

Capacitive system CSE



EN | Operating instructions

Version 1

CSE RailFR® (type C-SL G2 RailFR®) 24 V DC PELV

CSE RoadFR® (type C-SL G2 RoadFR®) 24 V DC PELV

Mayser GmbH & Co. KG

Örlinger Strasse 1–3

89073 Ulm

GERMANY

Tel.: +49 731 2061-0

Fax: +49 731 2061-222

E-mail: info.ulm@mayser.com

Website: www.mayser.com

Original instructions

Safety first!



- Read the instructions carefully before use.
- The warnings in the instructions are there to warn you of any unexpected dangers. Always heed the warnings.
- Keep the instructions somewhere safe so you can refer to them throughout the product's entire service life.
- Pass the instructions on to every subsequent owner or user of the product.
- Add any supplement received from the manufacturer to the instructions.
- **Observe the information under "Safety" (starting on page 5).**

Conformity



The design type of the product complies with the basic requirements of the following directives:

- 2014/30/EU (EMC)
- 2011/65/EU (RoHS)

The Declaration of Conformity is available in the Downloads section of our website: www.mayser.com.

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About these instructions

These instructions are part of the product.
 Mayser accepts no responsibility or warranty claims for damage and consequential damage due to failure to observe the instructions.

Validity These instructions are only valid for the products specified on the title page.

Target group These instructions are intended for the operating company and for electrically skilled persons. The electrically skilled person must be familiar with installation and commissioning.

Other applicable documents → Please also observe the following documents:

- Drawing of the sensor system (optional)
- Wiring diagram (optional)

Symbols used	Symbol	Meaning
	→ ...	Action with one step or with more than one step where the order is not relevant.
	1. ...	Action with more than one step where the order is relevant.
	• ... - ...	Bullets first level Bullets second level
	(See <i>Installation</i>)	Cross-reference

Danger symbols and information	Symbol	Meaning
	⚠ DANGER	Immediate danger leading to death or serious injury.
	⚠ WARNING	Imminent danger which may lead to death or serious injury.
	⚠ CAUTION	Possible danger which may lead to minor or moderate injuries.
	NOTE	Potential risk of damage to property or the environment. Information on easier and safer working practices.

Measurements used in drawings Unless otherwise stated, all measurements are in millimetres (mm).

Safety

Intended use

The CSE capacitive system has been designed to serve as a contactless collision protection system on bus and train doors. It evaluates the change in the capacitive field present around the sensor. The integrated output signal switching device transmits the evaluation of the capacitive field to the door control unit as a binary signal.

The CSE capacitive system is usually inserted into a rubber sleeve profile (optional).

Exclusions The product cannot be used as an anti-pinch sensor for safety-related applications.

Safety instructions

For your **own safety**, you must adhere to the following safety instructions.

➔ **Avoid electric shocks**

To avoid electrical injuries, disconnect electrical systems from the power supply and secure them to prevent them being switched back on. Do this before you start working on them.

➔ **In the event of a fault, put out of operation**

In the event of malfunctions and visible damage, put the product out of operation by decommissioning it.

To prevent irreparable damage to the **product**, you must observe the following safety instructions.

➔ **Do not open the product**

Never open, tamper with or alter the product.

➔ **Check supply voltage**

Check the supply voltage. It must correspond to the connecting voltage U_s specified on the type plate.

➔ **Establish a low-impedance connection to the vehicle chassis ground**

Ensure there is a low-impedance connection between the door panel and vehicle chassis ground.

➔ **Observe correct terminal assignment**

Observe the correct terminal assignment when connecting the supply voltage.

→ Provide protection for inductive loads

Implement appropriate protective measures when switching inductive loads.

→ Do not overload output

Ensure that the specified switching current is not exceeded.

→ Protect against strong electromagnetic pulses

Protect the product from excessive incoming electromagnetic radiation.

Strong electromagnetic pulses can impair the product's ability to function.

Residual dangers

There are no known residual dangers associated with this product.

