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# Equipment for High Performance Vehicles

Edition 2021

**Bosch Motorsport**





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# Control

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## Overview

### Engine Control Unit MS 6.1



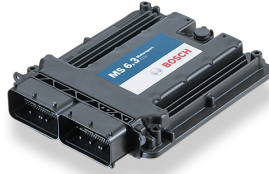
- Optimized for low pressure injection
- Basic number of low pressure control functions
- Basic number of engine functions
- Measurement with 21 analog inputs
- Multiple Software options available

### Engine Control Unit MS 6.2



- Optimized for low pressure injection
- Full number of low pressure control functions
- Full number of engine functions
- Measurement with 41 analog inputs
- Multiple Software options available

### Engine Control Unit MS 6.3



- Optimized for low and high pressure injection
- HP package for flat and V-engines optional
- Measurement with 21 analog inputs
- Multiple Software options available

### Engine Control Unit MS 6.4



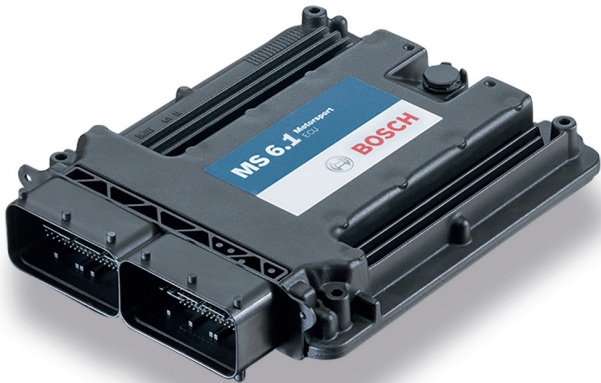
- Optimized for low and high pressure injection
- HP package for flat and V-engines inclusive
- Measurement with 41 analog inputs
- Multiple Software options available

### Engine Control Unit MS 7.4



- Optimized for low and high pressure injection
- Data logger included
- Gearbox control optionally included
- Gigabit data interface

## Engine Control Unit MS 6.1



### Features

- ▶ Optimized for low pressure injection
- ▶ Basic number of low pressure control functions
- ▶ Basic number of engine functions
- ▶ Measurement with 21 analog inputs
- ▶ Multiple Software options available

The MS 6.1 engine control unit manages gasoline engines up to 12 cylinders. As a member of our MS 6 family it features a powerful digital processing core with floating point arithmetic and a high-end FPGA for ultimate performance and flexibility. The MS 6 family utilizes a new software development process based on MATLAB/Simulink which significantly speeds algorithm development by using automatic code and documentation generation. Custom functions can be quickly and easily generated. The flexible hardware design allows the MS 6.1 to support complex or unusual engine or chassis configurations.

### Application

Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
------------------------	---

Physical engine model for fast application

- determine engine load by throttle position or air pressure signals
- mixture control and basic ignition guided by main signal relative load r/l
- Subsystems pit speed-, launch-, rpm-limiter and ASR are integrated inside torque control
- Separated power cut functions to assist several gear cut systems
- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift	
Electronic throttle control	Optional
VVT	Optional
Turbo control	Optional
Traction control	Optional
Launch control	Optional
LTE Ethernet telemetry support	
Internal logger	Partition 1, 1 GB memory, diagnostic channels, 50 free configurable channels, fastest sampling 50 Hz, digital filter respecting sampling theorem
Logger options	See Software Options (not included)

### Technical Specifications

#### Inputs

Analog inputs	21 (41 opt.)
Internal measurement	1 triax acceleration 1 ambient pressure 2 ECU temperature 2 ECU voltage
Thermocouple	2 K-type
Lambda	2 LSU 4.9
Knock	4
Digital inputs	9
Digital switch Engine ON/OFF	1
Power supplies	4 sensor supplies 5 V, 50 mA 3 sensor supplies 5 V, 150 mA 7 sensor grounds 2 sensor screens

#### Mechanical Data

Aluminum housing	
2 Bosch connectors, 196 pins in total	
Size	226 x 181 x 44 mm
Weight	1,086 g
Protection Classification	IP54
Temp. range (at internal sensors)	-20 to 80°C

#### Electrical Data

Power supply	6 to 18 V
CPU	Dual Core 667 MHz, FPGA

#### Outputs

Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
Ignition	Max. 12 cylinders, coils with integrated amplifier

Further outputs	2 x 4 amp pwm lowside switch 2 x 4 amp pwm lowside switch for Lambda heater 4 x 3 amp pwm lowside switch 8 x 2.2 amp pwm lowside switch 2 x 1 amp pwm lowside switch 2 x 1 amp pwm lowside switch low dump resistant 3 x 8,5 amp H-bridge (2 reserved for electronic throttle) 12 x low pressure injection for high impedance injectors 12 x ignition control
Outputs signals	1 x flywheel 1 x trigger wheel 1 x engine rpm
Application	Configurable flywheel- and trigger disc geometries Selectable links between functions and in- or outputs
Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab V7

System Configuration tool RaceCon 2.7.0.9 or later

### Mating Connectors (not included)

Mating Connector 91 pins F02U.B00.711-01

Mating Connector 105 pins F02U.B00.712-01

### Software Options (not included)

Engine Function Package I Electronic throttle control, VVT, Turbo control

Engine Function Package II Traction and launch control

Measurement Package Increase to 41 analog inputs

Logger Package I Extension for Partition 1: up to 720 channels, fastest sampling 1,000 Hz or 1 syncro, (max number of 1,080 channels to respect)

Logger Package II Partition 2: 720 channels, 1 GB memory, fastest sampling 1,000 Hz or 1 syncro, long-term recording, own data protection code (max number of 1,080 channels to respect)

Logger Package III Copy data of partition 1 to USB data stick

Gear Control Package I Gear control Mega-Line functionality, has to be used with Mega-Line components

(License model via Mega-Line) [included for base versions beginning with MS6A\_BASE\_0800 or comparable]

Gear Control Package II	Gear control Bosch Motorsport functionality
Gear Control Package III	Gear control coordination to external GCU systems [included for base versions beginning with MS6A_BASE_0600 or comparable]
Innovation License Device	Activation of engine speed functions* and near/far injection function per unit
Innovation Package Project	Activation of engine speed functions* and near/far injection function per project version

\*Engine speed functions: second or backup engine speed sensor, quick engine start, detection of engine reverse rotation

### Communication

2 Ethernet

3 CAN

1 LIN

1 USB

1 RS232

1 Time sync synchronization Ethernet

3 Network screens

### Installation Notes

Inspection services recommended after 220 h or 24 months, no components to replace.

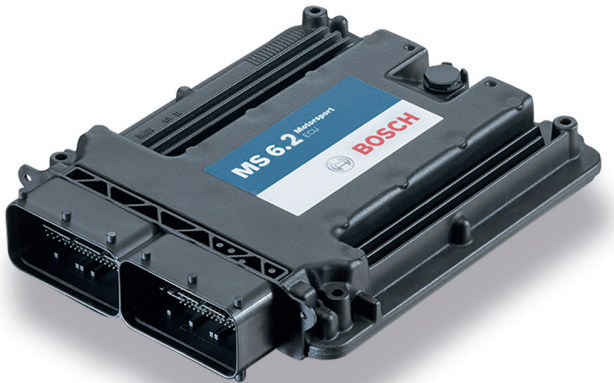
Depending on your experiences with calibration of ECUs we recommend calibration support from Bosch Motorsport.

Please remember that the mating connectors and the programming interface MSA-Box II are not included and must be ordered separately.

**Ordering Information****Engine Control Unit MS 6.1**Order number **F02U.V01.961-04****Software Options****Engine Function Package I**Order number **F02U.V02.001-01****Engine Function Package II**Order number **F02U.V02.002-01****Measurement Package**Order number **F02U.V02.000-01****Logger Package I**Order number **F02U.V01.993-01****Logger Package II**Order number **F02U.V01.998-01****Logger Package III**Order number **F02U.V02.082-01****Gear Control Package I**Order number **F02U.V02.107-01 (on request)****Gear Control Package II**Order number **F02U.V02.108-01****Gear Control Package III**Order number **F02U.V02.109-01 (on request)****Innovation License Device**Order number **F02U.V02.510-01****Innovation Package Project**Order number **F02U.V02.511-01****Accessories****Breakout Box BOB MS 6**Order number **F02U.V02.294-01****Mating Connector 91 pins**Order number **F02U.B00.711-01****Mating Connector 105 pins**Order number **F02U.B00.712-01****System Configuration Tool RaceCon**Order number **free download from our website****Data Analysis Tool WinDarab V7**Order number **free download from our website**



## Engine Control Unit MS 6.2



### Features

- ▶ Optimized for low pressure injection
- ▶ Full number of low pressure control functions
- ▶ Full number of engine functions
- ▶ Measurement with 41 analog inputs
- ▶ Multiple Software options available

The MS 6.2 engine control unit manages gasoline engines up to 12 cylinders. As a member of our MS 6 family it features a powerful digital processing core with floating point arithmetic and a high-end FPGA for ultimate performance and flexibility. The MS 6 family utilizes a new software development process based on MATLAB/Simulink which significantly speeds algorithm development by using automatic code and documentation generation. Custom functions can be quickly and easily generated. The flexible hardware design allows the MS 6.2 to support complex or unusual engine or chassis configurations.

### Application

Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
------------------------	---

#### Physical engine model for fast application

- determine engine load by throttle position or air pressure signals
- mixture control and basic ignition guided by main signal relative load rI
- Subsystems pit speed-, launch-, rpm-limiter and ASR are integrated inside torque control
- Separated power cut functions to assist several gear cut systems
- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift

Electronic throttle control

VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

Internal logger

Partition 1, 1 GB memory, diagnostic channels, 50 free configurable channels, fastest sampling 50 Hz, digital filter respecting sampling theorem

Logger options

See Software Options (not included)

### Technical Specifications

#### Mechanical Data

Aluminum housing

2 Bosch connectors, 196 pins in total

Size 226 x 181 x 44 mm

Weight 1,086 g

Protection Classification IP54

Temp. range (at internal sensors) -20 to 80°C

#### Electrical Data

Power supply 6 to 18 V

CPU Dual Core 667 MHz, FPGA

#### Inputs

Analog inputs 41

Internal measurement

- 1 triax acceleration
- 1 ambient pressure
- 2 ECU temperature
- 2 ECU voltage

Thermocouple 2 K-type

Lambda 2 LSU 4.9

Knock 4

Digital inputs 9

Digital switch Engine ON/OFF 1

Power supplies

- 4 sensor supplies 5 V, 50 mA
- 3 sensor supplies 5 V, 150 mA
- 7 sensor grounds
- 2 sensor screens

#### Outputs

Low pressure injection

Max. 12 cylinders up to 12,500 rpm, high impedance injectors only

Ignition

Max. 12 cylinders, coils with integrated amplifier

Further outputs	2 x 4 amp pwm lowside switch 2 x 4 amp pwm lowside switch for Lambda heater 4 x 3 amp pwm lowside switch 8 x 2.2 amp pwm lowside switch 2 x 1 amp pwm lowside switch 2 x 1 amp pwm lowside switch low dump resistant 3 x 8,5 amp H-bridge (2 reserved for electronic throttle) 12 x low pressure injection for high impedance injectors 12 x ignition control
Outputs signals	1 x flywheel 1 x trigger wheel 1 x engine rpm
Application	Configurable flywheel- and trigger disc geometries Selectable links between functions and in- or outputs
Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab V7
System Configuration tool RaceCon 2.7.0.9 or later

### Mating Connectors (not included)

Mating Connector 91 pins	F02U.B00.711-01
Mating Connector 105 pins	F02U.B00.712-01

### Software Options (not included)

Customer Code Area	Enable Customer Code Area
Logger Package I	Extension for Partition 1: up to 720 channels, fastest sampling 1,000 Hz or 1 syncro, (max number of 1,080 channels to respect)
Logger Package II	Partition 2: 720 channels, 1 GB memory, fastest sampling 1,000 Hz or 1 syncro, long-term recording, own data protection code (max number of 1,080 channels to respect)
Logger Package III	Copy data of partition 1 to USB data stick
Gear Control Package I	Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Mega-Line) [included for base versions be-

	ginning with MS6A_BASE_0800 or comparable]
Gear Control Package II	Gear control Bosch Motorsport functionality
Gear Control Package III	Gear control coordination to external GCU systems [included for base versions beginning with MS6A_BASE_0600 or comparable]
Innovation License Device	Activation of engine speed functions* and near/far injection function per unit
Innovation Package Project	Activation of engine speed functions* and near/far injection function per project version

\*Engine speed functions: second or backup engine speed sensor, quick engine start, detection of engine reverse rotation

### Communication

2 Ethernet
3 CAN
1 LIN
1 USB
1 RS232
1 Time sync synchronization Ethernet
3 Network screens

### Installation Notes

Inspection services recommended after 220 h or 24 months, no components to replace.

Depending on your experiences with calibration of ECUs we recommend calibration support from Bosch Motorsport.

Please remember that the mating connectors and the programming interface MSA-Box II are not included and must be ordered separately.

**Ordering Information****Engine Control Unit MS 6.2**Order number **F02U.V01.867-07****Software Options****Logger Package I**Order number **F02U.V01.993-01****Logger Package II**Order number **F02U.V01.998-01****Logger Package III**Order number **F02U.V02.082-01****Gear Control Package I**Order number **F02U.V02.107-01 (on request)****Gear Control Package II**Order number **F02U.V02.108-01****Gear Control Package III**Order number **F02U.V02.109-01 (on request)****Customer Code Area**Order number **F02U.V02.137-01****Innovation License Device**Order number **F02U.V02.510-01****Innovation Package Project**Order number **F02U.V02.511-01****Accessories****Breakout Box BOB MS 6**Order number **F02U.V02.294-01****Mating Connector 91 pins**Order number **F02U.B00.711-01****Mating Connector 105 pins**Order number **F02U.B00.712-01****System Configuration Tool RaceCon**Order number **free download from our website****Data Analysis Tool WinDarab V7**Order number **free download from our website**

## Engine Control Unit MS 6.3



### Features

- ▶ Optimized for low and high pressure injection
- ▶ HP package for flat and V-engines optional
- ▶ Measurement with 21 analog inputs
- ▶ Multiple Software options available

The MS 6.3 engine control unit manages gasoline engines up to 12 cylinders. As a member of our MS 6 family it features a powerful digital processing core with floating point arithmetic and a high-end FPGA for ultimate performance and flexibility. The MS 6 family utilizes a new software development process based on MATLAB/Simulink which significantly speeds algorithm development by using automatic code and documentation generation. Custom functions can be quickly and easily generated. The flexible hardware design allows the MS 6.3 to support complex or unusual engine or chassis configurations.

### Application

High pressure injection	Integrated power stages for the use of: 4 cylinders up to 12,500 rpm 6 cylinders up to 9,500 rpm 8 cylinders up to 8,500 rpm (depending injection types and pressure ranges)
HP package for flat and V-engines optional (2nd Bank, MSV2, cylinder 7&8, external cylinder 9-12)	
Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
Physical engine model for fast application	<ul style="list-style-type: none"> <li>• determine engine load by throttle position or air pressure signals</li> </ul>

- mixture control and basic ignition guided by main signal relative load rI
- Subsystems pit speed-, launch-, rpm-limiter and ASR are integrated inside torque control
- Separated power cut functions to assist several gear cut systems
- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift

Electronic throttle control

VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

Internal logger	Partition 1, 1 GB memory, diagnostic channels, 50 free configurable channels, fastest sampling 50 Hz, digital filter respecting sampling theorem
Logger options	See Software Options (not included)

### Technical Specifications

#### Mechanical Data

Aluminum housing	
2 Bosch connectors, 196 pins in total	
Size	226 x 181 x 44 mm
Weight	1,086 g
Protection Classification	IP54
Temp. range (at internal sensors)	-20 to 80°C

#### Electrical Data

Power supply	6 to 18 V
CPU	Dual Core 667 MHz, FPGA

#### Inputs

Analog inputs	21 (41 opt.)
Internal measurement	1 triax acceleration 1 ambient pressure 2 ECU temperature 2 ECU voltage
Thermocouple	2 K-type
Lambda	2 LSU 4.9
Knock	4
Digital inputs	9
Digital switch Engine ON/OFF	1

Power supplies	4 sensor supplies 5 V, 50 mA 3 sensor supplies 5 V, 150 mA 7 sensor grounds 2 sensor screens
<b>Outputs</b>	
Outputs	2 x high pressure pump with MSV control 8 x high pressure injection for magnetic injectors
High pressure injection	Integrated power stages for the use of: 4 cylinders up to 12,500 rpm 6 cylinders up to 9,500 rpm 8 cylinders up to 8,500 rpm (depending injection types and pressure ranges)
Booster extension (HPI5)	Application notes avl. for Bosch HDP5- and Hitachi Gen3 pumps. Hitachi Gen1 notes on request. Additional booster connectable to support 9 to 12 cylinders or to realize higher rpm
Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
Ignition	Max. 12 cylinders, coils with integrated amplifier
Further outputs	2 x 4 amp pwm lowside switch 2 x 4 amp pwm lowside switch for Lambda heater 4 x 3 amp pwm lowside switch 8 x 2.2 amp pwm lowside switch 2 x 1 amp pwm lowside switch 2 x 1 amp pwm lowside switch low dump resistant 3 x 8,5 amp H-bridge (2 reserved for electronic throttle) 12 x low pressure injection for high impedance injectors 12 x ignition control
Outputs signals	1 x flywheel 1 x trigger wheel 1 x engine rpm
Application	Configurable flywheel- and trigger disc geometries Selectable links between functions and in- or outputs
Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development

**Software Tools (free download)**

Data Analysis tool WinDarab V7
System Configuration tool RaceCon 2.7.0.9 or later

**Mating Connectors (not included)**

Mating Connector 91 pins	F02U.B00.711-01
Mating Connector 105 pins	F02U.B00.712-01

**Software Options (not included)**

High Pressure Injection Package	For flat- and V-engines (2nd Bank, MSV2, cylinder 7&8, external cylinder 9-12)
Measurement Package	Increase to 41 analog inputs
Customer Code Area	Enable Customer Code Area
Logger Package I	Extension for Partition 1: up to 720 channels, fastest sampling 1,000 Hz or 1 syncro, (max number of 1,080 channels to respect)
Logger Package II	Partition 2: 720 channels, 1 GB memory, fastest sampling 1,000 Hz or 1 syncro, long-term recording, own data protection code (max number of 1,080 channels to respect)
Logger Package III	Copy data of partition 1 to USB data stick
Gear Control Package I	Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Mega-Line) [included for base versions beginning with MS6A_BASE_0800 or comparable]
Gear Control Package II	Gear control Bosch Motorsport functionality
Gear Control Package III	Gear control coordination to external GCU systems [included for base versions beginning with MS6A_BASE_0600 or comparable]
Innovation License Device	Activation of engine speed functions* and near/far injection function per unit
Innovation Package Project	Activation of engine speed functions* and near/far injection function per project version

\*Engine speed functions: second or backup engine speed sensor, quick engine start, detection of engine reverse rotation



## Communication

2 Ethernet
3 CAN
1 LIN
1 USB
1 RS232
1 Time sync synchronization Ethernet
3 Network screens

## Installation Notes

Inspection services recommended after 220 h or 24 months, no components to replace.

Depending on your experiences with calibration of ECUs we recommend calibration support from Bosch Motorsport.

Please remember that the mating connectors and the programming interface MSA-Box II are not included and must be ordered separately.

## Ordering Information

**Engine Control Unit MS 6.3**  
Order number **F02U.V01.963-04**

### Software Options

**High Pressure Injection Package**  
Order number **F02U.V01.999-01**

**Measurement Package**  
Order number **F02U.V02.000-01**

**Logger Package I**  
Order number **F02U.V01.993-01**

**Logger Package II**  
Order number **F02U.V01.998-01**

**Logger Package III**  
Order number **F02U.V02.082-01**

**Gear Control Package I**  
Order number **F02U.V02.107-01 (on request)**

**Gear Control Package II**  
Order number **F02U.V02.108-01**

**Gear Control Package III**  
Order number **F02U.V02.109-01 (on request)**

**Customer Code Area**  
Order number **F02U.V02.137-01**

**Innovation License Device**  
Order number **F02U.V02.510-01**

**Innovation Package Project**  
Order number **F02U.V02.511-01**

### Accessories

**Breakout Box BOB MS 6**  
Order number **F02U.V02.294-01**

**Mating Connector 91 pins**  
Order number **F02U.B00.711-01**

**Mating Connector 105 pins**  
Order number **F02U.B00.712-01**

**System Configuration Tool RaceCon**  
Order number **free download from our website**

**Data Analysis Tool WinDarab V7**  
Order number **free download from our website**

## Engine Control Unit MS 6.4



### Features

- ▶ Optimized for low and high pressure injection
- ▶ HP package for flat and V-engines inclusive
- ▶ Measurement with 41 analog inputs
- ▶ Multiple Software options available

The MS 6.4 engine control unit manages gasoline engines up to 12 cylinders. As a member of our MS 6 family it features a powerful digital processing core with floating point arithmetic and a high-end FPGA for ultimate performance and flexibility. The MS 6 family utilizes a new software development process based on MATLAB/Simulink which significantly speeds algorithm development by using automatic code and documentation generation. Custom functions can be quickly and easily generated. The flexible hardware design allows the MS 6.4 to support complex or unusual engine or chassis configurations.

### Application

High pressure injection	Integrated power stages for the use of: 4 cylinders up to 12,500 rpm 6 cylinders up to 9,500 rpm 8 cylinders up to 8,500 rpm (depending injection types and pressure ranges)
HP package for flat and V-engines inclusive (2nd Bank, MSV2, cylinder 7&8, external cylinder 9-12)	
Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
Physical engine model for fast application	<ul style="list-style-type: none"> <li>• determine engine load by throttle position or air pressure signals</li> </ul>

- mixture control and basic ignition guided by main signal relative load rl
- Subsystems pit speed-, launch-, rpm-limiter and ASR are integrated inside torque control
- Separated power cut functions to assist several gear cut systems
- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift

Electronic throttle control

VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

Internal logger	Partition 1, 1 GB memory, diagnostic channels, 50 free configurable channels, fastest sampling 50 Hz, digital filter respecting sampling theorem
Logger options	See Software Options (not included)

### Technical Specifications

#### Mechanical Data

Aluminum housing	
2 Bosch connectors, 196 pins in total	
Size	226 x 181 x 44 mm
Weight	1,086 g
Protection Classification	IP54
Temp. range (at internal sensors)	-20 to 80°C

#### Electrical Data

Power supply	6 to 18 V
CPU	Dual Core 667 MHz, FPGA

#### Inputs

Analog inputs	41
Internal measurement	1 triax acceleration 1 ambient pressure 2 ECU temperature 2 ECU voltage
Thermocouple	2 K-type
Lambda	2 LSU 4.9
Knock	4
Digital inputs	9
Digital switch Engine ON/OFF	1

Power supplies	4 sensor supplies 5 V, 50 mA 3 sensor supplies 5 V, 150 mA 7 sensor grounds 2 sensor screens
<b>Outputs</b>	
Outputs	2 x high pressure pump with MSV control 8 x high pressure injection for magnetic injectors
High pressure injection	Integrated power stages for the use of: 4 cylinders up to 12,500 rpm 6 cylinders up to 9,500 rpm 8 cylinders up to 8,500 rpm (depending injection types and pressure ranges)
Booster extension (HPI5)	Application notes avl. for Bosch HDP5- and Hitachi Gen3 pumps. Hitachi Gen1 notes on request. Additional booster connectable to support 9 to 12 cylinders or to realize higher rpm
Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
Ignition	Max. 12 cylinders, coils with integrated amplifier
Further outputs	2 x 4 amp pwm lowside switch 2 x 4 amp pwm lowside switch for Lambda heater 4 x 3 amp pwm lowside switch 8 x 2.2 amp pwm lowside switch 2 x 1 amp pwm lowside switch 2 x 1 amp pwm lowside switch low dump resistant 3 x 8,5 amp H-bridge (2 reserved for electronic throttle) 12 x low pressure injection for high impedance injectors 12 x ignition control
Outputs signals	1 x flywheel 1 x trigger wheel 1 x engine rpm
Application	Configurable flywheel- and trigger disc geometries Selectable links between functions and in- or outputs
Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development

**Software Tools (free download)**

Data Analysis tool WinDarab V7

System Configuration tool RaceCon 2.7.0.9 or later

**Mating Connectors (not included)**

Mating Connector 91 pins F02U.B00.711-01

Mating Connector 105 pins F02U.B00.712-01

**Software Options (not included)**

Customer Code Area Enable Customer Code Area

Logger Package I Extension for Partition 1: up to 720 channels, fastest sampling 1,000 Hz or 1 syncro, (max number of 1,080 channels to respect)

Logger Package II Partition 2: 720 channels, 1 GB memory, fastest sampling 1,000 Hz or 1 syncro, long-term recording, own data protection code (max number of 1,080 channels to respect)

Logger Package III Copy data of partition 1 to USB data stick

Gear Control Package I Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Mega-Line) [included for base versions beginning with MS6A\_BASE\_0800 or comparable]

Gear Control Package II Gear control Bosch Motorsport functionality

Gear Control Package III Gear control coordination to external GCU systems [included for base versions beginning with MS6A\_BASE\_0600 or comparable]

Innovation License Device Activation of engine speed functions\* and near/far injection function per unit

Innovation Package Project Activation of engine speed functions\* and near/far injection function per project version

\*Engine speed functions: second or backup engine speed sensor, quick engine start, detection of engine reverse rotation

**Communication**

2 Ethernet

3 CAN

1 LIN

1 USB

- 1 RS232
- 1 Time sync synchronization Ethernet
- 3 Network screens

### Installation Notes

Inspection services recommended after 220 h or 24 months, no components to replace.

Depending on your experiences with calibration of ECUs we recommend calibration support from Bosch Motorsport.

Please remember that the mating connectors and the programming interface MSA-Box II are not included and must be ordered separately.

### Ordering Information

#### Engine Control Unit MS 6.4

Order number **F02U.V02.019-07**

#### Engine Control Unit MS 6 RX

FIA-homologated version for WRX Championship

Order number **F02U.V02.570**

#### Conversion MS 6.4 to MS 6 RX

Order number **F02U.V02.571**

### Software Options

#### Customer Code Area

Order number **F02U.V02.137-01**

#### Logger Package I

Order number **F02U.V01.993-01**

#### Logger Package II

Order number **F02U.V01.998-01**

#### Logger Package III

Order number **F02U.V02.082-01**

#### Gear Control Package I

Order number **F02U.V02.107-01 (on request)**

#### Gear Control Package II

Order number **F02U.V02.108-01**

#### Gear Control Package III

Order number **F02U.V02.109-01 (on request)**

#### Innovation License Device

Order number **F02U.V02.510-01**

#### Innovation Package Project

Order number **F02U.V02.511-01**

### Accessories

#### Breakout Box BOB MS 6

Order number **F02U.V02.294-01**

#### Mating Connector 91 pins

Order number **F02U.B00.711-01**

#### Mating Connector 105 pins

Order number **F02U.B00.712-01**

#### System Configuration Tool RaceCon

Order number **free download from our website**

#### Data Analysis Tool WinDarab V7

Order number **free download from our website**

## Engine Control Unit MS 7.4



### Features

- ▶ Optimized for low and high pressure injection
- ▶ Data logger included
- ▶ Gearbox control optionally included
- ▶ Gigabit data interface

The MS 7.4 engine control unit manages gasoline engines up to 12 cylinders. The MS 7 line features a powerful digital processing core with floating point arithmetic and a high-end FPGA for ultimate performance and flexibility. The MS 7 line utilizes a software development process based on MATLAB/Simulink which significantly speeds up algorithm development by using automatic code and documentation generation. Custom functions can be generated quickly and easily. The flexible hardware design allows the MS 7.4 to support complex or unusual engine or chassis configurations.

### Application

High pressure injection	Integrated power stages for triple injection and use of: 4 cylinders up to 14,600 rpm 6 cylinders up to 9,700 rpm 8 cylinders up to 7,300 rpm (depending injection types and pressure ranges)
HP package for flat and V-engines inclusive (2nd Bank, MSV2, external cylinder 9-12)	
Low pressure injection	Max. 12 cylinders up to 16,000 rpm, high impedance injectors only

Ignition	8 integrated power stages up to 20 A, alternatively up to 12 drivers for use with external power stages
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Physical engine model for fast application

- determine engine load by throttle position or air pressure signals
- mixture control and basic ignition guided by main signal relative load rl
- Subsystems pit speed-, launch-, rpm-limiter and ASR are integrated inside torque control
- Separated power cut functions to assist several gear cut systems
- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift

Electronic throttle control

VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

Internal logger	2 partitions with 4 GB memory each, diagnostic channels, fastest sampling 1 kHz, digital filter respecting sampling theorem, use of 4 GB USB data stick
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### Technical Specifications

#### Mechanical Data

Milled aluminum housing	
4 motorsport connectors, 264 pins in total	
Size without connectors	198 x 180 x 42 mm
Weight	1,610 g
Protection Classification	IP67
Temp. range (at internal sensors)	-20 to 85°C
Max. Vibration	Vibration Profile 1 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Power supply	6 to 18 V
CPU	Dual Core 1,000 MHz, FPGA

#### Inputs

Analog inputs	41
Combustion chamber pressure input	8
Selectable dig/ana inputs	8

Thermocouple	2 K-type
Lambda	2 LSU 4.9
Knock	4
Digital inputs	10
Digital switch Engine ON/OFF	1
Laptrigger input	1
Internal measurement	1 triax acceleration 1 ambient pressure 3 ECU temperature 10 ECU voltage (e.g. sensor supply) 6 ECU current (e.g. sensor supply)
Power supplies	4 sensor supplies 5 V, 50 mA 3 sensor supplies 5 V, 400 mA 1 sensor supply ubat, 250 mA 9 sensor grounds 2 sensor screens

### Outputs

Low pressure injection	Max. 12 cylinders up to 16,000 rpm, high impedance injectors only. Outputs can be used alternatively as low side switches 2.2 A without freewheeling
High pressure injection	Integrated power stages for triple injection and use of: 4 cylinders up to 14,600 rpm 6 cylinders up to 9,700 rpm 8 cylinders up to 7,300 rpm (for supply voltages >10 V, depending injection types and pressure ranges)
Booster extension (HPI5)	Application notes avl. for Bosch HDP5- and Hitachi Gen3 pumps. Hitachi Gen1 notes on request. Additional booster connectable to support 9 to 12 cylinders or to realize higher rpm.
Ignition	Max. 12 cylinders and coils with integrated power stage, or max. 8 cylinders and coils without integrated power stage, 20 A
Further outputs	2 x 4 amp pwm lowside switch 2 x 3 amp pwm lowside switch for Lambda heater 6 x 3 amp pwm lowside switch 4 x 2.2 amp pwm lowside switch 2 x 1 amp pwm lowside switch low dump resistant 3 x 8.5 amp H-bridge (2 reserved for electronic throttle)

	2 x high pressure pump with MSV control 4 x 12 mA for control of Moog valves
Outputs signals	5 x MUX outputs for internal signals like flywheel, knock signals, cylinder pressure

### Adaptation and Documentation

Configuration	Configurable flywheel- and trigger disc geometries Selectable links between functions and in- or outputs
Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab V7	
System Configuration tool RaceCon 2.7.0.9 or later	

### Environment (not included)

Programming interface cable	F02U.V02.327-01
Adapter cable to USB-port	F02U.V01.343-01
Rugged USB flash drive	F02U.V01.342-02
Connector for wiring harness	F02U.002.996-01

### Mating Connectors (not included)

LIFE (red)	AS618-35SN
Actuator (blue)	AS618-35SB
Combined (orange)	AS618-35SC
Sensor (yellow)	AS618-35SA

### Software Options (not included)

Gear Control Package I	Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Mega-Line) [included for base versions beginning with MS7A_BASE_0500 or comparable]
Gear Control Package II	Gear control Bosch Motorsport functionality
Gear Control Package III	Gear control coordination to external GCU systems [included for base versions beginning with MS7A_BASE_0400 or comparable]
Customer Code Area	Enable Customer Code Area
Cylinder pressure determination	On request

Knock detection and control based on cylinder pressure	On request
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### Communication

1 Ethernet 1 Gbit
2 Ethernet 100 Mbit
2 Realtime Ethernet
3 CAN
1 LIN
1 USB
1 RS232
1 Time sync synchronization Ethernet
2 Network screens

### Installation Notes

Inspection services recommended after 220 h or 24 months, internal battery to be replaced during service.

Depending on your experiences with calibration of ECUs we recommend calibration support from Bosch Motorsport.

Please remember that the mating connectors and the programming interface cable are not included and must be ordered separately.

### Ordering Information

**Engine Control Unit MS 7.4**  
Order number **F02U.V02.514-02**

#### Software Options

**Gear Control Package I**  
Order number **F02U.V02.263-01 (on request)**

**Gear Control Package II**  
Order number **F02U.V02.264-01**

**Gear Control Package III**  
Order number **F02U.V02.265-01 (on request)**

**Customer Code Area**  
Order number **F02U.V02.137-01**

**Cylinder pressure detection base package MS 7.x**  
Order number **F02U.V02.543-01**

**Knock detection via cylinder pressure evaluation MS 7.x**  
Order number **F02U.V02.544-01**

#### Accessories

**Breakout Box BOB 66-pole, Connector code blue**  
Order number **F02U.V02.295-01**

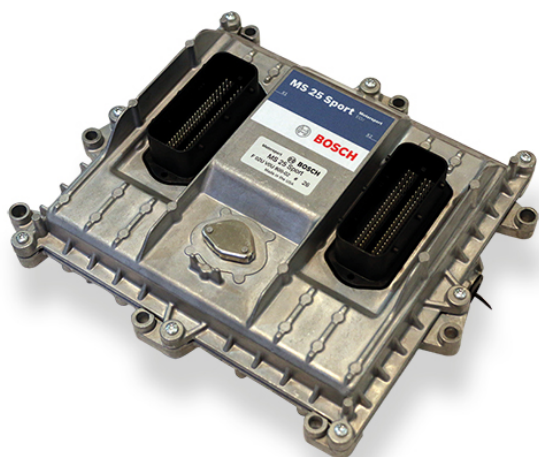
**Breakout Box BOB 66-pole, Connector code orange**  
Order number **F02U.V02.296-01**

**Breakout Box BOB 66-pole, Connector code yellow**  
Order number **F02U.V02.298-01**

**Breakout Box BOB MS 7, LIFE-Connector code red**  
Order number **F02U.V02.293-01**



## Engine Control Unit MS 25 Sport



### Features

- ▶ 8 injection output stages
- ▶ For solenoid injectors
- ▶ 96 data inputs
- ▶ Software options available

The MS 25 Sport is an ECU for Diesel engines with up to 8 cylinders. It is developed for use with Bosch solenoid injectors. The MS 25 Sport utilizes a software development process based on MATLAB® & Simulink®.

The MS 25 Sport is able to operate in 12 V or 24 V systems. The base SW is able to control one hydraulic bank configuration with Fuel Metering Unit (FMU) and Pressure Control Valve (PCV).

### Application

Engine layout	3, 4, 5, 6, 8, <3 on request
Injector type	Solenoid valve injectors
Control strategy	Quantity based
Hydraulic system	Fuel metering unit + Pressure control valve (2 bank optional)
Injection timing	2 pilot injections 1 main injection 2 post injections
Turbo boost control	Single or Bi-Turbo
Lambda measurement	Optional controls on request
Two bank hydraulic control	Optional
Traction control	Optional
Gear cut for sequential gearbox	Optional
Speed limiter	

Optional function packages available	
Calibration interface	CCP via CAN
Interface to Bosch Data Logging System	3 CAN interfaces
Max. vibration	Vibration Profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

### Technical Specifications

#### Mechanical Data

Aluminum product housing	Base plate with fluid cooling incl. pressure compensation element (PCE)
2 production type connectors with 192 pins	Separate coding each (192 x 1.2 mm pins)
Vibration damped circuit boards	Engine mountable with additional dampers
8 housing fixation points	
Size	260 x 250 x 81 mm
Protection classification	IP x 6k and IP x 9K
Weight	1,800 g
Temperature range	-40 to 85°C

#### Electrical Data

Power supply	12 or 24 V
1 internal atmospheric pressure sensor	
1 internal ECU temperature sensor for max. temperature	

#### Inputs

1 lambda interface LSU	LSU 4.9
7 general frequency inputs	4 wheel speed and one vehicle speed hall effect sensor inputs and 2 inductive turbo speed
1 input for inductive crankshaft sensor	Hall optional
1 input for Hall-effect camshaft sensor	Inductive optional

29 analog inputs

14 digital inputs

#### Outputs

8 injection power stages	3 banks for 8 cylinders
2 Fuel Metering Unit (High Pressure Pump)	2 bank system optional
2 Pressure Control Valve (Rail)	2 bank system optional
12 power stages (low side)	
1 power stage for lambda heater	
2 H-bridges	
3 sensor supply 5 V	

**Software**

RaceCon Calibration Software	free download
WinDarab Analysis Software	free download

**Optional Functionality**

Traction control SW upgrade
2 bank hydraulic control SW upgrade

**Environment (not included)**

Programming interface MS-ABox II	F02U.V00.327-03
Data logger C 70	F02U.V02.302-01
Display DDU 9	F02U.V02.300-02

**Mating connectors (not included)**

Mating connector I CONNECTOR KIT; MS 25 SPORT - X1 (Vehicle)	F02U.V0U.147-01
Mating connector II	F02U.V0U.148-01

CONNECTOR KIT; MS 25  
SPORT - X2 (Engine)

**Communication**

3 CAN interfaces (dash, application, customer use)	J1939 optional
1 LIN	Optional
1 SENT	Optional

**Installation Notes**

Depending on your experiences with calibration of Diesel ECUs we recommend calibration support from Bosch Motorsport.

Please remember that mating connectors and the programming interface MSA-Box II are not included and must be ordered separately.

**Ordering Information**

**Engine Control Unit MS 25 Sport**  
Order number **F02U.V0U.800-02**

## Overview

### Vehicle Control Unit VCU MS 50.4



- 667 MHz Dual Core Processor exclusively for vehicle control functionality (MAT-LAB based)
- Identical, dedicated 667 MHz Dual Core Processor exclusively for logging purposes
- High Speed Logging 200 kHz of 6 analogue inputs (optional)
- Real time Ethernet SERCOS 3
- Event logging, Configurable pre-event logging

### Vehicle Control Unit VCU MS 50.4P



- 866 MHz Dual Core Processor exclusively for vehicle control functionality (MAT-LAB based)
- Identical, dedicated 866 MHz Dual Core Processor exclusively for logging purposes
- High Speed Logging 200 kHz of 6 analogue inputs (optional)
- Real time Ethernet SERCOS 3
- Event logging, Configurable pre-event logging

## Vehicle Control Unit VCU MS 50.4



### Features

- ▶ 667 MHz Dual Core Processor exclusively for vehicle control functionality (MATLAB based)
- ▶ Identical, dedicated 667 MHz Dual Core Processor exclusively for logging purposes
- ▶ High Speed Logging 200 kHz of 6 analogue inputs (optional)
- ▶ Real time Ethernet SERCOS 3
- ▶ Event logging, Configurable pre-event logging

**The VCU MS 50.4 is a highly powerful processing / logging unit** for race applications. Based on our broad base of platform function, **we support you with customized VCU functions for a tailor-made solution.**

In addition, **you can quickly develop your individual customer software based on MATLAB/Simulink** to significantly speed up algorithm development (automatic code and documentation generation, requires CCA package) – including extensive simulation capabilities.

The device offers real time Ethernet functionality to exchange e.g. data used in control algorithms between devices (guaranteed latency time 1 ms).

### Application

Processor for customer code	667 MHz Dual Core
Processor for logger	667 MHz Dual Core
Configurable math channels	
User configurable CAN in/out messages	
Sampling rate logger	1 ms

Optional: Sampling rate high speed logger	5 $\mu$ s
Online data compression	
Logging rate	Max. 600 kB/s
Internal storage capacity	6 GB
LTE Ethernet telemetry support	
RS232 interface for GPS	

### Technical Specifications

#### Mechanical Data

Size	166 x 121 x 41 mm
Weight	$\leq$ 660 g
Protection classification	IP67
Operating temperature internal	-20 to 80°C
3 motorsport connectors, 198 pins in total	
Max. vibration	Vibration profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage	5 to 18 V
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#### Inputs

20 Analog channels 0 to 5 V, 0.5 % precision between 0.2 and 4.8 V, switchable pull-up

8 Digital PWM inputs  $f_{max}=30$  kHz Hall-type speed measurement possible, Switchable pullup 2.15 kOhm, (required for Hall), Tooth count differential\*

4 Digital PWM inputs  $f_{max}=30$  kHz Hall- and DF11 type speed measurement possible, Fixed pullup 2.15 kOhm (required for Hall), Tooth count differential\*

4 universal Thermocouple

1 Bosch Laptrigger

1 TimeSync master and slave (specific to Bosch measurement system)

Internal measurements:

- 1 ambient pressure
- 1 ECU temperature
- 20 supply voltage
- 20 supply current
- 1 battery voltage (external VCU supply)
- 1 external VCU supply current
- 4 HS output current
- 3-axis acceleration plus roll/pitch/yaw rate

#### Outputs

PWM High side	2*; 7.5 A each, PWM, 50 Hz
PWM Low side	4*; 2.2 A each, PWM, 10 kHz

\*can be enhanced by Upgrade I/O Package, see below

#### Power Supplies

12 V, 400 mA each	5*
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Switchable 5 V/12 V, 400 mA each	5*
Max overall current	4 A on all 12 V 2 A on all 5 V
Precision 12 V $\pm$ 1 % on the pin Precision 5 V $\pm$ 0.1 % on the pin	
Sensor ground	20

\*can be enhanced by Upgrade I/O Package, see below

### Adaptation and Documentation

Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab 7	
System Configuration tool RaceCon	Logger configuration, calibration and online measurement

### Upgrade Customer Code Area CCA

Provides the option to run customer developed software code on Bosch ECU

### Upgrade I/O Package

#### Communication

4 CAN

#### Inputs

4 Analog channels  
0 to 5 V,  
0.5 % precision between 0.2 and 4.8 V, switchable pull-up

4 Digital PWM inputs  
 $f_{max}$ =30 kHz  
Hall-type speed measurement possible,  
Fixed pullup 2.15 kOhm (required for Hall),  
Tooth count differential\*\*

4 LVDT, 5 pin configuration,  
excitation frequency 1 to 20 kHz,  
excitation voltage 0 to 5 V (rms)

#### Outputs

4 "TTL" Digital output, 10 kHz, PWM, 250 mA each  
2 PWM High side; 7.5 A each, PWM, 50 Hz  
4 PWM Low side; 2.2 A each, PWM, 10 kHz

#### Power Supplies

5 x12 V, 400 mA each  
5 switchable 5 V/12 V, 400 mA each

\*\* The tooth count differential between any two of the PWM inputs is available two measure e.g. shaft torsion.

### Upgrade High Speed Logging Package

6 ANA 0 to 5 V, 200 kHz logging rate

### Upgrade CCP Master

Enables CCP master functionality to request data from foreign devices via CAN/CCP protocol.

### Upgrade Real Time Ethernet

Enables the VCU to operate as a real time Ethernet master or slave. Guaranteed latency time of 1 ms. Ideal for time critical data transfer as needed in online control algorithms involving data from different devices.

Two interfaces allow for a ring topology (redundancy in case the RTE line experiences damage).

The VCU features a reasonable set of SERCOS3 instructions although not the full SERCOS3 standard is implemented. The ECU side can act as a SERCOS3 master; the logger side can act as a SERCOS3 slave.

### USB Accessories

Rugged USB flash drive
Mating connector for USB flash drive on car loom side
Adapter cable to PC USB-port

### Connectors

Connector LIFE (red) AS018-35PN	Mating connector AS618-35SN (not included)
Connector SENS-A (yellow) AS018-35PA	Mating connector AS618-35SA (not included)
Connector SENS-B (blue) AS018-35PB	Mating connector AS618-35SB (not included)

### Communication

3 Ethernet 100 Mbit
2 Realtime Ethernet SERCOS3
4 CAN*
1 LIN
1 USB
1 RS232 interface for GPS
1 Time sync synchronization Ethernet

\*can be enhanced by Upgrade I/O Package, see below

### Installation Notes

Inspection services recommended after 220 h or 2 years, no components to replace.

Please remember that the mating connectors and the programming interface MSA-Box II are not included and must be ordered separately.

## Ordering Information

### Vehicle Control Unit VCU MS 50.4

Order number **F02U.V02.965-02**

### Vehicle Control Unit VCU MS 50.4 + CCA

Order number **F02U.V03.012-01**

### Vehicle Control Unit VCU MS 50.4 + I/O\_PACK + CCA

Order number **F02U.V03.013-01**

## Software Options

### Customer Code Area CCA

Order number **F02U.V02.137-01**

### I/O Package

Order number **F02U.V02.777-01**

### High Speed Logging Package

Order number **F02U.V02.779-01**

### CCP Master

Order number **F02U.V02.213-01**

### Real Time Ethernet

Order number **F02U.V02.782-01**

## Accessories

### Rugged USB flash drive

Order number **F02U.V01.342-03**

### Mating connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

Order number **F02U.V01.343-01**

### Opening tool for shellsize 18

Order number **F02U.V01.394-01**

### Breakout Box BOB 66-pole

Connector code: blue

Order number **F02U.V02.295-01**

### Breakout Box BOB 66-pole

Connector code: yellow

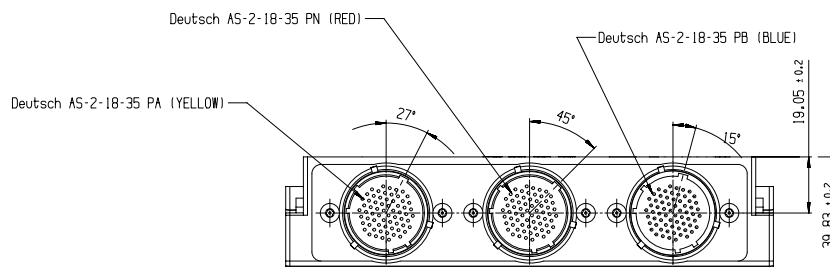
Order number **F02U.V02.298-01**

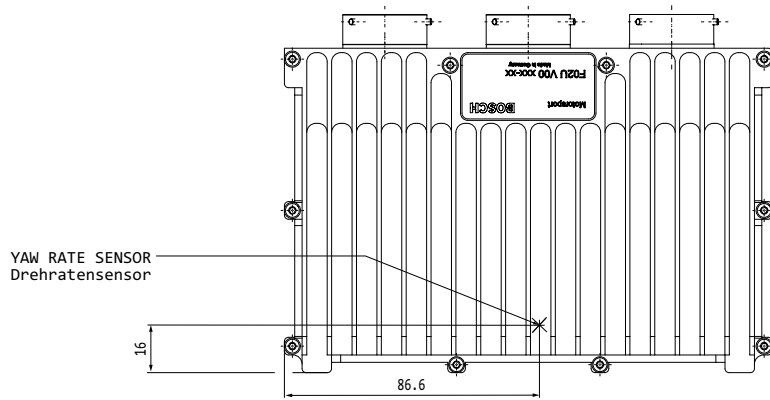
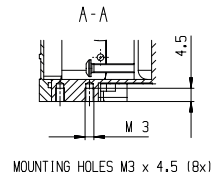
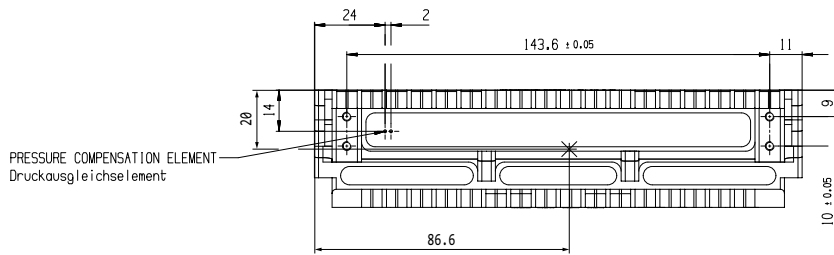
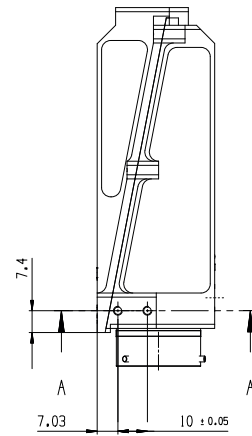
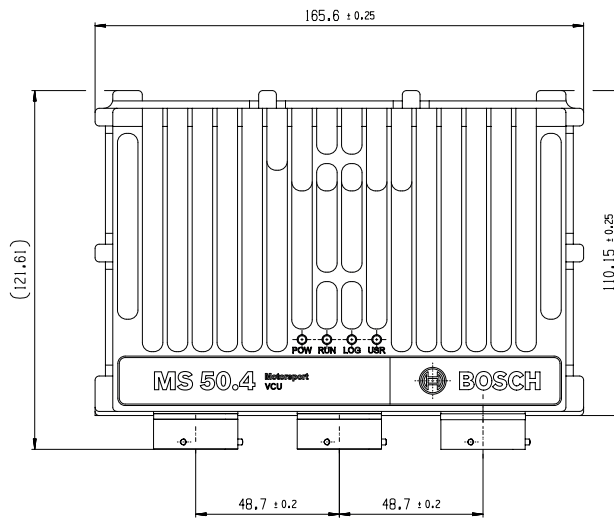
### Breakout Box BOB MS 7

Connector code: red

Order number **F02U.V02.293-01**

## Dimensions







## Vehicle Control Unit VCU MS 50.4P



### Features

- ▶ 866 MHz Dual Core Processor exclusively for vehicle control functionality (MATLAB based)
- ▶ Identical, dedicated 866 MHz Dual Core Processor exclusively for logging purposes
- ▶ High Speed Logging 200 kHz of 6 analogue inputs (optional)
- ▶ Real time Ethernet SERCOS 3
- ▶ Event logging, Configurable pre-event logging

**The VCU MS 50.4P (Performance) is a highly powerful processing / logging unit** for race applications.

Based on our broad base of platform function, **we support you with customized VCU functions for a tailor-made solution.**

In addition, **you can quickly develop your individual customer software based on MATLAB/Simulink** to significantly speed up algorithm development (automatic code and documentation generation, requires CCA package) – including extensive simulation capabilities.

The device offers real time Ethernet functionality to exchange e.g. data used in control algorithms between devices (guaranteed latency time 1 ms).

### Application

Processor for customer code	866 MHz Dual Core
Processor for logger	866 MHz Dual Core
Configurable math channels	
User configurable CAN in/out messages	
Sampling rate logger	1 ms

Optional: Sampling rate high speed logger	5 $\mu$ s
Online data compression	
Logging rate	> 800 kB/s
Internal storage capacity	6 GB
LTE Ethernet telemetry support	
RS232 interface for GPS	

### Technical Specifications

#### Mechanical Data

Size	166 x 121 x 41 mm
Weight	≤ 660 g
Protection classification	IP67
Operating temperature internal	0 to 80°C
3 motorsport connectors, 198 pins in total	
Max. vibration	Vibration profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage	5 to 18 V
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#### Inputs

20 Analog channels 0 to 5 V, 0.5 % precision between 0.2 and 4.8 V, switchable pull-up

8 Digital PWM inputs  $f_{max}=30$  kHz Hall-type speed measurement possible, Switchable pullup 2.15 kOhm, (required for Hall), Tooth count differential\*

4 Digital PWM inputs  $f_{max}=30$  kHz Hall- and DF11 type speed measurement possible, Fixed pullup 2.15 kOhm (required for Hall), Tooth count differential\*

4 universal Thermocouple

1 Bosch Laptrigger

1 TimeSync master and slave (specific to Bosch measurement system)

Internal measurements:

- 1 ambient pressure
- 1 ECU temperature
- 20 supply voltage
- 20 supply current
- 1 battery voltage (external VCU supply)
- 1 external VCU supply current
- 4 HS output current
- 3-axis acceleration plus roll/pitch/yaw rate

#### Outputs

PWM High side	2*; 7.5 A each, PWM, 50 Hz
PWM Low side	4*; 2.2 A each, PWM, 10 kHz

\*can be enhanced by Upgrade I/O Package, see below

#### Power Supplies

12 V, 400 mA each	5*
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Switchable 5 V/12 V, 400 mA each	5*
Max overall current	4 A on all 12 V 2 A on all 5 V
Precision 12 V $\pm$ 1 % on the pin Precision 5 V $\pm$ 0.1 % on the pin	
Sensor ground	20
*can be enhanced by Upgrade I/O Package, see below	

### Adaptation and Documentation

Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab 7	
System Configuration tool RaceCon	Logger configuration, calibration and online measurement

### Upgrade Customer Code Area CCA

Provides the option to run customer developed software code on Bosch ECU

### Upgrade I/O Package

#### Communication

4 CAN

#### Inputs

4 Analog channels  
0 to 5 V,  
0.5 % precision between 0.2 and 4.8 V, switchable pull-up

4 Digital PWM inputs  
 $f_{max}$ =30 kHz  
Hall-type speed measurement possible,  
Fixed pullup 2.15 kOhm (required for Hall),  
Tooth count differential\*\*

4 LVDT, 5 pin configuration,  
excitation frequency 1 to 20 kHz,  
excitation voltage 0 to 5 V (rms)

#### Outputs

4 "TTL" Digital output, 10 kHz, PWM, 250 mA each  
2 PWM High side; 7.5 A each, PWM, 50 Hz  
4 PWM Low side; 2.2 A each, PWM, 10 kHz

#### Power Supplies

5 x12 V, 400 mA each  
5 switchable 5 V/12 V, 400 mA each

\*\* The tooth count differential between any two of the PWM inputs is available two measure e.g. shaft torsion.

### Upgrade High Speed Logging Package

6 ANA 0 to 5 V, 200 kHz logging rate

### Upgrade CCP Master

Enables CCP master functionality to request data from foreign devices via CAN/CCP protocol.

### Upgrade Real Time Ethernet

Enables the VCU to operate as a real time Ethernet master or slave. Guaranteed latency time of 1 ms. Ideal for time critical data transfer as needed in online control algorithms involving data from different devices.

Two interfaces allow for a ring topology (redundancy in case the RTE line experiences damage).

The VCU features a reasonable set of SERCOS3 instructions although not the full SERCOS3 standard is implemented. The ECU side can act as a SERCOS3 master; the logger side can act as a SERCOS3 slave.

### USB Accessories

Rugged USB flash drive

Mating connector for USB flash drive on car loom side

Adapter cable to PC USB-port

### Connectors

Connector LIFE (red) AS018-35PN Mating connector AS618-35SN (not included)

Connector SENS-A (yellow) AS018-35PA Mating connector AS618-35SA (not included)

Connector SENS-B (blue) AS018-35PB Mating connector AS618-35SB (not included)

### Communication

3 Ethernet 100 Mbit

2 Realtime Ethernet SERCOS3

4 CAN\*

1 LIN

1 USB

1 RS232 interface for GPS

1 Time sync synchronization Ethernet

\*can be enhanced by Upgrade I/O Package, see below

### Installation Notes

Inspection services recommended after 220 h or 2 years, no components to replace.

Please remember that the mating connectors and the programming interface MSA-Box II are not included and must be ordered separately.

## Ordering Information

### Vehicle Control Unit VCU MS 50.4P

Order number **F02U.V02.966-02**

### Vehicle Control Unit VCU MS 50.4P + CCA

Order number **F02U.V03.014-01**

### Vehicle Control Unit VCU MS 50.4P + I/O\_PACK + CCA

Order number **F02U.V03.015-01**

## Software Options

### Customer Code Area CCA

Order number **F02U.V02.137-01**

### I/O Package

Order number **F02U.V02.777-01**

### High Speed Logging Package

Order number **F02U.V02.779-01**

### CCP Master

Order number **F02U.V02.213-01**

### Real Time Ethernet

Order number **F02U.V02.782-01**

## Accessories

### Rugged USB flash drive

Order number **F02U.V01.342-03**

### Mating connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

Order number **F02U.V01.343-01**

### Opening tool for shellsize 18

Order number **F02U.V01.394-01**

### Breakout Box BOB 66-pole

Connector code: blue

Order number **F02U.V02.295-01**

### Breakout Box BOB 66-pole

Connector code: yellow

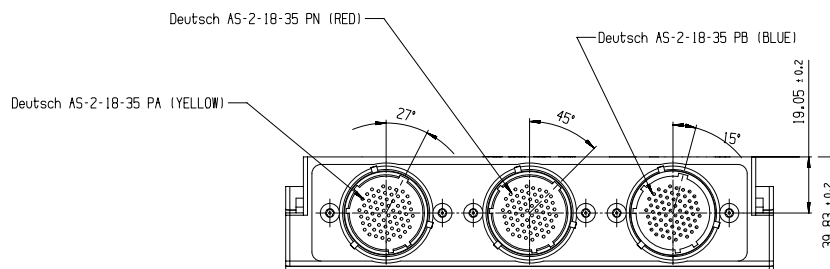
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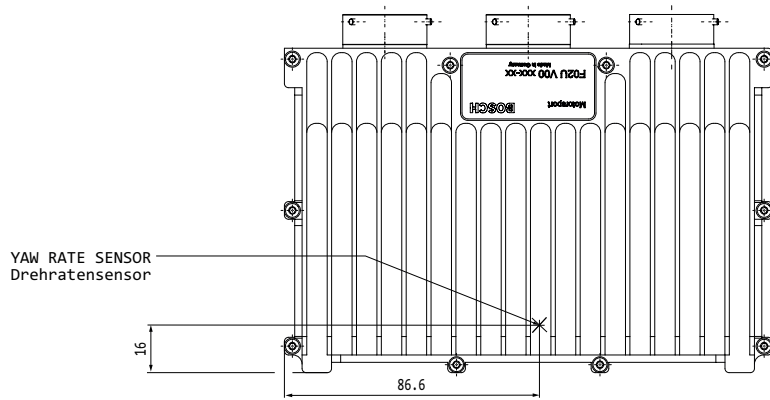
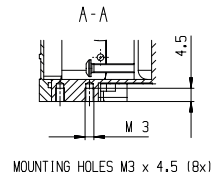
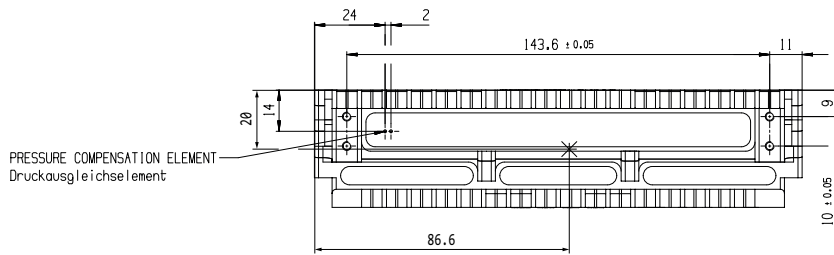
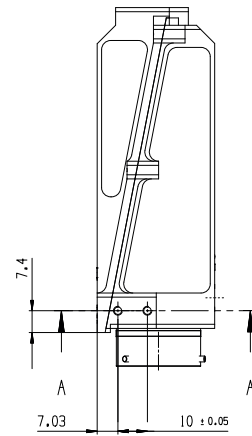
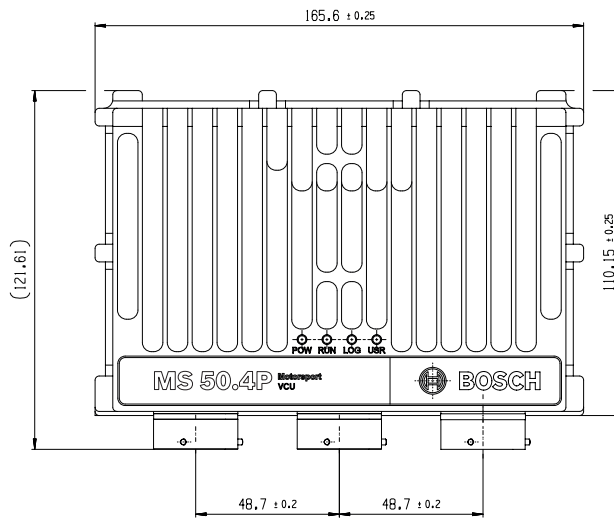
### Breakout Box BOB MS 7

Connector code: red

Order number **F02U.V02.293-01**

## Dimensions





# Displays

2

Displays

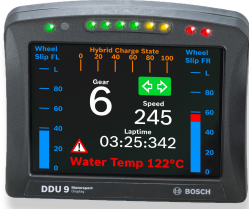
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## Overview

2

### Display DDU 9

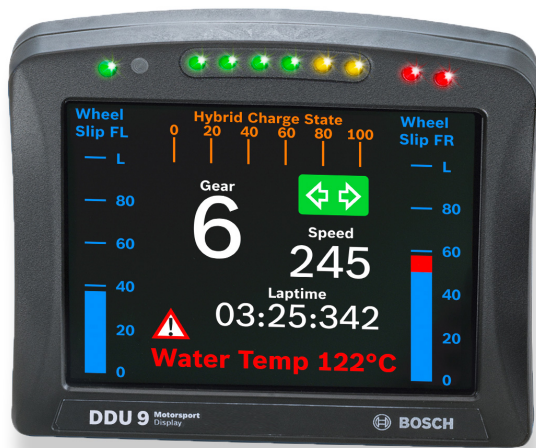


### Display DDU 10



- Cutting-edge 667 MHz Dual Core Processor
- Large trans-reflective color display
- Recording on USB flash drive (opt.)
- Supports GPS laptrigger, predated lap time etc.
- Page change based on events possible
- Features new user interface menu
- All new display element design generator
- 10 additional LEDs on both sides of the device
- Supports GPS laptrigger, predated lap time etc.
- Page change based on events possible

## Display DDU 9



### Features

- ▶ Cutting-edge 667 MHz Dual Core Processor
- ▶ Large trans-reflective color display
- ▶ Recording on USB flash drive (opt.)
- ▶ Supports GPS laptrigger, pre-dated lap time etc.
- ▶ Page change based on events possible

The display DDU 9 integrates a programmable full color dashboard display with a data logging system for motorsport applications for a very competitive price. Additional input devices can be connected via Ethernet and CAN buses.

Data Analysis Software WinDarab is available free of charge as “WinDarab V7 free” on our website. A basic logging function of 100 channels with recording of 50 ms (3 GB) is always included. The logger can be upgraded to full logging performance (max. 1 ms). In addition a 2<sup>nd</sup> logging partition of 1 GB (e.g. for long term recording) can be activated. Customers can implement own graphics, pictures etc. on the 12 freely configurable display pages. For quick data transfer from the car e.g. during pit stop, data copy to a USB stick is available as an option. The stick is connected to the wiring harness for the DDU 9.

The device comes with 4 analogue and 4 speed inputs as standard; further 12 analogue inputs are available as optional upgrade.

### Application

Display	<ul style="list-style-type: none"> <li>• 5.7” graphic color display</li> <li>• 12 user configurable display pages</li> <li>• 10 multicolor freely configurable (RGB) LEDs</li> </ul>
Resolution	640 x 480 pixel
Supported image file formats	BMP, GIF, JPG, PNG, TIF

Processor	667 MHz Dual Core
Converters	8 kHz AD converters with digital low pass filter
Internal power source	Li/Ion capacitor
Configurable math channels	
User configurable CAN in/out messages	
Sampling rate	50 ms (standard), max. 1 ms (optional)
Online data compression	
Logging rate	Max. 600 kB/s
Recording channels	100 channels (standard), up to 1,040 in total (optional)
Logged data download speed	Max. 1,000 kB/s
Internal storage capacity	3 GB (standard), plus 1 GB (optional)
LTE Ethernet telemetry support, GSM telemetry support	
RS232 for GPS and telemetry	
CCP-Master, data acquisition from ECU that support CAN calibration protocol (optional)	

### Technical Specifications

#### Mechanical Data

Size	151 x 126 x 33.5 mm
Weight	540 g
Protection Classification	IP54 to DIN 40050, Section 9, Issue 2008
Operating temperature internal	-20 to 85°C
Operating temperature Display	-20 to 70°C
Max. vibration	Vibration profile 1 (see Appendix or www.bosch-motorsport.com)

#### Electrical Data

Supply voltage	5 to 18 V
<b>Inputs</b>	
Analog channels	4 standard, additional 12 optional
Input range	0 to 5 V
Resolution	12 bit
Switchable pull up resistor	For all ANA_IN
Wheel speed inputs	4 Hall-effect or DF11, switchable

#### Outputs

Sensor supply 5 V ± 1 % (250 mA)	2
Sensor supply 10 V ± 1 % (250 mA)	1
Sensor supply U_Bat 250 mA	1
Sensor ground	4



**Environment**

External switch for page selection, 12 steps	B 261 209 658-01
External switch for brightness adjustment or page selection, 6 steps	B 261 209 659-01

**Optional Upgrades**

USB Kit	Rugged USB flash drive Bosch File System (BFS) format, works with Bosch File System (BFS) preformatted USB Flash drive only Adapter cable to USB-Port Adapter for wiring harness SW licence USB-Port unlocked
CCP_MASTER	CCP-Master (ASAP2 file from ECU manufacturer required)
FULL_LOG_1	Enable full logging performance of 3 GB partition 1
FULL_LOG_2	Enable full logging performance of 1 GB partition 2
I_O EXTENS	Enable additional 12 analog input channels

**Connectors and Wires**

Motorsport connector on Display	AS216-35PN
Mating connector AS616-35SN	F02U.000.466-01

**Pin Configuration**

Pin	Name	Comment	Status
1	KL_31		Incl.
2	KL_15		Incl.
3	KL_30		Incl.
4	Rev_In_3	Hall or DF11 switchable	Incl.
5	Rev_In_1	Hall or DF11 switchable	Incl.
6	KL_31		Incl.
7	CAN_2_L	CAN speed selectable	Incl.
8	Ethernet_2_TXP		Incl.
9	Ethernet_2_TXN		Incl.
10	Sens_Power_12V	over current protected	Incl.
11	Rev_In_4	Hall or DF11 switchable	Incl.
12	Rev_In_2	Hall or DF11 switchable	Incl.
13	Laptrigger_In		Incl.
14	CAN_2_H	CAN speed selectable	Incl.
15	CAN_1_H	CAN speed selectable	Incl.
16	Ethernet_2_RXP		Incl.
17	Sens_Gnd_4	fused	Incl.
18	Sens_Power 5V	over current protected	Incl.
19	ANA_IN_3	3.01 kOhm switchable	Incl.

Pin	Name	Comment	Status
20	ANA_IN_4	3.01 kOhm switchable	Incl.
21	Time_Sync	connection to Bosch ECU	Incl.
22	CAN_1_L	CAN speed selectable	Incl.
23	Ethernet_screen		Incl.
24	Ethernet_2_RXN		Incl.
25	Sens_Gnd_3	fused	Incl.
26	Sens_Power 5V	over current protected	Incl.
27	ANA_IN_7	3.01 kOhm switchable	Opt.
28	ANA_IN_1	3.01 kOhm switchable	Incl.
29	USB_Device_DP	to Bosch USB stick	Opt.
30	RS232_TX_Telemetry		Incl.
31	Ethernet_1_TXP		Incl.
32	Sens_Gnd_2	fused	Incl.
33	Sens_Power_10V	over current protected	Incl.
34	ANA_IN_8	3.01 kOhm switchable	Opt.
35	ANA_IN_10	3.01 kOhm switchable	Opt.
36	USB_Device_Gnd	to Bosch USB stick	Opt.
37	USB_Device_DN	to Bosch USB stick	Opt.
38	RS232_RX_Telemetry	e.g. GSM telemetry	Incl.
39	Ethernet_1_TXN		Incl.
40	Sens_Gnd_1	fused	Incl.
41	ANA_IN_11	3.01 kOhm switchable	Opt.
42	ANA_IN_9	3.01 kOhm switchable	Opt.
43	RS232_TX_GPS		Incl.
44	ANA_IN_16	3.01 kOhm switchable	Opt.
45	USB_Device_Power	to Bosch USB stick	Opt.
46	Ethernet_1_RXP		Incl.
47	ANA_IN_12	3.01 kOhm switchable	Opt.
48	ANA_IN_6	3.01 kOhm switchable	Opt.
49	ANA_IN_2	3.01 kOhm switchable	Incl.
50	ANA_IN_13	3.01 kOhm switchable	Opt.
51	ANA_IN_15	3.01 kOhm switchable	Opt.
52	Ethernet_1_RXN		Incl.
53	ANA_IN_5	3.01 kOhm switchable	Opt.
54	RS232_RX_GPS	for GPS sensor input	Incl.
55	ANA_IN_14	3.01 kOhm switchable	Opt.

**Communication**

CAN interfaces	2
Ethernet 100BaseT	2
Laptrigger input	1
RS232	Telemetry, GPS
Configuration via RaceCon	Over Ethernet or MSA-Box II

**Installation Notes**

Inspection services recommended after 220 h or 2 years, no components to replace.

**Ordering Information**

**Display DDU 9**  
Order number **F02U.V02.300-02**

**Software Options**

**CCP\_MASTER**  
Order number **F02U.V02.213-01**

**FULL\_LOG\_1**  
Order number **F02U.V02.304-01**

**FULL\_LOG\_2**  
Order number **F02U.V02.305-01**

**I\_O EXTENS**  
Order number **F02U.V02.205-01**

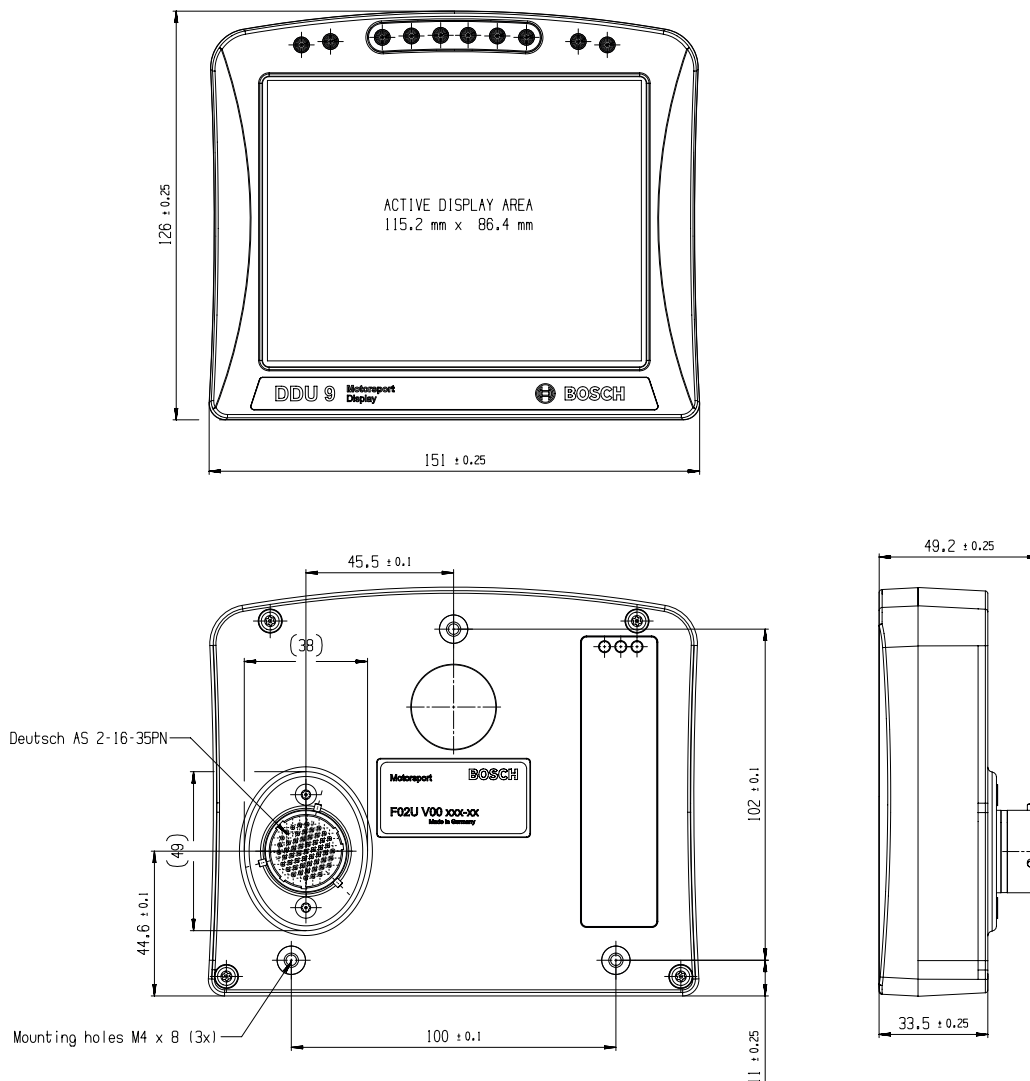
**Accessories**

**Vehicle Loom Basic**  
Order number **F02U.V02.735-01**

**Bench Loom**  
Order number **F02U.V02.349-01**

**USB Kit for C 70, C 80, DDU 9, DDU 10 and VCU**  
Order number **F02U.V02.214-01**

**Dimensions**



## Display DDU 10

2



### Features

- ▶ Features new user interface menu
- ▶ All new display element design generator
- ▶ 10 additional LEDs on both sides of the device
- ▶ Supports GPS laptrigger, pre-dated lap time etc.
- ▶ Page change based on events possible

The display DDU 10 integrates a programmable full color dashboard display with a data logging system for motorsport applications. Additional input devices can be connected via Ethernet, CAN buses and RS 232.

Data Analysis Software WinDarab is available free of charge as “WinDarab V7 free” on our website. A basic logging function of 100 channels with recording of 50 ms (3 GB) is always included. The logger can be upgraded to full logging performance (max. 1 ms). In addition a 2nd logging partition of 1 GB can be activated.

With the DDU 10, a completely new library of graphical elements for the individual design of display pages was implemented and an all-new user interface menu has been developed for the device. A configurable input activates the menu structure and the user can reset for example laptime, fuel consumption and many more, without having to connect a laptop to the DDU. The user can also install own graphics, pictures etc. on the 12 freely configurable display pages. For quick data transfer from the car, e.g. during pit stop, data copy to a USB stick is available as an option.

### Application

- |         |  |
|---------|--|
| Display | <ul style="list-style-type: none"> <li>• 7” graphic color display</li> <li>• 12 user configurable display pages</li> <li>• 20 multicolor freely configurable (RGB) LEDs</li> </ul> |
|---------|--|

Resolution	800 x 480 pixel
Supported image file formats	PNG, BMP, JPG, GIF
Processor	667 MHz Dual Core
Converters	8 kHz AD converters with digital low pass filter
Internal power source	Li/Ion capacitor
Configurable math channels	
User configurable CAN in/out messages	Up to 256 IDs (128 in and out)
Sampling rate	50 ms standard, max. 1 ms optional
Online data compression	
Logging rate	Max. 600 kB/s
Recording channels	100 channels standard, up to 1,080 in total optional
Logged data download speed	Max. 1,000 kB/s
Internal storage capacity	3 GB standard, plus 1 GB optional
Ambient light sensor	

### Technical Specifications

#### Mechanical Data

Size	198 x 134 x 35 mm
Weight	875 g
Protection classification	IP67
Operating temperature internal	-20 to 85°C
Max. vibration	Vibration profile 1 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage	6 to 18 V
Current consumption (without sensor supply)	2 A (at 12 V)

#### Inputs

Analog channels	4 standard, plus 12 optional
Input range	0 to 5 V
Resolution	12 bit
Switchable pull up resistor	For all analog inputs
Wheel speed inputs	4 Hall-effect or DF11, switchable

#### Outputs

Sensor supply 5 V ± 1 % (250 mA)	2
Sensor supply 10 V ± 1 % (250 mA)	1
Sensor supply U_Bat (250 mA)	1
Sensor ground	4

**Environment**

External switch for page selection, 12 steps B 261 209 658-01

External switch for brightness adjustment or page selection, 6 steps B 261 209 659-01

**Optional Upgrades**

USB Kit Rugged USB flash drive Bosch File System (BFS) format included, works with Bosch File System (BFS) preformatted USB Flash drive only  
Adapter cable to USB-Port  
Adapter for wiring harness  
SW license USB-Port unlocked

CCP\_MASTER CCP-Master (ASAP2 file from ECU manufacturer required)

FULL\_LOG\_1 Enable full logging performance of 3 GB partition 1

FULL\_LOG\_2 Enable full logging performance of 1 GB partition 2

I\_O\_EXTENS Enable additional 12 analog inputs and 2 CAN channels

**Connectors and Wires**

LIFE connector on display AS216-35PN

Mating connector F02U.000.466-01 AS616-35SN

Auxiliary connector on display AS212-35PN

Mating connector F02U.000.443-01 AS612-35SN

**Pin Configuration**

## LIFE connector

Pin	Name	Comment	Status
1	KL_31		Incl.
2	KL_15		Incl.
3	KL_30		Incl.
4	Rev_In_3	Hall or DF11 switchable	Incl.
5	Rev_In_1	Hall or DF11 switchable	Incl.
6	KL_31		Incl.
7	CAN_2_L	CAN speed selectable	Incl.
8	Ethernet_2_TXP		Incl.
9	Ethernet_2_TXN		Incl.
10	Sens_Power_12V	over current protected	Incl.
11	Rev_In_4	Hall or DF11 switchable	Incl.
12	Rev_In_2	Hall or DF11 switchable	Incl.
13	Laptrigger_In		Incl.
14	CAN_2_H	CAN speed selectable	Incl.

## LIFE connector

15	CAN_1_H	CAN speed selectable	Incl.
16	Ethernet_2_RXP		Incl.
17	Sens_Gnd_4	fused	Incl.
18	Sens_Power_5V	over current protected	Incl.
19	ANA_IN_3	3.01 kOhm switchable	Incl.
20	ANA_IN_4	3.01 kOhm switchable	Incl.
21	Time_Sync	connection to Bosch ECU	Incl.
22	CAN_1_L	CAN speed selectable	Incl.
23	Ethernet_screen		Incl.
24	Ethernet_2_RXN		Incl.
25	Sens_Gnd_3	fused	Incl.
26	Sens_Power_5V	over current protected	Incl.
27	ANA_IN_7	3.01 kOhm switchable	Opt.
28	ANA_IN_1	3.01 kOhm switchable	Incl.
29	USB_Device_DP	to Bosch USB stick	Opt.
30	RS232_TX_Telemetry		Incl.
31	Ethernet_1_TXP		Incl.
32	Sens_Gnd_2	fused	Incl.
33	Sens_Power_10V	over current protected	Incl.
34	ANA_IN_8	3.01 kOhm switchable	Opt.
35	ANA_IN_10	3.01 kOhm switchable	Opt.
36	USB_Device_Gnd	to Bosch USB stick	Opt.
37	USB_Device_DN	to Bosch USB stick	Opt.
38	RS232_RX_Telemetry	e.g. GSM telemetry	Incl.
39	Ethernet_1_TXN		Incl.
40	Sens_Gnd_1	fused	Incl.
41	ANA_IN_11	3.01 kOhm switchable	Opt.
42	ANA_IN_9	3.01 kOhm switchable	Opt.
43	RS232_TX_GPS		Incl.
44	ANA_IN_16	3.01 kOhm switchable	Opt.
45	USB_Device_Power	to Bosch USB stick	Opt.
46	Ethernet_1_RXP		Incl.
47	ANA_IN_12	3.01 kOhm switchable	Opt.
48	ANA_IN_6	3.01 kOhm switchable	Opt.
49	ANA_IN_2	3.01 kOhm switchable	Incl.
50	ANA_IN_13	3.01 kOhm switchable	Opt.
51	ANA_IN_15	3.01 kOhm switchable	Opt.
52	Ethernet_1_RXN		Incl.
53	ANA_IN_5	3.01 kOhm switchable	Opt.
54	RS232_RX_GPS	for GPS sensor input	Incl.
55	ANA_IN_14	3.01 kOhm switchable	Opt.

## Auxiliary connector

Pin	Name	Comment	Status
-----	------	---------	--------

Auxiliary connector		
1		Unused
2		Unused
3		Unused
4		Unused
5		Unused
6		Unused
7		Unused
8		Unused
9	Ethernet_3_TXP	Incl.
10	Ethernet_3_RXP	Incl.
11	Ethernet_3_RXN	Incl.
12	CAN_4_H	Opt.
13		Unused
14		Unused
15		Unused
16		Unused
17		Unused
18	Ethernet_screen	Incl.
19	Ethernet_3_TXN	Incl.
20	CAN_4_L	Opt.
21	CAN_3_H	Opt.
22	CAN_3_L	Opt.

### Communication

CAN interfaces	2 standard, plus 2 optional
Ethernet 100BaseT	3
Laptrigger input	1

RS232	Telemetry, GPS
Configuration via RaceCon	Over Ethernet or MSA-Box II
CCP-Master, data acquisition from ECU that support CAN calibration protocol (optional)	

### Installation Notes

Inspection services recommended after 220 h or 2 years, no components to replace.

This product may contain open source software. Information about license terms and other obligations is given in the manual.

### Ordering Information

#### Display DDU 10

Order number **F02U.V02.659-01**

#### CAN Keypad CK-M12

Order number **F02U.V0U.328-02**

#### Software Options

##### CCP\_MASTER

Order number **F02U.V02.213-01**

##### FULL\_LOG\_1

Order number **F02U.V02.304-01**

##### FULL\_LOG\_2

Order number **F02U.V02.305-01**

##### I\_O EXTENS

Order number **F02U.V02.205-01**

#### Accessories

##### USB Kit for C 70, C 80, DDU 9, DDU 10 and VCU

Order number **F02U.V02.214-01**

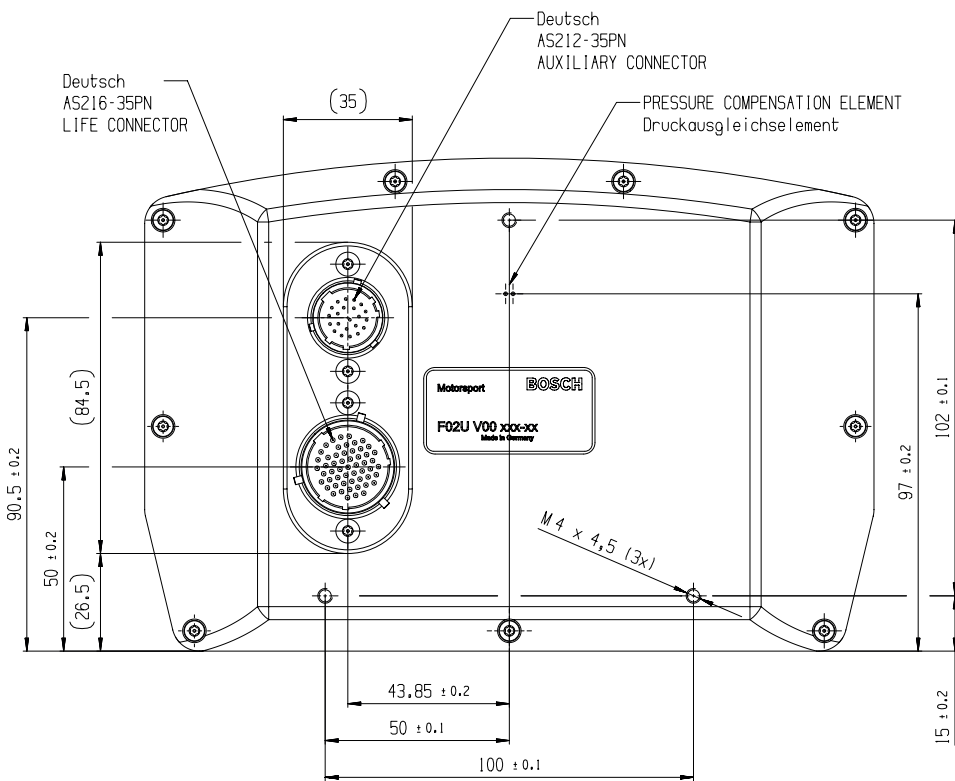
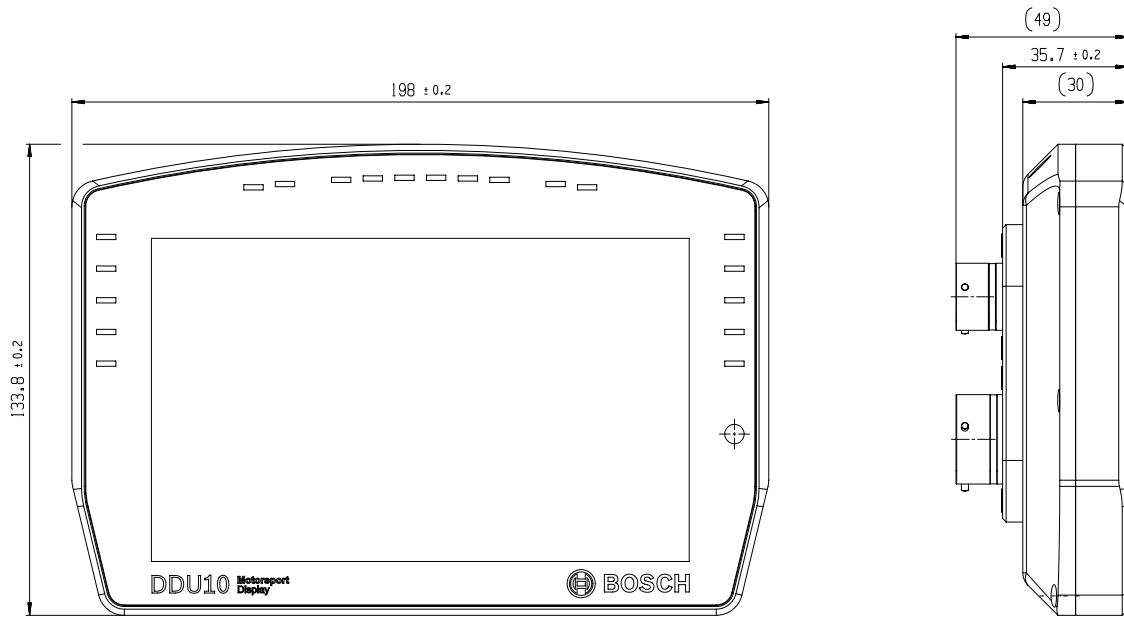
##### Vehicle Loom Basic

Order number **F02U.V02.735-01**

##### Bench Loom

Order number **F02U.V02.349-01**

Dimensions







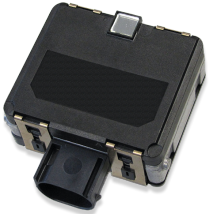
<b>Collision Avoidance Systems</b>	<b>50</b>
<b>Data Loggers</b>	<b>59</b>
<b>Injection Power Stages</b>	<b>69</b>
<b>CAN Keypad</b>	<b>76</b>
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<b>Sensor Interfaces</b>	<b>87</b>
<b>Telemetry System</b>	<b>98</b>
<b>Test System</b>	<b>106</b>

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## Overview

3

### Collision Avoidance System CAS-M light



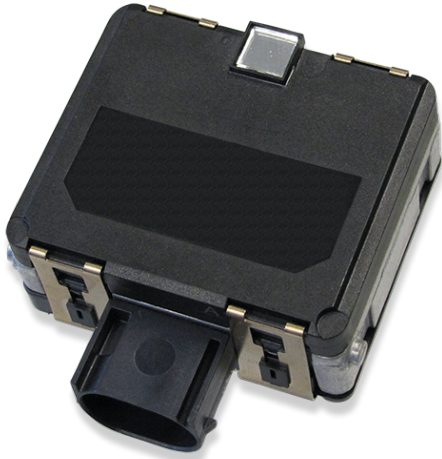
- Radar sensor with integrated logic
- Warning for overtake situations
- Easy system adaptation
- Universal CAN interface for various displays
- Visualization via display LEDs

### Collision Avoidance System CAS-M 3 EVO



- Approaching vehicle tracking
- Left/right passing alerts
- Improves visibility of objects in rain, mist or darkness
- Full Bosch Motorsport tool integration

## Collision Avoidance System CAS-M light



### Features

- ▶ Radar sensor with integrated logic
- ▶ Warning for overtake situations
- ▶ Easy system adaptation
- ▶ Universal CAN interface for various displays
- ▶ Visualization via display LEDs

The collision avoidance system CAS-M light helps the driver to focus on the track and warns him if a car is approaching from behind. The system provides information about relative speed and distance of the closest vehicle on the CAN bus. An additional display with CAN bus interface is required (e.g. DDU 9).

The information is based on a Bosch radar sensor which contains a FMCW radar transceiver operating in the frequency range of 76.0 - 77.0 GHz. Targets in front of the sensor are reflecting the radar signal and the relative speed and distance is determined via Doppler-effect and beat frequency.

The benefit is even more increased during darkness or in bad weather conditions. The system interface is very intuitive and adaptable to the drivers liking.

### Application

Operating temperature	-40 to 85°C
Storage temperature	-20 to 95°C
Range	150 m
Tracks	1 Object (nearest)
Interface	CAN
CAN rate	500 kbaud or 1 Mbaud
CAN update rate	50 Hz

### Technical Specifications

#### Mechanical Data

Weight of radar sensor MRR	199 g
Size	60x70x32 mm
Protection Classification	IP 6K6K (DIN 40 050) IP 6K7 (DIN 40 050)
Max. vibration	Randome vibration aeff = 30.8 m/s <sup>2</sup> , 3x8 h (according ISO/DIS 16750-3)

#### Electrical Data

Supply voltage	6.5 to 18 V
An external fuse has to be provided (rec. 10 A). External overvoltage protection is required (internal overvoltage protection up to 35 V).	
Reverse polarity voltage protection	-14 V max. t ≤ 60 sec

#### Connectors and Wires

Mating connector	F037.B00.168-01
Pin 1	GND
Pin 2	CAN-H
Pin 3	CAN-L
Pin 4	n.c.
Pin 5	n.c.
Pin 6	n.c.
Pin 7	n.c.
Pin 8	V+

### Installation Notes

The system includes a radar sensor and a detailed user manual.

Ordering information for suitable wiring looms for the different CAS-M light packages are specified in the user manual.

The system needs to be connected to the vehicle CAN bus (connection to display needed) and supplied with 12 V from the supply system on board.

The rear unit must be mounted 90° to the vehicles vertical and horizontal axis and within ± 200 mm of the vehicle lateral centerline.

Mounting distance of radar over ground: 300 to 1,000 mm

To achieve the expected performance from the radar sensor, it must have a clear and unobstructed view. There should be no material over the radar sensor and the sensor should be allowed a clear 180-degree field of view.

The system needs yaw rate and vehicle speed information.

Cat 6 A standard for Gigabit Ethernet.

See CAS-M light in action on <http://youtu.be/EzpSy-eJRi4>

**Legal**

The CAS-M 3 radar sensor is based on the Bosch Engineering MRRe14HBW radar sensor. The MRRe14HBW is frequency certified for the following countries:

**Country**

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Iceland, Liechtenstein, Norway, Switzerland

USA

Canada

Japan

Australia

**Country**

New Zealand

If the MRRe14HBW and hence the CAS-M 3 radar sensor SCU is not operated within this context, it lies within the customer's responsibility to ensure compliance of the application with national regulations and standards, e.g., electromagnetic compatibility and radio spectrum matters.

Link to the up-to-date EU Declaration of Conformity DoC:

<http://eu-doc.bosch.com>

(Please enter the model MRRe14HBW on which CAS-M sensors are based on to find the correct DoC in the database.)

