2WP

Two-Wheeler and Powersports

Bosch Concept for Motorcycle Safety

Motorcycle ABS (Anti-Lock Braking System)

Advanced Rider Assistance Systems (ARAS)

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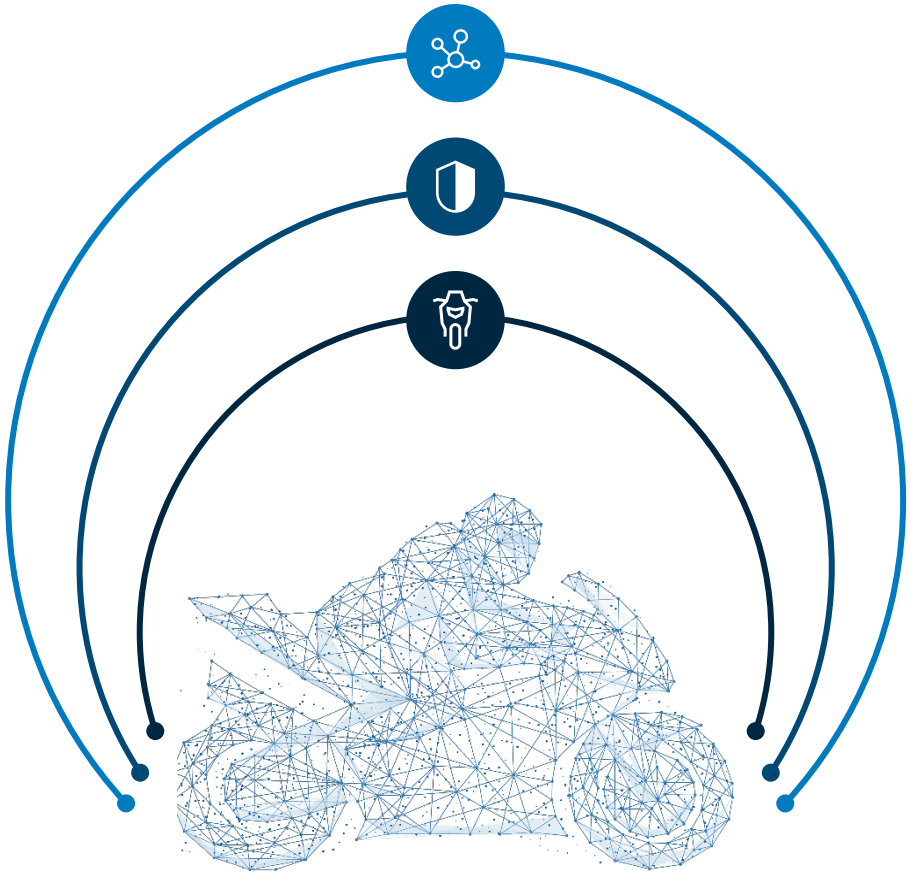
01

Bosch Concept for Motorcycle Safety

Comprehensive safety concept with three steps

Towards accident-free mobility



Connected with environment

Future safety functions

Predictive safety and comfort

Advanced Rider Assistance Systems (ARAS)

Vehicle stability

Motorcycle Stability Control (MSC)

Anti-Lock Braking System (ABS)

