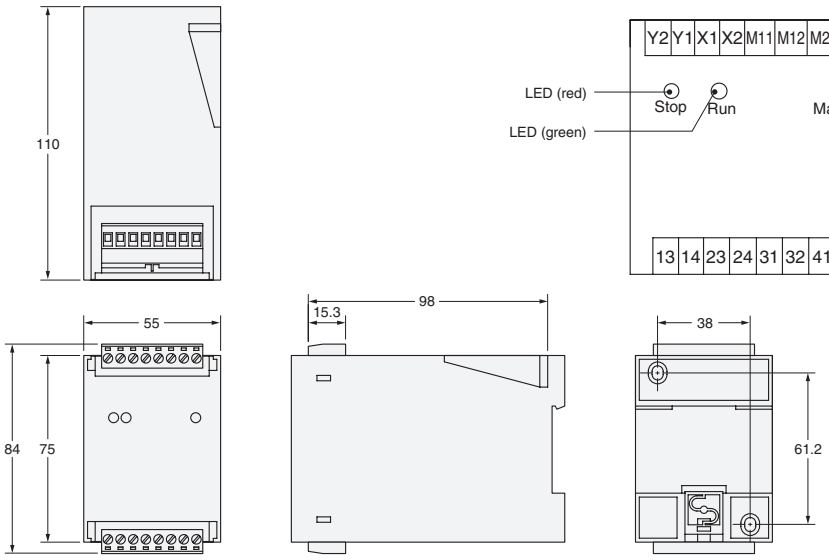
Wiring of Inputs and Outputs

Signal name	Terminal name	Description of operation	Wiring	
Power supply input	Y1, Y2	Power supply input terminals for MC3 Connect the power source to the Y1 and Y2 terminals.	Connect the power supply plus (24 VDC) to the Y1 terminal. Connect the power supply minus (GND) to the Y2 terminal.	
Safety Mat input	M11, M12, M21, M22	To turn ON safety outputs, all the connected safety mats must have no load. Otherwise, the safety outputs will NOT turn ON.		
Feedback/ reset input	X1, X2	To turn ON safety outputs, connection between X1 and X2 must change open => closed => open. Otherwise, the safety outputs will NOT turn ON.	Manual reset	
		To turn ON safety outputs, connection between X1 and X2 must be closed. Otherwise, the safety outputs will NOT turn ON.	Auto reset	
Safety output	13-14, 23-24	Turns ON/OFF according to the state of the safety mat inputs and feedback/reset inputs.	Keep these outputs Open when NOT used.	
Auxiliary output	31-32, 41-42	Turns ON/OFF according to the state of the opposite logic to the safety outputs.	Keep these outputs Open when NOT used.	

Dimensions

(Unit: mm)