**Ordering Information****CAS-M light (500 kbaud)**

Order number **F02U.V02.021-01**

**CAS-M light (1 Mbaud)**

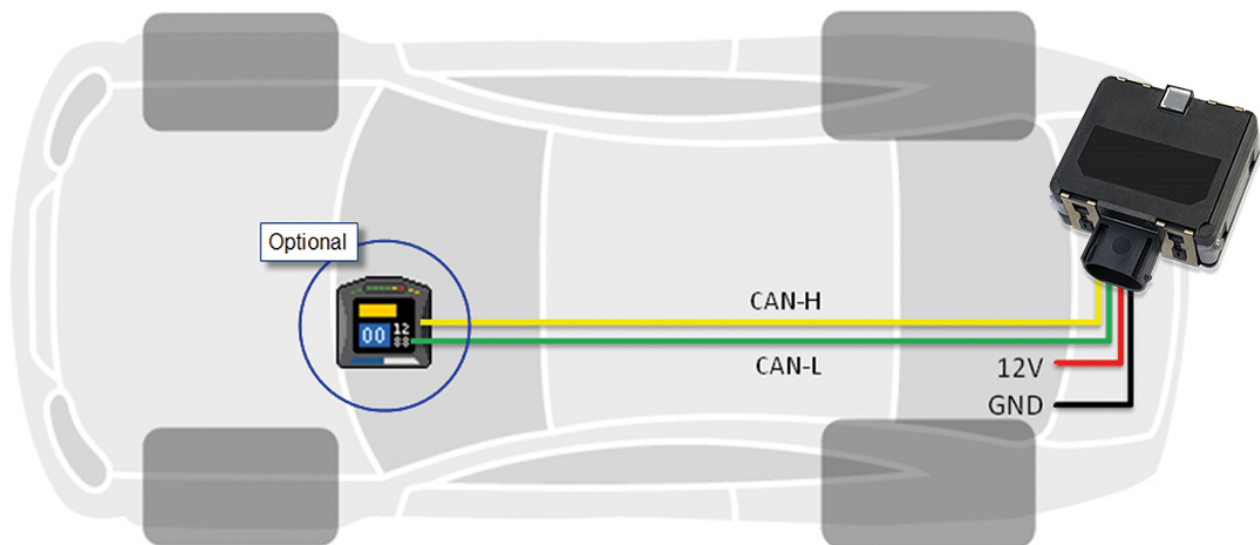
Order number **F02U.V02.220-01**

**CAS-M light incl. Display DDU 9 (500 kbaud)**

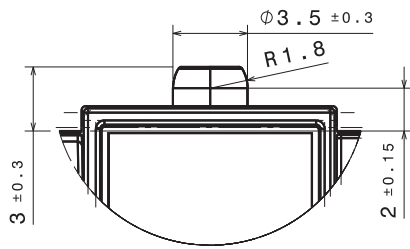
Order number **F02U.V02.591-01**

**CAS-M light incl. Display DDU 9 (1 Mbaud)**

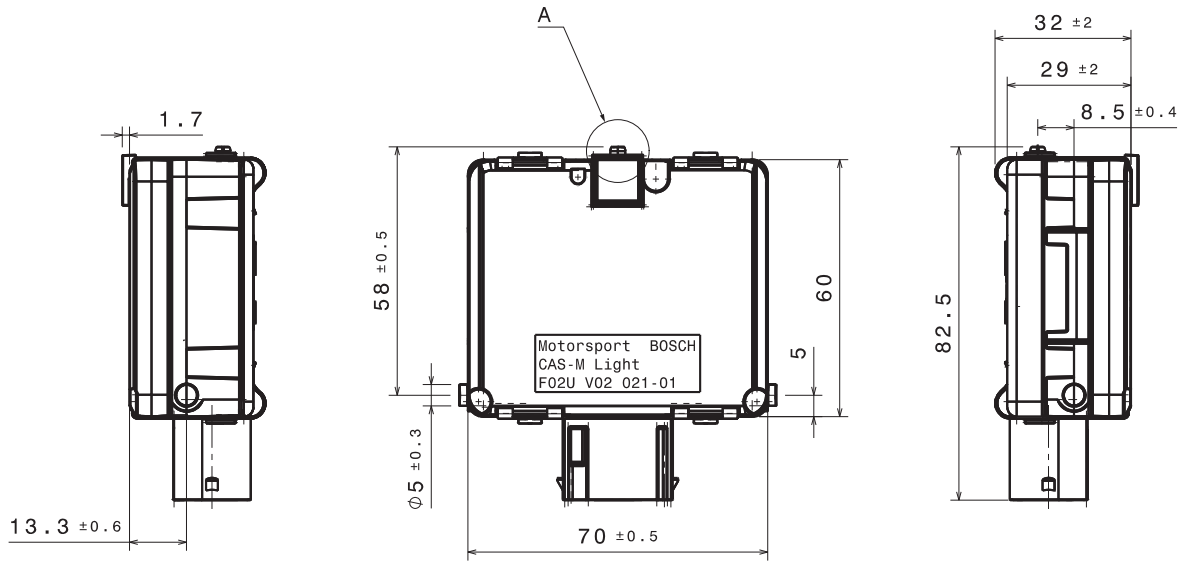
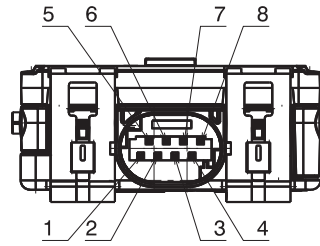
Order number **F02U.V02.592-01**

**Dimensions**

Wiring schematic



Detail A



Right view

Front view

Left view

Dimensions

## Collision Avoidance System CAS-M 3 EVO

3



### Features

- ▶ Approaching vehicle tracking
- ▶ Left/right passing alerts
- ▶ Improves visibility of objects in rain, mist or darkness
- ▶ Full Bosch Motorsport tool integration

The Collision Avoidance System-Motorsport 3 EVO (CAS-M 3 EVO) features a high-performance Bosch Motorsport **Display Unit** for fast video processing (right in the picture), and a **Rear Module**, composed from a Bosch mid-range radar sensor for a wider field of view in close-up range and a fast response high definition camera (left in the picture). The CAS-M 3 EVO system provides real time visualization and warns the driver about approaching or overtaking cars via intuitive marking of the cars on the display. It helps prevent the most common collisions and allows drivers to focus on the race. With a momentary glance, the driver can tell how many cars are following and their classification depending on distance and relative speed. The radar tracks up to 40 objects and marks up to four objects on the display. In addition, bright flashing LEDs alert the driver when any car attempts a passing maneuver. All of these features work at night or in the rain when visibility is typically poor. Furthermore, the real time gap of a marked object is measured and can be provided over CAN or Ethernet. The CAS-M 3 EVO system is fully integrated in the Bosch Motorsport Tool environment and can be configured with RaceCon.

### Application

Range	95 m
Horizontal field of view	

Radar	85° from 0 to 29 m 70° from 29 to 46 m 50° from 46 to 73 m 42° from 73 to 78 m 20° from 78 to 95 m
-------	--

Camera	78°
Number of tracked objects	Max. 40
Number of displayed classified objects	Max. 4
Display format	7"
Display resolution	800 x 480 pixel
User configurable CAN in/out messages	
User configurable LEDs	

### Technical Specifications

#### Mechanical Data

##### Display Unit

Size	198 x 134 x 35 mm
Weight	830 g
Protection classification	IP67
Operating temperature internal	-20 to 85°C

Max. vibration	Vibration profile 1 (See Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )
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##### Rear Module

Size	120 x 150 x 115 mm
Weight	880 g
Protection classification	IP67
Operating temperature	0 to 70°C (rearview camera internal temperature*)

Max. vibration	Vibration profile 1 (See Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )
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\*If the temperature limit is reached, forced air cooling of the camera is recommended.

#### Electrical Data

Supply voltage (Display and Rear Unit)	6 to 18 V
--	-----------

##### Current consumption

Display Unit	2 A (at 12 V)
Rear Module	0.7 A (at 12 V)

#### Communication

##### Display Unit

CAN	1x private CAN for radar, 1x CAN
Ethernet	1x private 1GBase-T Ethernet for camera, 1x 100Base-T Ethernet
Time sync synchronization Ethernet	1

<b>Rear Module</b>	
CAN	1x private CAN for radar
Ethernet	1x private 1GBase-T Ethernet for camera
<b>Software Tools (free download)</b>	
Data analysis tool	WinDarab 7 Light
System configuration tool	RaceCon
<b>Connectors and Wires</b>	
<b>Display Unit</b>	
Motorsport connector on device	AS212-35PN
Mating connector AS612-35SN	F02U.000.443-01
<b>Rear Module</b>	
Motorsport connector on device	AS212-35PN
Mating connector AS612-35SN	F02U.000.443-01
<b>Pin Configuration</b>	
<b>Display Unit</b>	
Pin 1	GigEthernet_TR3_N (private Eth camera)
Pin 2	GigEthernet_TR3_P (private Eth camera)
Pin 3	GigEthernet_TR2_N (private Eth camera)
Pin 4	GigEthernet_TR2_P (private Eth camera)
Pin 5	GigEthernet_TR1_N (private Eth camera)
Pin 6	GigEthernet_TR1_P (private Eth camera)
Pin 7	GigEthernet_TR0_N (private Eth camera)
Pin 8	GigEthernet_TR0_P (private Eth camera)
Pin 9	Ethernet_TXP
Pin 10	Ethernet_RXP
Pin 11	Ethernet_RXN
Pin 12	CAN_High_Vehicle
Pin 13	+12 V KL30
Pin 14	+12 V KL15
Pin 15	GND KL31
Pin 16	GND KL31
Pin 17	Time_Sync
Pin 18	ETH_Screen
Pin 19	Ethernet_TXN
Pin 20	CAN Low Vehicle
Pin 21	CAN High Radar (private CAN radar)

Pin 22	CAN Low Radar (private CAN radar)
<b>Rear Module</b>	
Pin 1	GigEthernet_TR3_P (private Eth camera)
Pin 2	GigEthernet_TR2_N (private Eth camera)
Pin 3	GigEthernet_TR2_P (private Eth camera)
Pin 4	GigEthernet_TR1_N (private Eth camera)
Pin 5	GigEthernet_TR1_P (private Eth camera)
Pin 6	GigEthernet_TR0_N (private Eth camera)
Pin 7	GigEthernet_TR0_P (private Eth camera)
Pin 8	+12 V Ubat
Pin 9	+12 V Ubat
Pin 10	+12 V Ubat (optional to display)
Pin 11	CAN High Radar (private CAN radar)
Pin 12	CAN Low Radar (private CAN radar)
Pin 13	n.c.
Pin 14	GigEthernet_TR3_N (private Eth camera)
Pin 15	GigEthernet Screen
Pin 16	n.c.
Pin 17	CAN Screen
Pin 18	GND
Pin 19	+12 V Ubat (optional to display)
Pin 20	GND
Pin 21	GND (optional to display)
Pin 22	GND (optional to display)

### Communication

<b>Display Unit</b>	
CAN	1x private CAN for radar, 1x CAN
Ethernet	1x private 1GBase-T Ethernet for camera, 1x 100Base-T Ethernet
Time sync synchronization Ethernet	1
<b>Rear Module</b>	
CAN	1x private CAN for radar



Ethernet	1x private 1GBase-T Ethernet for camera
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### Installation Notes

The rear unit must be mounted 90° to the vehicle's vertical and horizontal axis and within ± 200 mm of the vehicle lateral centerline.

Mounting distance of radar over ground: 300 to 1,000 mm

To achieve the expected performance from the radar sensor, it must have a clear and unobstructed view. There should be no material over the radar sensor and the sensor should be allowed a clear 180 degree field of view.

Consider the maximum vibration limits for the mounting position of the rear module. The system is approved referred to vibration profile 1, see [www.bosch-motorsport.com](http://www.bosch-motorsport.com).

Check the radar sensor for travel inside the radar bracket. In this case, remove the radar sensor and check the locking pins at both sides of the sensor. Due to vibrations, these pins can be deformed. Exceeding travel of the sensor can damage the electric contacts.

The system needs yaw rate and vehicle speed information.

Cat 6 A standard for Gigabit Ethernet.

This product may contain open source software. Information about license terms and other obligations is given in the manual.

For the private CAN network between display and rear module, no termination resistor is needed in the wiring harness. There are pre-installed termination resistors in the radar sensor and the display.

### Safety Notes

It is not permitted to use the system as mirror replacement.

### Legal

The CAS-M 3 radar sensor is based on the Bosch Engineering MRRe14HBW radar sensor. The MRRe14HBW is frequency certified for the following countries:

Country
Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Iceland, Liechtenstein, Norway, Switzerland
USA
Canada
Japan

Country
Australia
New Zealand

If the MRRe14HBW and hence the CAS-M 3 radar sensor SCU is not operated within this context, it lies within the customer's responsibility to ensure compliance of the application with national regulations and standards, e.g., electromagnetic compatibility and radio spectrum matters.

Link to the up-to-date EU Declaration of Conformity DoC:

<http://eu-doc.bosch.com>

(Please enter the model MRRe14HBW on which CAS-M sensors are based on to find the correct DoC in the database.)

### Ordering Information

#### Collision Avoidance System CAS-M 3 EVO

Order number **F02U.V02.648-02**

#### Acceleration Sensor MM5.10

Without wire (1)

Order number **F02U.V01.511-02**

#### Acceleration Sensor MM5.10

Wire with open end (2)

Order number **F02U.V01.511-92**

#### Acceleration Sensor MM5.10

Wire with motorsport connector (3)

Order number **F02U.V01.512-03**

#### Accessories

##### Display Unit

Order number **F02U.V02.660-01**

##### Rear Module

Consisting of parts (A) to (E)

Order number **F02U.V02.630-02**

##### Radar Bracket (A)

Order number **F037.D00.084-01**

##### Radar Unit (B)

Order number **F02U.V02.647-01**

##### Camera Unit (C)

Order number **F02U.V02.799-01**

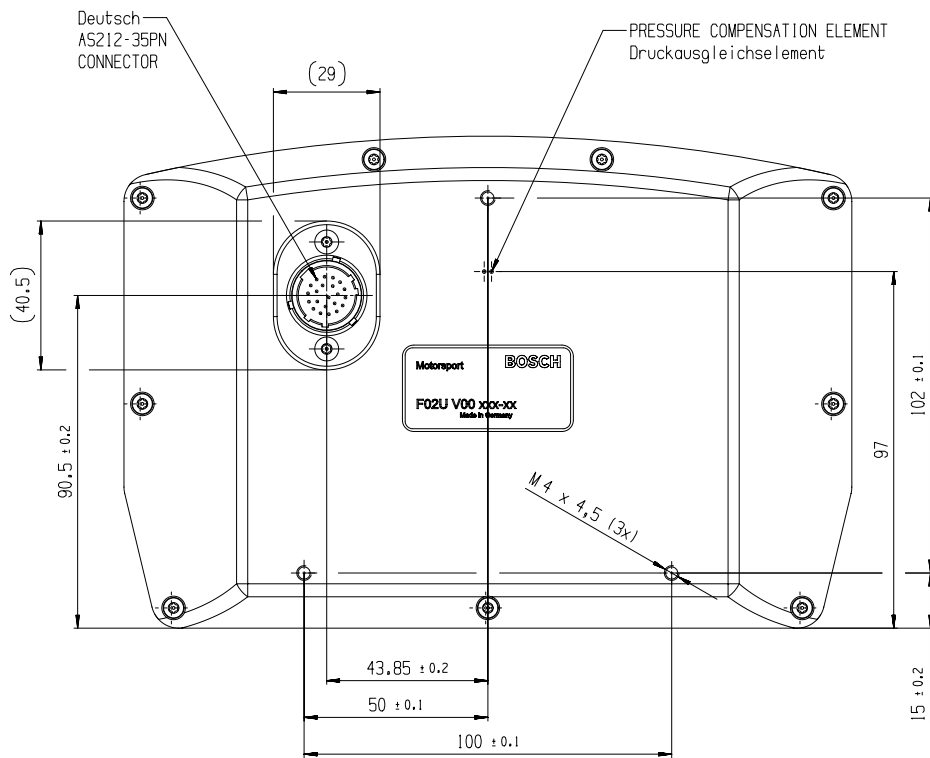
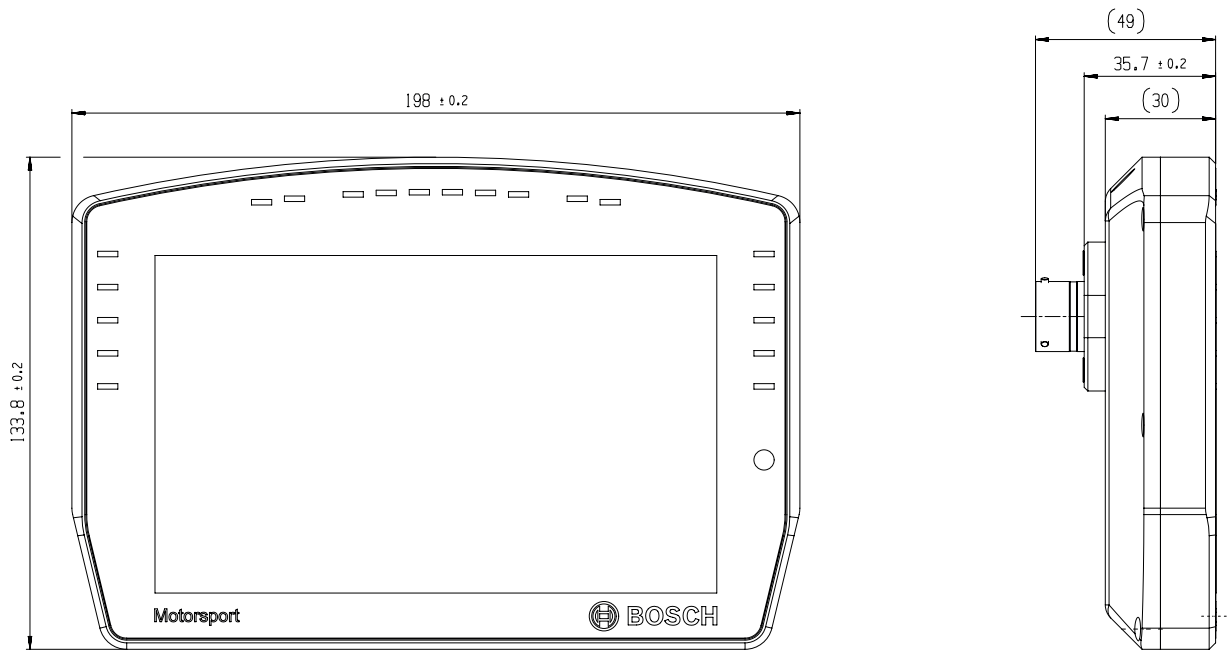
##### Wiring Harness (D)

Order number **F02U.V02.802-01**

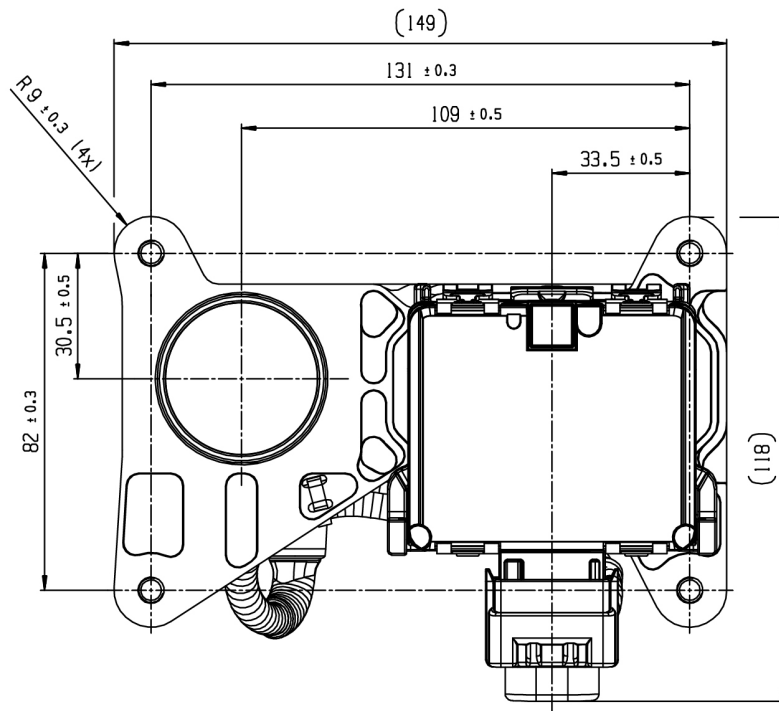
##### Interface Module (Housing and Electronics) (E)

Order number **F02U.V02.639-01**

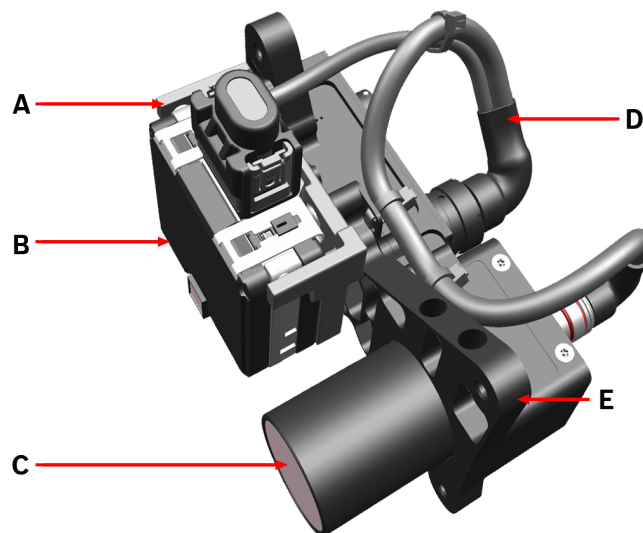
Dimensions



Display



Rear Module



- A: Radar Bracket
- B: Radar Sensor
- C: Camera
- D: Wiring Harness for Radar and Camera
- E: Interface Module (Housing and Electronics)

Spare Parts of the Rear Module

## Overview

### Data Logger C 70



- Cutting-edge 667 MHz Dual Core Processor
- Recording on USB flash drive (opt.)
- Supports GPS lap trigger, pre-dated lap time etc.
- High programming flexibility using mathematical functions and conditional channels

### Data Logger C 80



- Aluminum housing
- Powerful data logger with up to 20 GB memory
- Supports Bosch multi-logger configuration
- USB recording and full telemetry support

### USB Kit



- Capacity 2 GB
- Robust brass housing
- High performance push-pull connector
- Compatible with Data Loggers, Displays and VCUs

## Data Logger C 70

3



### Features

- ▶ Cutting-edge 667 MHz Dual Core Processor
- ▶ Recording on USB flash drive (opt.)
- ▶ Supports GPS lap trigger, pre-dated lap time etc.
- ▶ High programming flexibility using mathematical functions and conditional channels

The data logger C 70 integrates a programmable data logging system for motorsport applications for a very competitive price. Additional input devices can be connected via Ethernet and CAN buses. Data Analysis Software WinDarab is available free of charge as “WinDarab V7 free” on our website. The logger can be upgraded to a 2<sup>nd</sup> logging partition of 1 GB (e.g. for long term recording). For quick data transfer from the car e.g. during pit stop, data copy to a USB stick is available as an option. The stick is connected to the wiring harness for the C 70.

The device comes with 4 analogue and 4 speed inputs as standard; further 12 analogue inputs are available as optional upgrade.

### Application

Processor	667 MHz Dual Core
Converters	8 kHz AD converters with digital low pass filter
Internal power source	Li/Ion capacitor
Configurable math channels	
User configurable CAN in/out messages	
Sampling rate	Max. 1 ms
Online data compression	
Logging rate	Max. 600 kB/s
Recording channels	1,040

Logged data download speed	Max. 1,000 kB/s
Internal storage capacity	3 GB (standard), plus 1 GB (optional)
LTE Ethernet telemetry support, GSM telemetry support	
RS232 for GPS and telemetry	
CCP-Master, data acquisition from ECU that support CAN calibration protocol (optional)	

### Technical Specifications

#### Mechanical Data

Size	151 x 126 x 25.5 mm
Weight	450 g
Protection Classification	IP54 to DIN 40050, Section 9, Issue 2008
Operating temperature internal	-20 to 85°C
Max. vibration	Vibration profile 1 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage	5 to 18 V
<b>Inputs</b>	
Analog channels	4 standard, additional 12 optional
Input range	0 to 5 V
Resolution	12 bit
Switchable pull up resistor	For all ANA_IN
Wheel speed inputs	4 Hall-effect or DF11, switchable

#### Outputs

Sensor supply 5 V ± 1 % (250 mA)	2
Sensor supply 10 V ± 1 % (250 mA)	1
Sensor supply U_Bat 250 mA	1
Sensor ground	4

#### Environment

USB Kit	Rugged USB flash drive Bosch File System (BFS) format included, works with Bosch File System (BFS) preformatted USB Flash drive only Adapter cable to USB-Port Adapter for wiring harness SW license USB-Port unlocked
CCP_MASTER	CCP-Master (ASAP2 file from ECU manufacturer required)
FULL_LOG_2	Enable full logging performance of 1 GB partition 2

I_O EXTENS	Enable additional 12 analog input channels
------------	--

### Connectors and Wires

Motorsport connector on logger	AS216-35PN
Mating connector	F02U.000.466-01
AS616-35SN	

### Pin Configuration

Pin	Name	Comment	Status
1	KL_31		Incl.
2	KL_15		Incl.
3	KL_30		Incl.
4	Rev_In_3	Hall or DF11 switchable	Incl.
5	Rev_In_1	Hall or DF11 switchable	Incl.
6	KL_31		Incl.
7	CAN_2_L	CAN speed selectable	Incl.
8	Ethernet_2_TXP		Incl.
9	Ethernet_2_TXN		Incl.
10	Sens_Power_12V	over current protected	Incl.
11	Rev_In_4	Hall or DF11 switchable	Incl.
12	Rev_In_2	Hall or DF11 switchable	Incl.
13	Laptrigger_In		Incl.
14	CAN_2_H	CAN speed selectable	Incl.
15	CAN_1_H	CAN speed selectable	Incl.
16	Ethernet_2_RXP		Incl.
17	Sens_Gnd_4	fused	Incl.
18	Sens_Power 5V	over current protected	Incl.
19	ANA_IN_3	3.01 kOhm switchable	Incl.
20	ANA_IN_4	3.01 kOhm switchable	Incl.
21	Time_Sync	connection to Bosch ECU	Incl.
22	CAN_1_L	CAN speed selectable	Incl.
23	Com_screen	Ethernet and USB screen	Incl.
24	Ethernet_2_RXN		Incl.
25	Sens_Gnd_3	fused	Incl.
26	Sens_Power 5V	over current protected	Incl.
27	ANA_IN_7	3.01 kOhm switchable	Opt.
28	ANA_IN_1	3.01 kOhm switchable	Incl.
29	USB_Device_DP	to Bosch USB stick	Opt.
30	RS232_TX_Telemetry		Incl.
31	Ethernet_1_TXP		Incl.
32	Sens_Gnd_2	fused	Incl.
33	Sens_Power_10V	over current protected	Incl.
34	ANA_IN_8	3.01 kOhm switchable	Opt.
35	ANA_IN_10	3.01 kOhm switchable	Opt.
36	USB_Device_Gnd	to Bosch USB stick	Opt.

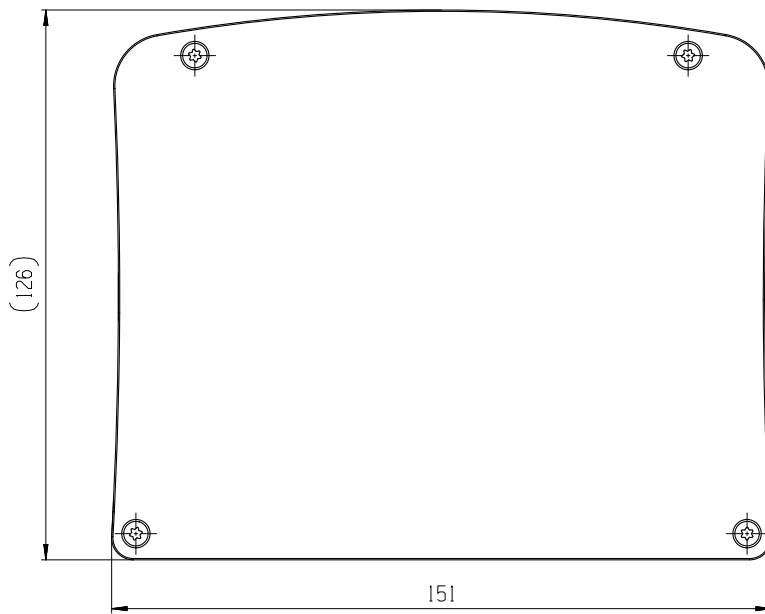
Pin	Name	Comment	Status
37	USB_Device_DN	to Bosch USB stick	Opt.
38	RS232_RX_Telemetry	e.g. GSM telemetry	Incl.
39	Ethernet_1_TXN		Incl.
40	Sens_Gnd_1	fused	Incl.
41	ANA_IN_11	3.01 kOhm switchable	Opt.
42	ANA_IN_9	3.01 kOhm switchable	Opt.
43	RS232_TX_GPS		Incl.
44	ANA_IN_16	3.01 kOhm switchable	Opt.
45	USB_Device_Power	to Bosch USB stick	Opt.
46	Ethernet_1_RXP		Incl.
47	ANA_IN_12	3.01 kOhm switchable	Opt.
48	ANA_IN_6	3.01 kOhm switchable	Opt.
49	ANA_IN_2	3.01 kOhm switchable	Incl.
50	ANA_IN_13	3.01 kOhm switchable	Opt.
51	ANA_IN_15	3.01 kOhm switchable	Opt.
52	Ethernet_1_RXN		Incl.
53	ANA_IN_5	3.01 kOhm switchable	Opt.
54	RS232_RX_GPS	for GPS sensor input	Incl.
55	ANA_IN_14	3.01 kOhm switchable	Opt.

### Communication

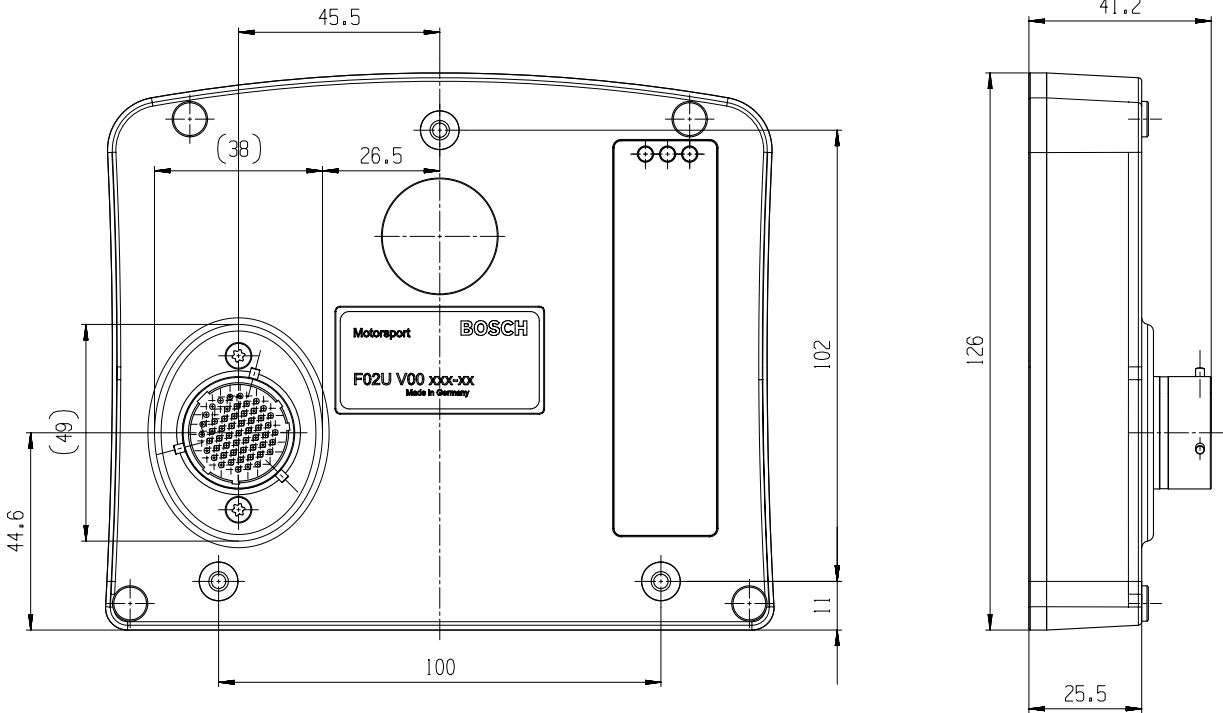
CAN interfaces	2
Ethernet 100BaseT	2
Laptrigger input	1
RS232	Telemetry, GPS
Configuration via RaceCon	Over Ethernet or MSA-Box II

### Installation Notes

Inspection services recommended after 220 h or 2 years, no components to replace.

**Ordering Information****Data Logger C 70**Order number **F02U.V02.302-01****Software Options****CCP\_MASTER**Order number **F02U.V02.213-01****FULL\_LOG\_2**Order number **F02U.V02.305-01****I\_O EXTENS**Order number **F02U.V02.205-01****Accessories****Vehicle Loom Basic**Order number **F02U.V02.735-01****Bench Loom**Order number **F02U.V02.349-01****USB Kit for C 70, C 80, DDU 9, DDU 10 and VCU**Order number **F02U.V02.214-01****Dimensions**





## Data Logger C 80

Partition 2:  
Additional 4 GB with  
FULL\_LOG\_2



3

### Features

- ▶ Aluminum housing
- ▶ Powerful data logger with up to 20 GB memory
- ▶ Supports Bosch multi-logger configuration
- ▶ USB recording and full telemetry support

The data logger C 80 is a professional data logging system for motorsport applications. This allows for synchronized acquisition of engine data from the ECU and chassis data from up to 26 analog and 4 digital input channels. Additional input devices can be connected via Ethernet and CAN buses.

Recorded data from the up to 16 GB logger can be downloaded via high speed Ethernet.

Software upgrades for the C 80 (field upgradable by entering a key) activate tailored configurations like a second logging partition of 4 GB, USB recording, CCP/XCP-master for simple data access to third party devices, as well as additional input channels.

### Application

Converters	10 kHz 12 bit AD converters with digital low pass filter
Configurable math channels	
User configurable CAN in/out messages	
Sampling rate	Max. 1,000 Hz for all channels
Online data compression	
Logging rate	600 kB/s standard, up to 800 kB/s with FULL_LOG_1
Recording channels	Up to 1.440
Logged data download speed	Max. 1,000 kB/s
Internal storage capacity	Partition 1: 6 GB, up to 16 GB with FULL_LOG_1,

3-port network switch

Telemetry Support via Ethernet (recommended) and RS232

RS232 GPS input

CCP/XCP-Master, data acquisition from ECU that support CAN calibration protocol (optional)

### Technical Specifications

#### Mechanical Data

Size	105 x 34.5 x 137.5 mm
Weight	462 g
Protection Classification	IP67 to DIN 40050, Section 9, Issue 2008
Operating temperature (internal)	-20 to 65°C
Max. vibration	Vibration profile 1 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage	8 to 18 V
Max. power consumption (w/o loads)	10 W at 14 V

#### Inputs

Analog channels	6
Input range	0 to 5 V
Resolution	12 bit
Switchable pull up resistor	3 kOhm

#### Outputs

PWM outputs (low side switch 2 A each)	4
Sensor supply 5 V ± 1 % (250 mA)	1

#### Environment

##### Software Upgrade CCP\_MASTER

CCP/XCP-Master (ASAP 2 file from ECU manufacturer required)

##### Software Upgrade FULL\_LOG\_1

Enable logging partition 1 with 4 GB memory, 600 kB/s (666 MHz)

##### Software Upgrade PERF\_LOG\_1

Increase logging partition 1 from 4 GB to 16 GB memory, 800 kB/s (866 MHz)

##### Software Upgrade FULL\_LOG\_2

Enable logging partition 2 with 4 GB memory. Ideally for protected access by different teams or to use as long-term logger.

##### Software Upgrade I\_O EXTENS

Additional analog channels	20
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Rotational channels (input Hall/ inductive)	4
Additional sensor supply 5 V (250 mA each)	3
Sensor supply 10 V (250 mA)	1
Sensor supply 12 V (1 A), non-regulated	1
RS232	GPS

#### USB Kit for C 80

Rugged USB flash drive Bosch File System (BFS) format included, works with BFS preformatted USB flash drive only

Adapter cable to USB-Port

Adapter for wiring harness

SW license USB-Port unlocked

#### Connectors and Wires

Motorsport connectors double density	2 x 41 pins
Mating connector I ASDD612-41SN	F02U.002.216-01
Mating connector II ASDD612-41SA	F02U.004.180-01

#### Pin Layout

##### ASDD212-41PN

Pin	Name	Description
1	KL30	
2; 3	KL15	
4; 5	KL31	
6	Ethernet Channel0 Tx plus	Wire Ethernet_0 - TX+
7	Ethernet Channel0 Tx minus	Wire Ethernet_0 - TX-
8	Ethernet Channel0 Rx plus	Wire Ethernet_0 - RX+
9	Ethernet Channel0 Rx minus	Wire Ethernet_0 - RX-
10	Ethernet Schirm	Ethernet Schirm
11	Ethernet Channel1 Tx plus	Wire Ethernet_0 - TX+
12	Ethernet Channel1 Tx minus	Wire Ethernet_0 - TX-
13	Ethernet Channel1 Rx plus	Wire Ethernet_0 - RX+
14	Ethernet Channel1 Rx minus	Wire Ethernet_0 - RX-
15	Ethernet Channel2 Tx plus	Wire Ethernet_0 - TX+
16	Ethernet Channel2 Tx minus	Wire Ethernet_0 - TX-
17	Ethernet Channel2 Rx plus	Wire Ethernet_0 - RX+

Pin	Name	Description
18	Ethernet Channel2 Rx minus	Wire Ethernet_0 - RX-
19	CAN_A_H	CAN_A - HIGH
20	CAN_A_L	CAN_A - LOW
21	CAN_B_H	CAN_B - HIGH
22	CAN_B_L	CAN_B - LOW
23	USB Power	500mA USB_Power
24	USB Data Plus	USB_OTG_Plus
25	USB Data Minus	USB_OTG_Minus
26	USB GND	USB_Ground
27	SENSPWR5_1	
28	SENSGND	
29	Timestamp	
30	LS_GND_1	Low-Side Ground2
31	LS_SWITCH_1	lowside switch 2A
32	LS_SWITCH_2	lowside switch 2A
33	LS_SWITCH_3	lowside switch 2A
34	LS_SWITCH_4	lowside switch 2A
35	LS_GND_2	Low-Side Ground2
36	ANAIN_M1_1	0 to 5V Analog
37	ANAIN_M1_2	0 to 5V Analog
38	ANAIN_M1_3	0 to 5V Analog
39	ANAIN_M1_4	0 to 5V Analog
40	ANAIN_M1_5	0 to 5V Analog
41	ANAIN_M1_6	0 to 5V Analog

##### ASDD212-41PA

Pin	Name	Description
1	UBATT_FUSE1	
2	SENSPWR10_1	
3	SENSPWR5_2	
4	SENSPWR5_3	
5	SENSPWR5_4	
6	SENSGND	
7	SENSGND	
8	RS232A TX	RS232A - Transmit
9	RS232A RX	RS232A - Receive
10	RS232B TX	RS232A - Transmit
11	RS232B RX	RS232A - Receive
12	RS232_GND	RS232_GND
13	REV1_P	DHE I/P or Inductive - KW+
14	REV1_M	DHE I/P or Inductive - KW-
15	REV2_P	DHE I/P or Inductive - KW+
16	REV2_M	DHE I/P or Inductive - KW-
17	REV3_P	DHE I/P or Inductive - KW+
18	REV3_M	DHE I/P or Inductive - KW-

Pin	Name	Description
19	REV4_P	DHE I/P or Inductive - KW+
20	REV4_M	DHE I/P or Inductive - KW-
21	ANAIN_M1_7	0 to 5V Analog
22	ANAIN_M1_8	0 to 5V Analog
23	ANAIN_M1_9	0 to 5V Analog
24	ANAIN_M1_10	0 to 5V Analog
25	ANAIN_M1_11	0 to 5V Analog
26	ANAIN_M1_12	0 to 5V Analog
27	ANAIN_M1_13	0 to 5V Analog
28	ANAIN_M1_14	0 to 5V Analog
29	ANAIN_M1_15	0 to 5V Analog
30	ANAIN_M1_16	0 to 5V Analog
31	ANAIN_M2_1	0 to 5V Analog
32	ANAIN_M2_2	0 to 5V Analog
33	ANAIN_M2_3	0 to 5V Analog
34	ANAIN_M2_4	0 to 5V Analog
35	ANAIN_M2_5	0 to 5V Analog
36	ANAIN_M2_6	0 to 5V Analog
37	ANAIN_M2_7	0 to 5V Analog
38	ANAIN_M2_8	0 to 5V Analog
39	ANAIN_M2_9	0 to 5V Analog
40	ANAIN_M2_10	0 to 5V Analog
41	LAPTRIGGER	

### Communication

Configuration via RaceCon over Ethernet or MSA-Box II	
CAN interfaces	2
Ethernet 100BaseT	3
Telemetry	Ethernet or RS232
Lap trigger input	1

### Installation Notes

Inspection services recommended after 220 h or 2 years, no components to replace.

Depending on your experience calibrating Bosch ECUs, we recommend calibration support from Bosch Motorsport.

Please remember that the mating connectors and the programming interface MSA Box II are not included and must be ordered separately.

Not reverse polarity protected on supply or outputs.

### Software

The required software (.pst file) for this device is available in the download area of our homepage [www.bosch-motorsport.com](http://www.bosch-motorsport.com).

Download data and save configurations before sending device as it will be reset during service.

### Ordering Information

#### Data Logger C 80 Logger Pack

Incl. FULL\_LOG\_1  
Order number **F02U.V03.083-01**

#### Data Logger C 80 Sensor Interface Pack

Incl. I\_O EXTENS  
Order number **F02U.V03.082-01**

#### Software Options

##### CCP\_MASTER

Order number **F02U.V02.213-01**

##### FULL\_LOG\_1

Order number **F02U.V02.304-01**

##### PERF\_LOG\_1

Order number **F02U.V03.054-01**

##### FULL\_LOG\_2

Order number **F02U.V02.305-01**

##### I\_O EXTENS

Order number **F02U.V02.205-01**

#### Accessories

##### USB Kit for C 70, C 80, DDU 9, DDU 10 and VCU

Order number **F02U.V02.214-01**

## USB Kit



### Features

- ▶ Capacity 2 GB
- ▶ Robust brass housing
- ▶ High performance push-pull connector
- ▶ Compatible with Data Loggers, Displays and VCUs

The USB Kit enables your DDU, data logger or VCU to store data on a USB flash drive. The Kit includes a rugged USB flash drive, an adapter cable to USB-port and a connection socket to the wiring harness. A key number to unlock the USB-port is also part of the Kit.

The rugged USB flash drive is securely mounted within a rugged brass housing designed to provide full protection against extreme environmental conditions. It is IP68 protected and resistant to extreme operating temperatures (-30 to 85°C). The USB flash drive is equipped with a rugged protection cap.

### Application

Operating temperature range	-30 to 85°C
Protection class	IP68
Tightening torque of Backnut for connection socket	1.5 to 2.0 Nm
Max. vibration	Vibration Profile 3 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

### Technical Specifications

#### Mechanical Data

Housing material	Brass
Weight	42 g
Length	72 mm
Bore diameter	15.5 mm

#### Electrical Data

Capacity	2 GB
Specification	USB 1.1/2.0
Data rate	USB 2.0 up to 480 MBit/s

#### Connectors and Wires

Pin layout for connection to vehicle loom (see also Dimensions)

Pin 1	Data -
Pin 2	+5 V
Pin 3	GND
Pin 4	Data +

#### Content of the Kit

Rugged USB flash drive
Adapter cable to PC USB-Port
Mating connector for USB flash drive on car loom side
Software license for USB-Port unlocked

### Installation Notes

The USB flash drive should be fixed on a soft surface to reduce stress.

### Ordering Information

#### USB Kit

Order number **F02U.V02.214-01**

#### USB Kit for C 60

Order number **F02U.V00.872-02**

#### Accessories

##### Rugged USB flash drive

Order number **F02U.V01.342-03**

##### Adapter cable to PC USB-Port

Order number **F02U.V01.343-01**

##### Mating connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

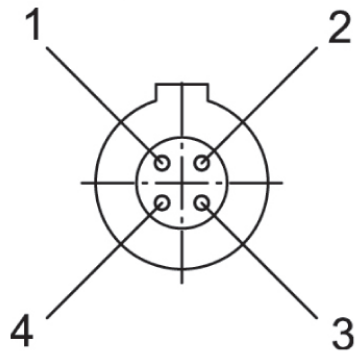
##### USB Kit for C 70, C 80, DDU 9, DDU 10 and VCU

Order number **F02U.V02.214-01**

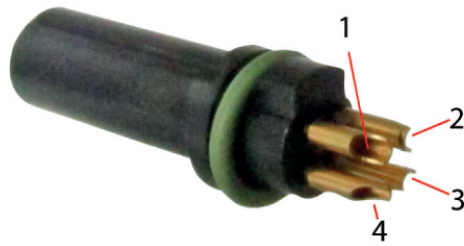
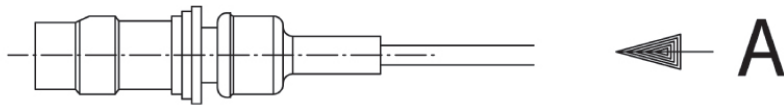
Dimensions

3

View A



- 1: Data-
- 2: +5V
- 3: GND
- 4: Data+



## Overview

### Injection Power Stage HPI 5



- Max. 8 cylinders
- Max. 14,000 rpm (4 cyl. operation)
- 550 g

### Injection Power Stage HPI 5-M 4C



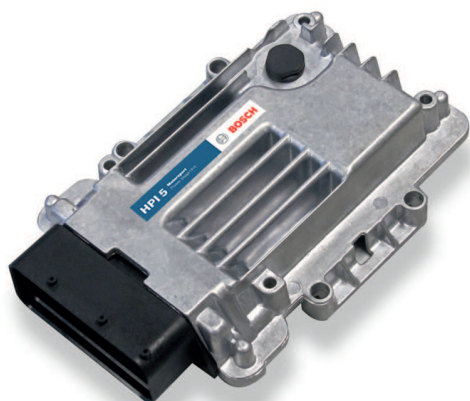
- Max. 4 cylinders
- Max. 15,000 rpm (4 cyl. operation)
- 400 g

### Injection Power Stage HPI 5-M 8C



- Max. 8 cylinders
- Max. 8,000 rpm (8 cyl. operation)
- 440 g

## Injection Power Stage HPI 5



3

### Features

- ▶ Max. 8 cylinders
- ▶ Max. 14,000 rpm (4 cyl. operation)
- ▶ 550 g

The injector power stage HPI 5 is a device for driving injectors and high pressure pumps for gasoline direct injection. Combined with a suitable ECU up to 8 injectors can be driven. The injectors are gathered in 4 groups of 2 injectors each. Within a group only one injector can be switched on at the same time. The 4 groups are totally independent, so that overlapping injection of injectors of different groups is possible. The HPI 5 is mainly designed to drive the Bosch high pressure pump HDP 5. Communication between main ECU and the HPI 5 is realized via CAN interface.

### Application

Max. number of cylinders	8
Max. rpm (8 cyl. operation)	7,000
Max. rpm (4 cyl. operation)	14,000

### Technical Specifications

#### Mechanical Data

Aluminum housing	
Each connector pin individually filtered	
Housing temperature	-25 to 85°C
Size (incl. connectors)	190 x 123 x 36 mm
Weight	550 g

#### Electrical Data

Voltage supply	14 V
Operating voltage	10 to 16 V
Operation voltage (engine start)	6.5 to 16 V
Nominal voltage	14 V

#### Connectors and Wires

Mating connector	D261.205.353-01
------------------	-----------------

### Communication

1 CAN (1 Mbaud)

### Ordering Information

**Injection Power Stage HPI 5**  
Optimized for Bosch HDP 5  
Order number **F02U.V00.929-02**

**Injection Power Stage HPI 5**  
Optimized for Hitachi HDP Gen 1  
Order number **F02U.V01.055-02**



## Injection Power Stage HPI 5-M 4C



### Features

- ▶ Max. 4 cylinders
- ▶ Max. 15,000 rpm (4 cyl. operation)
- ▶ 400 g

The injector power stage HPI 5-M 4C is a device for driving injectors and high pressure pumps for gasoline direct injection. Combined with a suitable ECU up to 4 injectors can be driven. Overlapping injection of injectors is possible. The HPI 5-M is mainly designed to drive the Bosch high pressure pump HDP 5. Communication between main ECU and the HPI 5-M is realized via CAN interface.

### Application

Max. number of cylinders	4
Max. rpm (4 cyl. operation)	15,000
Optimized for Bosch high pressure injection valve HDEV 5 and Bosch high pressure pump HDP 5	

### Technical Specifications

#### Mechanical Data

Aluminum housing	
Each connector pin individually filtered	
Housing temperature	-25 to 100°C
Size (incl. connectors)	167 x 97 x 39 mm
Protection Classification	IP67 to DIN 40050, Section 9, Issue 2008
Weight	400 g

#### Electrical Data

Voltage supply	14 V
Operating voltage	12 to 16 V

Operation voltage (engine start)	6.5 to 16 V
Nominal voltage	14 V

#### Connectors and Wires

Mating connector	AS616-26SN
------------------	------------

#### Pin Configuration

16-26 (size 16) 26#20 7,5 A		
Pin	Name	Comment
A	O_P_FSCVL1	Flow control valve #1 output low side
B	V_V_BAT_R	Battery plus
C	V_V_BAT_R	Battery plus
D	G_G_BAT	Battery minus
E	G_G_BAT	Battery minus
F	O_P_BANK2_LS4_LS6	Injector control output, Low side of HDEV Injector #4
G	O_P_BANK2_HS4_HS6	Injector control output, High side of HDEV Injector #4
H	O_P_BANK1_HS2_HS2	Injector control output, High side of HDEV Injector #2
I	O_P_BANK1_LS2_LS2	Injector control output, Low side of HDEV Injector #2
K	O_P_BANK2_LS3_LS3	Injector control output, Low side of HDEV Injector #3
L	O_P_BANK2_HS3_HS3	Injector control output, High side of HDEV Injector #3
M	O_P_BANK1_HS1_HS1	Injector control output, High side of HDEV Injector #1
N	O_P_BANK1_LS1_LS1	Injector control output, Low side of HDEV Injector #1
P	I_P_HPIND1_D1	Injector control, input signal for injector #1
R	O_P_FSCVH1	Flow control valve #1 output high side
S	I_P_HPIND2_D2	Injector control, input signal for injector #2
T	V_V_BAT_R	Battery plus
U	G_G_BAT	Battery minus
V	I_P_1SEL1	Flow control valve #1, input signal "SEL1"
W	I_P_HPIND4_D6	Injector control, input signal for injector #4
X	I_S_T15	Input "Terminal 15" (Ignition switch)
Y	B_D_CANL	CAN Interface, Signal "CAN Low"
Z	B_D_CANH	CAN Interface, Signal "CAN High"
a	I_P_HPIND3_D3	Injector control, input signal for injector #3

16-26 (size 16) 26#20 7,5 A

b	I_P_1SELO	Flow control valve #1, input signal "SELO"
c	I_P_1ON	Flow control valve #1, input signal "ON"

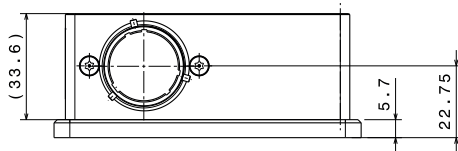
**Communication**

1 CAN (1 Mbaud)

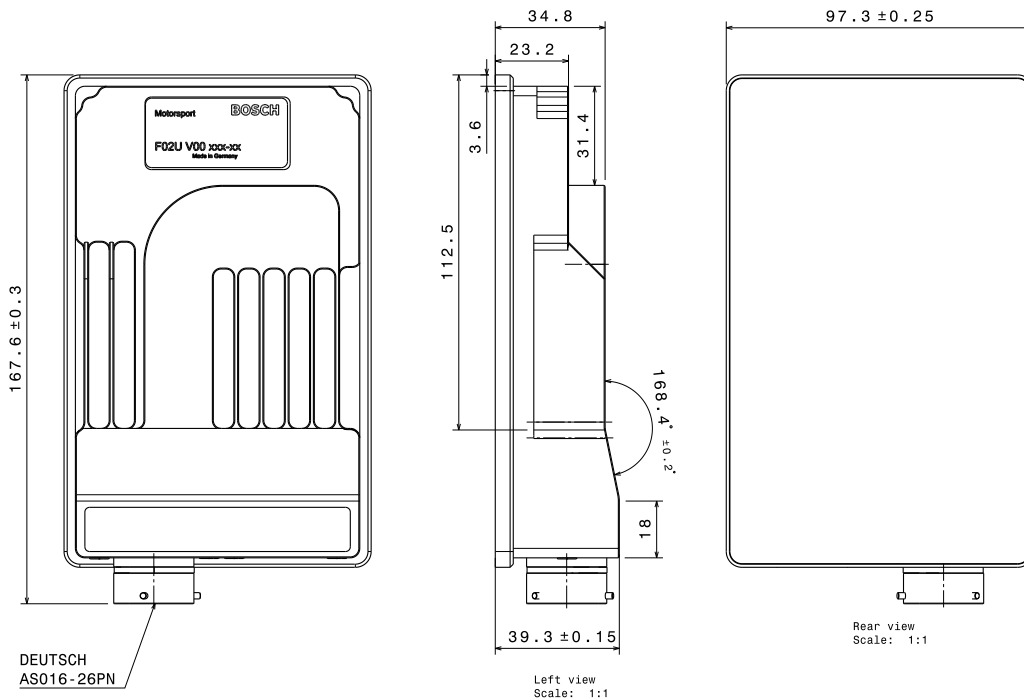
**Ordering Information**

**Injection Power Stage HPI 5-M 4C**  
Order number **F02U.V01.629-01**

**Dimensions**



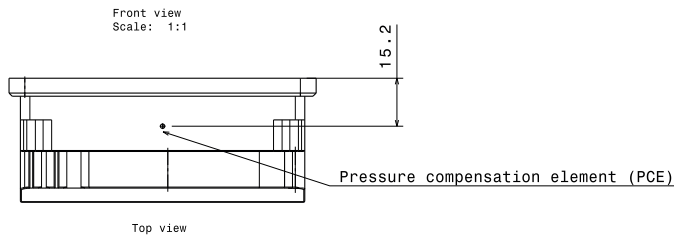
Bottom view  
Scale: 1:1



DEUTSCH  
AS016-26PN

Left view  
Scale: 1:1

Rear view  
Scale: 1:1



Front view  
Scale: 1:1

Top view

Pressure compensation element (PCE)

## Injection Power Stage HPI 5-M 8C



### Features

- ▶ Max. 8 cylinders
- ▶ Max. 8,000 rpm (8 cyl. operation)
- ▶ 440 g

The injector power stage HPI 5-M 8C is a device for driving injectors and high pressure pumps for gasoline direct injection. Combined with a suitable ECU up to 8 injectors can be driven. The injectors are gathered in 4 groups of 2 injectors each. Within a group only one injector can be switched on at the same time. The 4 groups are totally independent, so that overlapping injection of injectors of different groups is possible. The HPI 5-M is mainly designed to drive the Bosch high pressure pump HDP 5. Communication between main ECU and the HPI 5-M is realized via CAN interface.

### Application

Max. number of cylinders	8
Max. rpm (8 cyl. operation)	8,000
Max. rpm (6 cyl. operation)	9,500
Optimized for Bosch high pressure injection valve HDEV 5 and Bosch high pressure pump HDP 5	

### Technical Specifications

#### Mechanical Data

Aluminum housing	
Each connector pin individually filtered	
Housing temperature	-25 to 100°C
Size (incl. connectors)	167 x 97 x 39 mm
Protection Classification	IP67 to DIN 40050, Section 9, Issue 2008

Weight	440 g
<b>Electrical Data</b>	
Voltage supply	14 V
Operating voltage	12 to 16 V
Operation voltage (engine start)	6.5 to 16 V
Nominal voltage	14 V
<b>Connectors and Wires</b>	
Mating connector	AS616-26SN AS614-19SN

#### Pin Configuration

16-26 (size 16) 26#20 7,5 A

Pin	Name	Comment
A	O_P_FSCVL1	Flow control valve #1 output low side
B	V_V_BAT_R	Battery plus
C	V_V_BAT_R	Battery plus
D	G_G_BAT	Battery minus
E	G_G_BAT	Battery minus
F	O_P_BANK2_LS4_L S6	Injector control output, Low side of HDEV Injector #4 (6-cyl. engine: #6)
G	O_P_BANK2_HS4_H S6	Injector control output, High side of HDEV Injector #4 (6-cyl. engine: #6)
H	O_P_BANK1_HS2_H S2	Injector control output, High side of HDEV Injector #2 (6-cyl. engine: #2)
I	O_P_BANK1_LS2_L S2	Injector control output, Low side of HDEV Injector #2 (6-cyl. engine: #2)
K	O_P_BANK2_LS3_L S3	Injector control output, Low side of HDEV Injector #3 (6-cyl. engine: #3)
L	O_P_BANK2_HS3_H S3	Injector control output, High side of HDEV Injector #3 (6-cyl. engine: #3)
M	O_P_BANK1_HS1_H S1	Injector control output, High side of HDEV Injector #1 (6-cyl. engine: #1)
N	O_P_BANK1_LS1_L S1	Injector control output, Low side of HDEV Injector #1 (6-cyl. engine: #1)
P	I_P_HPIND1_D1	Injector control, input signal for injector #1 (6-cyl. engine: #1)
R	O_P_FSCVH1	Flow control valve #1 output high side
S	I_P_HPIND2_D2	Injector control, input signal for injector #2 (6-cyl. engine: #2)
T	V_V_BAT_R	Battery plus

## 16-26 (size 16) 26#20 7,5 A

U	G_G_BAT	Battery minus
V	I_P_1SEL1	Flow control valve #1, input signal "SEL1"
W	I_P_HPIND4_D6	Injector control, input signal for injector #4 (6-cyl. engine: #6)
X	I_S_T15	Input "Terminal 15" (Ignition switch)
Y	B_D_CANL	CAN Interface, Signal "CAN Low"
Z	B_D_CANH	CAN Interface, Signal "CAN High"
a	I_P_HPIND3_D3	Injector control, input signal for injector #3 (6-cyl. engine: #3)
b	I_P_1SELO	Flow control valve #1, input signal "SELO"
c	I_P_1ON	Flow control valve #1, input signal "ON"

## 14-19 (size 14) 19#20 7,5 A

Pin	Name	Comment
A	I_P_HPIND6_D5	Injector control, input signal for injector #6 (6-cyl. engine: #5)
B	O_P_BANK1_LS5_L S4	Injector control output, Low side of HDEV Injector #5 (6-cyl. engine: #4)
C	O_P_BANK1_HS5_H S4	Injector control output, High side of HDEV Injector #5 (6-cyl. engine: #4)
D	O_P_BANK2_HS7	Injector control output, High side of HDEV Injector #7 (6-cyl. engine: not used)
E	O_P_BANK2_LS7	Injector control output, Low side of HDEV Injector #7 (6-cyl. engine: not used)
F	O_P_BANK1_LS6_L S5	Injector control output, Low side of HDEV Injector #6 (6-cyl. engine: #5)

## 14-19 (size 14) 19#20 7,5 A

G	O_P_BANK1_HS6_H S5	Injector control output, High side of HDEV Injector #6 (6-cyl. engine: #5)
H	O_P_BANK2_HS8	Injector control output, High side of HDEV Injector #8 (6-cyl. engine: not used)
I	O_P_BANK2_LS8	Injector control output, Low side of HDEV Injector #8 (6-cyl. engine: not used)
K	I_P_HPIND8	Injector control output, Low side of HDEV Injector #8 (6-cyl. engine: not used)
L	G_G_BAT	Battery minus
M	O_P_FSCVH2	Flow control valve #2 output high side
N	I_P_2SELO	Flow control valve #2, input signal "SELO"
P	I_P_HPIND7	Injector control, input signal for injector #7 (6-cyl. engine: not used)
R	I_P_2SEL1	Flow control valve #2, input signal "SEL1"
S	O_P_FSCVL2	Flow control valve #2 output low side
T	G_G_BAT	Battery minus
U	I_P_2ON	Flow control valve #2, input signal "ON"
V	I_P_HPIND5_D4	Injector control, input signal for injector #5 (6-cyl. engine: #4)

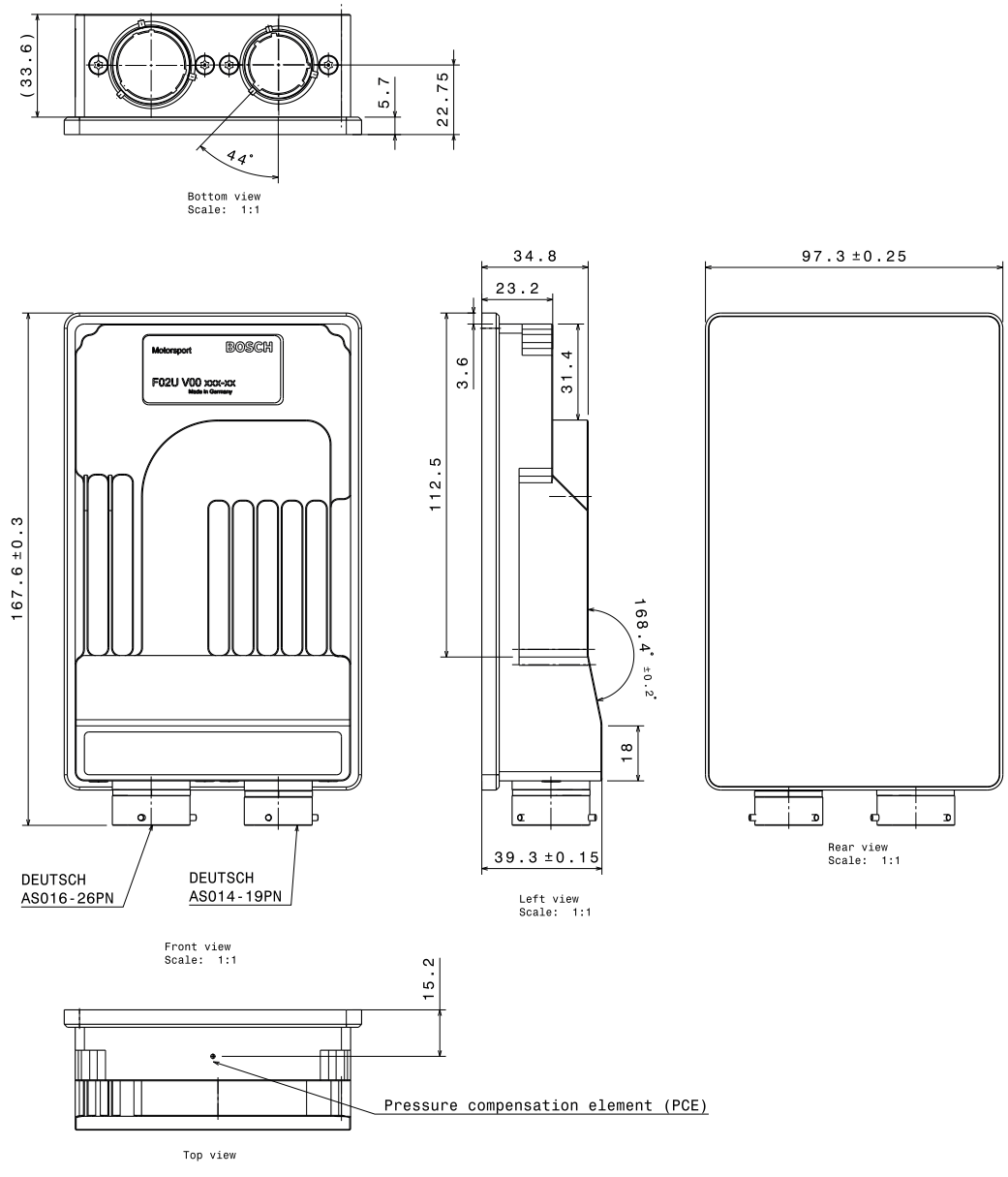
## Communication

1 CAN (1 Mbaud)

## Ordering Information

**Injection Power Stage HPI 5-M 8C**  
Order number **F02U.V01.630-01**

Dimensions



## CAN Keypad CK-M12

3



### Features

- ▶ 12 standard buttons with color indicator rings
- ▶ 9 additional digital switch inputs
- ▶ Moveable button inserts
- ▶ CAN input / output

The CAN Keypad CK-M12 allows for simplification of the dashboard by offering 12 buttons and 9 additional wired inputs to be evaluated and transmitted via CAN bus to other devices on the bus. Each button has an individually addressable LED indicating ring that can be used to acknowledge a button press event, indicate status of a device, or alert the driver to a fault condition. No special configuration software is needed, all feedback logic is done by PBX, DDU or ECU. Each keypad is supplied with 15 black inserts, optional insert kits are also available.

### Application

Usage	PBX / DDU / ECU Interface
Temperature range	-40 to 85°C

### Technical Specifications

#### Mechanical Data

Weight	280 g
Max. vibration	11 ms 30 G peak
Sealing	IP68

#### Electrical Data

Power supply Vs	9 to 32 V
Average current draw	100 mA
Max current draw	250 mA

### Characteristics

Signal output	CAN
CAN transmit rate	100 Hz*
CAN baud rate	1 Mbaud*
TX ID	0x800*
RX ID	0x801*
TX Data	1 bit status for each input
RX Data	4 bit integer for each indicator color, 4 bit integer for brightness

\* Custom CAN IDs / baud Rate Optional Upon Request

Note: CK-M12 DBC file available for CAN configuration

### Connectors and Wires

CK-M12 Termination	Flying Lead 24AWG
--------------------	-------------------

### Recommended Connectors





CK-M12	AS610-35PN
Mating	AS110-35SN

### Wire Identification

Wire	Function
Red	12/24 V Power
Black	Ground
Yellow	CAN high (CANH)
Green	CAN low (CANL)
White, Black Trace	Digital Input 1 activated by Ground
White, Brown Trace	Digital Input 2 activated by Ground
White, Red Trace	Digital Input 3 activated by Ground
White, Orange Trace	Digital Input 4 activated by Ground
White, Yellow Trace	Digital Input 5 activated by Ground
White, Green Trace	Digital Input 6 activated by Ground
White, Blue Trace	Digital Input 7 activated by Ground
White, Purple Trace	Digital Input 8 activated by Ground
White, Grey Trace	Digital Input 9 activated by Ground

### Insert Kits












#### Insert Road Race Kit

 A/C
 ABS
 Alarm Reset
 Anti-Lag

Insert Road Race Kit	
	Arrow x 4
	Brake Spray
	Boost Decrease
	Boost Increase
	Brightness Down
	Brightness Up
	Close Menu
	Cool Suit
	Cooling Fan
	Day/Night Mode
	Drink
	Flash Hi Beam
	Fuel Reserve
	Fuel Reset
	Full Course Yellow
	Function Toggle
	Gearbox Emergency
	Hazard Flasher
	Heated Windshield
	Helmet Fan
	High Beam
	Horn
	Launch
	Low Beam
	Map Down
	Map Up
	Neutral
	Open Menu
	Page Down
	Page Up
	PDU Reset
	Pit Switch
	Power
	Power Steering Reset
	Pump Out
	Push to Pass
	Radiator Spray
	Rain Light
	Reset

Insert Road Race Kit	
	Reverse
	Select
	Starter
	Traction Control Down
	Traction Control Up
	Wet Mode
	Windshield Spray
	Windshield Wiper
Insert Drag Race Kit	
	A/C
	Alarm Reset
	Anti-Lag
	Arrow x 4
	Boost Decrease
	Boost Increase
	Brightness Down
	Brightness Up
	Burnout
	Close Menu
	Cooling Fan
	Day/Night Mode
	Function Toggle
	Hazard Flasher
	High Beam
	Horn
	Launch
	Line Lock
	Low Beam
	Map Down
	Map Up
	Nitrous Arm
	Nitrous Purge
	Open Menu
	Page Down
	Page Up
	PDU Reset

Insert Drag Race Kit

-  Power
-  Pump Out
-  Push to Pass
-  Reset
-  Select
-  Starter
-  Traction Control Down
-  Traction Control Up
-  Transmission Brake
-  Windshield Spray
-  Windshield Wiper

Insert Alpha/Numeric Kit

A	V
B	W
C	X
D	Y
E	Z
F	!
G	-
H	+
I	0
J	1

Insert Alpha/Numeric Kit

K	2
L	3
M	4
N	5
O	6
P	7
Q	8
R	9
S	10
T	11
U	12

Installation Notes

Installation on flat surface recommended

Bolt size #10-32

Tightening Torque 0.7 +/- 0.1 Nm

Ordering Information

**CAN Keypad CK-M12**

Order number **F02U.V0U.328-02**

**Accessories**

**Insert Road Race Kit**

Order number **F02U.B0U.022-01**

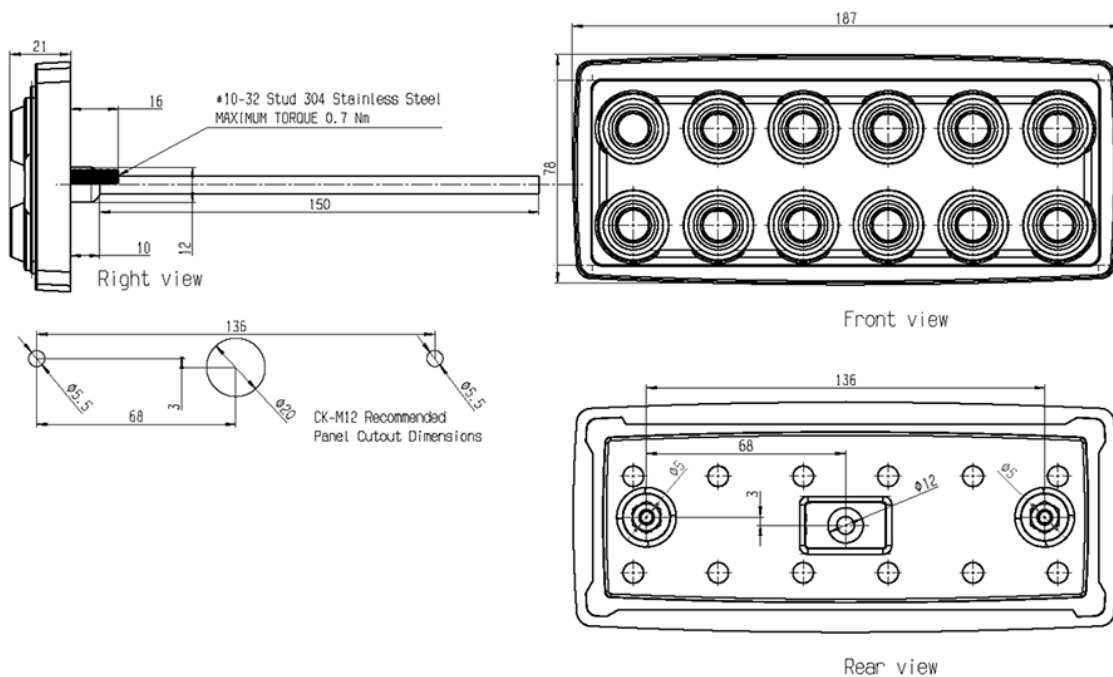
**Insert Drag Race Kit**

Order number **F02U.B0U.023-01**

**Insert Alpha/Numeric Kit**

Order number **F02U.B0U.024-01**

Dimensions





## Overview

### PowerBox PBX 90



- 120 A continuous current
- 36 outputs, 80 A high side switches
- Ethernet, CAN and LIN communication
- Software-tool integrated
- Easy programming of complex functions

### PowerBox PBX 190



- 250 A continuous current
- 52 outputs, 48 V high side switches
- Ethernet, CAN and LIN communication
- Precision current measurement
- Easy programming of complex functions

## PowerBox PBX 90

3



### Features

- ▶ 120 A continuous current
- ▶ 36 outputs, 80 A high side switches
- ▶ Ethernet, CAN and LIN communication
- ▶ Software-tool integrated
- ▶ Easy programming of complex functions

The PowerBox is an intelligent control and distribution unit for the electric grid in a modern racing car, which is seamlessly integrated into the Bosch Motorsport system architecture. It is capable to replace all conventional relays, fuses and circuit breakers, simplifies wiring harnesses and provides diagnostic capabilities. The integrated PBX-software guarantees an easy programming of complex functions by intuitive handling.

### Technical Specifications

#### Mechanical Data

Size	214 x 159 x 57.5 mm
Weight	830 g
Temp. range (at internal sensors)	-20 to 85°C

#### Electrical Data

Supply voltage range	5 to 20 V
Current consumption	<1 A
Maximum recommended output current	120 A continuously >180 A peak current (2 s)

#### Inputs

12 analogue inputs (16 bit resolution) switchable pull-up resistors  
4 digital inputs switchable pull-up/pull-down resistors

#### Outputs

4 high power channels up to 40 A (parallel up to 80 A)  
4 high power channels up to 25 A  
22 high power channels up to 15 A  
6 multi purpose outputs up to 15 A (low side, high side, push-pull, PWM; two output stages can be combined to form an H-bridge)  
1 sensor supply 5 V with individual ground pin

#### Software

Function development and calibration tool Bosch Motorsport PBX Suite

Connector X1: 38 way (ABS/ESR) Code 1

Pin	Signal	Cont. [A]	Peak [A]
1	HP_OUT3	40	150
2	OUT22	15	100
3	PWM_OUT6	15	75
4	OUT21	15	100
5	ANA_IN07	0 to 5 V, Pull-up	
6	ANA_IN08	0 to 5 V, Pull-up	
7	PWM_OUT4	15	75
8	CAN_3_H	1 Mbaud max.	
9	SENSGND	GND for AIN[x]	
10	SENSPWR_5V	0.4	
11	PWM_OUT2	15	75
12	PWM_OUT1	15	75
13	HP_OUT4	40	150
14	ANA_IN03	0 to 5 V, Pull-up	
15	ANA_IN04	0 to 5 V, Pull-up	
16	DIG_IN3	0 to 12 V, Pull-up, Pull-down	
17	DIG_IN4	0 to 12 V, Pull-up, Pull-down	
18	ANA_IN09	0 to 5 V, Pull-up	
19	ANA_IN10	0 to 5 V, Pull-up	
20	CAN_3_L	1 Mbaud max.	
21	BAT_GND	15	100
22	BAT_GND	15	100
23	BAT_GND	15	100
24	BAT_GND	15	100
25	HP_OUT7	25	150
26	OUT19	15	100
27	ANA_IN05	0 to 5 V, Pull-up	
28	OUT20	15	100
29	ANA_IN06	0 to 5 V, Pull-up	
30	OUT17	15	100
31	OUT18	15	100
32	ANA_IN11	0 to 5 V, Pull-up	
33	OUT15	15	100
34	OUT16	15	100

## Connector X1: 38 way (ABS/ESR) Code 1

35	ANA_IN12	0 to 5 V, Pull-up	
36	PWM_OUT3	15	75
37	PWM_OUT5	15	75
38	HP_OUT8	25	150

## Connector X2: 38 way (ABS/ESR) Code 2

Pin	Used for	Cont. [A]	Peak [A]
1	HP_OUT1	40	150
2	OUT14	15	100
3	OUT13	15	100
4	OUT02	15	100
5	OUT01	15	100
6	TIMESTAMP_I NOUT	1 kHz open drain	
7	CAN_2_H	1 Mbaud max.	
8	CAN_1_H	1 Mbaud max.	
9	ETH_1_RXN	10/100 Mbps	
10	ETH_1_TXN	10/100 Mbps	
11	ETH_2_RXN	10/100 Mbps	
12	ETH_2_TXN	10/100 Mbps	
13	HP_OUT2	40	150
14	BAT_GND	15	100
15	ANA_IN01	0 to 5 V, Pull-up	
16	ANA_IN02	0 to 5 V, Pull-up	
17	DIG_IN1	0 to 12 V, Pull-up, Pull-down	
18	DIG_IN2	0 to 12 V, Pull-up, Pull-down	
19	CAN_2_L	1 Mbaud max.	
20	CAN_1_L	1 Mbaud max.	
21	ETH_1_RXP	10/100 Mbps	
22	ETH_1_TXP	10/100 Mbps	
23	ETH_2_RXP	10/100 Mbps	
24	ETH_2_TXP	10/100 Mbps	
25	HP_OUT5	25	150
26	OUT11	15	100
27	OUT09	15	100
28	OUT12	15	100
29	OUT10	15	100
30	OUT07	15	100
31	OUT08	15	100

## Connector X2: 38 way (ABS/ESR) Code 2

32	LIN	Control of Bosch Motorsport LIN devices included. Support of other devices on request.	
33	OUT05	15	100
34	SHIELD_GND	shield	
35	OUT06	15	100
36	OUT03	15	100
37	OUT04	15	100
38	HP_OUT6	25	150

Connector X3: Amphenol Radsok Automotive Pinlock Connector 8 mm (35 mm<sup>2</sup>, 50 mm<sup>2</sup>)

Pin	Used for	Cont. [A]	Peak [A]
1	BATT_POS	120	180

## Communication

CAN	3
Ethernet	2
LIN	1, Control of Bosch Motorsport LIN devices included. Support of other devices on request.

## Installation Notes

Inspection services recommended after 220 h or 2 years, no components to replace.

## Ordering Information

**PowerBox PBX 90**

Order number **F02U.V01.794-06**

**CAN Keypad CK-M12**

Order number **F02U.V0U.328-02**

**Accessories****Mating Connector X1**

Order number **F02U.B00.760-01**

**Mating Connector X2**

Order number **F02U.B00.761-01**

**Mating Connector X3**

Order number **F02U.003.574-01**

**Power Cable 16 mm<sup>2</sup>**

L: 2,000 mm

Order number **F02U.V02.047-01**

**Power Cable 35 mm<sup>2</sup>**

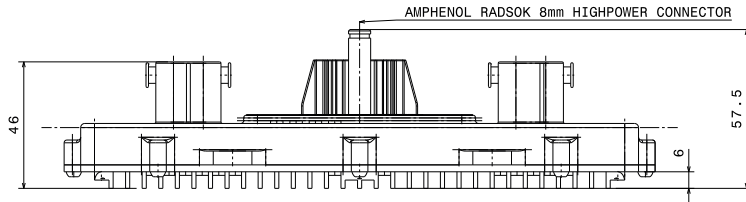
L: 2,000 mm

Order number **F02U.V02.048-01**

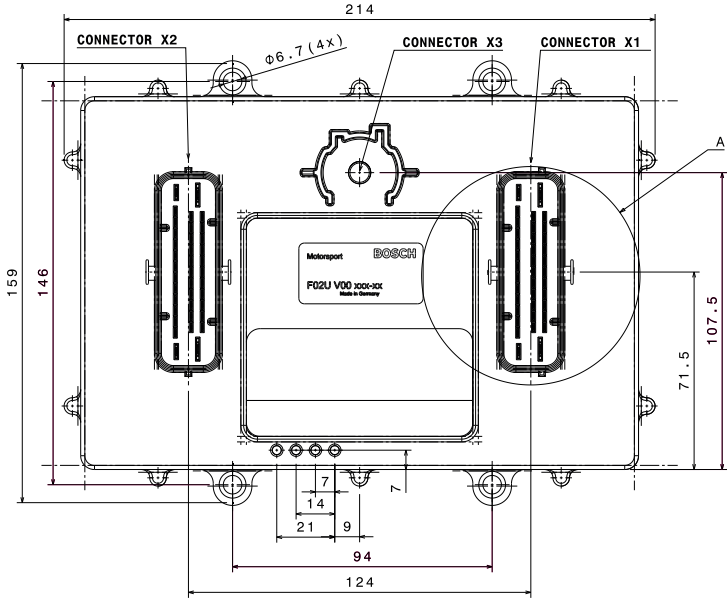
**Breakout Box BOB PBX 90**

Order number **F02U.V02.292-01**

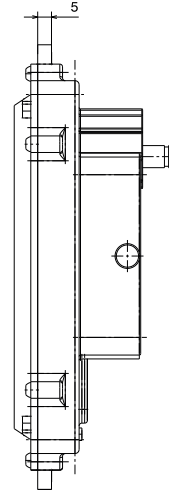
Dimensions



Bottom view

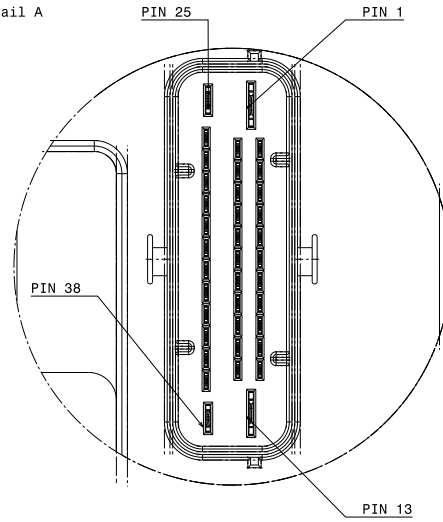


Front view



Left view

Detail A



## PowerBox PBX 190



### Features

- ▶ 250 A continuous current
- ▶ 52 outputs, 48 V high side switches
- ▶ Ethernet, CAN and LIN communication
- ▶ Precision current measurement
- ▶ Easy programming of complex functions

The PowerBox is an intelligent control and distribution unit for the electric grid in a modern racing car, which is seamlessly integrated into the Bosch Motorsport system architecture. It is capable to replace all conventional relays, fuses and circuit breakers, simplifies wiring harnesses and provides diagnostic capabilities. The integrated PBX-software guarantees an easy programming of complex functions by intuitive handling.

### Technical Specifications

#### Mechanical Data

Size	245 x 183 x 37 mm
Weight	1,270 g
Protection Classification	IP67
Internal G-sensors	
Temp. range (at internal sensors)	-20 to 85°C
Max. vibration	Vibration profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage range	5 to 16 V
Current consumption	<1 A continuously
Maximum recommended output current	250 A continuously; >310 A peak current (2 s)

### Inputs

- 18 analogue inputs (16 bit resolution) switchable pull-up resistors
- 10 digital inputs switchable pull-up/pull-down resistors

### Outputs

- 4 high power channels up to 40 A (parallel up to 80 A)
- 10 high power channels up to 25 A
- 26 high power channels up to 15 A
- 4 high side channels up to 25 A, up to 48 V
- 8 multi-purpose outputs up to 15 A (low side, high side, push-pull, PWM; two output stages can be combined to form an H-bridge)
- 2 sensor supplies 5 V with individual ground pin

### Software

- Function development and calibration tool
- Bosch Motorsport PBX Suite

### Pin Configuration

Connector X1: 37 Pins / 8STA62437SA

Pin	Signal	Cont. [A]	Peak [A]
A	HS_15A X1_A	15	100
B	HS_15A X1_B	15	100
C	HS_15A X1_C	15	100
D	HS_15A X1_D	15	100
E	HS_15A X1_E	15	100
F	HS_15A X1_F	15	100
G	HS_15A X1_G	15	100
H	HS_15A X1_H	15	100
J	HS_15A X1_J	15	100
K	HS_15A X1_K	15	100
L	HS_15A X1_L	15	100
M	HS_15A X1_M	15	100
N	HS_15A X1_N	15	100
P	PWM_15A X1_P	15	60
R	PWM_15A X1_R	15	60
S	PWM_15A X1_S	15	60
T	PWM_15A X1_T	15	60
U	HS_15A X1_U	15	100
V	HS_15A X1_V	15	100
W	HS_15A X1_W	15	100
X	HS_15A X1_X	15	100
Y	HS_15A X1_Y	15	100
Z	HS_15A X1_Z	15	100
a	HS_15A X1_a	15	100
b	HS_15A X1_b	15	100
c	PWM_15A X1_c	15	60
d	PWM_15A X1_d	15	60
e	PWM_15A X1_e	15	60
f	PWM_15A X1_f	15	60

## Connector X1: 37 Pins / 8STA62437SA

g	HS_15A X1_g	15	100
h	HS_15A X1_h	15	100
k	HS_15A X1_k	15	100
m	HS_15A X1_m	15	100
n	HS_15A X1_n	15	100
p	Power KL31	15	-
q	Power KL31	15	-
r	Power KL31	15	-

## Connector X2: 1 Pin / 8STA61201BN261

Pin	Signal	Cont. [A]	Peak [A]
1	Power Supply 12 V	200	240

## Connector X3: 19 Pins / 8STA62419SN

Pin	Signal	Cont. [A]	Peak [A]
A	HS_25A X3_A	25	150
B	HS_25A X3_B	25	150
C	HS_25A X3_C	25	150
D	HS_25A X3_D	25	150
E	HS_25A X3_E	25	150
F	HS_25A X3_F	25	150
G + H	HS_40A X3_G_H	40	150
J + T	HS_40A X3_J_T	40	150
K + U	HS_40A X3_K_U	40	150
L + N	HS_40A X3_L_N	40	150
M	HS_25A X3_M	25	150
P	HS_25A X3_P	25	150
R	HS_25A X3_R	25	150
S	HS_25A X3_S	25	150
V	Power KL31	25	-

## Connector X4: 6 Pins / 8STA61606SA

Pin	Signal	Cont. [A]	Peak [A]
A	HS48V_25A X4_A	25	100
B	HS48V_25A X4_B	25	100
C	HS48V_25A X4_C	25	100
D	HS48V_25A X4_D	25	100
E	Supply up to 48 V for X4	25	35
F	Supply up to 48 V for X4	25	35

## Connector X5: 66 Pins / 8STA6-18-35SN

Pin	Signal	Cont. [A]	Peak [A]
1	Analog Input X5_01	0 to 5 V, Pull-up	
2	Analog Input X5_02	0 to 5 V, Pull-up	
3	Analog Input X5_03	0 to 5 V, Pull-up	
4	Analog Input X5_04	0 to 5 V, Pull-up	
5	Analog Input X5_05	0 to 5 V, Pull-up	
6	Analog Input X5_06	0 to 5 V, Pull-up	

## Connector X5: 66 Pins / 8STA6-18-35SN

7	Analog Input X5_07	0 to 5 V, Pull-up
8	Analog Input X5_08	0 to 5 V, Pull-up
9	CAN 3 Interface Low-Level	Max. 1 Mbaud
10	Analog Input X5_10	0 to 5 V, Pull-up
11	Analog Input X5_11	0 to 5 V, Pull-up
12	Analog Input X5_12	0 to 5 V, Pull-up
13	Digital Input X5_13	0 to 12 V, Pull-up, Pull-down
14	Digital Input X5_14	0 to 12 V, Pull-up, Pull-down
15	CAN 3 Interface High-Level	Max. 1 Mbaud
16	LIN	Control of Bosch Motorsport LIN devices included. Support of other devices on request.
17	Analog Input X5_17	0 to 5 V, Pull-up
18	Analog Input X5_18	0 to 5 V, Pull-up
19	DGND-fused	5 A
20	DGND-fused	5 A
21	Digital Input X5_21	0 to 12 V, Pull-up, Pull-down
22	Digital Input X5_22	0 to 12 V, Pull-up, Pull-down
23	SERCOS1 TXP	
24	SERCOS1 TXN	
25	do not connect (use for internal debugging)	
26	do not connect (use for internal debugging)	
27	Analog Input X5_27	0 to 5 V, Pull-up
28	Digital Input X5_28	0 to 12 V, Pull-up, Pull-down
29	Digital Input X5_29	0 to 12 V, Pull-up, Pull-down
30	Analog Input X5_30	0 to 5 V, Pull-up
31	KL31-fused	
32	SERCOS1 RXP	
33	SERCOS1 RXN	
34	do not connect (use for internal debugging)	
35	do not connect (use for internal debugging)	
36	Digital Input X5_36	0 to 12 V, Pull-up, Pull-down
37	Digital Input X5_37	0 to 12 V, Pull-up, Pull-down
38	Analog_Screen	
39	Analog Input X5_39	0 to 5 V, Pull-up
40	KL31-fused	
41	SERCOS2 RXP	
42	SERCOS2 RXN	

Connector X5: 66 Pins / 8STA6-18-35SN		
43	Digital Input X5_43	0 to 12 V, Pull-up, Pull-down
44	Digital Input X5_44	0 to 12 V, Pull-up, Pull-down
45	Sensor GND for X5_51	5 A
46	Timesync	
47	COM_Screen	
48	CAN 1 Interface High-Level	Max. 1 Mbaud
49	SERCOS2 TXP	
50	SERCOS2_TXN	
51	Powersupply_5V X5_51	400 mA
52	Sensor GND for X5_58	5 A
53	ETHERNET1 RXN	10/100 Mbps
54	ETHERNET0 RXN	10/100 Mbps
55	CAN 2 Interface Low-Level	Max. 1 Mbaud
56	CAN 1 Interface Low-Level	Max. 1 Mbaud
57	Analog Input X5_57	0 to 5 V, Pull-up
58	Powersupply_5V X5_58	400 mA
59	ETHERNET1 RXP	10/100 Mbps
60	ETHERNET1 TXN	10/100 Mbps
61	ETHERNET0 TXN	10/100 Mbps
62	CAN 2 Interface High-Level	Max. 1 Mbaud
63	Analog Input X5_63	0 to 5 V, Pull-up
64	ETHERNET1 TXP	10/100 Mbps
65	ETHERNET0 RXP	10/100 Mbps
66	ETHERNET0 TXP	10/100 Mbps

### Communication

CAN	3
Ethernet	2

LIN	1	Control of Bosch Motorsport LIN devices included. Support of other devices on request.
Real time ethernet Sercos (optional)	2	

### Installation Notes

Inspection services recommended after 220 h or 2 years, no components to replace.

### Ordering Information

#### PowerBox PBX 190

Order number **F02U.V02.626-03**

#### CAN Keypad CK-M12

Order number **F02U.V0U.328-02**

### Accessories

#### Mating Connector X1

Order number **F02U.004.387-01**

#### Mating Connector X2

Socket 25 mm<sup>2</sup>

Order number **F02U.B01.044-01**

#### Mating Connector X2

Socket 35 mm<sup>2</sup>

Order number **F02U.B01.045-01**

#### Mating Connector X3

Order number **F02U.004.386-01**

#### Mating Connector X4

Order number **F02U.004.388-01**

#### Mating Connector X5

Order number **F02U.000.472-02**

#### Connector Opening Tool for Shellsize 24

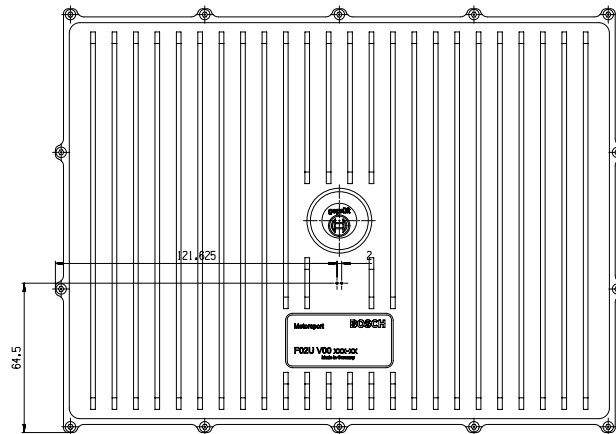
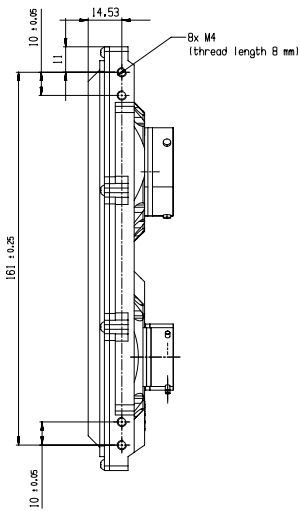
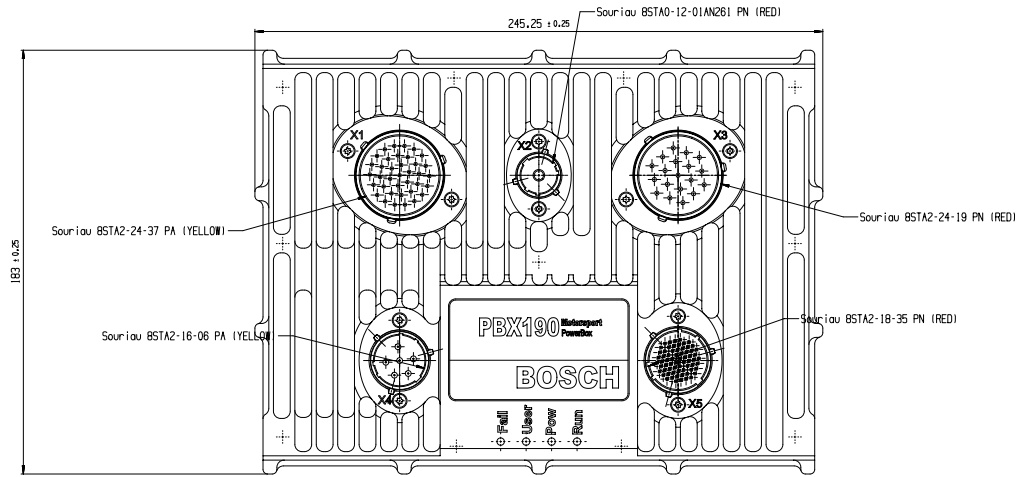
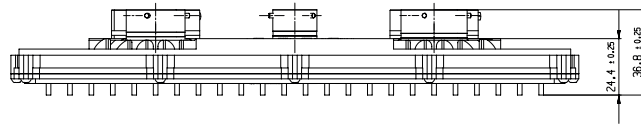
Order number **F02U.V02.434-01**

#### Breakout Box

Order number **F02U.V02.523-01**

Dimensions

3





## Overview

### Lambdatronic LT4



- Supply of up to 4 Bosch lambda sensors, type LSU 4.2, LSU 4.9 or Mini-LSU 4.9
- Integrated voltage compensation for sensor heater

### Lambdatronic LT4 ADV



- Supply of up to 4 Bosch lambda sensors, type LSU ADV
- Integrated voltage compensation for sensor heater

### Modular Sensor Interface M 60



- 30 input channels
- Each channel individually configurable
- Compact dimensions

### Modular Sensor Interface MSI 60



- 50 sensor inputs (differential analogue, single ended analogue, LVDT, frequency, RS232)
- High quality signal processing
- Compact dimensions

### Wheel Speed Signal Splitter



- ABS Wheel Speed Sensor Interface
- Lightweight Aluminum Housing

## Lambdatronic LT4

3



### Features

- ▶ Supply of up to 4 Bosch lambda sensors, type LSU 4.2, LSU 4.9 or Mini-LSU 4.9
- ▶ Integrated voltage compensation for sensor heater

The Lambdatronic LT4 provides controlled pumping current to supply up to 4 Bosch lambda sensors, type LSU 4.2, LSU 4.9 or Mini-LSU 4.9. The lambda value, the sensor temperature and diagnostics are available via CAN and analog signal.

