INTELLIGENT COLLISION WARNING SYSTEMS FOR TRAMS
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Bosch Engineering North America
Florian Waldenmaier
Bosch - Four business sectors
Key Figures 2018

Bosch Group

€ 77.9 billion euros in sales

410,000 associates

Mobility Solutions
- One of the world's largest suppliers of mobility solutions

Industrial Technology
- Leading in drive and control technology, packaging, and process technology

Energy and Building Technology
- One of the leading manufacturers of security and communication technology
- Leading manufacturer of energy-efficient heating products and hot-water solutions

Consumer Goods
- Leading supplier of power tools and accessories
- Leading supplier of household appliances

Rounded figures as of 12.17
Rail transport @ Bosch

Bosch Engineering GmbH

- System-Development Partner for sophisticated application based on Bosch product portfolio
- 100-percent subsidiary of Robert Bosch GmbH
- Founded in 1999
- >2750 associates at 15 sites in 9 countries

Business strategy of Bosch Rail Organization:
Make Bosch technology available for the railway industry under consideration of the rail specific requirements: standards and volumes

Competence Center for Railway specific Bosch components
Overview

- Based on automotive components
- In productive operation since 2017
- Compliant and certified to tram standards and homologated in several EU applications
- Continued function and performance optimization
- Basis for higher automation
Tram forward collision warning (TFCW)
Main use cases

Passenger Cars

Other Trams

Busses/Trucks

Buffer Stop
Tram forward collision warning (TFCW)
Warning Strategy

- Warning depends on:
  - Deceleration
  - Reaction time of the driver
  - Responds time of braking system
  - Safety offset

Example:
- Level 3 and 2: different optical, acoustical warning possible
- Level 1: automated brake intervention
Tram forward collision warning (TFCW)
Use case: pedestrian warning

The three warning areas can be parametrized by the customer...

...with three different output signals. Possible types of warning are e.g.

- Acoustical warning
- Optical warning
- Brake intervention
Tram forward collision warning (TFCW)
Examples of Integration: DVB Dresden and HTM The Haag
Tram forward collision warning (TFCW)
System characteristics

- The System warns before other trams, cars and buffer stops
  
  Optional: Pedestrian warning can be activated

- The tram driver is fully responsible, his authority must not be restricted by the system

- In case of an upcoming collision, the driver receives a warning
  
  Optional: If the tram driver does not react, the system will initiate a brake intervention
Tram forward collision warning (TFCW)
Selected References, Success Stories

**FRANKFURT**
- Development partnership
- 14 Systems installed and in operation in a retrofit project

**ULM**
- Original equipment of 12 new trams
- Delivery starting in 2018
- Retrofit of 10 existing vehicles planned

**THE HAGUE**
- Start of series equipment beginning of 2018
- 120 systems + 20 optional
- Retrofit project

**AMSTERDAM**
- 126 systems + 120 optional
- Original equipment
- Delivery starting in 2018
- Passenger service beginning of 2019

**HANNOVER**
- 2 tram systems with demonstrators
- Retrofit of the TW3000 fleet is planned
Tram forward collision warning (TFCW)

Testimonial – Frankfurt

„The FAST is a real innovation in the rolling stock market. The Bosch technology increases the operational safety and is widely accepted within our crew. We are delighted that we developed this system to series maturity together with such a competent partner like Bosch.“

M. Rüffer, CEO Technology and Operation VGF Frankfurt

- Development Partnership
- Preparation of 14 tram systems with Tram Forward Collision Warning
- The equipment of the whole fleet with Collision Warning Systems is planned
Tram forward collision warning (TFCW)

Conclusion

- TFCW is state-of-the-art technology in Europe
- Product is available for real tram operations
- Reduction of accidents → safety, availability, efficiency
- Quick break-even

Contact:
Bosch Engineering North America
Florian Waldenmaier
Mobile: 248 302-8728
Florian.Waldenmaier2@us.bosch.com

We can save lives.
THANK YOU

Florian Waldenmaier
BEG/CNA-W1
Mobile +1 248 302-8728
Florian.Waldenmaier2@us.bosch.com
www.bosch-engineering.de

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