Parts supplied

1x capacitive system

CSE with integrated evaluation unit

1x operating instructions**1x Declaration of Conformity**

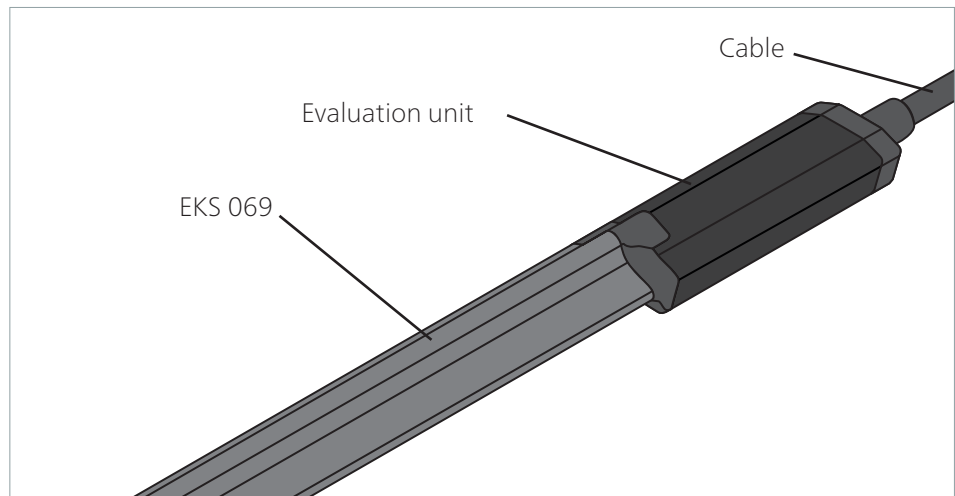
- Upon receipt, immediately check the parts supplied to ensure they are complete and in good condition.

Storage

- Store the sensor in a dry place inside the original packaging.
- Observe the storage temperature in accordance with the technical data.

Product overview

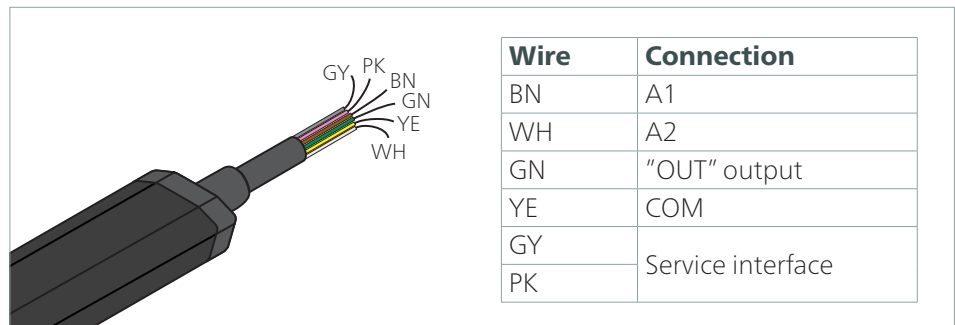
Sensor



Connections

Colour coding

BN	Brown
GN	Green
GY	Grey
PK	Pink
WH	White
YE	Yellow



Function

Embedded within a rubber sleeve profile (optional), the CSE capacitive system is attached to the closing edge of a bus or train door. It generates a capacitive field between the CSE and earth potential, which is constantly monitored by the integrated evaluation unit. The capacitive field forms the CSE detection area. The range of the detection area depends on the size of the objects being detected. The bigger the objects, the greater the range.

Detection

If a passenger or some other conductive object enters the CSE detection range, it causes a change in the capacitive field. The integrated evaluation unit detects this change, evaluates it and transmits the result to the door control unit via the "OUT" output. If the changes in the capacitive field remain below the defined switching threshold, the "OUT" output stays in the ON state. Greater changes in the capacitive field lead to the switching threshold being exceeded and the "OUT" output switches to the OFF state.

Under unfavourable general conditions, the door panel and object may come into contact with each other: e.g. due to a longer overtravel distance (inertia) or if the door control unit is slow to respond.

The CSE capacitive system is constantly active, i.e. the CSE never stops detecting. Therefore, the door control unit has to ignore the output signals of the integrated evaluation unit in certain situations, e.g. during the final door portal approach.

Functional test

When the door is opened, the change in the field causes a brief (min. t_{Δ}) switch in the output signal; the "OUT" output switches to the OFF state. This signal change can be used to carry out a regular functional test on the CSE.

