

# Equipment for High Performance Vehicles

Edition 2019

## Bosch Motorsport



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Invented for life



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# 01 Control Units






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<b>Engine Control Units Gasoline</b>	<b>12</b>
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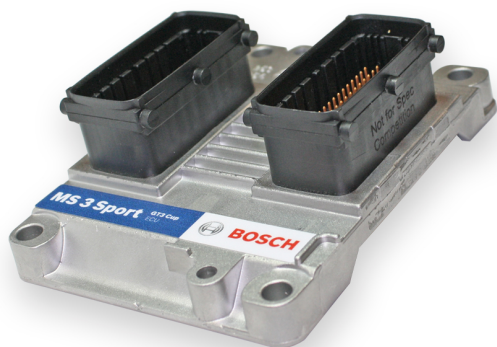
## Gasoline Engine Control Units Overview

1

Type	Engine Control Unit MS 3 Sport GT3 Cup	Engine Control Unit MS 6.1	Engine Control Unit MS 6.2	Engine Control Unit MS 6.3	Engine Control Unit MS 6.4
					
Low pressure	+	+	+	+	+
High pressure	-	-	-	+	+
HP package for 2 <sup>nd</sup> bank	-	-	-	Opt.	+
Cam ctrl, El. throttle ctrl, Turbo ctrl	El. throttle ctrl	Opt	+	+	+
Launch ctrl, Traction ctrl	Traction ctrl	Opt	+	+	+
Analogue inputs		21	41	21	41
Max. cyl./bank	22	12/2	12/2	12/1 (2 with HP package)	12/2
Lambda ctrl	Dual	Dual	Dual	Dual	Dual
Knock ctrl	+	+	+	+	+
Internal logger	-	+	+	+	+

Type	Engine Control Unit MS 7.4	Engine Control Unit MS 7.4 RX
		
Low pressure	+	+
High pressure	+	+
HP package for 2 <sup>nd</sup> bank	+	+
Cam ctrl, El. throttle ctrl, Turbo ctrl	+	+
Launch ctrl, Traction ctrl	+	FIA Homologation WRX
Analogue inputs	41	41
Max. cyl./bank	12/2	12/2
Lambda ctrl	Dual	Dual
Knock ctrl	+	+
Internal logger	+	+

## Engine Control Unit MS 3 Sport GT3 Cup



### Features

- ▶ Free and full access to the ECU
- ▶ No wiring changes necessary
- ▶ Support for 3rd party displays via CAN
- ▶ Plug and play with base “safe” calibration
- ▶ Pre-configured workbases for free Bosch Motorsport calibration tools

The MS 3 Sport GT3 Cup motorsport ECU enables you to optimize the software of Ex-Porsche GT3 Cup cars (996 GT3 Cup; 997 GT3 Cup) by getting full access to the ECU, allowing you to adapt it to any engine hardware changes. The software offers additional features and comes with a base calibration.

### Application

Compatible Porsche type series	996 GT3 Cup; 997 GT3 Cup
Engine layout	Max. 6 cyl., 2 bank
Control strategy	Alpha/n
Lambda control	Dual
Speed limiter	
Gear cut for sequential gear box	
Map switch corresponds to 3 different target lambda and spark maps.	
Fuel cut off	
Sequential fuel injection	
Asymmetric injection timing	
Asymmetric ignition timing	
Knock control	Inclusive
Traction control	Inclusive
Interface to Bosch Motorsport ABS M4 kit	

Support of 60-2 and 36-2 ignition trigger wheels

Max. vibration                      Vibration Profile 3 (see Appendix or [www.bosch-motorsport.com](http://www.bosch-motorsport.com))

### Technical Specifications

#### Mechanical Data

Extremely small and flat aluminum pressure casting housing

4 mounting points on housing

2 connectors with high pin density

Extremely shock and vibration proof hybrid technology

Size                                      120 x 90 x 40 mm

Weight                                   250 g

Temperature range                   -40 to 125°C

#### Electrical Data

Max. power consumption            10 W at 14 V

#### Power supply

Full operation                        9 to 16 V

Recommended                        11 to 14 V

#### Inputs

2 lambda interfaces LSU

4 inputs for Hall-effect wheel speed sensors

1 input for inductive crankshaft sensor

1 input for Hall-effect camshaft sensor

22 analog inputs 0 to 5 V

2 knock sensor inputs

#### Outputs

6 injection power stages

6 ignition power stages (7.5 to 8.0 A)

8 power stages (1 A/2 A; low side; PWM)

2 power stages for lambda heater

1 H-bridge (5 A)

2 sensor supplies 5 V/100 mA

#### Software Tools

Modas Sport Calibration Software            Inclusive

WinDarab Analysis Software                  On request

**Environment (not included)**

Programming interface MSA-Box II	F 02U V00 327-03
Data logger C 70	F 02U V02 300-02
Display DDU 9	F 02U V02 302-01

**Mating Connectors (not included)**

Mating Connector I	D 261 205 139-01
Mating Connector II	D 261 205 140-01

**Communication**

1 K-line serial interface
1 CAN interface

**Ordering Information****Engine Control Unit MS 3 Sport GT3 Cup**

Delivery with Porsche GT3 specific base calibration  
Order number **F 02U V0U 082-01**

## 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 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	Optional
VVT	Optional
Turbo control	Optional

Traction control	Optional
Launch control	Optional
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

#### Communication

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

#### 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>	
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 8 x high pressure injection for magnetic 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 7 Light
Data Application tool Modas Sport
System Configuration tool RaceCon

**Mating Connectors (not included)**

Mating Connector 91 pins	F 02U B00 711-01
Mating Connector 105 pins	F 02U 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 synchro, (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 synchro, long-term recording, own data protection code (max number of 1,080 channels to respect)
Logger Package III	Copy data to USB data stick, USB-port unlocked <ul style="list-style-type: none"> <li>Incl. adapter cable to USB-port</li> <li>Incl. rugged USB flash drive</li> <li>Incl. connector for wiring harness</li> </ul>
Gear Control Package I	Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Megaline)
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_0800 or comparable)
Ethernet Telemetry	Communication via Ethernet Telemetry Modem
Innovation License Device	Activation of engine speed functions* per unit
Innovation Package Project	Activation of engine speed functions* per project version

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

**Installation Notes**

Inspection services	Recommended after 220 h or 2 years, no components to replace
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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 **F 02U V01 961-03**

**Accessories**

**Breakout Box BOB MS 6**  
Order number **F 02U V02 294-01**



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**Software Options****Engine Function Package I**Order number **F 02U V02 001-01**

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**Engine Function Package II**Order number **F 02U V02 002-01**

---

**Measurement Package**Order number **F 02U V02 000-01**

---

**Logger Package I**Order number **F 02U V01 993-01**

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**Logger Package II**Order number **F 02U V01 998-01**

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**Logger Package III**Order number **F 02U V02 082-01**

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**Gear Control Package I**Order number **F 02U V02 107-01 (on request)**

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**Gear Control Package II**Order number **F 02U V02 108-01**

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**Gear Control Package III**Order number **F 02U V02 109-01 (on request)**

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**Ethernet Telemetry**Order number **F 02U V02 138-01**

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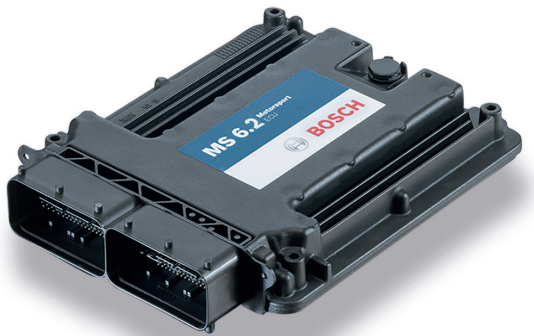
**Innovation License Device**Order number **F 02U V02 510-01**

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**Innovation Package Project**Order number **F 02U V02 511-01**

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## 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  $r_l$
- 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

VVT

Turbo control

Traction control

Launch control

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

#### Mechanical Data

Aluminum housing

2 Bosch connectors, 196 pins in total

Size	226 x 181 x 44 mm
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Weight	1,086 g
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Protection Classification	IP54
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Temp. range (at internal sensors)	-20 to 80°C
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#### Electrical Data

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

#### Communication

2 Ethernet

3 CAN

1 LIN

1 USB

1 RS232

1 Time sync synchronization Ethernet

3 Network screens

#### Inputs

Analog inputs	41
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Internal measurement	1 triax acceleration 1 ambient pressure 2 ECU temperature 2 ECU voltage
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Thermocouple	2 K-type
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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 8 x high pressure injection for magnetic 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 7 Light
Data Application tool Modas Sport
System Configuration tool RaceCon

### Mating Connectors (not included)

Mating Connector 91 pins	F 02U B00 711-01
Mating Connector 105 pins	F 02U B00 712-01

### Software Options (not included)

Logger Package I	Extension for Partition 1: up to 720 channels, fastest sampling 1,000 Hz or 1 synchro, (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 synchro, long-term recording, own data protection code (max number of 1,080 channels to respect)
Logger Package III	Copy data to USB data stick, USB-port unlocked <ul style="list-style-type: none"> <li>Incl. adapter cable to USB-port</li> <li>Incl. rugged USB flash drive</li> <li>Incl. connector for wiring harness</li> </ul>
Gear Control Package I	Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Megaline)
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_0800 or comparable)
Customer Code Area	Enable Customer Code Area
Ethernet Telemetry	Communication via Ethernet Telemetry Modem
Innovation License Device	Activation of engine speed functions* per unit
Innovation Package Project	Activation of engine speed functions* per project version

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

### Installation Notes

Inspection services	Recommended after 220 h or 2 years, no components to replace
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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 **F 02U V01 867-06**

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**Accessories**

**Breakout Box BOB MS 6**

Order number **F 02U V02 294-01**

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**Software Options**

**Logger Package I**

Order number **F 02U V01 993-01**

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**Logger Package II**

Order number **F 02U V01 998-01**

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**Logger Package III**

Order number **F 02U V02 082-01**

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**Gear Control Package I**

Order number **F 02U V02 107-01 (on request)**

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**Gear Control Package II**

Order number **F 02U V02 108-01**

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**Gear Control Package III**

Order number **F 02U V02 109-01 (on request)**

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**Customer Code Area**

Order number **F 02U V02 137-01**

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**Ethernet Telemetry**

Order number **F 02U V02 138-01**

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**Innovation License Device**

Order number **F 02U V02 510-01**

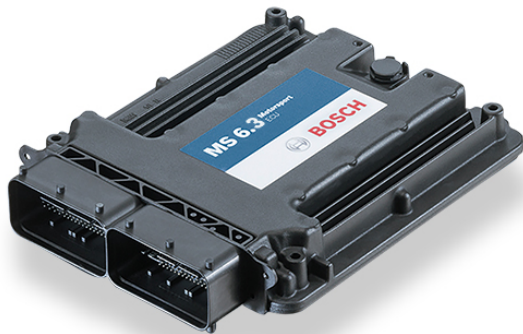
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**Innovation Package Project**

Order number **F 02U V02 511-01**

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## 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)
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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
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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

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

#### Communication

2 Ethernet

3 CAN

1 LIN

1 USB

1 RS232

1 Time sync synchronization Ethernet

3 Network screens

#### 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>	
Low pressure injection	Max. 12 cylinders up to 12,500 rpm, high impedance injectors only
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
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) 2 x high pressure pump with MSV control 12 x low pressure injection for high impedance injectors 8 x high pressure injection for magnetic 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 7 Light

Data Application tool Modas Sport

System Configuration tool RaceCon

**Mating Connectors (not included)**

Mating Connector 91 pins F 02U B00 711-01

Mating Connector 105 pins F 02U B00 712-01

**Software Options (not included)**

High Pressure Injection Package For flat- and V-engines (2nd Bank, MSV2, cylinder 7&amp;8, external cylinder 9-12)

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 synchro, (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 synchro, long-term recording, own data protection code (max number of 1,080 channels to respect)

Logger Package III Copy data to USB data stick, USB-port unlocked

- Incl. adapter cable to USB-port
- Incl. rugged USB flash drive
- Incl. connector for wiring harness

Gear Control Package I Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Megaline)

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\_0800 or comparable)

Customer Code Area Enable Customer Code Area

Ethernet Telemetry Communication via Ethernet Telemetry Modem

Innovation License Device Activation of engine speed functions\* per unit

Innovation Package Project Activation of engine speed functions\* per project version

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

## Installation Notes

Inspection services	Recommended after 220 h or 2 years, no components to replace
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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 **F 02U V01 963-03**

### Accessories

**Breakout Box BOB MS 6**  
Order number **F 02U V02 294-01**

### Software Options

**High Pressure Injection Package**  
Order number **F 02U V01 999-01**

**Measurement Package**  
Order number **F 02U V02 000-01**

**Logger Package I**  
Order number **F 02U V01 993-01**

**Logger Package II**  
Order number **F 02U V01 998-01**

**Logger Package III**  
Order number **F 02U V02 082-01**

**Gear Control Package I**  
Order number **F 02U V02 107-01 (on request)**

**Gear Control Package II**  
Order number **F 02U V02 108-01**

**Gear Control Package III**  
Order number **F 02U V02 109-01 (on request)**

**Customer Code Area**  
Order number **F 02U V02 137-01**

**Ethernet Telemetry**  
Order number **F 02U V02 138-01**

**Innovation License Device**  
Order number **F 02U V02 510-01**

**Innovation Package Project**  
Order number **F 02U V02 511-01**

## 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> <li>• mixture control and basic ignition guided by main signal relative load rI</li> <li>• Subsystems pit speed-, launch-, rpm-limiter and ASR are integrated inside torque control</li> <li>• Separated power cut functions to assist several gear cut systems</li> </ul>

- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift	
Electronic throttle control	
VVT	
Turbo control	
Traction control	
Launch control	
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

#### Communication

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

#### 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
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
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) 2 x high pressure pump with MSV control 12 x low pressure injection for high impedance injectors 8 x high pressure injection for magnetic 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 7 Light

Data Application tool Modas Sport

System Configuration tool RaceCon

### Mating Connectors (not included)

Mating Connector 91 pins F 02U B00 711-01

Mating Connector 105 pins F 02U B00 712-01

### Software Options (not included)

Logger Package I	Extension for Partition 1: up to 720 channels, fastest sampling 1,000 Hz or 1 synchro, (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 synchro, long-term recording, own data protection code (max number of 1,080 channels to respect)
Logger Package III	Copy data to USB data stick, USB-port unlocked <ul style="list-style-type: none"> <li>Incl. adapter cable to USB-port</li> <li>Incl. rugged USB flash drive</li> <li>Incl. connector for wiring harness</li> </ul>
Gear Control Package I	Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Megaline)
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_0800 or comparable)
Customer Code Area	Enable Customer Code Area
Ethernet Telemetry	Communication via Ethernet Telemetry Modem
Innovation License Device	Activation of engine speed functions* per unit
Innovation Package Project	Activation of engine speed functions* per project version

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

## Installation Notes

Inspection services Recommended after 220 h or 2 years, 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 **F 02U V02 019-06**

**Engine Control Unit MS 6 RX**  
FIA-homologated version for WRX Championship, available from 2/2018  
Order number **F 02U V02 570**

**Conversion MS 6.4 to MS 6 RX**  
Order number **F 02U V02 571**

### Accessories

**Breakout Box BOB MS 6**  
Order number **F 02U V02 294-01**

### Software Options

**Logger Package I**  
Order number **F 02U V01 993-01**

**Logger Package II**  
Order number **F 02U V01 998-01**

**Logger Package III**  
Order number **F 02U V02 082-01**

**Gear Control Package I**  
Order number **F 02U V02 107-01 (on request)**

**Gear Control Package II**  
Order number **F 02U V02 108-01**

**Gear Control Package III**  
Order number **F 02U V02 109-01 (on request)**

**Customer Code Area**  
Order number **F 02U V02 137-01**

**Ethernet Telemetry**  
Order number **F 02U V02 138-01**

**Innovation License Device**  
Order number **F 02U V02 510-01**

**Innovation Package Project**  
Order number **F 02U V02 511-01**

## Engine Control Unit MS 7.4



### Features

- ▶ Optimized for low and high pressure injection
- ▶ Data logger included
- ▶ Gearbox control optionally included
- ▶ Gigabit data interface
- ▶ FIA-homologated WRX-version available

The MS 7.4 engine control unit manages gasoline engines up to 12 cylinders. Our new 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
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

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

#### Versions

#### WRX Specials

FIA homologated MS 7-programms
RX-Antilag
RX-Launch

#### 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-motor-sport.com">www.bosch-motor-sport.com</a> )

#### Electrical Data

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

#### 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	
<b>Inputs</b>	
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
<b>Outputs</b>	
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 7 Light
Data Application tool Modas Sport
System Configuration tool RaceCon

**Environment (not included)**

Programming interface cable	F 02U V02 327-01
Adapter cable to USB-port	F 02U V01 343-01
Rugged USB flash drive	F 02U V01 342-02
Connector for wiring harness	F 02U 002 996-01

**Mating Connectors (not included)**

Life (red)	AS-6-18-35SN
Actuator (blue)	AS-6-18-35SB
Combined (orange)	AS-6-18-35SC
Sensor (yellow)	AS 6-18-35SA

**Software Options (not included)**

Gear Control Package I	Gear control Mega-Line functionality, has to be used with Mega-Line components (License model via Megaline)
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_0500 or comparable)
Combustion chamber pressure determination	On request
Knock detection and control based on combustion chamber pressure	On request

**Installation Notes**

Inspection services	Recommended after 250 h or 2 years, 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 **F 02U V02 514-01**

**Engine Control Unit MS 7.4 RX**

FIA-homologated version for WRX Championship  
Order number **F 02U V02 568**

**Conversion MS 7.4 to MS 7.4 RX**

Order number **F 02U V02 569**

**Accessories****Breakout Box BOB 66-pole, Connector code blue**

Order number **F 02U V02 295-01**

**Breakout Box BOB 66-pole, Connector code orange**

Order number **F 02U V02 296-01**

**Breakout Box BOB 66-pole, Connector code yellow**

Order number **F 02U V02 298-01**

**Breakout Box BOB MS 7, Life-Connector code red**

Order number **F 02U V02 293-01**

**Software Options****Gear Control Package I**

Order number **F 02U V02 263-01 (on request)**

**Gear Control Package II**

Order number **F 02U V02 264-01**

**Gear Control Package III**

Order number **F 02U V02 265-01 (on request)**

**Cylinder pressure detection base package MS 7.x**

Order number **F 02U V02 543-01**

**Knock detection via cylinder pressure evaluation MS 7.x**

Order number **F 02U V02 544-01**

**Ethernet Telemetry**

Order number **F 02U V02 138-01**

## Diesel Engine Control Units Overview

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Type	Engine Control Unit MS 15.1	Engine Control Unit MS 15.2	Engine Control Unit MS 25 Sport
			
Max. Cyl.	8	6	12
Injector types	Solenoid injectors	Piezo injectors	Solenoid injectors
Control strategy	Quantity based	Quantity based	Quantity based
Injections	Max. 5	Max. 4	Max. 5
Inputs/Outputs	60/32	60/30	53/30
Turbo boost control system	Single or twin turbo	Single or twin turbo	Single or twin turbo
Lambda measurement	+	+	Optional
Traction control system	Optional	Optional	Optional
Weight	1,780 g	1,780 g	1,800 g

## Engine Control Unit MS 15.1



### Features

- ▶ 8 injection output stages
- ▶ For solenoid injectors
- ▶ 60 data inputs

The MS 15.1 is an ECU for Diesel engines with up to 8 cylinders. It is developed for use with Bosch solenoid injectors.

### Application

Engines with the following numbers of cylinders are supported:	3, 4, 5, 6, 8, <3 on request
Injector type	Solenoid injectors
Control strategy	Quantity based
Injection timing	2 pilot injections 2 main injections 1 post injection
Turbo boost control	Single or Bi-Turbo
Lambda measurement	
Traction control	Optional
Gear cut for sequential gearbox	
Speed limiter	
Optional function packages available	
Interface to Bosch Data Logging System	
Max. vibration	Vibration profile 1 (see Appendix or <a href="http://www.bosch-motor-sport.com">www.bosch-motor-sport.com</a> )

### Technical Specifications

#### Mechanical Data

Aluminum housing
4 connectors in motorsport technology with high pin density, 187 pins
Vibration damped circuit boards

8 housing fixation points	
Size	210 x 199 x 36 mm
Protection Classification	IP67 to DIN 40050, Section 9, Issue 2008
Weight	1,780 g
Temperature range	-20 to 85°C

#### Electrical Data

Power consumption w/o inj.	Approx. 5 W at 14 V
Power consumption	Approx. 140 W at 14 V

#### Inputs

2 inputs for thermocouple exhaust gas temperature sensors
2 lambda interfaces LSU
4 inputs for wheel speed sensors; basic design for inductive sensors
4 inputs for turbo speed sensors; basic design for inductive sensors
1 input for inductive crankshaft sensor
1 input for Hall-effect camshaft sensor
3 system inputs 0 to 5 V
13 universal inputs 0 to 5 V, fixed pull-up
27 universal inputs 0 to 5 V, switchable pull-up
3 digital inputs

#### Outputs

8 injection power stages
12 power stages (low side)
2 power stages for lambda heater
2 H-bridges
2 sensor supplies 5 V/system use
3 sensor supplies 5 V/300 mA
3 sensor supplies 10 V/100 mA

#### Software Tools

Modas Sport Calibration Software	Inclusive
WinDarab Analysis Software	On request

#### Optional Functionality

Traction control SW upgrade	F 02U V00 778-01
Chassis SW upgrade	F 02U V00 779-01
Two bank hydraulic control SW upgrade	F 02U V00 949-01

**Environment (not included)**

Programming interface MSA-Box II	F 02U V00 327-03
Data logger C 70	F 02U V02 302-01
Display DDU 9	F 02U V02 300-02
Display DDU 8	F 02U V00 873-05

**Mating Connectors (not included)**

Mating Connector I AS 6-16-35 SN	F 02U 000 466-01
Mating Connector II AS 6-16-35 SB	F 02U 000 468-01
Mating Connector III AS 6-16-35 SC	F 02U 000 469-01
Mating Connector IV AS 6-12-35 SD	F 02U 000 445-01

**Installation Notes**

Internal battery for data preservation included.

Required service interval 12 months (internal battery is replaced).

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.

**Communication**

3 CAN interfaces (dash, application, customer use)

2 FireWire interfaces for external communication

**Ordering Information****Engine Control Unit MS 15.1**

Order number **F 01T A20 022-01**

**Software Options****SW Upgrade Traction Control**

Order number **F 02U V00 778-01**

**SW Upgrade Chassis**

Order number **F 02U V00 779-01**

**SW Upgrade Two Bank Hydraulic Control**

Order number **F 02U V00 949-01**



## Engine Control Unit MS 15.2



### Features

- ▶ 6 injection output stages
- ▶ For Piezo injectors
- ▶ 60 data inputs

The MS 15.2 is an ECU for Diesel engines with up to 6 cylinders. It is developed for use with Bosch Piezo injectors.

### Application

Engines with the following numbers of cylinders are supported:	3, 4, 5, 6, < 3 on request
Injector type	Piezo injectors
Control strategy	Quantity based
Injection timing	2 pilot injections 1 main injection 1 post injection
Turbo boost control	Single or Bi-Turbo
Lambda measurement	
Traction control	Optional
Gear cut for sequential gearbox	
Speed limiter	
Optional function packages available	
Interface to Bosch Data Logging System	
Max. vibration	Vibration profile 1 (see Appendix or <a href="http://www.bosch-motor-sport.com">www.bosch-motor-sport.com</a> )

### Technical Specifications

#### Mechanical Data

Aluminum housing
4 connectors in motorsport technology with high pin density, 187 pins
Vibration damped circuit boards

8 housing fixation points	
Size	210 x 199 x 36 mm
Protection Classification	IP67 to DIN 40050, Section 9, Issue 2008
Weight	1,780 g
Temperature range	-20 to 85°C

#### Electrical Data

Power consumption w/o inj.	Approx. 5 W at 14 V
Power consumption	Approx. 140 W at 14 V

#### Inputs

2 inputs for thermocouple exhaust gas temperature sensors
2 lambda interfaces LSU
4 inputs for wheel speed sensors; basic design for inductive sensors
4 inputs for turbo speed sensors; basic design for inductive sensors
1 input for inductive crankshaft sensor
1 input for Hall-effect camshaft sensor
3 system inputs 0 to 5 V
13 universal inputs 0 to 5 V, fixed pull-up
27 universal inputs 0 to 5 V, switchable pull-up
3 digital inputs

#### Outputs

6 injection power stages
12 power stages (low side)
2 power stages for lambda heater
2 H-bridges
2 sensor supplies 5 V/system use
3 sensor supplies 5 V/300 mA
3 sensor supplies 10 V/100 mA

#### Software Tools

Modas Sport Calibration Software	Inclusive
WinDarab Analysis Software	On request

#### Optional Functionality

Traction control SW upgrade	F 02U V00 778-01
Chassis SW upgrade	F 02U V00 779-01
Two bank hydraulic control SW upgrade	F 02U V00 949-01

**Environment (not included)**

Programming interface MSA-Box II	F 02U V00 327-03
Data logger C 70	F 02U V02 302-01
Display DDU 9	F 02U V02 300-02
Display DDU 8	F 02U V00 873-05

**Mating Connectors (not included)**

Mating Connector I AS 6-16-35 SA	F 02U 000 467-01
Mating Connector II AS 6-16-35 SB	F 02U 000 468-01
Mating Connector III AS 6-16-35 SC	F 02U 000 469-01
Mating Connector IV AS 6-12-35 SD	F 02U 000 445-01

**Piezo Specific Functions****Voltage Control**

Rail pressure dependent precontrol of the voltage difference between cut off voltage and stationary actuator voltage.

Closed-loop voltage control, injector individual.

Voltage precontrol to improve dynamic behavior.

**Discharging Time Control**

Voltage dependent precontrol of discharging current.

Closed-loop discharging time control, injector individual.

Discharging time precontrol to improve dynamic behavior.

**IVA Injector Voltage Adjustment**

Determination of injector voltage demand at reference rail pressure during injector inspection in plant before IQA-measurement.

Injector assignment of voltage setpoint curves within the ECU according to injector's IVA class.

**Temperature Compensation**

Determination of the temperature dependent changes of voltage demand.

Definition of a temperature dependent correction factor.

Multiplicative correction of the voltage setpoint.

**Installation Notes**

Internal battery for data preservation included.

Required service interval 12 months (internal battery is replaced).

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.

**Communication**

3 CAN interfaces (dash, application, customer use)

2 FireWire interfaces for external communication

**Ordering Information****Engine Control Unit MS 15.2**

Order number **F 01T A20 023-03**

**Software Options****SW Upgrade Traction Control**

Order number **F 02U V00 778-01**

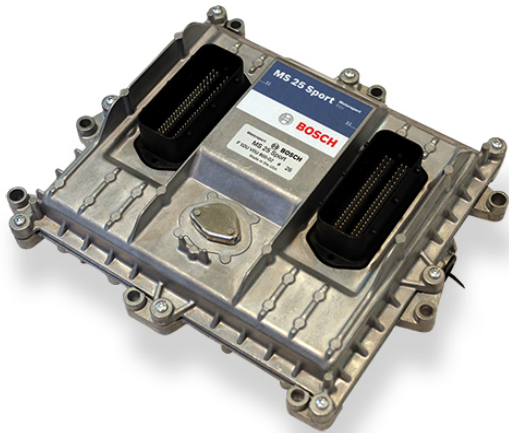
**SW Upgrade Chassis**

Order number **F 02U V00 779-01**

**SW Upgrade Two Bank Hydraulic Control**

Order number **F 02U V00 949-01**

## 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	

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 2 H-bridges
 

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 3 sensor supply 5 V
 

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### Software

RaceCon Calibration Software	free download
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WinDarab Analysis Software	free download
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### Optional Functionality

Traction control SW upgrade
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2 bank hydraulic control SW upgrade
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### Environment (not included)

Programming interface MSABox II	F 02U V00 327-03
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Data logger C 70	F 02U V02 302-01
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Display DDU 9	F 02U V02 300-02
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Display DDU 8	F 02U V00 873-05
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### Mating connectors (not included)

Mating connector I	F 02U V0U 147-01
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CONNECTOR KIT; MS 25 SPORT - X1 (Vehicle)
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Mating connector II CONNECTOR KIT; MS 25 SPORT - X2 (Engine)	F 02U V0U 148-01
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### Installation Notes

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

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

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### Communication

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

**Engine Control Unit MS 25 Sport**  
Order number **F 02U V0U 800-02**

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## Vehicle Control Unit VCU



### Features

- ▶ 667 MHz Dual Core Processor exclusively for customer code execution (MATLAB based)
- ▶ Identical, dedicated 667 MHz Dual Core Processor exclusively for logging purposes
- ▶ High Speed Logging 100 kHz of 6 analogue inputs (optional)
- ▶ Real time Ethernet SERCOS 3
- ▶ Event logging, Configurable pre-event logging

The Vehicle Control Unit (VCU) is a highly powerful processing unit for customer-developed functions integrating a flexible logging device with high speed logging capability of up to 100 kHz.

The processing cores feature floating-point arithmetic and a high-end FPGA for ultimate performance and flexibility. The customer software development process is based on MATLAB/Simulink to significantly speed up algorithm development (automatic code and documentation generation).

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

This device comes without software, all software is developed by the customer with the exception of drivers and low-level functions like pin setup, diagnostics, etc.

### Functions

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	10 $\mu$ s
Online data compression	
Logging rate	Max. 500 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	-20 to 80°C
3 motorsport connectors, 198 pins in total	
Max. vibration	Vibration profile 1 (see Appendix or <a href="http://www.bosch-motor-sport.com">www.bosch-motor-sport.com</a> )

#### Electrical Data

Supply voltage	5 to 18 V
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#### 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 optional I/O Package, see below

#### Inputs

Analog channels 0 to 5 V, 0.5 % precision between 0.2 and 4.8 V, switchable pull-up	20
Digital PWM inputs f_max=30 kHz Hall-type speed measurement possible, Switchable pullup 2.15 kOhm, (required for Hall), Tooth count differential provided	8
Digital PWM inputs f_max=30 kHz Hall- and DF11 type speed measurement possible, Fix pullup 2.15 kOhm (required for Hall), Tooth count differential provided	4

Thermocouple	4 universal
Bosch Laptrigger	1
TimeSync master and slave (specific to Bosch measurement system)	1
Internal measurement	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
<b>Outputs</b>	
PWM High side	2*; 7.5 A each, PWM, 50 Hz
PWM low side	4*; 2.2 A each, PWM, 10kHz
*: can be enhanced by optional I/O Package, see below	
<b>Power Supplies</b>	
12 V, 400 mA each	5*
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 optional I/O Package, see below	
<b>Adaptation and Documentation</b>	
Function documentation	Automatically created during code generation
MatLab code generation	Support for customer own MatLab function development
<b>Software Tools (free download)</b>	
Data Analysis tool WinDarab 7	Free
System Configuration tool Race-Con	Configurable flywheel- and trigger disc geometries, calibration and online measurement
<b>High Speed Logging Package (not included)</b>	
6 ANA	0 to 5 V, 100 kHz logging rate

**I/O Package (not included)****Communication**

4 CAN

**Inputs**

Analog channels 4  
0 to 20 V, 0.5 % precision between 0.8 and 19.2 V, switchable pull-up

Digital PWM inputs 4  
f\_max=30 kHz  
Hall-type speed measurement possible,  
Fix pullup 2.15 kOhm (required for Hall),  
Tooth count differential provided

LVDT 4

**Outputs**

Digital output 4 "TTL" out, 10 kHz, PWM, 250 mA each

PWM High side 2; 7.5 A each, PWM, 50 Hz

PWM low side 4; 2.2 A each, PWM, 10kHz

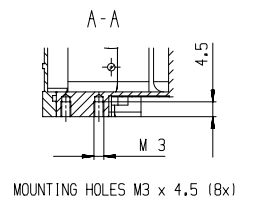
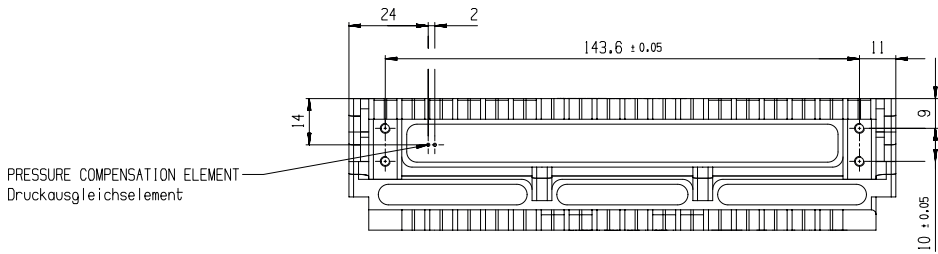
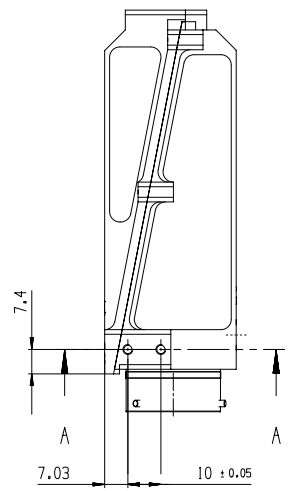
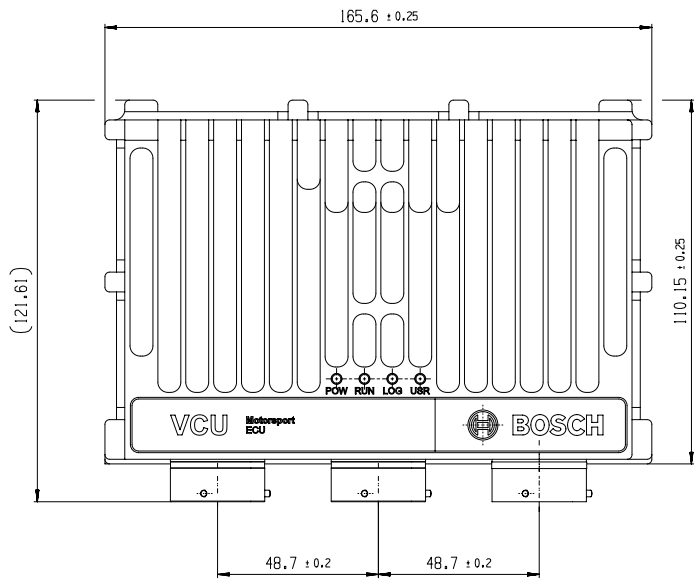
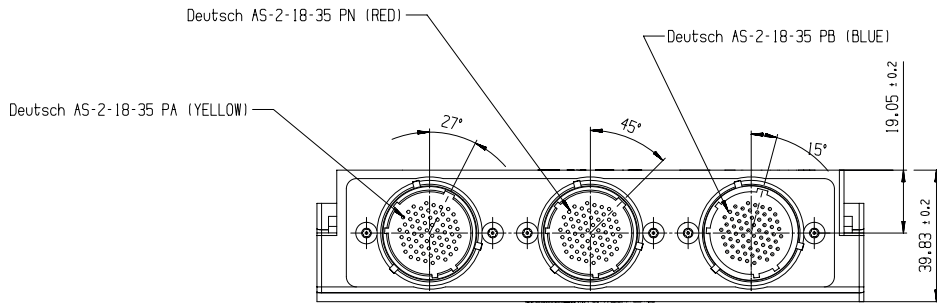
**Power Supplies**

12 V, 400 mA each 5

Switchable 5 V/12 V, 400 mA each 5

**Ordering Information****Vehicle Control Unit VCU**Order number **on request****Software Options****Upgrade High Speed Logging Package**Order number **F 02U V02 779-01****Upgrade I/O Package**Order number **F 02U V02 777-01****Upgrade Real Time Ethernet**Order number **F 02U V02 782-01****Upgrade USB Stick**Order number **F 02U V02 214-01****Upgrade Ethernet Telemetry**Order number **F 02U V02 138-01****Upgrade CCP Master**Order number **F 02U V02 213-01**

Dimensions







## 02 Displays



2

Displays

42

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## Displays Overview

	Display DDU 9	Display DDU 10
		
Display	5.7" trans-reflective color display	7" high brightness color display
Resolution	800 x 480 pixel	
Storage capacity	Up to 4 GB internal storage capacity	Data logger optional
Logging rate	Max. 300 kB/s	
USB flash drive recording	Opt.	
Processor	667 MHz Dual Core	866 MHz Dual Core
Housing material	Synthetic material housing	Aluminum housing with motorsport connectors
LEDs	10 multicolor freely configurable (RGB) LEDs	20 fully configurable LEDs
Analogue inputs	4 standard, additional 12 optional	Up to 16 analogue inputs
USB	Recording on USB flash drive optionally included	1 x USB
CAN	2	3
Ethernet	2	3
	Page change based on events possible	
	Supports GPS lap trigger, pre-dated lap time etc.	
		New library of graphical elements

## 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 <a href="http://www.bosch-motor-sport.com">www.bosch-motor-sport.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**

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_DATA USB-Port unlocked (Rugged USB flash drive Bosch File System (BFS) format included, works with Bosch File System (BFS) preformatted USB Flash drive only)	F 02U V02 214-01
Adapter cable to USB-Port (included in Upgrade USB_DATA)	F 02U V01 343-01
Adapter for wiring harness (included in Upgrade USB_DATA)	F 02U 002 996-01
CCP_MASTER CCP-Master (ASAP2 file from ECU manufacturer required)	F 02U V02 213-01
ETHER_TELE LTE Ethernet Telemetry	F 02U V02 138-01
FULL_LOG_1 Enable full logging performance of 3 GB partition 1	F 02U V02 304-01
FULL_LOG_2 Enable full logging performance of 1 GB partition 2	F 02U V02 305-01
I_O EXTENS Enable additional 12 analog input channels	F 02U V02 205-01

**Connectors and Wires**

Motorsport connector on Display	AS-216-35 PN
Mating connector AS-616-35 SN	F 02U 000 466-01

**Pin Configuration**

Pin	Name	Comment	Status
1	KL_31		Incl.
2	KL_15		Incl.
3	KL_30		Incl.

Pin	Name	Comment	Status
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	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.

Pin	Name	Comment	Status
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.

## Installation Notes

Inspection services	Recommended after 220 h or 2 years, no components to replace
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## Communication

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

## Ordering Information

### Display DDU 9

Order number **F 02U V02 300-02**

### Accessories

#### Vehicle Loom Basic

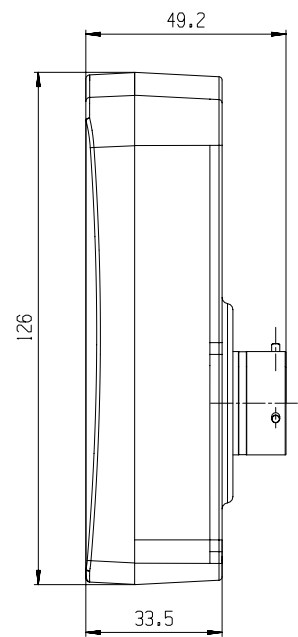
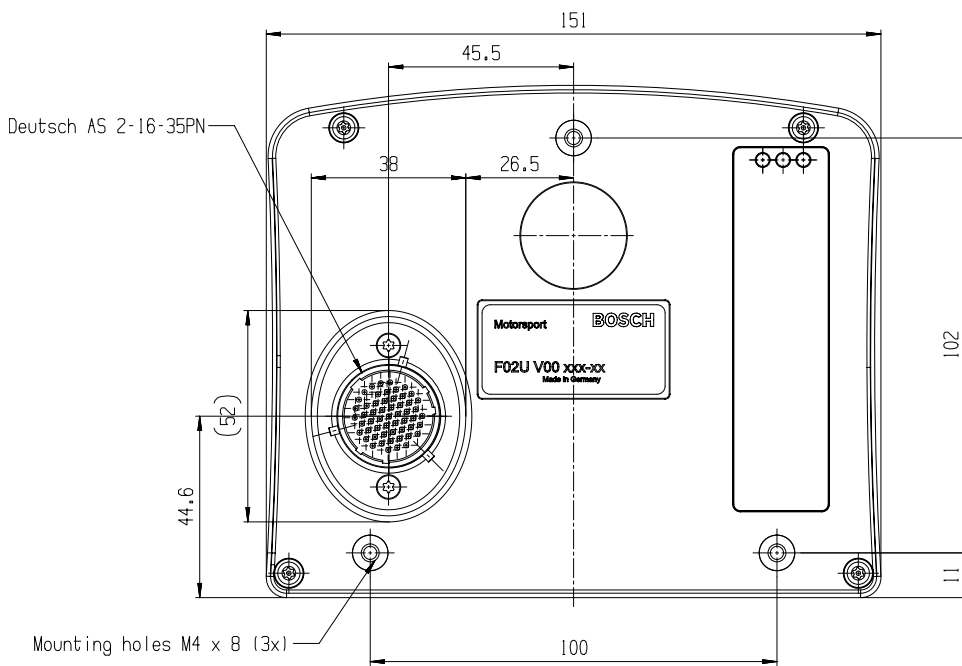
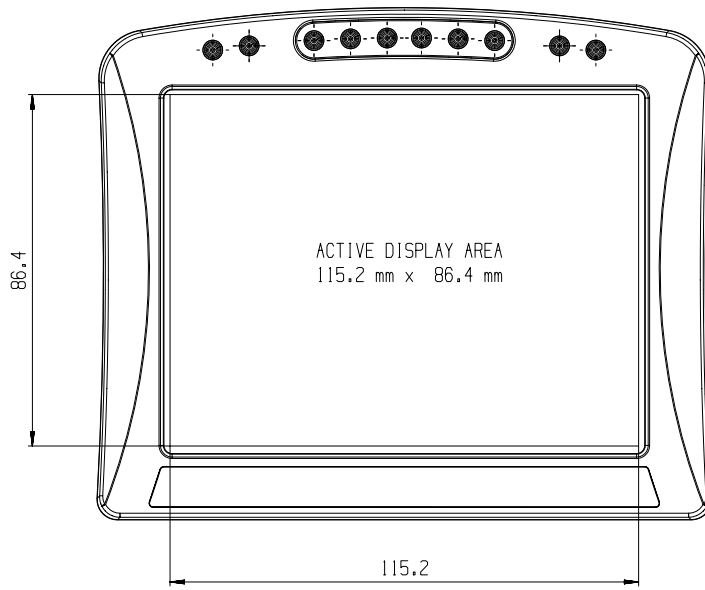
Order number **F 02U V02 735-01**

#### Bench Loom

Order number **F 02U V02 349-01**

Dimensions

2



## Display DDU 10



### 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 motor-sport 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	
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	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-motor-sport.com">www.bosch-motor-sport.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_DATA	USB-Port unlocked (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	included in Upgrade USB_DATA
Adapter for wiring harness	included in Upgrade USB_DATA
CCP_MASTER	CCP-Master (ASAP2 file from ECU manufacturer required)
ETHER_TELE	LTE Ethernet Telemetry
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 AS-2-16-35 PN	
Mating connector AS-6-16-35 SN	F 02U 000 466-01
Auxiliary connector AS-2-12-35 PN	
Mating connector AS-6-12-35 SN	F 02U 000 443-01

**Pin Configuration**

Life connector			
Pin	Name	Comment	Status
1	KL_31		Incl.
2	KL_15		Incl.
3	KL_30		Incl.

**Life connector**

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	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.



Life connector			
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
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.

Auxiliary connector		
20	CAN_4_L	Opt.
21	CAN_3_H	Opt.
22	CAN_3_L	Opt.

### Installation Notes

Inspection services	Recommended after 220 h or 2 years, no components to re-place.
---------------------	--

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

### 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

### Ordering Information

#### Display DDU 10

Order number **F 02U V02 659-01**

#### Accessories

##### Vehicle Loom Basic

Order number **F 02U V02 735-01**

##### Bench Loom

Order number **F 02U V02 349-01**

##### Adapter cable to USB-Port

Included in SW Upgrade USB\_DATA

Order number **F 02U V01 343-01**

##### Adapter cable for wiring harness

Included in SW Upgrade USB\_DATA

Order number **F 02U 002 996-01**

#### Software Options

##### USB\_DATA

Order number **F 02U V02 214-01**

##### CCP\_MASTER

Order number **F 02U V02 213-01**

##### ETHER\_TELE

Order number **F 02U V02 138-01**

##### FULL\_LOG\_1

Order number **F 02U V02 304-01**

##### FULL\_LOG\_2

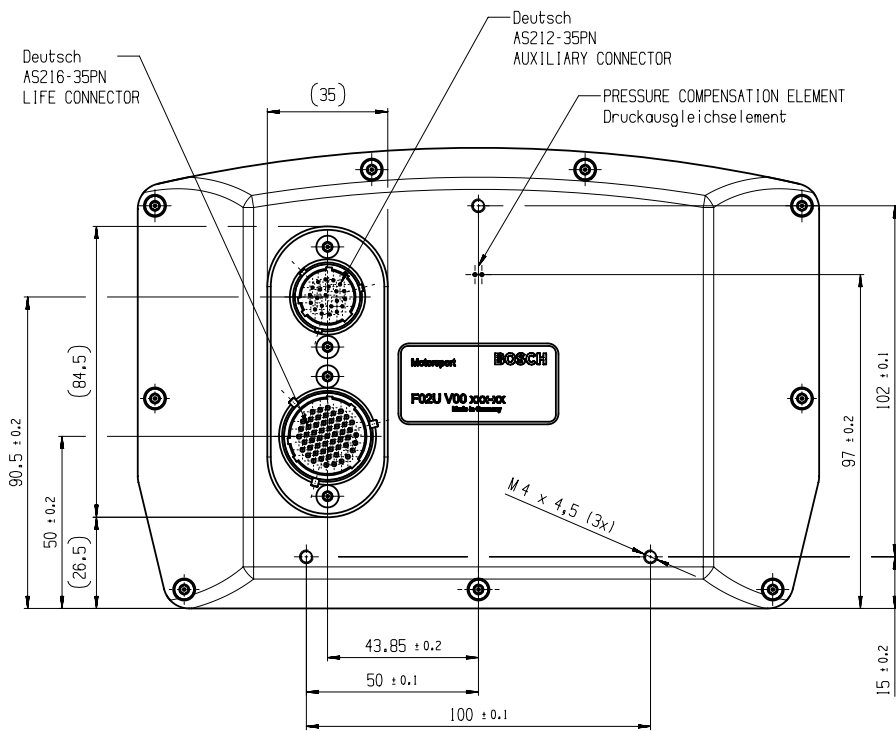
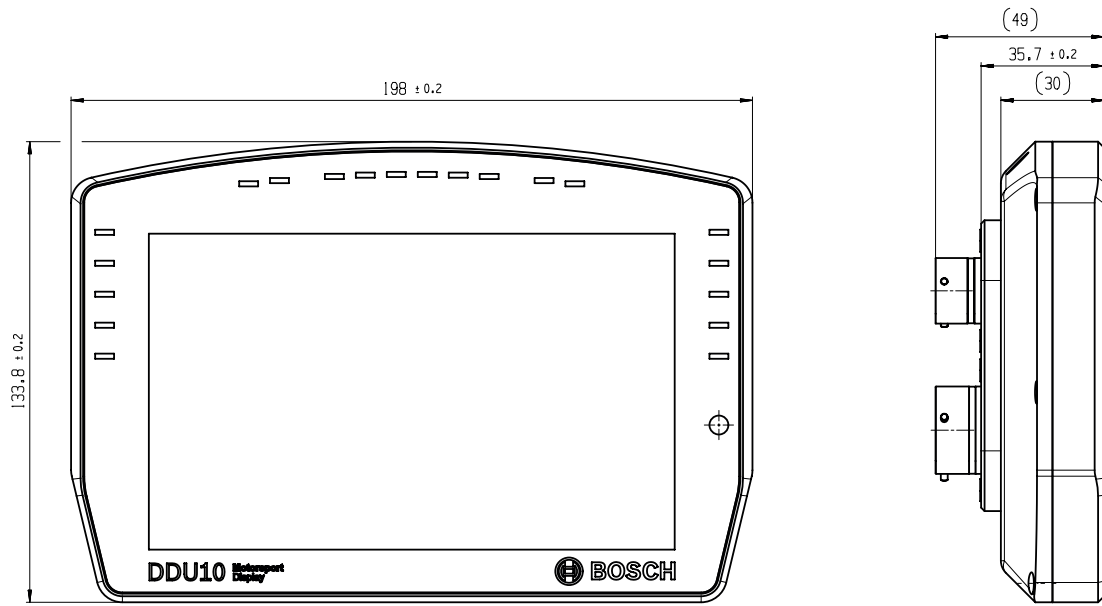
Order number **F 02U V02 305-01**

##### I\_O EXTENS

Order number **F 02U V02 205-01**

Dimensions

2



# 03 Electronics

3

<b>Collision Avoidance Systems</b>	<b>52</b>
<b>Data Loggers</b>	<b>59</b>
<b>Injection Power Stages</b>	<b>67</b>
<b>Keypad</b>	<b>73</b>
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<b>Telemetry</b>	<b>97</b>
<b>Test System</b>	<b>99</b>

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## Collision Avoidance System CAS-M light



3

### 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 globally harmonized 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
Vibration	Randome vibration aeff = 30.8 m/s <sup>2</sup> , 3x8 h (according ISO/DIS 16750-3)
Protection Classification	IP 6K6K (DIN 40 050) IP 6K7 (DIN 40 050)

#### 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	F 037 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.

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

### Ordering Information

**Collision Avoidance System CAS-M light (500 kbaud)**  
Order number **F 02U V02 021-01**

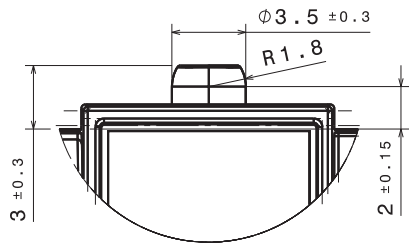
**Collision Avoidance System CAS-M light (1 Mbaud)**  
Order number **F 02U V02 220-01**

**Collision Avoidance System CAS-M light incl. Display DDU 9 (500 kbaud)**  
Order number **F02U V02 591-01**

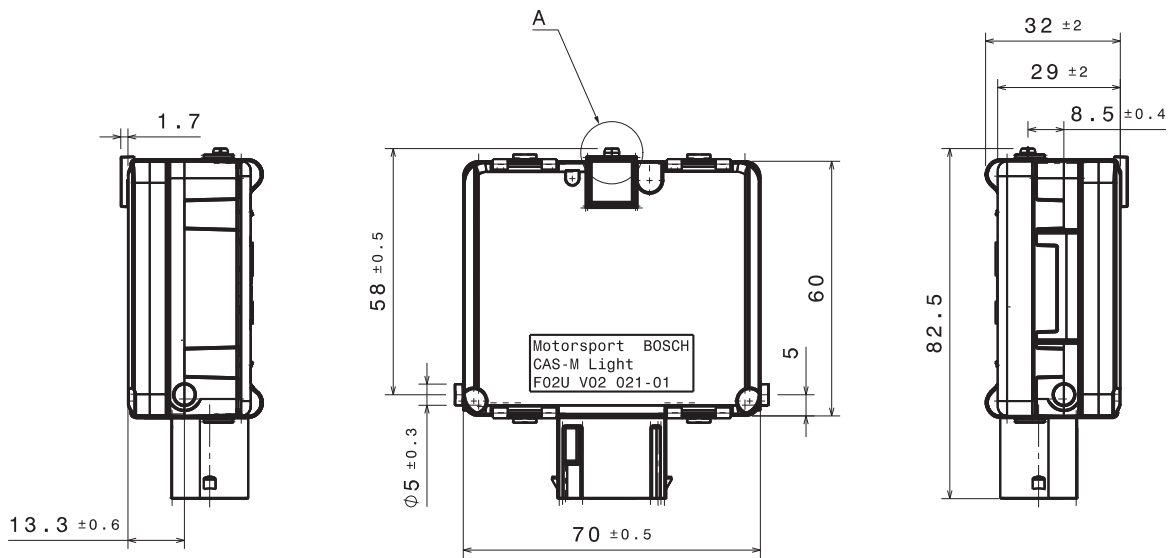
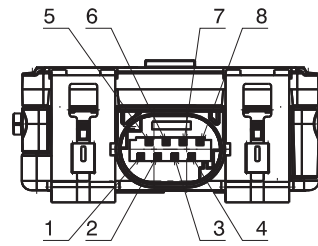
**Collision Avoidance System CAS-M light incl. Display  
DDU 9 (1 Mbaud)**

Order number **F 02U V02 592-01**

**Dimensions**



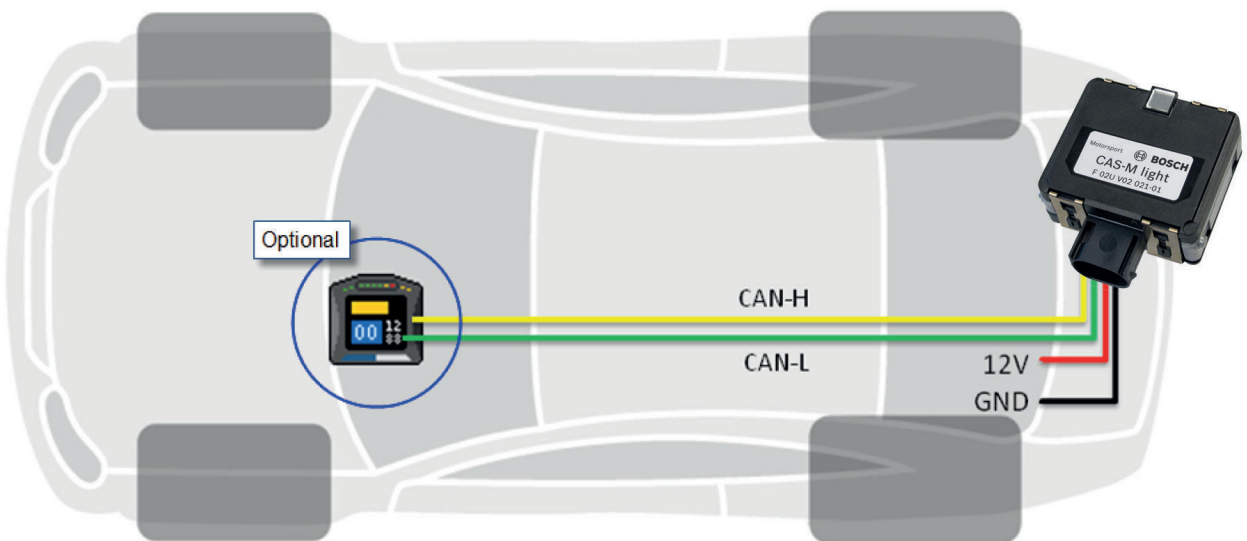
Detail A



Right view

Front view

Left view



Wiring schematic

## Collision Avoidance System CAS-M 3



3

### Features

- ▶ Real-time rearview display
- ▶ 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 3 (CAS-M 3) features a Bosch mid-range radar sensor for a wider field of view in close-up range, a high-performance Bosch Motorsport display for fast video processing and a fast response high definition camera.

The CAS-M 3 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 4 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 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

Dimensions	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> )
----------------	---

##### Rear Module

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

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

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

##### Rear Module

CAN	1x private CAN for radar
Ethernet	1x private 1GBase-T Ethernet for camera

**Software Tools (free download)**

Data analysis tool	WinDarab 7 Light
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System configuration tool	RaceCon
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**Connectors and Wires****Display Unit**

Motorsport connector on device	AS-2-12-35 PN
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Mating connector AS-6-12-35 SN	F 02U 000 443-01
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Pin 1	GigEthernet_TR3_N (private Eth camera)
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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_TRO_N (private Eth camera)
-------	--

Pin 8	GigEthernet_TRO_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)
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Pin 22	CAN Low Radar (private CAN radar)
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**Rear Module**

Motorsport connector on device	AS-2-12-35PN
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Mating connector AS-6-12-35SN	F 02U 000 443-01
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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_TRO_N (private Eth camera)
-------	--

Pin 7	GigEthernet_TRO_P (private Eth camera)
-------	--

Pin 8	+12 V Ubat
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Pin 9	+12 V Ubat
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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)
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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

An open mounting position for the radar sensor is recommended.

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.

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Cat 6 A standard for Gigabit Ethernet.

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

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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.

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### Safety Notes

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

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## Ordering Information

### Collision Avoidance System CAS-M 3

Order number **F 02U V02 648-01**

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### Accessories

#### Display Unit

Order number **F 02U V02 660-01**

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#### Rear Module

Order number **F 02U V02 630-01**

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#### Camera Unit

Order number **F 02U V02 620-01**

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### Radar Unit

Order number **F 02U V02 647-01**

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### Radar Bracket

Order number **F 037 D00 084-01**

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### Wiring Harness for Radar and Camera

Order number **F 02U V02 634-02**

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### Interface Module (Housing and Electronics)

Order number **F 02U V02 639-01**

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### Acceleration Sensor MM5.10

Without wire (1)

Order number **F 02U V01 511-02**

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### Acceleration Sensor MM5.10

Wire with open end (2)

Order number **F 02U V01 511-92**

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### Acceleration Sensor MM5.10

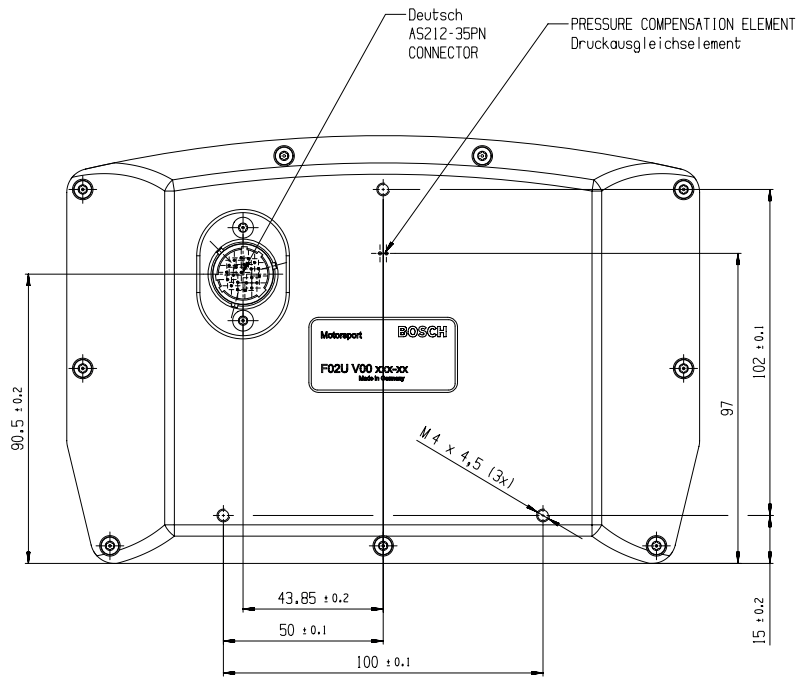
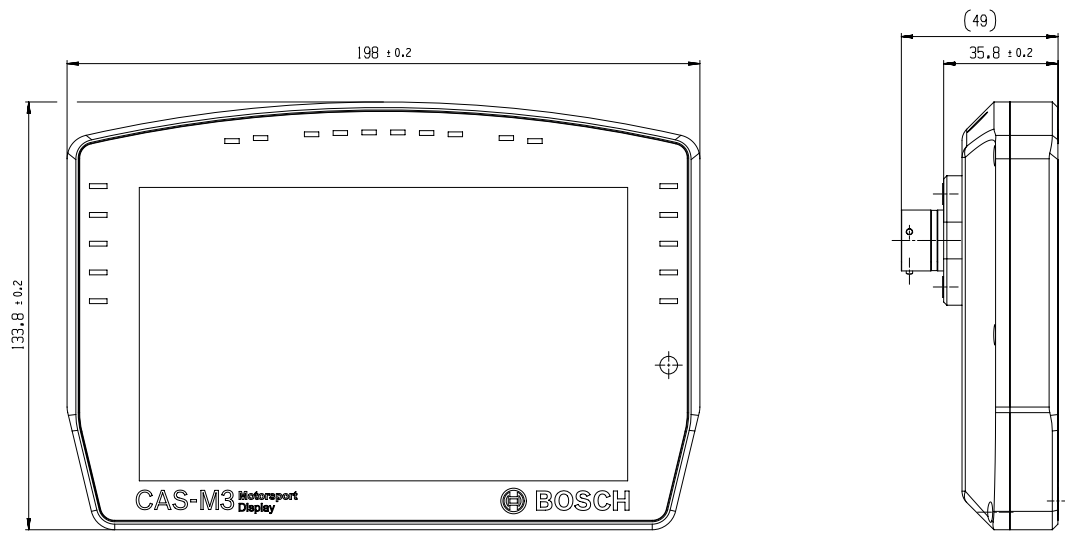
Wire with motorsport connector (3)

Order number **F 02U V01 512-03**

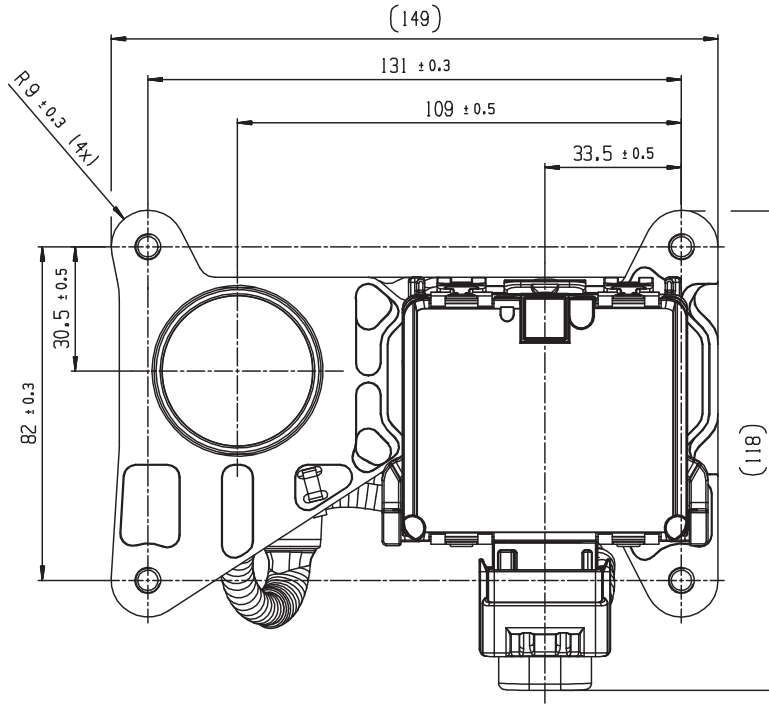
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Dimensions



Display



Rear Module

**Data Loggers Overview**

	Data Logger C 60	Data Logger C 70
		
Storage capacity	2 GB	3 GB (opt. 4 GB)
Logging rate	Max 300 kB/s	Max. 600 kB/s
Weight	495 g	450 g

## Data Logger C 60



3

### Features

- ▶ Compact and light weight data logger
- ▶ Aluminum housing
- ▶ Recording on USB flash drive (opt.)
- ▶ Two motorsport connectors

The data logger C 60 is a compact and light weight 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 2 GB logger can be downloaded via high speed Ethernet or via wireless connection with the BT 60 burst telemetry system.

Software upgrades for the C 60 (field upgradable by entering a key) activate additional recording on USB flash drive, CCP-master and additional input channels.

### Application

Converters	8 kHz 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	Max. 300 kB/s
Recording channels	Up to 720 per connected device
Logged data download speed	Max. 1,000 kB/s
Internal storage capacity	2 GB
3-port network switch	
BT 60 WLAN burst telemetry support	
FM 40 long range telemetry support, GSM telemetry support	

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
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 1

GPS input	
Additional analog channels	20
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
	F 02U V00 703-01

##### Software Upgrade 2

CCP-Master (ASAP 2 file from ECU manufacturer required)	F 02U V00 797-01
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### Software Upgrade 3

USB-Port unlocked (Rugged USB flash drive 2 GB Bosch File System (BFS) format included, works with Bosch File System (BFS) preformatted USB flash drive only)	F 02U V00 872-02
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Adapter cable to USB-Port (included in Upgrade)	F 02U V01 343-01
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Adapter for wiring harness (included in Upgrade)	F 02U 002 996-01
--	------------------

### Connectors and Wires

Motorsport connectors double density	2 x 41 pins
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Mating connector I AS-DD 6-12-41SN	F 02U 002 216-01
------------------------------------	------------------

Mating connector II AS-DD 6-12-41SA	F 02U 004 180-01
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### Installation Notes

Inspection services	Recommended after 100 h
---------------------	-------------------------

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.

### Accumulator Service

Internal accumulator for data preservation and clock included

Recommended service interval: 24 months (inclusive accumulator change)

Send device to Bosch dealer for service.

Charge accumulator for > 6 h after installation (supply with power).

Charge accumulator twice per year for > 6 h (supply with power).

### Communication

Configuration via RaceCon over Ethernet or MSA-Box II

CAN interfaces	2
----------------	---

Ethernet 100BaseT	3
-------------------	---

RS232	Telemetry
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Lap trigger input	1
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### Ordering Information

#### Data Logger C 60

Order number **F 02U V00 875-03**

#### Software Options

##### SW Upgrade 1

Order number **F 02U V00 703-01**

##### SW Upgrade 2

Order number **F 02U V00 797-01**

##### SW Upgrade 3

Order number **F 02U V00 872-02**

## 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-motor-sport.com">www.bosch-motor-sport.com</a> )

#### Electrical Data

Supply voltage	5 to 18 V
----------------	-----------

#### Inputs

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

#### Optional Upgrades

USB_DATA USB-Port unlocked (Rugged USB flash drive Bosch File System (BFS) format included, works with Bosch File System (BFS) preformatted USB Flash drive only)	F 02U V02 214-01
Adapter cable to USB-Port (included in Upgrade USB_DATA)	F 02U V01 343-01
Adapter for wiring harness (included in Upgrade USB_DATA)	F 02U 002 996-01

CCP_MASTER CCP-Master (ASAP2 file from ECU manufacturer required)	F 02U V02 213-01
ETHER_TELE LTE Ethernet Telemetry	F 02U V02 138-01
FULL_LOG_2 Enable full logging performance of 1 GB partition 2	F 02U V02 305-01
I_O EXTENS Enable additional 12 analog input channels	F 02U V02 205-01

### Connectors and Wires

Motorsport connector on logger	AS-216-35 PN
Mating connector AS-616-35 SN	F 02U 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.
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.

Pin	Name	Comment	Status
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.

### Installation Notes

Inspection services	Recommended after 220 h or 2 years, no components to replace
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**Communication**

CAN interfaces	2
Ethernet 100BaseT	2
Laptrigger input	1

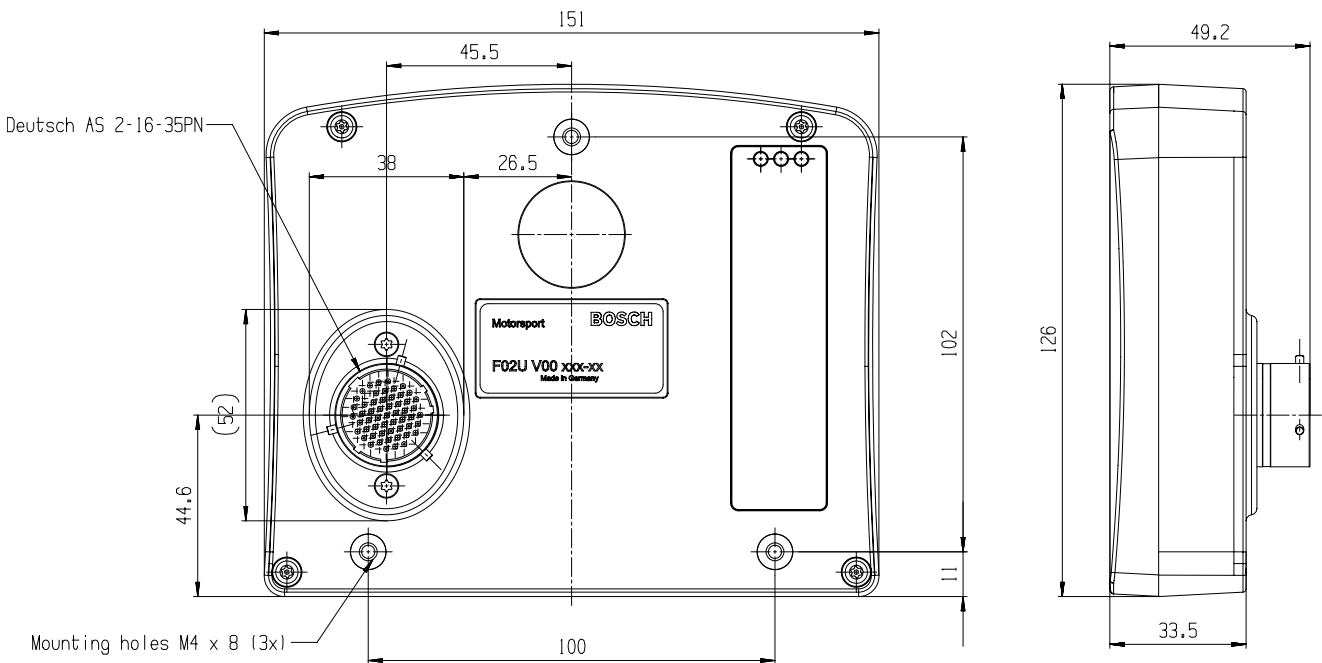
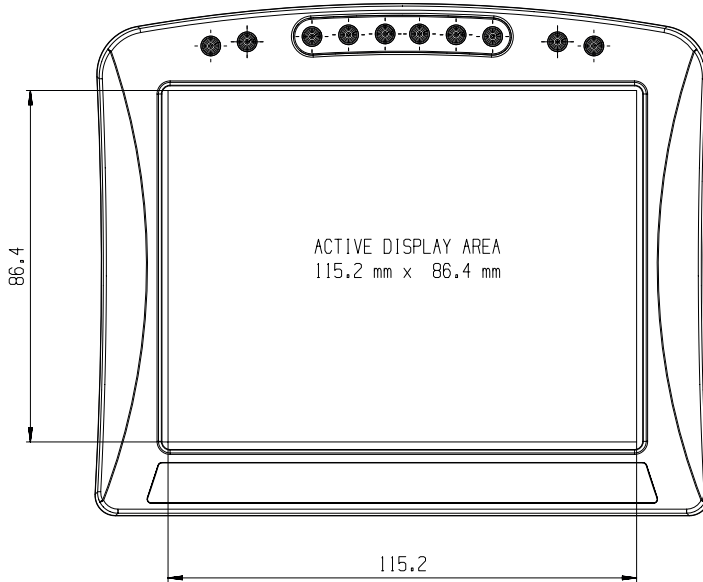
RS232	Telemetry, GPS
Configuration via RaceCon	Over Ethernet or MSA-Box II

**Ordering Information**

**Data Logger C 70**  
 Order number **F 02U V02 302-01**

**3**

**Dimensions**





## USB Upgrade Kit



### Features

- ▶ Capacity 2 GB
- ▶ Robust brass housing
- ▶ High performance push-pull connector

The Software Upgrade USB enables your DDU or data logger to store data on a USB flash drive. The required hardware is part of the Upgrade and includes an adapter cable to USB-port, a connection socket to the wiring harness and a rugged USB flash drive.

