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**BOSCH**

# Bosch Motorsport

## Racing Equipment 2026



**24h**  
LE MANS

 **BOSCH**

PREMIUM PARTNER



# Contacts

## Europe

Bosch Engineering GmbH  
Motorsport  
Robert-Bosch-Allee 1  
74232 Abstatt  
Germany  
motorsport@bosch.com

## United Kingdom

Robert Bosch Ltd  
Motorsport  
Units 5 & 6 NW03  
MIRA Technology Park  
Mira Drive  
Nuneaton CV13 6DE  
United Kingdom  
motorsport@uk.bosch.com

## France

Robert Bosch France S.A.S.  
Motorsport  
32, Avenue Michelet  
B.P. 170  
F - 93404 Saint-Ouen Cedex  
France  
Motorsport.France@fr.bosch.com

## North America

Bosch Engineering North America  
Motorsport  
38000 Hills Tech Drive  
Farmington Hills, MI 48331-3417  
United States of America  
BoschMotorsport@us.bosch.com

## Australia, New Zealand, and South Africa

Robert Bosch Pty. Ltd  
Motorsport  
1555 Centre Road  
Clayton, Victoria, 3168  
Australia  
motor.sport@au.bosch.com

## Asia Pacific

Bosch Engineering K.K.  
Motorsports Department  
1-9-32 Nakagawachuo  
Tsuzuki-ku  
Yokohama-shi  
Kanagawa, 224-8601  
Japan  
Teammailbox.Begjmsd@jp.bosch.com

## China

Bosch (China) Investment Ltd.  
333 Fuquan Road North  
Changning District  
20335, Shanghai  
P.R. China  
BEG.China@cn.bosch.com

This document represents the data as of April 2026. Data may change in the meantime. Current and binding information can be found at any time in our online catalog:

[www.bosch-motorsport.com](http://www.bosch-motorsport.com)

For contact, send an email to:

[motorsport@bosch.com](mailto:motorsport@bosch.com)

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<b>Control</b>	<b>1</b>
<b>Displays</b>	<b>2</b>
<b>Electronics</b>	<b>3</b>
<b>Fuel &amp; Spark</b>	<b>4</b>
<b>Actuators</b>	<b>5</b>
<b>Sensors</b>	<b>6</b>
<b>Brake</b>	<b>7</b>
<b>Software</b>	<b>8</b>
<b>More</b>	<b>9</b>
<b>Appendix</b>	<b>10</b>

---



<b>Control</b>	<b>11</b>	<b>Fuel &amp; Spark</b>	<b>141</b>
<b>Engine Control Units Gasoline</b>	<b>12</b>	<b>Fuel Pressure Regulators</b>	<b>142</b>
Engine Control Unit MS 6 CUP EVO	13	Fuel Pressure Regulator Mini 2	143
Engine Control Unit MS 6.1 EVO	18	Fuel Pressure Regulator Mini 5	145
Engine Control Unit MS 6.2 EVO	24	Fuel Pressure Regulator Mini A	146
Engine Control Unit MS 6.3 EVO	29	FPR Adaptor light	148
Engine Control Unit MS 6.4 EVO	35	<b>Fuel Pumps</b>	<b>149</b>
Engine Control Unit MS 6.4P EVO	40	Fuel Pump FP 165-E	150
Engine Control Unit MS 7.8	46	Fuel Pump FP 200-7	152
<b>Vehicle Control Units</b>	<b>50</b>	Fuel Pump FP 200-E	154
Vehicle Control Unit MS 50.4	51	HP Fuel Pump HDP 5	156
Vehicle Control Unit MS 50.4P incl. CCA and Multi-CCA	55	<b>Ignition Coils</b>	<b>158</b>
Vehicle Control Unit MS 50.4 CAN-FD	59	Ignition Coil C90i-E8	160
Vehicle Control Unit MS 50.4P CAN-FD incl. CCA and Multi-CCA	63	Ignition Coil C90i-E10	162
<b>Displays</b>	<b>67</b>	Ignition Coil C90i-pro	164
<b>Displays</b>	<b>68</b>	Ignition Coil C90i-pro evo	166
Display DDU 10	69	Ignition Coil C90i-WG	168
Display DDU 11	73	Ignition Coil P50	170
<b>Electronics</b>	<b>77</b>	Ignition Coil P50-M	172
<b>CAN Keypad</b>	<b>78</b>	Ignition Coil P65	174
CAN Keypad CK-M12	78	Ignition Coil P65-T	176
<b>Collision Avoidance Systems</b>	<b>82</b>	Ignition Coil P65-TWG	179
Collision Avoidance System CAS-M light	83	Ignition Coil P65-WG	181
Collision Avoidance System CAS-M 3 EVO	86	Ignition Coil P65-WS	183
<b>Data Loggers</b>	<b>91</b>	Ignition Coil PS-T	186
Data Logger C 70	92	<b>Ignition Modules</b>	<b>189</b>
Data Logger and Sensor Interface C 80	96	Ignition Module IM 3.2	190
USB Data Components	100	Ignition Module IM 4	193
<b>Power Boxes</b>	<b>102</b>	<b>Injection Valves</b>	<b>196</b>
PowerBox PBX 90	103	Injection Valve EV 14	197
PowerBox PBX 190	107	HP Injection Valve HDEV 6	202
<b>Sensor Interfaces</b>	<b>111</b>	<b>Actuators</b>	<b>203</b>
Data Logger and Sensor Interface C 80	112	<b>Electronic Throttle Body</b>	<b>204</b>
Lambdatronic LT4	116	Electronic Throttle Body	204
Lambdatronic LT4 ADV	118	<b>Wiper Direct Actuator</b>	<b>208</b>
Wheel Speed Signal Splitter	121	Wiper Direct Drive WDD2	208
<b>Telemetry System</b>	<b>124</b>	<b>Sensors</b>	<b>213</b>
Connectivity Gateway CG 3.2	124	<b>Air Pressure</b>	<b>214</b>
<b>Test System</b>	<b>129</b>	Pressure Sensor Air PS-AA	215
µLC Test System	129	Pressure Sensor Air PS-AS	217
Expansion Board CAN-FD	131	Pressure Sensor Air PSA-N	219
Expansion Board Current Loop Interface	132		
Expansion Board Digital Multichannel Pot.	133		
Expansion Board Digital Outputs	135		
Expansion Board E-Mobility	136		
Expansion Board FlexIO	138		

<b>Fluid Pressure</b>	<b>221</b>
Pressure Sensor Fluid PSC-260	222
Pressure Sensor Fluid PSS-10	224
Pressure Sensor Fluid PSS-140	226
Pressure Sensor Fluid PSS-250R	228
Pressure Sensor Fluid PSS-260	230
Pressure Sensor Fluid PSS-420	232
Pressure Sensor Fluid PSS-600	234
<b>Knock</b>	<b>236</b>
Knock Sensor KS4-P	237
Knock Sensor KS4-R	239
Knock Sensor KS4-R2	241
<b>Lambda</b>	<b>243</b>
Lambda Sensor Mini-LSU 4.9	244
Lambda Sensor LSU 4.9	247
Lambda Sensor LSU ADV	250
Lambda Sensor LSU ADV pre Turbo	253
<b>Pressure &amp; Temperature</b>	<b>256</b>
Pressure Sensor Combined PST 1	257
Pressure Sensor Combined PST 3	259
Pressure Sensor Combined PST 4	261
Pressure Sensor Combined PST-F 1	263
Pressure Sensor Combined PST-F 2 280 bar	266
Pressure Sensor Combined PST-F 2 350 bar	268
<b>Rotary Position</b>	<b>270</b>
Rotary Position Sensor RPS-F	270
<b>Speed</b>	<b>272</b>
Speed Sensor Hall-Effect HA-D 90	273
Speed Sensor Hall-Effect HA-Di	276
Speed Sensor Hall-Effect HA-M	280
Speed Sensor Hall-Effect HA-N	282
Speed Sensor Hall-Effect Mini-HA-P	284
Speed Sensor Hall-Effect Mini-HA-P sealed	288
<b>Steering Wheel Angle</b>	<b>291</b>
Steering Wheel Angle Sensor LWS	291
<b>Temperature</b>	<b>293</b>
Temperature Sensor NTC M5-HS	294
Temperature Sensor NTC M6-HS	296
Temperature Sensor NTC M8-HS	298
Temperature Sensor NTC M12	300
Temperature Sensor NTC M12-H	302
Temperature Sensor NTC M12-L	304
<b>Vehicle Dynamics</b>	<b>306</b>
Inertial Measurement Unit MM7.10	306

<b>Brake</b>	<b>309</b>
<b>Antilock Braking Systems ABS</b>	<b>310</b>
ABS M5 Kit	311
ABS M5 Kit Clubsport	314
ABS M5 Kit Porsche Cup	316
<b>Electronic Brake System EBS</b>	<b>318</b>
Electronic Brake System EBS	318
<b>Software</b>	<b>321</b>
<b>Analysis</b>	<b>322</b>
Analysis Tool WinDarab V7	322
<b>API</b>	<b>324</b>
COM-API for WinDarab Expert	324
<b>Customer Code Area</b>	<b>325</b>
CCA Development Environment	325
<b>Licenses</b>	<b>326</b>
License Manager	326
<b>RaceConnect</b>	<b>327</b>
RaceConnect	327
<b>Scrutineering</b>	<b>328</b>
Scrutineering Configurator and Tool	328
<b>Simulation</b>	<b>329</b>
Simulation Packages	329
<b>System Configuration</b>	<b>330</b>
System Configuration Tool RaceCon	330
<b>More</b>	<b>331</b>
<b>Breakout Boxes</b>	<b>332</b>
Breakout Box BOB 66-pole	333
Breakout Box BOB MS 6	334
Breakout Box BOB MS 7	335
Breakout Box BOB PBX 90	336
Breakout Box BOB PBX 190	337
<b>Communication Interface</b>	<b>338</b>
Com Interface MSA-Box II	338
Ethernet Data Read Cable	339
<b>Connector Opening Tool</b>	<b>341</b>
Connector Opening Tool for AS series	341
<b>Connectors</b>	<b>342</b>
Connectors	342
<b>Vibration Profiles</b>	<b>343</b>
Vibration Profile 1	343
Vibration Profile Shock	344

<b>Wiring Harnesses</b>	<b>345</b>
Customized Wiring Harnesses	345

<b>Appendix</b>	<b>347</b>
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<b>General Information</b>	<b>348</b>
General Information	348

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# Control

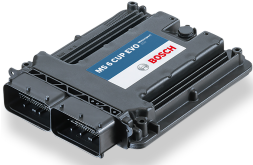
1

<b>Engine Control Units Gasoline</b>	<b>12</b>
<b>Vehicle Control Units</b>	<b>50</b>

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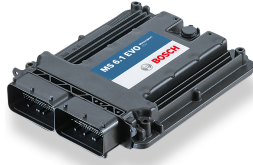
## Overview

### Engine Control Unit MS 6 CUP EVO



- Delivery for OEM with project-specific program status
- HP package for 4-cylinder engines
- 8 GB memory
- SENT sensor support

### Engine Control Unit MS 6.1 EVO



- Optimized for low-pressure injection
- Measurement with 21 analog inputs
- 4 GB memory plus 4 GB upgrade
- SENT sensor support

### Engine Control Unit MS 6.2 EVO



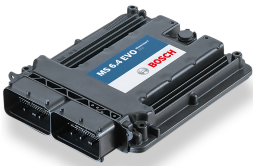
- Optimized for low-pressure injection
- Measurement with 38 analog inputs
- 4 GB memory plus 4 GB upgrade
- SENT sensor support

### Engine Control Unit MS 6.3 EVO



- Optimized for low- and high-pressure injection
- Measurement with 21 analog inputs
- 4 GB memory plus 4 GB upgrade
- SENT sensor support

### Engine Control Unit MS 6.4 EVO



- Optimized for low- and high-pressure injection
- Measurement with 38 analog inputs
- 4 GB memory plus 4 GB upgrade
- SENT sensor support

### Engine Control Unit MS 6.4P EVO



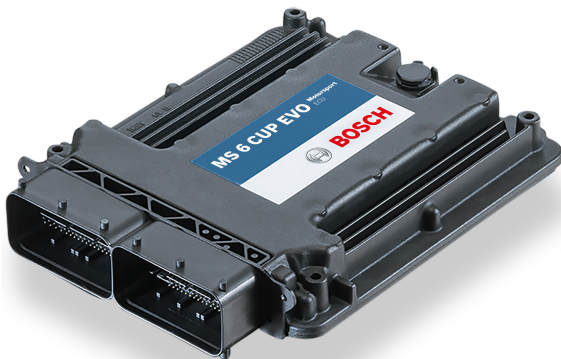
- 866 MHz Dual Core Processor for projects with high performance demand
- 4 GB memory plus 16 GB upgrade
- SENT sensor support

### Engine Control Unit MS 7.8 EVO



- Optimized for low- and high-pressure injection
- 5 CAN, 3 of them CAN-FD capable
- 4 x 8.5 A H-Bridge
- Gearbox control optionally included
- SENT sensor support

## Engine Control Unit MS 6 CUP EVO



### Features

- ▶ Delivery for OEM with project-specific program status
- ▶ HP package for 4-cylinder engines
- ▶ 8 GB memory
- ▶ SENT sensor support

The MS 6 CUP EVO engine control unit manages gasoline engines up to 4 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 CUP EVO to support complex or unusual engine or chassis configurations.

### Application

#### High pressure injection

- Max. 4 cylinders up to 12,500 rpm

#### Low pressure injection

- Max. 4 cylinders up to 12,500 rpm

#### Ignition

- 4 x ignition control, IGBT or BJT, coils with integrated amplifier

#### Physical engine model for fast application

- determine engine load by throttle position or air pressure signals
- mixture control and basic ignition guided by main signal relative load rI
- Subsystems pit speed-, launch-, rpm-limiter and ASR are integrated inside torque control

- Separated power cut functions to assist various gear cut systems
- Diagnostics
- Integrated safety strategy for 1 electronic throttle control

Integrated support of manual gearshift

Electronic throttle control

Variable Valve Timing VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

#### Internal logger Partition 1

- 4 GB memory
- 100 free configurable channels, 20 Hz sampling rate
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional

#### Internal logger Partition 2

- 4 GB memory
- 200 free configurable channels, 50 Hz sampling rate
- FULL\_LOG\_2 (1,500 channels/1 kHz sampling rate on Partition 2) optional

#### Logging rates

- Usage of all features: 300 kB/s
- Primary logging use case: 600 kB/s
- Logging data download rate: up to 4 MB/s

### Technical Specifications

#### Mechanical Data

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

#### Electrical Data

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

#### Inputs

##### 26 analog inputs

- 4 x reserved for electronic throttle controls
- 5 x no integrated pull-up
- 3 x option for angle synchronous measurement, no integrated pull-up
- 4 x fixed 3.01 kOhm pull-up
- 10 x switchable 3.01 kOhm pull-up

##### 6 internal measurements

- 1 x ambient pressure
- 1 x acceleration 6-axis

---

2 x ECU temperature

---

2 x ECU voltage

---

#### 4 function related inputs

---

1 x Thermocouple exhaust gas temperature sensor (K-type)

---

1 x Lambda interface for LSU 4.9 sensor type

---

2 x Knock sensors

---

#### 18 digital inputs

---

1 x switchable Hall or inductive sensor for flywheel measurement

---

2 x Hall sensor for sync wheel detection

---

4 x switchable Hall or DF11 sensors for camshaft position or wheel speed

---

2 x switchable Hall or inductive sensors for turbo speed measurement

---

1 x digital switch Engine ON/OFF

---

8 x digital, e.g. SENT

---

#### Sensor supplies and screens

---

4 x sensor supplies 5 V, 50 mA

---

3 x sensor supplies 5 V, 150 mA

---

7 x sensor grounds

---

2 x sensor screens

---

#### Outputs

---

##### 15 function related outputs

---

High Pressure Injection

---

4 x controls, magnetic injectors

---

1 x high pressure pump with MSV control

---

Low Pressure Injection

---

4 x controls, high impedance injectors

---

Ignition

---

4 x controls, IGBT or BJT, coils with integrated amplifier

---

1 x 8.5 A H-bridge reserved for electronic throttle

---

1 x 4 A pwm lowside switch for Lambda heater

---

##### 13 freely configurable outputs

---

2 x 8.5 A H-bridge

---

1 x 4 A pwm lowside switch

---

2 x 3 A pwm lowside switch

---

5 x 2.2 A pwm lowside switch

---

3 x 1 A pwm lowside switch

---

##### 3 outputs signals

---

1 x engine rpm

---

1 x flywheel

---

1 x trigger wheel

---

#### Software Tools (free download)

---

Data Analysis tool WinDarab V7

---

System Configuration tool RaceCon 2.7.0.9 or later

---

#### Mating Connectors (not included)

---

Mating Connector 91 pins F02U.B00.711-01

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Mating Connector 105 pins F02U.B00.712-01

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#### Norms

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##### Product Safety

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EN IEC 62368-1:2020+A11:2020

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##### Materials

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REACH - Nr. 1907/2006

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##### EMC

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UNECE10:rev.6/AMD1:2020

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KN41

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ISO11452-2

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ISO11452-4

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ISO10605

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ISO7637-2

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ISO7367-3

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ISO16750-2

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US FCC: Title 47, Part 15 Subpart B

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ICES-003

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##### Testing

---

SAEJ1211

---

#### Communication

---

2 Ethernet

---

3 CAN

---

1 LIN

---

8 SENT

---

1 RS232

---

1 Time sync synchronization Ethernet

---

3 Communication screens

---

#### Installation Notes

---

Maintenance Interval: 220 h or a maximum of two years

---

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.

---

#### Legal Restrictions

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Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

Extension for Partition 1

- 1,500 channels
- 1 kHz sampling rate

### FULL\_LOG\_2

Extension for Partition 2

- 1,500 channels
- 1 kHz sampling rate

### Gear Control

Project individual option

### Innovation License Device

Activation of a set of additional functions for a single device:

- Crank rotation direction detection (using sensor DG23i)
- Using a 2nd crank backup sensor
- Crank-Pre-set, quick start based on previous crank stop position
- Far-Bank, 2nd injector per cylinder possible
- Cam-only-synchronisation, engine run without crank sensor signal (specific cam trigger wheel needed)

### Innovation Package Project

Innovation Package Project has the same content as Innovation License Device, but license is valid for the whole project instead of a single device

### DATA\_USB

Data copy to USB flash drive

## Ordering Information

### Engine Control Unit MS 6 CUP EVO

Order number **F02U.V03.111-01**

### Rugged USB flash drive

Order number **F02U.V03.534-01**

### Connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

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

### Software Options

#### CCA Hardware Upgrade per device

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

#### FULL\_LOG\_1

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

#### FULL\_LOG\_2

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

#### Gear Control

Order number **on request**

#### Innovation License Device

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

#### Innovation Package Project

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

#### DATA\_USB

Order number **F02U.V03.476-01**

### Accessories

#### Breakout Box BOB MS 6 EVO

Order number **F02U.V02.294-02**

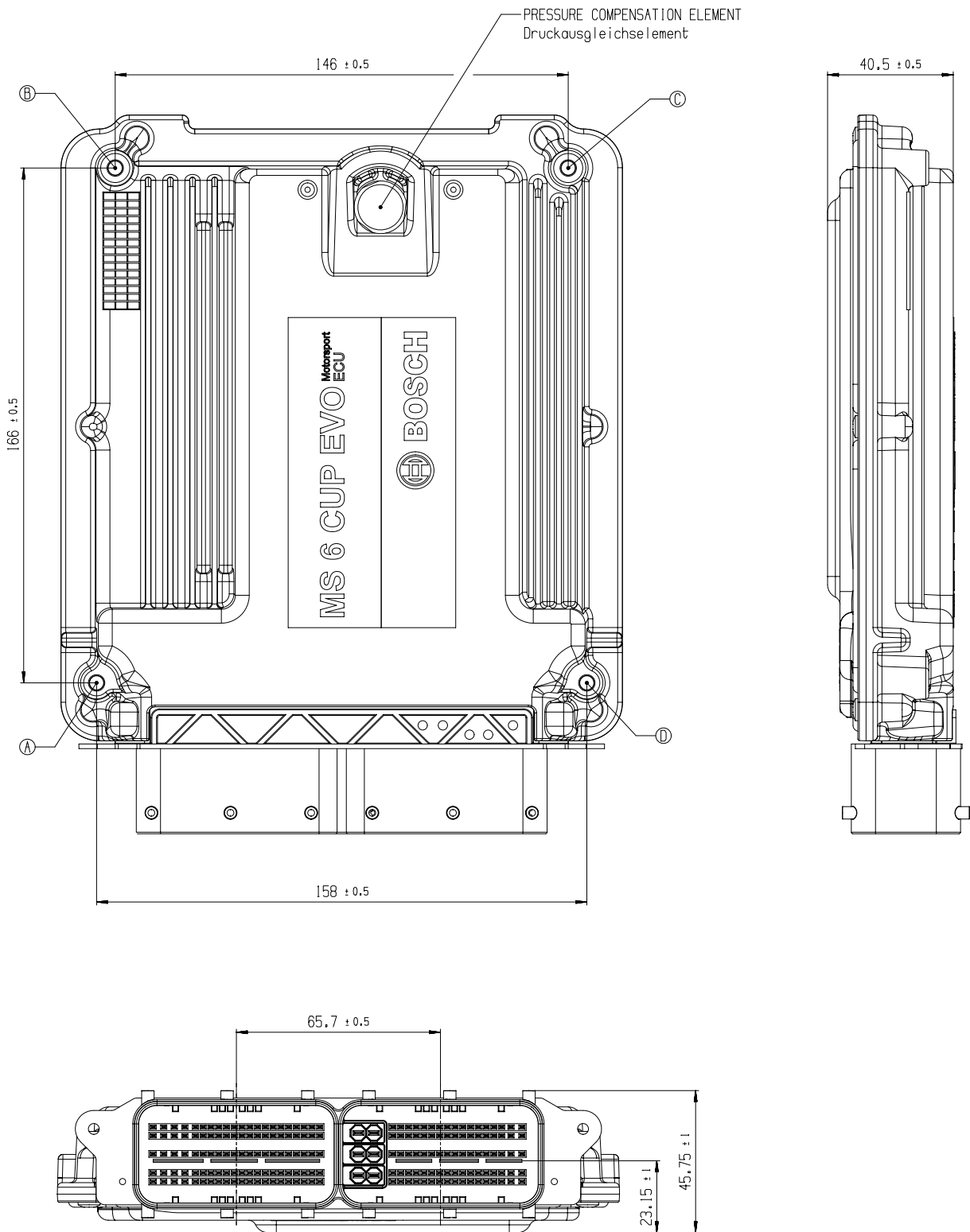
#### Mating Connector 91 pins

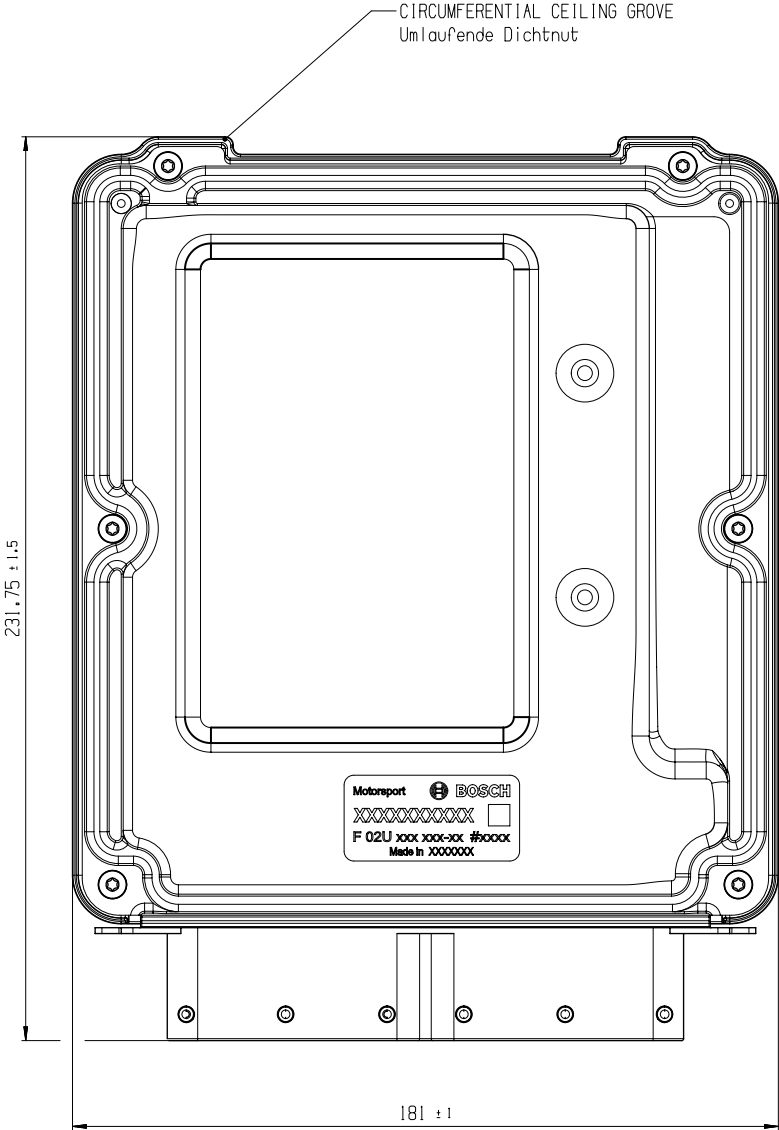
Order number **F02U.B00.711-01**

#### Mating Connector 105 pins

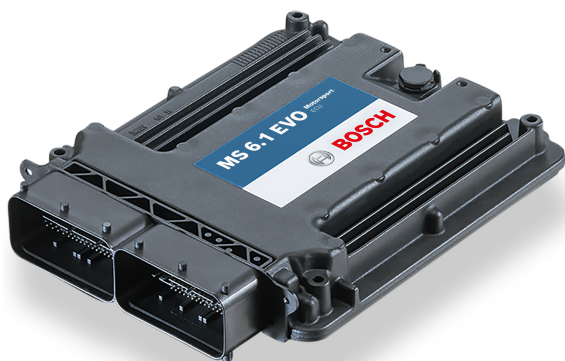
Order number **F02U.B00.712-01**

Dimensions





## Engine Control Unit MS 6.1 EVO



### Features

- ▶ Optimized for low-pressure injection
- ▶ Measurement with 21 analog inputs
- ▶ 4 GB memory plus 4 GB upgrade
- ▶ SENT sensor support

The MS 6.1 EVO 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 EVO 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

#### Ignition

- 12 x ignition control, IGBT or BJT, coils with integrated amplifier

#### Physical engine model for fast application

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

- Diagnostics
- Integrated safety strategy for electronic throttle control

Integrated support of manual gearshift

Electronic throttle control	Optional, see Upgrades
Variable Valve Timing VVT	Optional, see Upgrades
Turbo control	Optional, see Upgrades
Traction control	Optional, see Upgrades
Launch control	Optional, see Upgrades

LTE Ethernet telemetry support

#### Internal logger

- 4 GB memory on Partition 1 enabled
- 100 free configurable channels, 20 Hz
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory/1,500 channels/1 kHz sampling rate on Partition 2) optional

#### Logging rates

- Usage of all features: 300 kB/s
- Primary logging use case: 600 kB/s
- Logging data download rate: up to 4 MB/s

### Technical Specifications

#### Mechanical Data

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

#### Electrical Data

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

#### Inputs

##### 21 analog inputs

- 6 x reserved for electronic throttle controls
- 3 x no integrated pull-up
- 3 x option for angle synchronous measurement, no integrated pull-up
- 4 x fixed 3.01 kOhm pull-up
- 5 x switchable 3.01 kOhm pull-up

##### 6 internal measurements

- 1 x ambient pressure
- 1 x acceleration 6-axis
- 2 x ECU temperature
- 2 x ECU voltage

##### 8 function related inputs

- 1 x Thermocouple exhaust gas temperature sensors (K-type)

2 x Lambda interfaces for LSU 4.9 sensor types

1 x Lap trigger/beacon input

4 x Knock sensors

### 18 digital inputs

1 x switchable Hall or inductive sensor for flywheel measurement

2 x Hall sensor for sync wheel detection

4 x switchable Hall or DF11 sensors for camshaft position or wheel speed

2 x switchable Hall or inductive sensors for turbo speed measurement

1 x digital switch for engine ON/OFF

8 x digital, e.g. SENT

### Sensor supplies and screens

4 x sensor supplies 5 V / 50 mA

3 x sensor supplies 5 V / 150 mA

7 x sensor grounds

2 x sensor screens

### Outputs

#### 28 function related outputs

Low Pressure Injection

12 x 2.2 A controls, high impedance injectors

Ignition

12 x control, IGBT or BJT, coils with integrated amplifier

2 x 8.5 A H-bridge reserved for electronic throttle

2 x 4 A pwm lowside switch for Lambda heater

#### 19 freely configurable outputs

1 x 8.5 A H-bridge

2 x 4 A pwm lowside switch

4 x 3 A pwm lowside switch

8 x 2.2 A pwm lowside switch

4 x 1 A pwm lowside switch

#### 3 output signals

1 x engine rpm

1 x flywheel

1 x trigger wheel

### Software Tools (free download)

Data Analysis tool WinDarab V7

System Configuration tool RaceCon 2.7.0.9 or later

### Mating Connectors (not included)

Mating Connector 91 pins F02U.B00.711-01

Mating Connector 105 pins F02U.B00.712-01

### Norms

#### Product Safety

EN IEC 62368-1:2020+A11:2020

### Materials

REACH - Nr. 1907/2006

### EMC

UNECE10:rev.6/AMD1:2020

KN41

ISO11452-2

ISO11452-4

ISO10605

ISO7637-2

ISO7367-3

ISO16750-2

US FCC: Title 47, Part 15 Subpart B

ICES-003

### Testing

SAEJ1211

### Communication

2 Ethernet

3 CAN

1 LIN

8 SENT

1 RS232

1 Time sync synchronization Ethernet

3 Communication screens

### Installation Notes

Maintenance Interval: 220 h or a maximum of two years

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.

#### 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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

### Engine Function Package 1

- Electronic Throttle Control
- VVT
- Turbo Control

### Engine Function Package 2

- Traction Control
- Launch Control

### Measurement Package

#### 17 Additional analog inputs

- 7 x no integrated pull-up
- 1 x option for angle synchronous measurement, no integrated pull-up
- 1 x fixed 3.01 kOhm pull-up
- 8 x switchable 3.01 kOhm pull-up

**Extension** of the use of 8 digital channels as analogue / digital inputs (shared)

#### 1 Additional function related inputs

- 1 x Thermocouple K-type

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

Extension for Partition 1

- 1,500 channels
- 1 kHz sampling rate

### FULL\_LOG\_2

Activation of Partition 2

- 1,500 channels
- 1 kHz sampling rate
- 4 GB memory

### Gear Control Package 1

Gear control MEGA-Line functionality, has to be used with MEGA-Line components (License model via MEGA-Line)

-- [Link to MEGA-Line Support Request](#) --

-- [Link to MEGA-Line License Request Form](#) --

### Gear Control Package 2

Gear control Bosch Motorsport functionality

### SW Package MS 6 Drag 1

- Launch Time
- Launch Distance
- Torque Pre-Control
- Launch RPM Control
- Universal Outputs for Time/Distance Controls

### SW Package MS 6 Drag 2 (requires Drag 1 License)

- Acceleration Sensor MM5.10 included
- Time/Distance Boost Control
- Driveshaft Speed Control

- Driveshaft Gradient Control
- Acceleration Control
- Wheelie Control

### Innovation License Device

Activation of a set of additional functions for a single device:

- Crank rotation direction detection (using sensor DG23i)
- Using a 2nd crank backup sensor
- Crank-Preset, quick start based on previous crank stop position
- Far-Bank, 2nd injector per cylinder possible
- Cam-only-synchronisation, engine run without crank sensor signal (specific cam trigger wheel needed)

### Innovation Package Project

Innovation Package Project has the same content as Innovation License Device, but license is valid for the whole project instead of a single device

### DATA\_USB

Data copy to USB flash drive

**Ordering Information****Engine Control Unit MS 6.1 EVO**

Order number F02U.V03.113-01

**Rugged USB flash drive**

Order number F02U.V03.534-01

**Connector for USB flash drive on car loom side**

Order number F02U.002.996-01

**Adapter cable to PC USB-Port**

Order number F02U.V01.343-01

**Software Options****Engine Function Package 1**

Order number F02U.V02.001-01

**Engine Function Package 2**

Order number F02U.V02.002-01

**Measurement Package**

Order number F02U.V02.000-01

**CCA Hardware Upgrade per device**

Order number F02U.V02.137-01

**FULL\_LOG\_1**

Order number F02U.V02.304-01

**FULL\_LOG\_2**

Order number F02U.V02.305-01

**Gear Control Package 1**

Order number please contact MEGA-Line

**Gear Control Package 2**

Order number F02U.V02.108-01

**SW Package MS 6 Drag 1**

Order number F02U.V0U.409-01

**SW Package MS 6 Drag 2**

Order number F02U.V0U.410-01

**Innovation License Device**

Order number F02U.V02.510-01

**Innovation Package Project**

Order number F02U.V02.511-01

**DATA\_USB**

Order number F02U.V03.476-01

**Accessories****Breakout Box BOB MS 6 EVO**

Order number F02U.V02.294-02

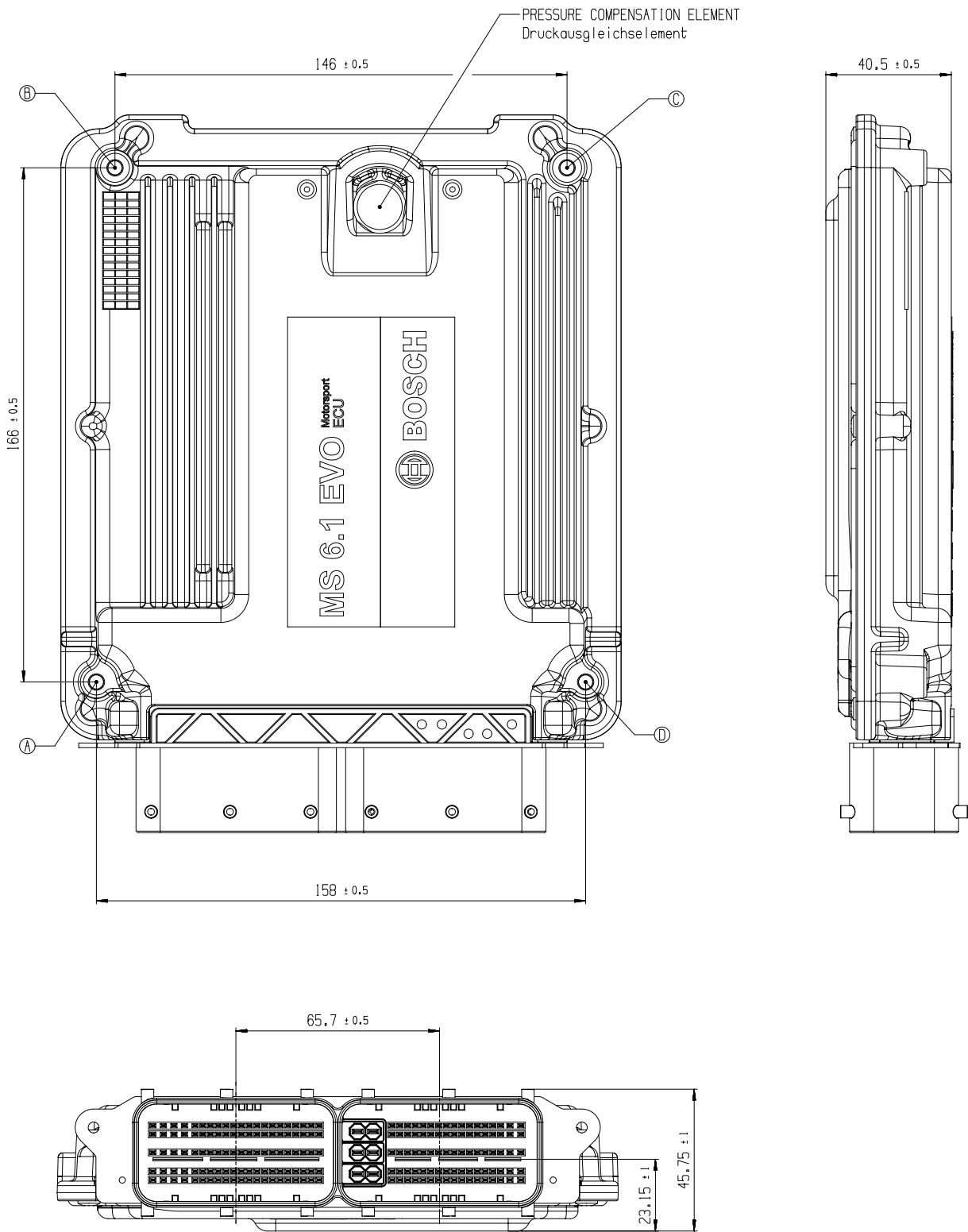
**Mating Connector 91 pins**

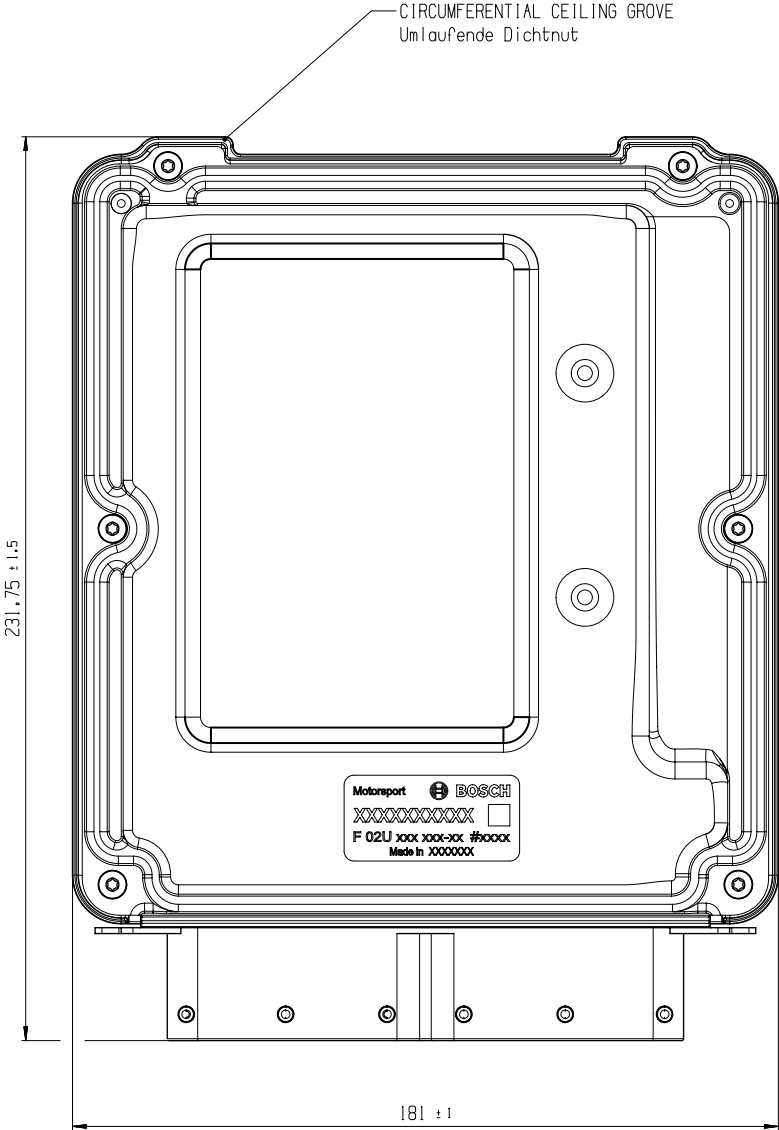
Order number F02U.B00.711-01

**Mating Connector 105 pins**

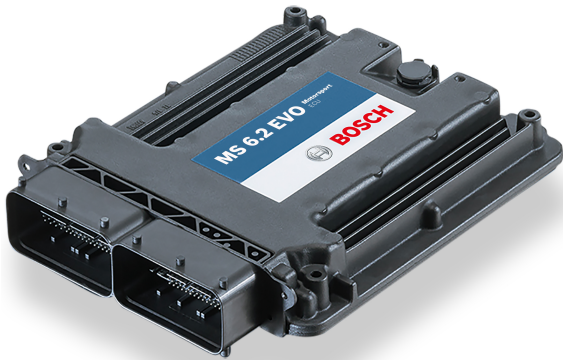
Order number F02U.B00.712-01

Dimensions





## Engine Control Unit MS 6.2 EVO



### Features

- ▶ Optimized for low-pressure injection
- ▶ Measurement with 38 analog inputs
- ▶ 4 GB memory plus 4 GB upgrade
- ▶ SENT sensor support

The MS 6.2 EVO 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 EVO 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

#### Ignition

- 12 x ignition control, IGBT or BJT, coils with integrated amplifier

#### Physical engine model for fast application

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

- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift

Electronic throttle control

Variable Valve Timing VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

#### Internal logger

- 4 GB memory on Partition 1 enabled
- 100 free configurable channels, 20 Hz
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory/1,500 channels/1 kHz sampling rate on Partition 2) optional

#### Logging rates

- Usage of all features: 300 kB/s
- Primary logging use case: 600 kB/s
- Logging data download rate: up to 4 MB/s

### Technical Specifications

#### Mechanical Data

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

#### Electrical Data

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

#### Inputs

##### 38 analog inputs

- 6 x reserved for electronic throttle controls
- 10 x no integrated pull-up
- 4 x option for angle synchronous measurement, no integrated pull-up
- 5 x fixed 3.01 kOhm pull-up
- 13 x switchable 3.01 kOhm pull-up

##### 8 analog/digital inputs (shared)

- 8 x option for angle synchronous measurement / digital (e.g. SENT)

##### 6 internal measurements

- 1 x ambient pressure
- 1 x acceleration 6-axis
- 2 x ECU temperature

2 x ECU voltage

### 9 function related inputs

2 x thermocouple exhaust gas temperature sensors (K-type)

2 x Lambda interfaces for LSU 4.9 sensor types

1 x lap trigger/beacon input

4 x knock sensors

### 10 digital inputs

1 x switchable Hall or inductive sensor for flywheel measurement

2 x Hall sensor for sync wheel detection

4 x switchable Hall or DF11 sensors for camshaft position or wheel speed

2 x switchable Hall or inductive sensors for turbo speed measurement

1 x digital switch for engine ON/OFF

### Sensor supplies and screens

4 x sensor supplies 5 V / 50 mA

3 x sensor supplies 5 V / 150 mA

7 x sensor grounds

2 x sensor screens

### Outputs

#### 28 function related outputs

Low Pressure Injection

12 x 2.2 A low pressure injection for high impedance injectors

Ignition

12 x ignition control, IGBT or BJT, coils with integrated amplifier

2 x 8.5 A H-bridge reserved for electronic throttle

2 x 4 A pwm lowside switch for Lambda heater

#### 19 freely configurable outputs

1 x 8.5 A H-bridge

2 x 4 A pwm lowside switch

4 x 3 A pwm lowside switch

8 x 2.2 A pwm lowside switch

4 x 1 A pwm lowside switch

### 3 output signals

1 x engine rpm

1 x flywheel

1 x trigger wheel

### Software Tools (free download)

Data Analysis tool WinDarab V7

System Configuration tool RaceCon 2.7.0.9 or later

### Mating Connectors (not included)

Mating Connector 91 pins F02U.B00.711-01

Mating Connector 105 pins F02U.B00.712-01

### Norms

#### Product Safety

EN IEC 62368-1:2020+A11:2020

#### Materials

REACH - Nr. 1907/2006

#### EMC

UNECE10:rev.6/AMD1:2020

KN41

ISO11452-2

ISO11452-4

ISO10605

ISO7637-2

ISO7367-3

ISO16750-2

US FCC: Title 47, Part 15 Subpart B

ICES-003

#### Testing

SAEJ1211

### Communication

2 Ethernet

3 CAN

1 LIN

8 SENT

1 RS232

1 Time sync synchronization Ethernet

3 Communication screens

### Installation Notes

Maintenance Interval: 220 h or a maximum of two years

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.

#### 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

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

Extension for Partition 1

- 1,500 channels
- 1 kHz sampling rate

### FULL\_LOG\_2

Activation of Partition 2

- 1,500 channels
- 1 kHz sampling rate
- 4 GB memory

### Gear Control Package 1

Gear control MEGA-Line functionality, has to be used with MEGA-Line components (License model via MEGA-Line)

-- [Link to MEGA-Line Support Request](#) --

-- [Link to MEGA-Line License Request Form](#) --

### Gear Control Package 2

Gear control Bosch Motorsport functionality

### SW Package MS 6 Drag 1

- Launch Timer
- Launch Distance
- Torque Pre-Control
- Launch RPM Control
- Universal Outputs for Time/Distance Controls

### SW Package MS 6 Drag 2 (requires Drag 1 License)

- Acceleration Sensor MM5.10 included
- Time/Distance Boost Control
- Driveshaft Speed Control
- Driveshaft Gradient Control
- Acceleration Control
- Wheelie Control

### Innovation License Device

Activation of a set of additional functions for a single device:

- Crank rotation direction detection (using sensor DG23i)
- Using a 2nd crank backup sensor

- Crank-Pre-set, quick start based on previous crank stop position
- Far-Bank, 2nd injector per cylinder possible
- Cam-only-synchronisation, engine run without crank sensor signal (specific cam trigger wheel needed)

### Innovation Package Project

Innovation Package Project has the same content as Innovation License Device, but license is valid for the whole project instead of a single device

### DATA\_USB

Data copy to USB flash drive

## Ordering Information

### Engine Control Unit MS 6.2 EVO

Order number **F02U.V03.115-01**

### Rugged USB flash drive

Order number **F02U.V03.534-01**

### Connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

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

## Software Options

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

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

### FULL\_LOG\_2

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

### Gear Control Package 1

Order number **please contact MEGA-Line**

### Gear Control Package 2

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

### SW Package MS 6 Drag 1

Order number **F02U.V0U.409-01**

### SW Package MS 6 Drag 2

Order number **F02U.V0U.410-01**

### Innovation License Device

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

### Innovation Package Project

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

### DATA\_USB

Order number **F02U.V03.476-01**

## Accessories

### Breakout Box BOB MS 6 EVO

Order number **F02U.V02.294-02**

### Mating Connector 91 pins

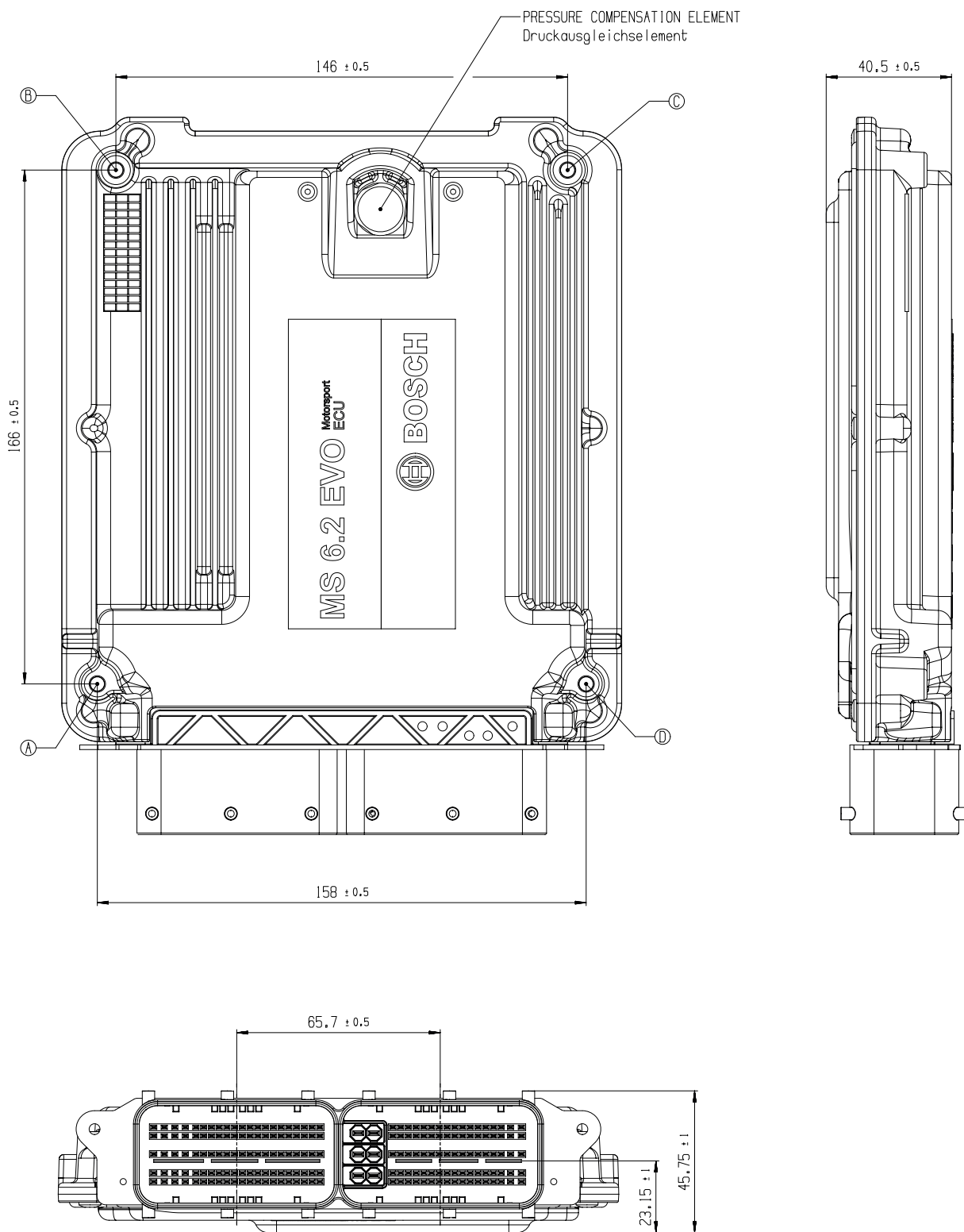
Order number **F02U.B00.711-01**

### Mating Connector 105 pins

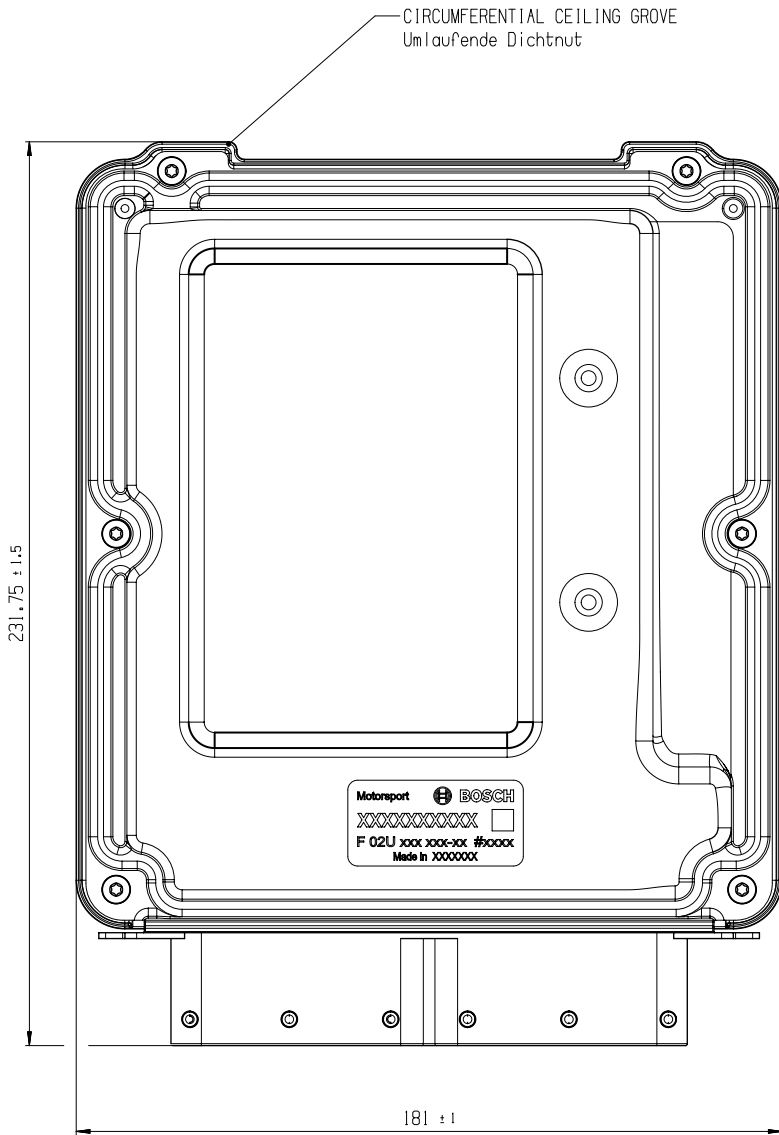
Order number **F02U.B00.712-01**

## Dimensions

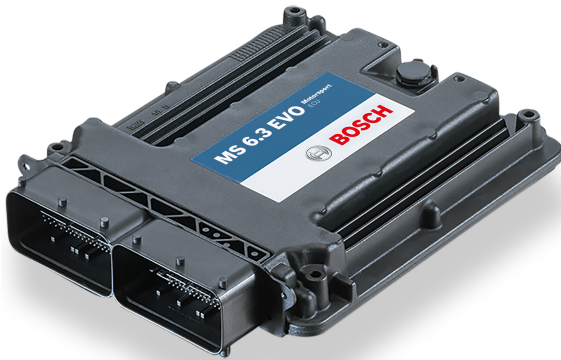
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## Engine Control Unit MS 6.3 EVO



### Features

- ▶ Optimized for low- and high-pressure injection
- ▶ Measurement with 21 analog inputs
- ▶ 4 GB memory plus 4 GB upgrade
- ▶ SENT sensor support

The MS 6.3 EVO 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 EVO 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 on injection types and pressure ranges)

#### Low pressure injection

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

#### Ignition

- 12 x ignition control, IGBT or BJT, coils with integrated amplifier

#### Physical engine model for fast application

- determine engine load by throttle position or air pressure signals

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

Integrated support of manual gearshift

Electronic throttle control

Variable Valve Timing VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

#### Internal logger

- 4 GB memory on Partition 1 enabled
- 100 free configurable channels, 20 Hz
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory/1,500 channels/1 kHz sampling rate on Partition 2) optional

#### Logging rates

- Usage of all features: 300 kB/s
- Primary logging use case: 600 kB/s
- Logging data download rate: up to 4 MB/s

### Technical Specifications

#### Mechanical Data

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

#### Electrical Data

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

#### Inputs

##### 21 analog inputs

- 6 x reserved for electronic throttle controls
- 3 x no integrated pull-up
- 3 x option for angle synchronous measurement, no integrated pull-up
- 4 x fixed 3.01 kOhm pull-up
- 5 x switchable 3.01 kOhm pull-up

##### 6 internal measurements

- 1 x ambient pressure

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1 x acceleration 6-axis

2 x ECU temperature

2 x ECU voltage

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#### 8 function related inputs

1 x Thermocouple exhaust gas temperature sensors (K-type)

2 x Lambda interfaces for LSU 4.9 sensor types

1 x Lap trigger/beacon input

4 x Knock sensors

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#### 18 digital inputs

1 x switchable Hall or inductive sensor for flywheel measurement

2 x Hall sensor for sync wheel detection

4 x switchable Hall or DF11 sensors for camshaft position or wheel speed

2 x switchable Hall or inductive sensors for turbo speed measurement

1 x digital switch for engine ON/OFF

8 x digital, e.g. SENT

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#### Sensor supplies and screens

4 x sensor supplies 5 V / 50 mA

3 x sensor supplies 5 V / 150 mA

7 x sensor grounds

2 x sensor screens

---

#### Outputs

##### 38 function related outputs

High Pressure Injection

2 x high pressure pump with MSV control

8 x high pressure injection for magnetic injectors

Low Pressure Injection

12 x 2.2 A low pressure injection for high impedance injectors

Ignition

12 x ignition control, IGBT or BJT, coils with integrated amplifier

2 x 8.5 A H-bridge reserved for electronic throttle

2 x 4 A pwm lowside switch for Lambda heater

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##### 19 freely configurable outputs

1 x 8.5 A H-bridge

2 x 4 A pwm lowside switch

4 x 3 A pwm lowside switch

8 x 2.2 A pwm lowside switch

4 x 1 A pwm lowside switch

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##### 3 output signals

1 x engine rpm

1 x flywheel

1 x trigger wheel

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#### Software Tools (free download)

Data Analysis tool WinDarab V7

System Configuration tool RaceCon 2.7.0.9 or later

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#### Mating Connectors (not included)

Mating Connector 91 pins F02U.B00.711-01

Mating Connector 105 pins F02U.B00.712-01

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#### Norms

##### Product Safety

EN IEC 62368-1:2020+A11:2020

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##### Materials

REACH - Nr. 1907/2006

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##### EMC

UNECE10:rev.6/AMD1:2020

KN41

ISO11452-2

ISO11452-4

ISO10605

ISO7637-2

ISO7367-3

ISO16750-2

US FCC: Title 47, Part 15 Subpart B

ICES-003

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##### Testing

SAEJ1211

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#### Communication

2 Ethernet

3 CAN

1 LIN

8 SENT

1 RS232

1 Time sync synchronization Ethernet

3 Communication screens

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#### Installation Notes

Maintenance Interval: 220 h or a maximum of two years

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.