"OUT" output

The CSE capacitive system is available in two versions:

- "HIGH active" semiconductor output (standard)
ON state = 24 V DC OFF state = 0 V DC
- "LOW active" semiconductor output (optional)
ON state = 0 V DC OFF state = 24 V DC

3 operating modes

The CSE capacitive system can be operated in three modes:

- 2 OUT mode (optional) 2x sensors 2x door panels
- 1 OUT mode (standard) 2x sensors 1x/2x door panel(s)
- Single mode (optional) 1x sensor 1x door panel

In 2 OUT mode, two separate output signals are provided. This allows the door control unit to distinguish between the sensors.

In 1 OUT mode, only one output signal is available. Consequently, it is not possible to differentiate between the sensors.

In both 2 OUT and 1 OUT mode, there are measures in place to prevent two sensors from detecting one another if they are moving towards each other.

The operating mode is preconfigured at the factory.

Fault handling

Fault detection

The CSE capacitive system monitors itself for internal faults. If it detects a fault, the "OUT" output switches to the OFF state; a sequence containing the relevant fault code is sent. This function can be optionally disabled at the factory.

Environmental influences

The system readjusts itself in response to gradual changes in temperature or humidity. Changes of this kind do not affect the output signal.

This also applies to normal levels of rainfall and snowfall.

Only extremely heavy rainfall or snowfall may mislead the integrated evaluation unit and cause a change in the output signal.

Reset

Automatic reset

If the CSE can no longer detect an object that it was detecting previously, the "OUT" output switches from the OFF state to the ON state after a delay t_w (see re-start time t_w under *Technical data*).

NOTE

In rare cases, the automatic reset may be triggered even though an object is still present in the detection area. This happens in the case of static objects that have not moved for some time. The constant learning process means that the system blanks such objects out as soon as the switching threshold is undershot (see *Object within detection area*).

Sensor surface

Resistance

The resistance ratings listed below (at a room temperature of 23 °C) depend on the sensor having an undamaged surface.

Physical resistance

	RailFR	RoadFR
IEC 60529: degree of protection	IP67	IP67
EN 45545-2: suitable for		
Hazard level	HL3	–
Set of requirements		
Sensor	R26	–
Cable	R15 and R16	–
UNECE R118: flame propagation test		
Sensor: sections 6.2.1 and 6.2.3	–	Passed
Cable: section 6.2.6	–	Passed

Chemical resistance

The sensor is resistant to a certain extent to normal chemical influences such as diluted acids and alkalis, as well as alcohol, over an exposure period of 24 hours.

The values in the table are the results of tests carried out in our laboratory. You must always conduct your own practical tests to verify that our products are suitable for your specific area of application.

Explanation of symbols:

- + = resistant
- ± = resistant to a certain extent
- = not resistant

	RailFR	RoadFR
Cyanoacrylate adhesive	+	+
Greases	+	+
Graffiti remover	±	±
Skin cream	+	±
Isopropanol	±	±
Alkaline cleaner	+	+
Plastic cleaners	+	+
Neutral cleaner	+	+
Phosphoric acid cleaner	+	+
Hydrochloric acid cleaner	+	+
Saline solution 5%	+	+
Soap solution	+	+
Spirit (ethyl alcohol)	±	+
Talc	+	+

Installation

For your own safety, you must also adhere to the following rules during installation:

- Disconnect from the power supply all devices and live parts that are located in the immediate vicinity.
- Secure them to prevent them being switched back on.
- Check that they are de-energised.

1. Visually inspect the sensor for damage.
If there are signs of damage, dispose of the sensor.
2. Insert the sensor into the rubber sleeve profile with the aid of dry compressed air.

NOTE

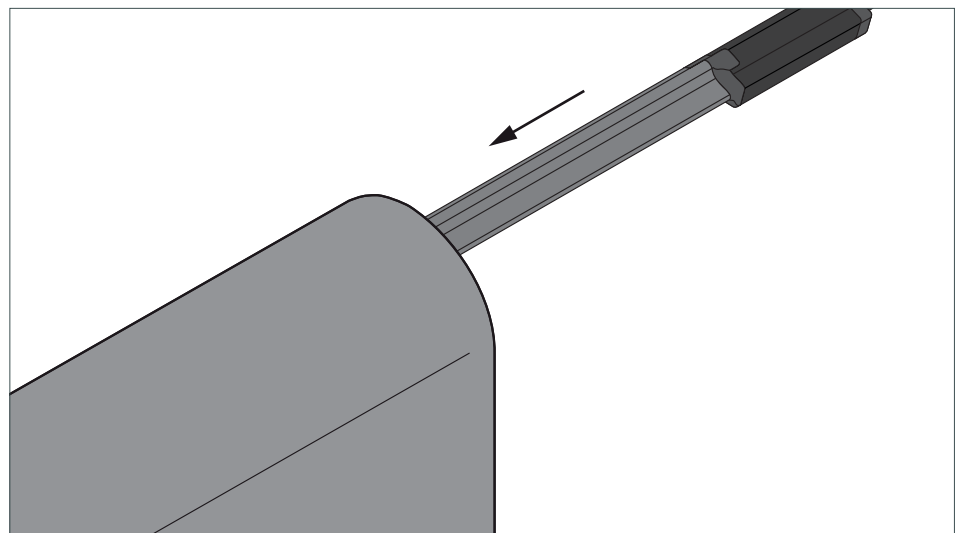
Sliding agents are not suitable. They leave residues behind between the rubber sleeve profile and sensor. This can impair or destroy the product's ability to function.