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-motor-sport.com">www.bosch-motor-sport.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 +

#### Installation Notes

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

#### Ordering Information

**SW Upgrade USB for DDU 7**  
Order number **F 02U V01 133-02**

**SW Upgrade USB for DDU 8**  
Order number **F 02U V00 871-02**

**SW Upgrade USB for C 50**  
Order number **F 02U V01 133-02**

**SW Upgrade USB for C 60**  
Order number **F 02U V00 872-02**

**SW Upgrade USB for MS 6**  
Order number **F 02U V01 993-01**

#### Accessories

**Rugged USB flash drive (included in SW Upgrade)**  
Order number **F 02U V01 342-03**

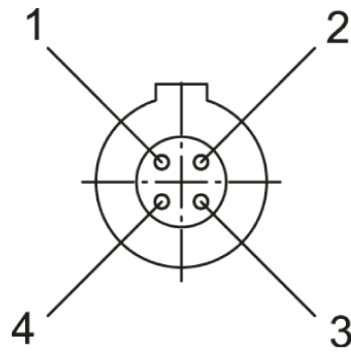
**Adapter cable to USB-Port (included in SW Upgrade)**  
Order number **F 02U V01 343-01**

**Adapter for wiring harness (included in SW Upgrade)**  
Order number **F 02U 002 996-01**

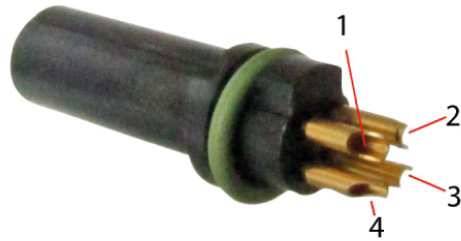
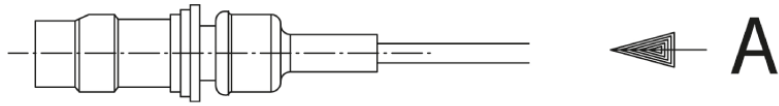
Dimensions

3

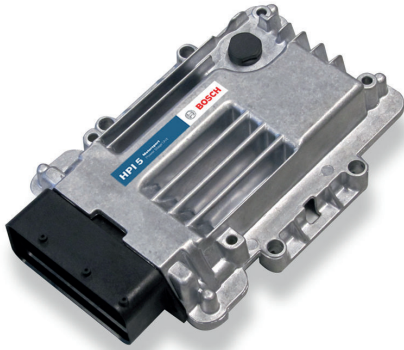
View A



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



## HPI 5



### 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	D 261 205 353-01
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#### Communication

1 CAN (1 Mbaud)
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### Ordering Information

#### HPI 5

Optimized for Bosch HDP 5  
Order number **F 02U V00 929-02**

## HPI 5-M 4C



3

### 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	AS 616-26SN
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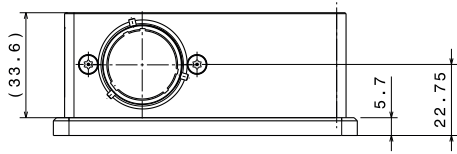
#### Communication

1 CAN (1 Mbaud)

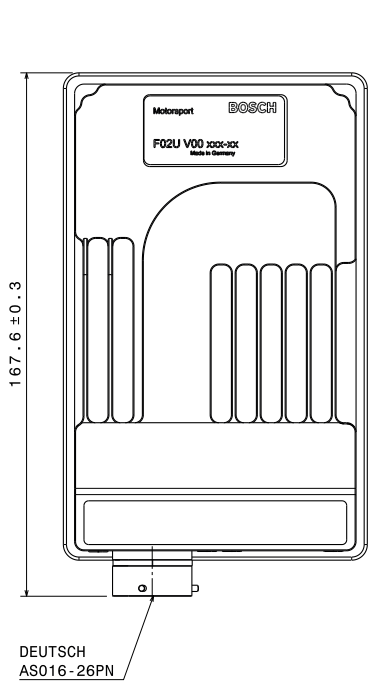
#### Ordering Information

**HPI 5-M 4C**  
Order number **F 02U V01 629-01**

Dimensions

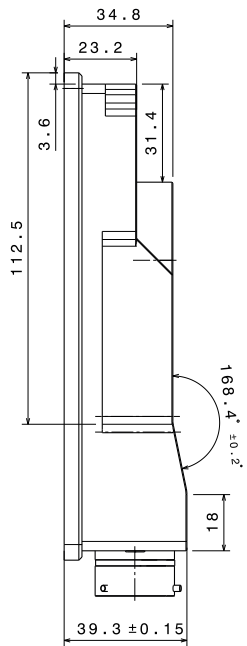


Bottom view  
Scale: 1:1

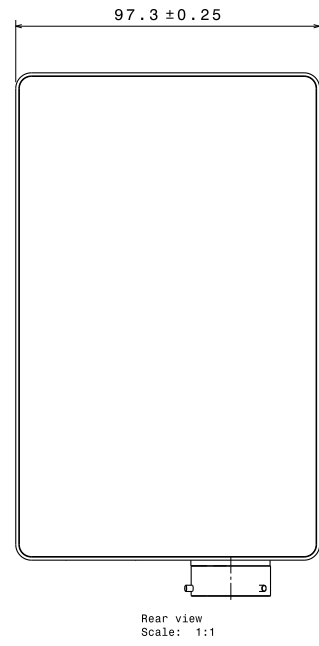


DEUTSCH  
AS016-26PN

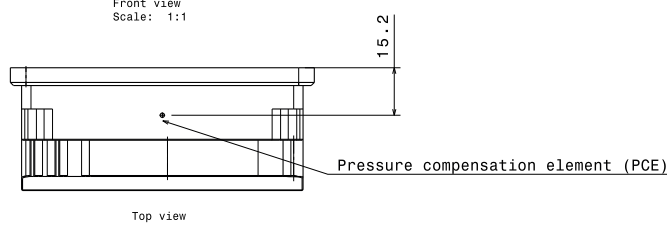
Front view  
Scale: 1:1



Left view  
Scale: 1:1



Rear view  
Scale: 1:1



Top view

Pressure compensation element (PCE)

## HPI 5-M 8C



3

### 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

#### 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	AS 616-26SN AS 614-19SN
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#### 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 (6-cyl. engine: #6)
G	O_P_BANK2_HS4_HS6	Injector control output, High side of HDEV Injector #4 (6-cyl. engine: #6)
H	O_P_BANK1_HS2_HS2	Injector control output, High side of HDEV Injector #2 (6-cyl. engine: #2)
I	O_P_BANK1_LS2_LS2	Injector control output, Low side of HDEV Injector #2 (6-cyl. engine: #2)
K	O_P_BANK2_LS3_LS3	Injector control output, Low side of HDEV Injector #3 (6-cyl. engine: #3)
L	O_P_BANK2_HS3_HS3	Injector control output, High side of HDEV Injector #3 (6-cyl. engine: #3)
M	O_P_BANK1_HS1_HS1	Injector control output, High side of HDEV Injector #1 (6-cyl. engine: #1)
N	O_P_BANK1_LS1_LS1	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
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)

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

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_HPINJD3_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_HPINJD6_D5	Injector control, input signal for injector #6 (6-cyl. engine: #5)
B	O_P_BANK1_LS5_LS4	Injector control output, Low side of HDEV Injector #5 (6-cyl. engine: #4)
C	O_P_BANK1_HS5_HS4	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_LS5	Injector control output, Low side of HDEV Injector #6 (6-cyl. engine: #5)
G	O_P_BANK1_HS6_HS5	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)

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

I	O_P_BANK2_LS8	Injector control output, Low side of HDEV Injector #8 (6-cyl. engine: not used)
K	I_P_HPINJD8	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_HPINJD7	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_HPINJD5_D4	Injector control, input signal for injector #5 (6-cyl. engine: #4)

## Communication

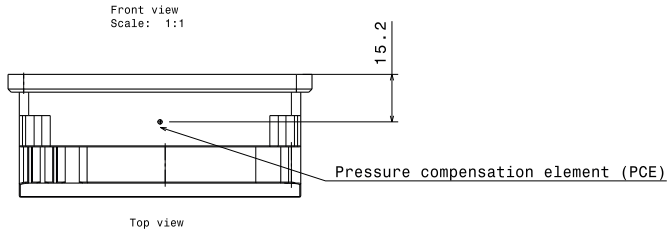
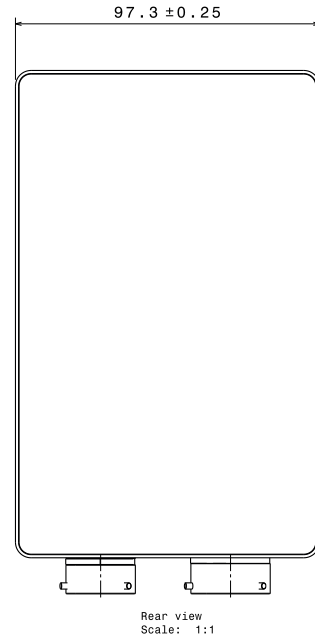
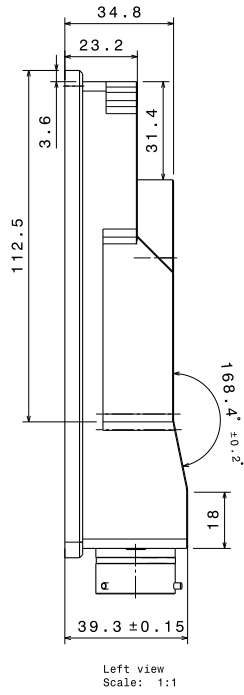
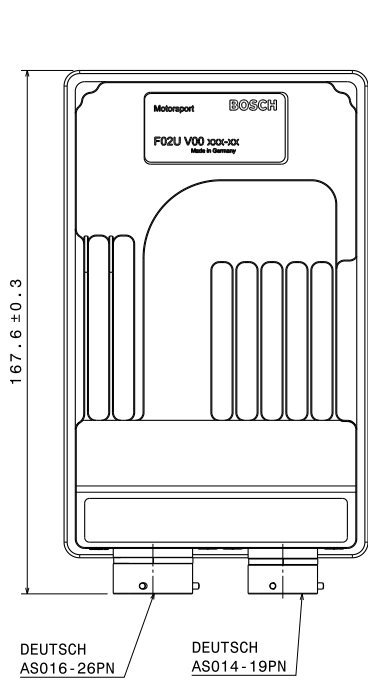
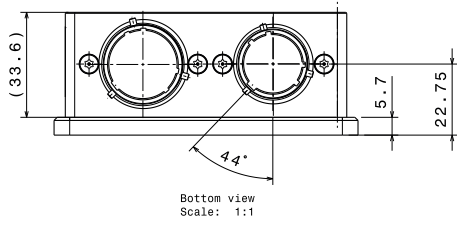
1 CAN (1 Mbaud)

## Ordering Information

**HPI 5-M 8C**Order number **F 02U V01 630-01**

Dimensions

3





## CAN Keypad CK-M12



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


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-  Brake Spray


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-  Boost Decrease


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-  Boost Increase


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-  Brightness Down


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-  Brightness Up


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-  Close Menu


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-  Cool Suit


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-  Cooling Fan


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-  Day/Night Mode


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-  Drink


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-  Flash Hi Beam


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-  Fuel Reserve


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-  Fuel Reset


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-  Full Course Yellow


---

-  Function Toggle


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-  Gearbox Emergency


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-  Hazard Flasher


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-  Heated Windshield


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-  Helmet Fan


---

-  High Beam


---

-  Horn


---

-  Launch


---

-  Low Beam


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-  Map Down


---

-  Map Up


---

-  Neutral


---

-  Open Menu


---

-  Page Down


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-  Page Up


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-  PDU Reset


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-  Pit Switch


---

-  Power


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-  Power Steering Reset


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-  Pump Out


## Insert Road Race Kit

-  Push to Pass


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-  Radiator Spray


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-  Rain Light


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-  Reset


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-  Reverse


---

-  Select


---

-  Starter


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-  Traction Control Down


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-  Traction Control Up


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-  Wet Mode


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-  Windshield Spray


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-  Windshield Wiper


## Insert Drag Race Kit

-  A/C


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-  Alarm Reset


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-  Anti-Lag


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-  Arrow x 4


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-  Boost Decrease


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-  Boost Increase


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-  Brightness Down


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-  Brightness Up


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-  Burnout


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-  Close Menu


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-  Cooling Fan


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-  Day/Night Mode


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-  Function Toggle


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-  Hazard Flasher


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-  High Beam


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-  Horn


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-  Launch


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-  Line Lock



















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-  Low Beam

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-  Map Down

## Insert Drag Race Kit

	Map Up
	Nitrous Arm
	Nitrous Purge
	Open Menu
	Page Down
	Page Up
	PDU Reset
	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	!

## Insert Alpha/Numeric Kit

G	-
H	+
I	0
J	1
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 2.5 +/- 0.1 Nm

## Ordering Information

**CAN Keypad CK-M12**

Order number **F 02U V0U 328-01**

**Accessories****Insert Road Race Kit**

Order number **F 02U B0U 022-01**

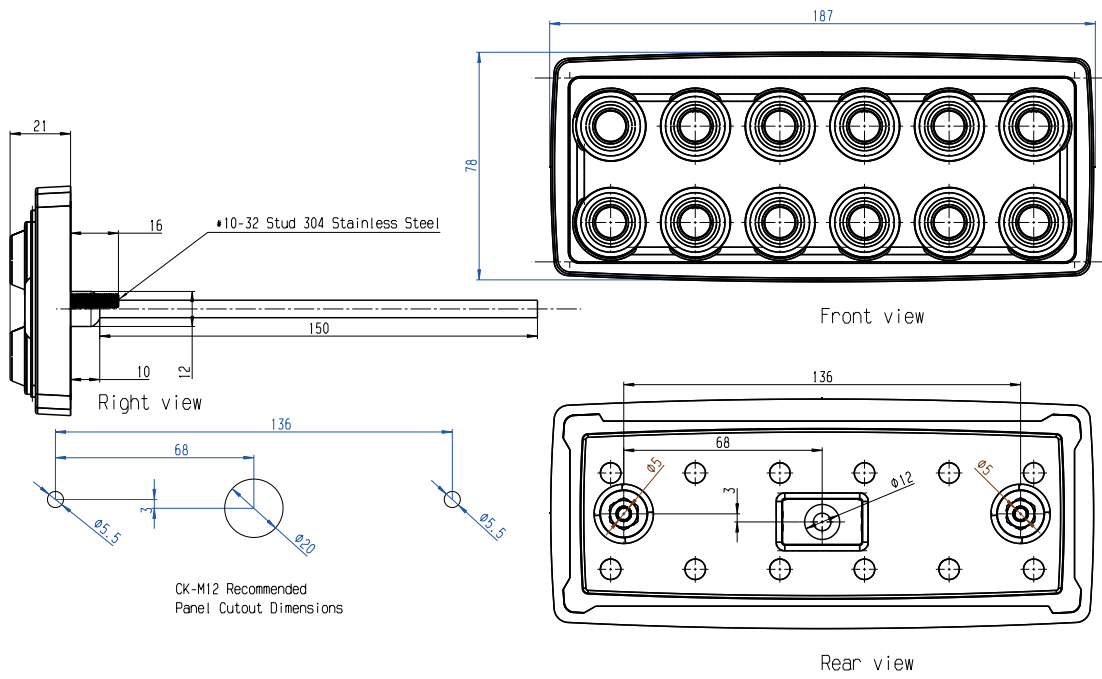
**Insert Drag Race Kit**

Order number **F 02U B0U 023-01**

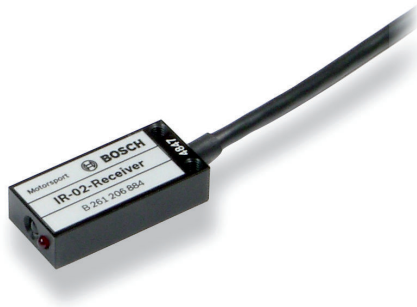
**Insert Alpha/Numeric Kit**

Order number **F 02U B0U 024-01**

Dimensions



## Lap Trigger IR-02 Receiver



### Features

- ▶ Infrared
- ▶ 39 g
- ▶ 15 m working range
- ▶ Different connectors available

This lap trigger system consists of an infrared transmitter station and a receiver installed in the car. The system allows an exact lap time measurement.

Section time measurement for comparison of different car setups is also available if several transmitters are used.

The receiver output signal pin is switched to ground for 20 ms when the car passes the main transmitter.

Notice: our old lap trigger IR is not compatible with IR-02. If both lap triggers are used at the same time, the transmitters have to be positioned with a minimum distance of 5 m.

### Technical Specifications

#### Mechanical Data

Size	42 x 20 x 10 mm
Weight	39 g
Aluminum housing	

#### Electrical Data

Frequency codes	16
Supply voltage	8 to 16 V
Output voltage	5 V
Working range	15 m
Working temperature	-25 to 70°C

#### Connectors and Wires

Pin 1/A	V+ (Battery voltage)
Pin 2/B	GND
Pin 3/C	Trigger signal

#### Installation Notes

Same height between receiver and transmitter

Visibility connection between receiver and transmitter

Avoid direct exposure to sunlight

#### Ordering Information

##### IR-02 Receiver KPSE 6E8 3AP DN A34

Order number **B 261 206 884-03**

##### IR-02 Receiver ASL-6-06-05PD-HE

Order number **B 261-206 887-03**

##### IR-02 Receiver KPTA 6E6-4P-C-DN

Order number **B 261 206 888-01**

## Lap Trigger IR-02 Transmitter

3



### Features

- ▶ Infrared
- ▶ 124 g
- ▶ 15 m working range

This lap trigger system consists of an infrared transmitter station and a receiver installed in the car. The system allows an exact lap time measurement. Section time measurement for comparison of different car setups is also available if several transmitters are used.

The receiver output signal pin is switched to ground for 20 ms when the car passes the main transmitter.

Notice: our old lap trigger IR is not compatible with IR-02. If both lap triggers are used at the same time, the transmitters have to be positioned with a minimum distance of 5 m.

### Technical Specifications

#### Mechanical Data

Size with diode	90 x 40 x 28 mm
Weight	124 g
Aluminum housing	

#### Electrical Data

Frequency codes	16 plus 16 offset codes for section times
Supply voltage	8 to 16 V
Working range	15 m
Working temperature	-25 to 70°C



### Installation Notes

- Same height between receiver and transmitter
- Visibility connection between receiver and transmitter
- Avoid direct exposure to sunlight

### Ordering Information

**Lap Trigger IR-02 Transmitter**  
Order number **B 261 206 890-01**

## PowerBoxes Overview

	PowerBox PBX 90	PowerBox PBX 190
		
Output current	120 A continuous, 180 A peak	250 A continuous
Inputs	16 (12 analogue, 4 digital)	28 (18 analog, 10 digital)
Outputs	36 single high current outputs, up to 80 A continuous	52 outputs / 28 inputs (18 analogue, 10 digital)
48 V high side switches	-	+
Housing material	Synthetic material housing	Aluminum housing with motorsport connectors
CAN	3	3
LIN	1	1
Ethernet	2	2
Real time Ethernet		2
	Easy programming of complex functions	Easy programming of complex functions
		Precise current measurement
	Reverse polarity protection	

## PowerBox PBX 90



3

### Features

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

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)

#### Communication

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

#### 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)
- 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



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

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
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	TIME-STAMP_IN-OUT	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.	

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

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
32	LIN		
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

## Installation Notes

Inspection services

Recommended after 220 h or 2 years, no components to replace

## Ordering Information

**PowerBox PBX 90**Order number **F 02U V01 794-05****Accessories****Mating Connector X1**Order number **F 02U B00 760-01****Mating Connector X2**Order number **F 02U B00 761-01****Mating Connector X3**Order number **F 02U 003 574-01****Power Cable 16 mm<sup>2</sup>**

L: 2,000 mm

Order number **F 02U V02 047-01**

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

L: 2,000 mm

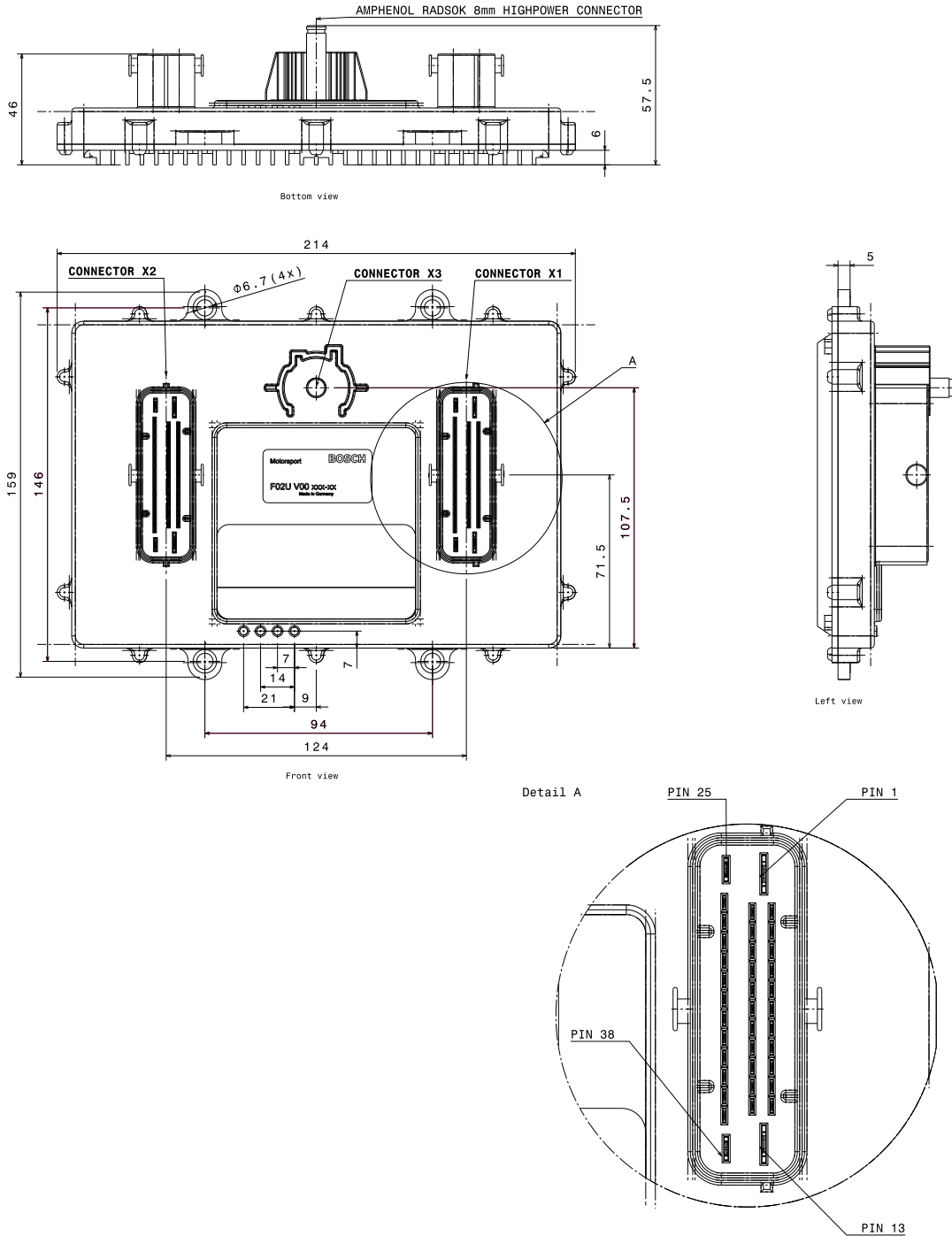
Order number **F 02U V02 048-01**

**Breakout Box BOB PBX 90**

Order number **F 02U V02 292-01**

**Dimensions**

3



## PowerBox PBX 190



### Features

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

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

#### 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)

#### 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

#### 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)

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 / 8STA6-24-37SA

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

## Connector X1: 37 Pins / 8STA6-24-37SA

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 1	15	100
b	HS_15A X1_b 1	15	100
c	PWM_15A X1_c 1	15	60
d	PWM_15A X1_d 1	15	60
e	PWM_15A X1_e 1	15	60
f	PWM_15A X1_f 1	15	60
g	HS_15A X1_g 1	15	100
h	HS_15A X1_h 1	15	100
k	HS_15A X1_k 1	15	100
m	HS_15A X1_m 1	15	100
n	HS_15A X1_n 1	15	100
p	Power KL31	15	-
q	Power KL31	15	-
r	Power KL31	15	-

## Connector X2: 1 Pin / 8STA6-12-01BN261

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

## Connector X3: 19 Pins / 8STA6-24-19SN

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

## Connector X3: 19 Pins / 8STA6-24-19SN

S	HS_25A X3_S	25	150
V	Power KL31	25	-

## Connector X4: 6 Pins / 8STA6-16-06SA

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	
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
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	
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	

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

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

### Installation Notes

Inspection services	Recommended after 220 h or 2 years, no components to replace
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### Ordering Information

#### PowerBox PBX 190

Order number **F 02U V02 626-02**

#### Accessories

##### Mating Connector X1

Order number **F 02U 004 387-01**

##### Mating Connector X2

Socket 25 mm<sup>2</sup>

Order number **F 02U B01 044-01**

##### Mating Connector X2

Socket 35 mm<sup>2</sup>

Order number **F 02U B01 045-01**

##### Mating Connector X3

Order number **F 02U 004 386-01**

##### Mating Connector X4

Order number **F 02U 004 388-01**

##### Mating Connector X5

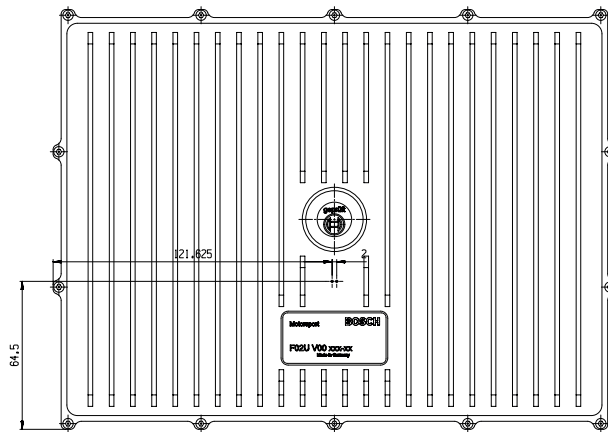
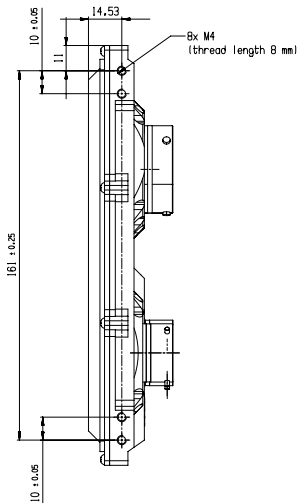
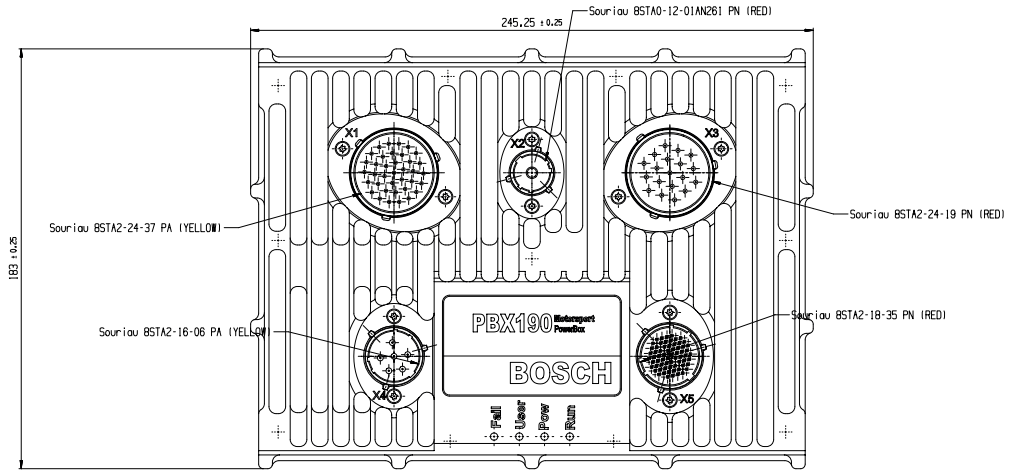
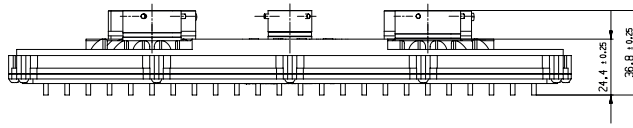
Order number **F 02U 000 472-02**

#### Breakout Box

Order number **F 02U V02 523-01**

Dimensions

3



## Lambdatronic LT4



### 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.

### Functions

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

Configuration with Modas Sport	Included
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#### 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	AS 6-14-35PN
Connector loom AS 1-14-35SN	F 02U 000 365-01
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

### Installation Notes

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.

### Communication

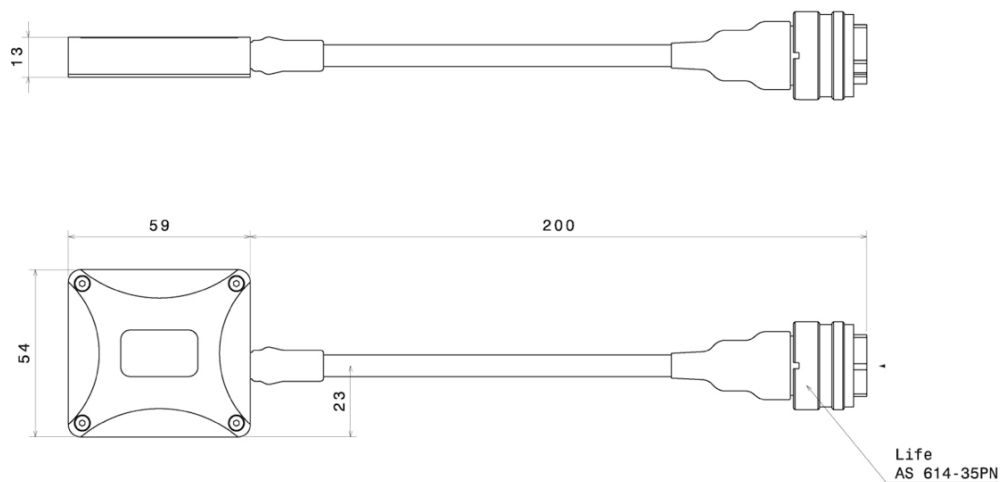
Communication link                      K-Line / CAN

### Ordering Information

#### Lambdatronic LT4

Order number **F 01T A20 070-09**

### Dimensions





## Lambdatronic LT4 ADV



### 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 which function is to supply and control up to four Bosch LSU ADV. The new 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 gets 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 light weight construction, as well as the possibility to control up to 4 Lambda Sensors LSU ADV with multiple user-configurable parameters.

### Functions

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*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-motor-sport.com">www.bosch-motor-sport.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

Configuration with Modas Sport	Included
--------------------------------	----------

#### 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	AS 6-14-35PN
Connector loom AS 1-14-35SN	F 02U 000 365-01
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

### Installation Notes

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.

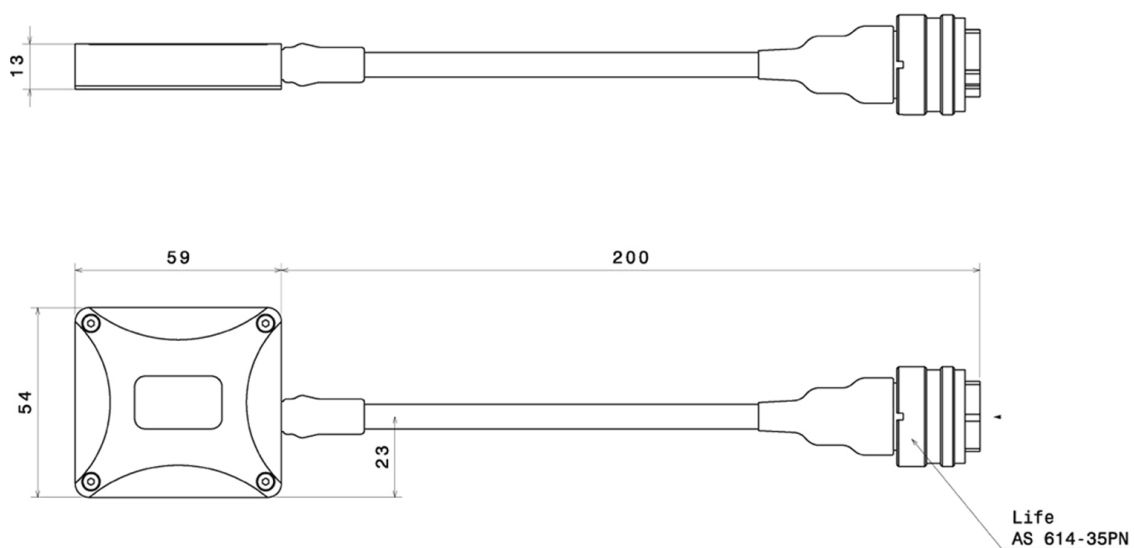
See the LT4 ADV function sheet for software documentation (e.g. CAN protocol).

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

### Ordering Information

**Lambdatronic LT4 ADV**  
Order number **F 02U V01 111-04**

### Dimensions



## Modular Sensor Interface M 60



### Features

- ▶ Compact sensor interface
- ▶ 30 input channels
- ▶ Each channel individually configurable

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)	F 02U V01 012-01
---	------------------

#### Connectors and Wires

Motorsport connectors double density	2 x 41 pins
Mating connector I AS-DD 6-12-41SN	F 02U 002 216-01
Mating connector II AS-DD 6-12-41SA	F 02U 004 180-01

### Installation Notes

Internal accumulator for data preservation and clock included
Required service interval: 24 months (internal accumulator is replaced)

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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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**3**

### Communication

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Configuration via RaceCon over Ethernet or MSA-Box II

---

CAN interfaces	2
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Ethernet 100BaseT	3
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### Ordering Information

#### Modular Sensor Interface M 60

Order number **F 02U V00 882-02**

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#### Software Options

##### SW Upgrade 1

Order number **F 02U V01 012-01**

---

## Modular Sensor Interface MSI 60



### Features

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

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

#### Environment

##### Software Upgrade 1

CCP-Master (ASAP 2 file from ECU manufacturer required)	F 02U V01 012-01
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#### Connectors and Wires

##### Connector 1: LIFE (red) X1 ECU: AS-2-12-35PN

Harness: AS 6-12-35SN; max. AWG22	F 02U 000 443-01
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##### Connector 2: SENSOR 1 (yellow) X2 ECU: ASDD-2-14-64PA

Harness: ASDD 6-14-64SA; max. AWG24	F 02U 003 098-01
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##### Connector 3: SENSOR 2 (red) X3 ECU: ASDD-2-14-64PN

Harness: ASDD 6-14-64SN; max. AWG24	F 02U 000 854-01
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### Ordering Information

#### Modular Sensor Interface MSI 60

Order number **F 02U V01 901-01**

#### Software Options

##### SW Upgrade 1

Order number **F 02U V01 012-01**

## Wheel Speed Signal Splitter



3

### 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 like the MS 4 ECUs.

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

#### Connector for Single Connector Type

Connector 1 (wide)	AS-012-35-PN
Mating connector AS-6-12-35-SN	F 02U 000 443-01

#### Connectors for Double Connector Type

Connector 1 (wide)	AS-2-12-35-PN
Mating connector AS-6-12-35-SN	F 02U 000 443-01
Connector 2 (small)	AS-2-08-35-PN
Mating connector AS-6-08-35-SN	F 02U 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

### 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

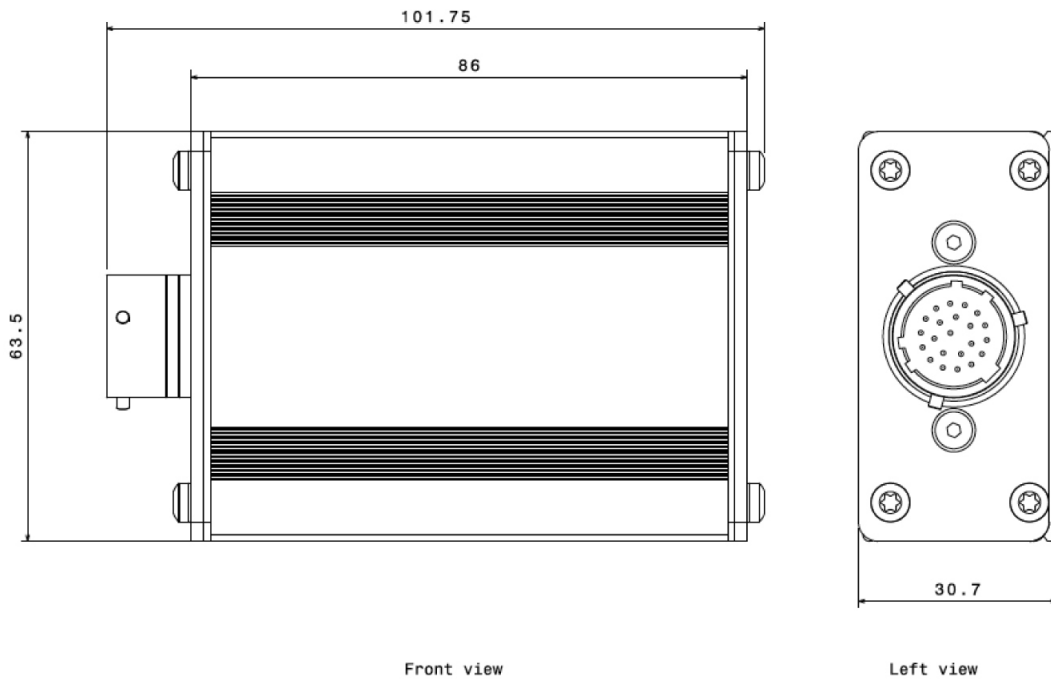
Order number **F 02U V00 335-03**

#### Double Connector Type

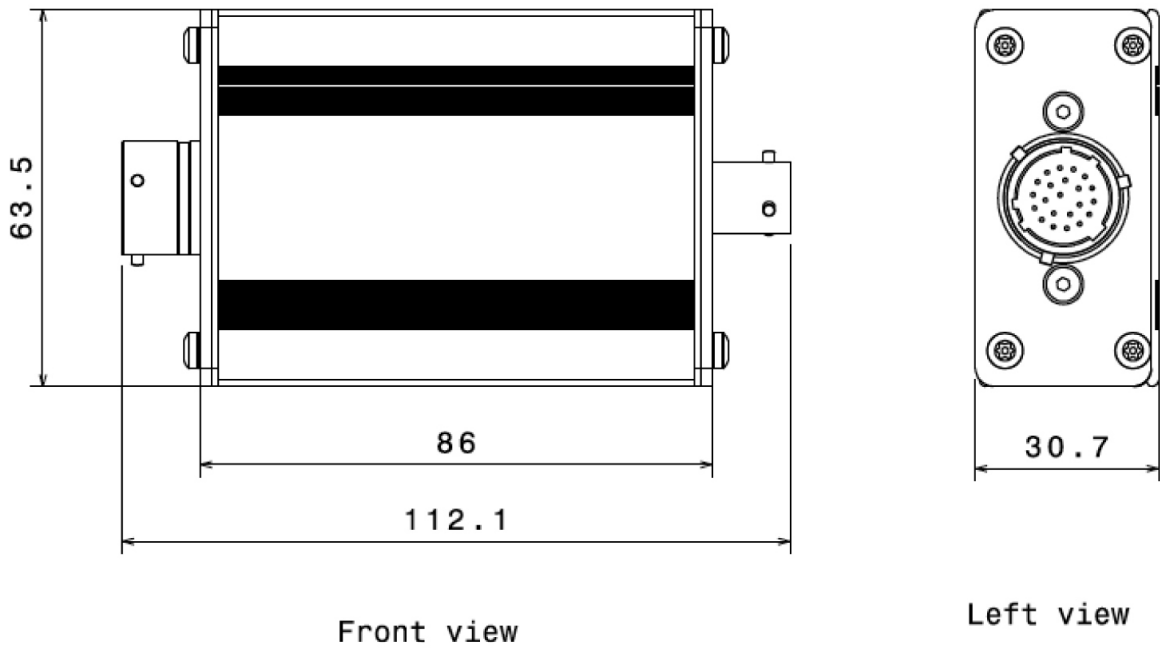
Order number **F 02U V00 203-03**

3

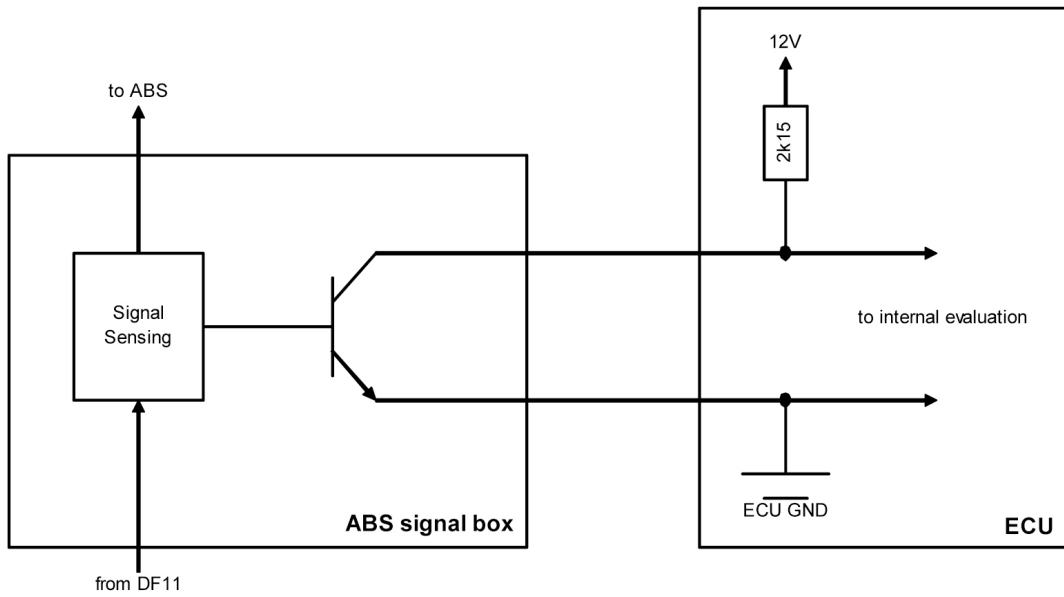
### Dimensions



Single Connector Type Housing



Double Connector Type Housing



Connection Scheme



## Telemetry System LTE65



### Features

- ▶ 4G-LTE connectivity
- ▶ No infrastructure setup required, built-in SIM card
- ▶ Advanced quality of service (USA only)
- ▶ Data can be sent to anywhere 4G-LTE is present
- ▶ For use with Bosch or 3<sup>rd</sup> party loggers

The LTE65 is a 4G-LTE based telemetry modem designed for real time telemetry data transfer on racetrack for use within the USA or within the EU.

The LTE65 system allows transmission of telemetry data for live review anywhere (multiple location - i.e. factory, office, transporter, etc.) 4G LTE network (with a receiver-configured unit) is available.

Any device can be configured as transmitter or as receiver. Multiple data routes (in car transmitter to receiver) are possible and configurable by the end user.

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 with a serial RS232 output stream can also be used as long as the 3<sup>rd</sup> party's telemetry tool supports the system.

### Technical Specifications

#### Mechanical Data

Size	114 x 65.5 x 22 mm
Weight	170 g

Max. vibration Transmitter	Vibration Profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )
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Housing with LED indicators

#### Car antenna (not included) recommended specifications:

Output impedance	50 Ohm
Total radiated efficiency	>50 % on all bands
Mean effective gain	≥ -3 dBi

#### Recommended antennas

MA241 Genesis LTE MIMO 2in1

Adhesive Mount Combination Antenna

2\* 4G MIMO LTE 698 to 896/1,710 to 2,700 MHz

#### Electrical Data

Data interface	Ethernet or RS232
Data rate	115,200 baud
Input voltage range	9 to 32 V
Recommended input voltage	12 to 14 V
Max. current	440 mA
Operation temperature range	-30 to 80°C (-22 to 176°F)

#### Connectors and Wires

Mating connector	ASDD606-09SN
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### Ordering Information

#### LTE65 Modem USA

Antenna not included

Order number **on request**

#### LTE65 Modem EU

Antenna not included

Order number **on request**

#### Software Options

##### Required yearly Maintenance

First year included

Order number **on request**

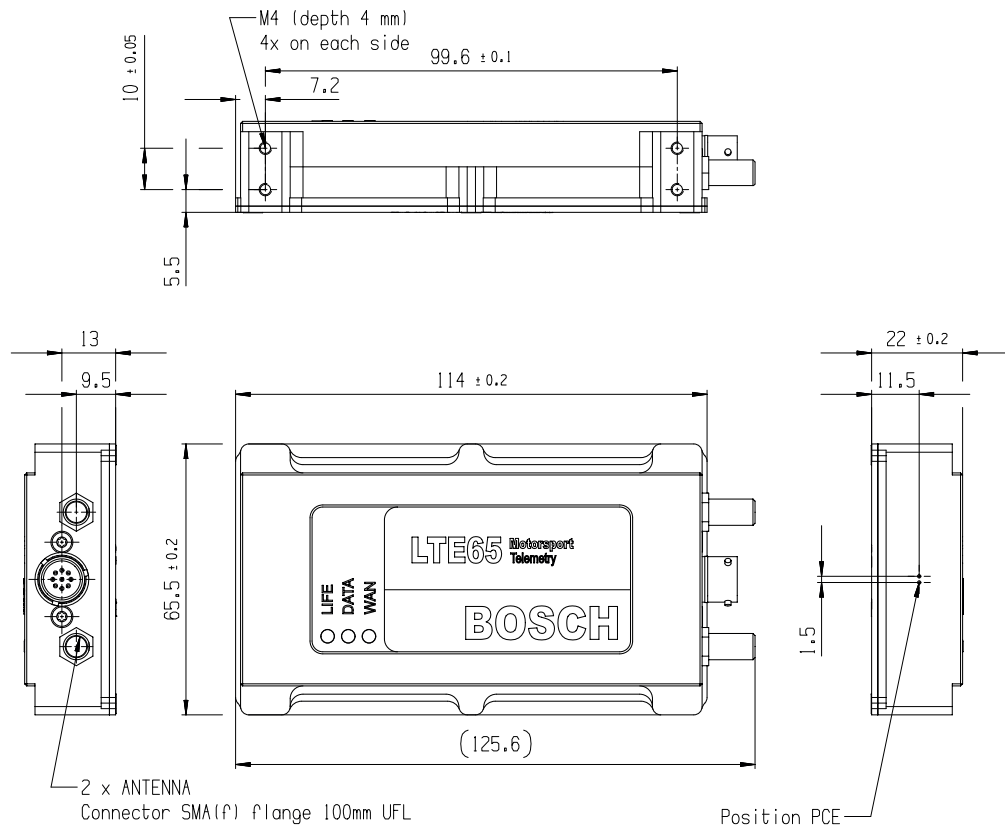
#### Serial Output (Receiver)

For use with 3<sup>rd</sup> party devices

Order number **on request**

Dimensions

3



## μLC Test System



### Features

- ▶ User-friendly interface
- ▶ Customer defined features feasible
- ▶ 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 cm x 11 cm 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.

### Functions

#### 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

#### 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

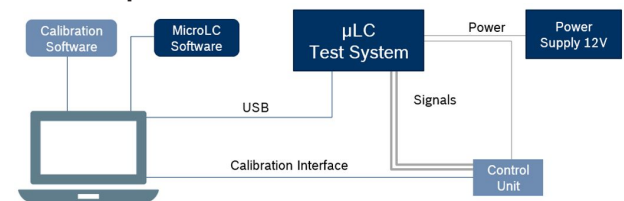
#### Analogue Interfaces

- 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

#### Additional Features

- 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

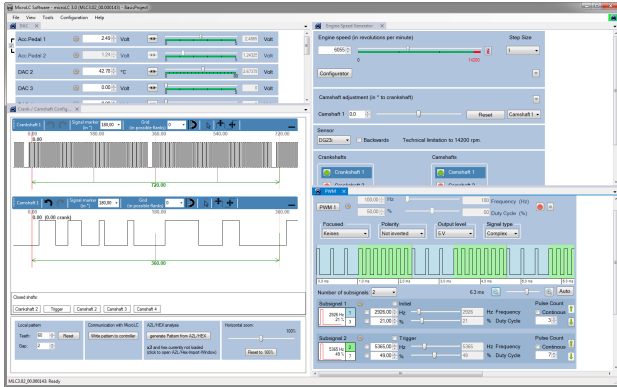
#### Test Setup



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°C to 40°C
Housing material	Aluminum
Dimensions	175 mm x 107 mm x 61 mm
Weight	690 g



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

### Ordering Information

#### µLC Test System

Order number **F 02U V02 303-02**

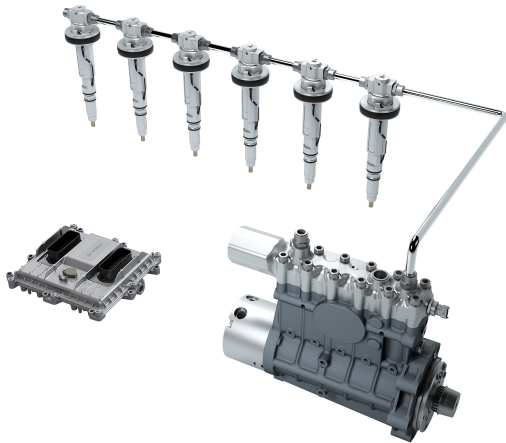
# 04 Injection and Ignition

4

<b>Diesel System Components</b>	<b>102</b>
<b>Injection Valves</b>	<b>104</b>
<b>Fuel Pumps</b>	<b>113</b>
<b>Fuel Pressure Regulators</b>	<b>125</b>
<b>Ignition Coils</b>	<b>134</b>
<b>Ignition Modules</b>	<b>176</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.).

Our goal is to offer the best balance of cost and performance for your application. This is why we offer different levels of modifications to choose from. Below is an example of the different levels for a 4-cylinder engine with 4 injectors, 1 high pressure pump and a single fuel rail:

### 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.



#### Notice

If your engine is originally equipped with Bosch components, modifications will be easier than replacing third party components.



#### Notice

We reserve the right to assess a fee for applications where the component specification requires an extraordinary amount of time.

**Dimensions**



Common Rail Pumps



Rails



Pressure Sensors



Injectors

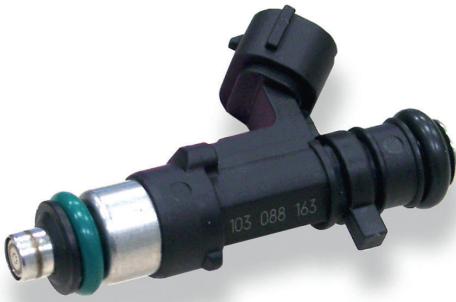


Pressure Control Valves

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

## Injection Valve EV 14



4

### Features

- ▶ Conical spray or 2-spray
- ▶ Flow rate at 3 bar: up to 1,462 cm<sup>3</sup>/min
- ▶ Spray angle 15 to 85°
- ▶ With or without extension

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 α	15 to 85°
Bent angle γ	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 **0 280 158 110**

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

Order number **0 280 158 200**

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

Order number **0 280 158 107**

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

Order number **0 280 158 013**

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

Order number **0 280 158 038**

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

Order number **0 280 158 116**

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

Order number **B 280 436 038-09**

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

Order number **B 280 436 038-10**

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

Order number **0 280 158 123**

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

Order number **B 280 436 038-08**

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

Order number **B 280 436 038-07**

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

Order number **0 280 158 040**

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

Order number **B 280 436 487-01**

#### Accessories

##### Clip for locking bush of plastic

Order number **2 431 314 021**

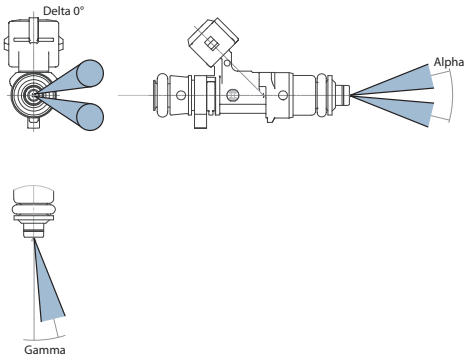
##### Clip for locking bush of steel

Order number **2 431 314 018**

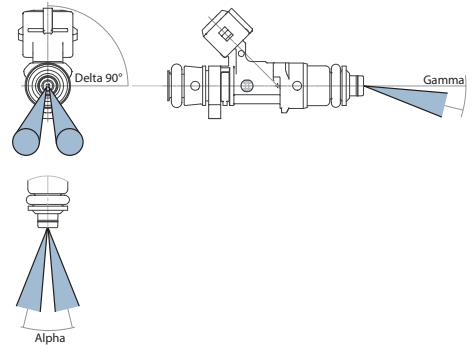


**Dimensions**

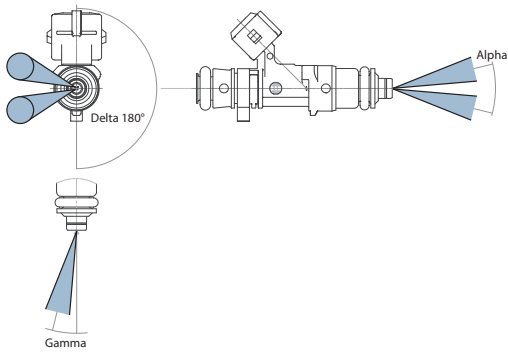
Spray bent to the „right“, Delta=0°



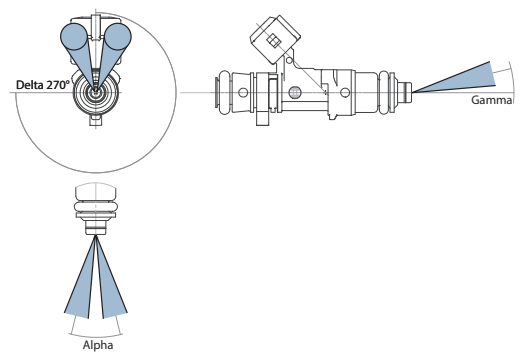
Spray bent „down“ (away from electr. connector), Delta=90°



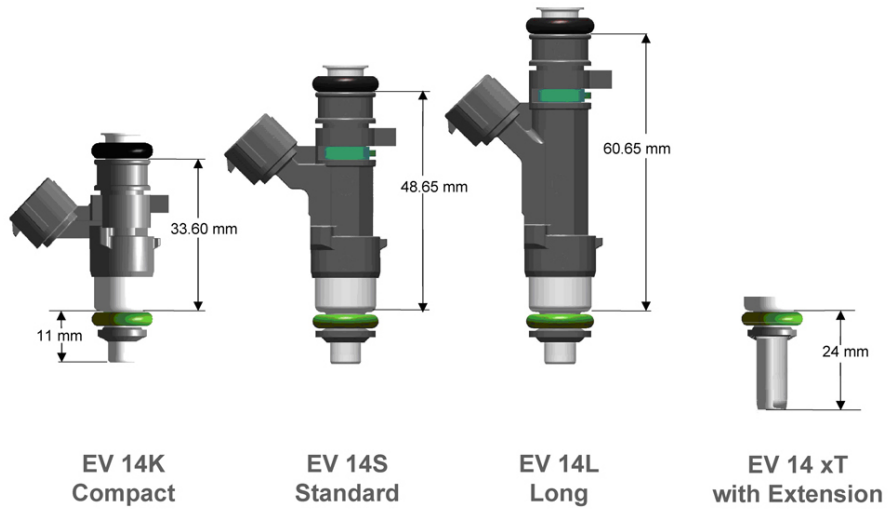
Spray bent to the „left“, Delta=180°



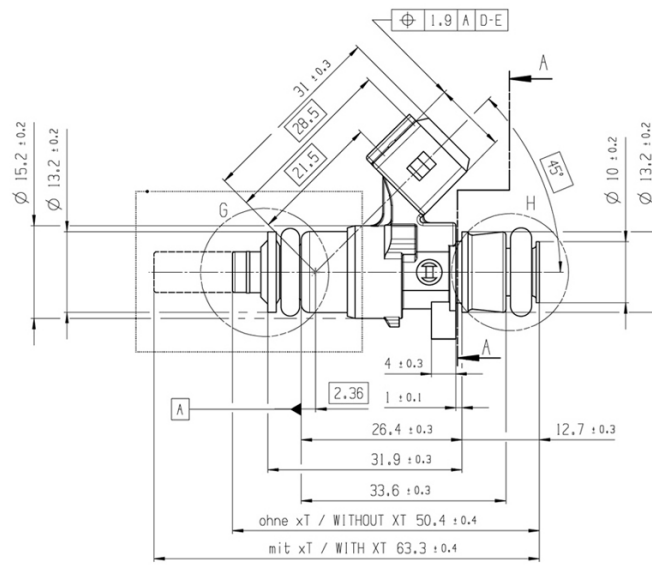
Spray bent „up“ (towards electr. connector), Delta=270°



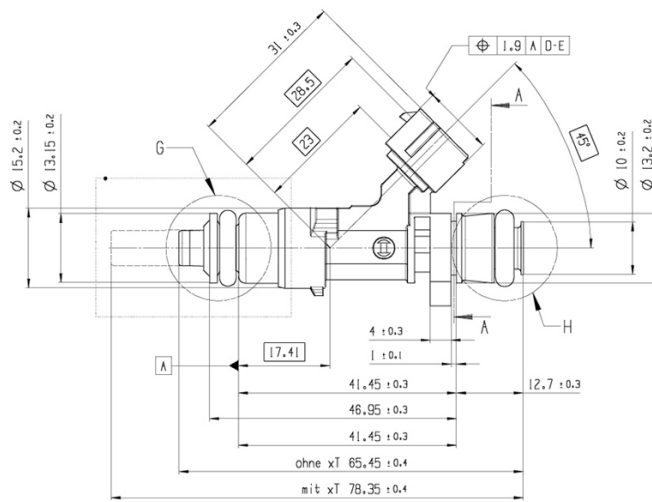
*Delta Angel*



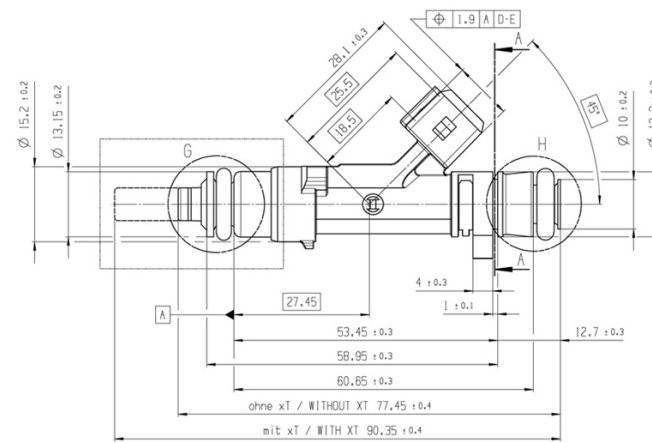
*Housing Variations*



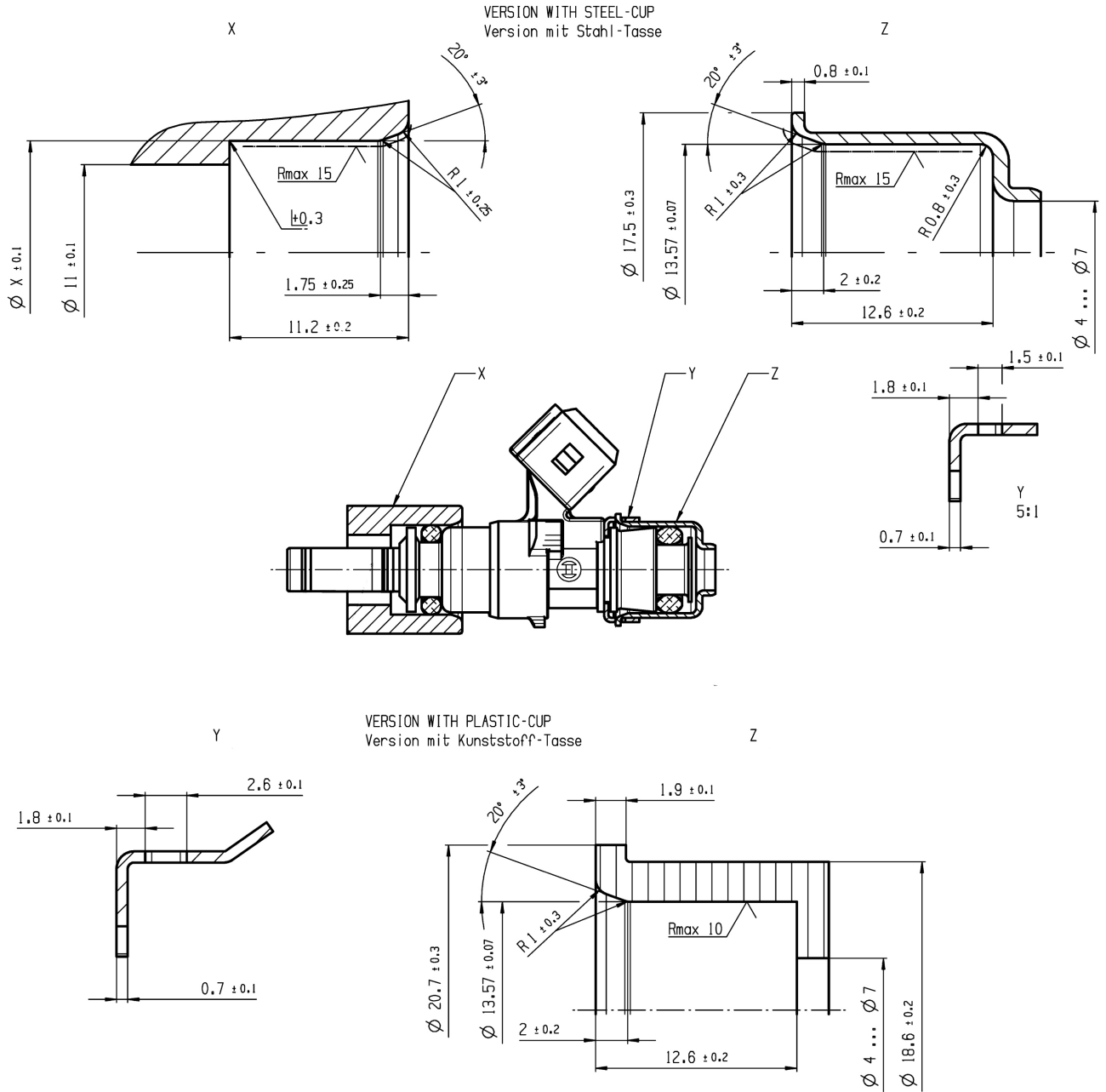
EV 14 Compact



EV 14 Standard



EV 14 Long



Mounting Instructions

## EV 14 Variations

## Variations of production type valves

Part Nr.	0 280 158 110	0 280 158 200	0 280 158 107	0 280 158 013	0 280 158 038
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°	0°	0°	0°	0°
$\delta$	0°	90°	0°	90°	0°
Resistance	12 Ohm	12 Ohm	12 Ohm	12 Ohm	12 Ohm

Part Nr.	0 280 158 116	0 280 158 123	0 280 158 040
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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.

## Variations of Motorsport valves

Part Nr.	B 280 436 038-07	B 280 436 038-08	B 280 436 038-09	B 280 436 038-10	B 280 436 487-01
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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

Further variations are available on request.

## HP Injection Valve HDEV 5.2



### Features

- ▶ Max. 500 bar
- ▶ Multi hole
- ▶ Flow rate at 100 bar: up to 1,640 g/min (n-heptane)
- ▶ 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 $t_i = 1.5$ ms
Leakage	≤2.5 mm <sup>3</sup> /min at 23°C

#### Electrical Data

Booster supply	65 to 90 V
Booster current	13.2 A
Booster time	500 μs
Power supply	12 V
Pick up current	9.6 A
Pick up time	800 μs
Hold power supply	12 V
Hold current	3.0 A hysteresis 0.8 A
Coil resistance	1,500 mOhm (ambient temp.)

#### Connectors and Wires

Mating connector Compact	D 261 205 359-01
Connector Jetronic (wire)	D 261 205 288-01
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.

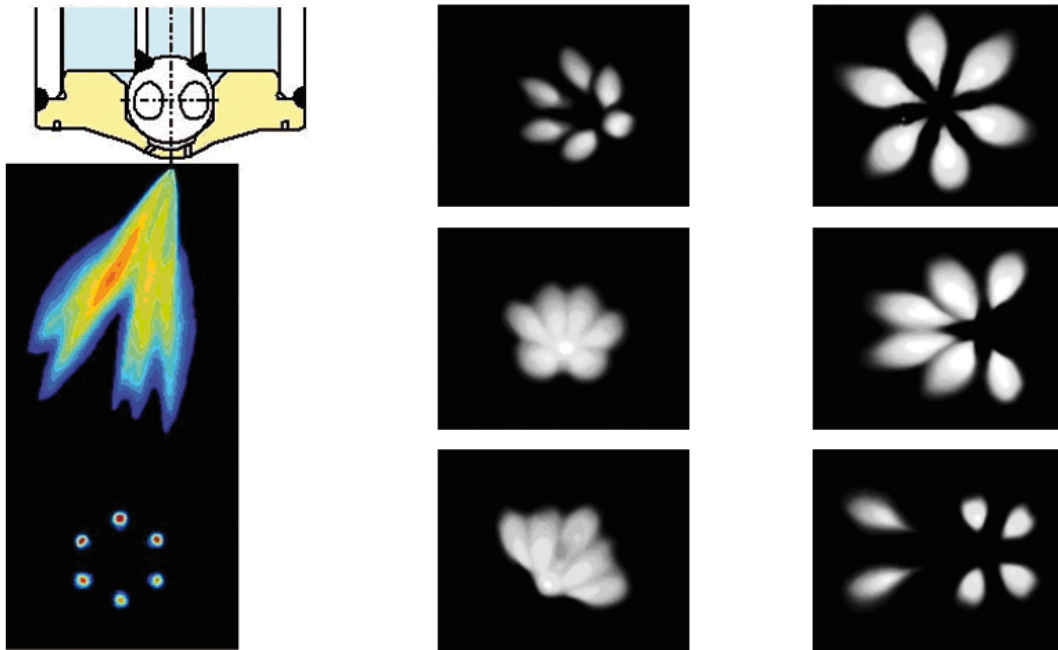
The injector can be cleaned (mechanically or chemically), if the tip will not be damaged.

Do not use supersonic cleaning.

### Ordering Information

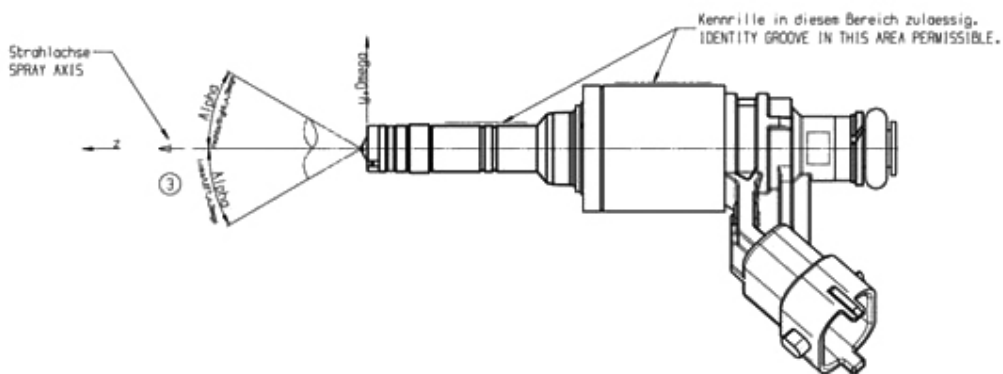
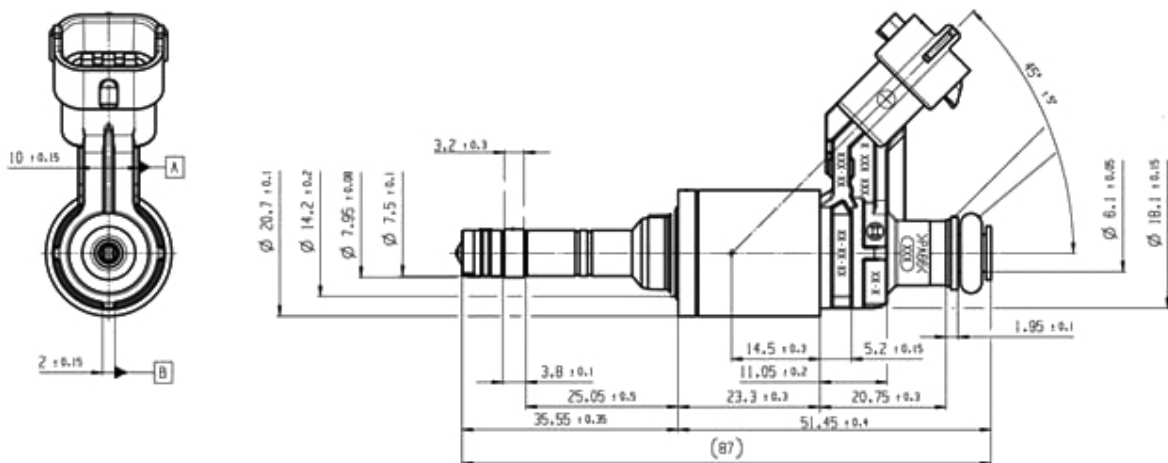
**HP Injection Valve HDEV 5.2**  
Order number **on request**

Dimensions



4

Spray variations, further variations on request



## HP Injection Valve HDEV 5.2 LC



### Features

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

The HDEV 5.2 LC 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 LC 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 LC 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	Max. 221.5 g
Diameter	20.7 mm
Length standard version	185 mm
Length short version	173 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 $t_i = 1.5$ ms
Leakage	≤2.5 mm <sup>3</sup> /min at 23°C

#### Electrical Data

Booster supply	65 to 90 V
Booster current	13.2 A
Booster time	500 μs
Power supply	12 V
Pick up current	9.6 A
Pick up time	800 μs
Hold power supply	12 V
Hold current	3.0 A hysteresis 0.8 A
Coil resistance	1,500 mOhm (ambient temp.)

#### Connectors and Wires

Mating connector Compact	On request
Connector Jetronic (wire)	D 261 205 288-01
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.

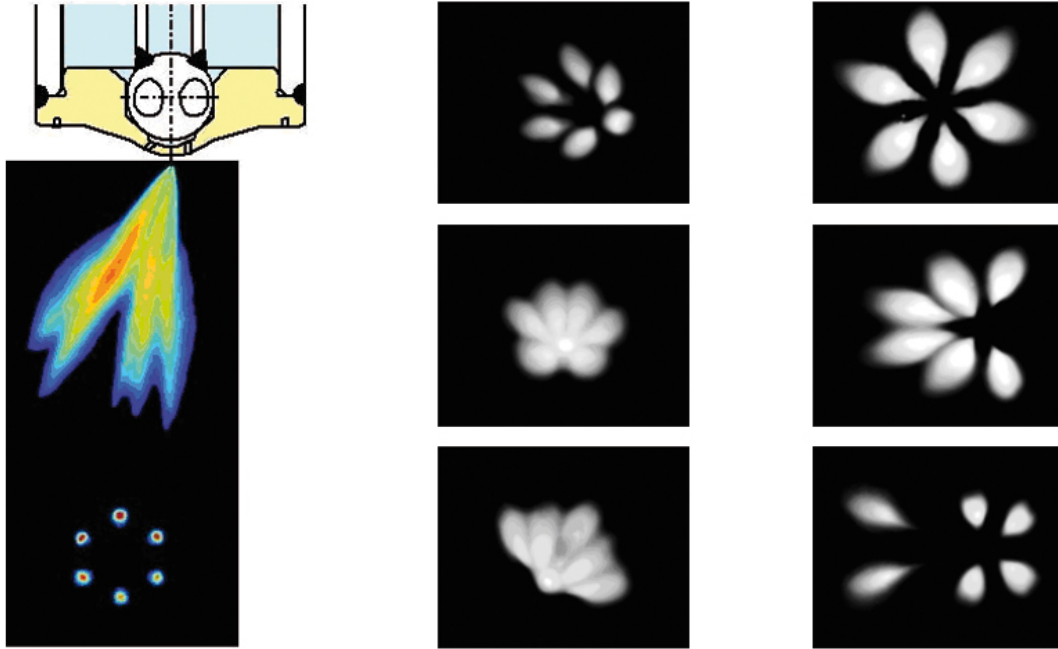
Ordering Information

Order number on request

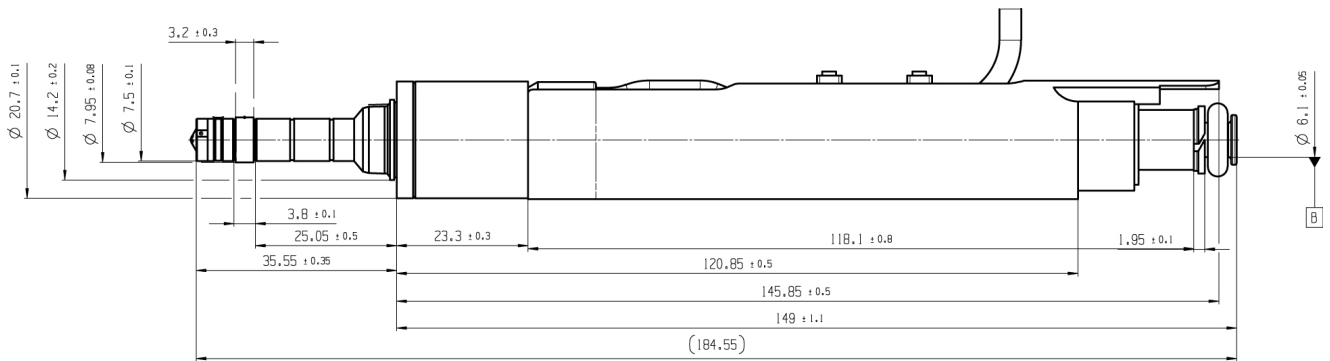
HP Injection Valve HDEV 5.2 LC

Dimensions

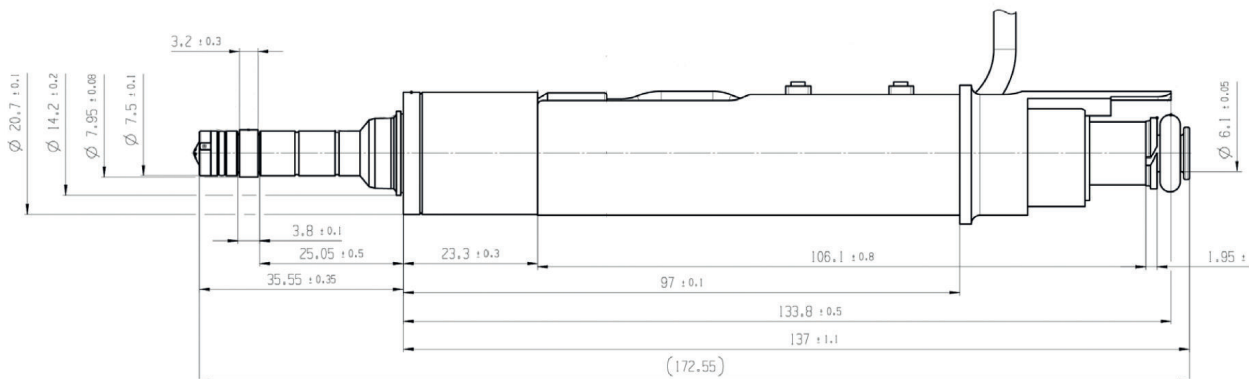
4



Spray variations, further variations on request








Standard version



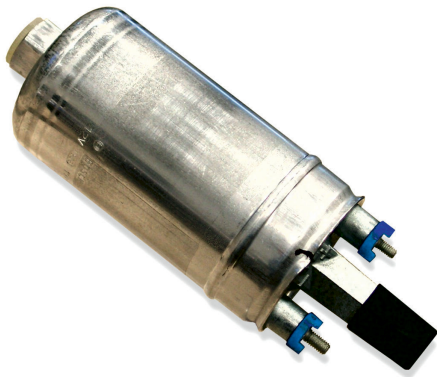
Short version



**Fuel Pumps Overview**

	Fuel Pump FP 165	Fuel Pump FP 200	Fuel Pump LPx-F1	HP Fuel Pump HDP 5	HP Fuel Pump HDP 5-LW
					
Flow rate gasoline (l/h)	>165	>200	>260 (>160 at 7 bar/120 W)	1.1 cm <sup>3</sup> /rot <sub>cam</sub>	1.1 cm <sup>3</sup> /rot <sub>cam</sub>
Max. pressure (bar)	5.0	5.0 or 8.0	<8.0	>200	Max. 500
Supply voltage (V)	6 to 16.5	6 to 16.5	48 (PWM controlled)	-(mech.)	-(mech.)
Temperature range (°C)	-20 to 90	-20 to 90	Max 80	-40 to 120	-40 to 120
Weight (g)	980	1,030	325	780	585
Max. vibration	3 mm at 10 to 18 Hz ≤40 m/s <sup>2</sup> at 18 to 60 Hz	3 mm at 10 to 18 Hz ≤40 m/s <sup>2</sup> at 18 to 60 Hz	Profil 1	600 m/s <sup>2</sup>	600 m/s <sup>2</sup>

## Fuel Pump FP 165



4

### Features

- ▶ >165 l/h
- ▶ 980 g
- ▶ Max. 5 bar
- ▶ Fuel lines screwed

The FP 165 is an inline roller cell pump for the installation outside the fuel tank.