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## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

### High Pressure Injection Package

Enables the control of a 2nd high pressure pump

### Measurement Package

#### 17 Additional analogue inputs

- 7 x no integrated pull-up
- 1 x option for angle synchronous measurement, no integrated pull-up
- 1 x fixed 3.01 kOhm pull-up
- 8 x switchable 3.01 kOhm pull-up

**Extension** of the use of 8 digital channels as analogue / digital inputs (shared)

#### 1 Additional function related inputs

- 1 x Thermocouple K-type

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

Extension for Partition 1

- 1,500 channels
- 1 kHz sampling rate

### FULL\_LOG\_2

Activation of Partition 2

- 1,500 channels
- 1 kHz sampling rate
- 4 GB memory

### Gear Control Package 1

Gear control MEGA-Line functionality, has to be used with MEGA-Line components (License model via MEGA-Line)

-- Link to MEGA-Line Support Request --

-- Link to MEGA-Line License Request Form --

### Gear Control Package 2

Gear control Bosch Motorsport functionality

### SW Package MS 6 Drag 1

- Launch Timer
- Launch Distance
- Torque Pre-Control
- Launch RPM Control
- Universal Outputs for Time/Distance Controls

### SW Package MS 6 Drag 2 (requires Drag 1 License)

- Acceleration Sensor MM5.10 included
- Time/Distance Boost Control
- Driveshaft Speed Control
- Driveshaft Gradient Control
- Acceleration Control
- Wheelie Control

### Innovation License Device

Activation of a set of additional functions for a single device:

- Crank rotation direction detection (using sensor DG23i)
- Using a 2nd crank backup sensor
- Crank-Pre-set, quick start based on previous crank stop position
- Far-Bank, 2nd injector per cylinder possible
- Cam-only-synchronisation, engine run without crank sensor signal (specific cam trigger wheel needed)

### Innovation Package Project

Innovation Package Project has the same content as Innovation License Device, but license is valid for the whole project instead of a single device

### DATA\_USB

Data copy to USB flash drive

## Ordering Information

### Engine Control Unit MS 6.3 EVO

Order number F02U.V03.110-01

### Rugged USB flash drive

Order number F02U.V03.534-01

### Connector for USB flash drive on car loom side

Order number F02U.002.996-01

### Adapter cable to PC USB-Port

Order number F02U.V01.343-01

## Software Options

### High Pressure Injection Package

Order number F02U.V01.999-01

### Measurement Package

Order number F02U.V02.000-01

### CCA Hardware Upgrade per device

Order number F02U.V02.137-01

### FULL\_LOG\_1

Order number F02U.V02.304-01

### FULL\_LOG\_2

Order number F02U.V02.305-01

### Gear Control Package 1

Order number please contact MEGA-Line

### Gear Control Package 2

Order number F02U.V02.108-01

### SW Package MS 6 Drag 1

Order number F02U.V0U.409-01

### SW Package MS 6 Drag 2

Order number F02U.V0U.410-01

### Innovation License Device

Order number F02U.V02.510-01

### Innovation Package Project

Order number F02U.V02.511-01

### DATA\_USB

Order number F02U.V03.476-01

## Accessories

### Breakout Box BOB MS 6 EVO

Order number F02U.V02.294-02

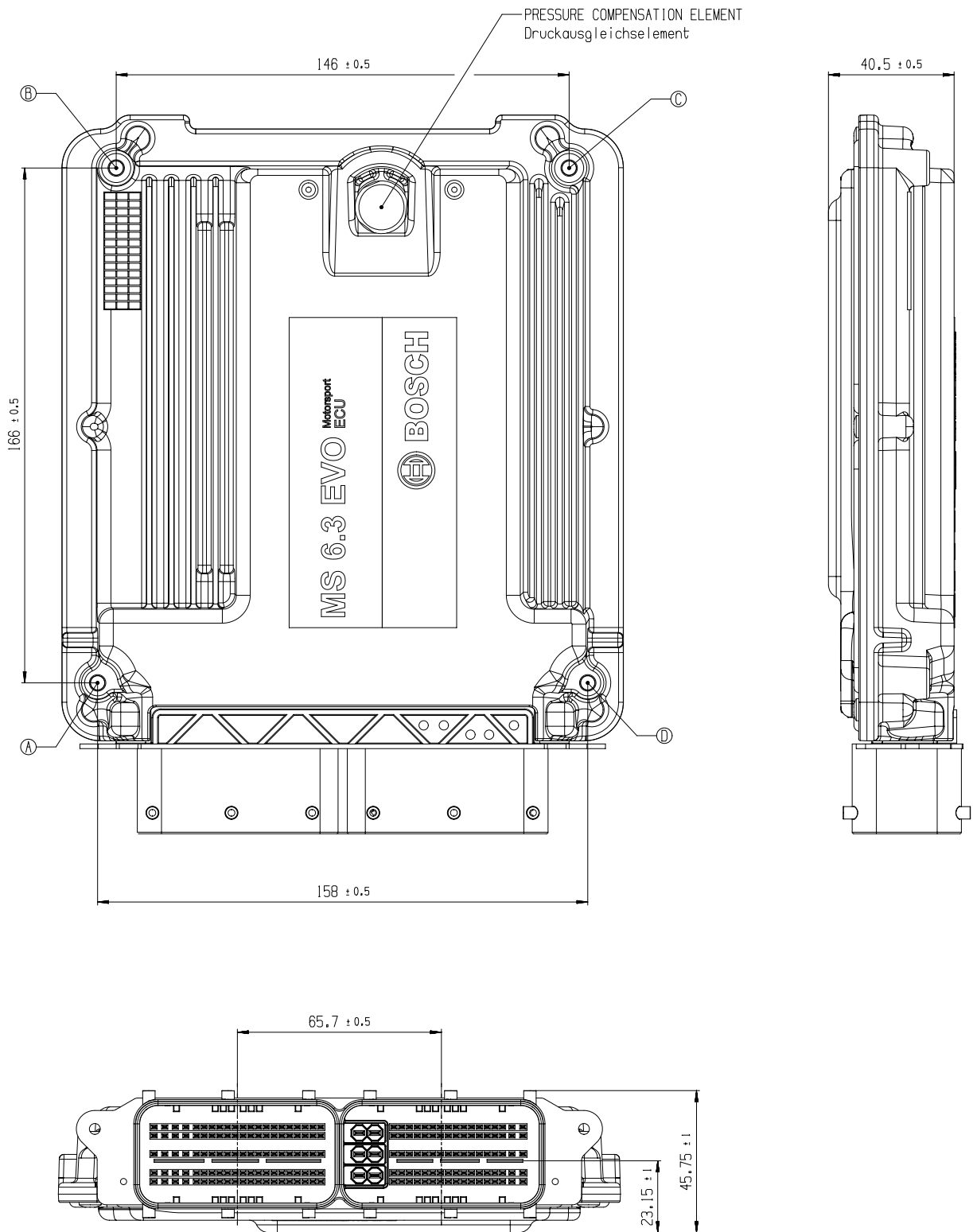
### Mating Connector 91 pins

Order number F02U.B00.711-01

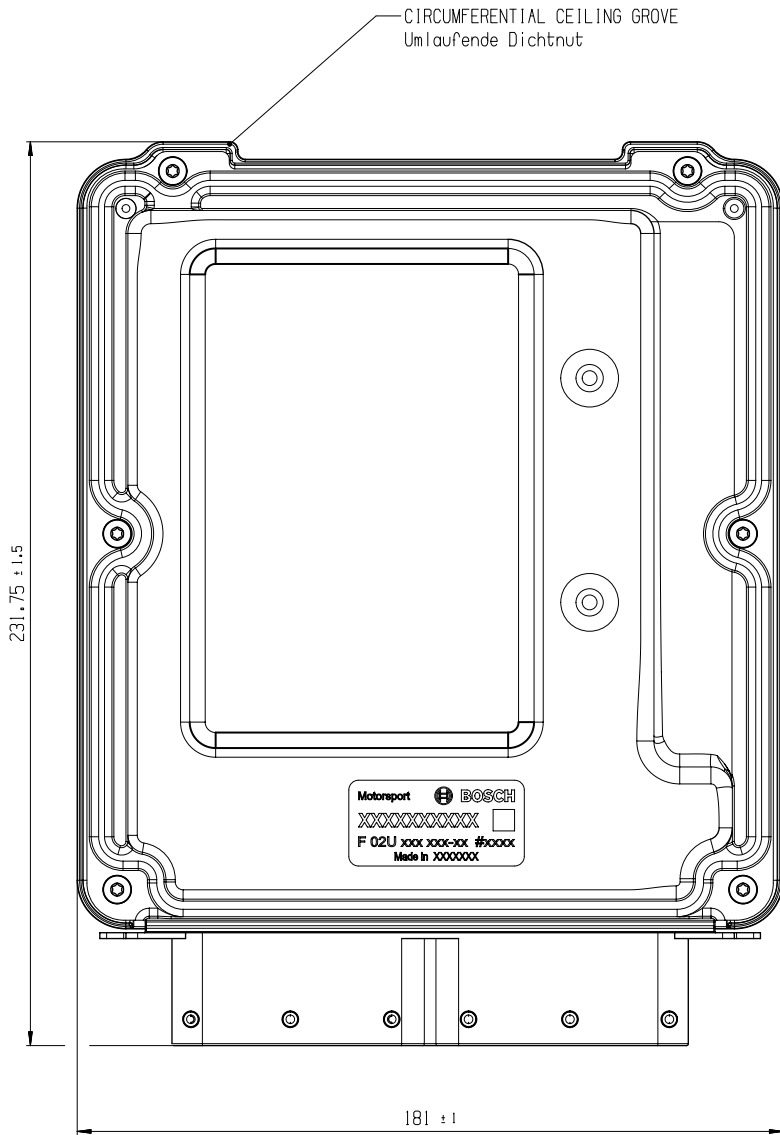
### Mating Connector 105 pins

Order number F02U.B00.712-01

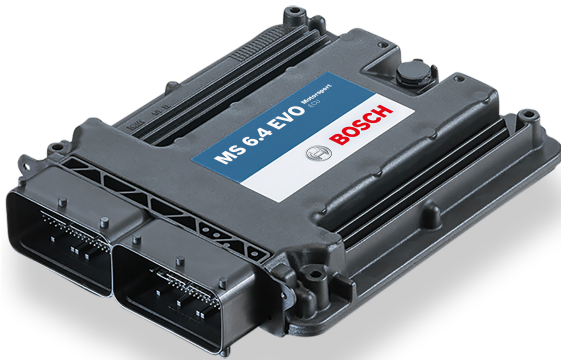
## Dimensions



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## Engine Control Unit MS 6.4 EVO



### Features

- ▶ Optimized for low- and high-pressure injection
- ▶ Measurement with 38 analog inputs
- ▶ 4 GB memory plus 4 GB upgrade
- ▶ SENT sensor support

The MS 6.4 EVO 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 EVO 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 on injection types and pressure ranges)

#### High Pressure Injection Package inclusive

Enables the control of a 2nd high pressure pump

#### Low pressure injection

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

#### Ignition

- 12 x ignition control, IGBT or BJT, coils with integrated amplifier

#### Physical engine model for fast application

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

Integrated support of manual gearshift

Electronic throttle control

Variable Valve Timing VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

#### Internal logger

- 4 GB memory on Partition 1 enabled
- 100 free configurable channels, 20 Hz
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory/1,500 channels/1 kHz sampling rate on Partition 2) optional

#### Logging rates

- Usage of all features: 300 kB/s
- Primary logging use case: 600 kB/s
- Logging data download rate: up to 4 MB/s

### Technical Specifications

#### Mechanical Data

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

#### Electrical Data

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

#### Inputs

##### 38 analog inputs

6 x reserved for electronic throttle controls
10 x no integrated pull-up
4 x option for angle synchronous measurement, no integrated pull-up
5 x fixed 3.01 kOhm pull-up
13 x switchable 3.01 kOhm pull-up

**8 analog/digital inputs (shared)**

8 x option for angle synchronous measurement / digital (e.g. SENT)

**6 internal measurements**

1 x ambient pressure

1 x acceleration 6-axis

2 x ECU temperature

2 x ECU voltage

**9 function related inputs**

2 x thermocouple exhaust gas temperature sensors (K-type)

2 x Lambda interfaces for LSU 4.9 sensor types

1 x lap trigger/beacon input

4 x knock sensors

**10 digital inputs**

1 x switchable Hall or inductive sensor for flywheel measurement

2 x Hall sensor for sync wheel detection

4 x switchable Hall or DF11 sensors for camshaft position or wheel speed

2 x switchable Hall or inductive sensors for turbo speed measurement

1 x digital switch for engine ON/OFF

**Sensor supplies and screens**

4 x sensor supplies 5 V / 50 mA

3 x sensor supplies 5 V / 150 mA

7 x sensor grounds

2 x sensor screens

**Outputs****38 function related outputs**

High Pressure Injection

2 x high pressure pump with MSV control

8 x high pressure injection for magnetic injectors

Low Pressure Injection

12 x 2.2 A low pressure injection for high impedance injectors

Ignition

12 x ignition control, IGBT or BJT, coils with integrated amplifier

2 x 8.5 A H-bridge reserved for electronic throttle

2 x 4 A pwm lowside switch for Lambda heater

**19 freely configurable outputs**

1 x 8.5 A H-bridge

2 x 4 A pwm lowside switch

4 x 3 A pwm lowside switch

8 x 2.2 A pwm lowside switch

4 x 1 A pwm lowside switch

**3 output signals**

1 x engine rpm

1 x flywheel

1 x trigger wheel

**Software Tools (free download)**

Data Analysis tool WinDarab V7

System Configuration tool RaceCon 2.7.0.9 or later

**Mating Connectors (not included)**

Mating Connector 91 pins F02U.B00.711-01

Mating Connector 105 pins F02U.B00.712-01

**Norms****Product Safety**

EN IEC 62368-1:2020+A11:2020

**Materials**

REACH - Nr. 1907/2006

**EMC**

UNECE10:rev.6/AMD1:2020

KN41

ISO11452-2

ISO11452-4

ISO10605

ISO7637-2

ISO7367-3

ISO16750-2

US FCC: Title 47, Part 15 Subpart B

ICES-003

**Testing**

SAEJ1211

**Communication**

2 Ethernet

3 CAN

1 LIN

8 SENT

1 RS232

1 Time sync synchronization Ethernet

3 Communication screens

**Installation Notes**

Maintenance Interval: 220 h or a maximum of two years

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.

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

Extension for Partition 1

- 1,500 channels
- 1 kHz sampling rate

### FULL\_LOG\_2

Activation of Partition 2

- 1,500 channels
- 1 kHz sampling rate
- 4 GB memory

### Gear Control Package 1

Gear control MEGA-Line functionality, has to be used with MEGA-Line components (License model via MEGA-Line)

-- [Link to MEGA-Line Support Request](#) --

-- [Link to MEGA-Line License Request Form](#) --

### Gear Control Package 2

Gear control Bosch Motorsport functionality

### SW Package MS 6 Drag 1

- Launch Timer
- Launch Distance
- Torque Pre-Control
- Launch RPM Control
- Universal Outputs for Time/Distance Controls

### SW Package MS 6 Drag 2 (requires Drag 1 License)

- Acceleration Sensor MM5.10 included
- Time/Distance Boost Control
- Driveshaft Speed Control
- Driveshaft Gradient Control
- Acceleration Control
- Wheelie Control

### Innovation License Device

Activation of a set of additional functions for a single device:

- Crank rotation direction detection (using sensor DG23i)
- Using a 2nd crank backup sensor

- Crank-Pre-set, quick start based on previous crank stop position
- Far-Bank, 2nd injector per cylinder possible
- Cam-only-synchronisation, engine run without crank sensor signal (specific cam trigger wheel needed)

### Innovation Package Project

Innovation Package Project has the same content as Innovation License Device, but license is valid for the whole project instead of a single device

### DATA\_USB

Data copy to USB flash drive

## Ordering Information

### Engine Control Unit MS 6.4 EVO

Order number **F02U.V03.114-01**

### Rugged USB flash drive

Order number **F02U.V03.534-01**

### Connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

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

## Software Options

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

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

### FULL\_LOG\_2

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

### Gear Control Package 1

Order number **please contact MEGA-Line**

### Gear Control Package 2

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

### SW Package MS 6 Drag 1

Order number **F02U.V0U.409-01**

### SW Package MS 6 Drag 2

Order number **F02U.V0U.410-01**

### Innovation License Device

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

### Innovation Package Project

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

### DATA\_USB

Order number **F02U.V03.476-01**

## Accessories

### Breakout Box BOB MS 6 EVO

Order number **F02U.V02.294-02**

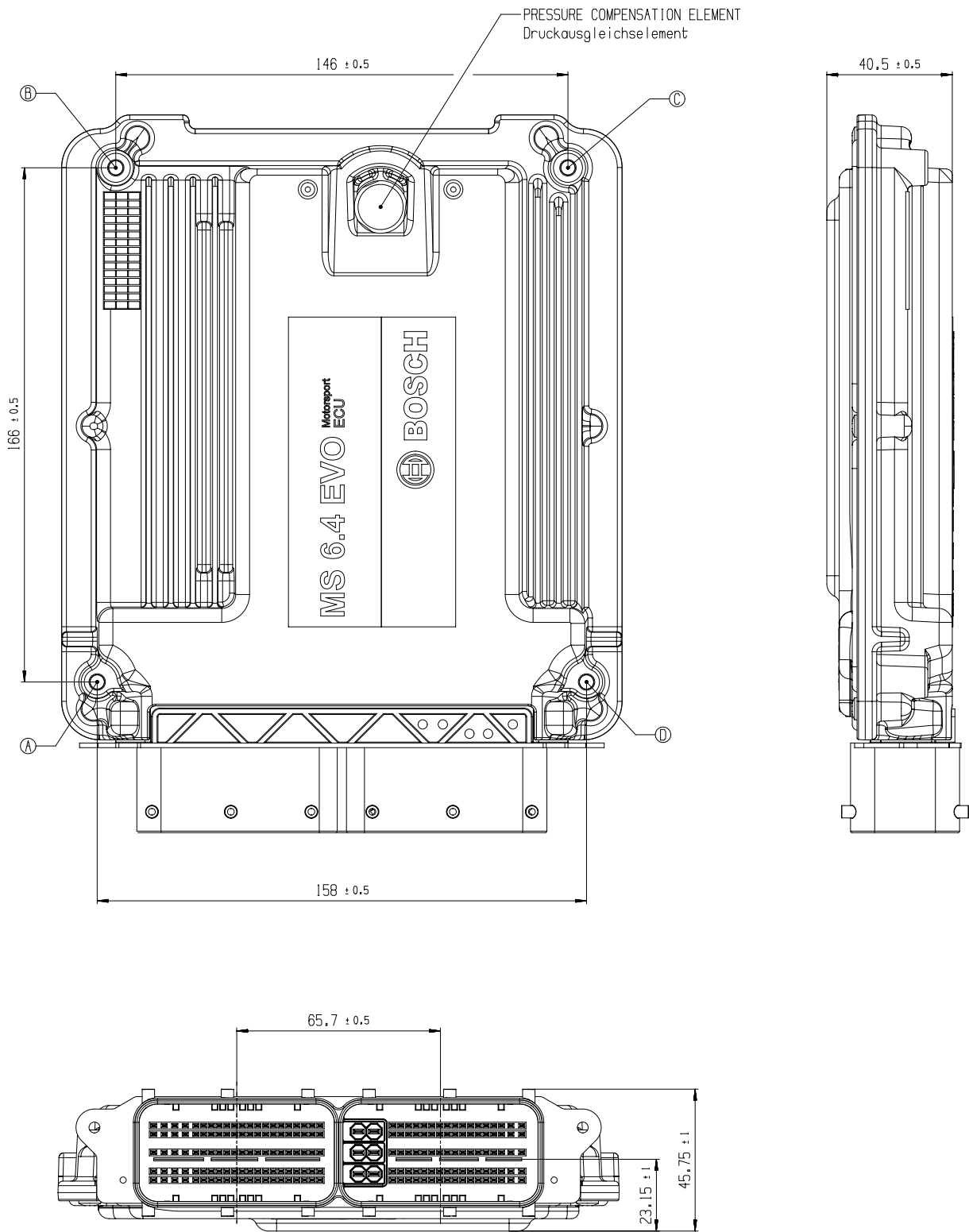
### Mating Connector 91 pins

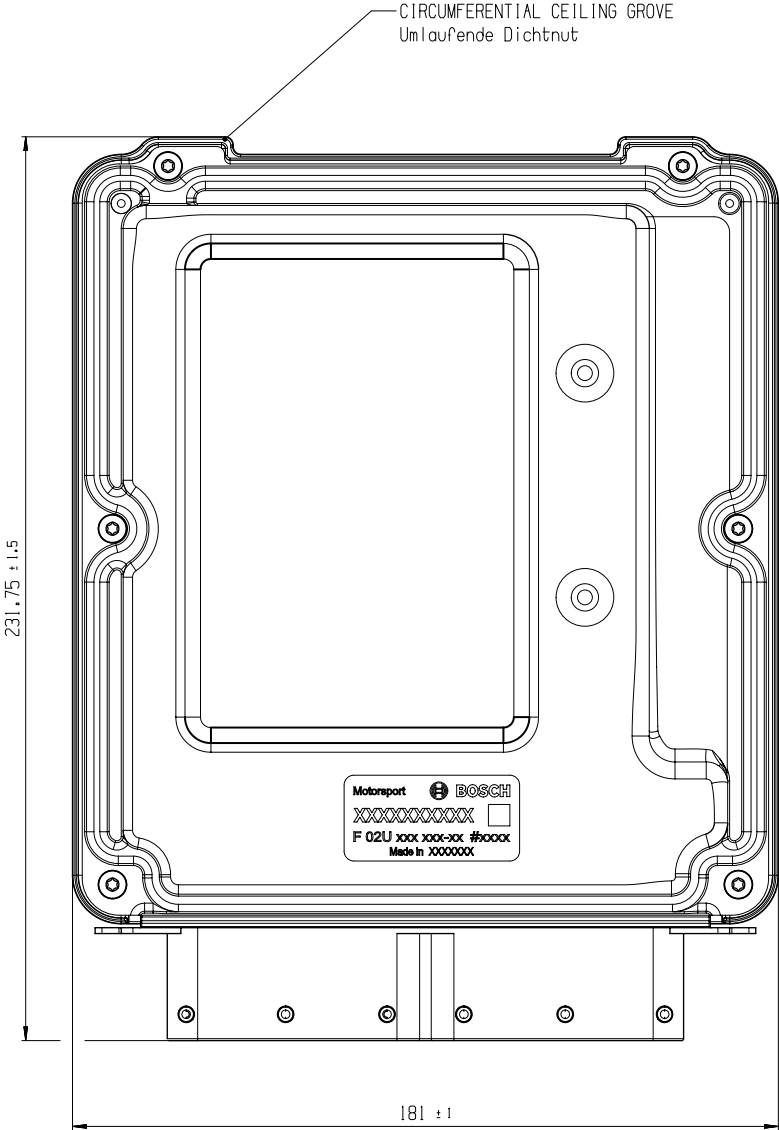
Order number **F02U.B00.711-01**

### Mating Connector 105 pins

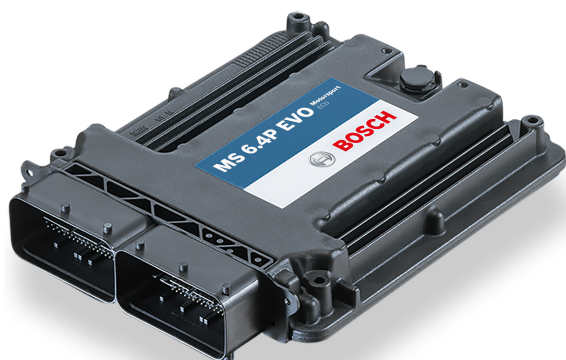
Order number **F02U.B00.712-01**

Dimensions





## Engine Control Unit MS 6.4P EVO



### Features

- ▶ 866 MHz Dual Core Processor for projects with high performance demand
- ▶ 4 GB memory plus 16 GB upgrade
- ▶ SENT sensor support

The MS 6.4P EVO engine control unit manages gasoline engines up to 12 cylinders. The MS 6 family provides high control performance, logging capabilities and an extensive feature set to improve performance in your application. It features a powerful digital processing core and a high-end FPGA for ultimate performance and flexibility. Custom functions can be provided quickly and easily as a service or implemented as customer code with MATLAB/Simulink. The MS 6 family is fully integrated into the Bosch Motorsport system architecture.

Hint: Specific Software Version for MS 6.4P EVO needed, not compatible with MS 6.4 EVO software.

### 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 on injection types and pressure ranges)

#### High Pressure Injection Package inclusive

Enables the control of a 2nd high pressure pump

#### Low pressure injection

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

#### Ignition

- 12 x ignition control, IGBT or BJT, coils with integrated amplifier

#### 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 various gear cut systems
- Diagnostics
- Integrated safety strategy for 2 electronic throttle controls

Integrated support of manual gearshift

Electronic throttle control

Variable Valve Timing VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

#### Internal logger

- 4 GB memory on Partition 1 enabled
- 100 free configurable channels, 20 Hz
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional
- PERF\_LOG\_1 (16 GB memory on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory/1,500 channels/1 kHz sampling rate on Partition 2) optional

#### Logging rates

- Usage of all features: 400 kB/s
- Primary logging use case: 800 kB/s
- Logging data download rate: up to 5 MB/s

### 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)	0 to 80°C

#### Electrical Data

Power supply	6 to 18 V
CPU	Dual Core 866 MHz, FPGA

#### Inputs

##### 38 analog inputs

- 6 x reserved for electronic throttle controls
- 10 x no integrated pull-up
- 4 x option for angle synchronous measurement, no integrated pull-up
- 5 x fixed 3.01 kOhm pull-up
- 13 x switchable 3.01 kOhm pull-up

**8 analog/digital inputs (shared)**

8 x option for angle synchronous measurement / digital (e.g. SENT)

**6 internal measurements**

1 x ambient pressure

1 x acceleration 6-axis

2 x ECU temperature

2 x ECU voltage

**9 function related inputs**

2 x thermocouple exhaust gas temperature sensors (K-type)

2 x Lambda interfaces for LSU 4.9 sensor types

1 x lap trigger/beacon input

4 x knock sensors

**10 digital inputs**

1 x switchable Hall or inductive sensor for flywheel measurement

2 x Hall sensor for sync wheel detection

4 x switchable Hall or DF11 sensors for camshaft position or wheel speed

2 x switchable Hall or inductive sensors for turbo speed measurement

1 x digital switch for engine ON/OFF

**Sensor supplies and screens**

4 x sensor supplies 5 V / 50 mA

3 x sensor supplies 5 V / 150 mA

7 x sensor grounds

2 x sensor screens

**Outputs****38 function related outputs**

High Pressure Injection

2 x high pressure pump with MSV control

8 x high pressure injection for magnetic injectors

Low Pressure Injection

12 x 2.2 A low pressure injection for high impedance injectors

Ignition

12 x ignition control, IGBT or BJT, coils with integrated amplifier

2 x 8.5 A H-bridge reserved for electronic throttle

2 x 4 A pwm lowside switch for Lambda heater

**19 freely configurable outputs**

1 x 8.5 A H-bridge

2 x 4 A pwm lowside switch

4 x 3 A pwm lowside switch

8 x 2.2 A pwm lowside switch

4 x 1 A pwm lowside switch

**3 output signals**

1 x engine rpm

1 x flywheel

1 x trigger wheel

**Software Tools (free download)**

Data Analysis tool WinDarab V7

System Configuration tool RaceCon 2.7.0.9 or later

**Mating Connectors (not included)**

Mating Connector 91 pins F02U.B00.711-01

Mating Connector 105 pins F02U.B00.712-01

**Norms****Product Safety**

EN IEC 62368-1:2020+A11:2020

**Materials**

REACH - Nr. 1907/2006

**EMC**

UNECE10:rev.6/AMD1:2020

KN41

ISO11452-2

ISO11452-4

ISO10605

ISO7637-2

ISO7367-3

ISO16750-2

US FCC: Title 47, Part 15 Subpart B

ICES-003

**Testing**

SAEJ1211

**Communication**

2 Ethernet

3 CAN

1 LIN

8 SENT

1 RS232

1 Time sync synchronization Ethernet

3 Communication screens

**Installation Notes**

Maintenance Interval: 220 h or a maximum of two years

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.

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

### CCA Hardware Upgrade per device

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

### FULL\_LOG\_1

Extension for Partition 1

- 1,500 channels
- 1 kHz sampling rate

### PERF\_LOG\_1 (requires FULL\_LOG\_1)

Increase logging Partition 1 from 4 GB to 16 GB memory

### FULL\_LOG\_2

Activation of Partition 2

- 1,500 channels
- 1 kHz sampling rate
- 4 GB memory

### Gear Control Package 1

Gear control MEGA-Line functionality, has to be used with MEGA-Line components (License model via MEGA-Line)

-- [Link to MEGA-Line Support Request](#) --

-- [Link to MEGA-Line License Request Form](#) --

### Gear Control Package 2

Gear control Bosch Motorsport functionality

**Specific project SW for MS 6.4P EVO, based on MS 6.4 EVO SW, offered as engineering service**

### SW Package MS 6 Drag 1

- Launch Timer
- Launch Distance
- Torque Pre-Control
- Launch RPM Control
- Universal Outputs for Time/Distance Controls

### SW Package MS 6 Drag 2 (requires Drag 1 License)

- Acceleration Sensor MM5.10 included
- Time/Distance Boost Control
- Driveshaft Speed Control
- Driveshaft Gradient Control
- Acceleration Control
- Wheelie Control

### Innovation License Device

Activation of a set of additional functions for a single device:

- Crank rotation direction detection (using sensor DG23i)

- Using a 2nd crank backup sensor
- Crank-Pre-set, quick start based on previous crank stop position
- Far-Bank, 2nd injector per cylinder possible
- Cam-only-synchronisation, engine run without crank sensor signal (specific cam trigger wheel needed)

### Innovation Package Project

Innovation Package Project has the same content as Innovation License Device, but license is valid for the whole project instead of a single device

### DATA\_USB

Data copy to USB flash drive

## Ordering Information

### Engine Control Unit MS 6.4P EVO

Order number F02U.V03.112-01

### Engine Control Unit MS 6 EVO RX

FIA-homologated version for WRX Championship

Order number **on request**

### Rugged USB flash drive

Order number F02U.V03.534-01

### Connector for USB flash drive on car loom side

Order number F02U.002.996-01

### Adapter cable to PC USB-Port

Order number F02U.V01.343-01

## Software Options

### CCA Hardware Upgrade per device

Order number F02U.V02.137-01

### FULL\_LOG\_1

Order number F02U.V02.304-01

### PERF\_LOG\_1

Order number F02U.V03.054-01

### FULL\_LOG\_2

Order number F02U.V02.305-01

### Gear Control Package 1

Order number **please contact MEGA-Line**

### Gear Control Package 2

Order number F02U.V02.108-01

### Specific project SW for MS 6.4 Performance, based on MS 6.4 SW, offered as engineering service

Order number **on request**

### SW Package MS 6 Drag 1

Order number F02U.V0U.409-01

### SW Package MS 6 Drag 2

Order number F02U.V0U.410-01

### Innovation License Device

Order number F02U.V02.510-01

### Innovation Package Project

Order number F02U.V02.511-01

### DATA\_USB

Order number F02U.V03.476-01

## Accessories

### Breakout Box BOB MS 6 EVO

Order number F02U.V02.294-02

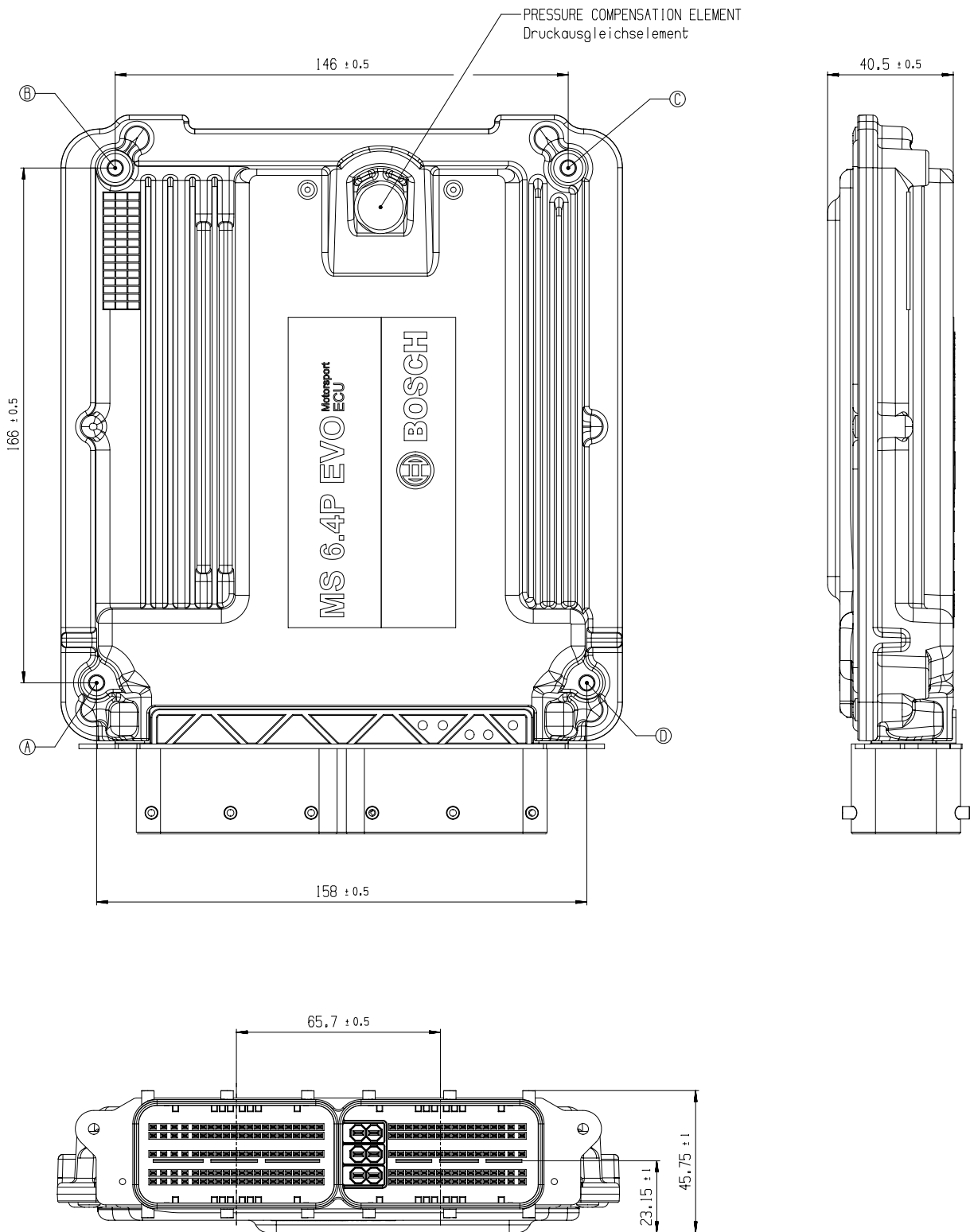
### Mating Connector 91 pins

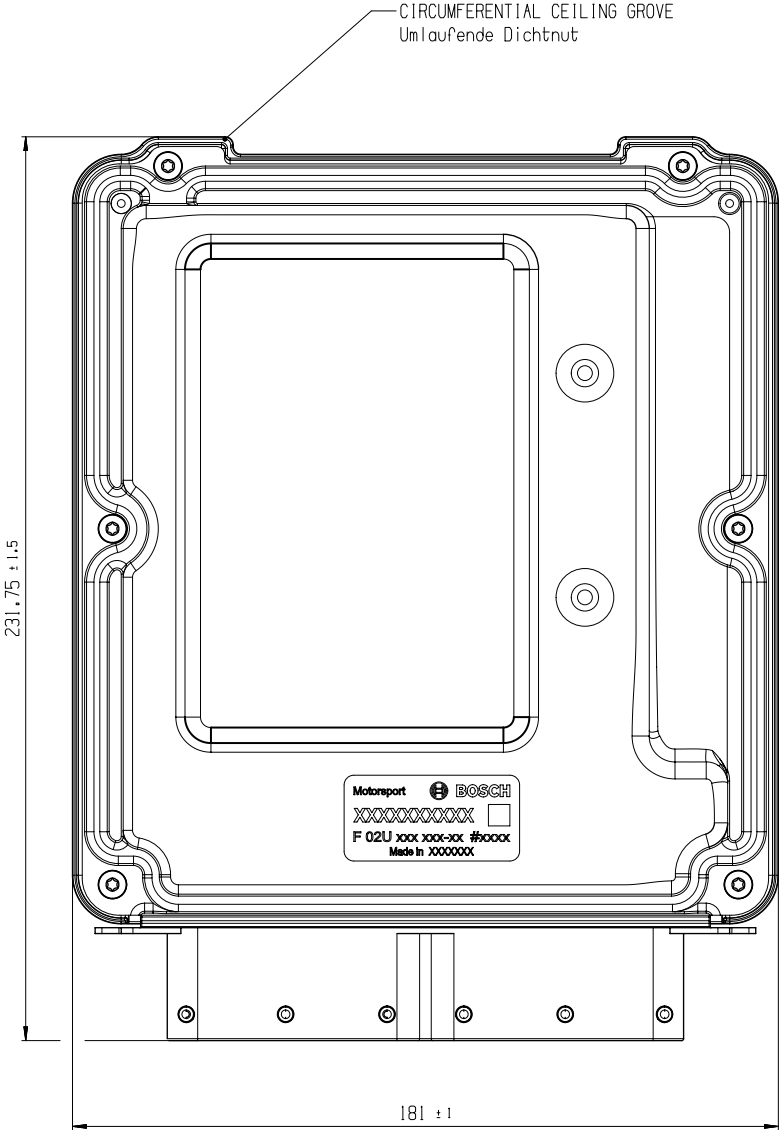
Order number F02U.B00.711-01

### Mating Connector 105 pins

Order number F02U.B00.712-01

Dimensions





## Engine Control Unit MS 7.8



### Features

- ▶ Optimized for low- and high-pressure injection
- ▶ 5 CAN, 3 of them CAN-FD capable
- ▶ 4 x 8.5 A H-Bridge
- ▶ Gearbox control optionally included
- ▶ SENT sensor support

The MS 7.8 engine control unit manages gasoline engines up to 12 cylinders. The MS 7 line features a powerful digital processing core with floating point arithmetic and a high-end FPGA for ultimate performance and flexibility. The MS 7 line utilizes a software development process based on MATLAB/Simulink which significantly speeds up algorithm development by using automatic code and documentation generation. Custom functions can be generated quickly and easily. The flexible hardware design allows the MS 7.8 to support complex or unusual engine or chassis configurations.

Version MS 7.8-ADV was developed for use with Lambda Sensor LSU ADV (higher max. Hexagon temperature).

### 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

(for supply voltages >10 V, depending on injection types and pressure ranges)

HP package for flat and V-engines inclusive (2nd Bank, fuel control valve 2, external cylinder 9-12)

#### 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 with fast decay

#### 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

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

Integrated support of manual gearshift

Electronic throttle control

Variable Valve Timing VVT

Turbo control

Traction control

Launch control

LTE Ethernet telemetry support

#### Internal logger

- FULL\_LOG\_1 (4 GB memory on Partition 1) enabled
- PERF\_LOG\_1 (16 GB memory on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory on Partition 2) enabled
- DATA\_USB (Data copy to USB flash drive) enabled

#### Logging rates

- Usage of all features: 400 kB/s
- Primary logging use case: >800 kB/s
- Logging data download rate: up to 6.2 MB/s

### Technical Specifications

#### Mechanical Data

Milled aluminum housing

4 motorsport connectors, 264 pins in total

Size without connectors 198 x 180 x 42 mm

Weight 1,560 g

Protection Classification IP67

Temp. range (at internal sensors) -20 to 85°C

Max. Vibration Vibration Profile 1

#### Electrical Data

Power supply 6 to 18 V

CPU Dual Core 1 GHz, FPGA

#### Inputs

46 analog inputs

8 analog/digital/SENT inputs (shared)

**12 digital inputs**

- 4 x switchable Hall/inductive
- 4 x Hall
- 4 x switchable Hall/DF11

**21 internal measurements**

- 8 x ECU Current (Sensor Supply)
- 8 x ECU Voltage (Sensor Supply)
- 1 x Boost Voltage
- 1 x Booster Supply Voltage
- 1 x Dynpwr Supply Voltage
- 1 x Supply Current
- 1 x USB Current

**18 function related inputs**

- 8 x fast ADC for combustion chamber pressure input
- 2 x thermocouple exhaust gas temperature sensors (multi-type)
- 2 x Lambda interfaces for LSU 4.9 sensor types (LSU-ADV version available, see Ordering Information)
- 1 x digital switch for engine ON/OFF
- 1 x digital input for beacon receiver
- 4 x knock sensors

**Sensor supplies and screens**

- 8 x sensor supply 400 mA, switchable 5 V/Vbat with voltage and current sensing
- 8 x sensor grounds
- 2 x sensor screens

**Outputs****38 function related outputs****High Pressure Injection**

- 2 x high pressure pump with fuel control valve
- 8 x high pressure injection for magnetic injectors

**Low Pressure Injection**

- 12 x 2.2 A low pressure injection for high impedance injectors

**Ignition**

- 12 x ignition control, IGBT or BJT, coils with integrated power stage, or max. 8 cylinders and coils without integrated power stage, 20 A
- 2 x 8.5 A H-bridge reserved for electronic throttle
- 2 x 3 A pwm lowside switch for Lambda heater

**15 freely configurable outputs**

- 2 x 8.5 A H-bridge
- 2 x 4 A pwm lowside switch
- 6 x 3 A pwm lowside switch
- 4 x 2.2 A pwm lowside switch
- 1 x 1 A pwm lowside switch low dump resistant

**5 output signals**

- 5 x MUX outputs for internal signals like flywheel, knock signals, cylinder pressure

**Adaptation and Documentation****Configuration**

- Configurable flywheel- and trigger disc geometries
- Selectable links between functions and in- or outputs

**Function documentation**

- Automatically created during code generation

**MatLab code generation**

- Support for customer own MatLab function development

**Software Tools (free download)**

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

**Mating Connectors**

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

**Communication**

- 1 Ethernet 1 Gbit
- 3 Ethernet 100 Mbit
- 5 CAN, 3 of them CAN-FD capable
- 1 LIN
- 1 USB
- 8 SENT
- 1 Time sync synchronization Ethernet
- 2 Network screens

**Installation Notes**

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

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

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

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Upgrades****CCA Hardware Upgrade per device**

- Enable Customer Code Area

**PERF\_LOG\_1**

Increase logging Partition 1 from 4 GB to 16 GB memory

**Gear Control Package 1**

Gear control MEGA-Line functionality, has to be used with MEGA-Line components (License model via MEGA-Line)

-- Link to MEGA-Line Support Request--

-- Link to MEGA-Line License Request Form --

**Gear Control Package 2**

Gear control Bosch Motorsport functionality

**Accessories**

- Rugged USB flash drive
- Mating connector for USB flash drive on car loom side
- Adapter cable to PC USB-Port
- Cylinder pressure detection base package
- Knock detection via cylinder pressure evaluation
- Programming interface cable

**Ordering Information****Engine Control Unit MS 7.8**

Order number **F02U.V03.249-02**

**Engine Control Unit MS 7.8-ADV**

Order number **F02U.V03.316-02**

**Rugged USB flash drive**

Order number **F02U.V03.534-01**

**Connector for USB flash drive on car loom side**

Order number **F02U.002.996-01**

**Adapter cable to PC USB-Port**

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

**Software Options****CCA Hardware Upgrade per device**

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

**PERF\_LOG\_1**

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

**Gear Control Package 1**

Order number **please contact MEGA-Line**

**Gear Control Package 2**

Order number **F02U.V02.264-01**

**Cylinder pressure detection base package**

Order number **F02U.V02.543-01**

**Knock detection via cylinder pressure evaluation**

Order number **F02U.V02.544-01**

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

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

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

Order number **F02U.V02.296-01**

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

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

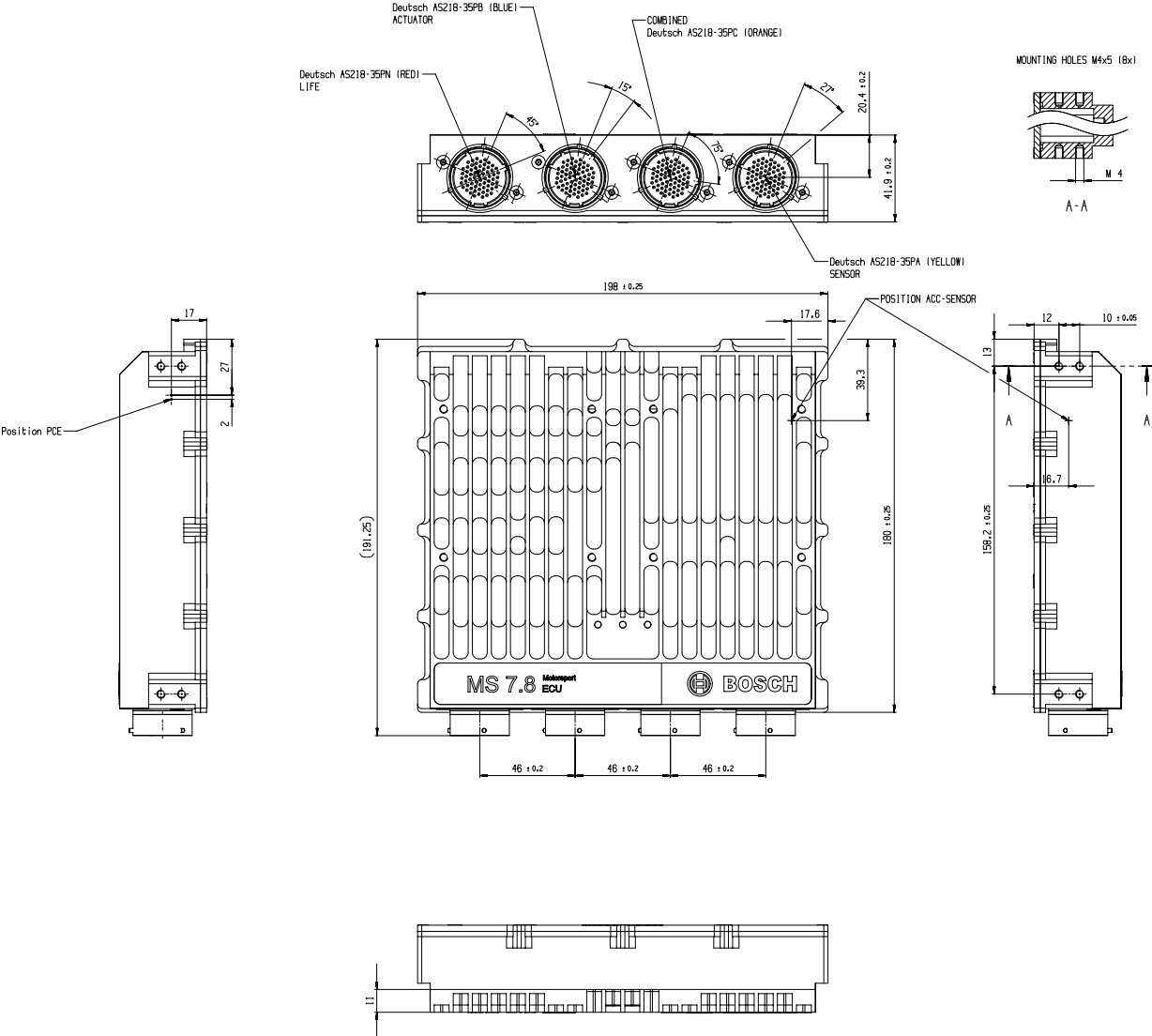
**Breakout Box BOB MS 7, LIFE-Connector code red**

Order number **F02U.V02.293-02**

**Programming interface cable**

Order number **F02U.V02.327-01**

Dimensions



See Offer Drawing for further information

## Overview

### Vehicle Control Unit MS 50.4

FOR EXISTING PROJECTS



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

### Vehicle Control Unit MS 50.4P incl. CCA and Multi-CCA

FOR EXISTING PROJECTS



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

### Vehicle Control Unit MS 50.4 CAN-FD



- 667 MHz Dual Core Processor exclusively for vehicle control functionality (MAT-LAB based)
- Identical, dedicated 667 MHz Dual Core Processor exclusively for logging purposes
- High Speed Logging 200 kHz of 6 analog inputs (optional)
- Up to 8 CAN buses, CAN 3 to CAN 8 are CAN-FD compatible

### Vehicle Control Unit MS 50.4P CAN-FD incl. CCA and Multi-CCA



- 866 MHz Dual Core Processor exclusively for vehicle control functionality (MAT-LAB based)
- Identical, dedicated 866 MHz Dual Core Processor exclusively for logging purposes
- High Speed Logging 200 kHz of 6 analog inputs (optional)
- Up to 8 CAN buses, CAN 3 to CAN 8 are CAN-FD compatible

## Vehicle Control Unit MS 50.4



### Features

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

The VCU MS 50.4 is a highly powerful processing / logging unit for race applications.