The LSU contains a Nernst and a pump cell. The lambda in the Nernst cell is controlled to  $\lambda = 1.013$  independent of the oxygen contents on the emission side, through a current through the pump cell. The current proportional output voltage of the IC is a measure of the lambda value.

The main feature and benefit of this unit is the combination of the Bosch well known lambda IC and a very compact box size with motorsport specification. Furthermore the analog signal output can be configured freely.

### Application

Application	Lambda 0.75 to 10.12
Compatible Bosch sensor type	LSU 4.2, LSU 4.9, Mini-LSU 4.9
Channels	4
Heater	Internal

### Technical Specifications

#### Mechanical Data

Weight with wire	98 g
Sealing	100 % humidity
Mounting	Velcro
Size w/o wire (w*l*h)	54 x 59 x 13 mm

Operating temp. range (housing)	-20 to 85°C
Storage temp. range	-20 to 85°C
Max. vibration	Vibration Profile 1 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Power supply $U_s$	(6.5) 10 to 14 V
Max power supply (1 min) $U_s$	Max. 26 V
Thermal dissipation loss	3 W at 14 V
Current $I_s$	5 A
Current $I_s$ (Heating up)	26 A

#### Software Tool (free download)

System Configuration tool RaceCon 2.7.0.9 or later

#### Characteristic

Signal output 1	CAN
Signal output 2	4 x 0 to 5 V "analog"
CAN- baud rate	500 kbaud or 1 Mbaud
Signal resolution	2,5 * 10 <sup>-4</sup> lambda
Signal sampling rate	100 Hz
CAN refresh rate	100 Hz

#### Connectors and Wires

Connector	AS614-35PN
Connector loom	F02U.000.365-01
AS114-35SN	
Sleeve	Viton
Wire size	26
Wire length L	20 cm

#### Pin Assignment

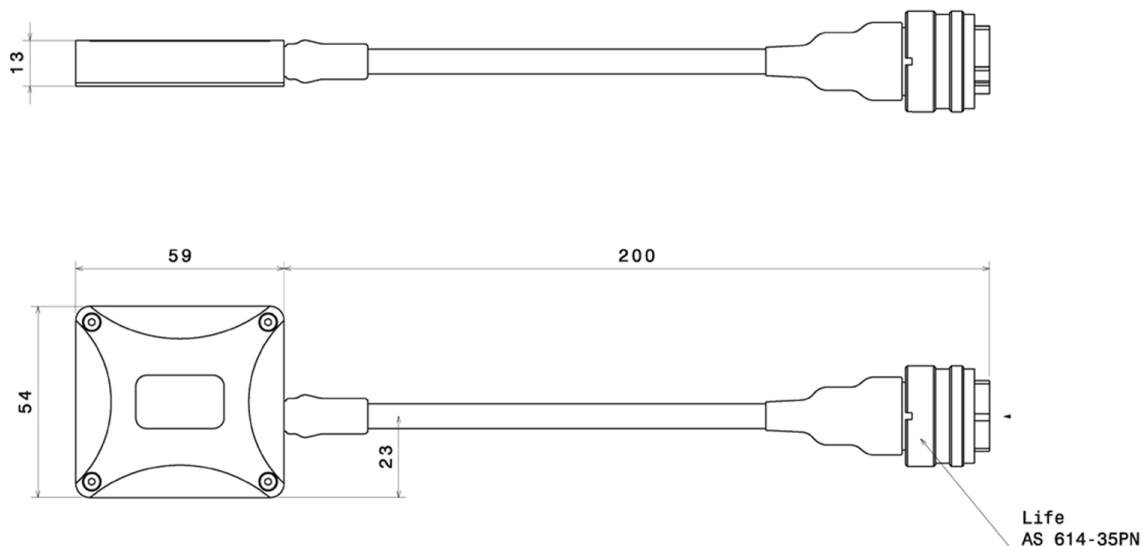
Pin	Function
1	+ 12 V (Battery +)
2	+ 12 V (Battery +)
3	Ground (Battery -)
4	Ground (Battery -)
5	K-Line diagnostic connection
6	CAN1 + (high)
7	CAN1 - (low)
8	Analog out 1
9	Analog out 2
10	Analog out 3
11	Analog out 4
12	Reference GND for analog out
13	Shield
14	Pump current LSU 1 IP1
15	Virtual GND LSU 1 VM1
16	Heater PWM LSU 1 Uh-1

17	Heater (Batt +) LSU 1 Uh+1
18	Setup current LSU 1 IA1
19	Nernst voltage LSU 1 UN1
20	Pump current LSU 2 IP2
21	Virtual GND LSU 2 VM2
22	Heater PWM LSU 2 Uh-2
23	Heater (Batt. +) LSU 2 Uh+2
24	Setup current LSU 2 IA2
25	Nernst voltage LSU 2 UN2
26	Pump current LSU 3 IP3
27	Virtual GND LSU 3 VM3
28	Heater PWM LSU 3 Uh-3
29	Heater (Batt +) LSU 3 Uh+3
30	Setup current LSU 3 IA3
31	Nernst voltage LSU 3 UN3
32	Pump current LSU 4 IP4
33	Virtual GND LSU 4 VM4
34	Heater PWM LSU 4 Uh-4
35	Heater (Batt. +) LSU 4 Uh+4
36	Setup current LSU 4 IA4
37	Nernst voltage LSU 4 UN4

### Communication

Communication link	K-Line / CAN
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### Dimensions



### Installation Notes

Typical lifetime: max. 220 h / 2 years

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program

The LT4 is designed to supply 4 Bosch lambda sensors, type LSU 4.2, LSU 4.9 or Mini-LSU 4.9

The LT4 is featured with voltage compensation for the heating profile

The unit can be connected to any CAN system (500 kbaud or 1 Mbaud) and analog measuring device.

To avoid signal errors, a cable length of maximum 1.5 m between sensor and box is recommended.

The unit is secure from miss-pinning.

The reference ground (GND\_REF) has to be connected either to the measuring device or to the system ground.

A ground offset of 2 V (max.) between GND and GND\_REF has not to be exceeded.

See the LT4 function sheet for software documentation (e.g. CAN protocol).

Please find further application hints in the offer drawing at our homepage.

### Ordering Information

#### Lambdatronic LT4

Order number **F01T.A20.070-09**

## Lambdatronic LT4 ADV

3



### Features

- ▶ Supply of up to 4 Bosch lambda sensors, type LSU ADV
- ▶ Integrated voltage compensation for sensor heater

The Lambdatronic LT4 ADV is a control module designed to supply and control up to four Bosch LSU ADV. The lambda sensor LSU ADV offers extended features as an improved robustness, a shorter heating time and less influence from the ambient pressure.

The LSU ADV contains a Nernst cell and a pump cell. The lambda value between the Nernst cell and an internal oxygen reference chamber is controlled to lambda 1.013, independent of the oxygen concentration on the emission side. This happens thanks to the pump current through the pump cell, responsible for the transmission of oxygen atoms in the sensor ceramic. The current proportional output voltage of the IC is translated in a lambda value. The LT4 ADV provides the sensors temperature and other diagnostics parameters over CAN. The 4 lambda signals can be read by using the CAN or analog output. The main feature and benefit of this unit is its compact design, its lightweight construction, as well as the possibility to control up to 4 Lambda Sensors LSU ADV with multiple user-configurable parameters.

### Application

Application	Lambda 0.75 to 5
Compatible Bosch sensor type	LSU ADV
Channels	4
Heater	Internal

### Technical Specifications

#### Mechanical Data

Weight with wire	98 g
Sealing	100 % humidity
Mounting	Velcro
Size w/o wire (w*l*h)	54 x 59 x 13 mm
Operating temp. range (housing)	-20 to 85°C
Storage temp. range	-20 to 85°C
Max. vibration	Vibration Profile 1 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Power supply $U_s$	(6.5) 10 to 14 V
Max power supply (1 min) $U_s$	Max. 26 V
Thermal dissipation loss	3 W at 14 V
Current $I_s$	5 A
Current $I_s$ (Heating up)	26 A

#### Software Tool (free download)

System Configuration tool RaceCon 2.7.0.9 or later

#### Characteristic

Signal output 1	CAN
Signal output 2	4 x 0 to 5 V "analog"
CAN- baud rate	500 kbaud or 1 Mbaud
Signal resolution	2,5 * 10 <sup>-4</sup> lambda
Signal sampling rate	100 Hz
CAN refresh rate	100 Hz

#### Connectors and Wires

Connector	AS614-35PN
Connector loom	F02U.000.365-01
AS114-35SN	
Sleeve	Viton
Wire size	26
Wire length L	20 cm

#### Pin Assignment

Pin	Function
1	+ 12 V (Battery +)
2	+ 12 V (Battery +)
3	Ground (Battery -)
4	Ground (Battery -)
5	K-Line diagnostic connection
6	CAN1 + (high)
7	CAN1 - (low)
8	Analog out 1
9	Analog out 2

10	Analog out 3
11	Analog out 4
12	Reference GND for analog out
13	Shield
14	Pump current LSU 1 IP1
15	Virtual GND LSU 1 VM1
16	Heater PWM LSU 1 Uh-1
17	Heater (Batt +) LSU 1 Uh+1
18	Not connected
19	Nernst voltage LSU 1 UN1
20	Pump current LSU 2 IP2
21	Virtual GND LSU 2 VM2
22	Heater PWM LSU 2 Uh-2
23	Heater (Batt. +) LSU 2 Uh+2
24	Not connected
25	Nernst voltage LSU 2 UN2
26	Pump current LSU 3 IP3
27	Virtual GND LSU 3 VM3
28	Heater PWM LSU 3 Uh-3
29	Heater (Batt +) LSU 3 Uh+3
30	Not connected
31	Nernst voltage LSU 3 UN3
32	Pump current LSU 4 IP4
33	Virtual GND LSU 4 VM4
34	Heater PWM LSU 4 Uh-4
35	Heater (Batt. +) LSU 4 Uh+4
36	Not connected
37	Nernst voltage LSU 4 UN4

### Communication

Communication link K-Line / CAN

### Installation Notes

Typical lifetime: max. 220 h / 2 years

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program

The LT4 ADV is designed to supply 4 Bosch lambda sensors, type LSU ADV

The LT4 ADV is featured with voltage compensation for the heating profile.

The unit can be connected to any CAN system (500 kbaud or 1 Mbaud) and analog measuring device.

To avoid signal errors, a cable length of maximum 1.5 m between sensor and box is recommended.

The unit is secure from miss-pinning.

The reference ground (GND\_REF) has to be connected either to the measuring device or to the system ground.

A ground offset of 2 V (max.) between GND and GND\_REF has not to be exceeded.

See the LT4 ADV function sheet for software documentation (e.g. CAN protocol).

Please find further application hints in the offer drawing at our homepage.

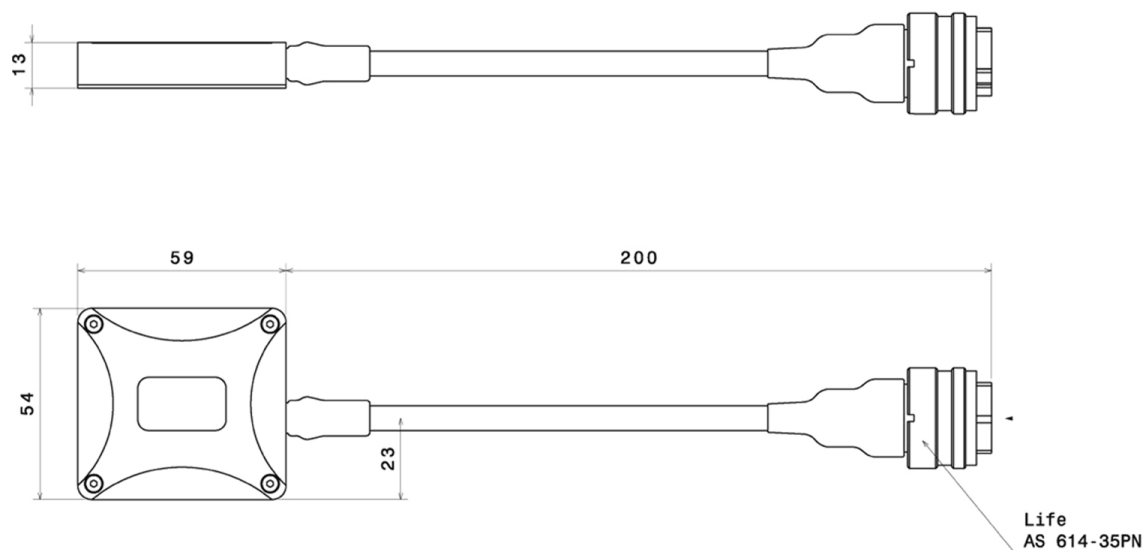
### Ordering Information

#### Lambdatronic LT4 ADV

Order number **F02U.V01.111-04**

3

### Dimensions



## Modular Sensor Interface M 60

3



### Features

- ▶ 30 input channels
- ▶ Each channel individually configurable
- ▶ Compact dimensions

The M 60 is a compact and light weight sensor interface unit for analog and digital sensors. Up to eight M 60 can be used to expand the number of input channels of the data logger C 60 as well as the display DDU 9. The M 60 are linked via high-speed Ethernet interface. This allows for synchronized acquisition of data from the different units and the ECU.

The M 60 offers 26 analog inputs, four rotational inputs, four pwm outputs and two independent CAN buses. Each analog input channel features an analog pre-filter, 8 x oversampling and highly linear digital filtering. The cut-off frequency of the digital filter is automatically adjusted to match the acquisition rate. The latency of the digital filters is corrected during recording, yielding zero filter delay in the recorded data.

The evaluation of each M 60 measurement channel is individually configurable with the PC configuration tool RaceCon.

### Application

8 kHz AD converters with digital low pass filter
Configurable math channels
User configurable CAN in/out messages
Max. 1,000 Hz acquisition rate for all channels
3-port network switch
RS232 GPS input
CCP-Master, data acquisition from ECU that support CAN calibration protocol (optional)

### Technical Specifications

#### Mechanical Data

Size	105 x 34.5 x 137.5 mm
Weight	495 g
Operating temperature	-20 to 65°C
Max. vibration	Vibration Profile 1 (See Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage	8 to 18 V
Max. power consumption (w/o loads)	10 W at 14 V

#### Inputs

Analog channels	26
Input range	0 to 5 V
Resolution	12 bit
Switchable pull up resistor	3 kOhm
Rotational channels (default Hall, Inductive as option)	4

#### Outputs

PWM outputs (low side switch 2 A each)	4
Sensor supply 5 V (350 mA each)	4
Sensor supply 10 V (350 mA each)	1
Sensor supply 12 V (1 A, non regulated)	1

#### Environment

##### Software Upgrade 1

CCP-Master (ASAP 2 file from ECU manufacturer required)	F02U.V01.012-01
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#### Connectors and Wires

Motorsport connectors double density	2 x 41 pins
Mating connector I ASDD612-41SN	F02U.002.216-01
Mating connector II ASDD612-41SA	F02U.004.180-01

#### Communication

Configuration via RaceCon over Ethernet or MSA-Box II	
CAN interfaces	2
Ethernet 100BaseT	3

#### Installation Notes

Internal accumulator for data preservation and clock included

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Inspection services recommended after 220 h or 2 years, internal battery to be replaced during service.

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Charge accumulator for > 6 h after installation.

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Charge accumulator twice per year for > 6 h.

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Send device to Bosch dealer for accumulator change.

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The required software (.pst file) for this device is available in the download area of our homepage [www.bosch-motorsport.com](http://www.bosch-motorsport.com).

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### Ordering Information

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#### **Modular Sensor Interface M 60**

Order number **F02U.V00.882-02**

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#### **Software Options**

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#### **SW Upgrade 1**

Order number **F02U.V01.012-01**

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## Modular Sensor Interface MSI 60

3



### Features

- ▶ 50 sensor inputs (differential analogue, single ended analogue, LVDT, frequency, RS232)
- ▶ High quality signal processing
- ▶ Compact dimensions

The MSI 60 is a high quality signal conditioning and data acquisition unit for analogue, digital, frequency and linear variable differential (LVDT) sensors.

MSI 60 offers a large number of freely configurable inputs (32 x differential analogue, 8 x single ended analogue, 8 x LVDT, 2 x frequency, 1 x RS 232 for GPS). Possible applications of the differential inputs include e.g. 31 TC-J type or TC-K type temperature sensors arranged in a sensor array (one diff. input used for compensation), PT100, PT1000 (specific pull up values available), NTC, strain gauges etc. Each differential input features 200 times oversampling.

The cut-off frequency of the digital filters in all inputs is automatically adjusted to match the acquisition rate. MSI 60 also corrects the latency of the digital filters during recording, yielding zero filter delay in the recorded data. Quantization of each MSI measurement channel is individually configurable. Data can be sent via Ethernet interface to any Bosch Motorsport logging device.

### Technical Specifications

#### Mechanical Data

Size	153 x 119 x 38 mm
Weight	645 g
Aluminum housing	
High density type motorsport connectors	

Vibration damped printed circuit boards	
Operating temperature	-20 to 85°C
Max. vibration	15 g sinus at 1,200 Hz for t < 5 h

#### Electrical Data

Max. power consumption (w/o sensor power supply)	15 W
Required power supply	7 to 18 V
2 frequency inputs 0 to 25.5 kHz for inductive sensor / Hall-effect sensor / DF11 sensor	
32 differential analogue inputs, switchable to single ended operation, -5 V to 5 V or 0 V to 5 V; switchable pull up values 3.01 kOhm and 4.99 kOhm, 49.9 kOhm to suit PT100/PT1000	
8 single ended analogue inputs, 0 V to 5 V; switchable pull up value 3.01 kOhm	
8 LVDT inputs, 2.5 kHz/5 kHz/10 kHz; 3 V/5 V/10 V RMS	
4 PWM outputs, max. 1 A each, max. 1 kHz	
2 x 5 V or 10 V switchable sensor power supply, max. 200 mA each	
2 x 5 V sensor power supply, max. 400 mA each	
1 x sensor power supply, max. 800 mA voltage = (MSI 60 supply voltage) -1.1 V; switched U_Batt	

#### Environment

##### Software Upgrade 1

CCP-Master (ASAP 2 file from ECU manufacturer required)	F02U.V01.012-01
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#### Connectors and Wires

Connector LIFE (red)	AS212-35PN
Mating Connector	AS612-35SN; max. AWG22 F02U.000.443-01
Connector SENSOR 1 (yellow)	ASDD214-64PA
Mating Connector	ASDD614-64SA; max. AWG24 F02U.003.098-01
Connector SENSOR 2 (red)	ASDD214-64PN
Mating Connector	ASDD614-64SN; max. AWG24 F02U.000.854-01

#### Communication

RS 232 interface for GPS (data reception only)
3 x Ethernet 100 MBit/s
2 x freely configurable up to 1 MBit CAN bus

#### Ordering Information

**Modular Sensor Interface MSI 60**  
Order number **F02U.V01.901-01**

#### Software Options

**SW Upgrade 1**  
Order number **F02U.V01.012-01**



## Wheel Speed Signal Splitter



### Features

- ▶ ABS Wheel Speed Sensor Interface
- ▶ Lightweight Aluminum Housing

Bosch Motorsport has developed a wheel speed module that converts the Bosch DF11 (differential dual hall sensors) signals to a signal that can be processed by peripheral engine controlling devices and data recording systems. The adapter can be plugged into any Bosch ABS M4 loom.

The operation principle is that it forwards the sensor information to the ABS. In addition it converts the speed info into a digital signal. The type of output is open collector. The connected device needs to contain an internal pull up resistor of 2.15 kOhm to 12 V.

The interface is available in two different housings supporting one connector or two connectors (see photo). The single connector type is used if the signal is fed back into an especially pre-defined ABS loom which connects e.g. to the original chassis loom. The double connector type is used if the speed signal is broadcast to the peripheral device via a separate loom.

The wheel speed signal splitter is designed to be used in combination with the Bosch Motorsport ABS system. Due to safety reasons it is not designed for usage in combination with other ABS systems.

### Application

Application	ABS wheel speed sensor interface
Compatible sensor type	Bosch DF 11
Operating temperature range	-20 to 85°C
Storage temperature range	-20 to 85°C

### Technical Specifications

#### Mechanical Data

Weight	53 g
Size (Single connector type)	101.8 x 63.5 x 30.3 mm
Size (Double connector type)	112.1 x 63.5 x 30.3 mm
Max. vibration	Vibration profile 1 (see Appendix or <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Power supply	12 V
Max. power supply (1 min)	25 V

#### Connectors

Connector 1 (wide)	AS212-35PN
Mating connector AS612-35SN	F02U.000.443-01
Connector 2 (small)	AS208-35PN
Mating connector AS608-35SN	F02U.000.430-01

#### Pinout Connector 1 (wide)

Pin	Description for one connector	Description for two connectors
1	Supply to DF11 (RR)	Supply to DF11 (RR)
2	Signal from DF11 (RR)	Signal from DF11 (RR)
3	Supply to DF11 (RL)	Supply to DF11 (RL)
4	Signal from DF11 (RL)	Signal from DF11 (RL)
5	Supply to DF11 (FR)	Supply to DF11 (FR)
6	Signal from DF11 (FR)	Signal from DF11 (FR)
7	Supply to DF11 (FL)	Supply to DF11 (FL)
8	Signal from DF11 (FL)	Signal from DF11 (FL)
9	Signal to ABS (FL)	Signal to ABS (FL)
10	DF11 supply from ABS (FL)	DF11 supply from ABS (FL)
11	Signal to ABS (FR)	Signal to ABS (FR)
12	DF11 supply from ABS (FR)	DF11 supply from ABS (FR)
13	Signal to ABS (RL)	Signal to ABS (RL)
14	DF11 supply from ABS (RL)	DF11 supply from ABS (RL)
15	Signal to ABS (RR)	Signal to ABS (RR)
16	DF11 supply from ABS (RR)	DF11 supply from ABS (RR)
17	Open collector Signal to ECU (FL)	Not used
18	Open collector Signal to ECU (FR)	Not used
19	UBat 12V	UBat 12V
20	Open collector Signal to ECU (RL)	Not used
21	Open collector Signal to ECU (RR)	Not used

22	ECU Ground	Not used
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**Pinout Connector 2 (small)**

Pin	Description for one connector	Description for two connectors
1	n.a.	Open collector Signal to ECU (FL)
2	n.a.	Open collector Signal to ECU (FR)
3	n.a.	Open collector Signal to ECU (RL)

4	n.a.	Open collector Signal to ECU (RR)
5	n.a.	Not used
6	n.a.	ECU Ground

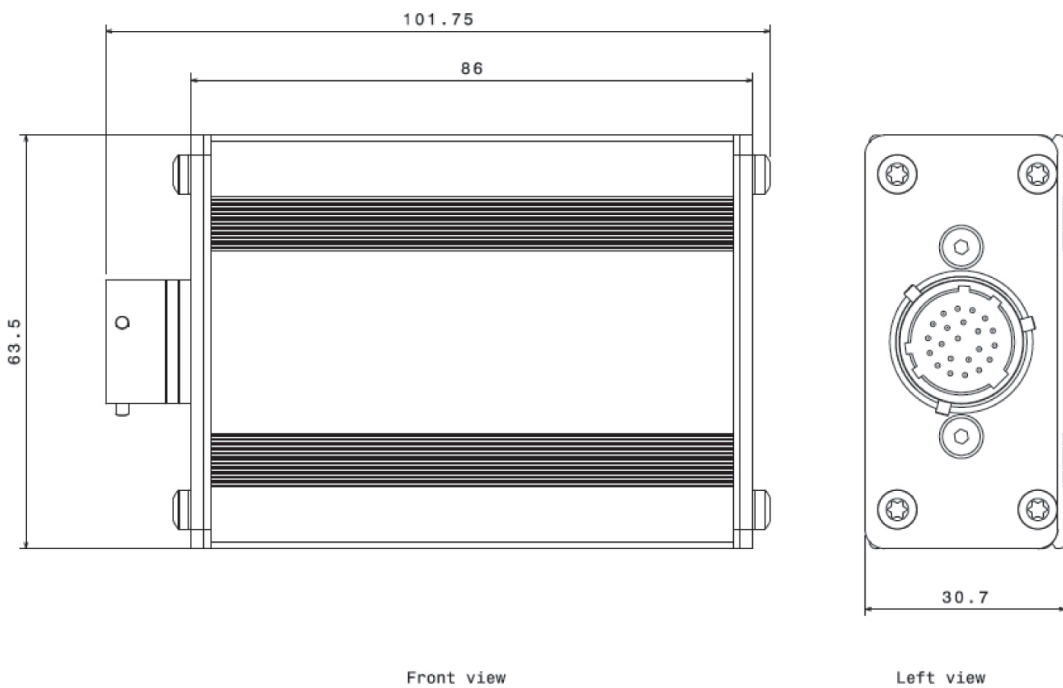
**Ordering Information**

**Single Connector Type**  
Order number **F02U.V00.335-03**

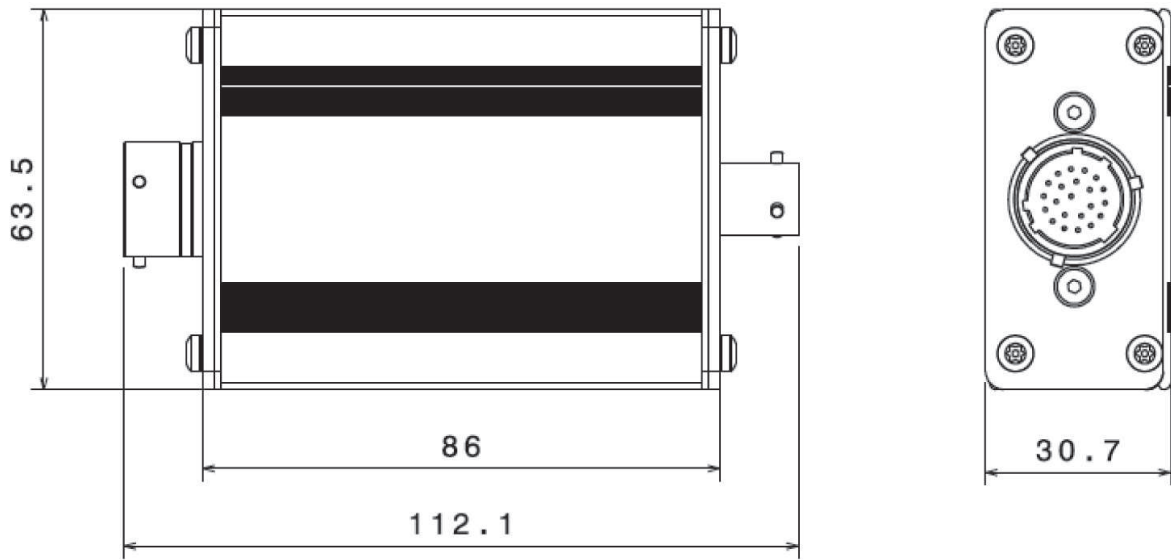
**Double Connector Type**  
Order number **F02U.V00.203-03**

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**Dimensions**



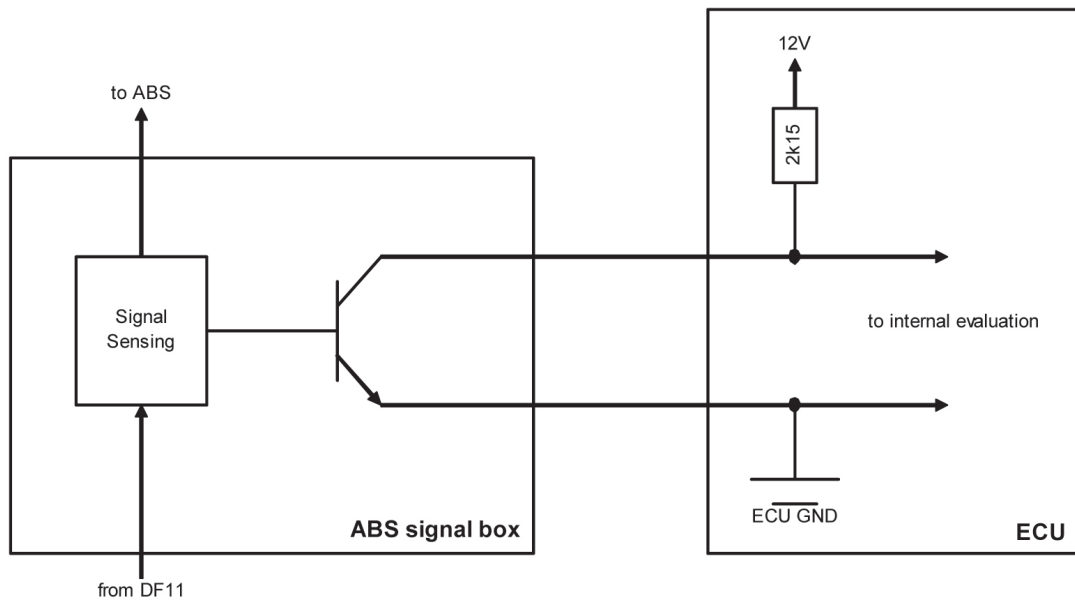
Single Connector Type Housing



Front view

Left view

Double Connector Type Housing

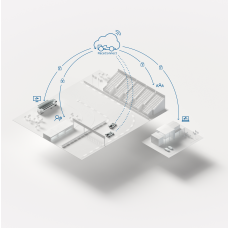


Connection Scheme

## Overview

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### RaceConnect



- LTE-based online telemetry system for continuous transfer of vehicle data to scalable, location-independent receivers. Secured data transfer and handling between the racecar and the cloud portal.
- Modular systems architecture and multi-disciplinary engineering expertise yields flexible and fast service enhancement and development according to customer needs.
- The ready-to-use solution requires no further infrastructure at the track.
- Realization of any combination of unidirectional communication routes between transmitter, cloud and receiver, for example, multiple transmitters to one receiver or one transmitter to multiple receivers.
- Full customer control and diagnostics due to accessing racecar data and modem connection status through the cloud interface.

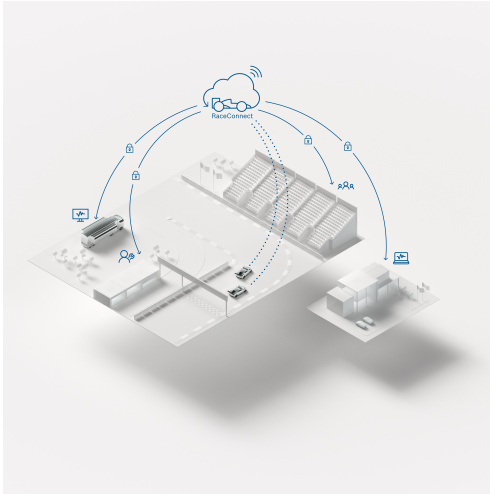
### Telemetry Modem LTE65-EU Telemetry Modem LTE65-US



- 4G-LTE connectivity (3G fall-back)
- No infrastructure setup required, built-in SIM card
- Data can be sent/received anywhere 4G or 3G cellular service is available
- Easy configuration at the Bosch RaceConnect website

- 4G-LTE connectivity (3G fall-back)
- No infrastructure setup required, built-in SIM card
- Data can be sent/received anywhere 4G or 3G cellular service is available
- Easy configuration at the Bosch RaceConnect website
- Cellular priority (USA only)

## RaceConnect



### Features

- ▶ LTE-based online telemetry system for continuous transfer of vehicle data to scalable, location-independent receivers. Secured data transfer and handling between the racecar and the cloud portal.
- ▶ Modular systems architecture and multi-disciplinary engineering expertise yields flexible and fast service enhancement and development according to customer needs.
- ▶ The ready-to-use solution requires no further infrastructure at the track.
- ▶ Realization of any combination of unidirectional communication routes between transmitter, cloud and receiver, for example, multiple transmitters to one receiver or one transmitter to multiple receivers.
- ▶ Full customer control and diagnostics due to accessing racecar data and modem connection status through the cloud interface.

RaceConnect combines years of expertise in component and system development with connectivity and cloud competence. The ready-to-use package for vehicle data transmission, storage and post-processing includes hardware, connectivity solutions, software services and system integration expertise.

### Ordering Information

#### **RaceConnect**

Please contact us for further information.

## Telemetry Modem LTE65-EU

3



### Features

- ▶ 4G-LTE connectivity (3G fallback)
- ▶ No infrastructure setup required, built-in SIM card
- ▶ Data can be sent/received anywhere 4G or 3G cellular service is available
- ▶ Easy configuration at the [Bosch RaceConnect website](#)

The LTE65-EU is a 4G-LTE based telemetry modem designed for real time telemetry data transfer on racetrack for use within Europe. The combination of LTE65-EU with RaceConnect cloud provides a highly flexible telemetry data distribution platform, where one transmitter can send to many receivers and many transmitters can send to one receiver. The usage of 4G-LTE cellular service allows for Plug & Play operation with minimal setup. The system has been validated on Bosch displays, ECUs and loggers; however, 3<sup>rd</sup> party loggers may also be used.

### Application

Data interface	RS232 or Ethernet
Max. transmit rate	2 Mbps
Max. receive rate	5 Mbps
Max. receive streams	10
Ethernet	100 BaseT
RS232 baud rates	19.2, 57.6 and 115.2 kB/sec
Display	3 LEDs for device status
Configuration	Bosch RaceConnect website

### Technical Specifications

#### Mechanical Data

Size	114 x 65.5 x 22 mm
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Weight	171 g
Protection classification	IP67
Operating temperature ambient	-30 to 65°C
Storage temperature	-30 to 85°C
Max. vibration	Vibration Profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage range	8 to 18 V 24 V operation possible on agreement with customer
Max. power consumption	6 W
Antenna impedance	50 Ohm
Antenna max. gain	5.78 dBi

#### Connectors and Wires

Connector on device	ASDD006-09PN
Mating connector	ASDD606-09SN

#### Pin Configuration

1	Battery plus
2	RS232 Rx
3	Reset
4	RS232 Tx
5	Battery negative
6	Eth RX+
7	Eth RX-
8	Eth TX+
9	Eth TX-

**Ordering Information****Modem LTE65-EU + Racer Subscription (1 year)**Order number **F02U.V02.932-01****Modem LTE65-EU + Pro Subscription (1 year)**Order number **F02U.V02.933-01****Modem LTE65-EU + Pro-High Subscription (1 year)**Order number **F02U.V02.934-01****Basic Kit Racer - GT**

2 Modems + 2 Racer Subscriptions (1 year) + Car Antenna + Pit Antenna + Pit Harness

Order number **on request****Basic Kit Pro - GT**

2 Modems + 2 Pro Subscriptions (1 year) + Car Antenna + Pit Antenna + Pit Harness

Order number **on request****Basic Kit Pro-High - GT**

2 Modems + 2 Pro-High Subscriptions (1 year) + Car Antenna + Pit Antenna + Pit Harness

Order number **on request****Software Options****Racer Subscription (1 year)**

500 MB / 20 hours per month

Order number **F02U.V02.929-01****Pro Subscription (1 year)**

2 GB / 60 hours per month

Order number **F02U.V02.930-01****Pro-High Subscription (1 year)**

10 GB / 100 hours per month

Order number **F02U.V02.931-01****Accessories****Car Antenna - GT**

Quantity 1 required per modem

Order number **F02U.00U.054-01****Car Antenna Package - Open Wheel**

Quantity 1 required per modem

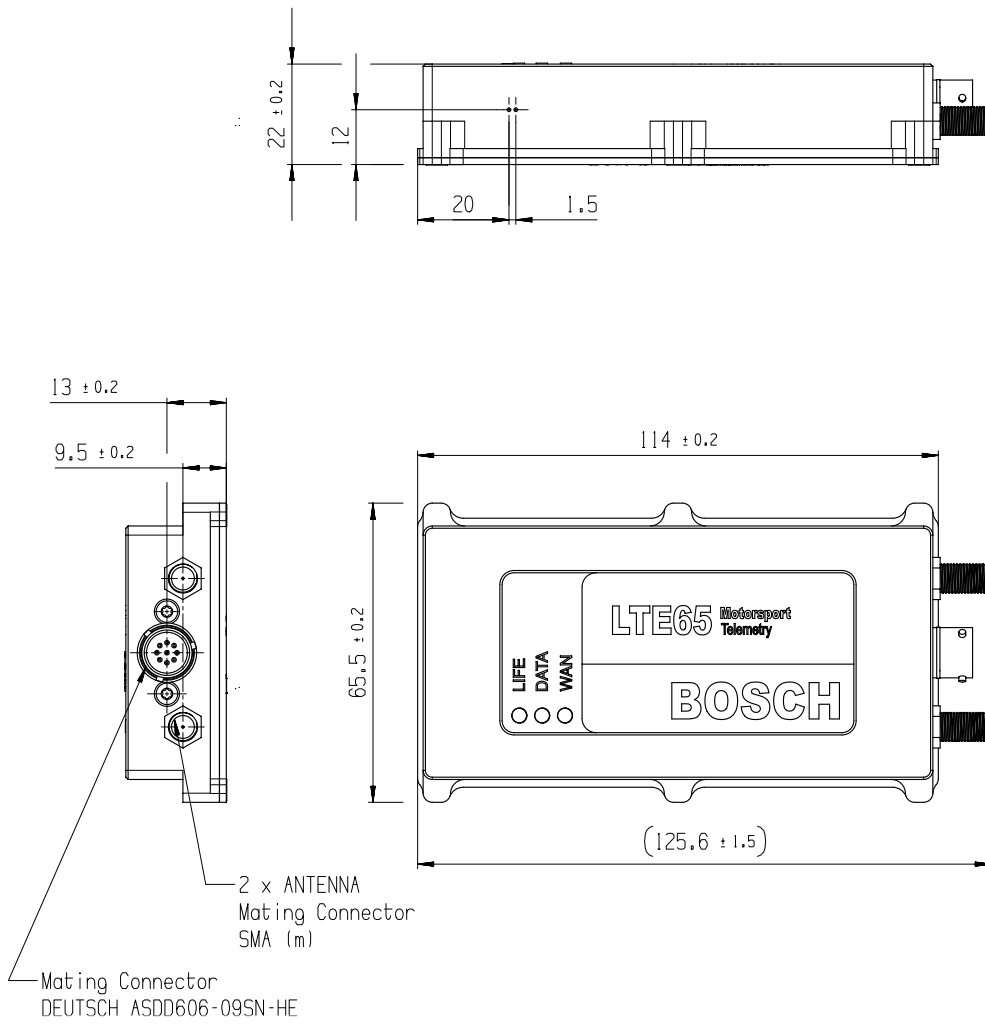
Order number **F02U.00U.069-01****Pitstand Antenna**

Quantity 1 required per modem

Order number **F02U.00U.070-01****Pitstand Harness**Order number **F02U.V02.804-02**

Dimensions

3





## Telemetry Modem LTE65-US



### Features

- ▶ 4G-LTE connectivity (3G fallback)
- ▶ No infrastructure setup required, built-in SIM card
- ▶ Data can be sent/received anywhere 4G or 3G cellular service is available
- ▶ Easy configuration at the Bosch RaceConnect website
- ▶ Cellular priority (USA only)

The LTE65-US is a 4G-LTE based telemetry modem designed for real time telemetry data transfer on racetrack for use within the USA and Canada. The combination of LTE65-US with RaceConnect cloud provides a highly flexible telemetry data distribution platform, where one transmitter can send to many receivers and many transmitters can send to one receiver. The usage of 4G-LTE cellular service allows for Plug & Play operation with minimal setup. The system has been validated on Bosch displays, ECUs and loggers; however, 3<sup>rd</sup> party loggers may also be used.

### Application

Data interface	RS232 or Ethernet
Max. transmit rate	2 Mbps
Max. receive rate	5 Mbps
Max. receive streams	10
Ethernet	100 BaseT
RS232 baud rates	19.2, 57.6 and 115.2 kB/sec
Display	3 LEDs for device status
Configuration	Bosch RaceConnect website

### Technical Specifications

#### Mechanical Data

Size	114 x 65.5 x 22 mm
Weight	171 g
Protection classification	IP67
Operating temperature ambient	-30 to 65°C
Storage temperature	-30 to 85°C
Max. vibration	Vibration Profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

#### Electrical Data

Supply voltage range	8 to 18 V 24 V operation possible on agreement with customer
Max. power consumption	6 W
Antenna impedance	50 Ohm
Antenna max. gain	5.78 dBi

#### Connectors and Wires

Connector on device	ASDD006-09PN
Mating connector	ASDD606-09SN

#### Pin Configuration

1	Battery plus
2	RS232 Rx
3	Reset
4	RS232 Tx
5	Battery negative
6	Eth RX+
7	Eth RX-
8	Eth TX+
9	Eth TX-

**Ordering Information****Telemetry Modem LTE65-US**

Subscription required, antenna not included  
Order number **F02U.V0U.746-02**

**Basic Kit Racer - GT**

2 Modems + Car Antenna + Pit Antenna + Pit Harness  
Order number **F02U.V0U.353-02**

**Basic Kit Pro - Open Wheel**

2 Modems + Car Antenna + Pit Antenna + Pit Harness  
Order number **F02U.V0U.354-01**

**Software Options****Racer Subscription (1 year)**

500 MB / 20 hours per month  
Order number **F02U.V0U.355-01**

**Pro Subscription (1 year)**

2 GB / 60 hours per month  
Order number **F02U.V0U.357-01**

**Pro-High Subscription (1 year)**

10 GB / 100 hours per month  
Order number **F02U.V0U.358-01**

**Accessories****Car Antenna - GT**

Quantity 1 required per modem  
Order number **F02U.00U.054-01**

**Car Antenna Package - Open Wheel**

Quantity 1 required per modem  
Order number **F02U.00U.069-01**

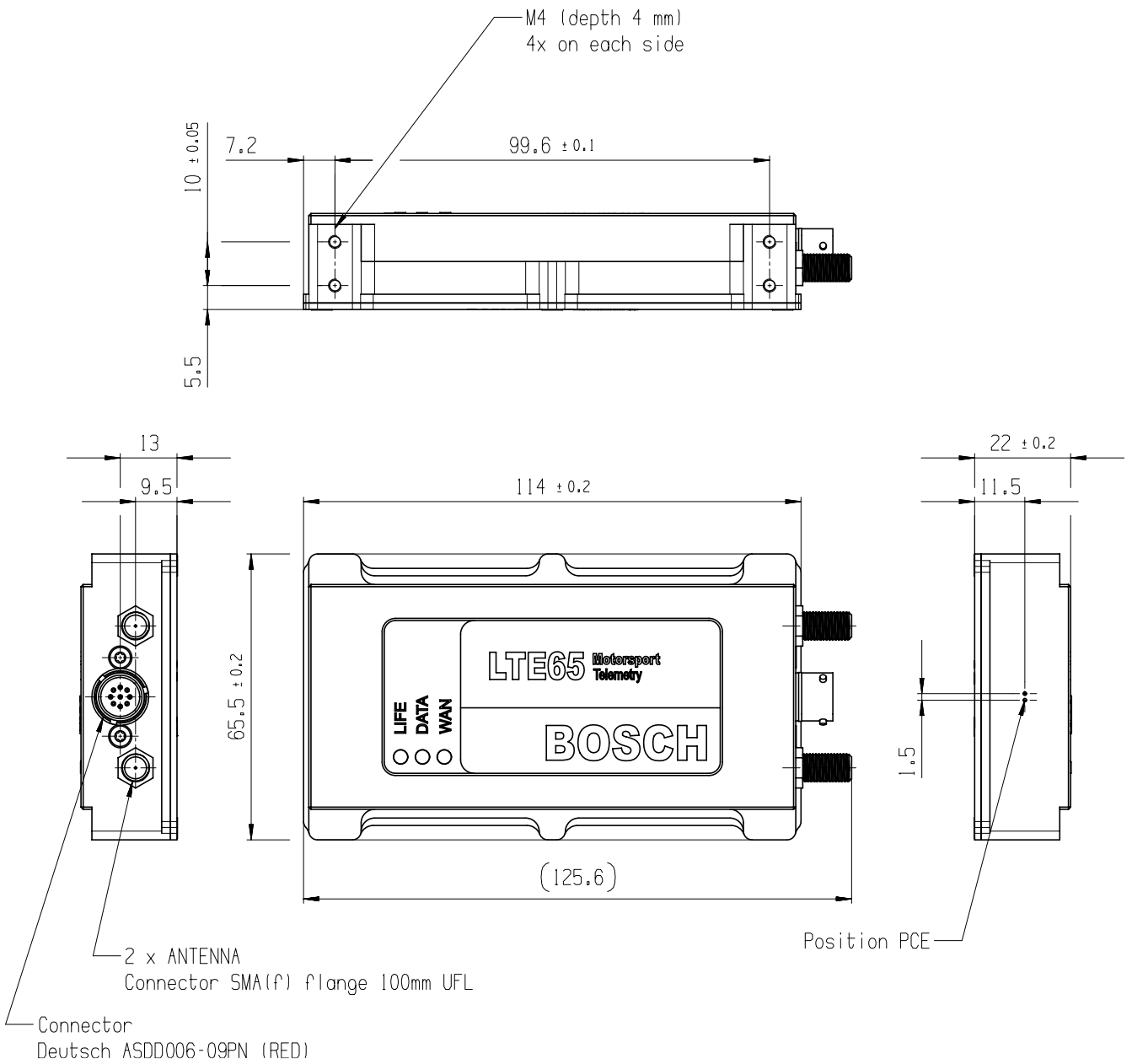
**Pitstand Antenna**

Quantity 1 required per modem  
Order number **F02U.00U.070-01**

**Pitstand Harness**

Order number **F02U.V02.804-02**

Dimensions



## μLC Test System



### Features

- ▶ User-friendly interface
- ▶ Functions can be extended with Expansion Boards
- ▶ Prepared for test automation
- ▶ Favorable test setup, consuming low space
- ▶ Simulation of typical automotive interfaces combined in one unit

The new and modern hardware-in-the-loop test system μLC Test System is suitable for mobile application, measuring a compact 17 x 11 x 6 cm. Initial test setup typically takes under ten minutes, since the system allows for a simple test setup.

It is a compact open-loop test system for quality assurance of control unit development and combines the simulation of all typical automotive sensors and communication protocols in one unit. Its interface is user-friendly and enables an easy operation and evaluation.

The μLC Test System is especially used for automotive control units with typical interfaces for sensors and bus systems such as analogue/digital inputs and outputs, PWM signals, SENT, CAN, LIN and speed sensors.

### Application

#### Engine Speed Simulation

- Up to 20,000 rpm
- Supported sensors: Hall, inductive, DG23i, TL4953
- Up to 2 crankshafts, up to 4 camshafts
  - each is independently configurable
  - auxiliary shaft
  - -180 to 180° camshaft adjustment
- Oscilloscope trigger signal for easier monitoring
- Error simulation for engine position management EPM

#### Vehicle Busses

- 2 \* CAN, up to 1 MBit/s, switchable 120 Ohm CAN bus terminator
- LIN Master/Slave
- SENT, full J2716 Jan. 2012 standard  
4 Outputs, alternative to PWM output

#### Analogue Interfaces

- 8 \* 10 bit DAC 0 to 5 V, max. 5 mA  
Internal or external supply
- 4 \* 12 bit DAC 0 to 5 V, max. 5 mA
- 6 \* 12 bit ADC 0 to 40 V, GND reference

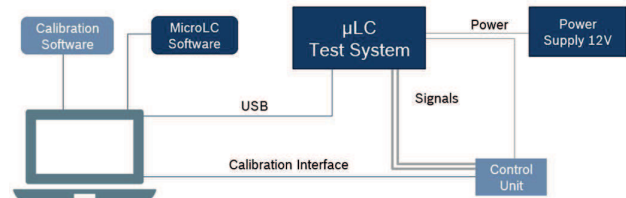
#### Digital Interfaces

- 6 \* Digital Out, max. 200 mA in total  
Output modes: Ground, 12 V, High impedance
- 2 \* Relays, max. 10 A, separate ECU power supply possible and incl. main relay sensing
- 2 \* PWM input, 1 Hz to 20 kHz
- 4 \* PWM output, max. 90 mA in total,  
0.1 Hz to 20 kHz  
Output voltages: 12 V, 5 V, GND
- Complex PWM with sub signals, each separately adjustable in frequency, duty cycle and pulse count

#### Additional Features

- Throttle body simulation
- Cylinder pressure simulation
  - Up to 8 cylinders with one device
  - Expandable with multiple devices
- USB connection completely galvanic decoupled
- All in- and outputs short-circuit protected and ESD protected
- EMC tested
- Expansion boards for additional HW features
- Multi device support with sync option for engine speed signals

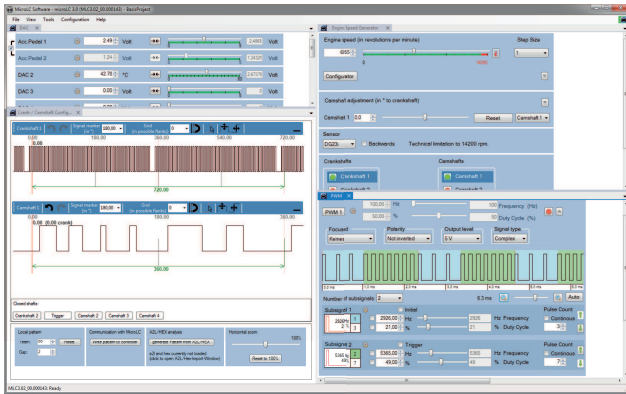
#### Test Setup



Note: Calculation intensive modules like cylinder pressure simulation can cause a limitation of e.g. the max. engine speed.

### Technical Specifications

Operating voltage	12 V DC
Current consumption	typ. < 1 A
ECU voltage	12 V / 24 V DC
ECU current	10 A
Permissible operation temperature	0 to 40°C
Housing material	Aluminum
Dimensions	175 x 107 x 61 mm
Weight	690 g



The screenshot shows the MicroLC Software with analog outputs, crank/ camshaft, RPM and complex PWM.

### Update and Support Subscription

- Recommended, but not mandatory
- Free in the first year of use, chargeable from the second year

### Ordering Information

#### μLC Test System

Order number **F02U.V02.303-02**

#### Software Options

#### Update and Support Subscription

Order number **F02U.V02.838-01**

#### Accessories

#### Expansion Board Current Loop Interface

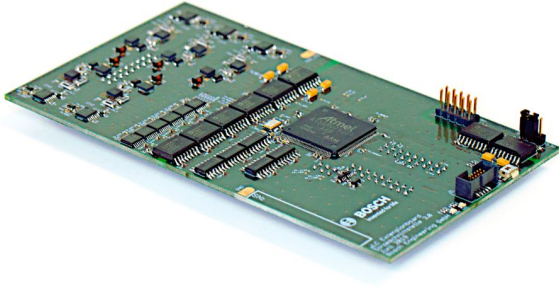
Order number **F02U.V02.889-01**

#### Expansion Board Digital Outputs

Order number **F02U.V02.904-01**

## Expansion Board Current Loop Interface

3



### Features

- ▶ All common wheel speed sensors can be simulated
- ▶ Simulation of gear speeds possible
- ▶ Speed calculation based on wheel circumference
- ▶ Current limits freely adjustable from 0 mA to 40 mA

The **Expansion Board Current Loop Interface** extends the functions of the **μLC Test System** without intervening the software and without activating additional mechanisms. The numbered outputs are available for this purpose. Using the five provided channels it is possible to simulate up to five independent sensors. With integrated Lua scripting and the provided API it is possible to create automated tests.

### Technical Specifications

TS	
Engine speed	-3,000 to 12,000 rpm
Local pattern / teeth	48 to 60
Signal duration forwards	35 to 55 μs

TS	
Signal duration backwards	80 to 100 μs
Gaps	0 to 10
Prefixed bit	35 to 45 (de)activatable
Duty Cycle	737,000 μs
Stand still signal duration	1,340 to 1,540 μs
Stand still signal	150,000 μs (de)activatable

AK	
Engine speed	-3,125 to 3,125 rpm
Local pattern / teeth	48 to 60
Parity	Even / odd parity
LR-Bit	(de)activatable
LM0-Bit	(de)activatable
LM1-Bit	(de)activatable
LM2-Bit	(de)activatable
Stand still signal	150,000 μs

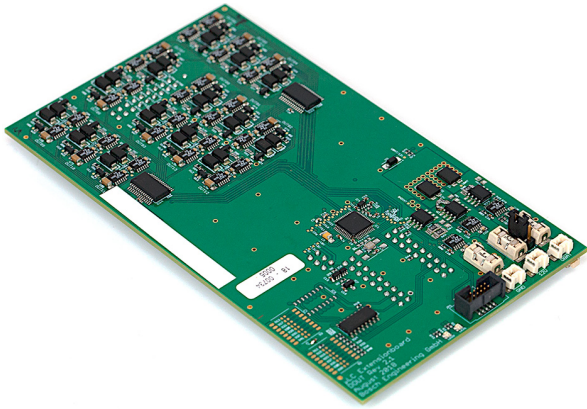
PWM-i	
Engine speed	-2,500 to 2,500 rpm
Local pattern / teeth	48 to 60
Duration LR	35 to 55 μs (de)activatable
Duration DR_L	80 to 100 μs
Duration DR_R	170 to 190 μs
Duration DR_L_EL	350 to 370 μs (de)activatable
Duration DR_R_EL	710 to 730 μs (de)activatable
Stand still signal duration	1,430 to 1,450 μs
Stand still signal period	737,000 μs

PWM-s	
Engine speed	-5,000 to 5,000 rpm
Local pattern / teeth	48 to 60

### Ordering Information

**Expansion Board Current Loop Interface**  
Order number **F02U.V02.889-01**

## Expansion Board Digital Outputs



### Features

- ▶ 14 additional digital outputs included
- ▶ Short circuit proof
- ▶ Change to individual states possible: Low, High, High-Z

The **Expansion Board Digital Outputs** extends the functions of the **μLC Test System** without intervening the software and without activating additional mechanisms. Digital Outputs provides 14 digital outputs, which can be switched individually to the states **Low**, **High** or **High-Z**. All outputs can be switched simultaneously.

### Application

Output voltage	Min	Max
μLC 3.1	-1 V	24 V

### Technical Specifications

#### DC characteristics

Parameters	Conditions	Value
$U_{out}$	Output = Low	<1.1 V
$U_{in}-U_{out}$	Output = High	<1.8 V
$R_{out}$	Output = High-Z	>10 MOhm
$I_{out> prot}$	Channel shutdown threshold	±1 A
$\Sigma I_{out> prot}$	Shutdown threshold total current all outputs	±3.33 A

#### Timing measured at $U_{in} = 24 V$

Parameters	Conditions	Value
$t_{rise}$	Load of 500 Ohm to GND	58 μs
	Load of 500 Ohm to 24 V	0.3 μs
	Without load	62 μs
$t_{fall}$	Load of 500 Ohm to GND	0.8 μs
	Load of 500 Ohm to 24 V	5.5 μs
	Without load	12 μs
$t_{restart}^*$		33.6 ms

\*: Restart time after overcurrent

### Ordering Information

**Expansion Board Digital Outputs**  
Order number **F02U.V02.904-01**



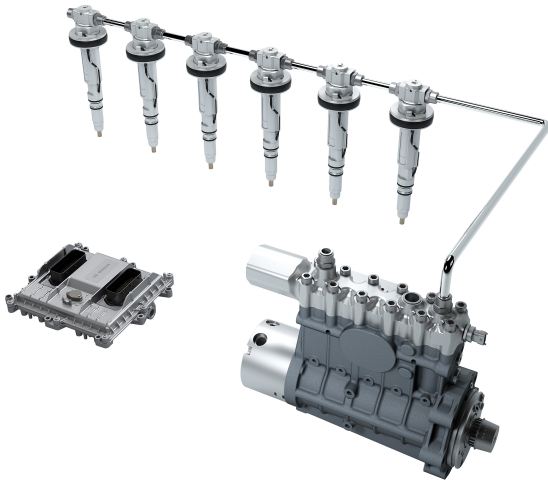


<b>Diesel System Components</b>	<b>112</b>
<b>Injection Valves</b>	<b>113</b>
<b>Fuel Pumps</b>	<b>121</b>
<b>Fuel Pressure Regulators</b>	<b>126</b>
<b>Ignition Coils</b>	<b>135</b>
<b>Ignition Modules</b>	<b>161</b>

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## Diesel System Components

4



### Features

- ▶ Modification of Common Rail systems
- ▶ Different modification levels available
- ▶ All hydraulic parts available

The geometry and characteristics of Diesel engine components are more dependent upon the application than those for gasoline engines. A single injector design will not fit all Diesel engines due to varying mechanical and nozzle geometry requirements. In addition, the injection system can vary from year to year even within the same make of car.

Bosch Motorsport uses the same Common Rail technology for racing that was developed for production vehicle applications. This includes both solenoid (magnetic) technology and the latest cutting-edge piezo technology.

Bosch Motorsport can offer a wide variety of modifications to fit the system to your specifications. These modifications include:

- Definition of suitable base components from other (or larger) engine applications.
- Adaptation of components for mating, fit and orientation to suit the selected application.
- Flow enhancement of injectors and rails.
- Injector nozzle adaptation (flow rate, number of holes, spray cone angle etc.).

### Technical Specifications

Common Rail Pumps	CP1H, CP3, CP4	
Rails		Max. 6 cyl./bank
Pressure Sensors	RDS	Max. 2,400 bar
Injectors	CRI 2 (Solenoid), CRI 3 (Piezo)	
Pressure Control Valves	DRV	Max. 2,400 bar

### Installation Notes

When contacting us for more information on our Diesel components, please have the following information ready so that we may best determine components required for your application:

- The base engine / the car where this engine originally is installed
- Model year and type of car / engine
- The base output level and the desired output level for the engine
- If it is originally equipped with Bosch components: the part numbers of the Bosch components
- Alternatively the car / engine manufacturer part number of the original injection system.

### Dimensions



Common Rail Pumps



Rails



Pressure Sensors



Injectors



Pressure Control Valves

## Overview

### Injection Valve EV 14



- Flow rate at 3 bar: up to 1,000 g/min (n-heptane)
- Max. 8 bar
- Conical spray or 2-spray
- With or without extension
- Spray angle 15 to 85°

### HP Injection Valve HDEV 5.2



- Flow rate at 100 bar: up to 1,640 g/min (n-heptane)
- Max. 500 bar
- Multi hole
- Spray angle 8 to 20°

## Injection Valve EV 14

4



### Features

- ▶ Flow rate at 3 bar: up to 1,000 g/min (n-heptane)
- ▶ Max. 8 bar
- ▶ Conical spray or 2-spray
- ▶ With or without extension
- ▶ Spray angle 15 to 85°

EV 14 injection valves are the latest revision of the EV 6 injection valve technology. EV 14 xT are the latest revision of the EV 12.

EV 14 is designed for a wide range of flow rates and spray patterns. Compact size and three standard versions simplify mounting in a variety of applications.

### Technical Specifications

#### Mechanical Data

System pressure	Max. 5 bar (8 bar for motorsport use)
Weight	≤ 30 g
Installation lengths	33.6, 48.65 or 60.65 mm
Fuel input	Top-feed injector
Operating temperature	-40 to 110°C
Permissible fuel temperatures	≤ 70°C
Climate-proof corresponding to saline fog test DIN 50 021	
Housing design	Compact (K), Standard (S), Long (L)
Spray type	C (Conical Spray) or E (2-Spray)
Flow rate at 3 bar (n-heptane)	151 to 1,462 cm <sup>3</sup> /min 103.5 to 1,000 g/min

Spray angle $\alpha$	15 to 85°
Bent angle $\gamma$	0 to 15°
Coil resistance	See variations
Fuel compatibility	E85 / M100 (After Methanol-operating, the valves must be flushed with standard gasoline-fuel.) Use with different media is not permitted.

#### Electrical Data

Power supply	6 to 16.5 V
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#### Connectors and Wires

Connectors	Jetronic, Sumitomo, Motorsport connectors
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#### Installation Notes

Please ask for more information before ordering.

#### Ordering Information

##### EV 14 CL, 103.5 g/min n-heptane

Order number **0280.158.110**

##### EV 14 ES, 116 g/min n-heptane

Order number **0280.158.200**

##### EV 14 CL, 150 g/min n-heptane

Order number **0280.158.107**

##### EV 14 ES, 150 g/min n-heptane

Order number **0280.158.013**

##### EV 14 CKxT, 237 g/min n-heptane

Order number **0280.158.038**

##### EV 14 EL, 237 g/min n-heptane

Order number **0280.158.116**

##### EV 14 CS, 387 g/min n-heptane

Order number **B280.436.038-09**

##### EV 14 CS, 387 g/min n-heptane

Order number **B280.436.038-10**

##### EV 14 ESxT, 429 g/min n-heptane

Order number **0280.158.123**

##### EV 14 CS, 503 g/min n-heptane

Order number **B280.436.038-08**

##### EV 14 CS, 503 g/min n-heptane

Order number **B280.436.038-07**

##### EV 14 CKxT, 670 g/min n-heptane

Order number **0280.158.040**

##### EV 14 CS, 670 g/min n-heptane

Order number **B280.436.487-01**

##### EV 14 ES, 697 g/min n-heptane

Order number **B280.436.469-01**

#### Accessories

##### Clip for locking bush of plastic

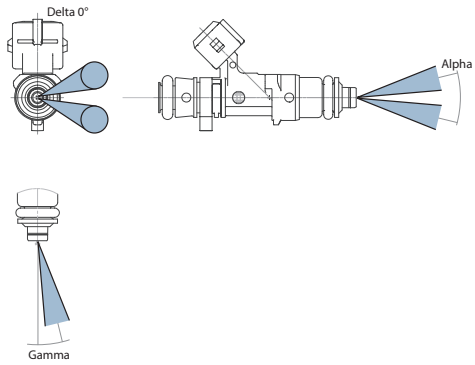
Order number **2431.314.021**

##### Clip for locking bush of steel

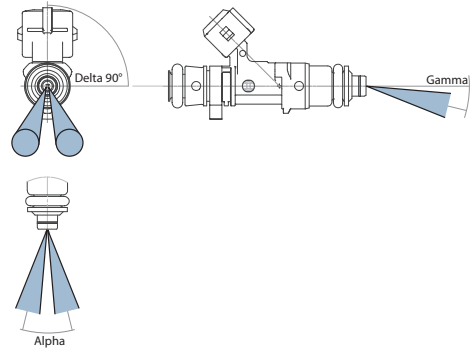
Order number **2431.314.018**

**Dimensions**

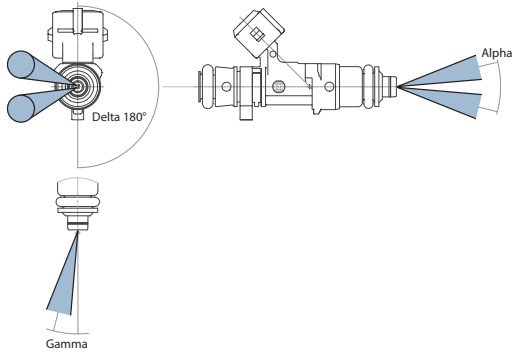
Spray bent to the „right“, Delta=0°



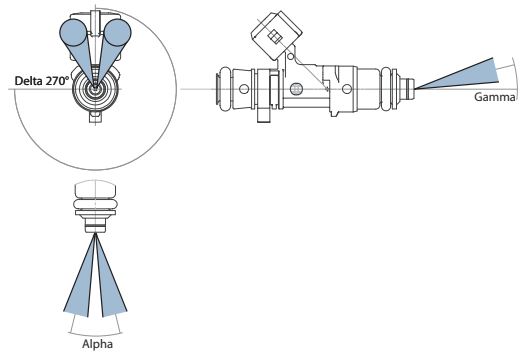
Spray bent „down“ (away from electr. connector), Delta=90°



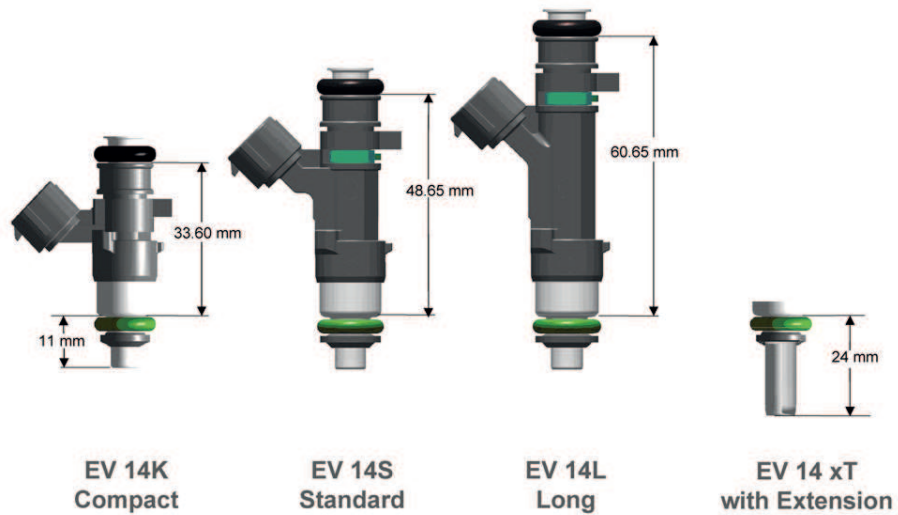
Spray bent to the „left“, Delta=180°



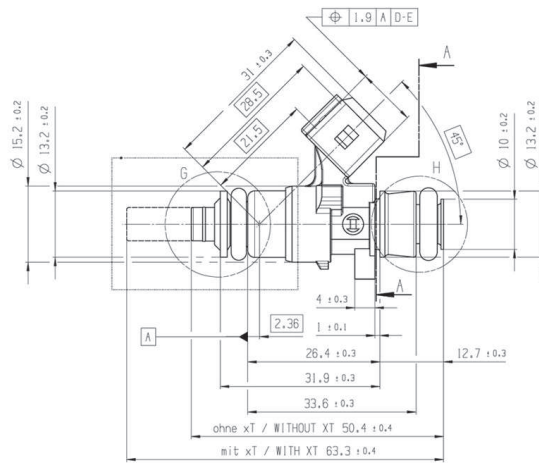
Spray bent „up“ (towards electr. connector), Delta=270°



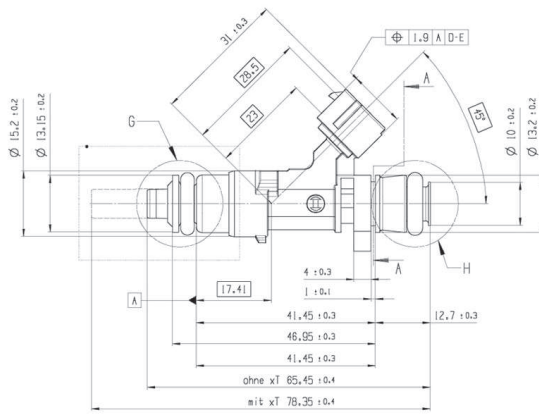
Delta Angel



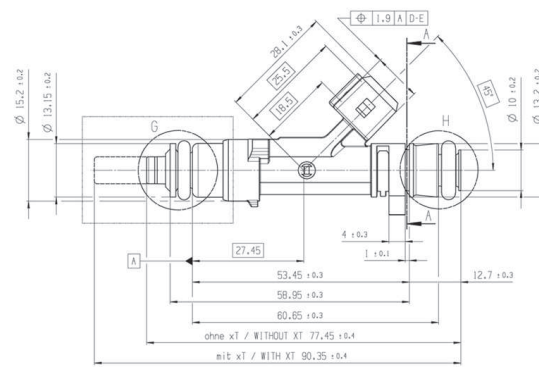
Housing Variations



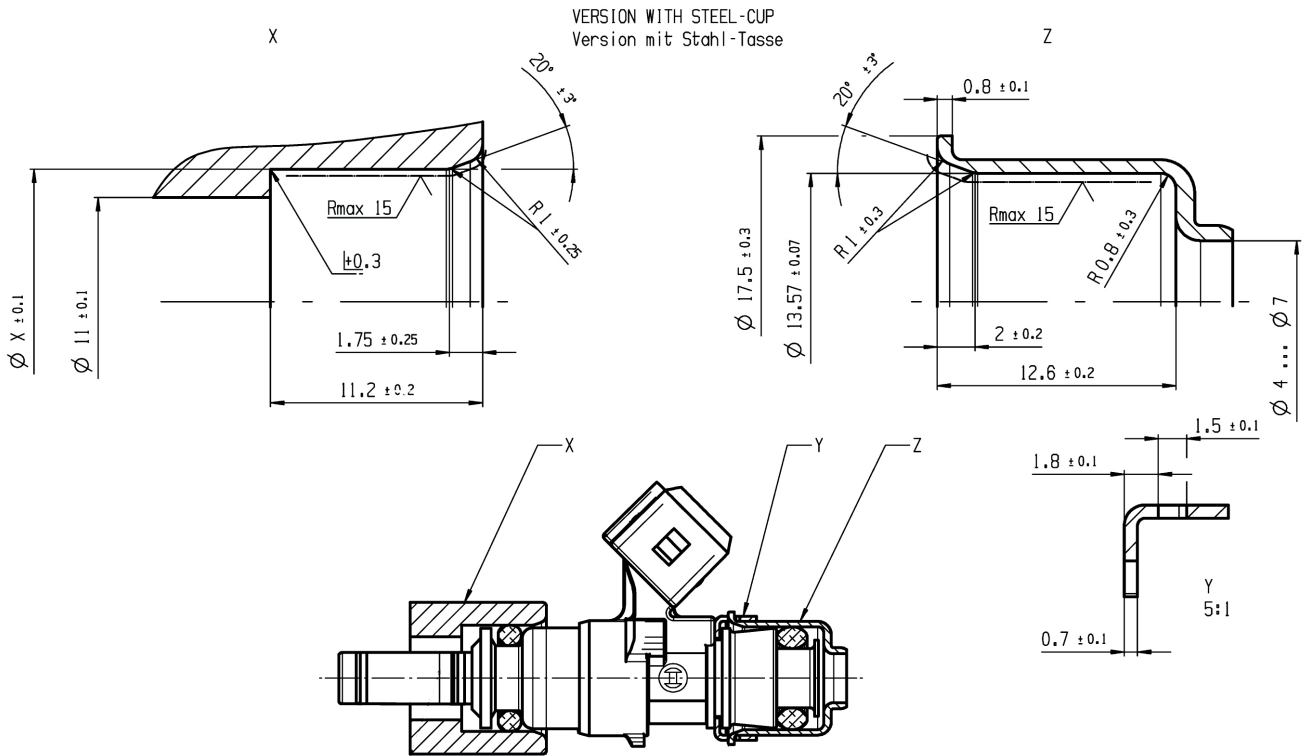
EV 14 Compact



EV 14 Standard



EV 14 Long



Mounting Instructions

**Variations of Motorsport Valves**

Part No.	B280.436.038-07	B280.436.038-08	B280.436.038-09	B280.436.038-10	B280.436.487-01
Flow rate/min	503 g/736 cm <sup>3</sup>	503 g/736 cm <sup>3</sup>	387 g/566 cm <sup>3</sup>	387 g/566 cm <sup>3</sup>	670 g/980 cm <sup>3</sup>
Type	C	C	C	C	C
Housing	S	S	S	S	S
$\alpha$	70°	25°	70°	25°	30°
$\gamma$	0°	0°	0°	0°	0°
$\delta$	-	-	-	-	0°
Resistance	12 Ohm	12 Ohm	12 Ohm	12 Ohm	12 Ohm

**Variations of Production Type Valves**

Part No.	0280.158.110	0280.158.200	0280.158.107	0280.158.013	0280.158.038
Flow rate/min	116 g/170 cm <sup>3</sup>	116 g/170 cm <sup>3</sup>	150 g/219 cm <sup>3</sup>	150 g/219 cm <sup>3</sup>	237 g/347 cm <sup>3</sup>
Type	C	E	C	E	C
Housing	L	S	L	S	KxT
$\alpha$	15°	15°	20°	19°	20°
$\gamma$	0°	90°	0°	0°	0°
$\delta$	0°	0°	0°	90°	0°
Resistance	12 Ohm	12 Ohm	12 Ohm	12 Ohm	12 Ohm

Part No.	0280.158.116	0280.158.123	0280.158.040
Flow rate/min	237 g/347 cm <sup>3</sup>	429 g/627 cm <sup>3</sup>	670 g/980 cm <sup>3</sup>
Type	E	E	C
Housing	L	SxT	KxT
$\alpha$	22°	25°	30°
$\gamma$	5°	0°	0°
$\delta$	90°	90°	0°
Resistance	12 Ohm	12 Ohm	12 Ohm

Further variations are available on request.



## HP Injection Valve HDEV 5.2



### Features

- ▶ Flow rate at 100 bar: up to 1,640 g/min (n-heptane)
- ▶ Max. 500 bar
- ▶ Multi hole
- ▶ Spray angle 8 to 20°

The HDEV 5.2 is a high pressure injector, which is developed to be used as a port or a direct injector. The function of the HDEV 5.2 is both to meter out the fuel and to obtain a well-defined mixture of fuel and air. It is an inward opening solenoid injector which is optimized regarding very short opening and closing times which ensures a very stable linearity at short injection times.

The benefit of this injector is a high spray variability concerning spray angle and spray shape. Also the flow rate can be defined in a big range. Bosch offers the spray targeting design according to the individual customer requirements. If your application conditions will not match the listed performance data, please ask for consultancy at Bosch Motorsport. In addition to the specific designed sample, Bosch offers cost effective production HDEV 5.2 on request.

### Application

Application at 100 bar (typical)	308 to 1,640 g/min
Fuel input	Top-feed injector
Fuel	Gasoline
Operating pressure	Up to 500 bar
Operating temperature range	-31 to 130°C

Storage temperature range	-40 to 70°C
Max. vibration	600 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Weight w/o wire	68 g
Diameter	20.7 mm
Length	87 mm
Flow rate at 100 bar (n-heptane)	up to 1,640 g/min
Number of holes	4 to 7 holes (typical)
Spray type	Multi hole
Spray angle overall	110° (typical)
Spray angle single beam	8 to 20°
Static flow tolerance	±4 %
Dynamic flow tolerance	±6 % at ti = 1.5 ms
Leakage	≤2.5 mm <sup>3</sup> /min at 23°C

#### Electrical Data

Booster supply	65 V
Booster current	13.4 A
Booster time	480 μs
Power supply	12 V
Pick up current	9.4 A
Pick up time	704 μs
Hold power supply	12 V
Hold current	3.7 A hysteresis 0.8 A
Coil resistance	1,500 mOhm (ambient temp.)

#### Connectors and Wires

Mating connector Compact	D261.205.359-01
Connector Jetronic (wire)	D261.205.288-01
Connector motorsport (wire)	On request
Pin 1	Pos
Pin 2	Gnd

### Installation Notes

The injector has to be supplied by a Bosch Motorsport Power Stage Unit (e.g. HPI 5 or HPI 1.16).

Listed electrical values may vary according to the application.

The injector can be cleaned (mechanically or chemically), if the tip will not be damaged.

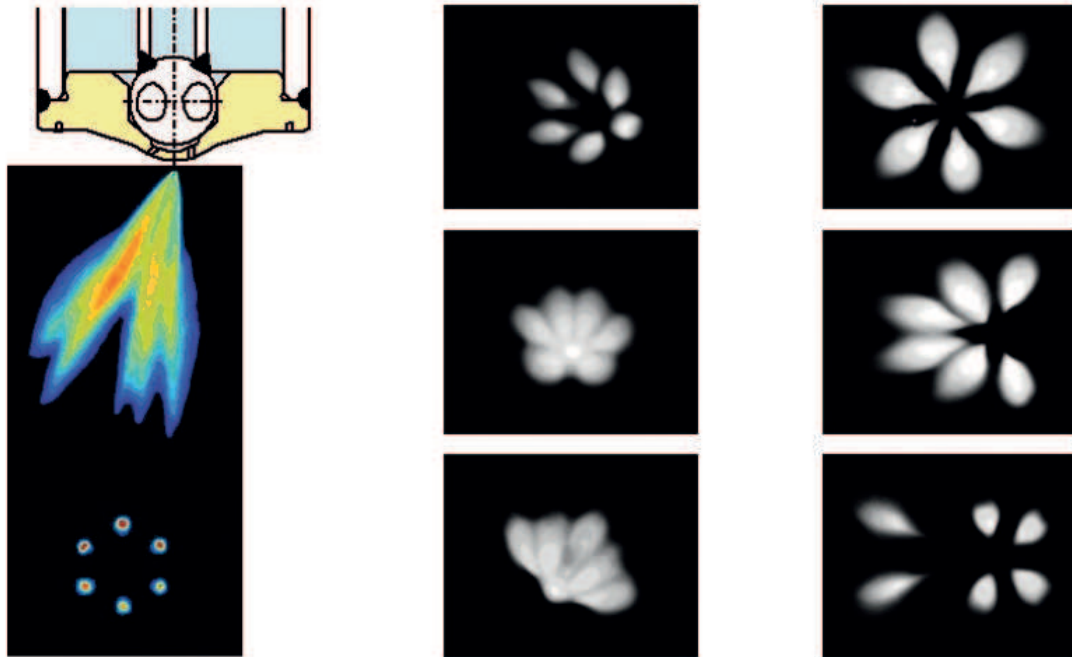
Do not use supersonic cleaning.

### Ordering Information

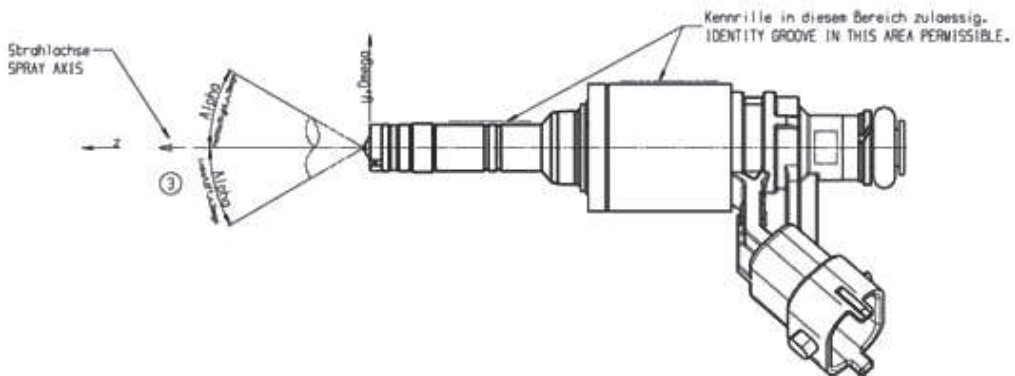
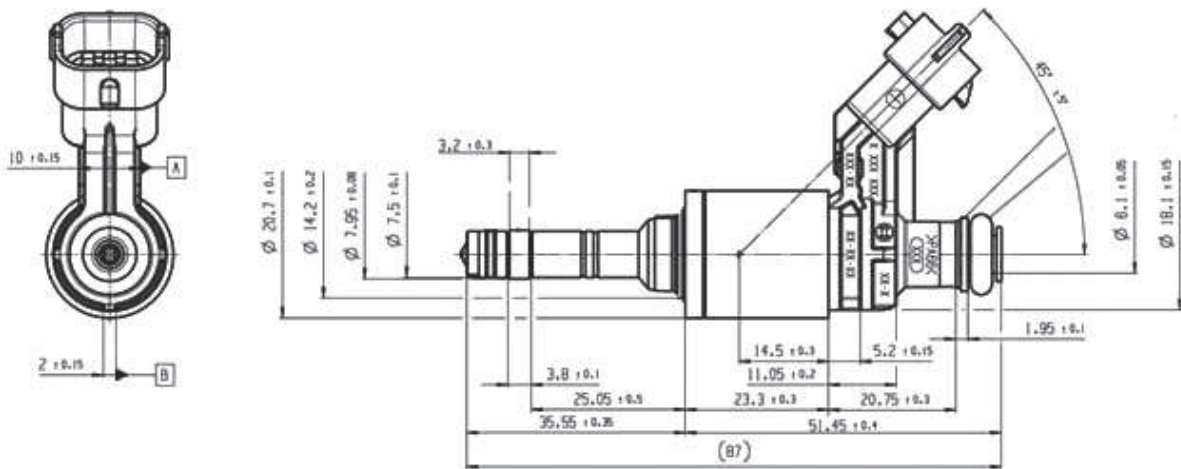
**HP Injection Valve HDEV 5.2**  
Order number **on request**

Dimensions

4



Spray variations, further variations on request



## Overview

### HP Fuel Pump HDP 5



- Max.  $1.1 \text{ cm}^3/\text{rot}_{\text{cam}}$
- 200 bar
- 780 g
- Integrated Flow Control Valve
- Internal Pressure Relief Valve

### HP Fuel Pump HDP 5-LW



- Max.  $1.1 \text{ cm}^3/\text{rot}_{\text{cam}}$
- Max. 500 bar
- 585 g
- Integrated Flow Control Valve
- Internal Pressure Relief Valve

## HP Fuel Pump HDP 5



4

### Features

- ▶ Max.  $1.1 \text{ cm}^3/\text{rot}_{\text{cam}}$
- ▶ 200 bar
- ▶ 780 g
- ▶ Integrated Flow Control Valve
- ▶ Internal Pressure Relief Valve

The HDP 5 is a compact high pressure single piston pump. The design allows achieving a big delivery volume as well as high efficiency, as needed in motorsport applications. Modifications in the number of cam lobes and cam lifts allow different flow requirements to be addressed.

The HDP 5 is equipped with an internal pressure relief valve to limit the maximum fuel pressure. It does not require a fuel return line into the fuel tank.

The pump has an integrated demand control for metering the amount of fuel supplied into the high pressure fuel system. It can be ordered with a compact connector or a motorsport connector.

Depending on the requirements of your engine (e.g. fuel consumption over rotation ratio) we recommend different types of tappets, piston springs and cam profiles. Please notice: Fuel delivery and maximum driveshaft speed depend on cam profile and type of tappet.

### Application

For high pressure manifold injection or gasoline direct injection

### Technical Specifications

#### Mechanical Data

Mass flow	Please see extra sheet
Efficiency	Please see extra sheet
Body design	Series

Flow capacity and max. engine speed	Depending on cam profile
Nominal pressure Standard version	200 bar

#### Possible customization

Rev B (iPRV)	500 bar or customization
Rev C (EVO)	= Rev B + reduced internal restrictions + introduction of EVO parts (outlet valve)
Rev D (Piston)	= Rev C + bigger piston diameter
Flange hole circle diameter	66 mm or 75 mm
Flange orientation	free
Electrical connector orientation	45° or customization
Hydraulic connection design	M14 x 1.5 or customization
Hydraulic connection orientation	LP 240° or customization, HP 180° or customization
Weight	Approx. 780 g
Supply pressure	4 to 7 bar
Operating temperature	-40 to 120°C
Storage temperature	-40 to 70°C
Compatible fuels	Unleaded fuels, E22, E85, M15
Fuel temperature	80°C, short term 130°C
Max. vibration	300 m/s <sup>2</sup>

#### Connectors and Wires

Electrical connector design	Series wire + compact connector
	Series wire + motorsport connector
	Motorsport wire + open end
	Motorsport wire + motorsport connector

#### Installation Notes

Mounting on cylinder head or adapter flag.

Available cam profiles on request.

Select the cam profile on fuel consumption requirements.

Avoid interference with FCV and hydraulic connections at flange orientation.

Avoid interference with flange at electrical connector orientation.

Please specify the electrical connector design and the wire length with your order.

**Ordering Information****Standard version**

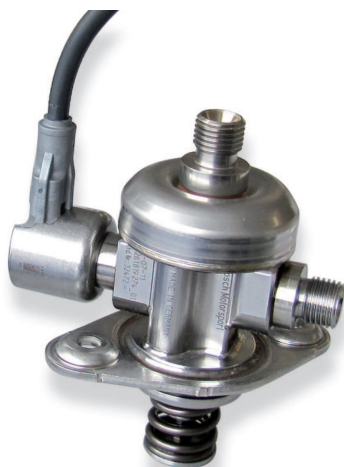
Series wire + compact connector

Order number **F02U.V00.912-03****Standard version**

Series wire + motorsport connector

Order number **F02U.V01.114-03****Rev B (iPRV)**Order number **on request****Rev C (EVO)**Order number **on request****Rev D (Piston)**Order number **on request****Accessories****Flat tappet (26 mm)**Order number **F02U.V01.156-01****Roller tappet (26 mm)**Order number **F02U.V01.163-01**

## HP Fuel Pump HDP 5-LW



4

### Features

- ▶ Max. 1.1 cm<sup>3</sup>/rot<sub>cam</sub>
- ▶ Max. 500 bar
- ▶ 585 g
- ▶ Integrated Flow Control Valve
- ▶ Internal Pressure Relief Valve

The HDP 5-LW is a compact high pressure single piston pump with a light weight housing. The design allows achieving a big delivery volume as well as high efficiency, as needed in motorsport applications. Modifications in the number of cam lobes and cam lifts allow different flow requirements to be addressed.

The HDP 5-LW is equipped with an internal pressure relief valve to limit the maximum fuel pressure. This pump does not require a fuel return line into the fuel tank.

The pump has an integrated demand control for metering the amount of fuel supplied into the high pressure fuel system. It can be ordered with a compact connector or a motorsport connector. Depending on the requirements of your engine (e.g. fuel consumption over rotation ratio) we recommend different types of tappets, piston springs and cam profiles. Please notice: Fuel delivery and maximum driveshaft speed depend on cam profile and type of tappet.

### Application

For high pressure manifold injection or gasoline direct injection

### Technical Specifications

#### Mechanical Data

Mass flow Please see extra sheet

Efficiency	Please see extra sheet
Body design	Lightweight
Flow capacity and max. engine speed	Depending on cam profile
Nominal pressure	500 bar or customization

#### Possible customization

Rev C (EVO)	= Rev B + reduced internal restrictions + introduction of EVO parts (outlet valve)
Rev D (Piston)	= Rev C + bigger piston diameter
Flange hole circle diameter	66 mm or 75 mm
Flange orientation	Free
Electrical connector orientation	0° or customization
Hydraulic connection design	M14 x 1.5 or customization
Weight	Approx. 585 g
Supply pressure	4 to 7 bar
Operating temperature	-40 to 120°C
Storage temperature	-40 to 70°C
Compatible fuels	Unleaded fuels, E22, E85, M15
Fuel temperature	80°C, short term 130°C
Max. vibration	300 m/s <sup>2</sup>

#### Connectors and Wires

Electrical connector design	Series wire + compact connector
	Series wire + motorsport connector
	Motorsport wire + open end
	Motorsport wire + motorsport connector
Hydraulic connection orientation	Fixed

#### Installation Notes

Mounting on cylinder head or adapter flag.
Available cam profiles on request.
Select the cam profile on fuel consumption requirements.
Avoid interference with FCV and hydraulic connections at flange orientation.
Avoid interference with flange at electrical connector orientation.
Please specify the electrical connector design and the wire length with your order.

**Ordering Information****Rev B (iPRV)**Order number **on request****Rev C (EVO)**Order number **on request****Rev D (Piston)**Order number **on request****Accessories****Flat tappet (26 mm)**Order number **F02U.V01.156-01****Roller tappet (26 mm)**Order number **F02U.V01.163-01**

## Overview

4

### Fuel Pressure Regulator Mini 2



- 5 to 10 bar
- 30 to 400 l/h reflow
- Adjusted at 105 l/h
- Aluminum housing
- All versions Methanol compatible

### Fuel Pressure Regulator Mini 5



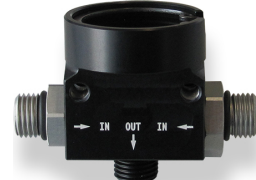
- 5 bar
- 15 to 220 l/h reflow
- Adjusted at 105 l/h
- Sheet steel housing

### Fuel Pressure Regulator Mini A



- 2.2 to 3.5 bar/3.5 to 5 bar
- 15 to 220 l/h reflow
- Pressure adjustable
- Sheet steel housing

### FPR Adaptor light



- Aluminum housing
- Fits to production type regulators and Motorsport regulators (FPR Mini 2, Mini 5, Mini A)
- Very light weight



## Fuel Pressure Regulator Mini 2



### Features

- ▶ 5 to 10 bar
- ▶ 30 to 400 l/h reflow
- ▶ Adjusted at 105 l/h
- ▶ Aluminum housing
- ▶ All versions Methanol compatible

Fuel pressure regulators are used to maintain constant fuel pressure at the injection valves. We offer this regulator for gasoline as well as for methanol applications.

The main benefit of this regulator includes a higher pressure range and a higher return flow rate in comparison to the production type regulators.

### Application

Pressure range	See ordering information
Reflow quantity	30 to 400 l/h
Fuel compatibility	Gasoline, E85, M100
Operating temperature	-40 to 120°C
Storage temperature	-40 to 100°C
Max. vibration	<600 m/s <sup>2</sup> at 5 to 250 Hz
Valve leakage	$Q_{leak} [cm^3/min] \leq 9$ (pneumatic) at $p [kPa] = 0.8 \times P_{nom}$

### Technical Specifications

#### Variations

Please see Ordering Information

#### Mechanical Data

Diameter	38.1+0.1-0.2 mm
Weight	Ca. 61 g
Mounting	Fastening with a clip

#### Connectors and Wires

Connector supply	Diam. 25 mm, O-ring 25x2.5
Connector reflow	Diam. 9.1 mm, O-ring 5x2.5

### Installation Notes

Never run the regulator without the integrated filter.

Please oil O-rings lightly with clean and silicone free engine oil before you install the regulator.

Please make a leak test after you have installed the regulator.

When the pressure regulator is removed and will be reused, the O-rings must be tested for fractures.

Operation of the pressure regulator with a medium other than gasoline is not allowed.

Using the FPR Adaptor light F02U.V02.248-01, you can rebuild the regulator an inline type.

This pressure regulator is not designed for in-tank mounting.

### Ordering Information

#### Fuel Pressure Regulator Mini 2

Pressure Range 5.0 bar

Order number **F02U.V02.166-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 6.0 bar

Order number **F02U.V02.168-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 7.0 bar

Order number **F02U.V02.170-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 8.0 bar

Order number **F02U.V02.171-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 10.0 bar

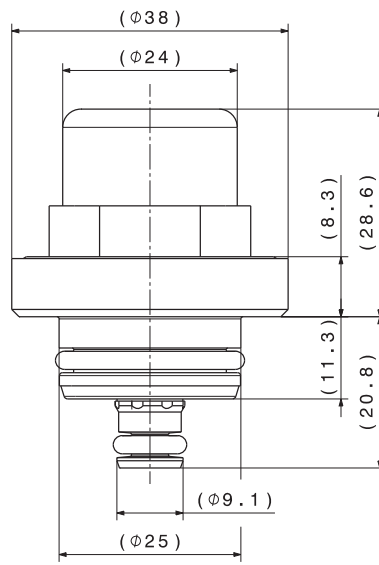
Order number **F02U.V02.172-01**

#### FPR Adaptor light

Order number **F02U.V02.248-01**

Dimensions

4



Complete dimensions on offer drawing at [www.bosch-motorsport.com](http://www.bosch-motorsport.com)

## Fuel Pressure Regulator Mini 5



### Features

- ▶ 5 bar
- ▶ 15 to 220 l/h reflow
- ▶ Adjusted at 105 l/h
- ▶ Sheet steel housing

Fuel pressure regulators are used to maintain constant fuel pressure at the injection valves. We modified this production type based regulator especially for motorsport use and increased the pressure level.