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Motorcycle ABS

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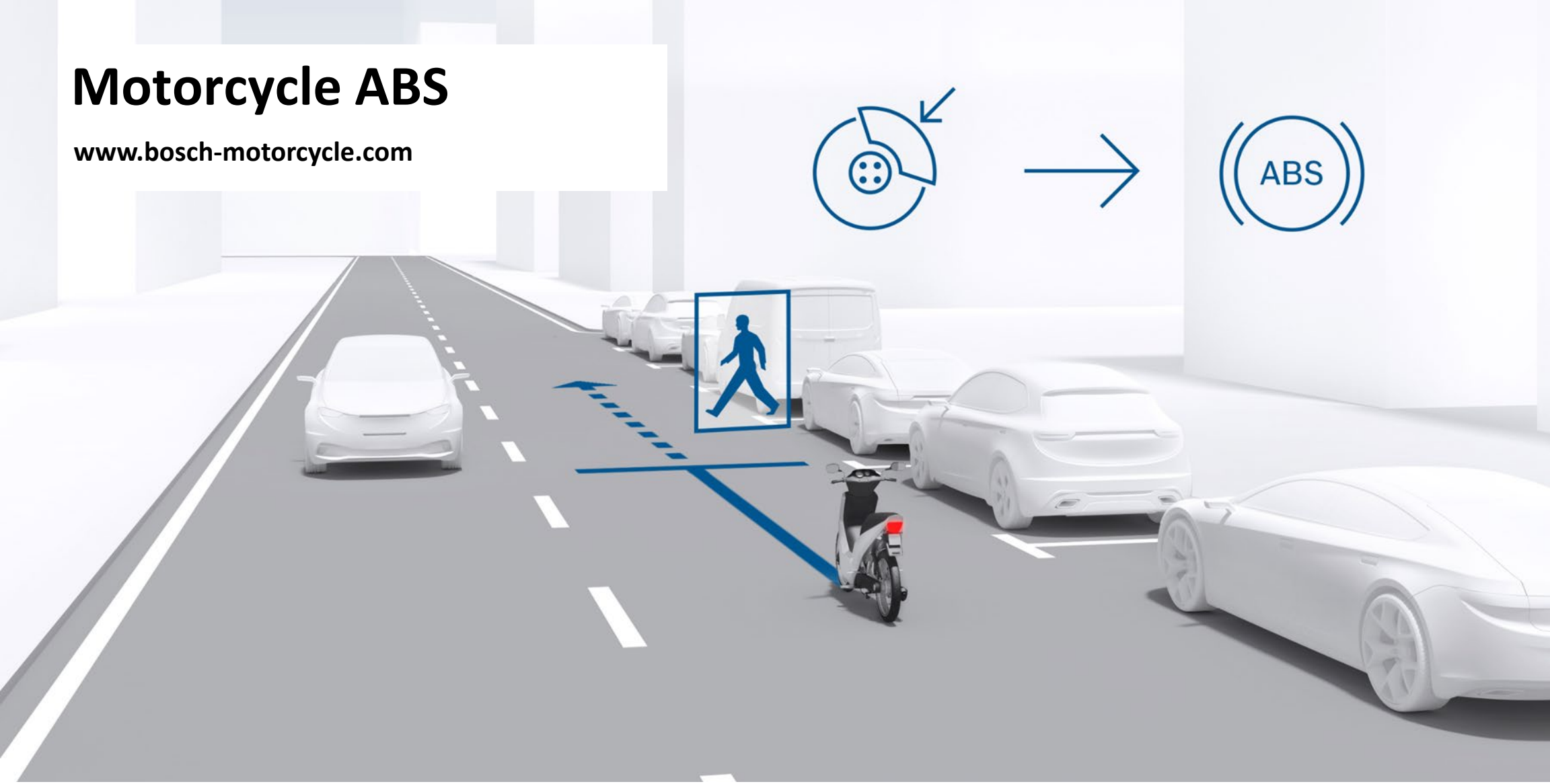
Motorcycle ABS

www.bosch-motorcycle.com



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Assistance systems
Motorcycle ABS