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

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

### Application

Processor for customer code	667 MHz Dual Core
-----------------------------	-------------------

Processor for logger	667 MHz Dual Core
----------------------	-------------------

Configurable math channels	
----------------------------	--

User configurable CAN in/out messages	
---------------------------------------	--

Online data compression	
-------------------------	--

#### Internal logger

- 1,500 channels
- FULL\_LOG\_1 (4 GB memory on Partition 1) enabled
- FULL\_LOG\_2 (4 GB memory on Partition 2) enabled
- High Speed Logging Package (Sampling rate 5  $\mu$ s) optional
- DATA\_USB (Data copy to USB flash drive) enabled

#### Logging rates

- Usage of all features: 600 kB/s

- Primary logging use case: >1,200 kB/s
- Logging data download rate: up to 6.2 MB/s

LTE Ethernet telemetry support

RS232 interface for GPS

### Technical Specifications

#### Mechanical Data

Size	166 x 121 x 41 mm
------	-------------------

Weight	$\leq$ 660 g
--------	--------------

Protection classification	IP67
---------------------------	------

3 motorsport connectors, 198 pins in total	
--------------------------------------------	--

Max. vibration	Vibration profile 1
----------------	---------------------

Operating temperature internal	-20 to 80°C
--------------------------------	-------------

#### Electrical Data

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

#### Inputs

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

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

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

4 x universal Thermocouple

1 x Bosch Laptrigger

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

Internal measurements:

1 x ambient pressure

1 x ECU temperature

20 x supply voltage

20 x supply current

1 x battery voltage (external VCU supply)

1 x external VCU supply current

4 x HS output current

1 x 3-axis acceleration plus roll/pitch/yaw rate

#### Outputs

2\* x 7.5 A each, PWM High side, 50 Hz

4\* x 2.2 A each, PWM Low side, 10 kHz

\*can be enhanced by Upgrade I/O Package

#### Sensor Supplies and Screens

5\* x 12 V, 400 mA each

5\* x Switchable 5 V/12 V, 400 mA each

4 A max overall current on all 12 V

2 A max overall current on all 5 V

12 V ± 1 % precision on the pin

5 V ± 0.1 % precision on the pin

20 x Sensor ground

\*can be enhanced by Upgrade I/O Package

### Adaptation and Documentation

Function documentation      Automatically created during code generation

MatLab code generation      Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab 7

System Configuration tool RaceCon      Logger configuration, calibration, and online measurement

### Connectors

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

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

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

### Communication

3 Ethernet 100 Mbit

4 CAN (+4 with Upgrade I/O Package)

1 LIN

1 USB

1 RS232 interface for GPS or Telemetry, switchable depending on SW version

1 Time sync synchronization Ethernet

### Installation Notes

Maintenance Interval: 220 h or a maximum of two years

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Upgrades

#### CCA Hardware Upgrade per device

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

#### Multi CCA Hardware Upgrade per device

Enables the use of an extra core to utilize more computing power in the device

### I/O Package

#### Communication

4 CAN

#### Inputs

4 Analog channels

0 to 5 V,

0.5 % precision between 0.2 and 4.8 V, switchable pull-up

4 Digital PWM inputs

f<sub>max</sub>=30 kHz

Hall-type speed measurement possible,

Fixed pullup 2.15 kOhm (required for Hall),

Tooth count differential\*\*

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

#### Outputs

4 "TTL" Digital output, 10 kHz, PWM, 25 mA each

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

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

#### Power Supplies

5 x12 V, 400 mA each

5 switchable 5 V/12 V, 400 mA each

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

### High Speed Logging Package

6 ANA

0 to 5 V, 200 kHz logging rate

### CCP/XCP\_MASTER

Enables CCP/XCP master functionality to request data from foreign devices via CAN/CCP protocol, XCP over Ethernet (UDP) or XCP via CAN.

(ASAP2 file from ECU manufacturer required)

## Ordering Information

### Vehicle Control Unit MS 50.4

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

### Vehicle Control Unit MS 50.4 incl. CCA Hardware Upgrade

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

### Rugged USB flash drive

Order number **F02U.V03.534-01**

### Connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

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

### Breakout Box BOB 66-pole

Connector code: blue

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

### Breakout Box BOB 66-pole

Connector code: yellow

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

### Breakout Box BOB MS 7

Connector code: red

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

## Software Options

### CCA Hardware Upgrade per device

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

### Multi CCA Hardware Upgrade VCU per device

Order number **F02U.V03.222-01**

### I/O Package

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

### High Speed Logging Package

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

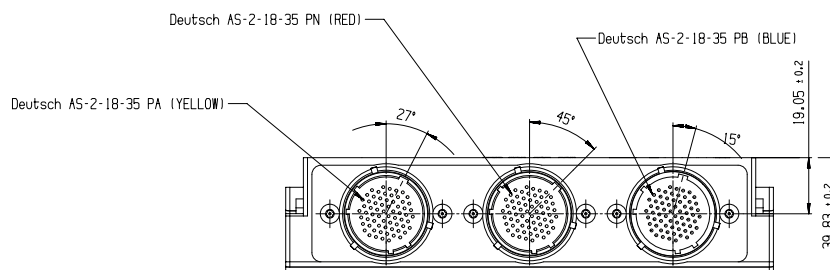
### CCP/XCP\_MASTER

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

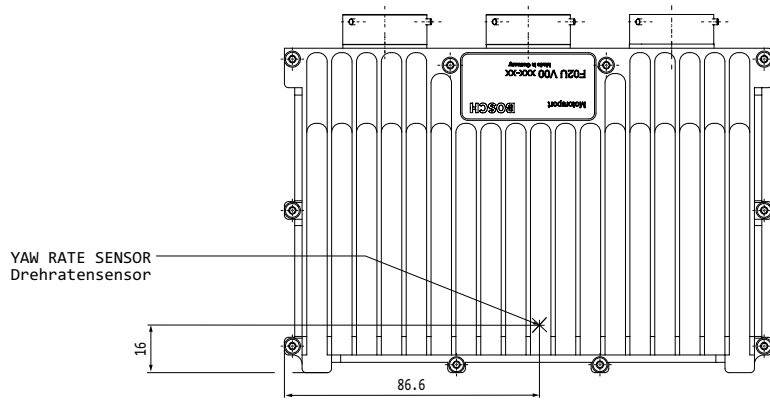
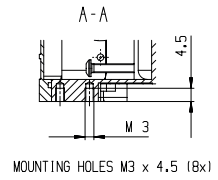
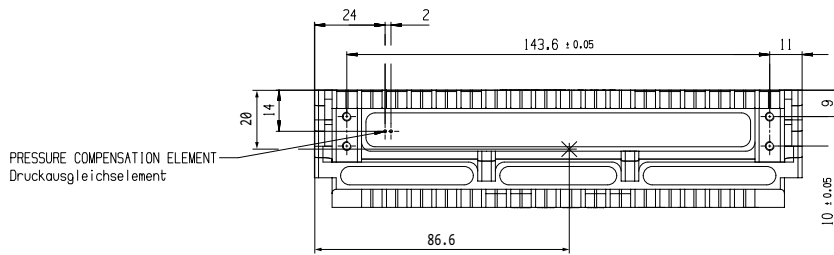
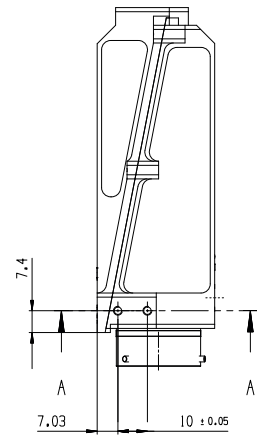
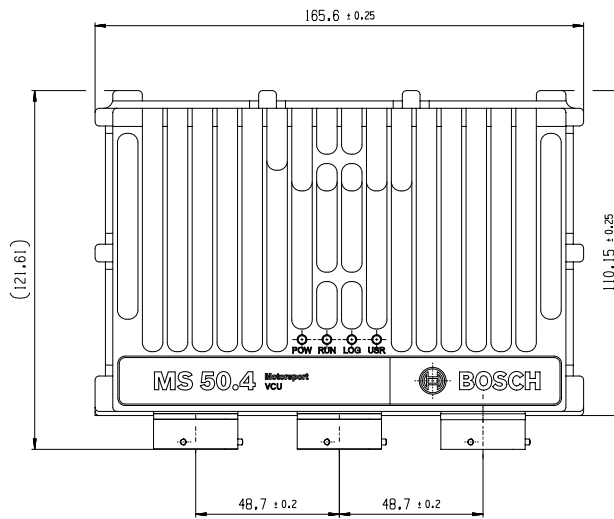
## Accessories

### Opening tool for shellsize 18

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



## Dimensions



YAW RATE SENSOR  
Drehratensensor

## Vehicle Control Unit MS 50.4P incl. CCA and Multi-CCA



### Features

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

The VCU MS 50.4P incl. CCA and Multi-CCA is a highly powerful processing / logging unit for race applications.

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

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

### Application

Processor for customer code	866 MHz Dual Core
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Processor for logger	866 MHz Dual Core
----------------------	-------------------

Configurable math channels	
----------------------------	--

User configurable CAN in/out messages	
---------------------------------------	--

Online data compression	
-------------------------	--

#### Internal logger

- 1,500 channels
- FULL\_LOG\_1 (4 GB memory on Partition 1) enabled
- PERF\_LOG\_1 (16 GB memory on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory on Partition 2) enabled
- High Speed Logging Package (Sampling rate 5  $\mu$ s) optional
- DATA\_USB (Data copy to USB flash drive) enabled

#### Logging rates

- Usage of all features: 800 kB/s
- Primary logging use case: >1,500 kB/s
- Logging data download rate: up to 7.5 MB/s

LTE Ethernet telemetry support

RS232 interface for GPS

#### Customer Code Area CCA

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

#### Multi CCA

Enables the use of an extra core to utilize more computing power in the device for running a second customer model

### Technical Specifications

#### Mechanical Data

Size	166 x 121 x 41 mm
------	-------------------

Weight	≤ 660 g
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Protection classification	IP67
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3 motorsport connectors, 198 pins in total

Max. vibration	Vibration profile 1
----------------	---------------------

Operating temperature internal	0 to 85°C
--------------------------------	-----------

Operation outside the temperature limits can be tested on request during the manufacturing tests.

#### Electrical Data

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

#### Inputs

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

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

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

4 universal Thermocouple

1 Bosch Laptrigger

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

Internal measurements:

1 x ambient pressure

1 x ECU temperature

20 x supply voltage

20 x supply current

1 x battery voltage (external VCU supply)

1 x external VCU supply current

4 x HS output current

1 x 3-axis acceleration plus roll/pitch/yaw rate

#### Outputs

2\* x PWM High side; 7.5 A each, PWM, 50 Hz

4\* x PWM Low side; 2.2 A each, PWM, 10 kHz

\*can be enhanced by Upgrade I/O Package

### Sensor Supplies and Screens

5\* x 12 V, 400 mA each

5\* x Switchable 5 V/12 V, 400 mA each

4 A max overall current on all 12 V

2 A max overall current on all 5 V

12 V  $\pm$  1 % precision on the pin

5 V  $\pm$  0.1 % precision on the pin

20 x Sensor ground

\*can be enhanced by Upgrade I/O Package

### Adaptation and Documentation

Function documentation      Automatically created during code generation

MatLab code generation      Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab 7

System Configuration tool RaceCon      Logger configuration, calibration, and online measurement

### Connectors

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

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

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

### Communication

3 Ethernet 100 Mbit

4 CAN (+4 with Upgrade I/O Package)

1 LIN

1 USB

1 RS232 interface for GPS or Telemetry, switchable depending on SW version

1 Time sync synchronization Ethernet

### Installation Notes

Maintenance Interval: 220 h or a maximum of two years

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Upgrades

#### I/O Package

##### Communication

4 CAN

##### Inputs

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

4 Digital PWM inputs  
f<sub>max</sub>=30 kHz  
Hall-type speed measurement possible,  
Fixed pullup 2.15 kOhm (required for Hall),  
Tooth count differential\*\*

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

##### Outputs

4 "TTL" Digital output, 10 kHz, PWM, 25 mA each

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

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

##### Power Supplies

5 x12 V, 400 mA each

5 switchable 5 V/12 V, 400 mA each

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

#### PERF\_LOG\_1

Increase logging Partition 1 from 4 GB to 16 GB memory

#### High Speed Logging Package

6 ANA      0 to 5 V, 200 kHz logging rate

#### CCP/XCP\_MASTER

Enables CCP/XCP master functionality to request data from foreign devices via CAN/CCP protocol, XCP over Ethernet (UDP) or XCP via CAN.

(ASAP2 file from ECU manufacturer required)

## Ordering Information

### Vehicle Control Unit MS 50.4P incl. CCA and Multi-CCA

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

### Rugged USB flash drive

Order number **F02U.V03.534-01**

### Connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

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

### Breakout Box BOB 66-pole

Connector code: blue

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

### Breakout Box BOB 66-pole

Connector code: yellow

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

### Breakout Box BOB MS 7

Connector code: red

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

## Software Options

### I/O Package

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

### PERF\_LOG\_1

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

### High Speed Logging Package

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

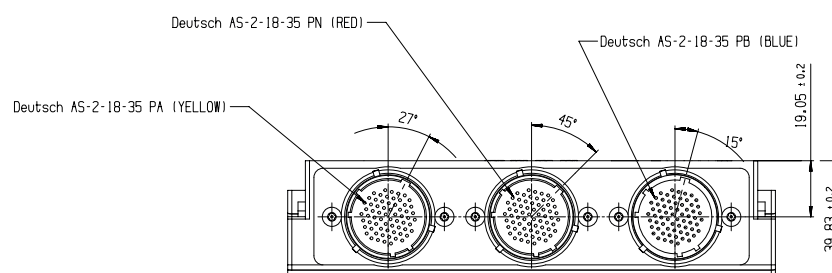
### CCP/XCP\_MASTER

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

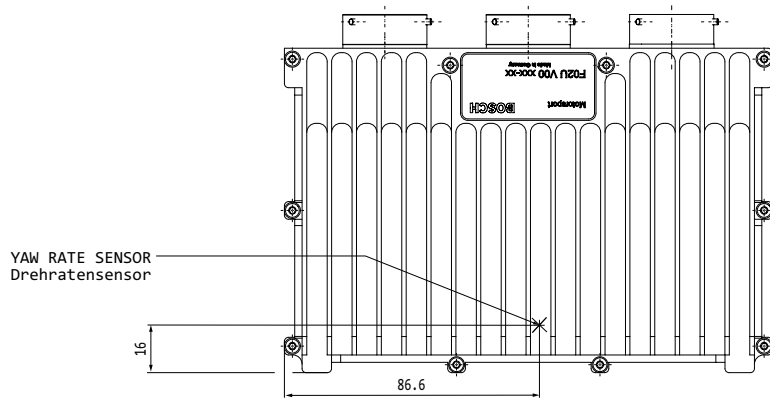
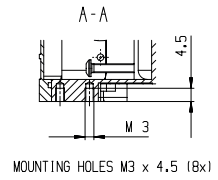
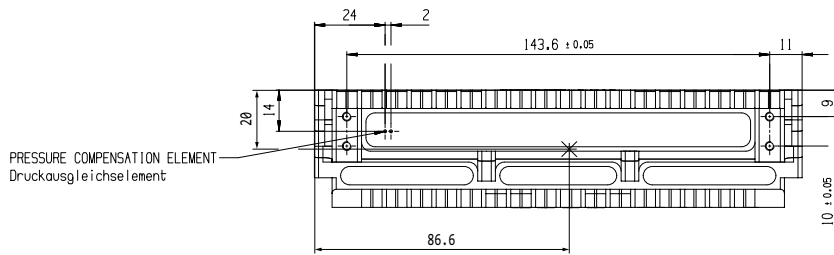
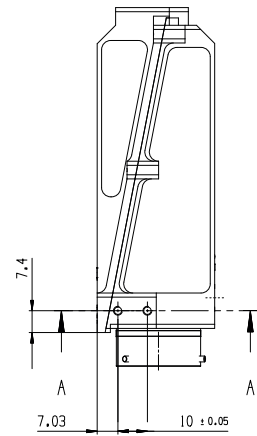
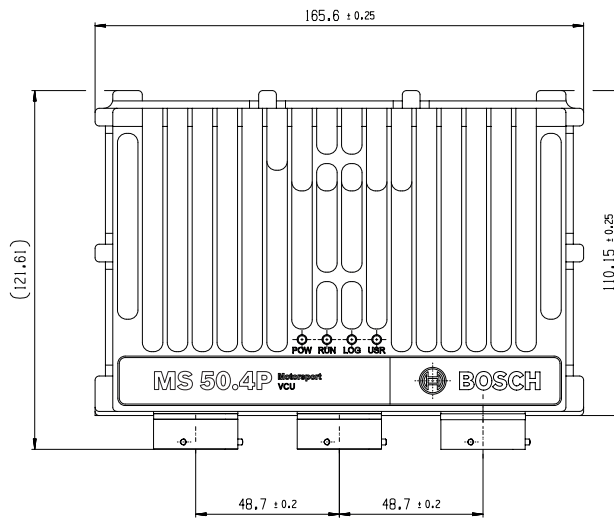
## Accessories

### Opening tool for shellsize 18

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



## Dimensions



## Vehicle Control Unit MS 50.4 CAN-FD



### Features

- ▶ 667 MHz Dual Core Processor exclusively for vehicle control functionality (MATLAB based)
- ▶ Identical, dedicated 667 MHz Dual Core Processor exclusively for logging purposes
- ▶ High Speed Logging 200 kHz of 6 analog inputs (optional)
- ▶ Up to 8 CAN buses, CAN 3 to CAN 8 are CAN-FD compatible

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

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

### Application

Processor for customer code	667 MHz Dual Core
Processor for logger	667 MHz Dual Core
Configurable math channels	
User configurable CAN in/out messages	
Online data compression	

#### Internal logger

- 1,500 channels
- FULL\_LOG\_1 (4 GB memory on Partition 1) enabled
- FULL\_LOG\_2 (4 GB memory on Partition 2) enabled
- High Speed Logging Package (Sampling rate 5  $\mu$ s) optional
- DATA\_USB (Data copy to USB flash drive) enabled

#### Logging rates

- Usage of all features: 600 kB/s
- Primary logging use case: >1,200 kB/s
- Logging data download rate: up to 6.2 MB/s

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
3 motorsport connectors, 198 pins in total	
Max. vibration	Vibration profile 1
Operating temperature internal	-20 to 80°C

#### Electrical Data

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

#### Inputs

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

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

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

4 x universal Thermocouple

1 x Bosch Laptrigger

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

Internal measurements:

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

#### Outputs

2\* x 7.5 A each, PWM High side, 50 Hz

4\* x 2.2 A each, PWM Low side, 10 kHz

\*can be enhanced by Upgrade I/O Package

#### Sensor Supplies and Screens

5\* x 12 V, 400 mA each

5\* x Switchable 5 V/12 V, 400 mA each

4 A max overall current on all 12 V

2 A max overall current on all 5 V

12 V ± 1 % precision on the pin  
5 V ± 0.1 % precision on the pin

20 x Sensor ground

\*can be enhanced by Upgrade I/O Package

### Adaptation and Documentation

Function documentation      Automatically created during code generation

MatLab code generation      Support for customer own MatLab function development

### Software Tools (free download)

Data Analysis tool WinDarab 7

System Configuration tool RaceCon      Logger configuration, calibration, and online measurement

### Connectors

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

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

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

### Communication

3 Ethernet 100 Mbit

4 CAN (+4 with Upgrade I/O Package), CAN 3 to CAN 8 are CAN-FD compatible

1 LIN

1 USB

1 RS232 interface for GPS or Telemetry, switchable depending on SW version

1 Time sync synchronization Ethernet

### Installation Notes

Maintenance Interval: 220 h or a maximum of two years

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Upgrades

#### CCA Hardware Upgrade per device

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

#### Multi CCA Hardware Upgrade per device

Enables the use of an extra core to utilize more computing power in the device

### I/O Package

#### Communication

4 CAN

#### Inputs

4 Analog channels

0 to 5 V,

0.5 % precision between 0.2 and 4.8 V, switchable pull-up

4 Digital PWM inputs

f<sub>max</sub>=30 kHz

Hall-type speed measurement possible,

Fixed pullup 2.15 kOhm (required for Hall),

Tooth count differential\*\*

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

#### Outputs

4 "TTL" Digital output, 10 kHz, PWM, 25 mA each

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

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

#### Power Supplies

5 x12 V, 400 mA each

5 switchable 5 V/12 V, 400 mA each

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

### High Speed Logging Package

6 ANA

0 to 5 V, 200 kHz logging rate

### CCP/XCP\_MASTER

Enables CCP/XCP master functionality to request data from foreign devices via CAN/CCP protocol, XCP over Ethernet (UDP) or XCP via CAN.

(ASAP2 file from ECU manufacturer required)

## Ordering Information

### Vehicle Control Unit MS 50.4 CAN-FD

Order number **F02U.V03.514-01**

### Rugged USB flash drive

Order number **F02U.V03.534-01**

### Connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

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

### Breakout Box BOB 66-pole

Connector code: blue

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

### Breakout Box BOB 66-pole

Connector code: yellow

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

### Breakout Box BOB MS 7

Connector code: red

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

## Software Options

### CCA Hardware Upgrade per device

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

### Multi CCA Hardware Upgrade VCU per device

Order number **F02U.V03.222-01**

### I/O Package

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

### High Speed Logging Package

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

### CCP/XCP\_MASTER

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

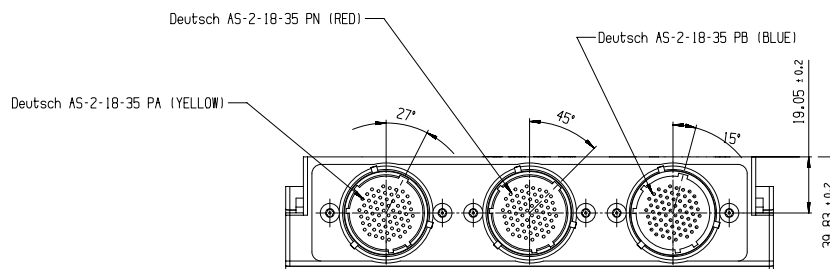
### Real Time Ethernet

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

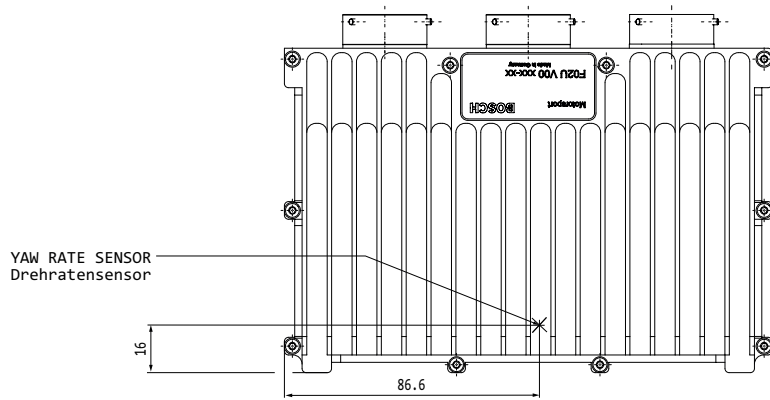
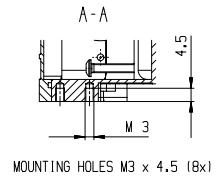
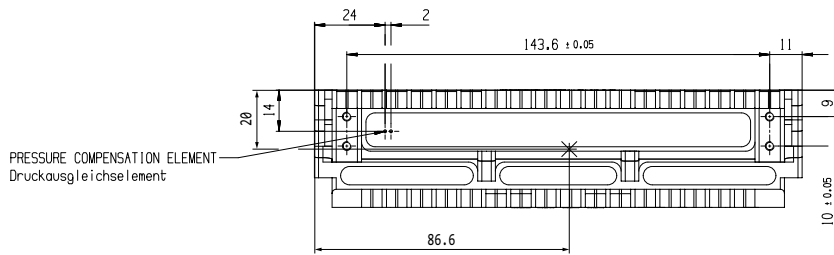
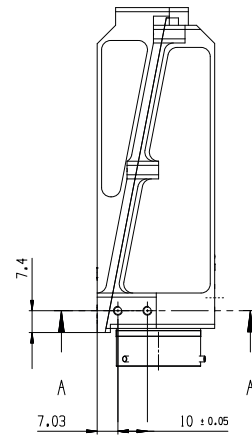
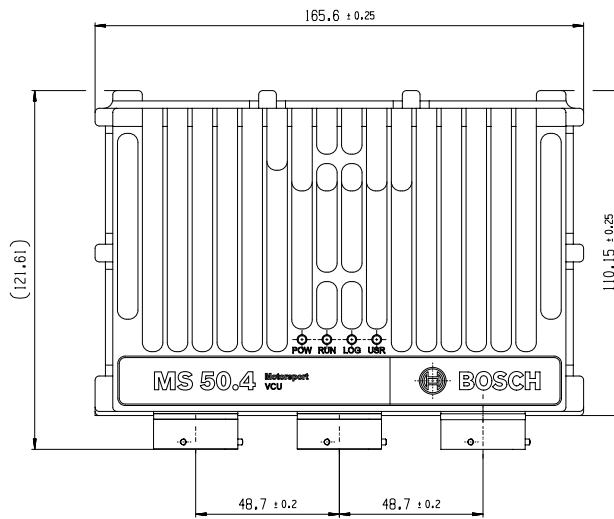
## Accessories

### Opening tool for shellsize 18

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



## Dimensions



## Vehicle Control Unit MS 50.4P CAN-FD incl. CCA and Multi- CCA



### Features

- ▶ 866 MHz Dual Core Processor exclusively for vehicle control functionality (MATLAB based)
- ▶ Identical, dedicated 866 MHz Dual Core Processor exclusively for logging purposes
- ▶ High Speed Logging 200 kHz of 6 analog inputs (optional)
- ▶ Up to 8 CAN buses, CAN 3 to CAN 8 are CAN-FD compatible

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

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

### Application

Processor for customer code	866 MHz Dual Core
Processor for logger	866 MHz Dual Core
Configurable math channels	
User configurable CAN in/out messages	
Online data compression	

### Internal logger

- 1,500 channels
- FULL\_LOG\_1 (4 GB memory on Partition 1) enabled
- PERF\_LOG\_1 (16 GB memory on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory on Partition 2) enabled

- High Speed Logging Package (Sampling rate 5  $\mu$ s) optional
- DATA\_USB (Data copy to USB flash drive) enabled

### Logging rates

- Usage of all features: 800 kB/s
- Primary logging use case: >1,500 kB/s
- Logging data download rate: up to 7.5 MB/s

LTE Ethernet telemetry support

RS232 interface for GPS

### Customer Code Area CCA

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

### Multi CCA

Enables the use of an extra core to utilize more computing power in the device for running a second customer model

## Technical Specifications

### Mechanical Data

Size	166 x 121 x 41 mm
Weight	≤ 660 g
Protection classification	IP67
3 motorsport connectors, 198 pins in total	

Max. vibration Vibration profile 1

Operating temperature internal 0 to 85°C

Operation outside the temperature limits can be tested on request during the manufacturing tests.

### Electrical Data

Supply voltage 5 to 18 V

### Inputs

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

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

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

4 universal Thermocouple

1 Bosch Laptrigger

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

Internal measurements:

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

**Outputs**

2\* x PWM High side; 7.5 A each, PWM, 50 Hz

4\* x PWM Low side; 2.2 A each, PWM, 10 kHz

\*can be enhanced by Upgrade I/O Package

**Sensor Supplies and Screens**

5\* x 12 V, 400 mA each

5\* x Switchable 5 V/12 V, 400 mA each

4 A max overall current on all 12 V

2 A max overall current on all 5 V

12 V  $\pm$  1 % precision on the pin

5 V  $\pm$  0.1 % precision on the pin

20 x Sensor ground

\*can be enhanced by Upgrade I/O Package

**Adaptation and Documentation**

Function documentation      Automatically created during code generation

MatLab code generation      Support for customer own Mat-Lab function development

**Software Tools (free download)**

Data Analysis tool WinDarab 7

System Configuration tool RaceCon      Logger configuration, calibration, and online measurement

**Connectors**

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

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

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

**Communication**

3 Ethernet 100 Mbit

4 CAN (+4 with Upgrade I/O Package), CAN 3 to CAN 8 are CAN-FD compatible

1 LIN

1 USB

1 RS232 interface for GPS or Telemetry, switchable depending on SW version

1 Time sync synchronization Ethernet

**Installation Notes**

Maintenance Interval: 220 h or a maximum of two years

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

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Upgrades****I/O Package****Communication**

4 CAN

**Inputs**

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

4 Digital PWM inputs  
f<sub>max</sub>=30 kHz  
Hall-type speed measurement possible,  
Fixed pullup 2.15 kOhm (required for Hall),  
Tooth count differential\*\*

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

**Outputs**

4 "TTL" Digital output, 10 kHz, PWM, 25 mA each

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

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

**Power Supplies**

5 x12 V, 400 mA each

5 switchable 5 V/12 V, 400 mA each

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

**PERF\_LOG\_1**

Increase logging Partition 1 from 4 GB to 16 GB memory

**High Speed Logging Package**

6 ANA      0 to 5 V, 200 kHz logging rate

**CCP/XCP\_MASTER**

Enables CCP/XCP master functionality to request data from foreign devices via CAN/CCP protocol, XCP over Ethernet (UDP) or XCP via CAN.

(ASAP2 file from ECU manufacturer required)

## Ordering Information

### Vehicle Control Unit MS 50.4P CAN-FD incl. CCA and Multi-CCA

Order number **F02U.V03.515-01**

### Rugged USB flash drive

Order number **F02U.V03.534-01**

### Connector for USB flash drive on car loom side

Order number **F02U.002.996-01**

### Adapter cable to PC USB-Port

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

### Breakout Box BOB 66-pole

Connector code: blue

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

### Breakout Box BOB 66-pole

Connector code: yellow

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

### Breakout Box BOB MS 7

Connector code: red

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

## Software Options

### I/O Package

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

### PERF\_LOG\_1

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

### High Speed Logging Package

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

### CCP/XCP\_MASTER

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

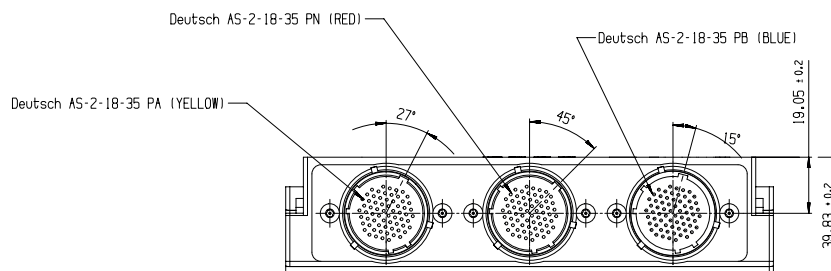
### Real Time Ethernet

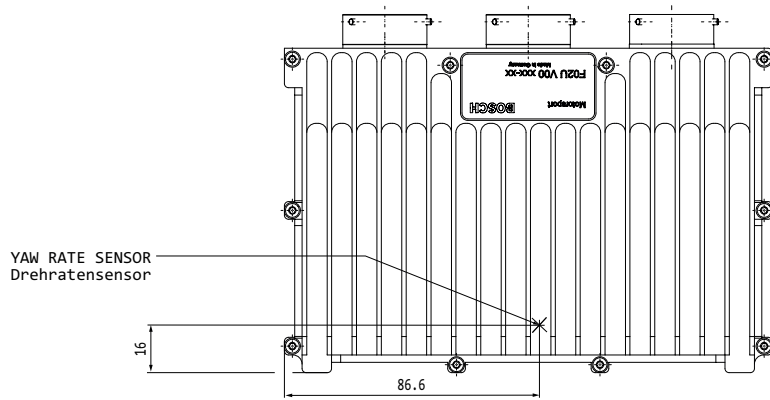
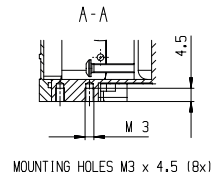
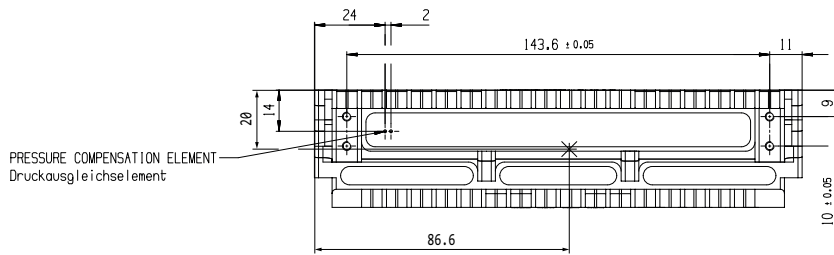
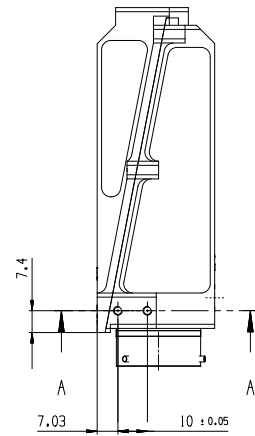
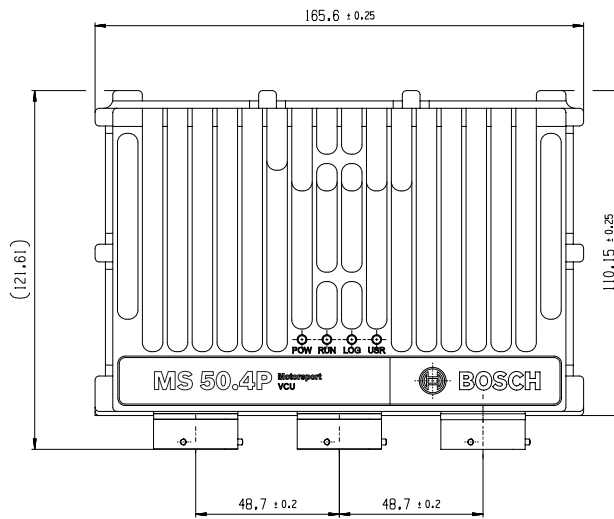
Order number **F02U.V02.782-01**

## Accessories

### Opening tool for shellsize 18

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





# Displays

2

## Overview

2

### Display DDU 10



### Display DDU 11



- Features user interface menu
  - Features display element design generator
  - 10 top-LEDs and 5 side-LEDs on both sides
  - Supports GPS laptrigger, predated lap time etc.
  - Page change based on events possible
- Features user interface menu
  - Features display element design generator
  - 8 top-LEDs and 5 side-LEDs on both sides
  - Supports GPS laptrigger, predated lap time etc.
  - Page change based on events possible

## Display DDU 10



### Features

- ▶ Features user interface menu
- ▶ Features display element design generator
- ▶ 10 top-LEDs and 5 side-LEDs on both sides
- ▶ Supports GPS laptrigger, pre-dated lap time etc.
- ▶ Page change based on events possible

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

Data Analysis Software WinDarab is available free of charge as “WinDarab V7 free” on our website. A basic logging function of 100 channels with recording of 50 ms (4 GB) is always included. The logger can be upgraded to full logging performance (max. 1 ms). In addition, a 2nd logging partition of 4 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
  - 7” graphic color display
  - 12 user configurable display pages
  - 20 multicolor freely configurable (RGB) LEDs

Resolution	800 x 480 pixel
Supported image file formats	PNG, BMP, JPG, GIF
Processor	667 MHz Dual Core
Converters	10 kHz 12 bit 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)
Online data compression	

#### Internal logger

- 4 GB memory on Partition 1 enabled
- 100 channels enabled
- 50 ms Sampling rate enabled
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory on Partition 2) optional

#### Logging rates

- Usage of all features: 600 kB/s
- Primary logging use case: 800 kB/s
- Logging data download rate: up to 4 MB/s

Ambient light sensor

### Technical Specifications

#### Mechanical Data

Size	198 x 134 x 35 mm
Weight	875 g
Protection classification	IP67
Operating temperature internal	-20 to 85°C
Max. vibration	Vibration profile 1

#### Electrical Data

Supply voltage	6 to 18 V
Current consumption (w/o sensor supply)	2 A (at 12 V)

#### Inputs

4 x analog channels, plus 12 optional
0 to 5 V input range
12 bit resolution
Switchable pull up resistors for all analog inputs
4 x Hall-effect or DF11 wheel speed inputs, switchable

#### Sensor Supplies and Screens

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

#### 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

## Connectors and Wires

LIFE connector on display AS216-35PN

Mating connector F02U.000.466-01 AS616-35SN

Auxiliary connector on display AS212-35PN

Mating connector F02U.000.443-01 AS612-35SN

## Pin Configuration

### LIFE connector

Pin	Name	Comment	Status
1	KL_31		Incl.
2	KL_15		Incl.
3	KL_30		Incl.
4	Rev_In_3	Hall or DF11 switchable	Incl.
5	Rev_In_1	Hall or DF11 switchable	Incl.
6	KL_31		Incl.
7	CAN_2_L	CAN speed selectable	Incl.
8	Ethernet_2_TXP		Incl.
9	Ethernet_2_TXN		Incl.
10	Sens_Power_12V	over current protected	Incl.
11	Rev_In_4	Hall or DF11 switchable	Incl.
12	Rev_In_2	Hall or DF11 switchable	Incl.
13	Laptrigger_In		Incl.
14	CAN_2_H	CAN speed selectable	Incl.
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. 1*
28	ANA_IN_1	3.01 kOhm switchable	Incl.
29	USB_Device_DP	to Bosch USB stick	Opt. 2*
30	RS232_TX_Telemetry	Transmit Telemetry data	Incl.
31	Ethernet_1_TXP		Incl.

### LIFE connector

32	Sens_Gnd_2	fused	Incl.
33	Sens_Power_10V	over current protected	Incl.
34	ANA_IN_8	3.01 kOhm switchable	Opt. 1*
35	ANA_IN_10	3.01 kOhm switchable	Opt. 1*
36	USB_Device_Gnd	to Bosch USB stick	Opt. 2*
37	USB_Device_DN	to Bosch USB stick	Opt. 2*
38	RS232_RX_Telemetry	Receive Telemetry data	Incl.
39	Ethernet_1_TXN		Incl.
40	Sens_Gnd_1	fused	Incl.
41	ANA_IN_11	3.01 kOhm switchable	Opt. 1*
42	ANA_IN_9	3.01 kOhm switchable	Opt.
43	RS232_TX_GPS	Transmit GPS data	Incl.
44	ANA_IN_16	3.01 kOhm switchable	Opt. 1*
45	USB_Device_Power	to Bosch USB stick	Opt. 2*
46	Ethernet_1_RXP		Incl.
47	ANA_IN_12	3.01 kOhm switchable	Opt. 1*
48	ANA_IN_6	3.01 kOhm switchable	Opt. 1*
49	ANA_IN_2	3.01 kOhm switchable	Incl.
50	ANA_IN_13	3.01 kOhm switchable	Opt. 1*
51	ANA_IN_15	3.01 kOhm switchable	Opt. 1*
52	Ethernet_1_RXN		Incl.
53	ANA_IN_5	3.01 kOhm switchable	Opt. 1*
54	RS232_RX_GPS	Receive GPS data	Incl.
55	ANA_IN_14	3.01 kOhm switchable	Opt. 1*

### 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. 1*
13		Unused	
14		Unused	
15		Unused	
16		Unused	
17		Unused	
18	Ethernet_screen		Incl.

**Auxiliary connector**

19	Ethernet_3_TXN	Incl.
20	CAN_4_L	Opt. 1*
21	CAN_3_H	Opt. 1*
22	CAN_3_L	Opt. 1*

Opt. 1\*: Requires Software Upgrade IO\_EXTENS

Opt. 2\*: Requires Software Upgrade DATA\_USB

**Communication**

CAN interfaces	2 standard, plus 2 optional
Ethernet 100BaseT	3
Laptrigger input	1
RS232	Telemetry, GPS
Configuration via RaceCon	Over Ethernet or MSA-Box II
CCP-Master, data acquisition from ECU that support CAN calibration protocol (optional)	

**Installation Notes**

Maintenance Interval: 220 h or a maximum of two years

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

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Upgrades****CCP/XCP\_MASTER**

Enables CCP/XCP master functionality to request data from foreign devices via CAN/CCP protocol, XCP over Ethernet (UDP) or XCP via CAN.

(ASAP2 file from ECU manufacturer required)

**FULL\_LOG\_1**

1,500 channels/1 kHz sampling rate on Partition 1

**FULL\_LOG\_2**

4 GB memory on Partition 2

**IO\_EXTENS**

Additional 12 analog inputs and 2 CAN channels

**DATA\_USB**

Data copy to USB flash drive

**ABSDIAG**

Upgrade Onboard Diagnostic Package ABS M5

- Enables functionality like error memory read and erase, and repair bleed from UIM menu in display

**Ordering Information****Display DDU 10**

Order number **F02U.V02.659-03**

**Rugged USB flash drive**

Order number **F02U.V03.534-01**

**Connector for USB flash drive on car loom side**

Order number **F02U.002.996-01**

**Adapter cable to PC USB-Port**

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

**Software Options****CCP/XCP\_MASTER**

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

**FULL\_LOG\_1**

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

**FULL\_LOG\_2**

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

**IO\_EXTENS**

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

**DATA\_USB**

Order number **F02U.V03.476-01**

**Accessories****CAN Keypad CK-M12**

Order number **F02U.V0U.328-04**

**Vehicle Loom Basic**

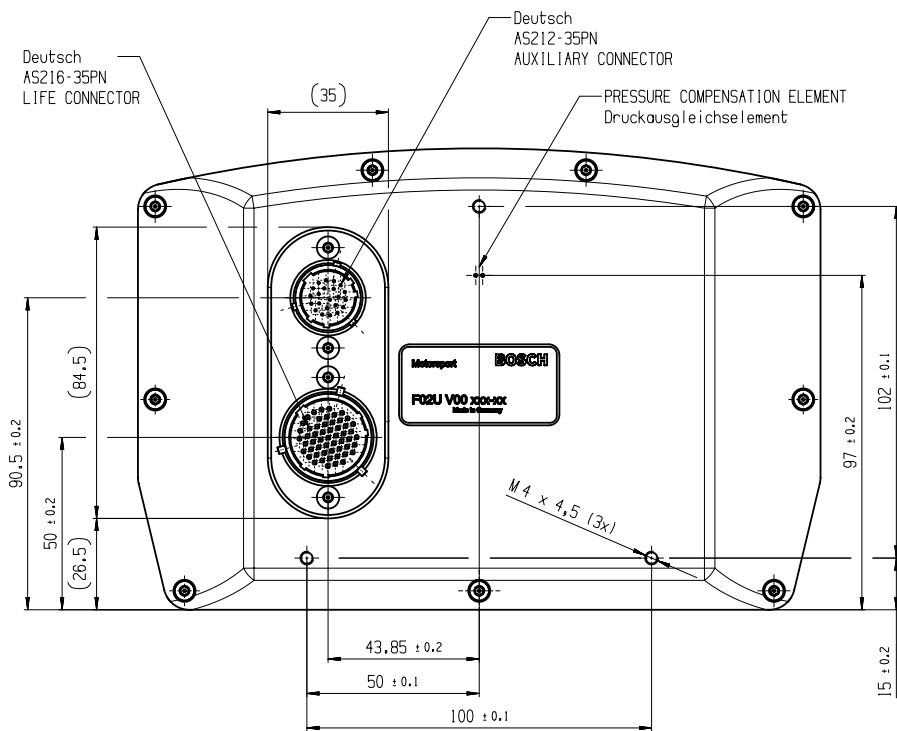
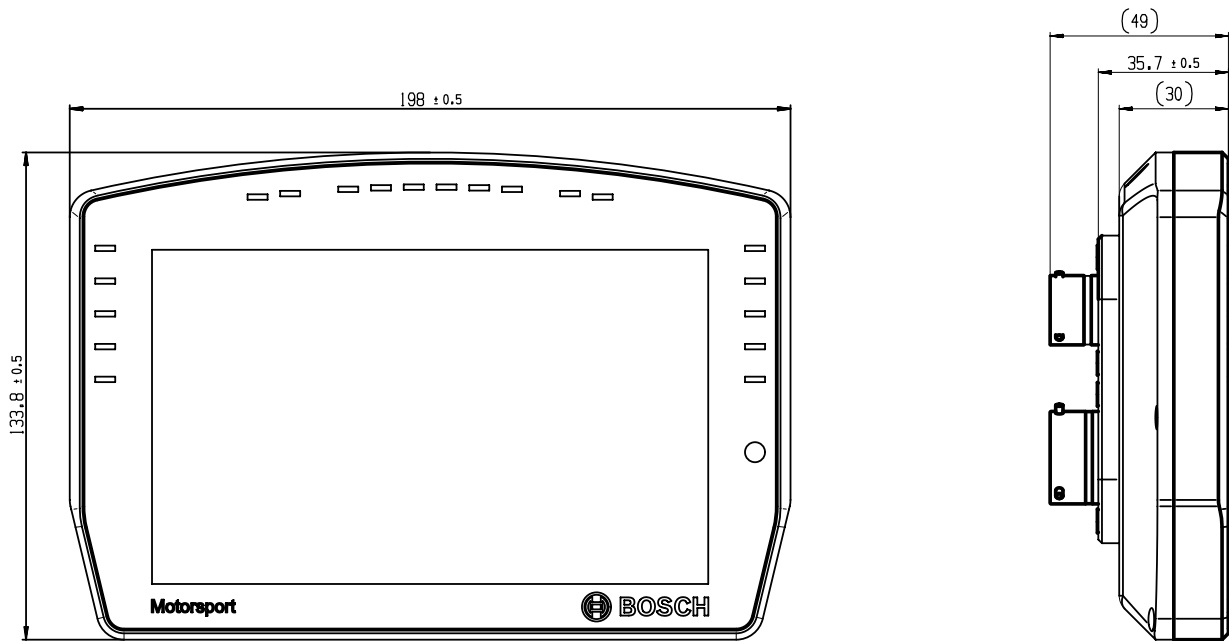
Order number **F02U.V02.735-01**

**Bench Loom**

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

Dimensions

2



## Display DDU 11



### Features

- ▶ Features user interface menu
- ▶ Features display element design generator
- ▶ 8 top-LEDs and 5 side-LEDs on both sides
- ▶ Supports GPS laptrigger, pre-dated lap time etc.
- ▶ Page change based on events possible

The display DDU 11 integrates a programmable full colour dashboard display with a data logging system for motorsport applications. Additional input devices can be connected via Ethernet, CAN buses, and RS 232.

A basic logging function of 100 channels with recording rate of 20 Hz (50 ms) (4 GB) is always included. The logger can be upgraded to full logging performance (max. 1 kHz (1 ms)). In addition, a 2nd logging partition of 4 GB can be activated. An optional external GPS Sensor keeps track of position on the racetrack.

With the DDU 11, a library of graphical elements for the individual design of display pages and a state-of-the-art user interface menu is available. For quick data transfer from the car, e.g., during pit stop, data logging to a USB stick is available as an option.

### Application

#### Display

6.5" graphic color display

48 user configurable pages (12 pages organized in 4 switchable page sets)

Resolution	800 x 480 pixel
Supported image file formats	PNG, BMP, JPG, GIF
Processor	667 MHz Dual Core

AD-Converters	10 kHz sampling rate with digital downsampling filter
Real time clock supply	Ultracap™, sustains realtime for 2 weeks
Configurable math channels	
User configurable CAN in/out messages	Up to 256 IDs (128 in and out)
Sampling rate	20 Hz (50 ms) standard, max. 1 kHz (1 ms) as optional upgrade (FULL_LOG_1/ FULL_LOG_2)

Online data compression

#### Internal logger

- 4 GB memory on Partition 1 enabled
- 100 channels enabled
- 50 ms Sampling rate enabled
- FULL\_LOG\_1 (1,500 channels/1 kHz sampling rate on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory on Partition 2) optional

#### Logging rates

- Usage of all features: 600 kB/s
- Primary logging use case: >800 kB/s
- Logging data download rate: up to 6.2 MB/s

Ambient light sensor

### Technical Specifications

#### Mechanical Data

Size	203 x 128 x 38.5 mm
Weight	649 g
Protection classification	IP67
Operating temperature internal	-20 to 85°C
Max. vibration	Vibration profile 1

#### Electrical Data

Supply voltage	6 to 18 V
Current consumption (w/o sensor supply)	<2 A (at 12 V)

#### Inputs (option)

4 x analog In (5 V/12 bit), Digital In, Wheelspeed HALL, or Wheelspeed DF11

1 x analog In (5 V/12 bit), Digital In or Laptrigger In

Switchable 3.01 kOhm pull-up resistors for all analog inputs

#### Sensor Supplies and Screens

1 x Sensor supply 5 V +/- 1% or UBAT switched (max. 250 mA)

1 x Sensor ground

#### Connectors and Wires

Mating Connector: TE Connectivity 3-1437290-7

Connector Pins: TE Connectivity 3-1447221-4

#### Pin Configuration

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

1	KL30_KL15/UBAT	Incl.
2	SENSGND	Incl.
3	SENSPWR (5 V or UBAT switched)	Incl.
4	SIG2_IN (Analog In, Digital In, Wheelspeed HALL, Wheelspeed DF11, switchable Pull-Up 3.01 k)	Opt. 1*
5	SIG4_IN (Analog In, Digital In, Wheelspeed HALL, Wheelspeed DF11, switchable Pull-Up 3.01 k)	Opt. 1*
6	USB_GND	Opt. 2*
7	USB_PWR	Opt. 2*
8	KL31/GND	Incl.
9	SIG5_IN_LAPTRG (Analog In, Digital In, switchable Pull-Up 3.01 k)	Opt. 1*
10	SIG1_IN (Analog In, Digital In, Wheelspeed HALL, Wheelspeed DF11, switchable Pull-Up 3.01 k)	Opt. 1*
11	SIG3_IN (Analog In, Digital In, Wheelspeed HALL, Wheelspeed DF11, switchable Pull-Up 3.01 k)	Opt. 1*
12	USB_DN	Opt. 2*
13	USB_DP	Opt. 2*
14	CAN_2_H_RS232_TX (switchable CAN or RS232)	Opt. 1*
15	CAN_1_H	Incl.
16	ETH_CHANNEL0_TXN (Ethernet 100BaseTX)	Incl.
17	ETH_CHANNEL0_TXP	Incl.
18	ETH_CHANNEL0_RXN	Incl.
19	ETH_CHANNEL0_RXP	Incl.
20	TIMESTAMP_INOUT (Timesync)	Incl.
21	CAN_2_L_RS232_RX (switchable CAN or RS232)	Opt. 1*
22	CAN_1_L	Incl.
23	ETH_CHANNEL1_TXN (Ethernet 100BaseTX)	Incl.
24	ETH_CHANNEL1_TXP	Incl.
25	ETH_CHANNEL1_RXN	Incl.
26	ETH_CHANNEL1_RXP	Incl.