The main benefit of this regulator include the competitively priced high quality and the high return flow rate.

### Application

Pressure range	5 bar
Reflow quantity	15 to 220 l/h
Reference pressure connector	Diam. 5 mm, tube connector

Fuel compatibility	Gasoline (E85 or M15 with shortened lifetime)
Operating temperature	-40 to 120°C
Storage temperature	-40 to 100°C
Max. vibration	<600 m/s <sup>2</sup> at 5 to 250 Hz
Valve leakage	$Q_{leak} [\text{cm}^3/\text{min}] \leq 9$ (pneumatic) at $p [\text{kPa}] = 0.8 \times P_{nom}$

### Technical Specifications

#### Mechanical Data

Diameter	34.9 mm
Weight	48.5 g
Mounting	Fastening with a clip

#### Characteristic

Set pressure accuracy	±2 % at 105 l/h
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#### Connectors and Wires

Connector supply	Diam. 25 mm, O-ring
Connector reflow	Diam. 9.15 mm, O-ring

### Installation Notes

The tube connector at the housing can be used to supply reference pressure to the regulator. This can be atmospheric pressure, air box pressure or manifold pressure.

Never run the regulator without the integrated filter.

Please oil O-rings lightly with clean and silicone free engine oil before you install the regulator.

Please make a leak test after you have installed the regulator.

When the pressure regulator is removed and will be reused, the O-rings must be tested for fractures.

Operation of the pressure regulator with a medium other than gasoline is not allowed.

This pressure regulator is not designed for in-tank mounting.

### Ordering Information

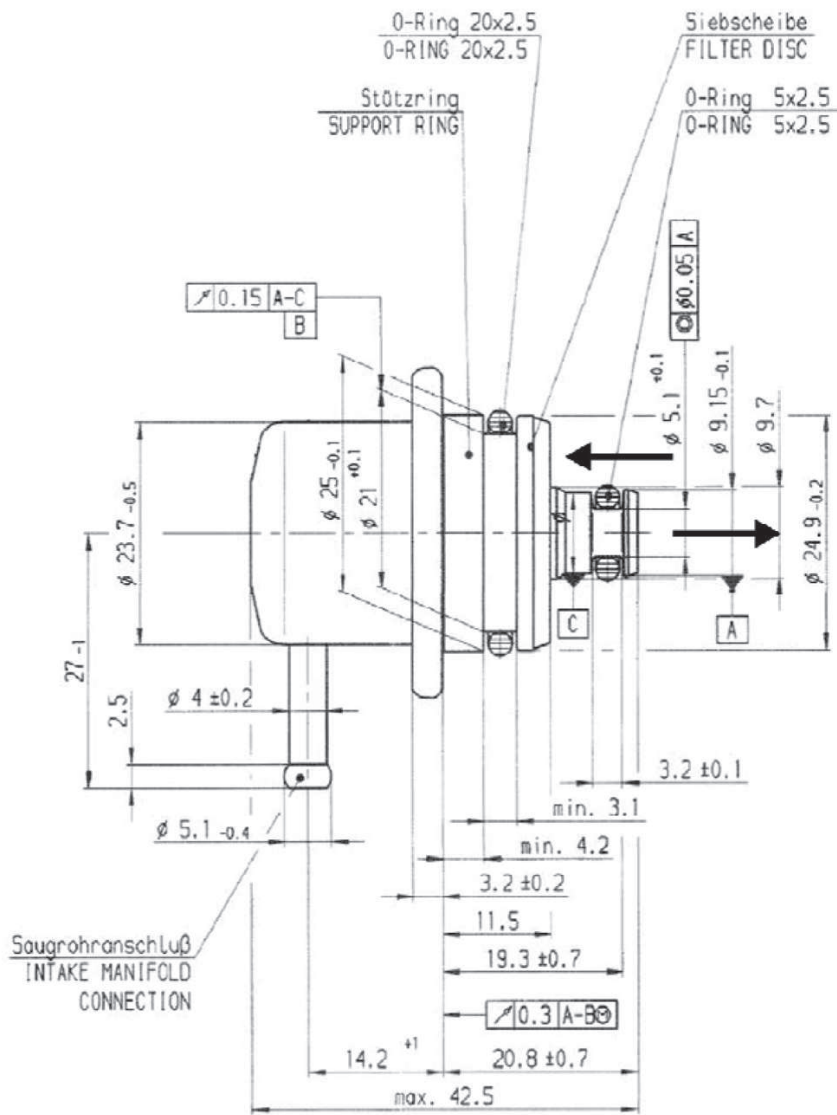
#### Fuel Pressure Regulator Mini 5

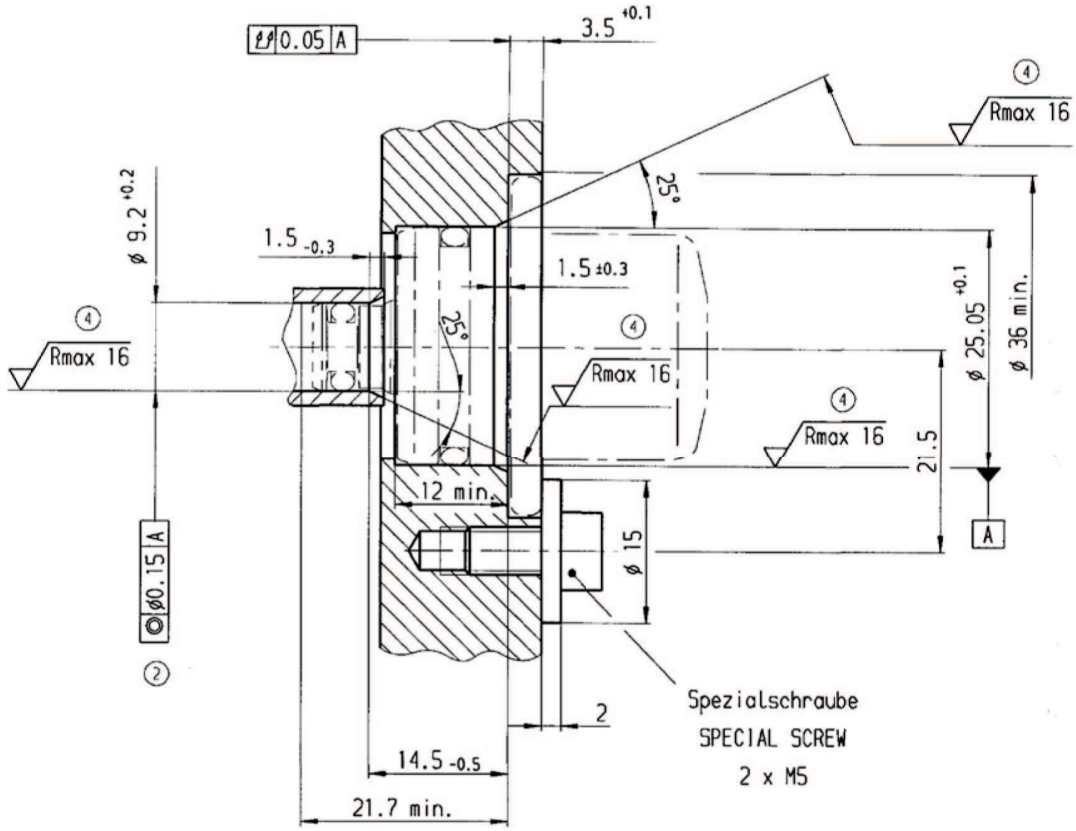
Order number **0280.B02.722-03**

#### FPR Adaptor light

Order number **F02U.V02.248-01**

Dimensions





Installation Recommendation

## Fuel Pressure Regulator Mini A



4

### Features

- ▶ 2.2 to 3.5 bar/3.5 to 5 bar
- ▶ 15 to 220 l/h reflow
- ▶ Pressure adjustable
- ▶ Sheet steel housing

Fuel pressure regulators are used to maintain constant fuel pressure at the injection valves. This regulator based on a production type regulator was specially designed for motorsport applications. The main benefit of this regulator is the adjustability of the fuel pressure.

### Application

Pressure range	2.2 to 3.5 bar 3.5 to 5.0 bar
Reflow quantity	15 to 220 l/h
Reference pressure connector	Diam. 5 mm, tube connector
Fuel compatibility	Gasoline, E85, M15

Operating temperature	-40 to 120°C
Storage temperature	-40 to 100°C
Max. vibration	<400 m/s <sup>2</sup> at 5 to 250 Hz
Valve leakage	$Q_{\text{leak}} [\text{cm}^3/\text{min}] \leq 9$ (pneumatic) at $p [\text{kPa}] = 0.8 \times P_{\text{nom}}$

### Technical Specifications

#### Mechanical Data

Diameter	34.9 mm
Weight	58 g
Mounting	Fastening with a clip

#### Connectors and Wires

Connector supply	Diam. 25 mm, O-ring
Connector reflow	Diam. 9.15 mm, O-ring

### Installation Notes

The tube connector at the housing can be used to supply reference pressure to the regulator. This can be atmospheric pressure, air box pressure or manifold pressure.

Never run the regulator without the integrated filter.

Please oil O-rings lightly with clean and silicone free engine oil before you install the regulator.

Please make a leak test after you have installed the regulator.

When the pressure regulator is removed and will be reused, the O-rings must be tested for fractures.

Operation of the pressure regulator with a medium other than gasoline is not allowed.

This pressure regulator is not designed for in-tank mounting.

### Ordering Information

#### Fuel Pressure Regulator Mini A

Pressure Range 2.2 to 3.5 bar  
Order number **B280.550.340-03**

#### Fuel Pressure Regulator Mini A

Pressure Range 3.5 to 5.0 bar  
Order number **B280.550.341-04**

#### FPR Adaptor light

Order number **F02U.V02.248-01**



## FPR Adaptor light

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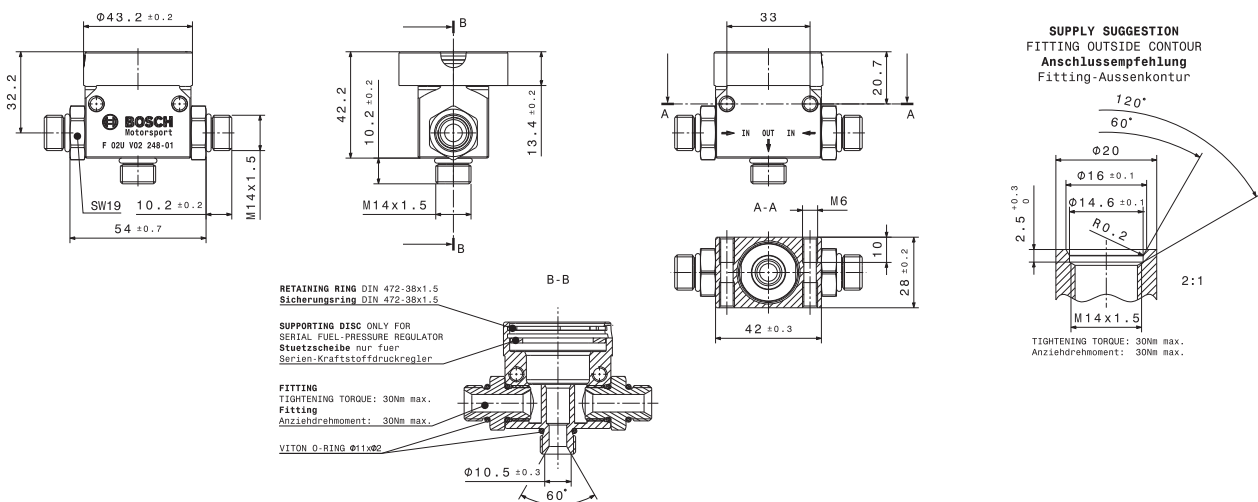


### Features

- ▶ Aluminum housing
- ▶ Fits to production type regulators and Motorsport regulators (FPR Mini 2, Mini 5, Mini A)
- ▶ Very light weight

This adaptor offers the opportunity to convert a rail pressure regulator into an inline pressure regulator. The adaptor is able to hold a production type regulator as well as a motorsport regulator. Delivery without regulator.

### Dimensions



### Application

Fuel compatibility	Gasoline, E85/M100
Operating temperature range	-40 to 120°C
Storage temperature range	-40 to 100°C
Max. vibration	<600 m/s <sup>2</sup> at 5 to 250 Hz

### Technical Specifications

#### Mechanical Data

Diameter	50 mm
Height	55 mm
Weight	92 g
Mounting	Screw fastening with M6 screws into housing or M5 screws through housing

#### Connectors and Wires

Connector supply	2 x M14 x 1.5
Connector reflow	M14 x 1.5

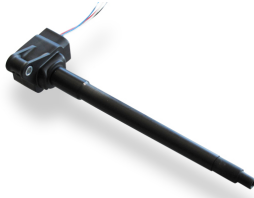
### Ordering Information

**FPR Adaptor light**  
Order number **F02U.V02.248-01**



## Overview

### Ignition Coil C90i-E8



- Max. 40 kV
- Max. 90 mJ
- Max. 5.0 kV/μs
- Max. 15,000 1/min
- Fits to spark plugs with a ceramic diameter of 8 mm

### Ignition Coil C90i-E10



- Max. 40 kV
- Max. 90 mJ
- Max. 5.0 kV/μs
- Max. 15,000 1/min
- Fits to spark plugs with a ceramic diameter of 10 mm

### Ignition Coil C90i-pro



- Max. 40 kV
- Max. 90 mJ
- Max. 5.0 kV/μs
- Max. 15,000 1/min
- Developed for Turbo-GDI engines

### Ignition Coil C90i-pro evo



- Max. 40 kV
- Max. 90 mJ
- Boosted spark current
- Max. 15,000 1/min
- Developed for engines with high gas turbulences

### Ignition Coil C90i-WG



- Max. 35 kV
- Max. 90 mJ
- Connection for high voltage wire
- Max. 15,000 1/min
- Developed for Turbo-GDI engines

### Ignition Coil P50/P50-M



- Max. 35 kV
- Max. 50 mJ
- Max. 3.0 kV/μs
- Max. 10,000 1/min
- High voltage contacting via high voltage wire and spark plug connector possible

### Ignition Coil P65



- Max. 35 kV
- Max. 65 mJ
- Max. 10,000 1/min
- Developed for GDI engines

### Ignition Coil P65-T



- Max. 33 kV
- Max. 65 mJ
- Max. 10,000 1/min (with reduced dwell time)
- Developed for GDI engines

### Ignition Coil P65-TWG



- Max. 33 kV
- Max. 65 mJ
- Connection for high voltage wire
- Max. 10,000 1/min (with reduced dwell time)
- Developed for GDI engines

### Ignition Coil P65-WG



- Max. 35 kV
- Max. 65 mJ
- Connection for 30 kV high voltage wire with locking pin (European standard)
- Max. 10,000 1/min
- Developed for GDI engines

### Ignition Coil P65-WS



- Max. 35 kV
- Max. 65 mJ
- Connection for high voltage wire according to SAE (American standard)
- Max. 10,000 1/min
- Developed for GDI engines

### Ignition Coil PS-T



- Max. 27 kV
- Max. 42 mJ
- Max. 1.5 kV/μs
- Max. 10,000 1/min

## Ignition Coil C90i-E8



4

### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Max. 5.0 kV/μs
- ▶ Max. 15,000 1/min
- ▶ Fits to spark plugs with a ceramic diameter of 8 mm

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed for direct cylinder head mounting.

For this single fire coil the customer can define the length of the spark plug connector.

The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≤ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	80 to 225 mm, depending on customer requirements
Weight w/o wire	< 270 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 8 mm	

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Internal

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
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#### Connectors and Wires

Connector	On request
Mating connector	On request
Pin 1	U <sub>batt</sub> red
Pin 2	ECU ignition power stage blue
Pin 3	Engine GND black
Pin 4	Ionic current signal white
Wire length	100 cm
Wire size	AWG 20/22

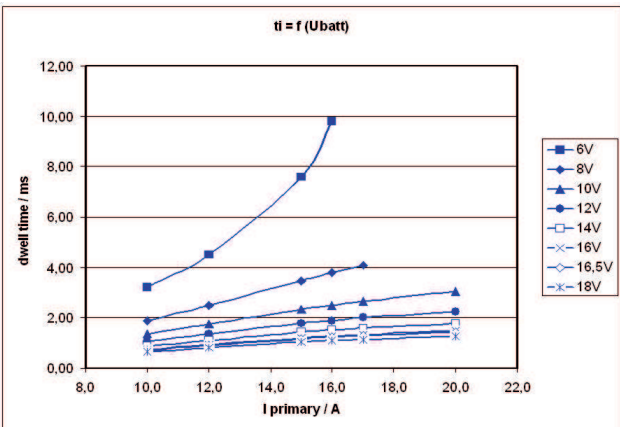
Various motorsport and automotive connectors are available on request.

Please specify the required wire length and the length of the spark plug connector with your order

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10 A	12 A	15 A	16 A	17 A	20 A
6 V	3.2	4.5	7.6	9.8		
8 V	1.88	2.49	3.47	3.79	4.10	
10 V	1.35	1.76	2.34	2.51	2.67	3.05
12 V	1.06	1.35	1.77	1.89	2.00	2.24
14 V	0.87	1.11	1.43	1.52	1.60	1.79
16 V	0.74	0.93	1.20	1.28	1.34	1.49
16.5 V	0.71	0.90	1.15	1.23	1.29	1.43
18 V	0.64	0.81	1.03	1.10	1.15	1.27

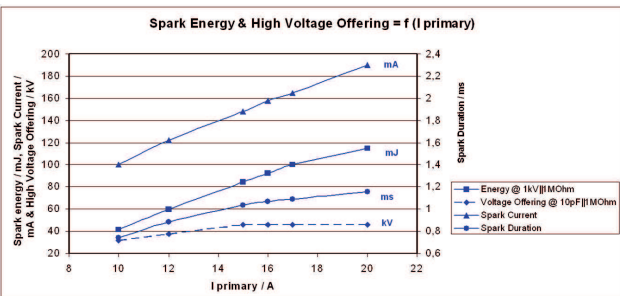
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	41.4 mJ	0.74 ms	100 mA	31.6 kV
12 A	59.5 mJ	0.882 ms	122 mA	37.4 kV
15 A	84.4 mJ	1.034 ms	148 mA	45.7 kV
16 A	92.6 mJ	1.07 ms	158 mA	46 kV
17 A	100 mJ	1.09 ms	165 mA	46 kV
20 A	115 mJ	1.16 ms	190 mA	46 kV



Spark energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 40 kV may reduce the lifetime.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

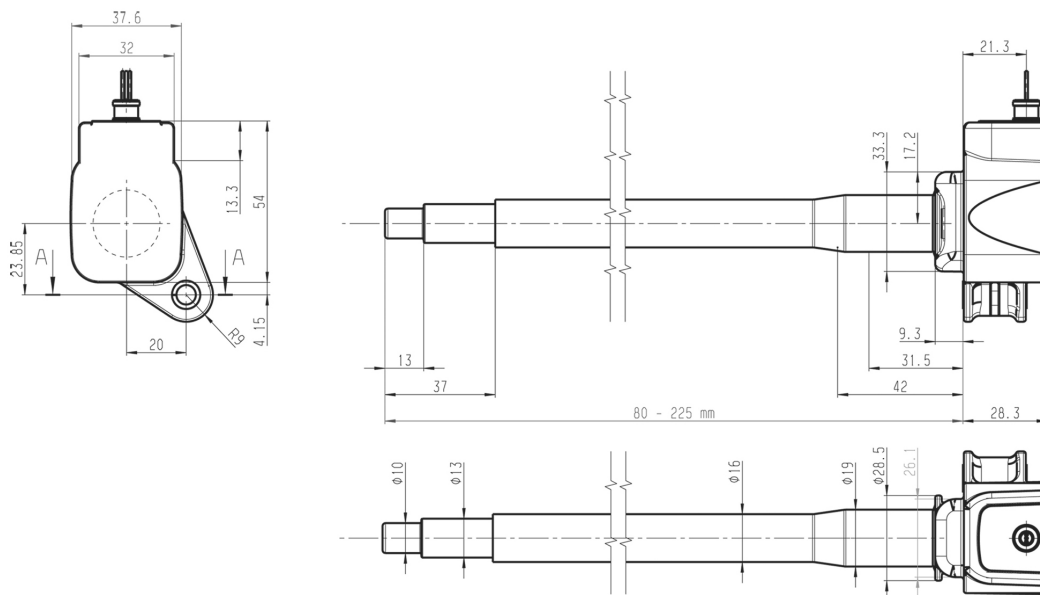
We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil C90i-E8**

Order number depending on customer requirements

**Dimensions**



## Ignition Coil C90i-E10



4

### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Max. 5.0 kV/μs
- ▶ Max. 15,000 1/min
- ▶ Fits to spark plugs with a ceramic diameter of 10 mm

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed for direct cylinder head mounting.

For this single fire coil the customer can define the length of the spark plug connector.

The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≤ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	114 to 225 mm, depending on customer requirements
Weight w/o wire	< 270 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 10 mm	

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Internal

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
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#### Connectors and Wires

Connector	On request
Mating connector	On request
Pin 1	U <sub>batt</sub> red
Pin 2	ECU ignition power stage blue
Pin 3	Engine GND black
Wire length	100 cm
Wire size	AWG 20/22

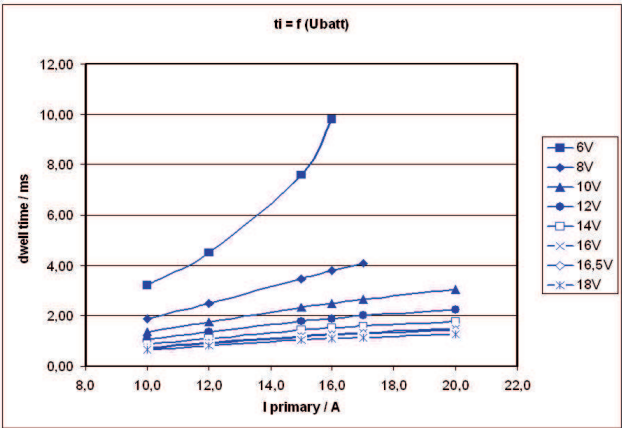
Various motorsport and automotive connectors are available on request.

Please specify the required wire length and the length of the spark plug connector with your order

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10 A	12 A	15 A	16 A	17 A	20 A
<b>6 V</b>	3.2	4.5	7.6	9.8		
<b>8 V</b>	1.88	2.49	3.47	3.79	4.10	
<b>10 V</b>	1.35	1.76	2.34	2.51	2.67	3.05
<b>12 V</b>	1.06	1.35	1.77	1.89	2.00	2.24
<b>14 V</b>	0.87	1.11	1.43	1.52	1.60	1.79
<b>16 V</b>	0.74	0.93	1.20	1.28	1.34	1.49
<b>16.5 V</b>	0.71	0.90	1.15	1.23	1.29	1.43
<b>18 V</b>	0.64	0.81	1.03	1.10	1.15	1.27

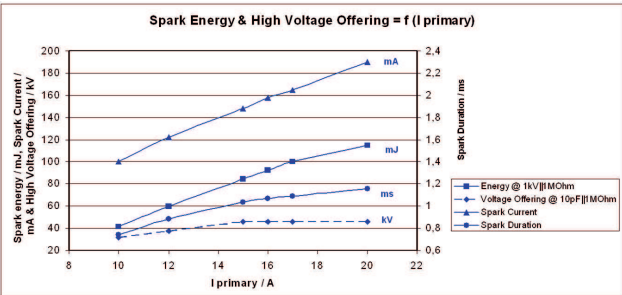
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

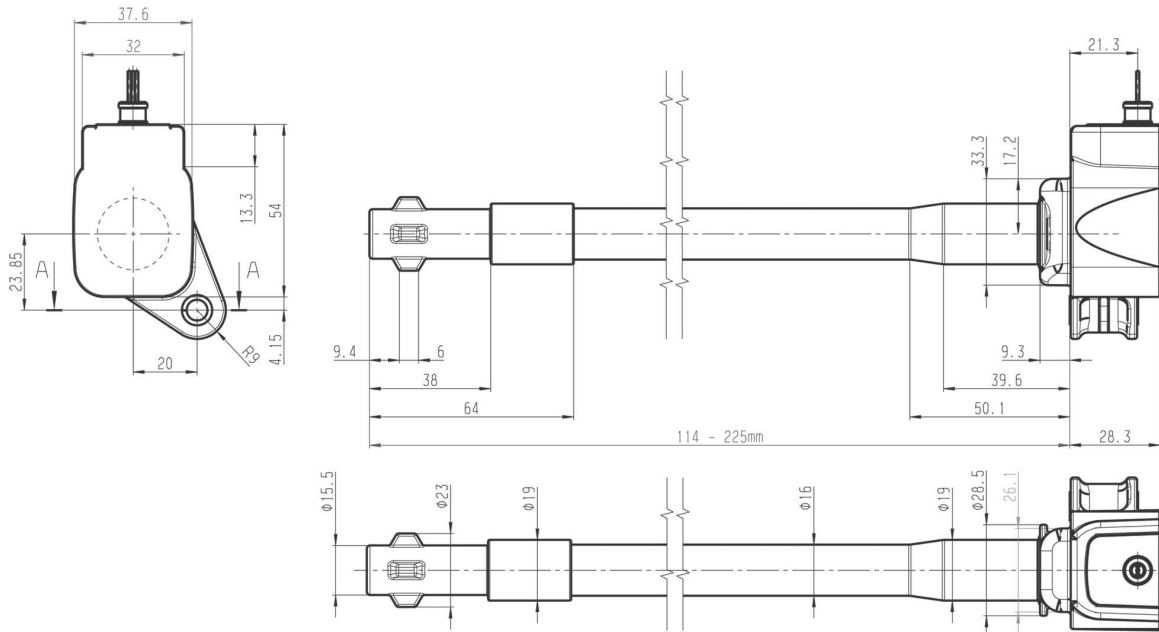
**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	41.4 mJ	0.74 ms	100 mA	31.6 kV
12 A	59.5 mJ	0.882 ms	122 mA	37.4 kV
15 A	84.4 mJ	1.034 ms	148 mA	45.7 kV
16 A	92.6 mJ	1.07 ms	158 mA	46 kV
17 A	100 mJ	1.09 ms	165 mA	46 kV
20 A	115 mJ	1.16 ms	190 mA	46 kV



Spark energy

**Dimensions**



**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above I<sub>prim</sub> = 16 A or 40 kV may reduce the lifetime.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil C90i-E10**

Order number depending on customer requirements

## Ignition Coil C90i-pro

4



### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Max. 5.0 kV/μs
- ▶ Max. 15,000 1/min
- ▶ Developed for Turbo-GDI engines

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed for direct cylinder head mounting. The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≤ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	168 mm
Weight w/o wire	250 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs

Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive
Suppression diode / EFU	Internal

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
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#### Connectors and Wires

Connector	On request
Mating connector	On request
Pin 1	U <sub>batt</sub> red
Pin 2	ECU ignition power stage blue
Pin 3	Engine GND black
Wire length	100 cm
Wire size	AWG 20/22
For spark plugs	Ceramic diameter d = 10 mm

Various motorsport and automotive connectors are available on request.

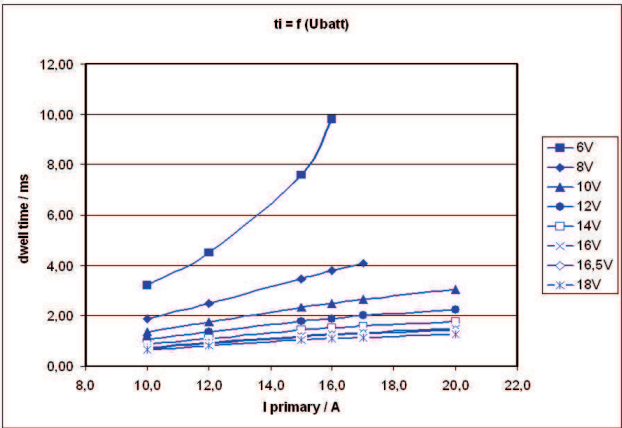
Please specify the required wire length and the length of the spark plug connector with your order

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10 A	12 A	15 A	16 A	17 A	20 A
<b>6 V</b>	3.2	4.5	7.6	9.8		
<b>8 V</b>	1.88	2.49	3.47	3.79	4.10	
<b>10 V</b>	1.35	1.76	2.34	2.51	2.67	3.05
<b>12 V</b>	1.06	1.35	1.77	1.89	2.00	2.24
<b>14 V</b>	0.87	1.11	1.43	1.52	1.60	1.79
<b>16 V</b>	0.74	0.93	1.20	1.28	1.34	1.49
<b>16.5 V</b>	0.71	0.90	1.15	1.23	1.29	1.43
<b>18 V</b>	0.64	0.81	1.03	1.10	1.15	1.27

Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement

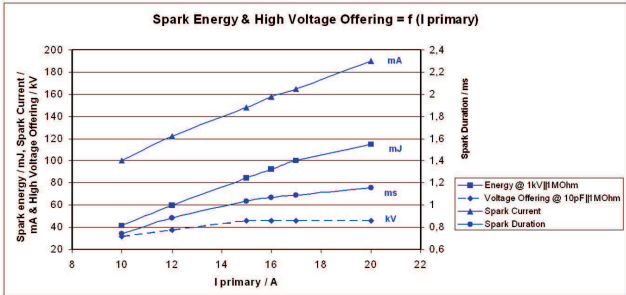




Dwell time

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	41.4 mJ	0.74 ms	100 mA	31.6 kV
12 A	59.5 mJ	0.882 ms	122 mA	37.4 kV
15 A	84.4 mJ	1.034 ms	148 mA	45.7 kV
16 A	92.6 mJ	1.07 ms	158 mA	46 kV
17 A	100 mJ	1.09 ms	165 mA	46 kV
20 A	115 mJ	1.16 ms	190 mA	46 kV



Spark energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 40 kV may reduce the lifetime.

Please find further application hints in the offer drawing at our homepage.

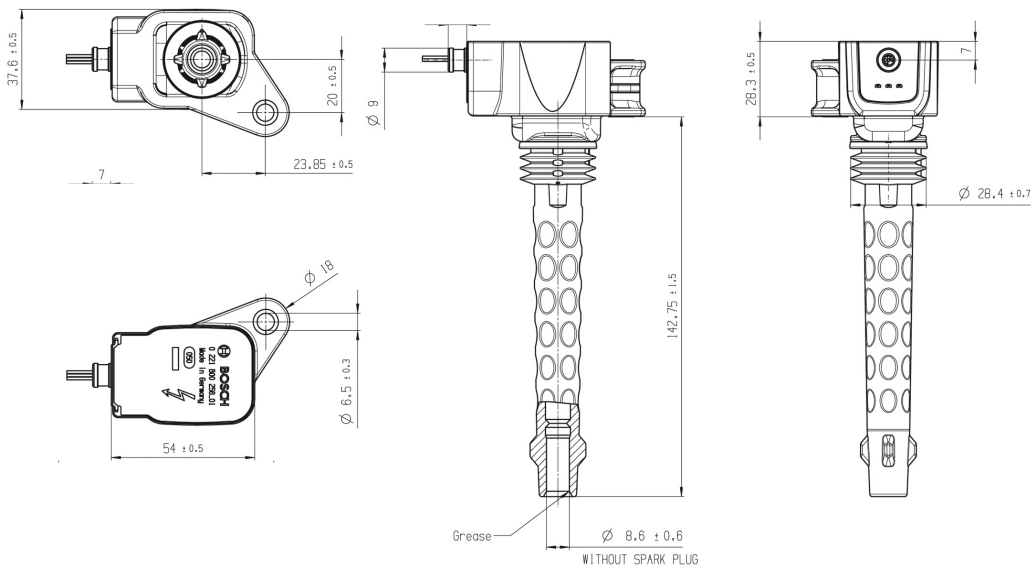
**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Single Fire Coil C90i-pro**  
Order number **0221.B00.256-01**

**Dimensions**



## Ignition Coil C90i-pro evo

4



### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Boosted spark current
- ▶ Max. 15,000 1/min
- ▶ Developed for engines with high gas turbulences

This single fire coil was developed for engines that need a stable spark because of their higher turbulences at the air fuel mixture inside the cylinder. It is designed for direct cylinder head mounting. The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≤ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	168 mm
Weight w/o wire	250 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement

High voltage rise time	≤ 5.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 265 mA
Spark duration at 1 kV    1 MOhm	≤ 0.65 ms
Noise suppression	Inductive
Suppression diode / EFU	Internal

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
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#### Connectors and Wires

Connector	On request
Mating connector	On request
Pin 1	U <sub>batt</sub> red
Pin 2	ECU ignition power stage blue
Pin 3	Engine GND black
Wire length	100 cm
Wire size	AWG 20/22
For spark plugs	Ceramic diameter d = 10 mm

Various motorsport and automotive connectors are available on request.

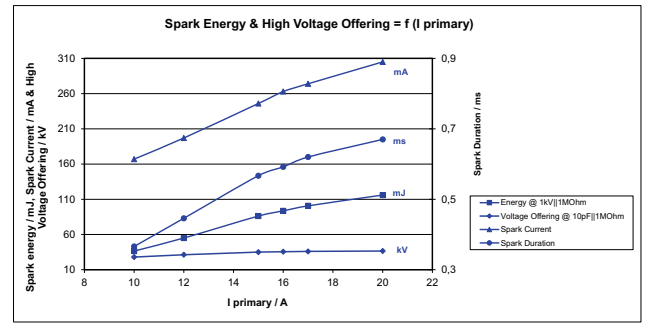
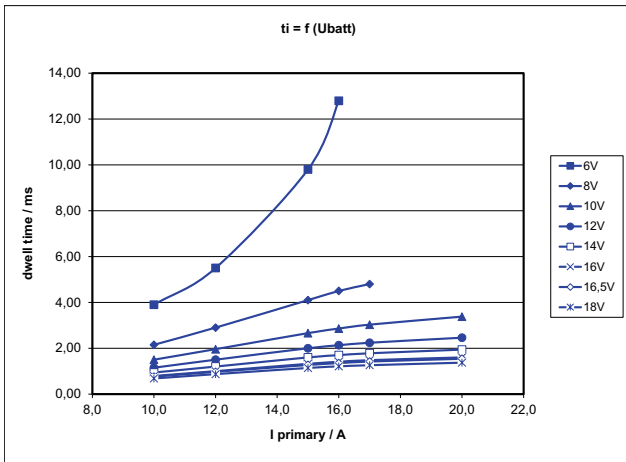
Please specify the required wire length and the length of the spark plug connector with your order

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10 A	12 A	15 A	16 A	17 A	20 A
<b>6 V</b>	3.90	5.50	9.80	12.80		
<b>8 V</b>	2.15	2.90	4.10	4.50	4.80	
<b>10 V</b>	1.50	1.96	2.66	2.86	3.03	3.38
<b>12 V</b>	1.15	1.50	2.00	2.13	2.24	2.46
<b>14 V</b>	0.94	1.20	1.60	1.70	1.78	1.94
<b>16 V</b>	0.79	1.00	1.32	1.41	1.48	1.60
<b>16.5 V</b>	0.76	0.97	1.27	1.35	1.42	1.54
<b>18 V</b>	0.68	0.69	1.14	1.21	1.26	1.37

Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement





Spark Energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 40 kV may reduce the lifetime.

Please find further application hints in the offer drawing at our homepage.

**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

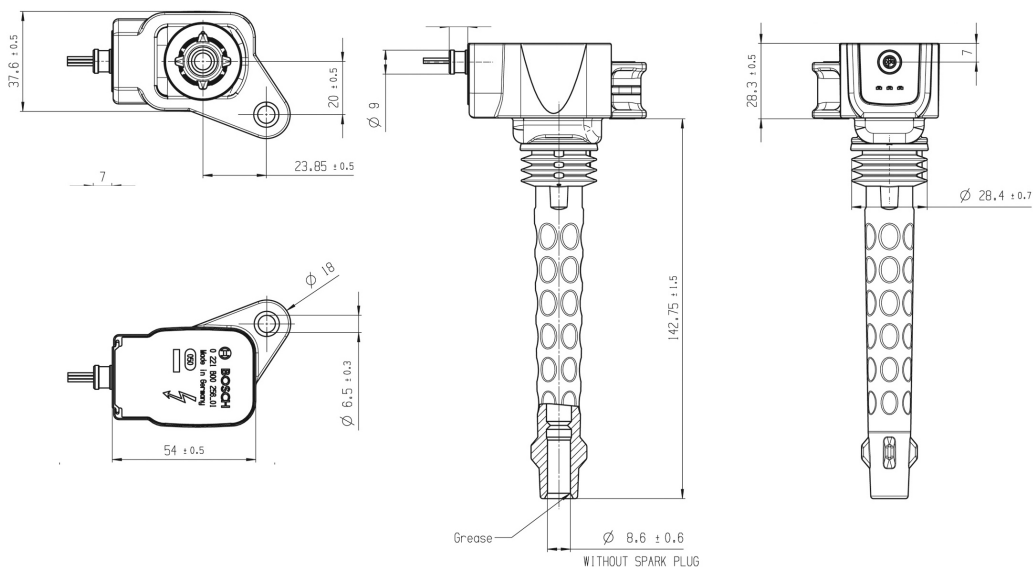
**Ignition Coil C90i-pro evo**

Order number **0221.B00.256-02**

Dwell time  
**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	36.5 mJ	0.366 ms	167 mA	28 kV
12 A	55 mJ	0.446 ms	197 mA	31.3 kV
15 A	86.2 mJ	0.567 ms	246 mA	35 kV
16 A	93.6 mJ	0.592 ms	263 mA	35.6 kV
17 A	100.7 mJ	0.62 ms	274 mA	36 kV
20 A	116 mJ	0.67 ms	305 mA	36.6 kV

**Dimensions**



## Ignition Coil C90i-WG



4

### Features

- ▶ Max. 35 kV
- ▶ Max. 90 mJ
- ▶ Connection for high voltage wire
- ▶ Max. 15,000 1/min
- ▶ Developed for Turbo-GDI engines

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed to connect a high voltage wire on the coil. The main benefit of this high performance coil is its high energy capability.

### Application

Spark energy	≤ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	83 mm
Weight w/o wire	210 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs
Max. high voltage	≤ 35 kV

Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive
Suppression diode / EFU	Internal

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
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#### Connectors and Wires

Connector primary side	On request
Mating connector primary side	On request
Pin 1	U <sub>batt</sub> red
Pin 2	ECU ignition power stage blue
Pin 3	Engine GND black
Wire length	100 cm
Wire size	AWG 20/22
30 kV grid connectors	See Accessories

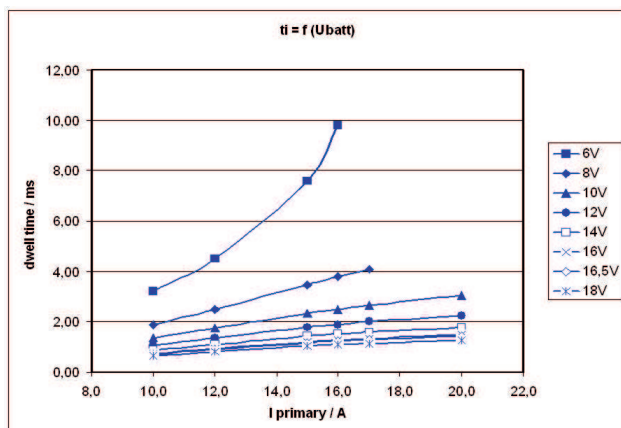
Various motorsport and automotive connectors are available on request.

Please specify the required wire length if you order the coil with a motorsport connector.

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10 A	12 A	15 A	16 A	17 A	20 A
<b>6 V</b>	3.2	4.5	7.6	9.8		
<b>8 V</b>	1.88	2.49	3.47	3.79	4.10	
<b>10 V</b>	1.35	1.76	2.34	2.51	2.67	3.05
<b>12 V</b>	1.06	1.35	1.77	1.89	2.00	2.24
<b>14 V</b>	0.87	1.11	1.43	1.52	1.60	1.79
<b>16 V</b>	0.74	0.93	1.20	1.28	1.34	1.49
<b>16.5 V</b>	0.71	0.90	1.15	1.23	1.29	1.43
<b>18 V</b>	0.64	0.81	1.03	1.10	1.15	1.27

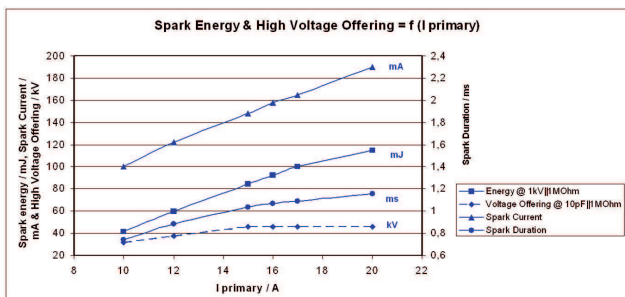
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	41.4 mJ	0.74 ms	100 mA	31.6 kV
12 A	59.5 mJ	0.882 ms	122 mA	37.4 kV
15 A	84.4 mJ	1.034 ms	148 mA	45.7 kV
16 A	92.6 mJ	1.07 ms	158 mA	46 kV
17 A	100 mJ	1.09 ms	165 mA	46 kV
20 A	115 mJ	1.16 ms	190 mA	46 kV



Spark energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug (high voltage wire).

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 35 kV may reduce the lifetime.

Please find further application hints in the offer drawing at our homepage.

**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil C90i-WG**

Order number **F02U.V02.430-01**

**Accessories**

**High Voltage Connector straight**

Please ask your local Bosch Service

Order number **0356.200.015**

**High Voltage Connector angled**

Please ask your local Bosch Service

Order number **0356.250.035**

**M3 Connector inside (required for every HV Connector)**

Please ask your local Bosch Service

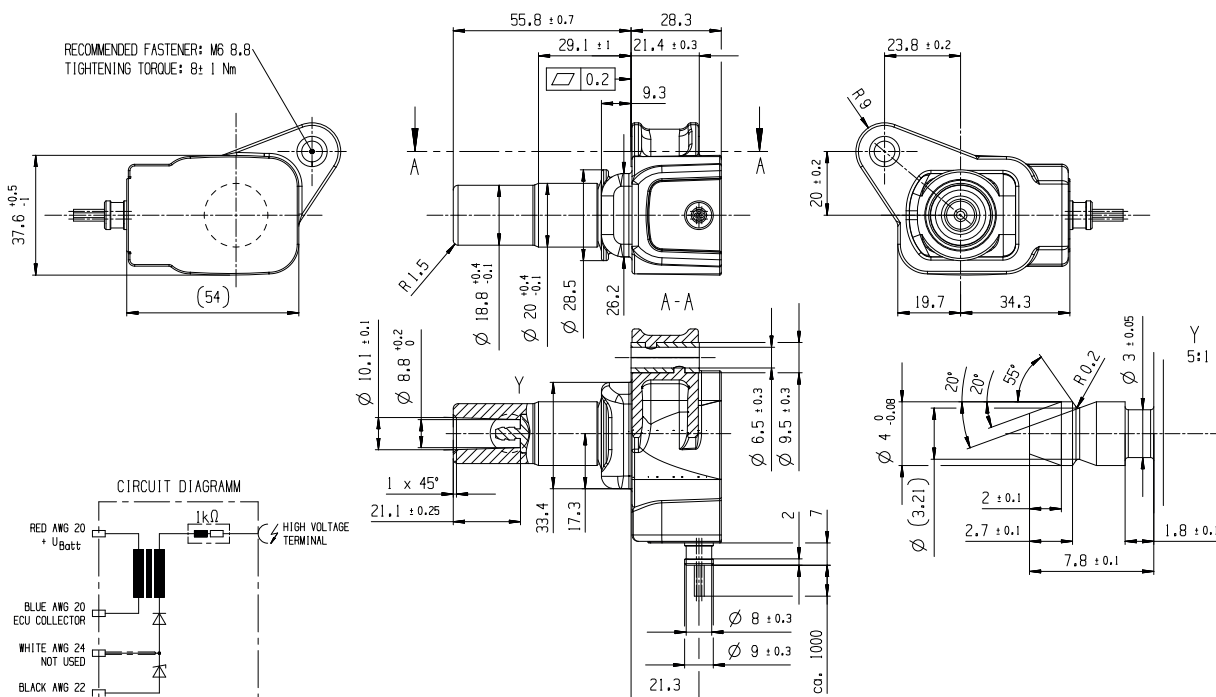
Order number **1350.521.001**

**High Voltage Wire 50 m**

Please ask your local Bosch Service

Order number **5956.563.015**

**Dimensions**



## Ignition Coil P50/P50-M



4

### Features

- ▶ Max. 35 kV
- ▶ Max. 50 mJ
- ▶ Max. 3.0 kV/μs
- ▶ Max. 10,000 1/min
- ▶ High voltage contacting via high voltage wire and spark plug connector possible

The single fire coil P50 is a low cost concept designed for direct mounting to the cylinder head. A high voltage ignition wire can optionally be connected to the secondary output terminal.

The coil P50 requires an ECU with internal ignition power stages for each single fire coil.

The coil P50-M is specifically for motorsport applications. This coil is operable in higher vibration environments.

### Application

Spark energy	≤ 50 mJ
Primary current	≤ 8.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	Please see Variations

### Technical Specifications

#### Variations

	P50	P50-M
Max. vibration	≤ 400 m/s <sup>2</sup> at 5 to 2,000 Hz	≤ 800 m/s <sup>2</sup> at 5 to 2,000 Hz
Weight	223 g	265 g
Spark plug connector	-	+

#### Mechanical Data

Weight	Please see Variations
Mounting	Pluggable

#### Electrical Data

Primary resistance with wire	370 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 3.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 92 mA
Spark duration at 1 kV    1 MOhm	≤ 1.15 ms
Noise suppression	With spark plug connector
Suppression diode / EFU	Integrated

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
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#### Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.335-01
3-pole Compact	
Pin 1	ECU ignition power stage
Pin 2	Engine GND
Pin 3	U <sub>batt</sub>

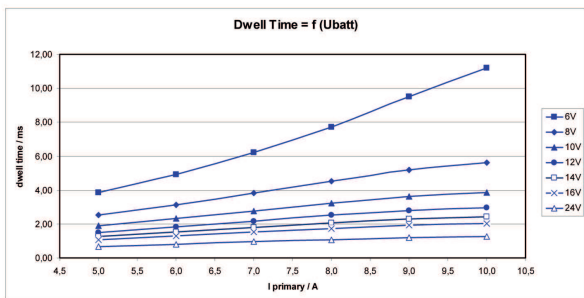
Various motorsport and automotive connectors are available on request.

For spark plugs	Ceramic diameter d=10 mm
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#### Characteristic dwell times [ms]

U <sub>batt</sub>	I primary					
	5.0 A	6.0 A	7.0 A	8.0 A	9.0 A	10 A
6 V	3.84	4.93	6.2	7.7	9.5	11.2
8 V	2.54	3.14	3.81	4.51	5.17	5.61
10 V	1.9	2.33	2.76	3.21	3.62	3.87
12 V	1.51	1.84	2.17	2.51	2.8	2.97
14 V	1.26	1.52	1.79	2.06	2.29	2.42
16 V	1.07	1.3	1.53	1.74	1.93	2.04
18 V	0.94	1.13	1.32	1.51	1.67	1.77
24 V	0.68	0.81	0.95	1.08	1.19	1.26
30 V	0.53	0.63	0.74	0.84	0.93	0.98

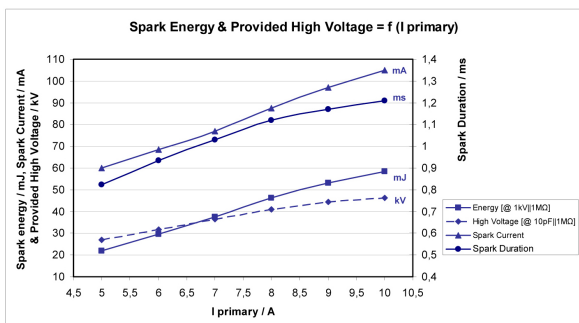
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

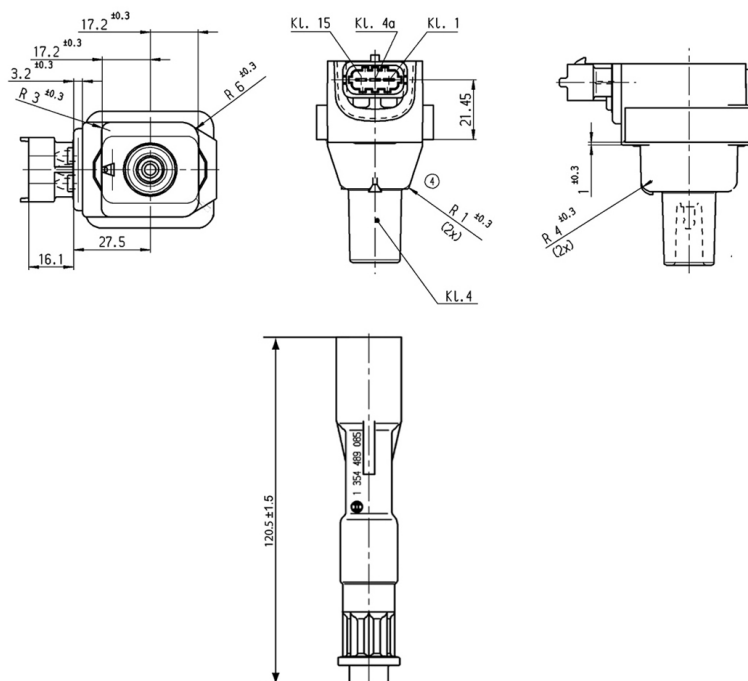
**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
5 A	22 mJ	0.82 ms	60 mA	26.8 kV
6 A	29.7 mJ	0.93 ms	68.5 mA	31.6 kV
7 A	37.5 mJ	1.03 ms	77 mA	36.4 kV
8 A	46.3 mJ	1.12 ms	87.5 mA	40.9 kV
9 A	53 mJ	1.17 ms	97 mA	44.4 kV
10 A	58.4 mJ	1.21 ms	105 mA	46.3 kV



Spark energy

**Dimensions**



**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

The coil P50 has no integrated transistor and requires an ECU with internal ignition power stages, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

Usage above I<sub>prim</sub> > 8.5 A or 35 kV may reduce the lifetime.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil P50**

Order number **0221.504.001**

**Ignition Coil P50-M**

Motorsport version

Order number **F02U.V00.869-01**

**Accessories**

**Accessory spark plug connector**

Order number **1354.489.085**

## Ignition Coil P65



4

### Features

- ▶ Max. 35 kV
- ▶ Max. 65 mJ
- ▶ Max. 10,000 1/min
- ▶ Developed for GDI engines

This single fire coil is a low cost concept, designed to get connected to the spark plug via a high voltage wire. The high voltage connector is specified according to the SAE standard.

The performance of the coil fulfills the demands of modern GDI engines.

The main benefits of this product are the high packaging flexibility and its high electrical performance at low costs.

### Application

Spark energy	≤ 65 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Length	180 mm
Weight w/o wire	225 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 10 mm	

#### Electrical Data

Primary resistance	570 mOhm
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Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.9 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 74 mA
Spark duration at 1 kV    1 MOhm	≤ 2.0 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Integrated

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> = 600 V)
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#### Connectors and Wires

Connector	Tyco AMP
Mating connector	D261.205.350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0 A	6.0 A	7.0 A	7.5 A	8.0 A	8.5 A
6 V	8.74	18.5				
8 V	4.5	6.4	9	10.8	13.9	
10 V	3.1	4.2	5.4	6	6.6	7.2
12 V	2.36	3.1	3.88	4.25	4.63	4.92
14 V	1.9	2.48	3.05	3.32	3.57	3.77
16 V	1.61	2.06	2.53	2.73	2.93	3.08
18 V	1.55	2	2.43	2.62	2.81	2.95
20 V	1.39	1.77	2.16	2.33	2.48	2.6
22 V	1.22	1.54	1.88	2.02	2.15	2.26
24 V	0.97	1.23	1.49	1.6	1.71	1.78

Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement

#### Spark energy and provided high voltage

I <sub>prim.</sub>	Spark energy	-duration	-current	Hi voltage
5 A	37.8 mJ	1.46 ms	49 mA	24.3 kV
6 A	54.5 mJ	1,74 ms	59 mA	28.9 kV
7 A	69.8 mJ	1.97 ms	69 mA	33.2 kV
7.5 A	77.6 mJ	2.04 ms	74 mA	35.8 kV
8 A	83.0 mJ	2.11 ms	77 mA	37.7 kV
8.5 A	88.0 mJ	2.16 ms	81 mA	39.0 kV

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

The coil P65 has no integrated transistor and requires an ECU with internal ignition power stages, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

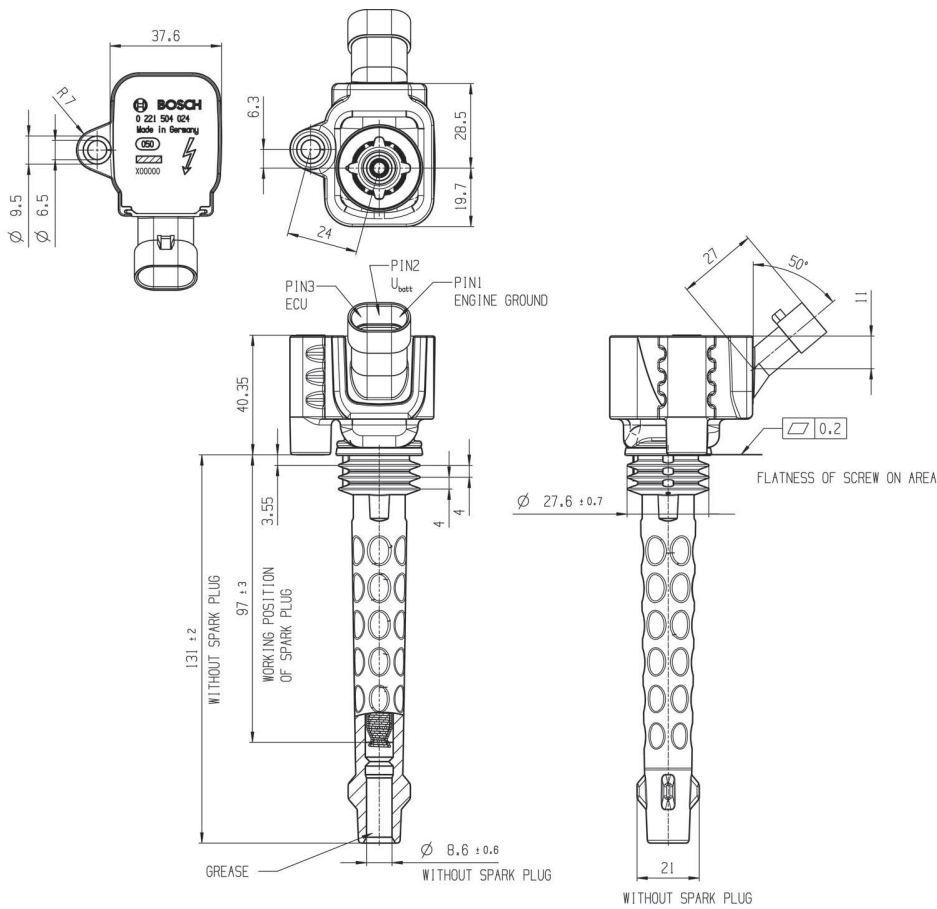
**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil P65**  
Order number **0221.504.024**

**Dimensions**





## Ignition Coil P65-T



4

### Features

- ▶ Max. 33 kV
- ▶ Max. 65 mJ
- ▶ Max. 10,000 1/min (with reduced dwell time)
- ▶ Developed for GDI engines

This single fire coil is a low cost concept designed for direct mounting on the cylinder head. The coil P65-T has an integrated transistor and requires an ECU with internal ignition drivers.

### Application

Spark energy	≤ 65 mJ
Primary current	≤ 7.0 A
Operating temperature range at outer core	-40 to 140°C
Storage temperature range	-40 to 140°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	143 mm
Weight	223 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 10 mm	

#### Electrical Data

Primary resistance with wire	Incapable of measurement
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.4 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 33 kV

Spark current	≤ 70 mA
Spark duration at 1 kV    1 MOhm	≤ 1.85 ms
Noise suppression	Inductive and 1 kOhm resistance
Integrated suppression diode / EFU	
Integrated power stage	

#### Characteristic

Measured with power stage	BIP 385
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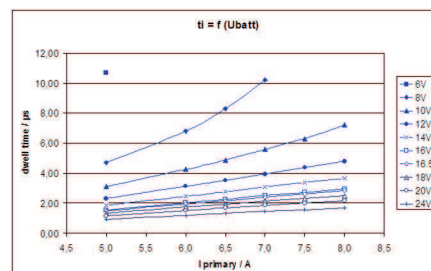
#### Connectors and Wires

Connector	Tyco 0-1488991-1
Mating connector	F02U.B00.555-01
Pin 1	ECU ignition signal
Pin 2	ECU GND
Pin 3	U <sub>batt</sub>

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0 A	5.5 A	6.0 A	6.5 A	7.0 A	7.5 A
<b>Max. 1000 /min</b>	10	9	8	7	6	5
<b>6 V</b>	10.7	11.6				
<b>8 V</b>	4.7	5.4	6.8	8.3	10.2	
<b>10 V</b>	3.1	3.55	4.25	4.87	5.6	6.3
<b>12 V</b>	2.32	2.66	3.12	3.51	3.94	4.36
<b>14 V</b>	1.86	2.1	2.45	2.75	3.07	3.36
<b>16 V</b>	1.55	1.77	2.03	2.26	2.51	2.73
<b>16.5 V</b>	1.49	1.7	1.95	2.17	2.40	2.61
<b>18 V</b>	1.34	1.51	1.73	1.92	2.13	2.31
<b>20 V</b>	1.16	1.33	1.51	1.67	1.85	2.0
<b>24 V</b>	0.93	1.05	1.19	1.32	1.45	1.57

Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



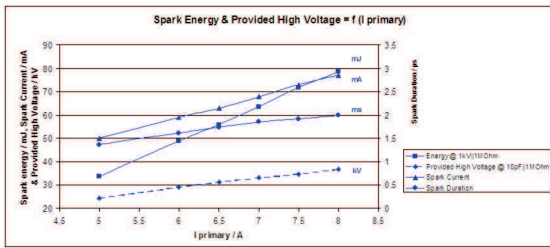
Dwell time

#### Spark energy and provided high voltage

I <sub>prim.</sub>	Spark energy	-duration	-current	Hi voltage
5 A	33.7 mJ	1.37 ms	50 mA	24.4 kV
5.5 A	42 mJ	1.54 ms	54 mA	27.0 kV



6 A	48.9 mJ	1.62 ms	59 mA	29.1 kV
6.5 A	55.9 mJ	1.74 ms	63 mA	31.2 kV
7 A	63.6 mJ	1.85 ms	68 mA	33.2V
7.5 A	71.9 mJ	1.92 ms	73 mA	34.7 kV



Spark energy

### Installation Notes

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

The coil P65-T has an integrated transistor and requires an ECU with internal ignition drivers with 10 to 20 mA current output.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

### Design Note

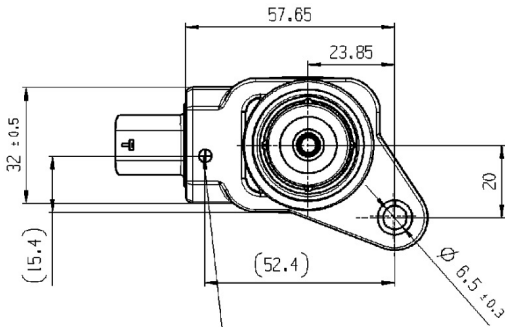
We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

### Ordering Information

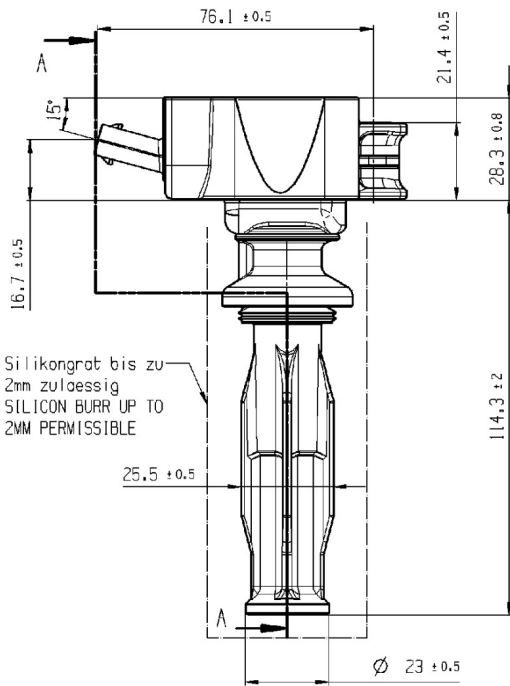
**Ignition Coil P65-T**  
Order number **0221.604.024**

Dimensions

4



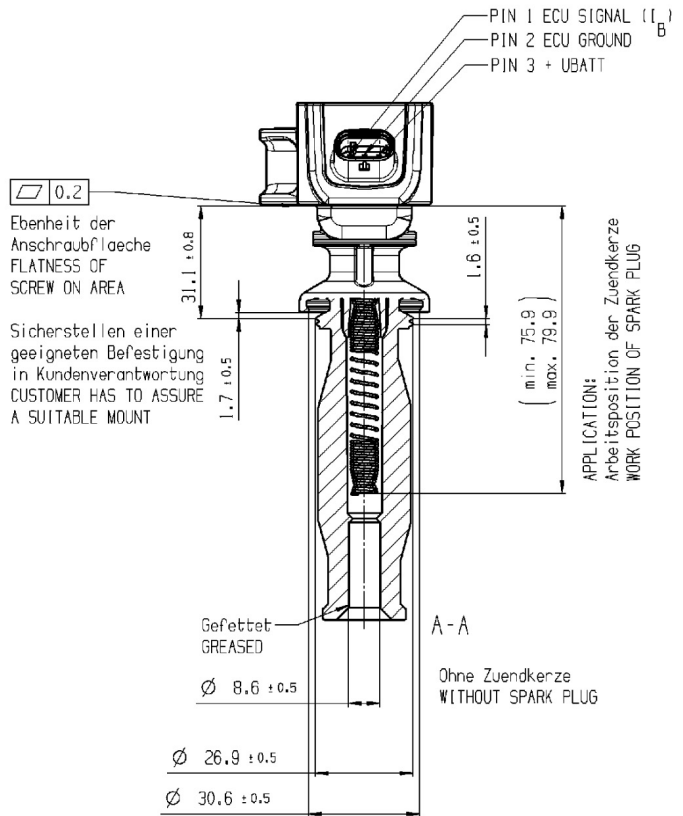
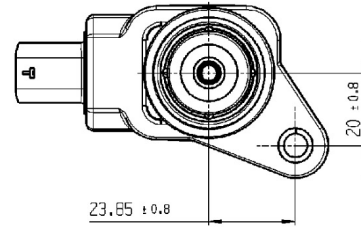
Temperatur-Messpunkt  
Endstufe  
TEMPERATURE MEASURING  
POINT POWER STAGE



Silikongrat bis zu  
2mm zulässig  
SILICON BURR UP TO  
2MM PERMISSIBLE

Ohne Zündkerze  
WITHOUT SPARK PLUG

Darstellung ohne Kerzenmantel und Feder  
EXPOSITION WITHOUT SPARK PLUG CONNECTOR  
AND SPRING



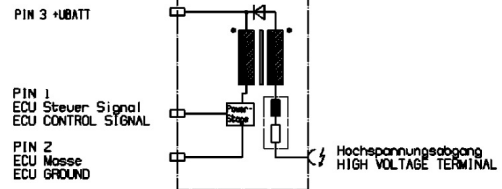
Ebenheit der  
Anschraubfläche  
FLATNESS OF  
SCREW ON AREA

Sicherstellen einer  
geeigneten Befestigung  
in Kundenverantwortung  
CUSTOMER HAS TO ASSURE  
A SUITABLE MOUNT

APPLICATION:  
Arbeitsposition der Zündkerze  
WORK POSITION OF SPARK PLUG

Ohne Zündkerze  
WITHOUT SPARK PLUG

Schaltbild  
CIRCUIT DIAGRAM:



## Ignition Coil P65-TWG



### Features

- ▶ Max. 33 kV
- ▶ Max. 65 mJ
- ▶ Connection for high voltage wire
- ▶ Max. 10,000 1/min (with reduced dwell time)
- ▶ Developed for GDI engines

This single fire coil is a low cost concept designed to connect a high voltage wire on the coil. The coil has an integrated transistor and requires an ECU with internal ignition drivers.

### Application

Spark energy	≤ 65 mJ
Primary current	≤ 7.0 A
Operating temperature range at outer core	-40 to 140°C
Storage temperature range	-40 to 140°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	83 mm
Weight	210 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance with wire	Incapable of measurement
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.4 kV/μs
Max. high voltage at	≤ 33 kV
Spark current	≤ 70 mA

Spark duration at 1 kV    1 MOhm	≤ 1.85 ms
Noise suppression	Inductive and 1 kOhm resistance
Integrated suppression diode / EFU	
Integrated power stage	

#### Characteristic

Measured with power stage	BIP 385
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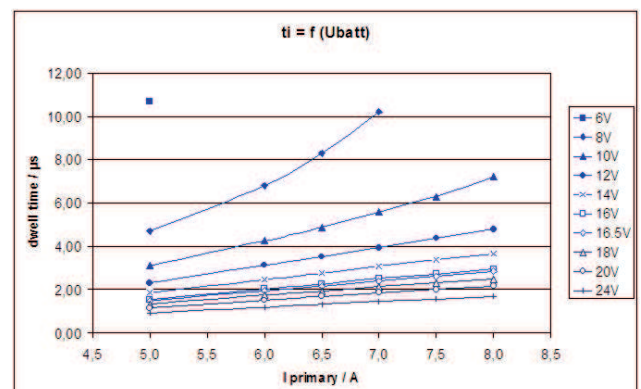
#### Connectors and Wires

Connector primary side	Tyco 0-1488991-1
Mating connector primary side	F02U.B00.555-01
Pin 1	ECU ignition signal
Pin 2	ECU GND
Pin 3	U <sub>batt</sub>
30 kV grid connector	See Accessories

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0 A	5.5 A	6.0 A	6.5 A	7.0 A	7.5 A
<b>Max. 1000 /min</b>	10	9	8	7	6	5
<b>6 V</b>	10.7	11.6				
<b>8 V</b>	4.7	5.4	6.8	8.3	10.2	
<b>10 V</b>	3.1	3.55	4.25	4.87	5.6	6.3
<b>12 V</b>	2.32	2.66	3.12	3.51	3.94	4.36
<b>14 V</b>	1.86	2.1	2.45	2.75	3.07	3.36
<b>16 V</b>	1.55	1.77	2.03	2.26	2.51	2.73
<b>16.5 V</b>	1.49	1.7	1.95	2.17	2.40	2.61
<b>18 V</b>	1.34	1.51	1.73	1.92	2.13	2.31
<b>20 V</b>	1.16	1.33	1.51	1.67	1.85	2.0
<b>24 V</b>	0.93	1.05	1.19	1.32	1.45	1.57

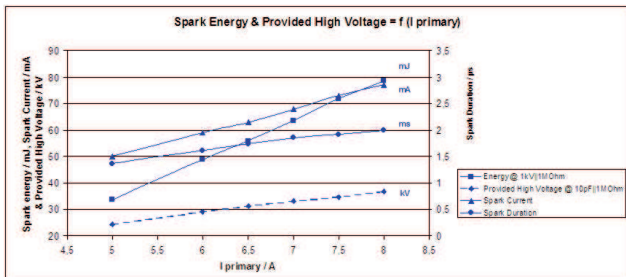
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
5 A	33.7 mJ	1.37 ms	50 mA	24.4 kV
5.5 A	42 mJ	1.54 ms	54 mA	27.0 kV
6 A	48.9 mJ	1.62 ms	59 mA	29.1 kV
6.5 A	55.9 mJ	1.74 ms	63 mA	31.2 kV
7 A	63.6 mJ	1.85 ms	68 mA	33.2V
7.5 A	71.9 mJ	1.92 ms	73 mA	34.7 kV



Spark Energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug (high voltage wire).

The coil P65-T has an integrated transistor and requires an ECU with internal ignition drivers with 10 to 20 mA current output.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil P65-TWG**

Order number **F02U.V02.429-01**

**Accessories**

**High Voltage Connector straight**

Please ask your local Bosch Service  
Order number **0356.200.015**

**High Voltage Connector angled**

Please ask your local Bosch Service  
Order number **0356.250.035**

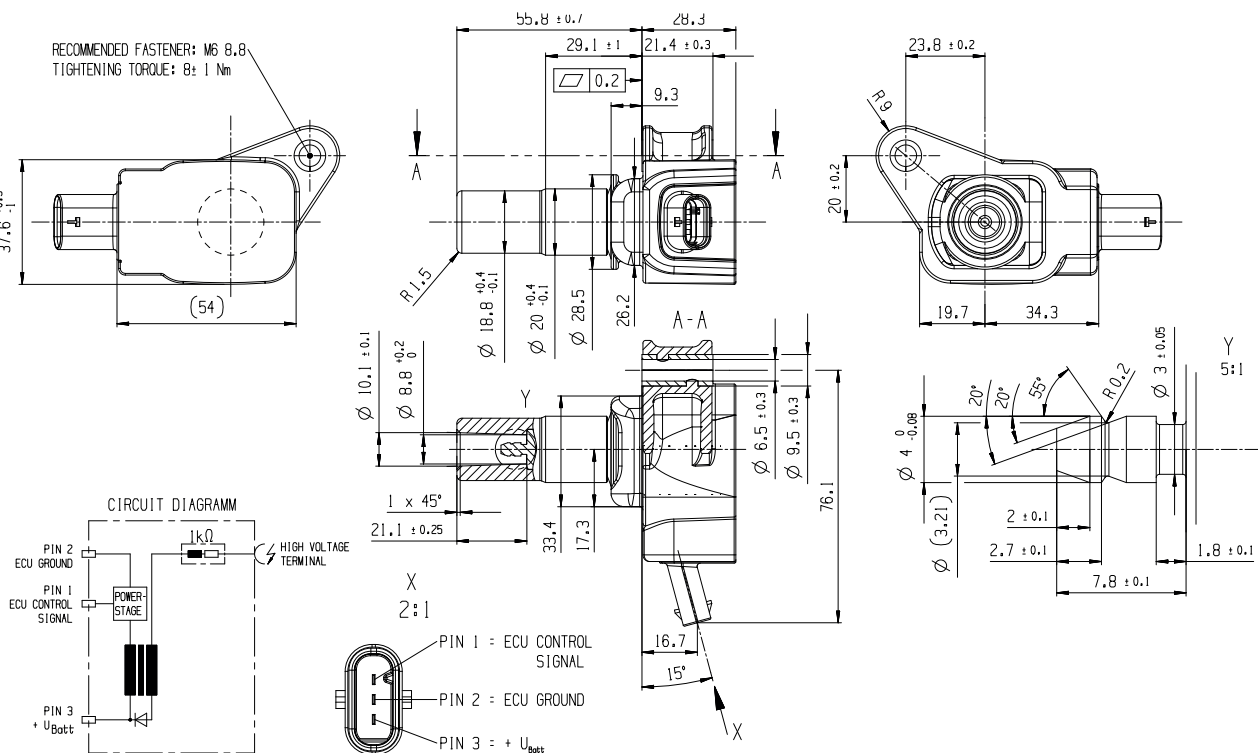
**M3 Connector inside (required for every HV Connector)**

Please ask your local Bosch Service  
Order number **1350.521.001**

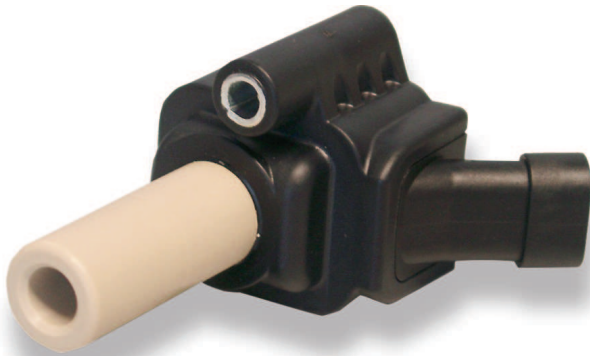
**High Voltage Wire 50 m**

Please ask your local Bosch Service  
Order number **5956.563.015**

**Dimensions**



## Ignition Coil P65-WG



### Features

- ▶ Max. 35 kV
- ▶ Max. 65 mJ
- ▶ Connection for 30 kV high voltage wire with locking pin (European standard)
- ▶ Max. 10,000 1/min
- ▶ Developed for GDI engines

This single fire coil is a low cost concept, designed to get connected to the spark plug via a high voltage wire. The high voltage connector is specified according to the European standard.

The performance of the coil fulfills the demands of modern GDI engines.

The main benefits of this product are the high packaging flexibility and its high electrical performance at low costs.

### Application

Spark energy	≤ 65 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Length	See offer drawing
Weight w/o wire	< 222 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance	570 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.9 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 74 mA
Spark duration at 1 kV    1 MOhm	≤ 2.0 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Integrated

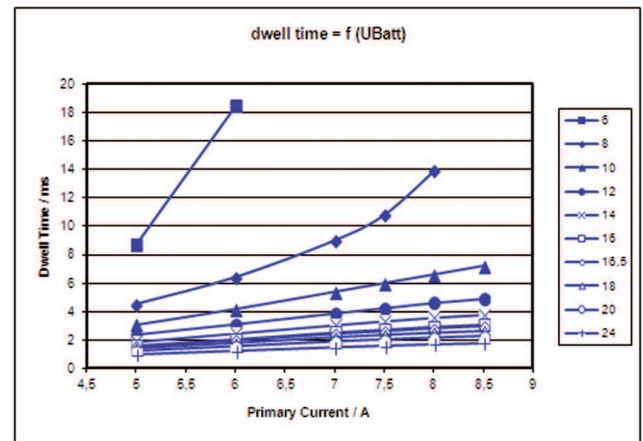
#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> = 600 V)
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#### Connectors and Wires

Connector	Tyco AMP
Mating connector	D261.205.350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]

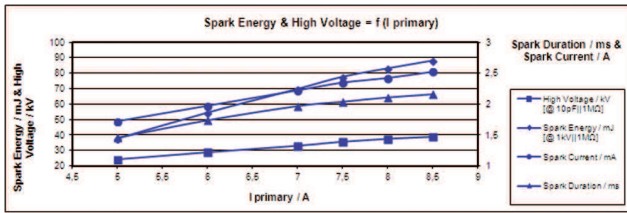


Dwell time

U <sub>batt</sub>	I primary					
	5.0 A	6.0 A	7.0 A	7.5 A	8.0 A	8.5 A
6 V	8.74	18.5				
8 V	4.5	6.4	9	10.8	13.9	
10 V	3.1	4.2	5.4	6	6.6	7.2
12 V	2.36	3.1	3.88	4.25	4.63	4.92
14 V	1.9	2.48	3.05	3.32	3.57	3.77
16 V	1.61	2.06	2.53	2.73	2.93	3.08
18 V	1.55	2	2.43	2.62	2.81	2.95
20 V	1.39	1.77	2.16	2.33	2.48	2.6
22 V	1.22	1.54	1.88	2.02	2.15	2.26
24 V	0.97	1.23	1.49	1.6	1.71	1.78

Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement

**Spark energy and provided high voltage**



Spark energy

I prim.	Spark energy	-duration	-current	Hi voltage
5 A	37.8 mJ	1.46 ms	49 mA	24.3 kV
6 A	54.5 mJ	1,74 ms	59 mA	28.9 kV
7 A	69.8 mJ	1.97 ms	69 mA	33.2 kV
7.5 A	77.6 mJ	2.04 ms	74 mA	35.8 kV
8 A	83.0 mJ	2.11 ms	77 mA	37.7 kV
8.5 A	88.0 mJ	2.16 ms	81 mA	39.0 kV

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

The coil P65 has no integrated transistor and requires an ECU with internal ignition power stages, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil P65-WG**

Order number **F02U.V01.927-01**

**Accessories**

**High Voltage Connector straight**

Please ask your local Bosch Service  
Order number **0356.200.015**

**High Voltage Connector angled**

Please ask your local Bosch Service  
Order number **0356.250.035**

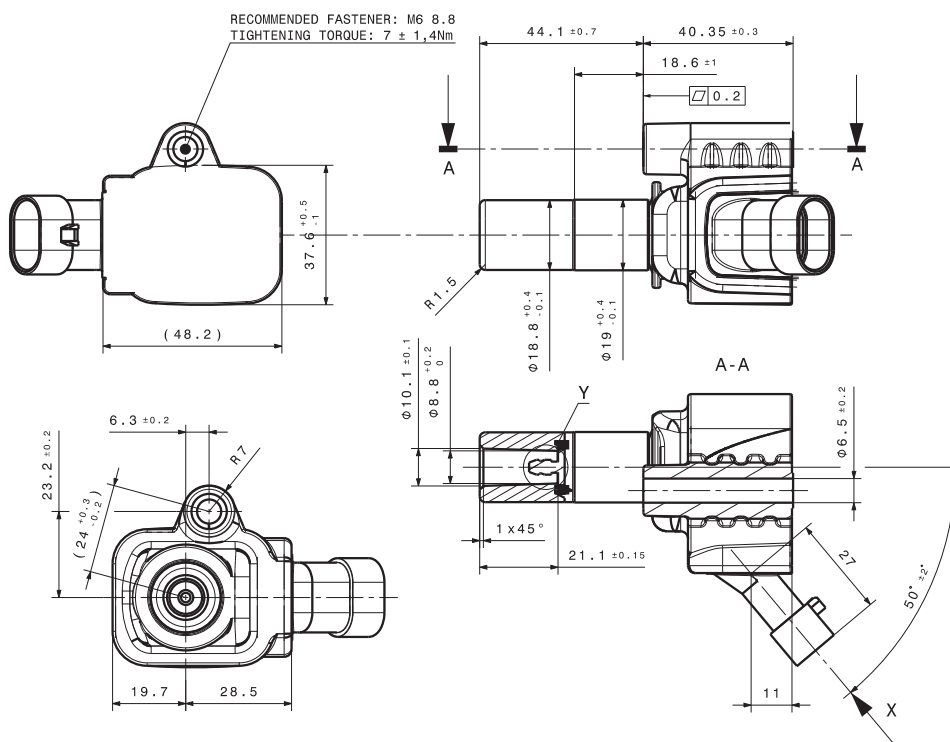
**M3 Connector inside (required for every HV Connector)**

Please ask your local Bosch Service  
Order number **1350.521.001**

**High Voltage Wire 50 m**

Please ask your local Bosch Service  
Order number **5956.563.015**

**Dimensions**





## Ignition Coil P65-WS



### Features

- ▶ Max. 35 kV
- ▶ Max. 65 mJ
- ▶ Connection for high voltage wire according to SAE (American standard)
- ▶ Max. 10,000 1/min
- ▶ Developed for GDI engines

This single fire coil is a low cost concept, designed to get connected to the spark plug via a high voltage wire. The high voltage connector is specified according to the SAE standard.

The performance of the coil fulfills the demands of modern GDI engines.

The main benefits of this product are the high packaging flexibility and its high electrical performance at low costs.

### Application

Spark energy	≤ 65 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Length	See offer drawing
Weight w/o wire	< 222 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance	570 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.9 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 74 mA
Spark duration at 1 kV    1 MOhm	≤ 2.0 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Integrated

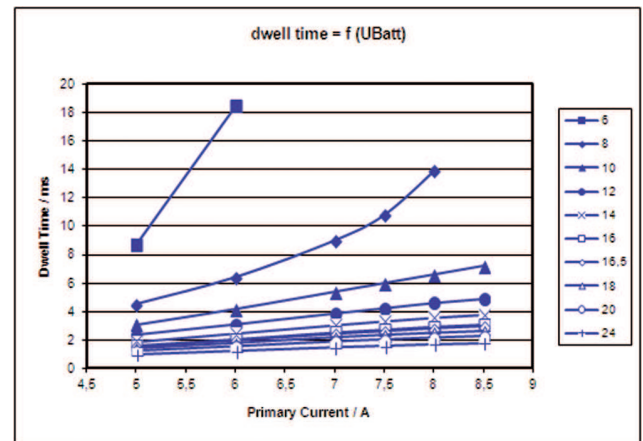
#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> = 600 V)
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#### Connectors and Wires

Connector	Tyco AMP
Mating connector	D261.205.350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]

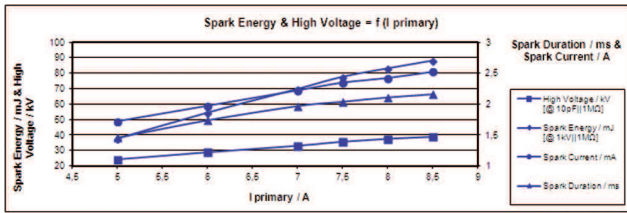


Dwell time

U <sub>batt</sub>	I primary					
	5.0 A	6.0 A	7.0 A	7.5 A	8.0 A	8.5 A
6 V	8.74	18.5				
8 V	4.5	6.4	9	10.8	13.9	
10 V	3.1	4.2	5.4	6	6.6	7.2
12 V	2.36	3.1	3.88	4.25	4.63	4.92
14 V	1.9	2.48	3.05	3.32	3.57	3.77
16 V	1.61	2.06	2.53	2.73	2.93	3.08
18 V	1.55	2	2.43	2.62	2.81	2.95
20 V	1.39	1.77	2.16	2.33	2.48	2.6
22 V	1.22	1.54	1.88	2.02	2.15	2.26
24 V	0.97	1.23	1.49	1.6	1.71	1.78

Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement

**Spark energy and provided high voltage**



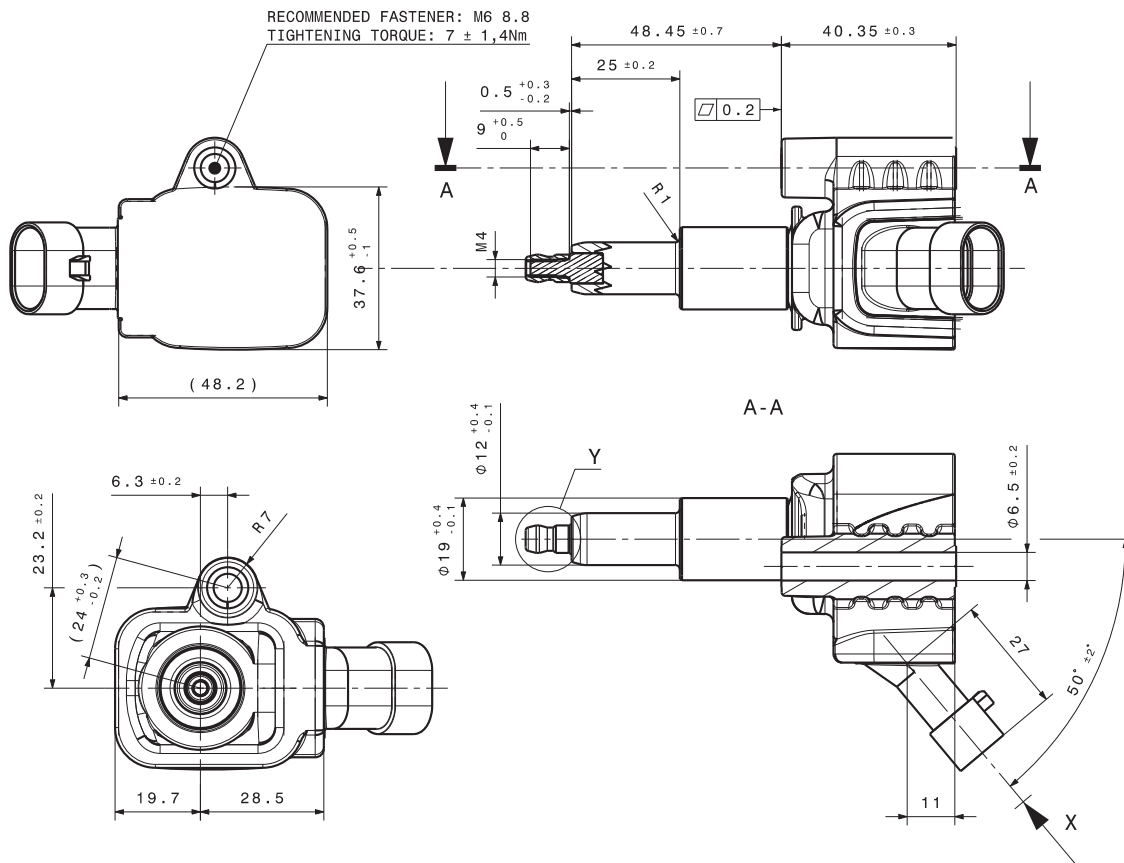
Spark energy

I prim.	Spark energy	-duration	-current	Hi voltage
5 A	37.8 mJ	1.46 ms	49 mA	24.3 kV
6 A	54.5 mJ	1,74 ms	59 mA	28.9 kV
7 A	69.8 mJ	1.97 ms	69 mA	33.2 kV
7.5 A	77.6 mJ	2.04 ms	74 mA	35.8 kV
8 A	83.0 mJ	2.11 ms	77 mA	37.7 kV
8.5 A	88.0 mJ	2.16 ms	81 mA	39.0 kV

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

**Dimensions**



The coil P65 has no integrated transistor and requires an ECU with internal ignition power stages, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil P65-WS**  
Order number **F02U.V01.926-01**

**Accessories**

**High Voltage Connector angled**  
Please ask your local Bosch Service  
Order number **0356.250.035**



## Ignition Coil PS-T



### Features

- ▶ Max. 27 kV
- ▶ Max. 42 mJ
- ▶ Max. 1.5 kV/μs
- ▶ Max. 10,000 1/min

This pencil coil is a basic low cost concept designed for cylinder head installation.

The coil PS-T has an integrated transistor and requires an ECU with internal ignition drivers.

The coil is only designed for spark plug shaft mounting. It is a basic concept for ignition applications.

### Application

Spark energy	≤ 42 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 800 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Diameter	22 mm
Weight	202 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance with wire	Incapable of measurement
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.5 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 27 kV

Spark current	≤ 80 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive
Suppression diode / EFU	Integrated
Power stage	Integrated

#### Characteristic

Measured with power stage	BIP 355
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#### Connectors and Wires

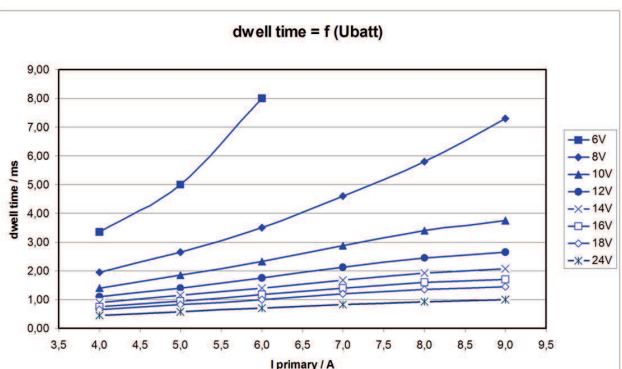
Connector	Bosch Compact
Mating connector	D261.205.336-01
4-pole Compact	
Pin 1	ECU ignition signal
Pin 2	ECU GND
Pin 3	Engine GND
Pin 4	U <sub>batt</sub>

Various motorsport and automotive connectors are available on request.

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	4.0 A	5.0 A	6.0 A	7.0 A	8.0 A	9.0 A
6 V	2.90	4.20	6.30	14.4	-	-
8 V	1.83	2.45	3.17	4.10	5.10	6.20
10 V	1.33	1.74	2.18	2.68	3.16	3.49
12 V	1.05	1.35	1.68	2.02	2.33	2.53
14 V	0.86	1.11	1.35	1.62	1.85	1.99
16 V	0.73	0.93	1.14	1.35	1.54	1.65
20 V	0.56	0.71	0.86	1.02	1.15	1.23
22 V	0.50	0.64	0.77	0.91	1.02	1.09
24 V	0.46	0.58	0.70	0.82	0.92	0.98

Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement

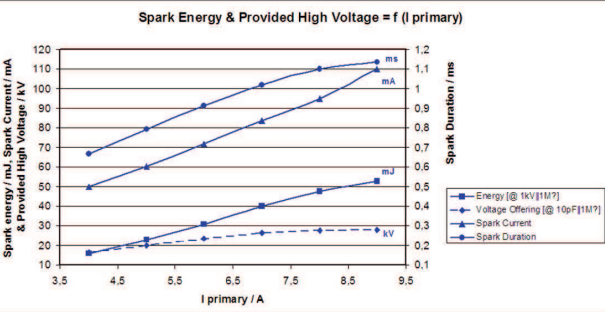


Dwell time

#### Spark energy and provided high voltage

I <sub>prim.</sub>	Spark energy	-duration	-curreant	Hi voltage
4 A	15.0 mJ	0.650 ms	46 mA	15.6 kV

5 A	22.8 mJ	0.793 ms	62 mA	19.3 kV
6 A	30.2 mJ	0.904 ms	73 mA	22.7 kV
7 A	38.2 mJ	1.010 ms	84 mA	26.0 kV
8 A	47.9 mJ	1.101 ms	96 mA	28.8 kV
9 A	52.9 mJ	1.130 ms	100 mA	30.2 kV

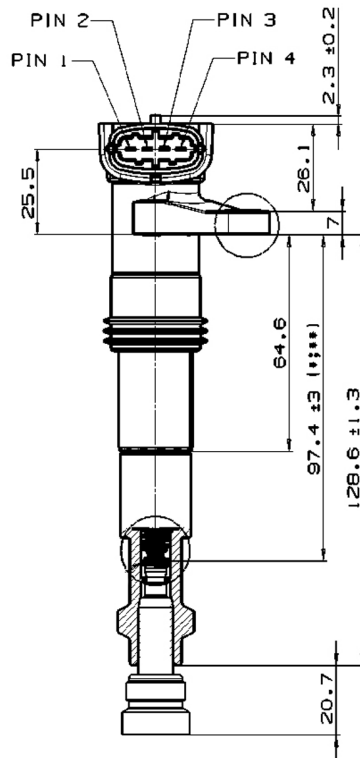
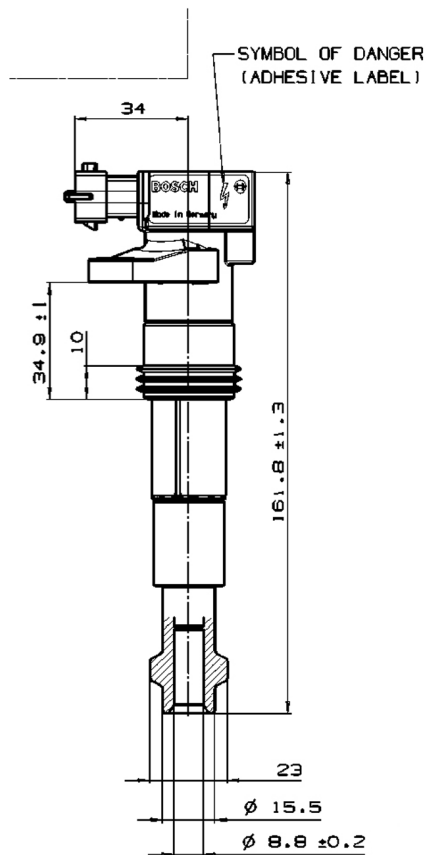


Spark energy

### Installation Notes

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

### Dimensions



The coil PS-T has an integrated transistor and requires an ECU with internal ignition drivers, e.g. MS 4.x or MS 4.x Sport.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

Please find further application hints in the offer drawing at our homepage.

In case of ignition-caused malfunctions, please use screened sensor wires.