Reduction in the number of serious and fatal two-wheeler **accidents**

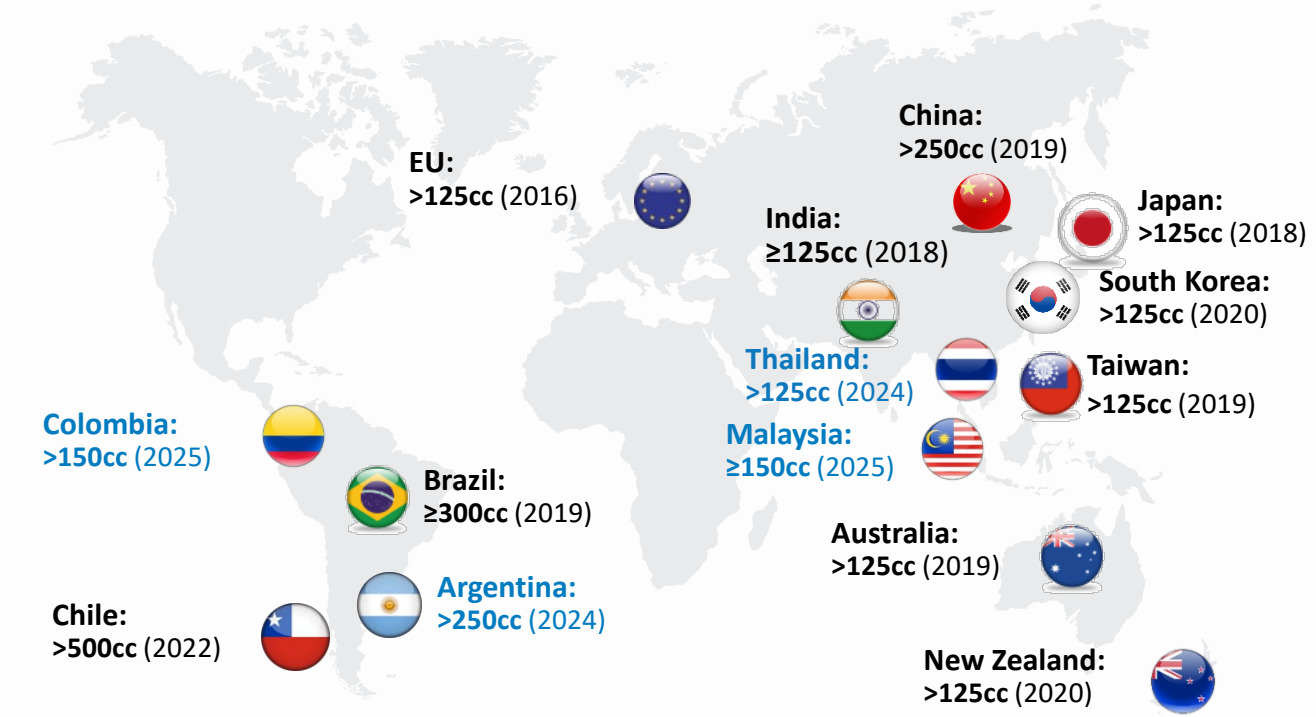
Safer braking instead of locking

Increased **vehicle stability** and enhanced **riding safety**

Global trends to improve road safety

Motorcycle ABS

Motorcycle ABS has become a standard safety equipment in many regions



Status: January, 2023

In “Global Plan for the Decade of Action for Road Safety

2021-2030”*,

WHO regards motorcycle ABS as one of the recommended measures to ensure vehicle safety.

Source: “Global Plan for the Decade of Action for Road Safety 2021-2030”, WHO (2021)

Motorcycle ABS benefits worldwide

Around 1/4th of all powered two-wheeler accidents

with injuries could be avoided by ABS

Germany

26%	Potential accident avoidance
31%	Reduction in collision speed
1%	No change
40%	Not ABS relevant accidents
1%	Unknown

[1] Source: GIDAS database (2001-2009) weighted data according to location, severity and accident type

[2] Source: Federal Statistical Office, Germany 2009 (DESTATIS)

India

33%	Potential accident avoidance
16%	Reduction in collision speed
18%	No change
26%	Not ABS relevant accidents
7%	Unknown

[1] based on 556 accidents w/ casualties in RASSI (involving 234 PTW accidents) (2009-2013)

Indonesia

27%	Potential accident avoidance
49%	Reduced collision speed / No change of accident
24%	Not ABS relevant accidents

[1] Source: Accident Research study by University of Indonesia (2018). 1.468 police reported crashes w/ casualties involving PTW (IRSMS data 2013-2016). Benefits on 2W-ABS transferred from Bosch Accident Research study India.

Motorcycle ABS benefits USA

Around 22% of all powered two-wheeler fatal accidents

in the USA could be avoided by ABS

USA

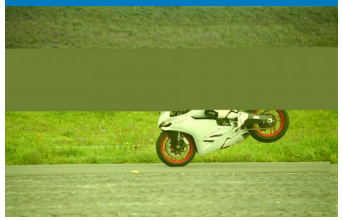
22%	Overall fatal accident avoidance
32%	Standard and Cruiser: Fatal accident avoidance
25%	Touring and Sport Touring: Fatal accident avoidance
19%	Sport: Fatal accident avoidance
12%	Super Sport: Fatal accident avoidance

Source: Effects of Antilock Braking Systems on Motorcycle Fatal Crash Rates: An Update, Insurance Institute for Highway Safety