Opt. 1\*: Requires Software Upgrade IO\_EXTENS  
 Opt. 2\*: Requires Software Upgrade DATA\_USB

## Communication

CAN interfaces	1
2 <sup>nd</sup> CAN interface or RS232 with IO_EXTENS	e.g., Telemetry or GPS
Ethernet 100BaseTX	2
Laptrigger input	1
Configuration via RaceCon	Over Ethernet or MSA-Box II
CCP-Master, data acquisition from ECU that support CAN Calibration Protocol (CCP_MASTER option)	
XCP-Master, data acquisition from ECU that support eXtended Calibration Protocol over UDP or CAN (CCP_MASTER option)	

## Installation Notes

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

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

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

### Display DDU 11

Order number **F02U.V03.208-03**

### Software Options

#### CCP/XCP\_MASTER

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

#### FULL\_LOG\_1

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

#### FULL\_LOG\_2

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

#### IO\_EXTENS

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

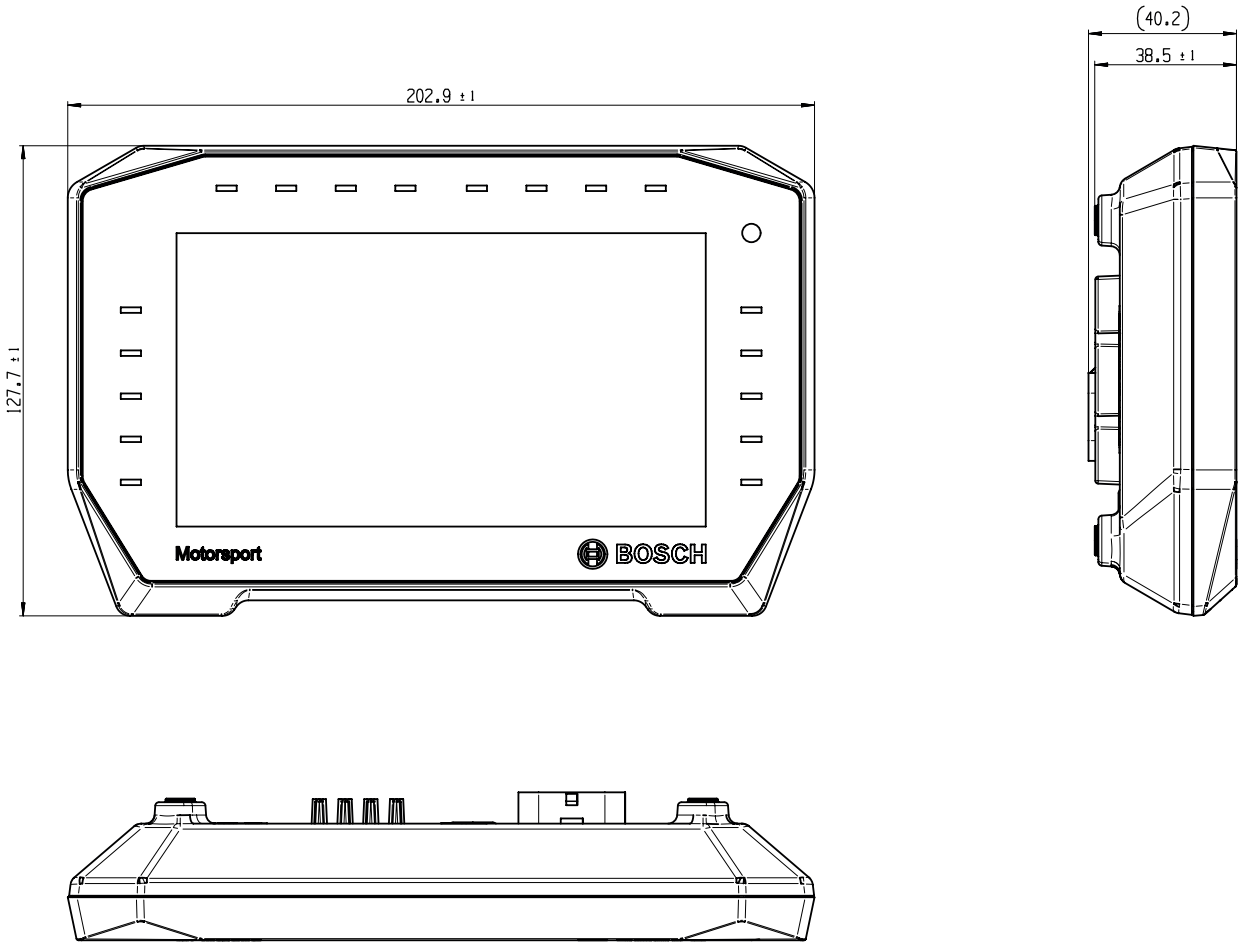
### Accessories

#### USB\_DATA Kit

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

Dimensions

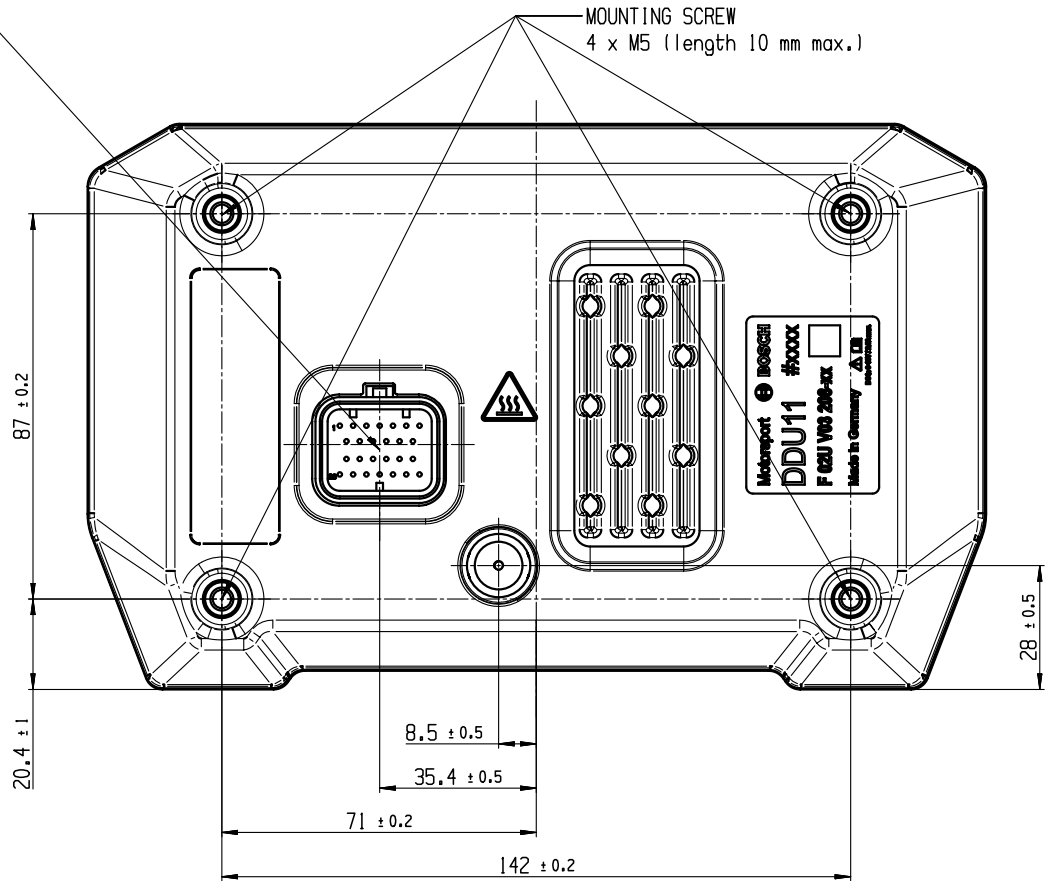
2



MATING CONNECTOR  
PLEASE REFER TO DATASHEET

MOUNTING SCREW  
4 x M5 (length 10 mm max.)

2



<b>CAN Keypad</b>	<b>78</b>
<b>Collision Avoidance Systems</b>	<b>82</b>
<b>Data Loggers</b>	<b>91</b>
<b>Power Boxes</b>	<b>102</b>
<b>Sensor Interfaces</b>	<b>111</b>
<b>Telemetry System</b>	<b>124</b>
<b>Test System</b>	<b>129</b>

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## CAN Keypad CK-M12

3



### Features

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

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

### Application

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

### Technical Specifications

#### Mechanical Data

Size	78 x 187 x 21 mm
Weight	280 g
Max. vibration	11 ms 30 G peak
Protection Classification	IP68

#### Electrical Data

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

### Characteristics

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

\* Custom CAN IDs / baud Rate Optional Upon Request

Note: CK-M12 DBC file available for CAN configuration

### Connectors and Wires

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

### Recommended Connectors





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

### Wire Identification

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

### Insert Kits












Insert Road Race Kit

 A/C
 ABS
 Alarm Reset
 Anti-Lag

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

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

## Insert Road Race Kit

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

## Insert Alpha/Numeric Kit

A	V
B	W
C	X
D	Y
E	Z
F	!
G	-
H	+
I	0
J	1
K	2
L	3
M	4

## Insert Road Race Kit

N	5
O	6
P	7
Q	8
R	9
S	10
T	11
U	12

## Installation Notes

Installation on flat surface recommended

Bolt size #10-32

Tightening Torque 0.7 +/- 0.1 Nm

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

**CAN Keypad CK-M12**

Order number **F02U.V0U.328-04**

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

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

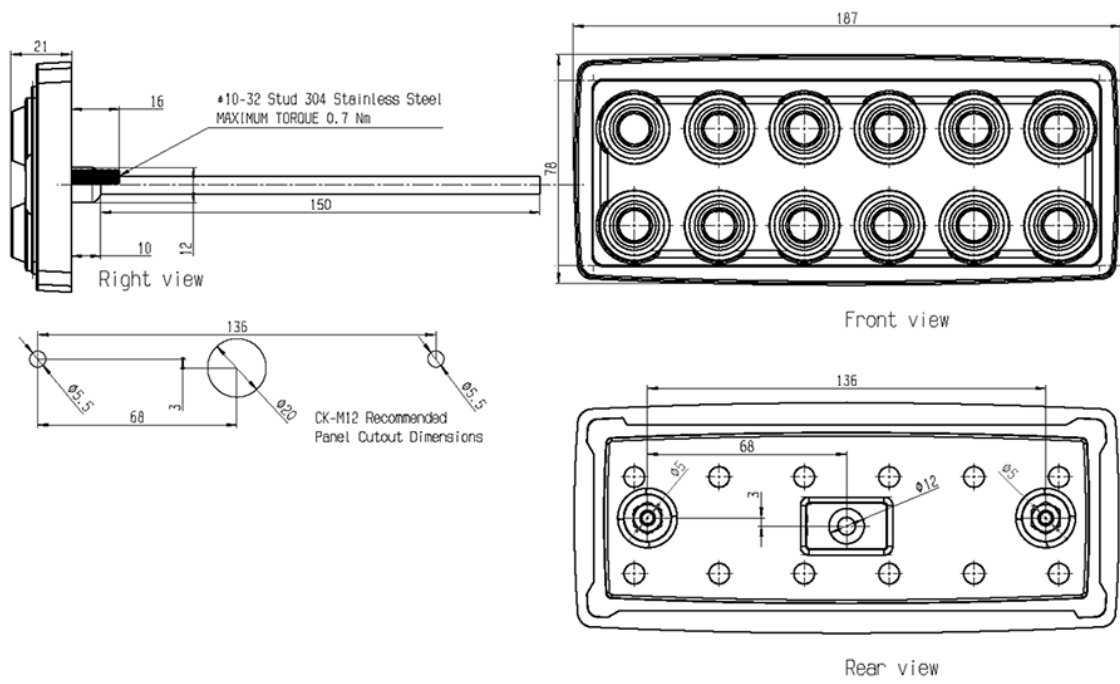
**Insert Drag Race Kit**

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

**Insert Alpha/Numeric Kit**

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

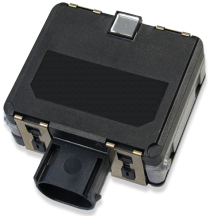
Dimensions



## Overview

3

### Collision Avoidance System CAS-M light



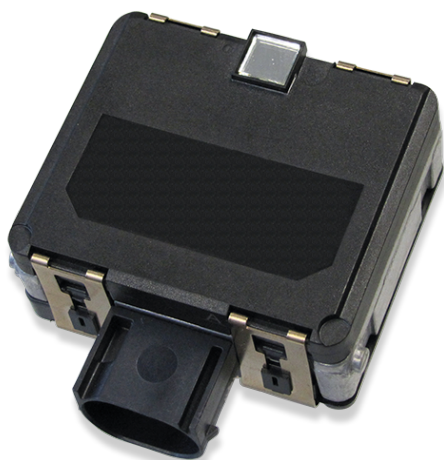
- Radar sensor with integrated logic
- Warning for overtake situations
- Easy system adaptation
- Universal CAN interface for various displays
- Visualization via display LEDs

### Collision Avoidance System CAS-M 3 EVO



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

## Collision Avoidance System CAS-M light



### Features

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

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

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

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

### Application

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

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

### Technical Specifications

#### Mechanical Data

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

#### Electrical Data

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

#### Connectors and Wires

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

### Installation Notes

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

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

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

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

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

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

The system needs yaw rate and vehicle speed information.

Cat 6 A standard for Gigabit Ethernet.

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

### Legal

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

#### Country

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

USA

Canada

Japan

Australia

New Zealand

#### Country

United Kingdom

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

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

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

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

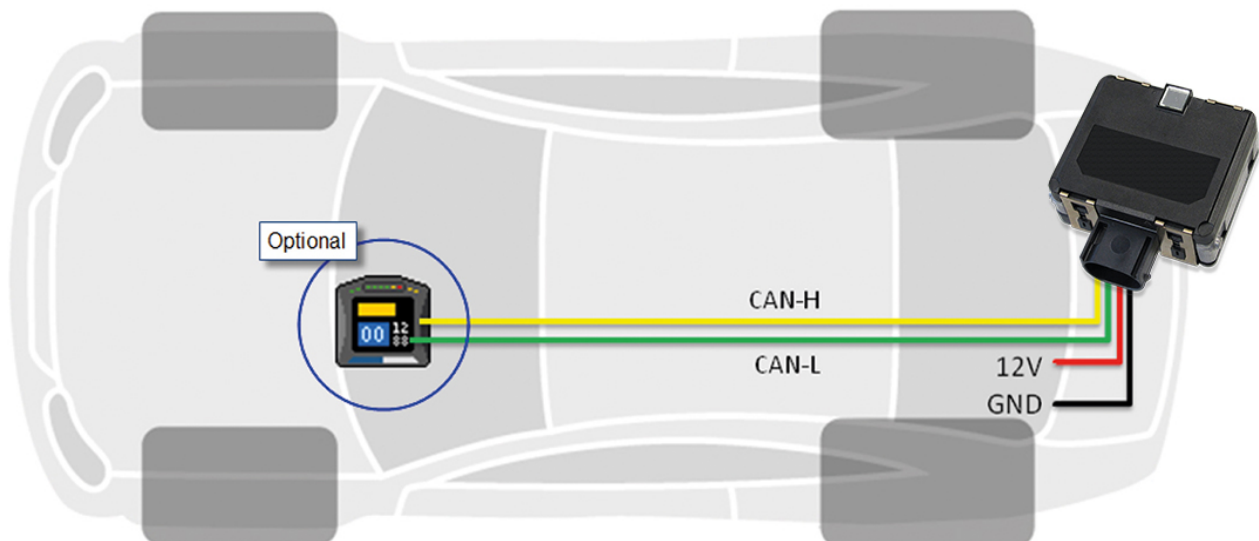
#### CAS-M light (500 kbaud)

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

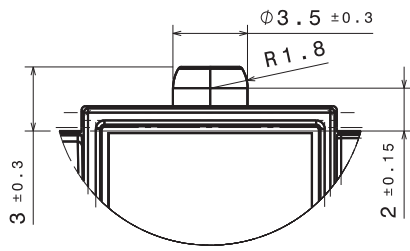
#### CAS-M light (1 Mbaud)

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

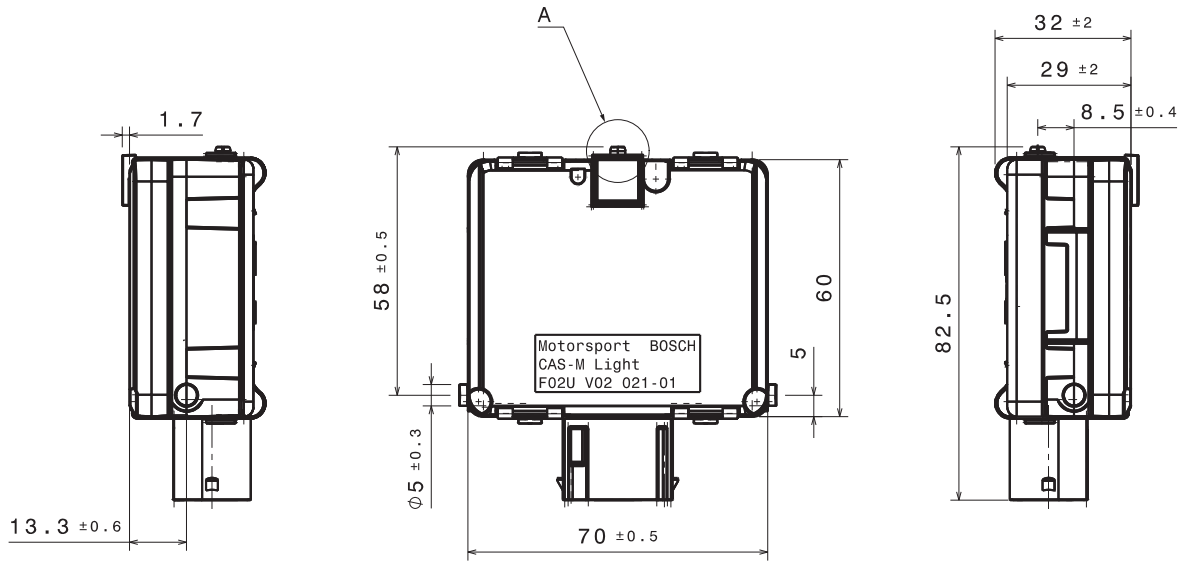
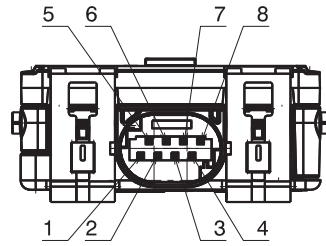
### Dimensions



Wiring schematic



Detail A



Right view

Front view

Left view

Dimensions

## Collision Avoidance System CAS-M 3 EVO

3



### Features

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

The Collision Avoidance System-Motorsport 3 EVO (CAS-M 3 EVO) features a high-performance Bosch Motorsport **Display Unit** for fast video processing (right in the picture), and a **Rear Module**, composed from a Bosch mid-range radar sensor for a wider field of view in close-up range and a fast response high definition camera (left in the picture).

The CAS-M 3 EVO system provides real time visualization and warns the driver about approaching or overtaking cars via intuitive marking of the cars on the display. It helps prevent the most common collisions and allows drivers to focus on the race. With a momentary glance, the driver can tell how many cars are following and their classification depending on distance and relative speed. The radar tracks up to 40 objects and marks up to four objects on the display. In addition, bright flashing LEDs alert the driver when any car attempts a passing maneuver. All of these features work at night or in the rain when visibility is typically poor. Furthermore, the real time gap of a marked object is measured and can be provided over CAN or Ethernet.

The CAS-M 3 EVO system is fully integrated in the Bosch Motorsport Tool environment and can be configured with RaceCon.

### Application

Range	95 m
-------	------

Horizontal field of view	
--------------------------	--

Radar	85° from 0 to 29 m 70° from 29 to 46 m 50° from 46 to 73 m 42° from 73 to 78 m 20° from 78 to 95 m
Camera	78°
Number of tracked objects	Max. 40
Number of displayed classified objects	Max. 4
Display format	7"
Display resolution	800 x 480 pixel
User configurable CAN in/out messages	
User configurable LEDs	

### Technical Specifications

#### Mechanical Data

##### Display Unit

Size	198 x 134 x 35 mm
Weight	830 g
Protection Classification	IP67
Operating temperature internal	-20 to 85°C
Max. vibration	Vibration profile 1

##### Rear Module

Size	120 x 150 x 115 mm
Weight	880 g
Protection classification	IP67
Operating temperature	0 to 70°C (rearview camera internal temperature*)
Max. vibration	Vibration profile 1

\*If the temperature limit is reached, forced air cooling of the camera is recommended.

#### Electrical Data

Supply voltage (Display and Rear Unit)	6 to 18 V
<b>Current consumption</b>	
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
<b>Software Tools (free download)</b>	
Data analysis tool	WinDarab 7 Light
System configuration tool	RaceCon
<b>Connectors and Wires</b>	
<b>Display Unit</b>	
Motorsport connector on device	AS212-35PN
Mating connector AS612-35SN	F02U.000.443-01
<b>Rear Module</b>	
Motorsport connector on device	AS212-35PN
Mating connector AS612-35SN	F02U.000.443-01
<b>Pin Configuration</b>	
<b>Display Unit</b>	<b>Rear Module for Vehicle Harness</b>
Pin No.	Pin No.
1 GigEthernet_TR3_N (private Eth camera <b>PEC</b> )	14
2 GigEthernet_TR3_P (PEC)	1
3 GigEthernet_TR2_N (PEC)	2
4 GigEthernet_TR2_P (PEC)	3
5 GigEthernet_TR1_N (PEC)	4
6 GigEthernet_TR1_P (PEC)	5
7 GigEthernet_TR0_N (PEC)	6
8 GigEthernet_TR0_P (PEC)	7
9 Ethernet_TXP	n/a - Connect to Bosch System Ethernet BSE
10 Ethernet_RXP	n/a - Connect to BSE
11 Ethernet_RXN	n/a - Connect to BSE
12 CAN_High_Vehicle	n/a - Connect to Bosch System CAN
13 +12 V KL30	n/a - Connect to Vehicle System Power <b>VSP</b>
14 +12 V KL15	n/a - Connect to VSP
15 GND KL31	n/a - Connect to VSP
16 GND KL31	n/a - Connect to VSP
17 Time_Sync	n/a - Connect Display to Bosch Logging System Time Sync
18 ETH_Screen	n/a - Connect to BSE
19 Ethernet_TXN	n/a - Connect to BSE
20 CAN Low Vehicle	n/a - Connect to Bosch System CAN
21 CAN High Radar (private CAN radar <b>PCR</b> )	11
22 CAN Low Radar (PCR)	12

<b>Rear Module</b>		<b>Display Unit for Vehicle Harness</b>
1	GigEthernet_TR3_P (private Eth camera <b>PEC</b> )	2
2	GigEthernet_TR2_N (PEC)	3
3	GigEthernet_TR2_P (PEC)	4
4	GigEthernet_TR1_N (PEC)	5
5	GigEthernet_TR1_P (PEC)	6
6	GigEthernet_TR0_N (PEC)	7
7	GigEthernet_TR0_P (PEC)	8
8	+12 V Ubat	n/a - Connect to VSP
9	+12 V Ubat	n/a - Connect to VSP
10	+12 V Ubat (opt. to display)	13 (opt. if KL30 not connected)
11	CAN High Radar (PCR)	21
12	CAN Low Radar (PCR)	22
13	n.c.	
14	GigEthernet_TR3_N (PEC)	1
15	GigEthernet Screen	
16	n.c.	
17	CAN Screen	n/c
18	GND	
19	+12 V Ubat (opt. to display)	13 (opt. if KL30 not connected)
20	GND	n/a - Connect to VSP
21	GND (opt. to display)	15 (opt. if KL31 not connected)
22	GND (opt. to display)	15 (opt. if KL31 not connected)

### Communication

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

### Installation Notes

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

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

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

Consider the maximum vibration limits for the mounting position of the rear module. The system is approved referred to vibration profile 1.

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

The system needs yaw rate and vehicle speed information.

Cat 6 A standard for Gigabit Ethernet.

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

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

### Safety Notes

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

### Legal

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

#### Country

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

USA

Canada

Japan

Australia

New Zealand

#### Country

United Kingdom

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

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

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

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

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

Order number **F02U.V02.648-03**

#### Accessories

##### Display Unit

Order number **F02U.V02.660-03**

##### Rear Module

Consisting of parts (A) to (E)

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

##### Radar Bracket (A)

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

##### Radar Sensor (B)

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

##### Camera (C)

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

##### Wiring Harness for Radar and Camera (D)

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

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

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

##### Inertial Measurement Unit MM7.10

Sensor with production type connector (1)

Order number **F02U.V03.092-01**

##### Inertial Measurement Unit MM7.10

Wire with motorsport connector (2)

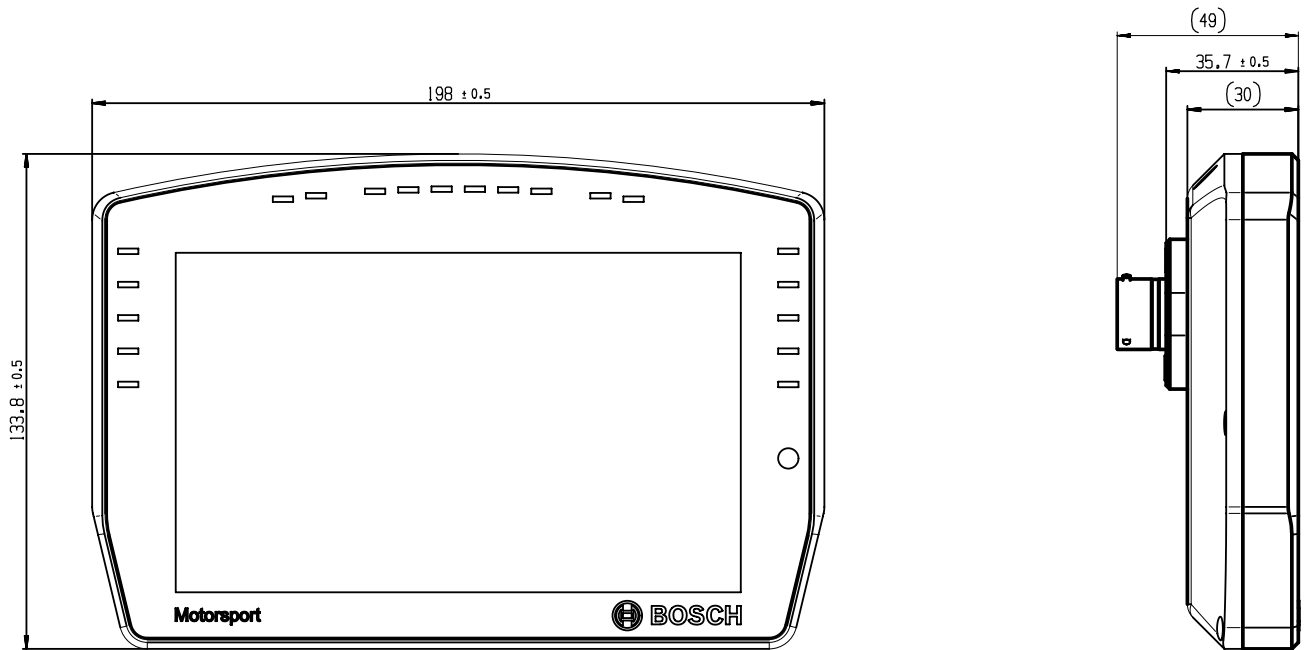
Order number **F02U.V03.092-02**

##### Inertial Measurement Unit MM7.10

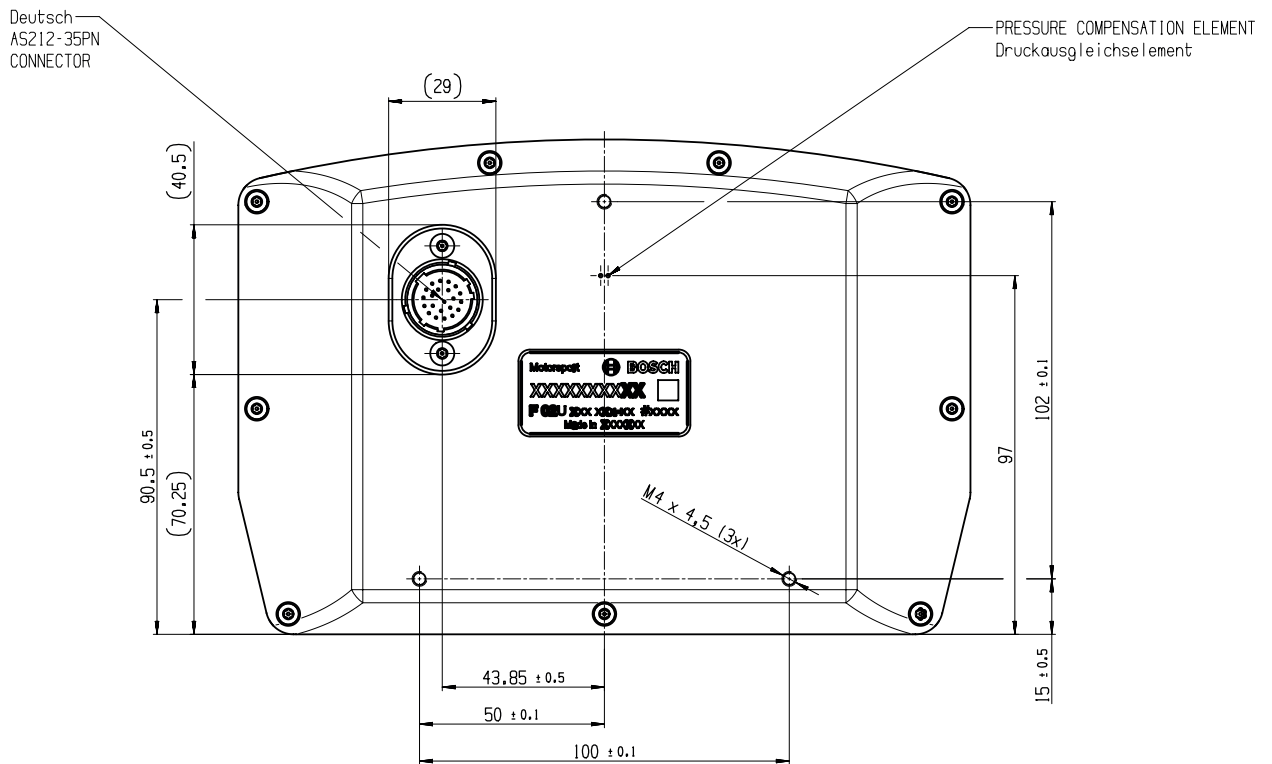
Wire with open end (3)

Order number **F02U.V03.092-90**

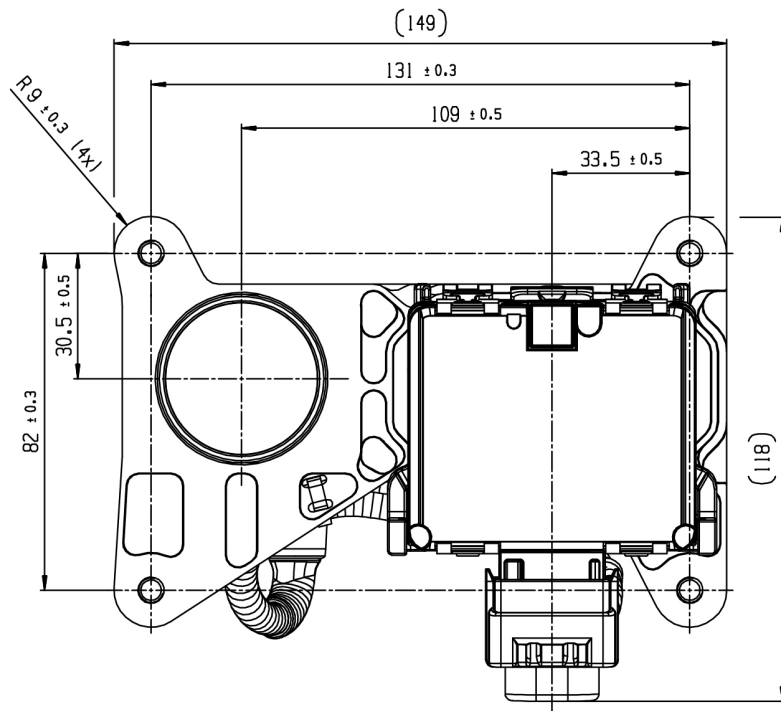
Dimensions



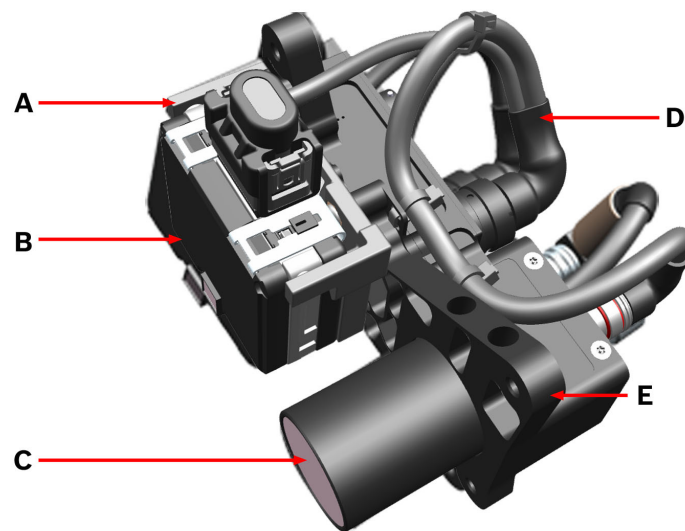
3



Display



Rear Module



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

Spare Parts of the Rear Module

## Overview

### Data Logger C 70



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

### Data Logger and Sensor Interface C 80



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

### USB Data Components



- Capacity 32 GB
- Robust brass housing
- High performance push-pull connector
- Compatible with ECUs, VCUs, DDUs, Data Loggers, ...

## 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 4 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 analog and 4 speed inputs as standard; further 12 analog inputs are available as optional upgrade.

### Application

Processor	667 MHz Dual Core
Converters	10 kHz 12 bit AD converters with digital low pass filter
Internal power source	Li/Ion capacitor
Configurable math channels	
User configurable CAN in/out messages	
Online data compression	

### Internal logger

- 4 GB memory on Partition 1 enabled
- 1,500 channels enabled

- 1 ms sampling rate enabled
- FULL\_LOG\_2 (4 GB memory on Partition 2) optional
- DATA\_USB (Data copy to USB flash drive) optional

### Logging rates

- Usage of all features: 600 kB/s
- Primary logging use case: >1,200 kB/s
- Logging data download rate: up to 6.2 MB/s

LTE Ethernet telemetry support, GSM telemetry support

### 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

#### Electrical Data

Supply voltage	5 to 18 V
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#### Inputs

4 x analog channels, additional 12 optional
0 to 5 V input range
12 bit resolution
switchable pull up resistor for all ANA_IN
4 x Hall-effect or DF11 wheel speed inputs, switchable

#### Sensor Supplies and Screens

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

#### Connectors and Wires

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

#### Pin Configuration

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

Pin	Name	Comment	Status
12	Rev_In_2	Hall or DF11 switchable	Incl.
13	Laptrigger_In		Incl.
14	CAN_2_H	CAN speed selectable	Incl.
15	CAN_1_H	CAN speed selectable	Incl.
16	Ethernet_2_RXP		Incl.
17	Sens_Gnd_4	fused	Incl.
18	Sens_Power_5V	over current protected	Incl.
19	ANA_IN_3	3.01 kOhm switchable	Incl.
20	ANA_IN_4	3.01 kOhm switchable	Incl.
21	Time_Sync	connection to Bosch ECU	Incl.
22	CAN_1_L	CAN speed selectable	Incl.
23	Com_screen	Ethernet and USB screen	Incl.
24	Ethernet_2_RXN		Incl.
25	Sens_Gnd_3	fused	Incl.
26	Sens_Power_5V	over current protected	Incl.
27	ANA_IN_7	3.01 kOhm switchable	Opt.
28	ANA_IN_1	3.01 kOhm switchable	Incl.
29	USB_Device_DP	to Bosch USB stick	Opt.
30	RS232_TX_Telemetry	Transmit Telemetry data	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	Receive Telemetry data	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	Transmit GPS data	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.

Pin	Name	Comment	Status
54	RS232_RX_GPS	Receive GPS data	Incl.
55	ANA_IN_14	3.01 kOhm switchable	Opt.

### Communication

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

### Installation Notes

Maintenance Interval: 220 h or a maximum of two years

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Upgrades

#### CCP/XCP\_MASTER

Enables CCP/XCP master functionality to request data from foreign devices via CAN/CCP protocol or XCP over Ethernet (UDP). (ASAP2 file from ECU manufacturer required)

#### FULL\_LOG\_2

4 GB memory on Partition 2

#### IO\_EXTENS

Additional 12 analog input channels

#### DATA\_USB

Data copy to USB flash drive

**Ordering Information****Data Logger C 70**

Order number F02U.V02.302-02

**Rugged USB flash drive**

Order number F02U.V03.534-01

**Connector for USB flash drive on car loom side**

Order number F02U.002.996-01

**Adapter cable to PC USB-Port**

Order number F02U.V01.343-01

**Software Options****CCP/XCP\_MASTER**

Order number F02U.V02.213-01

**FULL\_LOG\_2**

Order number F02U.V02.305-01

**IO\_EXTENS**

Order number F02U.V02.205-01

**DATA\_USB**

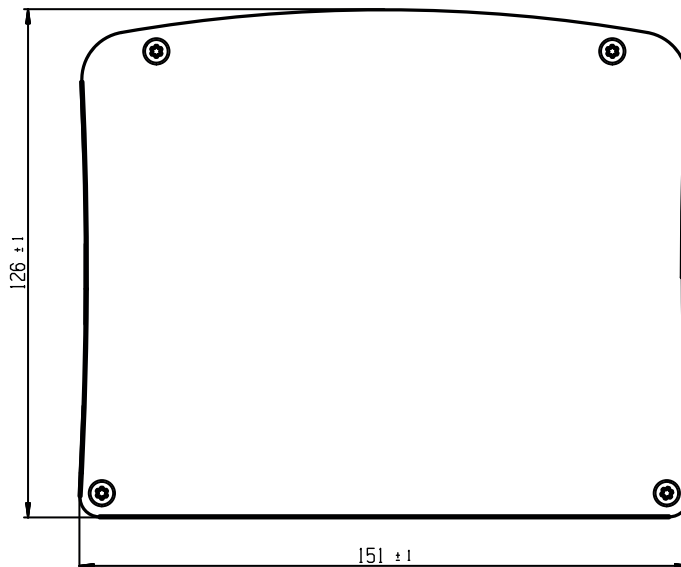
Order number F02U.V03.476-01

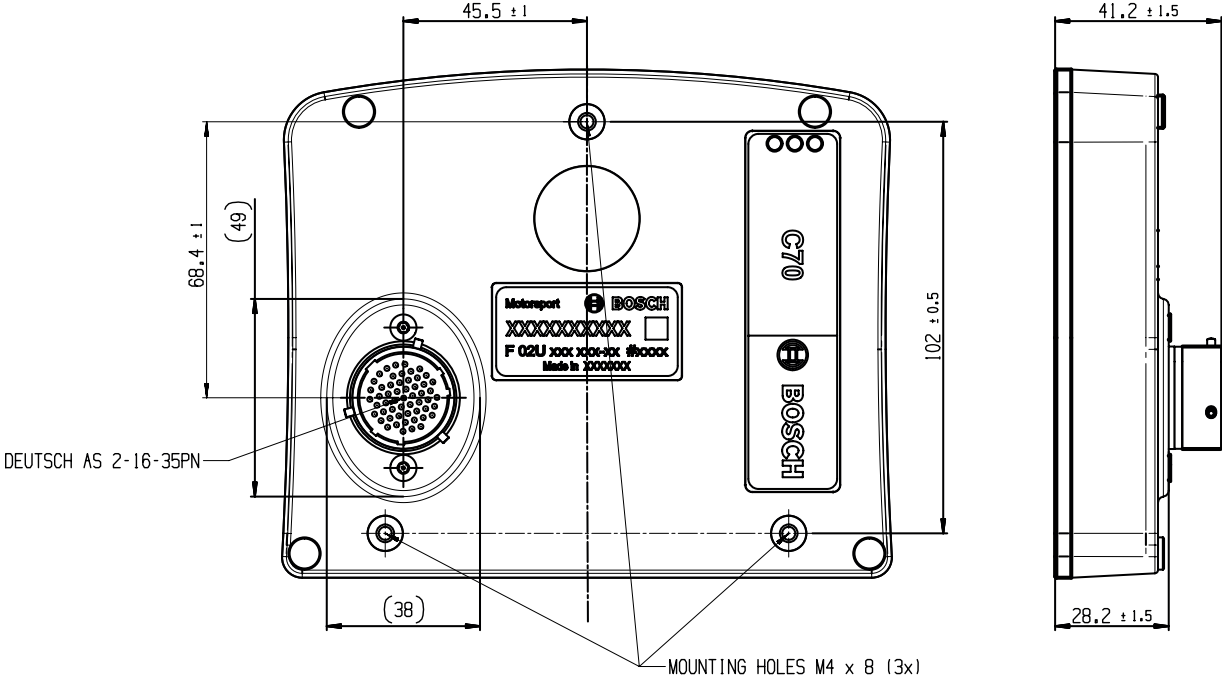
**Accessories****Vehicle Loom Basic**

Order number F02U.V02.735-01

**Bench Loom**

Order number F02U.V02.349-01

**Dimensions**



## Data Logger and Sensor Interface C 80

3



### Features

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

We offer the C 80 in two basic versions, on the one hand as a data logger and on the other hand as a sensor interface. Choose between these basic variants and combine or add functionalities now or later.

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

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

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

### Application

Converters	10 kHz 12 bit AD converters with digital low pass filter
Configurable math channels	
User configurable CAN in/out messages	
Sampling rate	
Online data compression	

### Internal logger

- FULL\_LOG\_1 (4 GB memory on Partition 1) enabled, optional in C80 Sensor Interface
- PERF\_LOG\_1 (16 GB memory on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory on Partition 2) optional
- 1,500 channels enabled
- 1 ms sampling rate enabled
- DATA\_USB (Data copy to USB flash drive) optional

### Logging rates

- Usage of all features: 800 kB/s
- Primary logging use case: >1,500 kB/s
- Logging data download rate: up to 7.5 MB/s

### 3-port network switch

Telemetry Support via Ethernet (recommended) and RS232

### Technical Specifications

#### Mechanical Data

Size	105 x 34.5 x 137.5 mm
Weight	462 g
Protection Classification	IP67 to DIN 40050, Section 9, Issue 2008
Max. vibration	Vibration profile 1
Operating temperature (internal)	0 to 85°C
Operation outside the temperature limits can be tested on request during the manufacturing tests.	

#### Electrical Data

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

#### Inputs

4 x digital channels
26 x analog channels
0 to 5 V input range
12 bit resolution
1 x 3 kOhm switchable pull up resistor

#### Sensor Supplies and Screens

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

#### Connectors and Wires

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

#### Pin Layout ASDD212-41PN

Pin	Name	Description
1	KL30	

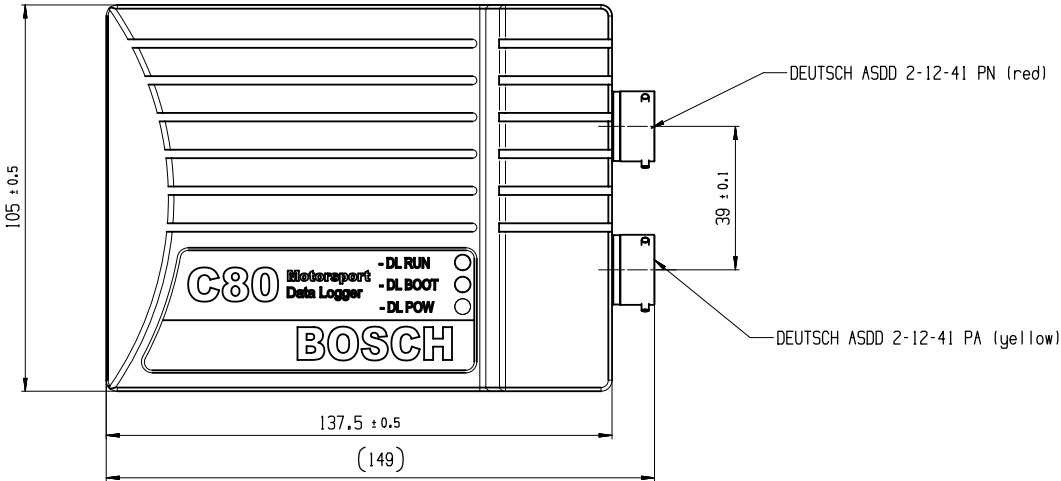
Pin	Name	Description
2; 3	KL15	
4; 5	KL31	
6	Ethernet Channel0 Tx plus	Wire Ethernet_0 - TX+
7	Ethernet Channel0 Tx minus	Wire Ethernet_0 - TX-
8	Ethernet Channel0 Rx plus	Wire Ethernet_0 - RX+
9	Ethernet Channel0 Rx minus	Wire Ethernet_0 - RX-
10	Ethernet Schirm	Ethernet Schirm
11	Ethernet Channel1 Tx plus	Wire Ethernet_0 - TX+
12	Ethernet Channel1 Tx minus	Wire Ethernet_0 - TX-
13	Ethernet Channel1 Rx plus	Wire Ethernet_0 - RX+
14	Ethernet Channel1 Rx minus	Wire Ethernet_0 - RX-
15	Ethernet Channel2 Tx plus	Wire Ethernet_0 - TX+
16	Ethernet Channel2 Tx minus	Wire Ethernet_0 - TX-
17	Ethernet Channel2 Rx plus	Wire Ethernet_0 - RX+
18	Ethernet Channel2 Rx minus	Wire Ethernet_0 - RX-
19	CAN_A_H	CAN_A - HIGH
20	CAN_A_L	CAN_A - LOW
21	CAN_B_H	CAN_B - HIGH
22	CAN_B_L	CAN_B - LOW
23	USB Power	500mA USB_Power
24	USB Data Plus	USB_OTG_Plus
25	USB Data Minus	USB_OTG_Minus
26	USB GND	USB_Ground
27	SENSPWR5_1	
28	SENSGND	
29	Timestamp	
30	LS_GND_1	Low-Side Ground2
31	LS_SWITCH_1	lowside switch 2A
32	LS_SWITCH_2	lowside switch 2A
33	LS_SWITCH_3	lowside switch 2A
34	LS_SWITCH_4	lowside switch 2A
35	LS_GND_2	Low-Side Ground2
36	ANAIN_M1_1	0 to 5V Analog
37	ANAIN_M1_2	0 to 5V Analog
38	ANAIN_M1_3	0 to 5V Analog
39	ANAIN_M1_4	0 to 5V Analog

Pin	Name	Description
40	ANAIN_M1_5	0 to 5V Analog
41	ANAIN_M1_6	0 to 5V Analog

#### Pin Layout ASDD212-41PA

Pin	Name	Description
1	UBATT_FUSE1	
2	SENSPWR10_1	
3	SENSPWR5_2	
4	SENSPWR5_3	
5	SENSPWR5_4	
6; 7	SENSGND	
8	RS232A TX	Transmit Telemetry data
9	RS232A RX	Receive Telemetry data
10	RS232B TX	Transmit GPS data
11	RS232B RX	Receive GPS data
12	RS232_GND	RS232 Ground
13	REV1_P	Hall / Inductive
14	REV1_M	Hall / Inductive
15	REV2_P	Hall / Inductive
16	REV2_M	Hall / Inductive
17	REV3_P	Hall / Inductive
18	REV3_M	Hall / Inductive
19	REV4_P	Hall / Inductive
20	REV4_M	Hall / Inductive
21	ANAIN_M1_7	0 to 5V Analog
22	ANAIN_M1_8	0 to 5V Analog
23	ANAIN_M1_9	0 to 5V Analog
24	ANAIN_M1_10	0 to 5V Analog
25	ANAIN_M1_11	0 to 5V Analog
26	ANAIN_M1_12	0 to 5V Analog
27	ANAIN_M1_13	0 to 5V Analog
28	ANAIN_M1_14	0 to 5V Analog
29	ANAIN_M1_15	0 to 5V Analog
30	ANAIN_M1_16	0 to 5V Analog
31	ANAIN_M2_1	0 to 5V Analog
32	ANAIN_M2_2	0 to 5V Analog
33	ANAIN_M2_3	0 to 5V Analog
34	ANAIN_M2_4	0 to 5V Analog
35	ANAIN_M2_5	0 to 5V Analog
36	ANAIN_M2_6	0 to 5V Analog
37	ANAIN_M2_7	0 to 5V Analog
38	ANAIN_M2_8	0 to 5V Analog
39	ANAIN_M2_9	0 to 5V Analog
40	ANAIN_M2_10	0 to 5V Analog
41	LAPTRIGGER	





## USB Data Components

3



### Features

- ▶ Capacity 32 GB
- ▶ Robust brass housing
- ▶ High performance push-pull connector
- ▶ Compatible with ECUs, VCUs, DDUs, Data Loggers, ...

Our USB Data Components enable your Bosch device to store data on a USB flash drive. We offer a rugged USB flash drive, a mating connector to the car loom side and an adapter cable to USB-port.

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 1

### Technical Specifications

#### Mechanical Data USB flash drive

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

#### Electrical Data

Capacity	32 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 +

#### USB Data Components

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

### Installation Notes

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

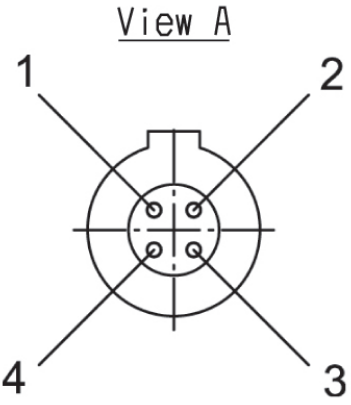
### Ordering Information

**Rugged USB flash drive**  
Order number **F02U.V03.534-01**

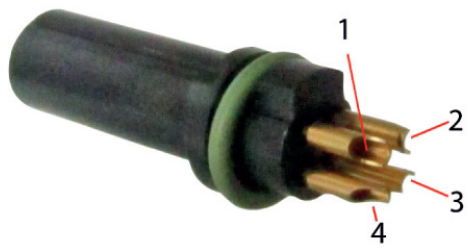
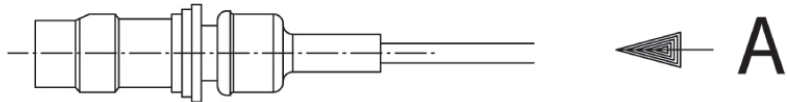
**Adapter cable to PC USB-Port**  
Order number **F02U.V01.343-01**

**Connector for USB flash drive on car loom side**  
Order number **F02U.002.996-01**

Dimensions



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



## Overview

3

### PowerBox PBX 90



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

### PowerBox PBX 190



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

## PowerBox PBX 90



### Features

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

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

### Technical Specifications

#### Mechanical Data

Size	214 x 159 x 57.5 mm
Weight	830 g
Protection Classification	Protected against ingress of particles > 1 mm, splash water proof
Temp. range (at internal sensors)	-20 to 85°C
Max. vibration	Vibration profile 1

#### Electrical Data

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

### Inputs

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

### Sensor Supplies and Screens

- 1 x sensor supply 5 V 400 mA with individual ground pin

### Outputs

- 4 x high power channels up to 40 A (parallel up to 80 A)
- 4 x high power channels up to 25 A
- 22 x high power channels up to 15 A
- 6 x multi purpose outputs up to 15 A (low side, high side, push-pull, PWM; two output stages can be combined to form an H-bridge)

### 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.	

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

21	BAT_GND	15	100
22	BAT_GND	15	100
23	BAT_GND	15	100
24	BAT_GND	15	100
25	HP_OUT7	25	150
26	OUT19	15	100
27	ANA_IN05	0 to 5 V, Pull-up	
28	OUT20	15	100
29	ANA_IN06	0 to 5 V, Pull-up	
30	OUT17	15	100
31	OUT18	15	100
32	ANA_IN11	0 to 5 V, Pull-up	
33	OUT15	15	100
34	OUT16	15	100
35	ANA_IN12	0 to 5 V, Pull-up	
36	PWM_OUT3	15	75
37	PWM_OUT5	15	75
38	HP_OUT8	25	150

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

Pin	Used for	Cont. [A]	Peak [A]
1	HP_OUT1	40	150
2	OUT14	15	100
3	OUT13	15	100
4	OUT02	15	100
5	OUT01	15	100
6	TIMESTAMP_I NOUT	1 kHz open drain	
7	CAN_2_H	1 Mbaud max.	
8	CAN_1_H	1 Mbaud max.	
9	ETH_1_RXN	10/100 Mbps	
10	ETH_1_TXN	10/100 Mbps	
11	ETH_2_RXN	10/100 Mbps	
12	ETH_2_TXN	10/100 Mbps	
13	HP_OUT2	40	150
14	BAT_GND	15	100
15	ANA_IN01	0 to 5 V, Pull-up	
16	ANA_IN02	0 to 5 V, Pull-up	
17	DIG_IN1	0 to 12 V, Pull-up, Pull-down	

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

18	DIG_IN2	0 to 12 V, Pull-up, Pull-down	
19	CAN_2_L	1 Mbaud max.	
20	CAN_1_L	1 Mbaud max.	
21	ETH_1_RXP	10/100 Mbps	
22	ETH_1_TXP	10/100 Mbps	
23	ETH_2_RXP	10/100 Mbps	
24	ETH_2_TXP	10/100 Mbps	
25	HP_OUT5	25	150
26	OUT11	15	100
27	OUT09	15	100
28	OUT12	15	100
29	OUT10	15	100
30	OUT07	15	100
31	OUT08	15	100
32	LIN	Control of Bosch Motorsport LIN devices included. Support of other devices on request.	
33	OUT05	15	100
34	SHIELD_GND	shield	
35	OUT06	15	100
36	OUT03	15	100
37	OUT04	15	100
38	HP_OUT6	25	150

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

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

## Communication

3 x CAN

2 x Ethernet

1 x LIN, Control of Bosch Motorsport LIN devices included. Support of other devices on request.