### Design Note

We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

### Ordering Information

#### Ignition Coil PS-T

Order number 0221.604.103

## Overview

### Ignition Module IM 3.2



- Max. 3 cylinders
- 47 g
- Fits to all ECUs without internal ignition power stage like MS 6
- Especially adapted for Coils P50(-M) and P65

### Ignition Module IM 4



- Max. 4 cylinders
- 54 g
- Fits to all ECUs without internal ignition power stage like MS 6
- Especially adapted for Coils P50(-M) and P65

## Ignition Module IM 3.2



4

### Features

- ▶ Max. 3 cylinders
- ▶ 47 g
- ▶ Fits to all ECUs without internal ignition power stage like MS 6
- ▶ Especially adapted for Coils P50(-M) and P65

This module is an external ignition power stage capable of supplying up to three non-transistorized ignition coils.

The IM input signal should be supplied by an ECU with ignition signal outputs in the range of 10 to 20 mA, e.g. MS 6.

The IM unit combines the robustness of a high quality production part with good electrical performance to provide an ideal solution for adapting non-transistorized coils to an ECU without internal ignition driver stages.

### Application

Primary current	≤ 8.5 A
Clamp voltage	380 ± 30 V
Operating temperature range at measuring point	-40 to 120°C
Storage temperature range	-40 to 130°C
Max. rpm (ensure chilled mounting position)	8,000
Max. vibration	400 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Size	71 x 48 x 21 mm
Weight w/o wire	47 g

Mounting	2 x M4 screws with spring washer
Operating temperature	-40 to 110°C
Permissible fuel temperatures	≤ 70°C

#### Electrical Data

U <sub>Batt</sub> typical	13.5 V
Voltage supply	6 to 16.5 V
I <sub>B</sub> high active on	min. 10 mA
I <sub>B</sub> low off	0 mA
I <sub>B</sub>	10 to 22 mA
I <sub>C</sub> typical	≤ 8.5 A
I <sub>C</sub> max. at T <sub>U</sub> < 120°C	< 10 A
U <sub>CE</sub> satt at I <sub>C</sub> = 5 A	< 3 V
U <sub>CE</sub> satt at I <sub>C</sub> max	< 9 V

#### Characteristic

Characteristic dwell time	See characteristic dwell time from the ignition coil used
Internal transistor	Triple Darlington

#### Connectors and Wires

Connector	Bosch Jetronic 7-pole
Mating connector	F02U.B00.252-01
7-pole Jetronic	
Pin 1	Collector transistor 1
Pin 2	Basis transistor 1
Pin 3	Collector transistor 2
Pin 4	Gnd
Pin 5	Basis transistor 2
Pin 6	Collector transistor 3
Pin 7	Basis transistor 3

#### Installation Notes

This ignition module can be used with Coils P50(-M) and P65 or comparable coils.

Please ensure that the connectors are safe from water.

The IM has to be mounted onto a cooling body. The mounting surface needs a planarity of 0.2 mm.

A heat conductive paste has to be used.

This ignition module is designed for use with engine control units which have no integrated ignition transistor.

Please observe the specified limit values.

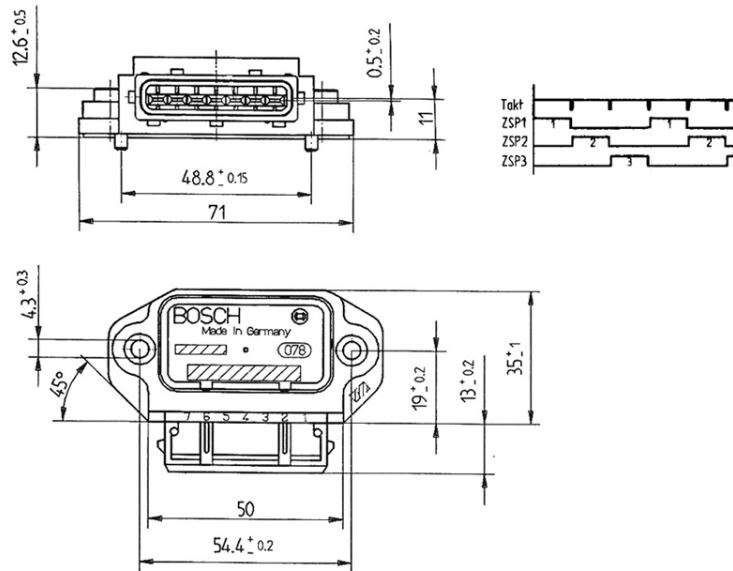
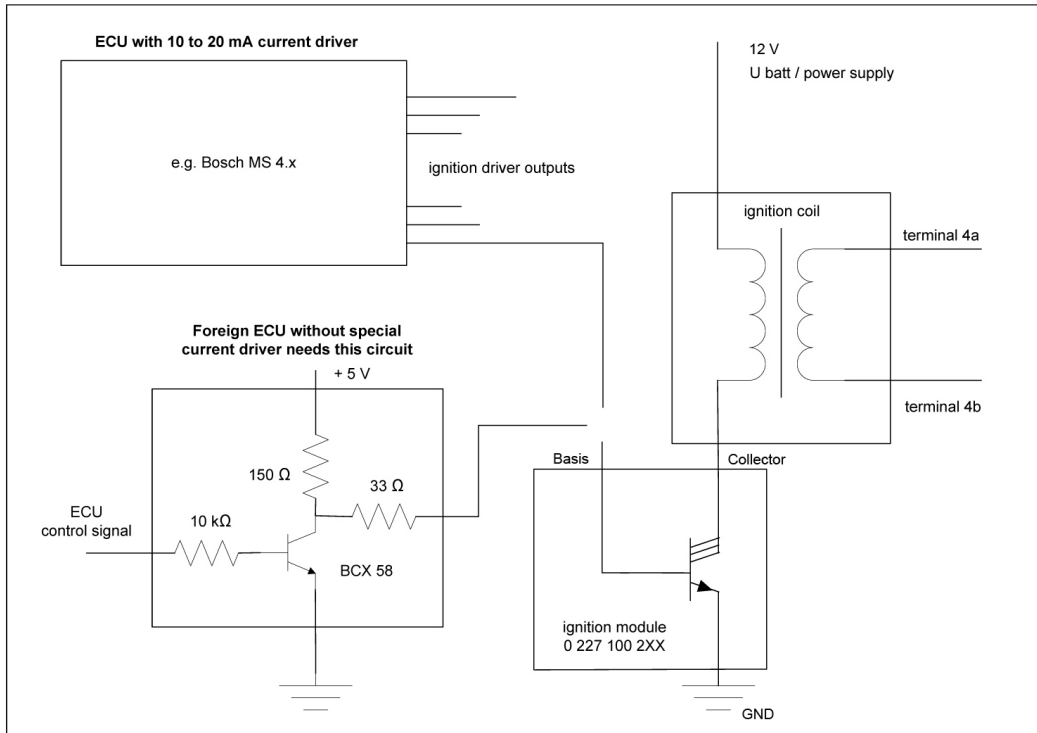
Please do not activate more than one ignition output stage parallel within a module.

Please find further application hints in the offer drawing at our homepage.

#### Ordering Information

**Ignition Module IM 3.2**  
Order number **0227.100.203**

Dimensions



## Ignition Module IM 4



4

### Features

- ▶ Max. 4 cylinders
- ▶ 54 g
- ▶ Fits to all ECUs without internal ignition power stage like MS 6
- ▶ Especially adapted for Coils P50(-M) and P65

This module is an external ignition power stage capable of supplying up to four non-transistorized ignition coils.

The IM input signal should be supplied by an ECU with ignition signal outputs in the range of 10 to 20 mA, e.g. MS 6.

The IM unit combines the robustness of a high quality production part with good electrical performance to provide an ideal solution for adapting non-transistorized coils to an ECU without internal ignition driver stages.

### Application

Primary current	≤ 8.5 A
Clamp voltage	380 ± 30 V
Operating temperature range at measuring point	-40 to 120°C
Storage temperature range	-40 to 130°C
Max. rpm (ensure chilled mounting position)	8,000
Max. vibration	400 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Size	70.5 x 68 x 20 mm
------	-------------------

Weight w/o wire	54 g
Mounting	2 x M4 screws with spring washer

#### Electrical Data

U <sub>Batt</sub> typical	13.5 V
Voltage supply	6 to 16.5 V
I <sub>B</sub> high active on	min. 10 mA
I <sub>B</sub> low off	0 mA
I <sub>B</sub>	10 to 22 mA
I <sub>C</sub> typical	< 8.5 A
I <sub>C</sub> max. at T <sub>U</sub> < 120°C	< 10 A
U <sub>CE</sub> satt at I <sub>C</sub> = 5 A	< 3 V
U <sub>CE</sub> satt at I <sub>C</sub> max	< 9 V

#### Connectors and Wires

Connector (Coil T1)	Bosch Jetronic 4-pole
Mating connector	D261.205.351-01
Jetronic 4-pole	
Pin 1	Collector transistor 4
Pin 2	Collector transistor 3
Pin 3	Collector transistor 2
Pin 4	Collector transistor 1
Connector (ECU)	Bosch Jetronic 5-pole
Mating connector	D261.205.352-01
Jetronic 5-pole	
Pin 1	Basis transistor 1
Pin 2	Basis transistor 2
Pin 3	Gnd
Pin 4	Basis transistor 3
Pin 5	Basis transistor 4

### Installation Notes

This ignition module can be used with Coils P50(-M) and P65 or comparable coils.

Please ensure that the connectors are safe from water.

The IM has to be mounted onto a cooling body. The mounting surface needs a planarity of 0.2 mm.

A heat conductive paste has to be used.

This ignition module is designed for use with engine control units which have no integrated ignition transistor.

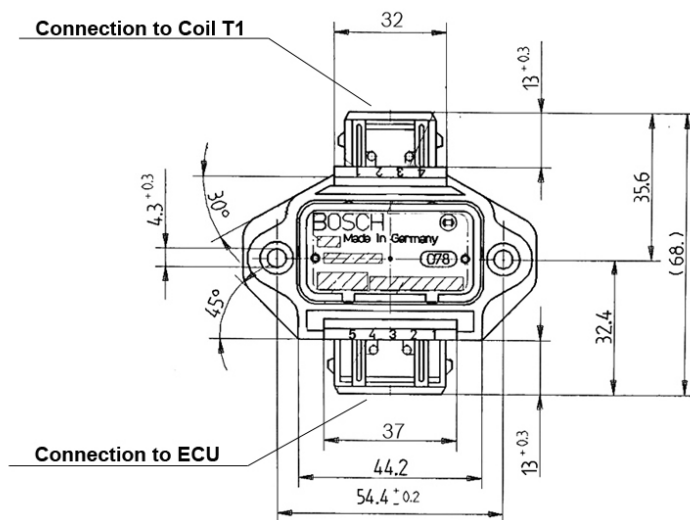
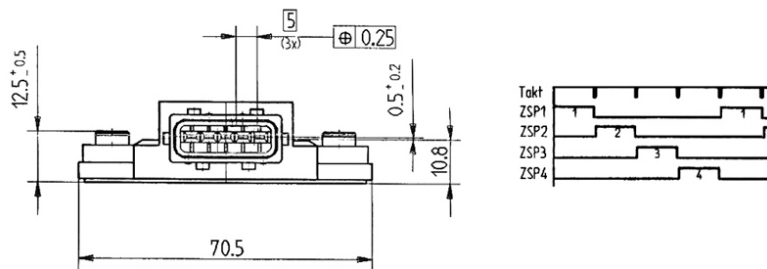
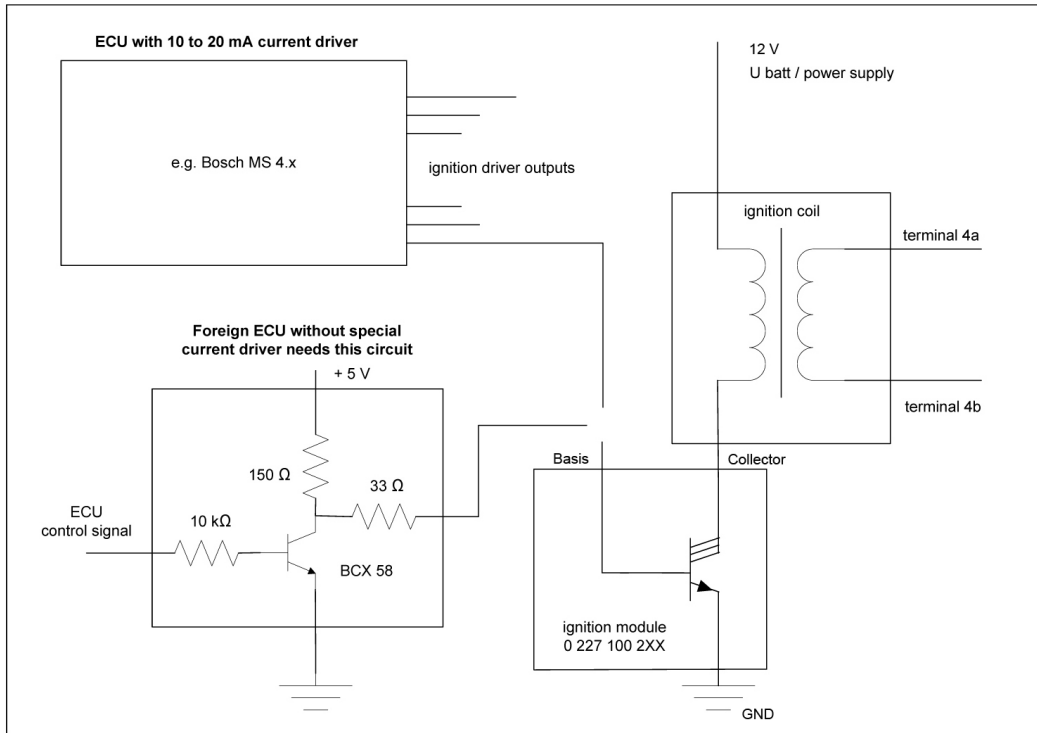
Please observe the specified limit values.

### Ordering Information

#### Ignition Module IM 4

Order number **0227.100.211**

Dimensions







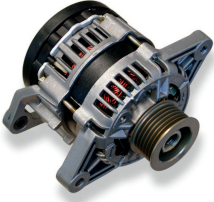
# Actuators

5

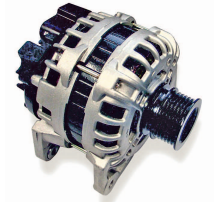
<b>Alternators</b>	<b>168</b>
<b>Electronic Throttle Body</b>	<b>177</b>
<b>Power Steering Pump</b>	<b>180</b>
<b>Starter</b>	<b>183</b>
<b>Wiper Motor</b>	<b>185</b>

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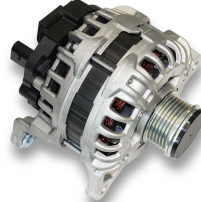
## Overview

**Alternator B0**

- >140 A
- 3,400 g
- Clockwise rotation
- Lightweight aluminum pulley
- Multifunctional regulator

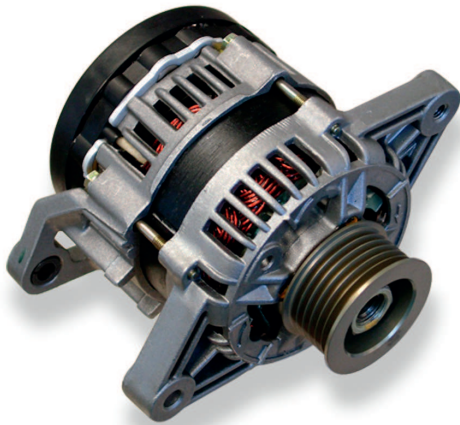
**Alternator B3 LIN**

- >200 A
- 4,800 g
- Clockwise rotation
- Steel pulley
- Motorsport optimized LIN1.3 regulator with latest ASIC technology

**Alternator B5**

- >150 A
- 5,600 g
- Clockwise rotation
- Steel pulley
- Multifunctional regulator

## Alternator B0



### Features

- ▶ >140 A
- ▶ 3,400 g
- ▶ Clockwise rotation
- ▶ Lightweight aluminum pulley
- ▶ Multifunctional regulator

This alternator is modified for motorsport demand and splash protected. The stator windings are hand-made and optimized for higher current output; the rotor is extra fine balanced and impregnated. Modifications are available on request.

### Application

Ambient temperature range	-30 to 90°C
Vibration protection	high
Installation without rubber mounting	

### Technical Specifications

#### Mechanical Data

Case material	Aluminum
Weight	3,400 g
Current regulator unit	integrated
Max. rotations	18,000 x 1/min
Diameter	108 mm
Length without shaft stub	128 mm
Distance between mounting points	154 mm

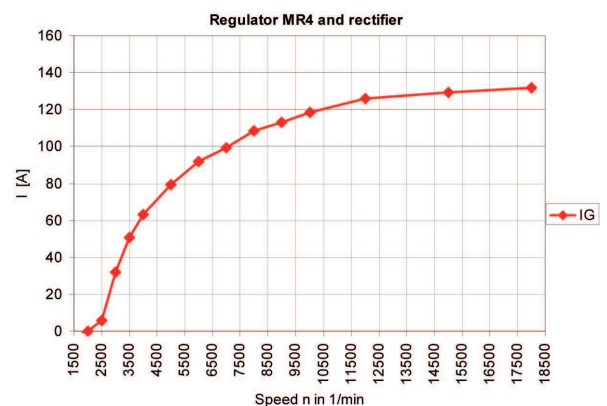
#### Electrical Data

Rated current	>140 A
Output voltage	13.5 V

Cut-in speed	3,000 x 1/min
Coupling	screws
Battery B+	M6
Tightening torque at B+	14 Nm
Control lamp D+	flat-pin connector, see drawing

### Characteristic

Rpm [1/min]	I <sub>c</sub> [A] at 90°C
2,000	0
2,500	6
3,000	32
3,500	51
4,000	63
5,000	80
6,000	90
7,000	98
8,000	105
9,000	111
10,000	116
12,000	121
15,000	127
18,000	131



### Installation Notes

Typical lifetime before service: max. 6,000 km / 30 h

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program.

An external cooling can contribute to increase the performance. It will only be effective if the incoming air is 30°Kelvin cooler than the ambient air. Otherwise, the restriction of airflow will negate any cooling benefits. If these conditions are met, the cooling air should be distributed over the center axis at the rear of the alternator for optimal cooling. The alternator fans are not able to generate negative pressure. It is possible to use external blower to support the al-

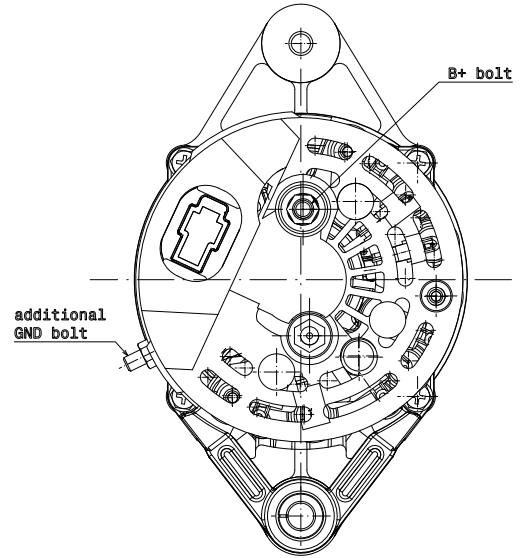
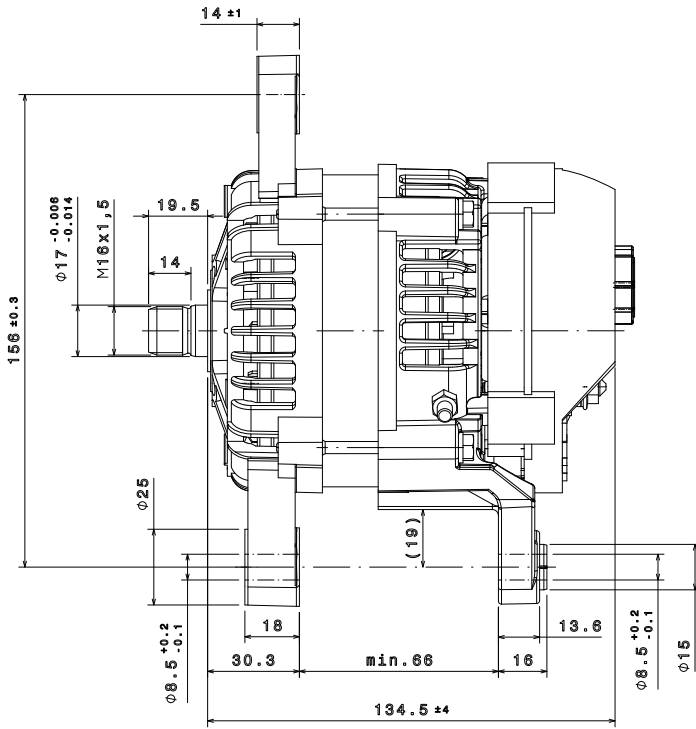
ternator. Debris at alternator cooling area can reduce cooling effect. This could also shorten the alternator service life. Installation without rubber mounting.

**Ordering Information**

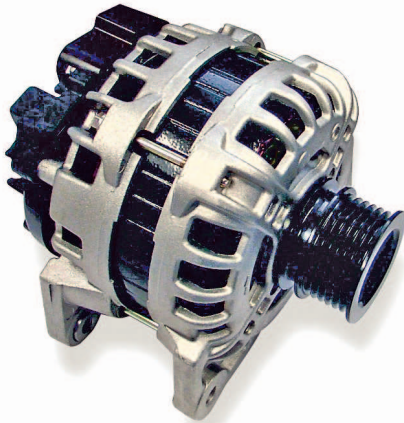
**Alternator B0**  
Order number **F02U.V02.996-01**

**Dimensions**

5



## Alternator B3 LIN



### Features

- ▶ >200 A
- ▶ 4,800 g
- ▶ Clockwise rotation
- ▶ Steel pulley
- ▶ Motorsport optimized LIN1.3 regulator with latest ASIC technology

The B3 LIN is a powerful 12 V motorsport alternator. It has an optimized hand wound stator winding (3 phase triangle), high current diodes (special Zener diode chips from Bosch production to retain load-dumps) and an extra fine balanced rotor with impregnated winding.

The LIN regulator (special Bosch developed ASIC) controls the alternator output voltage at B+ connection. The main benefit of this alternator is the high power output in a small low weight package. Furthermore, it is optimized concerning vibration endurance.

### Application

Application	>200 A at 7,000 rpm/85°C
Max. ambient temperature	105°C, high current only with supported cooling air
Max. ambient temperature (short-term)	120°C, high current only with supported cooling air
Rotating direction	Clockwise
Fixed frequency regulation with pulse width modulation	
Stand-by-mode	
High side output stage with defined ramp steepness and FET as freewheeling „diode“	
Emergency start at default mode	
Adjustable set values via LIN interface	

Outputs of status information via LIN interface

### Technical Specifications

#### Mechanical Data

Body material	Cast aluminum
Weight w/o pulley	4.8 kg
Max. rotations	18,000 x 1/min
Moment of inertia	22 kg*cm <sup>2</sup>
Outer diameter w/o screw	136 mm
Length w/o pulley	117 mm
Battery B+ connection	M8x1.25
Tightening torque at B+	22 Nm

#### Electrical Data

Regulating voltage	14.4 V default, up to 16 V via LIN
Temperature compensation	-10 mV/K
High temperature cut off derating	-250 mV/K
Excitation resistor (L)	Internal (external on request)
Cut-in-speed	3,000 x 1/min

#### LIN Protocol

LIN Version	1.3
LIN Speed	19.2 kbaud
Message ID	0xE9
Frame-content	Variant A
HT <sub>KN</sub>	144°C
GenID	5

#### LIN Protocol Rx-Frame

Byte	Bit	Value	Explanation
1	0 to 5	Voltage set value	Value from 10.6 V to 16.0 V
2	0 to 3	LR ramp time	Value from 0 % to 100 %
2	4 to 7	LR cut-off speed	Value from 2.400 rpm to 8.000 rpm
3	0 to 4	Excitation current limit	Value 2 A to 7.7 A
4	0 to 2	DataSelect Tx3/Byte4	Values see TCD
4	3	Blindzone	3.1 % or 12.6 %
4	4 to 6	HT cut-off threshold	Value from -16 to +12
4	7	Parameter set	Normal or [w/o battery]

#### LIN Protocol Tx-Frame 1

Byte	Bit	Value	Explanation
1	0	Flag HAT cut-off	no HT cut-off / HT cut-off

Byte	Bit	Value	Explanation
1	1	Flag Mechanical status	Alternator running / Alternator stopped
1	2	Flag Electrical error	not set / set
1	3 to 7	Duty cycle	Value from 0 % to 100 %
2	0 to 5	Excitation current limit	Value from 0 A to 7.75 A
2	6	Flag Communication error	Com. Ok / Com.-Error
2	7	Fleg Timeout	no Timeout / Timeout

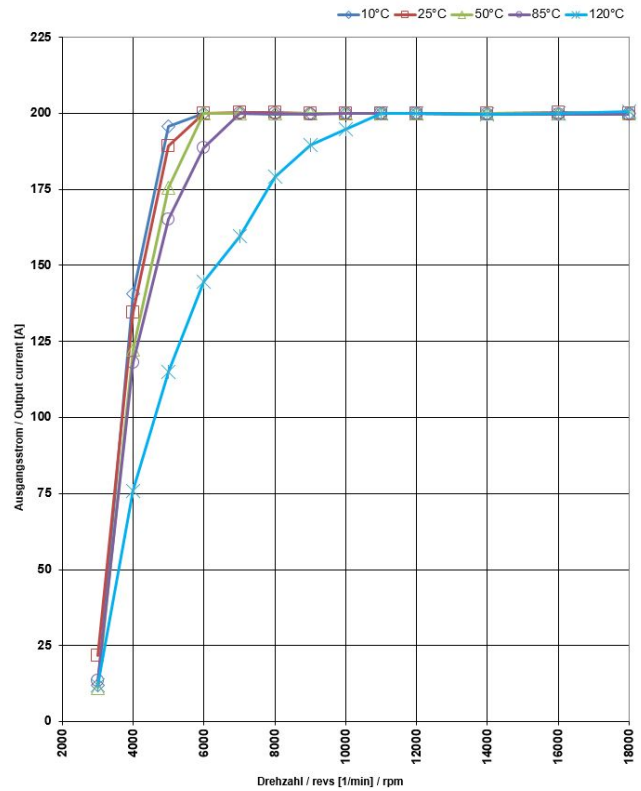
### LIN Protocol Tx-Frame 2

Byte	Bit	Value	Explanation
1	0 to 2	Alternator Manufacturer ID	Value "Bosch"
1	3 to 7	Alternator ID	Application specific
2	0 to 2	Chip Manufacturer ID	Application specific
2	3 to 7	Chip ID	Application specific

### Characteristic

Rpm [1/min]	IG [A] at 85°C
3,000	14
4,000	118
5,000	165
6,000	189
7,000	200
8,000	200
9,000	200
10,000	200
11,000	200
12,000	200
14,000	200
16,000	200
18,000	200

Stromkennlinie über Umgebungstemperatur  
Current curve over environment temperature



### Installation Notes

Typical lifetime before service: max. 6,000 km / 30 h

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program.

Ground connection for power and regulator is through the case. Ensure that the case has a high current, low electrical resistance connection to vehicle ground.

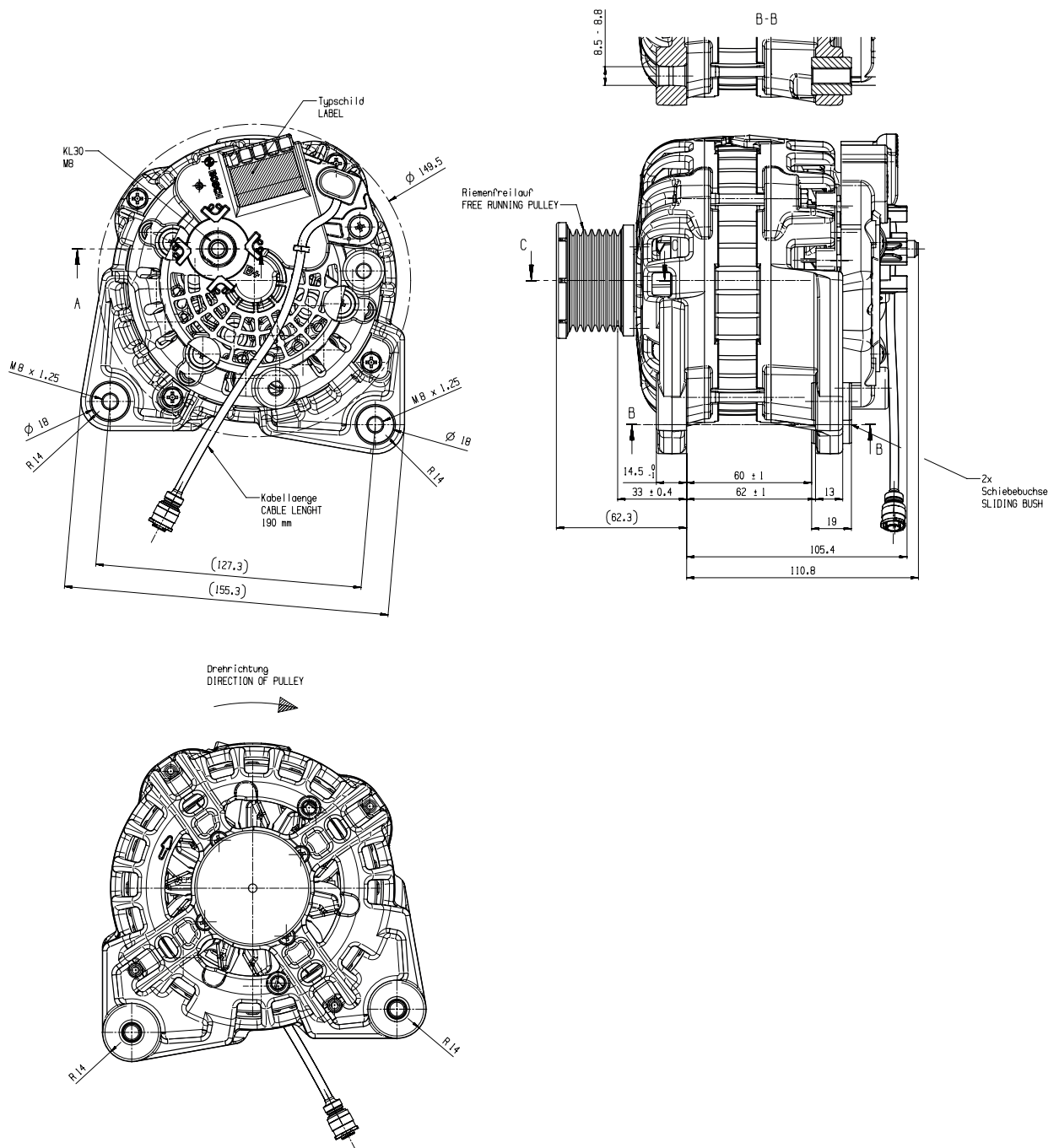
Rectifier diodes are designed and proved for B+ continuous output current of 210 A. The alternator is able to support more current, but this must be restricted for short time to prevent the destroying of rectifier diodes.

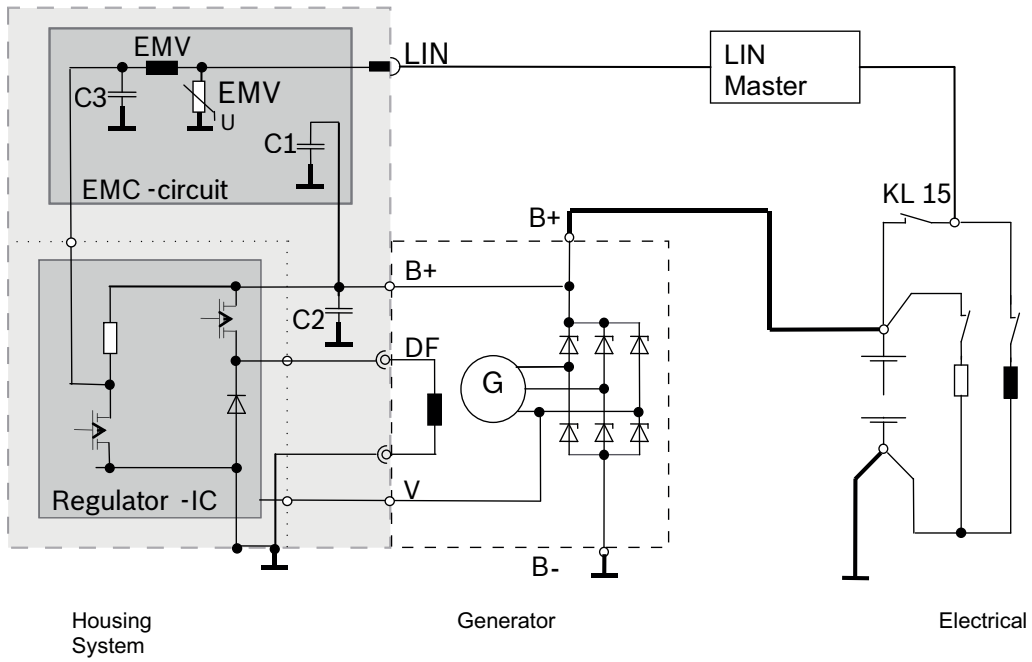
### Ordering Information

#### Alternator B3 LIN

Order number **F02U.V02.950-01**

Dimensions

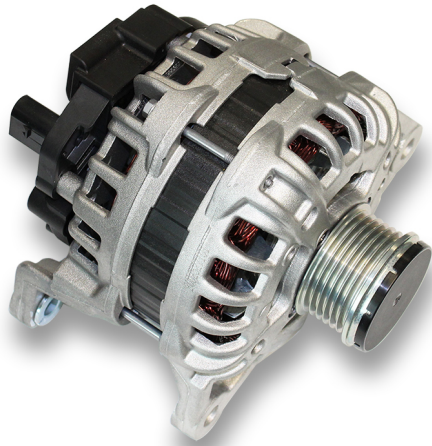




Schematic Diagram



## Alternator B5



### Features

- ▶ >150 A
- ▶ 5,600 g
- ▶ Clockwise rotation
- ▶ Steel pulley
- ▶ Multifunctional regulator

The B5 alternator is typical for Cup racecars. Robustness increase for motorsport use. Free-running pulley for reduction of wear.

The multifunctional regulator with special developed ASIC by Bosch controls the output voltage at B+ connection.

Three-arm design allows the use of a clamping arm.

### Application

Application	>122 A at 6,000 rpm/80°C
Max. ambient temperature	105°C, high current only with supported cooling air
Max. ambient temperature (short-term)	120°C, high current only with supported cooling air
Rotating direction	Clockwise

### Technical Specifications

#### Mechanical Data

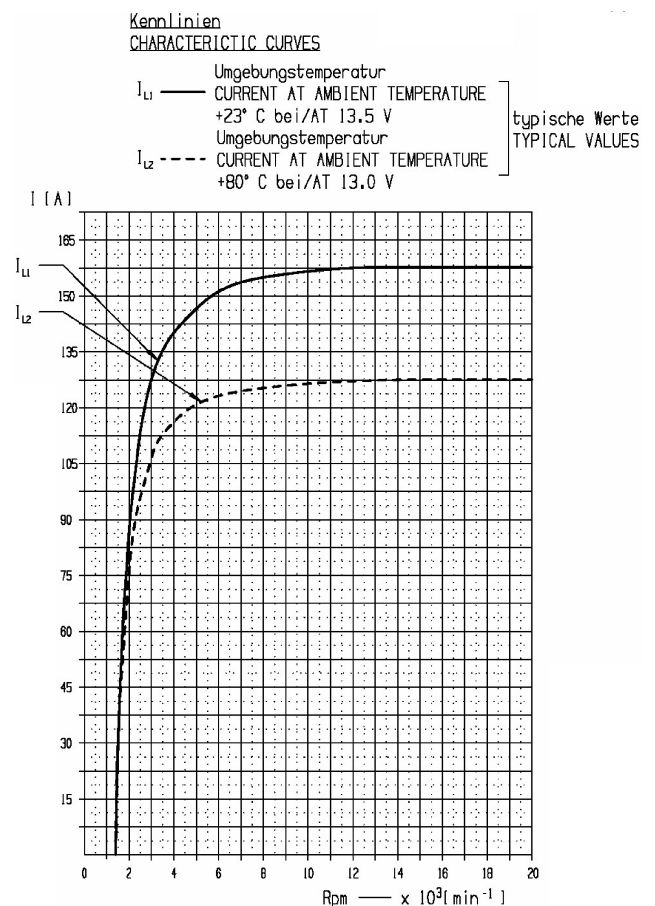
Body material	Cast Aluminum
Weight w/o pulley	5.6 kg
Max. rotations	13,000 x 1/min
Moment of inertia	26 kg*cm <sup>2</sup>
Outer diameter w/o screw	156 mm
Length w/o pulley	172 mm
Battery B+ connection	M8

Tightening torque at B+	15 Nm
<b>Electrical Data</b>	
Regulating voltage	14.4 V
Temperature compensation	-10 mV/K
High temperature cut off derating	-250 mV/K
Excitation resistor (L)	External
Cut-in-speed	1,400 x 1/min

#### Characteristic

Rpm [1/min]	$I_G$ [A] at 80°C
2,000	75
4,000	114
6,000	123
8,000	125
10,000	126
12,000	127
13,000	127.5

Please note: Measured with  $U = 13.1$  V and  $t = 20$  min



### Installation Notes

Typical lifetime before service: max. 6,000 km / 30 h

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program.

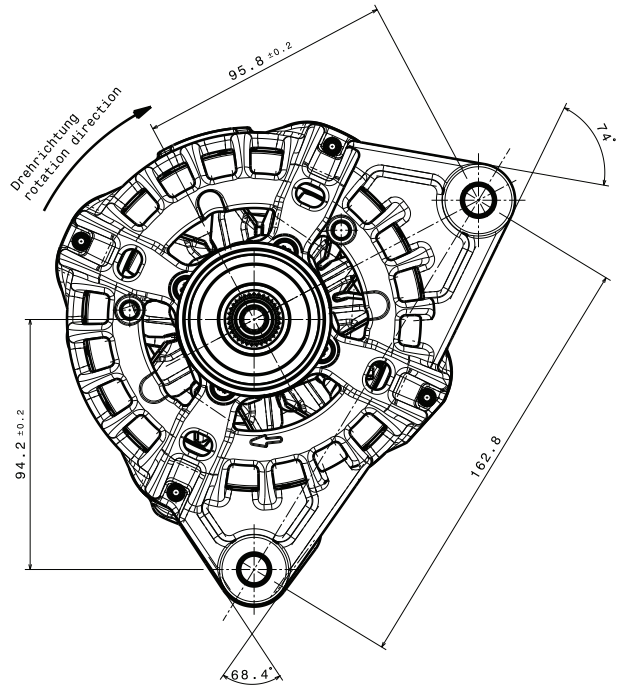
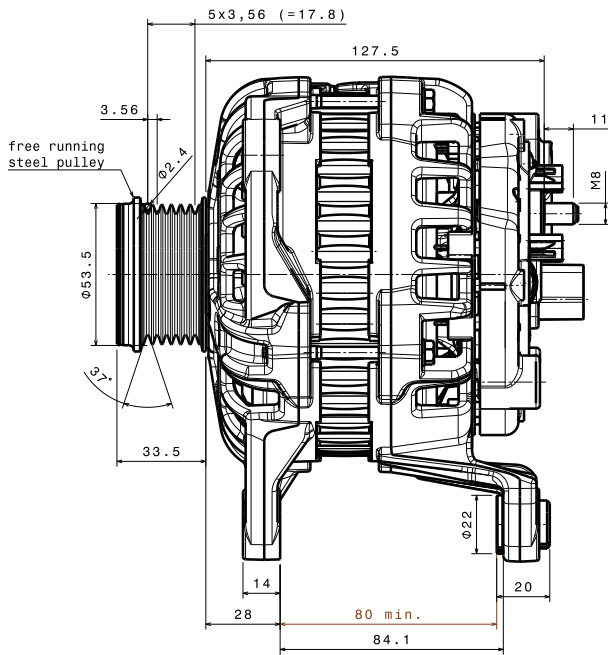
Ground connection for power and regulator is through the case. Ensure that the case has a high current, low electrical resistance connection to vehicle ground.

**Ordering Information**

**Alternator B5**  
Order number **F02U.V01.747-03**

**Dimensions**

5



## Electronic Throttle Body



54 mm  
60 mm  
68 mm  
82 mm

### Features

- ▶ Many bore diameters available
- ▶ Throttle position sensor is redundant
- ▶ For flex-fuel, CNG, LPG
- ▶ Idle default position

The throttle body is designed to control the fresh air of spark ignition engines in combination with an electronic throttle control system. ETB applications with flex-fuel, CNG and LPG are permissible if injected in the air flow after the throttle body.

A typical ETC system includes the following components: electronic throttle body, accelerator pedal module and electronic control unit.

You will find the available bore diameters in the variations table.

### Application

Temperature range	-40 to 140°C
Max. vibration	50 to 250 m/s <sup>2</sup> at 50 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Available bore diameters	32 mm 40 mm 44 mm 46 mm 50 mm 52 mm
--------------------------	--

#### Electrical Data

Supply voltage	6 to 16 V
Supply voltage sensor	5 ± 0.2 V
Max. allowed generator current	<10.0 A

#### Characteristic

Output signal I	0 to 5 V for 0 to 90°
Output signal II	5 to 0 V for 0 to 90°

#### Connectors and Wires

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

#### Installation Notes

For correct mounting please respect the hints on the next page "Mounting position".

The ETB can be connected directly to control units with ETC functionality.

Please find further application hints in the offer drawing at our homepage.

Two redundant sensors control the up to date throttle position.

All ETBs have an idle air position.

#### Ordering Information

##### Electronic Throttle Body 32 mm

Order number **0280.750.148**

##### Electronic Throttle Body 40 mm

Order number **0280.750.149**

##### Electronic Throttle Body 44 mm

Order number **0280.750.137**

##### Electronic Throttle Body 46 mm

Order number **F02U.V01.171-01**

##### Electronic Throttle Body 50 mm

Order number **0280.Y05.107-10**

##### Electronic Throttle Body 52 mm

Order number **F02U.V01.184-01**

##### Electronic Throttle Body 54 mm

Order number **0280.750.150**

##### Electronic Throttle Body 60 mm

Order number **0280.750.151**

##### Electronic Throttle Body 68 mm

Order number **0280.750.156**

##### Electronic Throttle Body 82 mm

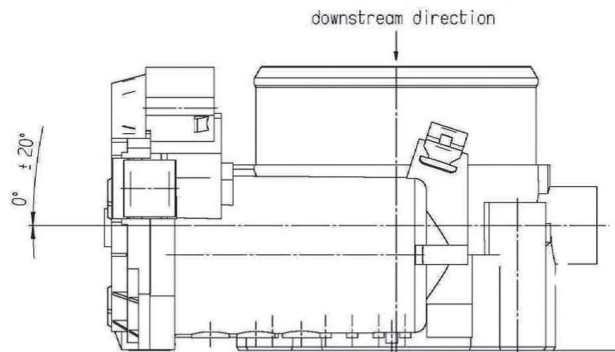
Order number **0280.750.101**

## Dimensions

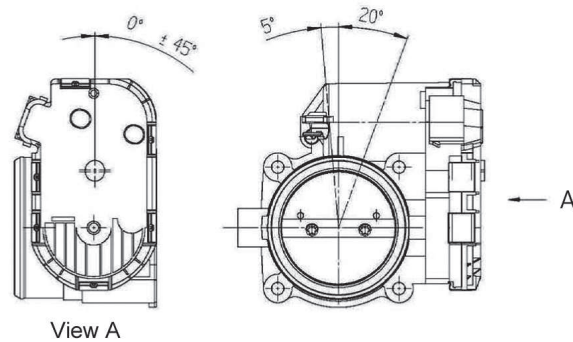
## Mounting position

## Mounting position of the Throttle Actuator

- Horizontal inclination of the Throttle shaft:  $\pm 20^\circ$
- Horizontal inclination of the cover:  $\pm 180^\circ$
- Mounting positions which deviate from this need separate testing.
- It has to be prevented that when mounted in the vehicle, no condensed moisture can soak into the Throttle shaft bore holes (e.g. from the crankcase ventilation)



IN CASE OF MOUNTING POSITION WITH DC-MOTOR ON TOP  
A COMBINATION OF THE ANGLES SHOWN BELOW IS NOT ALLOWED!

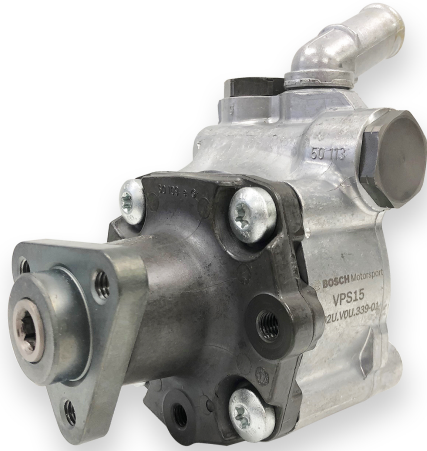


View A

## Variations

	Electronic Throttle Body 32 mm	Electronic Throttle Body 40 mm	Electronic Throttle Body 44 mm	Electronic Throttle Body 46 mm	Electronic Throttle Body 50 mm
Bore Diameter (mm)	32	40	44	46	50
Connector	D261.205.358-01	D261.205.358-01	D261.205.358-01	D261.205.356-01	D261.205.356-01
Pin 1 A	Motor -	Motor -	Motor -	Motor -	Motor -
Pin 2 B	Poti -	Poti -	Poti -	Poti -	Poti -
Pin 3 C	Poti +	Poti +	Poti +	Poti +	Poti +
Pin 4 D	Motor +	Motor +	Motor +	Motor +	Motor +
Pin 5 E	Poti 2	Poti 2	Poti 2	Poti 2	Poti 2
Pin 6 F	Poti 1	Poti 1	Poti 1	Poti 1	Poti 1
Flange diameter (mm)	40	50	50	58	58
Hole circle diameter (mm)	50 x 50	50 x 50	50 x 50	53 x 53	53 x 53
Weight (kg)	0.9	0.9	0.9	0.95	0.95
Max. air flow rate*	394 kg/h at 85° angle	695 kg/h at 85° angle	not specified	978 kg/h at 85° angle	not specified
Opening direction**	counterclockwise	counterclockwise	counterclockwise	counterclockwise	counterclockwise
	Electronic Throttle Body 52 mm	Electronic Throttle Body 54 mm	Electronic Throttle Body 60 mm	Electronic Throttle Body 68 mm	Electronic Throttle Body 82 mm
Bore Diameter (mm)	52	54	60	68	82
Connector	D261.205.356-01	D261.205.358-01	D261.205.358-01	D261.205.356-01	D261.205.358-01
Pin 1 A	Poti 1	Motor -	Motor -	Motor -	Motor -
Pin 2 B	Poti -	Poti -	Poti -	Poti -	Poti -
Pin 3 C	Motor -	Poti +	Poti +	Poti +	Poti +
Pin 4 D	Poti 2	Motor +	Motor +	Motor +	Motor +
Pin 5 E	Motor +	Poti 2	Poti 2	Poti 2	Poti 2
Pin 6 F	Poti +	Poti 1	Poti 1	Poti 1	Poti 1
Flange diameter (mm)	58	70	68.5	75	90
Hole circle diameter (mm)	53 x 53	60 x 60	60 x 60	65 x 65	75 x 75
Weight (kg)	0.95	0.95	0.95	1.1	1.1
Max. air flow rate*	not specified	not specified	not specified	not specified	not specified
Opening direction**	counterclockwise	counterclockwise	counterclockwise	counterclockwise	counterclockwise
*ambient conditions:	Air pressure : 1,000 mbar				
	Differential pressure $\Delta p$ : 600 mbar $\pm$ 25 mbar				
	Rel. humidity rF: 40%				
	Air temperature T: 24°C				
**Opening direction is related to view. See drawing on bottom of chapter "Dimensions".					

## Power Steering Pump VPS15



5

### Features

- ▶ Reduced power consumption up to 50 %
- ▶ 15 l/min flow at 10 bar
- ▶ Maximum pressure 135 bar
- ▶ Interchangeable valve screw allows for flow rates from 9 l/min to 15.0 l/min
- ▶ Flexible mounting orientation

There are many instances in motorsport where high steering load is encountered at low engine speed, such as navigating the garage or pit box exit. Traditional pumps have a ratiometric output which means the engine power at high revs is sacrificed for adequate pressure at low revs (pump must be oversized).

The Bosch Variable Displacement Power Steering Pump (VPS15) reclaims wasted power by reducing delivery margin as pump speed increases, while maintaining high fluid flow at low RPM. The VPS15 also allows for greatly reduced fluid temperatures, potentially eliminating the need for a cooler. The VPS15 can accommodate flow rates from 9 to 15 l/min with a replaceable flow screw at the pump outlet.

### Application

Delivery Pressure	Up to 135 bar
Delivery Volume (before controlled flow)	13 ccm/rev
Delivery Volume (controlled flow)	15 ± 0.7 l/min at 10 bar with Pentosin ATF
Pressure Limiting Valve	135 - 8 bar
Fluid Compatibility	Pentosin ATF, CHF 11s, CHF 202

Maximum Fluid Temperature (continuous)	120°C
Maximum Fluid Temperature (transient)	135°C
Recommended Speed	<4,500 RPM
Maximum Speed	9,000 RPM
Direction of rotation	Clockwise
Maximum Belt tension	3,000 N

### Technical Specifications

#### Mechanical Data

Length	154 mm
Width	99 mm
Height	151 mm
Weight	1.88 kg

#### Hydraulic Connections

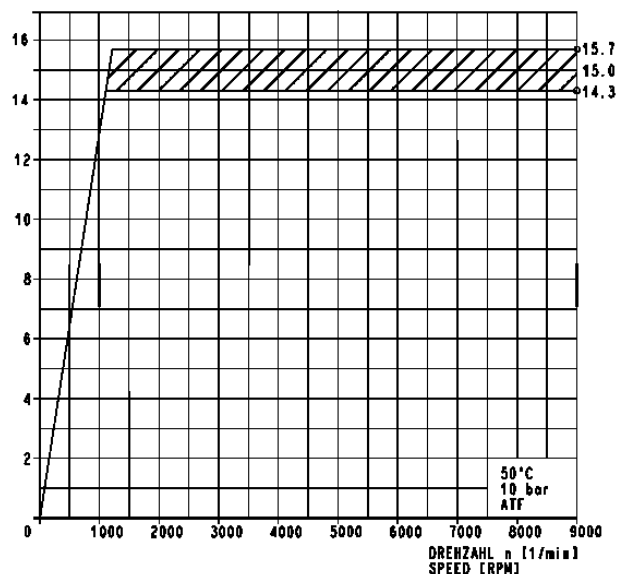
Inlet	Ø20 + 0.2 mm removable hose barb fitting
Outlet	M16x1.5 mm threaded fitting with crush washer

#### Torque Specs

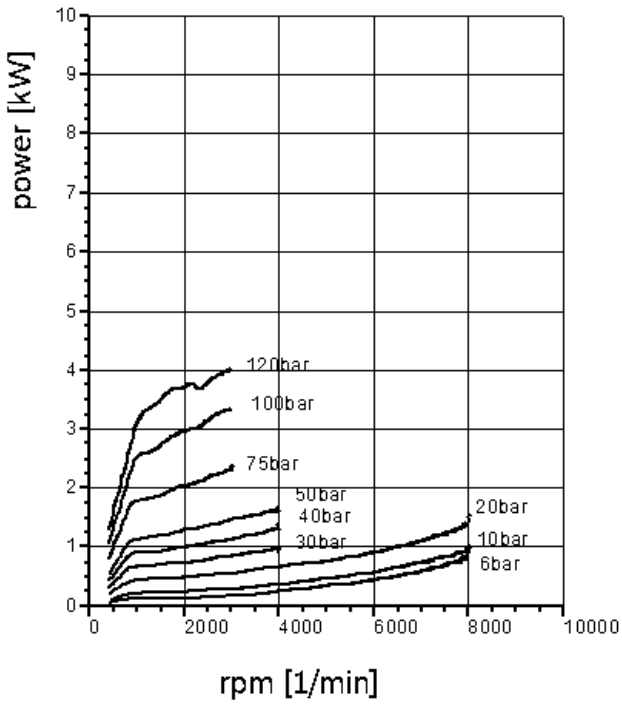
Valve Screw	65 + 5 Nm
Outlet Fitting	40 Nm max.

#### PRUEFOEL ATF

FOERDERSTROM-KENNLINIE  $Q$  [dm<sup>3</sup>/min] DISCHARGE VOLUME



Flow Data



Power Consumption

**Installation Notes**

- Please use within specified limit values only.
- Low pressure (inlet fitting) is press fit into the pump and can be removed.
- 3 bolt flange can be removed from pump shaft.
- Please find further mounting dimensions below.

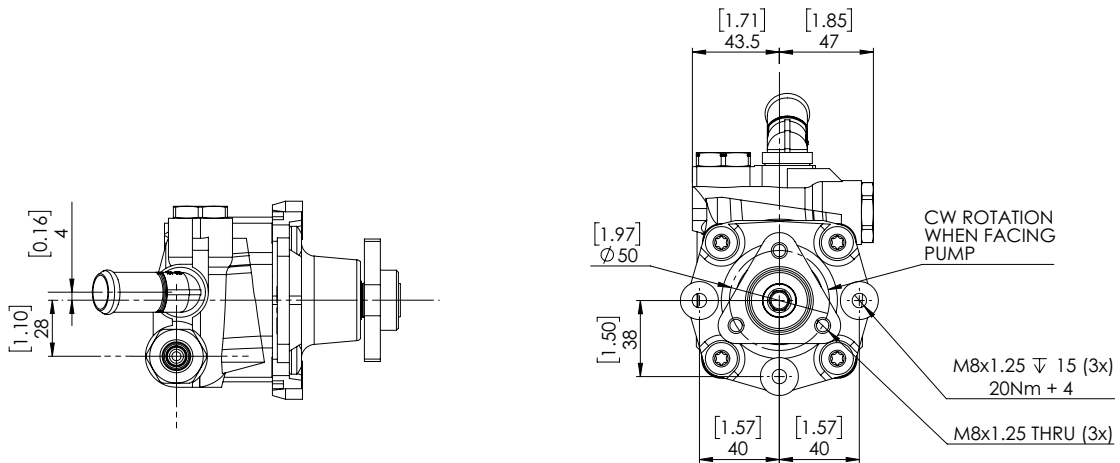
**Ordering Information**

**Power Steering Pump VPS15**  
Order number **F02U.V0U.339-01**

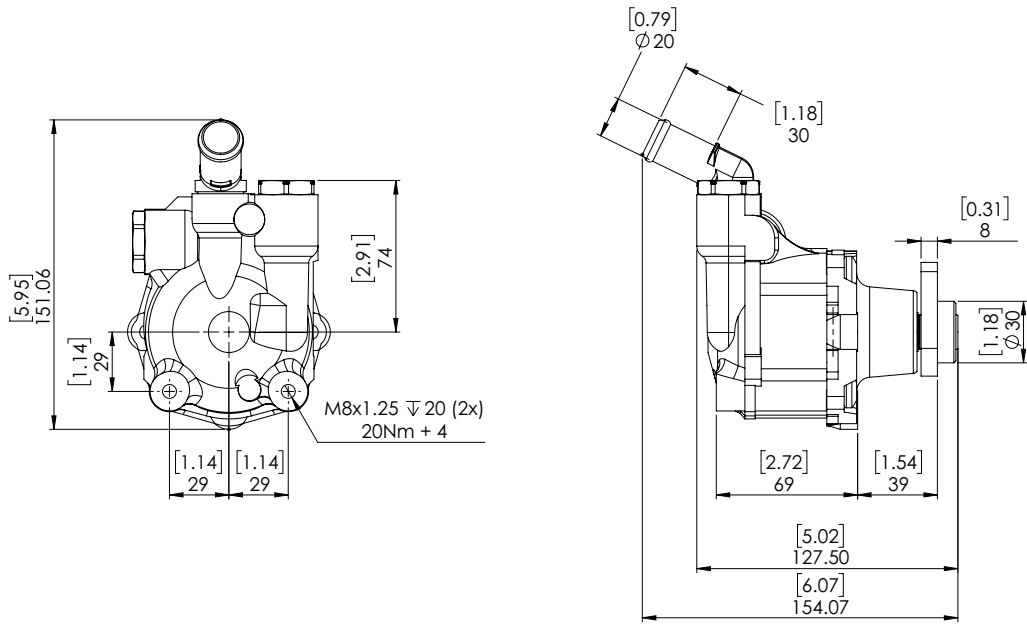
**Accessories**

**Valve Screw Spare Parts**  
Order number **F02U.B0U.025-01**

**Dimensions**

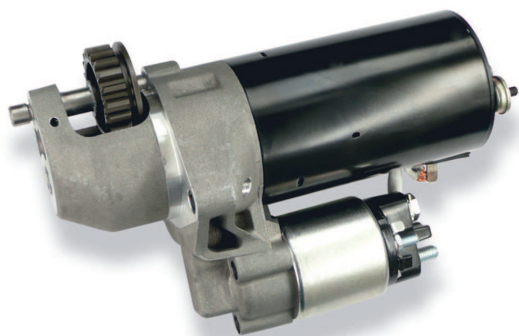


5





## Starter 1.7 kW



### Features

- ▶ 1.7 kW
- ▶ 3,600 x 1/min

This starter is specially constructed for motorsport demand. It is a pre-engaged drive starter; we offer it in counterclockwise version. Further special versions on request.

### Application

Max. temperature	150°C
------------------	-------

Vibration	High protection
-----------	-----------------

### Technical Specifications

#### Mechanical Data

Weight	3,700 g
Revolutions	3,600 x 1/min
Module	2,11
Direction of rotation	Counterclockwise
Internal gear ratio i	4.364 or 5.0

#### Electrical Data

Performance	1.7 kW
-------------	--------

### Installation Notes

Typical lifetime before service: max. 6,000 km / 30 h

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program.

### Ordering Information

#### Starter 1.7 kW

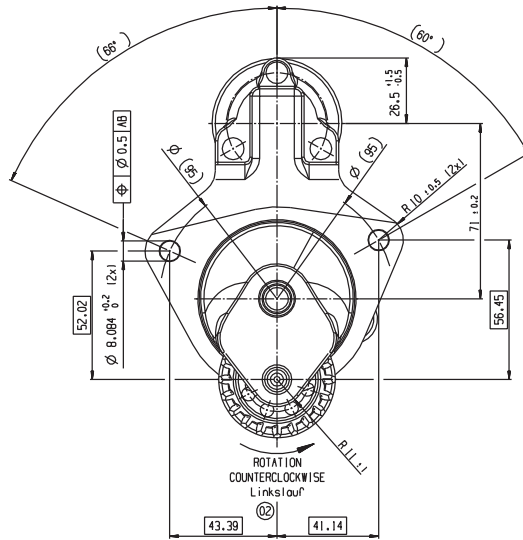
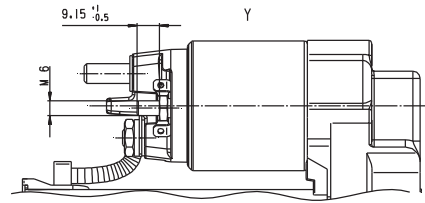
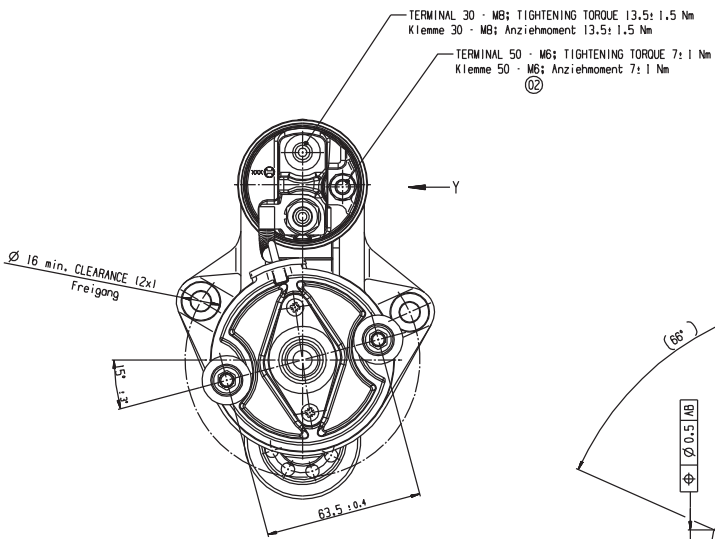
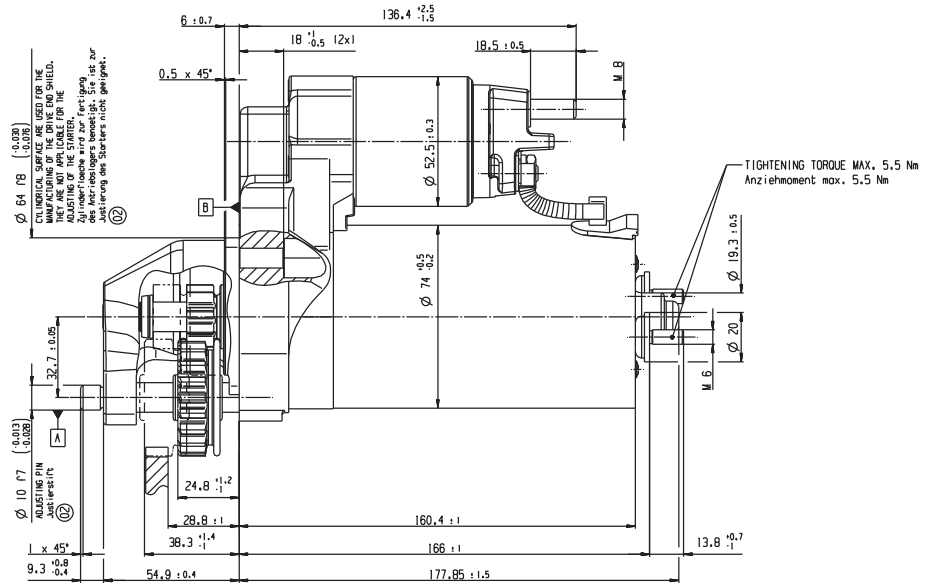
Internal gear ratio i = 4.364  
Order number **F02U.V02.970-01**

#### Starter 1.7 kW

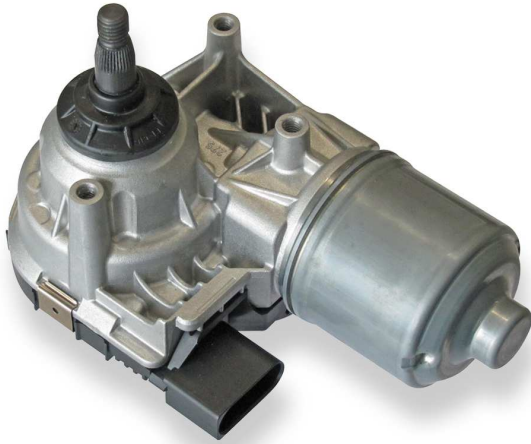
Internal gear ratio i = 5.0  
Order number **F02U.V02.971-01**

Dimensions

5



## Wiper Direct Actuator WDA



### Features

- ▶ Analog and LIN versions available
- ▶ Optimized hardware for motorsport applications
- ▶ Customer specific calibration of wiping angles and speed

The WDA is a wiper motor designed to execute reversing movements instead of rotating 360° like a conventional wiper.

Its function and many operating modes are managed by integrated control electronics. The user is able to control the desired operating mode simply by switching its analog inputs to ground (Analog version) or via LIN (LIN version). The gear, the motor and the electronics are all installed in the same housing.

The main benefit of this wiper motor is its direct rotation movement which replaces external gears and the possibility of programming the operating speed and end positions of all its function modes, upon request.

### Application

Operating temperature range -40 to 85°C

### Technical Specifications

**WDA Analog** Operating modes

- Stop
- Interval
- Speed 1
- Speed 2

**WDA LIN** Operating modes

- Stop
- Interval
- Speed 1
- Speed 2
- Single stroke

### Mechanical Data

Size	104.7 x 174.7 x 117.1 mm
Max. wipe cycles/min	Depending on wipe angle
Max. wipe angle	160°
Max. torque	35 Nm
Weight	1,270 g
Max. vibration	30 % of Vibration Profile 1 or 100 % of Vibration Profile 1 in combination with silentblocks (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

### Electrical Data

Power supply	9 to 16 V
Supply current at 40 cycles/min.	Typ. 3.4 A
Supply current at 60 cycles/min.	Typ. 6.3 A

### LIN Protocol

LIN Version	2.0
LIN Speed	19.2 kbaud
Message ID	0x31

BYTE 0 Value	0	0	Kl. X	Kl. 15	Counter
Bit	7	6	5	4	3 2 1 0

BYTE 1 Value	SPD2	SPD1	INT	SST	INT Mode
Bit	7	6	5	4	3 2 1 0

BYTE 2 Value	0	0	0	0	0 0 0 0
Bit	7	6	5	4	3 2 1 0

BYTE 3 Value	0	0	0	0	0 0 0 0
Bit	7	6	5	4	3 2 1 0

BYTE 4 Value	0	0	0	0	0 0 0 0
Bit	7	6	5	4	3 2 1 0

BYTE 5 Value	0	0	0	0	0 0 0 0
Bit	7	6	5	4	3 2 1 0

Byte	Bit	Signal	Explanation	Values [dez]
0	0 to 3	Counter	The counter has to be increased with each LIN-message	0 to 15
0	4	Kl. 15	Clamp 15 Bit has to be enabled for operation	ON=1 OFF=0
0	5	Kl. X	Clamp X Bit has to be enabled for operation	ON=1 OFF=0

1	0 to 3	INT Mode	Interval Mode (enabled if operation mode interval is set)	Interval speed: 1=1 2=5 3=9 4=13
1	4	SST	Single stroke operation mode (enabled once if Bit is set temporary)	ON=1 OFF=0
1	5	INT	Operation mode interval	ON=1 OFF=0
1	6	SPD1	Operation mode speed 1	ON=1 OFF=0
1	7	SPD2	Operation mode speed 2	ON=1 OFF=0
		STOP	Operation mode stop is enabled if SST, INT, SPD1 and SPD2 are OFF (default)	

### Connectors and Wires

Connector	CEP2M-AMP-4
Mating connector	F02U.B00.542-01
Various motorsport and automotive connectors available on request	

### Pinout Analog

Pin 1	AN2
Pin 2	AN1
Pin 3	Gnd
Pin 4	U <sub>s</sub>

### Pinout LIN

Pin 1	LIN
Pin 2	Special functions, e.g. Master/Slave
Pin 3	Gnd
Pin 4	U <sub>s</sub>

### Installation Notes

Typical lifetime: max. 220 h / 1 year

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program

The WDA Analog can be operated by switching the analog inputs between ground and voltage supply.

The WDA LIN can be operated by all ECUs with LIN 2.X Master function. Further information about the LIN-Frame available upon request.

Make sure that the wiper is in its workspace when restarting after a power failure (upper and lower limit).

Please contact us to define the desired angle of all the operating modes.

The acceleration values can be exceeded by using silentblocks (F02U 003 027-01).

Please ensure that the environmental conditions do not exceed the specifications.

Please find further application hints in the offer drawing at our homepage.

Please deliver the calibration sheet with your order placement.

LIN ID 0x32 (Tx) is used for internal WDA diagnostic purposes. Make sure that the LIN ID 0x32 is not used in your LIN network by any other device.

### Delivery Status

The motor will be delivered with three mounting screws. The screws are pre-assembled with a few thread turns.

- Self-tapping screw referred to DIN 7500
- PE M6x20
- Maximum tightening torque: 8 Nm

### Ordering Information

#### WDA LIN

Order number **F02U.V00.838-04**

#### WDA Analog

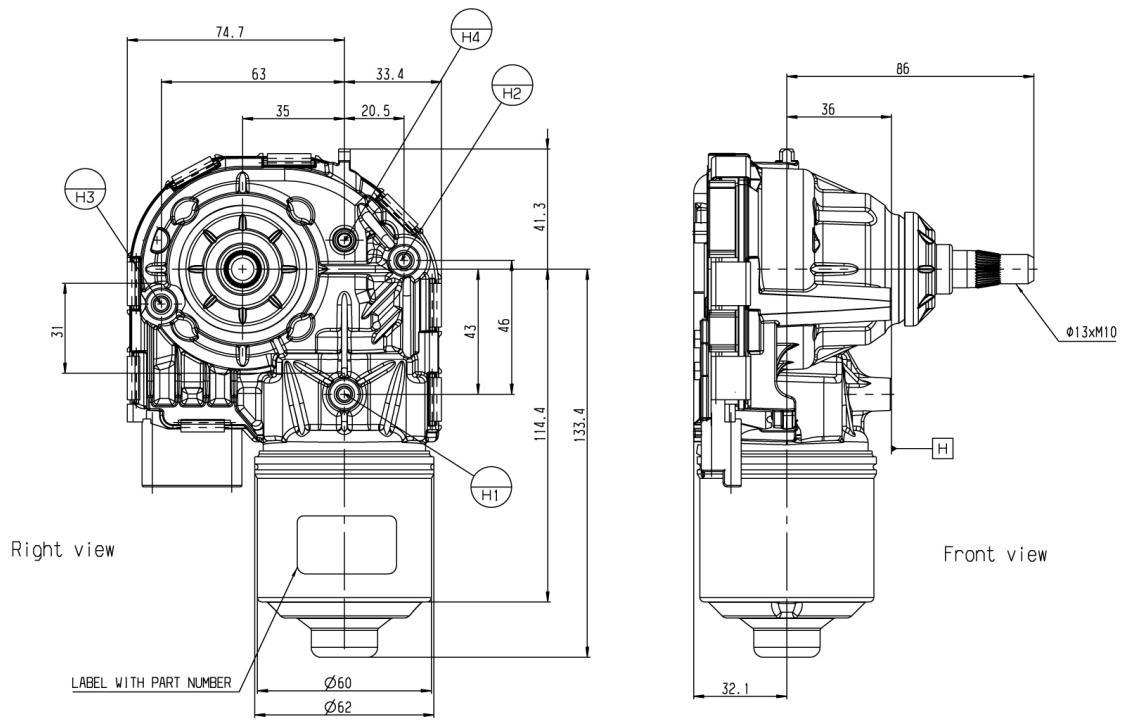
Order number **F02U.V00.938-03**

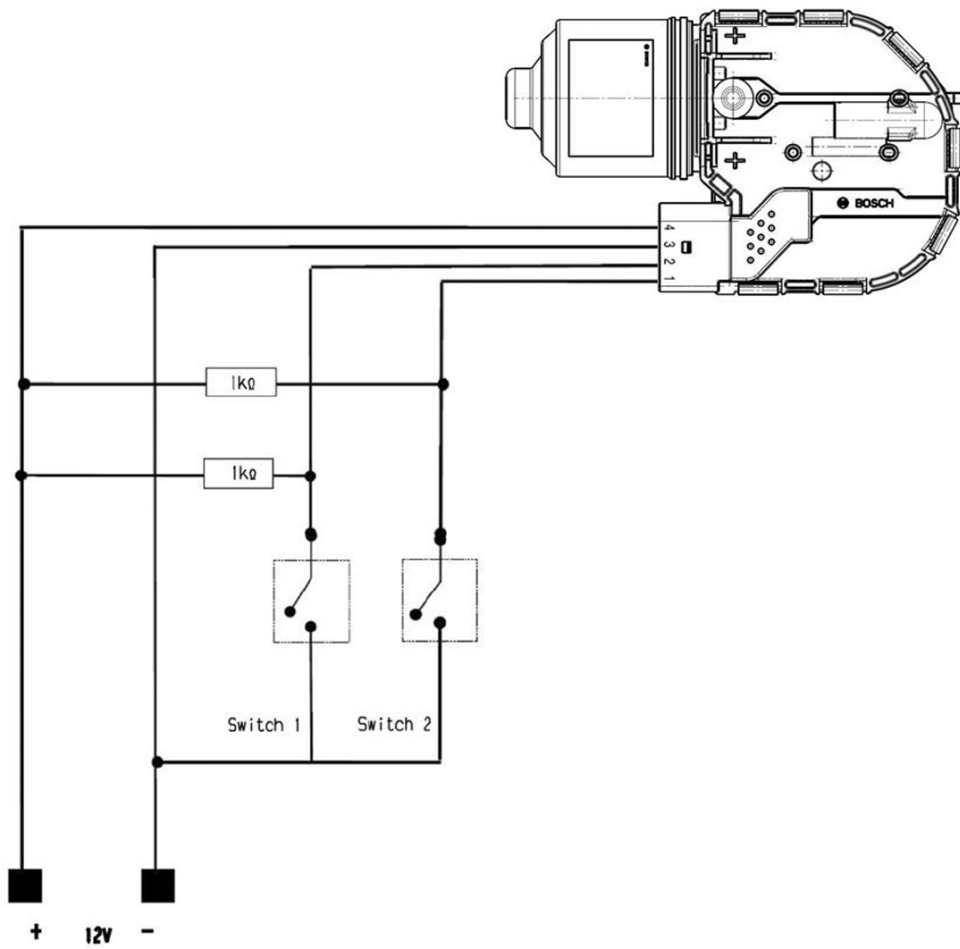
#### Accessories

##### Silentblock

Order number **F02U.003.027-01**

## Dimensions





Operating modes referring analog inputs configuration

Operating Mode	AN1 (Pin 2)	AN2 (Pin 1)
Stop	Power Supply	Power Supply
Interval	Power Supply	GND
Speed 1	GND	GND
Speed 2	GND	Power Supply

Operating modes referring switch configuration

Operating Mode	Switch 1	Switch 2
Stop	opened	opened
Interval	opened	closed
Speed 1	closed	closed
Speed 2	closed	opened



## e-GoKart Powertrain Young Star



6

### Features

- ▶ Ready to use solution
- ▶ Lowest maintenance costs due to highly reliable electrical powertrain
- ▶ Advanced software and permanent software monitoring
- ▶ Excellent drivability in all applications

The e-GoKart System combines traditional karting and future-oriented technology. High energy and power density of the air-cooled system components are ideal for small and lightweight vehicles like e-GoKarts. With high torque, the e-GoKart System supports convincing driving behavior and fun-to-drive. The e-GoKart System provides high power over a wide range for maximum vehicle speed. By intelligent software, the e-GoKart System gets the best out of the vehicle at any time and any driving profile, energy recuperation included. The system is safe and reliable based on automotive qualified components and a development approach according to automotive standards. The e-GoKart System is a platform for easy scalability over different vehicle classes and types.

### Application

System weight	41 kg
Nominal voltage	48 V (no special safety precautions are required)
Power modes	Reverse, boost, 3 different power maps (can be calibrated according to customer requirements)
Network	Optional external remote control with speed limitation to 5 km/h

Switches	At steering wheel: reverse and boost At body for system: On/Off, neutral/drive, key switch for 3 different power maps
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### Technical Specifications

#### Power Unit PU 5-10 Component specification

Technology	Claw pole electric motor with integrated inverter and $\mu$ C
Maximum engine power	8.0 kW
Scalable power maps	3 available
Maximum engine torque	50 Nm
Maximum speed	10.000 rpm
Weight	9,8 kg
Thermal system	Air cooled with integrated fans

#### Energy Storage ES 5-2.4 Component specification

Technology	Lithium-Ion with Battery Management System
Capacity	2 x 2.4 kWh
Driving time under racing conditions with 4.8 kW	More than 1 hour
Total charging time	4 hours (2 hours per battery)
Charge connector	230 V
Weight	2 to 4 x 15 kg
Thermal system	Passive cooled

#### Content of kit

Power Unit PU 5-10	
2 x Energy Storage ES 5-2.4	
Vehicle Control Unit VCU MS 40	
Display Unit DDU 18	
DC/DC converter	
Charger Energy Storage CH 5-1.2	
Wiring harness with switches	
Acceleration Pedal Sensor	F02U.V02.691-01
Brake Inductive Sensor	F02U.V02.690-01
Pressure Sensor	0261.545.030

### Installation Notes

Typical lifetime Battery: 80 % battery capacity after 2,200 h / 1,500 cycles according to Bosch standard validation program  
Typical lifetime PU and VCU: max. 3,000 h

For application with severe conditions and/or high volume, please contact your Bosch Motorsport counterpart in order to define the most appropriate validation program

### Ordering Information

**e-GoKart Powertrain Young Star**  
Order number **F02U.V02.649-02**



<b>Air Pressure</b>	<b>192</b>
<b>Fluid Pressure</b>	<b>205</b>
<b>Gear Shift</b>	<b>218</b>
<b>Knock</b>	<b>220</b>
<b>Lambda</b>	<b>227</b>
<b>Pressure &amp; Temperature</b>	<b>237</b>
<b>Rotary Position</b>	<b>250</b>
<b>Speed</b>	<b>252</b>
<b>Steering Wheel Angle</b>	<b>271</b>
<b>Temperature</b>	<b>273</b>
<b>Vehicle Dynamics</b>	<b>286</b>

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## Overview

### Pressure Sensor Air PS-AA



- Application: 0.1 to 1.15 bar or 0.2 to 2.5 bar
- Response time: 1 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 20 g

### Pressure Sensor Air PS-AL



- Application: 0.4 to 4.0 bar
- Response time: 1 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 15 g

### Pressure Sensor Air PS-AS



- Application: 0.2 to 3.0 bar
- Response time: 1 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 21 g

### Pressure Sensor Air PSA-N



- Application: 0.1 to 1.15 bar
- Response time: 0.1 ms
- Pressure reference type: Absolute
- Power supply: 11 to 16 V
- Weight: 21 g

### Pressure Sensor Air PSB-4



- Application: 0.5 to 4.0 bar
- Response time: 0.2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 20 g

### Pressure Sensor Air PSP



- Application: 0.2 to 3.0 bar
- Response time: 0.2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 17 g

## Pressure Sensor Air PS-AA



### Features

- ▶ Application: 0.1 to 1.15 bar or 0.2 to 2.5 bar
- ▶ Response time: 1 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 5 V
- ▶ Weight: 20 g

This sensor is designed to measure absolute air pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and electronic systems for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal. Two different pressure ranges are available (0.1 to 1.15 bar or 0.2 to 2.5 bar).

### Application

Application	Please see variations
Pressure reference type	absolute
Max. pressure	5 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Variations

	PS-AA (0.1 to 1.15 bar)	PS-AA (0.2 to 2.50 bar)
Tolerance (FS) at $U_s = 5\text{ V}$	$\pm 0.016\text{ bar}$	$\pm 0.034\text{ bar}$
Tolerance (FS)	$\pm 1.52\%$	$\pm 1.48\%$

Sensitivity	4,048 mV/bar	1,848 mV/bar
Offset	-4.8 mV	30.4 mV

#### Mechanical Data

Mounting	M6
Fitting	$12.05 \pm 0.8\text{ mm}$
Weight w/o wire	20 g
Sealing	O-ring 7.59 x 2.62 mm

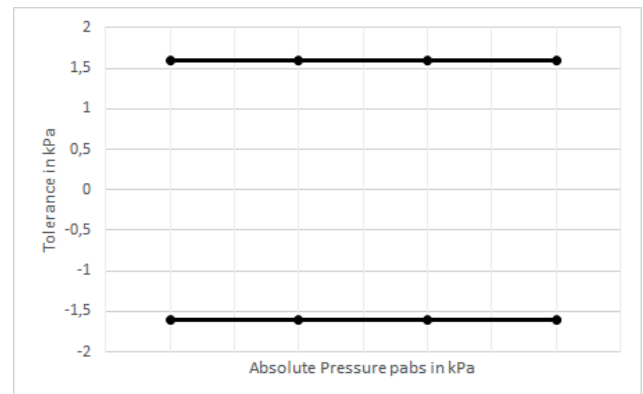
#### Electrical Dat

Power supply $U_s$	4.75 to 5.25 V
Max. power supply	16 V
Full scale output $U_A$ at 5 V	0.4 to 4.65 V
Current $I_s$	9 mA

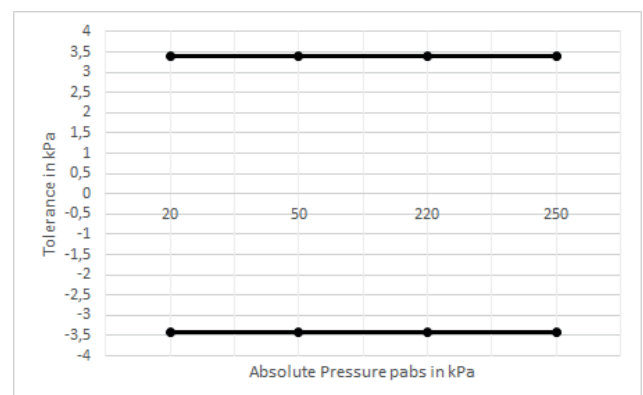
#### Characteristic

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5\text{ V}$	Please see variations
Tolerance (FS)	Please see variations
Sensitivity	Please see variations
Offset	Please see variations

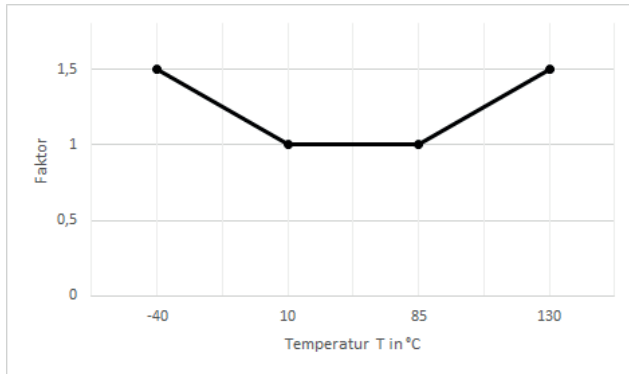
#### Tolerance 0.1 to 1.15 bar



#### Tolerance 0.2 to 2.5 bar



## Expansion of Tolerance



## Connectors and Wires

Connector	RB-COMP 1.1a/3P/Kod.1
Mating connector	D261.205.366-01
Pin 1	U <sub>S</sub>
Pin 2	Gnd
Pin 3	Sig

Various motorsport and automotive connectors are available on request.

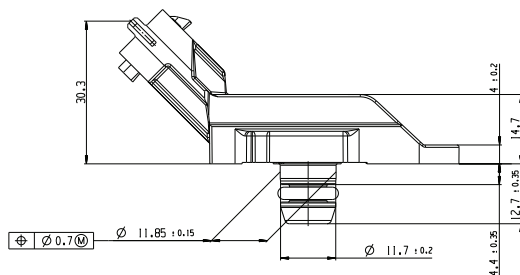
## Installation Notes

The PS-AA is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

## Dimensions

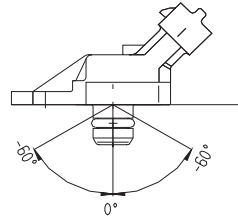


Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at  $I = 0.3$  A).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $\pm 60^\circ$ .



## Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

## Ordering Information

**Pressure Sensor Air PS-AA**

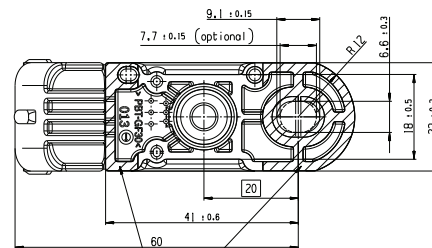
0.1 to 1.15 bar

Order number **0261.230.216**

**Pressure Sensor Air PS-AA**

0.2 to 2.5 bar

Order number **0261.230.284**



Auflageflaeche des Sensors.  
In diesem Bereich vollflaecheige Unterstuetzung vorsehen.  
SUPPORTING AREA OF SENSOR.  
THIS AREA SHOULD BE SUPPORTED BY A COHERENT PLANE SURFACE.

## Pressure Sensor Air PS-AL



### Features

- ▶ Application: 0.4 to 4.0 bar
- ▶ Response time: 1 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 5 V
- ▶ Weight: 15 g

This sensor is designed to measure absolute air-pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and an electronic for signal-amplification and temperature compensation. The output of the sensor is an analog, ratio metric signal.

### Application

Application	0.4 to 4 bar
Pressure reference type	absolute
Max. pressure	6 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Mechanical Data

Mounting	M6
Fitting	12.95 ± 0.8 mm
Weight w/o wire	15 g
Sealing	O-ring 9.25x1.78 mm

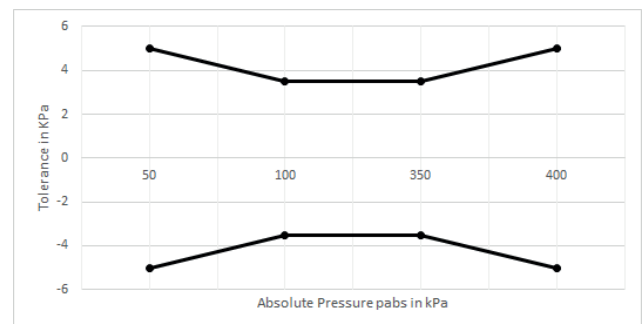
#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$ at 5 V	0.4 to 4.50 V
Current $I_s$	9 mA

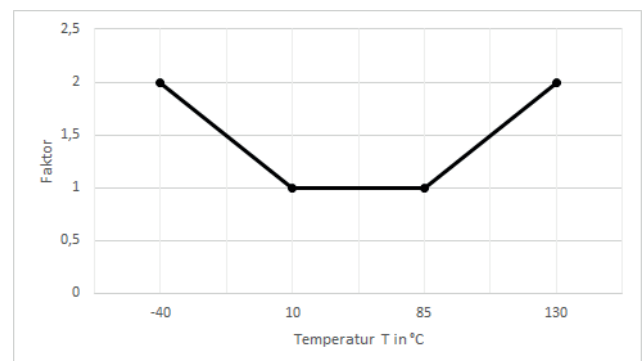
#### Characteristic

Response time $T_{10/90}$	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5$ V	± 0.035 bar / ± 0.050 bar
Tolerance (FS)	± 1.00 % / ± 1.43 %
Sensitivity	1,142.86 mV/bar
Offset	-71.43 mV

#### Tolerance



#### Expansion of Tolerance



#### Connectors and Wires

Connector	Hirschmann872-975- ...AK, Code A, Variant 1
Mating connector	F02U.B00.555-01
Pin 1	Sig
Pin 2	Gnd
Pin 3	$U_s$

Various motorsport and automotive connectors are available on request.

#### Installation Notes

The PS-AL is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

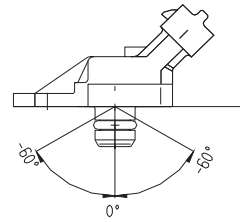
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at I = 0.3 A).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $\pm 60^\circ$ .



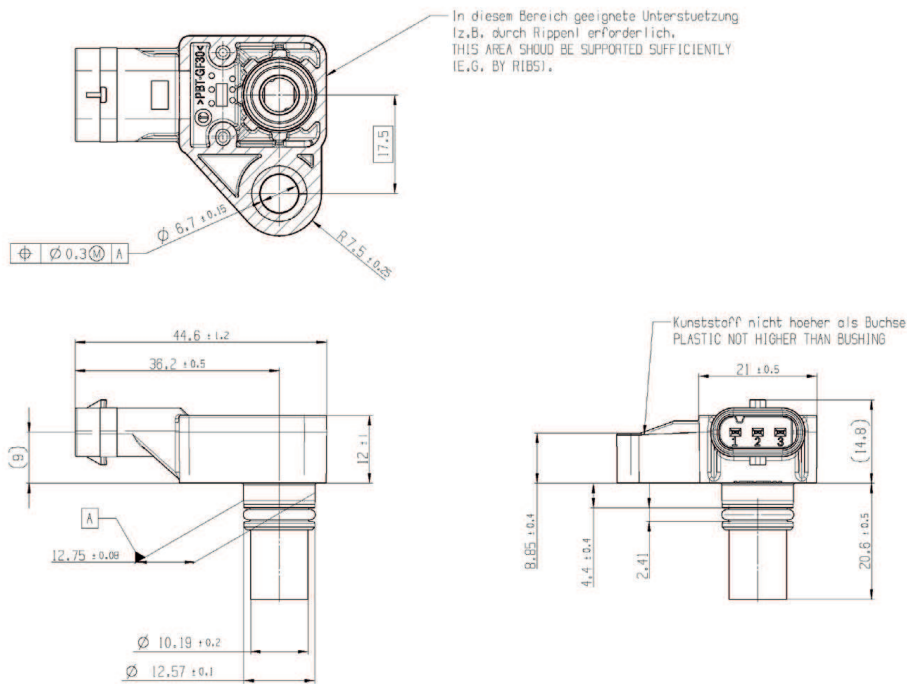
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

**Pressure Sensor Air PS-AL**  
Order number **0261.230.441**

**Dimensions**



## Pressure Sensor Air PS-AS



### Features

- ▶ Application: 0.2 to 3.0 bar
- ▶ Response time: 1 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 5 V
- ▶ Weight: 21 g

This sensor is designed to measure absolute air-pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and an electronic for signal-amplification and temperature compensation. The output of the sensor is an analog, ratio metric signal.

### Application

Application	0.2 to 3 bar (a)
Pressure reference type	absolute
Max. pressure	5 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Mechanical Data

Mounting	M6
Fitting	12.05 ± 0.8 mm
Weight w/o wire	21 g
Sealing	O-ring 7.59 x 2.62 mm

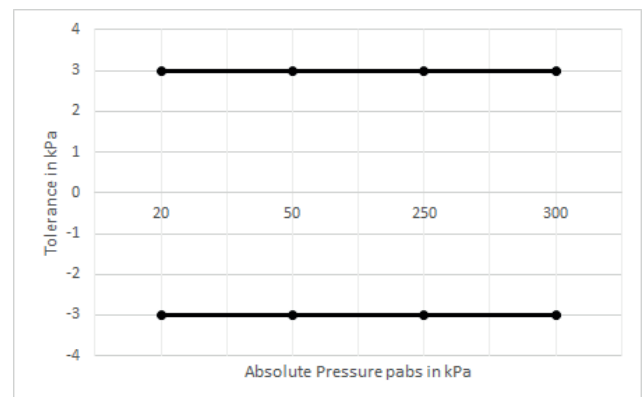
#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$ at 5 V	0.4 to 4.65 V
Current $I_s$	9 mA

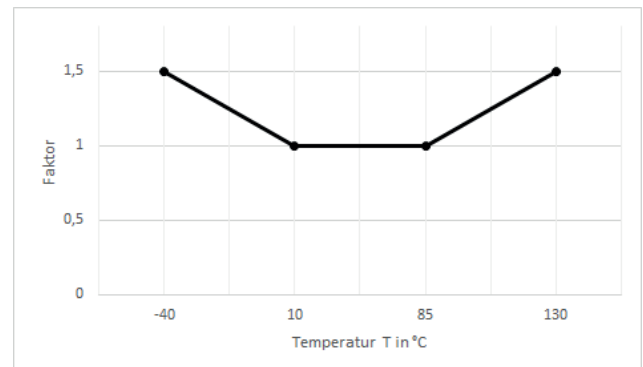
#### Characteristic

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5$ V	± 0.030 bar
Tolerance (FS)	± 1.07 %
Sensitivity	1,518 mV/bar
Offset	96 mV

#### Tolerance



#### Expansion of Tolerance



#### Connectors and Wires

Connector	RB-COMP 1.1a/3P/Kod.1
Mating connector	D261.205.366-01
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig

Various motorsport and automotive connectors are available on request.

#### Installation Notes

The PS-AS is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

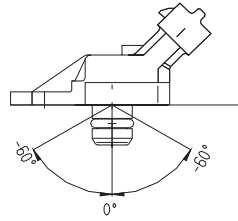
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2 \text{ ms}$ ) is recommended.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at  $I = 0.3 \text{ A}$ ).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $\pm 60^\circ$ .



### Safety Note

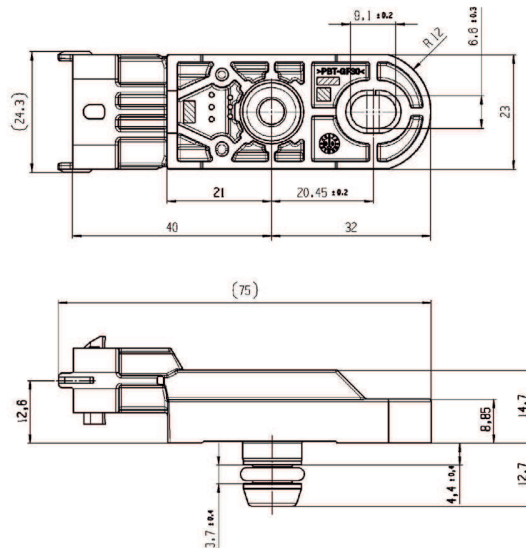
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Pressure Sensor Air PS-AS**  
Order number **0281.002.996**

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### Dimensions





## Pressure Sensor Air PSA-N



### Features

- ▶ Application: 0.1 to 1.15 bar
- ▶ Response time: 0.1 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 11 to 16 V
- ▶ Weight: 21 g

This sensor is designed to measure absolute air-pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and electronics for signal-amplification and temperature compensation. The output of the sensor is analog.