➔ Do not use **any** sliding agents when inserting the sensor.

NOTE

If the rubber sleeve profile is subjected to hard knocks (e.g. with a hammer), it can damage the sensor.

➔ Avoid subjecting the rubber sleeve profile to hard knocks when inserting the sensor.

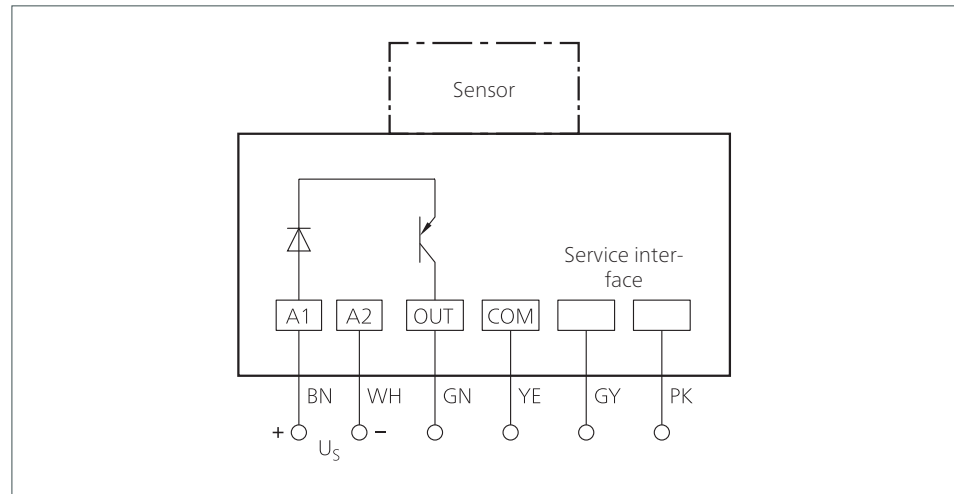


3. Seal the top end of the rubber sleeve profile to prevent the ingress of moisture and dirt.
4. Install the rubber sleeve profile – with the sensor inserted inside it – on the door panel.

5. Wire up the sensor (see *Connection examples*).

Colour coding

BN	Brown
GN	Green
GY	Grey
PK	Pink
WH	White
YE	Yellow



NOTE

If the connections

- between the sensors and door control unit
- between the door panel and vehicle chassis ground

are not low-impedance connections, the CSE's ability to function may be impaired.

- ➔ Ensure the use of low-impedance interfaces (< 1 ohm) between the sensors and door control unit.
- ➔ Ensure there is a low-impedance connection between the door panel and vehicle chassis ground.

NOTE

Incoming electromagnetic radiation that enters via the sensor connection cable can impair the sensor's ability to function.