## Installation Notes

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

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

### CCA Hardware Upgrade per device

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

## Ordering Information

### PowerBox PBX 90

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

### Software Options

#### CCA Hardware Upgrade per device

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

### Accessories

#### Mating Connector X1

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

#### Mating Connector X2

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

#### Mating Connector X3

Order number **F02U.B01.279-01**

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

L: 2,000 mm

Order number **F02U.V03.552-01**

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

L: 2,000 mm

Order number **F02U.V03.553-01**

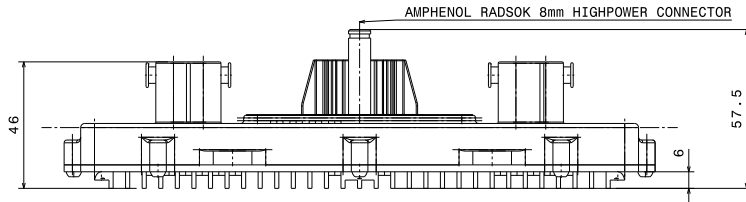
#### Breakout Box BOB PBX 90

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

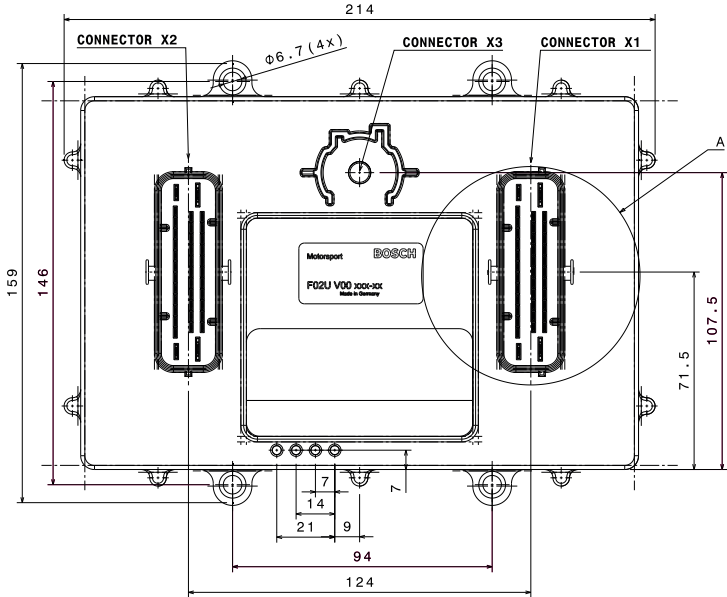
#### CAN Keypad CK-M12

Order number **F02U.V0U.328-04**

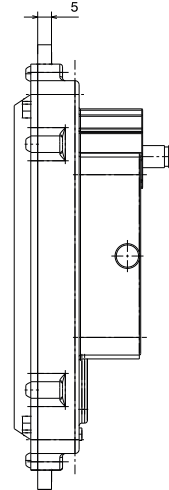
Dimensions



Bottom view

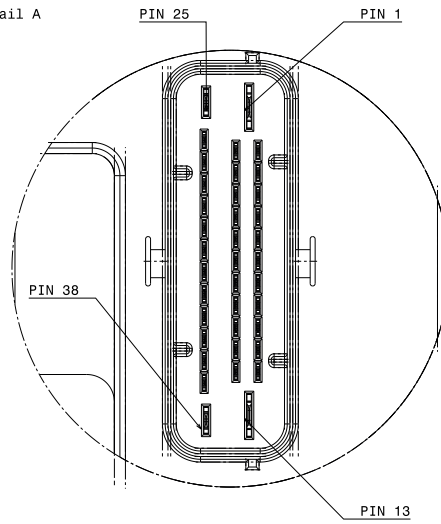


Front view



Left view

Detail A



## PowerBox PBX 190



### Features

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

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

### Technical Specifications

#### Mechanical Data

Size	245 x 183 x 37 mm
Weight	1,270 g
Protection Classification	IP67
Internal G-sensors	
Temp. range (at internal sensors)	-20 to 85°C
Max. vibration	Vibration profile 1

#### Electrical Data

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

### Inputs

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

### Sensor Supplies and Screens

- 2 x sensor supplies 5 V 400 mA with individual ground pin

### Outputs

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

### Software

- Function development and calibration tool
- Bosch Motorsport PBX Suite

### Pin Configuration

Connector X1: 37 Pins / 8STA62437SA

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

## Connector X1: 37 Pins / 8STA62437SA

Pin	Signal	Cont. [A]	Peak [A]
e	PWM_15A X1_e	15	60
f	PWM_15A X1_f	15	60
g	HS_15A X1_g	15	100
h	HS_15A X1_h	15	100
k	HS_15A X1_k	15	100
m	HS_15A X1_m	15	100
n	HS_15A X1_n	15	100
p	Power KL31	15	-
q	Power KL31	15	-
r	Power KL31	15	-

## Connector X2: 1 Pin / 8STA61201BN261

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

## Connector X3: 19 Pins / 8STA62419SN

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

## Connector X4: 6 Pins / 8STA61606SA

Pin	Signal	Cont. [A]	Peak [A]
A	HS48V_25A X4_A	25	50
B	HS48V_25A X4_B	25	50
C	HS48V_25A X4_C	25	50
D	HS48V_25A X4_D	25	50
E	Supply up to 48 V for X4	25	35
F	Supply up to 48 V for X4	25	35

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

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

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

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	Control of Bosch Motorsport LIN devices included. Support of other devices on request.
17	Analog Input X5_17	0 to 5 V, Pull-up
18	Analog Input X5_18	0 to 5 V, Pull-up
19	DGND-fused	5 A
20	DGND-fused	5 A
21	Digital Input X5_21	0 to 12 V, Pull-up, Pull-down
22	Digital Input X5_22	0 to 12 V, Pull-up, Pull-down
23	do not connect (use for internal debugging)	
24	do not connect (use for internal debugging)	
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	do not connect (use for internal debugging)	
33	do not connect (use for internal debugging)	
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	

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

41	do not connect (use for internal debugging)	
42	do not connect (use for internal debugging)	
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	do not connect (use for internal debugging)	
50	do not connect (use for internal debugging)	
51	Powersupply_5V X5_51	400 mA
52	Sensor GND for X5_58	5 A
53	ETHERNET1 RXN	10/100 Mbps
54	ETHERNET0 RXN	10/100 Mbps
55	CAN 2 Interface Low-Level	Max. 1 Mbaud
56	CAN 1 Interface Low-Level	Max. 1 Mbaud
57	Analog Input X5_57	0 to 5 V, Pull-up
58	Powersupply_5V X5_58	400 mA
59	ETHERNET1 RXP	10/100 Mbps
60	ETHERNET1 TXN	10/100 Mbps
61	ETHERNET0 TXN	10/100 Mbps
62	CAN 2 Interface High-Level	Max. 1 Mbaud
63	Analog Input X5_63	0 to 5 V, Pull-up
64	ETHERNET1 TXP	10/100 Mbps
65	ETHERNET0 RXP	10/100 Mbps
66	ETHERNET0 TXP	10/100 Mbps

## Communication

3 x CAN

2 x Ethernet

1 x LIN, Control of Bosch Motorsport LIN devices included. Support of other devices on request.

## Installation Notes

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

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Upgrades

## CCA Hardware Upgrade per device

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

## Ordering Information

## PowerBox PBX 190

Order number **F02U.V02.626-04**

## Software Options

## CCA Hardware Upgrade per device

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

## Accessories

## Mating Connector X1

Order number **F02U.004.387-01**

## Mating Connector X2

Socket 25 mm<sup>2</sup>Order number **F02U.B01.044-01**

## Mating Connector X2

Socket 35 mm<sup>2</sup>Order number **F02U.B01.045-01**

## Mating Connector X3

Order number **F02U.004.386-01**

## Mating Connector X4

Order number **F02U.004.388-01**

## Mating Connector X5

Order number **F02U.000.472-02**

## Connector Opening Tool for Shellsize 24

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

## Breakout Box

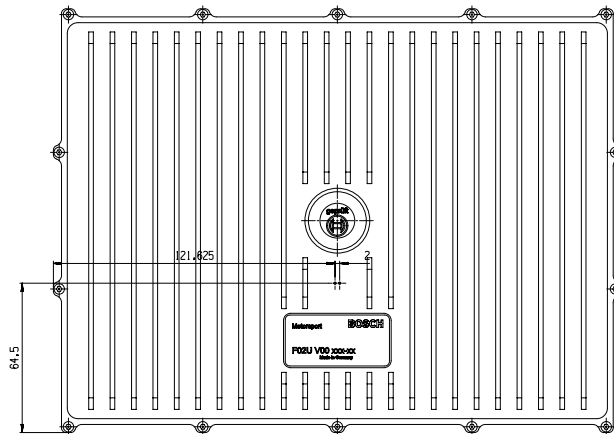
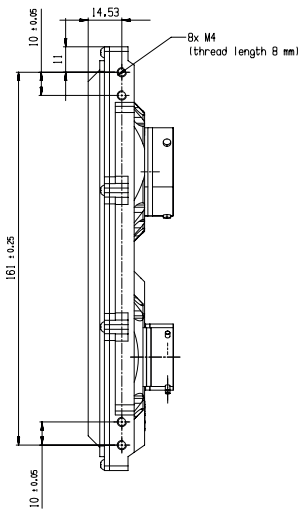
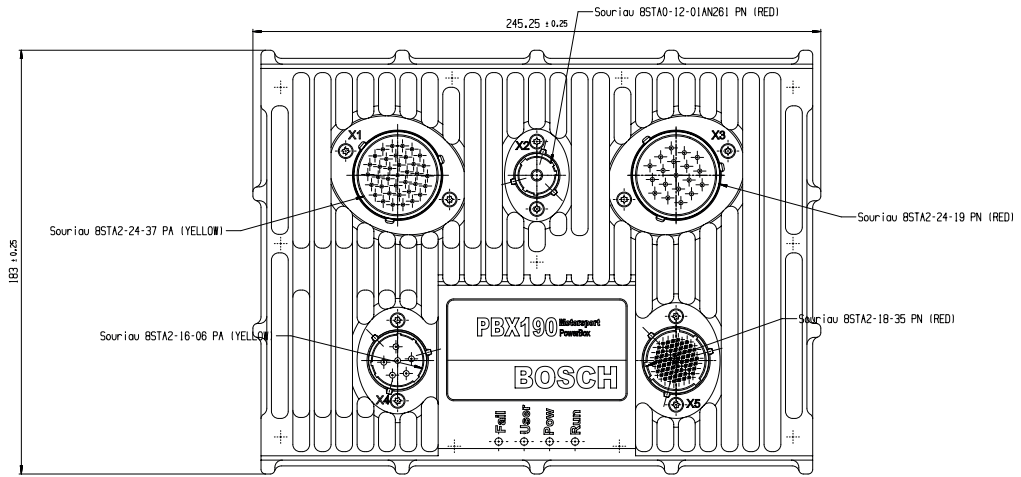
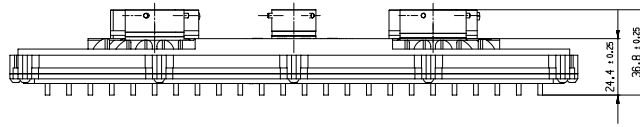
Order number **F02U.V02.523-01**

## CAN Keypad CK-M12

Order number **F02U.V0U.328-04**

Dimensions

3



## Overview

### Data Logger and Sensor Interface C 80



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

### Lambdatronic LT4



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

### Lambdatronic LT4 ADV



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

### Wheel Speed Signal Splitter



- ABS Wheel Speed Sensor Interface
- Lightweight Aluminum Housing

## Data Logger and Sensor Interface C 80

3



### Features

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

We offer the C 80 in two basic versions, on the one hand as a data logger and on the other hand as a sensor interface. Choose between these basic variants and combine or add functionalities now or later.

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

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

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

### Application

Converters	10 kHz 12 bit AD converters with digital low pass filter
Configurable math channels	
User configurable CAN in/out messages	
Sampling rate	
Online data compression	

### Internal logger

- FULL\_LOG\_1 (4 GB memory on Partition 1) enabled, optional in C80 Sensor Interface
- PERF\_LOG\_1 (16 GB memory on Partition 1) optional
- FULL\_LOG\_2 (4 GB memory on Partition 2) optional
- 1,500 channels enabled
- 1 ms sampling rate enabled
- DATA\_USB (Data copy to USB flash drive) optional

### Logging rates

- Usage of all features: 800 kB/s
- Primary logging use case: >1,500 kB/s
- Logging data download rate: up to 7.5 MB/s

### 3-port network switch

Telemetry Support via Ethernet (recommended) and RS232

### Technical Specifications

#### Mechanical Data

Size	105 x 34.5 x 137.5 mm
Weight	462 g
Protection Classification	IP67 to DIN 40050, Section 9, Issue 2008
Max. vibration	Vibration profile 1
Operating temperature (internal)	0 to 85°C
Operation outside the temperature limits can be tested on request during the manufacturing tests.	

#### Electrical Data

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

#### Inputs

4 x digital channels
26 x analog channels
0 to 5 V input range
12 bit resolution
1 x 3 kOhm switchable pull up resistor

#### Sensor Supplies and Screens

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

#### Connectors and Wires

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

#### Pin Layout ASDD212-41PN

Pin	Name	Description
1	KL30	

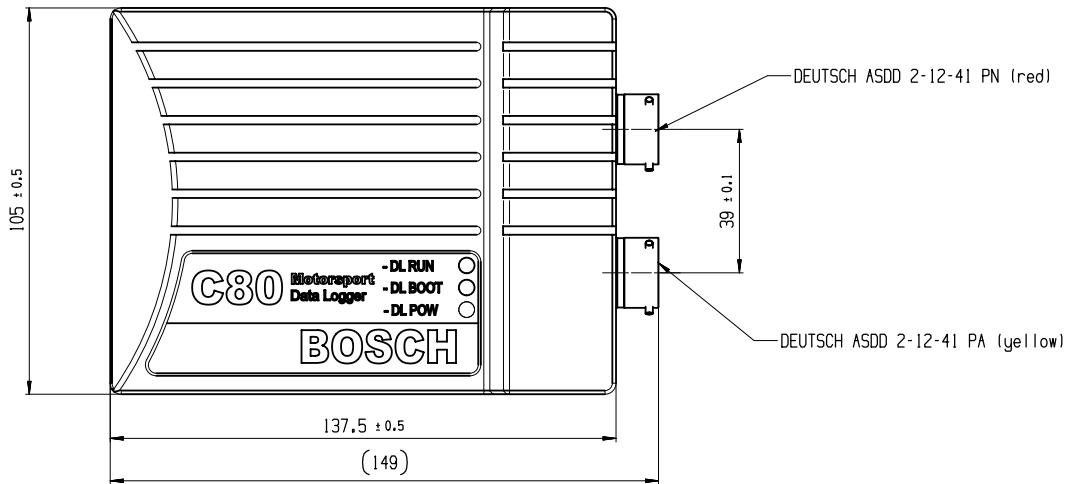
Pin	Name	Description
2; 3	KL15	
4; 5	KL31	
6	Ethernet Channel0 Tx plus	Wire Ethernet_0 - TX+
7	Ethernet Channel0 Tx minus	Wire Ethernet_0 - TX-
8	Ethernet Channel0 Rx plus	Wire Ethernet_0 - RX+
9	Ethernet Channel0 Rx minus	Wire Ethernet_0 - RX-
10	Ethernet Schirm	Ethernet Schirm
11	Ethernet Channel1 Tx plus	Wire Ethernet_0 - TX+
12	Ethernet Channel1 Tx minus	Wire Ethernet_0 - TX-
13	Ethernet Channel1 Rx plus	Wire Ethernet_0 - RX+
14	Ethernet Channel1 Rx minus	Wire Ethernet_0 - RX-
15	Ethernet Channel2 Tx plus	Wire Ethernet_0 - TX+
16	Ethernet Channel2 Tx minus	Wire Ethernet_0 - TX-
17	Ethernet Channel2 Rx plus	Wire Ethernet_0 - RX+
18	Ethernet Channel2 Rx minus	Wire Ethernet_0 - RX-
19	CAN_A_H	CAN_A - HIGH
20	CAN_A_L	CAN_A - LOW
21	CAN_B_H	CAN_B - HIGH
22	CAN_B_L	CAN_B - LOW
23	USB Power	500mA USB_Power
24	USB Data Plus	USB_OTG_Plus
25	USB Data Minus	USB_OTG_Minus
26	USB GND	USB_Ground
27	SENSPWR5_1	
28	SENSGND	
29	Timestamp	
30	LS_GND_1	Low-Side Ground2
31	LS_SWITCH_1	lowside switch 2A
32	LS_SWITCH_2	lowside switch 2A
33	LS_SWITCH_3	lowside switch 2A
34	LS_SWITCH_4	lowside switch 2A
35	LS_GND_2	Low-Side Ground2
36	ANAIN_M1_1	0 to 5V Analog
37	ANAIN_M1_2	0 to 5V Analog
38	ANAIN_M1_3	0 to 5V Analog
39	ANAIN_M1_4	0 to 5V Analog

Pin	Name	Description
40	ANAIN_M1_5	0 to 5V Analog
41	ANAIN_M1_6	0 to 5V Analog

#### Pin Layout ASDD212-41PA

Pin	Name	Description
1	UBATT_FUSE1	
2	SENSPWR10_1	
3	SENSPWR5_2	
4	SENSPWR5_3	
5	SENSPWR5_4	
6; 7	SENSGND	
8	RS232A TX	Transmit Telemetry data
9	RS232A RX	Receive Telemetry data
10	RS232B TX	Transmit GPS data
11	RS232B RX	Receive GPS data
12	RS232_GND	RS232 Ground
13	REV1_P	Hall / Inductive
14	REV1_M	Hall / Inductive
15	REV2_P	Hall / Inductive
16	REV2_M	Hall / Inductive
17	REV3_P	Hall / Inductive
18	REV3_M	Hall / Inductive
19	REV4_P	Hall / Inductive
20	REV4_M	Hall / Inductive
21	ANAIN_M1_7	0 to 5V Analog
22	ANAIN_M1_8	0 to 5V Analog
23	ANAIN_M1_9	0 to 5V Analog
24	ANAIN_M1_10	0 to 5V Analog
25	ANAIN_M1_11	0 to 5V Analog
26	ANAIN_M1_12	0 to 5V Analog
27	ANAIN_M1_13	0 to 5V Analog
28	ANAIN_M1_14	0 to 5V Analog
29	ANAIN_M1_15	0 to 5V Analog
30	ANAIN_M1_16	0 to 5V Analog
31	ANAIN_M2_1	0 to 5V Analog
32	ANAIN_M2_2	0 to 5V Analog
33	ANAIN_M2_3	0 to 5V Analog
34	ANAIN_M2_4	0 to 5V Analog
35	ANAIN_M2_5	0 to 5V Analog
36	ANAIN_M2_6	0 to 5V Analog
37	ANAIN_M2_7	0 to 5V Analog
38	ANAIN_M2_8	0 to 5V Analog
39	ANAIN_M2_9	0 to 5V Analog
40	ANAIN_M2_10	0 to 5V Analog
41	LAPTRIGGER	





## Lambdatronic LT4

3



### Features

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

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

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

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

### Application

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

### Technical Specifications

#### Mechanical Data

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

Operating temp. range (housing)	-20 to 85°C
Storage temp. range	-20 to 85°C
Max. vibration	Vibration Profile 1

#### Electrical Data

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

#### Software Tool (free download)

System Configuration tool RaceCon 2.7.0.9 or later

#### Characteristic

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

#### Connectors and Wires

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

#### Pin Assignment

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

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

### Communication

Communication link	K-Line / CAN
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### Installation Notes

Typical lifetime: max. 220 h / 2 years

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

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

The LT4 is featured with voltage compensation for the heating profile

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

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

The unit is secure from miss-pinning.

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

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

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

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

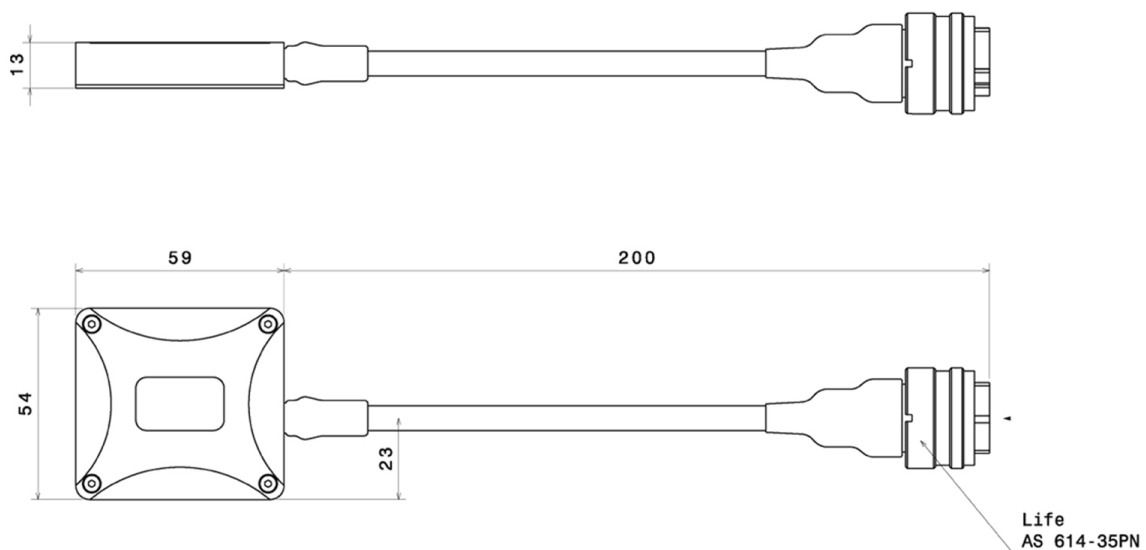
### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Lambdatronic LT4**  
Order number **F01T.A20.070-09**

### Dimensions



## Lambdatronic LT4 ADV

3



### Features

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

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

The LSU ADV contains a Nernst cell and a pump cell. The lambda value between the Nernst cell and an internal oxygen reference chamber is controlled to lambda 1.013, independent of the oxygen concentration on the emission side. This happens thanks to the pump current through the pump cell, responsible for the transmission of oxygen atoms in the sensor ceramic. The current proportional output voltage of the IC is translated in a lambda value. The LT4 ADV provides the sensors temperature and other diagnostics parameters over CAN. The 4 lambda signals can be read by using the CAN or analog output.

The main feature and benefit of this unit is its compact design, its lightweight construction, as well as the possibility to control up to 4 Lambda Sensors LSU ADV with multiple user-configurable parameters.

### Application

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

### Technical Specifications

#### Mechanical Data

Weight with wire	98 g
Sealing	100 % humidity
Mounting	Velcro
Size w/o wire (w*l*h)	54 x 59 x 13 mm
Operating temp. range (housing)	-20 to 85°C
Storage temp. range	-20 to 85°C
Max. vibration	Vibration Profile 1

#### Electrical Data

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

#### Software Tool (free download)

System Configuration tool RaceCon 2.7.0.9 or later

#### Characteristic

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

#### Connectors and Wires

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

#### Pin Assignment

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

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

### Communication

Communication link	K-Line / CAN
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### Installation Notes

Typical lifetime: max. 220 h / 2 years

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

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

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

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

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

The unit is secure from miss-pinning.

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

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

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

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

### Legal Restrictions

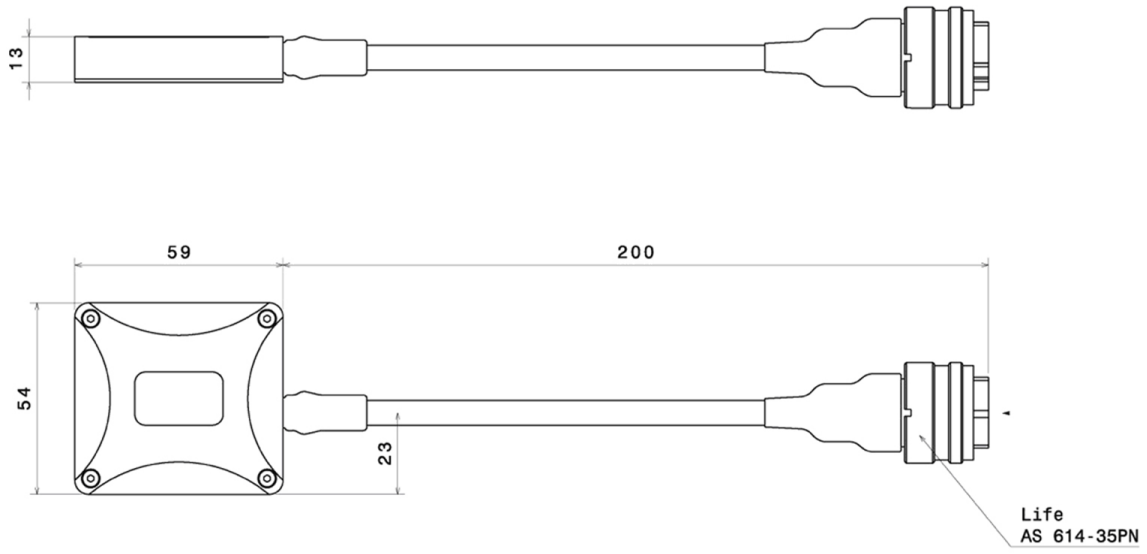
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Lambdatronic LT4 ADV

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

Dimensions



## Wheel Speed Signal Splitter



### Features

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

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

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

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

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

### Application

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

### Technical Specifications

#### Mechanical Data

Weight	53 g
Size (Single connector type)	101.8 x 63.5 x 30.3 mm
Size (Double connector type)	112.1 x 63.5 x 30.3 mm
Max. vibration	Vibration profile 1

#### Electrical Data

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

#### Connectors

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

#### Pinout Connector 1 (wide)

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

**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

**Legal Restrictions**

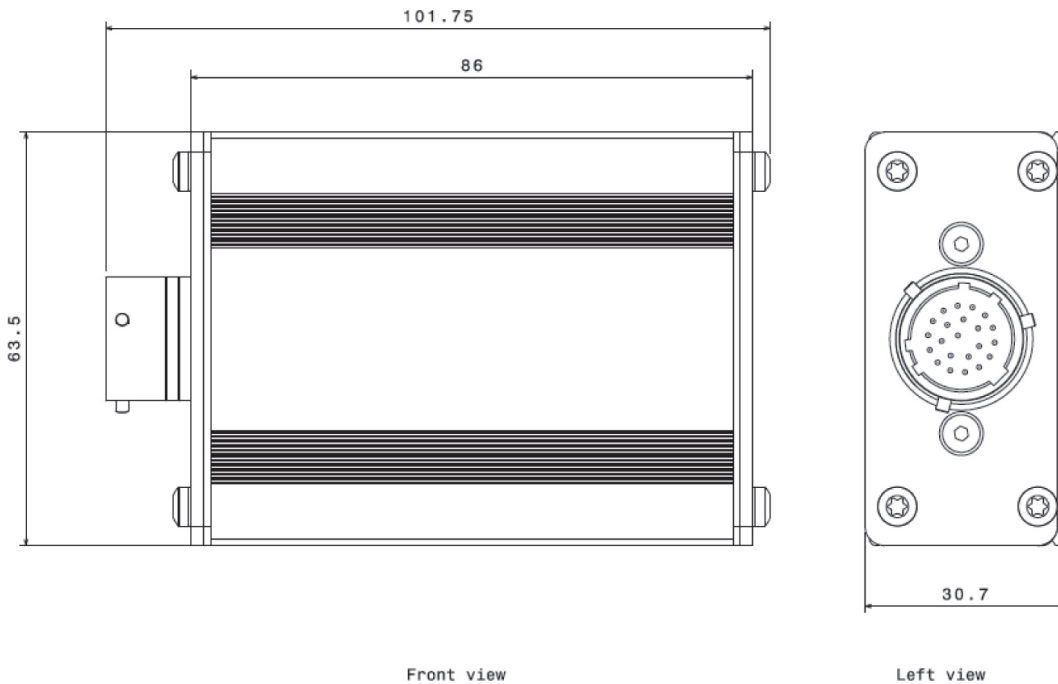
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information****Single Connector Type**

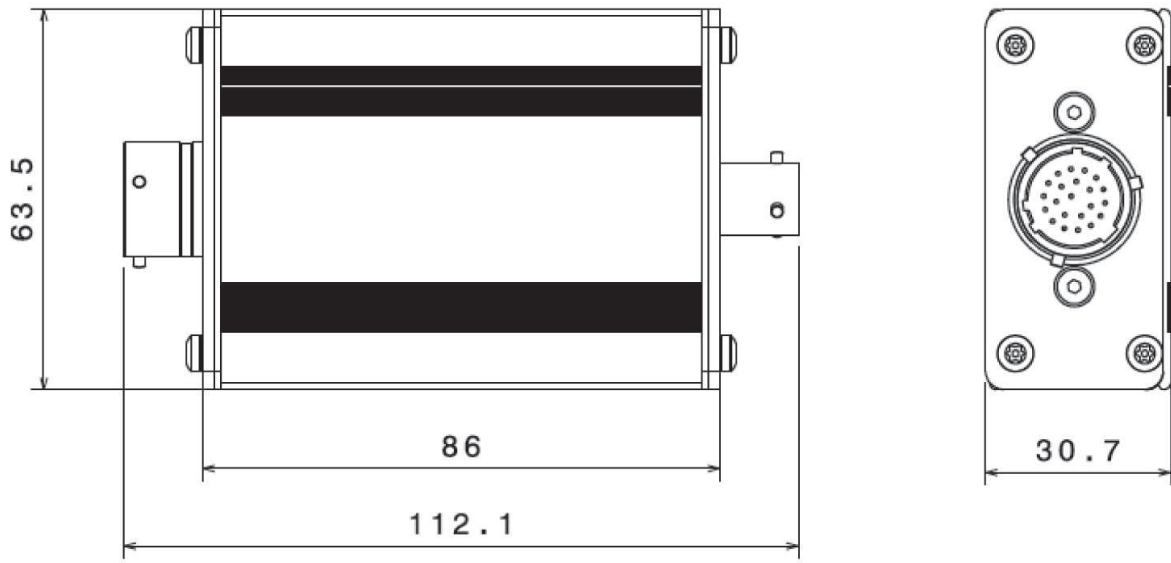
Order number **F02U.V00.335-03**

**Double Connector Type**

Order number **F02U.V00.203-03**

**Dimensions**

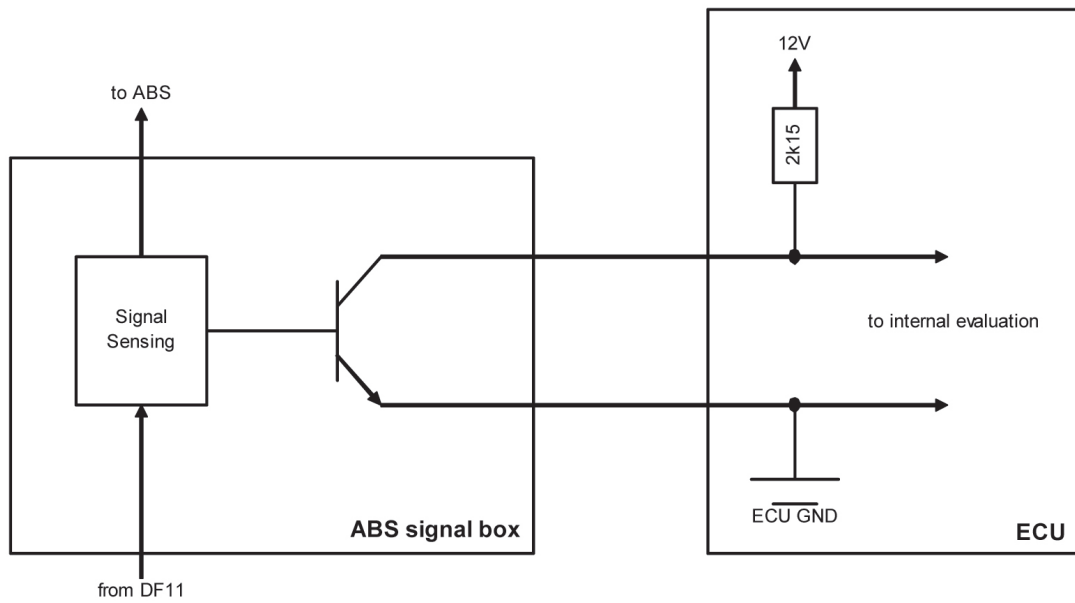
*Single Connector Type Housing*



Front view

Left view

Double Connector Type Housing



Connection Scheme

## Connectivity Gateway CG 3.2

3



### Features

- ▶ 1 device for world-wide use
- ▶ 2 simultaneous connections to distinct Mobile Operators
- ▶ Bi-directional communication capability
- ▶ Dual band multi-constellation Dead Reckoning GNSS
- ▶ WiFi 6; 4 Ethernet (including 1 Automotive Ethernet), 1 CAN-FD, 1 RS232, 16 GB internal storage memory

The CG 3.2 is the new Bosch Motorsport connectivity gateway for global operation: two world-wide 5G-SA modems with 4G fallback capability within a single device, four eSIMs and two 4FF SIM slots for simultaneous connection to two distinct Mobile Network Operators, one DR GNSS dual-band multi-constellation receiver, a WiFi link and 16 GB internal memory for data logging.

The combination of CG 3.2 with RaceConnect provides a highly flexible solution to manage from remote a race-cars fleet, optimise live data analysis, process and distribute data to multiple users and 3<sup>rd</sup> Party cloud/desktop applications for local/remote use.

The adoption of CG 3.2 allows for plug&play setup with the Bosch and Motec controllers, displays and loggers, but data can be RXed\TXed also from/to 3<sup>rd</sup> Party in-vehicle's devices; its integrated network switch allows VLANs for multiple systems to be connected to the device simultaneously and securely: e.g. scrutineering and chassis/engine loggers.

Bi-directional communication enables Race Control Marshalling, scrutineering, remote Fleet Management, FOTA and Configuration Over The Air, while new transmission strategies will maximise the data throughput also in challenging RF environment conditions.

To be noted that CG 3.2 is already compliant with 5G Slicing, 5G Private and 5G Hybrid networks.

Provided with a powerful 2 GHz quad-core CPU and a 2 TOPS NPU, the new Bosch Connectivity Gateway will also allow on-board ML & AI data/images processing when connected to IP cameras, for example.

In an IP67 light and robust aluminium enclosure, rated for the harsh motorsport environment, CG 3.2 integrates also super-capacitors to remain operational up to 30 s in case the main power source is detached.

Finally, this same device can be operated in the pit-stands as "receiver" to directly get the telemetry data in case Internet access to RaceConnect is not available.

**NOTE:** all the CG 3.2 functionalities described in this datasheet (simultaneous use of 2 MNOs, Configurable Radio Transmission Strategies, DR GNSS, datalogging, Wi-Fi, FW and Calibration OTA) will be gradually introduced starting from 2026 Q1. Please contact Bosch Motorsport for further details.

### Application

Configuration	Bosch RaceConnect Bosch RaceCon
Data Transmission	Bi-directional* *based on series regulations
Configurable Radio Transmission Strategies	Best Effort, Backfill, Redundant, with and w/o Data Priorities
Mobile Network Operators (MNO)	Multiple Global Carriers Up to 2 simultaneous MNOs
SIM Cards	4 eSIMs and 2 4FF SIM slots 5G Private Network ready
GNSS	Multi-band multi-constellation Dead-Reckoning
WiFi	WiFi 6, Single Antenna
Data Logger	RaceCon configurable 16 GB storage memory

### Technical Specifications

#### Mechanical Data

Max. size (incl. connectors)	158 x 117 x 31 mm
Weight	430 g
Operating temperature (internal)	-20 to 85°C
Max. vibrations	Vibration profile 1 (see <a href="http://www.bosch-motorsport.com">www.bosch-motorsport.com</a> )
IP class	67

#### Wired Communications

3 Ethernet	100BaseTX with managed switch for VLANs
1 Automotive Ethernet	100/1000BaseT1
1 CAN-FD	Configurable in RaceCon Compliant with CAN 2.0
1 RS232	19.2, 57.6 and 115.2 kB/sec

#### Wireless Communications

2 5G SA/NSA channels	Both with diversity and 4G fallback
1 WiFi 6	Single antenna, no MIMO
1 GNSS	L1, L5; multi-constellation; 10 Hz; DR optionally enabled

#### Electrical Data

Supply voltage range	8 to 18 V
Current consumption (typ.)	0.7 A at 13.4 V
CPU	Quad-core 1.8 GHz Cortex

NPU	2.3 TOPS
Keep Alive	30 sec w/ internal super-caps
6 temperature sensors	
12 in-chip temperature sensors	
1 internal 3 axis accelerometer	

#### External Antenna Connections

5G (1 & 2)	4 SMA sockets (gold)
GNSS	1 SMA socket (gold)
WiFi	1 SMA reverse polarity socket (silver)

#### Connectors and Wires

Mating connector	AS612-35SN
------------------	------------

#### PIN Configuration

PIN	TYPE	LABEL	DESCRIPTION
A-1	G OUT	COMSCR	Ethernet Cable Screen
A-2	I/O	ETHA_TRX-	Ethernet 100/1000Base-T1 (SPE)
A-3	I/O	ETH3_TXN	Ethernet 100Base-TX
A-4	I/O	ETH3_RXP	Ethernet 100Base-TX
A-5	I/O	ETH3_RXN	Ethernet 100Base-TX
A-6	I/O	ETH2_TXP	Ethernet 100Base-TX
A-7	I/O	ETH2_RXP	Ethernet 100Base-TX
A-8	I/O	ETH1_TXP	Ethernet 100Base-TX
A-9	I/O	ETH1_TXN	Ethernet 100Base-TX
A-10	I/O	ETH1_RXP	Ethernet 100Base-TX
A-11	I/O	CAN1_H	CAN-FD bus (5 Mbps)
A-12	I/O	RESERVED	
A-13	G	GND	GND for Pwr Supply
A-14	V	V_BAT	Pwr Supply: 8 to 18 V
A-15	I/O	ETHA_TRX+	Ethernet 100/1000Base-T1 (SPE)
A-16	I/O	ETH3_TXP	Ethernet 100Base-TX
A-17	I/O	ETH2_TXN	Ethernet 100Base-TX
A-18	I/O	ETH2_RXN	Ethernet 100Base-TX
A-19	I/O	ETH1_RXN	Ethernet 100Base-TX
A-20	I/O	CAN1_L	CAN-FD bus (5 Mbps)
A-21	I/O	RS232_RX	RS232 – 12 V (256 kbps)
A-22	I/O	RS232_TX	RS232 – 12 V (256 kbps)

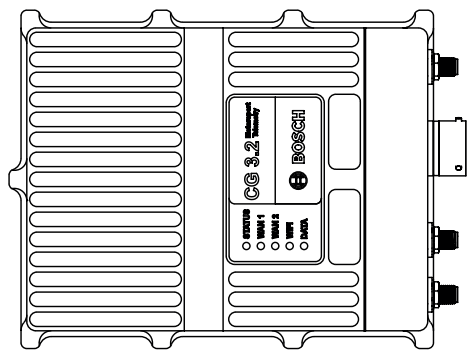
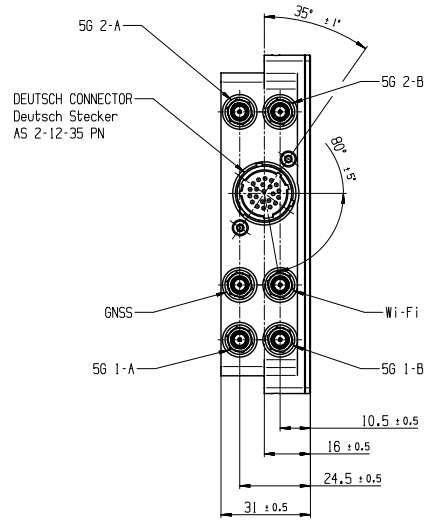
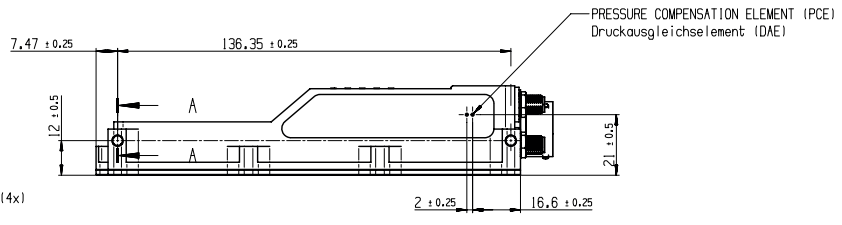
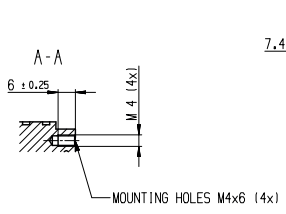
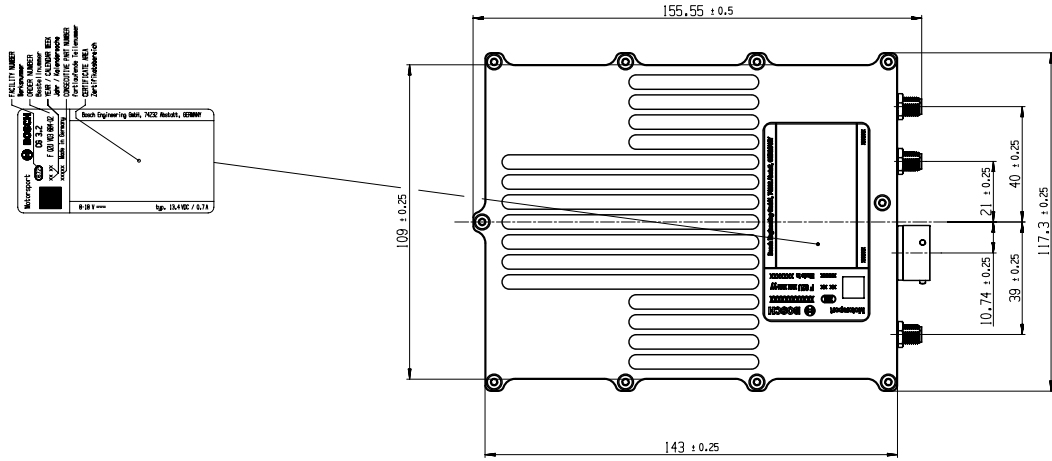
#### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. Radio type approval is not possible in the following countries: Nicaragua, Venezuela.

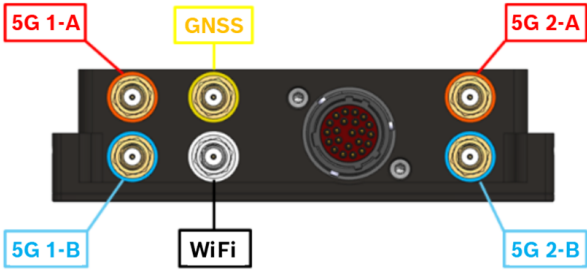
This list may change as geopolitics evolve.

**Ordering Information****Connectivity Gateway CG 3.2**Order number **F02U.V03.684-02****1y Dataplan 1 GB/month**Order number **BG02.000.070****1y Dataplan 4 GB/month**Order number **BG02.000.071****1y Dataplan 12 GB/month**Order number **BG02.000.072****FW & Config Over the Air**Order number **BG02.000.074****Extra DL for CG 3.2**Order number **BG02.000.069****1y Pit-stand RX Dataplan**Order number **BG02.000.073****CG 3.2 Pit stand harness**Order number **F02U.V0U.486-01****CG 3.2 Bench loom**Order number **F02U.V0U.487-01**

Dimensions



## Antennas Connection



5G 1-A	Main Antenna for Modem 1
5G 1-B	Diversity Antenna for Modem 1
5G 2-A	Main Antenna for Modem 2
5G 2-B	Diversity Antenna for Modem 2
GNSS	Antenna for GNSS
WiFi	Antenna for WiFi

Note: for the CG 3.2 antenna types and installation, please refer to the relative datasheet.

## µLC Test System



### Features

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

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

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

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

### Application

#### Engine Speed Simulation

- Up to 20,000 rpm
- Supported sensors: Hall, inductive, DG23i, TL4953
- Up to 2 cranks, 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

#### Analog Interfaces

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

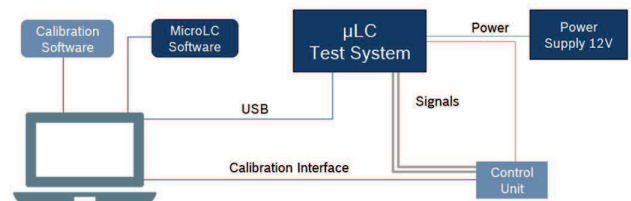
#### Digital Interfaces

- 6 \* Digital Out, max. 200 mA in total  
Output modes: Ground, 12 V, High impedance
- 2 \* Relays, max. 10 A, separate ECU power supply possible and incl. main relay sensing
- 2 \* PWM input, 8 Hz to 20 kHz
- 4 \* PWM output, max. 90 mA in total, 0.1 Hz to 20 kHz  
Output voltages: 12 V, 5 V, GND
- Complex PWM with sub signals, each separately adjustable in frequency, duty cycle and pulse count

#### Additional Features

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

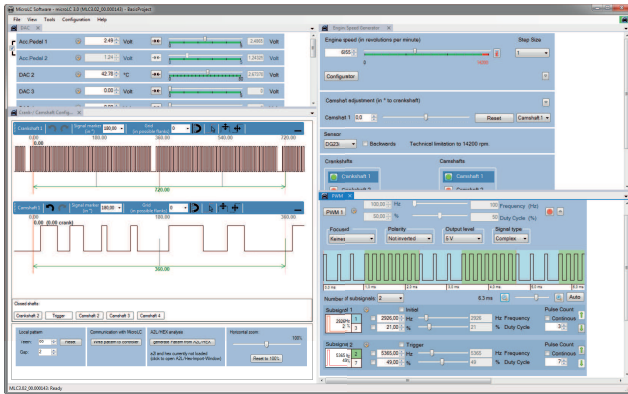
#### Test Setup



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

### Technical Specifications

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



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

### Update and Support Subscription

- Free in the first year of use, chargeable from the second year

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### µLC Test System

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

#### Software Options

#### Update and Support Subscription

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

#### Accessories

#### Expansion Board CAN-FD

Order number **F02U.V03.095-01**

#### Expansion Board Current Loop Interface

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

#### Expansion Board Digital Multichannel Pot.

Order number **F02U.V03.129-01**

#### Expansion Board Digital Outputs

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

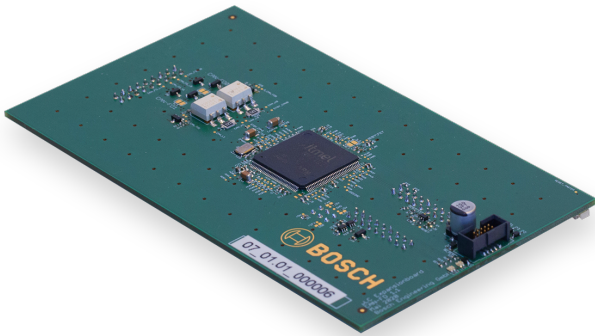
#### Expansion Board E-Mobility

Order number **F02U.V03.531-01**

#### Expansion Board FlexIO

Order number **F02U.V03.360-01**

## Expansion Board CAN-FD



### Features

- ▶ 2 independent channels
- ▶ Compatible with CAN and CAN-FD
- ▶ Switchable termination resistor

The **Expansion Board CAN-FD** extends the functions of the **μLC Test System** without intervening in the software and without additional enabling mechanisms. The card has two channels that are compatible with classic CAN as well as with CAN-FD. For CAN-FD, data bit rates of up to 5 Mbit/s are supported.

- Adjustable bit rates and sample points with optional Transmission Delay compensation for high bit rates
- Direct import of dbc and Fibex files
- Short circuit proof

### Technical Specifications

Parameter	Value
$U_{\text{Bus,prot}}$	±56 V
$U_{\text{CM}}$	±30 V
$R_{\text{Term}}$	120 Ohm

Parameter	Value
Max. data rate (CAN)	1 Mbit/s
Max. data rate (CAN-FD)	5 Mbit/s
Filter	Range-Filter for 11bit- and 29bit-IDs
Resolution timestamp	1 ms
Adjustable cycle times	1 ms - 65 s

### Legal Restrictions

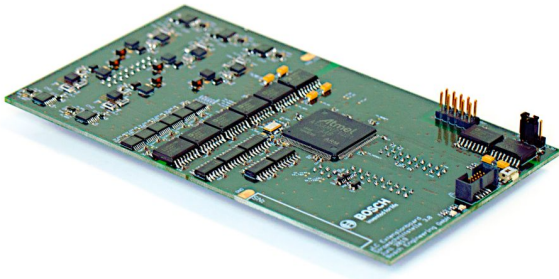
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Expansion Board CAN-FD**  
Order number **F02U.V03.095-01**

## Expansion Board Current Loop Interface

3



### Features

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

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

### Technical Specifications

TS	
Engine speed	-3,000 to 12,000 rpm
Local pattern / teeth	48 to 60
Signal duration forwards	35 to 55 µs
Signal duration backwards	80 to 100 µs
Gaps	0 to 10

TS		
Prefixed bit	35 to 45	(de)activatable
Duty Cycle	737,000 µs	
Stand still signal duration	1,340 to 1,540 µs	
Stand still signal	150,000 µs	(de)activatable
AK		
Engine speed	-3,125 to 3,125 rpm	
Local pattern / teeth	48 to 60	
Parity	Even / odd parity	
LR-Bit		(de)activatable
LM0-Bit		(de)activatable
LM1-Bit		(de)activatable
LM2-Bit		(de)activatable
Stand still signal	150,000 µs	
PWM-i		
Engine speed	-2,500 to 2,500 rpm	
Local pattern / teeth	48 to 60	
Duration LR	35 to 55 µs	(de)activatable
Duration DR_L	80 to 100 µs	
Duration DR_R	170 to 190 µs	
Duration DR_L_EL	350 to 370 µs	(de)activatable
Duration DR_R_EL	710 to 730 µs	(de)activatable
Stand still signal duration	1,430 to 1,450 µs	
Stand still signal period	737,000 µs	
PWM-s		
Engine speed	-5,000 to 5,000 rpm	
Local pattern / teeth	48 to 60	

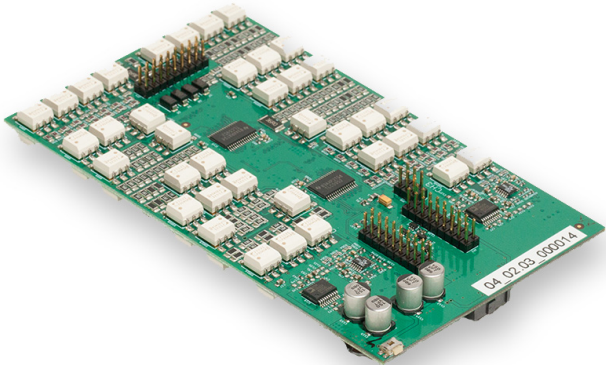
### Legal Restrictions

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### Ordering Information

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

# Expansion Board Digital Multichannel Pot.

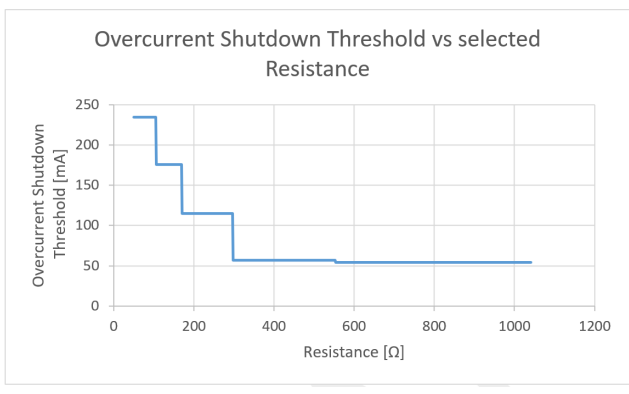


## Features

- ▶ 4 independent, galvanically isolated, AC-capable channels
- ▶ Wide range of resistance: 50 Ohm to 500 kOhm
- ▶ High accuracy and 19 Bit Resolution
- ▶ Overcurrent protection
- ▶ Non-mechanical solid-state switches

The **Digital Multichannel Potentiometer Expansion Board** extends the functionality of the **μLC Test System** by seamless integration into an existing device. It offers four independently configurable, galvanically isolated digital potentiometers with a wide range of resistance and excellent accuracy. All four channels feature individual protection by an automatic overcurrent shutdown with automatic retry.