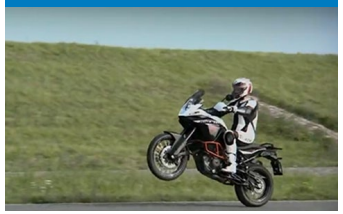
Functions for motorcycle ABS

Function portfolio

Rear-wheel lift-up mitigation



Wheelie mitigation



Anti-Lock Braking function

Motorcycle Stability Control

Traction control

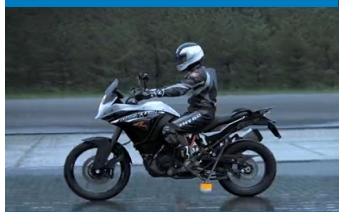
Anti-Lock Braking Systems (ABS)

Off-road control

Electronic combined braking system

Launch control

Drag torque control



Brake light activation

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Advanced rider assistance systems (ARAS)

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1 in 7

Accidents analysis

Motorcycle accidents could be prevented using radar-based assistance systems

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Advanced rider assistance systems (ARAS)

Radar-based assistance systems for two-wheelers

Innovative surround-sensing functions based on radar sensors for more safety and comfort.

Adaptive cruise control (ACC)

Forward collision warning

Blind spot detection

- Bosch's advanced rider assistance systems (ARAS) improve safety and comfort for motorcyclists by equipping the bike with radars, which serve as electronic eyes to monitor the surrounding area.
- ACC adjusts the vehicle speed to the flow of traffic and maintains the safe following distance necessary.
- If the forward collision warning system detects that a vehicle in front is dangerously close and the rider does not react to the situation, it warns the rider by an optical, acoustic and/or haptic signal.
- Whenever there is a fast-approaching vehicle in the rider's blind spot, the blind spot detection warns the rider by way of an optical signal, for example in the rear-view mirror.
- Blind spot detection also monitors the blind spot and assist the rider when changing lanes.

Collision reduction

by supporting the rider in critical situations

1 in 7

Advanced rider assistance systems (ARAS) could help prevent up to one in seven motorcycle accidents involving personal injury in Germany1)

1) Bosch accident research study 2018

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Advanced rider assistance systems (ARAS)

Development history in a glance

Start of Development

2013

Press launch event

ARAS public communication start

2018

Start of Production

Ducati, KTM and BMW

2020

Start of Production

Yamaha

2022

2017

Public road test

Europe

2019

Public road test

Japan

2021

Start of Production

Kawasaki

2023~

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Advanced rider assistance systems (ARAS)

For more comfort and safety

Bosch is teaching motorcycles how to see to take riding safety and comfort to a whole new level

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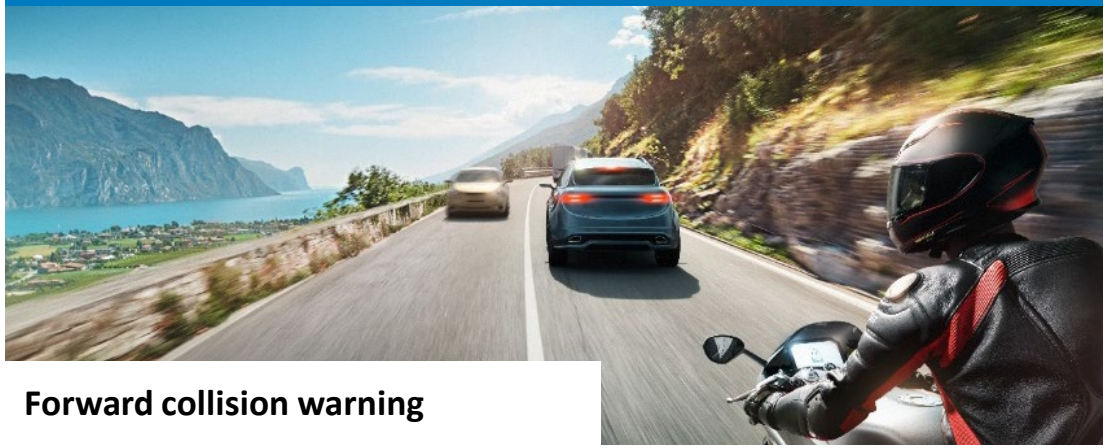
Advanced rider assistance systems (ARAS)