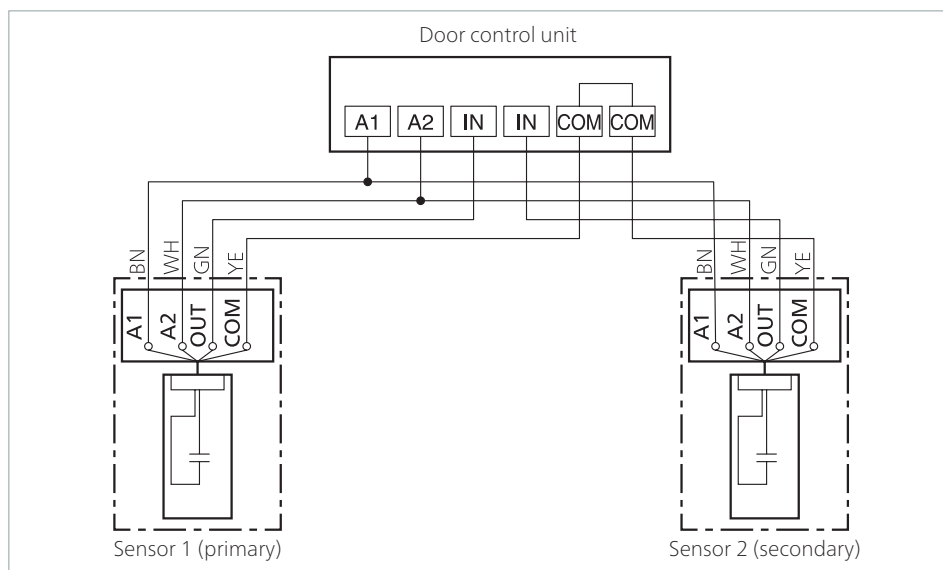
- ➔ Please ensure spatial separation between the sensor connection cable and lines with high electromagnetic potential.
- ➔ If possible, lay the lines for sensors 1 and 2 in parallel all the way up to the door control unit.
- ➔ The lines that run to connection A2 of sensors 1 and 2 must always be routed together with the other lines.

Connection examples

2 OUT mode

Colour coding

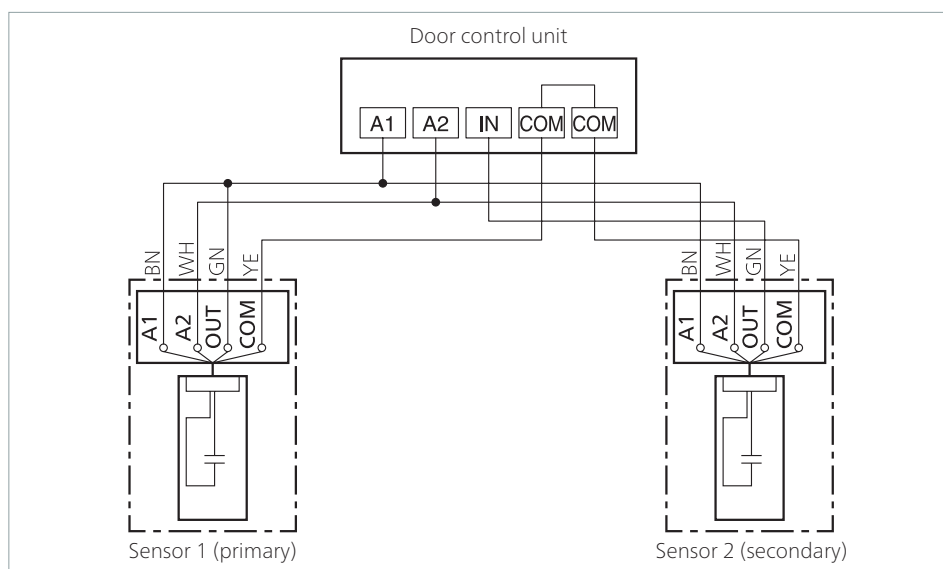
- BN Brown
- GN Green
- WH White
- YE Yellow



The "OUT" output of sensor 1 and the "OUT" output of sensor 2 are connected to the door control unit separately. This allows the output signal of each individual sensor to be evaluated.

In order for 2 OUT mode to be used, sensor 1 must be preconfigured for 2 OUT mode at the factory.

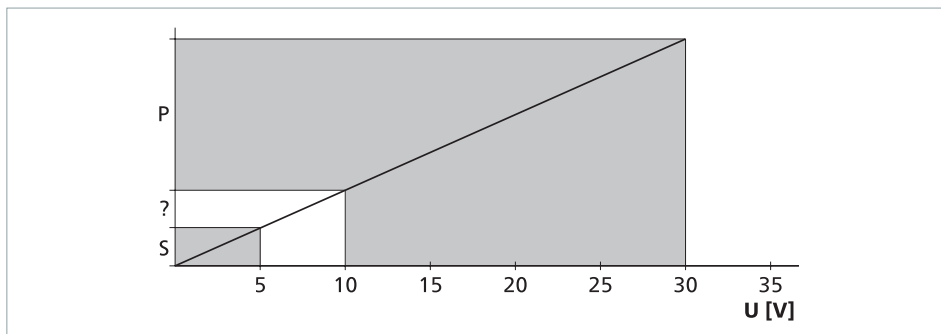
1 OUT mode



The "OUT" output of sensor 1 is connected to the "A1" operating voltage. The "OUT" output of sensor 2 is connected to the door control unit. Consequently, sensor 2 transmits the evaluation for **both** sensors to the door control unit. Sensor 1 automatically becomes the primary sensor as soon as the "OUT" output of sensor 1 is connected to line A1.