## Dimensions



## Application

Emulating Sensor Data

Designed to work for example with the sensor interface L9966 (FlexI)

## Technical Specifications

Maximum voltage on any input referred to μLC-GND -24 to 24 V

## Electrical Characteristics

Parameter	Value	Unit
Minimum Resistance	50	Ohm
Maximum Resistance	500	kOhm
Step Size	1	Ohm
Resolution	19	Bit

## Accuracy

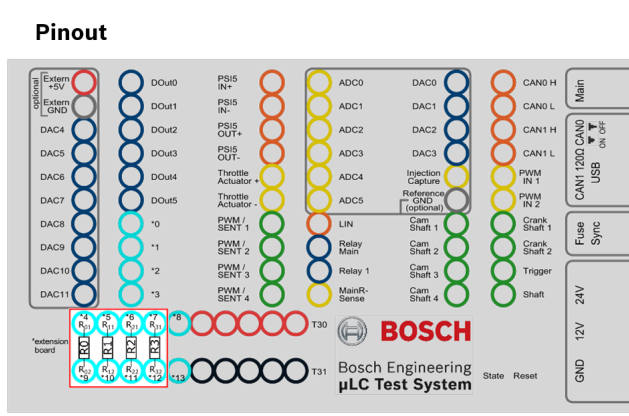
Parameter	Value
Entire Range	±0.5 Ohm ± 1 %

## Legal Restrictions

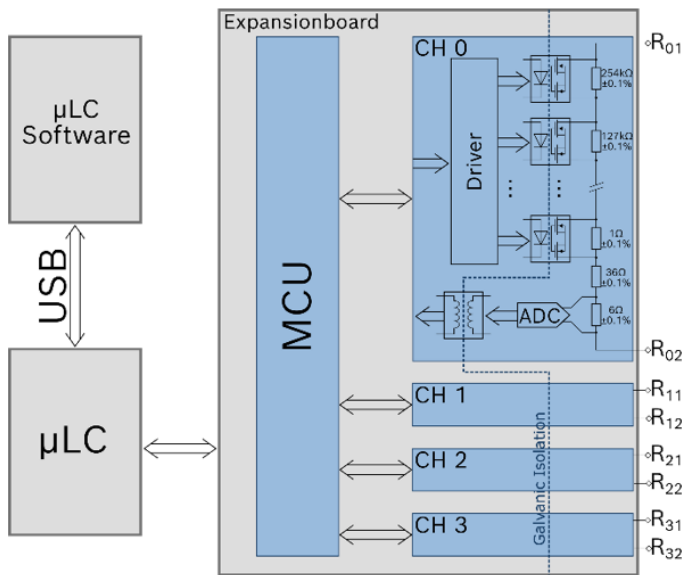
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

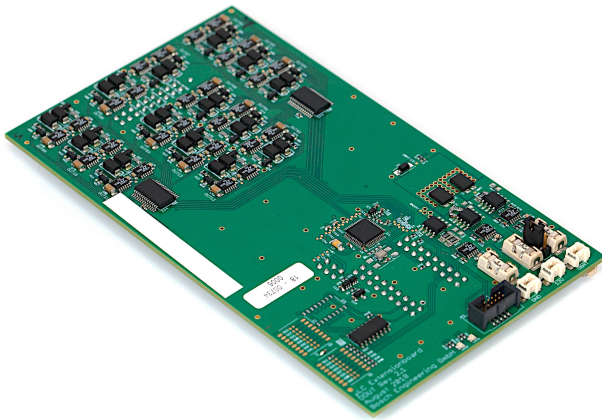
**Expansion Board Digital Multichannel Pot.**  
Order number **F02U.V03.129-01**



Block diagram:



## Expansion Board Digital Outputs



### Features

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

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

### Application

Output voltage	Min	Max
μLC 3.1	-1 V	24 V

### Technical Specifications

#### DC characteristics

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

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

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

\*: Restart time after overcurrent

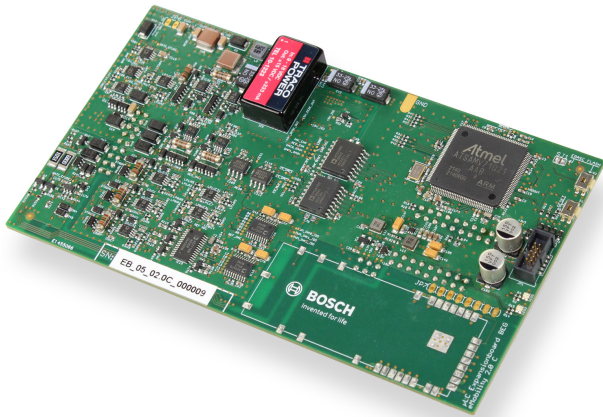
### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

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

## Expansion Board E-Mobility



3

### Features

- ▶ Expansion by sensor signal simulation of resolver signals, strand current signals, incremental encoder signals, and DAC
- ▶ High signal precision
- ▶ 16-bit resolution
- ▶ Galvanic isolation & protective circuits

The Expansion Board E-Mobility extends the functions of the  $\mu$ LC Test System with typical sensor signals from the e-mobility sector. This includes resolver signals, strand current signals, incremental encoder signals, and a 30 V-DAC.

All inputs and outputs are short-circuit protected against ground and supply voltage.

### Technical Specifications

#### Resolver Signals

Properties	Specifications
Output signals	Sine, inverted sine; Cosine, inverted cosine; Internal excitation signal
Excitation signal	Switchable between internally generated signal or externally supplied signal; Frequency range: 100 Hz to 10 kHz; Accuracy: $< \pm 5\%$
Amplitudes	Voltage: 1 to 2,5 V; Accuracy: $< \pm 250\text{ mV}$
Phases	Phase shift between envelopes adjustable between $0^\circ$ and $359^\circ$ ; Accuracy: $< \pm 10^\circ$

Properties	Specifications
Offset	Voltage: 0 to 10 V, signal can be shifted in 100 mV steps; Accuracy: $< \pm 250\text{ mV}$
Rotational speeds	Speed range: 60 to 15,000 rpm simulatable; Accuracy: $< \pm 5\%$

#### Strand Current Signals

Properties	Specifications
Amplitudes	Amplitudes of signals: adjustable 0.1 to 2.5 V; Accuracy: $< \pm 25\text{ mV}$
Phases	Phase shift to speed signals adjustable between $0^\circ$ and $359^\circ$ ; Accuracy: $< \pm 10^\circ$
Offset	Voltage: strand current signal shiftable between 0 and 2.5 V in 25 mV steps; Accuracy: $< \pm 25\text{ mV}$
Rotational speeds	Speed range: 60 to 15,000 rpm simulatable; Accuracy: $< \pm 5\%$

#### Incremental Encoder Signals

Properties	Specifications
Amplitudes	Amplitudes of signals: adjustable 2.5 to 12 V; Accuracy: $< \pm 250\text{ mV}$
Phases	Phase shift between signals adjustable between $0^\circ$ and $359^\circ$ ; Accuracy: $< \pm 10^\circ$
Offset	Signals between 0 and 2.5 V shiftable in 100 mV steps; Accuracy: $< \pm 250\text{ mV}$
Rotational speeds	Frequency range: 1 Hz to 10 kHz; Accuracy: $< \pm 5\%$
Pulse Width	Pulse width: 50 %; Accuracy: $< \pm 5\%$

#### DAC

Properties	Specifications
Voltage	Voltage range: 0 to 30 V; Accuracy: $< 500\text{ mV}$
Current	Output current without voltage drop; Voltage remains constant at 2.5 mA

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

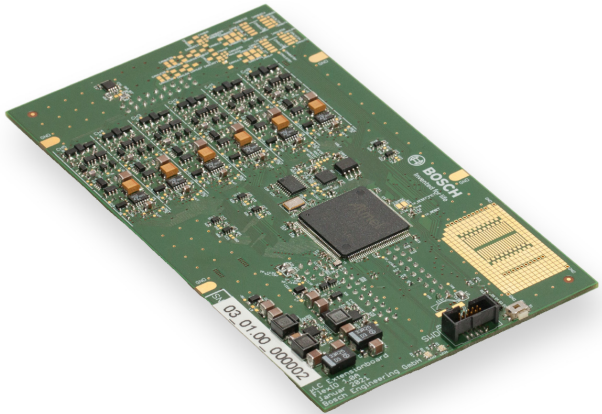
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**Expansion Board E-Mobility**  
Order number **F02U.V03.531-01**

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## Expansion Board FlexIO

3



### Features

- ▶ 6 additional channels, freely selectable between ADC, DAC, DOut, PWM, SENT
- ▶ SENT signals according to SAE J2716 standard from 2016 with integrated fault simulation
- ▶ Manipulation of analogue, PWM, and SENT signals

The Expansion Board FlexIO extends the functions of the  $\mu$ LC Test System by adding six versatile channels that can handle various types of signals, including analog and digital. It enables manipulation of different signal types, such as PWM and SENT, and supports complex configurations for advanced testing scenarios.

With features like error simulation and flexible signal processing, the board is well-suited for automotive and engineering applications where precision and adaptability are essential.

### Technical Specifications

Channel	Specification
ADC	Input voltage 0 to 56 V $\pm$ 100 mV

Channel	Specification
DAC	Output voltage 0 to 5 V $\pm$ 50 mV
DOut	Output voltage 12 V or high impedance
PWM-Out	Frequency 0.1 to 25,000 Hz $\pm$ 0,05 % Duty cycle 0 to 100 % $\pm$ 0,5 % Output voltage 0, 3.3 to 12 V, or high impedance
PWM-In	Frequency 1 to 20,000 Hz $\pm$ 0,5 % Duty cycle 0 to 100 % $\pm$ 1 %
SENT	Sensor types in the SAE J2716 Norm Tick length 2 to 90 $\mu$ s Message type Short 8, enhanced 12 or 16 Bit Multiplexing Error simulation

### Edge steepness for DOut, PWM-Out, SENT

Output	Conditions	trise max	tfall max
0 V / 3,3 V	$U_{low} = 0,5 \text{ V}$ , $U_{high} = 2,5 \text{ V}$ , $R_L = 390 \text{ Ohm}$	120 ns	120 ns
0 V / 5 V	$U_{low} = 0,5 \text{ V}$ , $U_{high} = 4,1 \text{ V}$ , $R_L = 390 \text{ Ohm}$	312 ns	66 ns
0 V / 12 V	$U_{low} = 1,2 \text{ V}$ , $U_{high} = 10,8 \text{ V}$ , $R_L = 390 \text{ Ohm}$	58 ns	120 ns

To determine the slew rate, an upper ( $U_{high}$ ) and a lower ( $U_{low}$ ) threshold voltage were defined. Subsequently, the maximum time span required for a switching process to transition from one voltage range to the other was determined. A load resistor ( $R_L$ ) value of 390 Ohm was selected.

### Legal Restrictions

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### Ordering Information

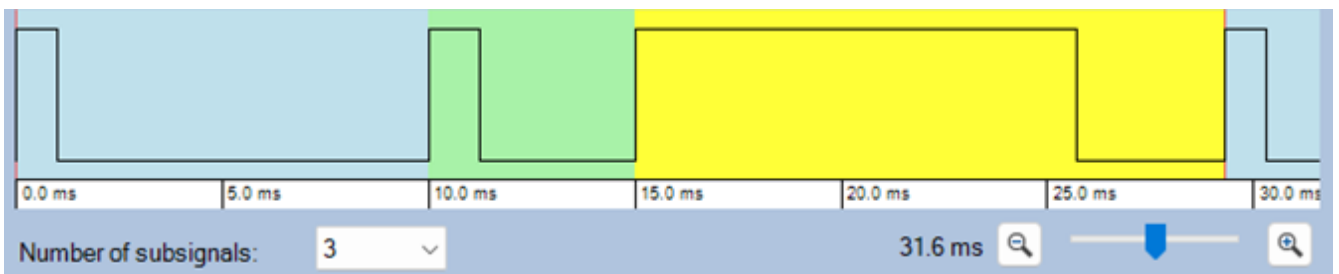
**Expansion Board FlexIO**  
Order number **F02U.V03.360-01**

## Dimensions

**Manipulation**

The manipulation module is used to manipulate analogue, PWM and SENT signals. To do this, the respective signal is read in via one of the six channels, manipulated and then output via one of the six channels. This means that up to three manipulations can be carried out simultaneously.

The output voltage of the analog signals, the frequency, the duty cycle, and the output voltage of the PWM signal as well as the fast channel data of the SENT signal can be manipulated. Additionally, you can limit the SENT data by defining a maximum and minimum value for the data.

**PWM**

The PWM signals can be set and inverted according to the table. Furthermore, it is possible to generate complex PWM signals, which consist of up to 7 partial signals. The frequency and duty cycle of the partial signals can be freely adjusted.



# Fuel & Spark

4

<b>Fuel Pressure Regulators</b>	<b>142</b>
<b>Fuel Pumps</b>	<b>149</b>
<b>Ignition Coils</b>	<b>158</b>
<b>Ignition Modules</b>	<b>189</b>
<b>Injection Valves</b>	<b>196</b>

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## Overview

4

### Fuel Pressure Regulator Mini 2



- 5 to 8 bar
- 30 to 400 l/h reflow
- Adjusted at 105 l/h
- Aluminum housing
- All versions Methanol compatible

### Fuel Pressure Regulator Mini 5



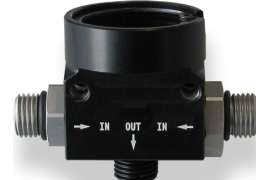
- 5 bar
- 15 to 220 l/h reflow
- Adjusted at 105 l/h
- Sheet steel housing

### Fuel Pressure Regulator Mini A



- 2.2 to 3.5 bar/3.5 to 5 bar
- 15 to 220 l/h reflow
- Pressure adjustable
- Sheet steel housing

### FPR Adaptor light



- Aluminum housing
- Fits to production type regulators and Motorsport regulators (FPR Mini 2, Mini 5, Mini A)
- Very light weight

## Fuel Pressure Regulator Mini 2



### Features

- ▶ 5 to 8 bar
- ▶ 30 to 400 l/h reflow
- ▶ Adjusted at 105 l/h
- ▶ Aluminum housing
- ▶ All versions Methanol compatible

Fuel pressure regulators are used to maintain constant fuel pressure at the injection valves.

We offer this regulator for gasoline as well as for methanol applications.

The main benefit of this regulator includes a higher pressure range and a higher return flow rate in comparison to the production type regulators.

### Application

Pressure range	See ordering information
Reflow quantity	30 to 400 l/h
Fuel compatibility	Gasoline, E85, M100
Operating temperature	-40 to 120°C
Storage temperature	-40 to 100°C
Max. vibration	<600 m/s <sup>2</sup> at 5 to 250 Hz
Valve leakage	$Q_{\text{leak}} [\text{cm}^3/\text{min}] \leq 9$ (pneumatic) at $p [\text{kPa}] = 0.8 \times P_{\text{nom}}$

### Technical Specifications

#### Mechanical Data

Diameter	38.1+0.1-0.2 mm
Weight	Ca. 61 g
Mounting	Fastening with a clip

#### Connectors and Wires

Connector supply	Diam. 25 mm, O-ring 25x2.5
Connector reflow	Diam. 9.1 mm, O-ring 5x2.5

### Installation Notes

Never run the regulator without the integrated filter.

Please oil O-rings lightly with clean and silicone free engine oil before you install the regulator.

Please make a leak test after you have installed the regulator.

When the pressure regulator is removed and will be reused, the O-rings must be tested for fractures.

Operation of the pressure regulator with a medium other than gasoline is not allowed.

Using the FPR Adaptor light F02U.V02.248-01, you can rebuild the regulator an inline type.

This pressure regulator is not designed for in-tank mounting.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Fuel Pressure Regulator Mini 2

Pressure Range 5.0 bar

Order number **F02U.V02.166-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 6.0 bar

Order number **F02U.V02.168-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 7.0 bar

Order number **F02U.V02.170-01**

#### Fuel Pressure Regulator Mini 2

Pressure Range 8.0 bar

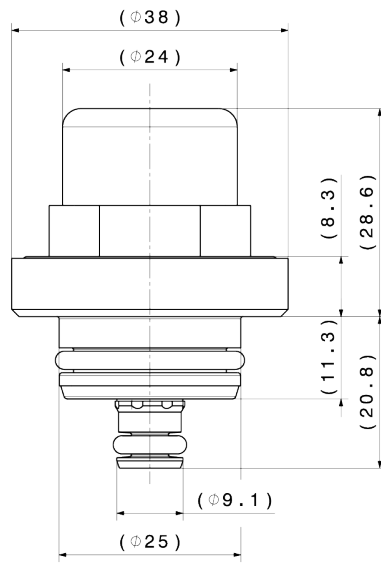
Order number **F02U.V02.171-01**

#### FPR Adaptor light

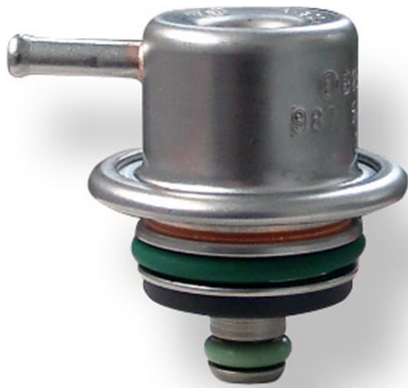
Order number **F02U.V02.248-01**

Dimensions

4



## Fuel Pressure Regulator Mini 5



### Features

- ▶ 5 bar
- ▶ 15 to 220 l/h reflow
- ▶ Adjusted at 105 l/h
- ▶ Sheet steel housing

Fuel pressure regulators are used to maintain constant fuel pressure at the injection valves.

We modified this production type based regulator especially for motorsport use and increased the pressure level.

The main benefit of this regulator include the competitively priced high quality and the high return flow rate.

### Application

Pressure range	5 bar
Reflow quantity	15 to 220 l/h
Reference pressure connector	Diam. 5 mm, tube connector
Fuel compatibility	Gasoline (E85 or M15 with shortened lifetime)
Operating temperature	-40 to 120°C
Storage temperature	-40 to 100°C
Max. vibration	<600 m/s <sup>2</sup> at 5 to 250 Hz
Valve leakage	$Q_{leak} [cm^3/min] \leq 9$ (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
<b>Characteristic</b>	
Set pressure accuracy	±2 % at 105 l/h
<b>Connectors and Wires</b>	
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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

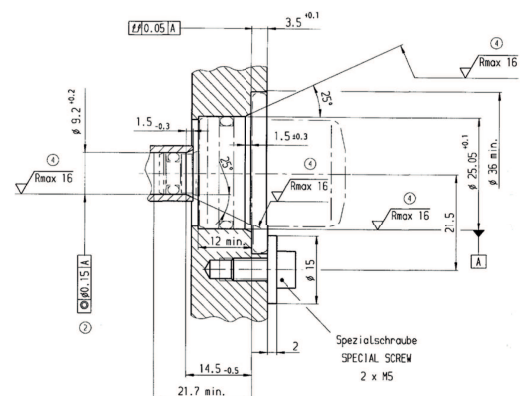
#### Fuel Pressure Regulator Mini 5

Order number **0280.B02.722-03**

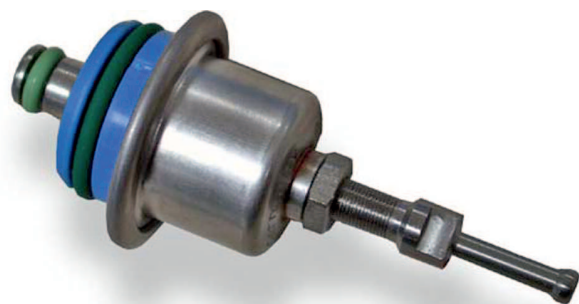
#### FPR Adaptor light

Order number **F02U.V02.248-01**

### Dimensions



## Fuel Pressure Regulator Mini A



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

### Features

- ▶ 2.2 to 3.5 bar/3.5 to 5 bar
- ▶ 15 to 220 l/h reflow
- ▶ Pressure adjustable
- ▶ Sheet steel housing

Fuel pressure regulators are used to maintain constant fuel pressure at the injection valves. This regulator based on a production type regulator was specially designed for motorsport applications. The main benefit of this regulator is the adjustability of the fuel pressure.

### Application

Pressure range	2.2 to 3.5 bar 3.5 to 5.0 bar
Reflow quantity	15 to 220 l/h
Reference pressure connector	Diam. 5 mm, tube connector
Fuel compatibility	Gasoline, E85, M15
Operating temperature	-40 to 120°C
Storage temperature	-40 to 100°C
Max. vibration	<400 m/s <sup>2</sup> at 5 to 250 Hz
Valve leakage	$Q_{\text{leak}} \text{ [cm}^3\text{/min]} \leq 9$ (pneumatic)

### Technical Specifications

#### Mechanical Data

Diameter	34.9 mm
Weight	58 g
Mounting	Fastening with a clip

#### Connectors and Wires

Connector supply	Diam. 2.5 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.

### Legal Restrictions

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### Ordering Information

#### Fuel Pressure Regulator Mini A

Pressure Range 2.2 to 3.5 bar  
Order number **B280.550.340-03**

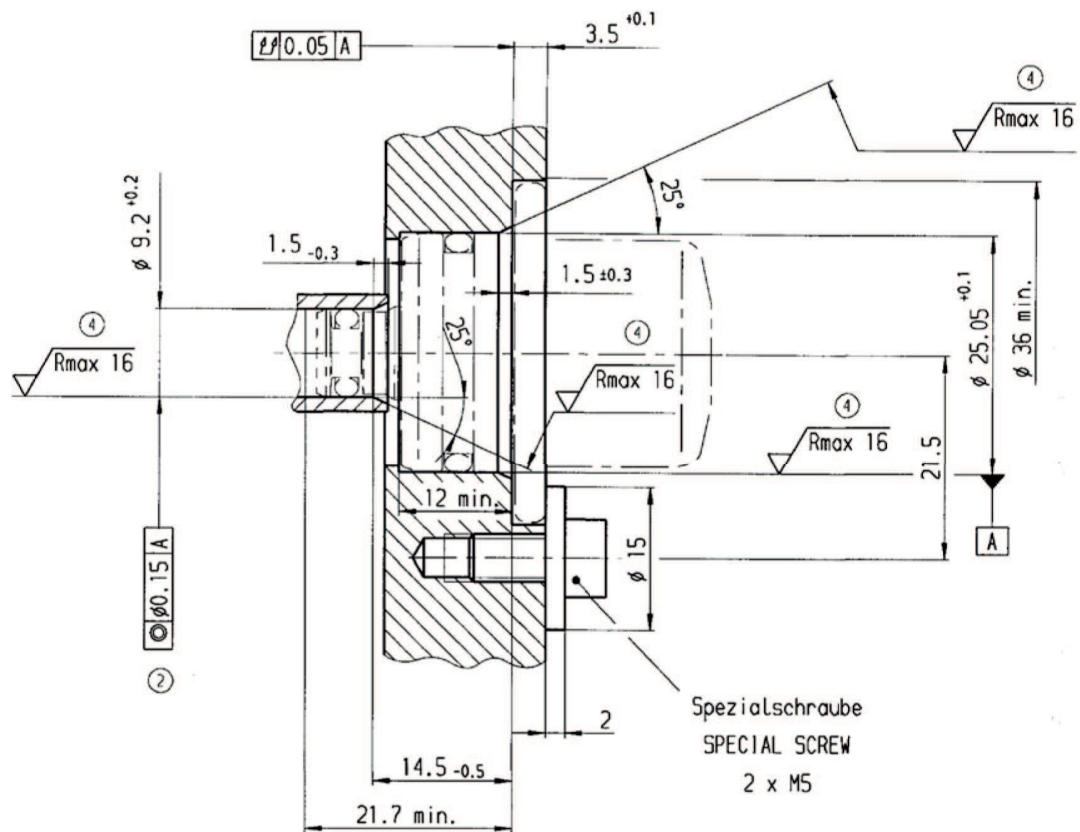
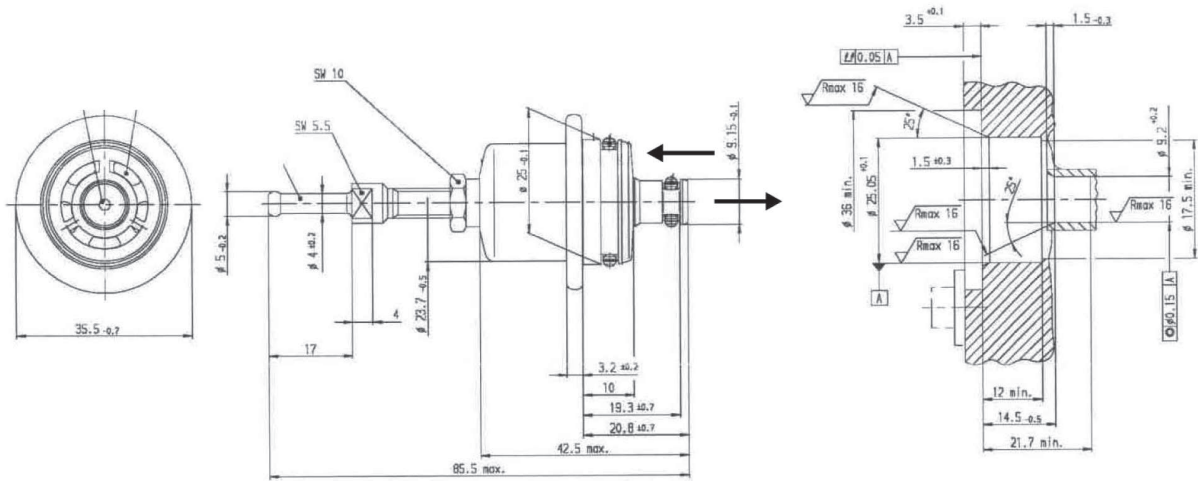
#### Fuel Pressure Regulator Mini A

Pressure Range 3.5 to 5.0 bar  
Order number **B280.550.341-05**

#### FPR Adaptor light

Order number **F02U.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

### Legal Restrictions

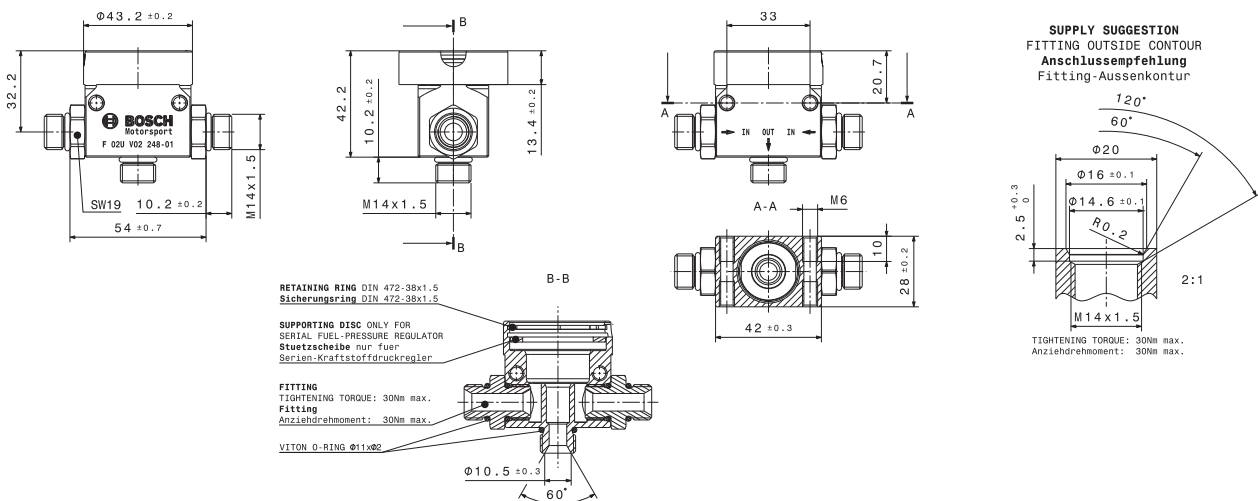
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### FPR Adaptor light

Order number **F02U.V02.248-01**

### Dimensions



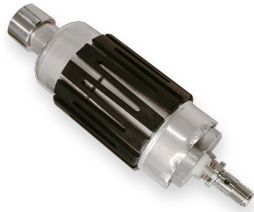
## Overview

**Fuel Pump FP 165-E**



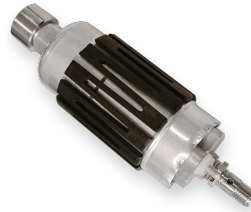
- >165 l/h
- Max. 6 bar
- 700 g
- Fuel lines screwed
- Internal pre-filter on suction side with 300 µm

**Fuel Pump FP 200-7**



- >200 l/h
- Internal pressure limiting valve
- 750 g
- Fuel lines screwed
- Internal pre-filter on suction side with 300 µm

**Fuel Pump FP 200-E**



- >200 l/h
- No internal pressure limiting valve
- 750 g
- Fuel lines screwed
- Internal pre-filter on suction side with 300 µm

**HP Fuel Pump HDP 5**



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

## Fuel Pump FP 165-E



4

### Features

- ▶ >165 l/h
- ▶ Max. 6 bar
- ▶ 700 g
- ▶ Fuel lines screwed
- ▶ Internal pre-filter on suction side with 300 µm

The FP 165-E is an inline roller cell pump for the installation outside the fuel tank (installation in the tank not proven).

It is capable of providing <165 l/h at 6 bar.

The FP 165-E is compatible with Gasoline up to E10 and Diesel fuel. It is a production type fuel pump, combining good quality at a low price.

### Application

Fuel pressure	0.5 up to 6 bar
Delivery rate at 5 bar and 22°C	190 l/h at 4.3 bar
Pressure limiting valve	8 to 10.0 bar rel.
Gasoline compatibility	Up to E10
Diesel compatibility	Given
Operating temperature range	-40 to 80°C ≤90°C for ≤5 h over 1.000 h lifetime ≤105°C for ≤1 h over 50 h life-time
Storage temperature range	-40 to 60°C
Max. vibration IEC 60068-2-34	10 Hz 19,4 (m/s <sup>2</sup> )/Hz 300 Hz 0,654 (m/s <sup>2</sup> )/Hz 1.000 Hz 0,059 (m/s <sup>2</sup> )/Hz

### Technical Specifications

#### Mechanical Data

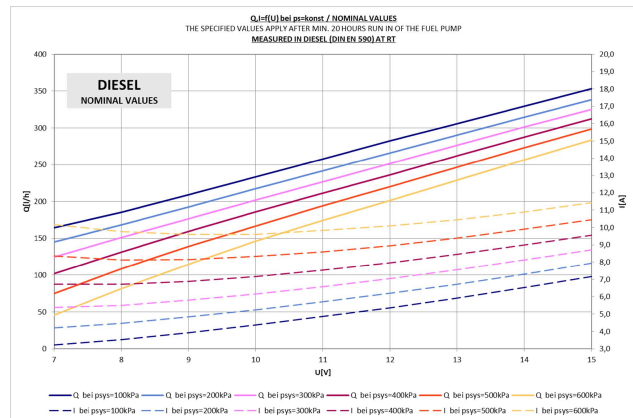
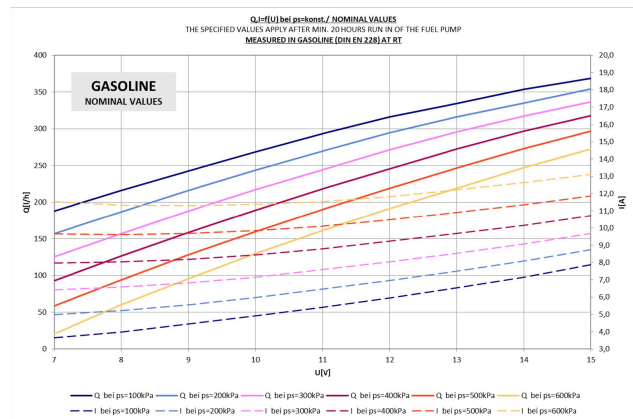
Diameter	60 mm
Length	162.6 mm
Weight	700 g
Mounting	Clamping

#### Electrical Data

Supply voltage	6 to 15 V
Operating voltage	13 V (26 V for 60 s)
Load current at 5 bar and 22°C	<14 A

#### Characteristic

Color	Silver
Non-return valve	Internal
Overpressure valve	Internal



#### 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

- Up to E100 with shorter lifetime
- 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

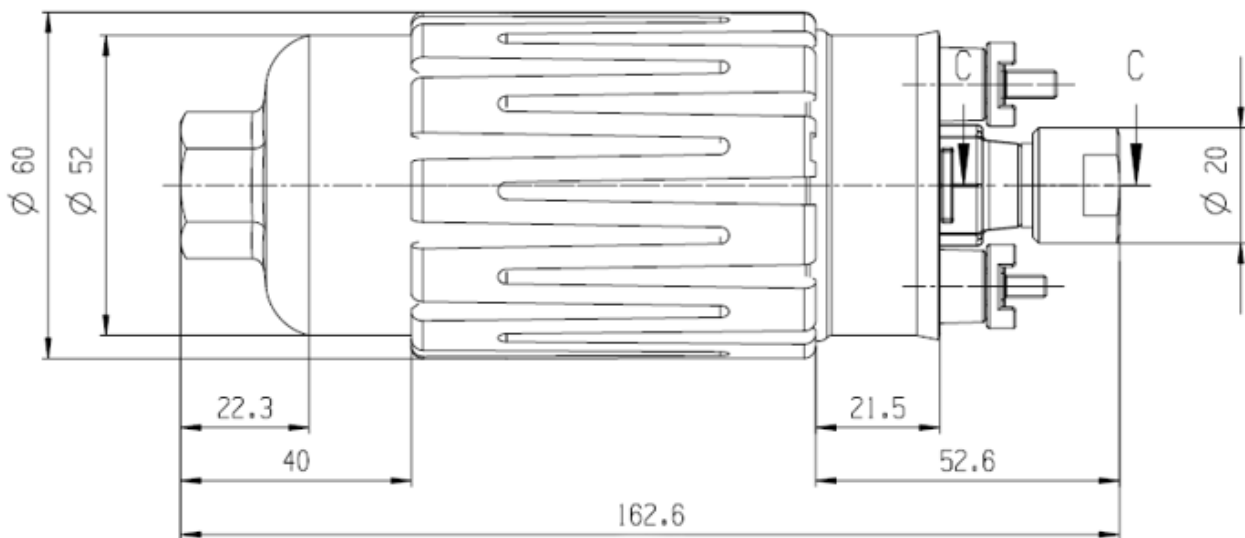
**Fuel Pump FP 165-E**  
Order number **F.02U.V03.137-01**

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

4

### Dimensions



## Fuel Pump FP 200-7



4

### Features

- ▶ >200 l/h
- ▶ Internal pressure limiting valve
- ▶ 750 g
- ▶ Fuel lines screwed
- ▶ Internal pre-filter on suction side with 300 µm

The FP 200-7 is an inline roller cell pump for the installation outside the fuel tank (installation in the tank is not proven).

It is capable of providing 200 l/h at 7 bar.

The FP 200-7 is compatible with Gasoline up to E10 and Diesel fuel. It is the replacement for the 0580.254.044 aftermarket fuel pump with higher performance.

### Application

Fuel pressure	Up to 7,5 bar
Gasoline delivery rate at 5 bar and 22°C	>220 to 270 l/h
Diesel delivery rate at 7 bar and 22°C	>185 to 235 l/h
Pressure limiting valve	8,0 to 10,0 bar
Gasoline compatibility	Up to E10
Diesel compatibility	Given
Operating temperature range	-40 to 80°C ≤90°C for ≤5 h over 1.000 h lifetime ≤105°C for ≤1 h over 50 h lifetime
Storage temperature range	-30 to 60°C
Max. vibration IEC 60068-2-34	10 Hz 19,4 (m/s <sup>2</sup> )/Hz 300 Hz 0,654 (m/s <sup>2</sup> )/Hz 1.000 Hz 0,059 (m/s <sup>2</sup> )/Hz

### Technical Specifications

#### Mechanical Data

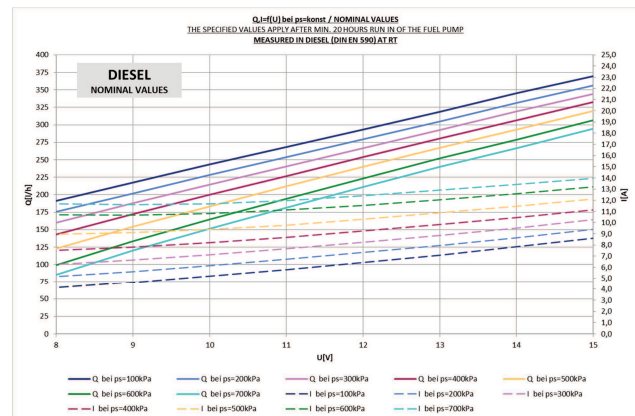
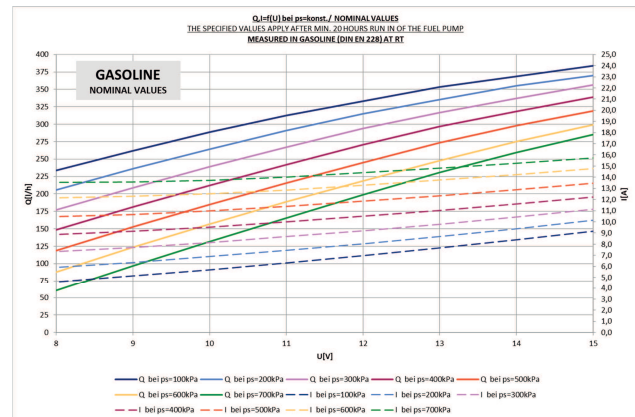
Diameter	60 mm
Length	197 mm
Weight	750 g (864 g incl. cable kit)
Mounting	Clamping

#### Electrical Data

Supply voltage	6 to 15 V (26 V for 60 s)
Operating voltage	13 V
Load current at 5 bar and 22°C	≤ 17 A

#### Characteristic

Color	Silver
Non-return valve	External
Fuel filtering	External, on pressure side
Over-pressure valve	Internal



#### Connectors and Wires

Electrical connector	+M4/-M5
Electrical mating connector	With ring wire M4 and M5
Mechanical connector intake side	M18x1.5
Mechanical connector pressure side	M12x1.5

**Installation Notes**

Up to E100 with shorter lifetime

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.

**Legal Restrictions**

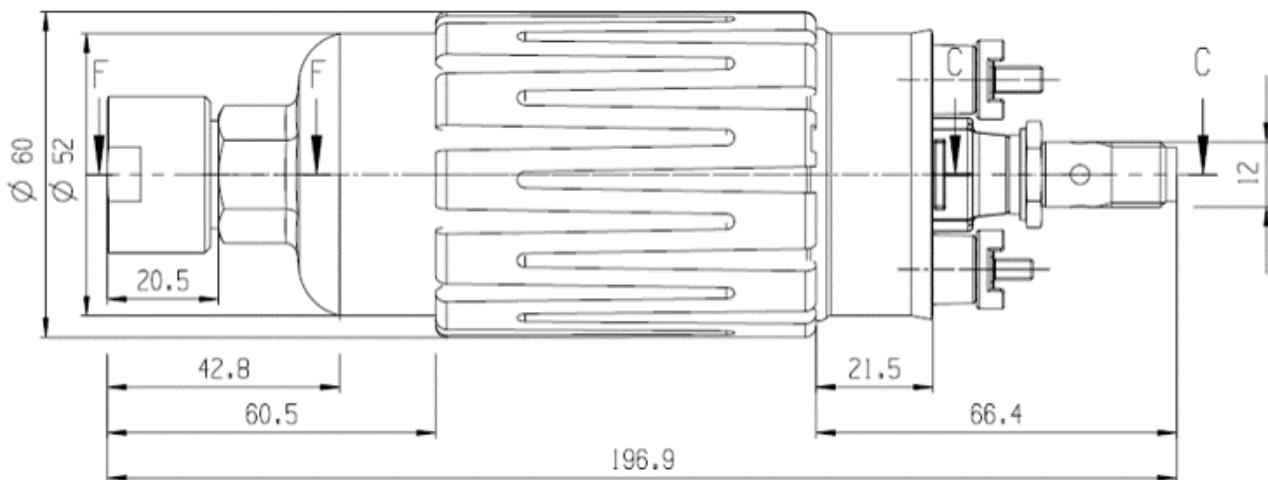
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Fuel Pump FP 200-7**

Order number **F.02U.V03.136-01**

4

**Dimensions**

## Fuel Pump FP 200-E



4

### Features

- ▶ >200 l/h
- ▶ No internal pressure limiting valve
- ▶ 750 g
- ▶ Fuel lines screwed
- ▶ Internal pre-filter on suction side with 300 µm

The FP 200-E is an inline roller cell pump for the installation outside the fuel tank (installation in the tank is not proven).

It is capable of providing 200 l/h at 8 bar.

The FP 200-E is compatible with Gasoline up to E10 and Diesel fuel.

The customer must ensure, by taking appropriate measures, that the pump is not operated at a pressure exceeding 8.0 bar.

Operating the pump at a pressure exceeding 8.0 bar can significantly reduce its lifespan and may also lead to external fuel leakage.

### Application

Fuel pressure	Max. 8,0 bar (absolute)
Gasoline delivery rate at 8 bar and 22°C	>200 l/h
Diesel delivery rate at 7 bar and 22°C	>180 l/h
Pressure limiting valve	Without. Subsequent assembly possible on pressure side by customer
Gasoline compatibility	Up to E10
Diesel compatibility	Given

Operating temperature range	-40 to 80°C ≤90°C for ≤5 h over 1.000 h lifetime ≤105°C for ≤1 h over 50 h lifetime
Storage temperature range	-30 to 60°C
Max. vibration IEC 60068-2-34	10 Hz 19,4 (m/s <sup>2</sup> )/Hz 300 Hz 0,654 (m/s <sup>2</sup> )/Hz 1.000 Hz 0,059 (m/s <sup>2</sup> )/Hz

### Technical Specifications

#### Mechanical Data

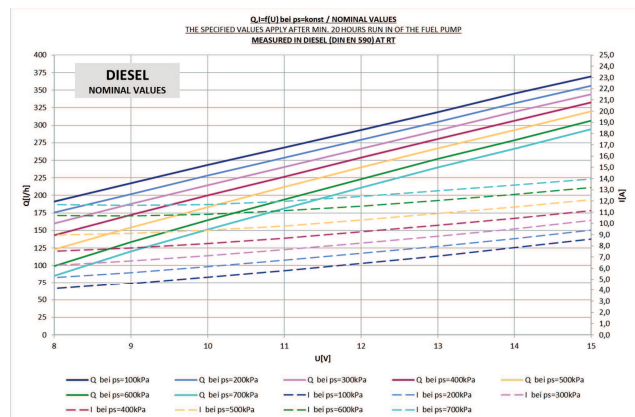
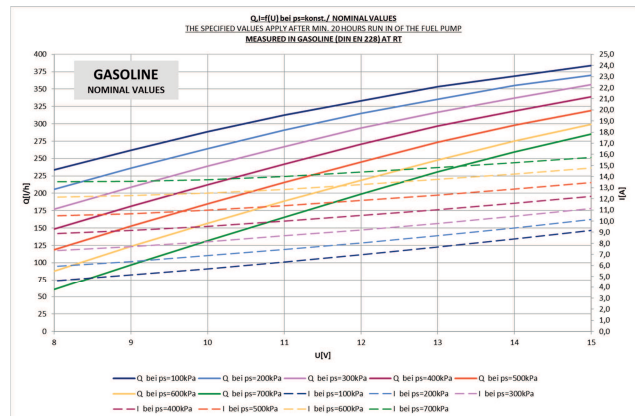
Diameter	60 mm
Length	197 mm
Weight	750 g (864 g incl. cable kit)
Mounting	Clamping

#### Electrical Data

Supply voltage	6 to 15 V (26 V for 60 s)
Operating voltage	13 V
Load current at 8 bar and 22°C	< 20 A

#### Characteristic

Color	Silver
Non-return valve	External
Fuel filtering	External, on pressure side
Over-pressure valve	Without



### Connectors and Wires

Electrical connector	+M4/-M5
Electrical mating connector	With ring wire M4 and M5
Mechanical connector intake side	M18x1.5
Mechanical connector pressure side	M12x1.5

### Installation Notes

- Up to E100 with shorter lifetime
- For technical reasons the values may vary.
- Use within the specified limit values only.
- You'll find further application hints in the offer drawing at our homepage.
- Be careful, there is no over-pressure valve inside.

### Safety Note

Operating the pump at pressures above 8.0 bar can significantly reduce the lifespan and may lead to external fuel leakage. Therefore, the customer must ensure, by taking appropriate measures, that the pump is not operated at a pressure exceeding 8.0 bar.

### Legal Restrictions

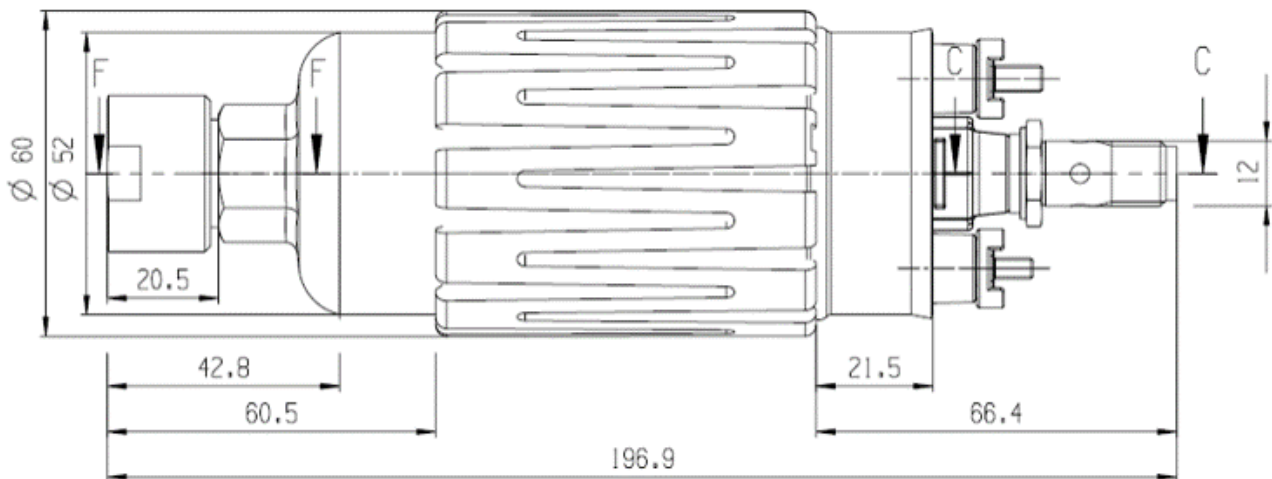
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Fuel Pump FP 200-E**  
Order number **0580.B00.12U-50**

4

### Dimensions



## HP Fuel Pump HDP 5



4

### Features

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

The HDP 5 is a compact high pressure single piston pump. The design allows achieving a big delivery volume as well as high efficiency, as needed in motorsport applications. Modifications in the number of cam lobes and cam lifts allow different flow requirements to be addressed.

The HDP 5 is equipped with an internal pressure relief valve to limit the maximum fuel pressure. It does not require a fuel return line into the fuel tank.

The pump has an integrated demand control for metering the amount of fuel supplied into the high pressure fuel system. It can be ordered with a compact connector or a motorsport connector.

Depending on the requirements of your engine (e.g. fuel consumption over rotation ratio) we recommend different types of tappets, piston springs and cam profiles. Please notice: Fuel delivery and maximum driveshaft speed depend on cam profile and type of tappet.

### Application

For high pressure manifold injection or gasoline direct injection

### Technical Specifications

#### Mechanical Data

Mass flow	Please see extra sheet
Efficiency	Please see extra sheet
Body design	Series

Flow capacity and max. engine speed	Depending on cam profile
Nominal pressure Standard version	200 bar
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>

#### 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

#### Connectors and Wires

##### Electrical connector design

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.

#### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information****Standard version**

Motorsport wire + compact connector  
Order number **0261.520.08F-01**

**Standard version**

Motorsport wire + motorsport connector  
Order number **F02U.V03.542-01**

**Rev B (iPRV)**

Order number **on request**

**Rev C (EVO)**

Order number **on request**

**Rev D (Piston)**

Order number **on request**

**Accessories****Flat tappet (26 mm)**

Order number **F02U.V01.156-01**

**Roller tappet (26 mm)**

Order number **F02U.V01.163-01**

## Overview

4

### Ignition Coil C90i-E8



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

### Ignition Coil C90i-E10



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

### Ignition Coil C90i-pro



- Max. 40 kV
- Min. 90 mJ
- Max. 5.0 kV/μs
- Max. 15,000 1/min
- Developed for Turbo-GDI engines

### Ignition Coil C90i-pro evo



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

### Ignition Coil C90i-WG



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

### Ignition Coil P50



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

### Ignition Coil P50-M



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

### Ignition Coil P65



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

### Ignition Coil P65-T



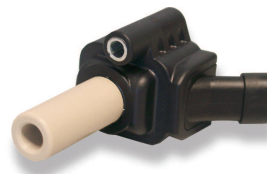
- Max. 33 kV
- Min. 65 mJ
- Max. 10,000 1/min (with reduced dwell time)
- Developed for GDI engines

### Ignition Coil P65-TWG



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

### Ignition Coil P65-WG



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

### Ignition Coil P65-WS



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

**Ignition Coil PS-T**

- Max. 27 kV
- Min. 42 mJ
- Max. 1.5 kV/ $\mu$ s
- Max. 10,000 1/min

## Ignition Coil C90i-E8



4

### Features

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

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed for direct cylinder head mounting.

For this single fire coil the customer can define the length of the spark plug connector.

The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≥ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	90 to 225 mm, depending on customer requirements
Weight w/o wire	< 270 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 8 mm	

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Internal

#### Characteristic

Measured with power stage	IGBT IRG4BC40S (U <sub>ce</sub> =600 V)
---------------------------	-----------------------------------------

#### 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	White: Ionic current signal measurement preparation
Wire length	100 cm
Wire size	AWG 20/22

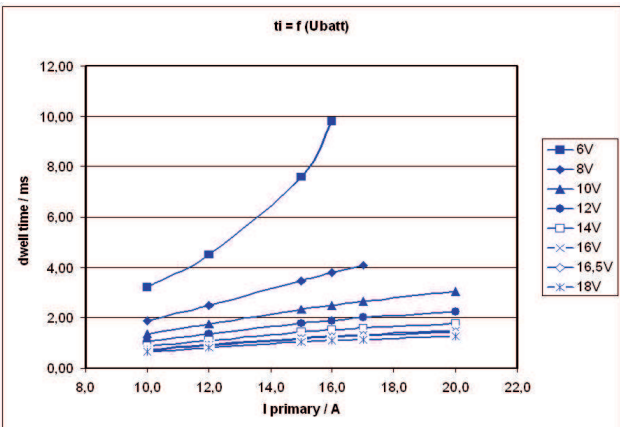
Various motorsport and automotive connectors are available on request.

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

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10A	12A	15A	16A	17A	20A
6V	3.2	4.5	7.6	9.8		
8V	1.88	2.49	3.47	3.79	4.10	
10V	1.35	1.76	2.34	2.51	2.67	3.05
12V	1.06	1.35	1.77	1.89	2.00	2.24
14V	0.87	1.11	1.43	1.52	1.60	1.79
16V	0.74	0.93	1.20	1.28	1.34	1.49
16.5V	0.71	0.90	1.15	1.23	1.29	1.43
18V	0.64	0.81	1.03	1.10	1.15	1.27

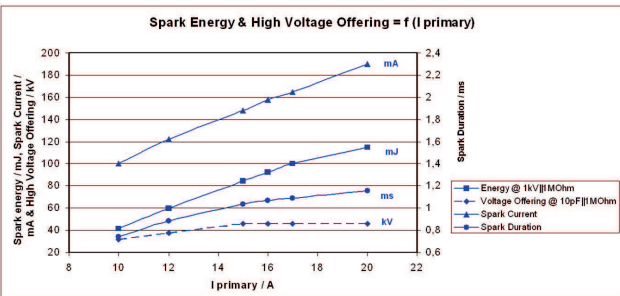
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

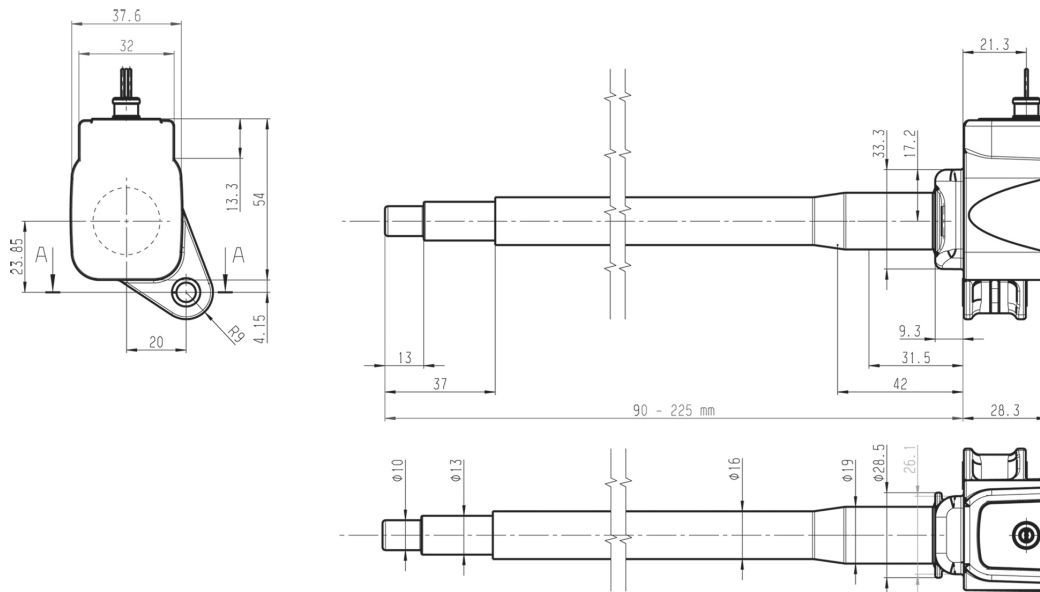
**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	41.4 mJ	0.74 ms	100 mA	31.6 kV
12 A	59.5 mJ	0.882 ms	122 mA	37.4 kV
15 A	84.4 mJ	1.034 ms	148 mA	45.7 kV
16 A	92.6 mJ	1.07 ms	158 mA	46 kV
17 A	100 mJ	1.09 ms	165 mA	46 kV
20 A	115 mJ	1.16 ms	190 mA	46 kV



Spark energy

**Dimensions**



See Offer Drawing for further information

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 40 kV may reduce the lifetime.

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

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

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

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil C90i-E8**

Order number depending on customer requirements

## Ignition Coil C90i-E10



4

### Features

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

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed for direct cylinder head mounting. For this single fire coil the customer can define the length of the spark plug connector. The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≥ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	114 to 225 mm, depending on customer requirements
Weight w/o wire	< 270 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 10 mm	

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Internal

#### Characteristic

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

Connector	On request
Mating connector	On request
Pin 1	U <sub>batt</sub> red
Pin 2	ECU ignition power stage blue
Pin 3	Engine GND black
Pin 4	White: Ionic current signal measurement preparation
Wire length	100 cm
Wire size	AWG 20/22

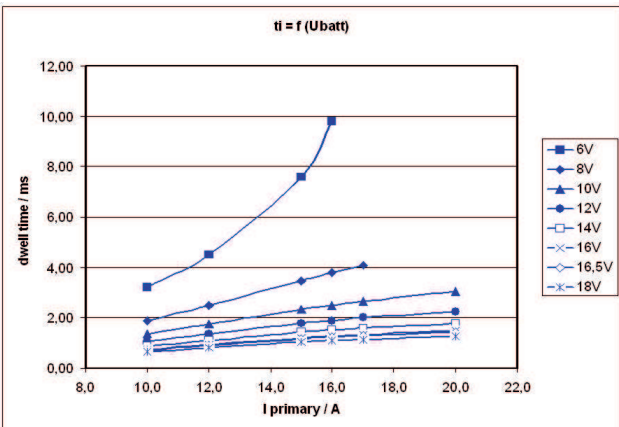
Various motorsport and automotive connectors are available on request.