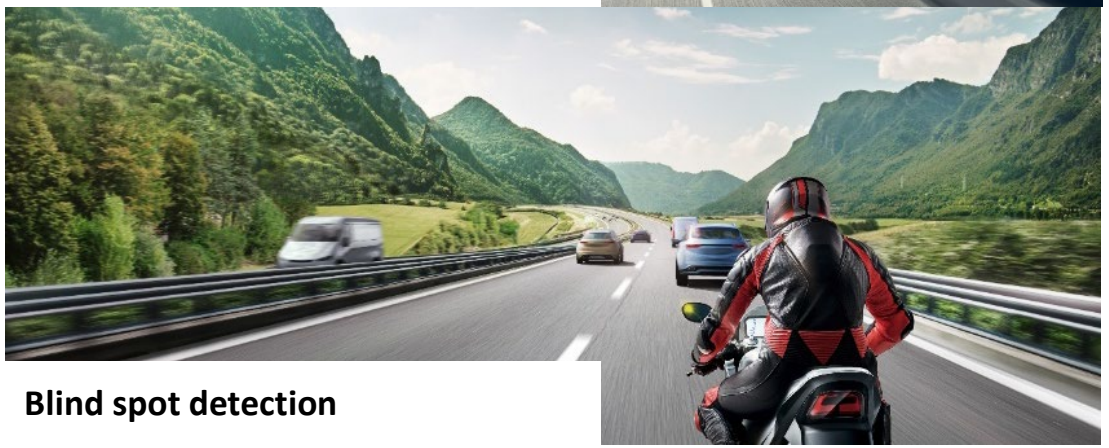
Enhancing predictive safety & comfort by surround sensing technology

In series production
with **Ducati, KTM, BMW, Kawasaki and Yamaha**

Adaptive cruise control (ACC)



Forward collision warning



Blind spot detection

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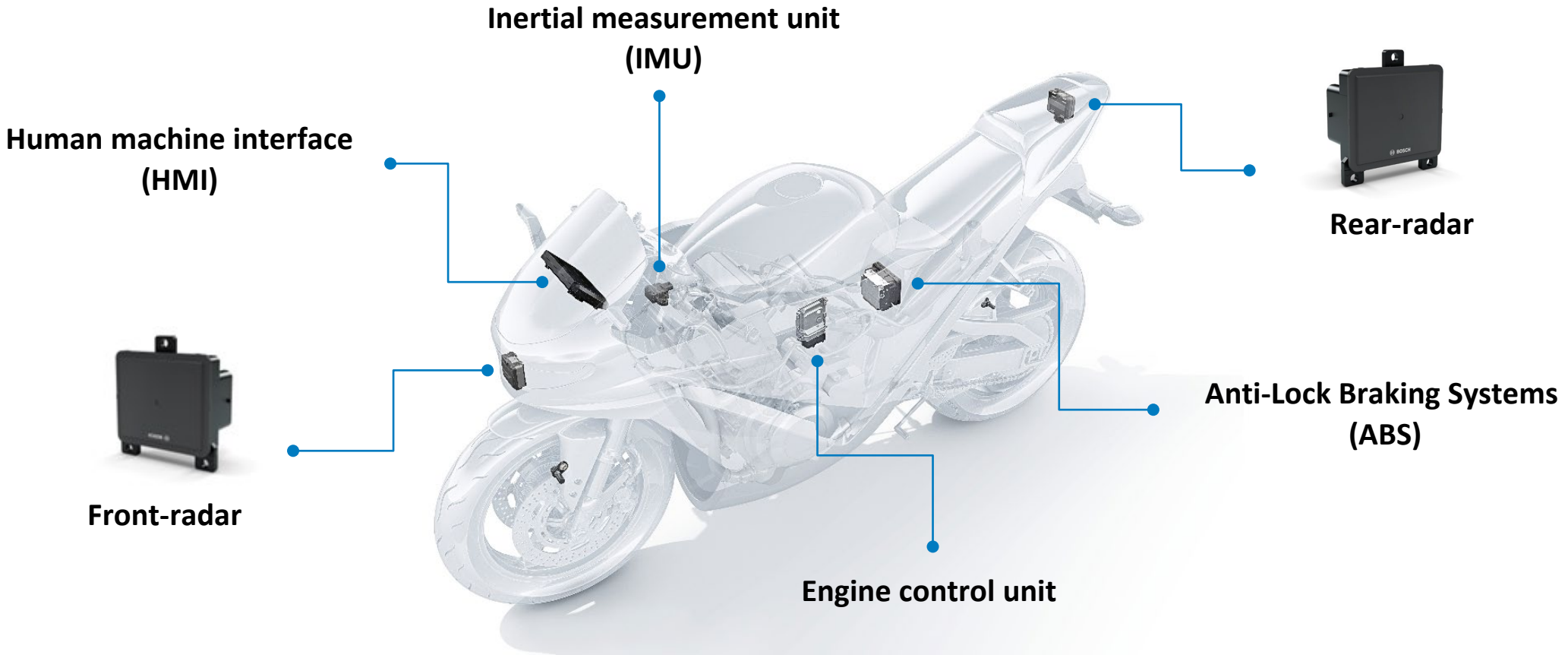
Advanced rider assistance systems (ARAS)