### Application

Application	0.1 to 1.15 bar
Pressure reference type	absolute
Max. pressure	5 bar
Operating temp. range	-40 to 125°C
Media temp. range	-40 to 125°C
Storage temp. range	-40 to 130°C
Max. vibration	0.19 mm at 100 to 200 Hz 250 m/s <sup>2</sup> at 200 to 500 Hz

### Technical Specifications

#### Mechanical Data

Mounting	2 x #4-40 screws
Fitting	Flat O-ring boss
Weight w/o wire	21 g
Sealing	O-ring 4.5 x 1.5 mm

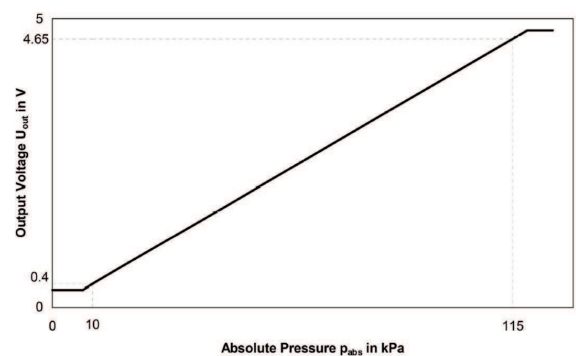
#### Electrical Data

Power supply $U_S$	11 to 16 V
Full scale output $U_A$	0.5 to 4.7 V
Typical current $I_S$	9 mA

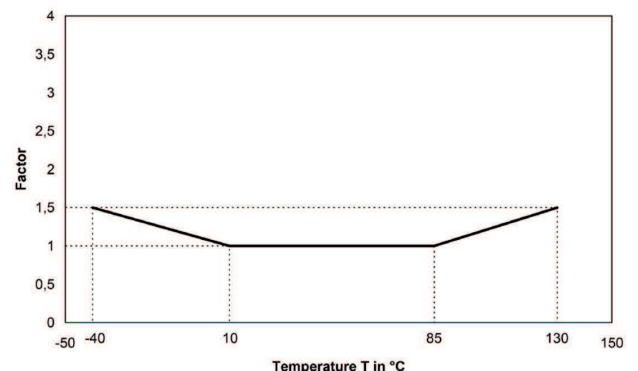
#### Characteristic

Response time $T_{10/90}$	1.0 ms
Compensated range	10 to 85°C
Tolerance (FS)	$\pm 0.016$ bar
Tolerance (FS)	$\pm 1.52$ %
Sensitivity	4,041.62 mV/bar
Offset	-4.16 mV

#### Tolerance



#### Expansion of Tolerance



#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	
Pin 1	$U_S$
Pin 2	Gnd
Pin 3	Sig
Pin 4	-
Pin 5	-
Various motorsport and automotive connectors are available on request.	
Sleeve	DR-25
Wire size	AWG 24
Wire length L	64.5 cm

**Installation Notes**

The PSA-N is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

To avoid noise, an ECU-input circuit with a RC-low pass filter (tau 0.2 ms) is recommended.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at I = 0.3 A).

Surface finish of the mounting surface should not exceed 0.8 micrometers RMS.

Surface flatness tolerance at sensor mount interface must not exceed +/- 0.025 mm after sensor is torqued in place.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

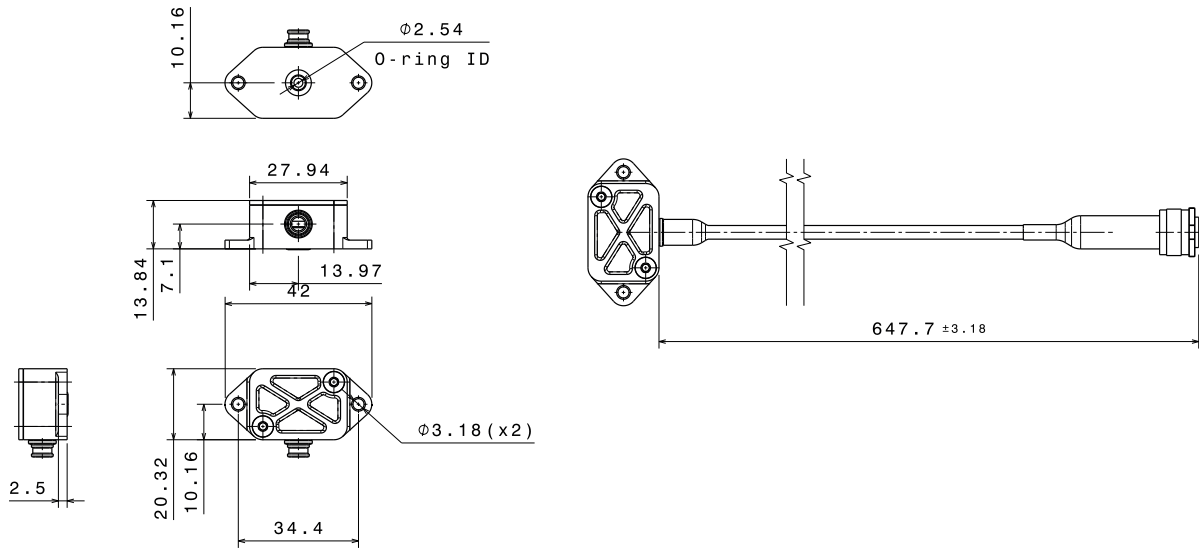
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

**Pressure Sensor Air PSA-N**  
Order number **F02U.V0U.197-02**

**Dimensions**



## Pressure Sensor Air PSB-4



### Features

- ▶ Application: 0.5 to 4.0 bar
- ▶ Response time: 0.2 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 5 V
- ▶ Weight: 20 g

This sensor is designed to measure absolute air-pressure, especially the air box and boost pressure of gasoline or Diesel engines over a wide range.

An integrated circuit combines a piezo-resistive sensor element, electronics for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal.

The main feature and benefit of this sensor is the combination of the high quality of the production part and an individual calibration. Each sensor is delivered with a calibration sheet to enable very small measurement tolerances. Furthermore the sensor has a very short response time.

### Application

Application	0.5 to 4 bar (a)
Pressure reference type	absolute
Max. pressure	6 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	-40 to 130°C
Max. vibration	20 m/s <sup>2</sup> at 10 to 1,000 Hz

### Technical Specifications

#### Mechanical Data

Mounting	M6
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Fitting	12.05 mm
Weight w/o wire	20 g
Sealing	O-ring 7.59 x 2.62 mm

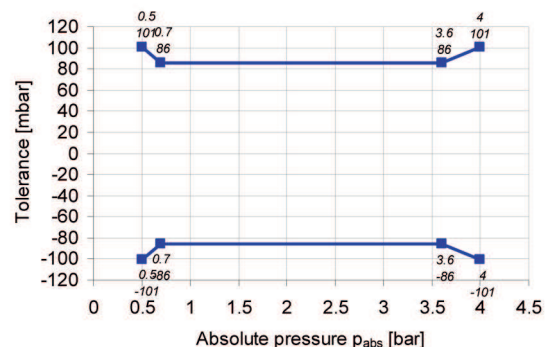
#### Electrical Data

Power supply $U_s$	4.5 to 5.5 V
Max power supply $U_s$ max.	16 V
Full scale output $U_A$ at 5 V	0.3 to 4.8 V
Current $I_s$	9 mA

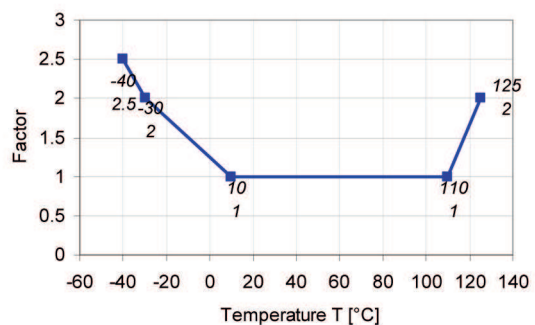
#### Characteristic

Response time $T_{10/90}$	0.2 ms
Compensated range	0 to 80°C
Tolerance (FS) at $U_s = 5$ V	$\pm 0.056$ bar
Tolerance (FS)	$\pm 1.4$ %
Sensitivity	1,143 mV/bar (an individual calibration sheet will be delivered)
Offset	-71 mV (an individual calibration sheet will be delivered)

#### Tolerance



#### Expansion of Tolerance



#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig
Pin 4	-

Pin 5	-
Various motorsport and automotive connectors are available on request.	
Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 100 cm
Please specify the required wire length with your order.	

**Installation Notes**

The PSB-4 is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at I = 0.3 A).

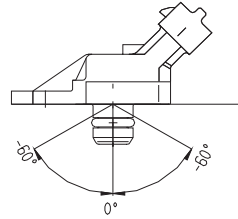
Please note that the 6mm tube connector has no function.

To optimize the accuracy of this sensor, an individual calibration sheet is delivered with each sensor.

Please find further application hints in the offer drawing. [www.bosch-motorsport.com](http://www.bosch-motorsport.com)

Free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System [www.bosch-motorsport.com](http://www.bosch-motorsport.com)

To avoid damage caused by condensate the maximum mounting position from vertical is +60°.



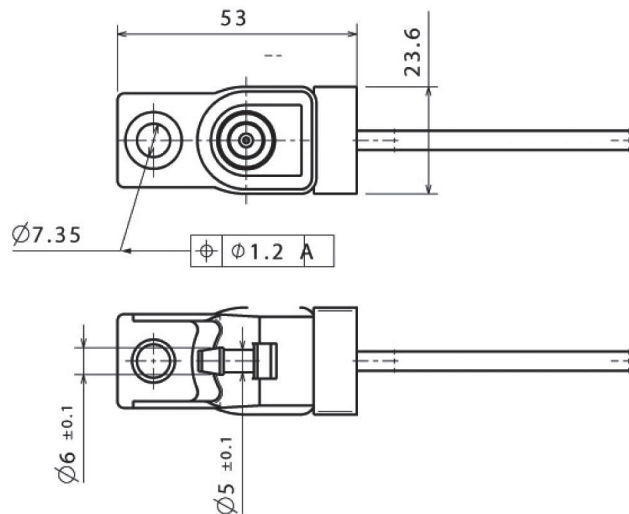
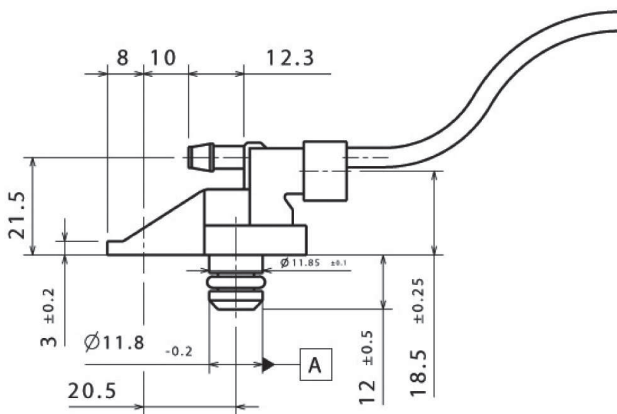
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

**Pressure Sensor Air PSB-4**  
Order number **B261.209.348-01**

**Dimensions**



## Pressure Sensor Air PSP



### Features

- ▶ Application: 0.2 to 3.0 bar
- ▶ Response time: 0.2 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 5 V
- ▶ Weight: 17 g

This sensor is designed to measure absolute air-pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and an electronic for signal-amplification and temperature compensation. The output of the sensor is an analog, ratio metric signal. The main feature and benefit of this sensor is the combination of both high quality production part and motorsport connector.

### Application

Application	0.2 to 3 bar (a)
Pressure reference type	absolute
Max. pressure	5 bar
Operating temp. range	-40 to 125°C
Media temp. range	-40 to 125°C
Storage temp. range	-40 to 130°C
Max. vibration	0.19 mm at 100 to 200 Hz 250 m/s <sup>2</sup> at 200 to 500 Hz

### Technical Specifications

#### Mechanical Data

Mounting	M6
Fitting	12.05 mm
Weight w/o wire	17 g

Sealing	O-ring 7.59 x 2.62 mm
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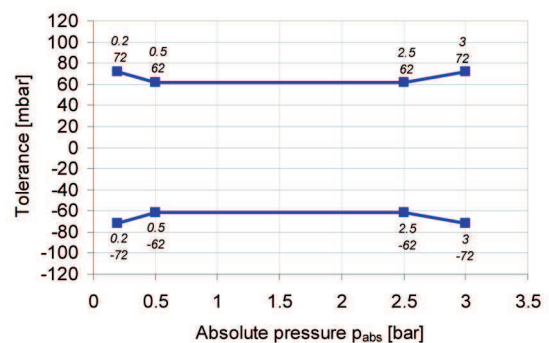
#### Electrical Data

Power supply $U_s$	4.5 to 5.5 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$ at 5 V	0.3 to 4.8 V
Current $I_s$	9 mA

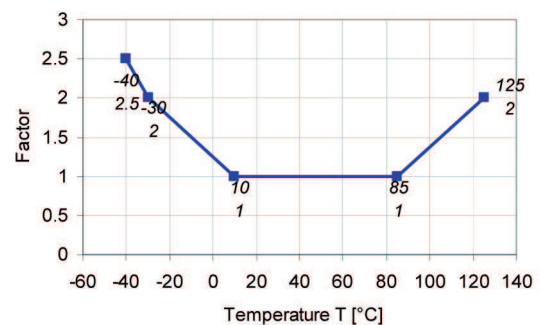
#### Characteristic

Response time T10/90	0.2 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5$ V	$\pm 0.042$ bar
Tolerance (FS)	$\pm 1.4$ %
Sensitivity	1,518 mV/bar
Offset	96 mV

#### Tolerance



#### Expansion of Tolerance



#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	
Pin 1	-
Pin 2	Gnd
Pin 3	Sig
Pin 4	$U_s$
Pin 5	-
Various motorsport and automotive connectors are available on request.	
Sleeve	DR-25

Wire size	AWG 24
Wire length L	15 to 100 cm
Please specify the required wire length with your order.	

**Installation Notes**

The PSP is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

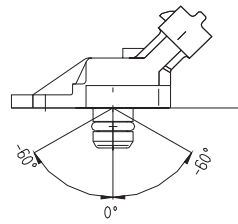
To avoid noise, an ECU-input circuit with a RC-low pass filter (tau = 2 ms) is recommended.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at I = 0.3 A).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is +60°.



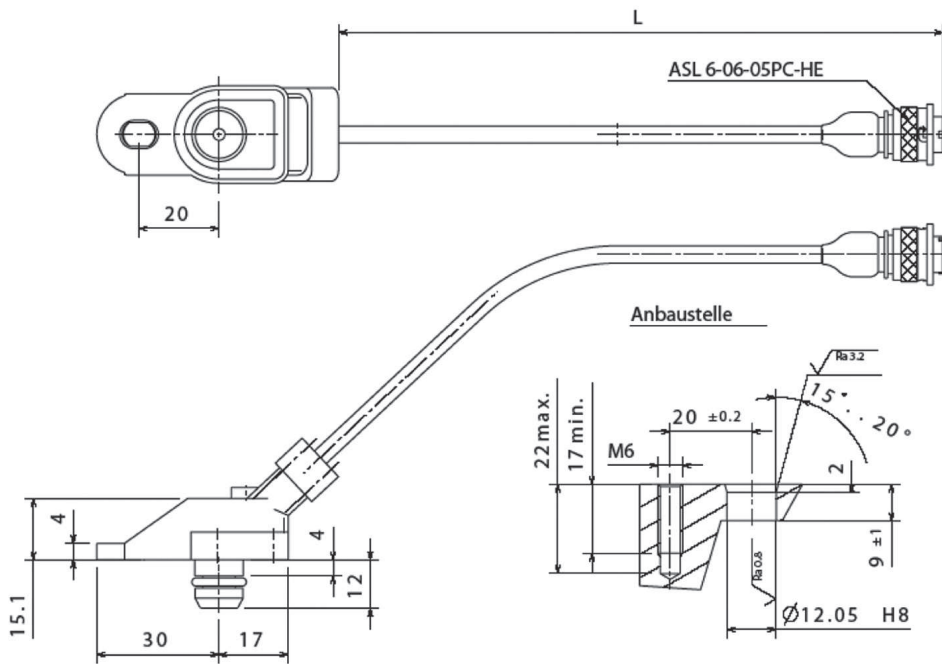
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

**Pressure Sensor Air PSP**  
Order number **B261.209.690-01**

**Dimensions**



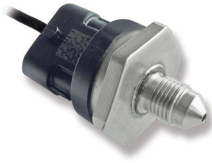
## Overview

### Pressure Sensor Fluid PSC-10



- Application: 0 to 10 bar
- Response time: 1.5 ms (5 V Variant) or 1 ms (12 V Variant)
- Pressure reference type: Absolute
- Power supply: 5 or 12 V
- Weight: 45 g

### Pressure Sensor Fluid PSC-260



- Application: 0 to 260 bar
- Response time: 2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 35 g

### Pressure Sensor Fluid PSM- SA



- Application: 0 to 3.5, 6, 10, 20, 35, 60, 70, 100, 200, 350, 700 bar
- Response time: 1 ms
- Pressure reference type: Absolute
- Power supply: 8 to 30 V
- Weight: 13 g

### Pressure Sensor Fluid PSS-10



- Application: 1 to 11 bar
- Response time: 1.5 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 45 g

### Pressure Sensor Fluid PSS-250R



- Application: 0 to 250 bar
- Response time: 1.5 ms
- Pressure reference type: Relative
- Power supply: 5 V
- Weight: 45 g

### Pressure Sensor Fluid PSS-140/260/420/600



- Application: 0 to 140, 260, 420, 600 bar
- Response time: 2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 35 g



## Pressure Sensor Fluid PSC-10



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### Features

- ▶ Application: 0 to 10 bar
- ▶ Response time: 1.5 ms (5 V Variant) or 1 ms (12 V Variant)
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 or 12 V
- ▶ Weight: 45 g

This sensor is designed to measure absolute pressure of various kinds of media e.g. Diesel, gasoline, water, engine oil, transmission oil or air. The sensor is available for two different supply voltage ranges. The sensor uses stainless steel measuring cells with piezo-resistive measuring bridges in thin layer technique, which are hermetically welded together with stainless steel pressure ports. This guarantees a complete media compatibility. The main benefit of this sensor is the high quality of a production part at a low price.

### Application

Application	0 to 10 bar (a)
Pressure reference type	absolute
Max. pressure	20 bar
Operating temp. range	-40 to 125°C
Media temp. range	-40 to 125°C
Storage temp. range	-20 to 50°C
Bio fuel compatibility	E 85 / M 100
Max. vibration	100 m/s <sup>2</sup> rms at 10 to 2,000 Hz

### Technical Specifications

#### Variations

	PSC-10 (5 V)	PSC-10 (12 V)
Power supply $U_s$	4.75 to 5.25 V	9 to 30 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric	0 to 5 V non-ratiometric
Response time T10/90	1.5 ms	1.0 ms
Sensitivity	400 mV/bar at $U_s = 5$ V	500 mV/bar
Offset	500 mV at $U_s = 5$ V	0 mV
Pin 1	-	$U_s$
Pin 2	Gnd	Gnd
Pin 3	Sig	Sig
Pin 4	$U_s$	-
Pin 5	-	-

#### Mechanical Data

Male thread	M10x1
Wrench size	17 mm
Installation torque	15 Nm
Weight w/o wire	45 g
Sealing	O-ring 8.1 x 1.6 mm

#### Electrical Data

Power supply $U_s$	Please see variations
Max power supply $U_s$ max	$\pm 30$ V
Full scale output $U_A$	Please see variations
Current $I_s$	8 mA

#### Characteristic

Response time T10/90	Please see variations
Compensated range	0 to 90°C
Tolerance (FS) at $U_s = 5$ V	$\pm 0.1$ bar
Tolerance (FS)	$\pm 1$ %
Sensitivity	Please see variations
Offset	Please see variations

#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01 ASL006-05SC-HE
Sleeve	DR-25
Wire size	AWG 24
Wire length L	13 to 95 cm

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.



## Installation Notes

The PSC-10 can be connected directly to most control units.

The sensor has a protection for over voltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

## Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

## Ordering Information

### Pressure Sensor Fluid PSC-10

4.75 to 5.25 V

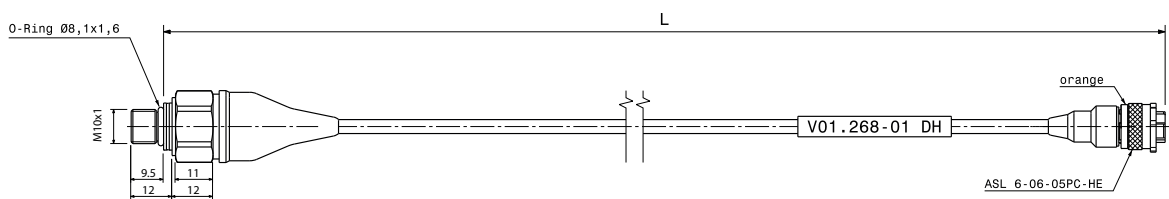
Order number **F02U.V01.268-01**

### Pressure Sensor Fluid PSC-10

9 to 30 V

Order number **F02U.V01.295-01**

## Dimensions



## Pressure Sensor Fluid PSC-260



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### Features

- ▶ Application: 0 to 260 bar
- ▶ Response time: 2 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 35 g

The PSC-260 is specially designed to measure absolute pressure in gasoline direct injection applications. This sensor is also compatible with other kind of fluids e.g. Diesel, engine oil, transmission oil or brake fluid.

The sensor uses a thin layer technique to achieve high accuracy pressure measurements. The stainless steel measuring cells with piezoresistive bridges are hermetically welded with stainless steel pressure ports. The internal reference ensures ambient pressure independent measurements.

The main benefits of this sensor are its high accuracy, its wide measurement range and its robust and compact design.

### Application

Application	0 to 260 bar (a)
Pressure reference type	absolute
Max. pressure	320 bar
Operating temp. range	-40 to 130°C (140°C)
Media temp. range	-40 to 130°C (140°C)
Storage temp. range	-30 to 60°C
Max. vibration	560 m/s <sup>2</sup> at 800 to 900 Hz 350 m/s <sup>2</sup> at 1.000 to 2.500 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10 x 1
Wrench size	27 mm
Installation torque	22 Nm in steel 32.5 Nm in aluminum
Weight w/o wire	35.2 g
Sealing	sealed cone

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	10 to 90 % $U_s$ ratio metric
Current $I_s$	12 mA

#### Characteristic

Load capacity	10 nF
Output resistance	10 Ohm
Tolerance (FS)	+ 1 % (0 to 100°C) + 1.5 % (-40 to 0°C and 100 to 130°C)
Sensitivity	15.38 mV/bar at $U_s = 5$ V
Offset	500 mV at $U_s = 5$ V

#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01 ASL006-05SC-HE
Pin 1	-
Pin 2	Gnd
Pin 3	Sig
Pin 4	$U_s$
Pin 5	-

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

Sleeve	DR-25
Wire length L	13 to 95 cm

### Installation Notes

The PSC-260 can be connected directly to most control units. Please consider the TCI for the electrical connection of the sensor.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

Please consider using the adapter F02U.002.711-01.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

#### Pressure Sensor Fluid PSC-260

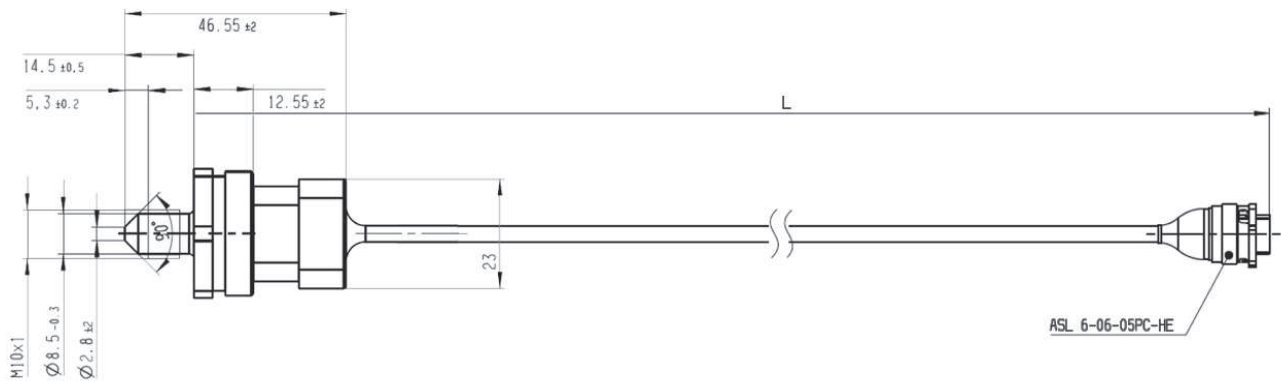
Order number **F02U.V00.990-03**

#### Accessories

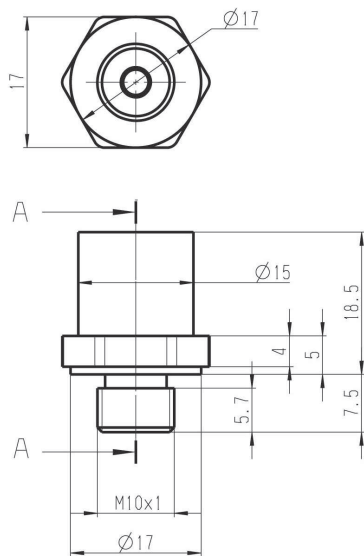
#### Adapter

Order number **F02U.002.711-01**

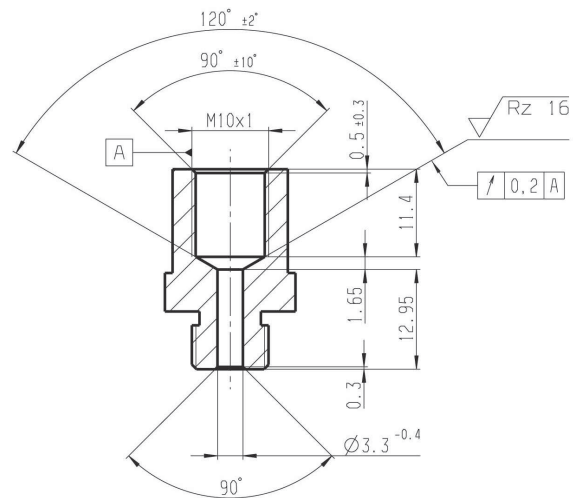
### Dimensions



Sensor



Adapter



## Pressure Sensor Fluid PSM-SA



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### Features

- ▶ Application: 0 to 3.5, 6, 10, 20, 35, 60, 70, 100, 200, 350, 700 bar
- ▶ Response time: 1 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 8 to 30 V
- ▶ Weight: 13 g

This sensor is designed to measure absolute pressure of various kinds of media e.g. Diesel, gasoline, water, engine oil, transmission oil or air. The sensor utilizes a flush metal diaphragm as a force collector. The force is transferred to a solid state piezo-resistive sensing element via a thin intervening film of noncompressible silicone oil. The housing is welded hermetically. An individual calibration sheet will be delivered with each sensor. The main feature and benefit of this sensor is a good protection against vibrations.

### Application

Pressure measurement range versions	3.5 to 700 bar
Pressure reference type	absolute
Operating temp. range	-40 to 150°C
Vibration	2 g (10 Hz to 60 Hz) and 20 g (60 Hz to 1 KHz)
Shock (1/2 sine)	50 g (11 ms) and 200 g (6 ms)
Bio fuel compatibility	E85/M100

### Technical Specifications

#### Mechanical Data

Housing	Stainless steel
Male thread	M8x1
Wrench size	11 mm
Installation torque	2.5 Nm max.
Weight	13 g + 20 g per meter of cable
Sealing	O-ring 6.35 x 1.6 VITON
Ingress Protection	IP66

#### Electrical Data

Supply voltage	8 to 32 V DC
Max current	< 8 mA
Non-Repeatability	± 0.05 % FSO typ.
CNL & H	± 0.25 % FSO
Bandwidth (-3 dB)	400 Hz
Output "FSO"	0.5 to 4.5 V = 4 V ± 50 mV

#### Characteristic

Compensated range	20 to 120°C
Long term stability	Offset = 0.1 % span/year; Span = 0.1 %/year
Zero offset at 23°C	0.5 V ± 50 mV (0.5 ± 100 mV for ranges ≤ 10 bar or 150 psi)
Sensitivity/Offset	(an individual calibration sheet will be delivered)
Thermal zero shift "TZS"	± 1 % FSO/100°C (± 2 % FSO/100°C for ranges ≤ 10 bar or 150 psi)
Thermal sensitivity shift "TSS"	± 1 %/100°C (± 1.5 %/100°C for ranges ≤ 10 bar or 150 psi)

#### Connectors and Wires

Connector	ASU603-05PC-HE
Mating connector	F02U.000.208-01
ASU003-05SC-HE	
Pin 1	U <sub>s</sub>
Pin 2	Gnd
Pin 3	Sig
Pin 4	-
Pin 5	Scr
Sleeve	Viton
Wire size	AWG 24
Wire length L	15 to 100 cm
Various motorsport and automotive connectors are available on request.	
Please specify the required wire length with your order.	

### Installation Notes

The PSM-SA can be connected directly to most control units.

Each mounting orientation is possible.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

100 % relative humidity is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

#### Pressure Sensor Fluid PSM-SA

0 to 3.5 bar

Order number **F02U.V01.946-01**

#### Pressure Sensor Fluid PSM-SA

0 to 6 bar

Order number **F02U.V01.947-01**

#### Pressure Sensor Fluid PSM-SA

0 to 10 bar

Order number **F02U.V01.948-01**

#### Pressure Sensor Fluid PSM-SA

0 to 20 bar

Order number **F02U.V01.949-01**

#### Pressure Sensor Fluid PSM-SA

0 to 35 bar

Order number **F02U.V01.950-01**

#### Pressure Sensor Fluid PSM-SA

0 to 60 bar

Order number **F02U.V01.951-01**

#### Pressure Sensor Fluid PSM-SA

0 to 70 bar

Order number **F02U.V01.724-01**

#### Pressure Sensor Fluid PSM-SA

0 to 100 bar

Order number **F02U.V01.952-01**

#### Pressure Sensor Fluid PSM-SA

0 to 200 bar

Order number **F02U.V01.953-01**

#### Pressure Sensor Fluid PSM-SA

0 to 350 bar

Order number **F02U.V01.954-01**

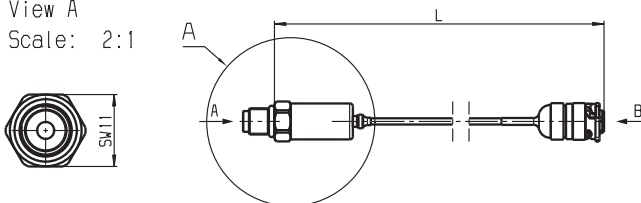
#### Pressure Sensor Fluid PSM-SA

0 to 700 bar

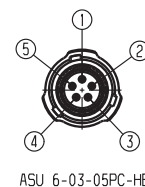
Order number **F02U.V02.064-01**

### Dimensions

View A  
Scale: 2:1

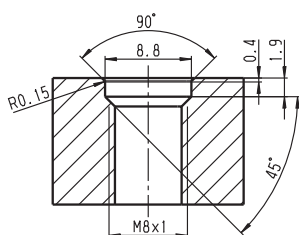


View B  
Scale: 2:1  
Electrical connection

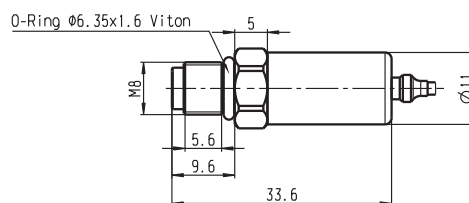


- 1: Supply (8 to 32VDC)
- 2: Ground
- 3: Signal (0.5 to 4.5V)
- 4: Not connected
- 5: Screen

Recommended mounting port



Detail A  
Scale: 2:1



## Pressure Sensor Fluid PSS-10



7

### Features

- ▶ Application: 1 to 11 bar
- ▶ Response time: 1.5 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 45 g

This sensor is designed to measure absolute pressure of various kinds of media e.g. Diesel, gasoline, water, engine oil, transmission oil or air.

The sensor uses stainless steel measuring cells with piezo-resistive measuring bridges in thin layer technique. These are hermetically welded together with stainless steel pressure ports. This guarantees a complete media compatibility.

The main benefit of this sensor is the high quality of a production part at a low price.

### Application

Application	1 to 11 bar (a)
Pressure reference type	absolute
Max. pressure	20 bar
Operating temp. range	-40 to 125°C (140°C)
Media temp. range	-40 to 125°C (140°C)
Storage temp. range	-20 to 50°C
Bio fuel compatibility	E 85 / M 100
Max. vibration	100 m/s <sup>2</sup> rms at 10 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
-------------	-------

Wrench size	17 mm
Installation torque	15 Nm
Weight w/o wire	45 g
Sealing	O-ring 7.65 x 1.63 mm

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	± 30 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
Current $I_s$	8 mA

#### Characteristic

Response time T10/90	1.5 ms
Compensated range	0 to 90°C
Tolerance (FS) at $U_s = 5$ V	± 0.1 bar
Tolerance (FS)	± 1 %
Sensitivity	400 mV/bar at $U_s = 5$ V
Offset	100 mV at $U_s = 5$ V

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.339-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$
Pin 4	-
Pin 5	-

### Installation Notes

The PSS-10 can be connected directly to most control units.

The sensor has a protection for over voltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

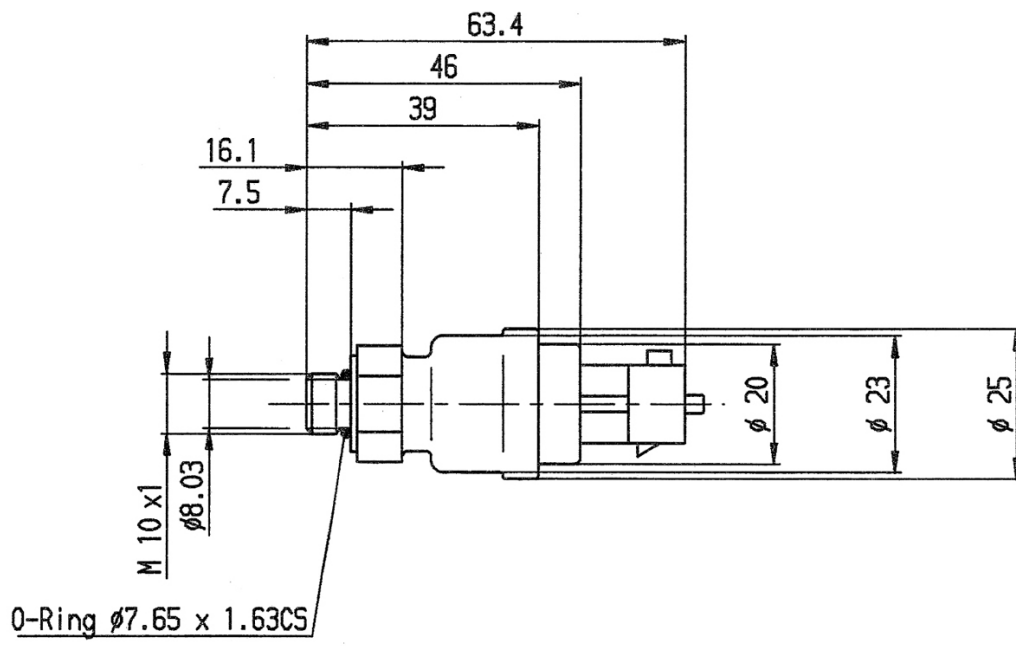
#### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Pressure Sensor Fluid PSS-10**  
Order number **B261.209.341-01**

## Dimensions



## Pressure Sensor Fluid PSS-250R



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### Features

- ▶ Application: 0 to 250 bar
- ▶ Response time: 1.5 ms
- ▶ Pressure reference type: Relative
- ▶ Power supply: 5 V
- ▶ Weight: 45 g

This sensor is designed to measure the pressure of media in relation to the ambient pressure (e.g. Diesel, gasoline, water, engine oil, transmission oil or air). The sensor is available for two different supply voltage ranges.

The sensor uses stainless steel measuring cells with piezo-resistive measuring bridges in thin layer technique, which are hermetically welded together with stainless steel pressure ports. This guarantees a complete media compatibility.

The main benefit of this sensor is the high quality of a production part at a low price

### Application

Application	0 to 250 bar (r)
Pressure reference type	relative
Max. pressure	500 bar
Operating temp. range	-40 to 125°C (140°C)
Media temp. range	-40 to 125°C (140°C)
Storage temp. range	-20 to 50°C
Bio fuel compatibility	E 85 / M 100
Max. vibration	100 m/s <sup>2</sup> rms at 10 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Wrench size	17 mm
Installation torque	15 Nm
Weight w/o wire	45 g
Sealing	O-ring 7.65 x 1.63 mm

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	± 30 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
Current $I_s$	8 mA

#### Characteristic

Response time T10/90	1.5 ms
Compensated range	0 to 90°C
Tolerance (FS)	± 2.5 bar
Tolerance (FS)	± 1 %
Sensitivity	16 mV/bar at $U_s = 5$ V
Offset	500 mV at $U_s = 5$ V

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.339-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$
Pin 4	-
Pin 5	-

### Installation Notes

The PSS-250R can be connected directly to most control units.

The sensor has a protection for over voltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

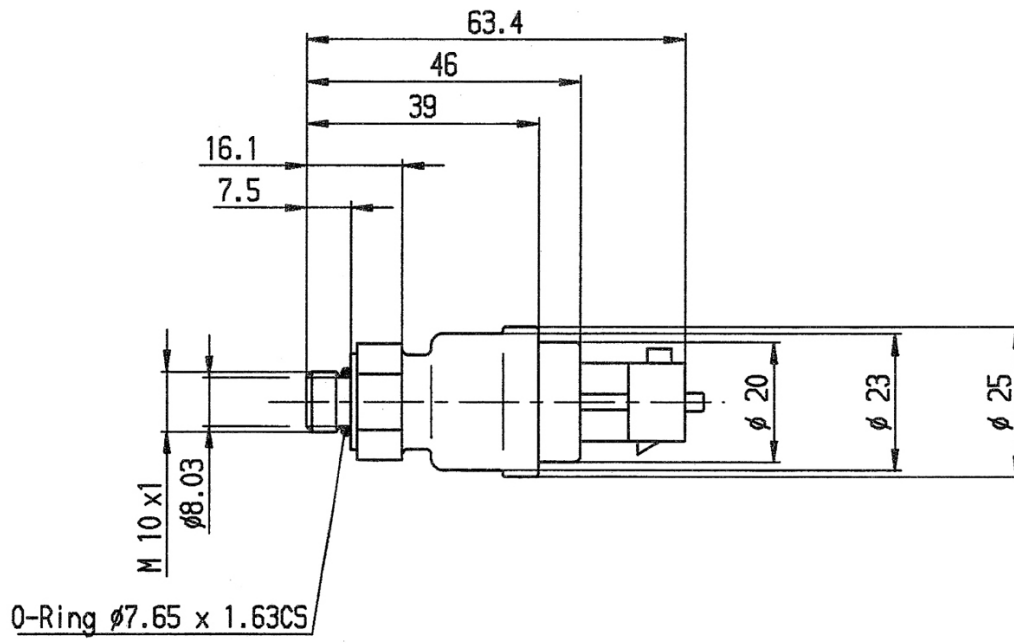
#### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.



**Ordering Information****Pressure Sensor Fluid PSS-250R**

4.75 to 5.25 V

Order number **B261.209.965-01****Dimensions**

## Pressure Sensor Fluid PSS-140/260/420/600



7

### Features

- ▶ Application: 0 to 140, 260, 420, 600 bar
- ▶ Response time: 2 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 35 g

The PSS is specially designed to measure absolute pressure in gasoline direct injection applications. This sensor is also compatible with other kind of fluids e.g. Diesel, engine oil, transmission oil or brake fluid.

The sensor uses a thin layer technique to achieve high accuracy pressure measurements. The stainless steel measuring cells with piezoresistive bridges are hermetically welded with stainless steel pressure ports. The internal reference ensures ambient pressure independent measurements.

The main benefits of this sensor are its high accuracy, its wide measurement range and its robust and compact design.

### Application

Application and max. pressure	Please see Variations
Pressure reference type	absolute
Operating and media temp. range	-40 to 130°C (140°C)
Storage temp. range	-30 to 60°C
Max. vibration	210 m/s <sup>2</sup> at 147 to 1,350 Hz 175 m/s <sup>2</sup> at 1,350 to 2,000 Hz

### Technical Specifications

#### Variations

	PSS -140	-260	-420	-600
Application (bar) 0 to	140	260	420	600
Max. pressure (bar)	180	320	560	660
Sensitivity at U <sub>s</sub> = 5 V (mV/bar)	28.57	15.38	9.52	6.67

#### Mechanical Data

Male thread	M10 x 1
Wrench size	27 mm
Installation torque	22 ± 2 Nm in aluminum 32.5 ± 2.5 Nm in steel
Weight w/o wire	35.2 g
Sealing	sealed cone

#### Electrical Data

Power supply U <sub>s</sub>	4.75 to 5.25 V
Max power supply U <sub>s</sub> max	16 V
Full scale output U <sub>A</sub>	10 to 90 % U <sub>s</sub> ratiometric
Current I <sub>s</sub>	12 mA

#### Characteristic

Load capacity	10 nF
Output resistance	10 Ohm
Tolerance (FS)	+ 1 % (0 to 100°C) + 1.5 % (-40 to 0°C and 100 to 130°C)
Sensitivity	Please see Variations
Offset	500 mV at U <sub>s</sub> = 5 V

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.366-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	U <sub>s</sub>

### Installation Notes

The PSS- can be connected directly to most control units. Please consider the TCI for the electrical connection of the sensor.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

Please consider using the adapter F02U.002.711-01.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

#### Pressure Sensor Fluid PSS-140

Order number **0261.545.053**

#### Pressure Sensor Fluid PSS-260

Order number **0261.545.040**

#### Pressure Sensor Fluid PSS-420

Order number **0261.545.136**

#### Pressure Sensor Fluid PSS-600

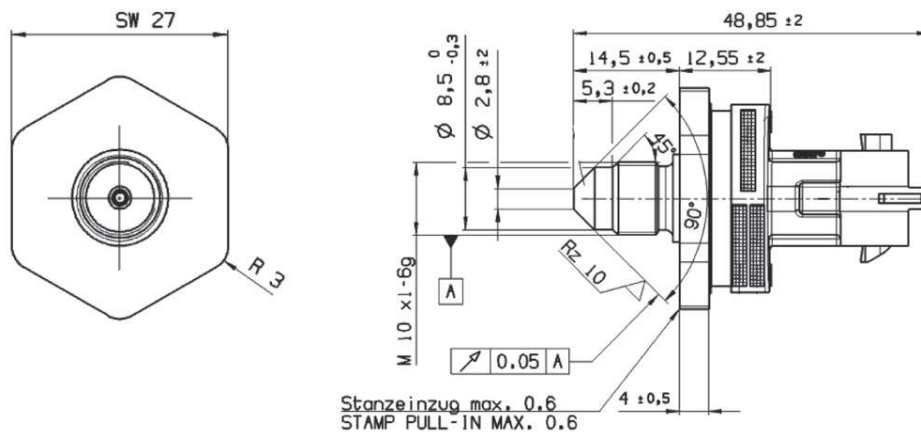
Order number **0261.B23.789-06**

### Accessories

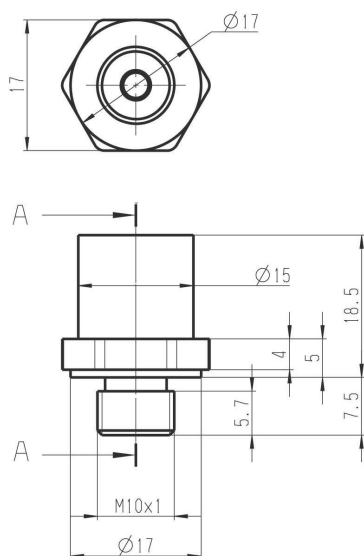
#### Adapter

Order number **F02U.002.711-01**

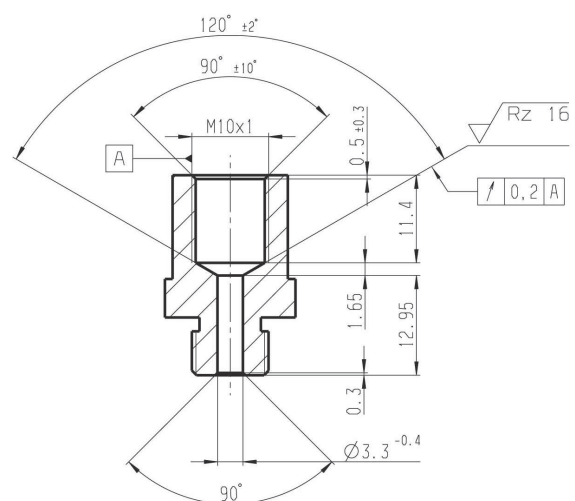
### Dimensions



Sensor



Adapter



## Gear Shift Sensor GSS-2



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### Features

- ▶ Max. vibration: 800 m/s<sup>2</sup> at 5 Hz to 2 kHz
- ▶ Weight w/o wire: 90 g
- ▶ Output signal: 0.4 to 4.5 V

This sensor is designed to measure force relative to gear shifting in order to control the engine operation allowing the driver to maintain no-lift-shift/full throttle during shifting (up and down).

A circuit of precise resistors and an integrated amplifier supply a force dependent output voltage signal. As soon as this signal exceeds a certain threshold value in the ECU, the ignition and injection can be adjusted automatically according to the individual ECU application.

The main feature and benefit of this sensor is the combination of high quality production part and robust design with metal housing and motorsport spec connection. Furthermore this sensor has a dual way functionality.

### Application

Measuring range	-450 to 450 N
Max. vibration	800 m/s <sup>2</sup> at 5 Hz to 2 kHz
Operating temperature range	0 to 80°C

### Technical Specifications

#### Mechanical Data

Weight w/o wire	90 g
Size	65 x 16 x 16 mm
Mounting	2 x M10 x 1
Tightening torque	22 Nm
Mech. range programmable up to	450 N
F <sub>max</sub>	800 N

Mech. load limit	1800 N
Max. cycles at 300 N	300,000 cycles

#### Electrical Data

Power supply	12 V
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#### Characteristic

Signal Output	0.5 to 4.5 V
Zero Output	2.5 V

#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	

Pin 1	U <sub>s</sub>
Pin 2	Gnd
Pin 3	Sig
Pin 4	-
Pin 5	Scr

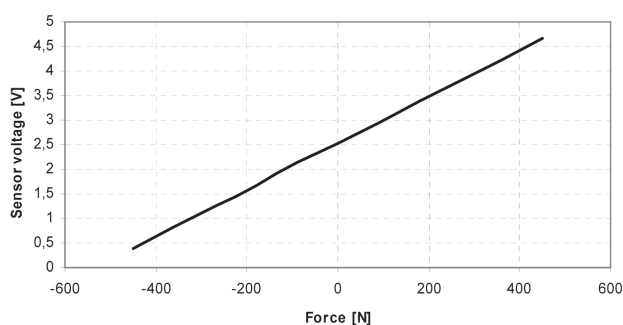
Various motorsport and automotive connectors are available on request.

Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 100 cm

Please specify the required wire length with your order.

#### Sensor voltage

Force (N)	Voltage (V)
450	4.673
360	4.225
270	3.797
180	3.397
90	2.941
0	2.538
-90	2.141
-180	1.672
-270	1.255
-360	0.820
-450	0.402



## Installation Notes

The GSS-2 can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated thread.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

## Safety Note

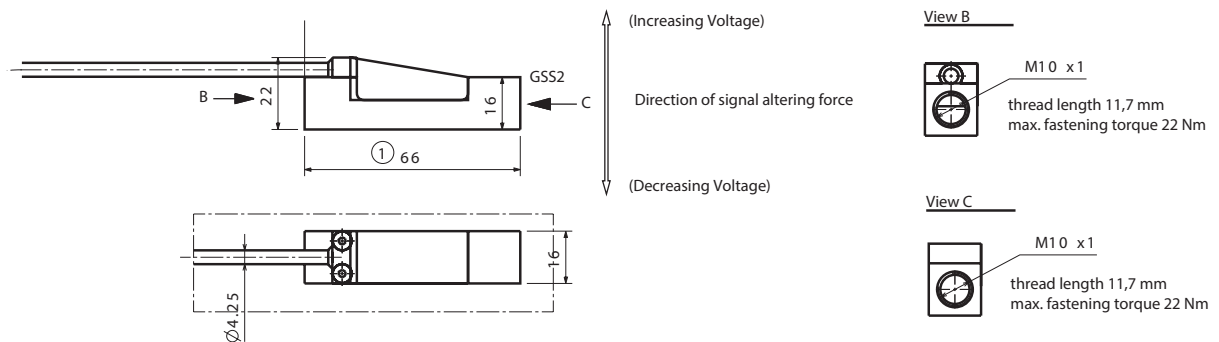
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

## Ordering Information

### Gear Shift Sensor GSS-2

Order number **B261.209.227-01**

## Dimensions



## Overview

**Knock Sensor KS4-P**



- Frequency: 3 to 25 kHz
- Weight: 48 g
- Height sensor head: 18 mm

**Knock Sensor KS4-R**



- Frequency: 3 to 25 kHz
- Weight: 82 g
- Height sensor head: 18 mm

**Knock Sensor KS4-R2**



- Frequency: 3 to 30 kHz
- Weight: 60 g
- Height sensor head: 14 mm

## Knock Sensor KS4-P



### Features

- ▶ Frequency: 3 to 25 kHz
- ▶ Weight: 48 g
- ▶ Height sensor head: 18 mm

This sensor is used for detecting structural born vibrations in spark ignition engines due to uncontrolled combustion. This sensor is suitable for operation in extreme conditions.

Due to the inertia of the seismic mass, the sensor moves in correlation to the engine block vibration; this motion results in a compressive force which is converted into a voltage signal via a piezoceramic sensor element. As a result, upper and lower voltage thresholds can be defined directly correlating to an acceleration magnitude.

The main benefits of this sensor are its robust mechanical design, compact housing and precise determination of structure-related noise. The small packaging is accomplished by integrating the connector directly to the sensor.

### Application

Application	3 to 25 kHz
Operating temperature range	-40 to 150°C
Storage temperature range	-30 to 60°C
Max. vibration	≤ 800 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Male thread (for cast)	M8x25
Male thread (for Al)	M8x30
Installation torque	20±5 Nm

Weight w/o wire	48 g
Protection	IP X9K

#### Electrical Data

Range of frequency	3 to 25 kHz
Sensitivity at 5 kHz	26 ± 8 mV/g
Max. sensitivity changing (life-time)	-17 %
Linearity between 5 to 15 kHz (from 5 kHz value)	-10 to 10 %
Linearity between 15 to 20 kHz (linear increasing with freq)	20 to 50 %
Main resonance frequency	30 kHz
Impedance	> 1 MOhm
Temperature dependence of sensitivity	0.04 mV/g°C
Capacity field	1,150 ± 200 pF

#### Connectors and Wires

Mating connector 2-pole	2-Pin RB-Kp.1 (F02U.B00.966-01) or 2-Pin Jetronic (D261.205.288-01)
Pin 1	Sig+
Pin 2	Sig-

#### Installation Notes

The KS4-P can be connected to all Bosch Motorsport ECUs featuring knock control

The sensor must rest directly on the brass compression sleeve during operation.

To ensure low-resonance coupling of the sensor to the measurement location, the contact surface must be clean and properly machined to provide a secure flush mounting.

Please route the sensor wire in a way that prevents resonance vibration.

Please find further application hints in the offer drawing at our homepage.

#### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

#### Ordering Information

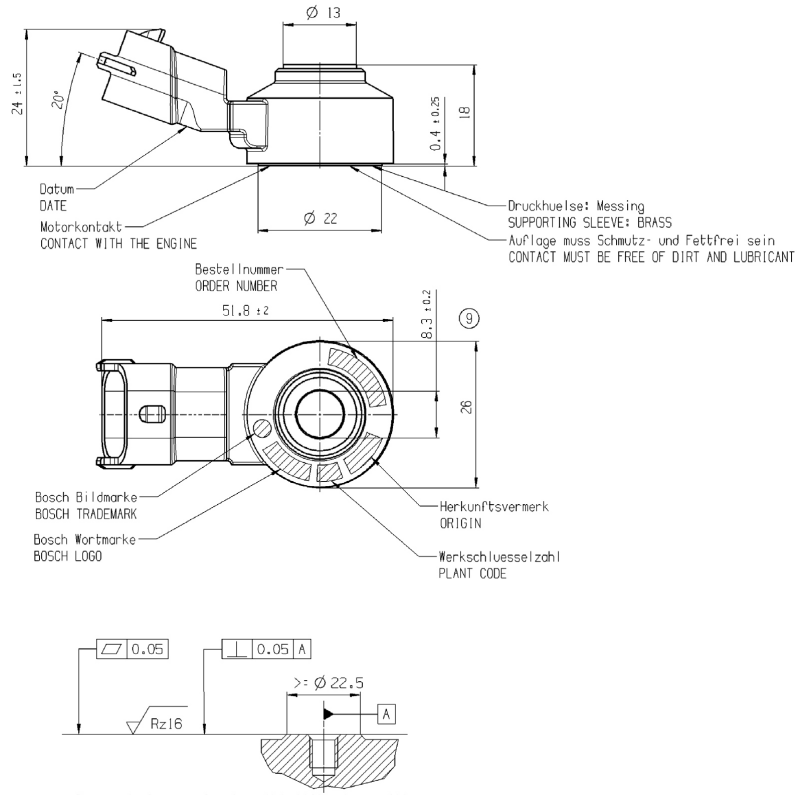
##### Knock Sensor KS4-P

Mating Connector: 2-Pin RB-Kp.1  
Order number **0261.231.173**

##### Knock Sensor KS4-P

Mating Connector: 2-Pin Jetronic  
Order number **0261.231.188**

Dimensions





## Knock Sensor KS4-R



### Features

- ▶ Frequency: 3 to 25 kHz
- ▶ Weight: 82 g
- ▶ Height sensor head: 18 mm

This sensor is used for detecting structural born vibrations in spark ignition engines due to uncontrolled combustion. This sensor is suitable for operation in extreme conditions.

Due to the inertia of the seismic mass, the sensor moves in correlation to the engine block vibration; this motion results in a compressive force which is converted into a voltage signal via a piezoceramic sensor element. As a result, upper and lower voltage thresholds can be defined directly correlating to an acceleration magnitude.

The main benefits of this sensor are its robust mechanical design, compact housing and precise determination of structure-related noise. Connection to this sensor can be tailored to customer requirements through specified wire lengths and various connector options.

### Application

Application	3 to 25 kHz
Operating temperature range	-40 to 130°C
Storage temperature range	-30 to 60°C
Max. vibration	≤ 800 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Male thread (for cast)	M8x25
Male thread (for Al)	M8x30
Installation torque	20 ± 5 Nm
Weight w/o wire	82 g

Protection	IP 54
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#### Electrical Data

Range of frequency	3 to 25 kHz
Sensitivity at 5 kHz	28.8 mV/g
Max. sensitivity changing (lifetime)	-17 %
Linearity between 5 to 15 kHz (from 5 kHz value)	-10 to 10 %
Linearity between 15 to 20 kHz (linear increasing with freq)	20 to 50 %
Main resonance frequency	> 30 kHz
Impedance	> 1 MOhm
Temperature dependence of sensitivity	0.04 mV/g°C
Capacity field	1,150 ± 200 pF

#### Connectors and Wires

Connector	A 261 230 252
Mating connector 2-pole	2-Pin RB-Kp.1 (D261.205.337-01), L=530 mm or 2-Pin RB-Kp.3 (F02U.B00.967-01), L=400 mm
Pin 1	Sig +
Pin 2	Sig -
Sleeve	PUR
Wire size	0.5 mm <sup>2</sup>
Wire length L	See Ordering Information
Various motorsport and automotive connectors on request.	

#### Installation Notes

The KS4-R can be connected to all Bosch Motorsport ECUs featuring knock control

The sensor must rest directly on the brass compression sleeve during operation.

To ensure low-resonance coupling of the sensor to the measurement location, the contact surface must be clean and properly machined to provide a secure flush mounting.

Please route the sensor wire in a way that prevents resonance vibration.

Please find further application hints in the offer drawing at our homepage.

#### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

Ordering Information

**Knock Sensor KS4-R**

Mating Connector 2-Pin RB-Kp.1, L = 530 mm

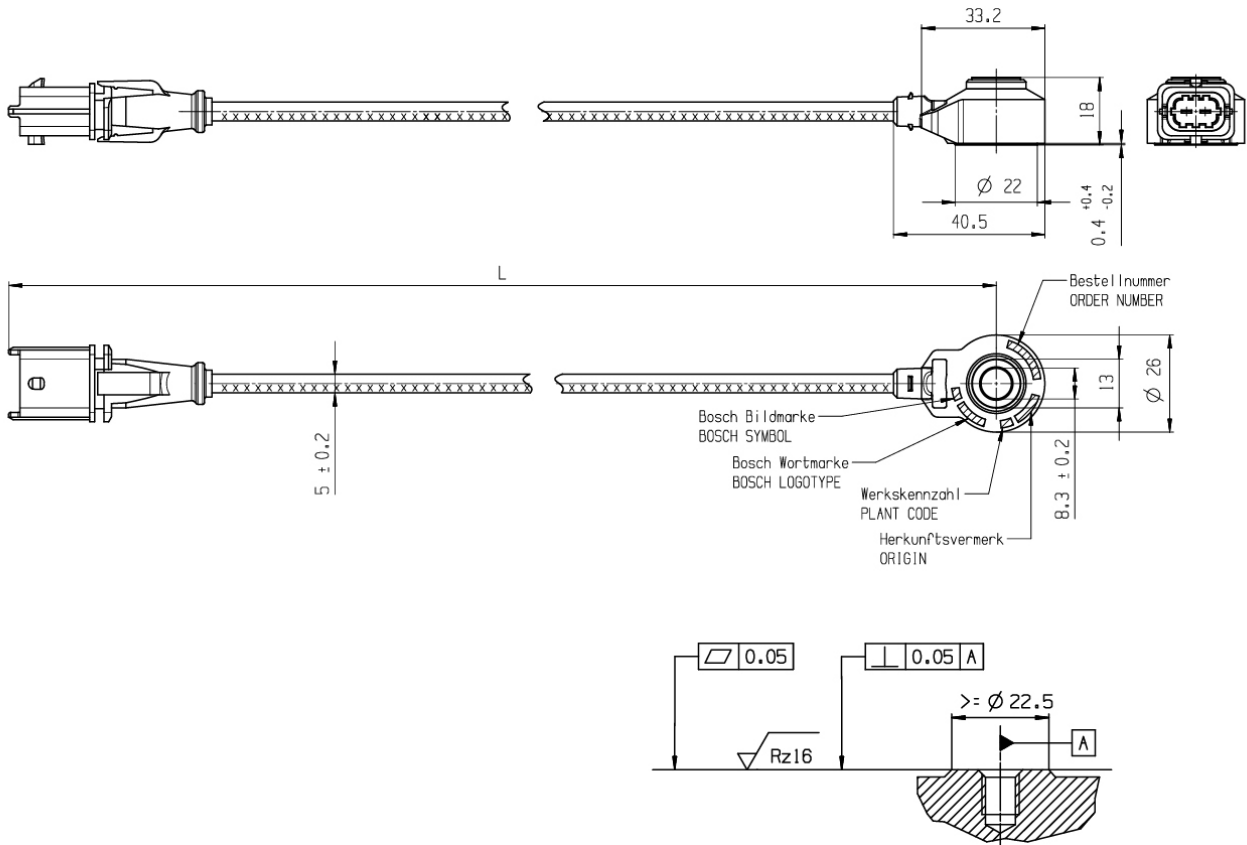
Order number **0261.231.218**

**Knock Sensor KS4-R**

Mating Connector 2-Pin RB-Kp.3, L = 400 mm

Order number **0261.231.223**

Dimensions



## Knock Sensor KS4-R2



### Features

- ▶ Frequency: 3 to 30 kHz
- ▶ Weight: 60 g
- ▶ Height sensor head: 14 mm

This sensor is used for detecting structural born vibrations in spark ignition engines due to uncontrolled combustion. This sensor is suitable for operation in extreme conditions.

Due to the inertia of the seismic mass, the sensor moves in correlation to the engine block vibration; this motion results in a compressive force which is converted into a voltage signal via a piezoceramic sensor element. As a result, upper and lower voltage thresholds can be defined directly correlating to an acceleration magnitude.

The main benefits of this sensor are its robust mechanical design, compact housing and precise determination of structure-related noise. This version is an optimized part for Motorsport applications based on a series application development. Compared to the previous version, the advantage of this new modification is that this product has an extended frequency and higher operating temperature rating.

### Application

Application	3 to 30 kHz
Operating temperature range	-40 to 150°C
Storage temperature range	-30 to 60°C
Max. vibration	≤ 800 m/s <sup>2</sup> at 0 to 24 kHz ≤ 4,000 m/s <sup>2</sup> at 5 to 24 kHz (short-term)

### Technical Specifications

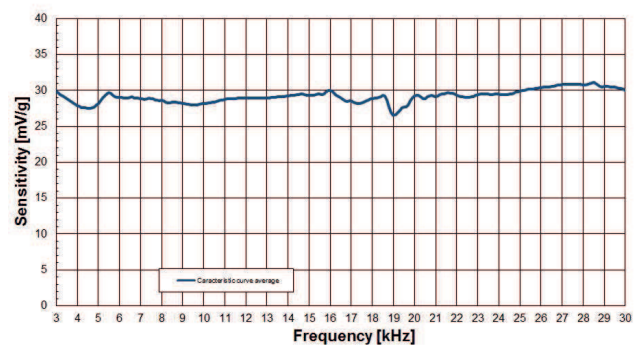
#### Mechanical Data

Fixing screw for cast iron	M8x25
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Fixing screw for aluminum	M8x30
Installation torque	20 + 5 Nm
Weight w/o Connector	60 g
Protection	IP 54

#### Electrical Data

Range of frequency	3 to 30 kHz
Max. sensitivity changing (lifetime)	-17 %
Linearity between 5 to 15 kHz (from 5 kHz value)	-10 to 10 %
Linearity between 15 to 20 kHz (linear increasing with freq)	20 to 50 %
Main resonance frequency	> 30 kHz



Ratio of frequency and sensitivity

Impedance	> 1 MOhm
Temperature dependence of sensitivity	0.04 mV/g°C
Capacity field	1,150 ± 200 pF

#### Connectors and Wires

Connector	ASX602-03PC-HE
Mating connector	F02U.002.840-01
ASX002-03SC-HE	
Pin 1	Sig
Pin 2	Gnd
Pin 3	Scr
Sleeve	Elastomer
Wire size	0.5 mm <sup>2</sup>
Wire length L	150 to 450 mm

Various motorsport and automotive connectors on request.

#### Installation Notes

The KS4-R2 can be connected to all Bosch Motorsport ECUs featuring knock control.

The sensor must rest directly on the brass compression sleeve during operation.

To ensure low-resonance coupling of the sensor to the measurement location, the contact surface must be clean and properly machined to provide a secure flush mounting.

Please route the sensor wire in a way that prevents resonance vibration.

Please find further application hints in the offer drawing at our homepage.

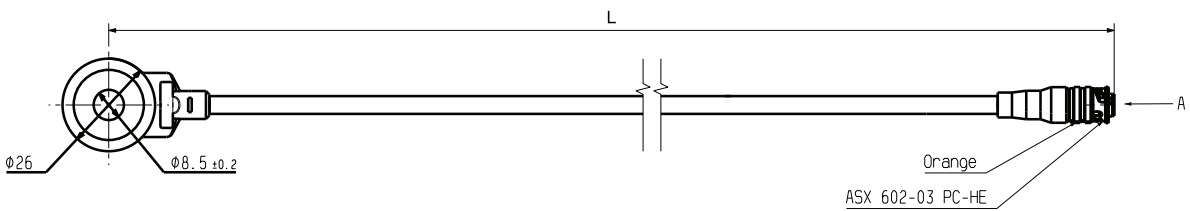
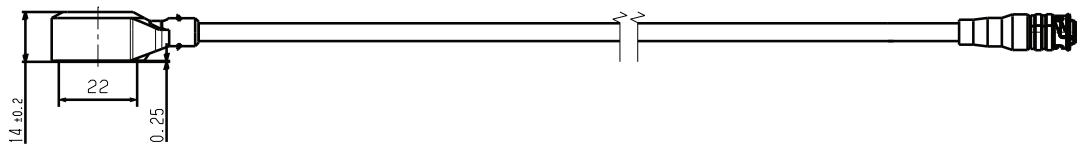
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

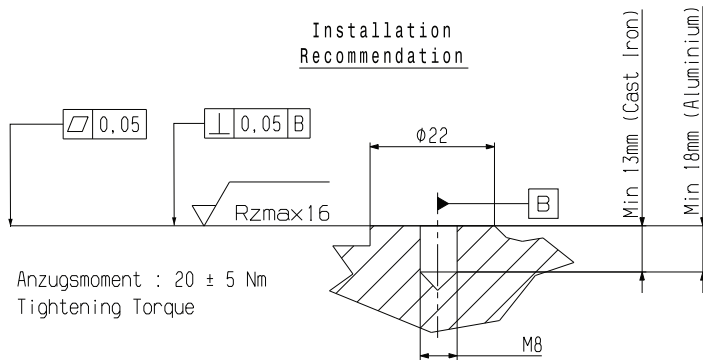
**Ordering Information**

**Knock Sensor KS4-R2**  
 Order number **F02U.V01.884-01**

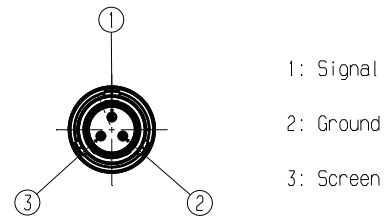
**Dimensions**



**Installation Recommendation**



**Detail A Electrical Connection**



## Overview

### Lambda Sensor LSU 4.9



- Application: lambda 0.65 to  $\infty$
- Exhaust gas temperature: 930°C (1,030 for a short time)
- Hexagon temperature: 600°C
- Thread: M18x1.5
- Weight: 120 g

### Lambda Sensor LSU ADV/ ADV pre Turbo



- Application: lambda 0.65 to  $\infty$
- Exhaust gas temperature: 930°C (1,030 for a short time)
- Hexagon temperature: 820°C
- Thread: M18x1.5
- Weight: 120 g

### Lambda Sensor Mini-LSU 4.9



- Application: lambda 0.65 to  $\infty$
- Exhaust gas temperature: 930°C (1,030 for a short time)
- Hexagon temperature: 700°C
- Thread: M16x1.5
- Weight: 28 g

## Lambda Sensor LSU 4.9



7

### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Exhaust gas temperature: 930°C (1,030 for a short time)
- ▶ Hexagon temperature: 600°C
- ▶ Thread: M18x1.5
- ▶ Weight: 120 g

This sensor is designed to measure the proportion of oxygen in exhaust gases of automotive engines (gasoline or Diesel).

The wide band lambda sensor LSU 4.9 is a planar  $ZrO_2$  dual cell limiting current sensor with integrated heater. Its monotonic output signal in the range of lambda 0.65 to air makes the LSU 4.9 capable of being used as a universal sensor for lambda 1 measurement as well as for other lambda ranges. The connector module contains a trimming resistor, which defines the characteristic of the sensor.

The main benefit of the LSU 4.9 is the robust design combined with the high Bosch production quality standard.

This lambda sensor operates only in combination with a special LSU-IC, used in most Bosch Motorsport ECUs and lambda control units like LT4. You'll find this unit and more on our homepage at Electronics/Sensor Interfaces.

### Application

Application	lambda 0.65 to $\infty$
Fuel compatibility	gasoline/Diesel/E85
Exhaust gas pressure	$\leq 2.5$ bar (higher with decrease accuracy)
Exhaust gas temperature range (operating)	$< 930^\circ\text{C}$

Exhaust gas temperature range (max.) for short time	$< 1,030^\circ\text{C}$
Hexagon temperature	$< 600^\circ\text{C}$
Wire and protective sleeve temperature	$< 250^\circ\text{C}$
Connector temperature	$< 140^\circ\text{C}$
Storage temperature range	$-40$ to $100^\circ\text{C}$
Max. vibration (stochastic peak level)	$300 \text{ m/s}^2$

### Technical Specifications

#### Variations

##### LSU 4.9 with automotive connector

Connector	1928.404.687
Mating connector	D261.205.356-01
Wire length L	95.0 cm

##### LSU 4.9 with motorsport connector

Connector	AS607-35PN
Mating connector	AS007-35SN
Wire length L	20.0 to 90.0 cm

#### Mechanical Data

Weight w/o wire	120 g
Thread	M18x1.5
Wrench size	22 mm
Tightening torque	40 to 60 Nm

#### Electrical Data

Power supply H+ nominal	7.5 V
System supply voltage	10.8 V to 16.5 V
Heater power steady state	7.5 W
Heater control frequency	$\geq 100$ Hz
Nominal resistance of Nernst cell	300 Ohm
Max current load for Nernst cell	250 $\mu\text{A}$

#### Characteristic

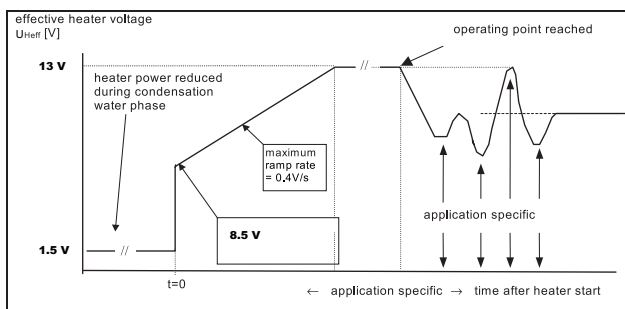
Signal output	$I_p$ meas
Accuracy at lambda 0.8	$0.80 \pm 0.01$
Accuracy at lambda 1	$1.016 \pm 0.007$
Accuracy at lambda 1.7	$1.70 \pm 0.05$

$I_p$ [mA]	lambda	$U_A$ [V], v=17	$U_A$ [V], v=8
-2.000	0.650	-	0.510
-1.602	0.700	-	0.707
-1.243	0.750	0.192	0.884
-0.927	0.800	0.525	1.041
-0.800	0.822	0.658	1.104
-0.652	0.850	0.814	1.177
-0.405	0.900	1.074	1.299

-0.183	0.950	1.307	1.409
-0.106	0.970	1.388	1.448
-0.040	0.990	1.458	1.480
0	1.003	1.500	1.500
0.015	1.010	1.515	1.507
0.097	1.050	1.602	1.548
0.193	1.100	1.703	1.596
0.250	1.132	1.763	1.624
0.329	1.179	1.846	1.663
0.671	1.429	2.206	1.832
0.938	1.701	2.487	1.964
1.150	1.990	2.710	2.069
1.385	2.434	2.958	2.186
1.700	3.413	3.289	2.342
2.000	5.391	3.605	2.490
2.150	7.506	3.762	2.565
2.250	10.119	3.868	2.614

**Please note:**  $U_A$  is not an output signal of the lambda sensor, but the output of the evaluation circuit. Only  $I_p$  correlates with the oxygen content of the exhaust gas. Amplification factor  $v=17$  is typically used for lean applications ( $\lambda > 1$ ), amplification factor  $v=8$  is typically used for rich applications ( $\lambda < 1$ ).

### Heater Strategy



### Connectors and Wires

Connector	Please see variations
Mating connector	Please see variations
Sleeve	fiber glass / silicone coated
Pin 1	Pump current APE / IP
Pin 2	Virtual ground IPN / VM
Pin 3	Heater voltage H- / Uh-

Pin 4	Heater voltage H+ / Uh+
Pin 5	Trim resistor RT / IA
Pin 6	Nernst voltage UN / RE
Wire length	Please see variations

Various motorsport and automotive connectors are available on request.

### Installation Notes

This lambda sensor operates only in combination with a special LSU-IC, used in most Bosch Motorsport ECUs and lambda control units like LT4. You'll find this unit and more on our homepage at Accessories/Expansion Modules.

The lambda sensor should be installed at point which permits the measurement of a representative exhaust-gas mixture, which does not exceed the maximum permissible temperature.

Install at a point where the gas is as hot as possible.

Observe the maximum permissible temperature.

As far as possible install the sensor vertically (wire upwards).

The sensor is not to be fitted near to the exhaust pipe outlet, so that the influence of the outside air can be ruled out.

The exhaust-gas passage opposite the sensor must be free of leaks in order to avoid the effects of leak-air.

Protect the sensor against condensation water.

The sensor is not to be painted, nor is wax to be applied or any other forms of treatment. Use only the recommended grease for lubricating the thread.

Please find further application hints in the offer drawing at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

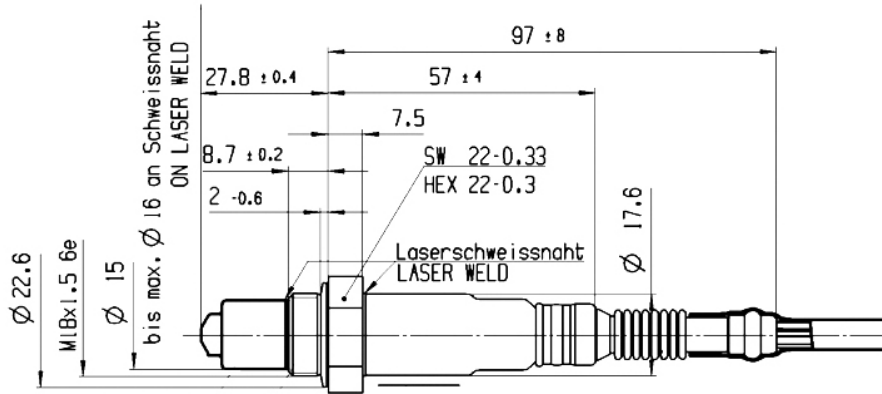
#### Lambda Sensor LSU 4.9

With automotive connector  
Order number **0258.017.025**

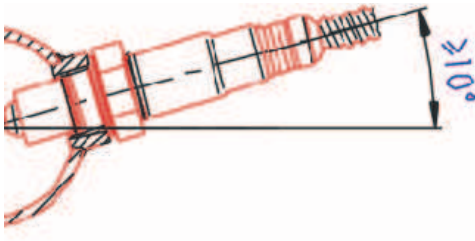
#### Lambda Sensor LSU 4.9

With motorsport connector  
Order number **B261.209.358-03**

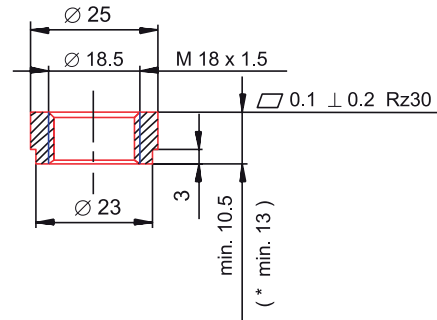
Dimensions



Mounting recommendation



Recommended design of the mating thread in the exhaust pipe:  
 THexagon > 600°C  
 or TGas > 930°C





## Lambda Sensor LSU ADV/ADV pre Turbo



### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Exhaust gas temperature: 930°C (1,030 for a short time)
- ▶ Hexagon temperature: 820°C
- ▶ Thread: M18x1.5
- ▶ Weight: 120 g

This sensor is designed to measure the proportion of oxygen in exhaust gases of automotive engines (gasoline or Diesel). A version with a protection tube of Inconel for pre-turbo-(supercharger) mounting is available.

The wide band lambda sensor LSU ADV is a planar  $ZrO_2$  dual cell limiting current sensor with integrated heater. Its monotonic output signal in the range of lambda 0.65 to air makes the LSU ADV capable of being used as a universal sensor for lambda 1 measurement as well as for other lambda ranges.

The LSU ADV has no trimming resistor inside the connector what results in just 5 connector pins. Compared to LSU 4.9, the LSU ADV has a wider working temperature range.

LSU ADV operates only in combination with a special evaluation unit used in lambda control unit LT4 ADV. You'll find this unit and more on our homepage at Electronics/Sensor Interfaces.

### Application

Application	lambda 0.65 to $\infty$
Fuel compatibility	gasoline/Diesel/E85
Exhaust gas pressure	$\leq 2.5$ bar (higher with decrease accuracy)

Exhaust gas temperature (operating)	$\leq 930^\circ\text{C}$ ( $\leq 980^\circ\text{C}$ pre Turbo Version)
Max. exhaust gas temperature for short time	$\leq 1,030^\circ\text{C}$
Hexagon temperature (operating)	$\leq 650^\circ\text{C}$
Max. hexagon temperature for short time	$\leq 700^\circ\text{C}$
Max. temperature at welding seam	$\leq 820^\circ\text{C}$ (pre Turbo Version)
Max. temperature difference between hexagon and welding seam	$\leq 330^\circ\text{C}$
Wire and protective sleeve temperature	$\leq 250^\circ\text{C}$
Connector temperature	$\leq 140^\circ\text{C}$
Storage temperature range	$-40$ to $100^\circ\text{C}$
Max. vibration (stochastic peak level)	$300 \text{ m/s}^2$

### Technical Specifications

#### Mechanical Data

Weight w/o wire	120 g
Thread	M18x1.5
Wrench size	22 mm
Tightening torque	40 to 60 Nm

#### Electrical Data

Power supply H+ nominal	7.5 V
System supply voltage	10.8 V to 16.5 V
Heater power steady state	8.7 W
Heater control frequency	$\geq 100$ Hz
Nominal resistance of Nernst cell	300 Ohm
Max current load for Nernst cell	$\leq 80 \mu\text{A}$
Switch-on time	$\leq 5$ s

#### Characteristic

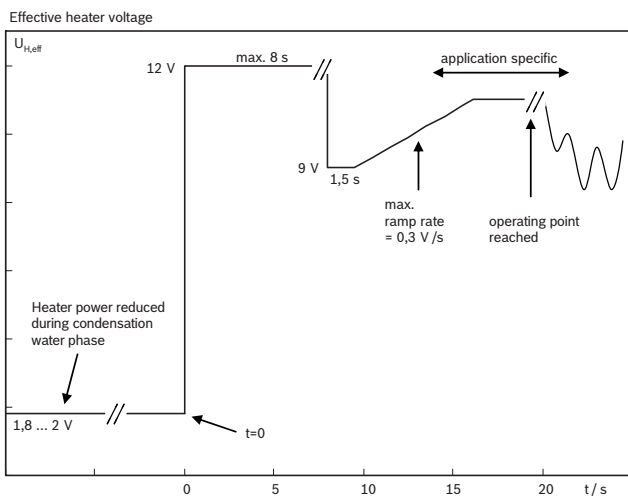
Signal output	$I_p$ meas
Accuracy at lambda 0.8	$-0.652 \pm 0.032 \text{ mA}$
Accuracy at lambda 1	$-0.018 \pm 0.008 \text{ mA}$
Accuracy at lambda 1.7	$0.515 \pm 0.022 \text{ mA}$

$I_p$ [mA]	lambda	$U_A$ [V], v=17	$U_A$ [V], v=8
-1.38000	0,650	0,048	0,817
-1.11000	0.700	0.332	0.950
-0.88000	0.750	0.574	1.064
-0.65000	0.800	0.816	1.178
-0.47500	0.850	1.000	1.265
-0.37000	0.880	1.111	1.317

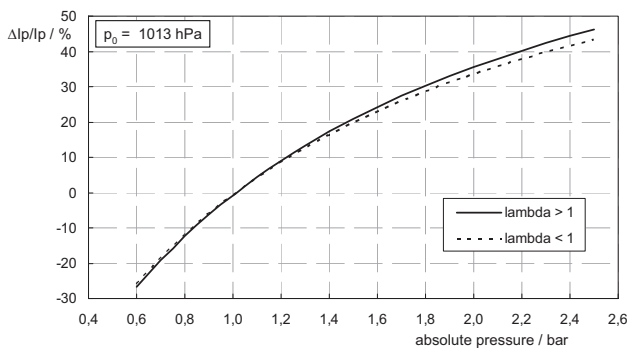
-0.30000	0.900	1.184	1.351
-0.16000	0.950	1.332	1.421
-0.07600	0.980	1.420	1.462
-0.04800	0.990	1.449	1.476
-0.02000	1.000	1.479	1.490
0.01167	1.030	1.512	1.506
0.03278	1.050	1.534	1.516
0.06444	1.080	1.568	1.532
0.08556	1.100	1.590	1.542
0.17000	1.180	1.679	1.584
0.23080	1.260	1.743	1.614
0.36000	1.430	1.879	1.678
0.40148	1.500	1.922	1.699
0.52000	1.700	2.047	1.758
0.54740	1.780	2.076	1.771
0.77000	2.430	2.310	1.881
1.40000	5.000	2.973	2.193

**Please note:** UA is not an output signal of the lambda sensor, but the output of the evaluation circuit. Only IP correlates with the oxygen content of the exhaust gas. Amplification factor  $v=17$  is typically used for lean applications ( $\lambda > 1$ ), amplification factor  $v=8$  is typically used for rich applications ( $\lambda < 1$ ).

**Heater Strategy**



**Pressure Compensation**



**Connectors and Wires**

**LSU ADV with automotive connector**

Connector	1 928 404 669
Mating connector	F02U.B00.725-01
Pin 1	IP/APE
Pin 2	VM/IPN
Pin 3	Uh-/H-
Pin 4	Uh+ / H+
Pin 5	nc
Pin 6	UN/RE
Wire length L	95.0 cm

**LSU ADV pre Turbo with automotive connector**

Connector	1254.488.136
Mating connector	F02U.B00.937-01
Pin 1	IP/APE
Pin 2	VM/IPN
Pin 3	Uh- / H-
Pin 4	Uh+ / H+
Pin 5	UN / RE

**LSU ADV pre Turbo with motorsport connector**

Connector	AS607-35PA
Mating connector	AS007-35SA
Pin 1	Uh+ / H
Pin 2	Uh- / H-
Pin 3	IP / APE
Pin 4	VM / IPN
Pin 5	UN / RE
Pin 6	nc

Please specify the required wire length with your order (ADV pre Turbo max. 33 cm/ADV max. 90 cm).

Sleeve fiber glass / silicone coated  
 Various motorsport and automotive connectors are available on request.

**Installation Notes**

This lambda sensor operates only in combination with a special evaluation unit used in lambda control unit LT4 ADV. You'll find this unit and more on our homepage at Accessories/Expansion Modules.

The lambda sensor should be installed at point which permits the measurement of a representative exhaust-gas mixture, which does not exceed the maximum permissible temperature.

Install at a point where the gas is as hot as possible.

Observe the maximum permissible temperature.

As far as possible install the sensor vertically (wire upwards).

The sensor is not to be fitted near to the exhaust pipe outlet, so that the influence of the outside air can be ruled out.

The exhaust-gas passage opposite the sensor must be free of leaks in order to avoid the effects of leak-air.

Protect the sensor against condensation water.

The sensor is not to be painted, nor is wax to be applied or any other forms of treatment. Use only the recommended grease for lubricating the thread.

Please find further application hints in the offer drawing at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

#### Lambda Sensor LSU ADV

Automotive connector, wire length 95 cm  
Order number **0258.027.010**

#### Lambda Sensor LSU ADV

Motorsport connector, wire length customer specific (max. 90 cm)  
Order number **F02U.V01.861-01**

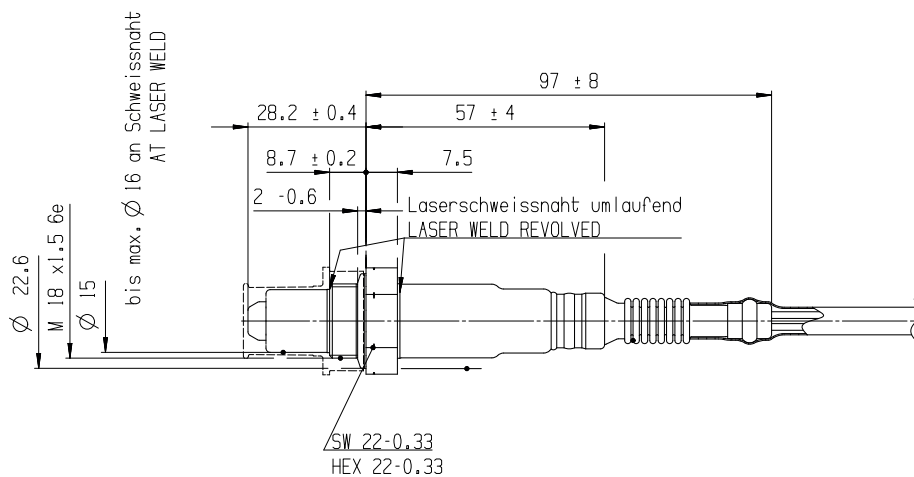
#### Lambda Sensor LSU ADV pre Turbo

Automotive connector, wire length 37 cm  
Order number **0258.027.211**

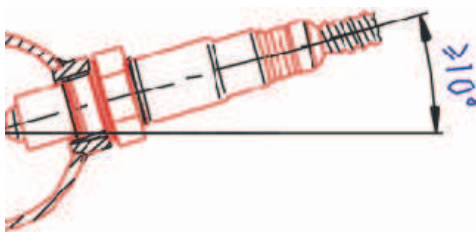
#### Lambda Sensor LSU ADV pre Turbo

Motorsport connector, wire length 33 cm  
Order number **F02U.V02.908-01**

### Dimensions



### Mounting recommendation

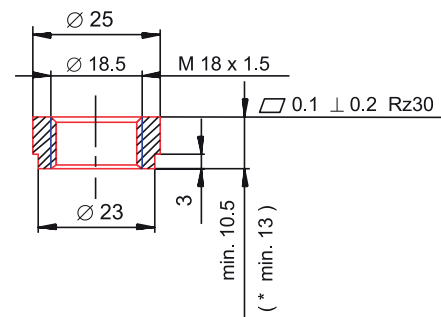


### Recommended design of the

mating thread in the exhaust pipe

\*: THexagon  $> 600^{\circ}\text{C}$  or

TGas  $> 930^{\circ}\text{C}$



## Lambda Sensor Mini-LSU 4.9



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### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Exhaust gas temperature: 930°C (1,030 for a short time)
- ▶ Hexagon temperature: 700°C
- ▶ Thread: M16x1.5
- ▶ Weight: 28 g

This sensor is designed to measure the proportion of oxygen in exhaust gases of automotive engines (gasoline or Diesel).

The wide band lambda sensor Mini-LSU 4.9 is a planar  $ZrO_2$  dual cell limiting current sensor with integrated heater. Its monotonic output signal in the range of lambda = 0.65 to air makes the LSU capable of being used as a universal sensor for lambda = 1 measurement as well as for lean and rich ranges. The connector housing contains a trimming resistor, which defines the characteristic of the sensor. The main benefit of the Mini-LSU 4.9 is its very compact design in combination with the high Bosch production quality standard. The Mini-LSU is produced and tested in a handmade process.

The complete light weight housing is made of Inconel which makes it resistant against high temperatures. The sensor element is more than 50 % smaller than it is in the production lambda sensor. It is connected over silver coated steel cables to make it more reliable against vibrations.

This lambda sensor operates only in combination with a special LSU-IC, used in most Bosch Motorsport ECUs and lambda control units like LT4. You'll find this unit and more on our homepage at Electronics/Sensor Interfaces.

### Application

Application	lambda 0.65 to $\infty$
-------------	-------------------------

Fuel compatibility	gasoline/Diesel/E85
Exhaust gas pressure	$\leq 2.5$ bar (higher with decrease accuracy)
Exhaust gas temperature range (operating)	$< 930^\circ\text{C}$
Exhaust gas temperature range (max.) for short time	$< 1,030^\circ\text{C}$
Hexagon temperature	$\leq 700^\circ\text{C}$
Wire and protective sleeve temperature	$< 250^\circ\text{C}$
Connector temperature	$< 150^\circ\text{C}$
Storage temperature range	$-40$ to $100^\circ\text{C}$
Max. vibration (stochastic peak level)	$300 \text{ m/s}^2$ (see Installation Notes)

### Technical Specifications

#### Variations

##### Mini-LSU 4.9 with automotive connector

Connector	1928.404.682
Mating connector	D261.205.356-01
Wire length L	950 mm

##### Mini-LSU 4.9 with motorsport connector

Connector	AS607-35PN
Mating connector	AS007-35SN
Wire length L	200 to 1,400 mm

#### Mechanical Data

Weight w/o wire	28 g
Thread	M16x1.5
Wrench size	17 mm
Tightening torque	60 Nm

#### Electrical Data

Power supply H+ nominal	7.5 V
System supply voltage H+ (min)	10.8 V
Heater power steady state	7.5 W
Heater control frequency	100 Hz
Nominal resistance of Nernst cell	300 Ohm
Max. current load for Nernst cell	250 $\mu\text{A}$

#### Characteristic

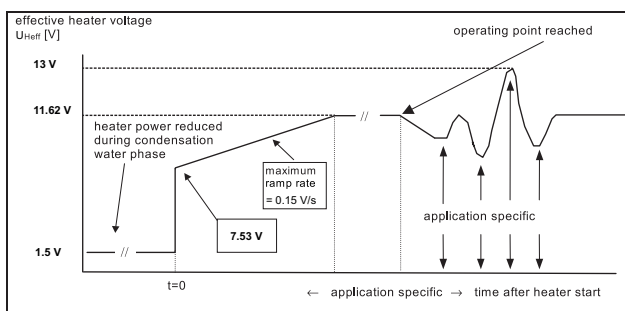
Signal output	$I_p$ meas
Accuracy at lambda 0.8	$0.80 \pm 0.01$
Accuracy at lambda 1	$1.016 \pm 0.007$
Accuracy at lambda 1.7	$1.70 \pm 0.05$

$I_p$ [mA]	lambda	$U_A$ [V], v=17	$U_A$ [V], v=8
-2.000	0.650	-	0.510

-1.602	0.700	-	0.707
-1.243	0.750	0.192	0.884
-0.927	0.800	0.525	1.041
-0.800	0.822	0.658	1.104
-0.652	0.850	0.814	1.177
-0.405	0.900	1.074	1.299
-0.183	0.950	1.307	1.409
-0.106	0.970	1.388	1.448
-0.040	0.990	1.458	1.480
0	1.003	1.500	1.500
0.015	1.010	1.515	1.507
0.097	1.050	1.602	1.548
0.193	1.100	1.703	1.596
0.250	1.132	1.763	1.624
0.329	1.179	1.846	1.663
0.671	1.429	2.206	1.832
0.938	1.701	2.487	1.964
1.150	1.990	2.710	2.069
1.385	2.434	2.958	2.186
1.700	3.413	3.289	2.342
2.000	5.391	3.605	2.490
2.150	7.506	3.762	2.565
2.250	10.119	3.868	2.614

**Please note:**  $U_A$  is not an output signal of the lambda sensor, but the output of the evaluation circuit. Only  $I_p$  correlates with the oxygen content of the exhaust gas. Amplification factor  $v=17$  is typically used for lean applications ( $\lambda > 1$ ), amplification factor  $v=8$  is typically used for rich applications ( $\lambda < 1$ ).

### Heater Strategy



### Resistance/LSU Temperature

R (Ohm)	Temp (°C)
80	1030
150	888
200	840
250	806
300 [operating point]	780
350	761
400	744
450	729

550	703
650	686
800	665
1000	642
1200	628
2500	567

### Connectors and Wires

Connector	Please see variations
Mating connector	Please see variations
Sleeve	fiber glass / silicone coated
Pin 1	Pump current APE / IP
Pin 2	Virtual ground IPN / VM
Pin 3	Heater voltage H- / Uh-
Pin 4	Heater voltage H+ / Uh+
Pin 5	Trim resistor RT / IA
Pin 6	Nernst voltage UN / RE
Wire length	Please see variations

Various motorsport and automotive connectors are available on request.