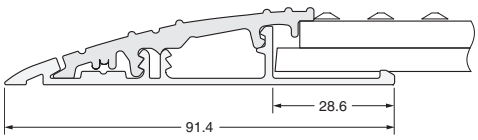
Safety Mat Controller
MC3



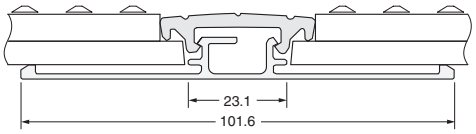
Terminal/LED arrangements

Trims

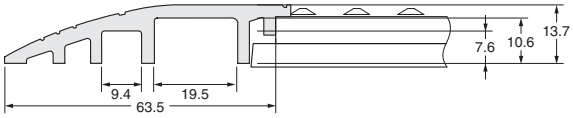
Ramp Trim with Yellow PVC Cover
UMRT□



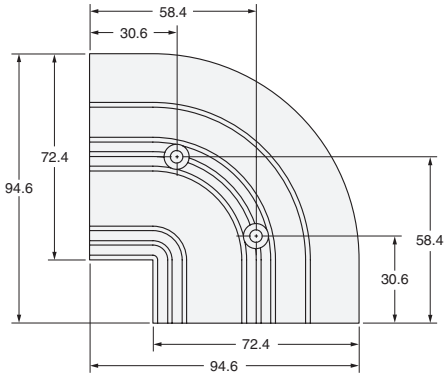
Joining Trim
UMJS□



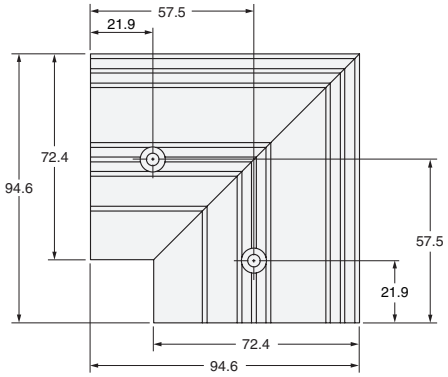
Aluminum Ramp Trim
UMAL



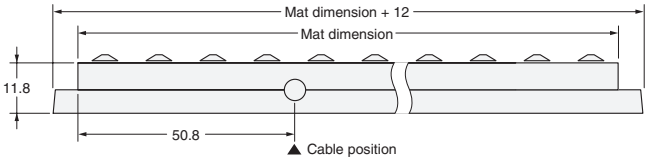
Molded Outside Corner
UMOC



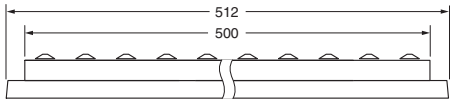
Molded Inside Corner
UMIC



Safety Mat

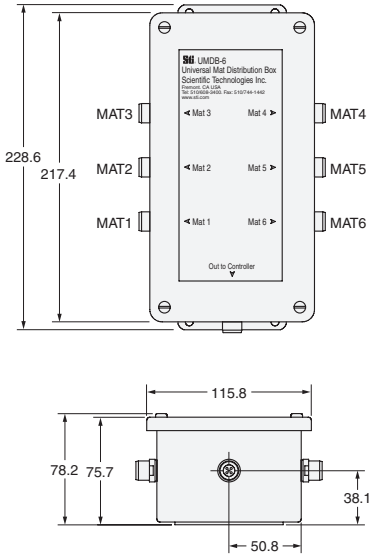


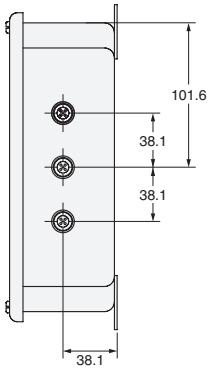
Example: UMYM5-0500-0500



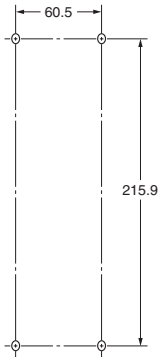
Accessories

Distribution Box
UMDB-6

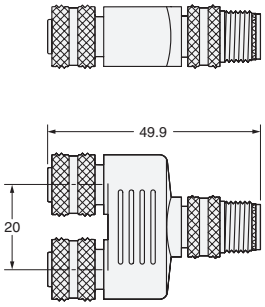




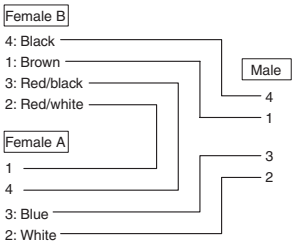
Mounting hole dimensions



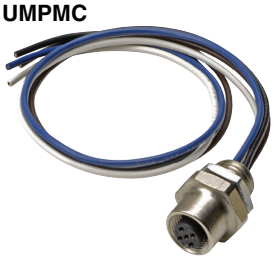
Y Connector
UM-Y-2-1

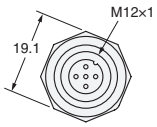


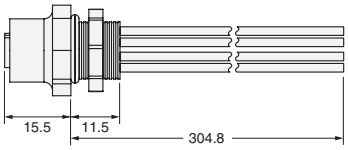
Internal wiring



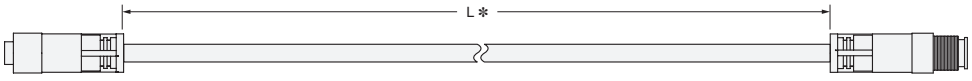
Panel-mount Connector
UMPMC







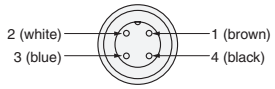
Extension Cable
UMEC-03
UMEC-05
UMEC-10
UMEC-15



*Cable length

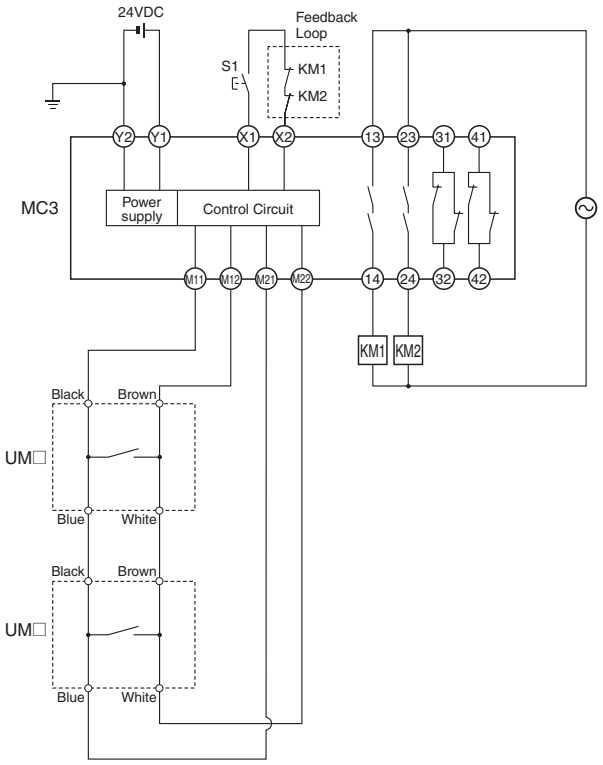
Model	L (m)
UMEC-03	3
UMEC-05	5
UMEC-10	10
UMEC-15	15