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

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10A	12A	15A	16A	17A	20A
6V	3.2	4.5	7.6	9.8		
8V	1.88	2.49	3.47	3.79	4.10	
10V	1.35	1.76	2.34	2.51	2.67	3.05
12V	1.06	1.35	1.77	1.89	2.00	2.24
14V	0.87	1.11	1.43	1.52	1.60	1.79
16V	0.74	0.93	1.20	1.28	1.34	1.49
16.5V	0.71	0.90	1.15	1.23	1.29	1.43
18V	0.64	0.81	1.03	1.10	1.15	1.27

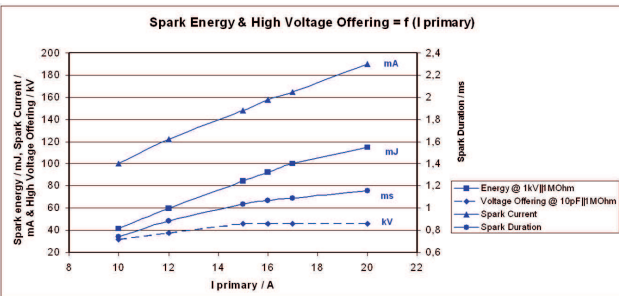
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	41.4 mJ	0.74 ms	100 mA	31.6 kV
12 A	59.5 mJ	0.882 ms	122 mA	37.4 kV
15 A	84.4 mJ	1.034 ms	148 mA	45.7 kV
16 A	92.6 mJ	1.07 ms	158 mA	46 kV
17 A	100 mJ	1.09 ms	165 mA	46 kV
20 A	115 mJ	1.16 ms	190 mA	46 kV



Spark energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 40 kV may reduce the lifetime.

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

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

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

**Legal Restrictions**

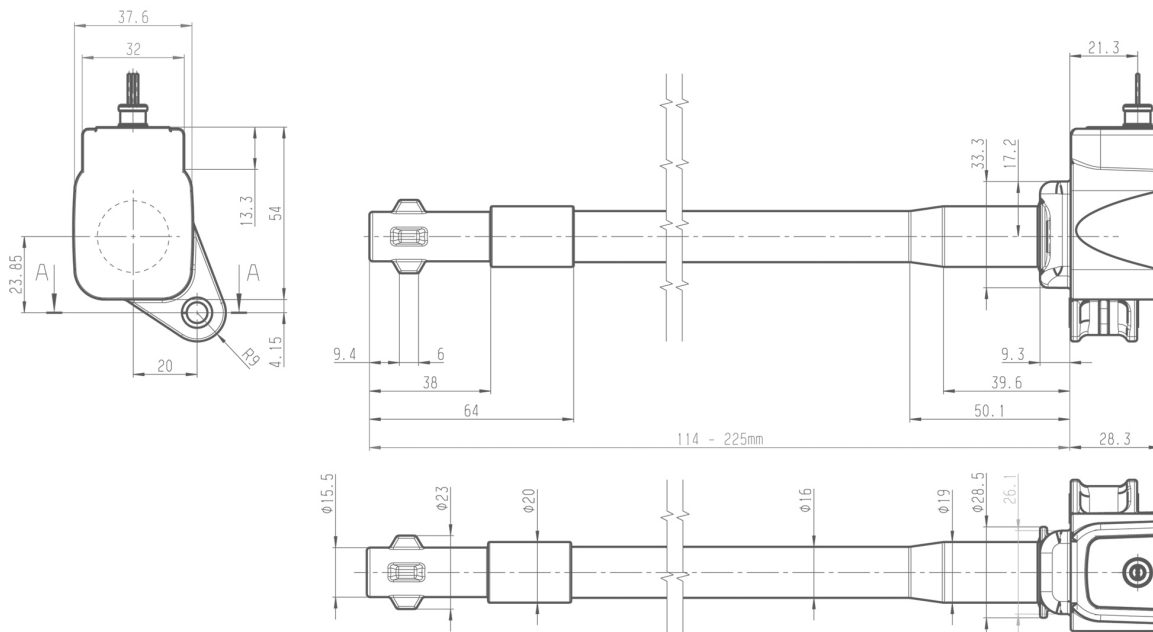
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitical events evolve.

**Ordering Information**

**Ignition Coil C90i-E10**

Order number depending on customer requirements

**Dimensions**



See Offer Drawing for further information

## Ignition Coil C90i-pro

4



### Features

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

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed for direct cylinder head mounting.

The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≥ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	168 mm
Weight w/o wire	250 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs

Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive
Suppression diode / EFU	Internal

#### Characteristic

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

Connector	On request
Mating connector	On request
Pin 1	Red: U <sub>batt</sub>
Pin 2	Blue: ECU ignition power stage
Pin 3	Black: Engine GND
Pin 4	White: Ionic current signal measurement preparation

Wire length	100 cm
Wire size	AWG 20/22/24
For spark plugs	Ceramic diameter d = 10 mm

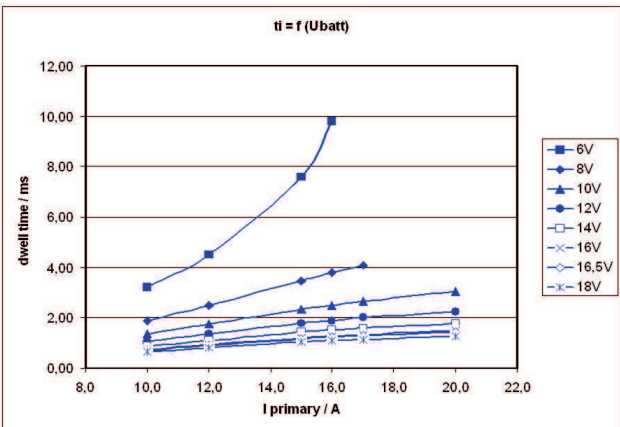
Various motorsport and automotive connectors are available on request.

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

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10 A	12 A	15 A	16 A	17 A	20 A
6 V	3.2	4.5	7.6	9.8		
8 V	1.88	2.49	3.47	3.79	4.10	
10 V	1.35	1.76	2.34	2.51	2.67	3.05
12 V	1.06	1.35	1.77	1.89	2.00	2.24
14 V	0.87	1.11	1.43	1.52	1.60	1.79
16 V	0.74	0.93	1.20	1.28	1.34	1.49
16.5 V	0.71	0.90	1.15	1.23	1.29	1.43
18 V	0.64	0.81	1.03	1.10	1.15	1.27

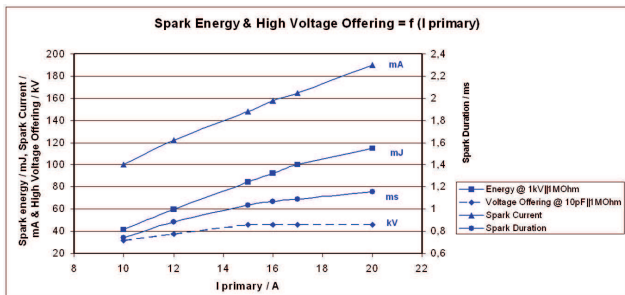
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



Dwell time

**Spark energy and provided high voltage**

I prim.	Spark energy	-duration	-current	Hi voltage
10 A	41.4 mJ	0.74 ms	100 mA	31.6 kV
12 A	59.5 mJ	0.882 ms	122 mA	37.4 kV
15 A	84.4 mJ	1.034 ms	148 mA	45.7 kV
16 A	92.6 mJ	1.07 ms	158 mA	46 kV
17 A	100 mJ	1.09 ms	165 mA	46 kV
20 A	115 mJ	1.16 ms	190 mA	46 kV



Spark energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 40 kV may reduce the lifetime.

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

**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.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

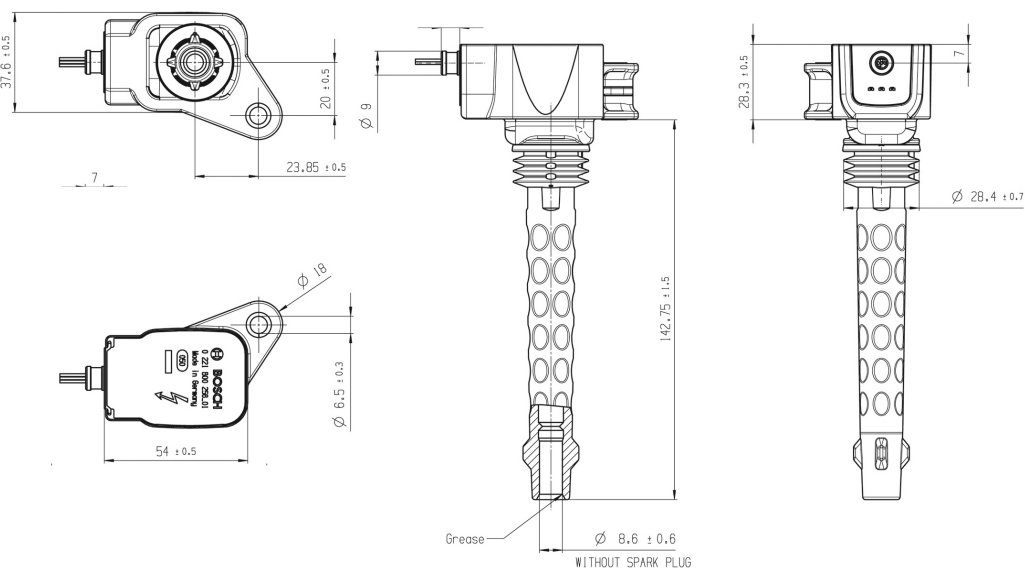
**Single Fire Coil C90i-pro**

Sample manufactured  
Order number **0221.B00.256-01**

**Single Fire Coil C90i-pro**

Order number **F037.000.996**

**Dimensions**



See Offer Drawing for further information

## Ignition Coil C90i-pro evo

4



### Features

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

This single fire coil was developed for engines that need a stable spark because of their higher turbulences at the air fuel mixture inside the cylinder. It is designed for direct cylinder head mounting. The main benefits of this high performance coil are its high energy capability and a very good provided high voltage.

### Application

Spark energy	≥ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	168 mm
Weight w/o wire	250 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement

High voltage rise time	≤ 5.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 40 kV
Spark current	≤ 265 mA
Spark duration at 1 kV    1 MOhm	≤ 0.65 ms
Noise suppression	Inductive
Suppression diode / EFU	Internal

#### Characteristic

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

Connector	On request
Mating connector	On request
Pin 1	Red: U <sub>batt</sub>
Pin 2	Blue: ECU ignition power stage
Pin 3	Black: Engine GND
Pin 4	White: Ionic current signal measurement preparation

Wire length	100 cm
Wire size	AWG 20/22/24
For spark plugs	Ceramic diameter d = 10 mm

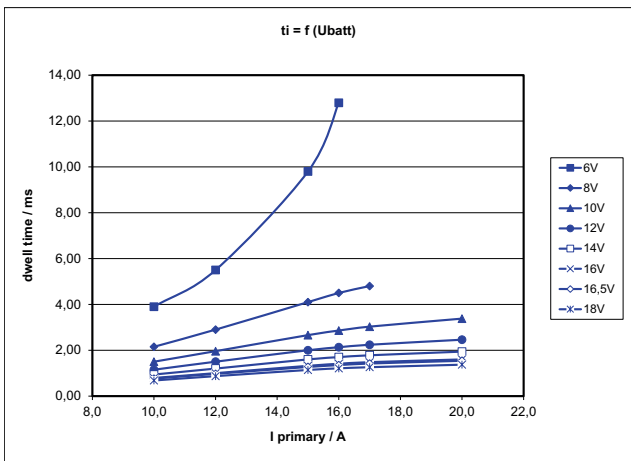
Various motorsport and automotive connectors are available on request.

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

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	10 A	12 A	15 A	16 A	17 A	20 A
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

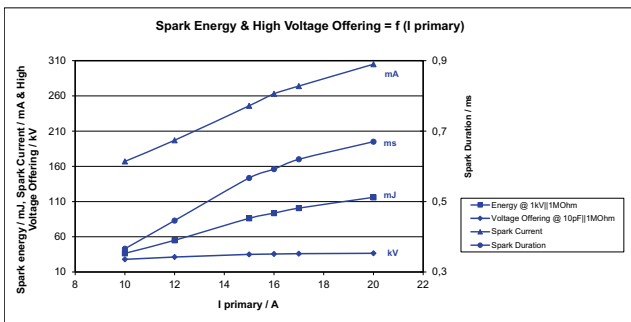
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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.

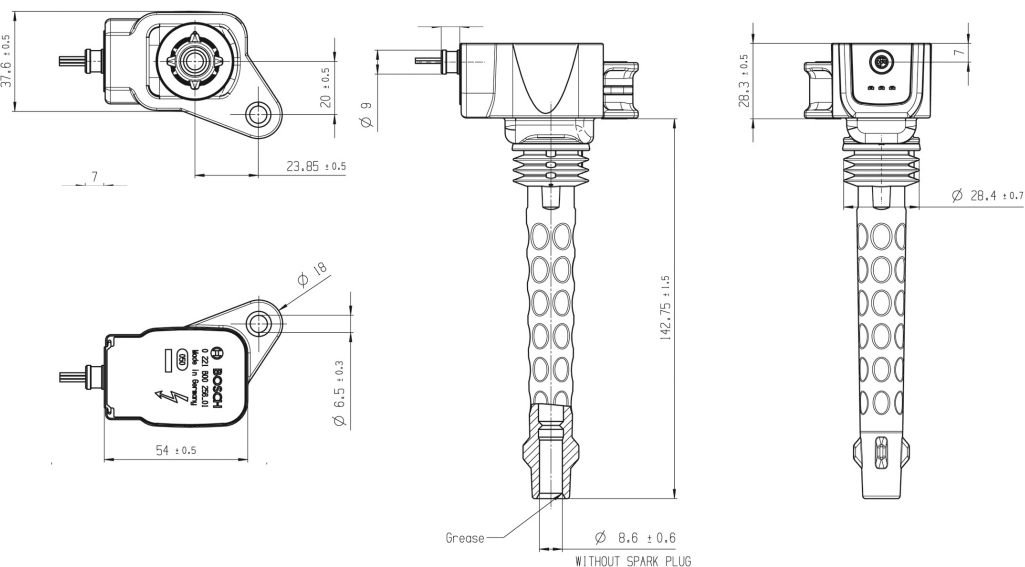
**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil C90i-pro evo**  
Order number **F037.000.997**

**Dimensions**



See Offer Drawing for further information

## Ignition Coil C90i-WG



4

### Features

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

This single fire coil was developed for the use e.g. in GDI (turbocharged) high performance engines. It is designed to connect a high voltage wire on the coil. The main benefit of this high performance coil is its high energy capability.

### Application

Spark energy	≥ 90 mJ
Primary current	≤ 16 A
Operating temperature range outer core	0 to 160°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 50 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	83 mm
Weight w/o wire	210 g
Mounting	screw fastening

#### Electrical Data

Primary resistance	185 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 5.0 kV/μs
Max. high voltage	≤ 35 kV

Spark current	≤ 160 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive
Suppression diode / EFU	Internal

#### Characteristic

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

Connector primary side	On request
Mating connector primary side	On request
Pin 1	U <sub>batt</sub> red
Pin 2	ECU ignition power stage blue
Pin 3	Engine GND black
Wire length	100 cm
Wire size	AWG 20/22
30 kV grid connectors	See Accessories

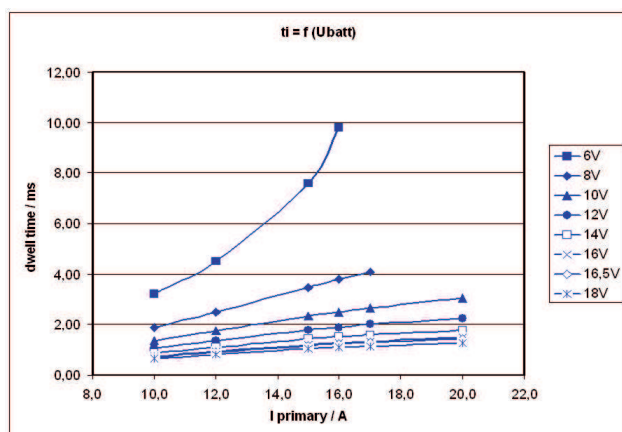
Various motorsport and automotive connectors are available on request.

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

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I primary					
	10 A	12 A	15 A	16 A	17 A	20 A
6V	3.2	4.5	7.6	9.8		
8V	1.88	2.49	3.47	3.79	4.10	
10V	1.35	1.76	2.34	2.51	2.67	3.05
12V	1.06	1.35	1.77	1.89	2.00	2.24
14V	0.87	1.11	1.43	1.52	1.60	1.79
16V	0.74	0.93	1.20	1.28	1.34	1.49
16.5V	0.71	0.90	1.15	1.23	1.29	1.43
18V	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

This coil is only for use with engine control units having an integrated ignition power stage, e.g. IGBT IRG4BC40S or BIP.

For technical reasons the values of the coils may vary.

Please regard the specified limit values (see "Electrical Data").

Usage above Iprim = 16 A or 35 kV may reduce the lifetime.

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

**Design Note**

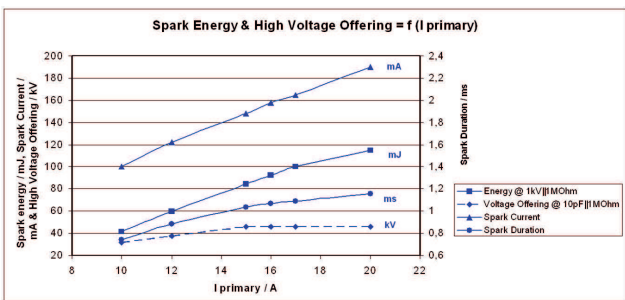
We strongly recommend the design of the spark plug shaft has to ensure that there are no sharp edges in the shaft geometry due to design or machining. Only in compliance with this recommendation, a proper function can be ensured.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil C90i-WG**  
Order number **F02U.V02.430-01**

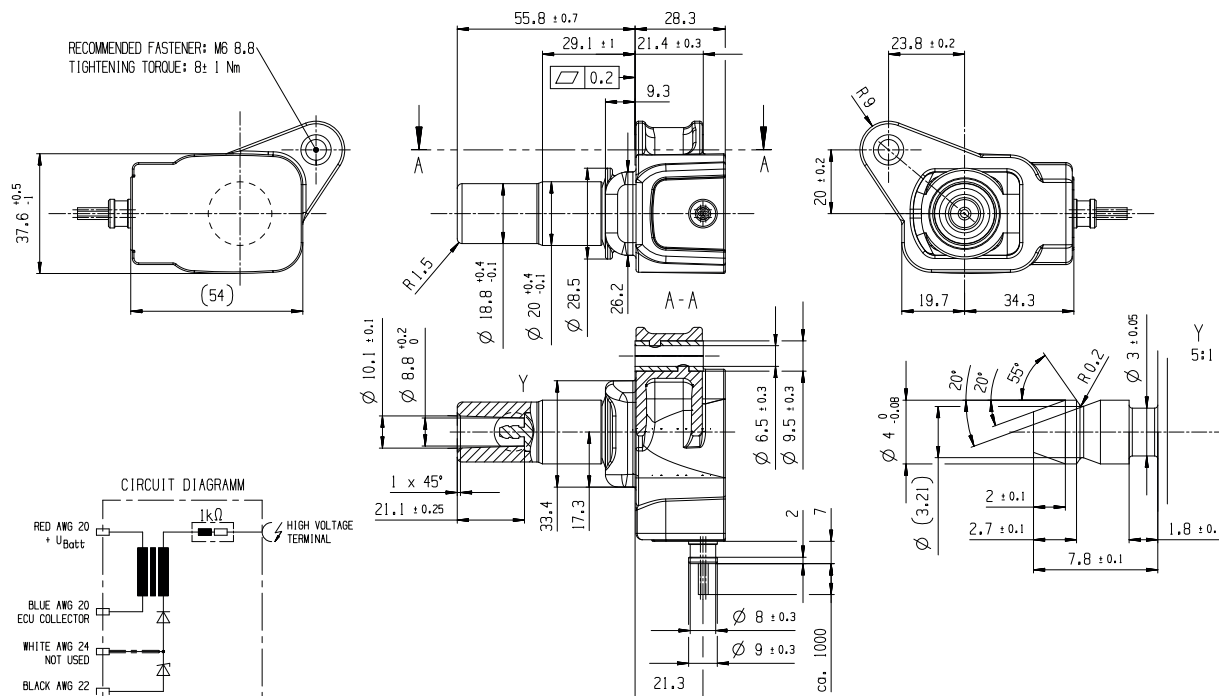


Spark energy

**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).

**Dimensions**



See Offer Drawing for further information

## Ignition Coil P50



4

### Features

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

The single fire coil P50 is a low cost concept designed for direct mounting to the cylinder head. A high voltage ignition wire can optionally be connected to the secondary output terminal. The coil P50 requires an ECU with internal ignition power stages for each single fire coil. The coil P50-M is specifically for motorsport applications. This coil is operable in higher vibration environments.

### Application

Spark energy	≥ 50 mJ
Primary current	≤ 8.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 400 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Weight	223 g
Mounting	Pluggable
Spark plug connector	-

#### Electrical Data

Primary resistance with wire	370 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 3.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 92 mA
Spark duration at 1 kV    1 MOhm	≤ 1.15 ms
Noise suppression	With spark plug connector
Suppression diode / EFU	Integrated

#### Characteristic

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

Connector	Bosch Compact
Mating connector	D261.205.335-01
3-pole Compact	
Pin 1	ECU ignition power stage
Pin 2	Engine GND
Pin 3	U <sub>batt</sub>

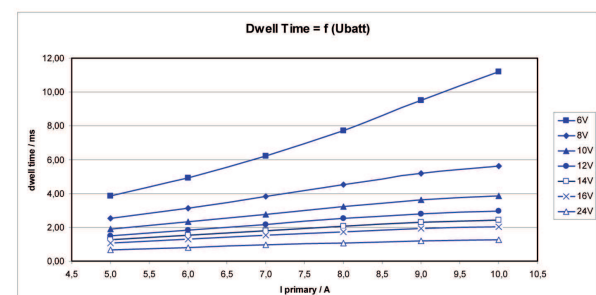
Various motorsport and automotive connectors are available on request.

For spark plugs Ceramic diameter d=10 mm

#### 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
6V	3.84	4.93	6.2	7.7	9.5	11.2
8V	2.54	3.14	3.81	4.51	5.17	5.61
10V	1.9	2.33	2.76	3.21	3.62	3.87
12V	1.51	1.84	2.17	2.51	2.8	2.97
14V	1.26	1.52	1.79	2.06	2.29	2.42
16V	1.07	1.3	1.53	1.74	1.93	2.04
18V	0.94	1.13	1.32	1.51	1.67	1.77
24V	0.68	0.81	0.95	1.08	1.19	1.26
30V	0.53	0.63	0.74	0.84	0.93	0.98

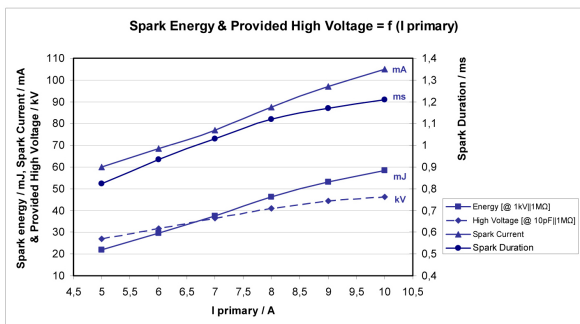
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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



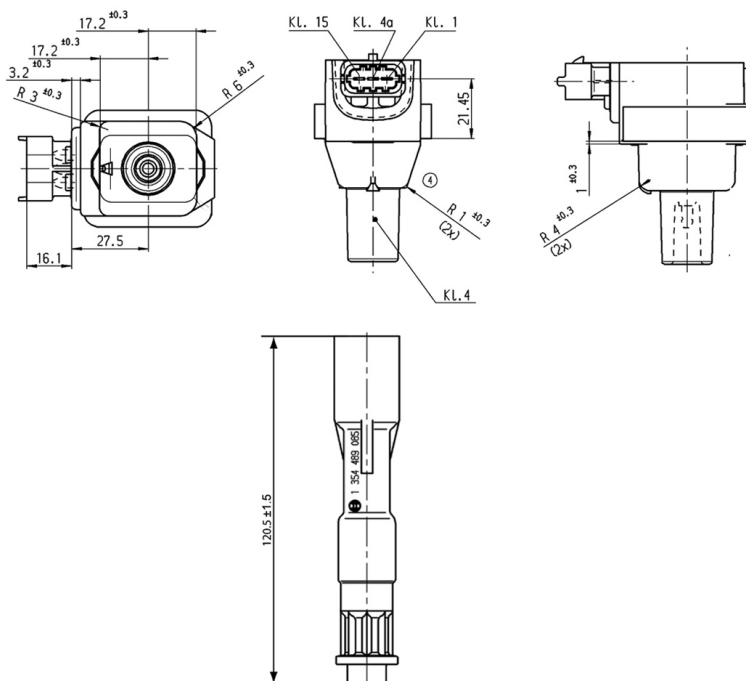
Spark energy

**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.

**Dimensions**



See Offer Drawing for further information

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.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil P50**

Order number **0221.504.001**

**Accessories**

**Accessory spark plug connector**

Order number **1354.489.085**

## Ignition Coil P50-M



4

### Features

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

The single fire coil P50 is a low cost concept designed for direct mounting to the cylinder head. A high voltage ignition wire can optionally be connected to the secondary output terminal. The coil P50 requires an ECU with internal ignition power stages for each single fire coil. The coil P50-M is specifically for motorsport applications. This coil is operable in higher vibration environments.

### Application

Spark energy	≥ 50 mJ
Primary current	≤ 8.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 800 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Weight	265 g
Mounting	Pluggable
Spark plug connector	+

#### Electrical Data

Primary resistance with wire	370 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 3.0 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 92 mA
Spark duration at 1 kV    1 MOhm	≤ 1.15 ms
Noise suppression	With spark plug connector
Suppression diode / EFU	Integrated

#### Characteristic

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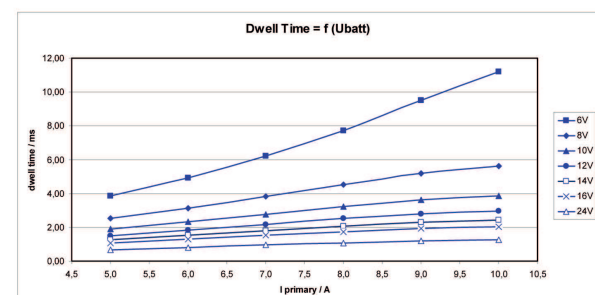
#### Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.335-01
3-pole Compact	
Pin 1	ECU ignition power stage
Pin 2	Engine GND
Pin 3	U <sub>batt</sub>
Various motorsport and automotive connectors are available on request.	
For spark plugs	Ceramic diameter d=10 mm

#### 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
6V	3.84	4.93	6.2	7.7	9.5	11.2
8V	2.54	3.14	3.81	4.51	5.17	5.61
10V	1.9	2.33	2.76	3.21	3.62	3.87
12V	1.51	1.84	2.17	2.51	2.8	2.97
14V	1.26	1.52	1.79	2.06	2.29	2.42
16V	1.07	1.3	1.53	1.74	1.93	2.04
18V	0.94	1.13	1.32	1.51	1.67	1.77
24V	0.68	0.81	0.95	1.08	1.19	1.26
30V	0.53	0.63	0.74	0.84	0.93	0.98

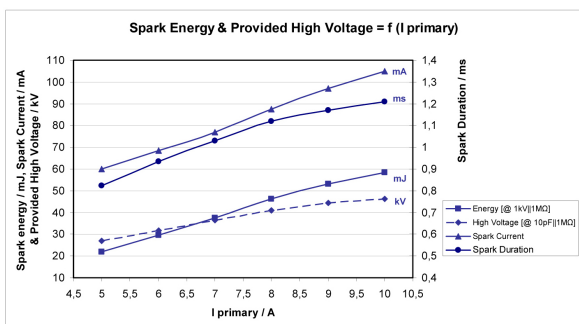
Measured values are without loom resistance. Loom resistance must be less than the primary resistance. The needed dwell time is to be verified through current measurement



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



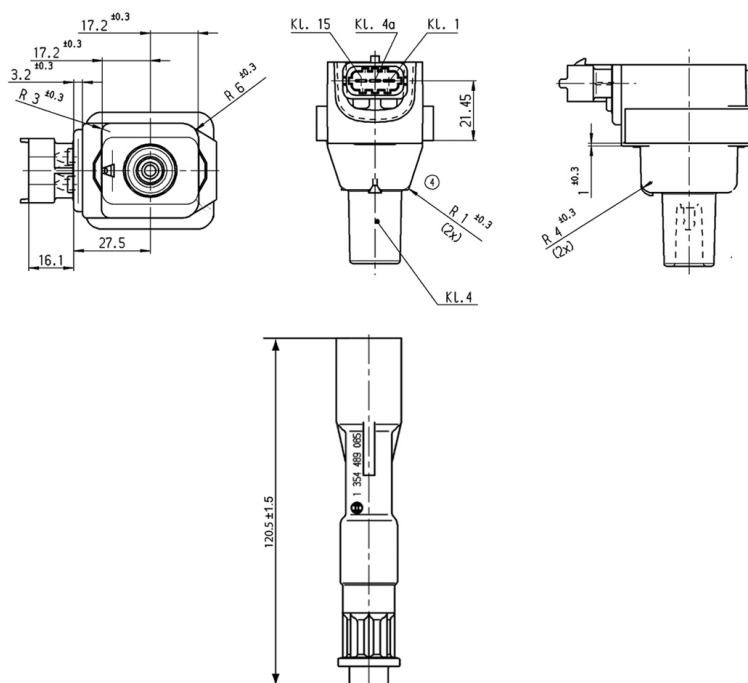
Spark energy

**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.

**Dimensions**



See Offer Drawing for further information

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.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil P50-M**

Order number **F02U.V00.869-01**

**Accessories**

**Accessory spark plug connector**

Order number **1354.489.085**

## Ignition Coil P65



4

### Features

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

This single fire coil is a low cost concept, designed to get connected to the spark plug via a high voltage wire. The high voltage connector is specified according to the SAE standard.

The performance of the coil fulfills the demands of modern GDI engines.

The main benefits of this product are the high packaging flexibility and its high electrical performance at low costs.

### Application

Spark energy	≥ 65 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Length	180 mm
Weight w/o wire	225 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 10 mm	

#### Electrical Data

Primary resistance	570 mOhm
Secondary resistance	Incapable of measurement

High voltage rise time	≤ 1.9 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 74 mA
Spark duration at 1 kV    1 MOhm	≤ 2.0 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Integrated

#### Characteristic

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

Connector	Tyco AMP
Mating connector	D261.205.350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0A	6.0A	7.0A	7.5A	8.0A	8.5A
6V	8.74	18.5				
8V	4.5	6.4	9	10.8	13.9	
10V	3.1	4.2	5.4	6	6.6	7.2
12V	2.36	3.1	3.88	4.25	4.63	4.92
14V	1.9	2.48	3.05	3.32	3.57	3.77
16V	1.61	2.06	2.53	2.73	2.93	3.08
18V	1.55	2	2.43	2.62	2.81	2.95
20V	1.39	1.77	2.16	2.33	2.48	2.6
22V	1.22	1.54	1.88	2.02	2.15	2.26
24V	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.

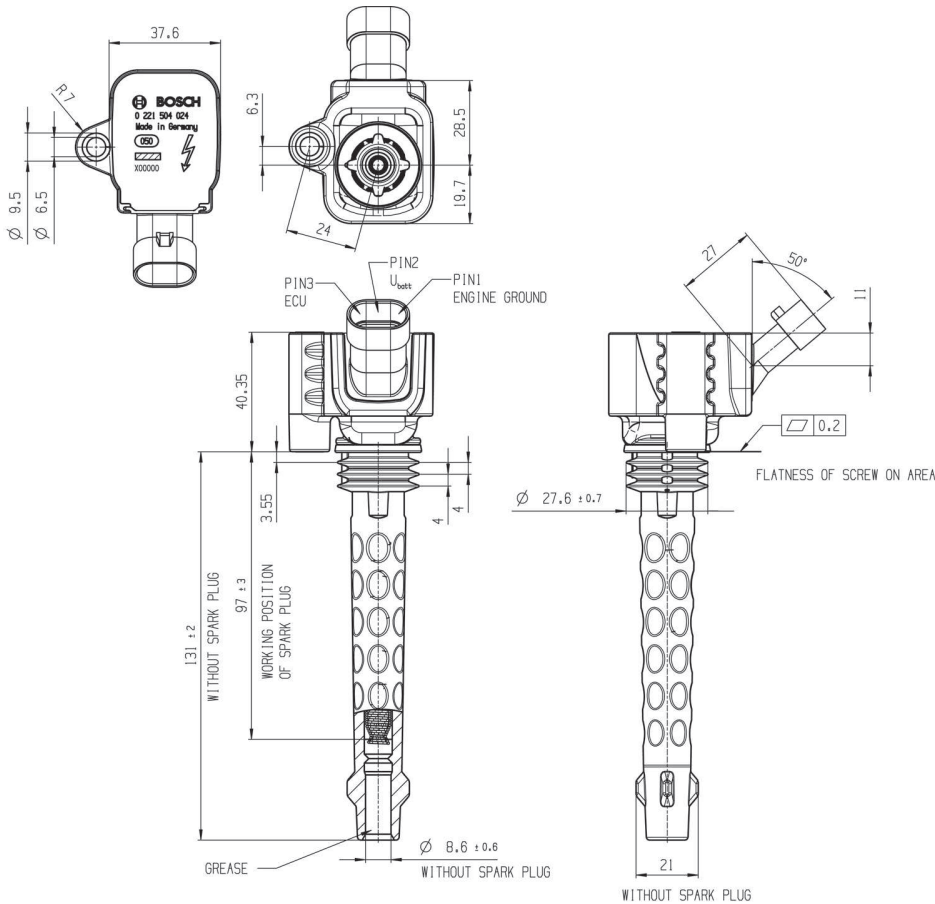
**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil P65**  
Order number **0221.504.024**

**Dimensions**



See Offer Drawing for further information

## Ignition Coil P65-T



4

### Features

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

This single fire coil is a low cost concept designed for direct mounting on the cylinder head. The coil P65-T has an integrated transistor and requires an ECU with internal ignition drivers.

### Application

Spark energy	≥ 65 mJ
Primary current	≤ 7.0 A
Operating temperature range at outer core	-40 to 140°C
Storage temperature range	-40 to 140°C
Max. vibration	≤ 480 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	143 mm
Weight	223 g
Mounting	Screw fastening
Fits to spark plugs with a ceramic diameter of 10 mm	

#### Electrical Data

Primary resistance with wire	Incapable of measurement
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.4 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 33 kV

Spark current	≤ 70 mA
Spark duration at 1 kV    1 MOhm	≤ 1.85 ms
Noise suppression	Inductive and 1 kOhm resistance
Integrated suppression diode / EFU	
Integrated power stage	

#### Characteristic

Measured with power stage	BIP 385
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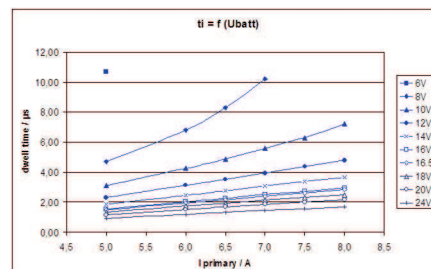
#### Connectors and Wires

Connector	Tyco 0-1488991-1
Mating connector	F02U.B00.555-01
Pin 1	ECU ignition signal
Pin 2	ECU GND
Pin 3	U <sub>batt</sub>

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0 A	5.5 A	6.0 A	6.5 A	7.0 A	7.5 A
<b>Max. 1000 /min</b>	10	9	8	7	6	5
<b>6 V</b>	10.7	11.6				
<b>8 V</b>	4.7	5.4	6.8	8.3	10.2	
<b>10 V</b>	3.1	3.55	4.25	4.87	5.6	6.3
<b>12 V</b>	2.32	2.66	3.12	3.51	3.94	4.36
<b>14 V</b>	1.86	2.1	2.45	2.75	3.07	3.36
<b>16 V</b>	1.55	1.77	2.03	2.26	2.51	2.73
<b>16.5 V</b>	1.49	1.7	1.95	2.17	2.40	2.61
<b>18 V</b>	1.34	1.51	1.73	1.92	2.13	2.31
<b>20 V</b>	1.16	1.33	1.51	1.67	1.85	2.0
<b>24 V</b>	0.93	1.05	1.19	1.32	1.45	1.57

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

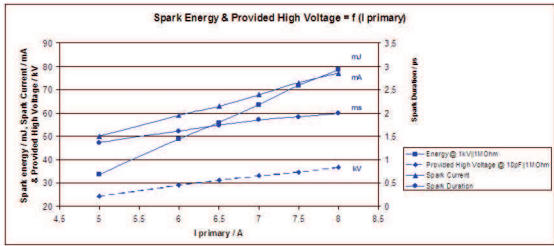


Dwell time

#### Spark energy and provided high voltage

I <sub>prim.</sub>	Spark energy	-duration	-current	Hi voltage
5 A	33.7 mJ	1.37 ms	50 mA	24.4 kV
5.5 A	42 mJ	1.54 ms	54 mA	27.0 kV

6 A	48.9 mJ	1.62 ms	59 mA	29.1 kV
6.5 A	55.9 mJ	1.74 ms	63 mA	31.2 kV
7 A	63.6 mJ	1.85 ms	68 mA	33.2V
7.5 A	71.9 mJ	1.92 ms	73 mA	34.7 kV



Spark energy

**Installation Notes**

During mounting of the spark plug please pay attention that full clamping and proper contacts are made to ensure safe connection between coil and spark plug.

The coil P65-T has an integrated transistor and requires an ECU with internal ignition drivers with 10 to 20 mA current output.

For technical reasons the values of the coils may vary.

Please regard the specified limit values.

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

In case of ignition-caused malfunctions, please use screened sensor wires.

**Design Note**

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

**Legal Restrictions**

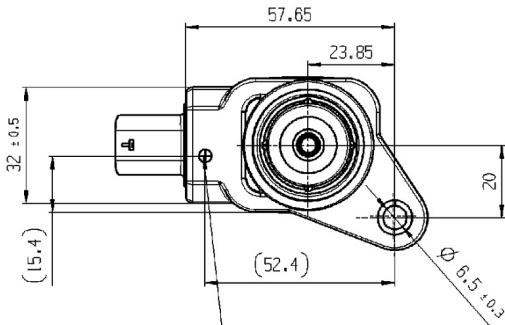
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil P65-T**  
Order number **0221.604.024**

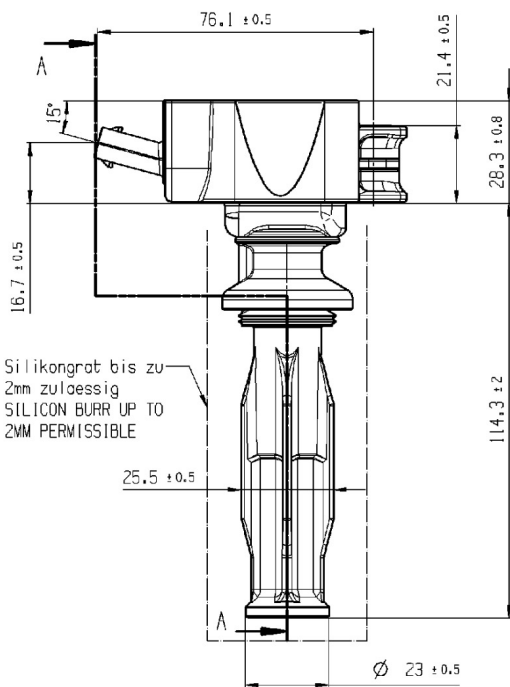
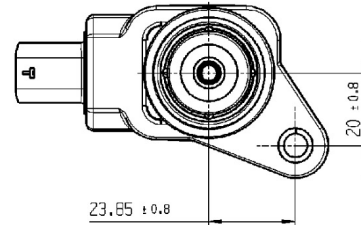
Dimensions

4



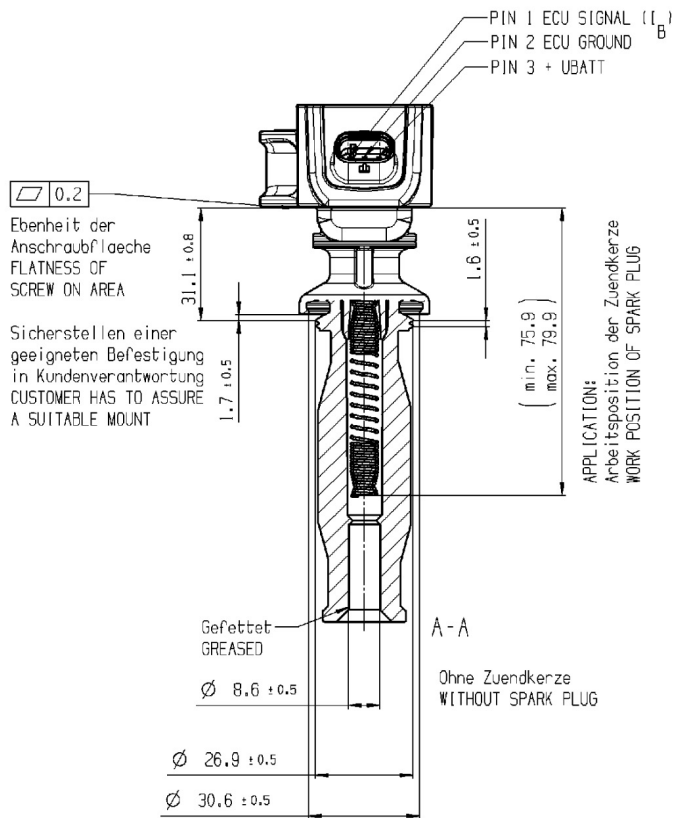
Temperatur-Messpunkt  
Endstufe  
TEMPERATURE MEASURING  
POINT POWER STAGE

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



Ebenheit der  
Anschraubfläche  
FLATNESS OF  
SCREW ON AREA

Sicherstellen einer  
geeigneten Befestigung  
in Kundenverantwortung  
CUSTOMER HAS TO ASSURE  
A SUITABLE MOUNT

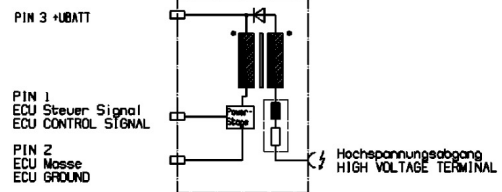
Gefettet  
GREASED

A-A

Ohne Zündkerze  
WITHOUT SPARK PLUG

APPLICATION:  
Arbeitsposition der Zündkerze  
WORK POSITION OF SPARK PLUG

Schaltbild  
CIRCUIT DIAGRAM:



See Offer Drawing for further information

## Ignition Coil P65-TWG



### Features

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

This single fire coil is a low cost concept designed to connect a high voltage wire on the coil. The coil has an integrated transistor and requires an ECU with internal ignition drivers.

### Application

Spark energy	≥ 65 mJ
Primary current	≤ 7.0 A
Operating temperature range at outer core	-40 to 140°C
Storage temperature range	-40 to 140°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Length	83 mm
Weight	210 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance with wire	Incapable of measurement
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.4 kV/μs
Max. high voltage at	≤ 33 kV
Spark current	≤ 70 mA

Spark duration at 1 kV    1 MOhm	≤ 1.85 ms
Noise suppression	Inductive and 1 kOhm resistance
Integrated suppression diode / EFU	
Integrated power stage	

#### Characteristic

Measured with power stage	BIP 385
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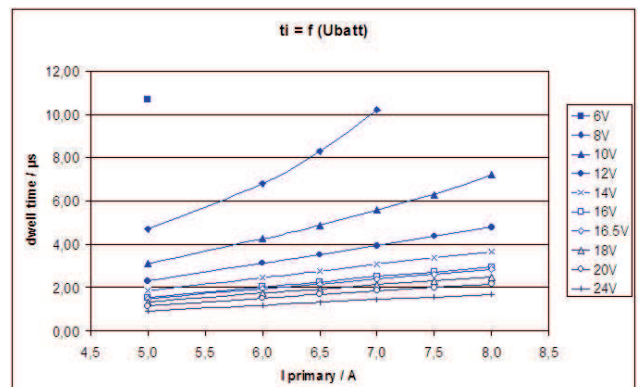
#### Connectors and Wires

Connector primary side	Tyco 0-1488991-1
Mating connector primary side	F02U.B00.555-01
Pin 1	ECU ignition signal
Pin 2	ECU GND
Pin 3	U <sub>batt</sub>
30 kV grid connector	See Accessories

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0 A	5.5 A	6.0 A	6.5 A	7.0 A	7.5 A
<b>Max. 1000 /min</b>	10	9	8	7	6	5
<b>6 V</b>	10.7	11.6				
<b>8 V</b>	4.7	5.4	6.8	8.3	10.2	
<b>10 V</b>	3.1	3.55	4.25	4.87	5.6	6.3
<b>12 V</b>	2.32	2.66	3.12	3.51	3.94	4.36
<b>14 V</b>	1.86	2.1	2.45	2.75	3.07	3.36
<b>16 V</b>	1.55	1.77	2.03	2.26	2.51	2.73
<b>16.5 V</b>	1.49	1.7	1.95	2.17	2.40	2.61
<b>18 V</b>	1.34	1.51	1.73	1.92	2.13	2.31
<b>20 V</b>	1.16	1.33	1.51	1.67	1.85	2.0
<b>24 V</b>	0.93	1.05	1.19	1.32	1.45	1.57

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



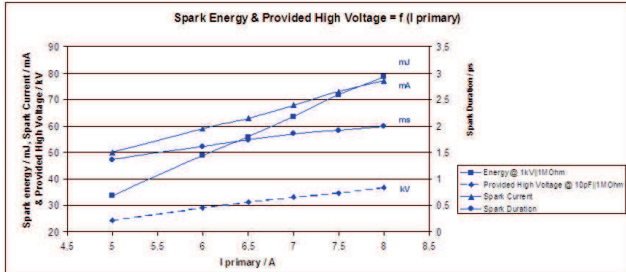
Dwell time

#### Spark energy and provided high voltage

I <sub>prim.</sub>	Spark energy	-duration	-current	Hi voltage
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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

4



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.

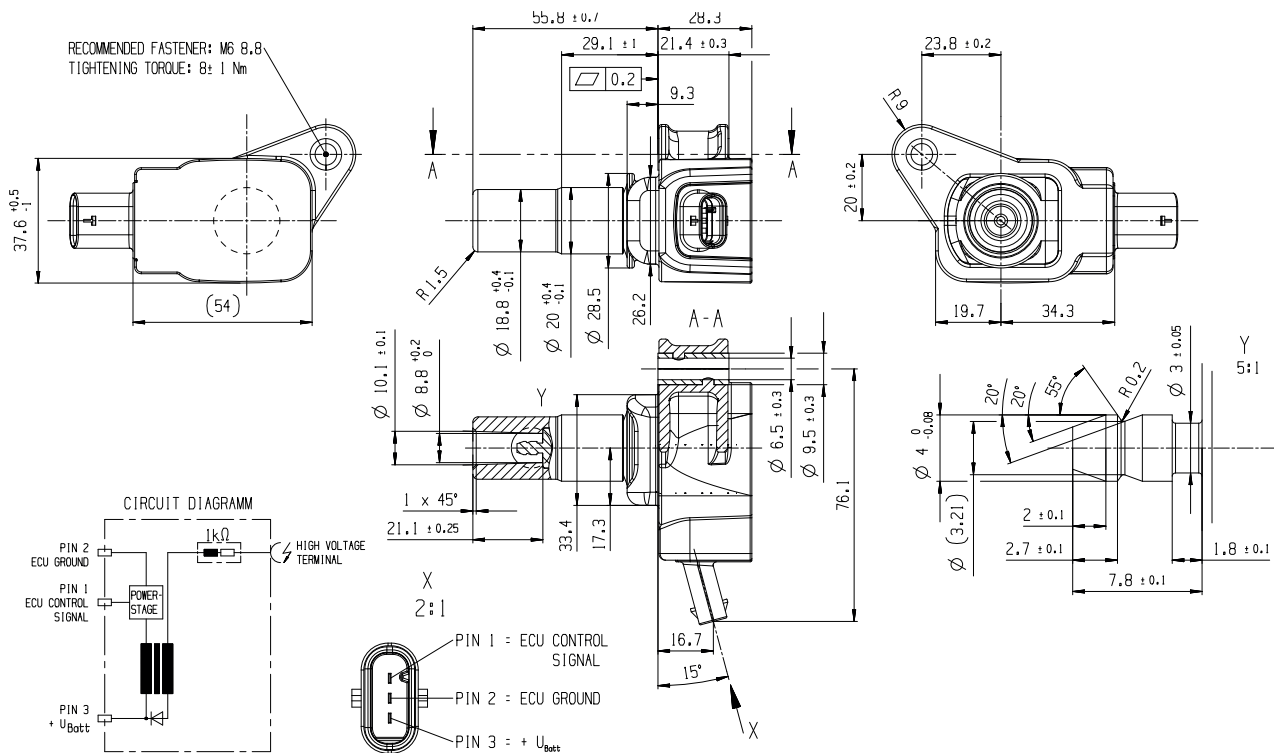
**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

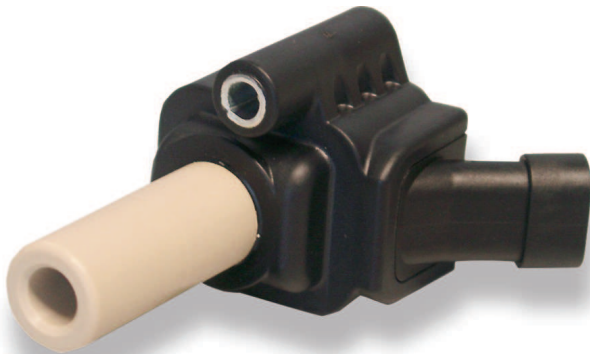
**Ignition Coil P65-TWG**  
Order number **F02U.V02.429-01**

**Dimensions**



See Offer Drawing for further information

## Ignition Coil P65-WG



### Features

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

This single fire coil is a low cost concept, designed to get connected to the spark plug via a high voltage wire. The high voltage connector is specified according to the European standard.

The performance of the coil fulfills the demands of modern GDI engines.

The main benefits of this product are the high packaging flexibility and its high electrical performance at low costs.

### Application

Spark energy	≥ 65 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Length	See offer drawing
Weight w/o wire	< 222 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance	570 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.9 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 74 mA
Spark duration at 1 kV    1 MOhm	≤ 2.0 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Integrated

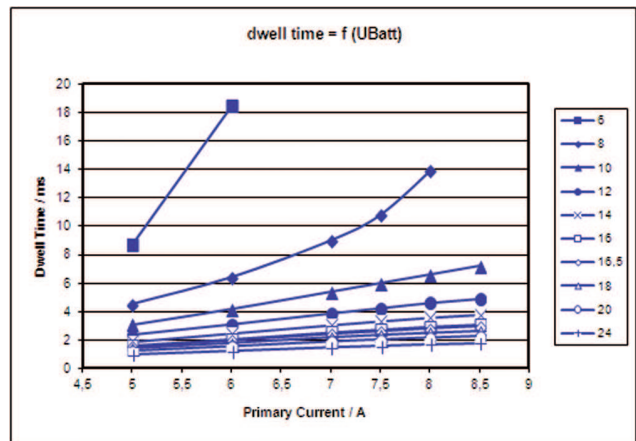
#### Characteristic

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

Connector	Tyco AMP
Mating connector	D261.205.350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]

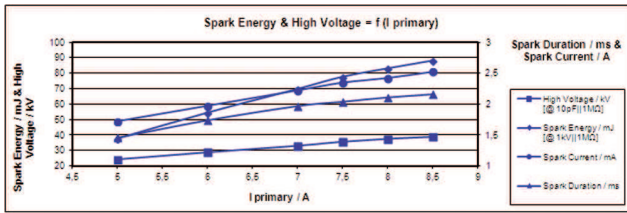


Dwell time

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0A	6.0A	7.0A	7.5A	8.0A	8.5A
6V	8.74	18.5				
8V	4.5	6.4	9	10.8	13.9	
10V	3.1	4.2	5.4	6	6.6	7.2
12V	2.36	3.1	3.88	4.25	4.63	4.92
14V	1.9	2.48	3.05	3.32	3.57	3.77
16V	1.61	2.06	2.53	2.73	2.93	3.08
18V	1.55	2	2.43	2.62	2.81	2.95
20V	1.39	1.77	2.16	2.33	2.48	2.6
22V	1.22	1.54	1.88	2.02	2.15	2.26
24V	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.