### Installation Notes

This lambda sensor operates only in combination with a special LSU-IC, used in most Bosch Motorsport ECUs and lambda control units like LT4. You'll find this unit and more on our homepage at Accessories/Expansion Modules.

The lambda sensor should be installed at point which permits the measurement of a representative exhaust-gas mixture and which does not exceed the maximum permissible temperature.

Install at a point where the gas is as hot as possible.

Observe the maximum permissible temperature.

Sensors should be installed as close to vertical as possible (wire upwards).

The sensor is not to be fitted near to the exhaust pipe outlet, so that the influence of the outside air can be ruled out.

The exhaust system up stand and surrounding the sensor must be sealed in order to avoid the effects of leakage air.

Protect the sensor against condensation water. The sensor is not to be painted, nor is wax to be applied or any other forms of treatment. Use only the recommended grease for lubricating the thread.

Please find further application hints in the offer drawing at our homepage.

A higher maximum vibration profile is possible and should be determined by the customer's individual application.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

Ordering Information

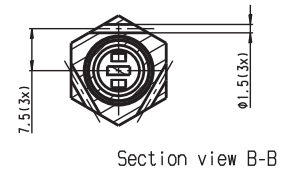
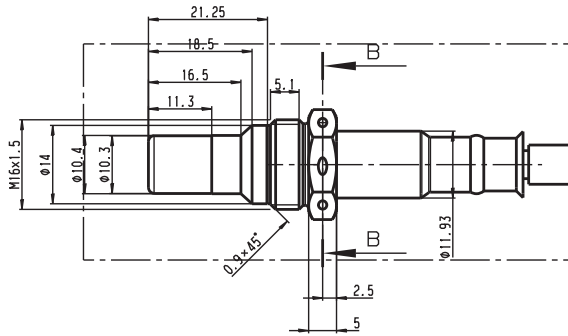
**Lambda Sensor Mini-LSU 4.9**

With automotive connector  
Order number **B258.490.103-30**

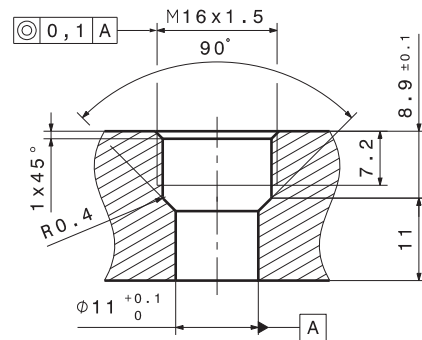
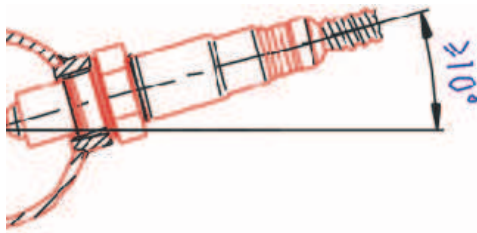
**Lambda Sensor Mini-LSU 4.9**

With motorsport connector  
Order number **F02U.V02.227-02**

Dimensions



Mounting recommendation



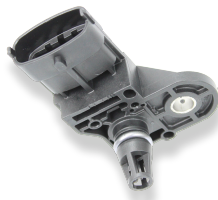
## Overview

### Pressure Sensor Combined PSM-SAT



- Pressure: 0 to 3.5, 6, 10, 20, 35, 60, 70, 100, 200, 350, 700 bar
- Temperature: -40 to 150°C
- Power supply: 8 to 32 V
- Weight: 15 g

### Pressure Sensor Combined PST 1/PST 3



- Pressure: 0.1 to 1.15 bar or 0.2 to 3 bar
- Temperature: -40 to 150°C or -40 to 140°C
- Power supply: 5 V
- Weight: 24 g

### Pressure Sensor Combined PST 4



- Pressure: 0.4 to 4 bar
- Temperature: -40 to 140°C
- Power supply: 5 V
- Weight: 22 g

### Pressure Sensor Combined PST-F 1



- Pressure: 0 to 10 bar
- Temperature: -40 to 140°C
- Power supply: 5 V
- Weight: 36 g

### Pressure Sensor Combined PST-F 2 280 bar



- Pressure: 0 to 280 bar
- Temperature: -40 to 140°C
- Power supply: 5 V
- Weight: 36 g

### Pressure Sensor Combined PST-F 2 350 bar



- Pressure: 0 to 350 bar
- Temperature: -40 to 140°C
- Power supply: 5 V
- Weight: 36 g



## Pressure Sensor Combined PSM-SAT



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### Features

- ▶ Pressure: 0 to 3.5, 6, 10, 20, 35, 60, 70, 100, 200, 350, 700 bar
- ▶ Temperature: -40 to 150°C
- ▶ Power supply: 8 to 32 V
- ▶ Weight: 15 g

This sensor is designed to measure absolute pressure of various kinds of media e.g. Diesel, gasoline, water, engine oil, transmission oil or air plus temperature.

The sensor utilizes a flush metal diaphragm as a force collector. The force is transferred to a solid state piezo-resistive sensing element via a thin intervening film of noncompressible silicone oil. The housing is welded hermetically. An individual calibration sheet will be delivered with each sensor.

The main feature and benefit of this sensor is a good protection against vibrations.

### Application

Pressure measurement range versions	3.5 to 700 bar
Pressure reference type	absolute
Operating temp. range	-40 to 150°C
Shock (1/2 sine)	50 g (11 ms) and 200 g (6 ms)
Bio fuel compatibility	E85/M100
Max. vibration	2 g (10 Hz to 60 Hz) and 20 g (60 Hz to 1 KHz)

### Technical Specifications

#### Mechanical Data

Housing	Stainless steel
---------	-----------------

Male thread	M8x1
Wrench size	12 mm
Installation torque	2.5 Nm max.
Weight	15 g + 20 g per meter of cable
Sealing	O-ring 6.35 x 1.6 VITON
Ingress Protection	IP66

#### Electrical Data

Supply voltage	8 to 32 V DC
Max current	< 8 mA
Non-Repeatability	± 0.05 % FSO typ.
CNL & H	± 0.25 % FSO
Bandwidth (-3 dB)	400 Hz
Output "FSO"	0.5 to 4.5 V = 4 V ± 50 mV

#### Characteristic

Compensated range	20 to 120°C
Long term stability	Offset = 0.1 % span/year; Span = 0.1 %/year
Zero offset at 23°C	0.5 V ± 50 mV (0.5 ± 100 mV for ranges ≤ 10 bar or 150 psi)
Sensitivity/Offset	(an individual calibration sheet will be delivered)
Thermal zero shift "TZS"	± 1 % FSO/100°C (± 2 % FSO/100°C for ranges ≤ 10 bar or 150 psi)
Thermal sensitivity shift "TSS"	± 1 %/100°C (± 1.5 %/100°C for ranges ≤ 10 bar or 150 psi)
Temperature sensor RTD	1,000 Ohms Platinum DIN EN 60751 63 % response time: 3 s max.

#### Connectors and Wires

Connector	ASU603-05PC-HE
Mating connector	F02U.000.208-01
ASU003-05SC-HE	
Pin 1	Power Supply
Pin 2	Ground
Pin 3	Pressure Signal
Pin 4	Temperature Signal +
Pin 5	Temperature Signal -
Sleeve	Viton
Wire size	AWG 24
Wire length L	15 to 100 cm
Various motorsport and automotive connectors are available on request.	
Please specify the required wire length with your order.	

#### Installation Notes

The PSM-SAT can be connected directly to most control units.  
Each mounting orientation is possible.



Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

100 % relative humidity is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

#### Pressure Sensor Fluid PSM-SAT

0 to 3.5 bar

Order number **F02U.V01.955-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 6 bar

Order number **F02U.V01.956-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 10 bar

Order number **F02U.V01.980-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 20 bar

Order number **F02U.V01.957-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 35 bar

Order number **F02U.V01.958-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 60 bar

Order number **F02U.V01.962-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 100 bar

Order number **F02U.V01.964-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 200 bar

Order number **F02U.V01.965-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 350 bar

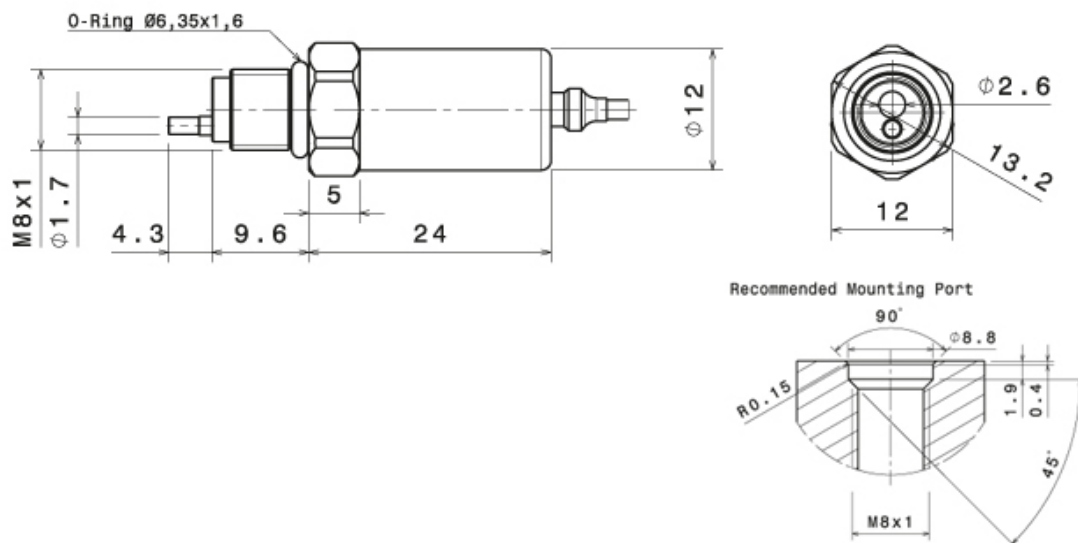
Order number **F02U.V01.966-01**

#### Pressure Sensor Fluid PSM-SAT

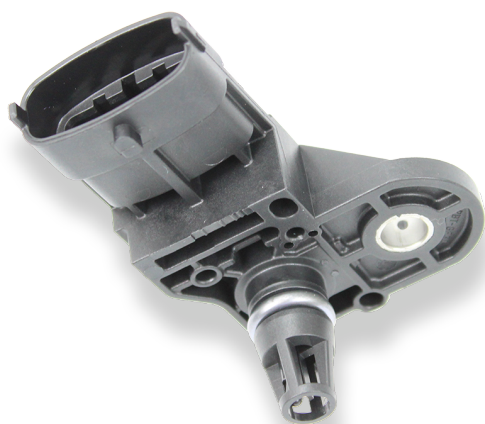
0 to 700 bar

Order number **F02U.V02.065-01**

### Dimensions



## Pressure Sensor Combined PST 1/PST 3



7

### Features

- ▶ Pressure: 0.1 to 1.15 bar or 0.2 to 3 bar
- ▶ Temperature: -40 to 150°C or -40 to 140°C
- ▶ Power supply: 5 V
- ▶ Weight: 24 g

This sensor is designed to measure absolute air pressure, especially the air box pressure of gasoline or Diesel engines plus temperature.

An integrated circuit combines a piezo-resistive sensor element and electronic systems for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal. Two different pressure ranges are available (0.1 to 1.15 bar or 0.2 to 3 bar).

### Application

Application 1	0.1 to 1.15 bar or 0.2 to 3 bar (a)
Application 2	-40 to 130°C
Reference	Absolute
Max. pressure	5 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Variations

**PST 1** (0.1 to 1.15 bar)    **PST 3** (0.2 to 3 bar)

Tolerance (FS) at $U_s = 5\text{ V}$	$\pm 0.016\text{ bar}$	$\pm 0.030\text{ bar}$
Tolerance (FS)	$\pm 1.52\%$	$\pm 1.07\%$
Sensitivity	4,048 mV/bar	1,518 mV/bar
Offset	-4.76 mV	96.43 mV

#### Mechanical Data

Mounting	M6
Fitting	12.05 $\pm$ 0.8 mm
Weight w/o wire	24 g
Sealing	O-ring 7.59 x 2.62 mm

#### Electrical Data

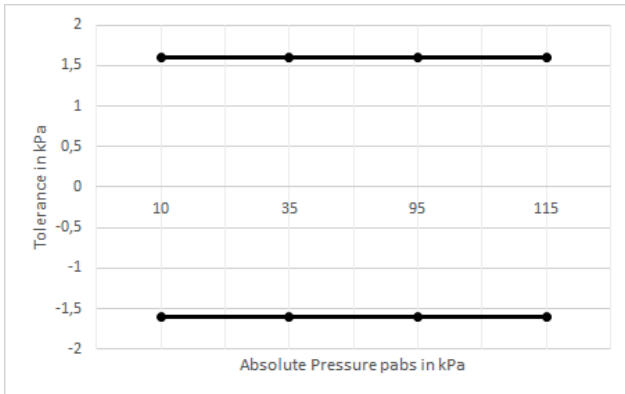
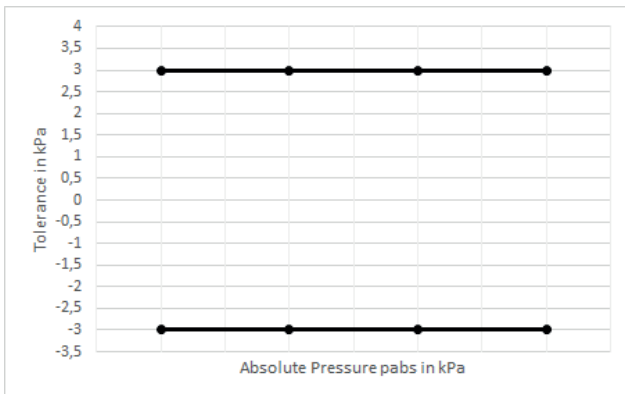
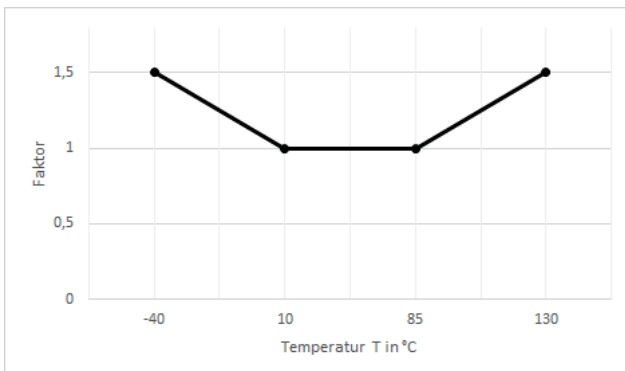
Power supply $U_s$	4.75 to 5.25 V
Max. power supply	16 V
Full scale output $U_A$ at 5 V	0.4 to 4.65 V
Current $I_s$	9 mA

#### Characteristic 1

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5\text{ V}$	Please see variations
Tolerance (FS)	Please see variations
Sensitivity	Please see variations
Offset	Please see variations

#### Characteristic 2

T [°C]	R [Ohm]
-40	45,303
-30	26,108
-20	15,458
-10	9,395
0	5,895
10	3,791
20	2,499
25	2,056
30	1,706
40	1,174
50	833.8
60	595.4
70	435.6
80	322.5
90	243.1
100	186.6
110	144.2
120	112.7
130	89.28

**Tolerance 0.1 to 1.15 bar****Tolerance 0.2 to 3 bar****Expansion of Tolerance****Connectors and Wires**

Connector	Bosch Compact
Mating connector	D261.205.360-01
Pin 1	Ground

Pin 2	Temperature Signal
Pin 3	Power Supply
Pin 4	Pressure Signal

Various motorsport and automotive connectors are available on request.

**Installation Notes**

The PST 1/PST 3 is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

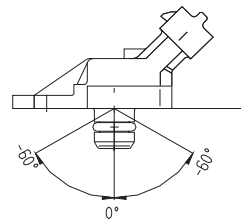
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at  $I = 0.3$  A).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $\pm 60^\circ$ .

**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information****Pressure Sensor Combined PST 1**

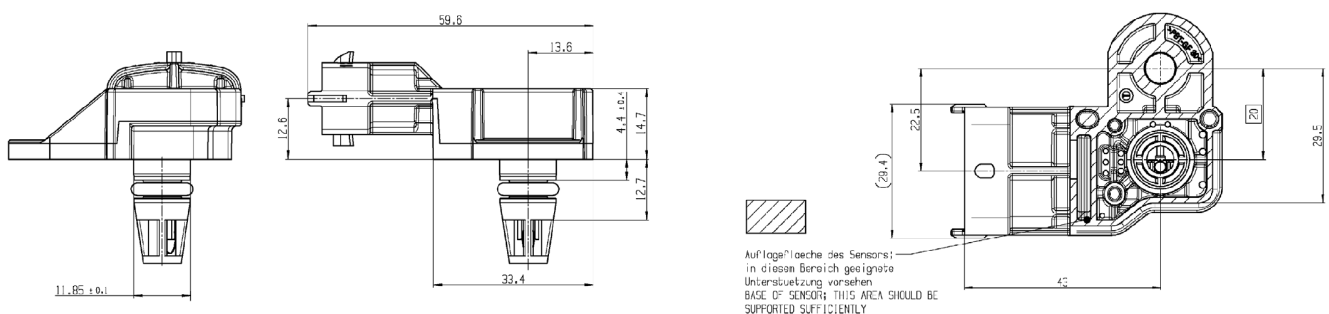
0.1 to 1.15 bar

Order number **0261.230.333**

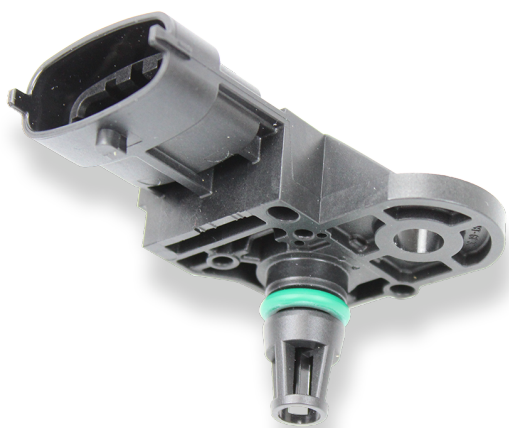
**Pressure Sensor Combined PST 3**

0.2 to 3 bar

Order number **0261.230.280**

**Dimensions**

## Pressure Sensor Combined PST 4



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### Features

- ▶ Pressure: 0.4 to 4 bar
- ▶ Temperature: -40 to 140°C
- ▶ Power supply: 5 V
- ▶ Weight: 22 g

This sensor is designed to measure absolute air pressure, especially the air box pressure of gasoline or Diesel engines plus temperature.

An integrated circuit combines a piezo-resistive sensor element and electronic systems for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal.

### Application

Application 1	0.4 to 4 bar (a)
Application 2	-40 to 130°C
Reference	Absolute
Max. pressure	6 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Mechanical Data

Mounting	M6 + Washer
Weight without wire	22 g
Fitting	12.05 ± 0.8 mm
Sealing	O-ring 7.59 x 2.62 mm

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	0.386 to 4.5 V
Current $I_s$	12 mA

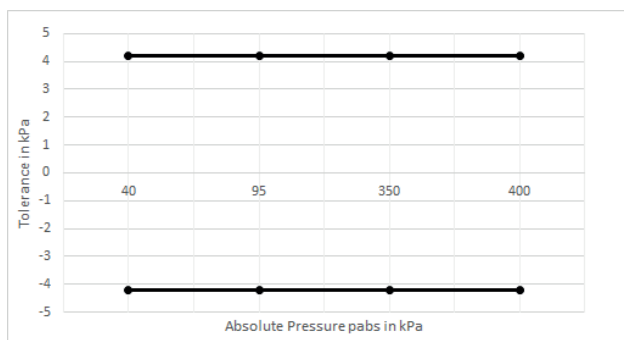
#### Characteristic 1

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5$ V	0.042 bar
Sensitivity	1,143 mV/bar
Offset	-71.43 mV

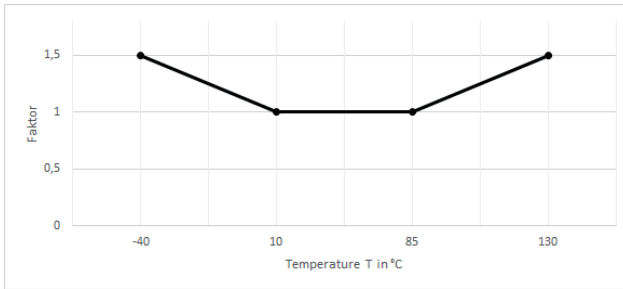
#### Characteristic 2

T [°C]	R [Ohm]
-40	45,303
-30	26,108
-20	15,458
-10	9,395
0	5,895
10	3,791
20	2,499
25	2,056
30	1,706
40	1,174
50	833.8
60	595.4
70	435.6
80	322.5
90	243.1
100	186.6
110	144.2
120	112.7
130	89.28

#### Tolerance



## Expansion of Tolerance



## Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.360-01
Pin 1	Ground
Pin 2	Temperature Signal
Pin 3	Power Supply
Pin 4	Pressure Signal

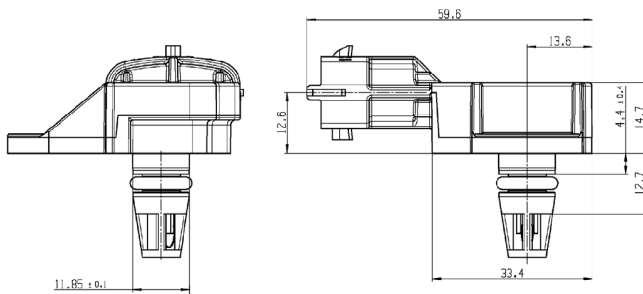
## Installation Notes

The PST 4 is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

## Dimensions

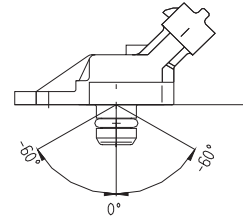


Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at  $I = 0.3$  A).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $\pm 60^\circ$ .



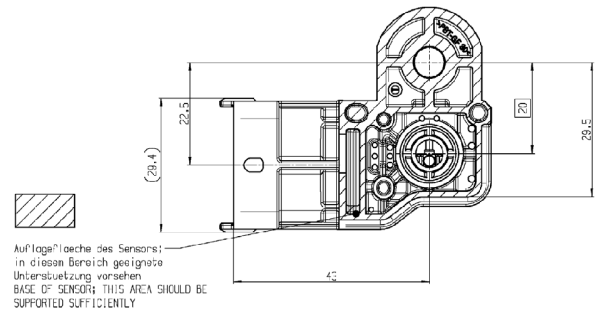
## Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

## Ordering Information

### Pressure Sensor Combined PST 4

Order number **0261.230.423**



## Pressure Sensor Combined PST-F 1



7

### Features

- ▶ Pressure: 0 to 10 bar
- ▶ Temperature: -40 to 140°C
- ▶ Power supply: 5 V
- ▶ Weight: 36 g

This sensor is designed to measure relative gasoline pressure and gasoline temperature in port injection systems.

The pressure measurement of the sensor is by means of a piezoresistive element which is acted on by a silicon diaphragm in contact with the fluid being measured. The reference (relative) pressure is provided via an opening in the sensor housing and acts on the active upper side of the silicon diaphragm.

### Application

Application 1	0 to 10 bar (a)
Application 2	-40 to 140°C
Reference	Relative
Max. pressure	20 bar
Operating temp. range	-40 to 140°C (140°C)
Media temp. range	-40 to 140°C (140°C)
Storage temp. range	-30 to 80°C
Fuel compatibility	Engine oils, most gasoline and Diesel fuels
Max. vibration	80 m/s <sup>2</sup> at 20 to 260 Hz 60 m/s <sup>2</sup> at 260 to 520 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Weight without wire	36 g
Wrench size	27 mm
Installation torque	40 Nm
Sealing	Sealed cone

#### Electrical Data

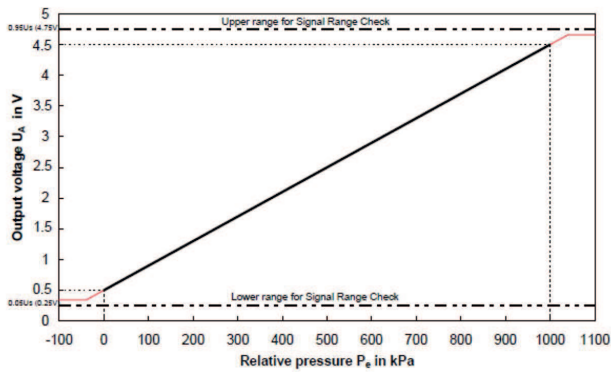
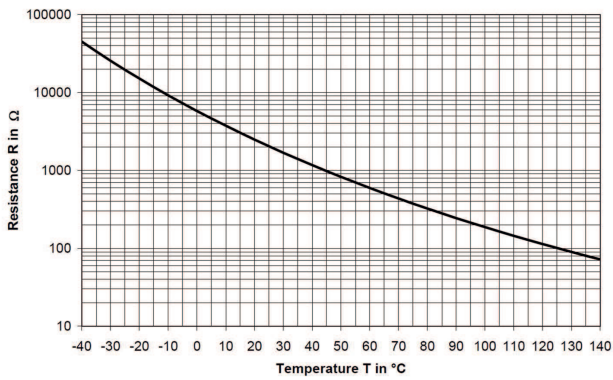
Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	0.5 to 4.5 V $U_s$ ratiometric
Current $I_s$	10 mA

#### Characteristic 1

Response time T10/90	Pressure: <5 ms Temperature: 9 s (response time of temperature signal in oil dip bath 20 to 100°C)
Compensated range	-40 to 130°C
Tolerance (FS) at $U_s$	+/-2 % at 25 to 85°C
Sensitivity	400 mV/bar at $U_s = 5$ V
Offset	500 mV at $U_s = 5$ V

#### Characteristic 2

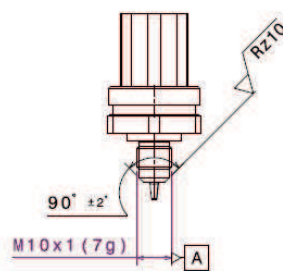
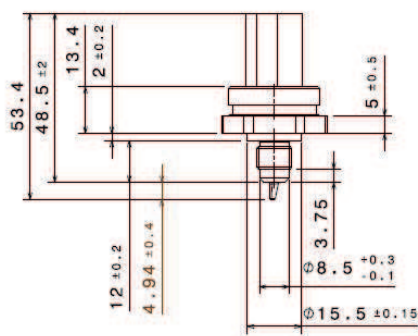
T [°C]	R [Ohm]
-40	44,864
-30	25,524
-20	15,067
-10	9,195
0	5,784
10	3,740
20	2,480
30	1,683
40	1,167
50	824
60	594
70	434.9
80	323.4
90	244
100	186.6
110	144.5
120	113.3
130	89.9
140	71.9



### Connectors and Wires

Connector	Bosch Trapezoid
Mating connector	F02U.B00.751-01

### Dimensions



Pin 2	Pressure Signal
Pin 3	Power Supply
Pin 4	Ground
Pin 5	Temperature Signal

### Installation Notes

The sensor can be connected directly to most control units.

For temperature measurement please use a pull-up resistor with an optimal value of 4.6 kOhm.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

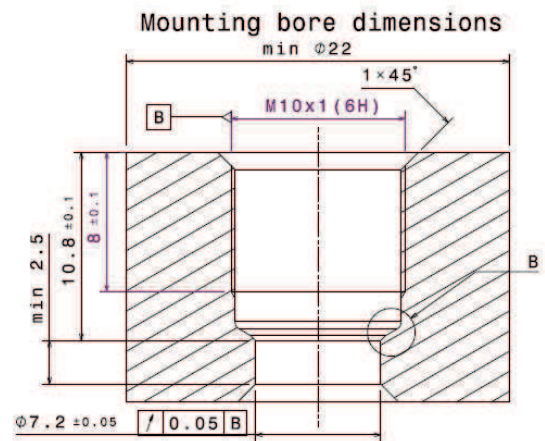
Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Pressure Sensor Combined PST-F 1**  
Order number **F02U.V0U.194-01**





## Pressure Sensor Combined PST-F 2 280 bar



7

### Features

- ▶ Pressure: 0 to 280 bar
- ▶ Temperature: -40 to 140°C
- ▶ Power supply: 5 V
- ▶ Weight: 36 g

This sensor is designed to measure absolute gasoline pressure and gasoline temperature in direct injection systems.

The pressure measurement is based on the expansion of a steel diaphragm, where strain gauges are placed to a Wheatstone bridge. The measured signal is proportional to the pressure and is processed in an application specific integrated circuit.

The temperature measurement is conducted by an NTC thermistor. The main feature of this sensor is its compact design and the integration of two functions (temperature and pressure measurements) in a common housing.

### Application

Application 1	0 to 280 bar
Reference	Absolute
Max. pressure	340 bar
Application 2	-40 to 140°C
Resistance at 25°C	10 kOhm
Operating temp. range	-40 to 140°C
Media temp. range	-40 to 140°C
Storage temp. range	-40 to 60°C
Biofuel compatibility	E26, E85
Max. vibration	210 m/s <sup>2</sup> RMS at 147 to 1,350 Hz 175 m/s <sup>2</sup> RMS at 1,350 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Weight without wire	36 g
Wrench size	27 mm
Installation torque	37.5 ± 2.5 Nm
Sealing	Sealed cone

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V (18 V for max. 1 h)
Full scale output $U_A$	0.5 to 4.5 V $U_s$ ratiometric
Current $I_s$	12 mA

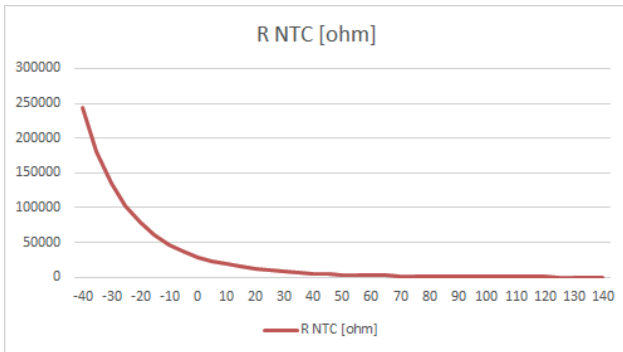
#### Characteristic 1

Response time T10/90	Pressure: 0.2 to 0.8 ms Temperature: 9 s (response time of temperature signal in oil dip bath 20 to 100°C)
Compensated range	-40 to 130°C
Tolerance (FS) at $U_s$	+/- 1 % at 0 to 100°C +/- 1.5 % at -40 to 0°C and 100 to 130°C
Sensitivity at $U_s = 5$ V	14.3 mV/bar
Offset	500 mV at $U_s = 5$ V

#### Characteristic 2

T [°C]	R [Ohm]
-40	243,241
-30	135,753
-20	78,716
-10	47,258
0	29,287
10	18,684
20	12,240
25	10,000
30	8,218
40	5,642
50	3,955
60	2,826
70	2,055
80	1,519
90	1,141
100	868.4
110	669.9
120	523.2
130	413.3
140	330.0





### Connectors and Wires

Connector	Hirschmann
Mating connector	F02U.B00.596-01
Pin 1	Ground
Pin 2	Pressure Signal
Pin 3	Temperature Signal
Pin 4	Power Supply

Various motorsport and automotive connectors are available on request.

### Installation Notes

The sensor can be connected directly to most control units.

For temperature measurement please use a pull-up resistor with an optimal value of 4.6 kOhm.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

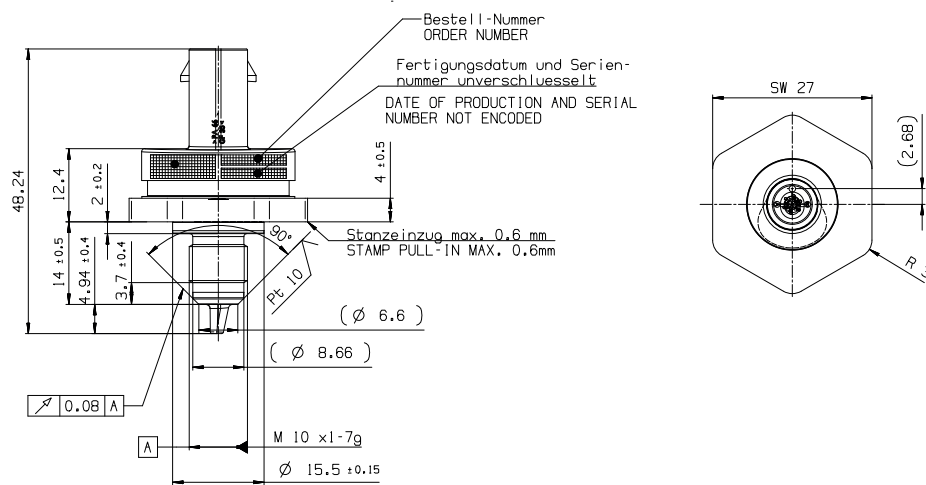
### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Pressure Sensor Combined PST-F 2 280 bar**  
Order number **0261.545.115**

### Dimensions



## Pressure Sensor Combined PST-F 2 350 bar



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### Features

- ▶ Pressure: 0 to 350 bar
- ▶ Temperature: -40 to 140°C
- ▶ Power supply: 5 V
- ▶ Weight: 36 g

This sensor is designed to measure absolute gasoline pressure and gasoline temperature in direct injection systems

The pressure measurement is based on the expansion of a steel diaphragm, where strain gauges are placed to a Wheatstone bridge. The measured signal is proportional to the pressure and is processed in an application specific integrated circuit.

The temperature measurement is conducted by an NTC thermistor. The main feature of this sensor is its compact design and the integration of two functions (temperature and pressure measurements) in a common housing.

### Application

Application 1	0 to 350 bar
Reference	Absolute
Max. pressure	390 bar
Application 2	-40 to 140°C
Resistance at 25°C	2 kOhm
Operating temp. range	-40 to 140°C
Media temp. range	-40 to 140°C
Storage temp. range	-40 to 60°C
Biofuel compatibility	E26, E85
Max. vibration	210 m/s <sup>2</sup> RMS at 147 to 1,350 Hz 175 m/s <sup>2</sup> RMS at 1,350 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Weight without wire	36 g
Wrench size	27 mm
Installation torque	37.5 ± 2.5 Nm
Sealing	Sealed cone

#### Electrical Data

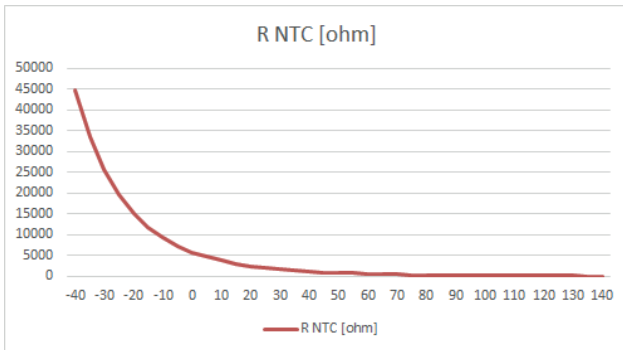
Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V (18 V for max. 1 h)
Full scale output $U_A$	0.5 to 4.5 V $U_s$ ratiometric
Current $I_s$	12 mA

#### Characteristic 1

Response time T10/90	Pressure: 0.2 to 0.8 ms Temperature: 9 s (response time of temperature signal in oil dip bath 20 to 100°C)
Compensated range	-40 to 130°C
Tolerance (FS) at $U_s$	+/- 1 % at 0 to 100°C +/- 1.5 % at -40 to 0°C and 100 to 130°C
Sensitivity at $U_s = 5$ V	11.43 mV/bar
Offset	500 mV at $U_s = 5$ V

#### Characteristic 2

T [°C]	R [Ohm]
-40	44,864
-30	25,524
-20	15,067
-10	9,195
0	5,784
10	3,740
20	2,480
25	2,038
30	1,683
40	1,167
50	825
60	594
70	434,9
80	323,4
90	244
100	186,6
110	144,5
120	113,3
130	89,8
140	71,9



### Connectors and Wires

Connector	Bosch Trapezoid
Mating connector	F02U.B00.751-01
Pin 1	-
Pin 2	Temperature Signal
Pin 3	Ground
Pin 4	Pressure Signal
Pin 5	Power Supply

Various motorsport and automotive connectors are available on request.

### Installation Notes

The sensor can be connected directly to most control units.

For temperature measurement please use a pull-up resistor with an optimal value of 4.6 kOhm.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

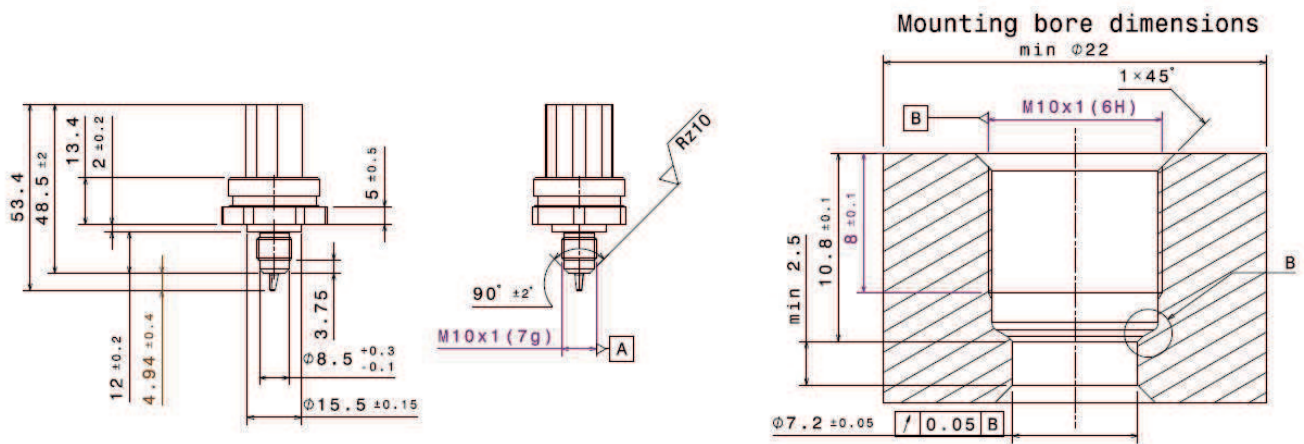
### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

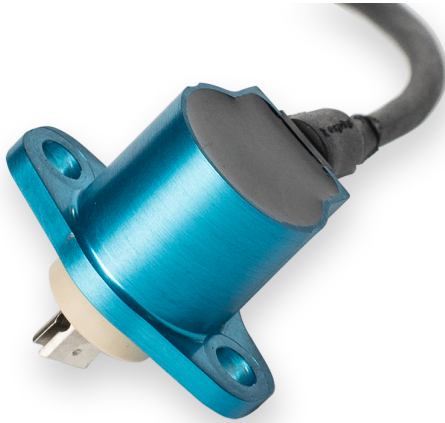
### Ordering Information

**Pressure Sensor Combined PST-F 2 350 bar**  
Order number **0261.B35.596-01**

### Dimensions



## Rotary Position Sensor RPS-F



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### Features

- ▶ Rotational movement measurement
- ▶ Hall effect technology
- ▶ Measurement range: 0 to 360° possible
- ▶ Analogue output 0.2 to 4.8 V
- ▶ Dual output, fully redundant possible

This sensor is designed to measure rotational movement of throttle position.

The electrical circuit is designed with a magnetic rotary sensor using a Hall element and digital signal processing; sensor output is ratiometric. The angular position is provided by a two pole magnet integrated in the sensor shaft.

The main benefit of this sensor is its contactless Hall effect technology and its robust design for motorsport applications which includes fully redundant power and ground.

### Application

Application	0 to 360° possible
Operating temperature range	0 to 150°C
Max. vibration	200 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

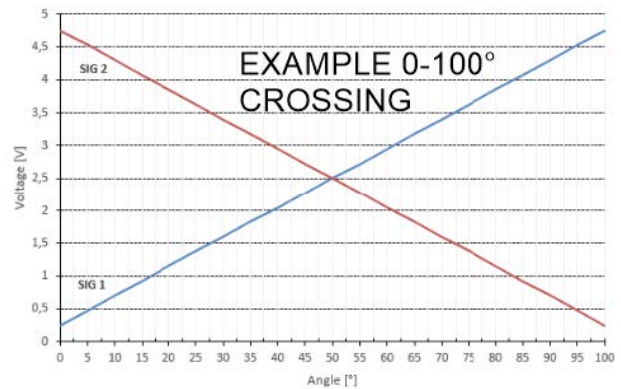
Weight w/o wire	< 36 g
Protection class	IP58
Mounting	2 x M4 screw
Lifetime	5 x 10 <sup>6</sup> operations of ±65°
Housing	Aluminum

#### Electrical Data

Power supply U <sub>S</sub>	5 ± 0.5 V regulated
Max. overvoltage	24 V
Half voltage tolerance	± 2°
Supply current	< 12.5 mA
Resolution	< 0.1°
Output voltage range	Ratiometric analog
Output load	> 10 kOhm

#### Characteristic

Max. rotation speed	600 RPM
Temp. coefficient	± 0.008° Rotation/°C 30°C nominal
Direction of rotation	Both
Redundancy	Yes



#### Flying lead and Wires

Red	U <sub>S</sub> 1
Blue	Gnd 1
White	Sig 1
Orange	U <sub>S</sub> 2
Green	Gnd 2
Yellow	Sig 2
Sleeve	DR-25
Wire size	AWG 26
Wire length L	100 cm

#### Installation Notes

The products of the RP series can be connected directly to most control units.

The sensor is designed with contactless Hall effect technology.

Any mounting orientation is possible.

Sensor is at mid point of electrical angle when shaft and wire exit are aligned as shown in the offer drawing.

Please find further application hints in the offer drawing at our homepage.

**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Fulfilled Legal Standards/Legal Requirements**

EMC Requirement	UNECE10
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**Ordering Information**

**Rotary Position Sensor RPS-F**

Single output, 360° range  
Order number **F02U.V0U.400-01**

**Rotary Position Sensor RPS-F**

Dual output, 100° range, crossing signals (throttle)  
Order number **F02U.V0U.401-01**

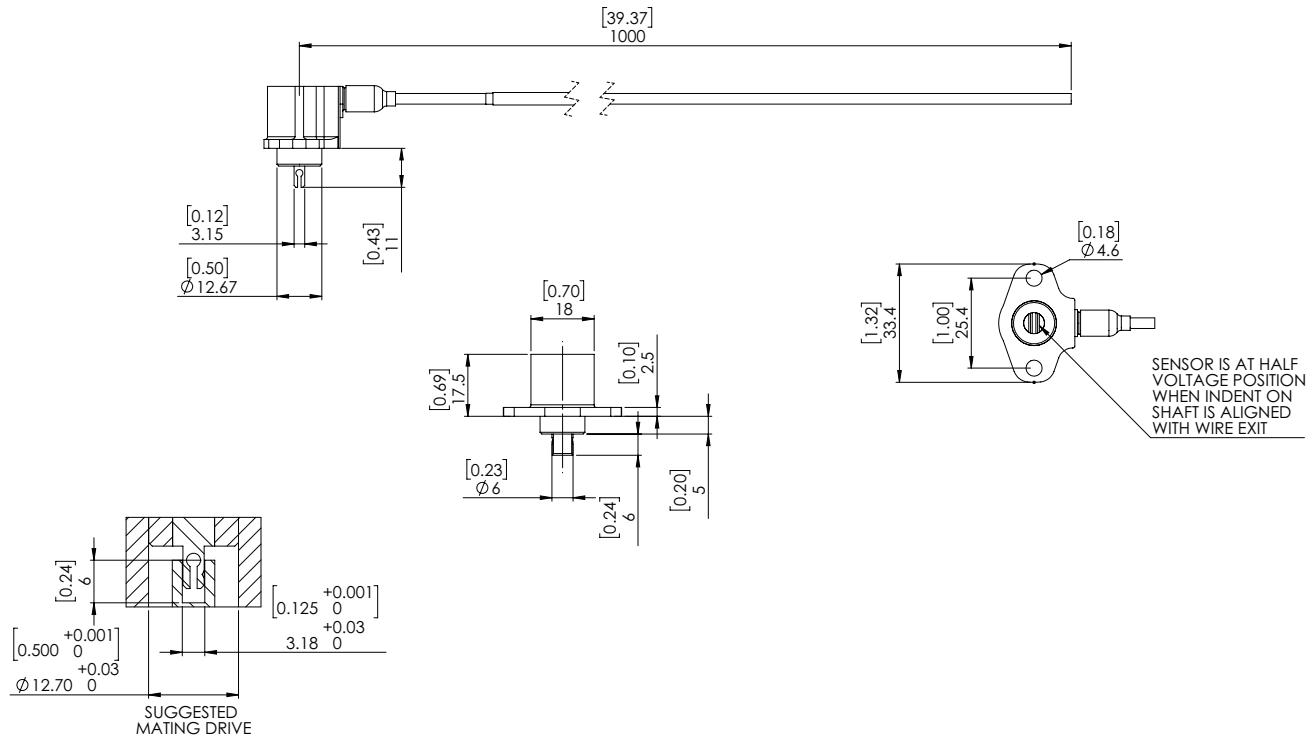
**Rotary Position Sensor RPS-F**

Dual output, 40° range, second signal 50 % of first (pedal)  
Order number **F02U.V0U.402-01**

**Rotary Position Sensor RPS-F**

Dual output, 100° range, second signal 50 % of first (pedal)  
Order number **F02U.V0U.403-01**

**Dimensions**



## Overview

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**Speed Sensor Hall-Effect HA-D 90**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.4 to 1.0 mm
- Bore diameter: 11.8 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 12 g

**Speed Sensor Hall-Effect HA-Di**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.4 to 1.0 mm
- Bore diameter: 12 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 12 g

**Speed Sensor Hall-Effect HA-M**



- Max. frequency:  $\leq 4.2$  kHz
- Air gap: 0.5 to 1.0 mm
- Bore diameter: 11.8 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 12 g

**Speed Sensor Hall-Effect HA-N**



- Max. frequency:  $\leq 4.2$  kHz
- Air gap: 0.4 to 1.5 mm
- Bore diameter: 10 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 8 g

**Speed Sensor Hall-Effect HA-P**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.5 to 1.0 mm
- Bore diameter: 18 mm
- Max. vibration: 1,000 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 70 g

**Speed Sensor Hall-Effect HA-P2**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.5 to 1.0 mm
- Bore diameter: 15 mm
- Max. vibration: 400 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 12 g

**Speed Sensor Hall-Effect Mini-HA-P**



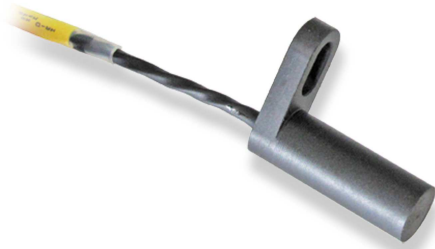
- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.2 to 1.0 mm
- Bore diameter: 11.5 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 20 g

**Speed Sensor Hall-Effect Mini-HA-P sealed**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.2 to 1.5 mm
- Bore diameter: 16 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 20 g

## Speed Sensor Hall-Effect HA-D 90



### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.4 to 1.0 mm
- ▶ Bore diameter: 11.8 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 12 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft\*, crankshaft or wheel speed), but it is not a “true power-on” sensor.

Due to the rotation of a ferromagnetic target wheel in front of the HA-D 90, the magnetic field is modulated at the place of the Hall probe.

The main feature and benefit of this sensor is a very good detection of the falling edge, due to a differential measuring method. This sensor is a combination of a high quality production part and robust design with a small housing.

\*: see Installation Notes

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap AG	0.4 to 1.0 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
Output type	Active high
External magnetic fields	$\leq 50$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	12 g
Mounting	Screw 1 x M6
Bore diameter	11.8 mm
Installation depth L2	30 mm
Tightening torque	6 Nm

#### Electrical Data

Power supply	5 to 18 V
Current IS	20 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	< 1.0 % ( $\leq 6$ kHz) < 1.5 % ( $\leq 10$ kHz)
Signal output	0.52 V to $< U_s$

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h	3.4 mm
Number of teeth	60-2

#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig
Pin 4	Nc
Pin 5	Nc

Various motorsport and automotive connectors available on request.

Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 100 cm

Please specify the required wire length with your order.

### Installation Notes

The HA-D 90 is no true-power-on sensor. It needs the falling edge of two teeth for correct working. After a time of 0.68 s without rotation of the detected wheel it needs again the falling edge of two teeth.

The HA-D 90 can be connected directly to most control units and data logging systems

Please specify the angle between the mounting and the target wheel.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

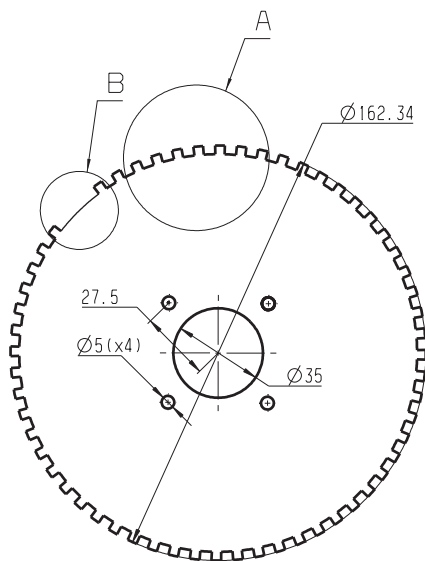
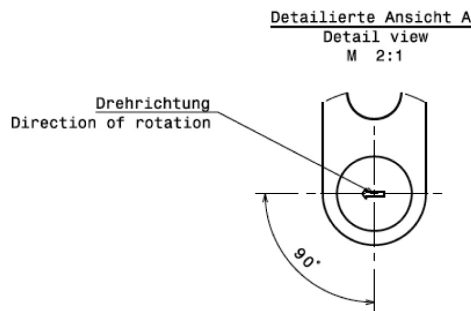
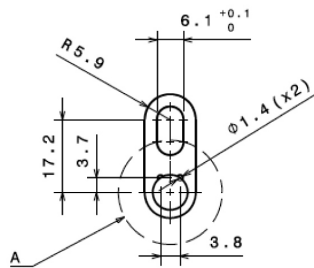
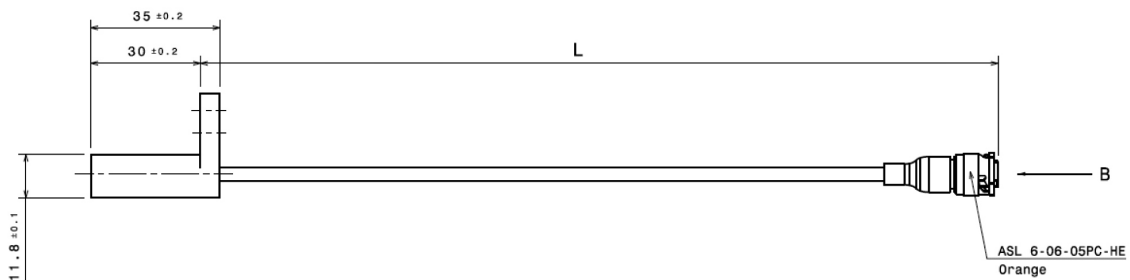
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

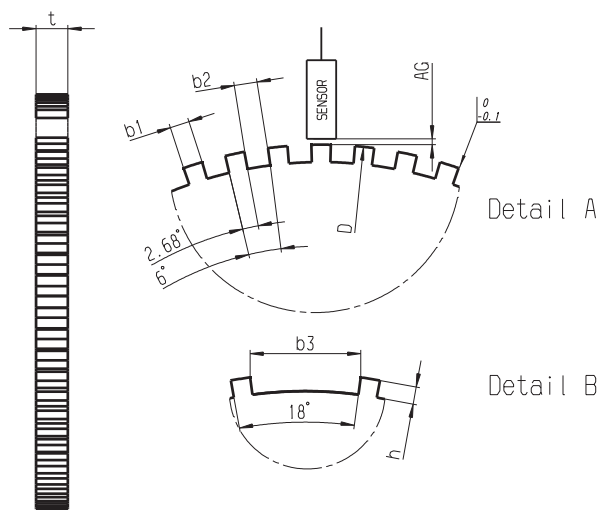
**Ordering Information**

**Speed Sensor Hall-Effect HA-D 90**  
Order number **F02U.V00.334-01**

**Dimensions**



60-2 Teeth



Left view



## Speed Sensor Hall-Effect HA-Di



### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.4 to 1.0 mm
- ▶ Bore diameter: 12 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 12 g

This sensor is designed for incremental measurement of rotational speed (e.g. crankshaft or wheel speed).

Due to the rotation of a ferromagnetic target wheel in front of the HA-Di, the magnetic field of the built-in magnet is modulated at the place of the sensors diff.

The main feature and benefit of this sensor is the detection of the rotational direction.

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz forward $\leq 6$ kHz backward
Target wheel air gap AG	0.4 to 1.0 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
External magnetic fields	$\leq 100$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	12 g
Mounting	Screw 1 x M5

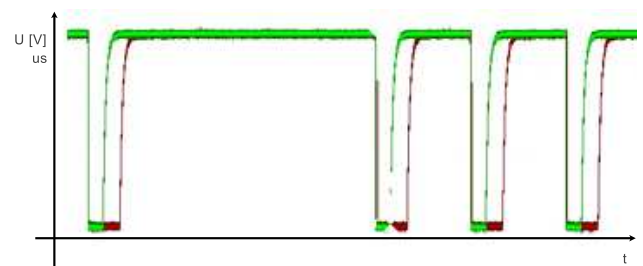
Bore diameter	$12 + 0.2$ mm
Installation depth L2	30 mm
Tightening torque	6 Nm

#### Electrical Data

Power supply	5 to 16 V (24 V for max. 5 min.)
Current IS	$< 20$ mA
Power-on time	1 ms

#### Characteristic

Signal output width forward	37 to 53 $\mu\text{s}$ (45)
Signal output width backward	75 to 105 $\mu\text{s}$ (90)
Accuracy (tolerance)	$\pm 1.5^\circ$ (for forward direction)
Signal output	0.52 V to $< U_s$



Signal output width (forward: green, backward: red)

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h	3.4 mm
Number of teeth	60-2

#### Alternative Target Wheel

Target wheel diameter	118 to 370 mm
Width of teeth b1	2.2 to 3.8 mm
Width of gap b2	$\geq 4$ mm
Depth of teeth h	$\geq 4$ mm
Target wheel width	$\geq 5$ mm
Relative magnetic permeability	$\mu(r) \geq 1000$

#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig
Pin 4	Nc
Pin 5	Nc

Various motorsport and automotive connectors available on request.

Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 100 cm
Please specify the required wire length with your order.	

**Installation Notes**

The HA-Di is no true-power-on sensor. It needs the falling edge of trigger wheel teeth for correct working. After a time of 0.68 s without rotation of the detected wheel it needs again the falling edge of two teeth.

Please specify the angle between the mounting and the target wheel.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

**Speed Sensor Hall-Effect HA-Di 0**  
Order number **F02U.V01.802-01**

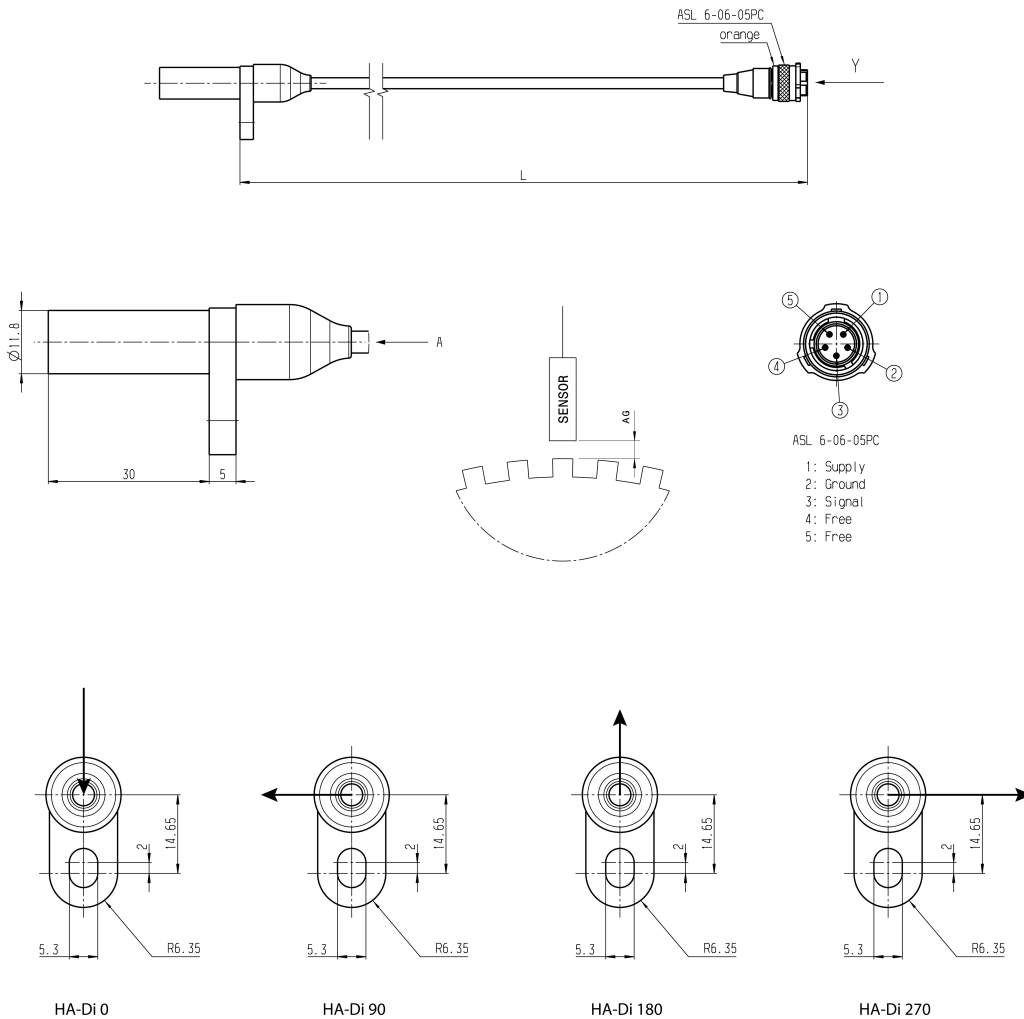
**Speed Sensor Hall-Effect HA-Di 90**  
Order number **F02U.V01.803-01**

**Speed Sensor Hall-Effect HA-Di 180**  
Order number **F02U.V01.804-01**

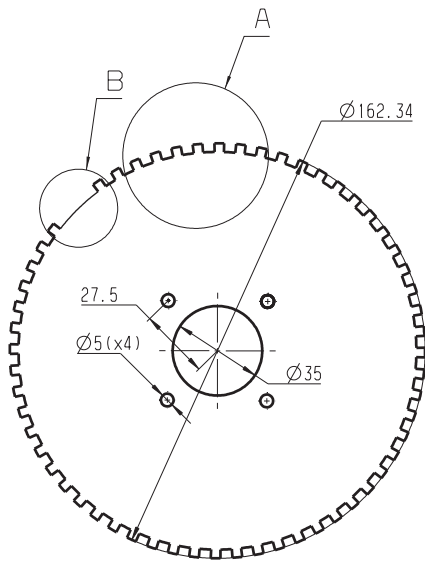
**Speed Sensor Hall-Effect HA-Di 270**  
Order number **F02U.V01.805-01**

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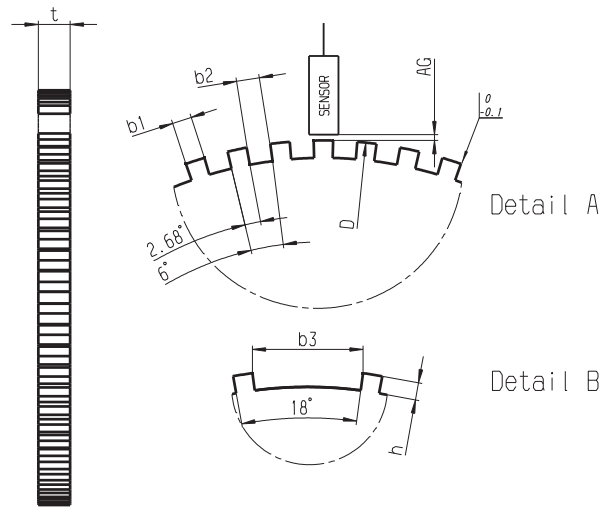
**Dimensions**



Direction of rotation of the target wheel, View A

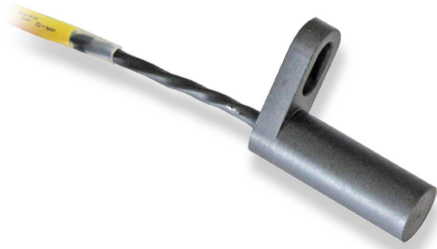


60-2Teeth



Left view

## Speed Sensor Hall-Effect HA-M



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### Features

- ▶ Max. frequency:  $\leq 4.2$  kHz
- ▶ Air gap: 0.5 to 1.0 mm
- ▶ Bore diameter: 11.8 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 12 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft or wheel speed).

Due to the rotation of a ferromagnetic target wheel in front of the HA-M, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal. We offer this sensor with two different types of output: Active high and Active low.

The main feature and benefit of this sensor is the combination of a high quality production part and robust design with metal housing and motorsport connectors.

### Application

Application	Speed
Max. frequency	$\leq 4.2$ kHz
Target wheel air gap	0.5 to 1.5 mm
Temperature range	- 40 to 160°C
Output circuit	Open collector for 1 kOhm
Output type	Please see Ordering Information
External magnetic fields	$< 1$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

##### Active low with connector / active high with connector

Connector	ASU603-03PN-HE
Mating connector	F02U.000.199-01
ASU003-03SN-HE	
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig

##### Active high, without connector

Red	$U_s$
Black	Gnd
Green	Sig

#### Mechanical Data

Weight w/o wire	12 g
Mounting	1 x M6
Bore diameter	11.8 mm
Installation depth L2	30 mm
Tightening torque	6 Nm

#### Electrical Data

Power supply	5 to 18 V
Current $I_s$	5.6 to 18 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	$< 4\%$ ( $\leq 4.2$ kHz)
Signal output	0.52 V to $< U_s$

#### Connectors and Wires

Various motorsport and automotive connectors available on request.

Pin layout	Please see Variations
Sleeve	DR-25
Wire size	AWG 24
Wire length L	10 to 100 cm

Please specify the required wire length with your order.

#### Installation Notes

The HA-M can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

#### Speed Sensor Hall Effect HA-M

Active low

Order number **B261.209.283-01**

#### Speed Sensor Hall Effect HA-M

Active high

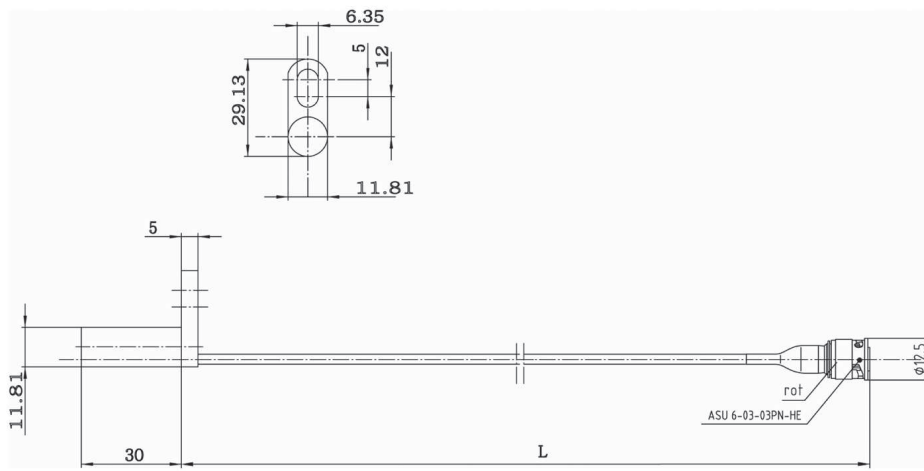
Order number **B261.209.295-01**

#### Speed Sensor Hall Effect HA-M

Active high, without connector

Order number **F02U.V00.627-01**

### Dimensions



## Speed Sensor Hall-Effect HA-N



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### Features

- ▶ Max. frequency:  $\leq 4.2$  kHz
- ▶ Air gap: 0.4 to 1.5 mm
- ▶ Bore diameter: 10 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 8 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft or wheel speed). Due to the rotation of a ferromagnetic target wheel in front of the HA-N, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The HA-N combines a robust sensing element with a lightweight aluminum housing that is well suited for motorsport use. The sensor element used was specifically selected for its resistance to demagnetization at high temperatures and is programmed for an active low output. This sensor element is approved for NASCAR competition as a camshaft speed sensor.

### Application

Application	Rotational speed
Max. frequency	$\leq 4.2$ kHz
Target wheel air gap AG	0.5 to 1.5 mm
Temperature range	-40 to $160^\circ\text{C}$
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$< 1 \text{ mT}$
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/ wire	13 g w/ 254 mm cable length and AS connector 28.5 g w/ 1,000 mm cable length flying lead
Bore diameter	10 mm
Installation depth L2	14 mm
Tightening torque	6 Nm

#### Electrical Data

Power supply	5 to 18 V
Current IS	5.6 to 18 mA

#### Characteristic

Accuracy repeatability of the falling edge tooth	$< 4\%$ ( $\leq 4.2$ kHz)
Signal output	$0.52 \text{ V to } V_s$

#### Connectors and Wires

##### Sensor AS connector

Connector	ASL606-05PA-HE
Mating connector	ASL006-05SA-HE
Pin 1	$V_s$
Pin 2	GND
Pin 3	Signal
Pin 4	Not used
Pin 5	Not used
Shrink sleeve	DR-25
Wire size	AWG 24
Wire length L	254 mm

##### Sensor Flying lead

WHT/ORG	$V_s$
WHT/BLU	GND
WHT	Signal
Shrink sleeve	DR-25
Wire size	AWG 24
Wire length L	1,000 mm

### Installation Notes

The HA-N can be directly connected to most control units and data logging systems.

If a trigger wheel with different dimensions is used (see environment), the technical function must be tested.

#### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

## Ordering Information

### Speed Sensor Hall-Effect HA-N

Sensor AS connector

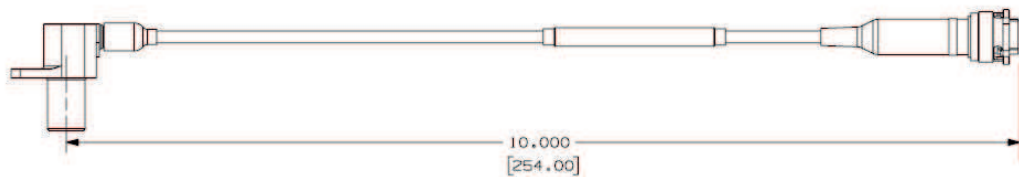
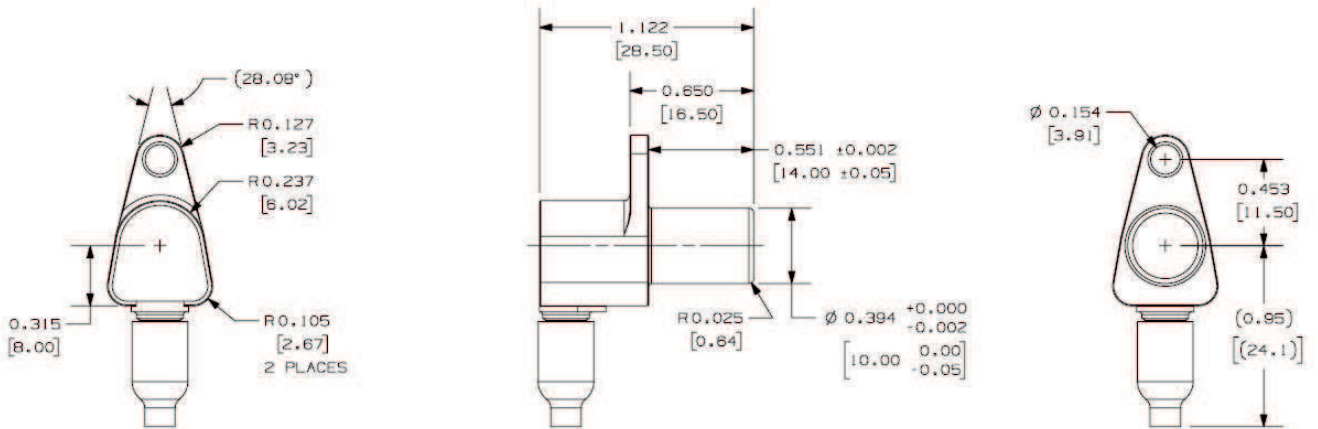
Order number **F02U.V0U.714-01**

### Speed Sensor Hall-Effect HA-N

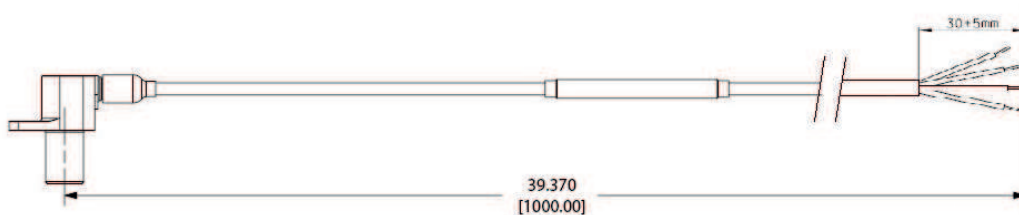
Sensor Flying lead

Order number **F02U.V0U.714-90**

## Dimensions



Sensor AS connector



Sensor Flying lead

## Speed Sensor Hall-Effect HA-P



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### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.5 to 1.0 mm
- ▶ Bore diameter: 18 mm
- ▶ Max. vibration:  $1,000 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 70 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft or wheel speed).

Due to the rotation of a ferromagnetic target wheel in front of the HA-P, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The main feature and benefit of this sensor is the combination of a high quality production part and robust design with metal housing.

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap	0.5 to 1.4 mm
Temperature range	-40 to 150°C
Output type	Active low
Output circuit	Open collector for 1 kOhm
Max. vibration	$1,000 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	70 g
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Mounting	With screw 1 x M6
Bore diameter	18 mm
Installation depth L2	24 mm
Tightening torque	8 Nm

#### Electrical Data

Power supply	4.5 to 24 V
Current IS	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	$< 1.5\%$ ( $\leq 6$ kHz) $< 2\%$ ( $\leq 10$ kHz)
Signal output	0.4 V to $< U_s$

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h	3.4 mm
Number of teeth	60-2

#### Connectors and Wires

Connector	1928.404.227
Mating connector 3-pole Compact	D261.205.335-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$

### Installation Notes

The HA-P can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

#### Safety Note

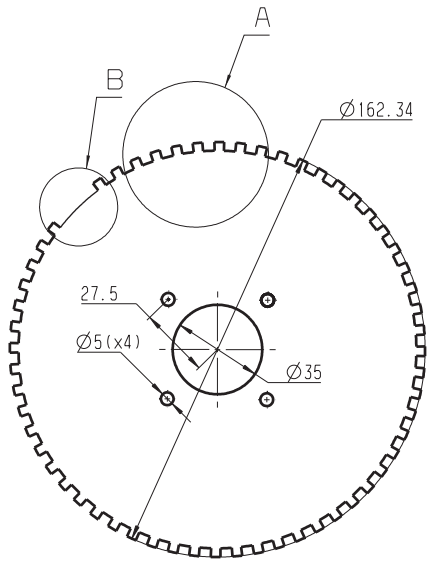
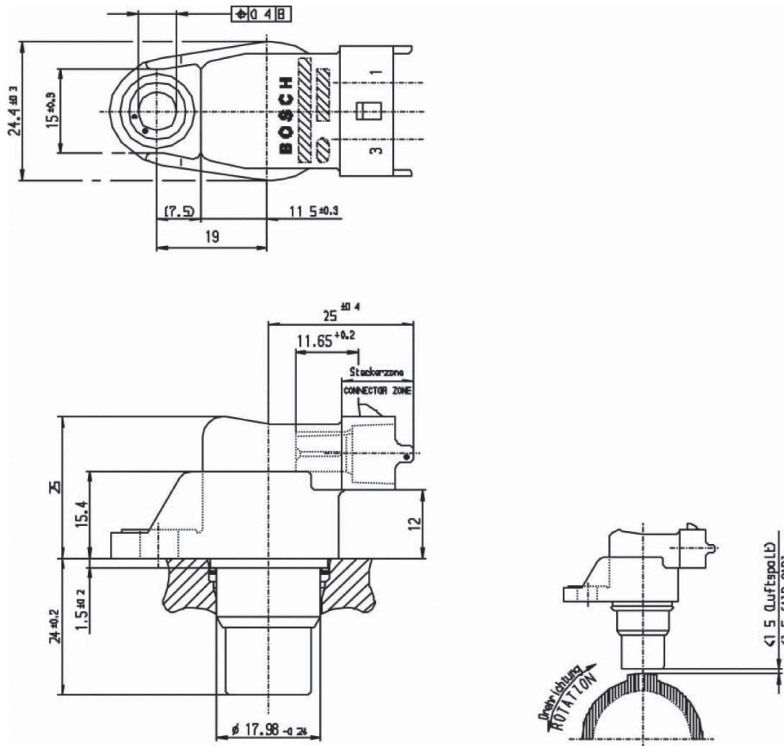
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

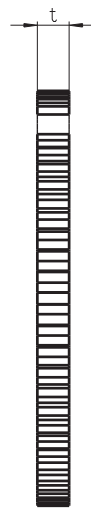
**Speed Sensor Hall-Effect HA-P**  
Order number **0232.103.037**



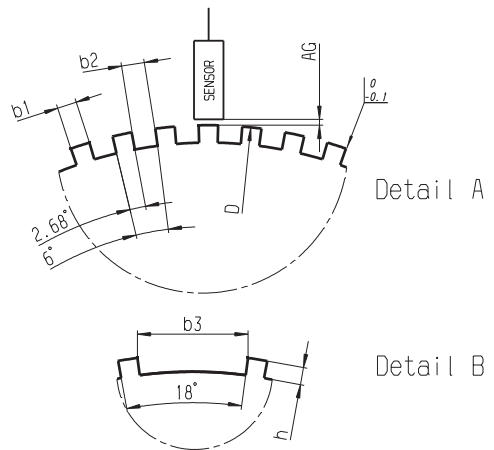
Dimensions



60-2Teeth



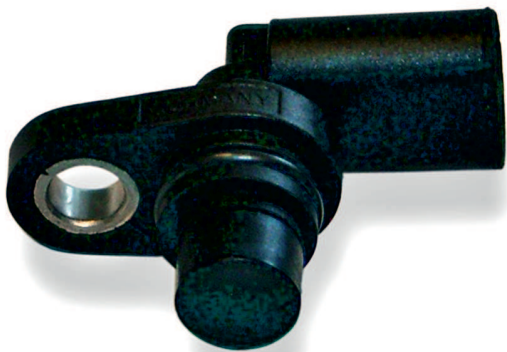
Left view



Detail A

Detail B

## Speed Sensor Hall-Effect HA-P2



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### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.5 to 1.0 mm
- ▶ Bore diameter: 15 mm
- ▶ Max. vibration:  $400 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 12 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft or wheelspeed).

Due to the rotation of a ferromagnetic target wheel in front of the HA-P2, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The main feature and benefit of this sensor is the combination of a high quality production part, robust design, very small housing and low weight.

### Application

#### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap	0.5 to 2.5 mm
Temperature range	-40 to 160°C
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$< 0.1$ mT
Max. vibration	$400 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	12 g
Bore diameter	15 mm
Installation depth L2	15 mm
Mounting	With screw 1 x M6
Tightening torque	8 Nm

#### Electrical Data

Power supply US	4.75 to 18 V
Current Is	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	
up to 1.5 mm	$< 4\%$ ( $\leq 10$ kHz)
up to 2.5 mm	$< 8\%$ ( $\leq 10$ kHz)
Signal output	0.4 V to $< U_s$

#### Connectors and Wires

Connector	Hirschmann 872-658-501 Cod.A
Mating connector	F02U.B00.520-01
Pin 1	$U_s$
Pin 2	Sig
Pin 3	Gnd

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h1	3.4 mm
Number of teeth	60-2

### Installation Notes

#### Application Notes

The HA-P2 can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

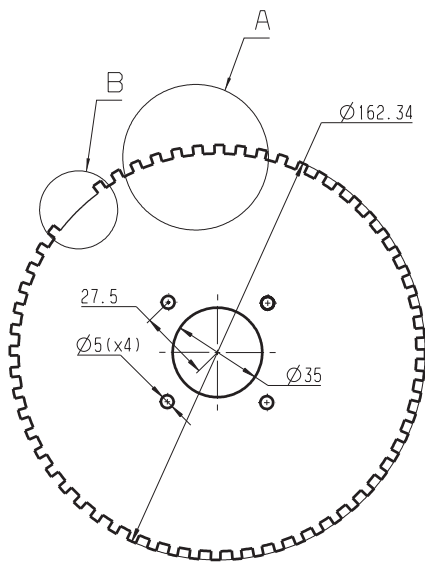
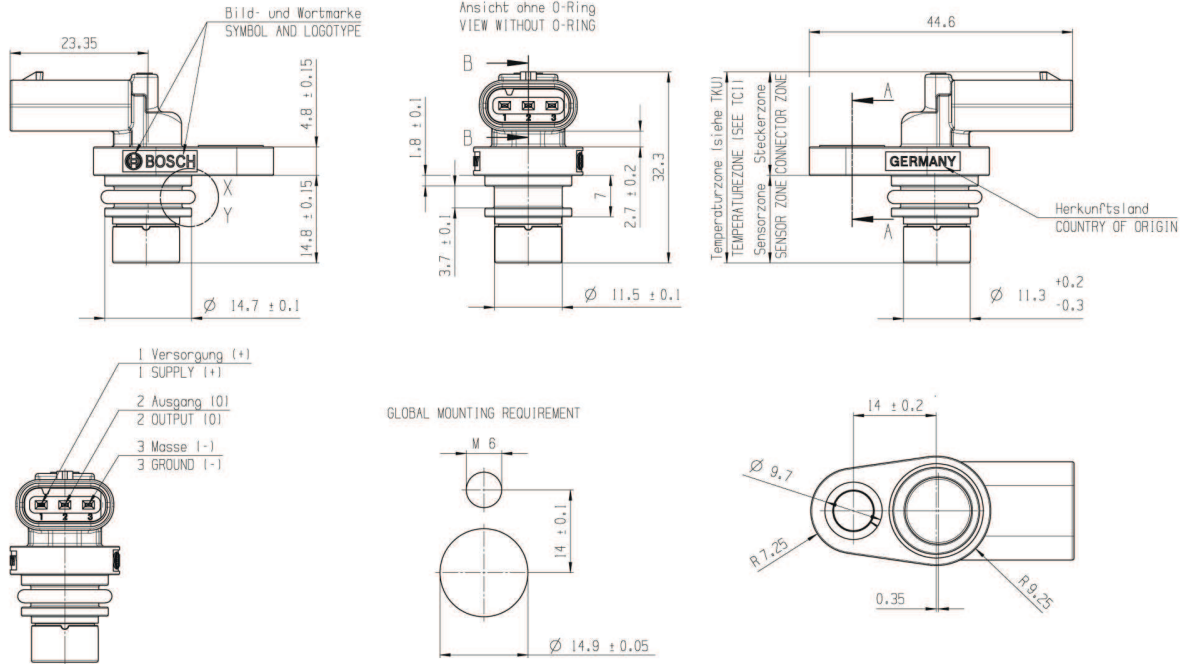
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

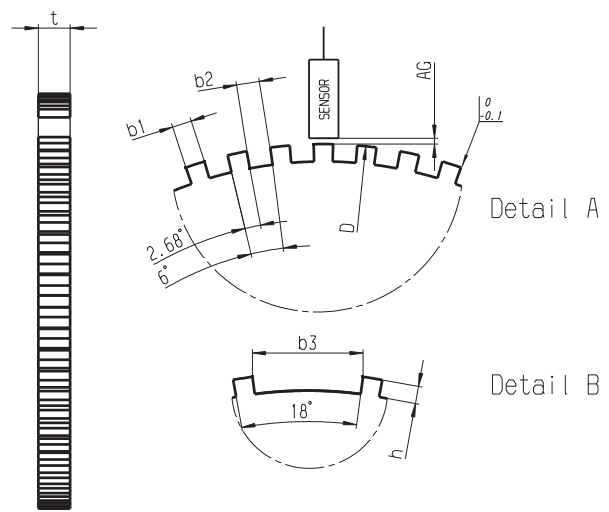
**Ordering Information**

**Speed Sensor Hall-Effect HA-P2**  
Order number **0232.103.111**

**Dimensions**



60-2 Teeth



Left view

## Speed Sensor Hall-Effect Mini-HA-P



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### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.2 to 1.0 mm
- ▶ Bore diameter: 11.5 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 20 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft or wheel speed).

Due to the rotation of a ferromagnetic target wheel in front of the Mini-HA-P, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The main feature and benefit of this sensor is the combination of a high quality production part and robust design with a very small housing.

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap	0.2 to 1.5 mm
Temperature range	-40 to $150^\circ\text{C}$
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$\leq 0.3$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

Connector	ASL606-05PC-HE	1234.482.092
Mating connector	ASL006-05SC-HE	F02U.B00.555-01
Pin 1	$U_s$	$U_s$
Pin 2	Gnd	Sig
Pin 3	Sig	Gnd
Pin 4	Nc	-
Pin 5	Nc	-

#### Mechanical Data

Weight w/o wire	19.2 g
Mounting	With screw 1 x M6
Bore diameter	11.5 mm
Installation depth L2	9 mm
Tightening torque	8 Nm

#### Electrical Data

Power supply	5 to 18 V
Current $I_S$	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	$< 3\%$ ( $\leq 6$ kHz)
	$< 5\%$ ( $\leq 10$ kHz)
Signal output	$0.4 \text{ V to } < U_s$

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h	3.4 mm
Number of teeth	60-2

#### Connectors and Wires

Connector	Please see Variations
Various motorsport and automotive connectors available on request.	
Sleeve	HT wire $\varnothing 5.2$ mm
Wire size	AWG 20
Wire length L	$< 27$ cm
Please specify the required wire length with your order.	

#### Installation Notes

The Mini-HA-P can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

#### Speed Sensor Hall-Effect Mini-HA-P

Connector ASL606-05PC-HE

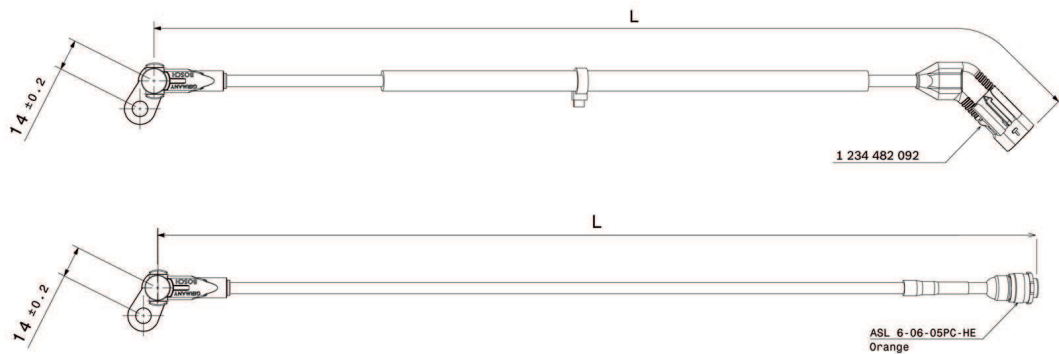
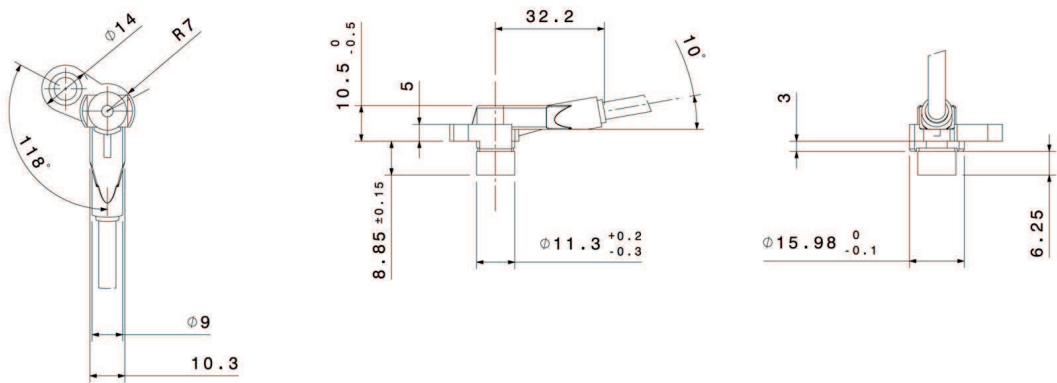
Order number **F02U.V00.564-02**

#### Speed Sensor Hall-Effect Mini-HA-P

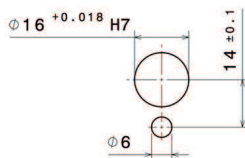
Connector 1 234 482 092

Order number **F02U.V00.566-02**

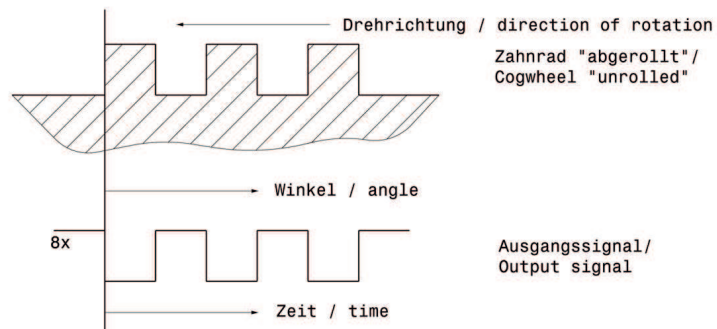
### Dimensions

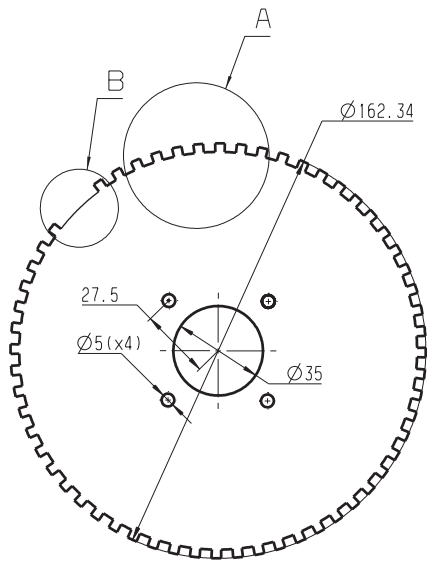


#### Einbauvorschrift Mounting requirement

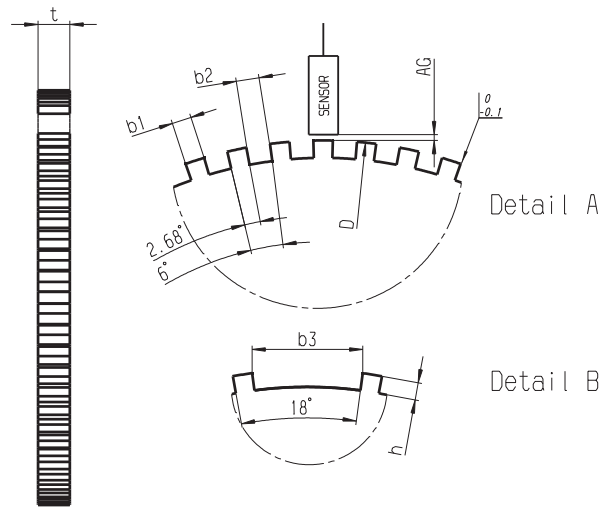


#### Signal-Definition Signal definition





60-2 Teeth



Left view

## Speed Sensor Hall-Effect Mini-HA-P sealed



### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.2 to 1.5 mm
- ▶ Bore diameter: 16 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 20 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft and wheelspeed).

Due to the rotation of a ferromagnetic target wheel in front of the Mini-HA-P sealed, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The main feature and benefit of this sensor is the combination of a high quality production part and a robust design with a very small housing.

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap	0.2 to 1.5 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$\leq 0.3$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

Connector	ASL606-05PC-HE	Without connector
Mating connector	ASL006-05SC-HE F02U.000.228-01	-
Pin 1	$U_s$	$U_s$ (red)
Pin 2	Gnd	Sig (green)
Pin 3	Sig	Gnd (black)
Pin 4	Nc	-
Pin 5	Nc	-
Wire length L	10 - 27 cm	27 cm

#### Mechanical Data

Weight w/o wire	19.2 g
Mounting	With screw 1 x M6
Bore diameter	16 mm
Installation depth L2	12 mm
Tightening torque	8 Nm

#### Electrical Data

Power supply	5 to 18 V
Current $I_S$	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	$< 3\%$ ( $\leq 6$ kHz) $< 5\%$ ( $\leq 10$ kHz)
Signal output	$0.4 \text{ V}$ to $< U_s$

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h	3.4 mm
Number of teeth	60-2

#### Connectors and Wires

Connector	Please see Variations
Sleeve	HT wire $\varnothing 5.2$ mm
Wire size	AWG 20
Wire length L	Please see Variations
Various motorsport and automotive connectors are available on request.	
Please specify the required wire length with your order.	

### Installation Notes

The Mini-HA-P sealed can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage.

**Safety Note**

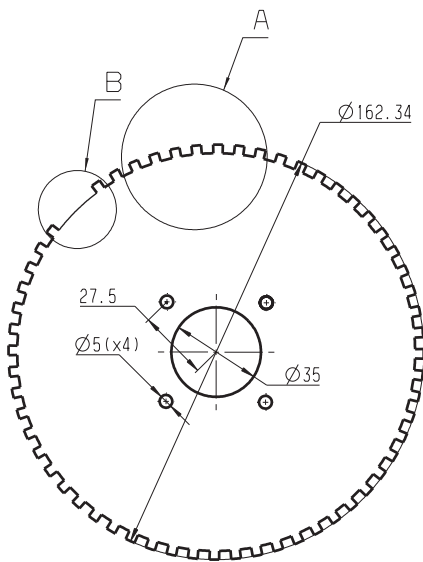
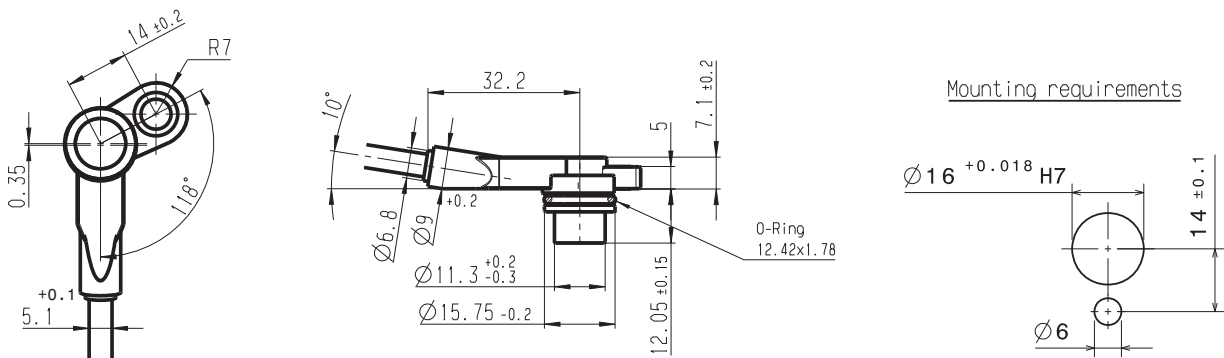
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

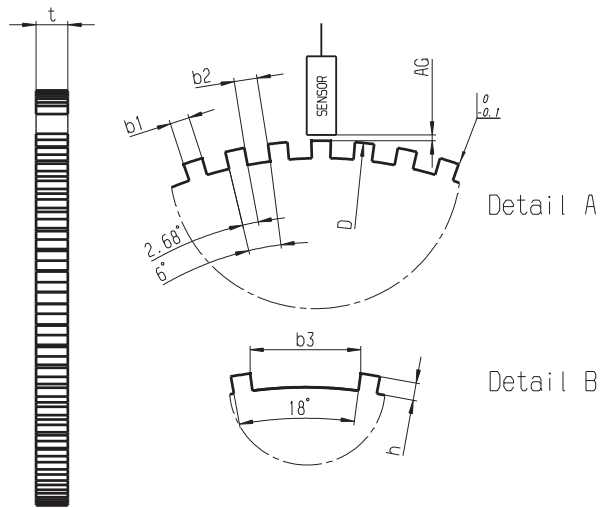
**Speed Sensor Hall-Effect Mini HA-P sealed**  
 Connector ASL606-05PC-HE  
 Order number **F02U.V00.500-01**

**Speed Sensor Hall-Effect Mini HA-P sealed**  
 Without connector  
 Order number **F02U.V00.570-01**

**Dimensions**



60-2 Teeth



Left view



# Steering Wheel Angle Sensor LWS



## Features

- ▶ Steering Wheel Angle:  $\pm 780^\circ$
- ▶ Angular Speed: 0 to 1,016°/s
- ▶ 500 kbaud CAN-output

This sensor is designed to measure rotational movement and angular speed, e.g. steering wheel angle and steering wheel speed.

