

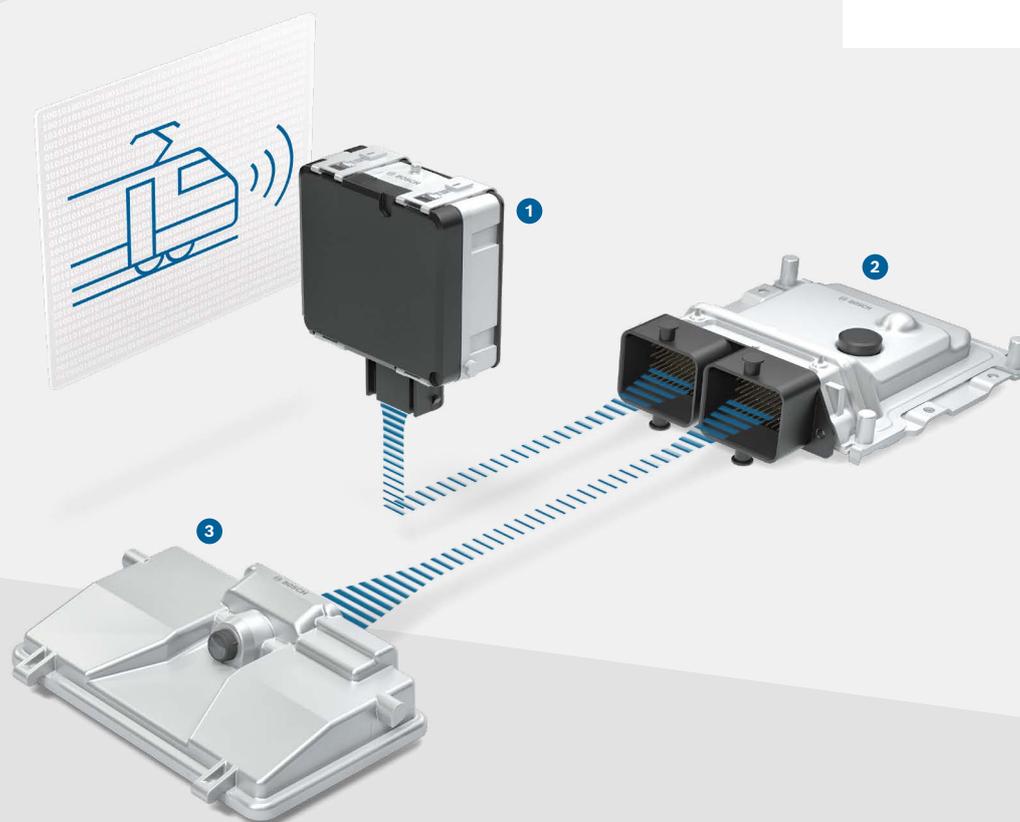
Driver assistance systems

Tram forward collision warning system

Bosch Engineering



BOSCH
Invented for life



PRODUCT BENEFITS

- ▶ Active support for tram drivers in critical situations in urban traffic
- ▶ Greater safety for driver and passengers as well as for all other road users in the immediate vicinity
- ▶ Trams more consistently on time thanks to reduction of accident frequency
- ▶ Reduced costs by avoiding or reducing accidents

- 1 Mid-range radar sensor
- 2 Rail control unit
- 3 Multi purpose camera

DANGER DETECTED

For tram drivers, tough situations like heavy commuter traffic or poor visibility quickly become serious challenges. Obstacles on the rails or road users who approach the rails have to be detected in enough time for the risks to be recognized.

DANGER AVERTED

When it comes to its collision warning system for light rail vehicles, Bosch Engineering relies on proven components from automotive technology to actively reduce the expensive consequences of accidents or prevent them altogether. If the system detects an impending collision, it warns the tram driver, and if the driver reacts too late or not at all, the system can initiate automatic braking.

GREEN LIGHT FOR GREATER SAFETY

The collision warning system consists of a multi purpose camera, a radar sensor and a control unit. The multi purpose camera monitors the track layout ahead, as well as vehicles and people and transmits this information in real time to the radar sensor. The object information of the video camera and radar sensor are fused to an overall picture of the environment. Taking the vehicle's speed into consideration, the system uses the information to determine the danger of a collision.