System solution from one hand



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Advanced rider assistance systems (ARAS)
System architecture overview

Detection

Mid-range radar sensors (front and/or rear)

Function

Advanced rider assistance systems

Adaptive cruise control

Forward collision warning

Blind spot detection

Actuation

Engine control unit

Accelerate

Motorcycle stability control

Decelerate

Human machine interface (HMI)

Warning

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Advanced rider assistance systems (ARAS)

Increased safety and comfort by surround sensing technology

Adaptive cruise control (ACC)

Enhanced comfort

Intelligent cruise control system for a more comfortable and relaxed highway riding

Advanced rider assistance systems (ARAS)
Adaptive cruise control

Description

Extension of the standard cruise control with an automatic adjustment of the speed and distance to the preceding vehicle.

- Speed range: 30 kph – 160 kph (maximum speed depending on region and customer request)
- Standard value-add feature: Curve speed control (comfortable speed adaptations around curves)

System requirements

- [x] Radar sensor (front)
- [ ] Radar sensor (rear)
- [x] Full integral ABS + Inertial measurement unit (IMU)
- [x] Human machine interface (HMI)
- [x] Engine control unit

Benefits

- Comfortable and relaxed highway riding and reduced risk of rear-end collisions
- Less strain for the rider on longer trips by easing the hand fatigue
- Supports the rider in maintaining a safe following distance

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Advanced rider assistance systems (ARAS)

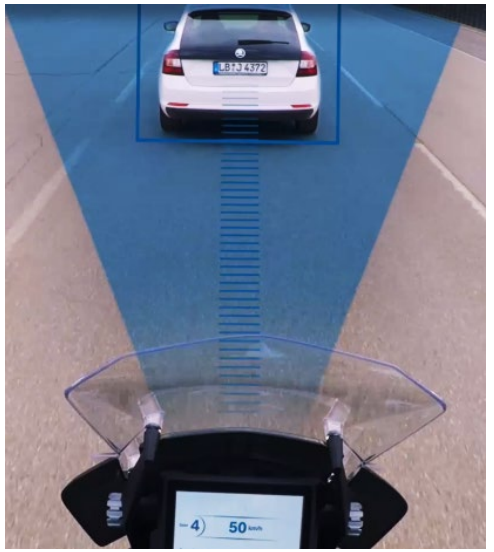
Adaptive cruise control (ACC)

System activated by switch

Adaptive cruise control can be activated from 30km/h upward

Front radar sensor monitors the distance to the vehicle ahead

Vehicle ahead slows down



System adjusts the speed

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Forward collision warning

Increased safety and comfort by surround sensing technology

Assists riders with warning to avoid forward collisions and mitigate the consequences

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Advanced rider assistance systems (ARAS)
Forward collision warning

Description

- Initiates a predictive warning to the rider in case of imminent collision to preceding car
- Provides early audible and/or visual warning

System requirements

- [x] Radar sensor (front)
- [ ] Radar sensor (rear)
- [x] Full integral ABS + Inertial measurement unit (IMU)
- [x] Human machine interface (HMI)

Benefits

- Faster rider reaction to critical situations
- Supports riders to decelerate in time / shorten the stopping distance to prevent frontal collision

*ABS not utilized for braking, but function software is in the ABS unit.