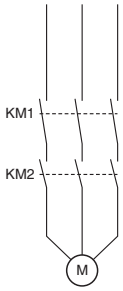
Pin arrangement



Application Examples

MC3 + UM□ (Manual Reset)

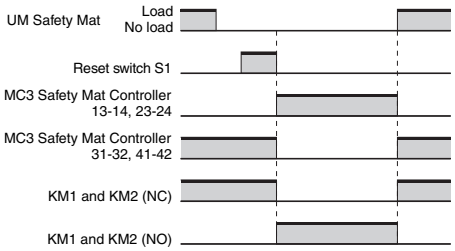




S1: Reset switch
KM and KM2: Magnetic Contactor
M: 3-phase motor

Note: 1. The circuit in this example is equivalent to a Safety Category 3 circuit.
2. Decide the mat size carefully considering the safety distance.
For safety distance calculation, read the "**Safety Precautions**" on **page 10**.
3. When operating in manual reset mode, be sure to remove the three yellow jumpers. (Jumpers are behind the terminal box.)

Timing Chart



Safety Precautions

Before installing and using the Safety Mat System, carefully read the instruction manual attached to the product.

⚠ WARNING

Serious injury may occur due to breakdown of safety outputs. Do not connect loads beyond the rated value to the safety outputs.

Serious injury may occur due to loss of required safety functions. Do not use the Safety Mat with logics that the operation of the mat might turn ON the guarded equipment. Use the Safety Mat with logics by which safety outputs turn OFF in a hazardous state.

Serious injury may occur due to loss of required safety functions. Wire the Safety Mat properly so that supply voltages or voltages for loads do NOT touch the safety inputs accidentally or unintentionally.

Serious injury may occur due to loss of required safety functions. Do not use a Safety Mat to detect children as it does not support child detection.

To use a Safety Mat for the purpose of entry detection, secure the following safety distance until a person reaches a hazardous area by walking on the mat. Otherwise, the machine may not stop before the person reaches the hazardous area, causing injury.

Calculation of the Minimum Safety Distance

The EN999 standards provide the following formula to calculate the minimum safety distance for floor-installed Safety Mats:

S = (1,600 x T) + 1,200 mm

In this equation, S is the minimum safety distance (unit: mm), the term 1,600 represents a standard approach speed of 1,600 mm/s, T is the overall stop time required for the machinery to stop, and the term 1,200 mm represents the length of a step and the length of an arm.

The overall stop time is comprised of two components:

T = t1 + t2

t1 : Maximum response time from the activation of the detection device to the point that the control device's output goes OFF (30 ms for these Safety Mats).

t2 : Response time of the machinery, i.e., the time required to stop the machine or remove the risk after receiving the output signal from the Safety Mat System.

The worst case scenario for the response time of the machinery (t2) must be used in the formula. The actual response time depends on various factors such as the machinery being used, the operating mode, the product being processed, and the point in the control cycle at which the stop signal is received. If there are other factors that may affect the response time, such as brake wear, these factors must be taken into account as well.

Example Calculation

In this example, the Safety Mats are used with machinery that has a measured worst-case response time of 0.485 s.

T = t1 + t2
= 30 ms + 485 ms
= 515 ms = 0.515 s

S = (1,600 x 0.515) + 1,200 mm
= 824 + 1,200 mm = 2,024 mm

Consequently, the Safety Mat must be installed at a minimum distance of 2,024 mm from the danger source.

Note: 1. Read the Instruction Sheet included with the Safety Mat System thoroughly for details on designing and installing the Safety Mat System to provide the minimum safety distance mentioned above.

2. The Safety Mat's Ramp Trim and Molded Corner are not considered part of the Safety Mat's detecting area. Do not include the Ramp Trim and Molded Corner in the safety distance.