In order to achieve this, the sensor is using the giant magneto resistive (GMR) effect. The detection of the absolute angle is realized by means of toothed measuring gears with different ratio including small magnets. Corresponding GMR elements that change their electrical resistance according to the magnetic field direction detects the angle position of the measuring gears.

The measured voltages are A/D converted and a microcontroller performs the angle calculations. The steering angle and the steering angle speed are provided on a CAN-interface.

## Application

Steering wheel angle	$\pm 780^\circ$
Angular speed	0 to 1,016°/s
Operating temperature range	-40 to 85°C

## Technical Specifications

### Mechanical Data

Weight	Approx. 34 g
Size	83 x 60 x 21.35 mm
Protection class	IP5K0

### Electrical Data

Power supply	7 to 16 V
Max input current	< 150 mA
CAN speed	500 kbaud

### CAN Message

#### CAN ID 01 0x2B0 LWS\_Standard

Byte	Value / Bit							
	7	6	5	4	3	2	1	0
0	LWS_ANGLE							
1	LWS_ANGLE							
2	LWS_SPEED							
3	Reserved					TRIM	CAL	OK
4	Reserved							

#### CAN ID 02 0x7C0 LWS\_Config

Byte	Value / Bit							
	7	6	5	4	3	2	1	0
0	Reserved					CCW		
1	Reserved							

### Truth Table

TRIM	OK	CAL	ANGLE	SPEED	Sensor state
1	1	1	Value	Value	Sensor is calibrated and sensor information is valid.
1	1	0	7FFFh	Value	Sensor is not calibrated, speed information is valid.
1	0	0	7FFFh	FFh	Sensor is in failure mode, sensor information is not valid.
0	0	0	7FFFh	FFH	Sensor is in failure mode, sensor information is not valid.

Other combinations for TRIM, OK and CAL are not valid.

### Signal Overview

OK	Failure status
1	Sensor information valid
0	Sensor information invalid, an internal sensor fault occurred
CAL	Calibration status
1	Sensor calibrated
0	Sensor not calibrated
TRIM	Trimming Status
1	Sensor trimmed
0	Sensor not trimmed, this is handled as a sensor failure (OK = 0)
CCW	Command code word
3h	Sets the signal LWS_Angle to 0°
5h	Resets the calibration status of the angle

**Characteristics****Steering Wheel Angle**

Measuring range	$\pm 780^\circ$
Absolute physical resolution	$0.1^\circ$
Nonlinearity	$\pm 2.5^\circ$
Hysteresis	0 to $5^\circ$

**Angular Speed**

Measuring range	0 to $1,016^\circ/\text{s}$
Over range limit	$\pm 2,500^\circ/\text{s}$
Absolute physical resolution	$4^\circ/\text{s}$

**Connectors and Wires**

Connector	Bosch 7 pole
Mating connector	F02U.B00.656-01
Pin 1	Gnd
Pin 2	12 V
Pin 3	CAN High
Pin 4	CAN Low
Pin 5	Not connected
Pin 6	Not connected
Pin 7	Not connected

**CAN Parameters**

Byte order	LSB (Intel)
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CAN speed	500 kbaud
CAN update rate	100 Hz / 10 ms

**Installation Notes**

The LWS can be connected directly to most control units and data logger systems via CAN bus.

Please avoid abrupt temperature changes.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing.

A zero adjustment is needed before using the sensor for the first time. To do so, reset the calibration with CCW = 5h. After resetting the calibration, a new calibration needs to be started with CCW = 3h. The sensor is now newly calibrated and can be used immediately.

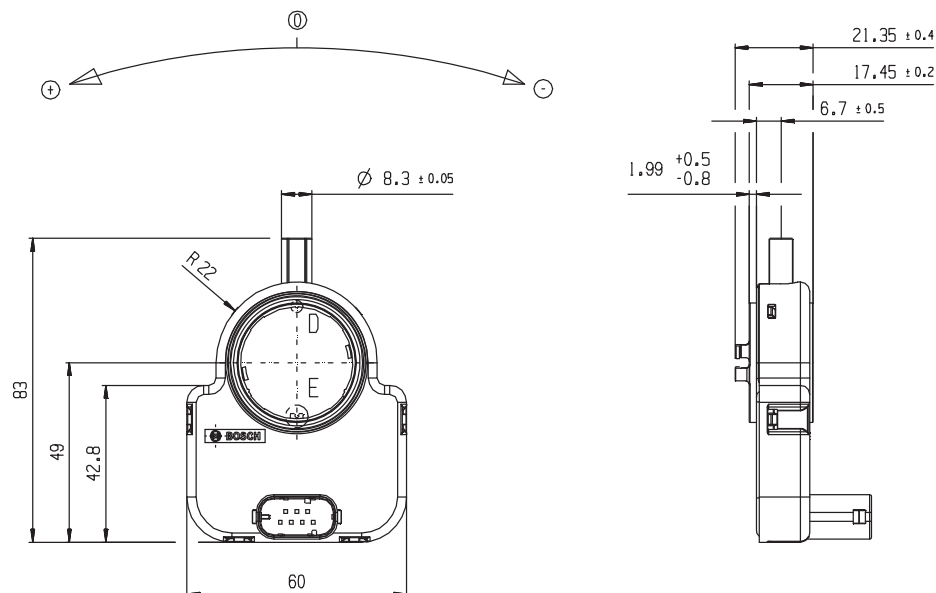
Zero the sensor after every assembly.

**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

**Steering Wheel Angle Sensor LWS**  
Order number **F02U.V02.894-01**

**Dimensions**

Housing Size

## Overview

### Temperature Sensor NTC M5-HS



- Application: -55 to 300°C
- Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- Male thread: M5
- Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

### Temperature Sensor NTC M6-HS



- Application: -55 to 300°C
- Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- Male thread: M6 x 1
- Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

### Temperature Sensor NTC M8-HS



- Application: -55 to 300°C
- Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- Male thread: M8 x 1
- Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

### Temperature Sensor NTC M12



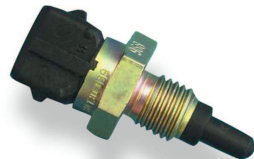
- Application: -40 to 130°C
- Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- Male thread: M12 x 1.5
- Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

### Temperature Sensor NTC M12-H



- Application: -40 to 130°C
- Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- Male thread: M12 x 1.5
- Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

### Temperature Sensor NTC M12-L



- Application: -40 to 130°C
- Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- Male thread: M12 x 1.5
- Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

## Temperature Sensor NTC M5-HS



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### Features

- ▶ Application: -55 to 300°C
- ▶ Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- ▶ Male thread: M5
- ▶ Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

This sensor is designed to measure temperatures up to 300°C of oil, water, fuel or air. This signal is used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC-sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises and the resistance decreases. To improve a good protection against the ambient temperature, the housing is made of stainless steel and partly filled with an isolation-paste. The main benefit of the sensor is a very compact design and its very short response time.

### Application

Application	-55 to 300°C
Storage temperature range	0 to 100°C
Bio fuel compatibility	-

### Technical Specifications

#### Mechanical Data

Male thread	M5
Wrench size	8 mm
Installation torque	8 Nm
Weight w/o wire	6 g

Sealing	O-Ring 4 x 1 mm
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#### Electrical Data

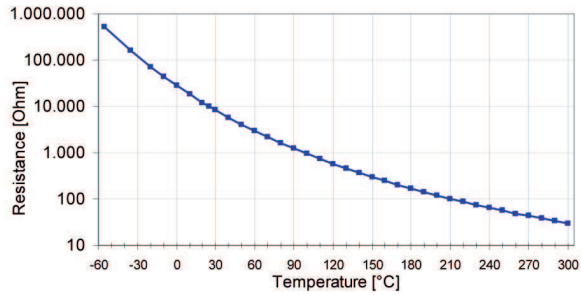
Characteristic	NTC
Nominal resistance at 25°C	10 kOhm $\pm 1\%$

#### Characteristic

Accuracy at 25°C (homogeneous cond.)	$\pm 0.3^\circ\text{C}$
Accuracy at 100°C (homogeneous cond.)	$\pm 1.3^\circ\text{C}$
Response time tau 63 in still water	< 4 s

#### Characteristic Application

T [°C]	R [Ohm]
-55	519,910
-35	158,090
-20	71,668
-10	44,087
0	27,936
10	18,187
20	12,136
25	10,000
30	8,284
40	5,774
50	4,103
60	2,967
70	2,182
80	1,629
90	1,234
100	946.6
120	578.1
140	368.8
160	244.4
180	167.6
200	118.5
220	86.08
240	64.08
260	48.76
280	37.86
300	29.94



### Connectors and Wires

Connector	ASL606-05PN-HE
Mating connector	F02U.000.231-01
ASL006-05SN-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+
Pin 4	-
Pin 5	-

Various motorsport and automotive connectors are available on request.

Wire size	AWG 24
Wire length L	15 to 50 cm
Please specify the required wire length with your order.	

### Installation Notes

The NTC M5-HS can be connected directly to most control units using a pull-up resistance (typically 1 or 3 kOhm) .

Any mounting orientation is possible.

Please find further application hints in the offer drawing at our homepage.

Free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

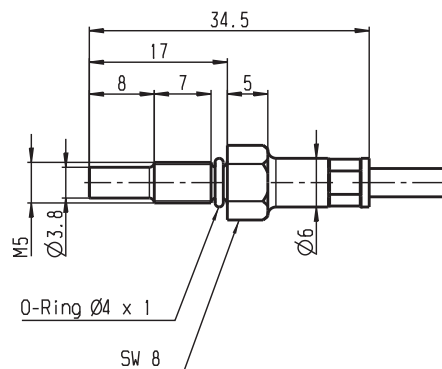
### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Temperature Sensor NTC M5-HS**  
Order number **F02U.V00.510-01**

### Dimensions



## Temperature Sensor NTC M6- HS



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### Features

- ▶ Application: -55 to 300°C
- ▶ Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- ▶ Male thread: M6 x 1
- ▶ Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

This sensor is designed to measure temperatures up to 300°C of oil, water, fuel or air. This signal is used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC-sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises and the resistance decreases. To improve a good protection against the ambient temperature, the housing is made of stainless steel and partly filled with an isolation-paste. The main benefit of the sensor is a very compact design and its very short response time.

### Application

Application	-55 to 300°C
Storage temperature range	0 to 100°C
Bio fuel compatibility	-

### Technical Specifications

#### Mechanical Data

Male thread	M6x1
Wrench size	10 mm
Installation torque	8 Nm
Weight w/o wire	6.5 g

Sealing	O-Ring 4.47 x 1.78 mm
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#### Electrical Data

Characteristic	NTC
Nominal resistance at 25°C	10 kOhm $\pm 1\%$

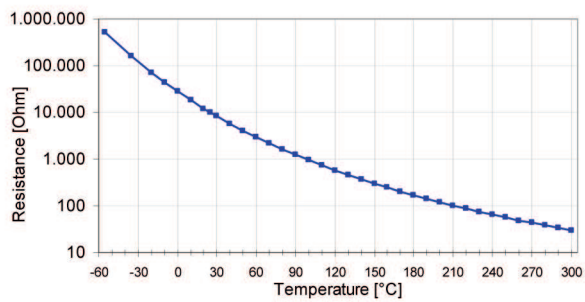
#### Characteristic

Accuracy at 25°C (homogeneous cond.)	$\pm 0.3^\circ\text{C}$
Accuracy at 100°C (homogeneous cond.)	$\pm 1.3^\circ\text{C}$
Response time tau 63 in still water	< 4 s

#### Characteristic Application

T [°C]	R [Ohm]
-55	519,910
-35	158,090
-20	71,668
-10	44,087
0	27,936
10	18,187
20	12,136
25	10,000
30	8,284
40	5,774
50	4,103
60	2,967
70	2,182
80	1,629
90	1,234
100	946.6
110	735.5
120	578.1
130	459.4
140	368.8
150	298.9
160	244.4
170	201.6
180	167.6
190	140.4
200	118.5
210	100.7
220	86.08
230	74.05
240	64.08
250	55.75
260	48.76
270	42.87

280	37.86
290	33.59
300	29.94



### Connectors and Wires

Connector	ASL606-05PN-HE
Mating connector	F02U.000.231-01
ASL006-05SN-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+

Pin 4	-
Pin 5	-

Various motorsport and automotive connectors are available on request.

Wire size	AWG 24
Wire length L	15 to 50 cm

Please specify the required wire length with your order.

### Installation Notes

The NTC M6-HS can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

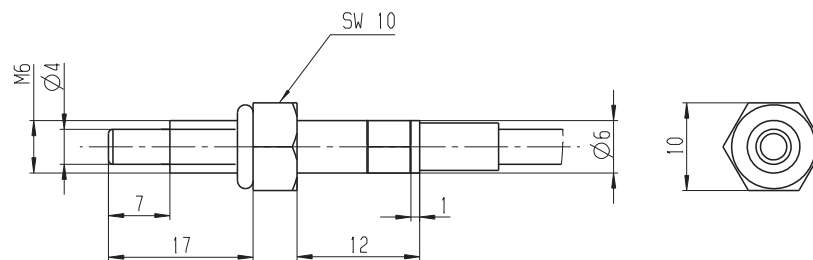
Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging at our homepage.

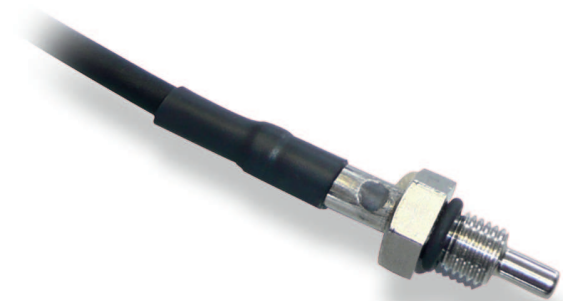
### Ordering Information

**Temperature Sensor NTC M6-HS**  
Order number **F02U.V00.486-01**

### Dimensions



## Temperature Sensor NTC M8-HS



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### Features

- ▶ Application: -55 to 300°C
- ▶ Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- ▶ Male thread: M8 x 1
- ▶ Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

This sensor is designed to measure temperatures up to 300°C of oil, water, fuel or air. This signal is used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC-sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises and the resistance decreases. To improve a good protection against the ambient temperature, the housing is made of stainless steel and partly filled with an isolation-paste. The main benefit of the sensor is a very robust design and its very short response time.

### Application

Application	-55 to 300°C
Storage temperature range	0 to 100°C
Bio fuel compatibility	-

### Technical Specifications

#### Mechanical Data

Male thread	M8x1
Wrench size	12 mm
Installation torque	8 Nm
Weight w/o wire	8 g

Sealing	O-Ring 6.35 x 1.78 mm
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#### Electrical Data

Characteristic	NTC
Nominal resistance at 25°C	10 kOhm $\pm 1\%$

#### Characteristic

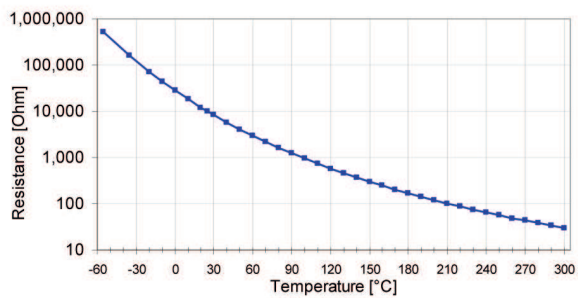
Accuracy at 25°C (homogeneous cond.)	$\pm 0.3^\circ\text{C}$
Accuracy at 100°C (homogeneous cond.)	$\pm 1.3^\circ\text{C}$
Response time tau 63 in still water	< 4 s

#### Characteristic Application

T [°C]	R [Ohm]
-55	519,910
-35	158,090
-20	71,668
-10	44,087
0	27,936
10	18,187
20	12,136
25	10,000
30	8,284
40	5,774
50	4,103
60	2,967
70	2,182
80	1,629
90	1,234
100	946.6
110	735.5
120	578.1
130	459.4
140	368.8
150	298.9
160	244.4
170	201.6
180	167.6
190	140.4
200	118.5
210	100.7
220	86.08
230	74.05
240	64.08
250	55.75
260	48.76
270	42.87



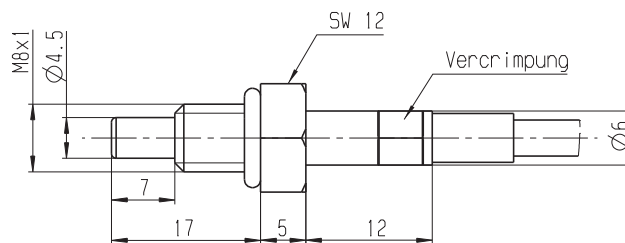
280	37.86
290	33.59
300	29.94



### Connectors and Wires

Connector	ASL606-05PN-HE
Mating connector	F02U.000.231-01
ASL006-05SN-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+
Pin 4	-
Pin 5	-

### Dimensions



Various motorsport and automotive connectors are available on request.

Wire size AWG 24

Wire length L 15 to 50 cm

Please specify the required wire length with your order.

### Installation Notes

The NTC M8-HS can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

### Safety Note

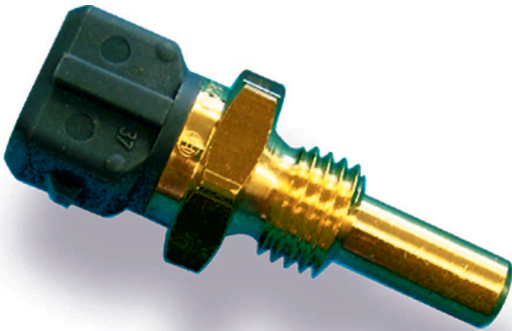
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Temperature Sensor NTC M8-HS**

Order number **F02U.V00.509-01**

## Temperature Sensor NTC M12



7

### Features

- ▶ Application: -40 to 130°C
- ▶ Accuracy at 25°C: ± 1.4°C
- ▶ Accuracy at 100°C: ± 3.4°C
- ▶ Male thread: M12 x 1.5
- ▶ Nominal resistance: 2.5 kOhm ± 5 % (at 20°C)

This sensor is designed to measure fluid temperature e.g. oil, water or fuel. This signal may be used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises. The sensing element of the temperature sensor is made of semiconducting heavy metal oxide and oxidized mixed crystals, which are equipped with a protective housing. The main benefit of the sensor is the combination of a high quality production part and a robust and compact design.

### Application

Application	-40 to 130°C
Storage temp. range	0 to 100°C
Bio fuel compatibility	E85/M22
Max. vibration	600 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Male thread	M12x1.5
Wrench size	19 mm
Installation torque	25 Nm

Weight w/o wire	29 g
Sealing	Not included

#### Electrical Data

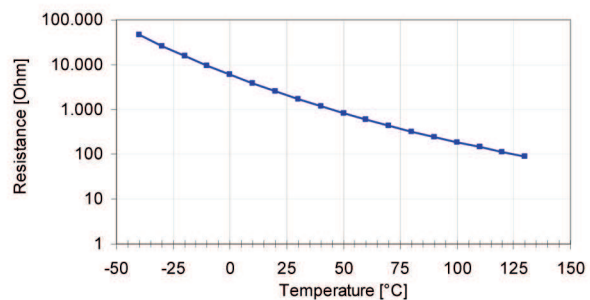
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm ± 5 %

#### Characteristic

Accuracy at 25°C	± 1.4°C
Accuracy at 100°C	± 3.4°C
Response time tau 63 in still water	< 15 s

#### Characteristic Application

T [°C]	R [Ohm]
-40	45,313
-30	26,114
-20	15,462
-10	9,397
0	5,896
10	3,792
20	2,500
30	1,707
40	1,175
50	834
60	596
70	436
80	323
90	243
100	187
110	144
120	113
130	89



#### Connectors and Wires

Connector	Bosch Jetronic
Mating connector	D261.205.288-01
2-pole Jetronic	
Pin 1	SIG+
Pin 2	SIG-

## Installation Notes

The NTC M12 can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

Any mounting orientation is possible.

Please find further application hints in the offer drawing.  
[www.bosch-motorsport.com](http://www.bosch-motorsport.com)

Free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging at our homepage.

## Safety Note

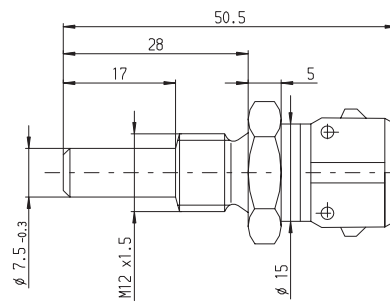
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

## Ordering Information

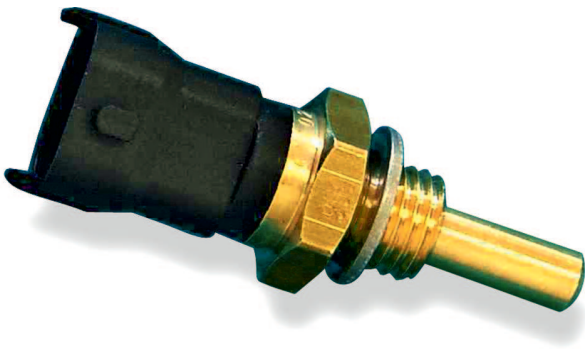
**Temperature Sensor NTC M12**

Order number **0280.130.026**

## Dimensions



## Temperature Sensor NTC M12-H



7

### Features

- ▶ Application: -40 to 130°C
- ▶ Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- ▶ Male thread: M12 x 1.5
- ▶ Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

This sensor is designed to measure fluid temperature e.g. oil, water or fuel. This signal may be used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises. The sensing element of the temperature sensor is made of semiconducting heavy metal oxide and oxidized mixed crystals, which are equipped with a protective housing. The main benefit of the sensor is the combination of a high quality production part and a robust and compact design.

### Application

Application	-40 to 150°C
Storage temperature range	-30 to 60°C
Bio fuel compatibility	E85/M22
Max. vibration	300 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Male thread	M12x1.5
Wrench size	19 mm

Installation torque	18 Nm
Weight w/o wire	28.3 g
Sealing	Al-washer

#### Electrical Data

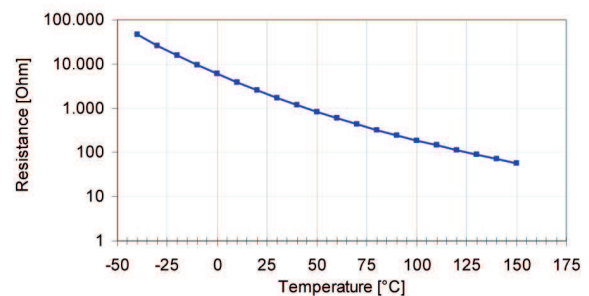
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm $\pm 6\%$

#### Characteristic

Accuracy at 25°C	$\pm 1.4^\circ\text{C}$
Accuracy at 100°C	$\pm 0.8^\circ\text{C}$
Response time tau 63 in still water	< 15 s

#### Characteristic Application

T [°C]	R [Ohm]
-40	45,313
-30	26,114
-20	15,462
-10	9,397
0	5,896
10	3,792
20	2,500
30	1,707
40	1,175
50	834
60	596
70	436
80	323
90	243
100	187
110	144
120	113
130	89
140	71
150	57



#### Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.337-01
2-pole Compact	

Pin 1	SIG+
Pin 2	SIG-

### Installation Notes

The NTC M12-H can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

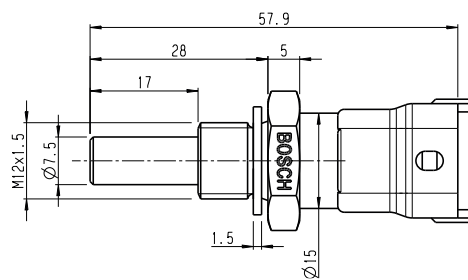
### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

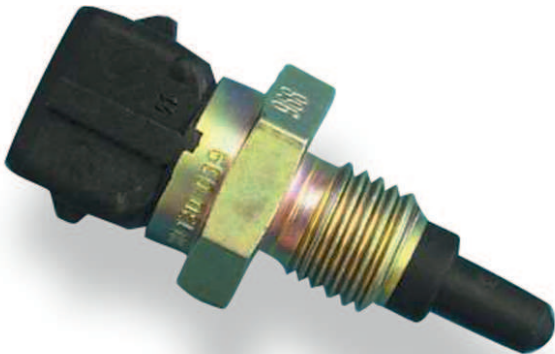
### Ordering Information

**Temperature Sensor NTC M12-H**  
Order number **0281.002.170**

### Dimensions



## Temperature Sensor NTC M12-L



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### Features

- ▶ Application: -40 to 130°C
- ▶ Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- ▶ Male thread: M12 x 1.5
- ▶ Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

This sensor is designed to measure air temperature e.g. in the air box or ambient temperature. This signal may be used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises. The sensing element of the temperature sensor is made of semiconducting heavy metal oxide and oxidized mixed crystals, which are equipped with a protective housing.

The main benefit of the sensor is the combination of a high quality production part and a robust and compact design.

### Application

Application	-40 to 140°C
Storage temp. range	-30 to 60°C
Bio fuel compatibility	E85/M22
Max. vibration	300 m/s <sup>2</sup> at 50 to 250 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M12x1.5
Wrench size	19 mm

Installation torque	15 Nm
Weight w/o wire	24.6 g
Sealing	Not included

#### Electrical Data

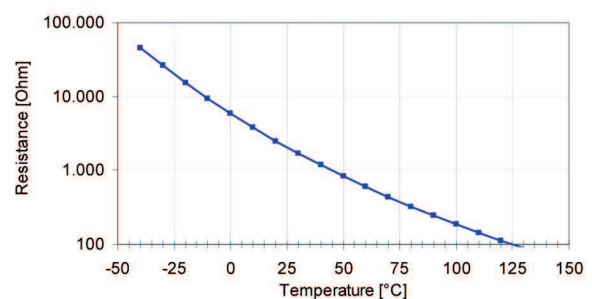
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm $\pm 5\%$

#### Characteristic

Accuracy at 25°C	$\pm 1.4^\circ\text{C}$
Accuracy at 100°C	$\pm 3.4^\circ\text{C}$
Response time tau 63 in still water	< 10 s

#### Characteristic Application

T [°C]	R [Ohm]
-40	45,313
-30	26,114
-20	15,462
-10	9,397
0	5,896
10	3,792
20	2,500
30	1,707
40	1,175
50	834
60	596
70	436
80	323
90	243
100	187
110	144
120	113
130	89
140	71



#### Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.288-01
2-pole Jetronic	
Pin 1	SIG+
Pin 2	SIG-

### Installation Notes

The NTC M12-L can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

### Safety Note

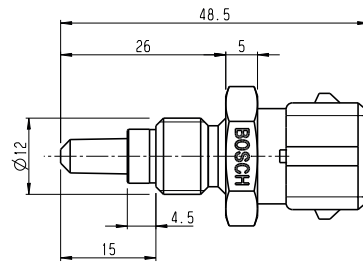
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Temperature Sensor NTC M12-L**

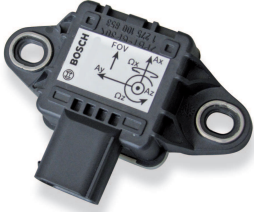
Order number **0280.130.039**

### Dimensions



## Overview

### Acceleration Sensor MM5.10 Acceleration Sensor MM5.10-R



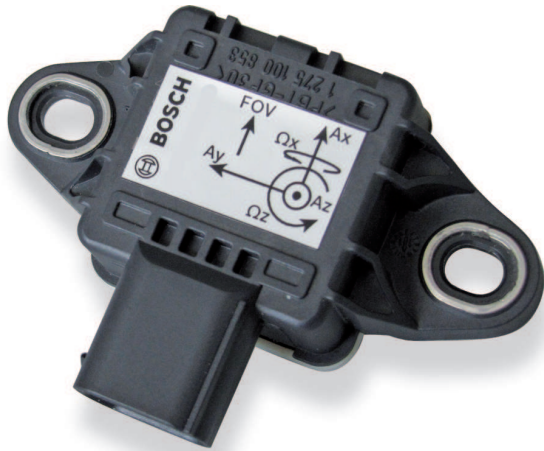
- Application 1:  $\pm 163^\circ/\text{s}$  (roll rate/ yaw rate)
- Application 2:  $\pm 4.2 \text{ g}$  (X, Y and Z acceleration)
- Weight w/o wire: 35 g
- Size: 80 x 56 x 21 mm
- Power supply: 7 to 18 V



- Application 1:  $\pm 163^\circ/\text{s}$  (roll rate/ yaw rate)
- Application 2:  $\pm 4.2 \text{ g}$  (X, Y and Z acceleration)
- Weight w/o wire: 28 g
- Size: 34 x 34 x 16.5 mm
- Power supply: 7 to 18 V



## Acceleration Sensor MM5.10



### Features

- ▶ Application 1:  $\pm 163^\circ/\text{s}$  (roll rate/ yaw rate)
- ▶ Application 2:  $\pm 4.2 \text{ g}$  (X, Y and Z acceleration)
- ▶ Weight w/o wire: 35 g
- ▶ Size: 80 x 56 x 21 mm
- ▶ Power supply: 7 to 18 V

The MM5.10 was designed to measure the physical effects of rotational and linear acceleration. In order to achieve this, the sensor includes MEMS measuring elements connected to an appropriate integrated circuit.

A rotational acceleration around the integrated sensing elements generates a Coriolis force which changes the internal capacity of the micro machined sensing parts. Furthermore, a pure surface micro machined element is used to measure the vehicle linear acceleration in all 3 axis. This combination of rotational and linear acceleration sensors enables a precise measurement of the vehicle dynamics.

The main feature and benefit of this sensor is the combination of 3 linear and 2 rotational accelerometers and its high speed 1 Mbaud CAN-signal output.

### Application

Application I	$\pm 163^\circ/\text{s}$ (roll rate/yaw rate)
Application II	$\pm 4.2 \text{ g}$ (X, Y and Z acceleration)
Operating temperature range	-20 to 85°C

### Technical Specifications

#### Mechanical Data

Weight w/o wire	35 g
Size	80 x 56 x 21 mm

#### Electrical Data

Power supply	7 to 18 V
Max input current	90 mA
CAN speed	1 Mbaud or 500 kbaud

#### CAN Message

##### CAN ID 01 0x174

Byte	Value
0	Yaw rate
1	
2	Reserved
3	
4	Acc Y-axis
5	
6	Reserved
7	Unused

##### CAN ID 02 0x178

Byte	Value
0	Roll rate
1	
2	Reserved
3	
4	Acc X-axis
5	
6	Reserved
7	Unused

##### CAN ID 03 0x17C

Byte	Value
0	Reserved
1	
2	Reserved
3	
4	Acc Z-axis
5	
6	Reserved
7	Unused

#### Characteristic

##### Characteristic Application I

Measuring range	$\pm 160^\circ/\text{s}$
Over range limit	$\pm 1,000^\circ/\text{s}$
Absolute physical resolution	0.1°/s
Cut-off frequency (-3 dB)	15 Hz; 30 Hz; 60 Hz

##### Characteristic Application II

Measuring range	$\pm 4.2 \text{ g}$
Over range limit	$\pm 10 \text{ g}$
Absolute physical resolution	0.01 g
Cut-off frequency (-3 dB)	15 Hz; 30 Hz; 60 Hz

**Connectors and Wires**

Connector (1)	AMP 114-18063-076
Mating connector (1)	F02U.B00.435-01
Pin 1	Gnd
Pin 2	CANL
Pin 3	CANH
Pin 4	UBat
Wire with open end (2)	
Red wire	UBat
Black wire	Gnd
White wire	CANH
Blue wire	CANL
Connector (3)	ASL606-05PC-HE
Mating connector (3)	ASL006-05SC-HE
Pin 1	UBat
Pin 2	Gnd
Pin 3	CANH
Pin 4	CANL
Pin 5	Not connected
Sleeve	DR-25
Wire size with open end (2)	4 x AWG24
Wire length L	15 to 100 cm

**CAN Parameters**

Byte order	LSB (Intel)
CAN speed	1 Mbaud or 500 kbaud
Bit mask	unsigned
Offset (all signals)	0x8000 hex
Quantization Yaw Rate	0.005 [°/s/digit]
Quantization Roll Rate	0.005 [°/s/digit]
Quantization Acc X-axis	0.0001274 [g/digit]

Quantization Acc Y-axis	0.0001274 [g/digit]
Quantization Acc Z-axis	0.0001274 [g/digit]

**Installation Notes**

Mounting position: Connector opposite to driving direction.

The MM5.10 can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated fixing holes.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage and calibration sheet.

Please deliver the calibration sheet with your order placement.

Please note:

CAN ID 0x0170 (Rx) or 0x75 (Rx) is used for synchronization and configuration of the sensor (SYNC). Make sure that the CAN ID 0x170 (Rx) or 0x75 (Rx) is not used in your CAN network by any other device.

**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information****Acceleration Sensor MM5.10**

Without wire (1)

Order number **F02U.V01.511-02**

**Acceleration Sensor MM5.10**

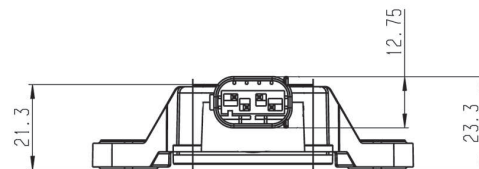
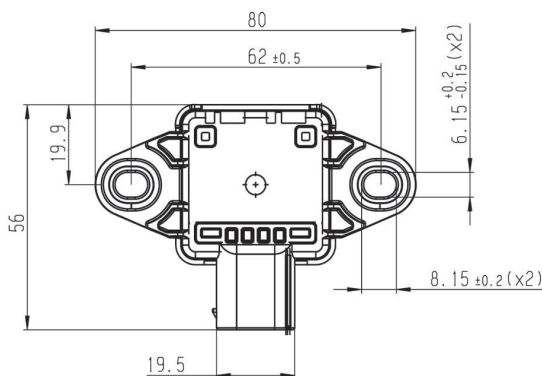
Wire with open end (2)

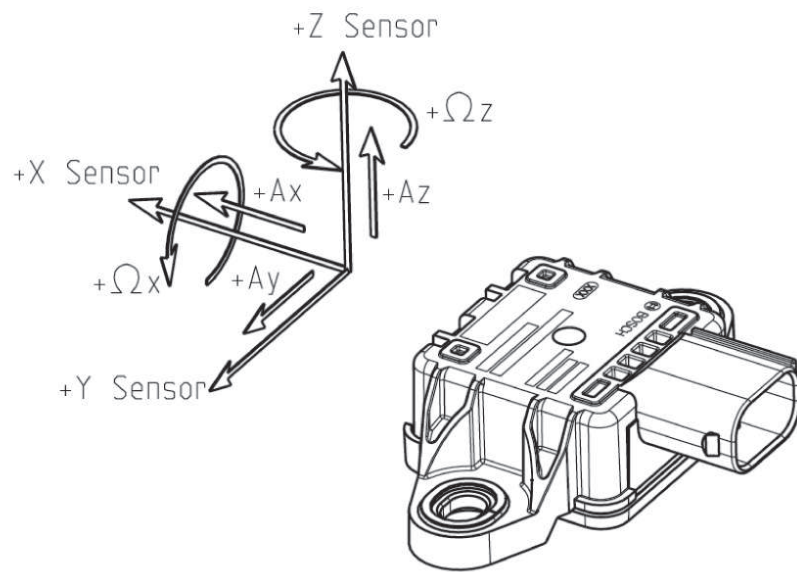
Order number **F02U.V01.511-92**

**Acceleration Sensor MM5.10**

Wire with motorsport connector (3)

Order number **F02U.V01.512-03**

**Dimensions**



Axis Scheme

## Acceleration Sensor MM5.10-R



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### Features

- ▶ Application 1:  $\pm 163^\circ/\text{s}$  (roll rate/ yaw rate)
- ▶ Application 2:  $\pm 4.2 \text{ g}$  (X, Y and Z acceleration)
- ▶ Weight w/o wire: 28 g
- ▶ Size: 34 x 34 x 16.5 mm
- ▶ Power supply: 7 to 18 V

The MM5.10-R was designed to measure the physical effects of rotational and linear acceleration. In order to achieve this, the sensor includes MEMS measuring elements connected to an appropriate integrated circuit.

A rotational acceleration around the integrated sensing elements generates a Coriolis force which changes the internal capacity of the micro machined sensing parts. Furthermore, a pure surface micro machined element is used to measure the vehicle lineal acceleration in all 3 axes. This combination of rotational and linear acceleration sensors enables a precise measurement of the vehicle dynamics.

The main features and benefits of this sensor are the aluminum compact housing, the combination of 3 linear and 2 rotational accelerometers and its high speed 1 Mbaud CAN-signal output.

### Application

Application I	$\pm 163^\circ/\text{s}$ (roll rate/yaw rate)
Application II	$\pm 4.2 \text{ g}$ (X, Y and Z acceleration)
Operating temperature range	-20 to 85°C

### Technical Specifications

#### Mechanical Data

Weight w/o wire	28 g
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Size	34 x 34 x 16.5 mm
------	-------------------

#### Electrical Data

Power supply	7 to 18 V
Max input current	90 mA
CAN speed	1 Mbaud or 500 kbaud

#### CAN Message

##### CAN ID 01 0x174

Byte	Value
0	Yaw rate
1	
2	Reserved
3	
4	Acc Y-axis
5	
6	Reserved
7	Unused

##### CAN ID 02 0x178

Byte	Value
0	Roll rate
1	
2	Reserved
3	
4	Acc X-axis
5	
6	Reserved
7	Unused

##### CAN ID 03 0x17C

Byte	Value
0	Reserved
1	
2	Reserved
3	
4	Acc Z-axis
5	
6	Reserved
7	Unused

#### Characteristic

##### Characteristic Application I

Measuring range	$\pm 160^\circ/\text{s}$
Over range limit	$\pm 1,000^\circ/\text{s}$
Absolute physical resolution	0.1°/s
Cut-off frequency (-3 dB)	15 Hz; 30 Hz; 60 Hz

##### Characteristic Application II

Measuring range	$\pm 4.2 \text{ g}$
Over range limit	$\pm 10 \text{ g}$

Absolute physical resolution	0.01 g
Cut-off frequency (-3 dB)	15 Hz; 30 Hz; 60 Hz

### Connectors and Wires

Connector	ASX002-05PA-HE
Mating connector	ASX602-05SA-HE
Pin 1	UBat
Pin 2	CANH
Pin 3	Not connected
Pin 4	CANL
Pin 5	Gnd
Sleeve	DR-25

### CAN Parameters

Byte order	LSB (Intel)
CAN speed	1 Mbaud or 500 kbaud
Bit mask	unsigned
Offset (all signals)	0x8000 hex
Quantization Yaw Rate	0.005 [°/s/digit]
Quantization Roll Rate	0.005 [°/s/digit]
Quantization Acc X-axis	0.0001274 [g/digit]
Quantization Acc Y-axis	0.0001274 [g/digit]
Quantization Acc Z-axis	0.0001274 [g/digit]

### Installation Notes

Mounting position: Connector opposite to driving direction.

The MM5.10-R can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated fixing holes.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing at our homepage and calibration sheet.

Please deliver the calibration sheet with your order placement.

Please note:

CAN ID 0x0170 (Rx) is used for synchronization and configuration of the sensor (SYNC). Make sure that the CAN ID 0x170 is not used in your can network by any other device.

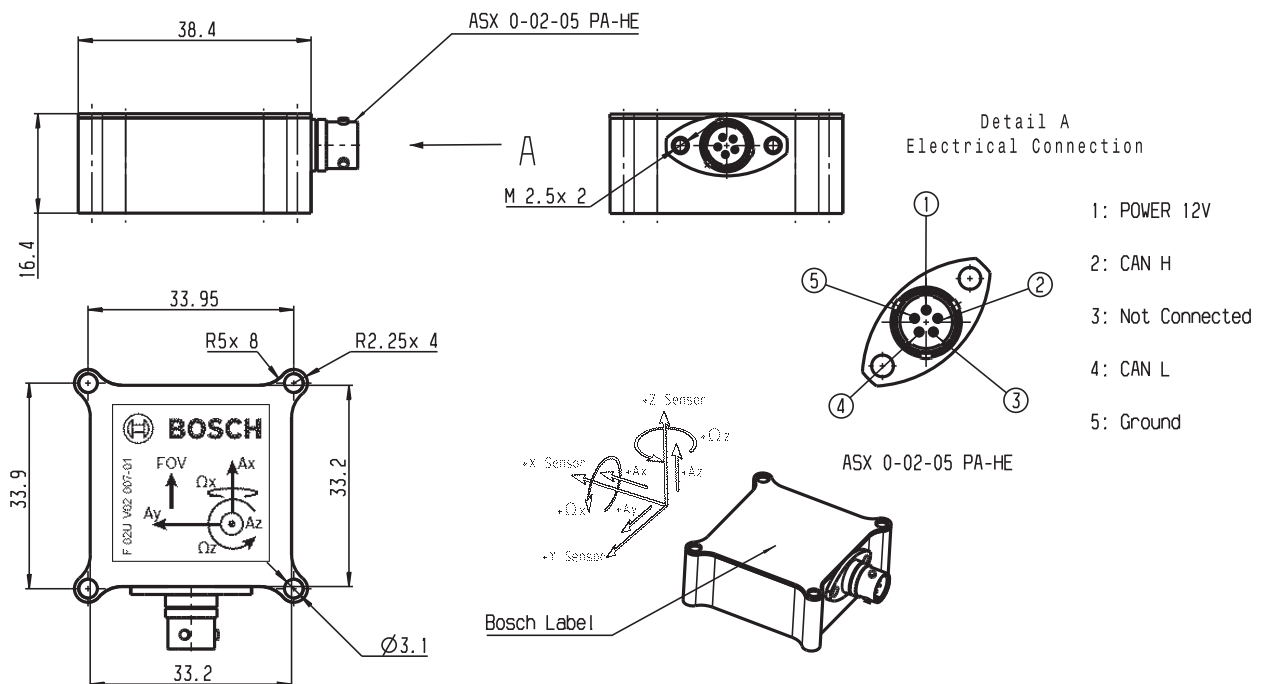
### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Acceleration Sensor MM5.10-R**  
Order number **F02U.V02.007-01**

### Dimensions





**Brake**

**8**

**ABS Systems**

**294**

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## Overview

### ABS M5 Kit



- Suitable for front-wheel, rear-wheel and four-wheel drive vehicles

### ABS M5 Kit Clubsport



- Suitable for front-wheel, rear-wheel and four-wheel drive vehicles
- Generic wiring harness to fit all engine bay and front foot well locations for the hydraulic module
- Same ABS hardware as standard ABS M5 Kit

### ABS M5 Kit Porsche Cup



- Plug & Play ABS M5 Kit for Porsche 997 Cup and 991 Cup Gen 1 and Gen 2
- Tested and developed on racetracks like Spa and Nordschleife
- Detailed installation instruction available at our website
- 1 Mbaud CAN



## ABS M5 Kit



### Features

- Suitable for front-wheel, rear-wheel and four-wheel drive vehicles

We developed ABS M5 for the operation in front-, rear- or 4-wheel drive vehicles. A vehicle specific wiring harness is included in the Kit.

The ABS M5 is specifically adapted for motorsport use. Individual car parameters like e.g. vehicle weight, vehicle track, wheel weights, wheel circumferences, wheel base or number of increments can be calibrated with software free of charge. Please contact your Bosch Motorsport dealer for further information.

### Technical Specifications

#### Variations

Option	Kit 1	Kit 2	Clubsport
F02U.V05.2	89-01	90-01	91-01 92-01 93-01 94-01 95-01 96-01
Customized wiring loom	+	+	-
ABS-Off position optional on position 1	+	+	-
Selection of ABS maps via Bosch 12-position switch or via specified CAN signal	+	+	+*
Motorsport connectors for wheel speed sensors	-	+	-
Flexible CAN terminals	+	+	+**
Downforce depending slip regulation	+	+	-

Option	Kit 1	Kit 2	Clubsport
Lateral acceleration slip regulation	+	+	-
Corner inside wheel slip reduction regulation	+	+	-

Find more details under **Dimensions**.

+\*: fixed Kit Content

+\*\*: Adjustable via Coding Plug

#### Mechanical Data

##### Hydraulic unit

Serial housing, dust- and damp-proof

Vibration damped circuit board

38 pin connector

2 hydraulic valves per wheel

2 brake circuits (front and rear)

2 hydraulic high pressures pumps

2 hydraulic accumulators 3 cm<sup>3</sup>/each

Standard fittings 2 x master cylinders M12 x 1  
4 x brake cylinders M10 x 1

Size 122 x 110 x 122 mm

Operating temperature -30 to 130°C

Max. shock 50 g less than 6 ms

#### Electrical Data

Supply voltage 10 to 16 V  
max. 24 V for 5 min

Max. peak voltage 35 V for 200 ms

Power consumption Pump 230 W

Power consumption Relay 170 W

Power consumption Electronics 8 W

#### Inputs

4 active wheel speed DF11i, DF11S or DF11V

Brake pressure (front brake circuit / rear brake circuit)

Longitudinal acceleration, lateral acceleration, yaw rate (MM5.10 sensor)

11 adjustment settings (applicable for OEMs)

ABS function can be deactivated (Pos. 1 or Pos. 12)

#### Outputs

ABS warning light (MIL)

EBD warning light (MIL) if needed

TTL wheel speed signal FL / FR / RL / RR

#### Content of Kit and Weights

Hydraulic unit	1,910 g
2 pressure sensors	40 g/each
Yaw/acceleration sensor	60 g
12 position function switch	50 g

4 wheel speed sensors DF11 standard	50 g/each
ABS warning light (MIL)	50 g
Vehicle specific wiring harness with motorsport connectors	Depends on version
Clubsport wiring harness	1,540 g
Mounting and vibration-dampening boards	80 g
Mounting board for hydraulic unit	212 g

### Optional Accessories

Data logger C 70	F02U.V02.302-01
Display DDU 9	F02U.V02.300-02
Display DDU 10	F02U.V02.659-01
Communication interface MSA Box II	F02U.V00.327-03
Wheel speed signal splitter with 1 motorsport connector	F02U.V01.928-01

### Communication

ABS and Yaw rate sensor	CAN1
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Diagnostics	MSA Box II
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### Ordering Information

<b>ABS M5 Kit 1</b> Order number <b>F02U.V05.289-01</b>
<b>ABS M5 Kit 2</b> Order number <b>F02U.V05.290-01</b>
<b>ABS M5 Kit Clubsport</b> DF11i, 500 kbaud Order number <b>F02U.V05.291-01</b>
<b>ABS M5 Kit Clubsport</b> DF11i, 1 Mbaud Order number <b>F02U.V05.292-01</b>
<b>ABS M5 Kit Clubsport</b> DF11S, 500 kbaud Order number <b>F02U.V05.293-01</b>
<b>ABS M5 Kit Clubsport</b> DF11S, 1 Mbaud Order number <b>F02U.V05.294-01</b>
<b>ABS M5 Kit Clubsport</b> DF11V, 500 kbaud Order number <b>F02U.V05.295-01</b>
<b>ABS M5 Kit Clubsport</b> DF11V, 1 Mbaud Order number <b>F02U.V05.296-01</b>

### Dimensions

#### ABS M5 Kit Variations

	ABS M5 Kit 1	ABS M5 Kit 2	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport
Type	Kit 1	Kit 2	1 Mbaud, DF11i	500 kbaud, DF11i	1 Mbaud, DF11S
Wiring harness	Specific	Specific	Generic	Generic	Generic
4 wheelspeed sensors DF11S	Included, with standard connectors	Included, with motorsport connectors	Not included	Not included	Included, with standard connectors
Wheel speed signal splitter	included*	Included*	included*	included*	included*
Fuses	Not included	Not included	Not included	Not included	Not included
Brake pipe fittings	Not included	Not included	Not included	Not included	Not included

	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport	ABS M5 Kit Porsche 991 Cup Gen 1	ABS M5 Kit Porsche 991 Cup Gen 2
Type	500 kbaud, DF11S	500 kbaud, DF11V	1 Mbaud, DF11V	Model year 2015	Model year 2017
Wiring harness	Generic	Generic	Generic	Specific	Specific
4 wheelspeed sensors DF11S	Included, with standard connectors	Not included	Not included	Included, Porsche specific DF11S	Included, Porsche specific DF11S
Wheel speed signal splitter TTL	included*	included*	included*	Included, DF11	Included, DF11
Fuses	Not included	Not included	Not included	Included	Included
Brake pipe fittings	Not included	Not included	Not included	Included	Included

\*TTL splitter incl. in ABS Hardware, DF11 splitter optional



**Ordering Information****ABS M5 Kit Clubsport**

DF11i, 500 kbaud

Order number **F02U.V05.291-01****ABS M5 Kit Clubsport**

DF11i, 1 Mbaud

Order number **F02U.V05.292-01****ABS M5 Kit Clubsport**

DF11S, 500 kbaud

Order number **F02U.V05.293-01****ABS M5 Kit Clubsport**

DF11S, 1 Mbaud

Order number **F02U.V05.294-01****ABS M5 Kit Clubsport**

DF11V, 500 kbaud

Order number **F02U.V05.295-01****ABS M5 Kit Clubsport**

DF11V, 1 Mbaud

Order number **F02U.V05.296-01**

## ABS M5 Kit Porsche Cup



### Features

- ▶ Plug & Play ABS M5 Kit for Porsche 997 Cup and 991 Cup Gen 1 and Gen 2
- ▶ Tested and developed on racetracks like Spa and Nordschleife
- ▶ Detailed installation instruction available at our website
- ▶ 1 Mbaud CAN

The ABS M5 Kit Porsche Cup is a derivative of the successful ABS M5 kit and specifically designed for Porsche 997 Cup and 991 Cup. A vehicle specific wiring harness is included in the kit. Individual car parameters like e.g. vehicle weight, vehicle track, wheel weights, wheel circumferences, wheel base or number of increments can be calibrated with software free of charge. Please contact your Bosch Motorsport dealer for further information.

### Technical Specifications

#### Variations

	997 Cup (System DF11S)	991 Cup (System DF11i)
4 wheel speed sensors	Included, Porsche specific DF11S	Not included, series sensors fit
ABS warning light (MIL)	Included	Included (LED type)
Brake pipe fittings	Not included	Included
Fuses	Not included	Included
Holder for Hydraulic unit	Included, standard	Included, Porsche specific

#### Mechanical Data

##### Hydraulic unit

Vibration damped circuit board

38 pin connector	
2 hydraulic valves per wheel	
2 brake circuits (front and rear)	
2 hydraulic accumulators 5 cm <sup>3</sup> /each	
Standard fittings	2 x master cylinders M12 x 1 4 x brake cylinders M10 x 1
Size	122 x 110 x 122 mm
Weight	1,910 g
Operating temperature	-30 to 130°C
Max. shock	50 g less than 6 ms

#### Electrical Data

Supply voltage	10 to 16 V, max. 24 V for 5 min
Max. peak voltage	35 V for 200 ms
Power consumption pump	230 W
Power consumption relay	170 W
Power consumption electronics	8 W

#### Inputs

4 active wheel speed DF11	
2 brake pressure (front brake circuit, rear brake circuit)	
Longitudinal acceleration	
Lateral acceleration	
12 position function switch:	<ul style="list-style-type: none"> <li>• 11 maps preconfigured</li> <li>• 1 switch position for ABS function OFF</li> </ul>

#### Outputs

ABS warning light (MIL)	
CAN channels: see manual	

#### Optional Accessories

Data logger C 70	F02U.V02.302-01
Display DDU 9	F02U.V02.300-02

#### Content of Kit

##### Hydraulic unit

Holder for Hydraulic unit	See Variations
4 Wheel speed sensors	See Variations
2 pressure sensors	
MM5.10 acceleration sensor	
Vibrations damping board for acceleration sensor	
12 position function switch	
ABS warning light (MIL)	See Variations
Specific wiring harness	
Brake pipe fittings	See Variations
Fuses	See Variations
Fuse mounting bracket	

**Required Content**

Brake pipes not included, available at Bosch Motorsport dealer

**Communication**

CAN via MSA Box II

**Ordering Information**

**ABS M5 Kit Porsche 997 Cup**  
Order number **F02U.V05.289-20**

**ABS M5 Kit Porsche 991 Cup Gen 1**  
2015 Model Year  
Order number **F02U.V05.289-18**

**ABS M5 Kit Porsche 991 Cup Gen 2**  
2017 Model Year  
Order number **F02U.V05.289-19**

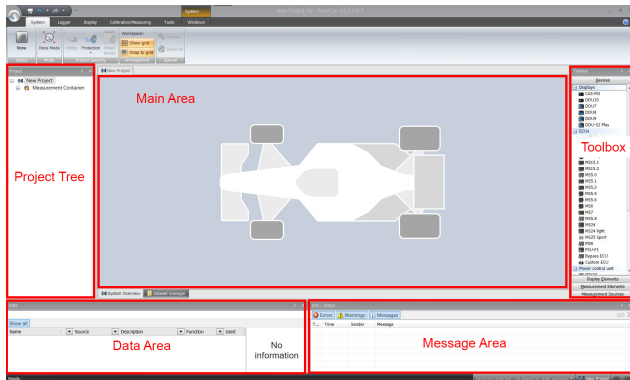
# Software

9

<b>Calibration</b>	<b>302</b>
<b>Simulation</b>	<b>303</b>
<b>Analysis</b>	<b>306</b>
<b>Customer Code Area</b>	<b>308</b>

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## Calibration Tool RaceCon



### Features

- ▶ An all integrated software tool for configuration and calibration

RaceCon is an all integrated software tool for configuration and calibration of Bosch Motorsport hardware products, such as ECUs, displays, loggers. The communication is based on Bosch Motorsport MSA-Box interface.

### Application

Calibration of ECU maps and curves  
ECU data file up- and download

Parameter file up- and download  
Diagnostic functionality for Bosch Motorsport ECUs  
Data file / Work base management  
Integrated flash functionality  
Integrated Bosch sensor database  
Configuration of Bosch Motorsport displays  
Configuration of Bosch Motorsport data loggers  
Configuration of Bosch Motorsport CAN modules  
Communication via K-Line/CAN/Ethernet (KWP/CCP/XCP)  
CAN communication log functionality (baud rate changeable)  
Quick data access over Race Mode  
Intuitive design, easy to use

### Technical Specifications

#### Environment

##### PC

IBM PC Pentium/AMD Athlon compatible, min. 1.6 GHz  
Min. 2 GB RAM  
Min. 1 GB free hard disc space  
VGA/WGA monitor (min. 1,024 x 768)  
Recommended Operation System Windows 10

#### Optional Accessories

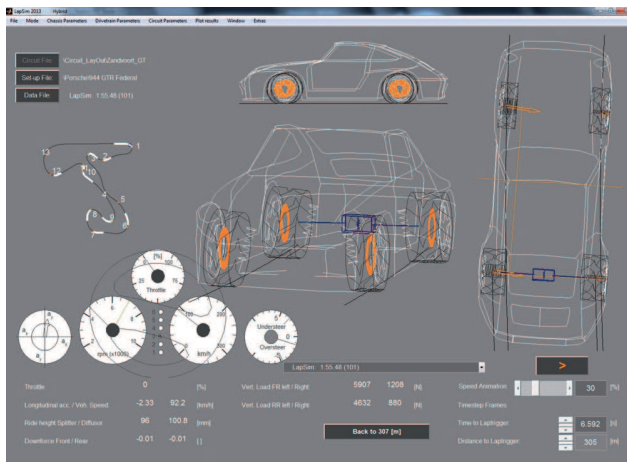
MSA-Box II F02U.V00.327-03

### Ordering Information

**Calibration Tool RaceCon**  
Order number **free download at our homepage**



## Simulation Tool LapSim



### Features

- ▶ Professional Simulation Tool
- ▶ Free / Chassis / Engine Versions available
- ▶ Find the Operation Manual here.
- ▶ Find the Installation Manual here.

#### LapSim Chassis

is both an analysis tool as well as a vehicle simulation program. By further processing the on-car recorded data, using parts of the simulation models, a much more profound analysis of the vehicle behavior can be gained. Due to the direct link with the simulation model, vehicle parameters can be validated like aerodynamics, tire behavior, engine power, as well as driver performance. The visualization of the vehicle behavior creates a much easier and better understanding of the influence of several vehicle parameters on the performance independent of the technical background of the user.

#### LapSim Engine

supplies an easy to use engine simulation package capable of generating a torque/power and a corresponding ignition curves out of the main parameters of an engine. The model is able to simulate any 4-stroke spark ignition (SI) race engine currently seen on the market, with or without air restrictor(s). To summarize, the engine software is aiming for 95 % accuracy but 5 % the effort of complex engine software packages. The engine software avoids a vast number of variables in order to define every engine detail, in order to improve usability as well as computational performance. The engine package is integrated in the lap simulation.

### Application

#### Data Analysis

Post processing of the on-car recorded data with simulation models. Calculating vehicle handling state, aerodynamics, differential function, etc.

Determination of tire parameters out of on-car recorded data. Possibility to analyze tire performance over the laps.

Direct comparison between several outings and/or simulation model.

3D Animation of vehicle behavior for a better and more thorough understanding.

By comparing recorded data with simulation data a validation possibility of vehicle parameters and vehicle functioning is made.

LapSim software adds all vehicle parameters to WinDarab Files and creates automatic database.

#### Chassis Simulation model

Practical Pacejka like tire model. Tire parameters can easily be determined out of on-car recorded data. No tire data required.

Full vehicle model including limited slip (or visco-) differential  
3D aero maps

Ride height dependent suspension kinematics

Calculation time 3-4 times faster than real car

(PVI - 3 GHz)

Automatic set-up optimization

#### Engine Simulation model

Engine model generates torque/power curve as well as ignition angle

Normally aspirated engines, with or without restrictor

2,3,4 and 5 valve cylinder heads

2-zone burn model in order to cope with all possible compression ratios and chamber geometries

Ignition point is determined by adjustable maximum pressure in cylinder

Fully adjustable camshaft profile

Engine model generates pressure curve over 720° crankshaft, which is integrated to calculate engine torque/power

10 seconds calculation time for 0 to 10,000 rpm range

### Ordering Information

#### LapSim Chassis Free Version

Order number **free download at our homepage**

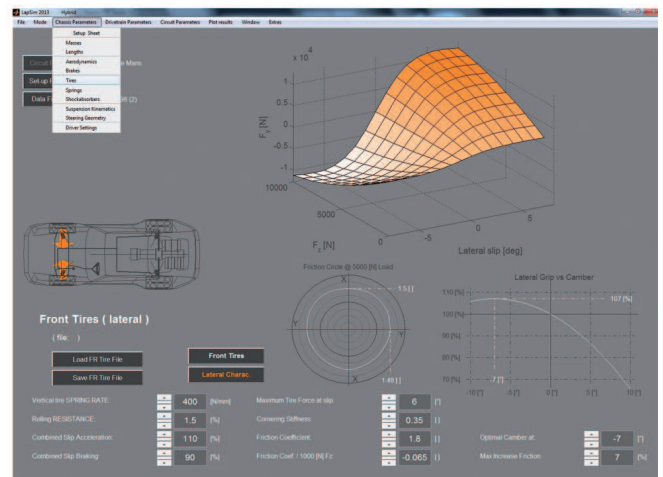
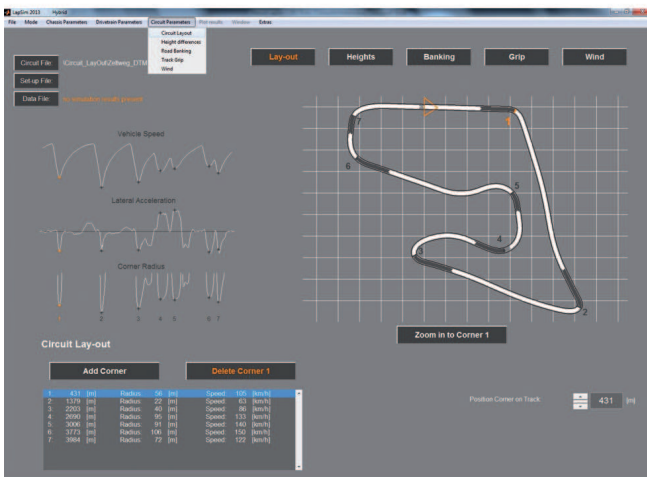
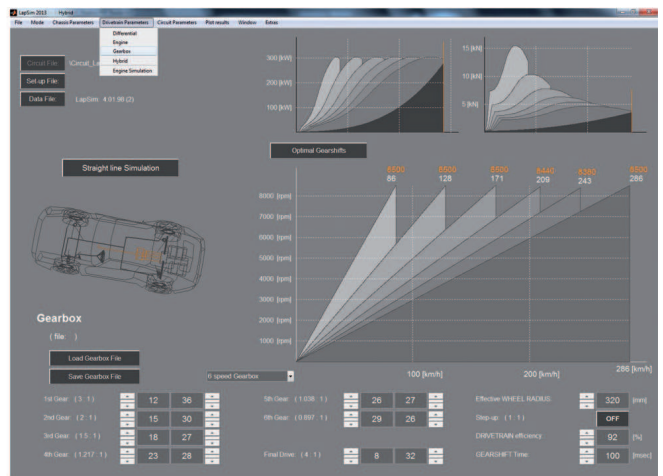
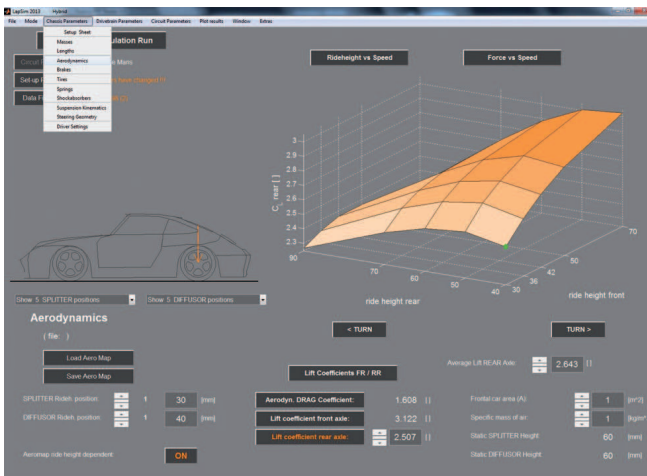
#### LapSim Chassis License

Order number **B261.206.432-01**

#### LapSim Chassis and Engine License

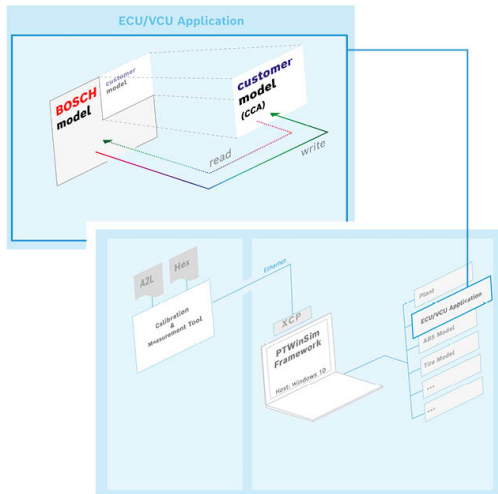
Order number **F01T.A20.057-01**

Dimensions



A few Screenshots

## Simulation Packages



### Features

- ▶ Simulate Bosch model and Customer model together in the same simulation environment
- ▶ Develop Bosch Motorsport control systems (ECU/VCU) in a simulation environment with other plant models (e.g. tire, ABS)
- ▶ Enables use of Bosch models (via *PTWinSim*) in other simulation environments like *rFpro*
- ▶ Execute your control system faster than real-time on a Windows 10 PC
- ▶ Perform real-time analysis on telemetry streams or other data sources

These simulation packages allow customers that use Bosch Motorsport control systems to simulate the functionality without using the hardware. These packages enable the user to run Bosch Motorsport and customer code area functions within the *PTWinSim*® environment.

*PTWinSim*® provides a framework and supporting functionality enabling several applications to execute in a coherent time frame on a variety of hosts. Applications ranging from Engine Control Unit code to vehicle system models with complex control algorithms are simply adapted for the simulation environment. Furthermore, with WinDarab COM API, Bosch Motorsport customers can use WinDarab datasets as stimuli and logging for their simulated control system.

Device Simulation Runtime provides the runtime licenses to run a Bosch Motorsport simulation package within *PTWinSim*®. This requires an individual and project specific simulation software, which needs to be ordered separately.

CCA Simulation Package also provides the option for users of CCA to generate their own simulation software. Device Simulation Runtime is included.

### Technical Specifications

Recommended Operation System Windows 10, min. Update Version 1803

### Required and not included Software

MathWorks Requirements	CCA S.P.*	Device S.P.*
MATLAB R2018b	x	
Simulink	x	
Real-Time Workshop	x	
Real-Time Workshop Embedded Coder	x	
Fixed-Point Toolbox	x	
Simulink Fixed-Point	x	
Stateflow	x	
Stateflow Coder	x	
Vehicle Network Toolbox	x	
Min. <i>PTWinSim</i> 4.09	x	x
Compiler		
Microsoft Visual Studio, Version 2017	x	x
Application tool		
RaceCon 2.7 or later	x	x

\*S.P.: Simulation Package

### Ordering Information

#### CCA Simulation Package

CCA Simulation development target to build and execute customer code.

Including 1 Device Simulation Runtime license and 1 year maintenance.

Order number **F02U.V02.893-01**

#### Device Simulation Runtime

Device Simulation Runtime license to execute simulation on a PC and 1 year maintenance

Order number **F02U.V02.891-01**

#### CCA Simulation Package Annual Maintenance

Order number **F02U.V02.892-01**

#### Device Simulation Runtime Annual Maintenance

Order number **F02U.V02.890-01**

## Analysis Tool WinDarab V7



### Features

- ▶ State of the art user interface
- ▶ Versatile diagrams
- ▶ Numerous analysis functions
- ▶ Customizable mathematical channels and filters
- ▶ Software based license without dongle

WinDarab V7 is an evaluation tool for monitoring and analyzing of logged data and is specially designed for motorsport use. Monitor vehicle data using on-line telemetry and compare logged data by reading out your data logger. WinDarab V7 features a state of the art user interface and reads out both engine and chassis data.

The follower of WinDarab V6 offers simplified and ergonomic handling as well as new features and a revised license system to work without a dongle. Choose between the *Free* and the *Expert* version depending on your purpose.

The enormous bandwidth of features makes WinDarab V7 a perfect evaluation tool for motorsport engineers.

### Application

#### Diagrams

Oscilloscope  
X-/Y-plot to create scatterbands  
Histogram  
3D-diagram

#### Analysis

Overlay of different laps  
Time or distance based analysis  
Absolute and relative values  
One-touch channel statistics (min./max., avg., etc.)

Regression lines, user defined lines  
Lap reports and lap based comparisons  
Replay offline data in realtime

#### Advanced Analysis

User defined math channels  
User defined conditions to filter data  
FFT analysis

#### Racetracks

Racetrack creation based on v/acc or GPS data  
Racetrack segmentation

#### Telemetry

Replay online data in realtime  
Gauges for realtime visualization

#### User Interface

Flexible display setup and arrangement  
Storable display setup and arrangement  
Lap browser

#### Data Transmission

Direct data input without intermediate hardware  
Protection/encryption of logged data files  
ASCII import and export

#### License System

Dongle-free working in all WinDarab V7 variations  
Activation/update via internet  
Annual maintenance for up-to-date versions

#### Environment

##### PC

IBM PC Pentium/AMD Athlon compatible, min. 1.6 GHz  
Min. 1 GB RAM  
Min. 1 GB free HD space  
VGA / WGA monitor (min. 1,024 x 768)  
Recommended Operation System Windows 10

### Technical Specifications

#### Variations

	Free	Expert
Max. open files	4	unlimited
Max. measuring data windows	2	unlimited
Max. areas in measuring data windows	4	unlimited
Histogram	+	+
x/y-plot	+	+
Distribution	+	+
min/max-tables	+	+
Fourier-transformation	+	+

Outing report	+	+
Lap analysis	-	+
Flowcharts	-	+
Instrument panel	+	+
User defined physical units	+	+
Racetrack generation via speed/lateral G or GPS	+	+
ASCII export	+	+
Available operators for math channels.	+, -, *, /, ^, <i>sqr (x), sqrt (x)</i>	All
Extras settings/comments	-	+

Desktop load/save	+	+
Telemetry	+	+
Programming interface (API)	-	Opt.

### Ordering Information

#### WinDarab Free Version

Order number **free download at our homepage**

#### WinDarab Expert

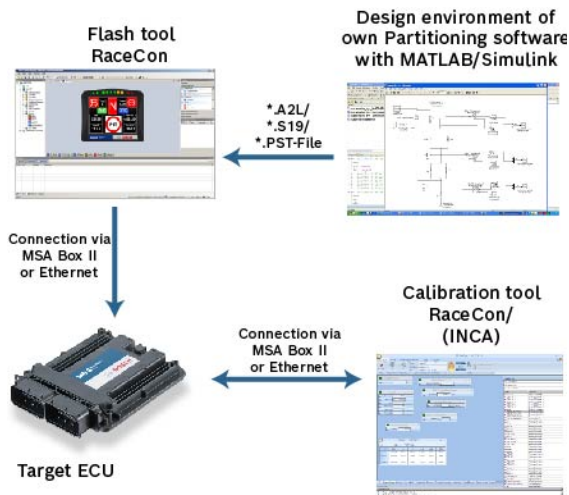
Order number **F02U.V01.308-01**

#### Software Options

#### Software licence API for WinDarab Expert

Order number **F02U.V01.682-01**

## Customer Code Area CCA



### Features

- ▶ Calculation directly in Bosch main ECU possible
- ▶ Communication binding via Software free cuts
- ▶ Unlimited bandwidth interfaces
- ▶ One Box Design (compact solution, no extra weight)

Bosch provides the option to run software code on Bosch ECUs that has been developed by our customers. This code is run in the customer code area (CCA) and is protected against access of anyone else. Within the engine ECU families MS 6 and MS 7 this feature can be run in parallel to all engine ECU functionality.

We deliver it with a full environment for Matlab/Simulink, a compiled Bosch Motorsport model as library and a package of Matlab/Simulink interfaces to all I/Os.

### Technical Specifications

#### General Functions

Support for generating executables that include algorithm, device-driver and real-time operating system

Multitasking scheduling using time synchronous (and asynchronous) tasks, task pre-emption and temporary task overruns

Environment for Matlab/Simulink

Full I/O access with Bosch-Motorsport device drivers

Full read access to all Bosch signals

Development environment with reduced Bosch "unit\_blockset"

Real time calibration

Calibration and measurement interface XCP via Ethernet

SW-Download via Bosch Motorsport calibration tool RaceCon

Software option for all MS 6.x, MS 7.x

Free maintenance for the first 12 month, afterwards with costs.

### Required and not included Software

Operation System: Windows 10

MathWorks Requirements

MATLAB R2018b

Simulink

Real-Time Workshop

Real-Time Workshop Embedded Coder

Fixed-Point Toolbox

Simulink Fixed-Point

Stateflow

Stateflow Coder

Vehicle Network Toolbox

Compiler

Wind River

### Development Hints

Depending on your experiences with SW-Development of Bosch Motorsport ECUs, we recommend SW-Development support from Bosch Motorsport.

### Ordering Information

#### Customer Code Area CCA

Onetime payment for development environment and first .pst will be offered on request.

Order number **on request**

#### Accessories

**Hardware upgrade for CCA per device for MS 6.x, MS 7.x**

Order number **F02U.V02.137-01**

**More**

**10**

<b>Breakout Boxes</b>	<b>310</b>
<b>Communication Interface</b>	<b>316</b>
<b>Connector Opening Tool</b>	<b>317</b>
<b>Connectors</b>	<b>318</b>
<b>Wiring Harnesses</b>	<b>319</b>

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## Overview

**Breakout Box BOB 66-pole**



**Breakout Box BOB MS 6**



**Breakout Box BOB MS 7**



**Breakout Box BOB PBX 90**



- Compact, lightweight housing in low-profile design with high-density packaging
  - Robust 4 mm standard jacks for measuring leads
  - Signal integrity of high-speed data links ensured by product-specific version
  - Standard configurations and fully customized versions available
  - No more lost jumpers due to patented 90° rotatable connectors
- Compact, lightweight housing in low-profile design with high-density packaging
  - Robust 4 mm standard jacks for measuring leads
  - Signal integrity of high-speed data links ensured by product-specific version
  - Standard configurations and fully customized versions available
  - No more lost jumpers due to patented 90° rotatable connectors
- Compact, lightweight housing in low-profile design with high-density packaging
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  - Signal integrity of high-speed data links ensured by product-specific version
  - Standard configurations and fully customized versions available
  - No more lost jumpers due to patented 90° rotatable connectors
- Compact, lightweight housing in low-profile design with high-density packaging
  - Robust 4 mm standard jacks for measuring leads
  - Signal integrity of high-speed data links ensured by product-specific version
  - Standard configurations and fully customized versions available
  - No more lost jumpers due to patented 90° rotatable connectors

10

**Breakout Box BOB PBX 190**



- Compact, lightweight housing in low-profile design with high-density packaging
- Robust 4 mm standard jacks for measuring leads
- Signal integrity of high-speed data links ensured by product-specific version
- No more lost jumpers due to patented 90° rotatable connectors



## Breakout Box BOB 66-pole



### Features

- ▶ Compact, lightweight housing in low-profile design with high-density packaging
- ▶ Robust 4 mm standard jacks for measuring leads
- ▶ Signal integrity of high-speed data links ensured by product-specific version
- ▶ Standard configurations and fully customized versions available
- ▶ No more lost jumpers due to patented 90° rotatable connectors

The Breakout Box BOB enables the operator to perform measurements and modify connections during operation. The jumpers allow to individually open or close each single connection without removing the jumper. Jacks provide access to all signals for measurement purposes. The box is essential for development and test environments in the lab and vehicle.

### Technical Specifications

#### Mechanical Data

Size	225 x 130 x 35 mm
------	-------------------

Weight	1,100 g
4 mm standard jacks for measuring leads	66

#### Connectors and Wires

F02U.V02.295-01 code blue	
Connector on housing	AS018-35PB
Connector on wire	AS618-35SB
F02U.V02.296-01 code orange	
Connector on housing	AS018-35PC
Connector on wire	AS618-35SC
F02U.V02.297-01 code red	
Connector on housing	AS018-35PN
Connector on wire	AS618-35SN
F02U.V02.298-01 code yellow	
Connector on housing	AS018-35PA
Connector on wire	AS618-35SA
F02U.V02.299-01 code violet (universal)	
Connector on housing	AS018-35PU
Connector on wire	AS618-35SU
Wire length L (all)	Ca. 50 cm

#### Ordering Information

##### Breakout Box BOB 66-pole

Connector code: orange  
Order number **F02U.V02.296-01**

##### Breakout Box BOB 66-pole

Connector code: red  
Order number **F02U.V02.297-01**

##### Breakout Box BOB 66-pole

Connector code: violet (universal use)  
Order number **F02U.V02.299-01**

#### Accessories

##### Breakout Box BOB 66-pole

Connector code: blue  
Order number **F02U.V02.295-01**

##### Breakout Box BOB 66-pole

Connector code: yellow  
Order number **F02U.V02.298-01**

## Breakout Box BOB MS 6



### Features

- ▶ Compact, lightweight housing in low-profile design with high-density packaging
- ▶ Robust 4 mm standard jacks for measuring leads
- ▶ Signal integrity of high-speed data links ensured by product-specific version
- ▶ Standard configurations and fully customized versions available
- ▶ No more lost jumpers due to patented 90° rotatable connectors

The Breakout Box BOB enables the operator to perform measurements and modify connections during operation. The jumpers allow to individually open or close each single connection without removing the jumper. Jacks provide access to all signals for measurement purposes. The box is essential for development and test environments in the lab and vehicle. This version was especially developed for use with Engine Control Units MS 6.

### Technical Specifications

#### Mechanical Data

Size	355 x 270 x 50 mm
Weight	4,100 g
4 mm standard jacks for measuring leads	176
Ethernet connectors	4
Ethernet wire	2 x inclusive
USB connectors	2
USB jumper	inclusive

#### Connectors and Wires

Wire length L	2 x 60 cm
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### Ordering Information

**Breakout Box BOB MS 6**  
Order number **F02U.V02.294-01**

## Breakout Box BOB MS 7



### Features

- ▶ Compact, lightweight housing in low-profile design with high-density packaging
- ▶ Robust 4 mm standard jacks for measuring leads
- ▶ Signal integrity of high-speed data links ensured by product-specific version
- ▶ Standard configurations and fully customized versions available
- ▶ No more lost jumpers due to patented 90° rotatable connectors

The Breakout Box BOB enables the operator to perform measurements and modify connections during operation. The jumpers allow to individually open or close each single connection without removing the jumper. Jacks provide access to all signals for measurement purposes. The box is essential for development and test environments in the lab and vehicle. This version was especially developed for use with the LIFE connector of Engine Control Units MS 7 and Vehicle Control Unit VCU.

### Ordering Information

#### Breakout Box BOB MS 7

Connector code: red

Order number **F02U.V02.293-01**

## Breakout Box BOB PBX 90



### Features

- ▶ Compact, lightweight housing in low-profile design with high-density packaging
- ▶ Robust 4 mm standard jacks for measuring leads
- ▶ Signal integrity of high-speed data links ensured by product-specific version
- ▶ Standard configurations and fully customized versions available
- ▶ No more lost jumpers due to patented 90° rotatable connectors

The Breakout Box BOB enables the operator to perform measurements and modify connections during operation. The jumpers allow to individually open or close each single connection without removing the jumper. Jacks provide access to all signals for measurement purposes. The box is essential for development and test environments in the lab and vehicle. This version was especially developed for use with PowerBox PBX 90.

### Technical Specifications

#### Mechanical Data

Size	255 x 220 x 45 mm
Weight	2,400 g
4 mm standard jacks for measuring leads	68
Ethernet connectors	4
Ethernet wire	2 x inclusive

#### Connectors and Wires

Wire length L	2 x 60 cm
---------------	-----------

### Ordering Information

**Breakout Box BOB PBX 90**  
Order number **F02U.V02.292-01**

## Breakout Box BOB PBX 190



### Features

- ▶ Compact, lightweight housing in low-profile design with high-density packaging
- ▶ Robust 4 mm standard jacks for measuring leads
- ▶ Signal integrity of high-speed data links ensured by product-specific version
- ▶ No more lost jumpers due to patented 90° rotatable connectors

The Breakout Box BOB enables the operator to perform measurements and modify connections during operation. The jumpers allow to individually open or close each single connection without removing the jumper. Jacks provide access to all signals for measurement purposes. The box is essential for development and test environments in the lab and vehicle. This version was especially developed for use with PowerBox PBX 190.

### Technical Specifications

#### Mechanical Data

Size	355 x 265 x 50 mm
Weight	5,800 g
4 mm standard jacks for measuring leads	112
Ethernet connectors	8
Ethernet wire	4 x inclusive

#### Connectors and Wires

Wire length L	2 x 4 x 55 cm
---------------	---------------

### Ordering Information

**Breakout Box BOB PBX 190**  
Order number **F02U.V02.523-01**

## Com Interface MSA-Box II



### Features

- Communication interface for PC-supported calibration on K-line, CAN or Ethernet interface

The MSA-Box II is the low cost unit for PC-supported calibration and configuration on Ethernet, K-Line or CAN interface of an ECU.

The MSA-Box II is coupled to the PC via the USB interface. This ensures a powerful and universal link to all common PCs. The coupling to the ECU is effected via Ethernet, K-Line or CAN-interface of the diagnosis interface.

### Technical Specifications

#### Mechanical Data

Size	84 x 38 x 25 mm
Temperature range	0 to 70°C
Compact design	
Fully suitable for motor vehicle use	
All inputs and outputs to the PC with galvanic separation	

#### Electrical Data

Input voltage (vehicle side)	8 to 32 V
Power supply through the connection to the ECU from board mains with galvanic separation	
Power consumption (powered by USB)	Typ. 0.5 W
USB	USB 2.0, high speed (480 MBit/sec)
Ethernet	100 MBit/sec
K-Line	300 Bd up to 320 kBd
CAN	10 kBit/s up to 1 MBit/s
Recommended Operation System	Windows 10

#### Connectors and Wires

Connector AS612-35PN	F02U.000.441-01
Mating connector AS012-35SN	F02U.000.258-01
Pin 1	Terminal 30 (permanent pos)
Pin 2	Terminal 15 (switch pos)
Pin 3	GND
Pin 4	CAN_High
Pin 10	K-Line
Pin 8	RxD+
Pin 9	RxD-
Pin 11	TxD+
Pin 12	TxD-
Pin 16	CAN_Low
Pin 22	SCR
Diagnosis wire length	2 m
USB wire length	0.5 m

#### Ordering Information

##### Com Interface MSA-Box II

Order number **F02U.V00.327-03**

## Connector Opening Tool for AS series



### Features

- ▶ Quick and easy opening of ECU connectors

The Connector Opening Tool helps you to open connectors of ECUs like MS 7.4.

### Technical Specifications

#### Mechanical Data

Material	Stainless steel
----------	-----------------

### Ordering Information

#### Opening tool for shellsize 16

Order number **F02U.V01.393-01**

#### Opening tool for shellsize 18

Order number **F02U.V01.394-01**

## Connectors



### Features

- ▶ Bosch Jetronic and Compact connectors inclusive contacts and sealings
- ▶ Autosport connectors from Deutsch, Tyco, etc.
- ▶ Connectors with 3 to 128 pins

Convenient to the Wiring Harnesses, we have a wide range of connectors on offer.

From single pin and Bosch series connectors above TE-connectors to Deutsch-motorsport connectors, you can choose from a big variation.

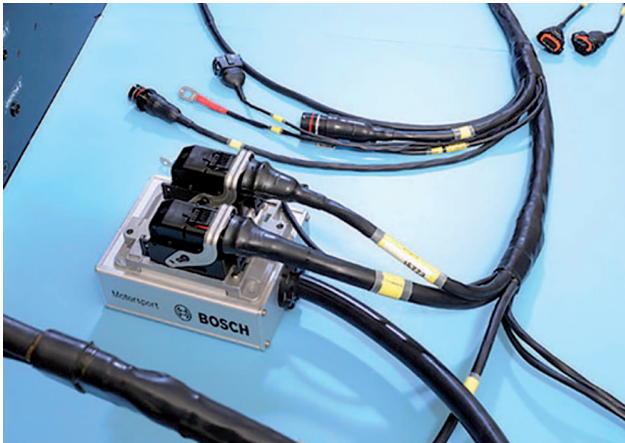
You can get from us different Deutsch-motorsport connectors of the series AS, ASL, ASU, ASX and ASDD. According to the series, these are 3 to 128-pin connectors.

At Bosch connectors you can choose from connectors of the Jetronic or Compact series. Furthermore you receive convenient contacts and sealings to our Bosch-connectors.

If you are interested, give us a call!



## Customized Wiring Harnesses



### Features

- ▶ One-stop-shop for consulting, manufacturing, development and service
- ▶ Manufacture of individual pieces and small batches
- ▶ Use of the highest quality materials
- ▶ Full test coverage based on the latest testing equipment for all products
- ▶ The complete package, from a single pin to a complete wiring harness

### Our expertise

Bosch Motorsport specialists have decades of experience in design and manufacture of customized wiring solutions for race cars and prototypes.

Increasing complexity in race cars necessitates a high degree of understanding in the electrical architecture of the project. We provide to you the extensive system know-how and the expertise of our specialists.

As a system supplier, we are familiar with the full spectrum of electronic requirements of the components in a racecar – from high current and high voltage applications to high-speed data networks.

### Our offer

Whether it is complete vehicle wiring, test equipment or a simple adapter – we design, plan, construct and test according to your individual requirements and requests.

If you want to build your wiring yourself, we also offer consulting and development support independently from our manufacturing services.

Give us a call!



# Appendix

11

<b>General Information</b>	<b>322</b>
<b>Vibration Profiles</b>	<b>323</b>

---

## General Information

### ESD, Handling and Transport

Please be mindful of the specifications concerning ESD. Never grab into the connectors. Please follow the regulations when transporting devices (e.g. ESD packaging materials).

### Service

To ensure full functionality every time, Bosch Motorsport recommends annual functional testing of all equipment.

### Battery

Some of the devices use Lithium-Ion batteries. Please use extra caution to be certain that the correct removal procedure is followed. Abide by the maintenance cycle schedule to ensure correct operation. Bosch Motorsport recommends maintenance once a year.

### Installation

The correct installation extends reliability and durability. Please follow the specifications regarding temperature, humidity, vibration and liquid compatibility.

## Vibration Profile 1

### Broadband noise: 8h/direction

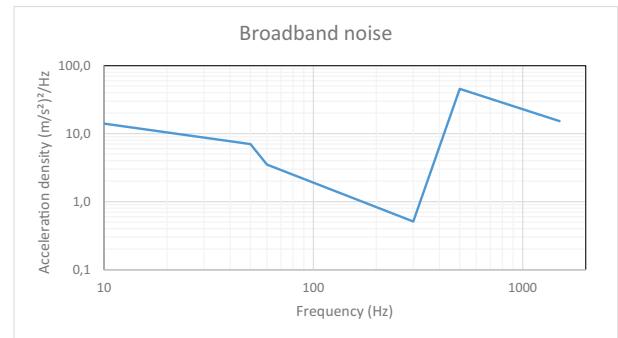
Frequency (Hz)	Acceleration density (m/s <sup>2</sup> ) <sup>2</sup> /Hz
20	50.4
55	26.0
180	1.0
300	1.0
360	0.56
1,000	0.6
2,000	0.6
Effective value $a_{\text{Eff}}$	55.4 m/s <sup>2</sup>

### Sine: 8h/direction

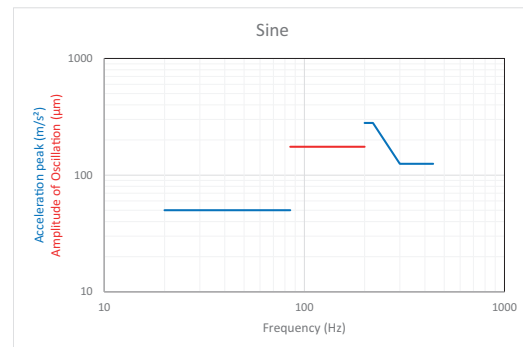
Alteration rate of frequency: 2.4 oct./min

Frequency (Hz)	Acceleration peak (m/s <sup>2</sup> )
100	50
180	200
250	200
350	60
2,000	60

## Dimensions



### Broadband noise



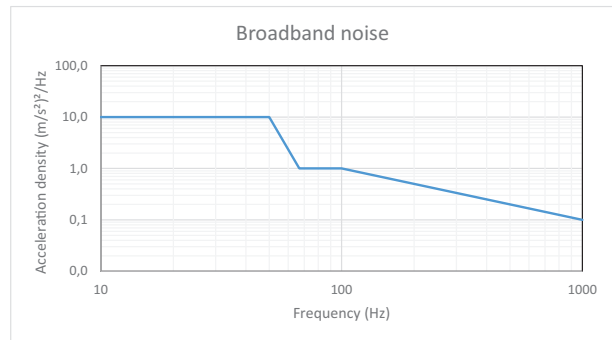
### Sine

## Vibration Profile 2

### Broadband noise: 8h/direction

Frequency (Hz)	Acceleration density (m/s <sup>2</sup> ) <sup>2</sup> /Hz
10	10.0
50	10.0
66.7	1.0
100	1.0
1,000	0.1
Effective value $a_{\text{Eff}}$	26.9 m/s <sup>2</sup>

### Dimensions



Broadband noise

## Vibration Profile 3

### Broadband noise

Frequency (Hz)	Acceleration density (m/s <sup>2</sup> ) <sup>2</sup> /Hz
10	14.0
50	7.0
60	3.5
300	0.5
500	45.6
1,500	15.3
Effective value a <sub>Eff</sub>	168 m/s <sup>2</sup>

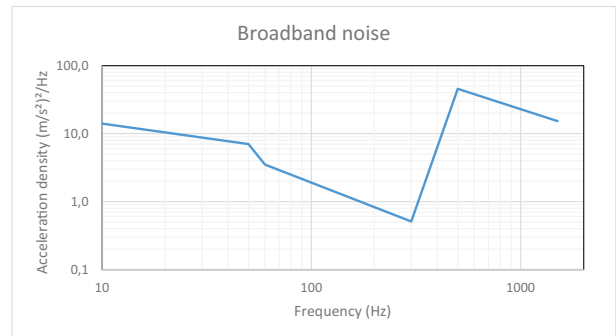
### Sine

Alteration rate of frequency: 1 oct./min

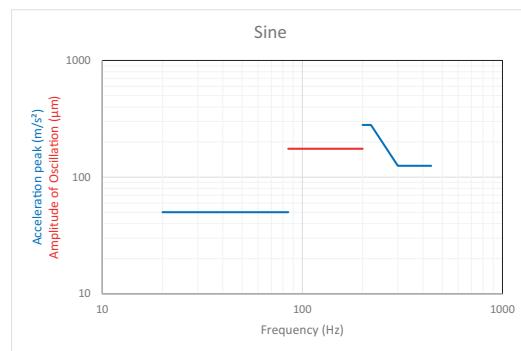
Frequency (Hz)	Amplitude of acceleration (m/s <sup>2</sup> )	Amplitude of oscillation lane (µm)
20	50	
85	50	
85		175
200		175
200	280	
220	280	
300	125	

Frequency (Hz)	Amplitude of acceleration (m/s <sup>2</sup> )	Amplitude of oscillation lane (µm)
440	125	

### Dimensions



Broadband noise



Sine

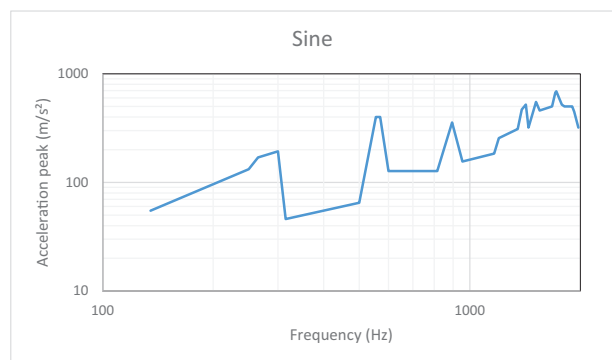
## Vibration Profile 4

### Sine 80h/direction

Frequency (Hz)	Acceleration peak (m/s <sup>2</sup> )
135	55
250	132
265	170
300	193
315	46
500	65
555	400
570	400
600	127
815	127
895	356
955	156
1165	184
1200	256
1350	310
1385	470
1420	520
1445	320

Frequency (Hz)	Acceleration peak (m/s <sup>2</sup> )
1515	550
1550	460
1675	500
1710	670
1720	690
1780	520
1810	500
1900	500
1925	448
1975	320

### Dimensions



Sine

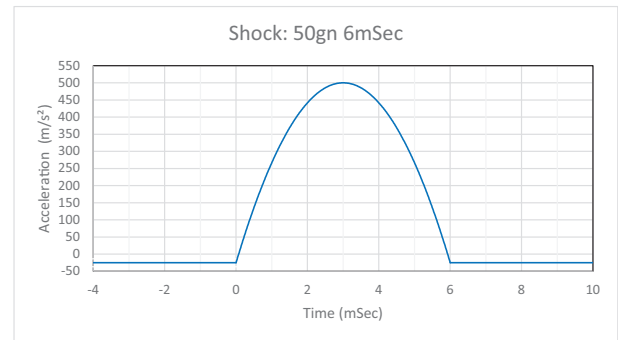


## Shock

**Shock: 10 shocks (pos. and neg.) / direction**  
50gn 6mSec ISO 16750-3

Time (mSec)	Acceleration Density (m/s <sup>2</sup> ) <sup>2</sup> /Hz
-4	-25
0	-25
3	500
6	-25
10	-25

## Dimensions





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Motorsport**

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