It is capable of providing 165 l/h at 5 bar. Bio-fuel can be delivered up to E85 (shortens lifetime!).

The FP 165 is a production type fuel pump, combining good quality at a low price.

### Application

Fuel pressure	5 bar
Delivery rate at 5 bar and 22°C	205 ± 5 l/h at 14 V
Pressure limiting valve	7 to 12.5 bar rel.
Fuel compatibility	Up to E85 with shorter lifetime
Diesel compatibility	Not released
Operating temperature range	-20 to 90°C
Storage temperature range	-40 to 70°C
Max. vibration	3 mm at 10 to 18 Hz ≤40 m/s <sup>2</sup> at 18 to 60 Hz

### Technical Specifications

#### Mechanical Data

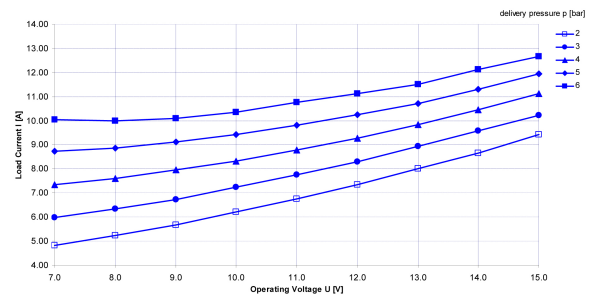
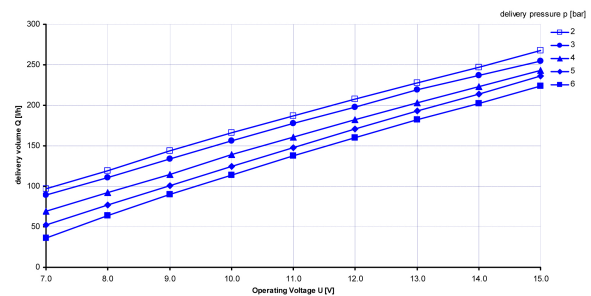
Diameter	60 mm
Length	168 mm
Weight	980 g
Mounting	Clamping

#### Electrical Data

Supply voltage	6 to 16.5 V
Operating voltage	13.8 V
Load current at 5 bar and 22°C	11.0 ± 2 A

#### Characteristic

Surface coating	None
Color	Silver
Non-return valve	Internal
Fuel filtering	External, on pressure side



#### Connectors and Wires

Electrical connector	+M4/-M5
Electrical mating connector	with ring wire M4 and M5
Mechanical connector intake side	M14x1.5
Mechanical connector pressure side	M12x1.5

#### Installation Notes

With E26/E85 fuel run-time max. 500 h.

For technical reasons the values may vary.

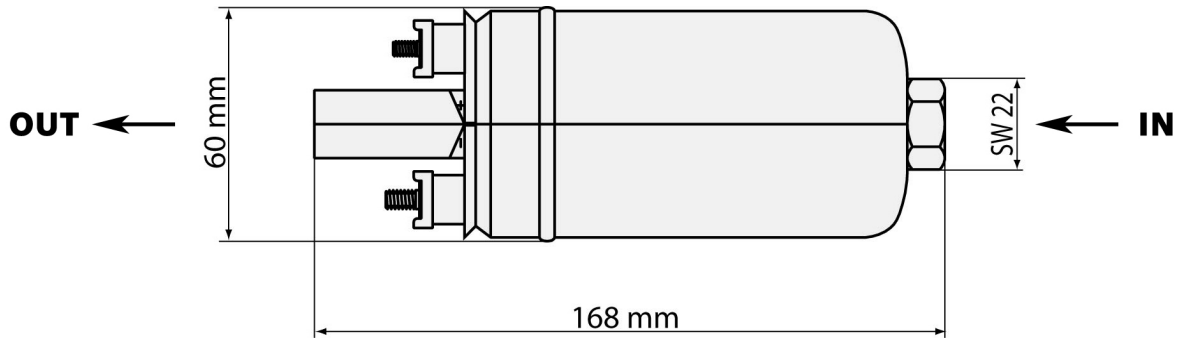
Please use within the specified limit values only.

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

#### Ordering Information

**Fuel Pump FP 165**  
Order number **0 580 254 979**

Dimensions



# Fuel Pump FP 200



4

## Features

- ▶ >200 l/h
- ▶ 1,030 g
- ▶ Max. 5 bar/8 bar
- ▶ Fuel lines screwed

The FP 200 is an inline roller cell pump for the installation outside or inside the fuel tank. It is capable of providing 200 l/h at 5 bar (8 bar). Bio-fuel can be delivered up to E85 (shortens lifetime!). The FP 200 is one of the most popular aftermarket fuel pumps and has an excellent price.

## Application

Fuel pressure	5 bar or 8 bar
Delivery rate at 5 bar and 22°C	260 ± 5 l/h at 14 V
Delivery rate at 8 bar and 22°C	220 ± 5 l/h at 14 V
Pressure limiting valve	10 to 12.5 bar rel.
Fuel compatibility	Up to E85 with shorter lifetime
Diesel compatibility	Not released
Operating temperature range	-20 to 90°C
Storage temperature range	-40 to 70°C
Max. vibration	3 mm at 10 to 18 Hz ≤40 m/s <sup>2</sup> at 18 to 60 Hz

## Technical Specifications

### Mechanical Data

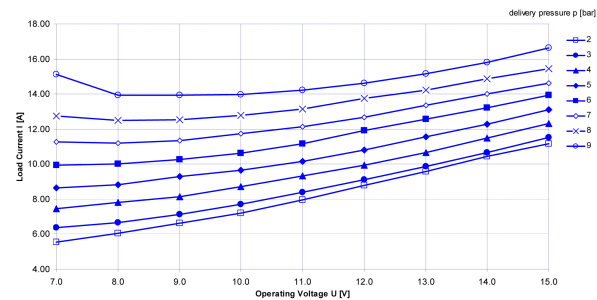
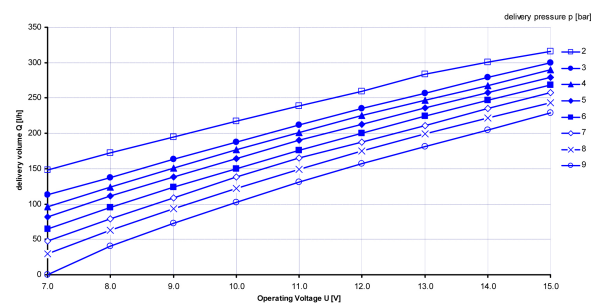
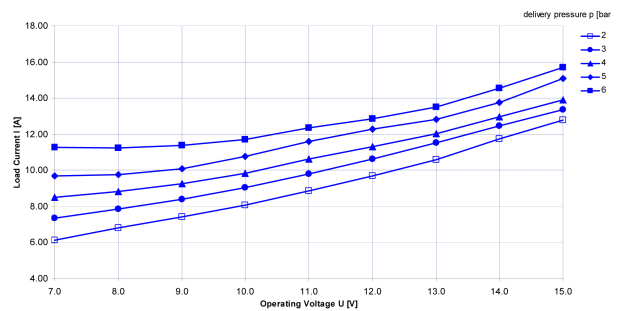
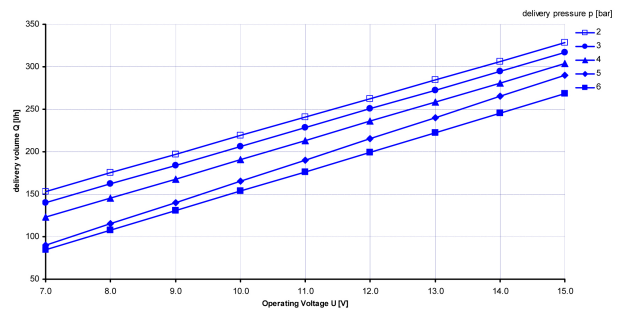
Diameter	60 mm
Length	196 mm
Weight	1,030 g
Mounting	Clamping

### Electrical Data

Supply voltage	6 to 16.5 V
Operating voltage	13.8 V
Load current at 5 bar and 22°C	≤ 15 A
Load current at 8 bar and 22°C	≤ 18 A

### Characteristic

Surface coating	None
Color	Silver
Non-return valve	External
Fuel filtering	External, on pressure side



**Connectors and Wires**

Electrical connector	+M6/-M5
Electrical mating connector	With ring wire M6 and M5
Mechanical connector intake side	M18x1.5
Mechanical connector pressure side	M12x1.5

**Installation Notes**

With E26/E85 fuel run-time max. 500 h.  
 For technical reasons the values may vary.

Please use within the specified limit values only.

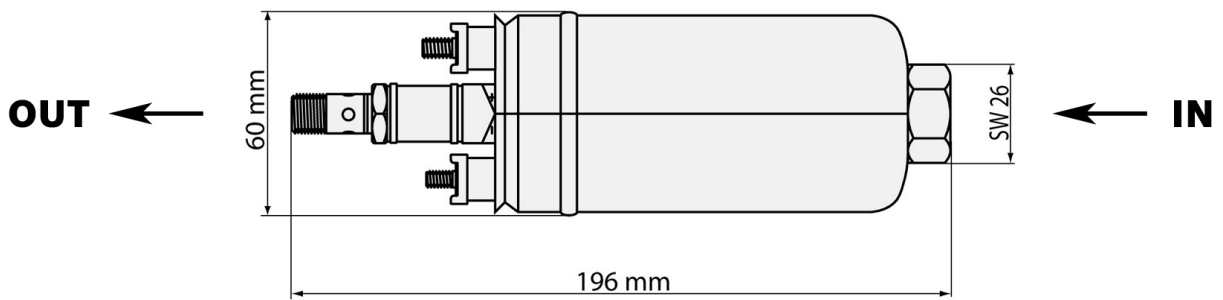
Please find further application hints in the offer drawing at our home-page.

**Ordering Information**

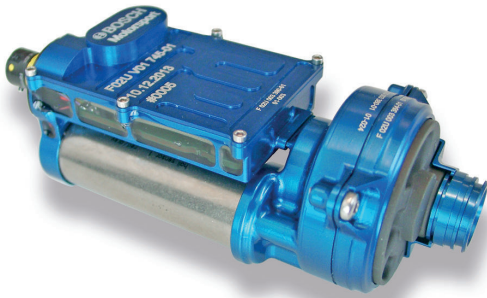
**Fuel Pump FP 200**  
 Max. Pressure 5 bar  
 Order number **0 580 254 044**

**Fuel Pump FP 200**  
 Max. Pressure 8 bar  
 Order number **B 261 205 413-01**

**Dimensions**



## Fuel Pump LPx-F1



4

### Features

- ▶ > 160 l/h at 7 bar (g)
- ▶ 325 g
- ▶ Max. 8 bar (g)
- ▶ Brushless motor
- ▶ PWM speed controlled

The Bosch LPx-F1 fuel pump features a PWM controlled BLDC motor. Its main purposes include low pressure fuel systems up to 8 bar as well as acting as an in-tank feeding pump for high pressure applications. The supply voltage is 48 V.

### Application

Fuel pressure	< 8 bar (g)
Delivery rate at 22°C	> 160 l/h at 7 bar (g) (120 W)
Max. delivery rate	> 260 l/h
Max. temperature fuel	65°C
Max. ambient temperature	80°C
Storage temperature range	-40 to 70°C
Max. vibration	See vibration profile 1
Max. dry run time	< 5 min
Duration for pressure build up	< 200 ms from (0 ... 160 l/h at 8 bar abs at T <sub>fuel</sub> = 65°C)
Fuel compatibility	F1 gasoline fuel
Fuel incompatibility	Diesel, ethanol

### Technical Specifications

#### Mechanical Data

Pump	50 (25) mm x 125 mm
Electronic	47 x 60 x 20 mm
Weight	325 g

Housing	Aluminum
Sucking/intake side	Open pump element
Pressure side	M12x1
Inspection and maintenance interval	Every 35 operating hours; Pump impeller and impeller casing has to be replaced

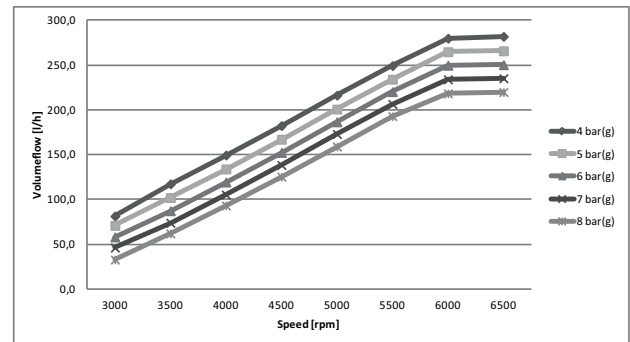
#### Electrical Data

Supply voltage	48 V ± 2 V
Load current	3.5 A at 6,500 rpm and 8 bar (see diagrams)
Speed control	PWM
Built in Deutsch Autosport connector	

#### Characteristic

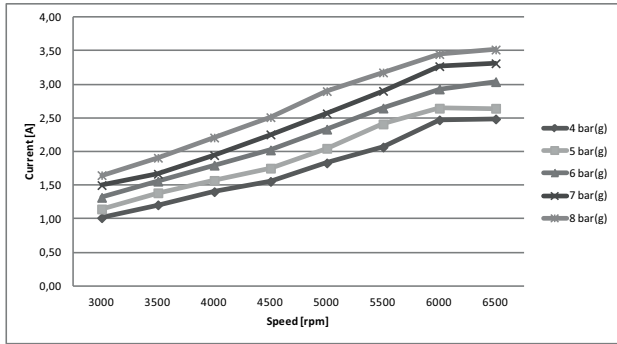
Surface coating	Anodization
Color	Blue
Non-return valve	External
Fuel filtering	Possible both sides

#### Volumeflow



Pump speed [rpm]	Pressure					l/h
	4 bar (g)	5 bar (g)	6 bar (g)	7 bar (g)	8 bar (g)	
3,000	81.3	70.8	58.0	46.1	32.7	l/h
3,500	117.3	102.0	87.2	73.8	61.9	l/h
4,000	149.4	133.9	119.3	105.2	93.2	l/h
4,500	182.2	167.0	152.3	138.3	125.2	l/h
5,000	216.2	200.7	186.5	172.8	158.9	l/h
5,500	249.2	234.0	220.1	206.4	192.8	l/h
6,000	279.8	264.7	249.6	233.9	218.2	l/h
6,500	281.8	265.8	250.2	235.0	219.7	l/h

**Current**



Pump speed [rpm]	Pressure					A
	4 bar (g)	5 bar (g)	6 bar (g)	7 bar (g)	8 bar (g)	
3,000	1.01	1.14	1.32	1.50	1.65	A
3,500	1.21	1.39	1.56	1.67	1.91	A
4,000	1.40	1.57	1.80	1.94	2.21	A
4,500	1.55	1.75	2.02	2.25	2.51	A
5,000	1.83	2.05	2.33	2.57	2.90	A
5,500	2.07	2.41	2.65	2.90	3.18	A
6,000	2.47	2.64	2.93	3.27	3.45	A
6,500	2.48	2.64	3.04	3.31	3.52	A

**Connectors and Wires**

Electrical connector	ASL 0-06-05PA-HE-952K
Electrical mating connector	on request
Pin 1	U <sub>batt</sub> (48 V, 3 A)
Pin 2	PGND
Pin 3	Nc

Pin 4	PWM_IN
Pin 5	SIG_OUT (optional)
Mechanical connector intake side	open
Mechanical connector pressure side	M12x1

**PWM Signal**

Frequency	10 Hz to 5 kHz
PWM Load	10 % equals 0 rpm pump speed 90 % equals 7,000 rpm pump speed
MAX voltage	± 36 V
Logical 0	typical < 1.0 V
Logical 1	typical > 2.4 V
Input impedance	47 kOhm (< 3.3 V) 38.5 kOhm ( at 5 V) 25.5 kOhm (at 24 V)
Switching delay	< 8 ms
Input Current ("1")	130 µA (at + 5 V)

**Installation Notes**

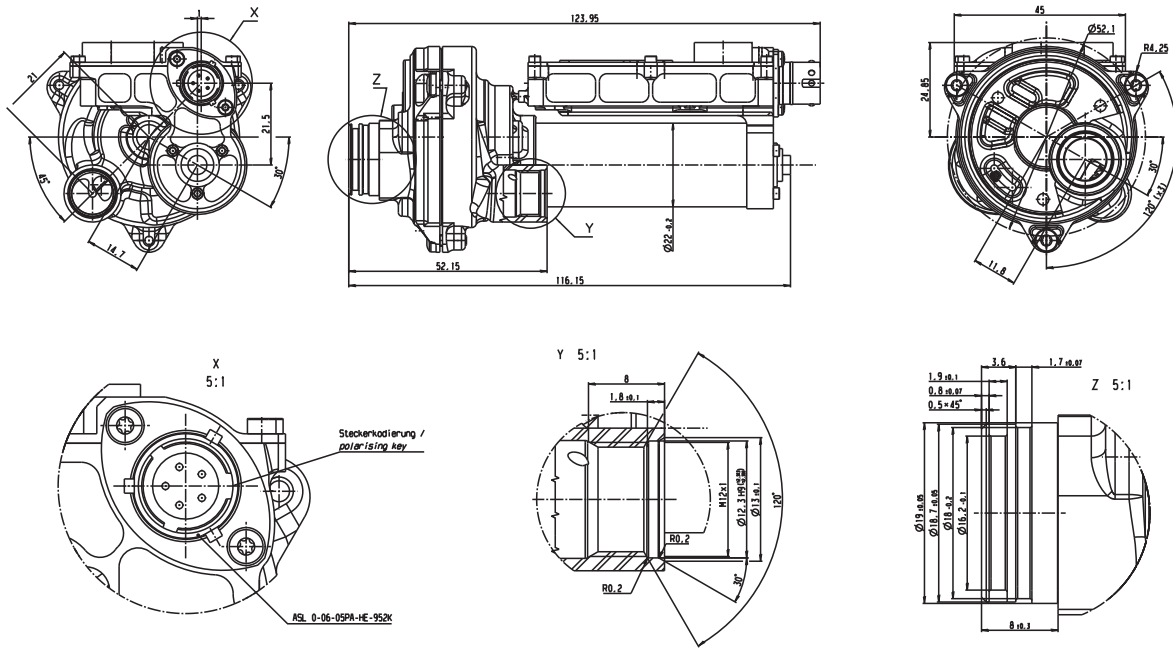
For technical reasons the values may vary.

Please find further application hints in the offer drawing at our home-page.

**Ordering Information**

**Fuel Pump LPx-F1**  
Order number **F 02U V01 745-02**

Dimensions





## HP Fuel Pump HDP 5



### Features

- ▶ 200 bar or more
- ▶ Max.  $1.1 \text{ cm}^3/\text{rot}_{\text{cam}}$
- ▶ Integrated Flow Control Valve
- ▶ Internal Pressure Relief Valve
- ▶ 780 g

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 **F 02U V00 912-03**

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#### Standard version

Series wire + motorsport connector  
Order number **F 02U V01 114-03**

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#### Rev B (iPRV)

Order number **on request**

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#### Rev C (EVO)

Order number **on request**

---

#### Rev D (Piston)

Order number **on request**

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#### Accessories

##### Flat tappet (26 mm)

Order number **F 02U V01 156-01**

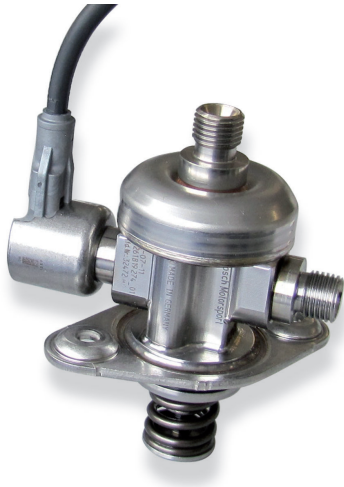
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##### Roller tappet (26 mm)

Order number **F 02U V01 163-01**

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## HP Fuel Pump HDP 5-LW



### Features

- ▶ Max. 500 bar
- ▶ Max. 1.1 cm<sup>3</sup>/rot<sub>cam</sub>
- ▶ Integrated Flow Control Valve
- ▶ Internal Pressure Relief Valve
- ▶ 585 g

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	Lighthweight

Flow capacity and max. engine speed	Depending on cam profile
Nominal pressure	500 bar or customization
<b>Possible customization</b>	
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 **F 02U V01 156-01**




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**Roller tappet (26 mm)**

Order number **F 02U V01 163-01**

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## Fuel Pressure Regulators Overview

	Fuel Pressure Regulator Mini 2	Fuel Pressure Regulator Mini 5	Fuel Pressure Regulator Mini A
			
Pressure adjust (bar) at 105 l/h	Variations 5.0 / 5.5 / 6 / 6.5 / 7 / 8 / 10	5.0	Variations 2.2 to 3.5 or 3.5 to 5.0
Reflow rate l/h	30 to 400	15 to 220	15 to 220
Adjustable	No	No	Yes
Max. vibrations	<600 m/s <sup>2</sup> at 5 to 250 Hz	<600 m/s <sup>2</sup> at 5 to 250 Hz	<400 m/s <sup>2</sup> at 5 to 250 Hz
Weight (g)	61	48.5	58

## Fuel Pressure Regulator Mini 2



4

### Features

- ▶ 5 to 10 bar
- ▶ All versions Methanol compatible
- ▶ 30 to 400 l/h reflow
- ▶ Adjusted at 105 l/h
- ▶ Aluminum housing

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	$Q_{\text{leak}} [\text{cm}^3/\text{min}] \leq 9$ (pneumatic) at $p [\text{kPa}] = 0.8 \times P_{\text{nom}}$

### 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 F 02U 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 **F 02U V02 166-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 5.5 bar  
Order number **F 02U V02 167-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 6.0 bar  
Order number **F 02U V02 168-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 6.5 bar  
Order number **F 02U V02 169-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 7.0 bar  
Order number **F 02U V02 170-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 8.0 bar  
Order number **F 02U V02 171-01**

#### Fuel Pressure Regulator Mini 2

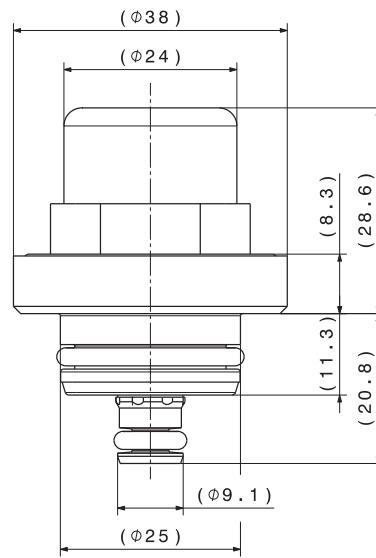
Pressure Range 10.0 bar  
Order number **F 02U V02 172-01**

### Accessories

#### FPR Adaptor light

Order number **F 02U V02 248-01**

## Dimensions



Complete dimensions on offer drawing at [www.bosch-motorsport.com](http://www.bosch-motorsport.com)

## Fuel Pressure Regulator Mini 5



4

### 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	$Q_{leak} [cm^3/min] \leq 9$ (pneumatic) at $p [kPa] = 0.8 \times P_{nom}$

### 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
-----------------------	-----------------

#### 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

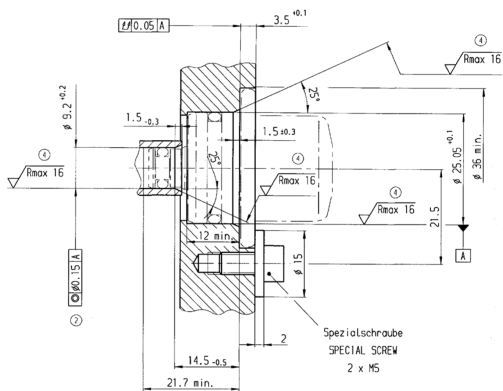
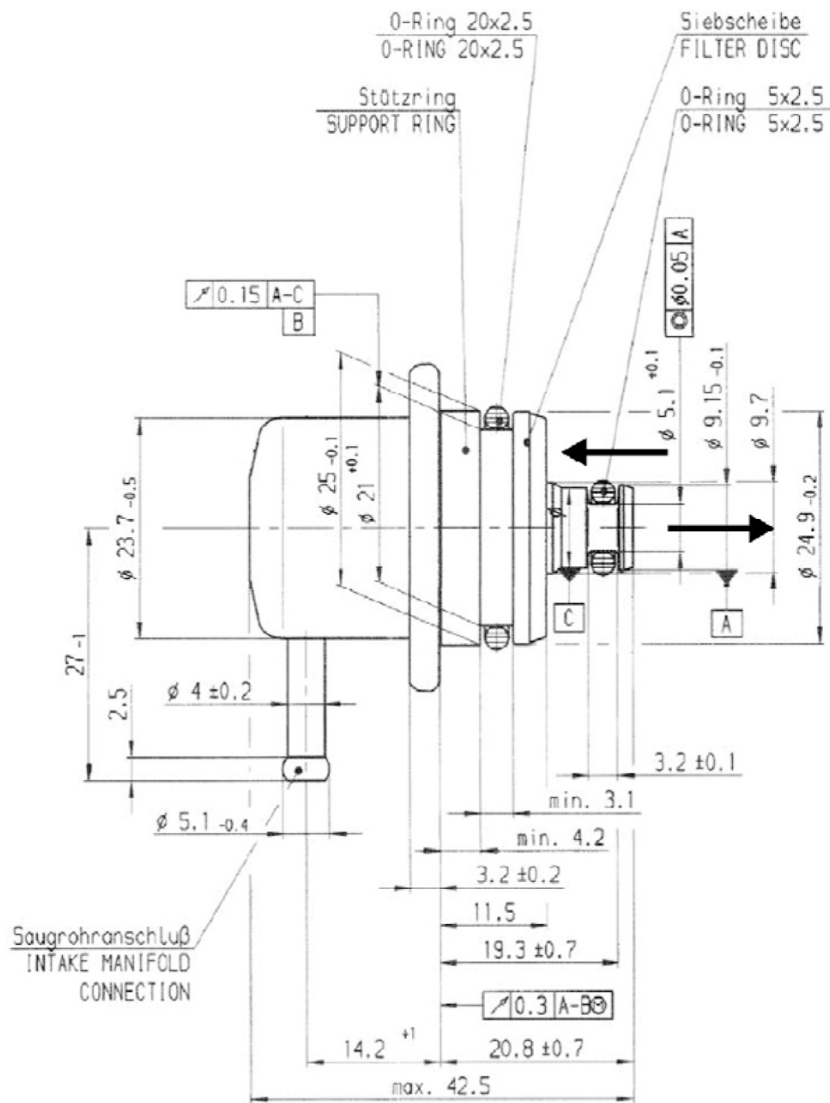
**Fuel Pressure Regulator Mini 5**  
Order number **0 280 B02 722-03**

#### Accessories

**FPR Adaptor light**  
Order number **F 02U V02 248-01**

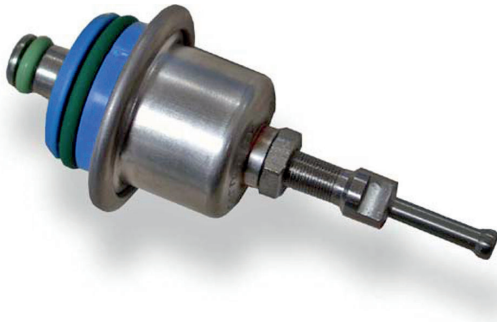


Dimensions



Installation Recommendation

## Fuel Pressure Regulator Mini A



$$\text{at } p \text{ [kPa]} = 0.8 \times P_{\text{nom}}$$

4

### Features

- ▶ 2.2 to 3.5 bar/3.5 to 5 bar
- ▶ Pressure adjustable
- ▶ 15 to 220 l/h reflow
- ▶ 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)

### 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 **B 280 550 340-03**

#### Fuel Pressure Regulator Mini A

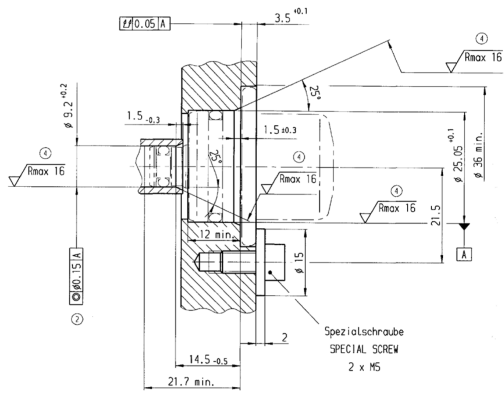
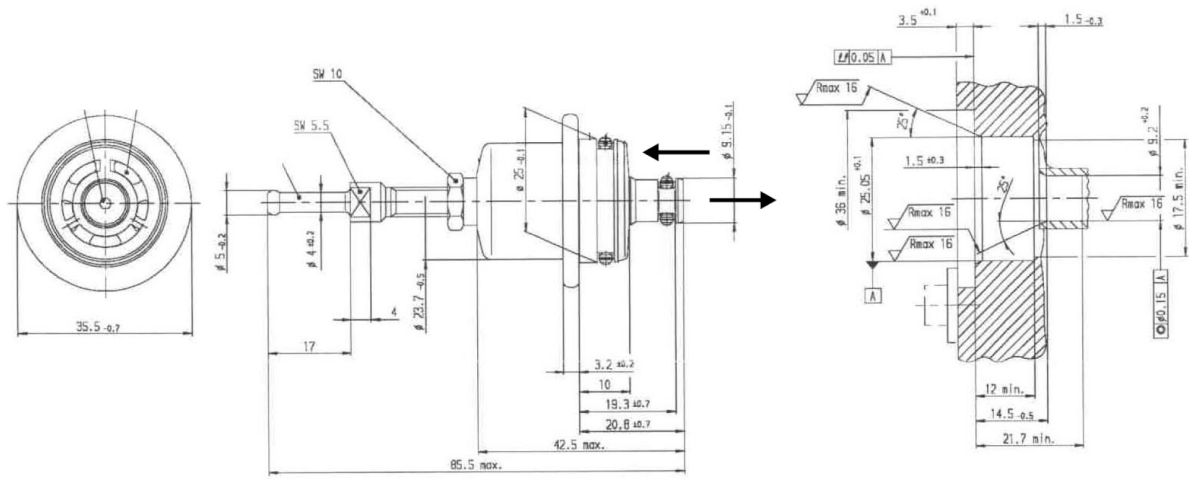
Pressure Range 3.5 to 5.0 bar  
Order number **B 280 550 341-03**

#### Accessories

##### FPR Adaptor light

Order number **F 02U V02 248-01**

Dimensions



Installation Recommendation

## FPR Adaptor light



4

### 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.

### 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

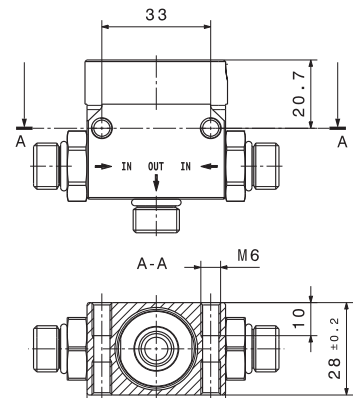
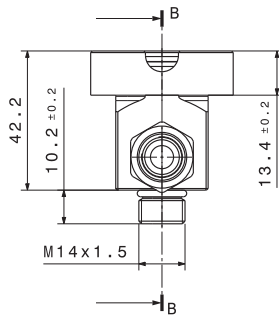
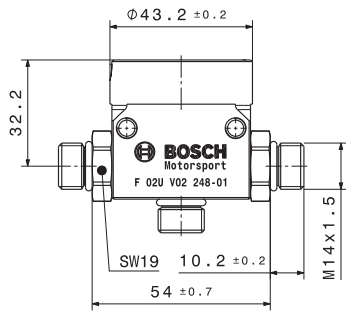
Connector supply	2 x M14 x 1.5
Connector reflow	M14 x 1.5

### Ordering Information

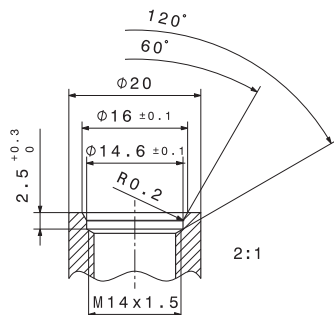
#### FPR Adaptor light

Order number **F 02U V02 248-01**

Dimensions



**SUPPLY SUGGESTION**  
**FITTING OUTSIDE CONTOUR**  
**Anschlussempfehlung**  
**Fitting-Aussenkontur**



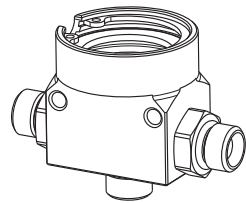
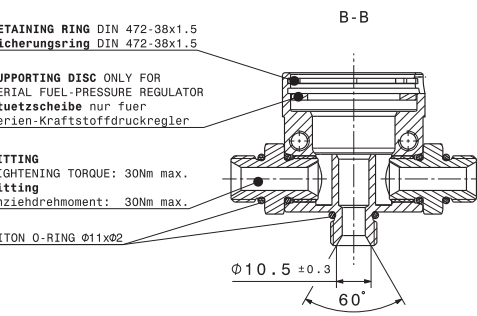
TIGHTENING TORQUE: 30Nm max.  
 Anziehdrehmoment: 30Nm max.

RETAINING RING DIN 472-38x1.5  
 Sicherungsring DIN 472-38x1.5

SUPPORTING DISC ONLY FOR  
 SERIAL FUEL-PRESSURE REGULATOR  
 Stuetzscheibe nur fuer  
 Serien-Kraftstoffdruckregler

FITTING  
 TIGHTENING TORQUE: 30Nm max.  
 Fitting  
 Anziehdrehmoment: 30Nm max.

VITON O-RING  $\phi 11 \times \phi 2$






Ignition Coils Overview

4

	Ignition Coil C75	Ignition Coil C75-E8	Ignition Coil C90i-E8	Ignition Coil C90i-E10	Ignition Coil C90i-pro E10
					
Spark energy (mJ)	75	75	90	90	90
Spark duration (ms)	0.7	0.7	1.1	1.1	1.1
Spark current (mA)	224	224	160	160	160
Primary current (A)	≤ 17	≤ 17	≤ 16	≤ 16	≤ 16
Int. power stage	no	no	no	no	no
Max. high voltage (kV at 10 MOhm    10 pF)	35.0	35.0	40.0	40.0	40.0
Secondary connector	Fix	Fix	80 to 220 mm	114 to 225 mm	Fix

	Ignition Coil C90i-pro evo	Ignition Coil P50	Ignition Coil P50-M	Ignition Coil P65	Ignition Coil P65-T
					
Spark energy (mJ)	90	50	50	65	65
Spark duration (ms)	0.65	1.15	1.15	2	1.85
Spark current (mA)	265	92	92	74	70
Primary current (A)	≤ 16	≤ 8.5	≤ 8.5	≤ 7.5	≤ 7.0
Int. power stage	no	no	no	no	yes
Max. high voltage (kV at 10 MOhm    10 pF)	40.0	35.0	35.0	35.0	33.0
Secondary connector	Fix	Fix for 30 kV grid	Fix with 1 354 489 085	Fix	Fix

	Ignition Coil P65-WG	Ignition Coil P65-WS	Ignition Coil PS-T
			
Spark energy (mJ)	65	65	42
Spark duration (ms)	2	2	1.1
Spark current (mA)	74	74	80
Primary current (A)	≤ 7.5	≤ 7.5	≤ 7.5
Int. power stage	no	no	yes
Max. high voltage (kV at 10 MOhm    10 pF)	35.0	35.0	27.0
Secondary connector	Fix	Fix	Fix

## Ignition Coil C75



### Features

- ▶ Max. 35 kV
- ▶ Max. 75 mJ
- ▶ Max. 8.0 kV/μs
- ▶ Especially developed for GDI engines
- ▶ Max. 15,000 1/min

This single fire coil was developed for the use e.g. in GDI 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	≤ 75 mJ
Primary current	≤ 17 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	160 mm
Weight w/o wire	195 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	330 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 8.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV

Spark current	≤ 240 mA
Spark duration at 1 kV    1 MOhm	≤ 0.68 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 white
Pin 3	Engine GND black
Wire length	100 cm
Wire size	AWG 20/22
For spark plugs	Ceramic diameter d = 10 mm

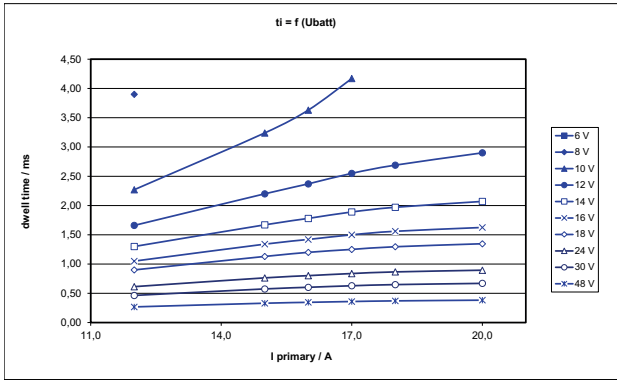
Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I primary					
	12 A	15 A	16 A	17 A	18 A	20 A
6 V						
8 V	3.9					
10 V	2.27	3.24	3.63	4.17		
12 V	1.66	2.2	2.37	2.55	2.69	2.9
14 V	1.3	1.67	1.78	1.89	1.97	2.07
16 V	1.05	1.34	1.42	1.5	1.56	1.62
18 V	0.9	1.13	1.2	1.25	1.30	1.35
24 V	0.61	0.76	0.80	0.84	0.87	0.90
30 V	0.46	0.58	0.60	0.63	0.65	0.67
48 V	0.27	0.33	0.35	0.36	0.37	0.38

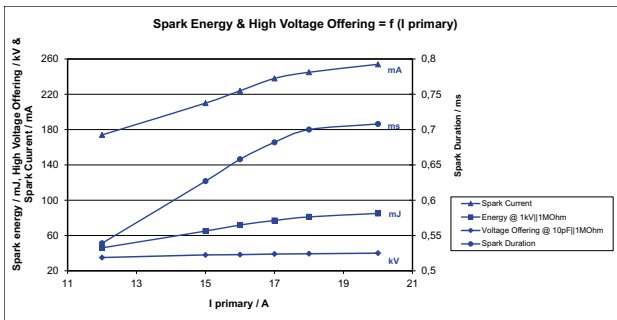
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

Spark energy and provided high voltage

I prim.	Spark energy	-duration	-current	Hi voltage
12 A	46 mJ	0.539 ms	174 mA	35 kV
15 A	65 mJ	0.627 ms	210 mA	38 kV
16 A	71.9 mJ	0.658 ms	224 mA	38.3 kV
17 A	77 mJ	0.682 ms	238 mA	39 kV
18 A	81.1 mJ	0.7 ms	245 mA	39.3 kV
20 A	85 mJ	0.708 ms	254 mA	40 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 = 17 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.

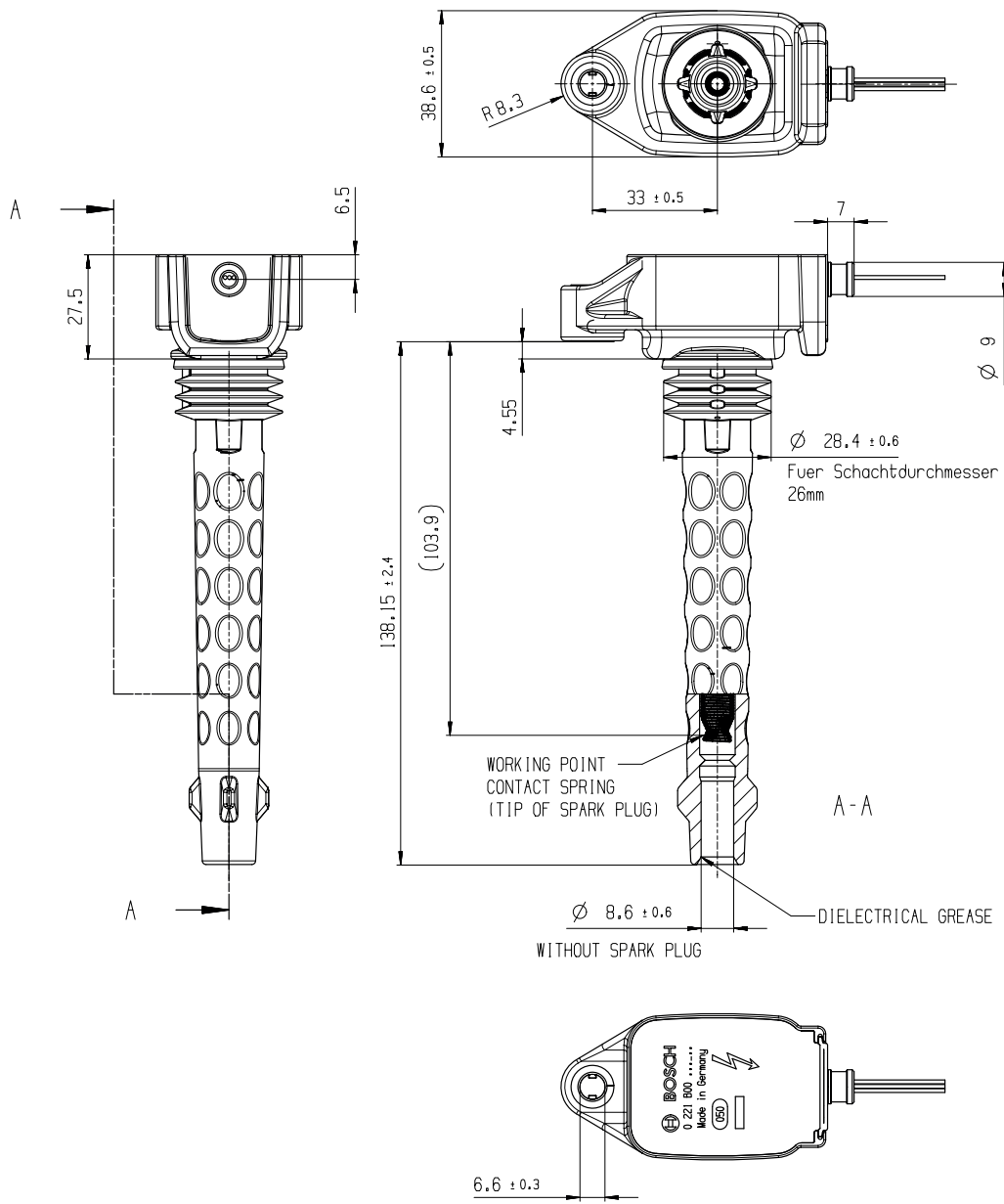
Ordering Information

Ignition Coil C75

Order number 0 221 B00 347-03



Dimensions



## Ignition Coil C75-E8



4

### Features

- ▶ Max. 35 kV
- ▶ Max. 75 mJ
- ▶ Max. 8.0 kV/μs
- ▶ Especially developed for GDI engines
- ▶ Max. 15,000 1/min

This single fire coil was developed for the use e.g. in GDI 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	≤ 75 mJ
Primary current	≤ 17 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 (L)	customized
Weight w/o wire	195 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	330 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 8.0 kV/μs

Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 240 mA
Spark duration at 1 kV    1 MOhm	≤ 0.68 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 white
Pin 3	Engine GND black
Wire length	100 cm
Wire size	AWG 20/22
For spark plugs	Ceramic diameter d = 8 mm (7 to 9 mm)

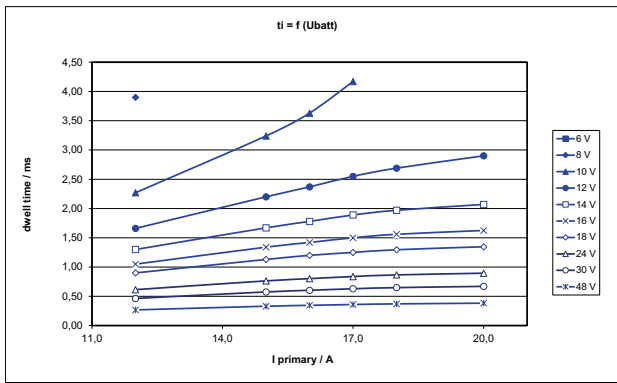
Various motorsport and automotive connectors are available on request.

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 primary					
	12 A	15 A	16 A	17 A	18 A	20 A
6 V						
8 V	3.9					
10 V	2.27	3.24	3.63	4.17		
12 V	1.66	2.2	2.37	2.55	2.69	2.9
14 V	1.3	1.67	1.78	1.89	1.97	2.07
16 V	1.05	1.34	1.42	1.5	1.56	1.62
18 V	0.9	1.13	1.2	1.25	1.30	1.35
24 V	0.61	0.76	0.80	0.84	0.87	0.90
30 V	0.46	0.58	0.60	0.63	0.65	0.67
48 V	0.27	0.33	0.35	0.36	0.37	0.38

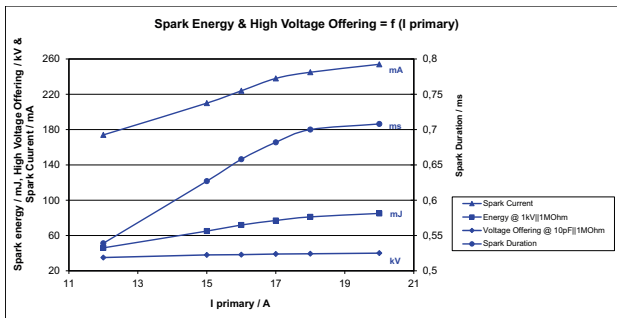
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



*Dwell time*

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
12 A	46 mJ	0.539 ms	174 mA	35 kV
15 A	65 mJ	0.627 ms	210 mA	38 kV
16 A	71.9 mJ	0.658 ms	224 mA	38.3 kV
17 A	77 mJ	0.682 ms	238 mA	39 kV
18 A	81.1 mJ	0.7 ms	245 mA	39.3 kV
20 A	85 mJ	0.708 ms	254 mA	40 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 = 17 A or 35 kV may reduce the lifetime.

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

**Design Note**

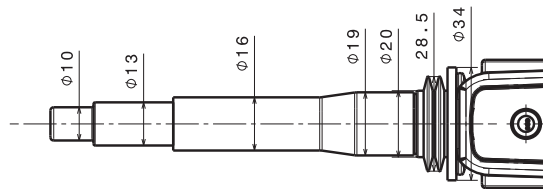
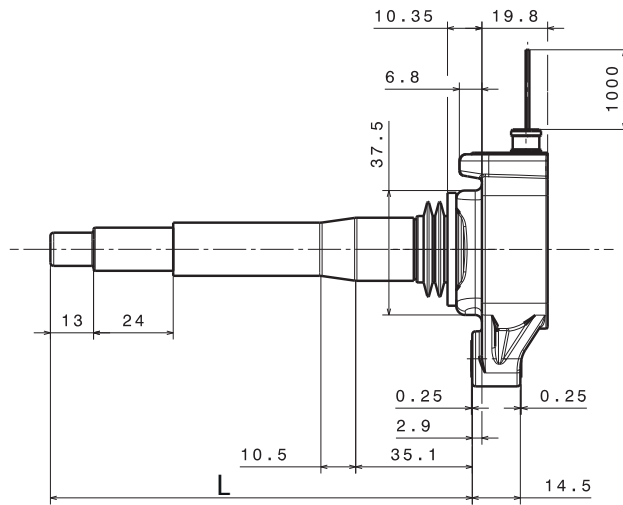
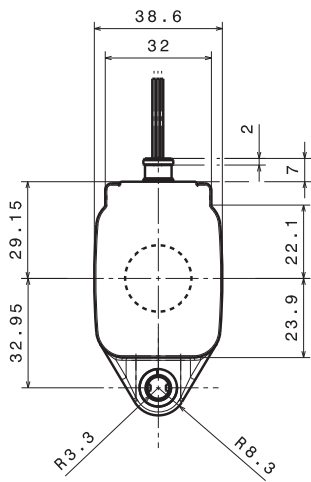
We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil C75-E8**

Order number **F 02U V02 086-01**

Dimensions



## Ignition Coil C90i-E8



### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Max. 5.0 kV/μs
- ▶ Fits to spark plugs with a ceramic diameter of 8 mm
- ▶ Max. 15,000 1/min

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
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 supression	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

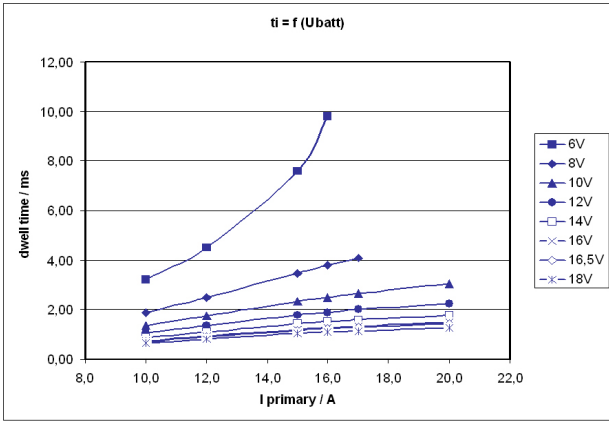
Various motorsport and automotive connectors are available on request.

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 primary					
	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

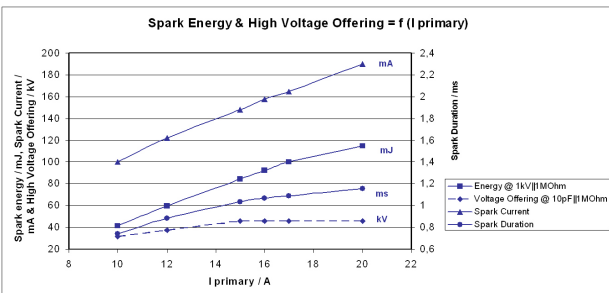
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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 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.

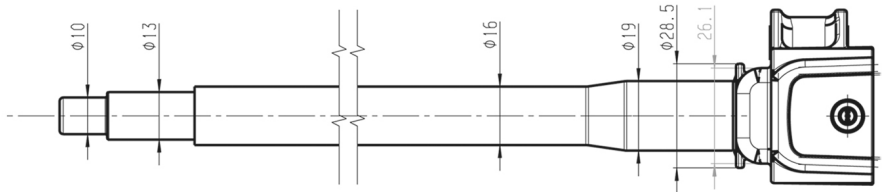
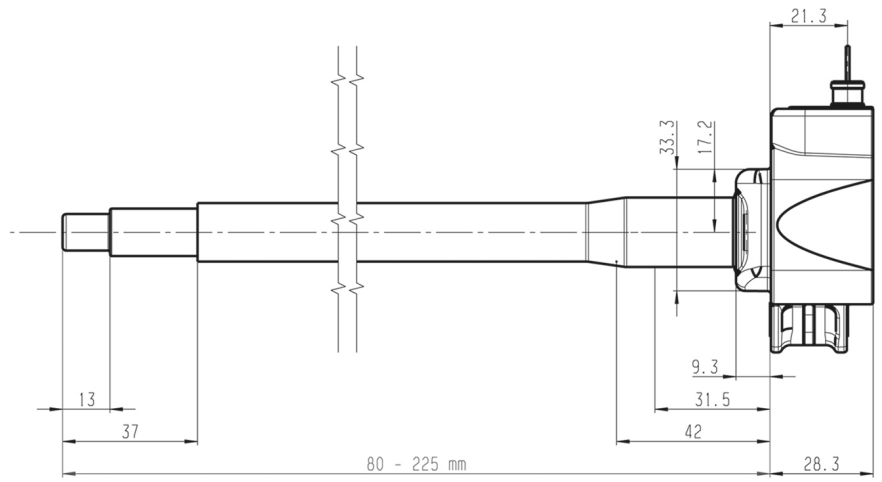
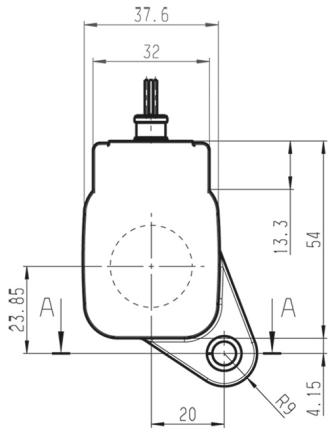
Ordering Information

Ignition Coil C90i-E8

Please specify the required wire and spark plug connector length with your order.

Order number **F 02U V01 368-01**

Dimensions



## Ignition Coil C90i-E10



4

### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Max. 5.0 kV/μs
- ▶ Fits to spark plugs with a ceramic diameter of 10 mm
- ▶ Max. 15,000 1/min

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
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.

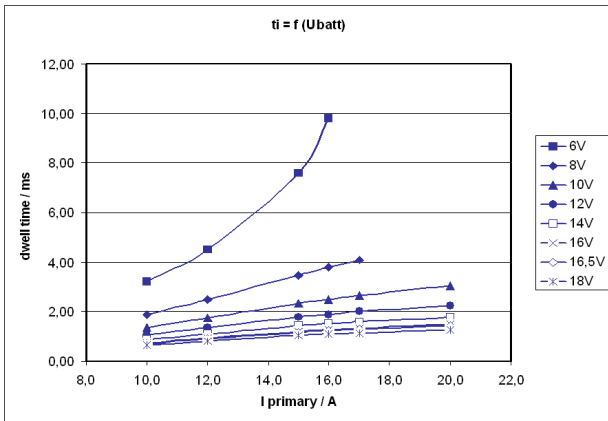
Please specify the required wire length and the length of the spark plug connector with your order

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I primary					
	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

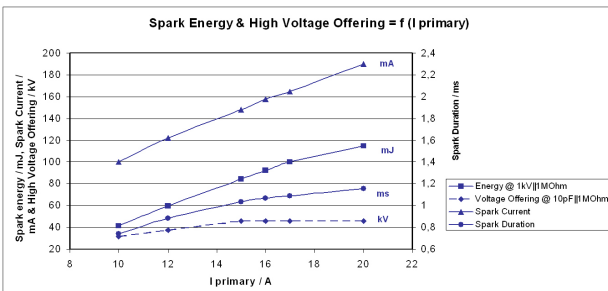




Dwell time

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 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

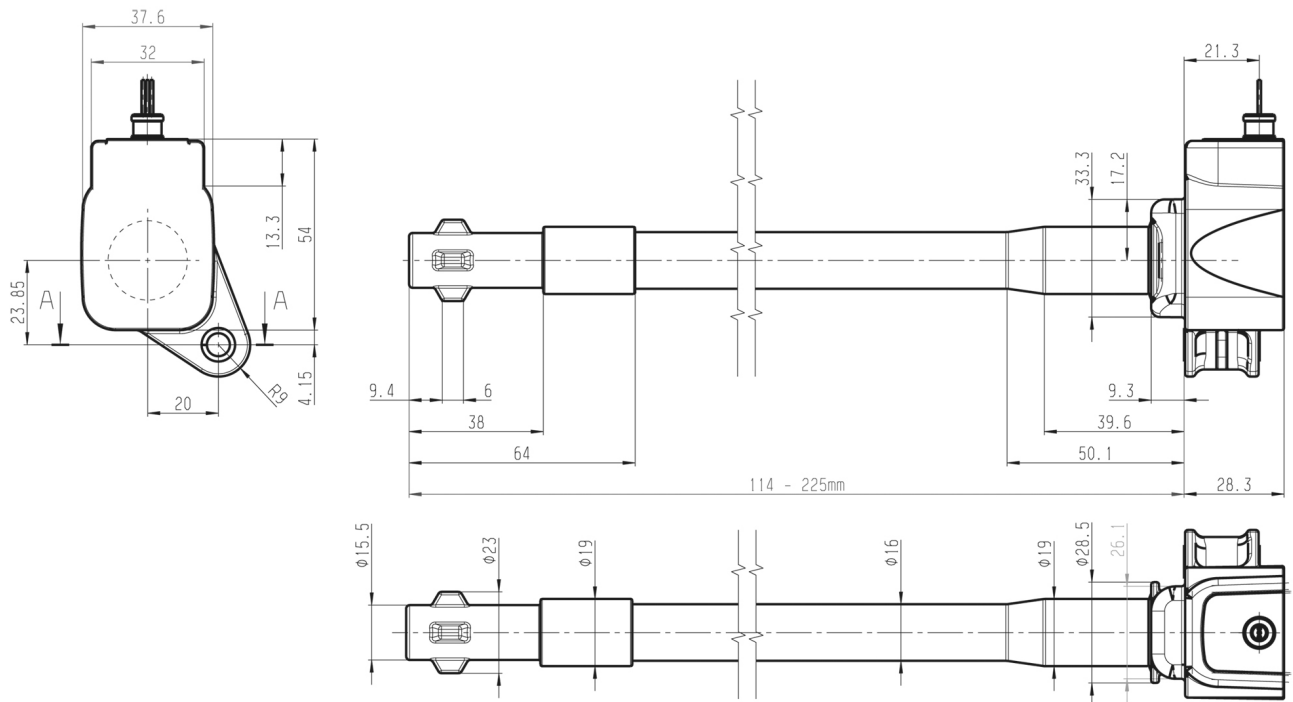
Ignition Coil C90i-E10

Please specify the required wire and spark plug connector length with your order.

Order number **F 02U V01 369-01**

Dimensions

4



## Ignition Coil C90i-pro



### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Max. 5.0 kV/μs
- ▶ Especially developed for Turbo-GDI engines
- ▶ Max. 15,000 1/min

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

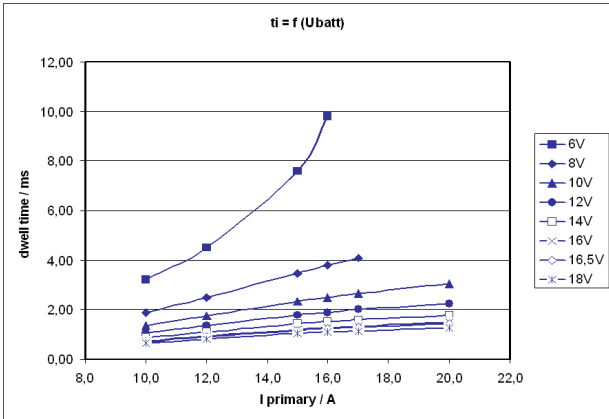
Various motorsport and automotive connectors are available on request.

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 primary					
	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

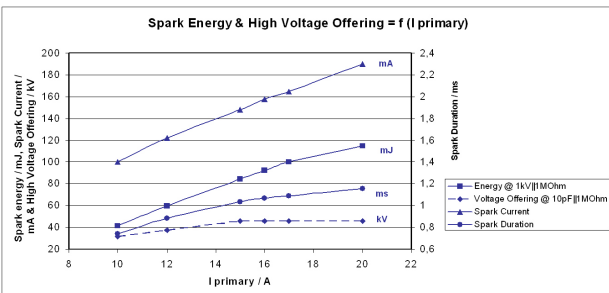
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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 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.

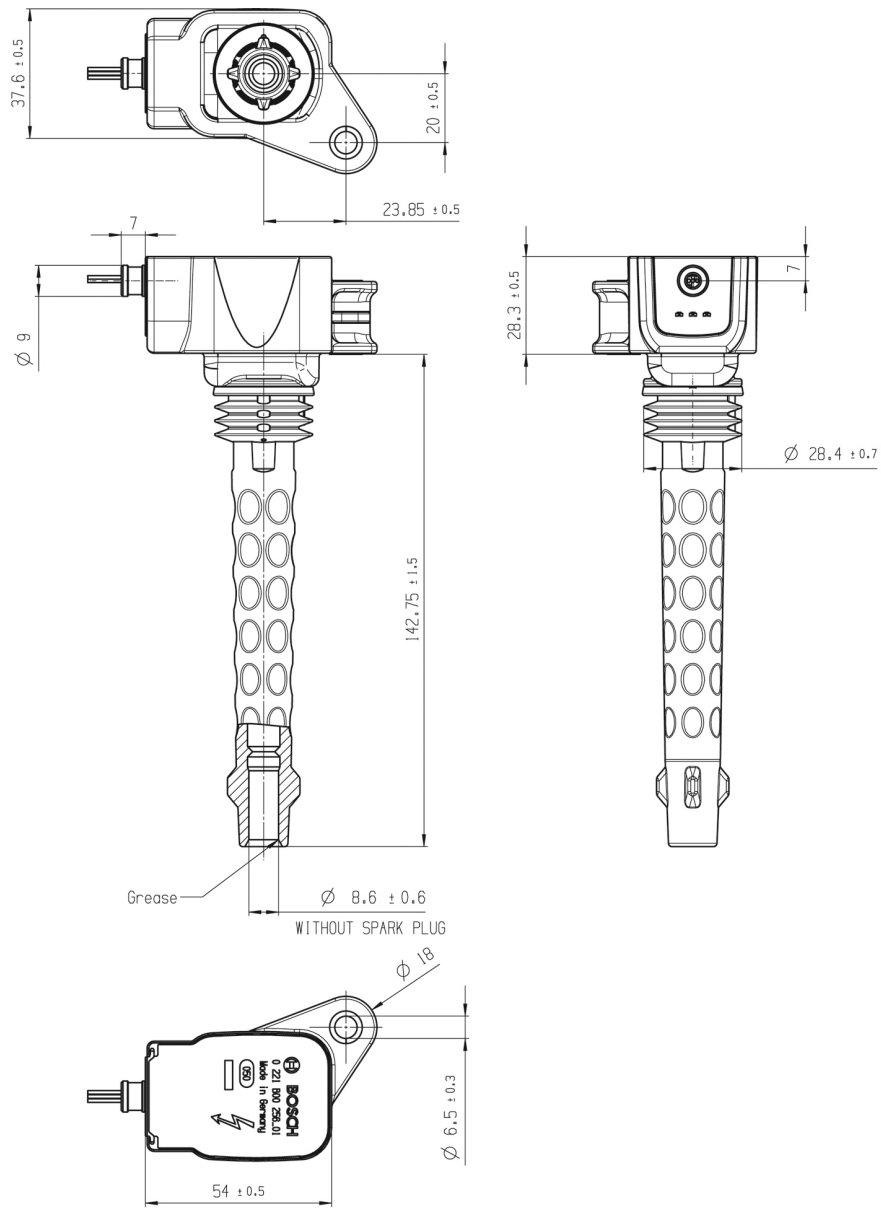
Design Note

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 **0 221 B00 256-01**

Dimensions



## Ignition Coil C90i-pro evo



4

### Features

- ▶ Max. 40 kV
- ▶ Max. 90 mJ
- ▶ Boosted spark current
- ▶ Especially for engines with high gas turbulences
- ▶ Max. 15,000 1/min

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

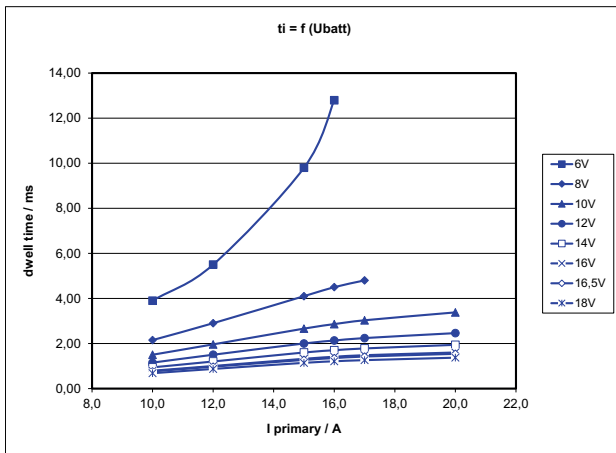
Various motorsport and automotive connectors are available on request.

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 primary					
	10 A	12 A	15 A	16 A	17 A	20 A
6 V	3.90	5.50	9.80	12.80		
8 V	2.15	2.90	4.10	4.50	4.80	
10 V	1.50	1.96	2.66	2.86	3.03	3.38
12 V	1.15	1.50	2.00	2.13	2.24	2.46
14 V	0.94	1.20	1.60	1.70	1.78	1.94
16 V	0.79	1.00	1.32	1.41	1.48	1.60
16.5 V	0.76	0.97	1.27	1.35	1.42	1.54
18 V	0.68	0.69	1.14	1.21	1.26	1.37

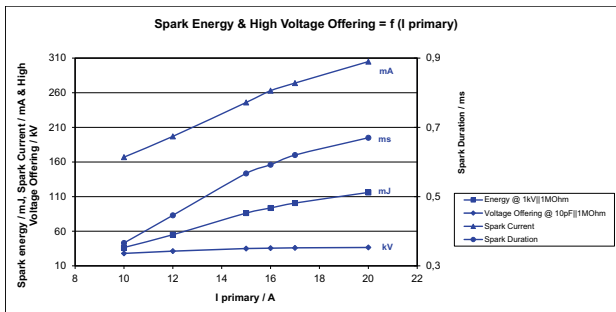
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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



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.

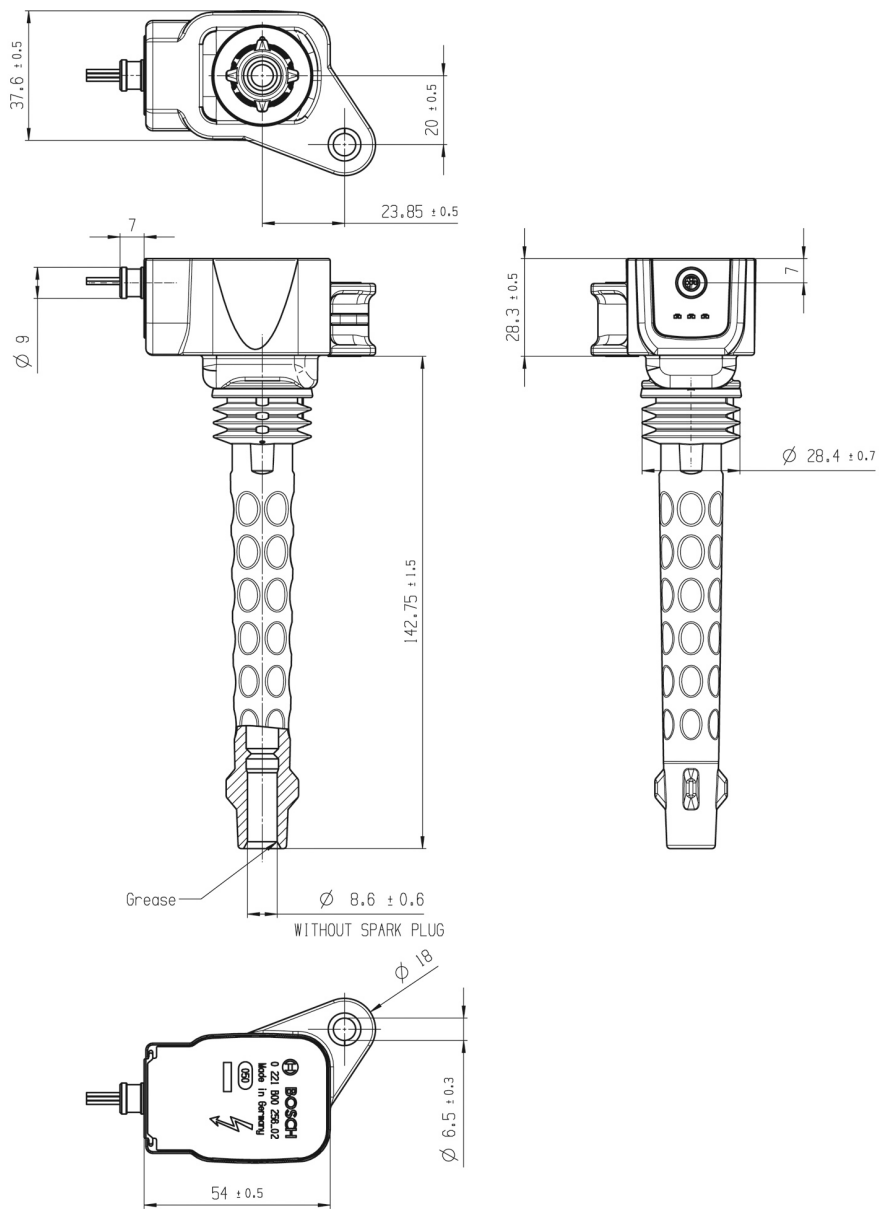
Ordering Information

Ignition Coil C90i-pro evo

Order number 0 221 B00 256-02

Dimensions

4





## Ignition Coil C90i-WG



### Features

- ▶ Max. 35 kV
- ▶ Max. 90 mJ
- ▶ Especially developed for Turbo-GDI engines
- ▶ Max. 15,000 1/min
- ▶ Connection for high voltage wire

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

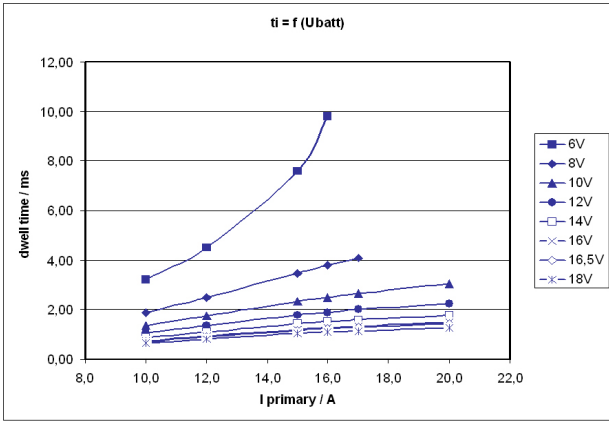
Various motorsport and automotive connectors are available on request.

Please specify the required wire length if you order the coil with a motorsport connector.

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I primary					
	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

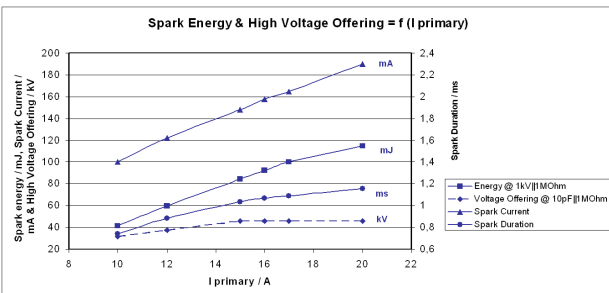
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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 (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 I<sub>prim</sub> = 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 **F 02U V02 430-01**

Accessories

High Voltage Connector straight

Please ask your local Bosch Service

Order number **0 356 200 015**

High Voltage Connector angled

Please ask your local Bosch Service

Order number **0 356 250 035**

M3 Connector inside (required for every HV Connector)

Please ask your local Bosch Service

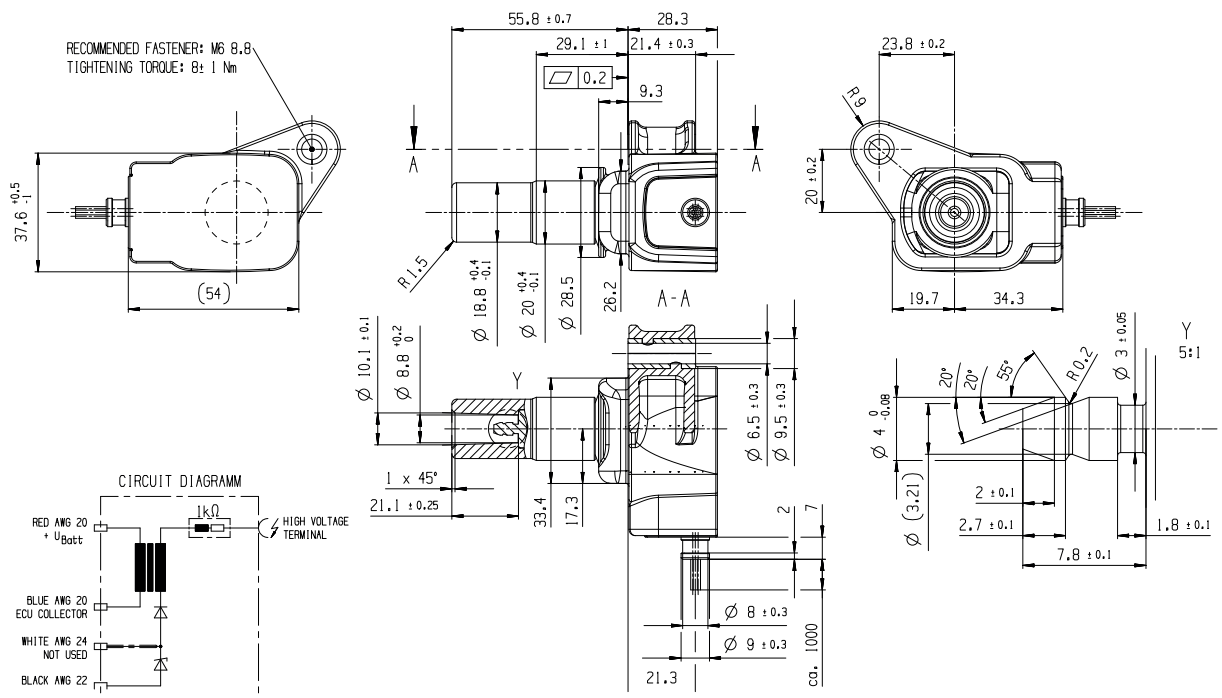
Order number **1 350 521 001**

High Voltage Wire 50 m

Please ask your local Bosch Service

Order number **5 956 563 015**

Dimensions



## Ignition Coil P50/P50-M



4

### Features

- ▶ Max. 35 kV
- ▶ Max. 50 mJ
- ▶ Max. 3.0 kV/μs
- ▶ High voltage contacting via high voltage wire and spark plug connector possible
- ▶ Max. 10,000 1/min

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 3-pole Compact	D 261 205 335-01
Pin 1	ECU ignition power stage
Pin 2	Engine GND
Pin 3	U <sub>batt</sub>

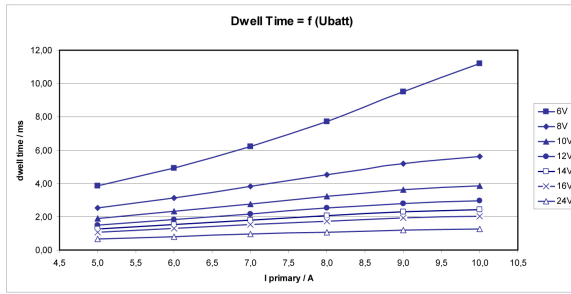
Various motorsport and automotive connectors are available on request.