The switch from secondary to primary takes place automatically. The internal monitoring function of the "OUT" output detects whether external voltage is present and, if it is, the level of this voltage.

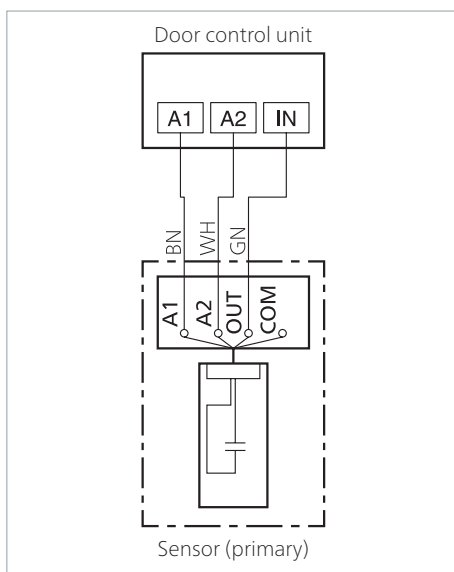
Voltage at OUT	Sensor is
$U < 5\text{ V}$	S Secondary
$5\text{ V} < U < 10\text{ V}$? Undefined
$U > 10\text{ V}$	P Primary



Single mode

Colour coding

- BN Brown
- GN Green
- WH White



There is only one sensor installed on the door panel and connected to the door control unit. Only three lines need to be wired up.

In order for single mode to be used, the sensor must be preconfigured for single mode at the factory.

If only one sensor is operated on one door panel, the function that allows sensors to blank each other out in the final closure area is absent. During this phase of the closing movement, the "OUT" output signal has to be ignored by the door control unit.

Commissioning

1. Check the rubber sleeve profile for damage.

NOTE

Damage to the rubber sleeve profile – and possibly also the sensor as a result – can lead to malfunctions.

- ➔ Take the sensor out of operation as soon as you identify any damage that could impair safe operation.
- ➔ Dispose of the rubber sleeve profile **and** sensor.

2. Connect the supply voltage.
3. Wait approx. 1 s until initialisation is complete.
4. If the doors are open, close them.

Testing the function

2 OUT mode

Prerequisite: supply voltage connected.

1. Open the doors.
The "OUT" outputs of sensors 1 and 2 switch to the OFF state briefly and then return to the ON state (functional check).
2. Move an object into the detection area of sensor 1.
The "OUT" output of sensor 1 switches to the OFF state.
3. Make sure that the detection areas of the sensors are clear of objects.
4. Move an object into the detection area of sensor 2.
The "OUT" output of sensor 2 switches to the OFF state.
5. Make sure that the detection areas of the sensors are clear of objects.
6. Close the doors.
If the closing movement is performed without switching to the OFF state, the functional test has been completed successfully. The CSE capacitive system is now ready for operation.

If the functional test could not be completed correctly, see *Troubleshooting and remedies*.

1 OUT mode

Prerequisite: supply voltage connected.

1. Open the doors.
The "OUT" output of sensor 2 switches to the OFF state briefly and then returns to the ON state (functional check).
2. Move an object into the detection area of sensor 1.
The "OUT" output of sensor 2 switches to the OFF state.
3. Make sure that the detection areas of the sensors are clear of objects.
4. Move an object into the detection area of sensor 2.
The "OUT" output of sensor 2 switches to the OFF state.
5. Make sure that the detection areas of the sensors are clear of objects.
6. Close the doors.
If the closing movement is performed without switching to the OFF state, the functional test has been completed successfully. The CSE capacitive system is now ready for operation.

If the functional test could not be completed correctly, see *Troubleshooting and remedies*.

Single mode

Prerequisite: supply voltage connected.