Precautions for Safe Use

- Turn OFF the power supply before wiring. Also, do not touch any terminals (current-carrying parts) while the power is ON. Doing so may result in electric shock.
- Do not perform wiring when there is a risk of lightning. Doing so may result in electric shock.
- Apply properly specified voltages to the Safety Mat inputs. Applying inappropriate voltages cause the Safety Mat to fail to perform its specified function, which leads to the loss of safety functions or damages to the Safety Mat.
- Use a power supply of the specified voltage. Do not use power supplies with large ripples or power supplies that intermittently generate incorrect voltages.
- Do not use the Safety Mat for a load that exceeds the Safety Mat's switching capacity (contact voltage, contact current) or other contact ratings. Doing so will reduce the specified performance, causing insulation failure, contact welding, and contact failure, and the Safety Mat may be damaged or burnt.
- The durability of the Safety Mat depends greatly on the switching conditions. Confirm operation under the actual conditions in which the Safety Mat will be used. Make sure the number of switching operations is within the permissible range. If a Safety Mat is used after performance has deteriorated, it may result in insulation failure between circuits and burning of the Safety Mat itself.
- Do not use the Safety Mat where flammable gases or explosive gases may be present. Doing so may cause combustion or explosion due to Relay heating or arcing during switching.
- Do not drop or disassemble the Safety Mat. Doing so may reduce the product characteristics and may result in damage, electric shock, or burning.
- To prevent short-circuit or ground failure of the load, connect protection elements such as fuses. Not doing so may damage or burn the load.
- When installing trims, be careful not to get injured by the edge of the trim, etc.

Precautions for Correct Use

Make sure to use the Safety Mat UM series in combination with the Safety Mat Controller MC series.

Handle with care

1. Do not drop the Safety Mat to the ground or expose to excessive vibration or mechanical shocks. The Safety Mat may be damaged and may not function properly.
2. Do not apply loads on a certain location of the Safety Mat for a long period of time. It may damage the Safety Mat.
3. Do not use the Safety Mat submerged in water or in locations continuously subject to splashes of water.
4. Store the Safety Mat in a vertical (standing) position prior to install so that loads are not applied to the Safety Mat.

Solvents

Adhesion of solvent such as alcohol, thinner, trichloroethane or gasoline on the product should be avoided.
Such solvents make the marking on the Safety Mat illegible and cause deterioration of parts.

Storage conditions of the Safety Mat

Do not store in such conditions stated below.
1. In direct sunlight
2. At ambient temperatures out of the range of -37 to 66°C.
3. At air pressure out of the range of 86 to 106 kPa.
4. In corrosive or combustible gases
5. With vibration or mechanical shocks out of the rated values.
6. Under splashing of oil, chemicals
7. In the atmosphere containing dust, saline or metal powder.

The Safety Mat may be damaged and may not function properly.

Storage conditions of the Safety Mat Controller

Do not store in such conditions stated below.
1. In direct sunlight
2. At ambient temperatures out of the range of 0 to 55°C.
3. At relative humidity out of the range of 90%RH or under such temperature change that causes condensation.
4. At air pressure out of the range of 86 to 106 kPa.
5. In corrosive or combustible gases
6. With vibration or mechanical shocks out of the rated values.
7. Under splashing of water, oil, chemicals
8. In the atmosphere containing dust, saline or metal powder.

The Safety Mat Controller may be damaged and may not function properly.

Wiring of the Safety Mat Controller

1. Use the following to wire to the Safety Mat Controller
   - Stranded wire (Flexible wire): 0.2 to 2.5 mm^2
   - Solid wire: 0.2 to 2.5 mm^2
   - Strip the cover of wire no longer than 7 mm.
2. Tighten each screw with a specified torque of 0.4 to 0.5 N·m, or the Safety Mat Controller may malfunction or generate heat.
3. Ground the negative side of the power supply. A controller with the positive side grounding will not work.

Mounting of multiple Safety Mat Controllers

1. In closely contacted mounting, the rated carry current is 3 A. Use at 3 A or less voltage.
2. When applying more than 3A , place the mats farther than 25 mm from the nearest MC3.

Mounting of the Safety Mat Controller to DIN rails

Use end plates (PFP-M: sold separately) on both ends of MC3.

Use of air valve

1. After installing a mat, loose the air valve on the surface of the mat for 30 seconds or more in order to make the internal air pressure equal to external air pressure.Then, close the air valve.
2. Turn the air valve with a torque at 1.5 N·m or less.
3. Do not store or use the the mat with loose air valve. It may allow water penetration.

Mounting of the Safety Mat

1. Use- dedicated trims to secure the circumference of the Safety Mat for installation.
2. Do not install the Safety Mat on an environment with a projection. Install it on a flat surface.
3. Do not pull the cables to lift or move the Safety Mat.
4. Do not use the Safety Mat with a cover on it.

Others

This is a Class A product (Product in industrial setting). Use of the product in residential setting may cause radio disturbance. In such case, take appropriate measures.

Read and Understand This Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

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Application Considerations

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OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

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- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

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Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

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Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

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