For spark plugs	Ceramic diameter d=10 mm
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### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	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

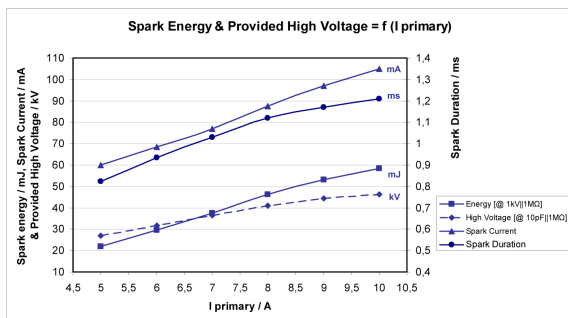
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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

**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 Iprim > 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**

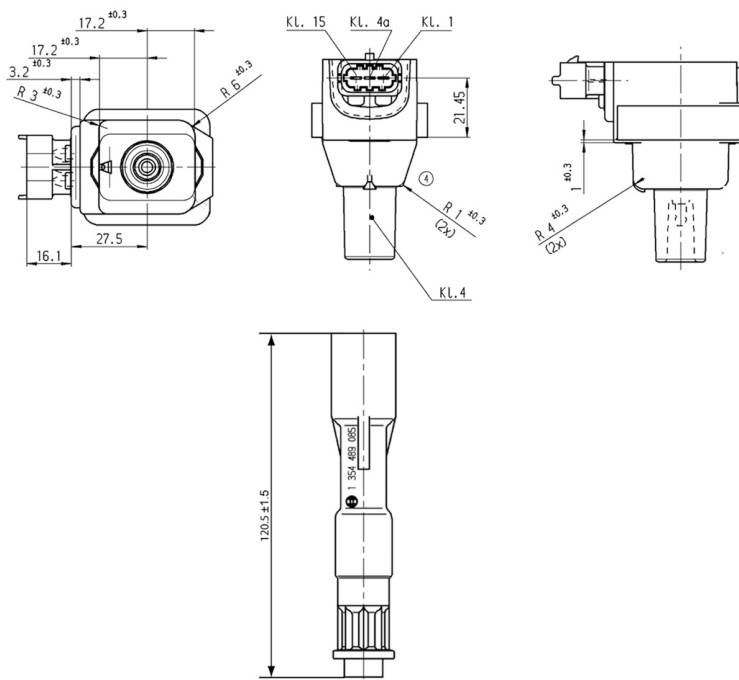
**Ignition Coil P50**  
Order number **0 221 504 001**

**Ignition Coil P50-M**  
Motorsport version  
Order number **F 02U V00 869-01**

**Accessories**

**Accessory spark plug connector**  
Order number **1 354 489 085**

Dimensions



## Ignition Coil P65



### Features

- ▶ Max. 35 kV
- ▶ Max. 65 mJ
- ▶ Developed for GDI engines
- ▶ Max. 10,000 1/min

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
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	D 261 205 350-01
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**

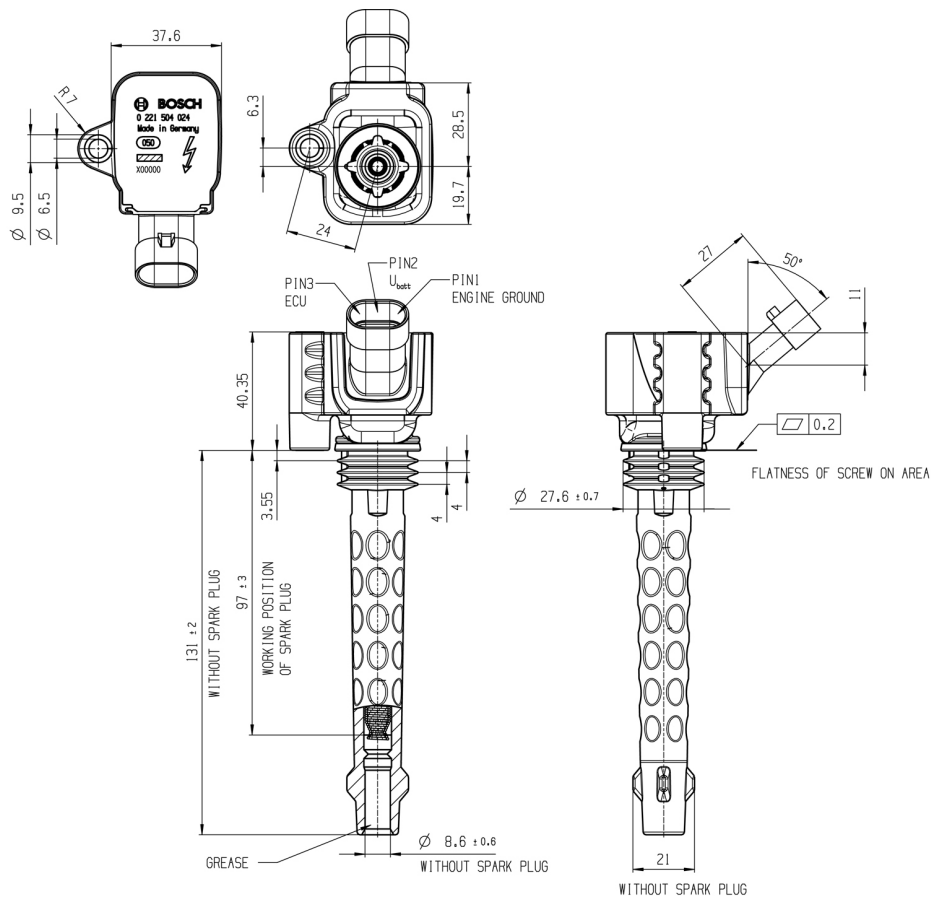
We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**

**Ignition Coil P65**

Order number **0 221 504 024**

**Dimensions**





## Ignition Coil P65-T



### Features

- ▶ Max. 33 kV
- ▶ Max. 65 mJ
- ▶ Developed for GDI engines
- ▶ Max. 10,000 1/min (with reduced dwell time)

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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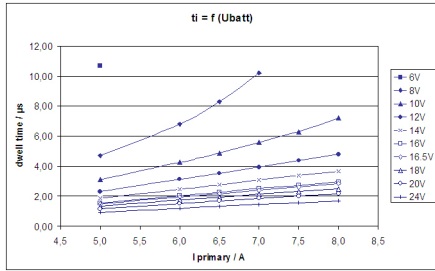
#### Connectors and Wires

Connector	Tyco 0-1488991-1
Mating connector	F 02U 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 primary					
	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

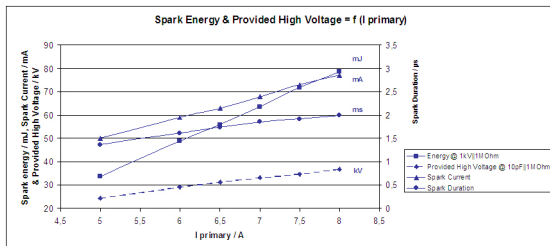
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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.

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

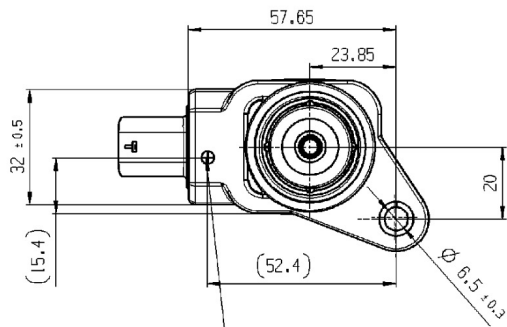
We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

Ordering Information

Ignition Coil P65-T

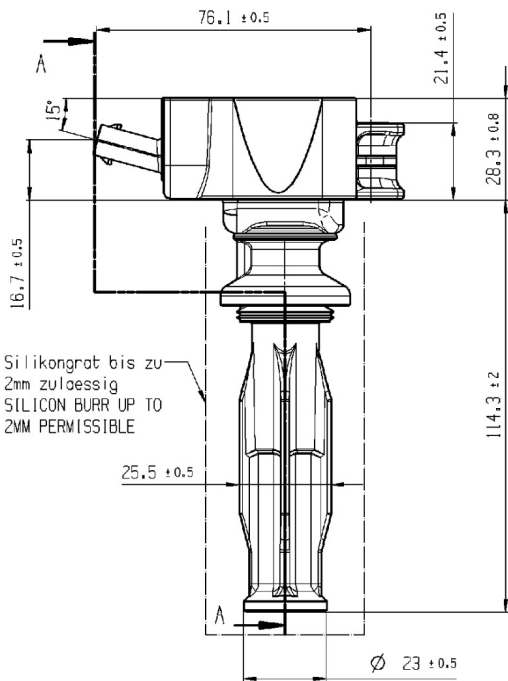
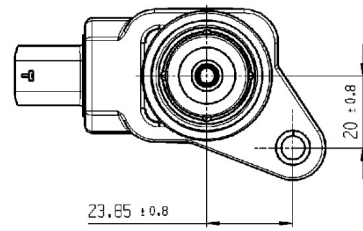
Order number 0 221 604 024

Dimensions



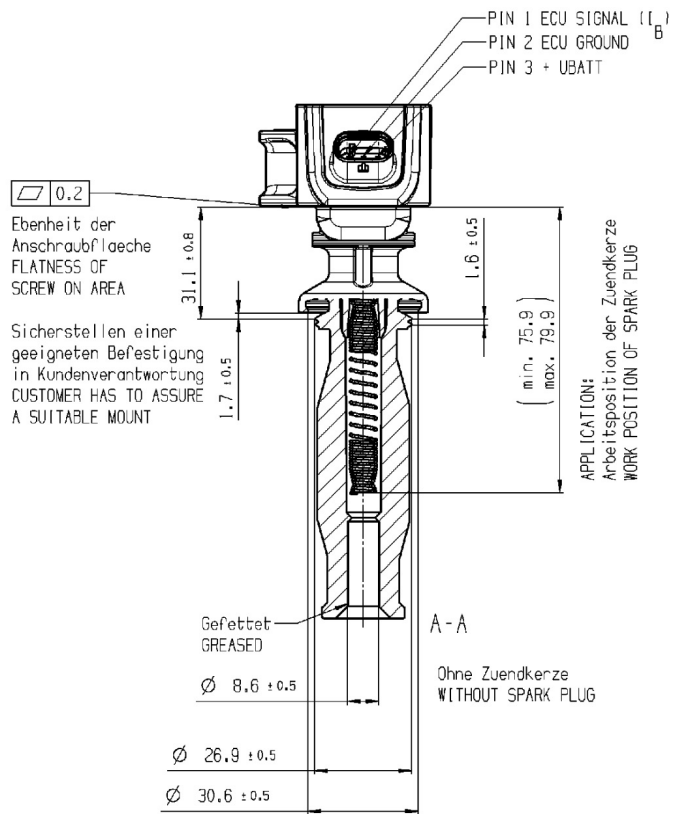
Temperatur-Messpunkt  
Endstufe  
TEMPERATURE MEASURING  
POINT POWER STAGE

Darstellung ohne Kerzenmantel und Feder  
EXPOSITION WITHOUT SPARK PLUG CONNECTOR  
AND SPRING

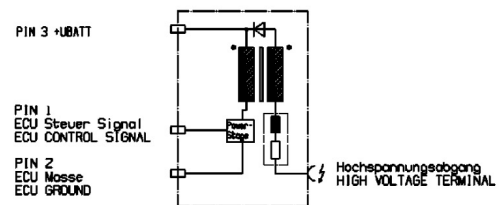


Silikongrat bis zu  
2mm zulässig  
SILICON BURR UP TO  
2MM PERMISSIBLE

Ohne Zündkerze  
WITHOUT SPARK PLUG



Schaltbild  
CIRCUIT DIAGRAM:



Temperatur-Messpunkt

## Ignition Coil P65-TWG



4

### Features

- ▶ Max. 33 kV
- ▶ Max. 65 mJ
- ▶ Developed for GDI engines
- ▶ Max. 10,000 1/min (with reduced dwell time)
- ▶ Connection for high voltage wire

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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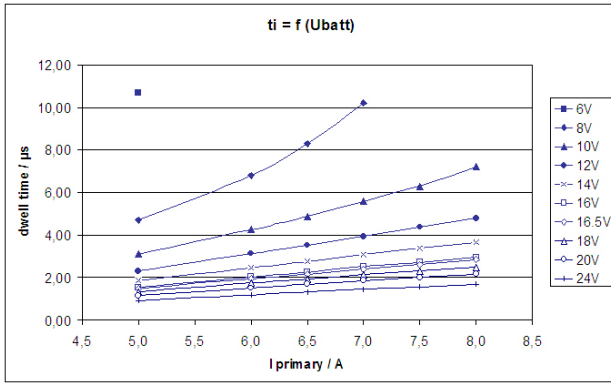
#### Connectors and Wires

Connector primary side	Tyco 0-1488991-1
Mating connector primary side	F 02U 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 primary					
	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

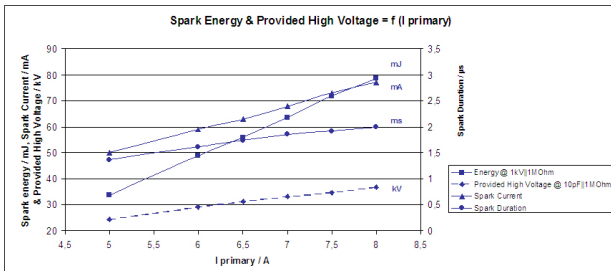
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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 **F 02U V02 429-01**

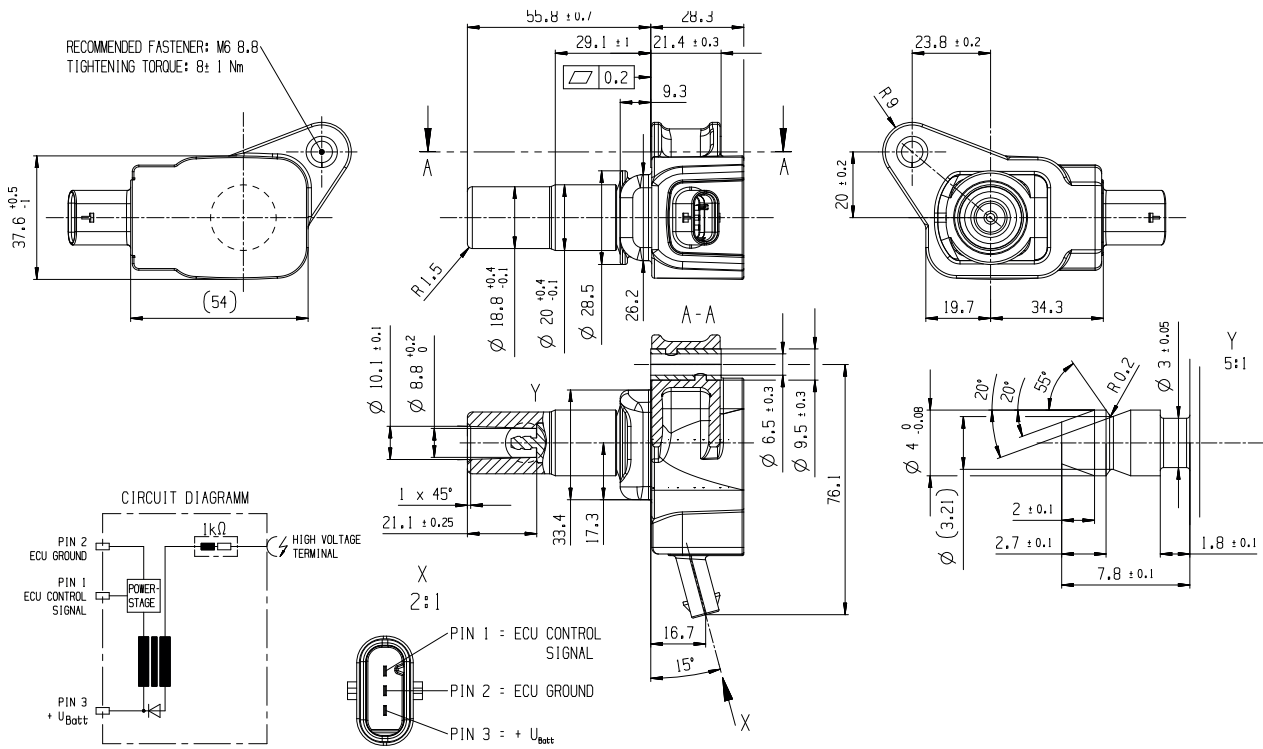
**Accessories**  
**High Voltage Connector straight**  
Please ask your local Bosch Service  
Order number **0 356 200 015**

**High Voltage Connector angled**  
Please ask your local Bosch Service  
Order number **0 356 250 035**

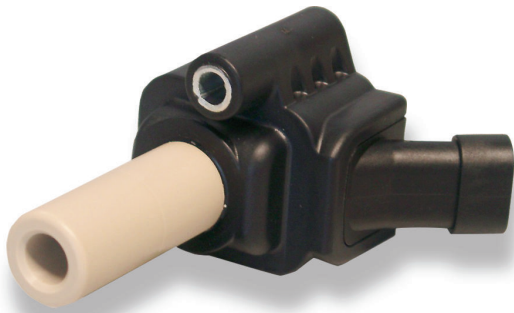
**M3 Connector inside (required for every HV Connector)**  
Please ask your local Bosch Service  
Order number **1 350 521 001**

**High Voltage Wire 50 m**  
Please ask your local Bosch Service  
Order number **5 956 563 015**

Dimensions



## Ignition Coil P65-WG



### Features

- ▶ Connection for 30 kV high voltage wire with locking pin (European standard)
- ▶ Max. 35 kV
- ▶ Max. 65 mJ
- ▶ Developed for GDI engines
- ▶ Max. 10,000 1/min

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

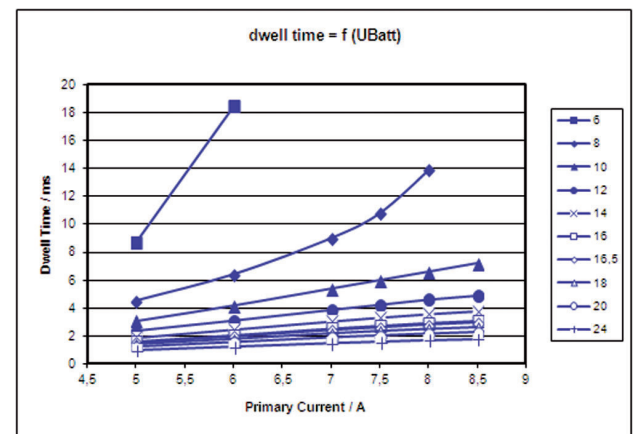
#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> = 600 V)
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#### Connectors and Wires

Connector	Tyco AMP
Mating connector	D 261 205 350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]



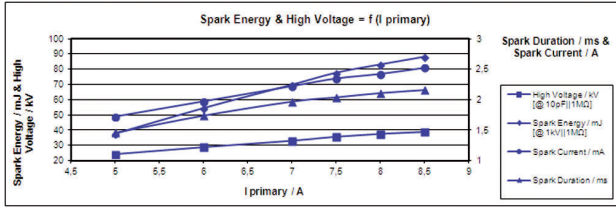
#### Dwell time

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 **F 02U V01 927-01**

**Accessories**

**High Voltage Connector straight**  
Please ask your local Bosch Service  
Order number **0 356 200 015**

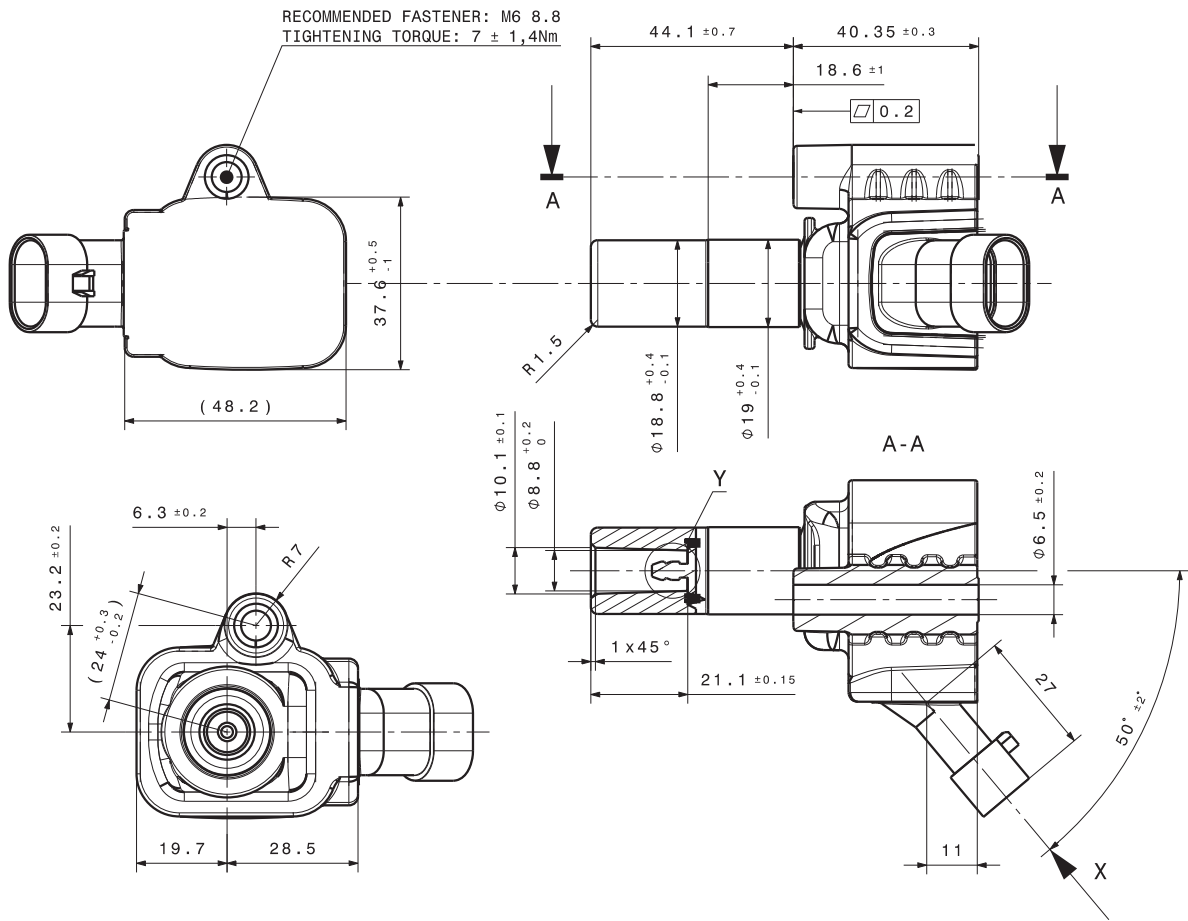
**High Voltage Connector angled**  
Please ask your local Bosch Service  
Order number **0 356 250 035**

**M3 Connector inside (required for every HV Connector)**  
Please ask your local Bosch Service  
Order number **1 350 521 001**

**High Voltage Wire 50 m**  
Please ask your local Bosch Service  
Order number **5 956 563 015**



Dimensions



## Ignition Coil P65-WS



4

### Features

- ▶ Connection for high voltage wire according to SAE (American standard)
- ▶ Max. 35 kV
- ▶ Max. 65 mJ
- ▶ Developed for GDI engines
- ▶ Max. 10,000 1/min

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

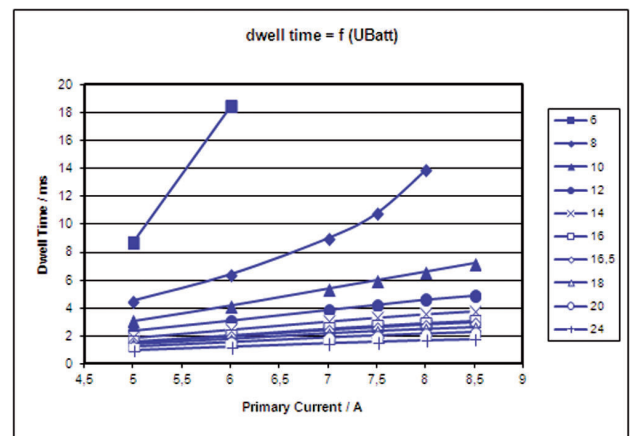
#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
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#### Connectors and Wires

Connector	Tyco AMP
Mating connector	D 261 205 350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]



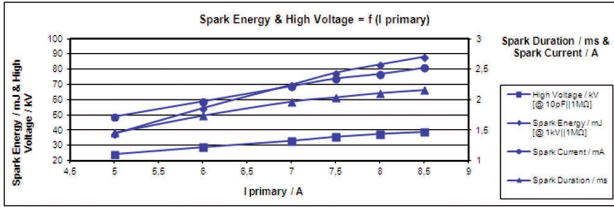
#### Dwell time

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.

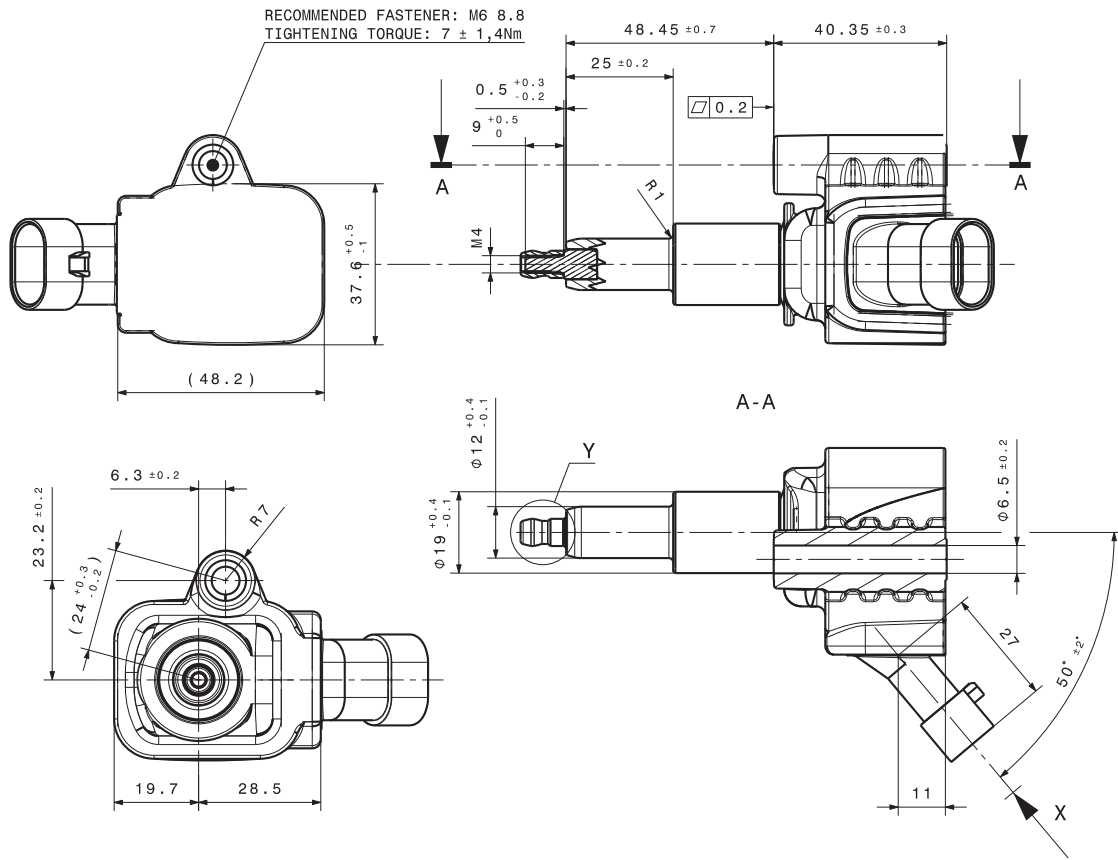
**Ordering Information**

**Ignition Coil P65-WS**  
Order number **F 02U V01 926-01**

**Accessories**

**High Voltage Connector angled**  
Please ask your local Bosch Service  
Order number **0 356 250 035**

Dimensions



## 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

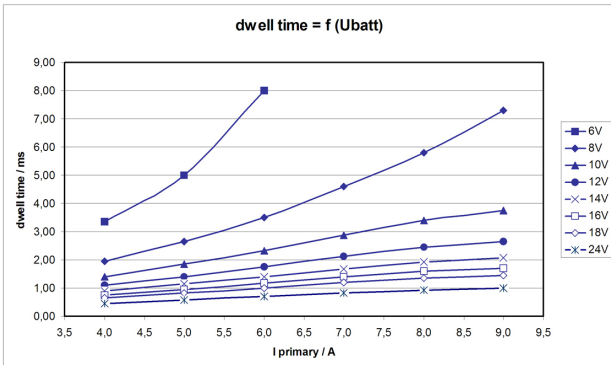
Connector	Bosch Compact
Mating connector 4-pole Compact	D 261 205 336-01
Pin 1	ECU ignition signal
Pin 2	ECU GND
Pin 3	Engine GND
Pin 4	U <sub>batt</sub>

Various motorsport and automotive connectors are available on request.

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I primary					
	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

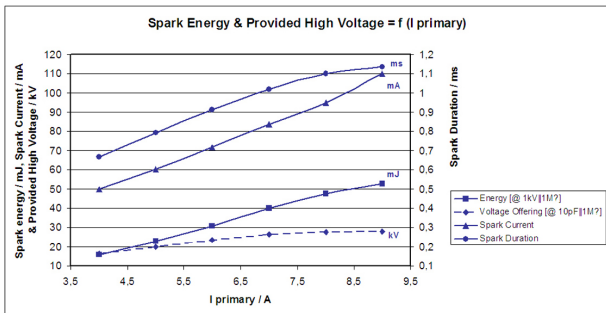
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-currant	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.

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**

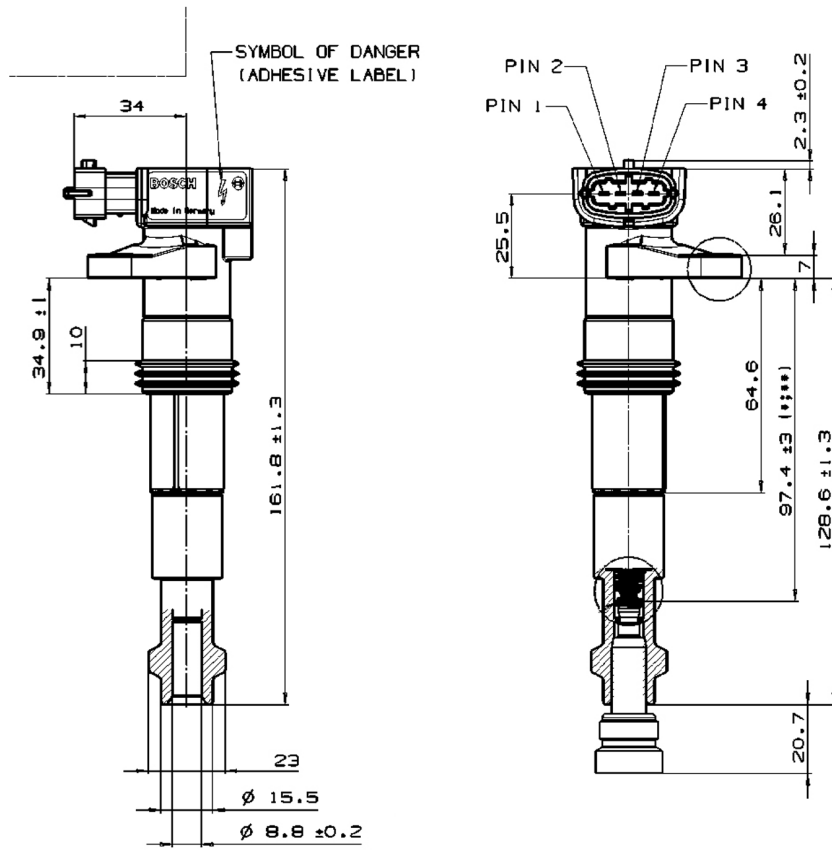
We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Ordering Information**



**Ignition Coil PS-T**

Order number **0 221 604 103**

Dimensions



## Ignition Modules Overview

	Ignition Module IM 3.2	Ignition Module IM 4
		
Max. current (A)	8.5	8.5
Clamping voltage (V)	380 ± 30	380 ± 30
Power stages	3	4
Weight (g)	47	54
Primary connector	Bosch Jetronic 7 pins	Bosch Jetronic 4 pins + 5 pins



## Ignition Module IM 3.2



### 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 7-pole Jetronic	F 02U B00 252-01
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.

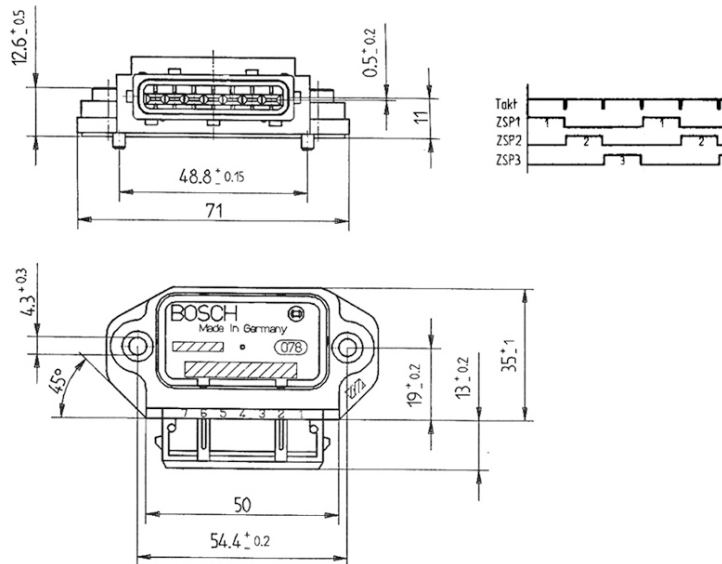
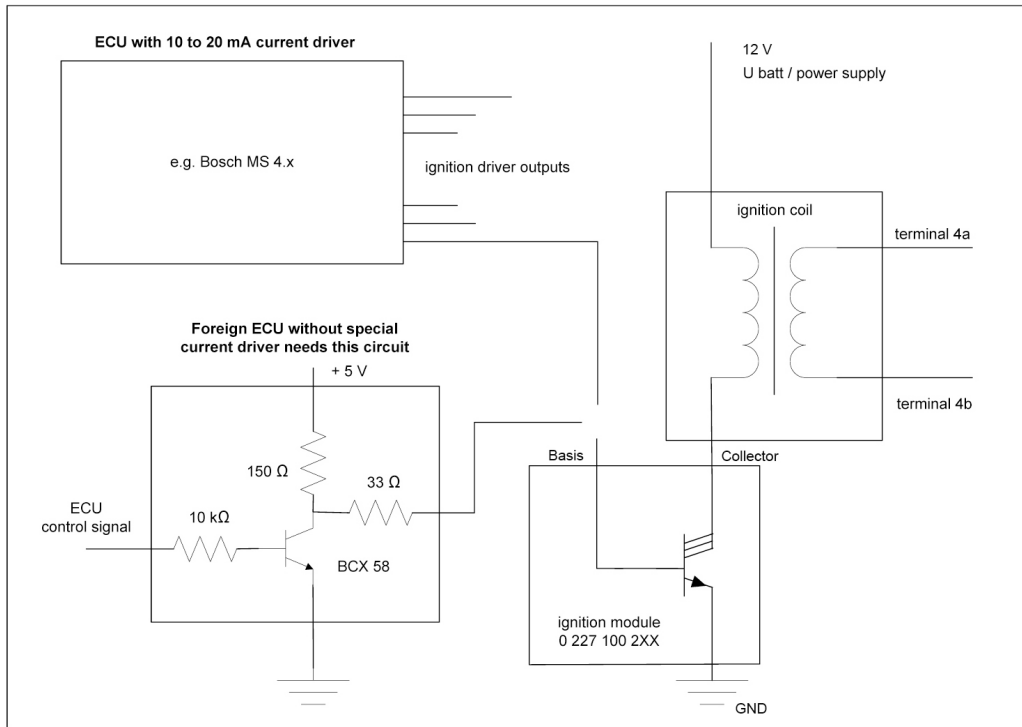
Ordering Information

Order number **0 227 100 203**

Ignition Module IM 3.2

Dimensions

4



## Ignition Module IM 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 Jetronic 4-pole	D 261 205 351-01
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 Jetronic 5-pole	D 261 205 352-01
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.

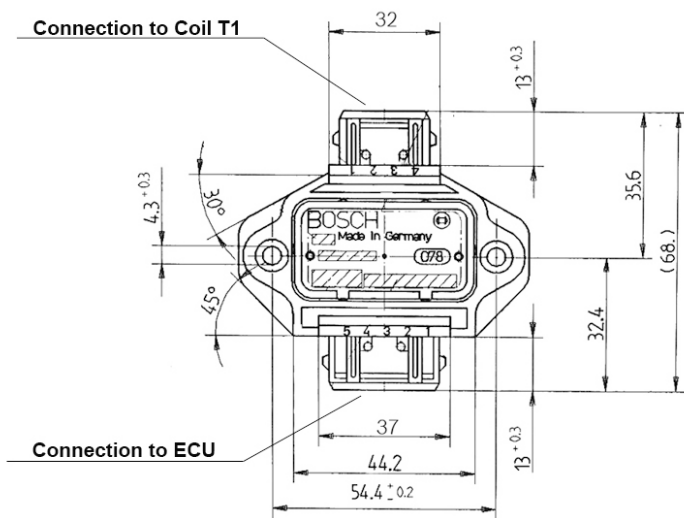
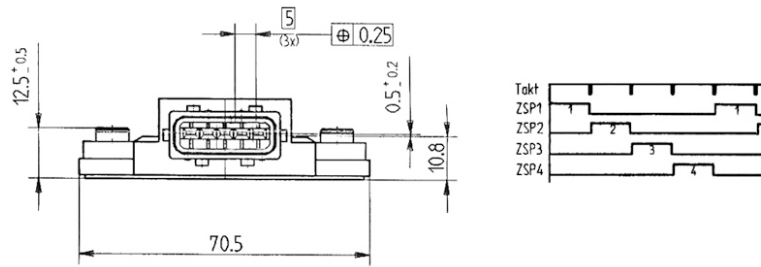
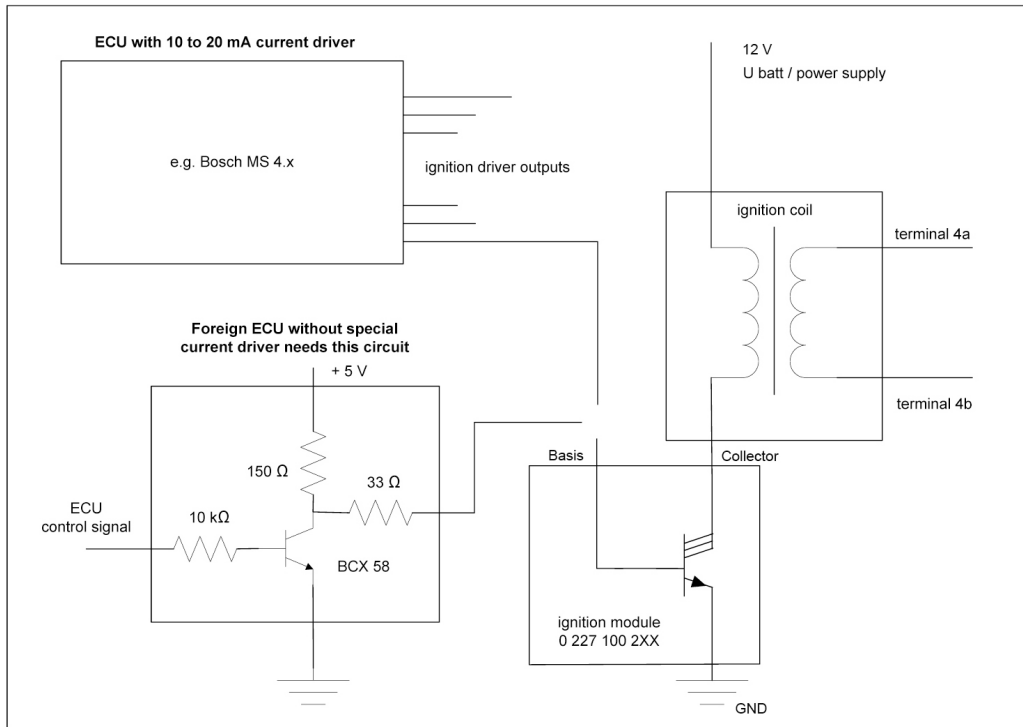
This ignition module is designed for use with engine control units which have no integrated ignition transistor.

Please observe the specified limit values.

#### Ordering Information

**Ignition Module IM 4**  
Order number **0 227 100 211**

Dimensions



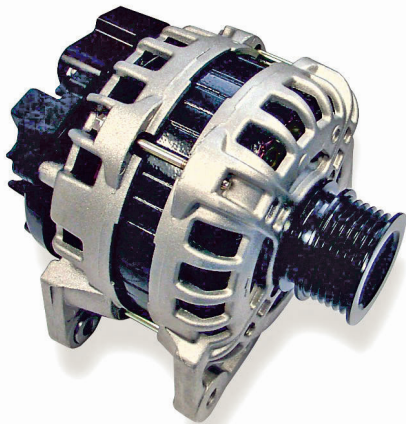
# 05 Actuators

5

<b>Alternators</b>	<b>182</b>
<b>Electric Coolant Pump</b>	<b>191</b>
<b>Electronic Throttle Body</b>	<b>196</b>
<b>Starter</b>	<b>199</b>
<b>Wiper Motor</b>	<b>201</b>

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## Alternator B3



5

### Features

- ▶ With multifunctional regulator
- ▶ 4,800 g
- ▶ 210 A
- ▶ Clockwise rotation

The B3 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 double impregnated winding.

The multifunctional 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	210 A at 10,000 rpm/90°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	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

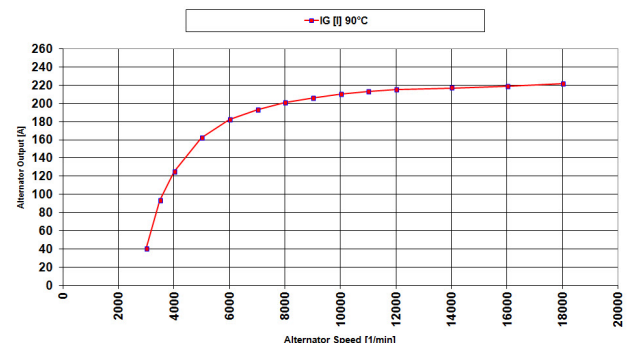
#### Electrical Data

Regulating voltage	14.2 V
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

#### Characteristic

Rpm [1/min]	I <sub>G</sub> [A] at 90°C
3,000	40
3,500	93
4,000	125
5,000	162
6,000	182
7,000	193
8,000	201
9,000	206
10,000	210
11,000	213
12,000	215
14,000	217
16,000	219
18,000	222

Please note: Measured with U=13.1 V and t=20 min



**Installation Notes**

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.

Operating the alternator is only permitted with the installed regulator and a connected 12 V battery (Lithium battery not proved).

The excitation current can also be realized by an external lamp (on request).

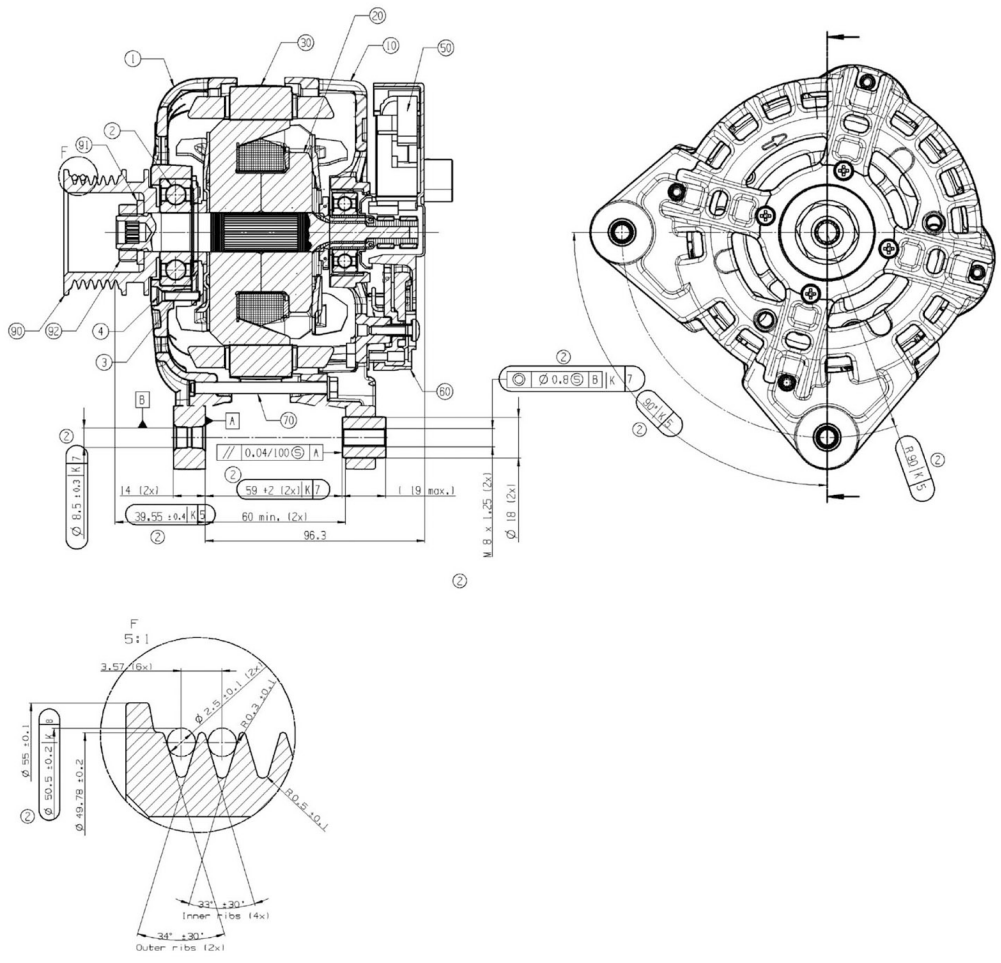
Please find further application hints at our homepage.

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**

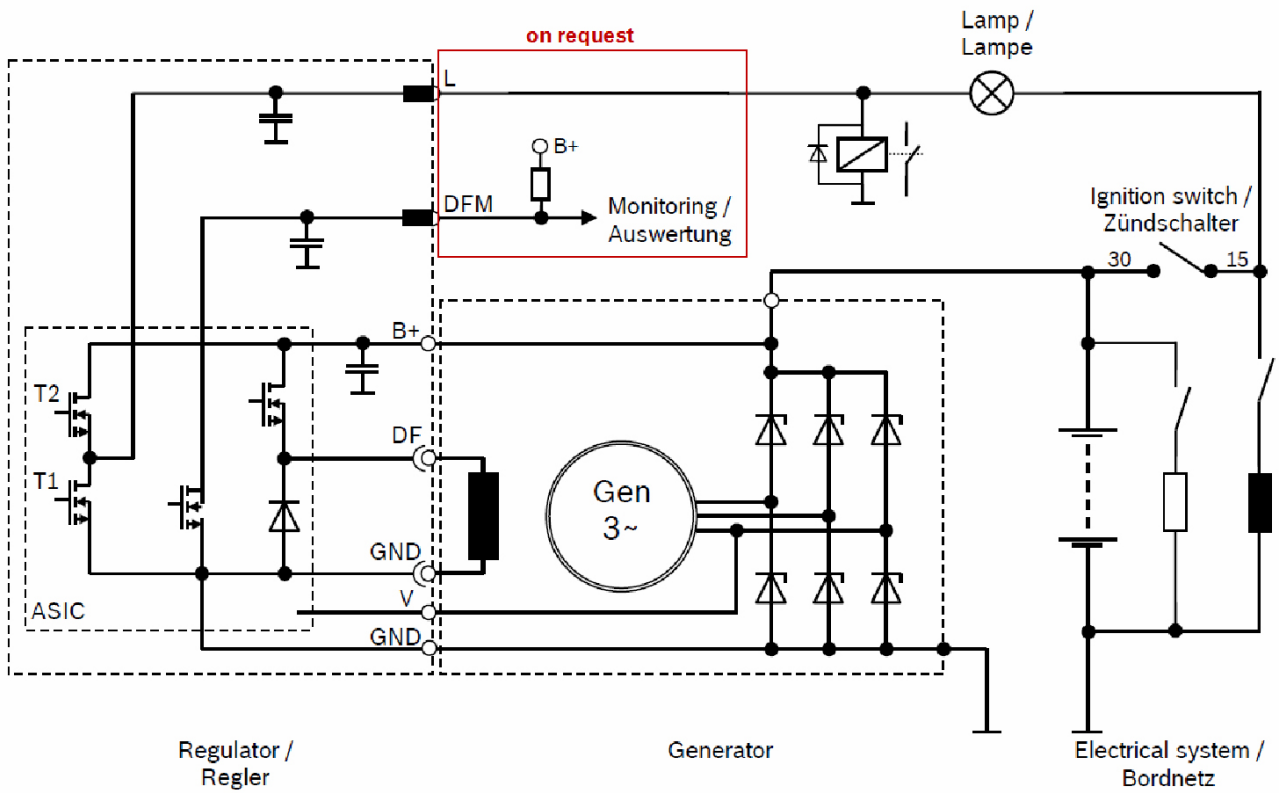
**Alternator B3**  
Order number **on request**

**Dimensions**



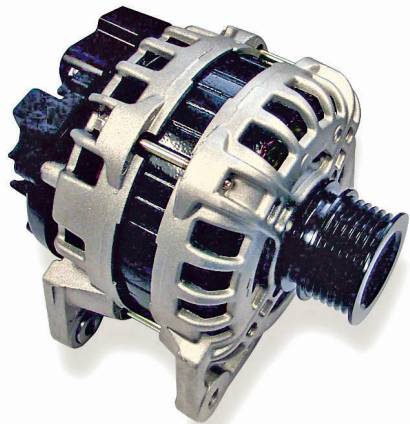
Principle wiring diagram of the system

Prinzipschaltbild des Systems





## Alternator B3 LIN



### Features

- ▶ Electrically and mechanically identical with B3
- ▶ Motorsport optimized LIN2.1 regulator with latest ASIC technology
- ▶ 4,800 g
- ▶ 210 A
- ▶ Clockwise rotation

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 double 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	210 A at 10,000 rpm/90°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	
Switching-on via LIN interface	
High side output stage with defined ramp steepness and FET as free-wheeling „diode“	
Emergency start and 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

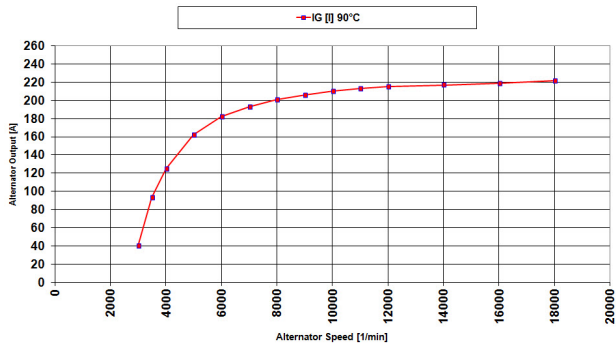
#### Electrical Data

Regulating voltage	14.2 V
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

#### Characteristic

Rpm [1/min]	I <sub>G</sub> [A] at 90°C
3,000	40
3,500	93
4,000	125
5,000	162
6,000	182
7,000	193
8,000	201
9,000	206
10,000	210
11,000	213
12,000	215
14,000	217
16,000	219
18,000	222

Please note: Measured with U=13.1 V and t=20 min

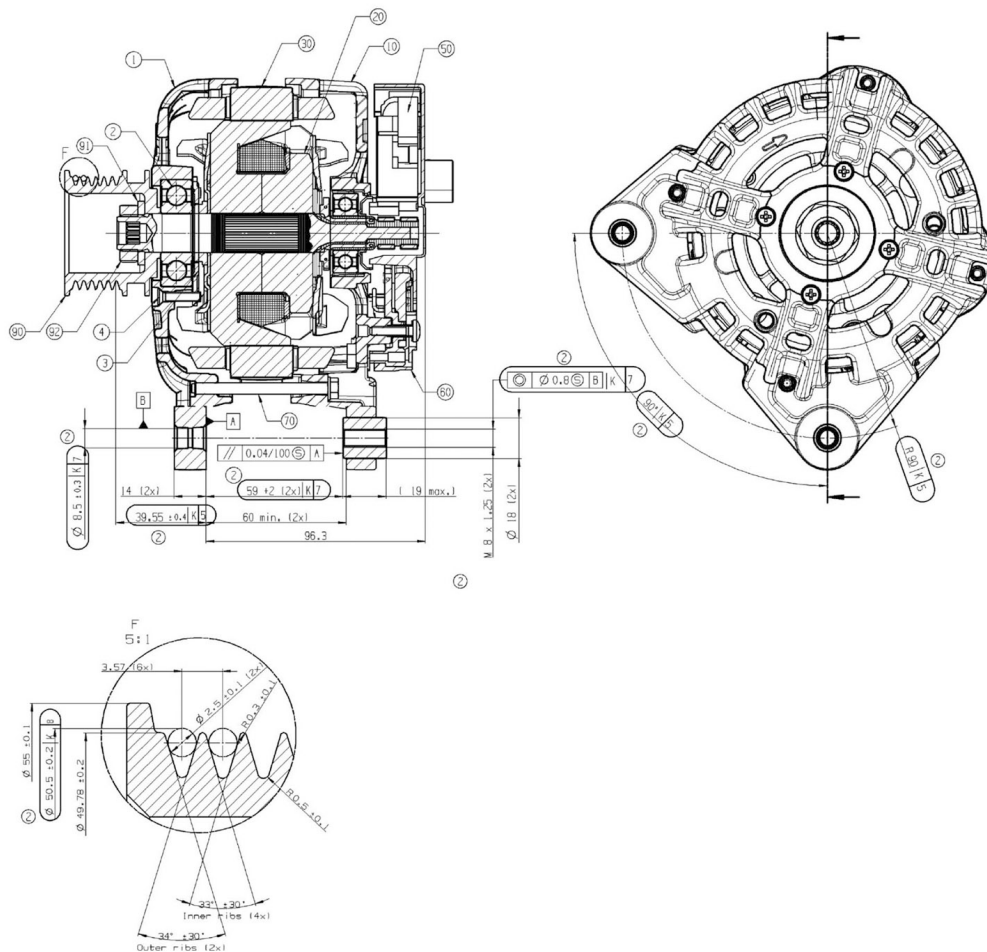


**Installation Notes**

**5** 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.

Operating the alternator is only permitted with the installed regulator and a connected 12 V battery (Lithium battery not proved).

**Dimensions**



The excitation current can also be realized by an external lamp (on request).

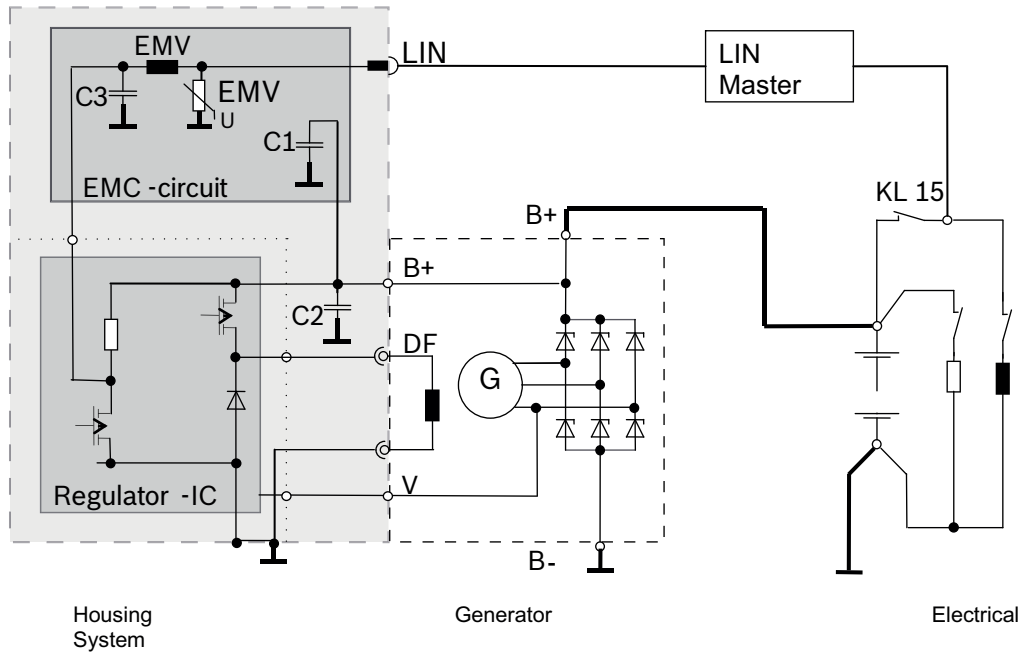
Please find further application hints at our homepage.

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**

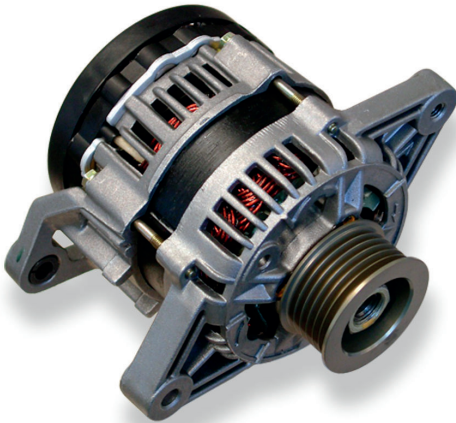
**Alternator B3 LIN**

Order number on request



Schematic Diagram

## Alternator GCM1



5

### Features

- ▶ 3,400 g
- ▶ 140 A
- ▶ Clockwise or anticlockwise rotation
- ▶ Special lightweight aluminum pulley available

This alternator is modified for motorsport demand and splash protected. The stator windings are handmade and optimized for higher current output; the rotor is extra fine balanced and double impregnated. Clockwise and anticlockwise versions are possible, modifications are available on request.

### Application

Ambient temperature range -30 to 90°C

Vibration protection high

Installation without rubber mounting.

### Technical Specifications

#### Mechanical Data

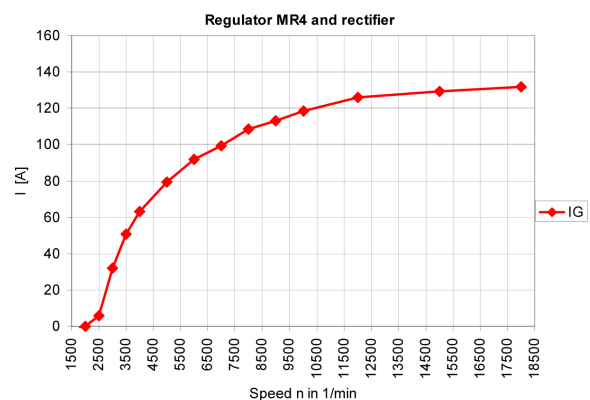
Case material	aluminum
Weight	3,400 g
Current regulator unit	integrated
Max. rotations	18,000 x 1/min
Diameter	108 mm
Length without shaft stub	128 mm
Distance between mounting points	154 mm

### 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]	$I_g$ [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

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 air flow 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 alternator. Debris at alternator cooling area can reduce cooling effect. This could also shorten the alternator service life. Installation without rubber mounting.

### Ordering Information

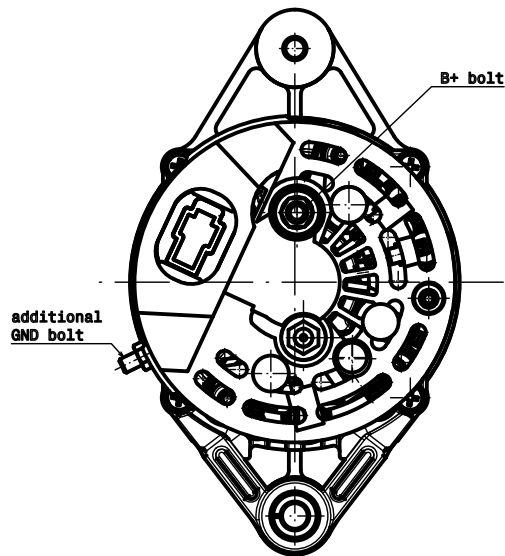
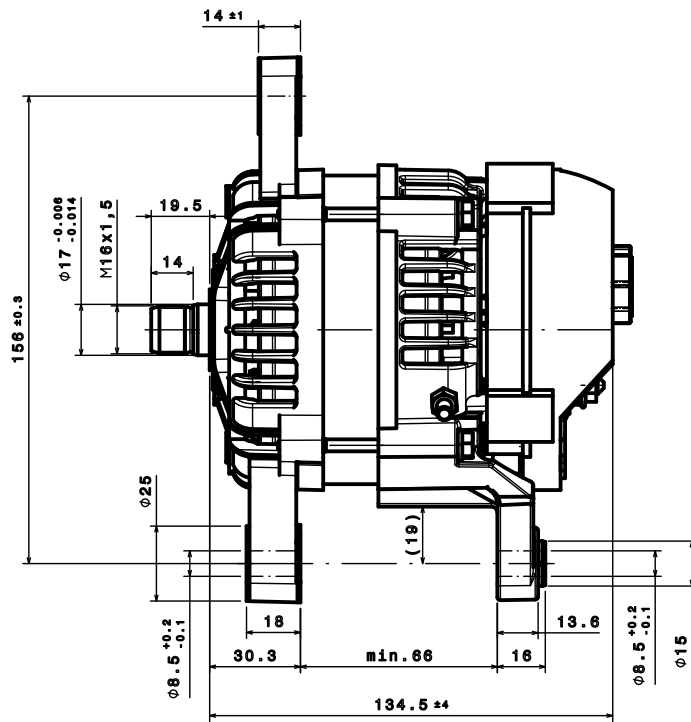
#### **Alternator GCM1**

Application, Rotation Direction and  
Order number **on request**

---

Dimensions

5



# Electric Coolant Pump ECP 160



## Features

- ▶ > 160 l/min at 1.5 bar (g)
- ▶ 926 g (Pump Unit + Electronic Box)
- ▶ Brushless motor
- ▶ PWM speed controlled
- ▶ Spiral housing additive manufactured

The Bosch ECP 160 coolant pump features a PWM controlled BLDC motor. Its main purpose are coolant systems. The supply voltage is 12 V.

## Application

Max. differential pressure (el. limited)	<2.4 bar (g)
Delivery rate at 22°C	160 l/min at 1.5 bar (g) (690 W)
Max. delivery rate	<240 l/min
Max. coolant temperature	135°C
Max. ambient temperature	85°C
Max. vibration Pump Unit and Electronic Box	See Vibration Profile 1 on our homepage
Max. dry run time (new condition)	< 30 s
Duration for pressure build up	< 1,000 ms (from 0 to 160 l/min at 1.5 bar (g) at T_coolant = 95°C)
Coolant compatibility	Automotive coolant fluids

## Technical Specifications

### Mechanical Data

Size Pump Unit	105 x 90 x 95 mm
Size Electronic Box	110 x 97 x 45 mm
Weight Pump Unit	445 g
Weight Electronic Box	481 g
Weight total	926 g

Protection Classification Pump Unit	IP55
Protection Classification Electronic Box	IP67
Housing Pump Unit and Electronic Box	Aluminum
Intake side	Wiggins clamps 1 ¼"
Pressure side	Wiggins clamps 1 ¼"
Periodically service after 100 operating hours	<ul style="list-style-type: none"> <li>• Maintenance of Pump Unit</li> <li>• See also maintenance list</li> </ul>
Periodically service after 200 operating hours or after 2 years	<ul style="list-style-type: none"> <li>• Functional test of Electronics</li> <li>• See also maintenance list</li> </ul>

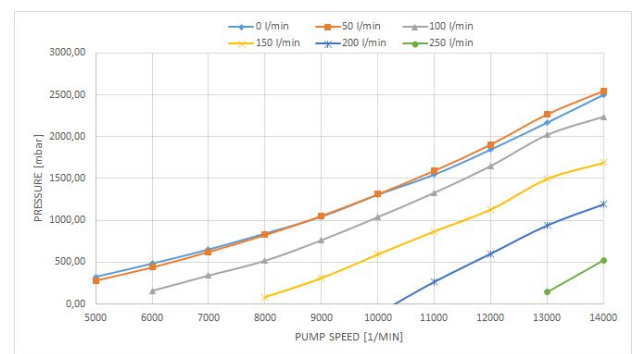
## Electrical Data

Supply voltage	9 to 18 V DC
Load current	51.1 A at 13,500 rpm and 1.5 bar (g); 160 l/min (see diagrams)
Max. current	62 A
Max. released short-term power (el. limited)	750 W
Speed control	PWM

## Characteristic

Surface coating	Anodization
Color	Black
Fluid filtering	Possible both sides

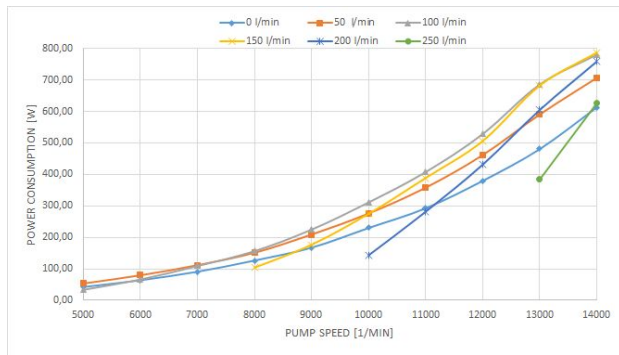
## Pressure



	Flow rate l/min					
Pump speed 1/min	0	50	100	150	200	250
5,000	327	281				mbar
6,000	484	438	160			r

7,000	653	623	341			
8,000	843	825	519	84		
9,000	1045	1051	764	311		
10,000	1308	1312	1040	594	0	
11,000	1547	1593	1330	869	266	
12,000	1846	1905	1651	1130	603	
13,000	2168	2267	2022	1495	940	144
14,000	2502	2546	2240	1688	1193	524

**Power Consumption**



	Flow rate l/min					
Pump speed 1/min	0	50	100	150	200	250
5,000	43	54	34			W at 13.5 V DC
6,000	64	80	66			
7,000	91	112	109			
8,000	127	151	156	104		
9,000	168	209	225	177		
10,000	230	276	311	275	143	
11,000	293	358	408	389	282	
12,000	380	462	528	506	431	
13,000	481	591	686	682	605	384
14,000	613	707	781	787	759	626

**Connectors and Wires**

Pin A	Power Supply
Pin B	GND
12 V electrical connector	Souriau 8 STA 0-16-75PN 251 (red)
PWM-Signal	Souriau 8 STA 2-02-05PN (red)

Pin 1	Not connected (NC)
Pin 2	GND
Pin 3	Signal PWM
Pin 4	Not connected (NC)
Pin 5	Not connected (NC)
Mechanical connector intake side	Wiggins clamps W994-20D 1 ¼” Wiggins welding flange W903-B20D 1 ¼” Wiggins connecting sleeve W908-20D 1 ¼”
Mechanical connector pressure side	Wiggins clamps W994-20D 1 ¼” Wiggins welding flange W903-B20D 1 ¼” Wiggins connecting sleeve W908-20D 1 ¼”

Cable length	500 mm
Air intake	19 mm hose support

**PWM Signal**

Frequency	250 Hz
Voltage	$U_{low}$ 0 to 0.8 V; $U_{high}$ 3.3 to 18 V

Type of Operation	T <sub>on</sub> / Duty Cycle	Rotation Speed
Not defined	0 to 0.499 ms / 0 %	-
Stop motor	0.5 to 1.0 ms / 0 to 25 %	0 %
First commutation, not permitted for usage	1.0 to 1.33 ms / 25 to 33 %	0 %
Operation width	1.33 to 2.0 ms / 33 to 50 %	33 to 100 %
Maximum speed	2.0 to 2.5 ms / 50 to 62.5 %	100 %
Not defined	2.501 to 4.0 ms / 62.5 to 100 %	-

**Ordering Information**

**Electric Coolant Pump ECP 160**  
Incl. Pump Unit and Electronic Box  
Order number **F 02U V02 499-02**

**Electronic Box**  
Order number **F 02U V02 500-01**

**Pump Unit**  
Order number **F 02U V02 501-02**

**Accessories**  
**Connector Souriau 8STA616-75SN**  
Order number **F 02U 004 556-01**

**Connector Souriau 8STA602-05SN**  
Order number **F 02U 004 678-01**



**Wiggins connectors**

One set for one pump:

2 x clamp

2 x welding flange

2 x connecting sleeve

4 x O-Ring

Order number **F 02U V02 502-01**

**Clamp**

Order number **F 02U 004 503-01**

**Welding flange**

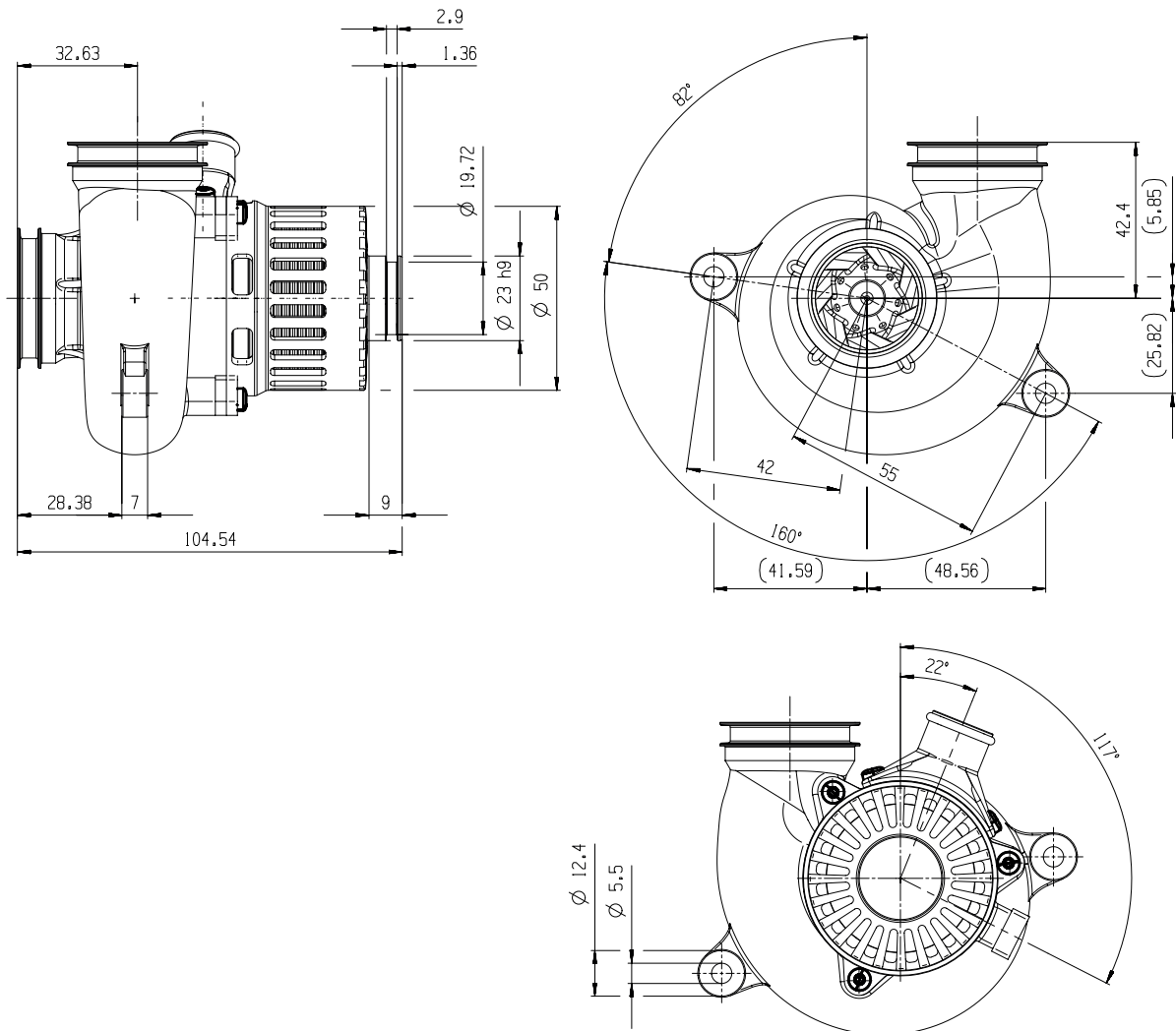
Order number **F 02U 004 504-01**

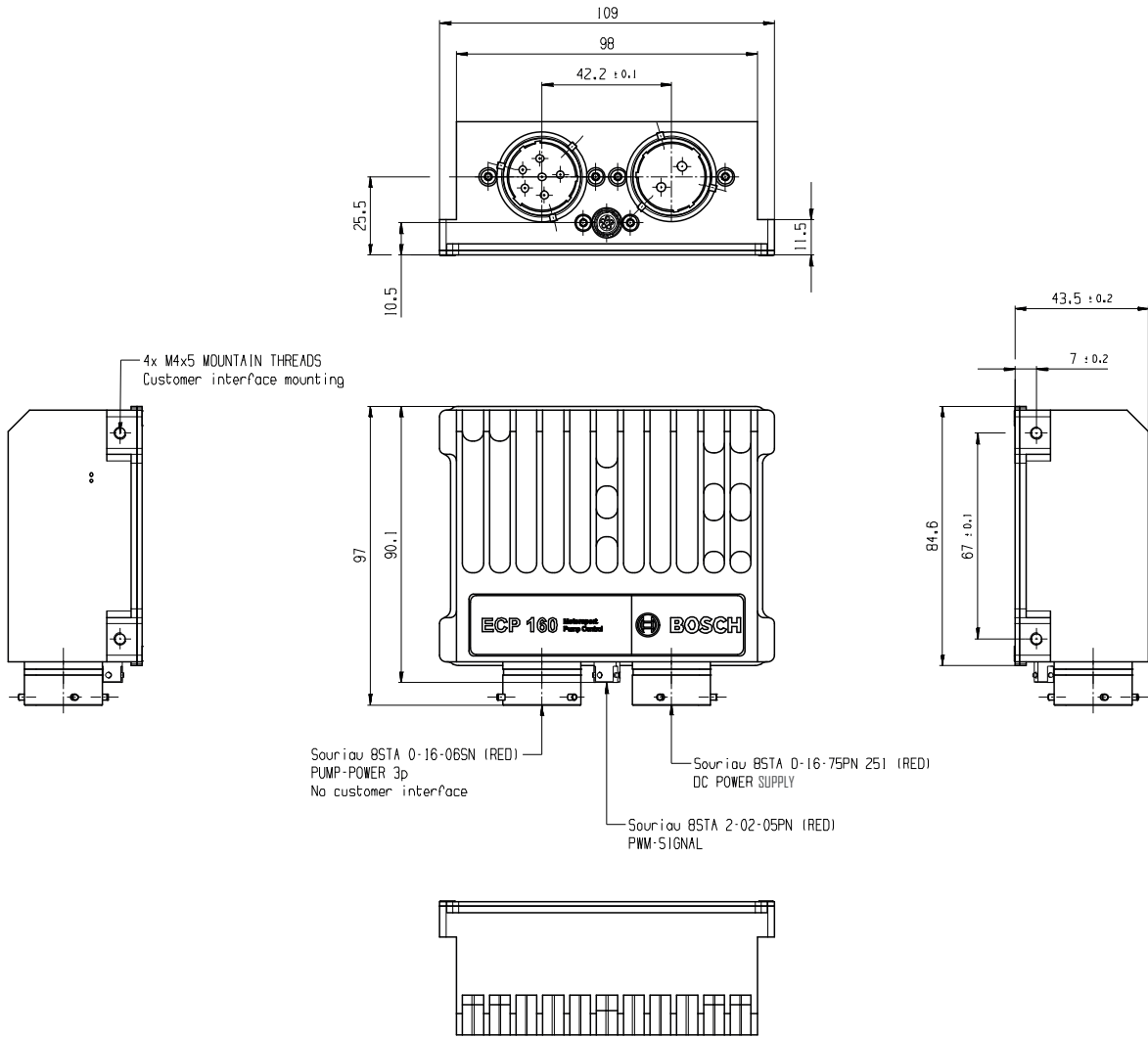
**Connecting sleeve**

Order number **F 02U 004 502-01**

**O-Ring**

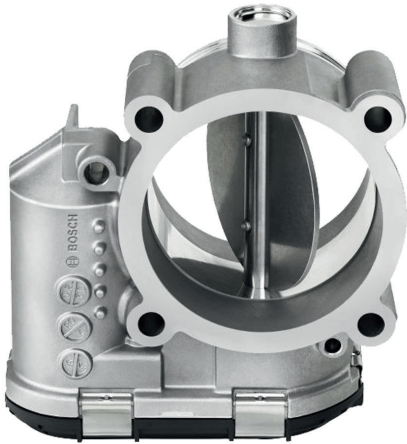
Order number **F 02U 004 506-01**

**Dimensions**



## **Electric Coolant Pump ECP 160 CAN**

## Electronic Throttle Body



5

### 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
	54 mm
	60 mm
	82 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 **0 280 750 148**

##### Electronic Throttle Body 40 mm

Order number **0 280 750 149**

##### Electronic Throttle Body 44 mm

Order number **0 280 750 137**

##### Electronic Throttle Body 46 mm

Order number **F 02U V01 171-01**

##### Electronic Throttle Body 50 mm

Order number **0 280 Y05 107-10**

##### Electronic Throttle Body 52 mm

Order number **F 02U V01 184-01**

##### Electronic Throttle Body 54 mm

Order number **0 280 750 150**

##### Electronic Throttle Body 60 mm

Order number **0 280 750 151**

##### Electronic Throttle Body 68 mm

Order number **0 280 750 156**

##### Electronic Throttle Body 82 mm

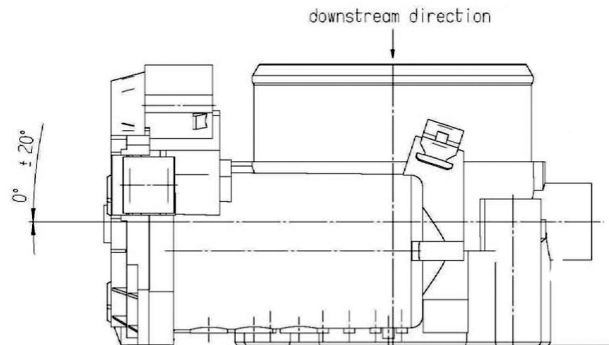
Order number **0 280 750 101**

## Dimensions

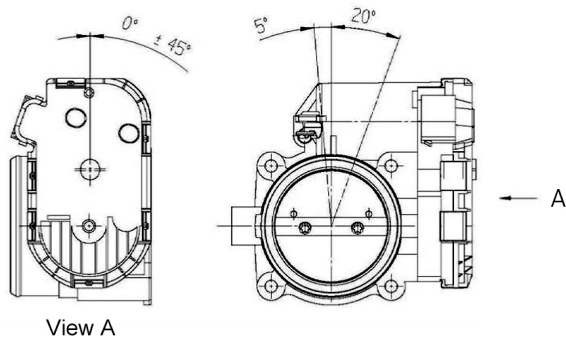
### Mounting position

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!