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Advanced rider assistance systems (ARAS)

Forward collision warning - Automatic brake pulse

Description

- Early detection of impending collisions
- Gives warning if the rider is not reacting to the prior acoustic or optical warning
- Extension of forward collision warning function with brake jerk

System requirements

- [x] Radar sensor (front)
- [ ] Radar sensor (rear)
- [x] Full integral ABS + Inertial measurement unit (IMU)
- [x] Human machine interface (HMI)

Benefits

- Most intense warning to draw rider’s attention toward the impending collision
- Rider warning for collision avoidance / mitigation even when rider is not looking at HMI
- Decreased reaction time

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Advanced rider assistance systems (ARAS)

Forward collision warning

Front radar sensor monitors the distance to the vehicle ahead

System will give visual/audible/tactic signal when motorcycle is approaching too close to the vehicle ahead.

Rider applies break

Secure safe distance from vehicle ahead

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Blind spot detection

Increased safety and comfort by surround sensing technology

Keeping an eye on the blind spot to increase the riding safety and assist when changing lanes

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Advanced rider assistance systems (ARAS)
Blind spot detection

Description

- Rear radar monitors the hard-to-see areas on either side of the vehicle and informs the rider
- Warning the rider of vehicles in the blind spot and fast approaching vehicles in adjacent lane

System requirements

- [ ] Radar sensor (front)
- [x] Radar sensor (rear)
- [x] Full integral ABS + Inertial measurement unit (IMU)
- [x] Human machine interface (HMI)

Benefits

- Helps to prevent rear-end collisions when changing lanes
- Additional safety back-up for rider when checking surrounding traffic situation

*ABS not utilized for braking, but function software is in the ABS unit.

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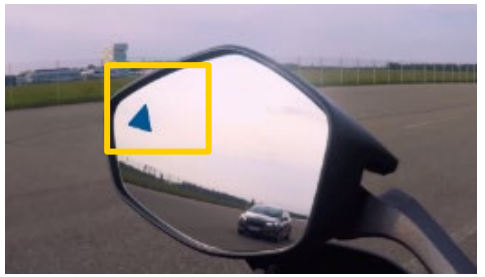
Advanced rider assistance systems (ARAS)

Blind spot detection

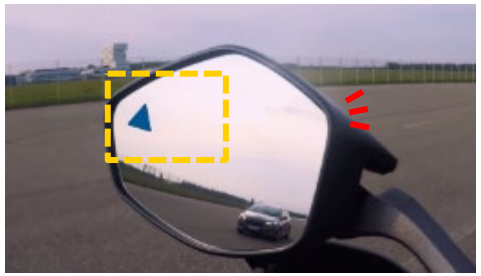
Rear radar sensor monitors the situation behind the motorcycle

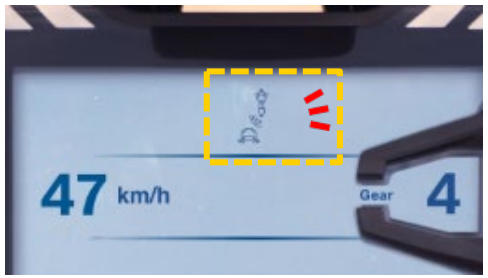
The system informs rider when another vehicle is in the blind spot or a faster vehicle is approaching in a neighbouring lane



Rider sets blinker to change lane

The system warns rider when another vehicle is in the blind spot or a faster vehicle is approaching in a neighbouring lane





Rider can change lanes safely

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Market voice for advanced rider assistance systems

Positive function feedback from customers and journalists

"This is a great improvement from existing cruise controls."

"With the BSD system watching your back and the ACC managing and monitoring the traffic in front – it is super relaxed."

"This tech (ACC) makes freeway riding in particular a total breeze and I can't wait until more motorcycles offer this."

"I would strongly recommend to take radar options!"

ROAD/SHOW BY CNET

MOTORRAD

ULTIMATE MOTORCYCLING

Automotive media Response.

CYCLE WORLD

YOUNG マシン MACHINE

rider MOTORCYCLING AT ITS BEST

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