1. Open the door.
The "OUT" output switches to the OFF state briefly and then returns to the ON state (functional check).
2. Move an object into the detection area of the sensor.
The "OUT" output switches to the OFF state.
3. Make sure that the detection area of the sensor is clear of objects.
4. Close the door.
In the final closure area, the door control unit has to ignore detection of the opposing closing edge.
If the closing movement is performed, the functional test has been completed successfully. The CSE capacitive system is now ready for operation.

If the functional test could not be completed correctly, see *Troubleshooting and remedies*.

Object within detection area

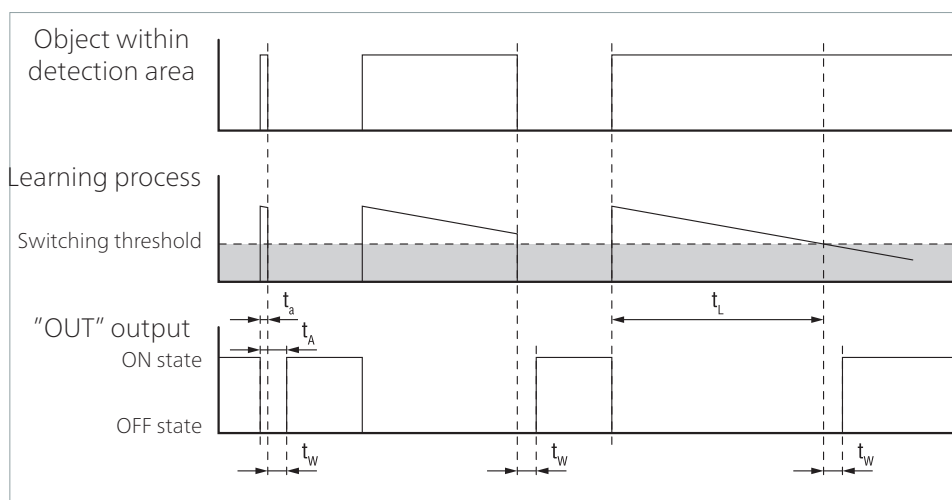
If the sensor detects an object in the detection area, the "OUT" output switches to the OFF state for at least 500 ms (t_a).

A learning process commences whenever an object is detected. If an object retains its position after being detected, the sensor starts to learn that this object is present and blanks it out when the switching threshold is undershot. The time required for the learning process (t_L) depends on the detected object but is subject to a maximum of 5000 ms.

If the dynamic object has left the detection area again or if it has been learnt by the system after becoming static (switching threshold undershot), the restart time (t_w) begins running. At the end of the restart time, the "OUT" output switches back to the ON state.

Key:

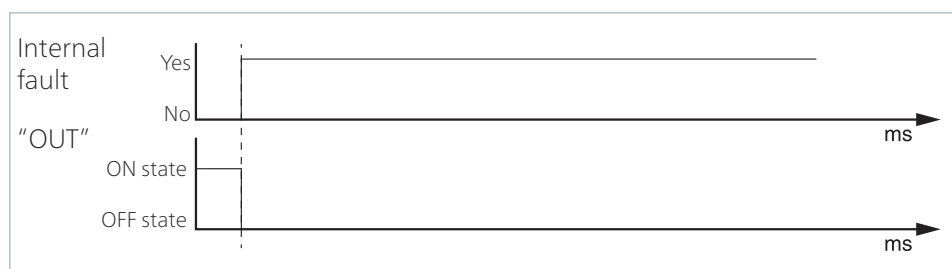
- t_a = reaction time
- t_A = active time
- t_w = restart time
- t_L = learning process



Internal fault

In the event of a fault, the "OUT" output repeatedly outputs a sequence representing the fault (standard).

Optional: The "OUT" output switches to the OFF state permanently in the event of a fault. The sequence representing the fault is not sent. This option has to be preconfigured at the factory.



Decommissioning

- ➔ Disconnect the CSE capacitive system and secure it to prevent unintentional reconnection.
- ➔ Attach a clear notice to the CSE capacitive system stating that it is temporarily or permanently out of service.

Recommissioning

- ➔ Carry out the commissioning process (see *Commissioning*).

Maintenance and cleaning

The sensor sits inside a rubber sleeve profile, where it is protected. Consequently, maintenance and cleaning are mainly restricted to the rubber sleeve profile.

Maintenance

The sensor is maintenance-free.