## Electronic Throttle Body Variations

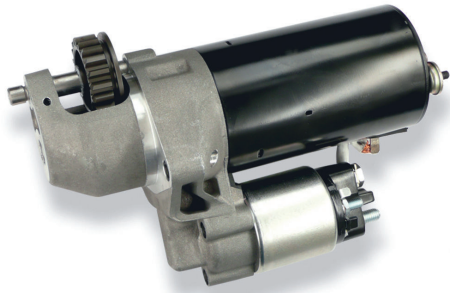
	Electronic Throttle Body 32 mm	Electronic Throttle Body 40 mm	Electronic Throttle Body 44 mm	Electronic Throttle Body 46 mm	Electronic Throttle Body 50 mm
					
Bore diameter (mm)	32	40	44	46	50
Connector	D 261 205 358-01	D 261 205 358-01	D 261 205 358-01	D 261 205 356-01	D 261 205 356-01
Pin 1 A	Motor -	Motor -	Motor -	Poti 1	Poti 2
Pin 2 B	Poti -	Poti -	Poti -	Poti -	Poti -
Pin 3 C	Poti +	Poti +	Poti +	Motor -	Motor +
Pin 4 D	Motor +	Motor +	Motor +	Poti 2	Poti 1
Pin 5 E	Poti 2	Poti 2	Poti 2	Motor +	Motor -
Pin 6 F	Poti 1	Poti 1	Poti 1	Poti +	Poti +
Flange diameter (mm)	40	50	50	58	58
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	clockwise	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	D 261 205 356-01	D 261 205 358-01	D 261 205 358-01	D 261 205 358-01	D 261 205 358-01
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
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 **	clockwise	counterclockwise	counterclockwise	counterclockwise	counterclockwise

\* ambient conditions: Air pressure  $p=1000$  mbar, Differential pressure  $\Delta p=600$  mbar  $\pm 25$  mbar, rel. humidity  $rF=40$  %, Air temperature  $T=24^{\circ}\text{C}$

\*\* Opening direction is related to view A. See drawings on bottom of chapter "Dimensions".

## 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 clockwise and counter-clockwise 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

#### Electrical Data

Performance	1.7 kW
-------------	--------

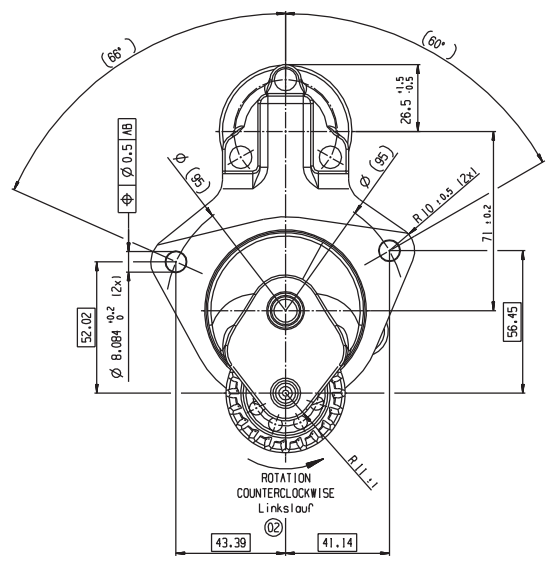
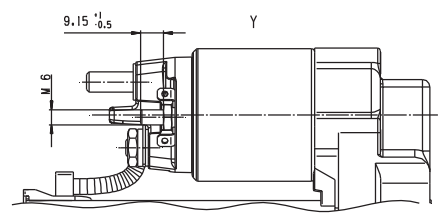
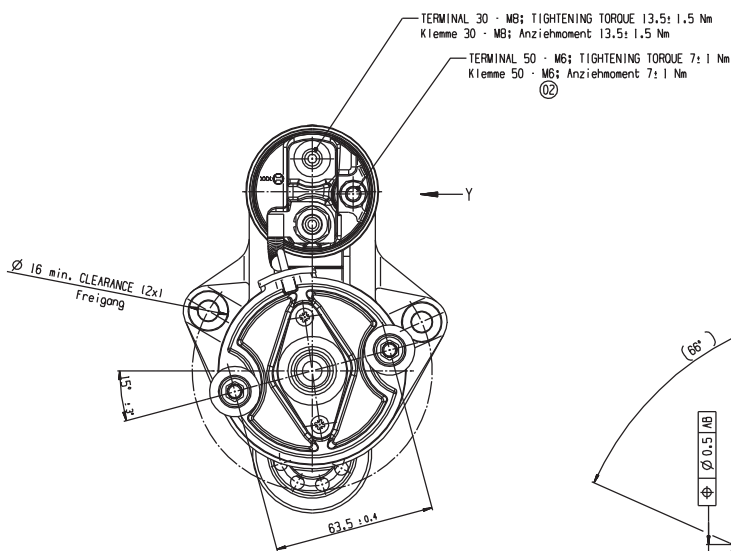
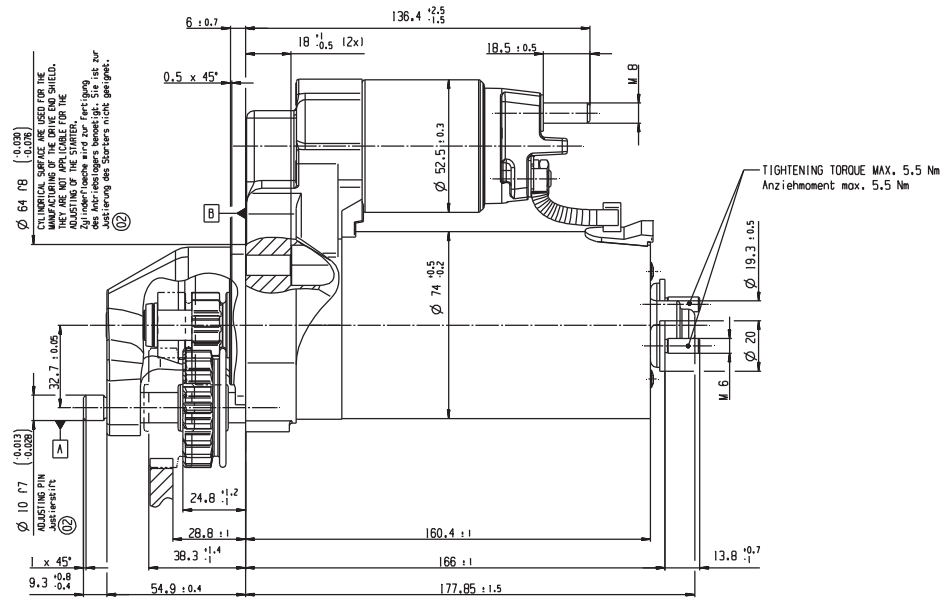
### Ordering Information

#### Starter 1.7 kW

Order number **on request**

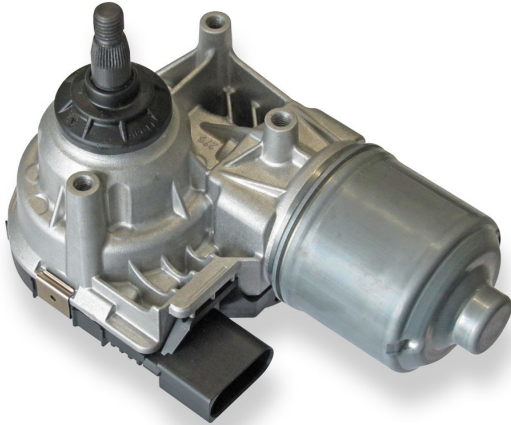
Dimensions

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

Max. Vibration	30 % of Vibration Profile 1 or 100 % of Vibration Profile 1 in combination with silentblocks (see Accessories)
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

### 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				
Interframe-Space	20 to 40 ms				

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 ... 3	Counter	The counter has to be increased with each LIN-message	0 ... 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 ... 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	F 02U 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

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.

### 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 Analog

Order number **F 02U V00 938-03**

#### WDA LIN

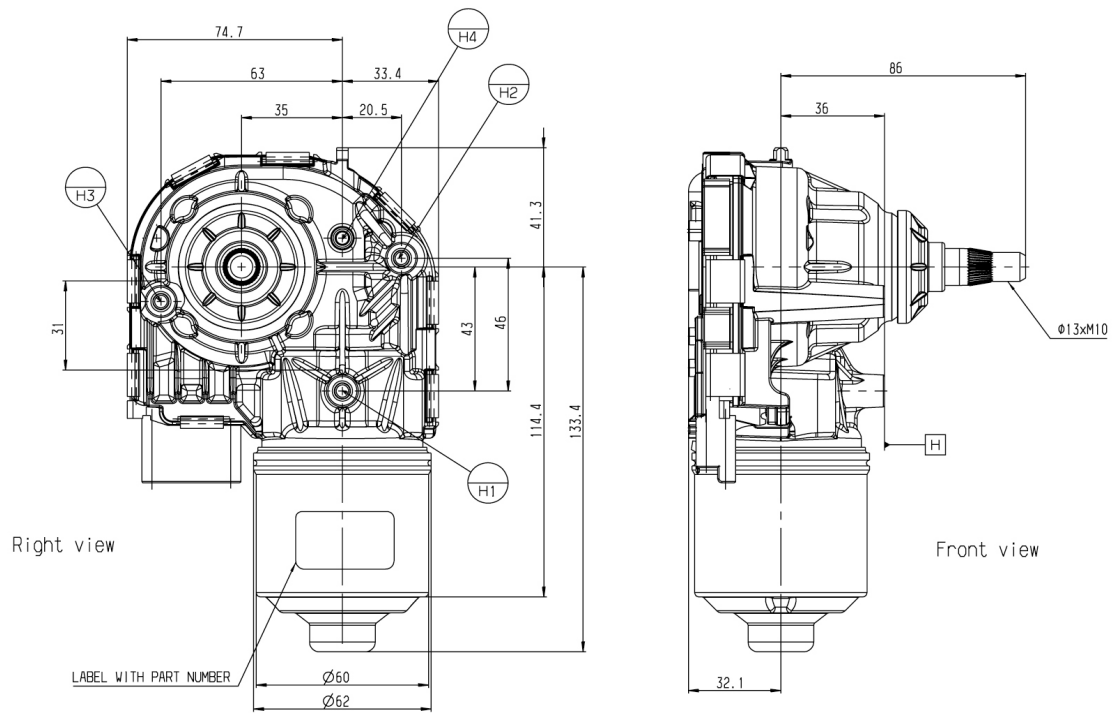
Order number **F 02U V00 838-04**

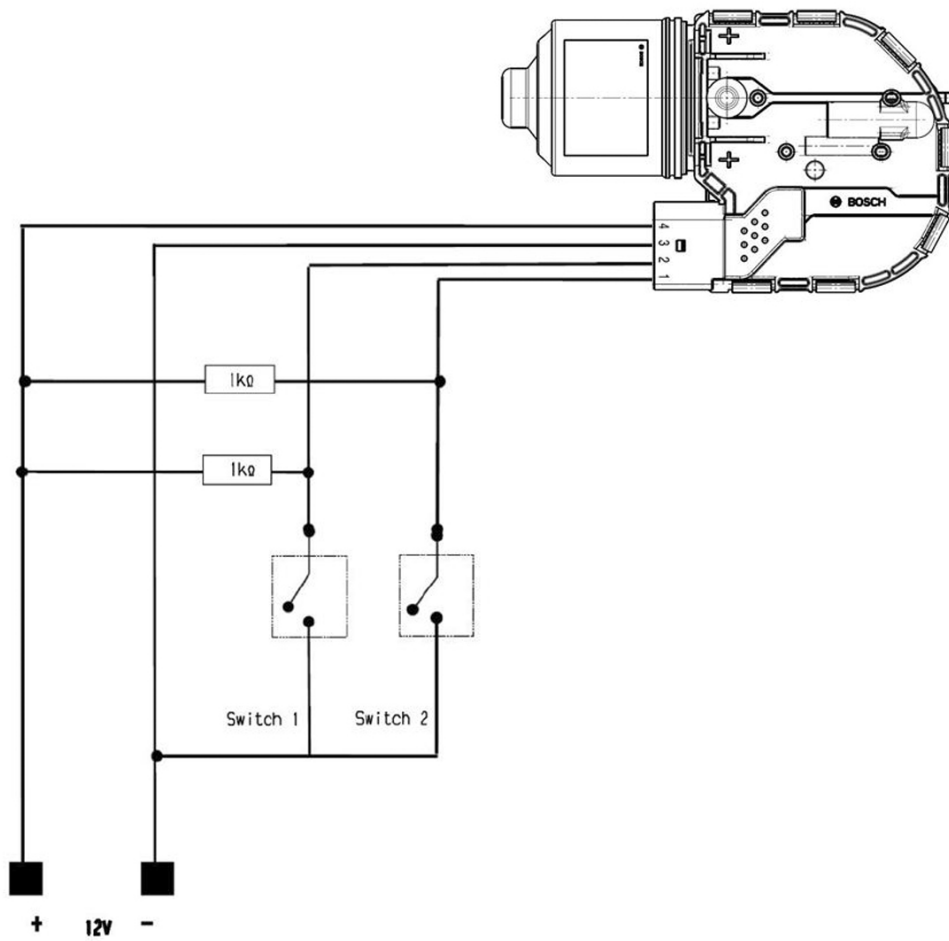
#### Accessories

##### Silentblock

Order number **F 02U 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

# 06 Electrified Powertrain

6

e-GoKart Powertrain

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## e-GoKart Powertrain "YoungStar"



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

### Technical Specifications

#### Boost Recuperation Machine "BRM"

##### 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 kg
Thermal system	Air cooled with integrated fans

#### Battery

##### 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 x 15 kg
Thermal system	Passive cooled

#### Content of kit

Boost Recuperation "BRM"	
2 x 48 V battery pack	
Controller VCU	
HMI	
DC/DC converter	
External AC/DC charger	
Wiring harness with switches	
Acceleration Pedal Sensor	F 02U V02 691-01
Brake Inductive Sensor	F 02U V02 690-01
Pressure Sensor	0 261 545 030

### Ordering Information

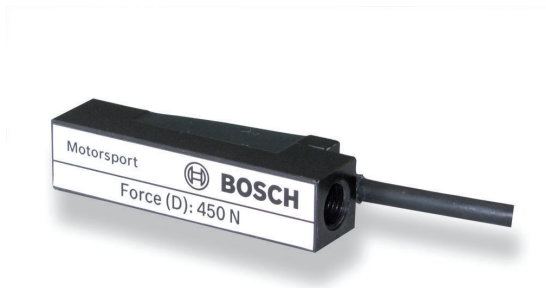
#### e-GoKart Powertrain "YoungStar"

Order number **F 02U V02 649-02**

<b>Gear Shift Sensor</b>	<b>208</b>
<b>Knock Sensors</b>	<b>210</b>
<b>Lambda Sensors</b>	<b>217</b>
<b>Linear Position Sensors</b>	<b>228</b>
<b>Pressure Sensors Air</b>	<b>239</b>
<b>Pressure Sensors Fluid</b>	<b>253</b>
<b>Pressure Sensors Combined</b>	<b>266</b>
<b>Rotary Position Sensors</b>	<b>282</b>
<b>Speed Sensors</b>	<b>297</b>
<b>Temperature Sensors</b>	<b>322</b>
<b>Thermocouple Probes</b>	<b>333</b>
<b>Vehicle Dynamics Sensors</b>	<b>345</b>

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## Gear Shift Sensor GSS-2



### Features

- ▶ Strain gauge technology
- ▶ Measurement range: -450 to 450 N
- ▶ Analog output

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	ASL 6-06-05PC-HE
Mating connector ASL 0-06-05SC-HE	F 02U 000 228-01

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.

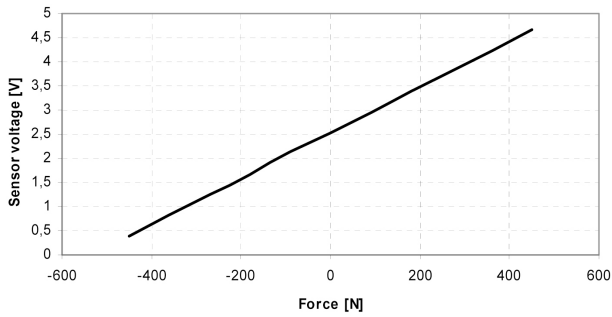
Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 100 cm

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





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.

**Installation Notes**

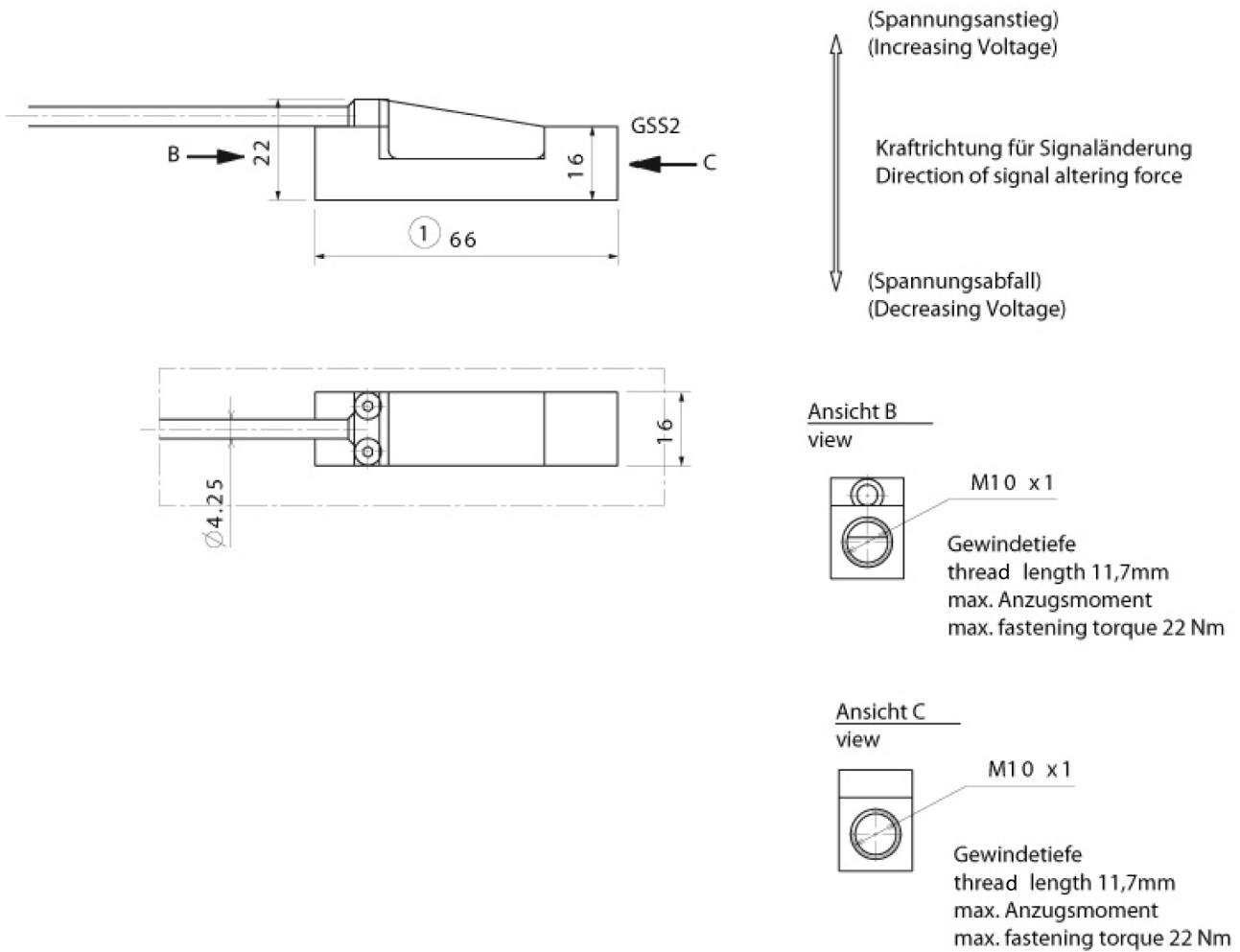
The GSS-2 can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.




**Ordering Information**

**Gear Shift Sensor GSS-2**  
Order number **B 261 209 227-01**

**Dimensions**



## Knock Sensors Overview

	Knock Sensor KS4-P	Knock Sensor KS4-R	Knock Sensor KS4-R2
			
Frequency range (kHz)	1 to 20	1 to 20	3 to 25
Temperature range (°C)	-40 to 130	-40 to 130	-40 to 130
Capacity field (pF)	800 to 1,400	800 to 1,400	1,150 ± 200
Max. vibration (m/s <sup>2</sup> )	≤ 800; ≤ 4,000 short term	≤ 800; ≤ 4,000 short term	≤ 800; ≤ 4,000 short term
Weight (g)	48	82	60

## Knock Sensor KS4-P



### Features

- ▶ Engine vibration measurements
- ▶ Measurement range 3 to 25 kHz
- ▶ Robust design
- ▶ Integrated series connector

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 (F 02U B00 966-01) Or 2-Pin Jetronic (D 261 205 288-01)
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

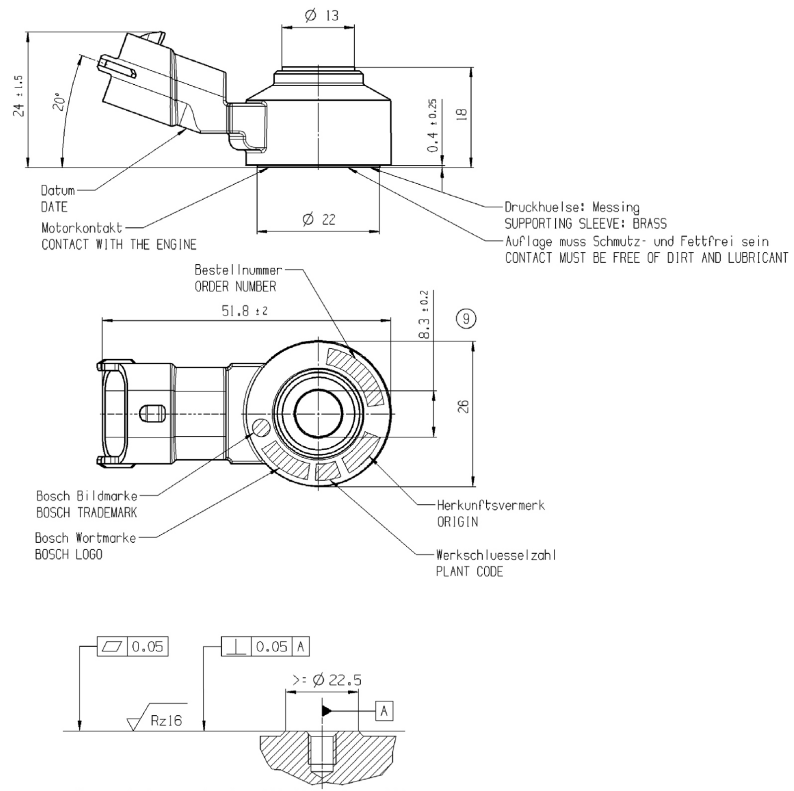
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

#### Ordering Information

**Knock Sensor KS4-P**  
Mating Connector: 2-Pin RB-Kp.1  
Order number **0 261 231 173**

**Knock Sensor KS4-P**  
Mating Connector: 2-Pin Jetronic  
Order number **0 261 231 188**

Dimensions



## Knock Sensor KS4-R



### Features

- ▶ Engine vibration measurements
- ▶ Measurement range 3 to 25 kHz
- ▶ Robust design

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

#### 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 (D 261 205 337-01), L=530 mm or 2-Pin RB-Kp.3 (F 02U B00 967-01), L=400 mm
Pin 1	Sig +
Pin 2	Sig -
Sleeve	PUR
Wire size	AWG 24
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

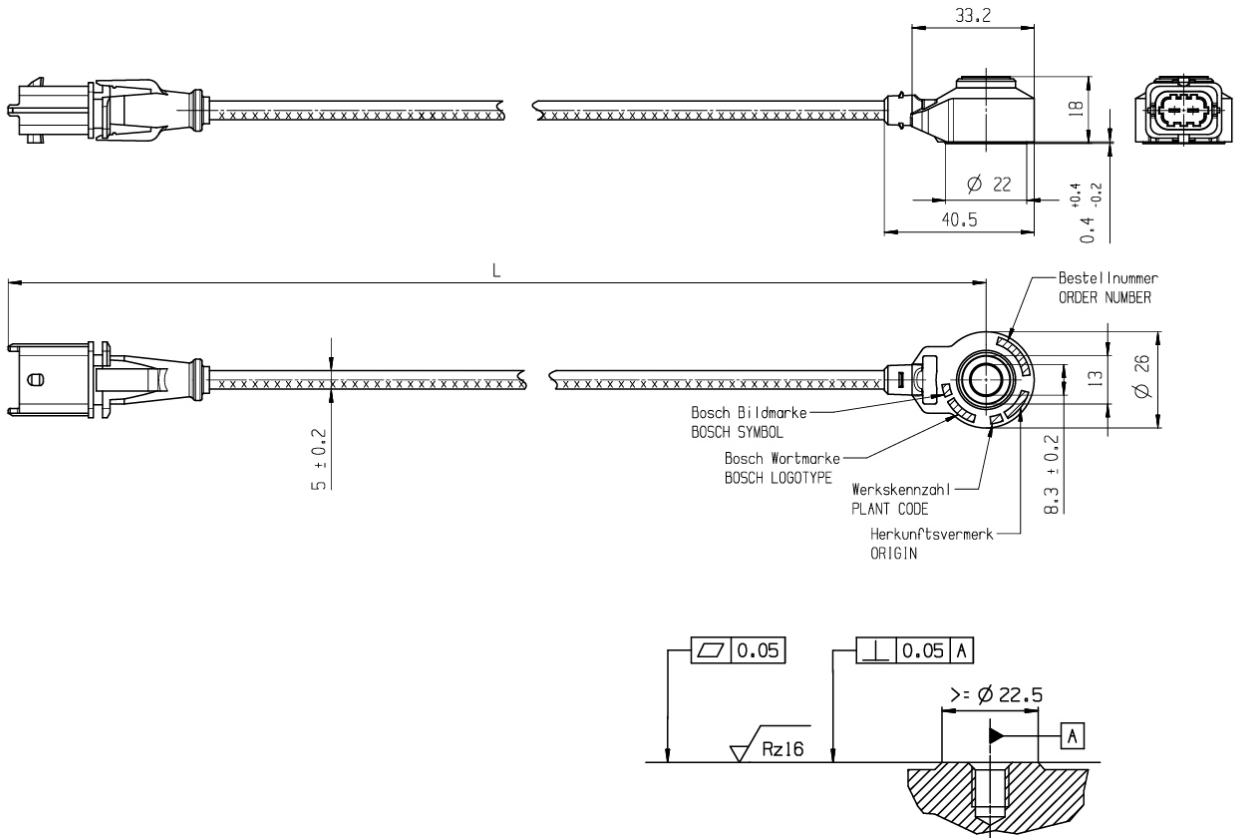
**Knock Sensor KS4-R**

Mating Connector 2-Pin RB-Kp.1, L = 530 mm  
 Order number **0 261 231 218**

**Knock Sensor KS4-R**

Mating Connector 2-Pin RB-Kp.3, L = 400 mm  
 Order number **0 261 231 223**

Dimensions



## Knock Sensor KS4-R2



### Features

- ▶ Engine vibration measurements
- ▶ Measurement range 3 to 30 kHz
- ▶ Robust design
- ▶ Compact housing

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)

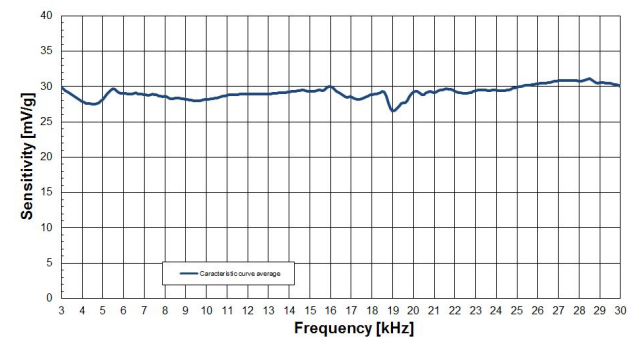
### Technical Specifications

#### Mechanical Data

Fixing screw for cast iron	M8x25
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 (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



#### 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	ASX 602-03PC-HE
Mating connector ASX 002-03SC-HE	F 02U 002 840-01
Pin 1	Sig
Pin 2	Gnd
Pin 3	Scr
Sleeve	Elastomer
Wire size	AWG 20
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.

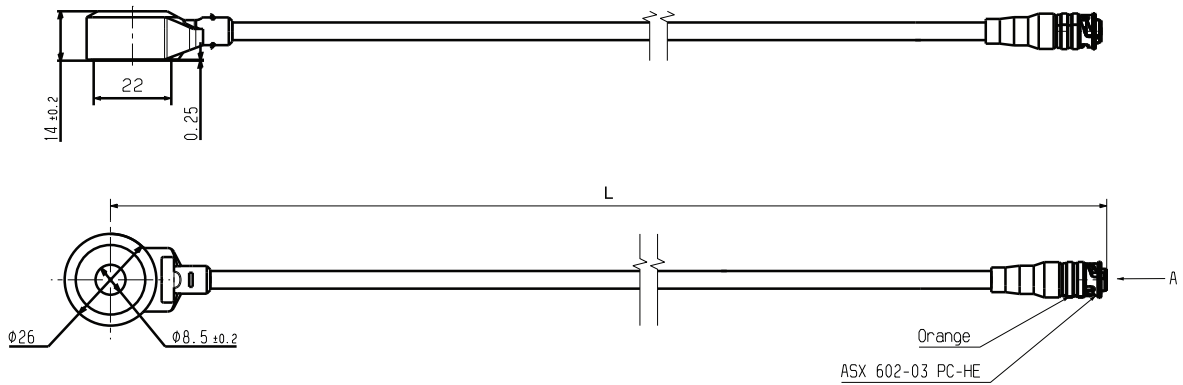
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

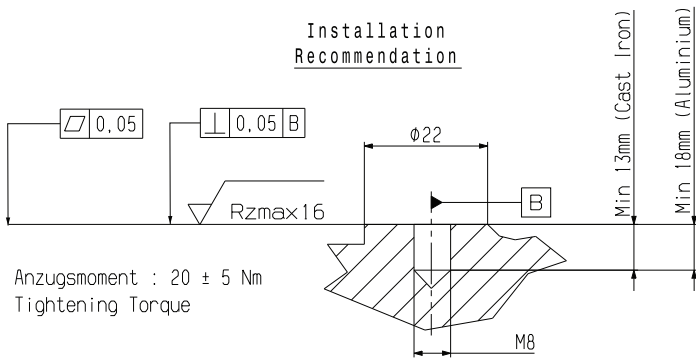
**Ordering Information**

**Knock Sensor KS4-R2**  
Order number **F 02U V01 884-01**

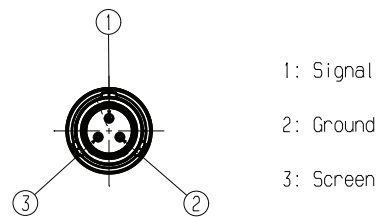
**Dimensions**



**Installation Recommendation**







**Detail A Electrical Connection**





## Lambda Sensors Overview

	Lambda Sensor LSU 4.9	Lambda Sensor LSU ADV	Lambda Sensor LSU ADV pre Turbo	Lambda Sensor Mini-LSU 4.9
				
Application (Lambda)	0.65 to $\infty$	0.65 to $\infty$	0.65 to $\infty$	0.65 to $\infty$
Hexagon temperature (°C)	<600	≤700	≤820	≤700
Exhaust gas temperature (°C)	<930 (<1,030 for short time)	<930 (<1,030 for short time)	<980 (<1,030 for short time)	<930 (<1,030 for short time)
Fuel compatibility	Gasoline/E85/Diesel	Gasoline/E85/Diesel	Gasoline/E85/Diesel	Gasoline/E85/Diesel
Threat	M18 x 1.5	M18 x 1.5	M18 x 1.5	M16 x 1.5

## Lambda Sensor LSU 4.9



## 7

### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Wide band
- ▶ Exhaust gas temperature range (max.) for short time  $\leq 1,030^{\circ}\text{C}$
- ▶ Max. Hexagon temperature  $600^{\circ}\text{C}$

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  $\text{ZrO}_2$  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	1 928 404 687
Mating connector	D 261 205 356-01
Wire length L	95.0 cm

##### LSU 4.9 with motorsport connector

Connector	AS 6-07-35PN
Mating connector	AS 0-07-35SN
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 $\mu\text{A}$

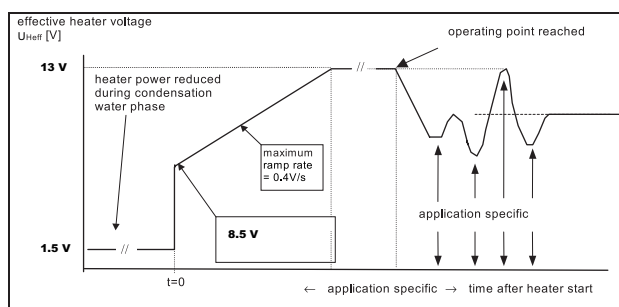
#### Characteristic

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	$1.70 \pm 0.05$		
<b><math>I_p</math> [mA]</b>	<b>lambda</b>	<b><math>U_A</math> [V], v=17</b>	<b><math>U_A</math> [V], v=8</b>
-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

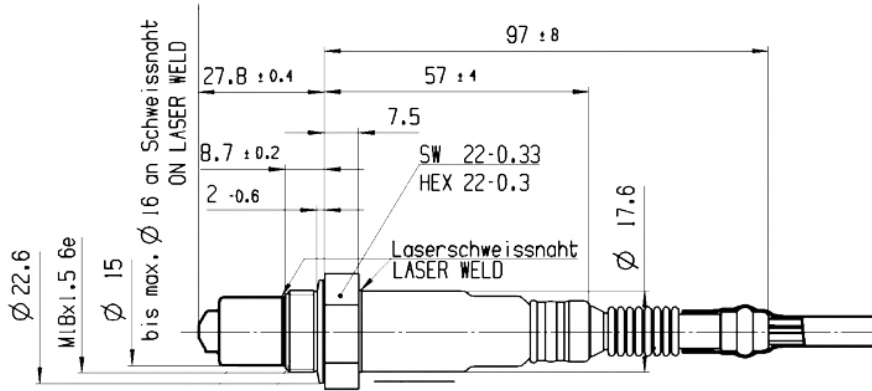
#### Lambda Sensor LSU 4.9

With automotive connector  
Order number **0 258 017 025**

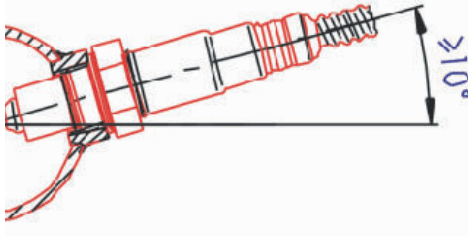
#### Lambda Sensor LSU 4.9

With motorsport connector  
Order number **B 261 209 358-03**

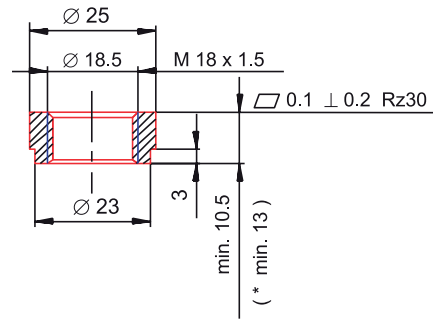
Dimensions



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  $\infty$
- ▶ Wide band
- ▶ Max. exhaust gas temperature range 1,030°C for a short time
- ▶ Max. Hexagon temperature 700°C for a short time
- ▶ Without trim resistance in connector

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 m/s <sup>2</sup>

### Technical Specifications

#### Variations

##### 1.) LSU ADV with automotive connector

Connector	1 928 404 669
Mating connector	F 02U B00 725-01
Pin 1	APE
Pin 2	IPN
Pin 3	H-
Pin 4	Uh+ / H+
Pin 5	RE
Pin 6	nc
Wire length L	95.0 cm

##### 2.) LSU ADV pre Turbo with automotive connector

Connector	1 254 488 136
Mating connector	F 02U B00 937-01
Pin 1	IP/APE
Pin 2	VM/IPN
Pin 3	Uh- / H-
Pin 4	Uh+ / H+
Pin 5	UN / RE
Pin 6	nc

##### 3.) LSU ADV (pre Turbo) with motorsport connector

Connector	AS 6-07-35PA
Mating connector	AS 0-07-35SA
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).

**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	≥ 100 Hz
Nominal resistance of Nernst cell	300 Ohm
Max current load for Nernst cell	≤ 80 μA
Switch-on time	≤ 5 s

**Characteristic**

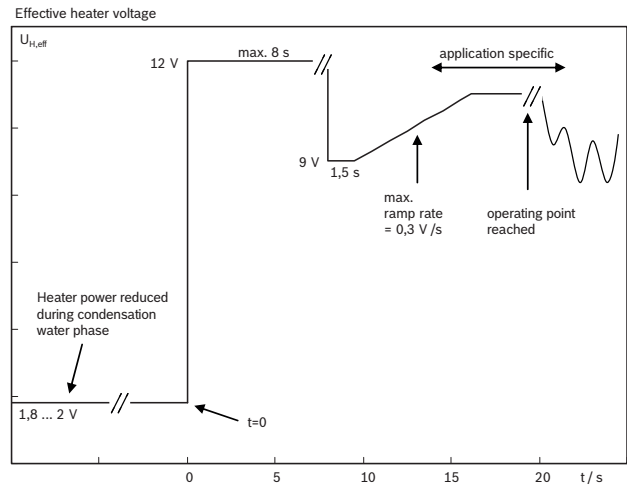
Signal output	$I_p$ meas
Accuracy at lambda 0.8	-0.652 ± 0.032 mA
Accuracy at lambda 1	-0.018 ± 0.008 mA
Accuracy at lambda 1.7	0.515 ± 0.022 mA

$I_p$ [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

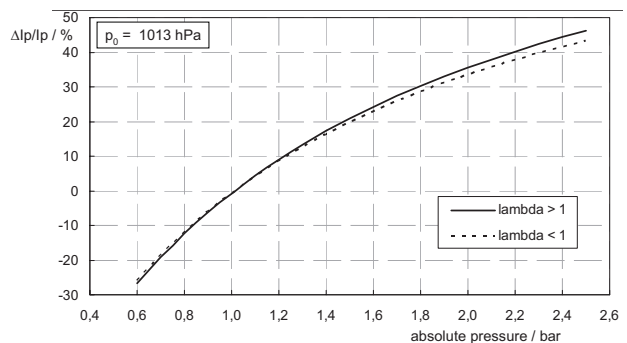
0.06444	1.080	1.568	1.532
0.08556	1.100	1.590	1.542
0.17000	1.180	1.679	1.584
0.23080	1.260	1.743	1.614
0.36000	1.430	1.879	1.678
0.40148	1.500	1.922	1.699
0.52000	1.700	2.047	1.758
0.54740	1.780	2.076	1.771
0.77000	2.430	2.310	1.881
1.40000	5.000	2.973	2.193

**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**

Connector	Please see variations
Mating connector	Please see variations
Sleeve	fiber glass / silicone coated

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 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 **0 258 027 010**

#### Lambda Sensor LSU ADV

Motorsport connector, wire length customer specific (max. 90 cm)  
Order number **F 02U V01 861-01**

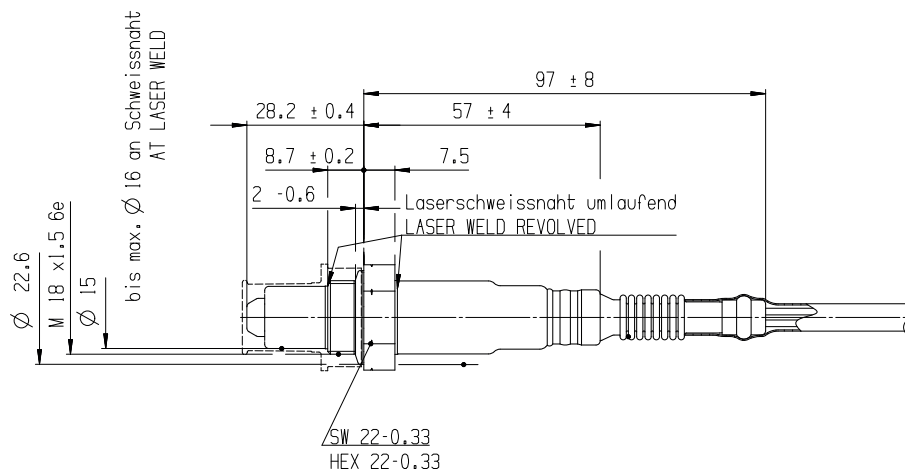
#### Lambda Sensor LSU ADV pre Turbo

Automotive connector, wire length 37 cm  
Order number **0 258 027 052**

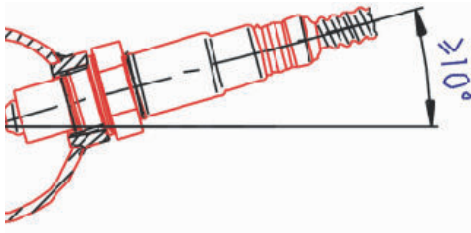
#### Lambda Sensor LSU ADV pre Turbo

Motorsport connector, wire length 33 cm  
Order number **F 02U V02 066-01**

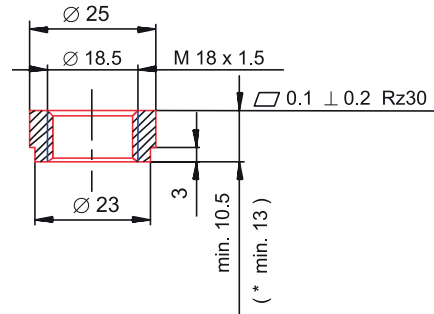
### Dimensions



## Mounting recommendation



## Recommended design of the mating thread in the exhaust pipe

\*:  $T_{Hexagon} > 600^{\circ}\text{C}$  or $T_{Gas} > 930^{\circ}\text{C}$ 



## Lambda Sensor Mini-LSU 4.9



### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Wide band
- ▶ Inconel sensor housing
- ▶ Exhaust gas temperature range (max.) for short time < 1,030°C
- ▶ Max. Hexagon temperature 700°C

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°C

Exhaust gas temperature range (max.) for short time	< 1,030°C
Hexagon temperature	$\leq 700^\circ\text{C}$
Wire and protective sleeve temperature	< 250°C
Connector temperature	< 150°C
Storage temperature range	-40 to 100°C
Max. vibration (stochastic peak level)	300 m/s <sup>2</sup> (see Installation Notes)

### Technical Specifications

#### Variations

##### Mini-LSU 4.9 with automotive connector

Connector	1 928 404 682
Mating connector	D 261 205 356-01
Wire length L	950 mm

##### Mini-LSU 4.9 with motorsport connector

Connector	AS 6-07-35PN
Mating connector	AS 0-07-35SN
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 $\mu\text{A}$

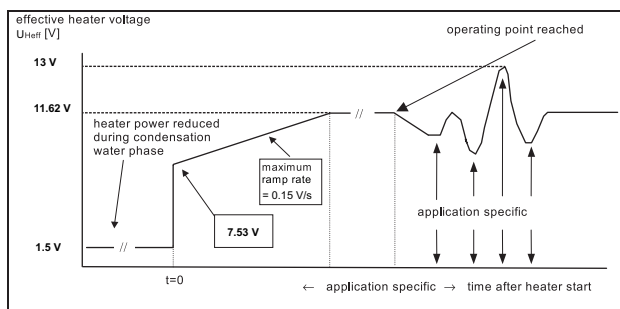
#### Characteristic

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:**  $U_{\lambda}$  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 home-page.

A higher maximum vibration profile is possible and should be determined by the customer's individual application.

**Safety Note**

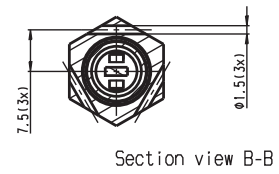
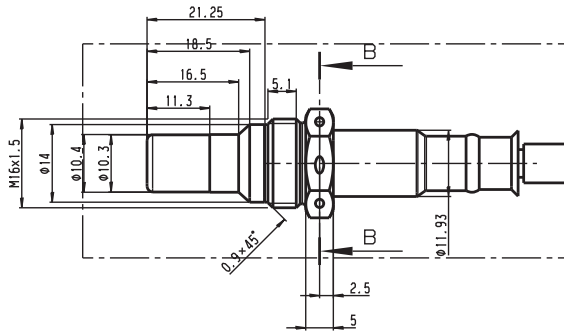
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

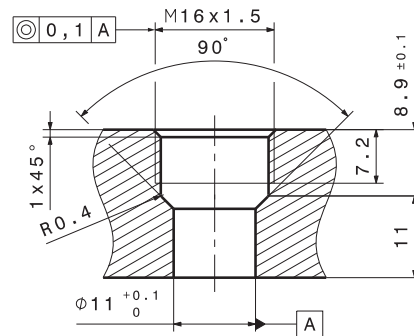
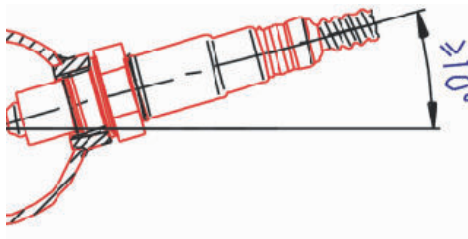
**Lambda Sensor Mini-LSU 4.9**  
 With automotive connector  
 Order number **B 258 490 103-30**

**Lambda Sensor Mini-LSU 4.9**  
 With motorsport connector  
 Order number **F 02U V02 227-02**






**Dimensions**



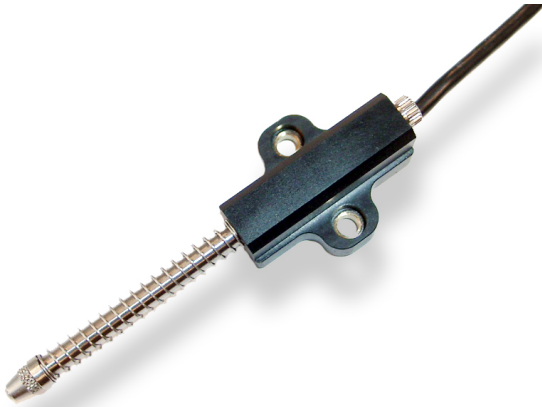
**Mounting recommendation**



## Linear Position Sensors Overview

	Linear Position Sensor LP 25-H	Linear Position Sensor LP 75	Linear Position Sensor LP 100	Linear Position Sensor LP 100-H	Linear Position Sensor LP 150
					
Application (mm)	0 to 25	0 to 75	0 to 100	0 to 100	0 to 150
Redundant	No	No	No	No	No
Housing	Glass filled polymer	Aluminum	Aluminum	Aluminum	Aluminum
Weight w/o wire (g)	28	78	85	35	115
Technology	Hall contactless	Linear tape	Linear tape	Hall contactless	Linear tape
Temperature range (°C)	-40 to 140	-30 to 100	-40 to 100	-40 to 125	-40 to 85
Output signal I (V)	0.5 to 4.5	0.025 to 4.975	0.025 to 4.975	0.025 to 4.975	0 to 5
Output signal II (V)	-	-	-	-	-

## Linear Position Sensor LP 25-H



### Features

- ▶ Linear movement measurement
- ▶ Measurement range up to 25 mm
- ▶ Superior accuracy  $\pm 2.5\%$
- ▶ Operating temperature  $-40$  to  $140^{\circ}\text{C}$

The sensor is designed to measure linear movement, e.g. the stabilizer bar movement. The electronic is designed with a stainless steel magnetic shaft with Hall element. The Hall element is disposed between two magnets in association with a movable specially formed ferromagnetic part. This is used to control flux in the sensor in order to produce a linearly varying output voltage dependent on the position.

The main benefit of this sensor is its contactless Hall effect technology and its robust design for motorsport applications.

### Application

Application	Up to 25 mm
Operating temperature range	$-40$ to $140^{\circ}\text{C}$
Max. vibration	Vibration Profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

### Technical Specifications

#### Mechanical Data

Weight w/o wire	21 g
Protection class	IP68 & IP69K
Mounting	2 x M3
Shaft bearing life	25 million cycles
Housing	Glass filled polymer
Shaft	Stainless steel 303

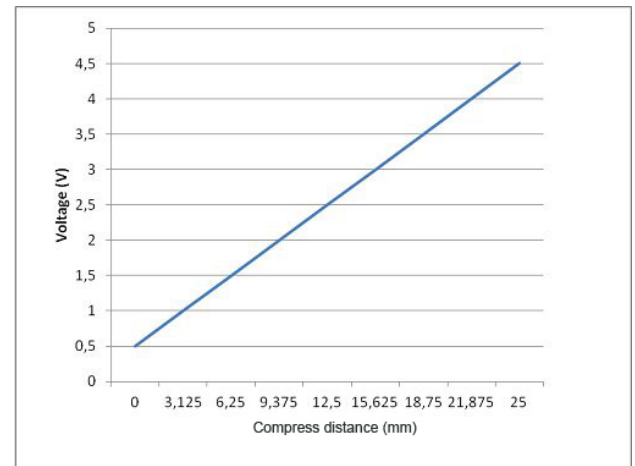
#### Electrical Data

Power supply $U_s$	$5\text{ V} \pm 0.5\text{ V}$
Current $I_S$	$< 15\text{ mA}$
Resolution	0.025 % of measurement range

#### Characteristic

Temperature coefficient	$< \pm 0.003\%$ FS/ $^{\circ}\text{C}$
Superior accuracy	$< \pm 2.5\%$ FS

Other electrical stroke available on request.



#### Connectors and Wires

Connector	ASU 6-03-03 PA-HE
Connector loom ASU 0-03-03SA	F 02U 000 194-01
Pin 1	Power 5 V
Pin 2	Ground
Pin 3	Signal 0.5 to 4.5 V
Sleeve	FDR-25
Wire size	AWG 26
Wire length L	150 to 500 mm

Various motorsport and automotive connectors on request.

Please specify the requested wire length with your order.

#### Installation Notes

The sensor can be connected directly to most control units.

The sensor is designed with contactless Hall effect technology.

Each mounting orientation is possible.

Sensor is at mid point of electrical stroke when the tip of the shaft is exactly 34 mm away from the housing. Please refer this in the offer drawing.

The sensor is also ferromagnetic sensitive. Please make sure the mounting material is not ferromagnetism. This can lead to inaccurate measurement.

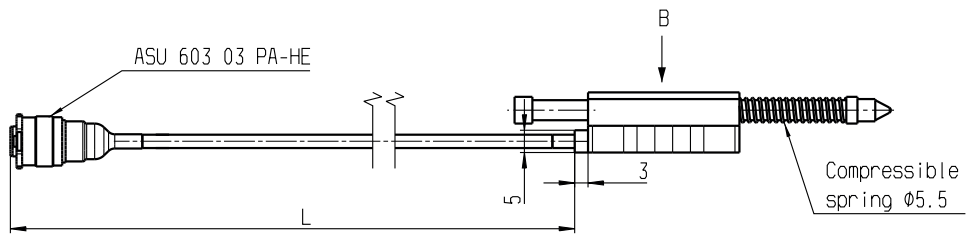
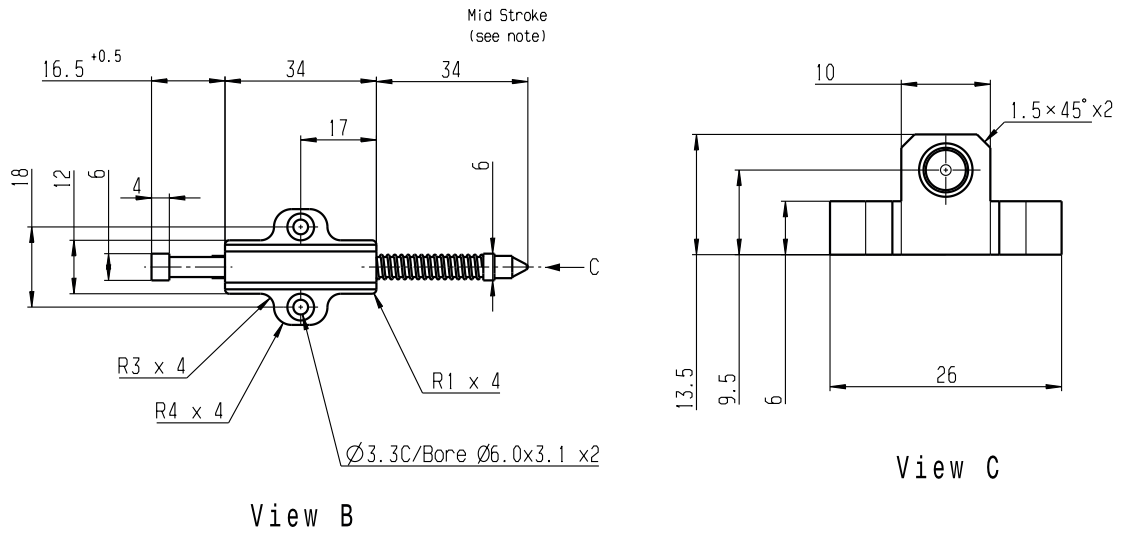
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

**Linear Position Sensor LP 25-H**  
 Order number **F 02U V02 008-01**

**Dimensions**



## Linear Position Sensor LP 75



### Features

- ▶ Measurement range: 0 to 75 mm
- ▶ Aluminum housing
- ▶ Low power consumption

The LP 75 is a linear potentiometer which is designed to measure the relative position of two points, e.g. the gear position, throttle position or suspension movement.

The operating mode of this sensor is based on the linear tape potentiometer principle where the distance travelled between the moving end to the wiper is proportional to the resistance between them.

The advantage of this LP is its compact and lightweight design together with its wider operating temperature range

### Application

Application	0 to 75 mm
Temperature range	-30 to 100°C
Max. vibration	126 m/s <sup>2</sup> at 10 to 12 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	78 g
Min. length	220 mm
Mounting	2 x M5
Tightening torque	10 Nm
Protection	IP66
Max. shaft velocity	10 m/sec

#### Electrical Data

Power supply	5 V
Power supply max.	67 V
Nominal resistance	3 kOhm

Resistance tolerance	10 %
Non-linearity	0.15 %

#### Connectors and Wires

Connector (see Ordering Information)	KPSE 6E8-33P-DN-A34
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Connector loom KPSE 0E8-33S-DN	F 02U 000 115-01
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Pin 1	U <sub>s</sub>
-------	----------------

Pin 2	Gnd
-------	-----

Pin 3	Sig
-------	-----

Or

Connector (see Ordering Information)	ASL 6-06-05PA-HE
--------------------------------------	------------------

Connector loom ASL 0-06-05SA-HE	F 02U 000 226-01
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Pin 1	U <sub>s</sub>
-------	----------------

Pin 2	Gnd
-------	-----

Pin 3	Sig
-------	-----

Pin 4	-
-------	---

Pin 5	-
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Sleeve	DR-25
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Wire size	AWG 24
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Wire length L	15 to 45 cm
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Various motorsport and automotive connectors on request.

Please specify the requested wire length with your order.

### Installation Notes

The LP 75 can be connected directly to most electronic control units and data logging systems.

Each mounting orientation is possible.

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

### Safety Note

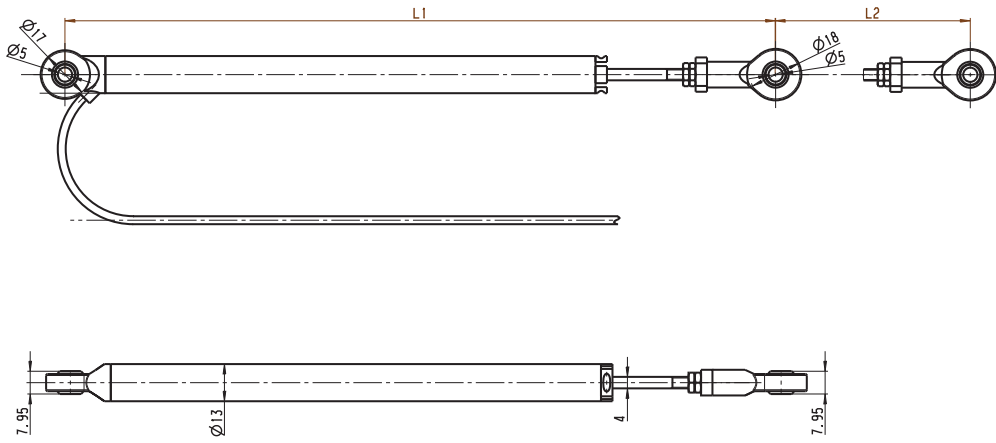
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Linear Position Sensor LP 75**  
Connector KPSE 6E8-33P-DN-A34  
Order number **B 261 209 852-01**

**Linear Position Sensor LP 75**  
Connector ASL 6-06-05PA-HE  
Order number **B 261 209 856-01**

Dimensions





## Linear Position Sensor LP 100



### Features

- ▶ Measurement range: 0 to 100 mm
- ▶ Aluminum housing
- ▶ Low power consumption

The LP 100 is a linear potentiometer which is designed to measure the relative position of two points, e.g. the gear position, throttle position or suspension movement.

Its operating mode is based on the linear tape potentiometer principle where the distance travelled between the moving end to the wiper is proportional to the resistance between them.

The advantage of this LP is its compact and lightweight design together with its wider operating temperature range.

### Application

Application	0 to 100 mm
Temperature range	-40 to 100°C
Max. vibration	126 m/s <sup>2</sup> at 10 to 12 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	85 g
Min. length [L1]	227 mm
Mounting	2 x M5
Tightening torque	10 Nm
Protection	IP65

#### Electrical Data

Power supply	5 V
Power supply max.	74 V
Nominal resistance	4 kOhm
Resistance tolerance	10 %
Non-linearity	0.15 %

### Connectors and Wires

Connector (see Ordering Information)	KPSE 6E8-33P-DN-A34
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Connector loom KPSE 0E8-33S-DN	F 02U 000 115-01
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Pin 1	U <sub>s</sub>
-------	----------------

Pin 2	Gnd
-------	-----

Pin 3	Sig
-------	-----

Or

Connector (see Ordering Information)	ASL 6-06-05PA-HE
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Connector loom ASL 0-06-05SA-HE	F 02U 000 226-01
------------------------------------	------------------

Pin 1	U <sub>s</sub>
-------	----------------

Pin 2	Gnd
-------	-----

Pin 3	Sig
-------	-----

Pin 4	-
-------	---

Pin 5	-
-------	---

Sleeve	DR-25
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Wire size	AWG 24
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Wire length L	15 to 25 cm
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Various motorsport and automotive connectors on request.

Please specify the requested wire length with your order.

### Installation Notes

The LP 100 can be connected directly to most electronic control units and data logging systems.

Each mounting orientation is possible.

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

### Safety Note

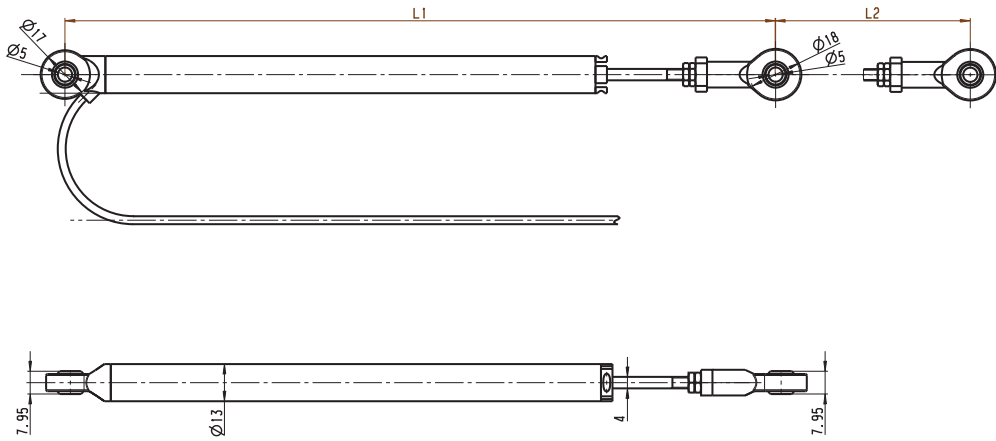
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Linear Position Sensor LP 100**  
Connector KPSE 6E8-33P-DN-A34  
Order number **B 261 209 853-01**

**Linear Position Sensor LP 100**  
Connector ASL 6-06-05PA-HE  
Order number **B 261 209 857-01**

Dimensions



# Linear Position Sensor LP 100-H



## Features

- ▶ Linear movement measurement
- ▶ Measurement range up to 100 mm
- ▶ Operating temperature -40 to 125°C

The sensor is designed to measure linear movement, e.g. the stabilizer bar movement. The electronic is designed with a stainless steel magnetic shaft with Hall element. The Hall element is disposed between two magnets in association with a movable specially formed ferromagnetic part. This is used to control flux in the sensor in order to produce a linearly varying output voltage dependent on the position.

The main benefit of this sensor is its contactless Hall effect technology and its robust design for motorsport applications.

## Application

Application	Up to 100 mm
Operating temperature range	-40 to 125°C
Max. vibration	Vibration Profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )

## Technical Specifications

### Mechanical Data

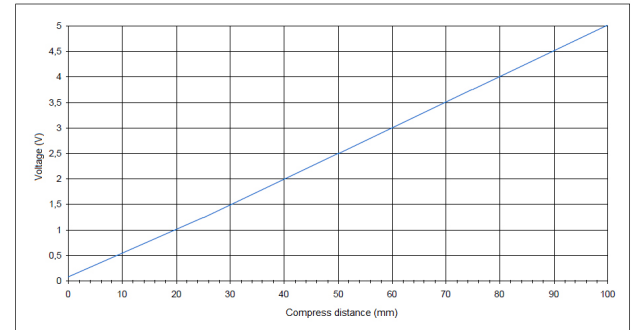
Weight	35 g
Protection class	IP68 & IP69K
Mounting	2 x M4
Shaft bearing life	25 million cycles
Housing	Aluminum sulphur anodised
Shaft	Stainless steel 303

### Electrical Data

Power supply $U_s$	5 V $\pm$ 0.25 V
Current $I_S$ , during power on settlement	< 100 mA
Current $I_S$ , normal operation	< 45 mA
Resolution	0.025 % of measurement range

## Characteristic

Temperature coefficient	< $\pm$ 0.003 % FS/°C
Sensitivity tolerance	< $\pm$ 2.5 % FS
Non-Linearity	< $\pm$ 0.5 % FS



## Connectors and Wires

Connector	ASU 6-03-03 PA-HE
Connector loom ASU 0-03-03SA	F 02U 000 194-01
Pin 1	Power 5 V
Pin 2	Ground
Pin 3	Signal 0.05 to 4.95 V
Sleeve	FDR-25
Wire size	AWG 26
Wire length L	15 to 50 cm

Various motorsport and automotive connectors on request.

Please specify the requested wire length with your order.

## Installation Notes

The sensor can be connected directly to most control units.

The sensor is designed with contactless Hall effect technology.

Each mounting orientation is possible.

The sensor is also ferromagnetic sensitive. Please make sure the mounting material is not ferromagnetic. This can lead to inaccurate measurement.

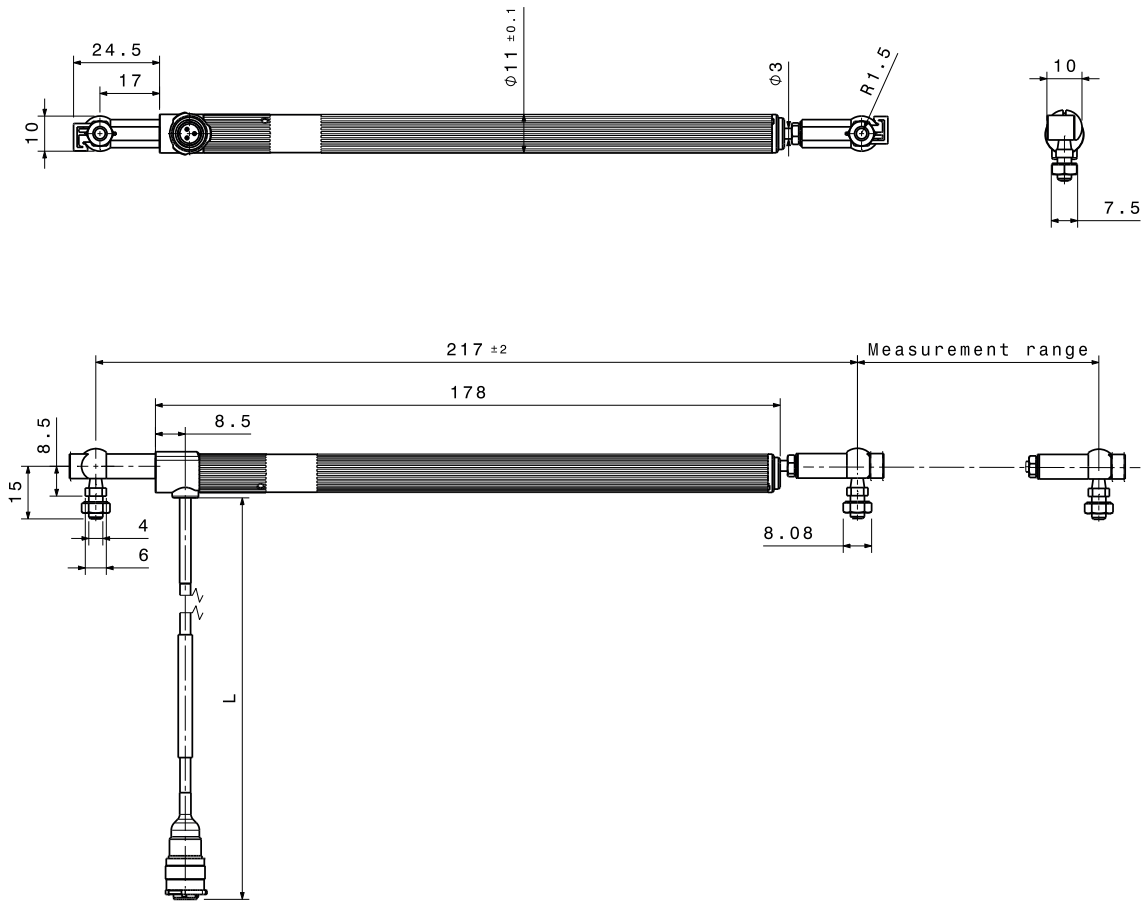
## Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

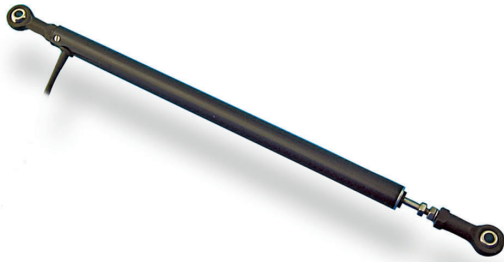
## Ordering Information

**Linear Position Sensor LP 100-H**  
Order number **F 02U V02 061-01**

Dimensions



## Linear Position Sensor LP 150



### Features

- ▶ Measurement range: 0 to 150 mm
- ▶ Aluminum housing
- ▶ Low power consumption

The LP 150 is a linear potentiometer which is designed to measure the relative position of two points, e.g. the gear position, throttle position or suspension movement.