In the event of a hazard due to an obstacle, the system calculates whether an optical and / or acoustic warning should be given to the driver. It determines whether the threat presented by an obstacle warrants a visual and/or acoustic warning to the driver. It sends a signal via relay output to trigger automatic braking,

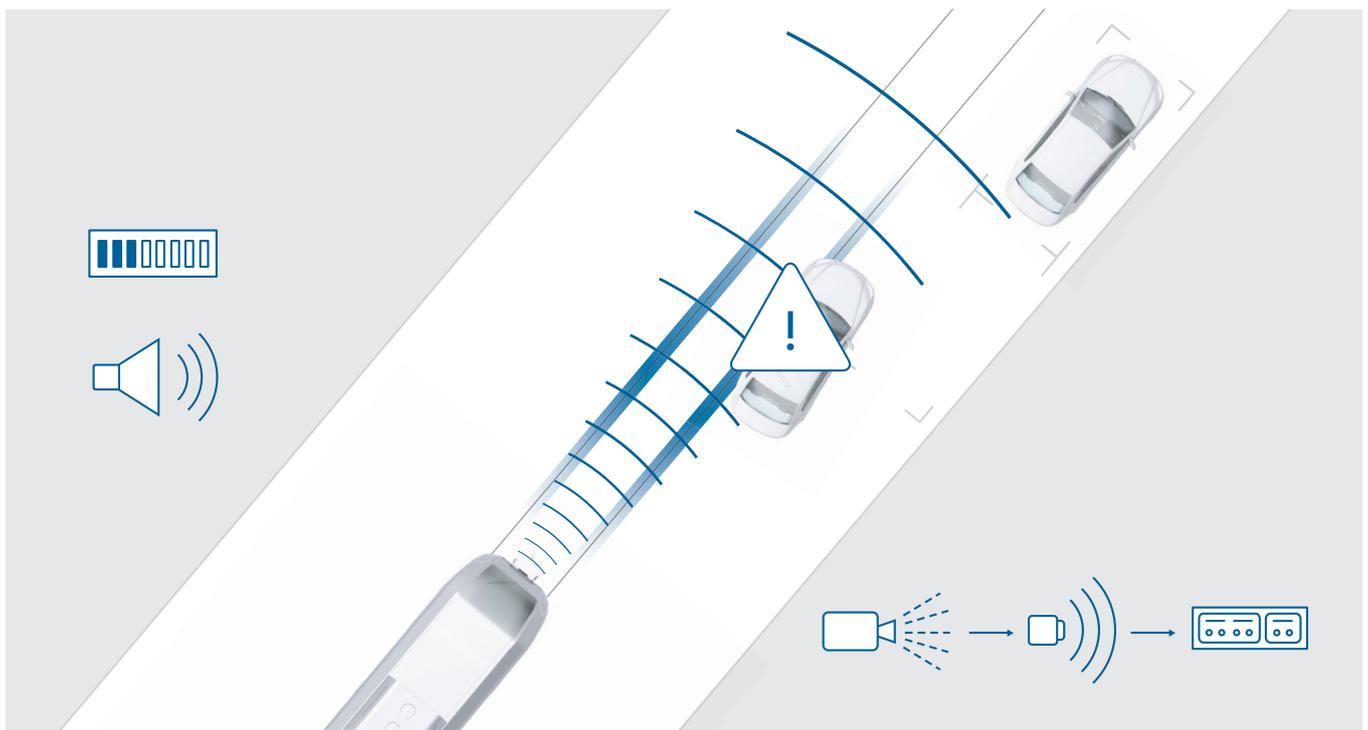
should the driver respond too late or not at all to the system's warning. The relay's switching function can be checked automatically when the system starts up to confirm that it is working properly. The tram drivers can take action – they can override the system or stop the initiation of automatic braking via the driver control function if the dangerous situation has already been resolved.