- ➔ Repeat the functional test monthly.
- ➔ Check the rubber sleeve profile for damage once a month.

NOTE

Damage to the rubber sleeve profile – and possibly also the sensor as a result – can lead to malfunctions.

- ➔ Take the sensor out of operation as soon as you identify any damage that could impair safe operation.
- ➔ Dispose of the rubber sleeve profile **and** sensor.

Cleaning

- ➔ Clean the outside of the rubber sleeve profile with a mild cleaning agent.
- ➔ After cleaning, remove any cleaning agent residues.

Troubleshooting and remedies

Prerequisites:

- The CSE capacitive system has passed the latest test (see *Commissioning*).
- The CSE is connected to the supply voltage.
- No sensor has been activated.

Fault	Possible cause	Remedy
Not functioning at all	No or incorrect supply voltage	1. Check supply voltage, compare with type plate 2. Check wiring: is everything connected correctly?
	If supply voltage is correctly connected: CSE is faulty	➔ Replace sensor
Accidental activation	No low-impedance connection	➔ Check for a low-impedance connection between the door panel and vehicle chassis ground
	Sensors not aligned parallel	➔ Check that the sensors located opposite each other are aligned parallel on the front edge; are the door panels off-centre in relation to each other?
	Objects overlooked	➔ Are there still some objects in the detection area, e.g. tools?
	Internal fault	➔ Perform a restart (see <i>Commissioning</i>)
	Problem of accidental activation cannot be resolved: CSE is faulty	➔ Replace sensor

Still unable to resolve the fault?

➔ Contact Mayser-Support: Tel. +49 731 2061-188.

➔ In the event of enquiries, have the information from the type plate to hand.

Type plate There is a type plate on the sensor cable for identification purposes.

Replacement parts

No replacement parts are available for the CSE capacitive system. The CSE can only be replaced in its entirety.

Disposal

Sensor The devices produced by Mayser are professional electronic tools exclusively intended for commercial use (known as B2B devices). Unlike the B2C (business-to-consumer) devices mainly used in private households, they must not be disposed of at the collection centres of public waste management organisations (e.g. municipal recycling depots). At the end of their useful life, the devices may be returned to us for disposal.
WEEE reg. no. DE 39141253

- Packaging**
- Wood, cardboard, plastics
- ➔ When disposing of the product:
- Ensure compliance with the relevant national disposal regulations and statutory requirements.
 - Ensure that any disposal company you use receives a list of the aforementioned materials along with the product.
 - Ensure that the materials are recycled or disposed of in an environmentally friendly way.

Technical data

CSE	RailFR	RoadFR
Testing basis	German Federal Railway Authority Regulation No. EMV 06, EN 45545-2, EN 50121-3-2, EN 50124-1, EN 50153, EN 50155	UNECE R10, UNECE R118 sections 6.2.1, 6.2.3 and 6.2.6
Connecting voltage U_s		
Nominal voltage	PELV: 24 V DC	
Voltage tolerance	-30 to +25%	
Nominal current	100 mA	
Power consumption	< 2.5 W	
Times		
Reaction time t_a	< 50 ms	
Restart time t_w	< 1 s	
Active time t_A	Min. 500 ms	

CSE	RailFR	RoadFR
Outputs		
“OUT” semiconductor output		
Switching voltage (max.)	$U_s - 0.7 \text{ V}$	
Switching current (max.)	100 mA	
Line length (max.)		
Supply and signal lines	10 m	
Service interface	3 m	
Mechanical operating conditions		
IEC 60529: degree of protection	IP67	
Tensile load		
Cable (max.)	20 N	
Pull-in tab	50 N	
Max. humidity (23 °C)	95%	
Operating temperature	-40 to +65 °C	
Storage temperature	-10 to +30 °C	
EN 50155: classes		
Operating temperature class	OT2	–
Temperature change class	H1 ±3 K/s	–
Interruption class		
Switching current < 10 mA	S2	–
Switching current 10 to 100 mA	S1	–
EN 45545-2: suitable for		
Hazard level	HL3	–
Set of requirements		
Sensor	R26	–
Cable	R15 and R16	–
IEC 61373: shock and vibration	Category 1, class B	–
UNECE R118: flame propagation test		
Sensor: 6.2.1 and 6.2.3	–	Passed
Cable: 6.2.6	–	Passed
Weight: EKS 069 + end pieces	110 g/m + 40 g	