Its operating mode is based on the linear tape potentiometer principle where the distance travelled between the moving end to the wiper is proportional to the resistance between them.

The advantage of this LP is its precise and compact design with an anodized aluminum cylindrical housing, low power consumption and infinite resolution

### Application

Application	0 to 150 mm
Temperature range	-40 to 85°C

### Technical Specifications

#### Mechanical Data

Weight w/o wire	118 g
Min. length	282 mm
Mounting	2 x M5
Tightening torque	10 Nm
Protection	IP65
Max. shaft velocity	1 m/sec

#### Electrical Data

Power supply	5 V
Power supply max.	130 V

Nominal resistance	6 kOhm
Resistance tolerance	10 %
Non-linearity	0.15 %

### Connectors and Wires

Connector	ASL 6-06-05PA-HE
Connector loom ASL 0-06-05SA-HE	F 02U 000 226-01
Pin 1	U <sub>s</sub>
Pin 2	Gnd
Pin 3	Sig
Pin 4	-
Pin 5	-
Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 25 cm

Various motorsport and automotive connectors on request.

Please specify the requested wire length with your order.

### Installation Notes

The LP 150 can be connected directly to most electronic control units and data logging systems.

Ball joints at shaft end and case.

Each mounting orientation is possible.

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

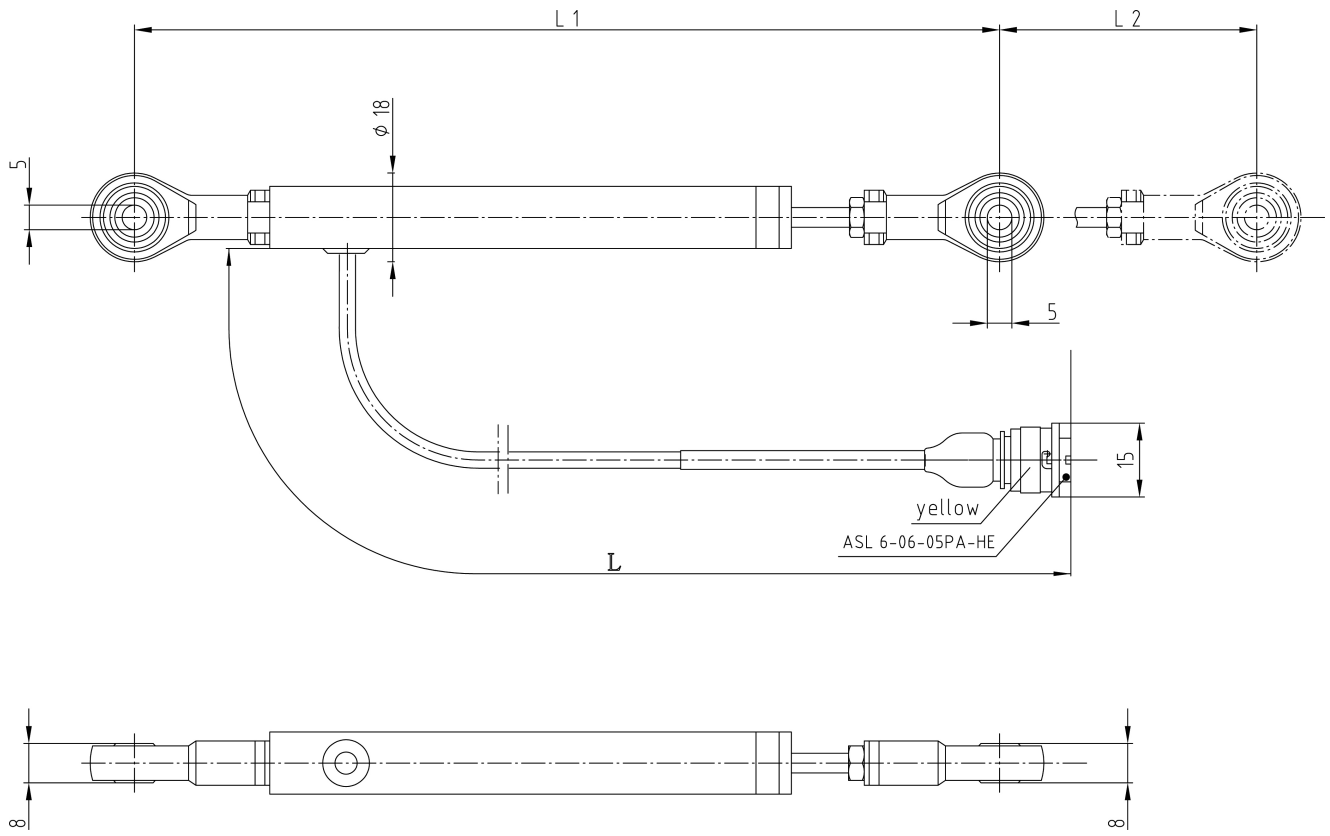
### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.




### Ordering Information

**Linear Position Sensor LP 150**  
Order number **B 261 209 534-01**

Dimensions



## Pressure Sensors Air Overview

	Pressure Sensor Air PSA-N	Pressure Sensor Air PSB-4	Pressure Sensor Air PSP
			
Application (bar)	0.1 to 1.15	0.5 to 4.0	0.2 to 3.0
Response time (ms)	0.1	0.2	0.2
Pressure reference type	Absolute	Absolute	Absolute
Temperature range (°C)	-40 to 130	-40 to 130	-40 to 125
Power supply (V)	11 to 14	5	5

## Pressure Sensor Air PS-AA



### Features

- ▶ Absolute air pressure measurement 0.1 to 1.15 bar or 0.2 to 2.5 bar
- ▶ Analog output

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

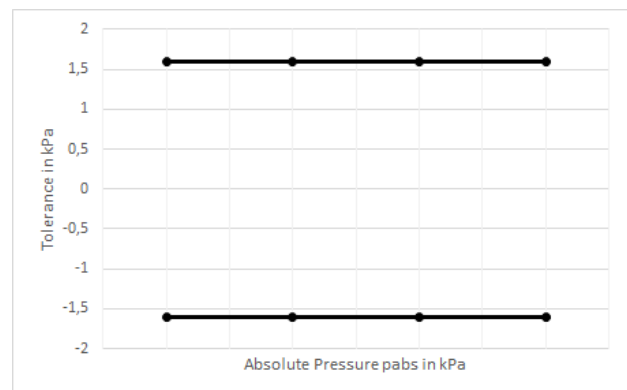
### Electrical Data

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

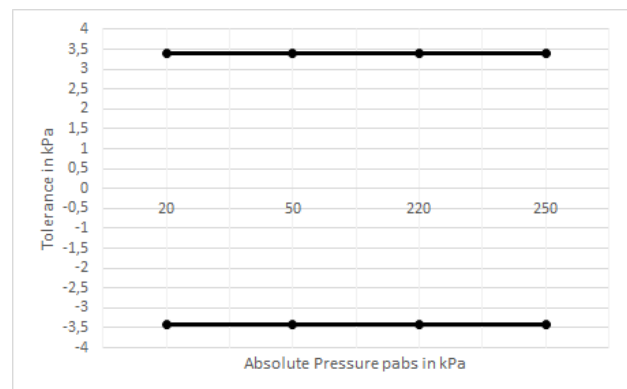
### Characteristic

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

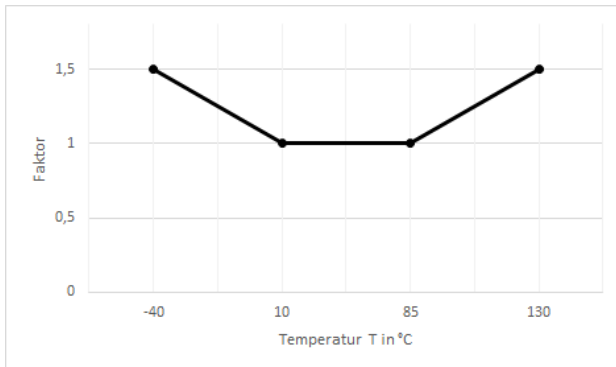


#### Tolerance 0.2 to 2.5 bar





## Expansion of Tolerance



## Connectors and Wires

Connector RB-COMP 1.1a/3P/Kod.1

Mating connector D 261 205 366-01

Pin 1  $U_s$

Pin 2 Gnd

Pin 3 Sig

Various motorsport and automotive connectors are available on request.

## Installation Notes

The PS-AA is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

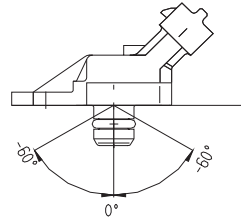
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

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

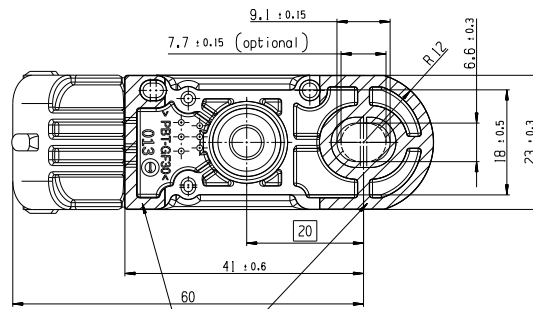
Order number **0 261 230 216**

### Pressure Sensor Air PS-AA

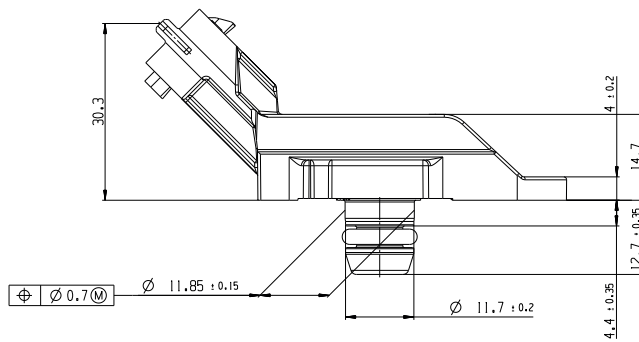
0.2 to 2.5 bar

Order number **0 261 230 284**

Dimensions



Auflagefläche des Sensors.  
 In diesem Bereich vollflächige Unterstützung vorsehen.  
 SUPPORTING AREA OF SENSOR.  
 THIS AREA SHOULD BE SUPPORTED BY A COHERENT PLANE SURFACE.



## Pressure Sensor Air PS-AL



### Features

- ▶ Absolute air pressure measurement 0.4 to 4 bar
- ▶ Analog output

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

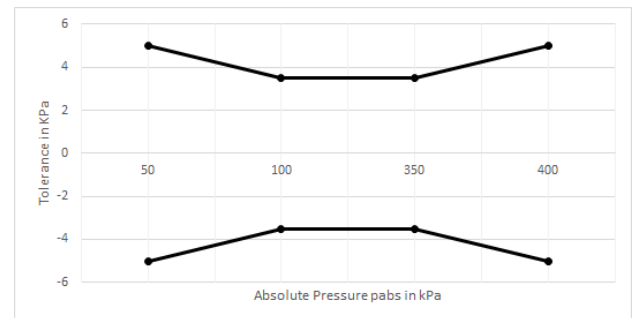
Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V

Full scale output $U_A$ at 5 V	0.4 to 4.50 V
Current $I_s$	9 mA

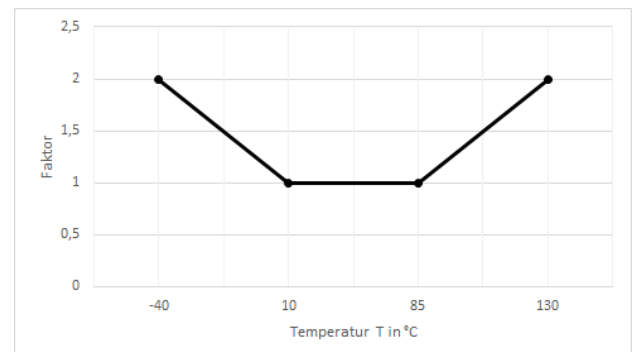
#### Characteristic

Response time T10/90	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	F 02U 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.

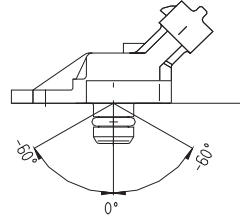
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

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  $\pm 60^\circ$ .



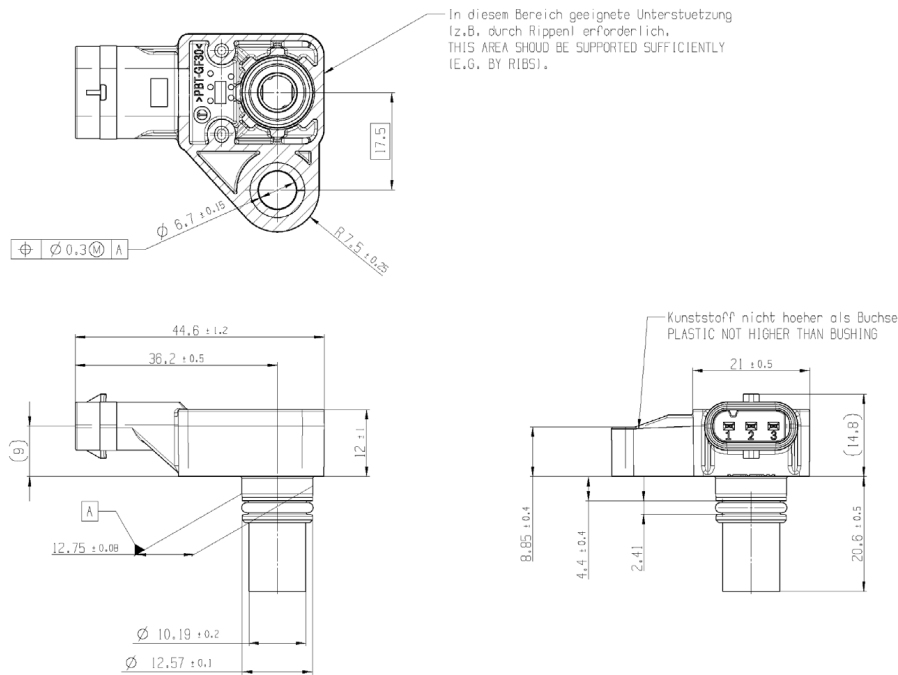
**Safety Note**

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 **0 261 230 441**

**Dimensions**



## Pressure Sensor Air PS-AS



### Features

- ▶ Absolute air pressure measurement 0.2 to 3 bar
- ▶ Analog output

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

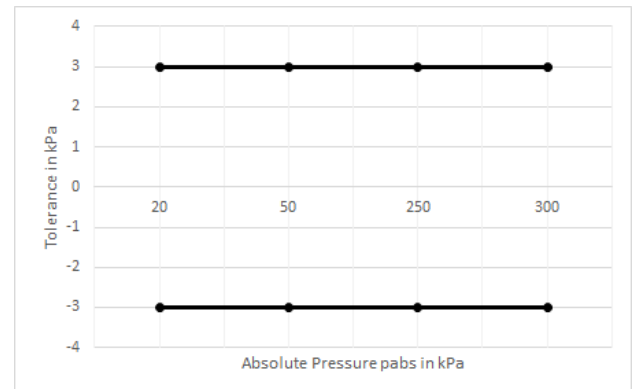
#### Electrical Data

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

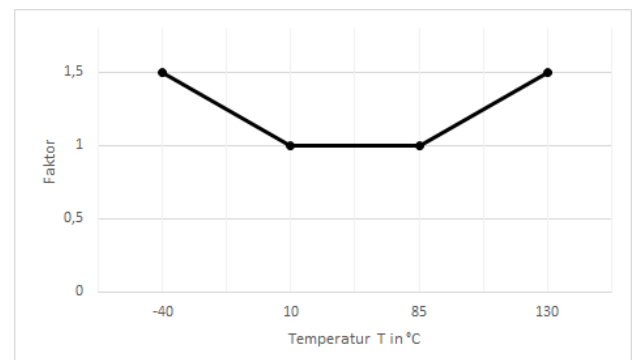
### Characteristic

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	D 261 205 366-01
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.

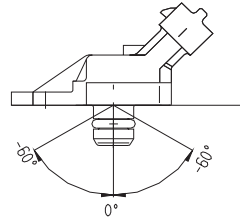
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

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

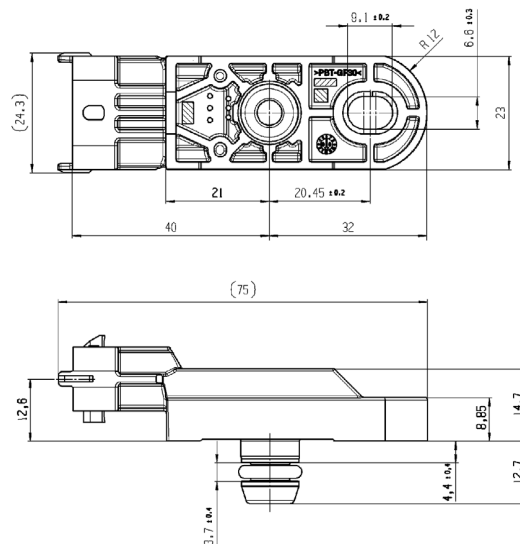
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Pressure Sensor Air PS-AS**  
Order number **0 281 002 996**

## 7

### Dimensions



## Pressure Sensor Air PSA-N



### Features

- ▶ Absolute air pressure measurements
- ▶ Measurement range 0.1 to 1.15 bar
- ▶ Analog output
- ▶ Very short response time

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

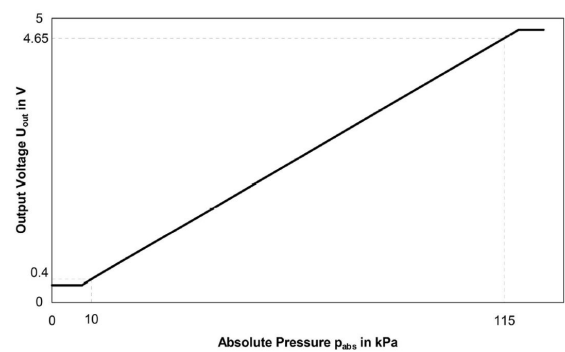
#### Electrical Data

Power supply $U_s$	11 to 16 V
Full scale output $U_A$	0.3 to 4.7 V
Typical current $I_s$	9 mA

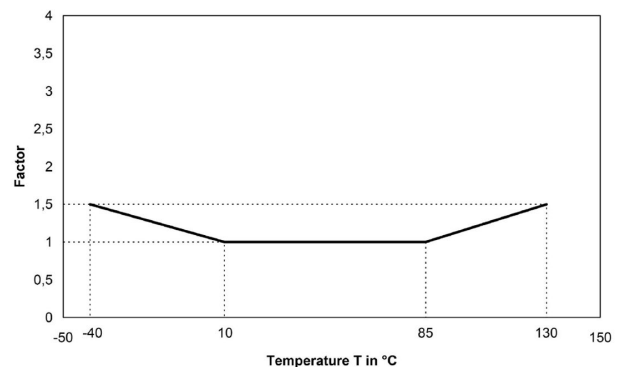
#### Characteristic

Response time T10/90	1.0 ms
Compensated range	10 to 85°C
Tolerance (FS)	± 0.016 bar
Tolerance (FS)	± 1.52 %
Sensitivity	4,041.62 mV/bar
Offset	-4.16 mV

#### Tolerance



#### Expansion of Tolerance



#### Connectors and Wires

Connector	ASL 6-06-05PC-HE
Mating connector	F 02U 000 228-01
ASL 0-06-05SC-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

Please specify the required wire length with your order.

### 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 ( $\tau = 2$  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  $\pm 0.025$  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.

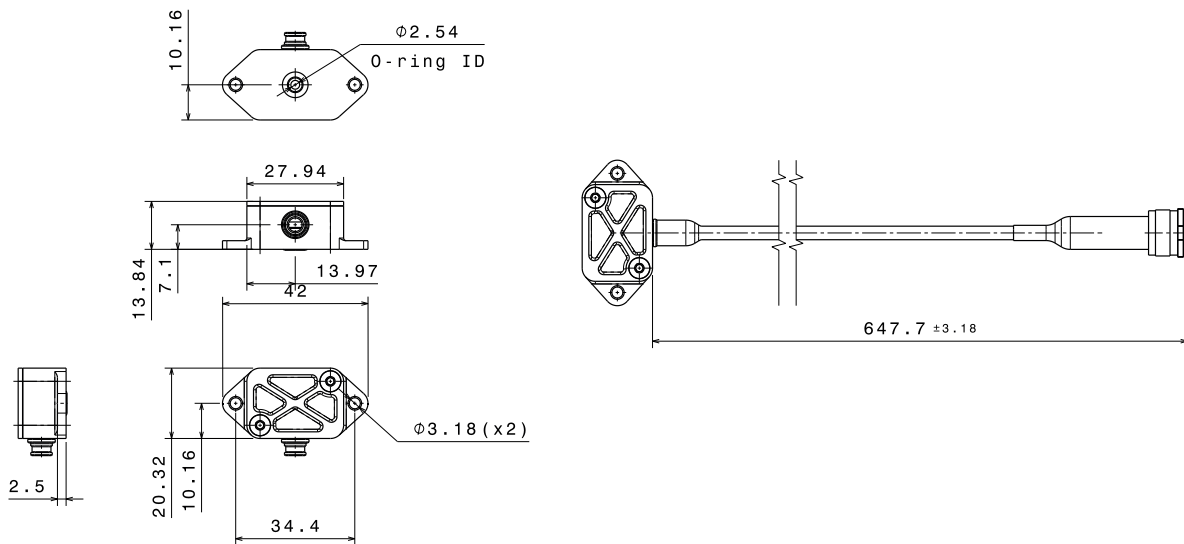
### Safety Note

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 **F 02U V0U 197-02**

### Dimensions





## Pressure Sensor Air PSB-4



### Features

- ▶ Absolute air pressure measurement
- ▶ Measurement range 0.5 to 4.0 bar
- ▶ Analog output
- ▶ Very short response time

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
Fitting	12.05 mm

Weight w/o wire	20 g
Sealing	O-ring 7.59 x 2.62 mm

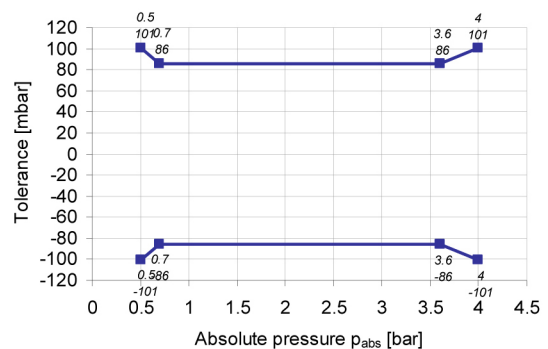
#### Electrical Data

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

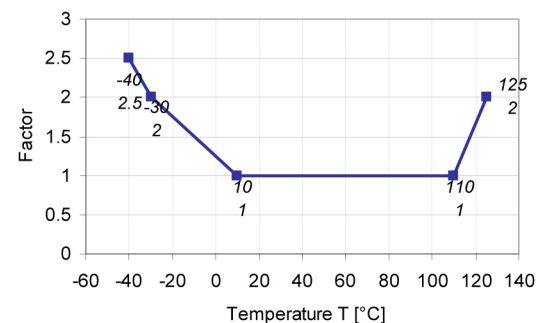
#### Characteristic

Response time T10/90	0.2 ms
Compensated range	0 to 80°C
Tolerance (FS) at $U_S = 5$ V	± 0.056 bar
Tolerance (FS)	± 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	ASL 6-06-05PC-HE
Mating connector	F 02U 000 228-01
ASL 0-06-05SC-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  $I = 0.3 A$ ).

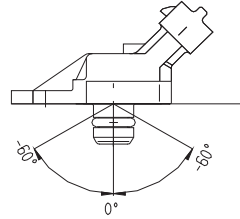
Please note that the 6mm tube connector has no function.

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  $\pm 60^\circ$ .



### Safety Note

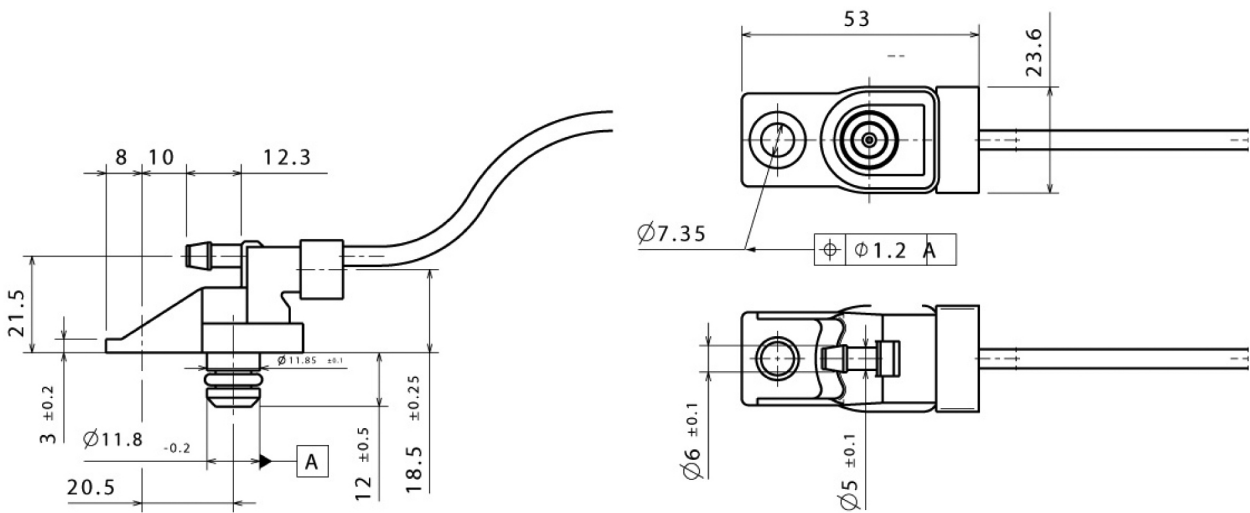
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Pressure Sensor Air PSB-4**

Order number **B 261 209 348-01**

### Dimensions



## Pressure Sensor Air PSP



### Features

- ▶ Absolute air pressure measurement
- ▶ Measurement range 0.2 to 3.0 bar
- ▶ Analog output
- ▶ Very short response time

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 motor-sport 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

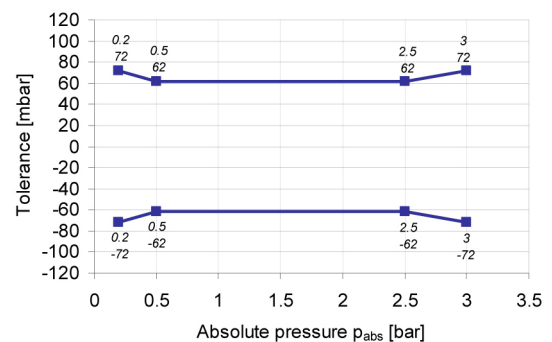
#### Electrical Data

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

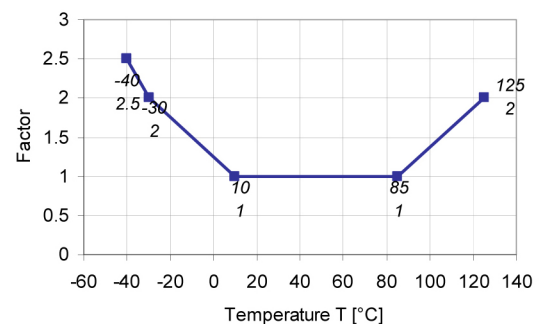
#### Characteristic

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	ASL 6-06-05PC-HE
Mating connector	F 02U 000 228-01
ASL 0-06-05SC-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.

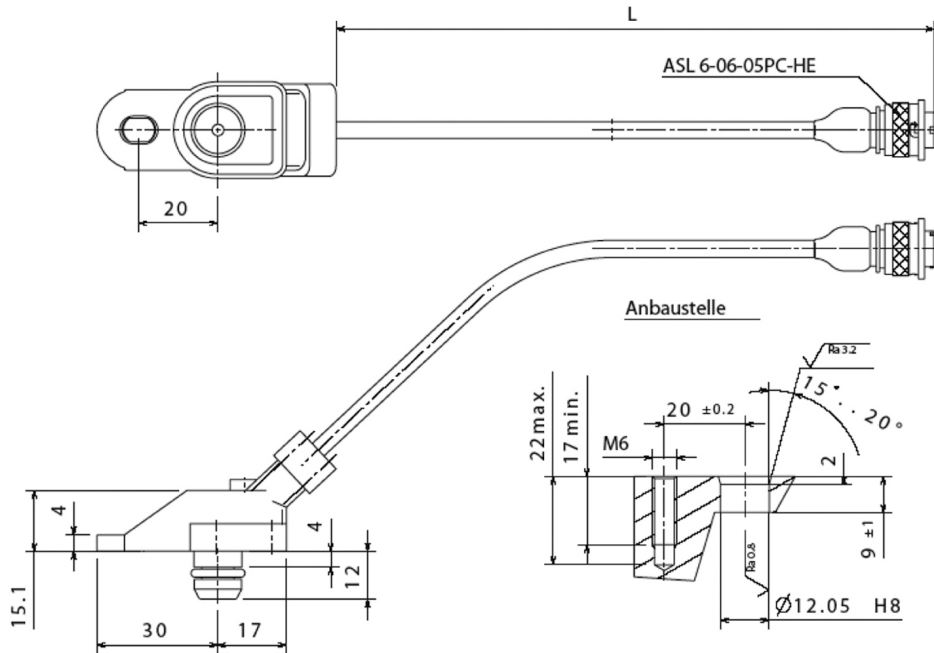
The sensor can be connected directly to most control units.

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).

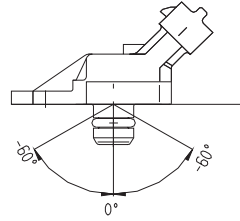
Avoid miss-pinning (max. 5 minutes at  $I = 0.3$  A).

### Dimensions



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 PSP**  
Order number **B 261 209 690-01**

## Pressure Sensors Fluid Overview

	Pressure Sensor Fluid PSC-10	Pressure Sensor Fluid PSC-260	Pressure Sensor Fluid PSM-SA	Pressure Sensor Fluid PSS-10	Pressure Sensor Fluid PSS-10R
					
Application (bar)	0 to 10	0 to 260	Variations 0 to 3.5 . 0 to 700	0.5 to 11	0 to 10
Response time Tl10/90	1.5 ms (5 V variation) or 1 ms (12 V variation)	2 ms	1 ms	1.5 ms	1.5 ms
Pressure reference type	Absolute	Absolute	Absolute	Absolute	Relative
Temperature range (°C)	-40 to 125	-40 to 130	-40 to 150	-40 to 125	-40 to 125
Power supply (V)	5 or 12	5	8 to 30	5	5

	Pressure Sensor Fluid PSS-100R	Pressure Sensor Fluid PSS-250R	Pressure Sensor Fluid PSS-140/260/420/600
			
Application (bar)	0 to 100	0 to 250	0 to 140 0 to 260 0 to 420 0 to 600
Response time Tl10/90	1.5 ms (5 V variation) or 1 ms (12 V variation)	1.5 ms (5 V variation) or 1 ms (12 V variation)	2 ms
Pressure reference type	Relative	Relative	Absolute
Temperature range (°C)	-40 to 125	-40 to 125	-40 to 130
Power supply (V)	5 or 12	5 or 12	5

## Pressure Sensor Fluid PSC-10



7

### Features

- ▶ Absolute fluid pressure measurement
- ▶ Measurement range 0 to 10 bar
- ▶ Analog output

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 % $U_s$ ratio-metric	0 to 5 V non-ratio-metric

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	± 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	± 0.1 bar
Tolerance (FS)	± 1 %
Sensitivity	Please see variations
Offset	Please see variations

#### Connectors and Wires

Connector	ASL 6-06-05PC-HE
Mating connector ASL 0-06-05SC-HE	F 02U 000 228-01
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

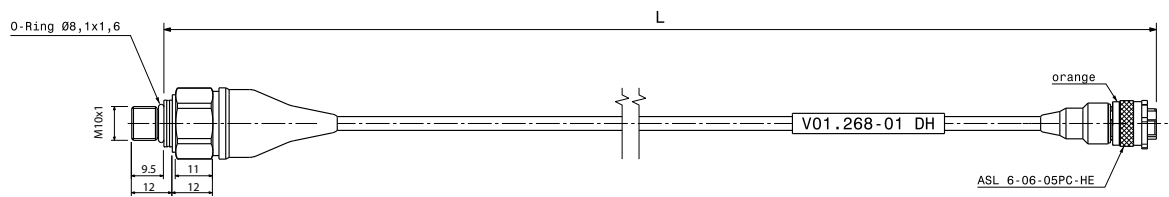
Order number **F 02U V01 268-01**

### Pressure Sensor Fluid PSC-10

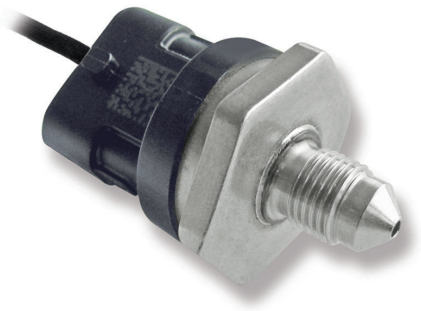
9 to 30 V

Order number **F 02U V01 295-01**

## Dimensions



## Pressure Sensor Fluid PSC-260



### Features

- ▶ Absolute fluid pressure measurement
- ▶ Measurement range 0 to 260 bar
- ▶ For gasoline, Diesel, oil or brake fluid
- ▶ Robust and compact design
- ▶ High robustness against vibrations

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	ASL 6-06-05PC-HE
Mating connector ASL 0-06-05SC-HE	F 02U 000 228-01
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 F 02U 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.

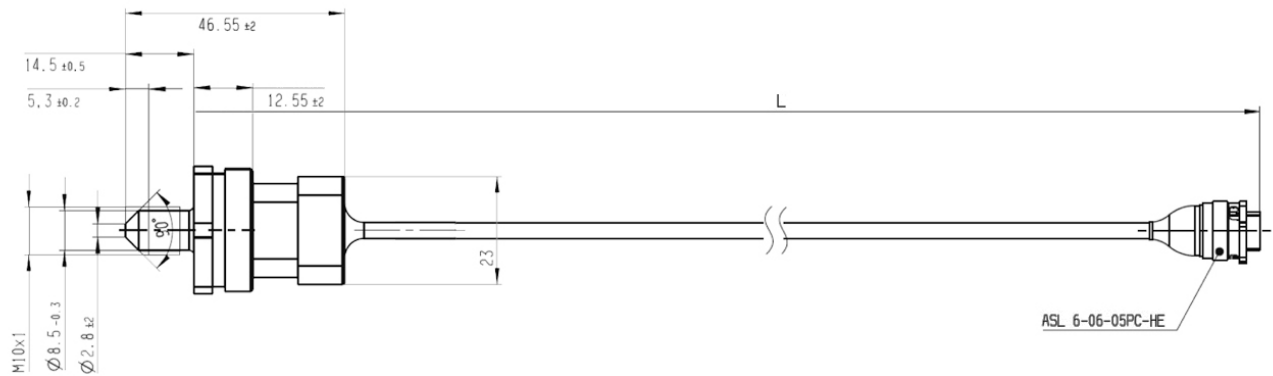
**Ordering Information**

**Pressure Sensor Fluid PSC-260**  
Order number **F 02U V00 990-03**

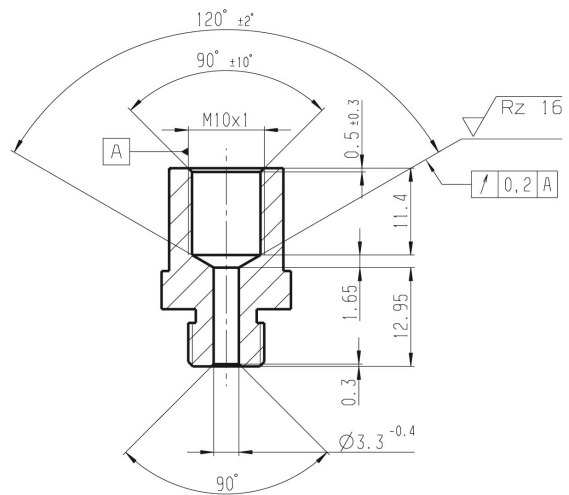
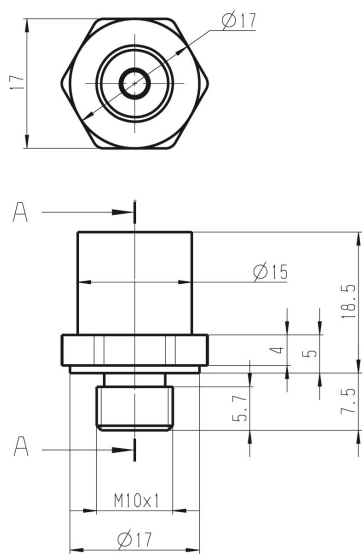
**Accessories**

**Adapter**  
Order number **F 02U 002 711-01**

**Dimensions**



*Sensor*



*Adapter*

## Pressure Sensor Fluid PSM-SA



### Features

- ▶ Absolute fluid or air pressure measurement
- ▶ Measurement range versions 3.5 to 700 bar
- ▶ High robustness against vibrations
- ▶ Compact design
- ▶ Analog output

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 piezoresistive 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
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Ingress Protection	IP66
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#### Electrical Data

Supply voltage	8 to 32 VDC
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Max current	< 8 mA
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Non-Repeatability	± 0.05 % FSO typ.
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CNL & H	± 0.25 % FSO
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Bandwidth (-3 dB)	400 Hz
-------------------	--------

Output "FSO"	0.5 to 4.5 V = 4 V ± 50 mV
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#### Characteristic

Compensated range	20 to 120°C
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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)
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Thermal sensitivity shift "TSS"	± 1 %/100°C (± 1.5 %/100°C for ranges ≤ 10 bar or 150 psi)
---------------------------------	--

#### Connectors and Wires

Connector	ASU 6-03-05PC-HE
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Mating connector ASU 0-03-05SC-HE	F 02U 000 208-01
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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
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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 **F 02U V01 946-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 6 bar  
Order number **F 02U V01 947-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 10 bar  
Order number **F 02U V01 948-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 20 bar  
Order number **F 02U V01 949-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 35 bar  
Order number **F 02U V01 950-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 60 bar  
Order number **F 02U V01 951-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 70 bar  
Order number **F 02U V01 724-01**

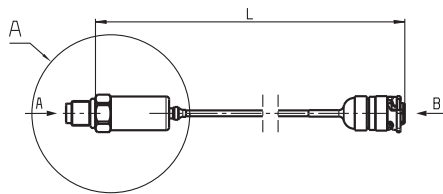
**Pressure Sensor Fluid PSM-SA**  
0 to 100 bar  
Order number **F 02U V01 952-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 200 bar  
Order number **F 02U V01 953-01**

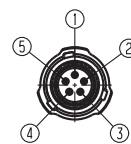
**Pressure Sensor Fluid PSM-SA**  
0 to 350 bar  
Order number **F 02U V01 954-01**

**Pressure Sensor Fluid PSM-SA**  
0 to 700 bar  
Order number **F 02U V02 064-01**

**Dimensions**



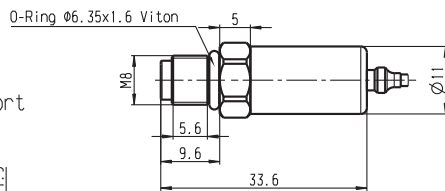
View B  
Scale: 2:1  
Electrical connection



- 1: Supply (8 to 32VDC)
- 2: Ground
- 3: Signal (0.5 to 4.5V)
- 4: Not connected
- 5: Screen

ASU 6-03-05PC-HE

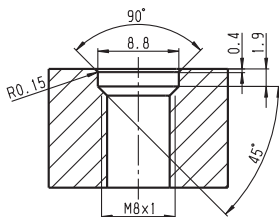
Detail A  
Scale: 2:1



View A  
Scale: 2:1



Recommended mounting port



## Pressure Sensor Fluid PSS-10



### Features

- ▶ Absolute fluid pressure measurements
- ▶ Measurement range 1 to 11.0 bar
- ▶ Analog output
- ▶ Integrated series connector

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	$\pm 30$ 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	$\pm 0.1$ bar
Tolerance (FS)	$\pm 1$ %
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 D 261 205 339-01
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

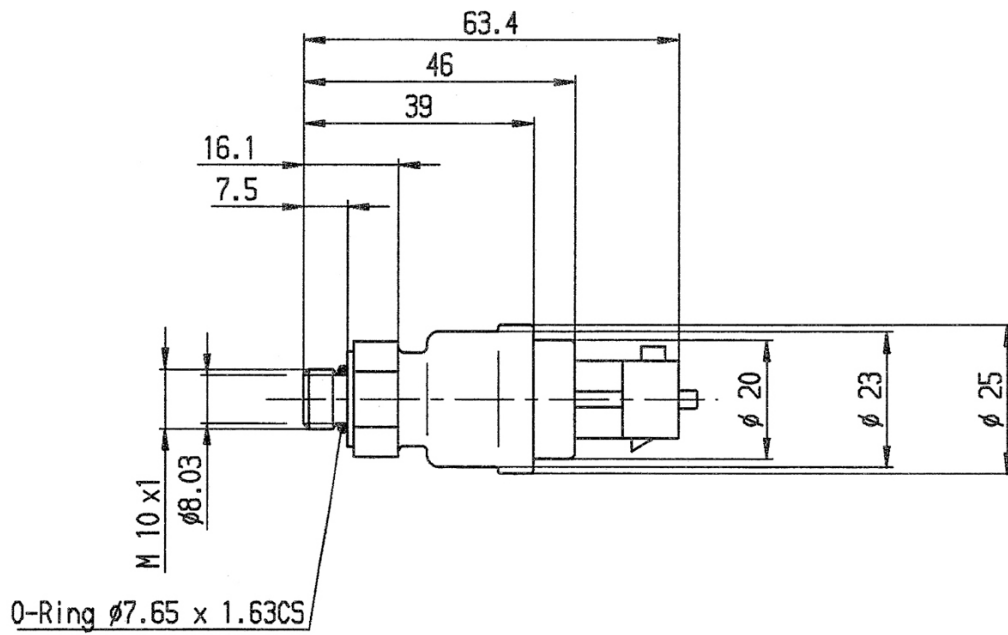
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

## Ordering Information

Order number **B 261 209 341-01**

Pressure Sensor Fluid PSS-10

## Dimensions



## Pressure Sensor Fluid

### PSS-250R



7

#### Features

- ▶ Relative fluid pressure measurements
- ▶ Measurement range 0 to 250 bar
- ▶ Analog output
- ▶ Integrated series connector

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	Please see variations
Media temp. range	Please see variations
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

	PSS-250R (5 V)	PSS-250R (12 V)
Operating temp. range	-40 to 125°C (140°C)	-40 to 125°C

Media temp. range	-40 to 125°C (140°C)	-40 to 125°C
Power supply $U_s$	4.75 to 5.25 V	8 to 26 V
Full scale output $U_A$	10 to 90 % $U_s$ ratio-metric	0.5 to 4.5 V non-ratiometric
Response time T10/90	1.5 ms	1.0 ms
Sensitivity	16 mV/bar at $U_s = 5$ V	16 mV/bar
Offset	500 mV at $U_s = 5$ V	500 mV
Mating connector	3-pole Compact D 261 205 339-01	3-pole Compact D 261 205 334-01

#### 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 $U_s$	Please see variations
Max power supply $U_s$ max	± 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)	± 2.5 bar
Tolerance (FS)	± 1 %
Sensitivity	Please see variations
Offset	Please see variations

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	Please see variations
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

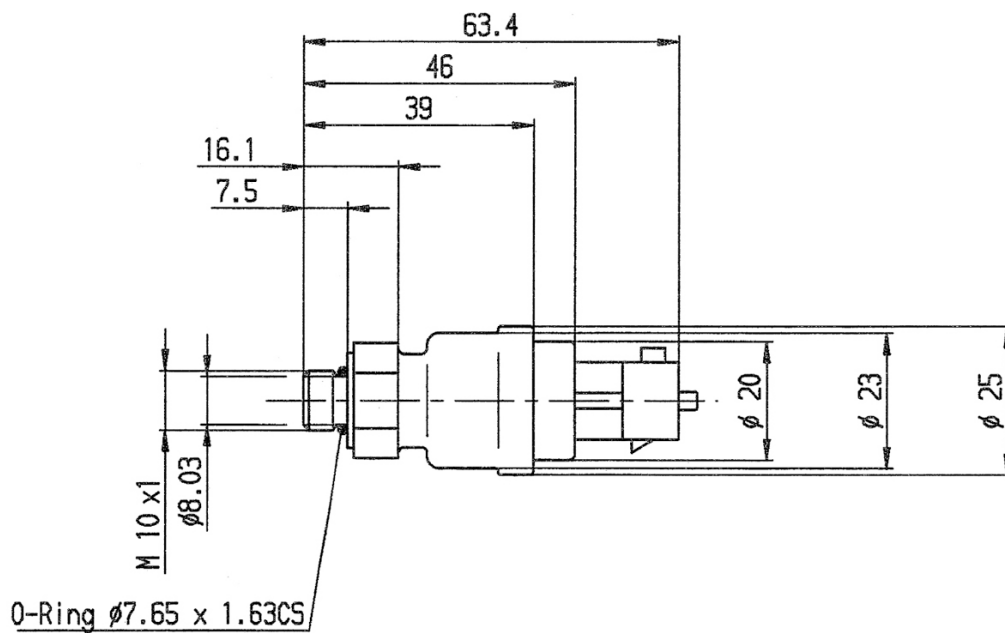
Order number **B 261 209 965-01**

### Pressure Sensor Fluid PSS-250R

8 to 26 V

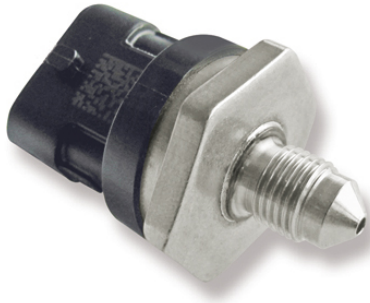
Order number **B 261 209 067-01**

## Dimensions



## Pressure Sensor Fluid

### PSS-140/260/420/600



#### Features

- ▶ Absolute fluid pressure measurement
- ▶ Measurement range variations 0 to 600 bar
- ▶ For gasoline, Diesel, oil or brake fluid
- ▶ Robust and compact design

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 D 261 205 366-01
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 F 02U 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 **0 261 545 053**

**Pressure Sensor Fluid PSS-260**

Order number **0 261 545 040**

**Pressure Sensor Fluid PSS-420**

Order number **0 261 545 136**

**Pressure Sensor Fluid PSS-600**

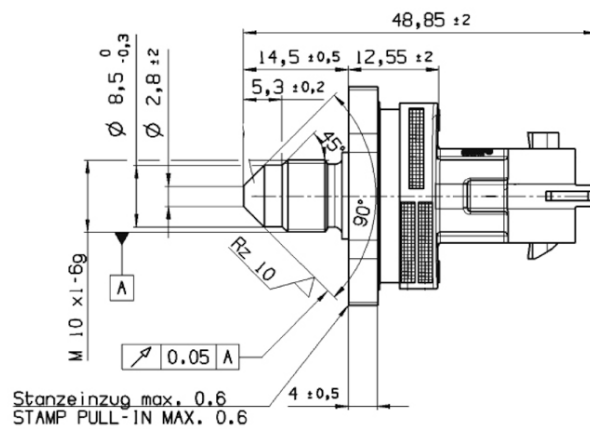
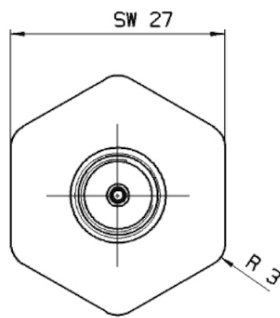
Order number **0261.B23.789-06**

**Accessories**

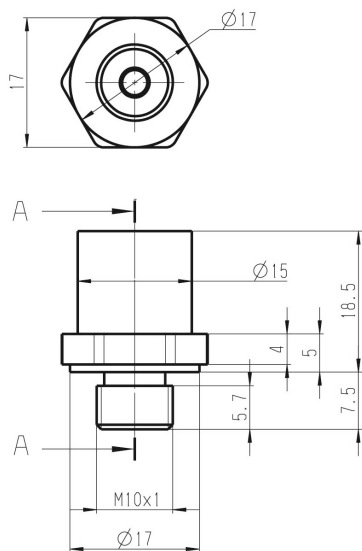
**Adapter**

Order number **F 02U 002 711-01**

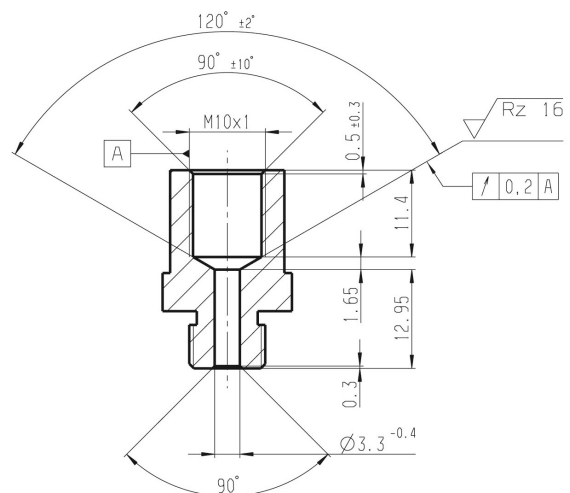
**Dimensions**





*Sensor*



*Adapter*



## Pressure Sensors Combined Overview

	Pressure Sensor Combined PSM-SAT	Pressure Sensor Combined PST-F 1
		
Application 1 (bar)	Variations 0 to 3.5 . . 0 to 700	0 to 10.0
Response time Application 1	1 ms (T110/90)	<5 ms (T110/90)
Application 2 (°C)	-40 to 150	-40 to 140
Response time Application 2	Max. 3 s (63 %)	9 s (response time of temperature signal in oil dip bath 20 to 100°C)
Medium	Fluid / air	Fluid
Pressure reference type	Absolute	Ambient
Operating temperature range (°C)	-40 to 150	-40 to 130
Power supply (V)	8 to 32	5

## Pressure Sensor Combined PSM-SAT



### Features

- ▶ Absolute fluid or air pressure plus temperature measurement
- ▶ Measurement range versions 3.5 to 700 bar
- ▶ Temperature measurement: PT1000
- ▶ High robustness against vibrations
- ▶ Analog output

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
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	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	ASU 6-03-05PC-HE
Mating connector ASU 0-03-05SC-HE	F 02U 000 208-01
Pin 1	U <sub>s</sub>
Pin 2	Gnd
Pin 3	Sig
Pin 4	Temp. +
Pin 5	Temp. -
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 **F 02U V01 955-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 6 bar

Order number **F 02U V01 956-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 10 bar

Order number **F 02U V01 980-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 20 bar

Order number **F 02U V01 957-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 35 bar

Order number **F 02U V01 958-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 60 bar

Order number **F 02U V01 962-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 100 bar

Order number **F 02U V01 964-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 200 bar

Order number **F 02U V01 965-01**

#### Pressure Sensor Fluid PSM-SAT

0 to 350 bar

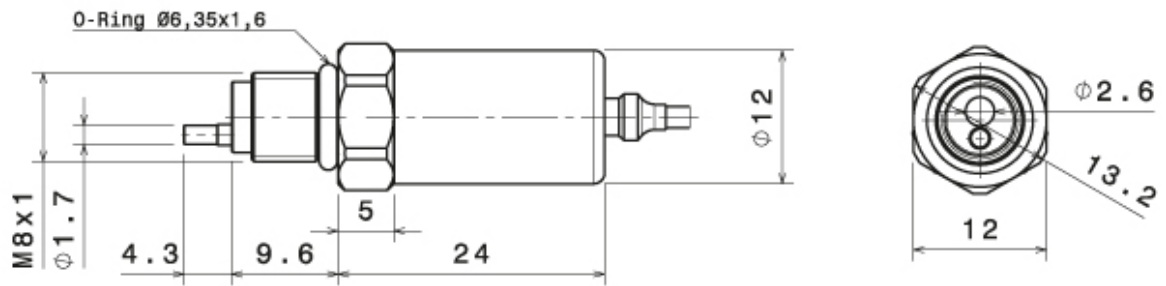
Order number **F 02U V01 966-01**

#### Pressure Sensor Fluid PSM-SAT

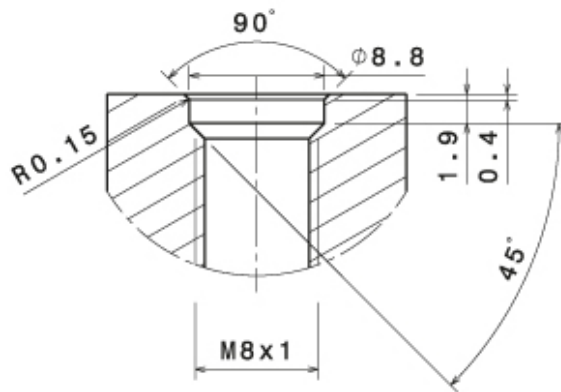
0 to 700 bar

Order number **F 02U V02 065-01**

## Dimensions



## Recommended Mounting Port



## Pressure Sensor Combined PST 1/PST 3



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### Features

- ▶ Absolute air pressure measurement range 0.1 to 1.15 bar or 0.2 to 3 bar
- ▶ Temperature measurement range -40 to 130°C
- ▶ Analog output

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 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

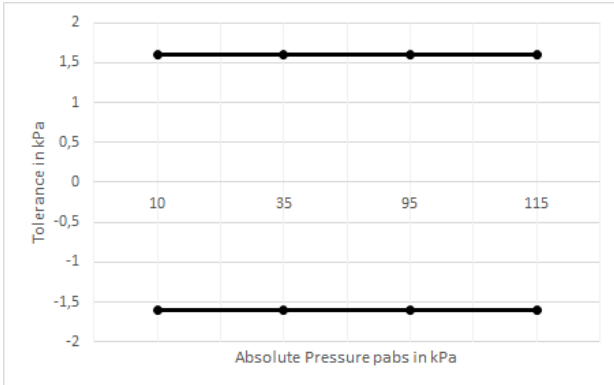
Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5\text{ V}$	Please see variations
Tolerance (FS)	Please see variations
Sensitivity	Please see variations
Offset	Please see variations

#### Characteristic 2

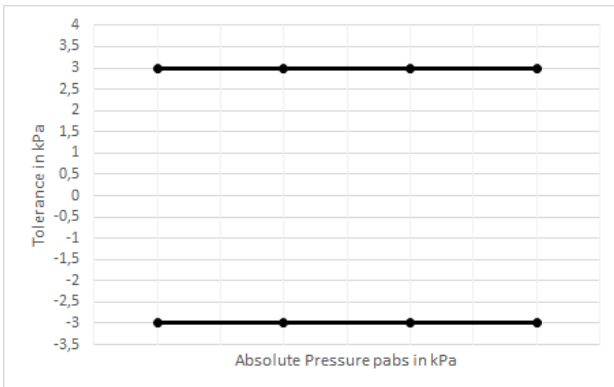
T [°C]	R [Ohm]
-40	45,303
-30	26,108
-20	15,458
-10	9,395
0	5,895
10	3,791
20	2,499
25	2,056
30	1,706
40	1,174
50	833.8
60	595.4
70	435.6
80	322.5
90	243.1
100	186.6

110	144.2
120	112.7
130	89.28

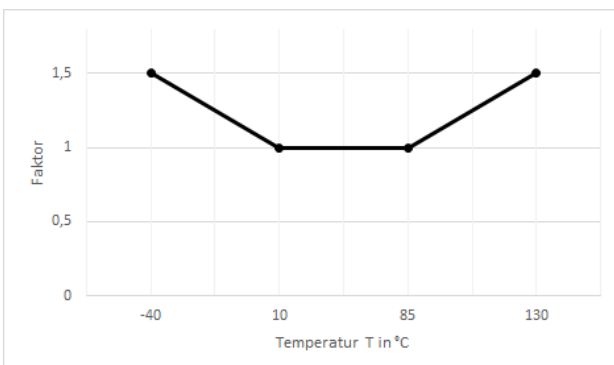
### Tolerance 0.1 to 1.15 bar



### Tolerance 0.2 to 3 bar



### Expansion of Tolerance



### Connectors and Wires

Connector	Bosch Compact
Mating connector	D 261 205 360-01

Pin 1	Gnd
Pin 2	NTC
Pin 3	U <sub>s</sub>
Pin 4	Sig. Pressure

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.

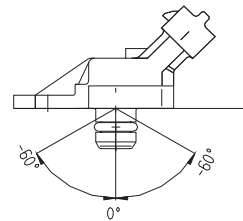
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

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

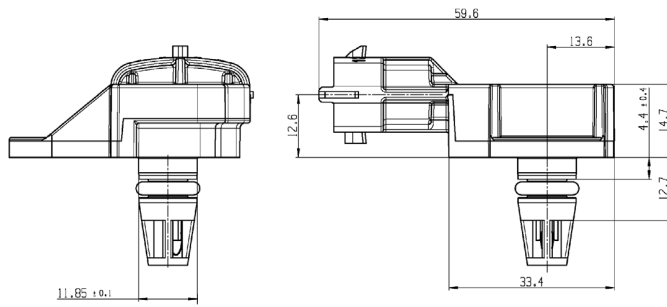
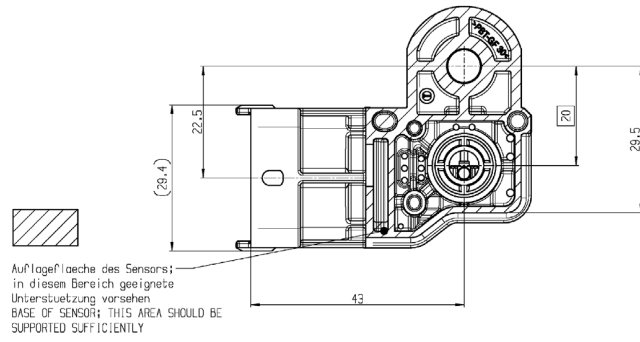
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Pressure Sensor Combined PST 1**  
0.1 to 1.15 bar  
Order number **0 261 230 333**

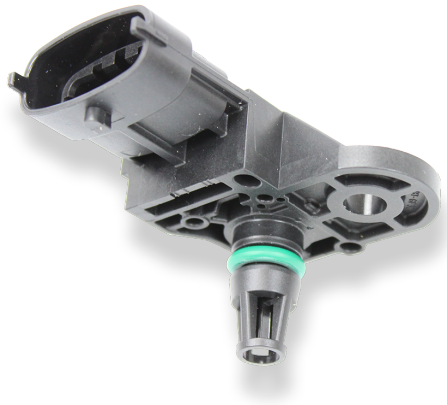
**Pressure Sensor Combined PST 3**  
0.2 to 3 bar  
Order number **0 261 230 280**

Dimensions





## Pressure Sensor Combined PST 4



### Features

- ▶ Absolute air pressure measurement range 0.4 to 4 bar
- ▶ Temperature measurement range -40 to 130°C
- ▶ Analog output

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.

### 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

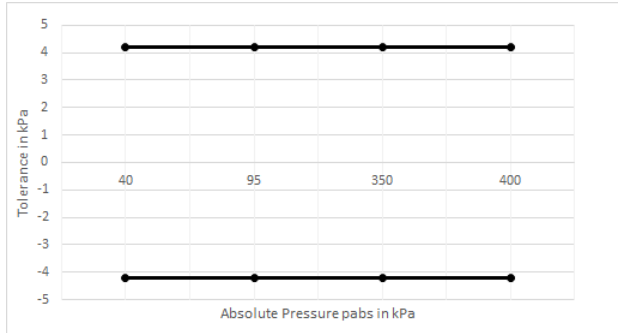
#### Characteristic 1

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

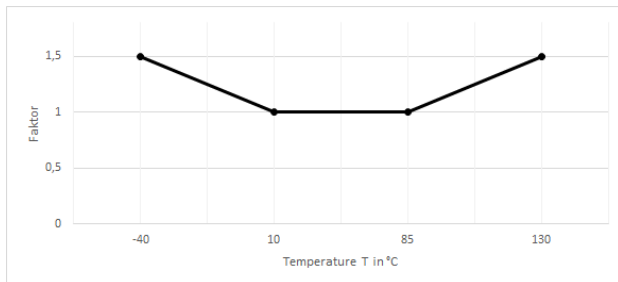
#### Characteristic 2

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	D 261 205 360-01
Pin 1	Gnd
Pin 2	NTC
Pin 3	$U_s$
Pin 4	Sig press

## 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.

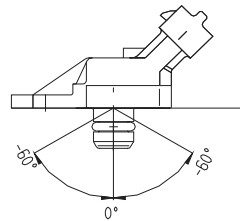
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2$  ms) is recommended.

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  $\pm 60^\circ$ .



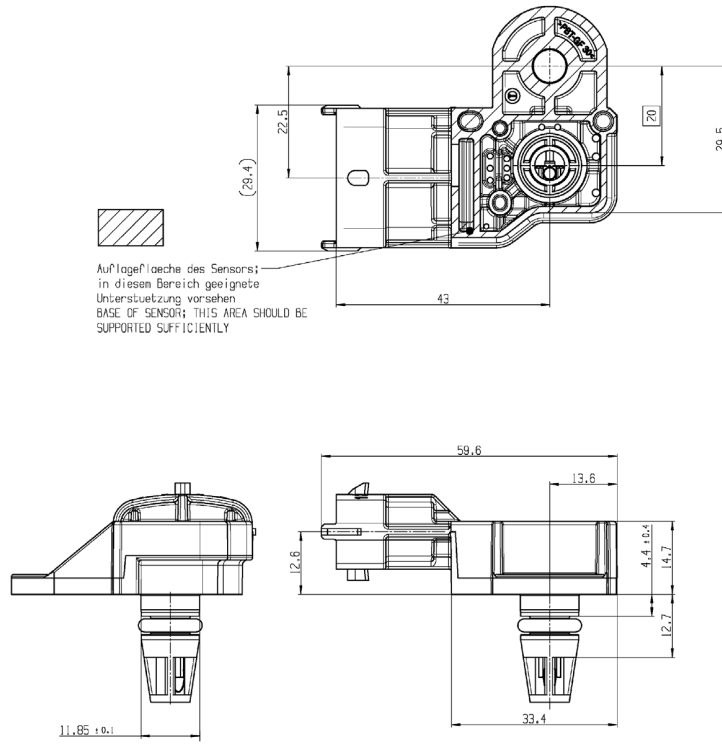
## Safety Note

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 **0 261 230 423**

## Dimensions



## Pressure Sensor Combined PST-F 1



### Features

- ▶ Relative fluid pressure and temperature measurements
- ▶ Pressure measurement range 0 to 10 bar
- ▶ Temperature measurement range -40 to 140°C

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

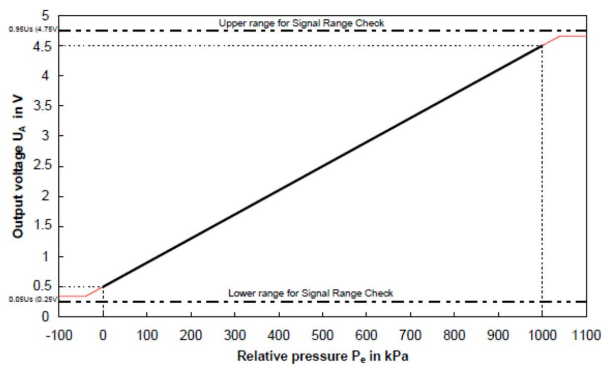
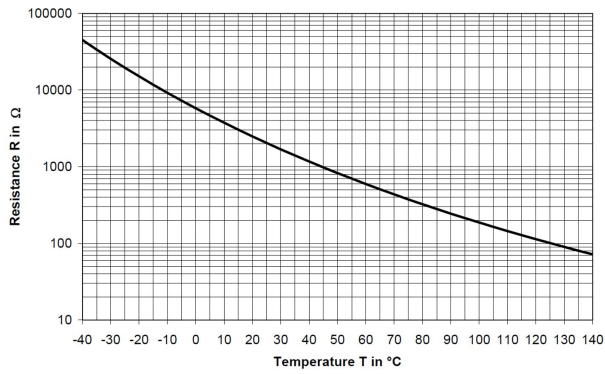
Power supply $U_S$	4.75 to 5.25 V
Max power supply $U_S$ max	16 V
Full scale output $U_A$	0.5 to 4.5 V $U_S$ ratiometric
Current $I_S$	10 mA

#### 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	F 02U B00 751-01

Pin 2	Sig
Pin 3	$U_s$
Pin 4	Gnd
Pin 5	NTC

**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.

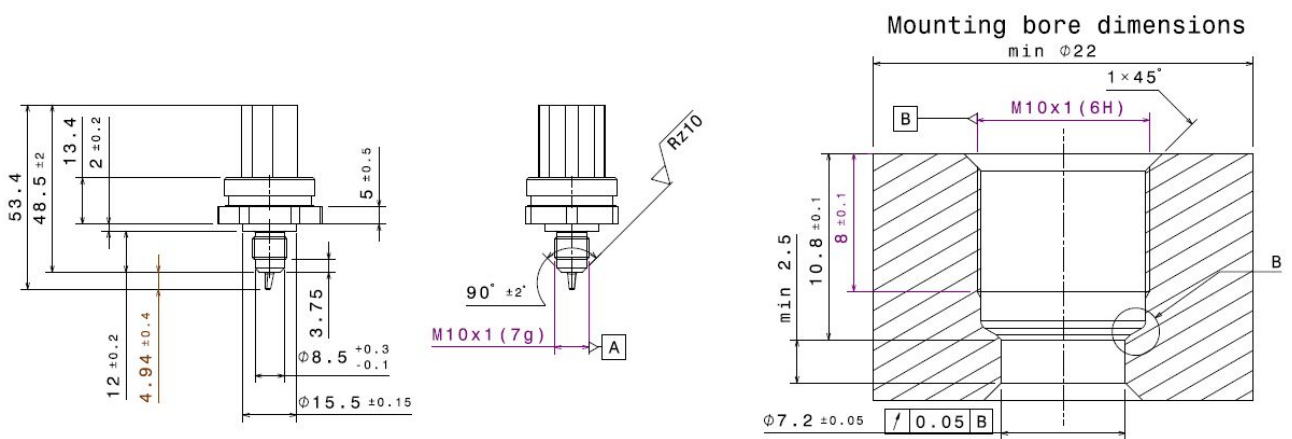
**Safety Note**

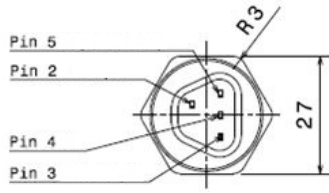
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

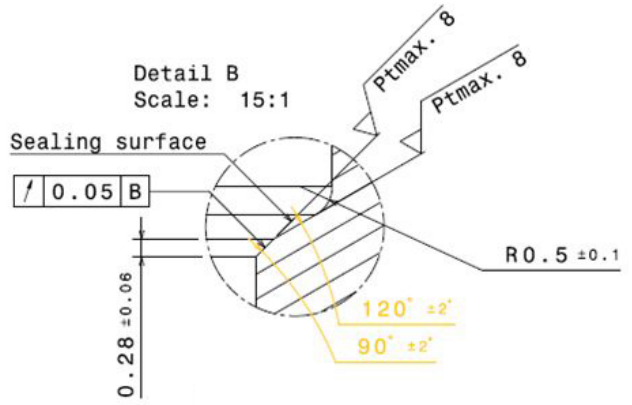
**Pressure Sensor Combined PST-F 1**  
Order number **F 02U V0U 194-01**

**Dimensions**





Mounting notes:  
 -Tightening torque: 37.5 NM (+/-2.5 NM)  
 -Lubrication required for thread surfaces, avoid allowing lubricant in pressure port  
 -No contamination of surface sealing area allowed



## Pressure Sensor Combined PST-F 2



### Features

- ▶ Absolute fluid pressure and temperature measurements
- ▶ Pressure measurement range 0 to 280/350 bar
- ▶ Temperature measurement range -40 to 140°C

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	Please see Variations
Application 2	-40 to 140°C
Reference	Absolute
Max. pressure	Please see Variations
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

#### Variations

	PST-F2 (280 bar)	PST-F2 (350 bar)
Application 1	0 to 280 bar (a)	0 to 350 bar (a)

Max. pressure	340 bar	390 bar
Pin 1	Gnd	-
Pin 2	Sig	NTC
Pin 3	NTC	Gnd
Pin 4	U <sub>s</sub>	Sig
Pin 5	-	U <sub>s</sub>
Sensitivity at U <sub>s</sub> = 5 V	14.3 mV/bar	11.43 mV/bar

#### 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 <sub>s</sub>	4.75 to 5.25 V
Max power supply U <sub>s</sub> max	16 V (18 V for max. 1 h)
Full scale output U <sub>A</sub>	0.5 to 4.5 V U <sub>s</sub> ratiometric
Current I <sub>s</sub>	12 mA

#### Characteristic 1

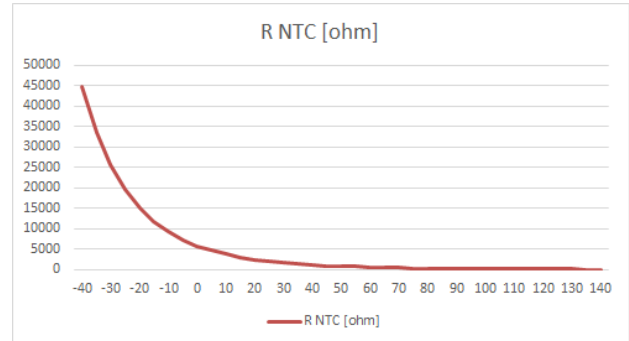
Response time T10/90	Pressure: 0.2 to 0.8 ms Temperature: 9 s (response time of temperature signal in oil dip bath 20 to 100°C)
Compensated range	-40 to 130°C
Tolerance (FS) at U <sub>s</sub>	+/- 1% at 0 to 100°C +/- 1.5% at -40 to 0°C and 100 to 130°C
Sensitivity	Please see Variations
Offset	500 mV at U <sub>s</sub> = 5 V

#### Characteristic 2a, 10 kOhm

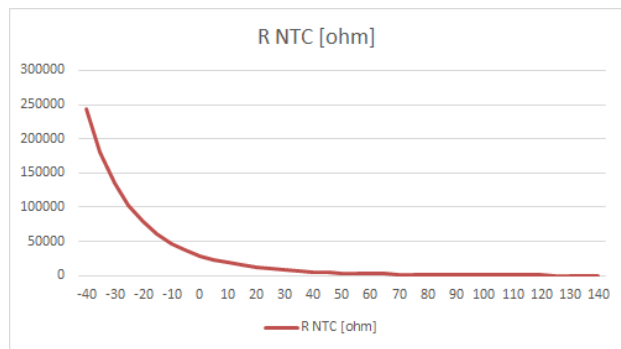
T [°C]	R [Ohm]
-40	243,241
-30	135,753
-20	78,716
-10	47,258
0	29,287
10	18,684
20	12,240
25	10,000

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

110	144,5
120	113,3
130	89,8
140	71,9



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**Characteristic 2b, 2 kOhm**

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

**Connectors and Wires**

Connector	Bosch Compact
Mating connector	F 02U B00 596-01
Pin 1	Please see Variations
Pin 2	Please see Variations
Pin 3	Please see Variations
Pin 4	Please see Variations
Pin 5	Please see Variations

Various motorsport and automotive connectors are available on request.

**Installation Notes**

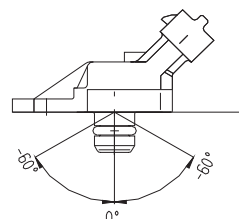
The sensor can be connected directly to most control units.

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.

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.

### Pressure Sensor Combined PST-F 2

0 to 350 bar

Order number **0 261 B35 596-01**

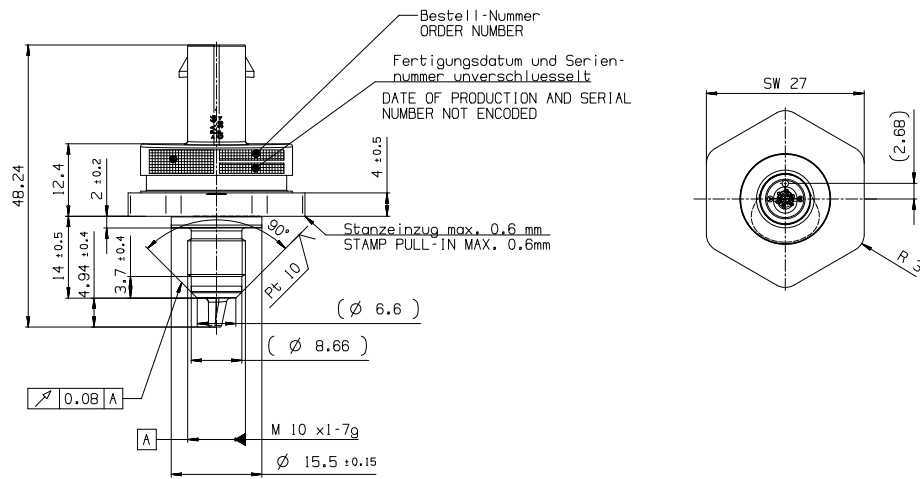
### Ordering Information

#### Pressure Sensor Combined PST-F 2






0 to 280 bar

Order number **0 261 545 115**

### Dimensions



## Rotary Position Sensors Overview

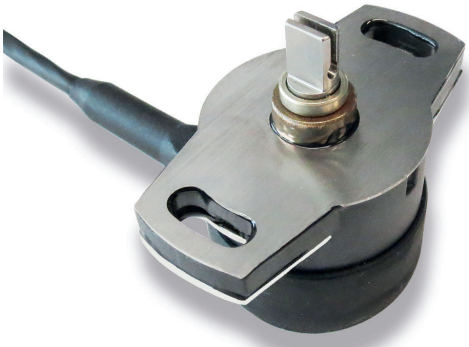
	Rotary Position Sensor RP 40-H red	Rotary Position Sensor Mini-RP 100-M	Rotary Position Sensor RP 100/130/308	Rotary Position Sensor RP 100-H red	Rotary Position Sensor RP 100 twin
					
Application	0 to 40°	0 to 100°	0 to 100° or 0 to 130° or 0 to 308°	0 to 360°	0 to 100°
Redundant	Yes	No	No	Yes	Yes
Housing	Synthetic	Aluminum	Synthetic	Aluminum	Synthetic
Weight w/o wire (g)	50	32	32	50	32
Technology	Hall contactless	Linear tape	Linear tape	Hall contactless	Linear tape
Temperature range (°C)	-40 to 125	-55 to 125	-40 to 150	-40 to 125	-40 to 150
Rotating direction	Clockwise	Anticlockwise	Anticlockwise	Clockwise	Clockwise
Output signal I (V)	4.5 to 0.5	0.05 to 4.95	0 to 5	4.75 to 0.25	0 to 5
Output signal II (V)	2.25 to 0.25	-	-	0.25 to 4.75	0 to 2.5

Rotary Position Sensor RP 360-H



Application	0 to 360°
Redundant	No
Housing	Synthetic
Weight w/o wire (g)	35
Technology	Hall contactless
Temperature range (°C)	-40 to 140
Rotating direction	Anticlockwise
Output signal I (V)	0.5 to 4.5
Output signal II (V)	-

## Rotary Position Sensor RP 40-H red



### Features

- ▶ Rotational position measurement
- ▶ Measurement range 40° full redundancy
- ▶ Operating temperature -40 to 125°C
- ▶ Accuracy  $<\pm 0.5\%$  FS

This sensor is designed to measure the rotational position of the acceleration pedal.