The system monitoring function gives the driver an overview of components' system status, which can be displayed using LED, for example. How the warning is given, the warning/braking thresholds, and other system parameters can be individually customized

RECOGNIZING – AND LEVERAGING – STRENGTHS

Combining the data from the multi purpose camera and mid-range radar sensor improves obstacle detection. The principle of sensor data fusion, adopted from the field of automation development for road vehicles, selectively merges the strengths of multiple sensor principles. In this way, it boosts both the reliability and the availability of the sensor technology.

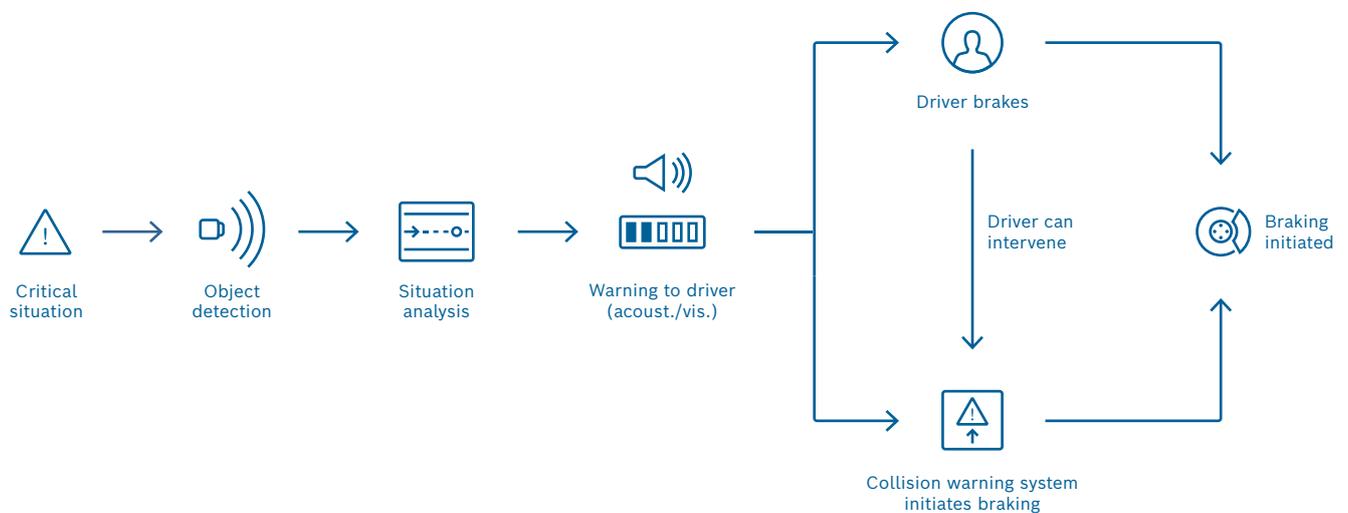
Detecting critical situations



TECHNICAL CHARACTERISTICS

System	
Aperture	up to +/- 35° horizontal
Speed	max. 80 km/h
Compatibility	Electromagnetic compatibility (EMC) as per DIN EN50121-3-2
Output interface	8 digital outputs
Warning and braking threshold	can be tailored for customer
Input interfaces	up to 4 analog inputs, e.g. speed signal, warning/ braking acknowledgement, relay monitoring
Certification	EN50155

Tram forward collision warning system



improved

safety

through avoiding collisions by means of early warning or braking system

lower

cost

for the correction of accident consequences, as collisions can be avoided or significantly reduced

simple

integration

thanks to compact components

high

availability

of light rail vehicles: fewer accidents means less vehicle downtime

TASK

The collision warning system for trams supports drivers in critical situations. Especially in congested traffic or poor visibility conditions, the system warns the driver about obstacles on the rails in plenty of time. This lets drivers avoid accidents, or at least significantly limit the effects.

FUNCTION

Consisting of a multi purpose camera, a radar sensor, and a control unit, the system monitors the track ahead and any possible obstacles in front of the vehicle in real time. If it detects a potential collision, it sends a warning to the driver. And should the driver respond too late or not at all, the collision warning system can initiate automatic braking.