The electronic is designed with a magnetic rotary sensor with Hall elements and digital signal processing. The angular position is provided by a two pole magnet integrated in the sensor shaft. A Hall effect sensor is disposed between two magnets in association with a movable specially formed ferromagnetic part. This is used to control flux in the sensor in order to produce a linearly varying output voltage dependent on the position.

The main benefit of this sensor is its contactless Hall effect technology and its robust design for motorsport applications.

### Application

Application	40° full redundancy
Operating temperature range	-40 to 125°C
Max. Vibration	Vibration Profile 1 (see Appendix or <a href="http://www.bosch-motor-sport.com">www.bosch-motor-sport.com</a> )

### Technical Specifications

#### Mechanical Data

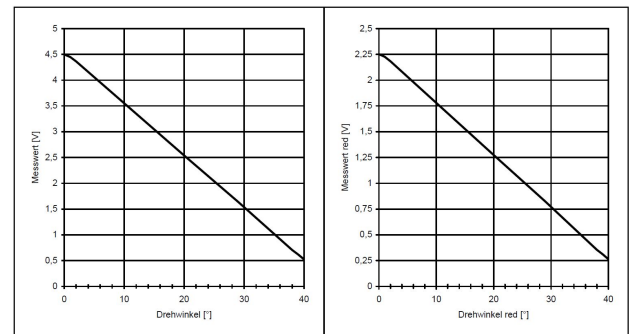
Weight w/o wire	50 g
Protection class	IP67
Mounting	2 x M4
Lifetime	500 x 10 <sup>6</sup> rotations
Housing	Temperature resistant plastic

#### Electrical Data

Power supply $U_s$	5 V $\pm$ 0.5 V
Current $I_S$	< 40 mA

#### Characteristic

Max. rotation speed	120 min <sup>-1</sup>
Accuracy	< $\pm 0.5\%$ FS
Direction of rotation	Clockwise



#### Signal 1 / Signal 2

#### Connectors and Wires

Connector	F 02U 000 424-01
AS 6-07-35PN	
Mating connector	F 02U 000 238-01
AS 0-07-35SN	
Pin 1	Power 5 V Sensor 1
Pin 2	Ground Sensor 1
Pin 3	Signal Sensor 1
Pin 4	Power 5 V Sensor 2
Pin 5	Ground Sensor 2
Pin 6	Signal Sensor 2
Sleeve	FDR-25
Wire size	AWG 24
Wire length L	150 to 1,000 $\pm$ 5 mm

#### Installation Notes

The sensor can be connected directly to most control units.

The sensor is designed with contactless Hall effect technology.

Each 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.

#### Safety Note

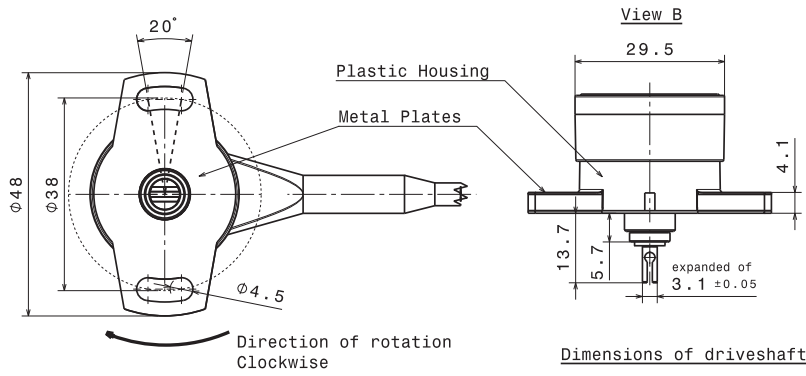
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

Ordering Information

Order number **F 02U V01 997-01**

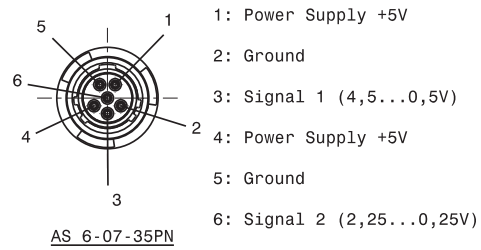
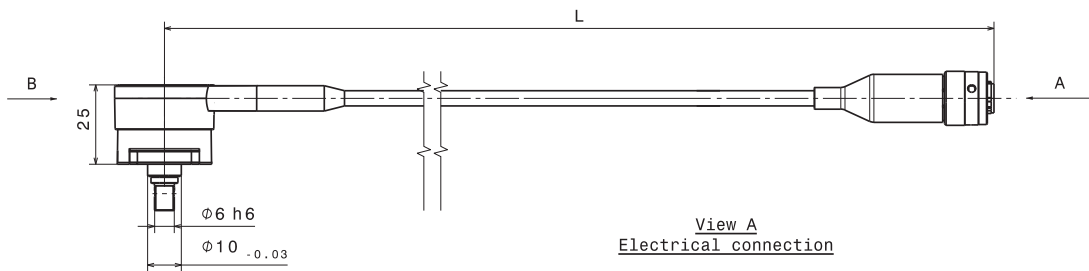
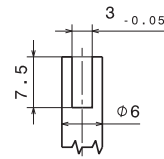
Rotary Position Sensor RP 40-H red

Dimensions



When the shaft marking is pointing to the wire exit the magnet is located in an electrical center position

Dimensions of driveshaft



## Rotary Position Sensor Mini-RP 100-M



### Features

- ▶ Rotational movement measurement
- ▶ Measurement range: 0 to 100°
- ▶ Compact design
- ▶ Robust housing

This sensor is designed to measure rotational movement, e.g. throttle angle or spring travel. A throttle rotation moves an internal slider (wiper) on a resistive element which is supplied with voltage. Thus voltage proportional to the angle can be measured. The housing and the bearings are made of high temperature resistant plastic. The mounting plate is protected with a metal cover to ensure a good fixation. The sensor is fitted in a shrink down boot for additional protection. The main benefit of this sensor is the combination of high accuracy, motorsport spec connection and a very small and robust aluminum housing.

### Application

Application	0 to 100°
Operating temperature range	-55 to 125°C
Storage temperature range	0 to 100°C
Max. vibration	200 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	32 g
Protection class	IP65
Mounting	2 x M4

Lifetime	50 x 10 <sup>6</sup> rotations
Housing	Aluminum alloy

#### Electrical Data

Power supply U <sub>s</sub>	5 V
Max. power supply	<15 V
Total resistance	1.5 kOhm ± 20%
Current I <sub>s</sub>	1 µA
Max. allowable contact current	1 mA

#### Characteristic

Max. rotation speed	120 min <sup>-1</sup>
Temp. coefficient	5 ppm/°K
Direction of rotation	Anti-clockwise

Both rotation directions are available on request.

#### Connectors and Wires

Connector	ASL 6-06-05PA-HE
Connector loom	ASL 0-06-05SA-HE
Pin 1 (A)	U <sub>s</sub>
Pin 2 (B)	Gnd
Pin 3 (C)	Sig
Pin 4 (D)	-
Pin 5 (E)	-
Sleeve	DR-25
Wire size	AWG 24
Wire length L	16 to 30 cm

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

#### Installation Notes

The products of the RP series can be connected directly to most control units.

The sensor has no internal mechanical stops.

Each mounting orientation is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Both rotation directions and other rotation angles available on request.

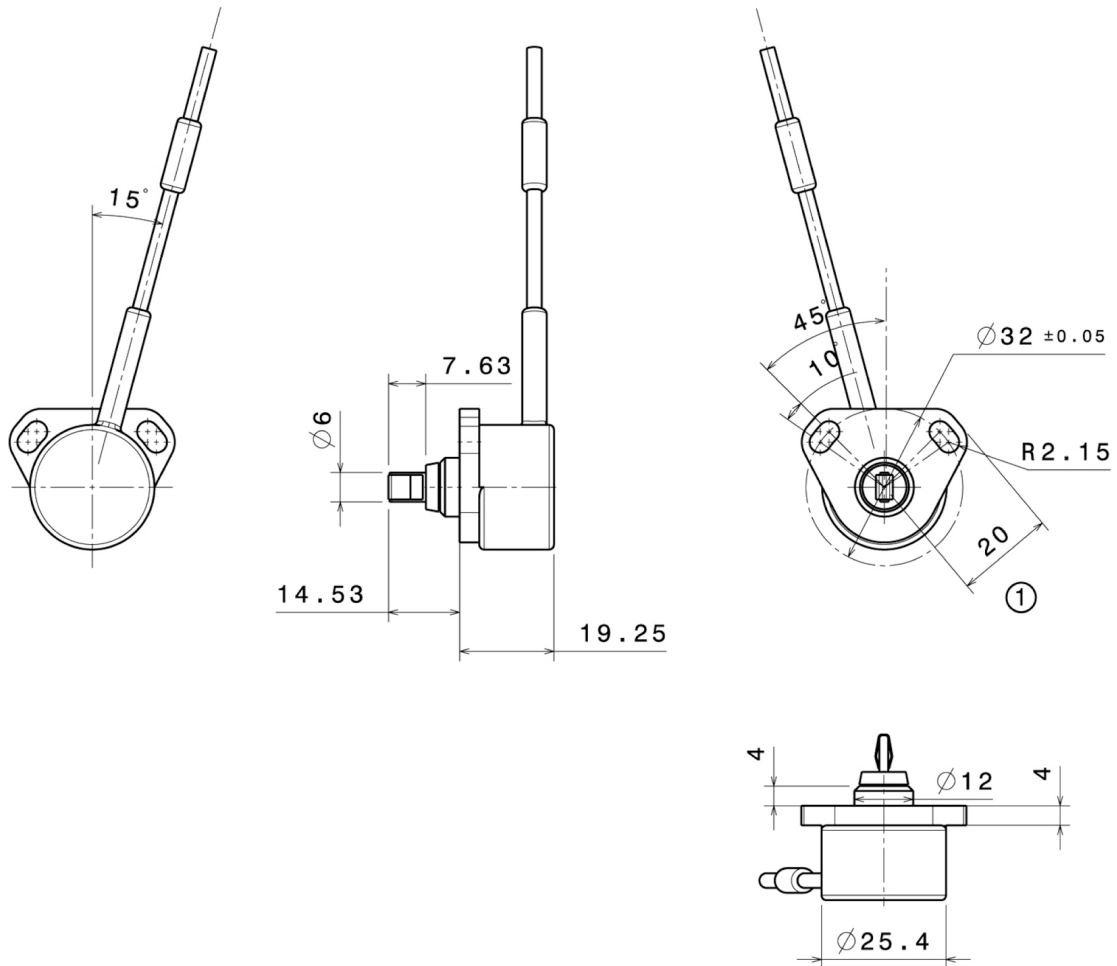
Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

**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**

**Rotary Position Sensor Mini-RP 100-M**  
Order number **B 261 209 587-01**

**Dimensions**

## Rotary Position Sensor RP 100/130/308



### Features

- ▶ Rotational movement measurement
- ▶ Measurement range: 0 to 100°, 0 to 130° or 0 to 308°
- ▶ Wide operating temperature range

This sensor is designed to measure rotational movement, e.g. throttle angle, spring travel, gearbox position or steering angle.

A throttle rotation moves an internal slider (wiper) on a resistive element which is supplied with voltage. Thus voltage proportional to the angle can be measured. The housing and the bearings are made of high temperature resistant plastic. The mounting plate is protected with a metal cover to ensure a good fixation. The sensor is fitted in a shrink down boot for additional protection. The main benefit of this sensor is the combination of both high accuracy and motorsport spec connection.

### Application

Application	Please see variations
Operating temperature range	-40 to 150°C
Max. vibration	200 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Variations

	RP 100	RP 130	RP 308
Application	0 to 100°	0 to 130°	0 to 308°
Total resistance	3 kOhm ± 20 %	3 kOhm ± 20 %	5 kOhm ± 20 %

### Mechanical Data

Weight w/o wire	32 g
Protection class	IP65
Mounting	2 x M4
Lifetime	50 x 10 <sup>6</sup> rotations
Housing	Synthetic material

### Electrical Data

Power supply U <sub>s</sub>	5 V
Max. power supply	42 V
Total resistance	Please see variations
Current I <sub>s</sub>	1 µA
Max. allowable contact current	10 mA

### Characteristic

Max. rotation speed	120 min <sup>-1</sup>
Temp. coefficient	5 ppm/°K
Direction of rotation	Anti-clockwise
Both rotation directions are available on request	

### Connectors and Wires

Connector	ASL 6-06-05PA-HE
Connector loom ASL 0-06-05SA-HE	F 02U 000 226-01
Pin 1 (A)	U <sub>s</sub>
Pin 2 (B)	Gnd
Pin 3 (C)	Sig
Pin 4 (D)	-
Pin 5 (E)	-
Sleeve	DR-25
Wire size	AWG 24
Wire length L	16 to 30 cm

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

### Installation Notes

The products of the RP series can be connected directly to most control units.

The sensor has no internal mechanical stops.

Each mounting orientation is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing. [www.bosch-motorsport.com](http://www.bosch-motorsport.com)

Both rotation directions and other rotation angles available on request.

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**

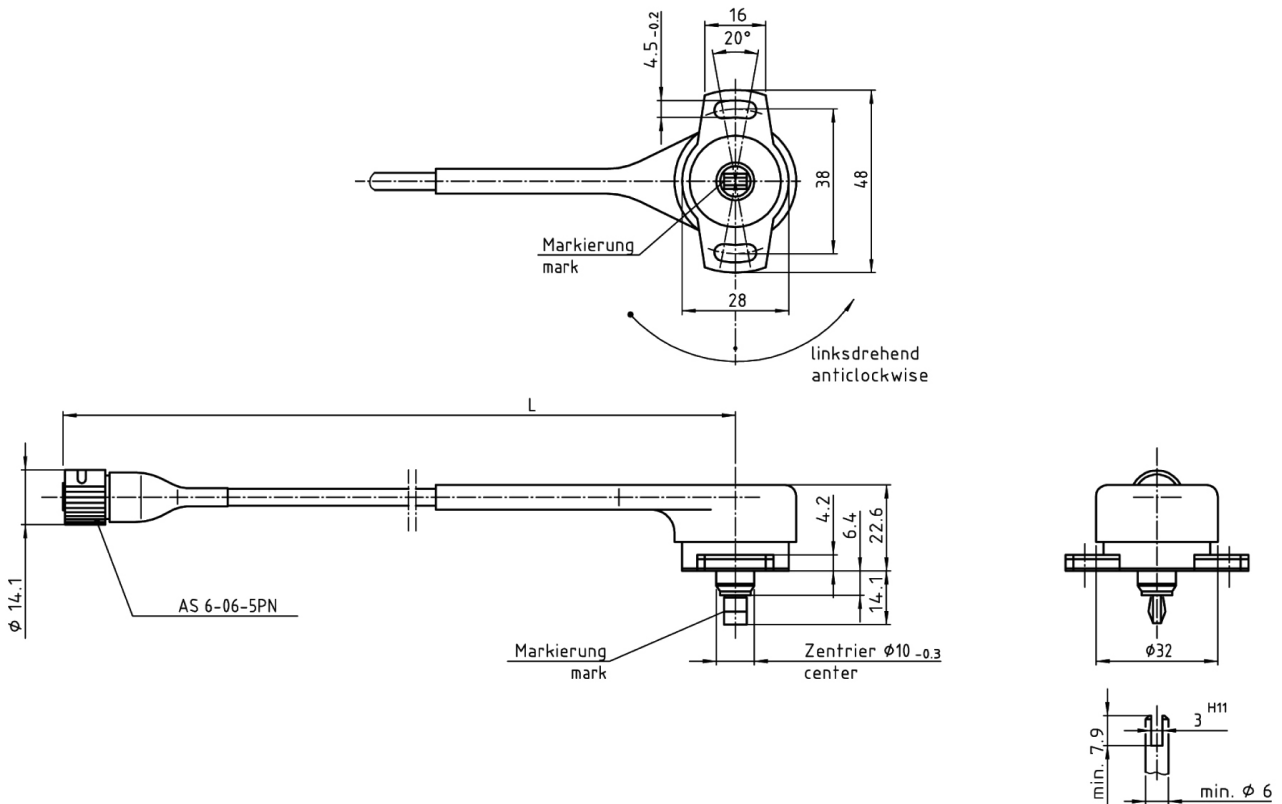
**Rotary Position Sensor RP 100**  
Order number **B 261 209 127-01**

**Rotary Position Sensor RP 130**  
Order number **B 261 209 128-02**

**Rotary Position Sensor RP 308**  
Order number **B 261 209 570-01**

**Dimensions**

7





## Rotary Position Sensor RP 100-H red



### Features

- ▶ Rotational position measurement
- ▶ Measurement range 100° full redundancy
- ▶ Operating temperature -40 to 125°C
- ▶ Accuracy  $<\pm 0.5\%$  FS

This sensor is designed to measure the rotational position of the acceleration pedal.

The electronic is designed with a magnetic rotary sensor with Hall elements and digital signal processing. The angular position is provided by a two pole magnet integrated in the sensor shaft. A Hall effect sensor is disposed between two magnets in association with a movable specially formed ferromagnetic part. This is used to control flux in the sensor in order to produce a linearly varying output voltage dependent on the position.

The main benefit of this sensor is its contactless Hall effect technology and its robust design for motorsport applications.

### Application

Application	100° full redundancy
Operating temperature range	-40 to 125°C
Max. Vibration	Vibration Profile 1 (see Appendix or <a href="http://www.bosch-motor-sport.com">www.bosch-motor-sport.com</a> )

### Technical Specifications

#### Mechanical Data

Weight w/o wire	50 g
Protection class	IP67
Mounting	2 x M4

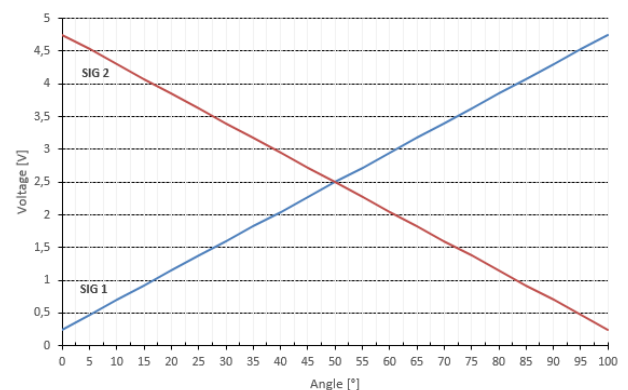
Lifetime	50 x 10 <sup>6</sup> rotations
Housing	Aluminum alloy

#### Electrical Data

Power supply $U_s$	5 V $\pm$ 0.5 V
Current $I_S$	< 40 mA

#### Characteristic

Max. rotation speed	120 min <sup>-1</sup>
Accuracy	< $\pm 0.5\%$ FS
Direction of rotation	Clockwise



### Connectors and Wires

Connector AS 6-07-35PN	F 02U 000 424-01
Mating connector AS 0-07-35SN	F 02U 000 238-01
Pin 1	Power 5 V Sensor 1
Pin 2	Ground Sensor 1
Pin 3	Signal Sensor 1
Pin 4	Power 5 V Sensor 2
Pin 5	Ground Sensor 2
Pin 6	Signal Sensor 2
Sleeve	DR-25
Wire size	AWG 24
Wire length L	150 to 750 $\pm$ 5 mm

### Installation Notes

The sensor can be connected directly to most control units.

The sensor is designed with contactless Hall effect technology.

Each 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.

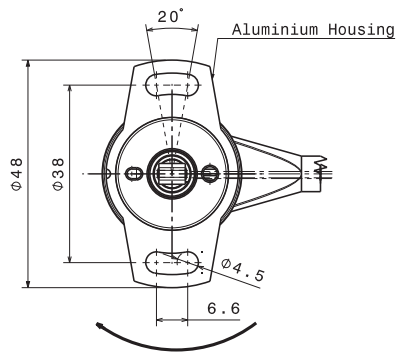
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

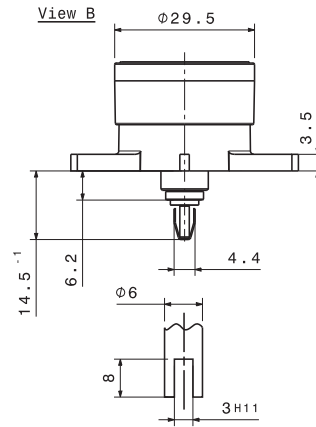
**Ordering Information**

**Rotary Position Sensor RP 100-H red**  
 Order number **F 02U V02 196-01**

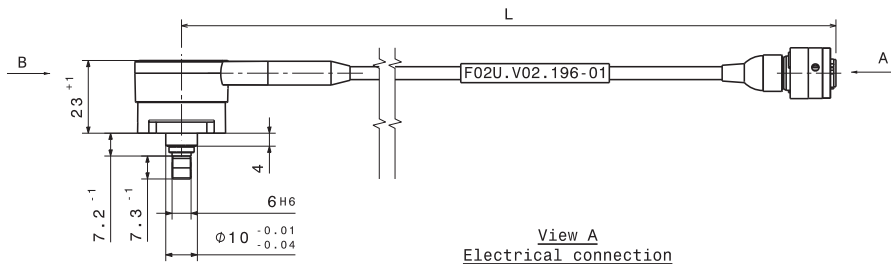
**Dimensions**



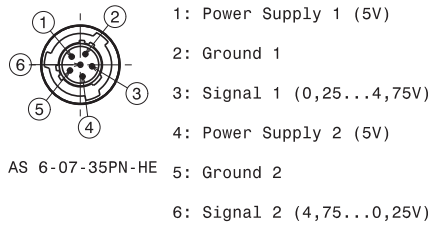
When the shaft marking is pointing to the wire exit the magnet is located in an electrical center position



Dimension of driveshaft  
 Scale 2:1



View A  
 Electrical connection



## Rotary Position Sensor RP 100 twin



### Features

- ▶ Rotational movement measurement
- ▶ Dual output
- ▶ Measurement range: 0 to 100°
- ▶ Wide operating temperature range

This sensor is designed to measure rotational movement, e.g. gearbox position or throttle angle. A throttle rotation moves an internal slider (wiper) on a resistive element which is supplied with voltage. Thus voltage proportional to the angle can be measured. The housing and the bearings are made of high temperature resistant plastic. The mounting plate is protected with a metal cover to ensure a good fixation. The sensor is fitted in a shrink down boot for additional protection. The main benefit of this sensor is the extremely high reliability through the redundant sensor design.

### Application

Application	0 to 100°
Operating temperature range	-40 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 and w/o connector	32 g
Protection class	IP65
Mounting	2 x M4
Lifetime	50 x 10 <sup>6</sup> rotations
Housing	Synthetic material

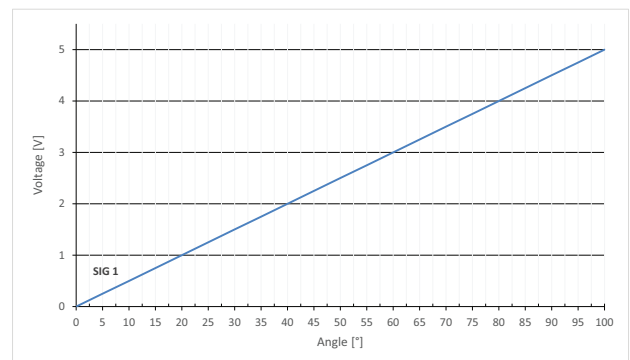
### Electrical Data

Power supply $U_s$	5 V
Max. power supply	42 V
Total resistance	3 kOhm $\pm$ 20 %
Current $I_S$	1 $\mu$ A
Max. allowable contact current	10 mA

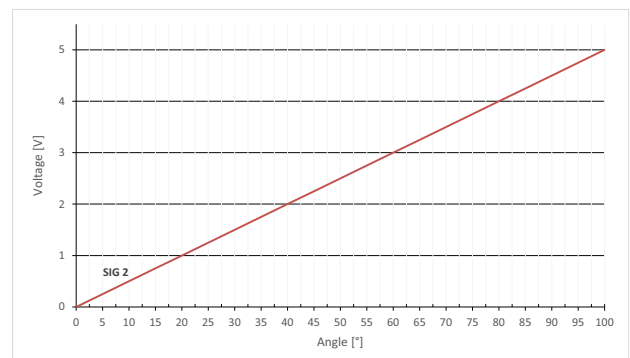
### Characteristic

Max. rotation speed	120 min <sup>-1</sup>
Temp. coefficient	5 ppm/°K
Direction of rotation	Clockwise
Both rotation directions are available on request	

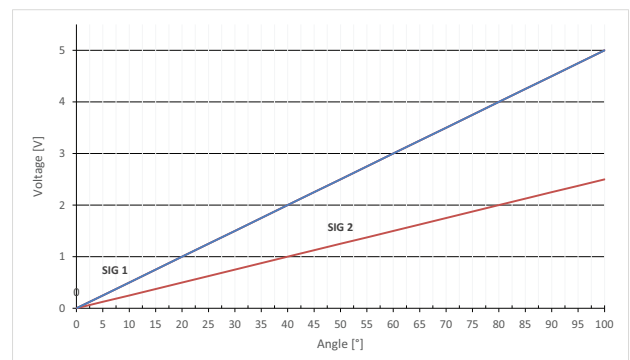
### Redundancy



Signal 1 without Connector



Signal 2 without Connector



Signal 1 and Signal 2 with AS Connector

Reduction of Signal 2 caused by voltage divider inside AS Connector.

### Connectors and Wires

#### Sensor without Connector

Black wire	U <sub>s</sub>
------------	----------------

Red wire	Gnd
----------	-----

White wire	Sig1
------------	------

Black wire	U <sub>s</sub>
------------	----------------

Red wire	Gnd
----------	-----

White wire	Sig2
------------	------

Wire size	6 x AWG22
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#### Sensor with AS Connector

Connector	AS 6-07-35PN
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Mating connector AS 0-07-35SN	F 02U 000 238-01
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PIN 1	U <sub>s</sub>
-------	----------------

PIN 2	Gnd
-------	-----

PIN 3	Sig1
-------	------

PIN 4	U <sub>s</sub>
-------	----------------

PIN 5	Gnd
-------	-----

PIN 6	Sig2
-------	------

#### In general

Sleeve	DR-25
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Wire length L	16 to 30 cm
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#### In general

Various motorsport and automotive connectors on request.

Please specify the requested wire length with your order.

### Installation Notes

The products of the RP series can be connected directly to most control units.

The sensor has no internal mechanical stops.

Each mounting orientation is possible.

Please find further application hints in the offer drawing ([www.bosch-motorsport.com](http://www.bosch-motorsport.com)).

Both rotation directions and other rotation angles available on request.

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

#### Rotary Position Sensor RP 100 twin

Sensor without Connector

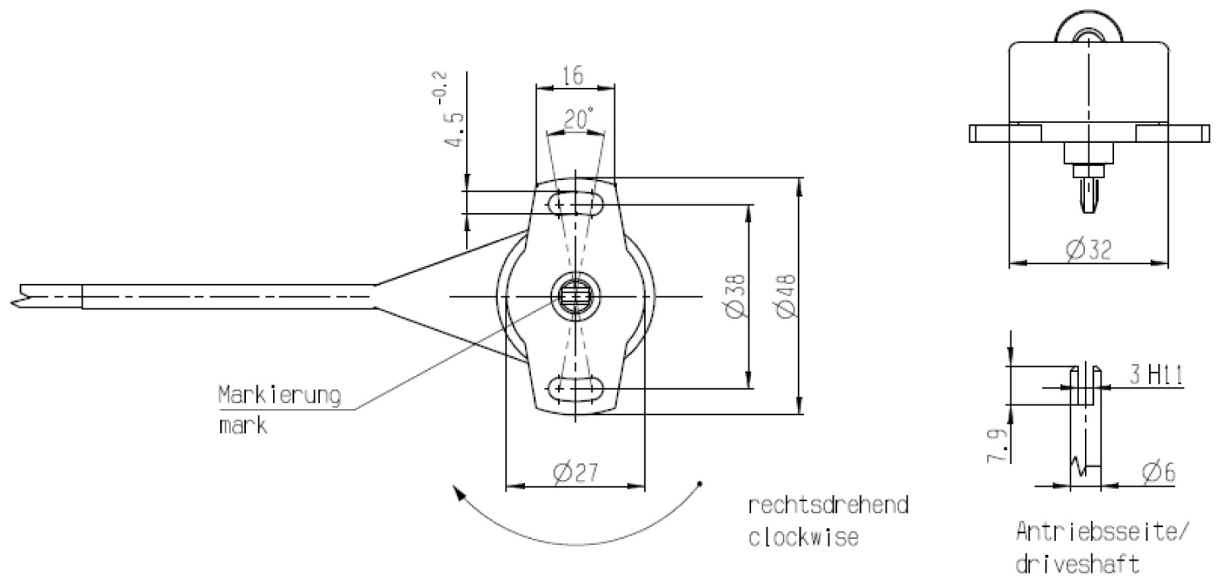
Order number **B 261 209 591-90**

#### Rotary Position Sensor RP 100 twin

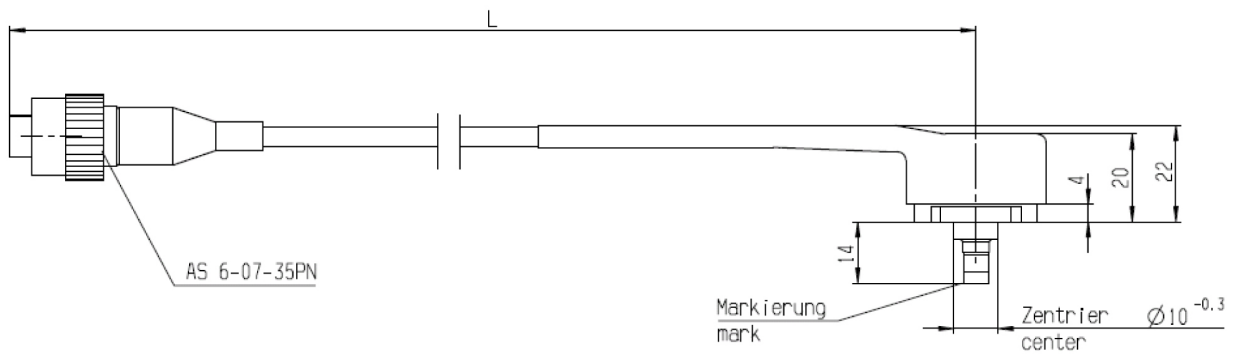
Sensor with AS Connector

Order number **B 261 209 591-02**

Dimensions



Sensor without Connector



Sensor with AS Connector

## Rotary Position Sensor RP 360-H



7

### Features

- ▶ Rotational movement measurement
- ▶ Hall effect technology
- ▶ Measurement range: 0 to 360°
- ▶ Analogue output 0.5 to 4.5 V

This sensor is designed to measure rotational movement, e.g. throttle angle, spring travel, gearbox position or steering angle.

The electronic is designed with a magnetic rotary sensor with Hall elements and digital signal processing. The angular position is provided by a two pole magnet integrated in the sensor shaft. A Hall effect sensor is disposed between two magnets in association with a movable specially formed ferromagnetic part. This is used to control flux in the sensor in order to produce a linearly varying output voltage dependent on the position.

The main benefit of this sensor is its contactless Hall effect technology and its robust design for motorsport applications. Other measurement ranges are available on request.

### Application

Application	0 to 360°
Operating temperature range	-40 to 140°C (5 V supply)
Storage temperature range	-55 to 140°C
Max. vibration	200 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	< 35 g
Protection class	IP68
Mounting	2 x M4

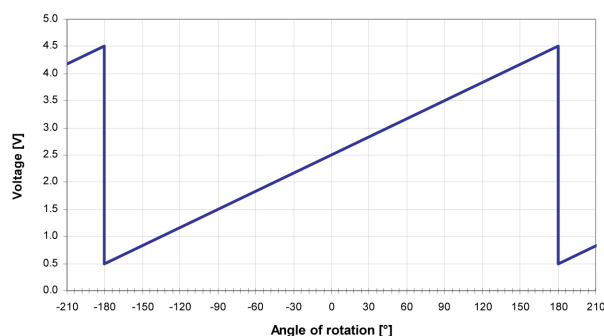
Lifetime	20 x 10 <sup>6</sup> operations of ±75°
Housing	Synthetic material

#### Electrical Data

Power supply $U_s$	5 ± 0.5 V regulated 9 V to 30 V unregulated
Max. power supply	30 V
Total resistance	10 kOhm
Current $I_s$	< 12.5 mA
Resolution	0.025 % of measurement range
Output voltage range	0.5 to 4.5 V
Output load	10 kV

#### Characteristic

Max. rotation speed	600 min <sup>-1</sup>
Temp. coefficient	< 30 ppm/°K in 5 V supply mode < 90 ppm/°K in 9 V to 30 V supply mode
Direction of rotation	Anti-clockwise
Both rotation directions are available on request.	
Redundancy	No



#### Connectors and Wires

Connector	ASL 6-06-05PA-HE
Mating connector	F 02U 000 226-01
ASL 0-06-05SA-HE	
Pin 1 (A)	$U_s$
Pin 2 (B)	Gnd
Pin 3 (C)	Sig
Pin 4 (D)	-
Pin 5 (E)	-
Sleeve	DR-25
Wire size	AWG 24
Wire length L	16 to 45 cm

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Various motorsport and automotive connectors are available on request.

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Please specify the required wire length with your order.

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### Installation Notes

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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.

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Operating temperature range for unregulated supply: -40 to 135.7°C (9 V supply). Derate upper temperature limit by 1.7°C for every 1 V increase in supply, e.g. -40 to 100°C at 30 V.

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Both rotation directions and other measurement ranges are available on request.

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

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### Safety Note

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The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

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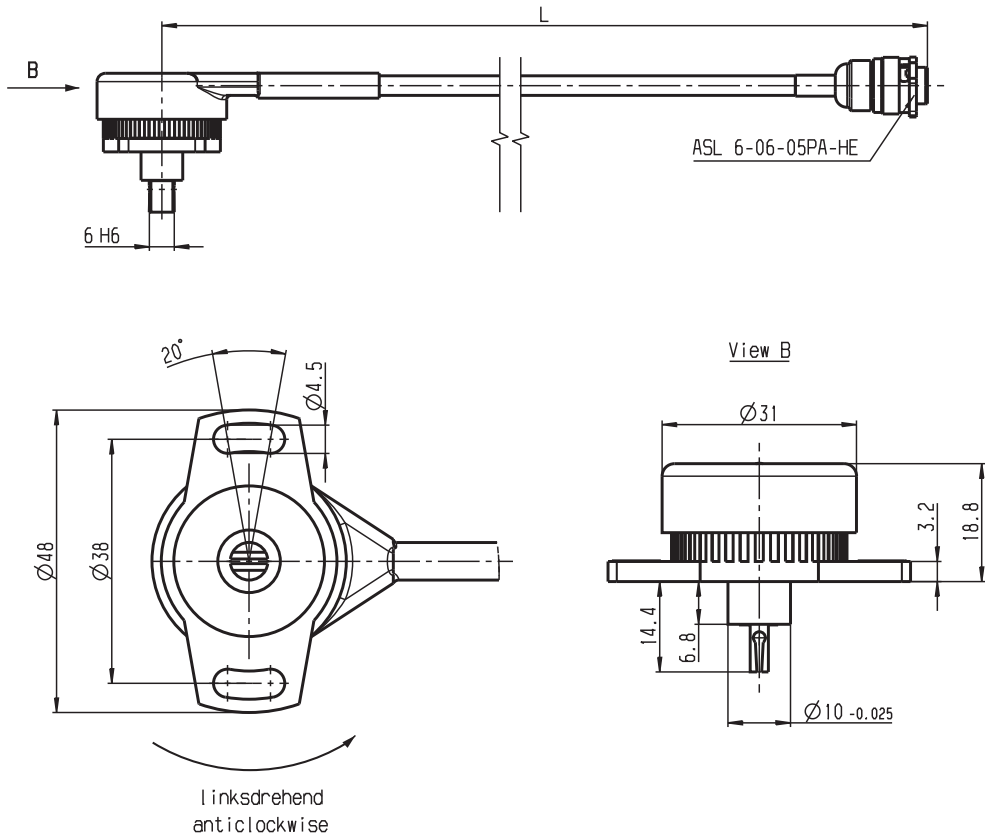
### Ordering Information

#### Rotary Position Sensor RP 360-H

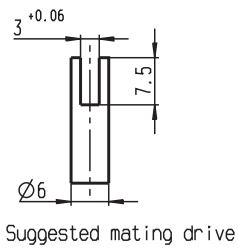
Order number **F 02U V00 641-02**

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Dimensions








Sensor is at mid point of electrical angle when mark on shaft and cable exit are aligned as shown



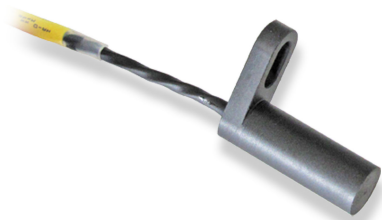


## Speed Sensors Overview

	Hall-Effect Speed Sensor HA-D 90	Hall-Effect Speed Sensor HA-Di	Hall-Effect Speed Sensor HA-M	Hall-Effect Speed Sensor HA-N	Hall-Effect Speed Sensor HA-P
					
Max. frequency (kHz)	≤ 10	≤ 10	≤ 10	≤ 4.2	≤ 10
Temperature range (°C)	-40 to 150	-40 to 150	-40 to 160	-40 to 160	-40 to 150
Target wheel air gap AG (mm)	0.4 to 1.2	0.4 to 1.2	0.5 to 1.5	0.5 to 1.5	0.5 to 1.4
Bore diameter (mm)	11.8	12+0.2	11.8	10	18
Max. vibration	1,200 m/s <sup>2</sup> at 10 Hz to 2 kHz	1,200 m/s <sup>2</sup> at 10 Hz to 2 kHz	1,200 m/s <sup>2</sup> at 10 Hz to 2 kHz	1,200 m/s <sup>2</sup> at 10 Hz to 2 kHz	1,000 m/s <sup>2</sup> at 10 Hz to 2 kHz
Defined mounting position	+	+, rotating direction detection	-	-	-

	Hall-Effect Speed Sensor HA-P2	Hall-Effect Speed Sensor Mini-HA-P	Hall-Effect Speed Sensor Mini-HA-P sealed	Inductive Speed Sensor IA-C
				
Max. frequency (kHz)	≤ 10	≤ 10	≤ 10	≤ 15
Temperature range (°C)	-40 to 160	-40 to 150	-40 to 150	-40 to 130
Target wheel air gap AG (mm)	0.5 to 2.5	0.2 to 1.5	0.2 to 1.5	0.8±0.3
Bore diameter (mm)	15	11.5	16	18
Max. vibration	400 m/s <sup>2</sup> at 10 Hz to 2 kHz	1,200 m/s <sup>2</sup> at 10 Hz to 2 kHz	1,200 m/s <sup>2</sup> at 10 Hz to 2 kHz	800 m/s <sup>2</sup> max. 80 h
Defined mounting position	-	-	-	-

## Hall-Effect Speed Sensor HA-D 90



### Features

- ▶ Camshaft/crankshaft/wheel speed
- ▶ Also available with 0°, 180° and 270° mounting position
- ▶ Very high precision measurement
- ▶ Self-learning
- ▶ Measuring of differences with 2 Hall sensors

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	≤ 10 kHz
Target wheel air gap AG	0.4 to 1.2 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
Output type	Active high
External magnetic fields	≤ 50 mT
Max. vibration	1,200 m/s <sup>2</sup> 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 % (≤ 6 kHz) < 1.5 % (≤ 10 kHz)
Signal output	0.52 V to < U <sub>s</sub>

#### 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	ASL 6-06-05PC-HE
Mating connector ASL 0-06-05SC-HE	F 02U 000 228-01
Pin 1	U <sub>s</sub>
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.

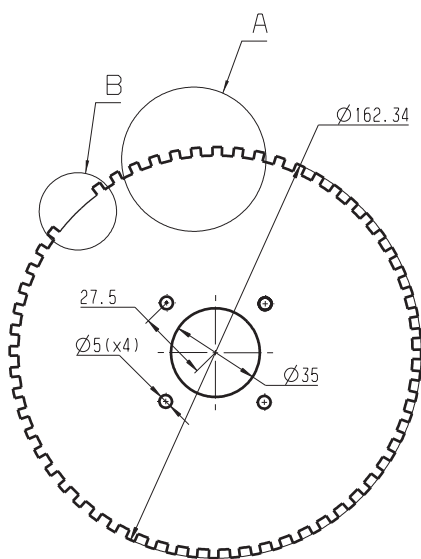
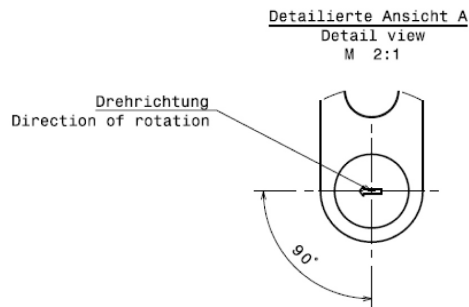
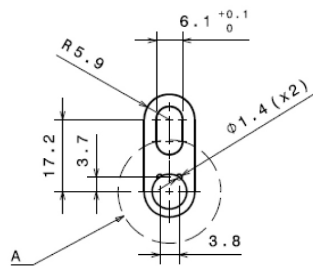
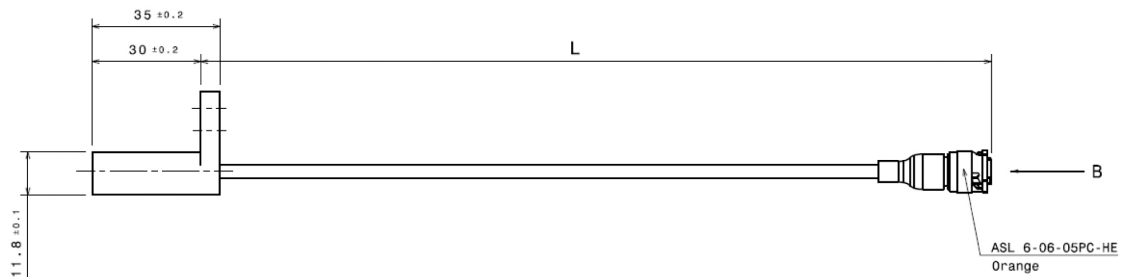
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

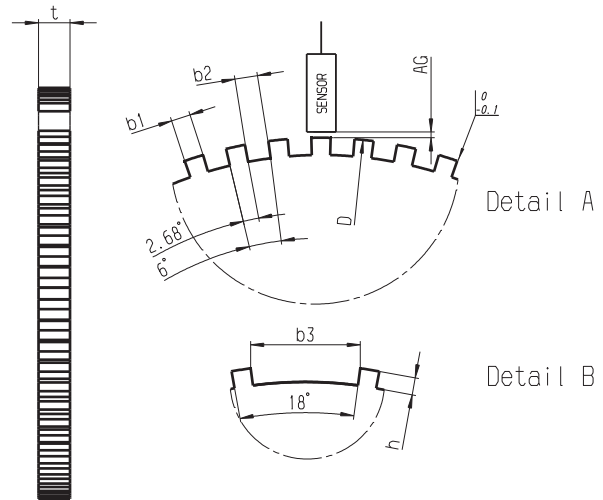
**Ordering Information**

**Hall-Effect Speed Sensor HA-D 90**  
 Order number **F 02U V00 334-01**

**Dimensions**



60-2 Teeth



Left view

## Hall-Effect Speed Sensor HA-Di



### Features

- ▶ Crankshaft or wheel speed
- ▶ Available with 0°, 90°, 180° and 270° mounting position
- ▶ Detecting the rotational direction
- ▶ Self-learning
- ▶ Measuring of differences with 3 Hall sensors

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	≤ 10 kHz forward ≤ 6 kHz backward
Target wheel air gap AG	0.4 to 1.2 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
External magnetic fields	≤ 100 mT
Max. vibration	1,200 m/s <sup>2</sup> 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

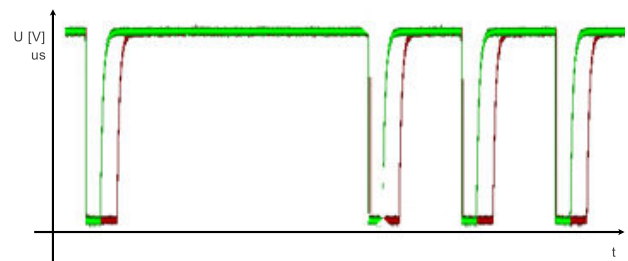
Installation depth L2	30 mm
Tightening torque	6 Nm

#### 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 μs (45)
Signal output width backward	75 to 105 μs (90)
Accuracy (tolerance)	±1.5° (for forward direction)
Signal output	0.52 V to < U <sub>S</sub>



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	≥4 mm
Depth of teeth h	≥4 mm
Target wheel width	≥5 mm
Relative magnetic permeability	μ (r) ≥1000

#### Connectors and Wires

Connector	ASL 6-06-05PC-HE
Mating connector	F 02U 000 228-01
ASL 0-06-05SC-HE	
Pin 1	U <sub>S</sub>

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

#### Hall-Effect Speed Sensor HA-Di 0

Order number **F 02U V01 802-01**

#### Hall-Effect Speed Sensor HA-Di 90

Order number **F 02U V01 803-01**

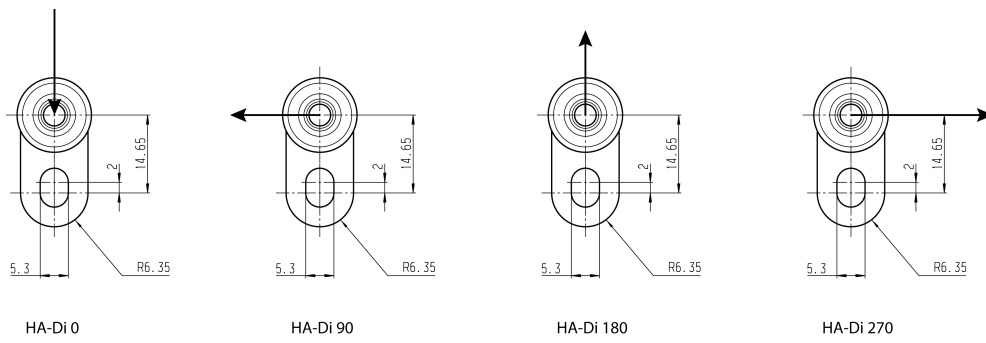
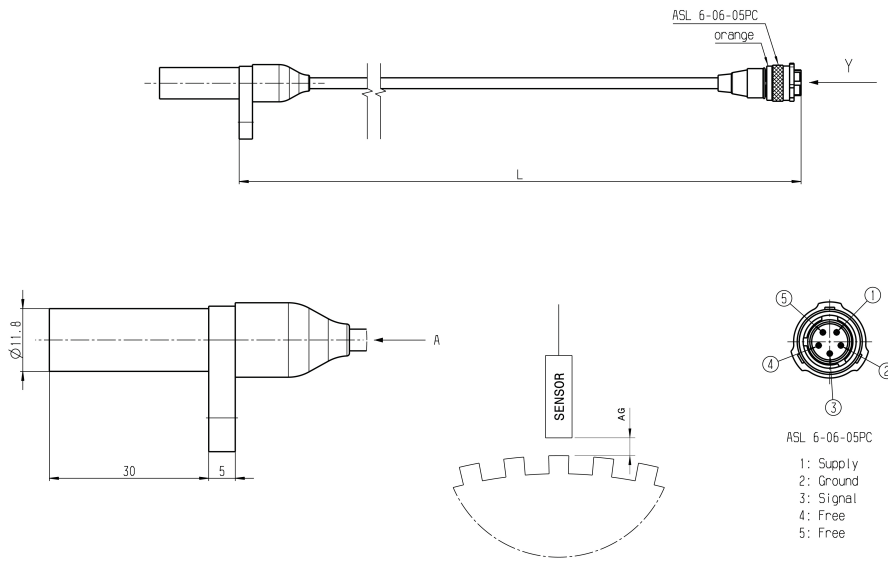
#### Hall-Effect Speed Sensor HA-Di 180

Order number **F 02U V01 804-01**

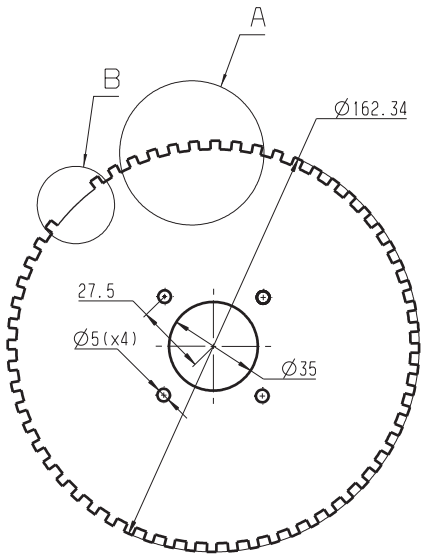
#### Hall-Effect Speed Sensor HA-Di 270

Order number **F 02U V01 805-01**

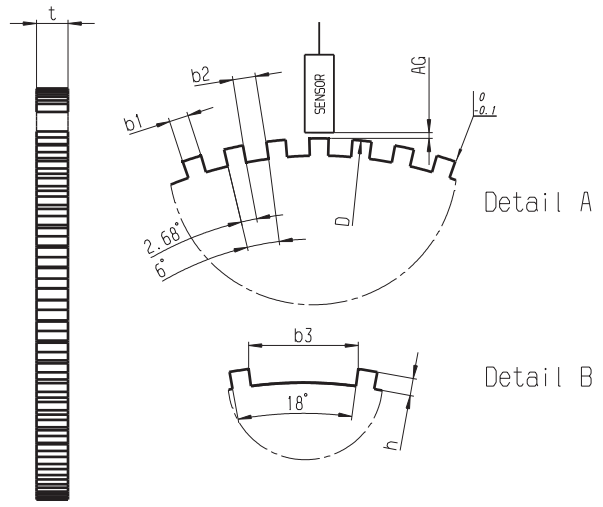
Dimensions



Direction of rotation of the target wheel, View A

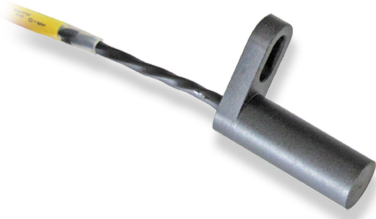


60-2Teeth



Left view

## Hall-Effect Speed Sensor HA-M



### Features

- ▶ Camshaft/crankshaft/wheel speed
- ▶ Max. frequency 10 kHz
- ▶ Self-learning
- ▶ Active high/low programmable

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	≤10 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 m/s <sup>2</sup> at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

##### Active low with connector / active high with connector

Connector	ASU 6-03-03PN-HE
Mating connector	F 02U 000 199-01
ASU 0-03-03SN-HE	
Pin 1	U <sub>s</sub>
Pin 2	Gnd

Pin 3	Sig
-------	-----

##### Active high, without connector

Red	U <sub>s</sub>
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 <sub>s</sub>	5.6 to 18 mA

##### Characteristic

Accuracy repeatability of the falling edge of tooth	< 4 % (≤ 6 kHz) < 8 % (≤ 10 kHz)
Signal output	0.52 V to < U <sub>s</sub>

##### 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

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 home-page.

**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

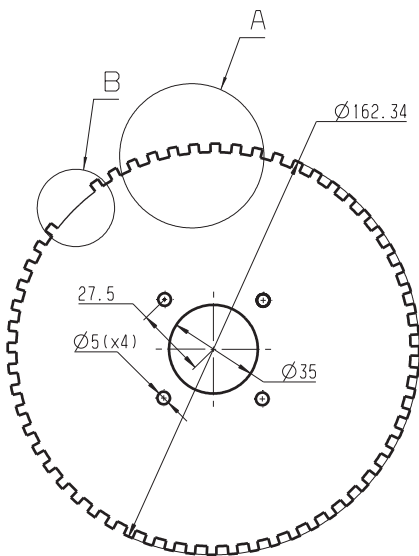
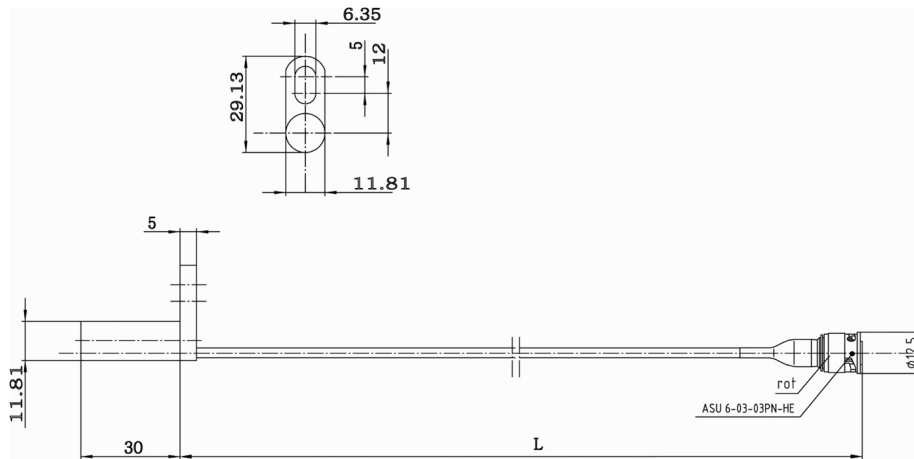
**Ordering Information**

**HA-M**  
Active low  
Order number **B 261 209 283-01**

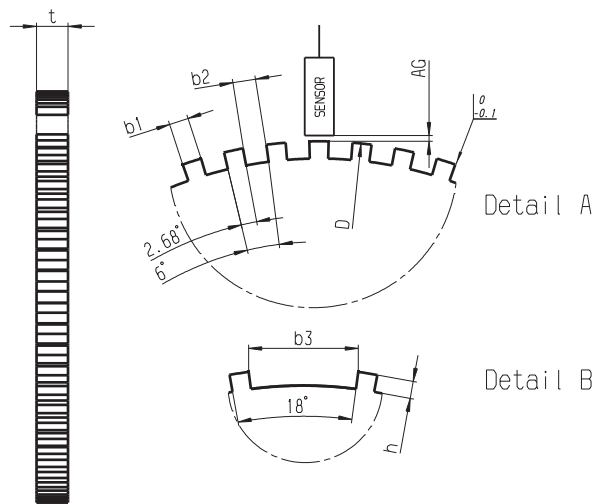
**HA-M**  
Active high  
Order number **B 261 209 295-01**

**HA-M**  
Active high, without connector  
Order number **F 02U V00 627-01**

**Dimensions**



60-2 Teeth



Left view

## Hall-Effect Speed Sensor HA-N



### Features

- ▶ Camshaft/crankshaft/wheel speed
- ▶ Max. frequency 4.2 kHz
- ▶ Lightweight anodized aluminum housing

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	≤ 4.2 kHz
Target wheel air gap AG	0.5 to 1.5 mm
Temperature range	-40 to 160°C
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	< 1 mT
Max. vibration	1,200 m/s <sup>2</sup> 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 I <sub>S</sub>	5.6 to 18 mA

#### Characteristic

Accuracy repeatability of the falling edge tooth	<4 % (≤ 4.2 kHz)
Signal output	0.52 V to V <sub>S</sub>

#### 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

Sensor AS connector	
Connector	ASL 6-06-05PA-HE
Mating connector	ASL 0-06-05SA-HE
Pin 1	V <sub>S</sub>
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 <sub>S</sub>
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.

**Hall-Effect Speed Sensor HA-N**

Sensor Flying lead

Order number **F 02U V0U 714-90**

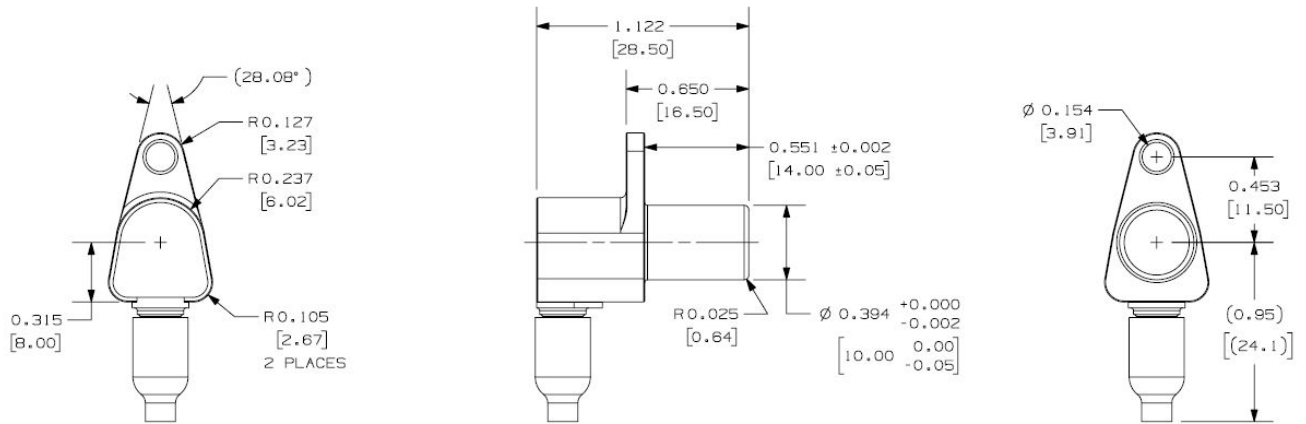
**Ordering Information**

**Hall-Effect Speed Sensor HA-N**

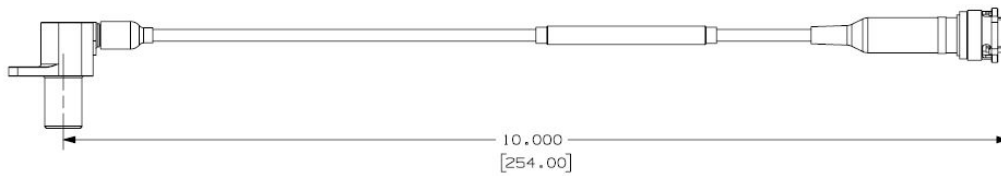
Sensor AS connector

Order number **F 02U V0U 714-01**

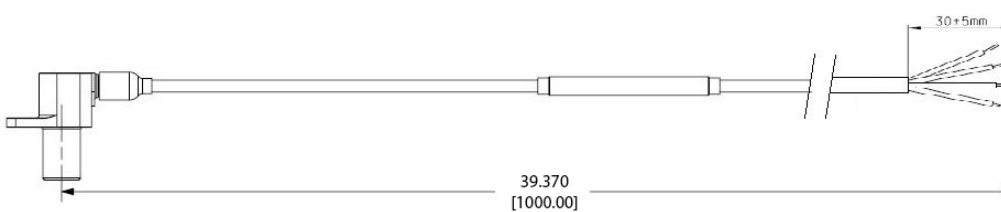
**Dimensions**



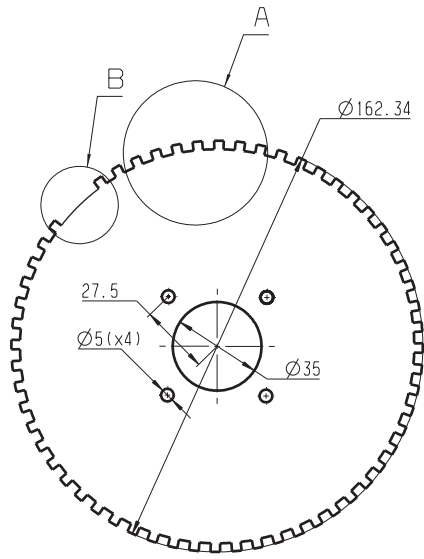
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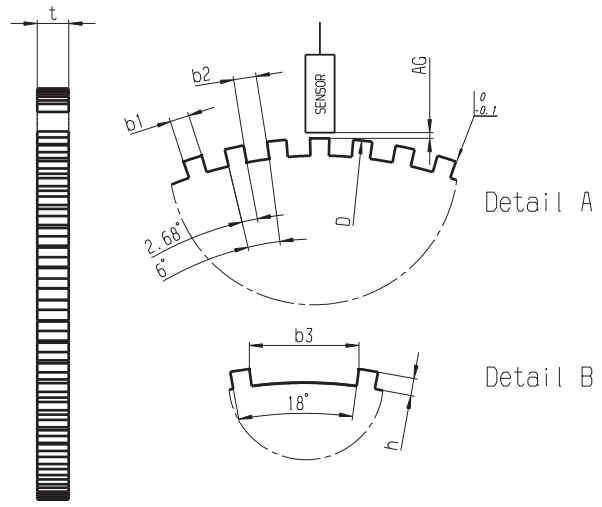
Sensor AS connector



Sensor Flying lead



60-2 Teeth



Left view

## Hall-Effect Speed Sensor HA-P



### Features

- ▶ Camshaft or wheel speed
- ▶ 24.0 mm depth
- ▶ Robust design
- ▶ Active low

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	≤ 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 m/s <sup>2</sup> at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	70 g
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 I <sub>S</sub>	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	< 1.5 % (≤6 kHz) < 2 % (≤10 kHz)
Signal output	0.4 V to < US

#### 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	1 928 404 227
Mating connector 3-pole Compact	D 261 205 335-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	U <sub>s</sub>

#### 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.

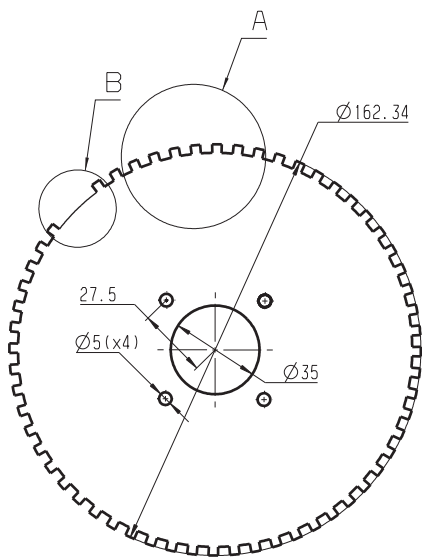
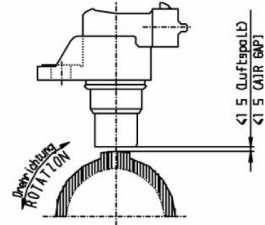
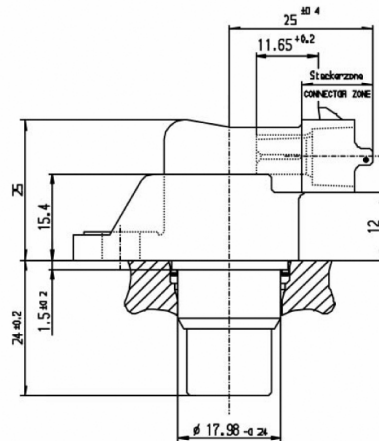
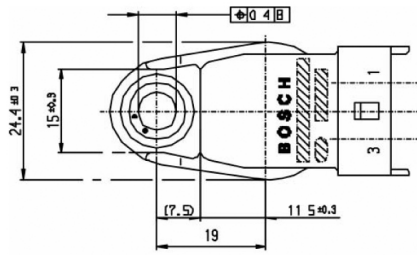
#### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

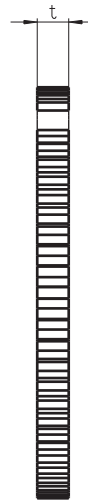
#### Ordering Information

**Hall-Effect Speed Sensor HA-P**  
Order number **0 232 103 037**

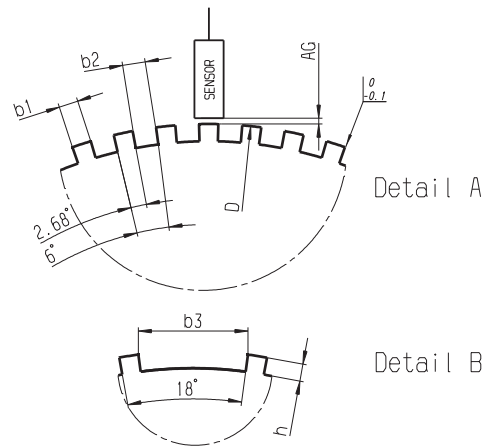
Dimensions



60-2Teeth



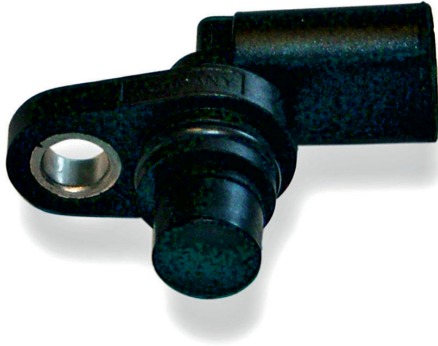
Left view



Detail A

Detail B

## Hall-Effect Speed Sensor HA-P2



### Features

- ▶ Camshaft/crankshaft/wheel speed
- ▶ 15 mm depth
- ▶ Very small housing
- ▶ Very light weight
- ▶ Active low

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-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	≤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 m/s <sup>2</sup> 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 % (≤ 10 kHz)
up to 2.5 mm	< 8 % (≤ 10 kHz)

Signal output	0.4 V to < U <sub>s</sub>
---------------	---------------------------

#### Connectors and Wires

Connector	Hirschmann 872-658-501 Cod.A
Mating connector	F 02U B00 520-01
Pin 1	U <sub>s</sub>
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 home-page.

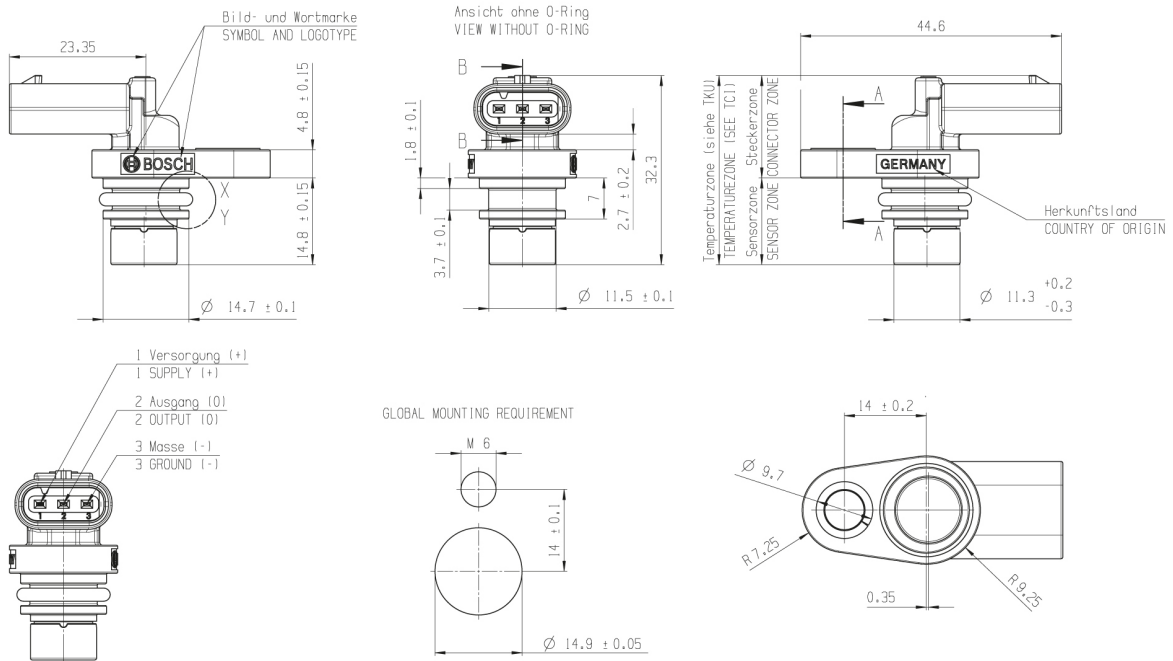
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

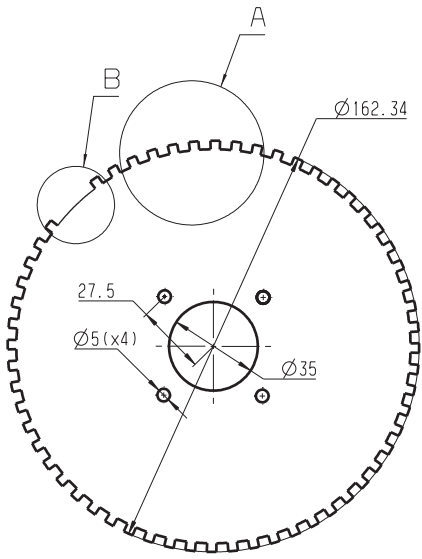
**Ordering Information**

**Hall-Effect Speed Sensor HA-P2**  
 Order number **0 232 103 111**

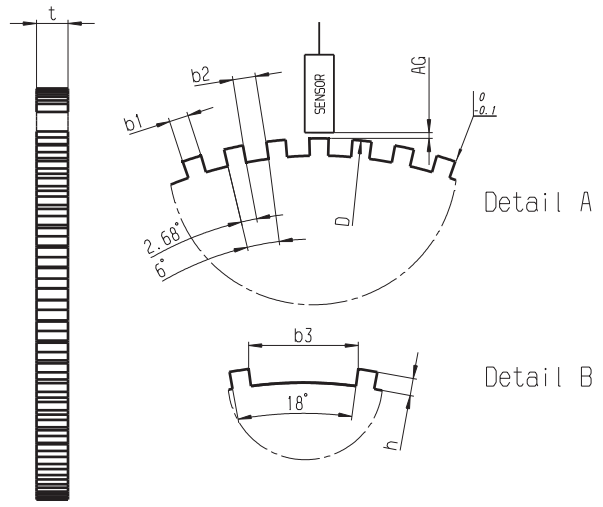
**Dimensions**







60-2Teeth



Left view

## Hall-Effect Speed Sensor Mini-HA-P



## 7

### Features

- ▶ Camshaft or wheel speed
- ▶ Max. frequency  $\leq 10$  kHz
- ▶ High vibration resistance
- ▶ Low weight
- ▶ Small housing

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°C
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$\leq 0.3$ mT
Max. vibration	1,200 m/s <sup>2</sup> at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

Connector	ASL 6-06-05PC-HE	1 234 482 092
Mating connector	ASL 0-06-05SC-HE	F 02U 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 IS	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	< 3 % ( $\leq 6$ kHz) < 5 % ( $\leq 10$ 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	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 home-page.

**Safety Note**

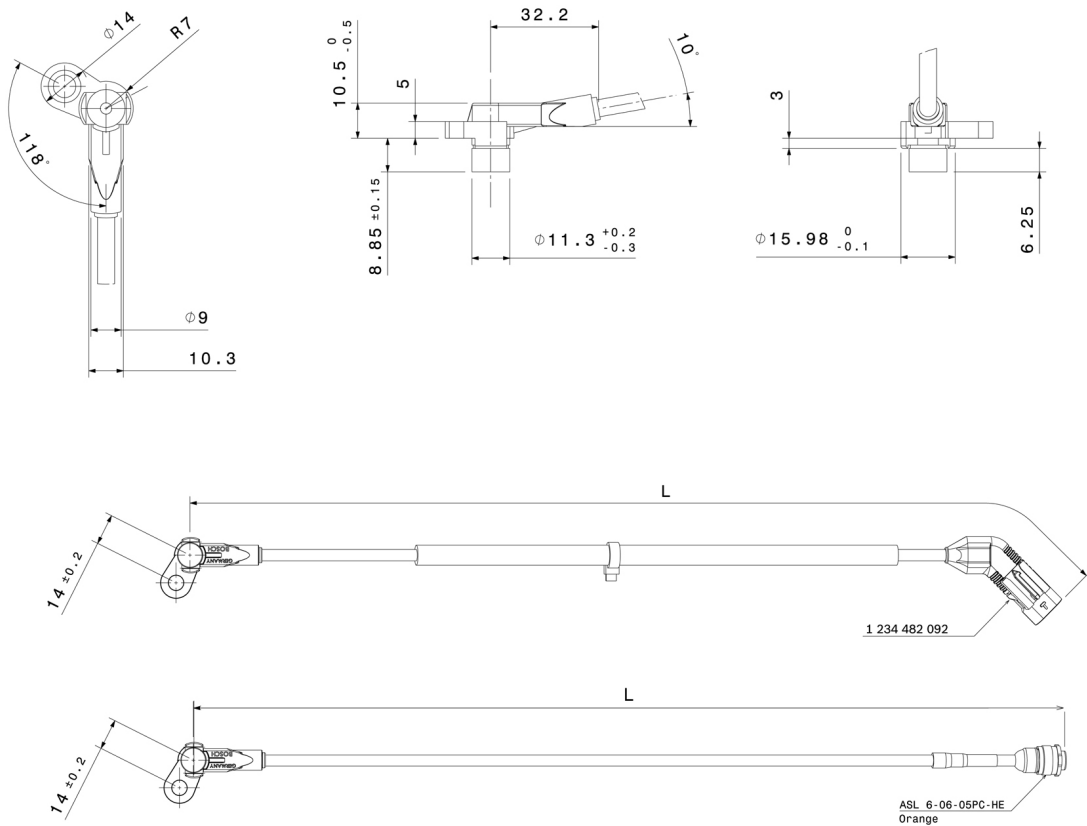
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Ordering Information**

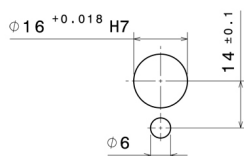
**Mini-HA-P**  
 Connector ASL 6-06-05PC-HE  
 Order number **F 02U V00 564-02**

**Mini-HA-P**  
 Connector 1 234 482 092  
 Order number **F 02U V00 566-02**

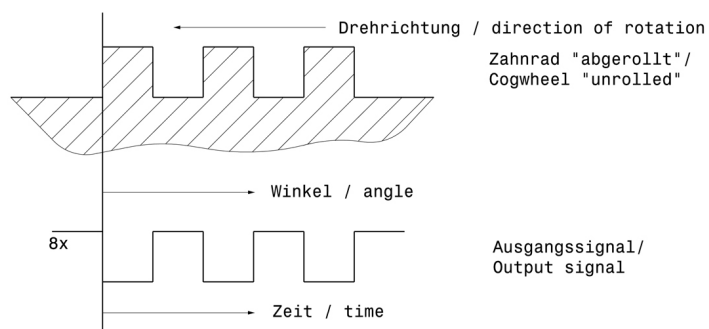
**Dimensions**

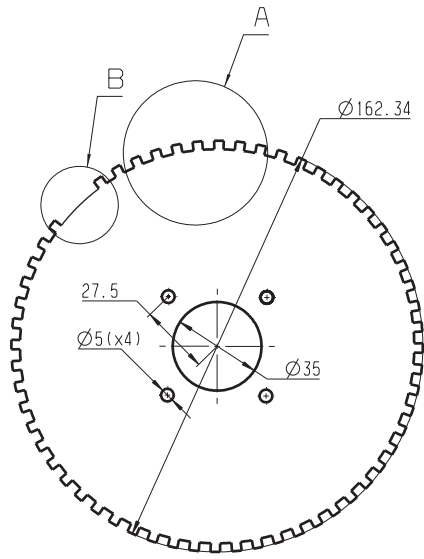


**Einbauvorschrift**  
 Mounting requirement

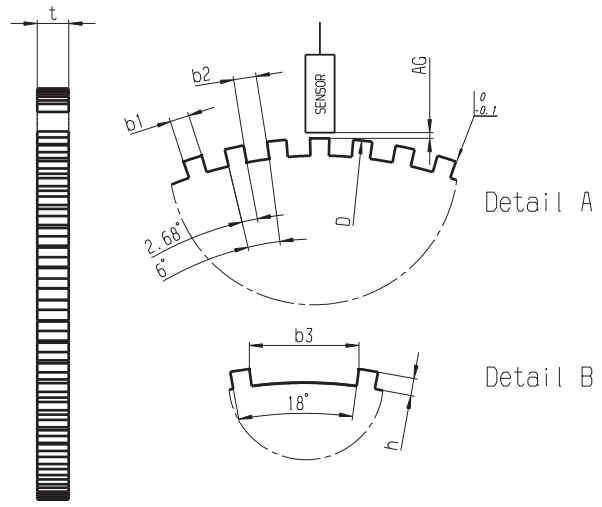


**Signal-Definition**  
 Signal definition





60-2 Teeth



Left view

## Hall-Effect Speed Sensor Mini-HA-P sealed



### Features

- ▶ Camshaft/crankshaft/wheel speed
- ▶ Max. frequency  $\leq 10$  kHz
- ▶ High vibration resistance
- ▶ Very small housing
- ▶ O-ring sealing

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft and wheel-speed).

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 m/s <sup>2</sup> at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

Connector	ASL 6-06-05PC-HE	Without connector
Mating connector	ASL 0-06-05SC-HE F 02U 000 228-01	-
Pin 1	U <sub>s</sub>	U <sub>s</sub> (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 <sub>S</sub>	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	< 3 % ( $\leq 6$ kHz) < 5 % ( $\leq 10$ kHz)
Signal output	0.4 V to < U <sub>s</sub>

#### 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.

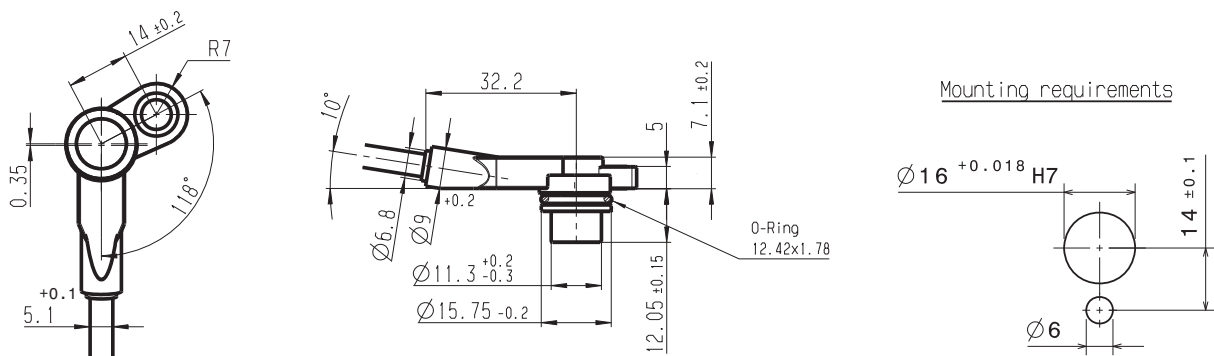
**Ordering Information**

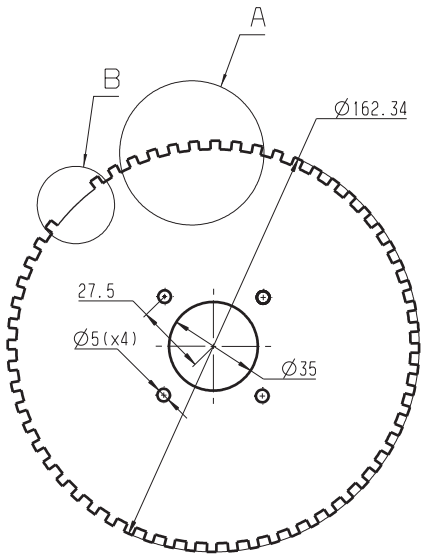
**Hall-Effect Speed Sensor Mini HA-P sealed**  
 Connector ASL 6-06-05PC-HE  
 Order number **F 02U V00 500-01**

**Hall-Effect Speed Sensor Mini HA-P sealed**  
 Without connector  
 Order number **F 02U V00 570-01**

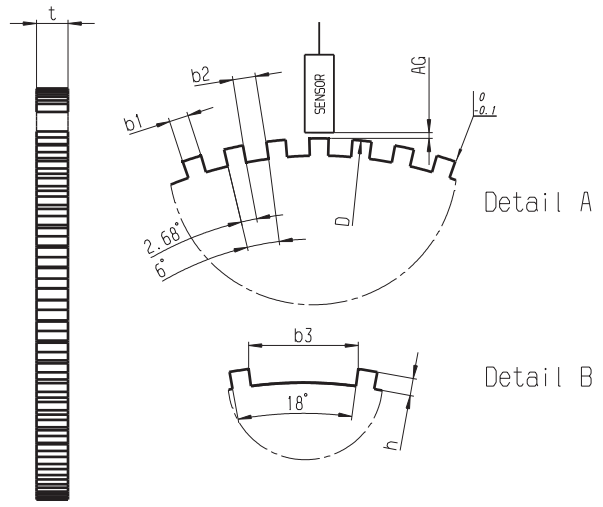
7

**Dimensions**



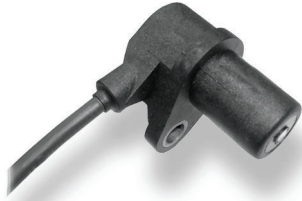


60-2Teeth



Left view

## Inductive Speed Sensor IA-C



### Features

- ▶ Crankshaft or wheel speed
- ▶ 24.0 mm, 315° depth/lead
- ▶ Bore diameter 18 mm

This sensor is designed for incremental measurement of rotational speed (e.g. crankshaft or wheelspeed). The inductive sensor consists of a bar magnet with a soft magnetic pole pin supporting an induction coil with two connections. Every time a ferromagnetic ring gear turns past this sensor, it generates a voltage in the coil which is directly proportional to the periodic variation in the magnetic flux. The rotational speed is reflected on a periodic interval between the voltage's zero transition points.

It is available in a DR-25 sleeve with various connector options.

The main benefit of this sensor is the combination of a high quality production part and robust, compact design.

### Application

Application	Speed
Max. frequency	≤ 15 kHz
Target wheel air gap AG	0.8 ± 0.3 mm
Operating temp. range (sensing head)	-40 to 130°C
Storage temperature range	-40 to 100°C
Max. vibration	800 m/s <sup>2</sup> max. 80 h

### Technical Specifications

#### Mechanical Data

Magnetic pole	Round
Bore diameter	18 mm
Tightening torque	8 Nm
Weight w/o wire	40 g
Installation depth L2	23.7 mm

#### Electrical Data

Coil resistance	860 Ohm ± 10 %
Inductance max.	370 mH ± 15 %
Output voltage max.	200 VP-P

#### Environment

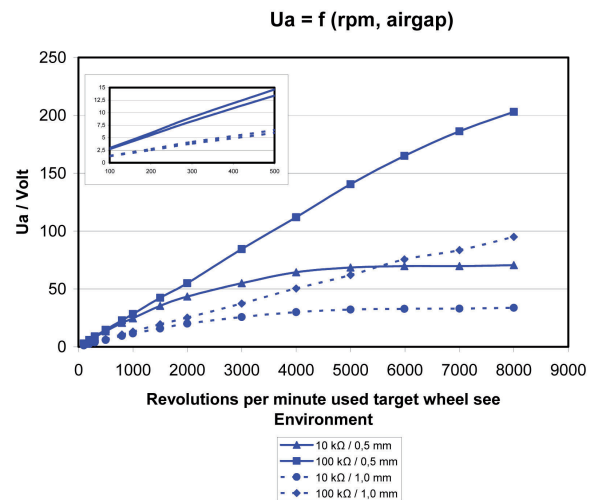
Target wheel diameter D	160.43 mm
Thickness t	> 5 mm
Width of teeth b1	4.1 mm
Width of gap b2	4.3 mm
Depth of teeth h1	3.5 mm
Depth of teeth h2	1.75 mm
Number of teeth	60-2

#### Connectors and Wires

Connector	1 928 404 227
Mating connector	D 261 205 335-01
3-pole Compact	
Pin 1	Sig+
Pin 2	Sig-
Pin 3	Scr

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.



### Installation Notes

The inductive speed sensor IA-C is developed for wheels made of ferromagnetic material.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please contact our technical consultancy for more information.



Please find further application hints in the offer drawing at our home-page.

The inductive speed sensor IA-C is developed for wheels made of ferromagnetic material.

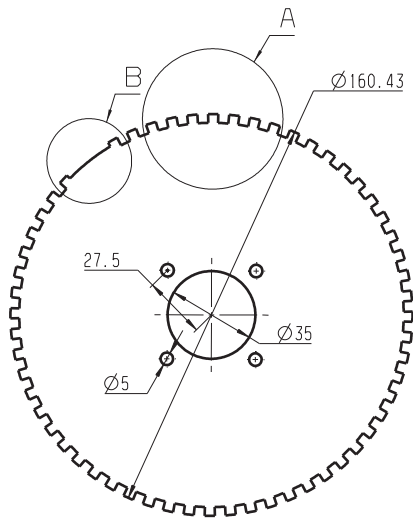
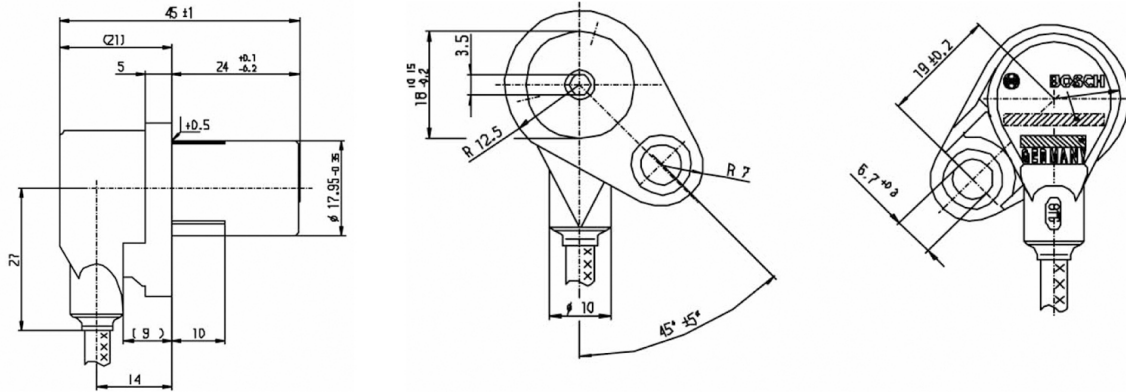
**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

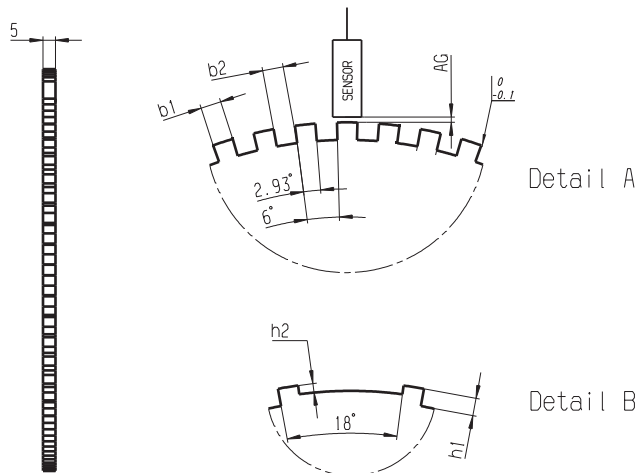
**Ordering Information**

**Inductive Speed Sensor IA-C**  
 Order number **0 261 210 136**

**Dimensions**








60-2 Teeth



Left view

## Temperature Sensors NTC Overview

	Temperature Sensor NTC M5-HS	Temperature Sensor NTC M8-HS	Temperature Sensor NTC M12	Temperature Sensor NTC M12-H	Temperature Sensor NTC M12-L
					
Application (°C)	-55 to 300	-55 to 300	-40 to 130	-40 to 150	-40 to 140
Response time $\tau_{63}$	< 4	< 4	< 15	< 15	< 10
Accuracy at 25°C	± 0.3	± 0.3	± 1.4	± 1.4	± 1.4
Accuracy at 100°C	± 1.3	± 1.3	± 3.4	± 0.8	± 3.4
Male thread	M5 x 1	M8 x 1	M12 x 1.5	M12 x 1.5	M12 x 1.5
Nominal resistance (kOhm)	10 ± 1 % (at 25°C)	10 ± 1 % (at 25°C)	2.5 ± 5 % (at 20°C)	2.5 ± 6 % (at 20°C)	2.5 ± 5 % (at 20°C)

## Temperature Sensor NTC M5-HS



### Features

- ▶ Wide measurement range: -55 to 300°C
- ▶ Very short response time
- ▶ Strong protection against ambient temperature
- ▶ Compact and robust design

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

#### Electrical Data

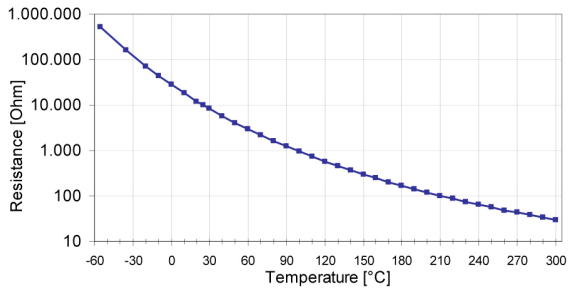
Characteristic	NTC
Nominal resistance at 25°C	10 kOhm ± 1 %

#### Characteristic

Accuracy at 25°C (homogeneous cond.)	± 0.3°C
Accuracy at 100°C (homogeneous cond.)	± 1.3°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	ASL 6-06-05PN-HE
Mating connector ASL 0-06-05SN-HE	F 02U 000 231-01
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.

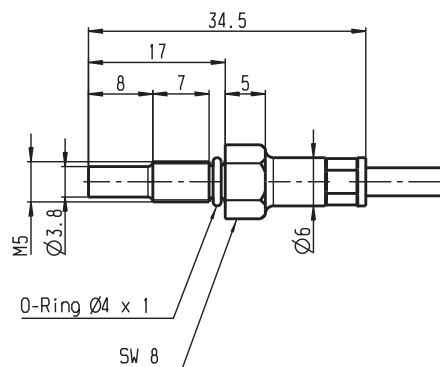
### Safety Note

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 **F 02U V00 510-01**

### Dimensions



## Temperature Sensor NTC M8- HS



### Features

- ▶ Wide measurement range: -55 to 300°C
- ▶ Very short response time
- ▶ Strong protection against ambient temperature
- ▶ Robust design

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

#### Electrical Data

Characteristic	NTC
Nominal resistance at 25°C	10 kOhm ± 1 %

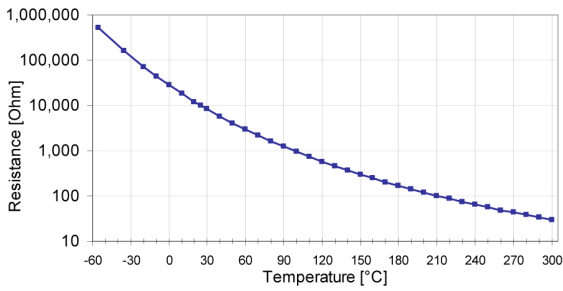
### Characteristic

Accuracy at 25°C (homogeneous cond.)	± 0.3°C
Accuracy at 100°C (homogeneous cond.)	± 1.3°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



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 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.

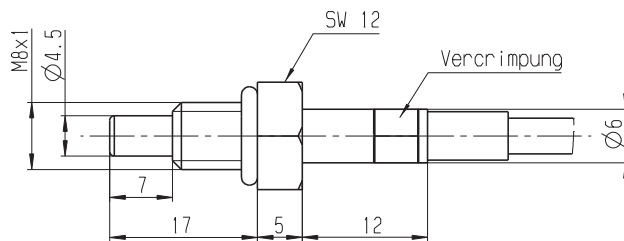
**Ordering Information**

**Temperature Sensor NTC M8-HS**  
 Order number **F 02U V00 509-01**

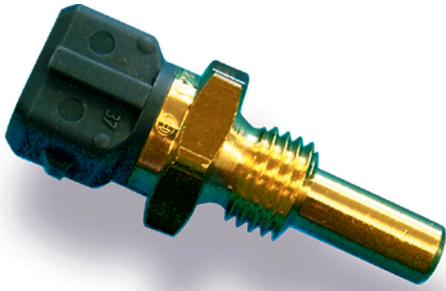
**7 Connectors and Wires**

Connector	ASL 6-06-05PN-HE
Mating connector	F 02U 000 231-01
ASL 0-06-05SN-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+
Pin 4	-

**Dimensions**



## Temperature Sensor NTC M12



### Features

- ▶ Measurement range: -40 to 130°C
- ▶ Robust design

This sensor is designed to measure fluid temperatures 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 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

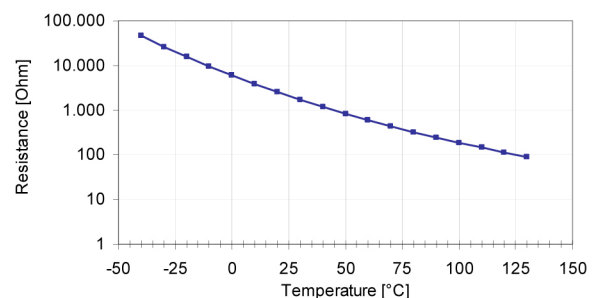
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm ± 5 %

### 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 2-pole Jetronic	D 261 205 288-01
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

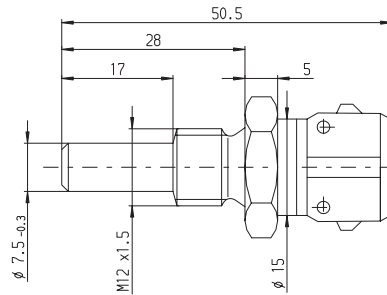
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

**Temperature Sensor NTC M12**

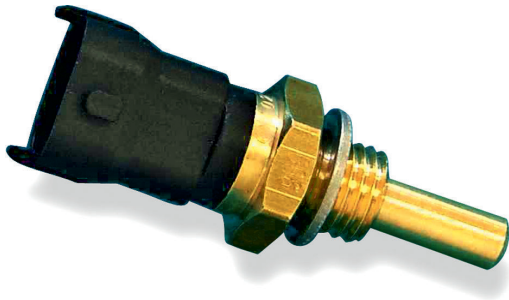
Order number **0 280 130 026**

### Dimensions





## Temperature Sensor NTC M12-H



### Features

- ▶ Measurement range: -40 to 150°C
- ▶ Robust design

This sensor is designed to measure fluid temperatures 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 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

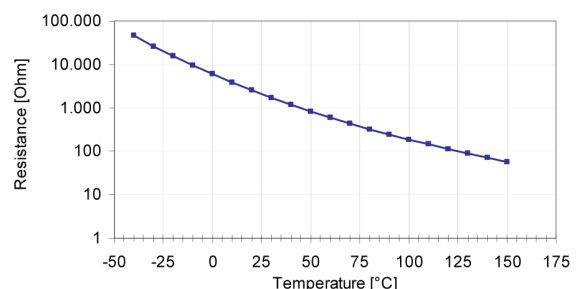
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm ± 6 %

### Characteristic

Accuracy at 25°C	± 1.4°C
Accuracy at 100°C	± 0.8°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	D 261 205 337-01
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.

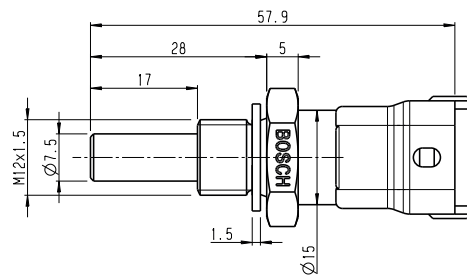
### Safety Note

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 **0 281 002 170**

### Dimensions



## Temperature Sensor NTC M12-L



### Features

- ▶ Measurement range: -40 to 140°C
- ▶ Air temperature measurement
- ▶ Robust design

This sensor is designed to measure air temperature e.g. in the air box or ambient temperature. The 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

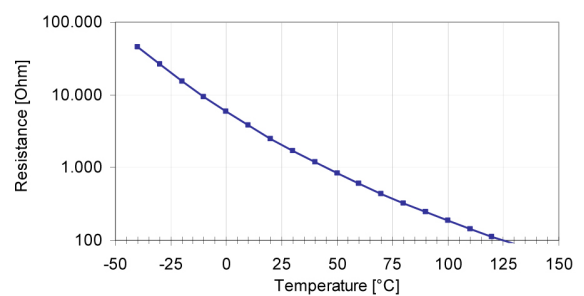
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm ± 5%

### Characteristic

Accuracy at 25°C	± 1.4°C
Accuracy at 100°C	± 3.4°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 2-pole Jetronic	D 261 205 288-01
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.

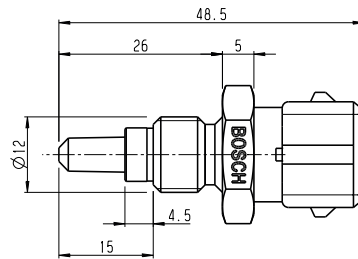
### Safety Note

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 **0 280 130 039**

### Dimensions



### Thermocouple Probes Overview

	Thermocouple Probe TCP K	Thermocouple Probe TCP KA	Thermocouple Probe TCP KC	Thermocouple Probe TCP KN 2
				
Typ	K	K	K	K
Application (°C)	-200 to 1,000	0 to 1,250	0 to 1,250	0 to 1,250
Output signal (mV)	-5.9 to 52.4	0 to 5,000	0 to 5,000	0 to 5,000
Integrated amplifier	-	+	+	+
Thread	M8 x 1 (optional)	M12 x 1	M8 x 1	M14 x 1.5
Design	Straight	Angled 90°	Straight	Straight
Mounting depth (mm)	Ca. 250	38	38.5	50
Temp. range external electronics (°C)	On request	0 to 120	0 to 120	0 to 125

## Thermocouple Probe TCP K



### Features

- ▶ Thermocouple Type K
- ▶ Thermo material: NiCr-Ni
- ▶ Measurement range: -200 to 1,000°C (1,300°C)
- ▶ Flexible mounting depth
- ▶ Analog output (Thermo voltage)

This sensor is designed to measure exhaust gas temperatures up to 1,300°C.

Thermocouples are temperature sensors that supply a temperature corresponding voltage without any additional external energy source.

The thermocouple has a metal mantle that includes two isolated inner wires made of thermo material NiCr-Ni Type K.

The benefits of this sensor are the combination of high quality production part, robust design with metal housing and motorsport connector and a very quick response time.

### Application

Application	-200 to 1,000°C (1,300)°C
Max. vibration	800 m/s <sup>2</sup> at 5 to 500 Hz

### Technical Specifications

#### Mechanical Data

Male thread	See adapter
Wrench size	See adapter
Installation torque	See adapter
Weight with wire	47 g
Sensor tip bend radius	R 20

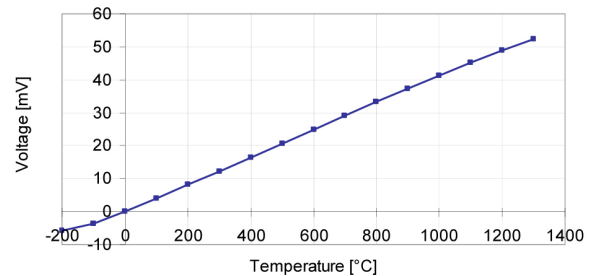
#### Electrical Data

Voltage supply	NiCr/Ni Typ K
Full scale output	DIN IEC 584-1

### Characteristic Application

Accuracy (max. value) ± 1.5°C or 0.004 \* t

T [°C]	U [mV]
-200	-5.891
-100	-3.554
0	0.000
100	4.096
200	8.138
300	12.209
400	16.397
500	20.644
600	24.905
700	29.129
800	33.275
900	37.326
1,000	41.276
1,100	45.119
1,200	48.838
1,300	52.410



### Connectors and Wires

Connector	ASL 6-06-05PD-HE
Mating connector	F 02U 000 229-01
ASL 0-06-05SD-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+
Pin 4	-
Pin 5	Src
Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 75 cm

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

### Installation Notes

The TCP K can be connected to Bosch Motorsport ECUs with thermocouple inputs (w/o pull-up resistant) or to external devices, which amplify the sensor voltage.

Recommended max. continuous utilization temperature 1,000°C, short-term utilization temperature 1,300°C.

The sensor can be mounted individually according to the customer request.

The sensor tip is flexible/ bendable and can be fixed by a special adapter (B 261 209 159-01).

The length of the sensor tip can be modified on request.

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.

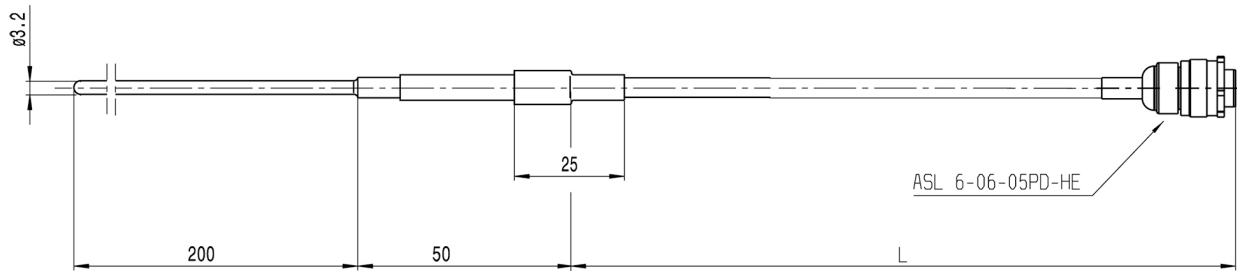
### Ordering Information

**Thermocouple Probe TCP K**  
Order number **B 261 209 385-01**

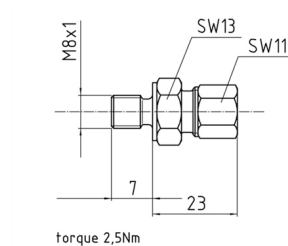
### Accessories

**Thermocouple Probe TCP K Adapter**  
Order number **B 261 209 159-01**

### Dimensions



Sensor



Adapter

## Thermocouple Probe TCP KA



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### Features

- ▶ Thermocouple Type K
- ▶ Thermo material: NiCr-Ni
- ▶ Measurement range: 0 to 1,250°C
- ▶ Analog output (0 to 5 V) or CAN

This sensor is designed to measure exhaust gas temperatures up to 1,250°C.

Thermocouples are temperature sensors that supply a temperature corresponding voltage without any additional external energy source. The thermocouple has a metal mantle that includes two isolated inner wires made of thermo material NiCr-Ni Type K. The voltage is amplified by an electronic circuit powered by 12 V.

Please note that the operating temperature of the external electronics is from 0 to 120°C.

The benefits of this sensor are the combination of high quality production part, robust design and its integrated amplifier.

### Application

Application	0 to 1,250°C
Operating temp. range (ext. electronics)	0 to 120°C

### Technical Specifications

#### Mechanical Data

Male thread	M12x1
Wrench size	17 mm
Installation torque	15 Nm
Weight with wire	85 g

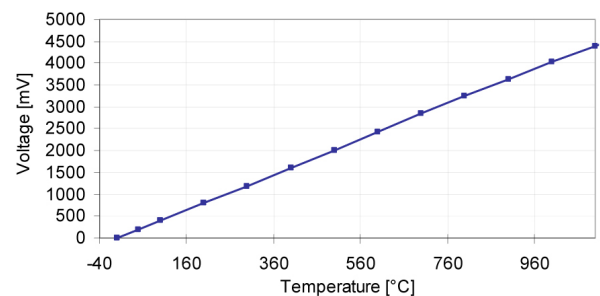
#### Electrical Data

Voltage supply	12 V
----------------	------

#### Analog Variant

Full scale output	0 to 5 V
-------------------	----------

T [°C]	U [mV]
0	0
50	197
100	399
200	793
300	1,190
400	1,598
500	2,012
600	2,427
700	2,839
800	3,243
900	3,638
1,000	4,022
1,100	4,396
1,200	4,759
1,250	5,000



#### CAN Variant

#### CAN Message

CAN ID 0x3F0 (default)

Byte	Value
0	Thermocouple Temperature
1	
2	Ambient Temperature
3	

#### CAN Signals

Length	16 Bit
Byte order	Motorola (Big Endian)
Bit mask	Signed
Factor	0.1°C/Bit



CAN Variant	
Offset	0.0
<b>CAN Parameter</b>	
CAN speed	1 Mbaud or 500 kbaud (default 1 Mbaud)
CAN frequency	100 Hz Thermocouple Temp. 1 Hz Ambient Temp.
Phys. unit	Degrees Celsius (default) or Degrees Fahrenheit
CAN Frame ID	0x1 to 0x7F0 (default 0x3F0)

Please specify the requested CAN parameters with your order in the calibration sheet.

### Connectors and Wires

Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 75 cm

Analog Variant	
Connector	F 02U B00 292-01
Mating connector	D 261 205 357-01
Pin 1	Sig
Pin 2	Gnd
Pin 3	U <sub>s</sub>

CAN Variant	
Connector	ASU 6-03-05PB-HE
Mating connector	F 02U 000 207-01

CAN Variant	
ASU 0-03-05SB-HE	
Pin 1	U <sub>s</sub>
Pin 2	Gnd
Pin 3	CAN High
Pin 4	CAN Low

### Installation Notes

The sensor can be mounted individually according to the customer's request.

Please note that the operating temperature range of the external electronics is from 0 to 120°C.

Recommended bending radius of the wire of the sensor element is minimum 20 mm to ensure the sensor works properly and for a longer lifespan of the sensor.

Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for Bosch Data Logging System at our homepage.

### Safety Note

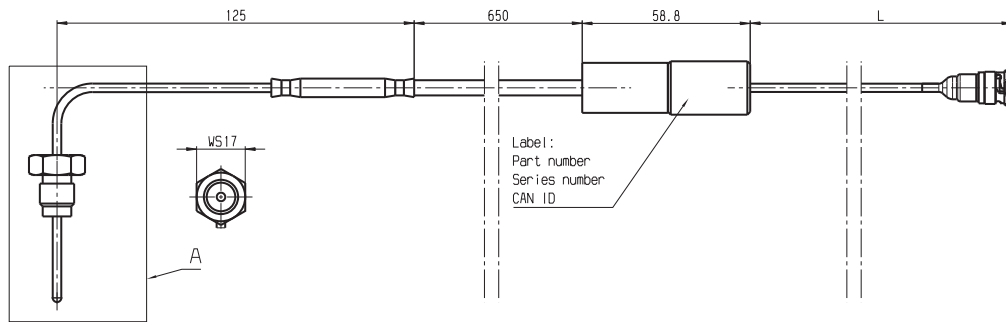
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Ordering Information

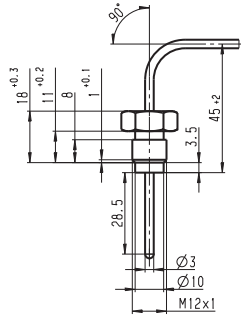
**Thermocouple Probe TCP KA**  
Analog Variant  
Order number **F 02U V01 664-01**

**Thermocouple Probe TCP KA**  
CAN Variant  
Order number **F 02U V02 422-01**

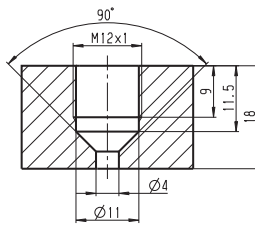
Dimensions



Detail A  
Scale: 1:1



Recommended mounting hole



CAN Variant (Analog Variant: see website)

## Thermocouple Probe TCP KC



### Features

- ▶ Thermocouple Type K
- ▶ Thermo material: NiCr-Ni
- ▶ Measurement range: 0 to 1,250°C
- ▶ Analog output (0 to 5 V) or CAN

This sensor is designed to measure exhaust gas temperatures up to 1,250°C.

Thermocouples are temperature sensors that supply a temperature corresponding voltage without any additional external energy source. The thermocouple has a metal mantle that includes two isolated inner wires made of thermo material NiCr-Ni Type K.

The voltage is amplified by an electronic circuit powered by 12 V. Please note that the operating temperature of the external electronics is from 0 to 120°C.

The sensing element is protected by a single-walled housing made of Nimonic 75 to enable its placement before turbo chargers.

The benefits of this sensor are the combination of high quality production part, robust design and its integrated amplifier at more attractive price.

### Application

Application	0 to 1,250°C
Max. vibration	Vibration profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )
Operating temp. range (ext. electronics)	0 to 120°C

### Technical Specifications

#### Mechanical Data

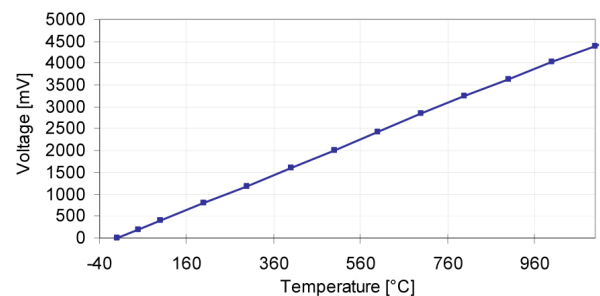
Male thread	M8x1
Wrench size	11 mm
Installation torque	12 Nm
Weight w/o wire	Ca. 18 g

#### Electrical Data

Voltage supply	12 V
----------------	------

#### Analog Variant

Full scale output	0 to 5 V
T [°C]	U [mV]
0	0
50	197
100	399
200	793
300	1,190
400	1,598
500	2,012
600	2,427
700	2,839
800	3,243
900	3,638
1,000	4,022
1,100	4,396
1,200	4,759
1,250	5,000



#### CAN Variant

#### CAN Message

CAN ID 0x3F0 (default)

Byte	Value
0	Thermocouple Temperature
1	
2	Ambient Temperature
3	

#### CAN Signals

Length	16 Bit
Byte order	Motorola (Big Endian)
Bit mask	Signed
Factor	0.1°C/Bit

CAN Variant	
Offset	0.0

**CAN Parameter**

CAN speed	1 Mbaud or 500 kbaud (default 1 Mbaud)
CAN frequency	100 Hz Thermocouple Temp. 1 Hz Ambient Temp.
Phys. unit	Degrees Celsius (default) or Degrees Fahrenheit
CAN Frame ID	0x1 to 0x7F0 (default 0x3F0)

Please specify the requested CAN parameters with your order in the calibration sheet.

**Connectors and Wires**

Sleeve	DR-15
Sleeve from amplifier to connector	DR-25
Wire size	AWG 24
Wire length L	20 to 92 cm

**Analog Variant**

Connector	ASU 6-03-03PD-HE
Mating connector	ASU 0-03-03SD-HE
Pin 1	Power supply 5 to 16 V
Pin 2	Gnd
Pin 3	Signal 0 to 5 V

**CAN Variant**

Connector	ASU 6-03-05PB-HE
Mating connector	F 02U 000 207-01

CAN Variant	
ASU 0-03-05SB-HE	

Pin 1	$U_s$
Pin 2	Gnd
Pin 3	CAN High
Pin 4	CAN Low
Pin 5	Not connected

**Installation Notes**

The TCP KC can be connected to Bosch Motorsport ECUs with a 0 to 5 V analog signal input (w/o pull-up resistor) or to external data logging devices.

The sensor can be mounted individually according to the customer's request.

Please note that the operating temperature range of the external electronics is from 0 to 120°C.

Recommended bending radius of the wire of the sensor element is minimum 20 mm to ensure the sensor works properly and for a longer lifespan of the sensor.

Any mounting orientation is possible.

**Safety Note**

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

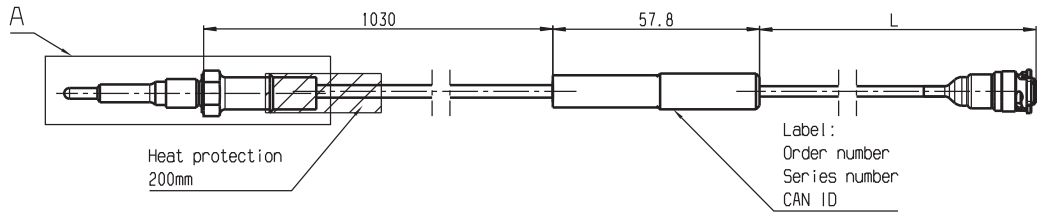
**Ordering Information****Thermocouple Probe TCP KC**

Analog Variant  
Order number **F 02U V02 041-01**

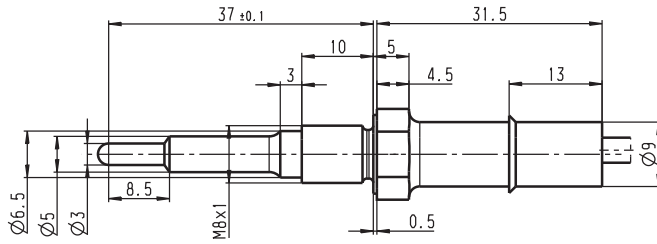
**Thermocouple Probe TCP KC**

CAN Variant  
Order number **F 02U V02 423-01**

Dimensions



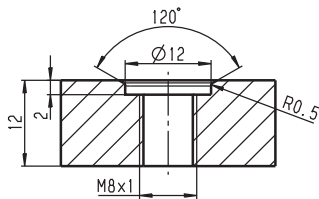
Detail A  
Scale: 2:1



Front view  
Scale: 2:1

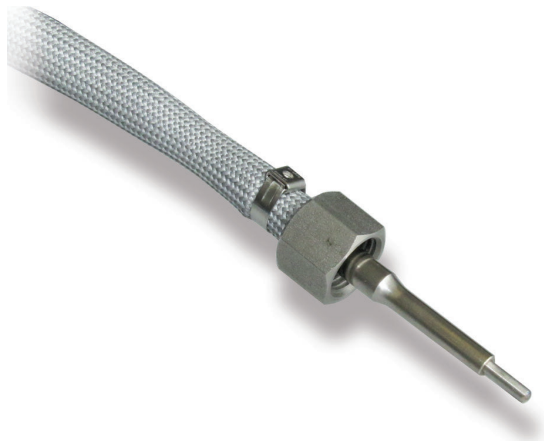


Recommended mounting hole



CAN Variant (Analog Variant: see website)

## Thermocouple Probe TCP KN 2



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### Features

- ▶ Thermocouple Type K
- ▶ Thermo material: NiCr-Ni
- ▶ Measurement range: 0 to 1,250°C
- ▶ Analog output (0 to 5 V) or CAN

This sensor is designed to measure exhaust gas temperatures up to 1,250°C.

Thermocouples are temperature sensors that supply a temperature corresponding voltage without any additional external energy source. The thermocouple has a metal mantle that includes two isolated wires made of thermo material NiCr-Ni Type K.

The voltage is amplified by an electronic circuit powered by 12 V. Please note that the operating temperature of the external electronics is from 0 to 125°C.

The sensing element is protected by a double-walled housing made of Nimonic 75 to enable its placement before turbo chargers.

The benefits of this sensor are the combination of high quality production part, robust design and its integrated amplifier

### Application

Application	0 to 1,250°C
Operating temp. range (ext. electronics)	0 to 125°C

### Technical Specifications

#### Mechanical Data

Male thread	M14x1.5
Wrench size	17 mm
Installation torque	15 Nm
Weight with wire	85 g

### Electrical Data

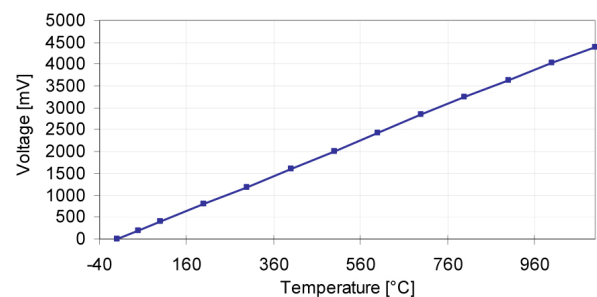
Voltage supply	12 V
----------------	------

#### Analog Variant

Full scale output	0 to 5 V
-------------------	----------

#### T [°C]                      U [mV]

0	0
50	197
100	399
200	793
300	1,190
400	1,598
500	2,012
600	2,427
700	2,839
800	3,243
900	3,638
1,000	4,022
1,100	4,396
1,200	4,759
1,250	5,000



#### CAN Variant

#### CAN Message

CAN ID 0x3F0 (default)

Byte	Value
0	Thermocouple Temperature
1	
2	Ambient Temperature
3	

#### CAN Signals

Length	16 Bit
Byte order	Motorola (Big Endian)

CAN Variant	
Bit mask	Signed
Factor	0.1°C/Bit
Offset	0.0
CAN Parameter	
CAN speed	1 Mbaud or 500 kbaud (default 1 Mbaud)
CAN frequency	100 Hz Thermocouple Temp. 1 Hz Ambient Temp.
Phys. unit	Degrees Celsius (default) or Degrees Fahrenheit
CAN Frame ID	0x1 to 0x7F0 (default 0x3F0)
Please specify the requested CAN parameters with your order in the calibration sheet.	

### Connectors and Wires

Sleeve	DR-25
Wire size	AWG 24
Wire length L	15 to 75 cm

Analog Variant	
Connector	ASU 6-03-03PB-HE
Mating connector ASU 0-03-03SB-HE	F 02U 000 195-01
Pin 1	Power supply 5 to 16 V
Pin 2	Gnd
Pin 3	Signal 0 to 5 V
CAN Variant	
Connector	ASU 6-03-05PB-HE
Mating connector ASU 0-03-05SB-HE	F 02U 000 207-01
Pin 1	U <sub>s</sub>

CAN Variant	
Pin 2	Gnd
Pin 3	CAN High
Pin 4	CAN Low
Pin 5	Not connected

### Installation Notes

The TCP KN2 can be connected to Bosch Motorsport ECUs with a 0 to 5 V analog signal input (w/o pull-up resistor) or to external data logging devices.

The sensor can be mounted individually according to the customer's request.

Please note that the operating temperature range of the external electronics is from 0 to 125°C.

Recommended bending radius of the wire of the sensor element is minimum 20 mm to ensure the sensor works properly and for a longer lifespan of the sensor.

Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for 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

#### Thermocouple Probe TCP KN 2

Analog Variant

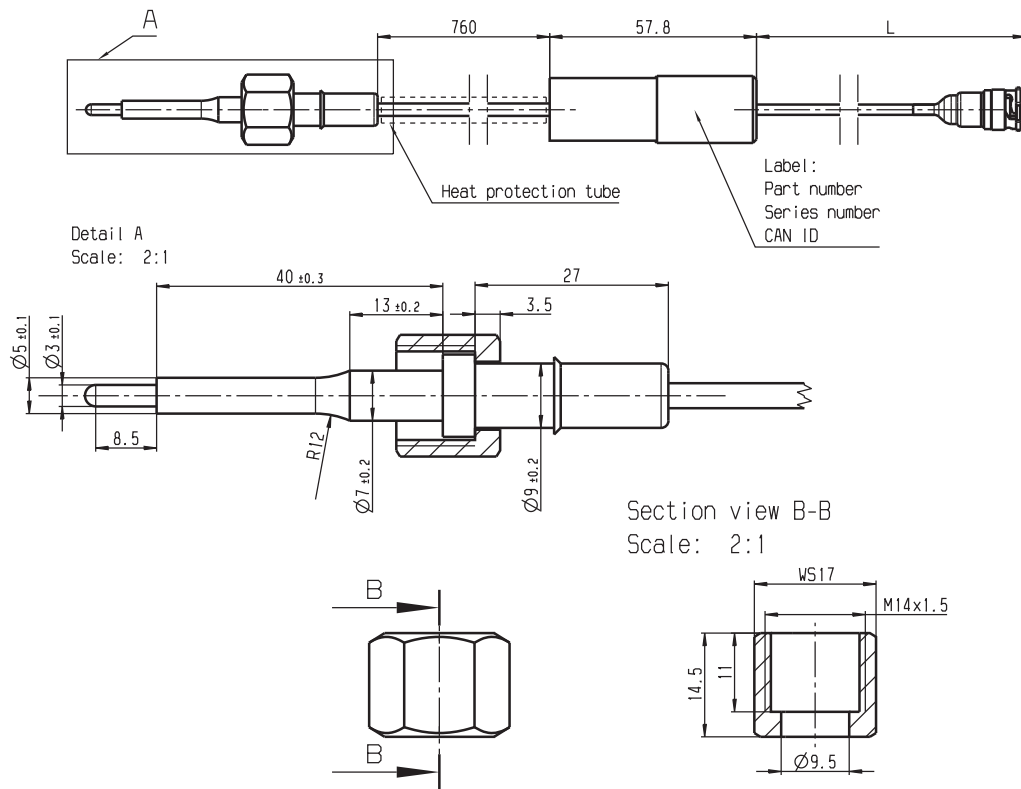
Order number **F 02U V01 863-01**

#### Thermocouple Probe TCP KN 2

CAN Variant

Order number **F 02U V02 425-01**

Dimensions



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CAN Variant (Analog Variant: see website)



## Acceleration Sensor MM5.10



### Features

- ▶ 2-axis rotation rate (yaw rate, roll rate)
- ▶ 3-axis accelerometer (X, Y, Z)
- ▶ 1 Mbaud or 500 kbaud CAN-output
- ▶ 15 Hz low-pass filtered
- ▶ Measurement ranges:  $\pm 4.2$  g;  $\pm 163^\circ/\text{s}$

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 lineal 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	$\pm 4.2$ 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 02 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
<b>Characteristic Application II</b>	
Measuring range	±4.2 g
Over range limit	±10 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)	F 02U 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)	ASL-6-06-05PC-HE
Mating connector (3)	ASL-0-06-05SC-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

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.

### 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 **F 02U V01 511-02**

#### Acceleration Sensor MM5.10

Wire with open end (2)

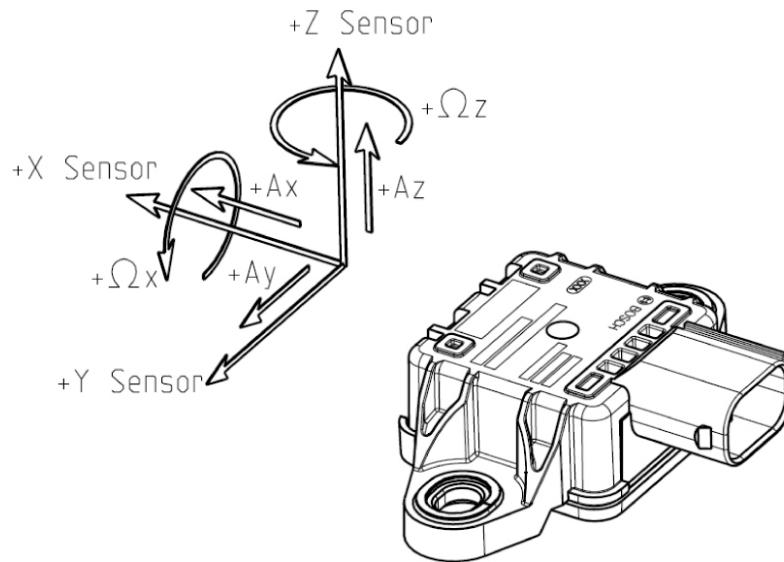
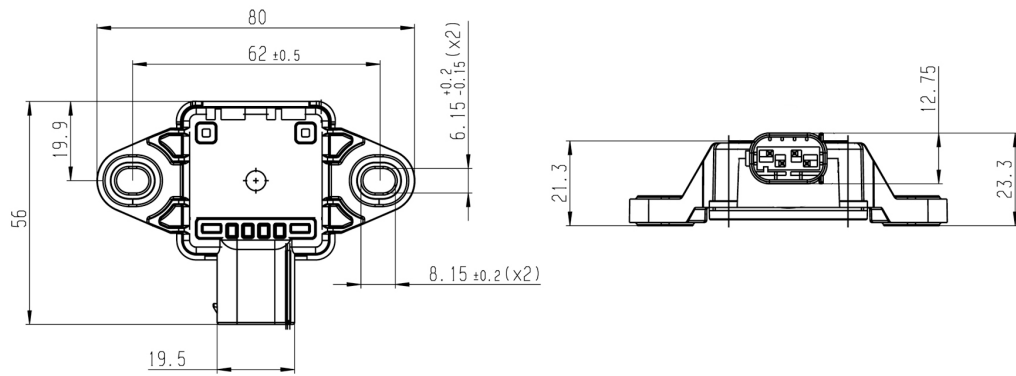
Order number **F 02U V01 511-92**

#### Acceleration Sensor MM5.10

Wire with motorsport connector (3)

Order number **F 02U V01 512-03**

## Dimensions



Axis Scheme

## Acceleration Sensor MM5.10-R



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### Features

- ▶ 2-axis rotation rate (yaw rate, roll rate)
- ▶ 3-axis accelerometer (X, Y, Z)
- ▶ 1 Mbaud or 500 kbaud CAN-output
- ▶ Aluminum housing
- ▶ Integrated motorsport connector

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
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 02 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
<b>Characteristic Application II</b>	
Measuring range	±4.2 g
Over range limit	±10 g
Absolute physical resolution	0.01 g
Cut-off frequency (-3 dB)	15 Hz; 30 Hz; 60 Hz
<b>Connectors and Wires</b>	
Connector	ASX 0-02-05PA-HE
Mating connector	ASX 6-02-05SA-HE
Pin 1	UBat
Pin 2	CANH
Pin 3	Not connected
Pin 4	CANL
Pin 5	Gnd
Sleeve	DR-25
<b>CAN Parameters</b>	
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

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.

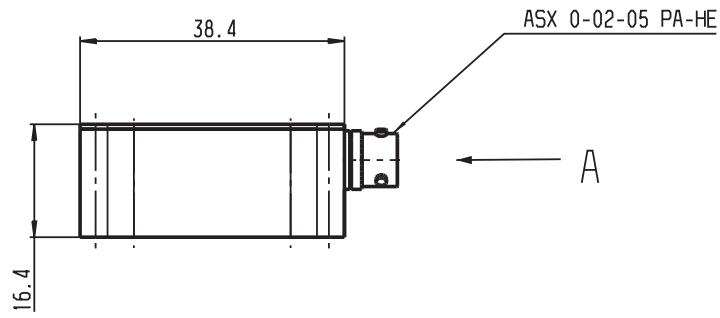
### Safety Note

The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

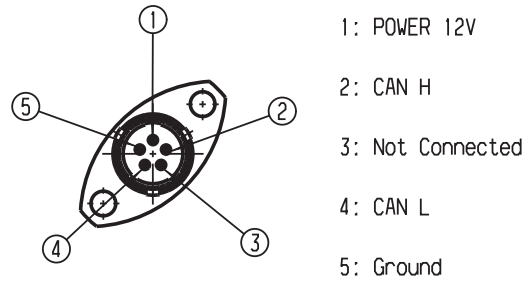
### Ordering Information

**Acceleration Sensor MM5.10-R**  
Order number **F 02U V02 007-01**

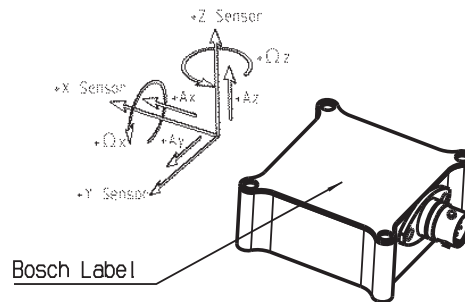
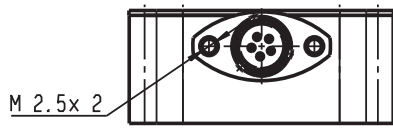
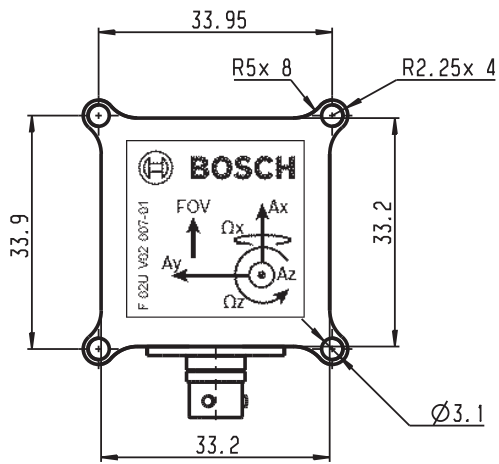
Dimensions



Detail A  
Electrical Connection



ASX 0-02-05 PA-HE



# 08 Brake Control

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ABS

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## ABS Overview

	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 wheel speed sensors DF11S	Included, with standard connectors	Included, with motor-sport connectors	Not included	Not included	Included, with standard connectors
Wheel speed signal splitter TTL	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 Porsche 991 Cup Gen 1	ABS M5 Kit Porsche 991 Cup Gen 2
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Type	500 kbaud, DF11S	Model year 2015	Model year 2017
Wiring harness	Generic	Specific	Specific
4 wheel speed sensors DF11S	Included, with standard connectors	Included, Porsche specific DF11S	Included, Porsche specific DF11S
Wheel speed signal splitter TTL	Included*	Included, DF11	Included, DF11
Fuses	Not included	Included	Included
Brake pipe fittings	Not included	Included	Included

\*TTL Splitter incl. in ABS Hardware, DF11 Splitter optional



## 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	Club-sport	Kit 1	Kit 2	
	F 02UV05	291-01	289-01	290-01
		292-01		
		293-01		
		294-01		
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	-	+	+	
Lateral acceleration slip regulation	-	+	+	
Corner inside wheel slip reduction regulation	-	+	+	

+\*: 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 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

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

#### Communication

ABS and Yaw rate sensor CAN1

Diagnostics MSA Box II

#### 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-damping boards	80 g
Mounting board for hydraulic unit	212 g
<b>Optional Accessories</b>	
Data logger C 70	F 02U V02 302-01
Display DDU 9	F 02U V02 300-02

Display DDU 10	F 02U V02 659-01
Communication interface MSA Box II	F 02U V00 327-02
Wheel speed signal splitter with 1 motorsport connector	F 02U V01 928-01

### Ordering Information

#### ABS M5 Kit 1

Order number **F 02U V05 289-01**

#### ABS M5 Kit 2

Order number **F 02U V05 290-01**

## ABS M5 Kit Clubsport



### Features

- ▶ 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

The ABS M5 Kit Clubsport is developed for the operation in front-, rear- or 4-wheel drive vehicles. A generic wiring harness is included in the kit. This enables us to provide the kit with a significantly reduced price in comparison to the standard ABS M5 Kit with individual loom.

The ABS M5 Kit Clubsport 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

#### Mechanical Data

##### Hydraulic unit with attached ECU

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 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

Brake pressure (front brake circuit / rear brake circuit)

Longitudinal acceleration, lateral acceleration, yaw rate (MM5.10 sensor)

11 adjustment settings

ABS function can be deactivated (Pos. 12)

#### Outputs

ABS warning light (MIL)

TTL wheel speed signal FL / FR / RL / RR

#### Communication

ABS and Yaw Rate Sensor      CAN1

Diagnostics      MSA Box II

#### Content of Kit and Weights

Hydraulic unit with attached ECU      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

Standard wiring harness      1,540 g

Mounting and vibration-damping boards      80 g

Mounting board for hydraulic unit      212 g

#### Optional Accessories

Data logger C 70      F 02U V02 302-01

Display DDU 9      F 02U V02 300-02

Display DDU 10      F 02U V02 659-01

Communication interface MSA Box II      F 02U V00 327-02

Wheel speed signal splitter with 1 motorsport connector      F 02U V01 928-01

**Ordering Information**

**ABS M5 Kit Clubsport**

DF11i, 500 kbaud

Order number **F 02U V05 291-01**

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**ABS M5 Kit Clubsport**

DF11i, 1 Mbaud

Order number **F 02U V05 292-01**

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**ABS M5 Kit Clubsport**

DF11S, 500 kbaud

Order number **F 02U V05 293-01**

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**ABS M5 Kit Clubsport**

DF11S, 1 Mbaud

Order number **F 02U V05 294-01**

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## ABS M5 Kit Porsche 991 Cup



### Features

- ▶ Plug & Play ABS M5 Kit for Porsche 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 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, wheelbase or number of increments can be calibrated with software free of charge. Please contact your Bosch Motorsport dealer for further information.

### Technical Specifications

#### Mechanical Data

##### Hydraulic unit with attached ECU

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	F 02U V02 302-01
Display DDU 9	F 02U V02 300-02

#### Communication

CAN via MSA Box II

#### Content of Kit

Hydraulic unit with attached ECU
Holder for Hydraulic unit
Wheel speed signal splitter
2 pressure sensors
MM5.10 acceleration sensor
Vibrations damping board for acceleration sensor
12 position function switch
ABS warning light (MIL)
Specific wiring harness
Brake pipe fittings
Fuses
Fuse mounting bracket

#### Required Content

Brake pipes not included, available at Bosch Motorsport dealer

### Ordering Information

**ABS M5 Kit Porsche 991 Cup Gen 1**  
2015 Model Year  
Order number **F 02U V05 289-18**

**ABS M5 Kit Porsche 991 Cup Gen 2**  
2017 Model Year  
Order number **F 02U V05 289-19**



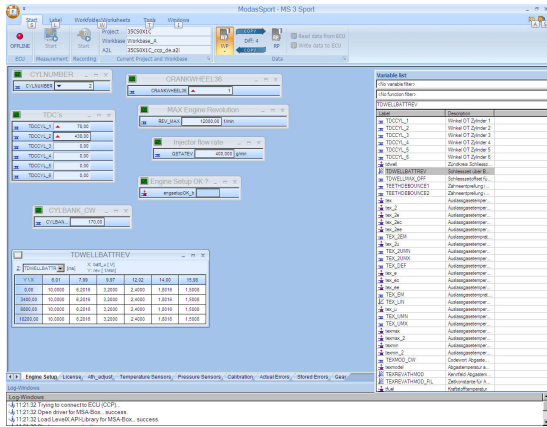
# 09 Software

9

<b>Calibration</b>	<b>360</b>
<b>Simulation</b>	<b>362</b>
<b>Analysis</b>	<b>364</b>
<b>Customer Code Area</b>	<b>366</b>

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# Modas Sport



## Features

### ► Calibration software tool for Bosch ECUs

Modas Sport is the calibration tool for Bosch Motorsport ECUs. It integrates a lot of meaningful features to manage our engine control units at the dyno and the racetrack.

## Functions

Calibration tool for MS 3, MS 4.x, MS 5.x, MS 15, MS 3 Sport, MS 4 Sport, MS 15 Sport

Visualization, processing and management of calibration, measurement and documentation data

### Measuring system

Numeric data visualization

Bitwise, decimal, hexadecimal data visualization

Recording of measurement data (needs WinDarab to analyze)

Oscilloscope (graphic data visualization)

### Calibration system

Visualization and manipulation of parameters (calibration data)

Parameter file manager

Data file manager (copy & compare)

Macro manager

Potiboard support integrated

## Administration

Work base management

Integrated K-Line flashing tool

Intuitive design, easy to use, based on latest technology

## Technical Specifications

### Function requirements

#### PC

IBM PC compatible, min. 1.6 GHz

Approx. 512 MB RAM

Approx. 100 MB free hard disc space

VGA monitor (min. 1,024 x 768)

#### Operating systems

Windows XP 32 Bit, Vista 32/64 Bit, Windows 7 32/64 Bit

### Optional Accessories

MSA-Box II F 02U V00 327-02

WinDarab Free data analysis Software On request

## Communication

CAN (CCP), K-Line (KWP2000)

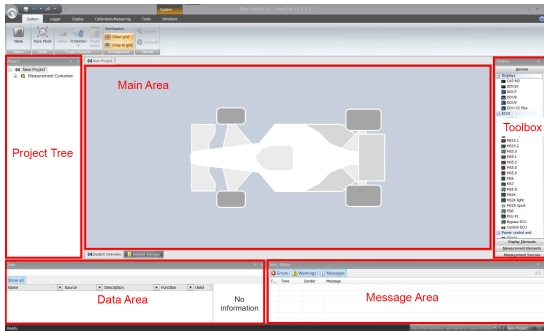
## Ordering Information

### Modas Sport

Order number **Free download at our homepage**



## 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.

### Functions

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)

Windows Vista 32/64 Bit, Windows 7 32/64 Bit, Windows 10 32/64 Bit

#### Optional Accessories

MSA-Box II

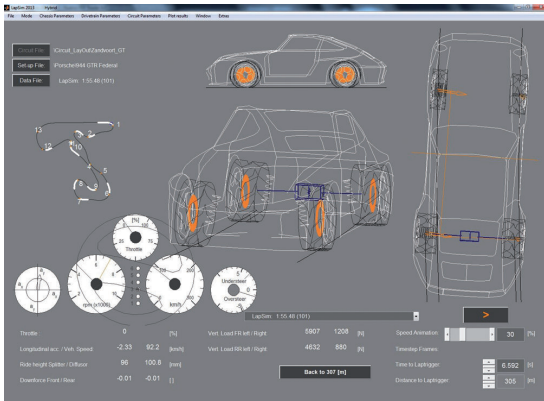
F 02U V00 327-02

#### Ordering Information

##### RaceCon

Order number **free download**

## LapSim



### Features

- ▶ Professional Simulation Tool
- ▶ Free / Chassis / Engine Versions available
- ▶ Find more at [www.lapsim.nl](http://www.lapsim.nl)

#### 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.

### Functions

#### 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**

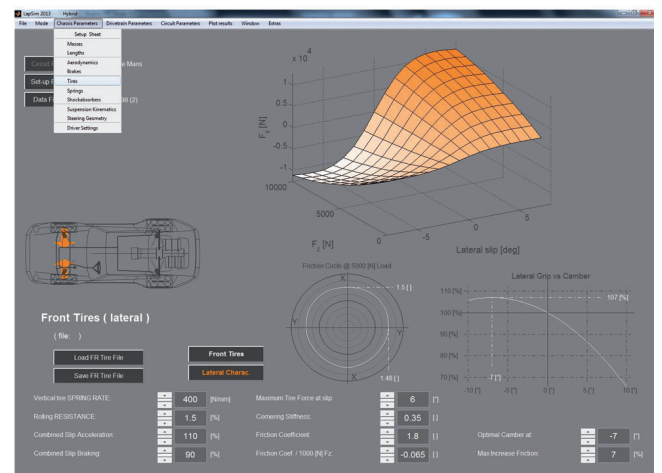
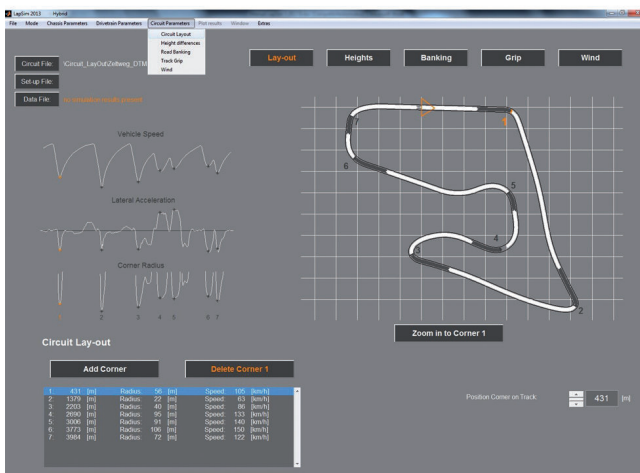
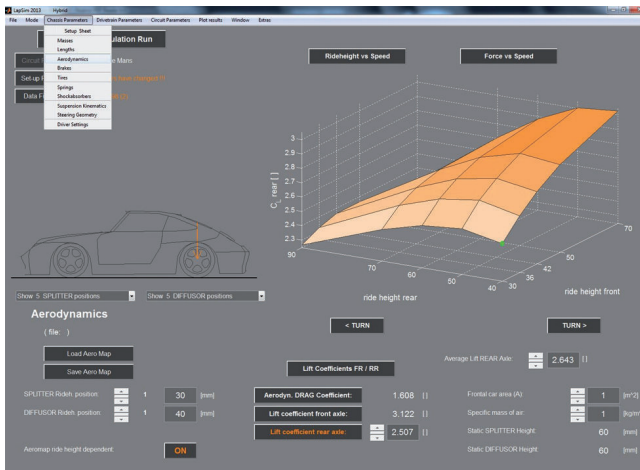
#### LapSim Chassis License

Order number **B 261 206 432-01**

#### LapSim Chassis and Engine License

Order number **F 01T A20 057-01**

Dimensions



A few Screenshots

## 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 online 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.

### Functions

#### 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)

##### Operating systems

- Windows XP 32 Bit, Vista 32/64 Bit, Windows 7 32/64 Bit

### 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.	+, -, *, /, ^, $\sqrt{x}$ , $\sqrt[3]{x}$	All

Extras settings/comments	-	+
Desktop load/save	+	+
Telemetry	+	+
Programming interface (API)	-	Opt.

### Ordering Information

#### WinDarab Free

Order number **Free download**

#### WinDarab Expert

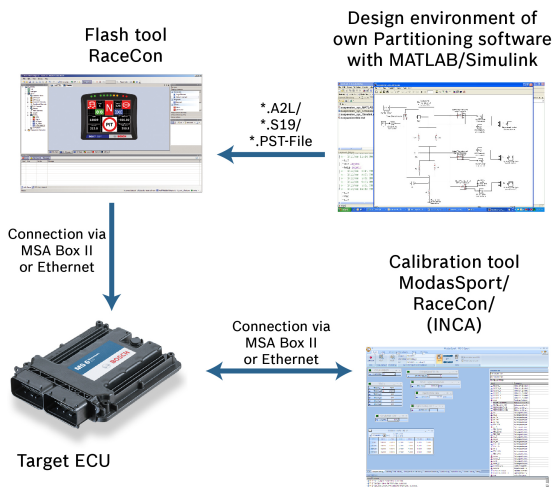
Order number **F 02U V01 308-01**

#### Software Options

##### Software licence API for WinDarab Expert

Order number **F 02U 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 CCP via CAN or XCP via Ethernet

SW-Download via Bosch Motorsport calibration tool RaceCon

Software option for all MS 6.x, MS 7.x

### Required and not included Software

MathWorks Requirements

MATLAB R2013b

Simulink

Real-Time Workshop

Real-Time Workshop Embedded Coder

Fixed-Point Toolbox

Simulink Fixed-Point

Stateflow

Stateflow Coder

Vehicle Network Toolbox

Compiler

Wind River

### Operating Systems

Windows 7, 64 Bit SP1

### 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 **F 02U V02 137-01**

# 10 Accessories

10

<b>Breakout Boxes</b>	<b>368</b>
<b>Communication Interface</b>	<b>373</b>
<b>Connector Opening Tool</b>	<b>374</b>
<b>Connectors</b>	<b>375</b>
<b>Wiring Harnesses</b>	<b>376</b>

---

## 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

F 02U V02 295-01 code blue

Connector on housing	AS 0-18-35PB
----------------------	--------------

Connector on wire	AS 6-18-35SB
F 02U V02 296-01 code orange	
Connector on housing	AS 0-18-35PC
Connector on wire	AS 6-18-35SC
F 02U V02 297-01 code red	
Connector on housing	AS 0-18-35PN
Connector on wire	AS 6-18-35SN
F 02U V02 298-01 code yellow	
Connector on housing	AS 0-18-35PA
Connector on wire	AS 6-18-35SA
F 02U V02 299-01 code violet (universal)	
Connector on housing	AS 0-18-35PU
Connector on wire	AS 6-18-35SU
Wire length L (all)	Ca. 50 cm

### Ordering Information

#### Breakout Box BOB 66-pole

Connector code: blue  
Order number **F 02U V02 295-01**

#### Breakout Box BOB 66-pole

Connector code: orange  
Order number **F 02U V02 296-01**

#### Breakout Box BOB 66-pole

Connector code: red  
Order number **F 02U V02 297-01**

#### Breakout Box BOB 66-pole

Connector code: yellow  
Order number **F 02U V02 298-01**

#### Breakout Box BOB 66-pole

Connector code: violet (universal use)  
Order number **F 02U V02 299-01**



## 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
---------------	-----------

### Ordering Information

#### Breakout Box BOB MS 6

Order number **F 02U 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.

### Ordering Information

#### Breakout Box BOB MS 7

Order number **F 02U 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 **F 02U 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 **F 02U V02 523-01**

## 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
Operating Systems	Windows XP 32 Bit, Vista 32 Bit

#### Connectors and Wires

Connector AS 6-12-35PN	F 02U 000 441-01
Mating connector AS 0-12-35SN	F 02U 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

**MSA-Box II**  
Order number **F 02U V00 327-03**

## Connector Opening Tool for AS series



### Features

- ▶ Quick and easy opening of ECU connectors

### Technical Specifications

#### Mechanical Data

Material	Stainless steel
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### Ordering Information

**Opening tool for shellsize 16**  
Order number **F 02U V01 393-01**

**Opening tool for shellsize 18**  
Order number **F 02U V01 394-01**

## Connectors



- ▶ 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.

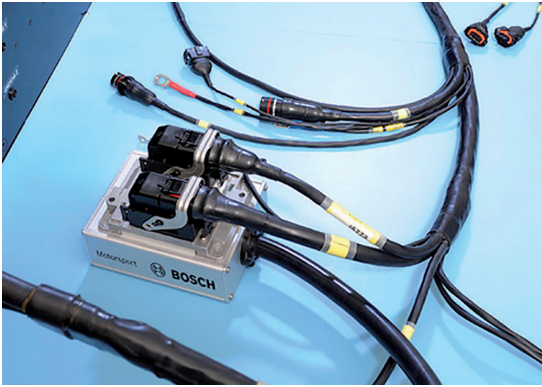
You can get from us different Deutsch-motorsport connectors of the series AS, ASL, ASU, ASX and ASDD. According to the series, these are 3 to 128-pin connectors. At Bosch connectors you can choose from connectors of the Jetronic or Compact series. Furthermore you receive convenient contacts and sealings to our Bosch-connectors.

If you are interested, give us a call!

### Features

- ▶ Bosch Jetronic and Compact connectors inclusive contacts and sealings

## 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 race car – 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!



# 11 Appendix

11

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## 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

Frequency (Hz)	Acceleration peak (m/s <sup>2</sup> )
100	50
180	200
250	200
350	60
2,000	60

## Vibration Profile 2

### Broadband noise: 8h/direction

Frequency (Hz)	Acceleration density (m/s <sup>2</sup> ) <sup>2</sup> /Hz
10	10

50	10
66.7	1
100	1
1,000	0.1
Effective value $a_{\text{Eff}}$	26.9 m/s <sup>2</sup>

## 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	0.51
500	45.6
1,500	15.26
Effective value $a_{\text{Eff}}$	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	
440	125	



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**Bosch Engineering GmbH  
Motorsport**

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