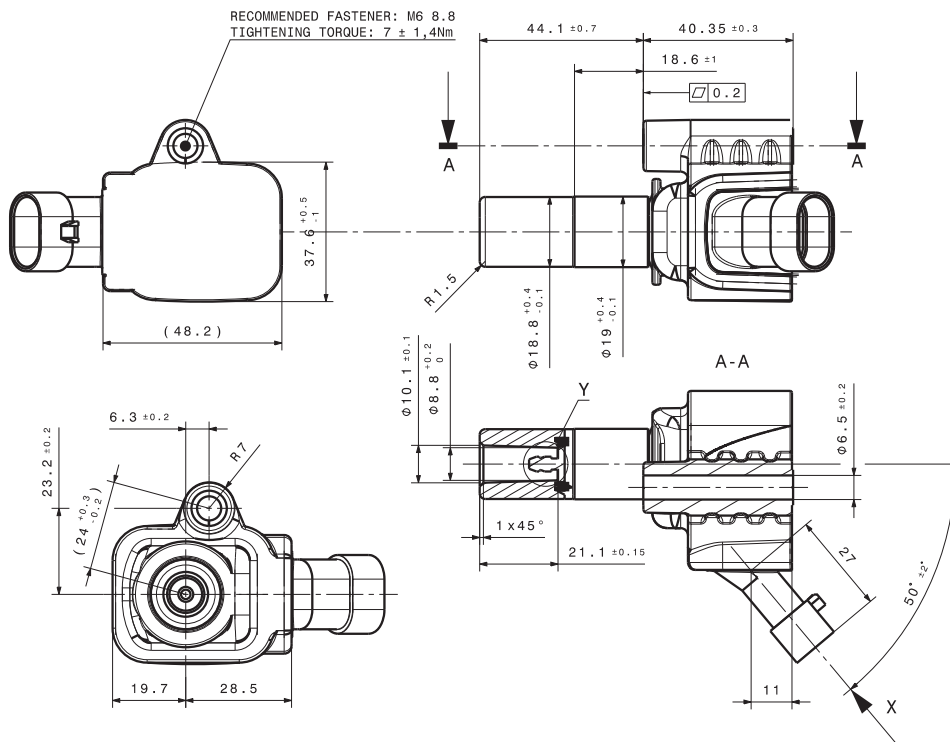
**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Ignition Coil P65-WG**  
Order number **F02U.V01.927-01**

**Dimensions**



See Offer Drawing for further information

## Ignition Coil P65-WS



### Features

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

This single fire coil is a low cost concept, designed to get connected to the spark plug via a high voltage wire. The high voltage connector is specified according to the SAE standard.

The performance of the coil fulfills the demands of modern GDI engines.

The main benefits of this product are the high packaging flexibility and its high electrical performance at low costs.

### Application

Spark energy	≥ 65 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 250 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Length	See offer drawing
Weight w/o wire	< 222 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance	570 mOhm
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.9 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 35 kV
Spark current	≤ 74 mA
Spark duration at 1 kV    1 MOhm	≤ 2.0 ms
Noise suppression	Inductive and 1 kOhm resistance
Suppression diode / EFU	Integrated

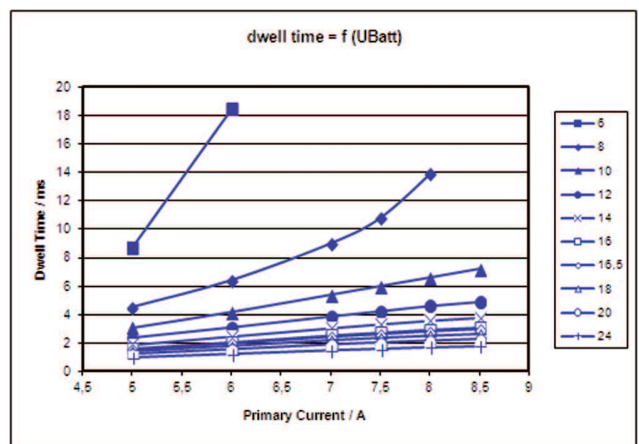
#### Characteristic

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

Connector	Tyco AMP
Mating connector	D261.205.350-01
Pin 1	Engine GND
Pin 2	U <sub>batt</sub>
Pin 3	ECU ignition power stage

#### Characteristic dwell times [ms]

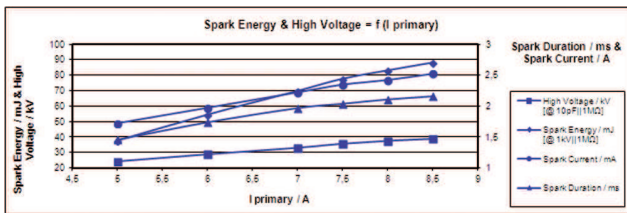


Dwell time

U <sub>batt</sub>	I <sub>primary</sub>					
	5.0A	6.0A	7.0A	7.5A	8.0A	8.5A
6V	8.74	18.5				
8V	4.5	6.4	9	10.8	13.9	
10V	3.1	4.2	5.4	6	6.6	7.2
12V	2.36	3.1	3.88	4.25	4.63	4.92
14V	1.9	2.48	3.05	3.32	3.57	3.77
16V	1.61	2.06	2.53	2.73	2.93	3.08
18V	1.55	2	2.43	2.62	2.81	2.95
20V	1.39	1.77	2.16	2.33	2.48	2.6
22V	1.22	1.54	1.88	2.02	2.15	2.26
24V	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.

### Legal Restrictions

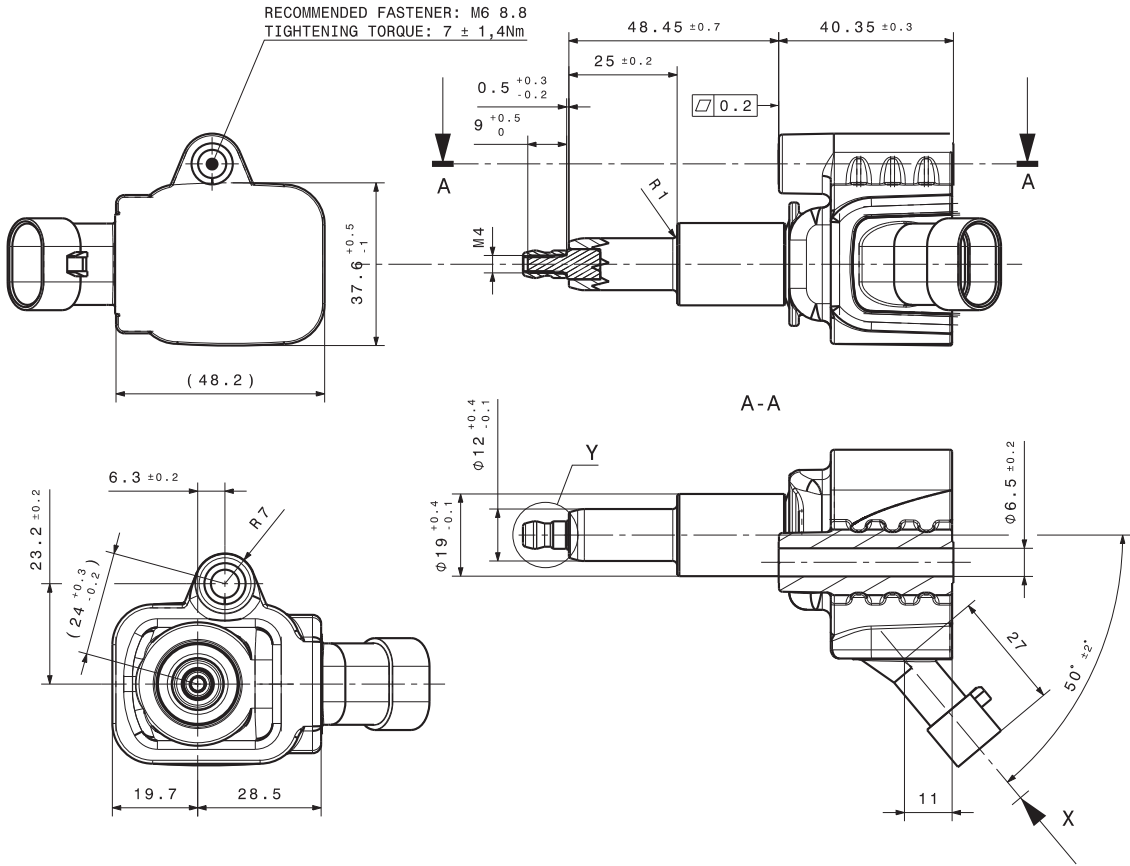
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### Ordering Information

#### Ignition Coil P65-WS

Order number **F02U.V01.926-01**

Dimensions



See Offer Drawing for further information

## Ignition Coil PS-T



4

### Features

- ▶ Max. 27 kV
- ▶ Min. 42 mJ
- ▶ Max. 1.5 kV/μs
- ▶ Max. 10,000 1/min

This pencil coil is a basic low cost concept designed for cylinder head installation.

The coil PS-T has an integrated transistor and requires an ECU with internal ignition drivers.

The coil is only designed for spark plug shaft mounting. It is a basic concept for ignition applications.

### Application

Spark energy	≥ 42 mJ
Primary current	≤ 7.5 A
Operating temperature range at outer core	-20 to 140°C
Storage temperature range	-40 to 100°C
Max. vibration	≤ 800 m/s <sup>2</sup> at 5 to 2,500 Hz

### Technical Specifications

#### Mechanical Data

Diameter	22 mm
Weight	202 g
Mounting	Screw fastening

#### Electrical Data

Primary resistance with wire	Incapable of measurement
Secondary resistance	Incapable of measurement
High voltage rise time	≤ 1.5 kV/μs
Max. high voltage at 1 MOhm    10 pF	≤ 27 kV

Spark current	≤ 80 mA
Spark duration at 1 kV    1 MOhm	≤ 1.1 ms
Noise suppression	Inductive
Suppression diode / EFU	Integrated
Power stage	Integrated

#### Characteristic

Measured with power stage	BIP 355
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#### Connectors and Wires

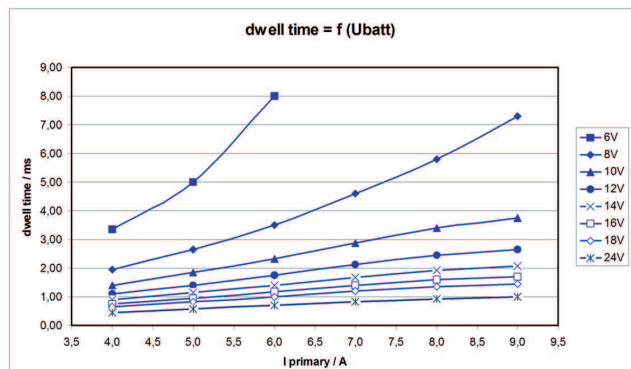
Connector	Bosch Compact
Mating connector	D261.205.336-01
4-pole Compact	
Pin 1	ECU ignition signal
Pin 2	ECU GND
Pin 3	Engine GND
Pin 4	U <sub>batt</sub>

Various motorsport and automotive connectors are available on request.

#### Characteristic dwell times [ms]

U <sub>batt</sub>	I <sub>primary</sub>					
	4.0 A	5.0 A	6.0 A	7.0 A	8.0 A	9.0 A
6V	2.90	4.20	6.30	14.4	-	-
8V	1.83	2.45	3.17	4.10	5.10	6.20
10V	1.33	1.74	2.18	2.68	3.16	3.49
12V	1.05	1.35	1.68	2.02	2.33	2.53
14V	0.86	1.11	1.35	1.62	1.85	1.99
16V	0.73	0.93	1.14	1.35	1.54	1.65
20V	0.56	0.71	0.86	1.02	1.15	1.23
22V	0.50	0.64	0.77	0.91	1.02	1.09
24V	0.46	0.58	0.70	0.82	0.92	0.98

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

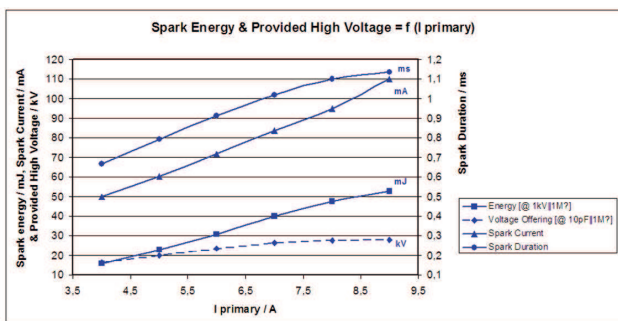


Dwell time

#### Spark energy and provided high voltage

I <sub>prim.</sub>	Spark energy	-duration	-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.

### Legal Restrictions

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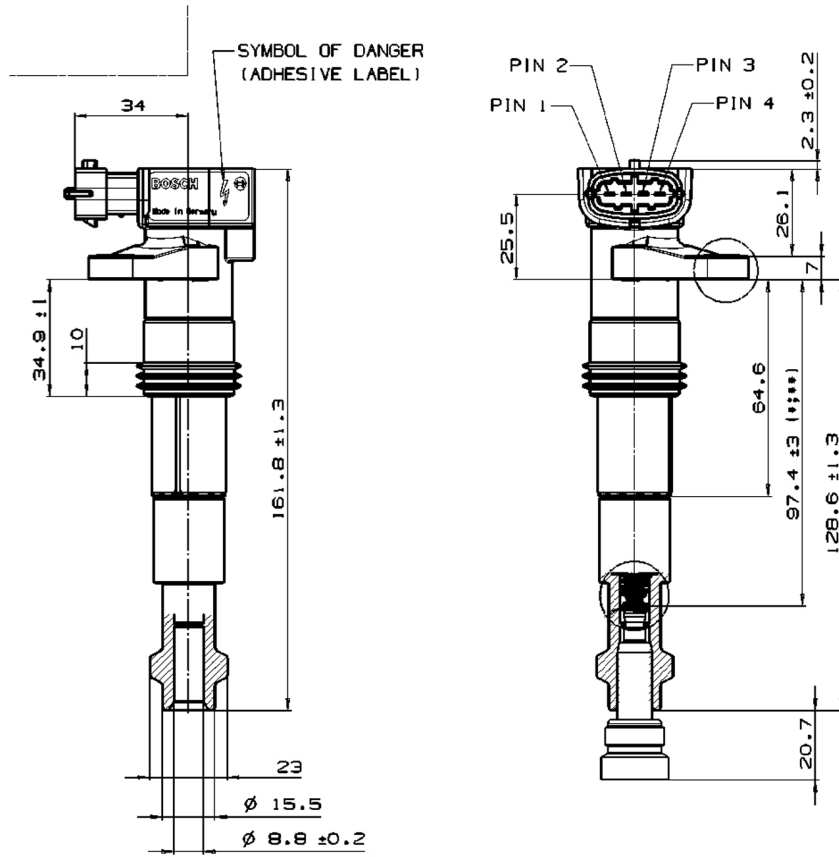
### Ordering Information

#### Ignition Coil PS-T

Order number **0221.604.103**

Dimensions

4



See Offer Drawing for further information

## Overview

### Ignition Module IM 3.2



- Max. 3 cylinders
- 47 g
- Fits to all ECUs without internal ignition power stage like MS 6
- Especially adapted for Coils P50(-M) and P65

### Ignition Module IM 4



- Max. 4 cylinders
- 54 g
- Fits to all ECUs without internal ignition power stage like MS 6
- Especially adapted for Coils P50(-M) and P65

## Ignition Module IM 3.2



4

### Features

- ▶ Max. 3 cylinders
- ▶ 47 g
- ▶ Fits to all ECUs without internal ignition power stage like MS 6
- ▶ Especially adapted for Coils P50(-M) and P65

This module is an external ignition power stage capable of supplying up to three non-transistorized ignition coils.

The IM input signal should be supplied by an ECU with ignition signal outputs in the range of 10 to 20 mA, e.g. MS 6.

The IM unit combines the robustness of a high quality production part with good electrical performance to provide an ideal solution for adapting non-transistorized coils to an ECU without internal ignition driver stages.

### Application

Primary current	$\leq 8.5$ A
Clamp voltage	$380 \pm 30$ 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	$\leq 70$ °C

#### Electrical Data

$U_{\text{Batt}}$ typical	13.5 V
Voltage supply	6 to 16.5 V
$I_{\text{B}}$ high active on	min. 10 mA
$I_{\text{B}}$ low off	0 mA
$I_{\text{B}}$	10 to 22 mA
$I_{\text{C}}$ typical	$\leq 8.5$ A
$I_{\text{C}}$ max. at $T_{\text{U}} < 120$ °C	$< 10$ A
$U_{\text{CE}}$ satt at $I_{\text{C}} = 5$ A	$< 3$ V
$U_{\text{CE}}$ satt at $I_{\text{C}}$ max	$< 9$ V

#### Characteristic

Characteristic dwell time	See characteristic dwell time from the ignition coil used
Internal transistor	Triple Darlington

#### Connectors and Wires

Connector	Bosch Jetronic 7-pole
Mating connector	F02U.B00.252-01
7-pole Jetronic	
Pin 1	Collector transistor 1
Pin 2	Basis transistor 1
Pin 3	Collector transistor 2
Pin 4	Gnd
Pin 5	Basis transistor 2
Pin 6	Collector transistor 3
Pin 7	Basis transistor 3

#### Installation Notes

This ignition module can be used with Coils P50(-M) and P65 or comparable coils.

Please ensure that the connectors are safe from water.

The IM has to be mounted onto a cooling body. The mounting surface needs a planarity of 0.2 mm.

A heat conductive paste has to be used.

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

Please observe the specified limit values.

Please do not activate more than one ignition output stage parallel within a module.

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

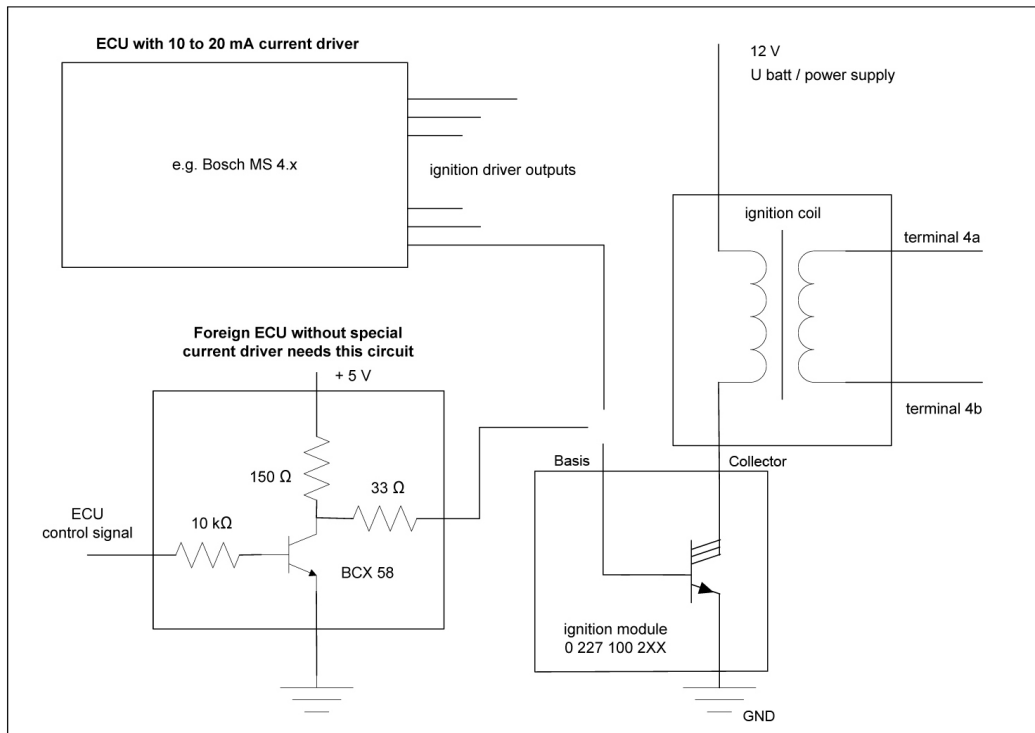
**Legal Restrictions**

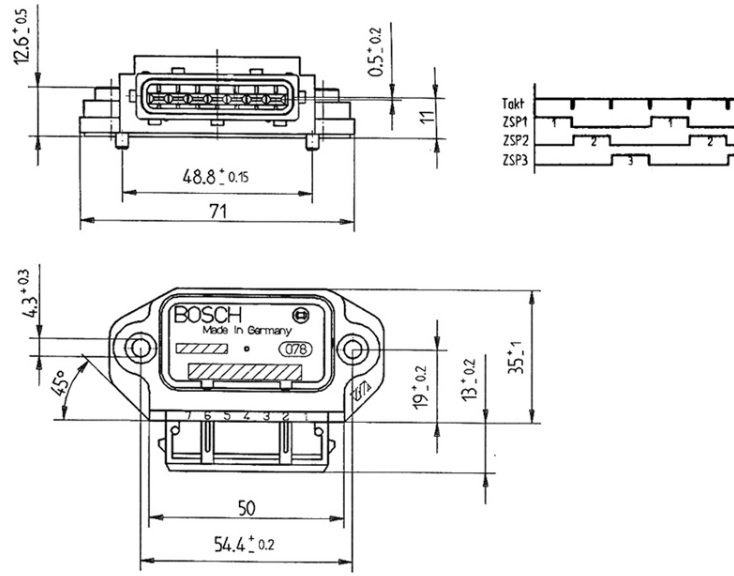
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**Ordering Information**

**Ignition Module IM 3.2**  
 Order number **0227.100.203**

**Dimensions**





See Offer Drawing for further information

## 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
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#### Electrical Data

U <sub>Batt</sub> typical	13.5 V
Voltage supply	6 to 16.5 V
I <sub>B</sub> high active on	min. 10 mA
I <sub>B</sub> low off	0 mA
I <sub>B</sub>	10 to 22 mA
I <sub>C</sub> typical	< 8.5 A
I <sub>C</sub> max. at T <sub>U</sub> < 120°C	< 10 A
U <sub>CE</sub> satt at I <sub>C</sub> = 5 A	< 3 V
U <sub>CE</sub> satt at I <sub>C</sub> max	< 9 V

#### Connectors and Wires

Connector (Coil T1)	Bosch Jetronic 4-pole
Mating connector	D261.205.351-01
Jetronic 4-pole	
Pin 1	Collector transistor 4
Pin 2	Collector transistor 3
Pin 3	Collector transistor 2
Pin 4	Collector transistor 1
Connector (ECU)	Bosch Jetronic 5-pole
Mating connector	D261.205.352-01
Jetronic 5-pole	
Pin 1	Basis transistor 1
Pin 2	Basis transistor 2
Pin 3	Gnd
Pin 4	Basis transistor 3
Pin 5	Basis transistor 4

#### Installation Notes

This ignition module can be used with Coils P50(-M) and P65 or comparable coils.

Please ensure that the connectors are safe from water.

The IM has to be mounted onto a cooling body. The mounting surface needs a planarity of 0.2 mm.

A heat conductive paste has to be used.

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

Please observe the specified limit values.

#### Legal Restrictions

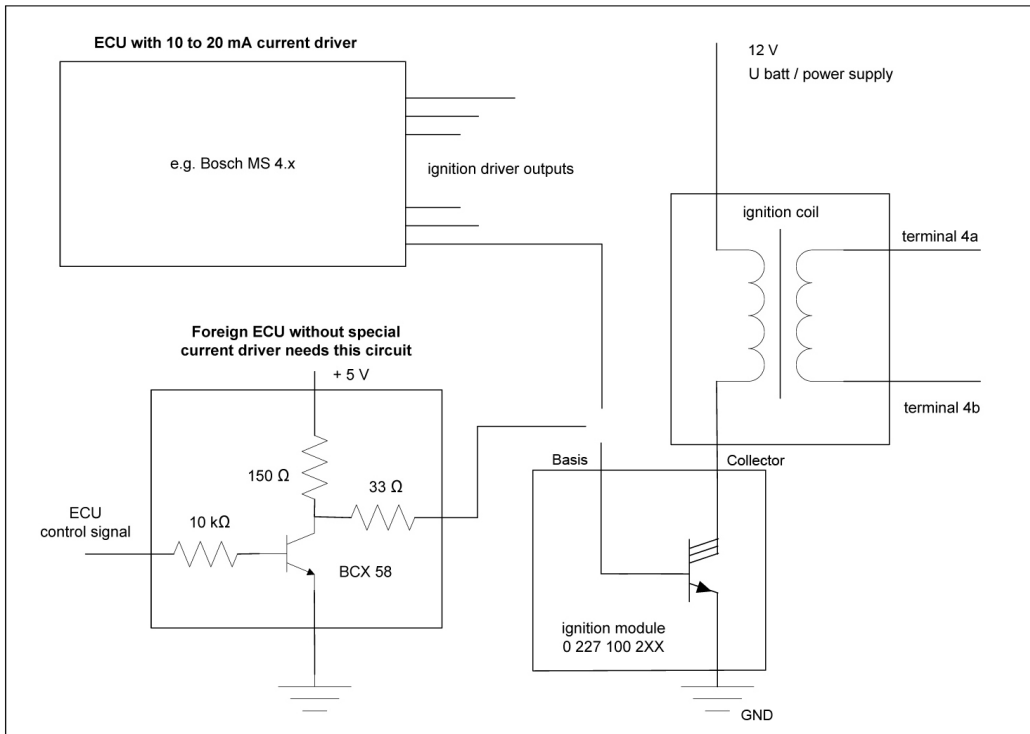
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

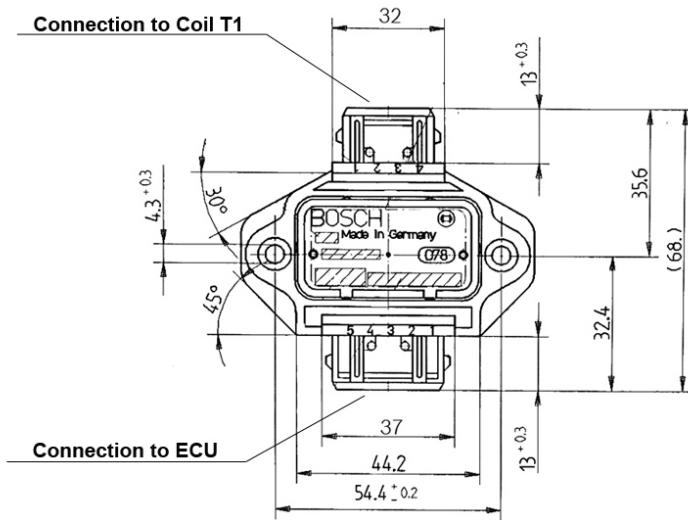
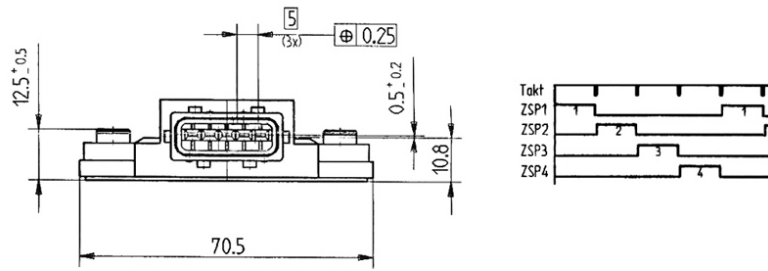
Ordering Information

**Ignition Module IM 4**  
 Order number **0227.100.211**

Dimensions

4





See Offer Drawing for further information

## Overview

### Injection Valve EV 14



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

### HP Injection Valve HDEV 6



**COMING SOON**

- Flow rate at 100 bar: up to 1,640 g/min (n-heptane)
- Max. 350 bar (higher on request)
- Up to 20 holes
- Spray angle 8 to 20°

## Injection Valve EV 14



### Features

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

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

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

### Technical Specifications

#### Mechanical Data

System pressure	Max. 5 bar (8 bar for motorsport use)
Weight	≤ 30 g
Installation lengths	33.6, 48.65 or 60.65 mm
Fuel input	Top-feed injector
Operating temperature	-40 to 110°C
Permissible fuel temperatures	≤ 70°C
Climate-proof corresponding to saline fog test DIN 50 021	
Housing design	Compact (K), Standard (S), Long (L)
Spray type	C (Conical Spray) or E (2-Spray)
Flow rate at 3 bar (n-heptane)	151 to 1,462 cm <sup>3</sup> /min 103.5 to 1,000 g/min
Spray angle α	15 to 85°

Bent angle γ	0 to 15°
Coil resistance	See variations
Fuel compatibility	E85 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.

#### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

#### Ordering Information

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

Order number **0280.158.200**

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

Order number **0280.158.107**

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

Order number **0280.158.013**

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

Order number **0280.158.038**

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

Order number **0280.158.116**

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

Order number **B280.436.038-09**

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

Order number **B280.436.038-10**

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

Order number **0280.158.123**

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

Order number **B280.436.038-08**

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

Order number **B280.436.038-07**

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

Order number **0280.158.040**

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

Order number **B280.436.487-01**

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

Order number **B280.436.469-01**

#### Accessories

##### Clip for locking bush of plastic

Order number **2431.314.021**

##### Clip for locking bush of steel

Order number **2431.314.018**

## Dimensions

## Variations of Production Type Valves

Part No.	0280.158.200	0280.158.107	0280.158.013	0280.158.038	0280.158.116
Flow rate/min	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>	237 g/347 cm <sup>3</sup>
Type	E	C	E	C	E
Housing	S	L	S	KxT	L
$\alpha$	15°	20°	19°	20°	22°
$\gamma$	90°	0°	0°	0°	5°
$\delta$	0°	0°	90°	0°	90°
Resistance	12 Ohm	12 Ohm	12 Ohm	12 Ohm	12 Ohm

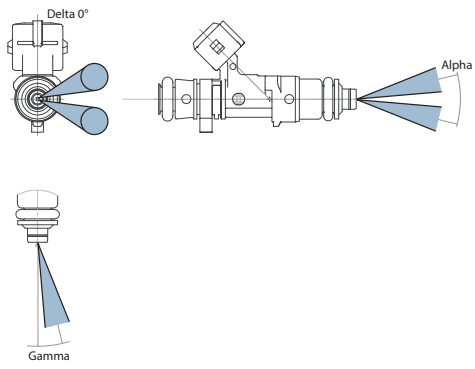
Part No.	0280.158.123	0280.158.040
Flow rate/min	429 g/627 cm <sup>3</sup>	670 g/980 cm <sup>3</sup>
Type	E	C
Housing	SxT	KxT
$\alpha$	25°	30°
$\gamma$	0°	0°
$\delta$	90°	0°
Resistance	12 Ohm	12 Ohm

## Variations of Motorsport Type Valves

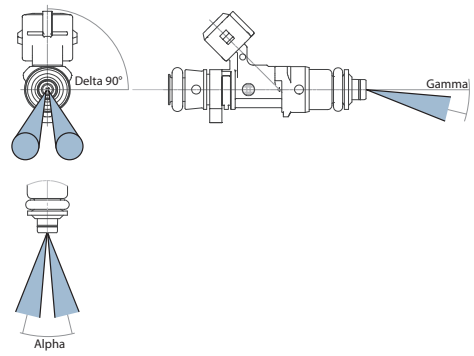
Part No.	B280.436.038-07	B280.436.038-08	B280.436.038-09	B280.436.038-10	B280.436.487-01
Flow rate/min	503 g/736 cm <sup>3</sup>	503 g/736 cm <sup>3</sup>	387 g/566 cm <sup>3</sup>	387 g/566 cm <sup>3</sup>	670 g/980 cm <sup>3</sup>
Type	C	C	C	C	C
Housing	S	S	S	S	S
$\alpha$	70°	25°	70°	25°	30°
$\gamma$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

Further variations are available on request.

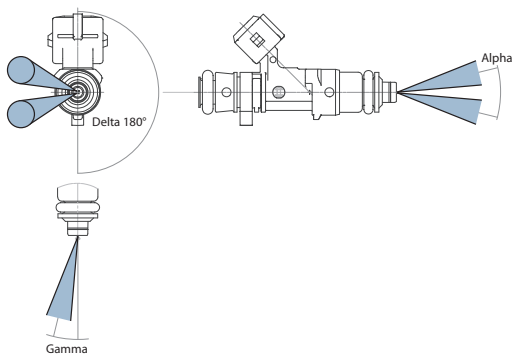
Spray bent to the „right“, Delta=0°



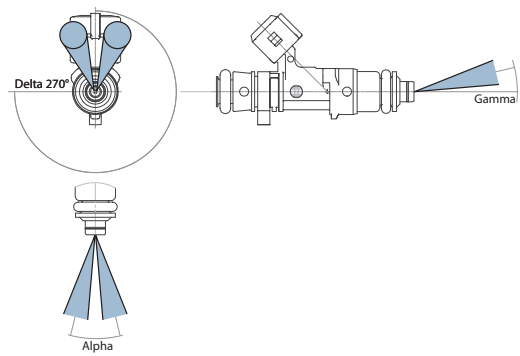
Spray bent „down“ (away from electr. connector), Delta=90°



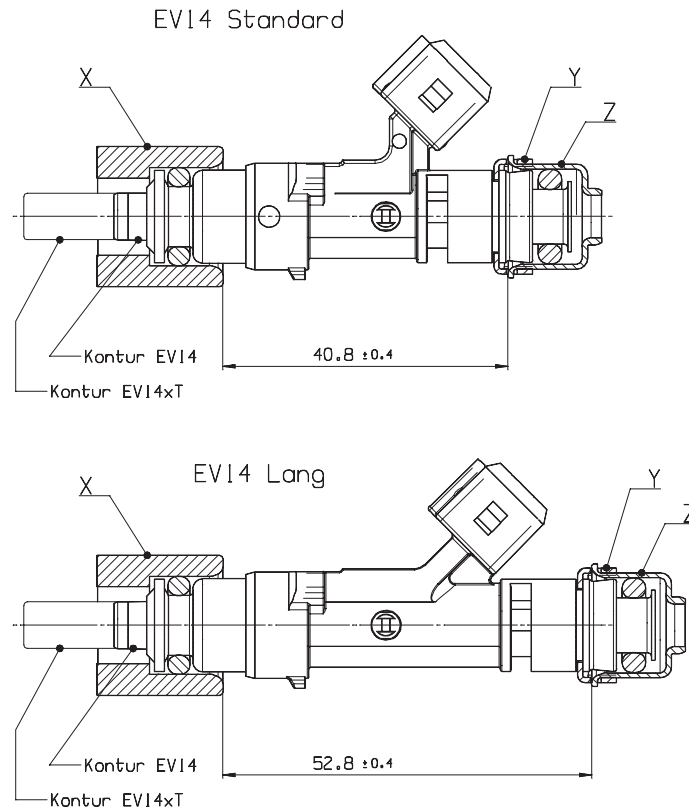
Spray bent to the „left“, Delta=180°



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



Delta Angles



Max. 2° Winkelabweichung zwischen Ventil-Achse und Aufnahmebohrung an Fuel Rail bzw. Saugrohr zulaessig.

MAX. 2° ANGLE DEVIATION IS PERMISSIBLE BETWEEN THE INJECTOR AXIS AND THE FUEL RAIL CUP, RESPECTIVELY TO THE INTAKE MANIFOLD.

#### X= Ø 14:

FOR STANDARD APPLICATIONS  
(AVERAGE O-RING SQUEEZE AT NOMINAL VALUE AND AXIAL ASSEMBLY: APP. 7%)  
MAX. 2° ANGLE DEVIATION IS PERMISSIBLE BETWEEN THE INJECTOR AXIS AND THE FUEL RAIL CUP, RESPECTIVELY TO THE INTAKE MANIFOLD.

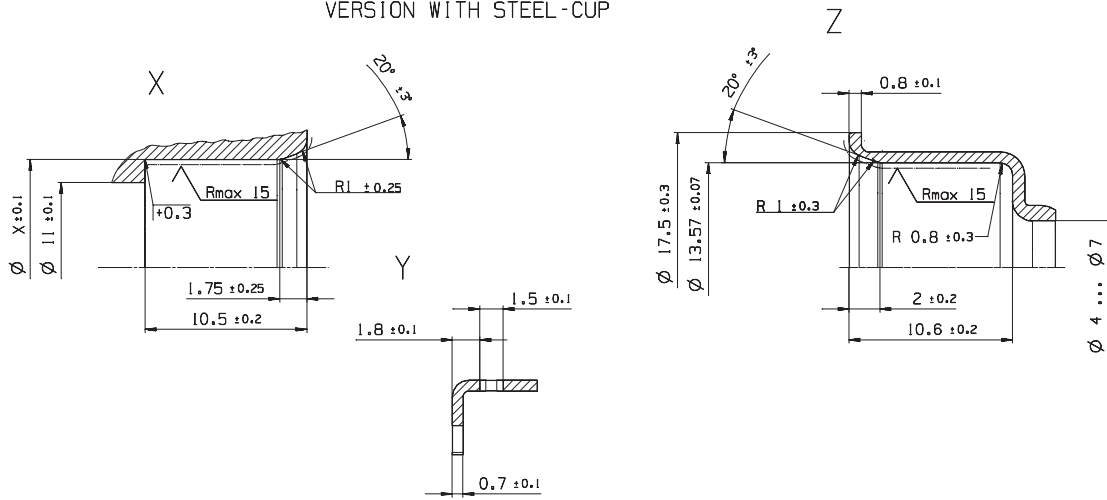
Fuer Standardanwendungen  
(mittlere O-Ring Verpressung bei axialem Einbau und Nennmassen: ca. 7%)  
Max. 2° Winkelabweichung zwischen Ventil-Achse und Aufnahmebohrung an Fuel Rail bzw. Saugrohr zulaessig.

#### X= Ø 13.6:

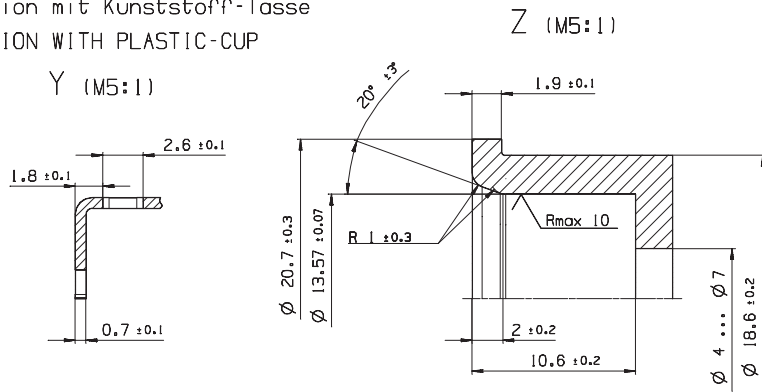
FOR APPLICATIONS WITH EXTENDED REQUIREMENTS  
E. G. TURBO APPLICATION, EXPOSED INSTALLATION  
(AVERAGE O-RING SQUEEZE AT NOMINAL VALUE AND AXIAL ASSEMBLY: APP. 14%, NOTE HIGHER ASSEMBLY FORCES)  
MAX. 1° ANGLE DEVIATION IS PERMISSIBLE BETWEEN THE INJECTOR AXIS AND THE FUEL RAIL CUP, RESPECTIVELY TO THE INTAKE MANIFOLD.

Fuer Anwendungen mit erhoeheten Anforderungen, z. B. Turboapplikation, exponierter Einbau (mittlere O-Ring Verpressung bei axialem Einbau und Nennmassen: ca. 14%, hoehere Einbaukraefte beachten)  
Max. 1° Winkelabweichung zwischen Ventil-Achse und Aufnahmebohrung an Fuel Rail bzw. Saugrohr zulaessig.

Version mit Stahl-Tasse  
VERSION WITH STEEL-CUP



Version mit Kunststoff-Tasse  
VERSION WITH PLASTIC-CUP



Mounting Instructions

## HP Injection Valve HDEV 6

4



# COMING SOON

### Features

- ▶ Flow rate at 100 bar: up to 1,640 g/min (n-heptane)
- ▶ Max. 350 bar (higher on request)
- ▶ Up to 20 holes
- ▶ Spray angle 8 to 20°

The high-pressure fuel injector HDEV 6 is a component of a gasoline-direct fuel-injection system of an otto cycle engine. The HDEV 6 is arranged between the fuel rail and the combustion chamber in the cylinder head.

The function of the HDEV 6 is to meter the high-pressurized fuel and achieve a targeted atomized air and fuel mixture in a defined location in the combustion chamber.

It is an inward opening solenoid injector which is optimized regarding high mass flow, fast opening and closing, leading to a very stable linearity.

The benefit of this injector is a high spray variability concerning hole numbers, spray shape, and spray angles. Also, the flow rate can be defined in a wide range.

Bosch offers the spray targeting design according to the individual customer requirements and can support with additional services, e.g. CFD Simulation, State of the art Spray measurements, and further services.

If your application conditions will not match the listed performance data, please ask for consultancy at Bosch Motorsport. Bosch offers cost effective production HDEV 6 on request.

### Installation Notes

The injector must be supplied by a Bosch Motorsport ECU or Power Stage Unit (e.g. HPI 5 or HPI 1.16).

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**HP Injection Valve HDEV 6**  
Order number **On request**

# Actuators

5

<b>Electronic Throttle Body</b>	<b>204</b>
<b>Wiper Direct Actuator</b>	<b>208</b>

---

## 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 on the Data Sheet.

### Application

Temperature range	-40 to 140°C
Permissible vibration excitation	50 Hz a = 50 m/s <sup>2</sup>
	200 Hz a = 250 m/s <sup>2</sup>
	220 Hz a = 250 m/s <sup>2</sup>
	250 Hz a = 150 m/s <sup>2</sup>
	500 Hz a = 150 m/s <sup>2</sup>
	550 Hz a = 100 m/s <sup>2</sup>
	1200 Hz a = 100 m/s <sup>2</sup>
	2000 Hz a = 50 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Available bore diameters	32 mm
	40 mm
	44 mm

46 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.

#### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

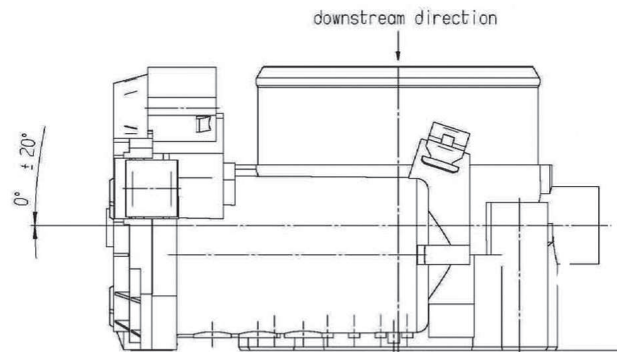
**Ordering Information****Electronic Throttle Body 32 mm**Order number **0280.750.148****Electronic Throttle Body 40 mm**Order number **0280.750.149****Electronic Throttle Body 44 mm**Order number **0280.750.137****Electronic Throttle Body 46 mm**Order number **F02U.V01.171-01****Electronic Throttle Body 52 mm**Order number **F02U.V01.184-02****Electronic Throttle Body 54 mm**Order number **0280.750.150****Electronic Throttle Body 60 mm**Order number **0280.750.151****Electronic Throttle Body 82 mm**Order number **0280.750.101**

## Dimensions

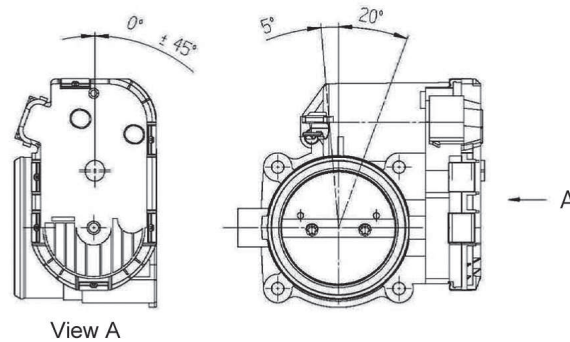
## Mounting Position

Mounting position of the Throttle Actuator

- Horizontal inclination of the Throttle shaft:  $\pm 20^\circ$
- Horizontal inclination of the cover:  $\pm 180^\circ$
- Mounting positions which deviate from this need separate testing.
- It has to be prevented that when mounted in the vehicle, no condensed moisture can soak into the Throttle shaft bore holes (e.g. from the crankcase ventilation)



IN CASE OF MOUNTING POSITION WITH DC-MOTOR ON TOP  
A COMBINATION OF THE ANGLES SHOWN BELOW IS NOT ALLOWED!



## Variations

	Electronic Throttle Body 32 mm	Electronic Throttle Body 40 mm	Electronic Throttle Body 44 mm	Electronic Throttle Body 46 mm
Bore Diameter (mm)	32	40	44	46
Connector	D261.205.358-01	D261.205.358-01	D261.205.358-01	D261.205.356-01
Pin 1 A	Motor -	Motor -	Motor -	Motor -
Pin 2 B	Poti -	Poti -	Poti -	Poti -
Pin 3 C	Poti +	Poti +	Poti +	Poti +
Pin 4 D	Motor +	Motor +	Motor +	Motor +
Pin 5 E	Poti 2	Poti 2	Poti 2	Poti 2
Pin 6 F	Poti 1	Poti 1	Poti 1	Poti 1
Flange diameter (mm)	40	50	50	58
Hole circle diameter(mm)	50x50	50x50	50x50	53x53
Weight (kg)	0.9	0.9	0.9	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
Opening direction**	counterclockwise	counterclockwise	counterclockwise	counterclockwise

	Electronic Throttle Body 52 mm	Electronic Throttle Body 54 mm	Electronic Throttle Body 60 mm	Electronic Throttle Body 82 mm
Bore Diameter (mm)	52	54	60	82
Connector	D261.205.356-01	D261.205.358-01	D261.205.358-01	D261.205.358-01
Pin 1 A	Poti 1	Motor -	Motor -	Motor -
Pin 2 B	Poti -	Poti -	Poti -	Poti -
Pin 3 C	Motor -	Poti +	Poti +	Poti +
Pin 4 D	Poti 2	Motor +	Motor +	Motor +
Pin 5 E	Motor +	Poti 2	Poti 2	Poti 2
Pin 6 F	Poti +	Poti 1	Poti 1	Poti 1
Flange diameter (mm)	58	70	68.5	90
Hole circle diameter (mm)	53 x 53	60 x 60	60 x 60	75 x 75
Weight (kg)	0.95	0.95	0.95	1.1
Max. air flow rate*	not specified	not specified	not specified	not specified
Opening direction**	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".

## Wiper Direct Drive WDD2



5

### Features

- ▶ CAN and LIN control available
- ▶ Optimized for motorsport applications
- ▶ Customer specific calibration of wiping angles and speed

The Wiper Direct Drive WDD2 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 modifying CAN or LIN messages. 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.

### Application

Operating temperature range    -40 to 85°C

### Technical Specifications

#### Mechanical Data

Size	116.3/136.3 x 160 x 111 mm
Max. wipe cycles/min	63 cpm
Max. wipe angle	345°
Max. torque	34 Nm
Weight	1,040 g
Max. vibration	Application specific

#### Electrical Data

Power supply	12 V / 24 V typical (9 V to 32 V range)
--------------	-----------------------------------------

Supply current at 60 cycles/min.    Typ. 12 A/13.5 V

### Operating Modes

WDD2 CAN/LIN Operating modes	<ul style="list-style-type: none"> <li>• Extended Park</li> <li>• Alternate Park</li> <li>• Service Position</li> <li>• Go to URP</li> <li>• Go to LRP</li> <li>• Interval</li> <li>• Continuous</li> <li>• Immediate Stop</li> </ul>
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### LIN Protocol

LIN Version	2.2
LIN Speed	19.2 kb/s
Message IDs	0x31, 0x30, 0x32,

### CAN Protocol

CAN Version	2.2
CAN Speed	500 kb/s or 1,000 kb/s
Message IDs	0x6000, 0x6006, 0x6001

### Connectors and Wires

Mating connector	MOLEX 31034-5016
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### Pinout

Pin 1	Unused
Pin 2	Unused
Pin 3	Unused
Pin 4	LIN
Pin 5	Unused
Pin 6	GND
Pin 7	Unused
Pin 8	UBAT
Pin 9	Unused
Pin 10	Unused
Pin 11	CAN_H
Pin 12	CAN_L

### Communication

LDF or DBC on request

### Installation Notes

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

The WDD2 can be operated by LIN or CAN. LIN and CAN values are sent at each startup.

The CAN bus speed is automatically detected upon the initial connection and then stored in the device. Any subsequent changes in the CAN speed will be detected by the device during startup. The new CAN speed will be applied after a power cycle of the WDD2.

Make sure that the wiper is in its workspace when restarting after a power failure (upper and lower limit).

Using silentblocks (F02U.003.027-01) may improve durability in high vibration applications.

Please ensure that the environmental conditions do not exceed the specifications.

### 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
- M6x19
- Maximum tightening torque: 8 to 9 Nm

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Wiper Direct Drive WDD2

Short Shaft 85 mm

Order number **F02U.V03.657-01**

#### Wiper Direct Drive WDD2

Long Shaft 105 mm

Order number **F02U.V03.658-01**

### Accessories

#### Silentblock

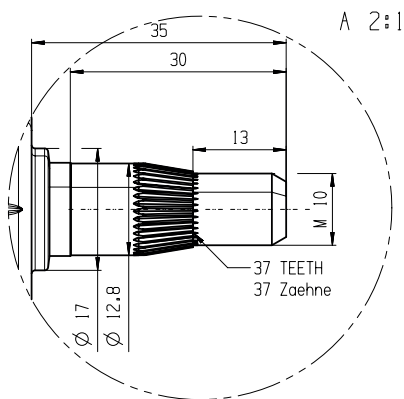
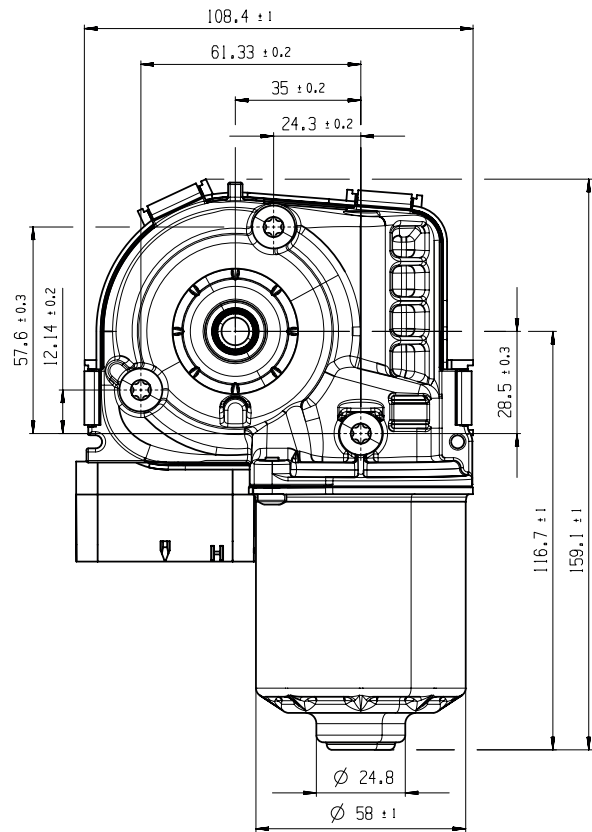
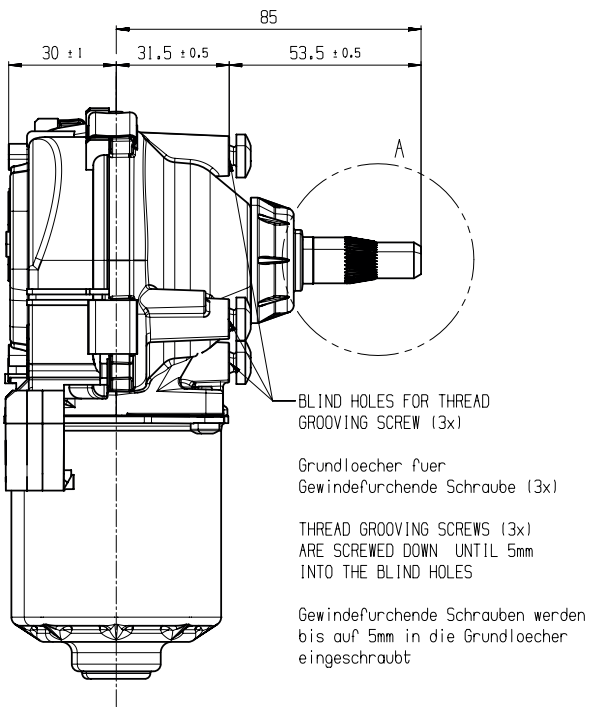
Order number **F02U.003.027-01**

#### Mating Connector MOLEX 31034-516

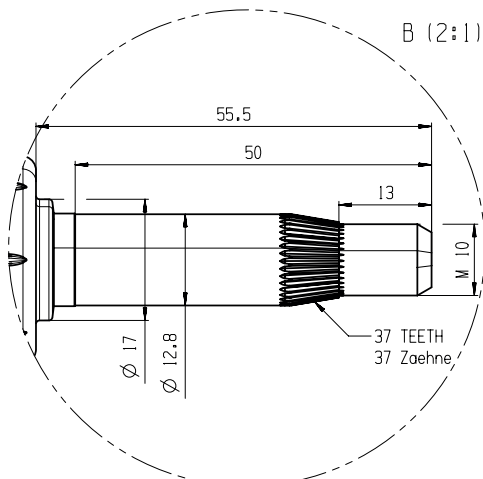
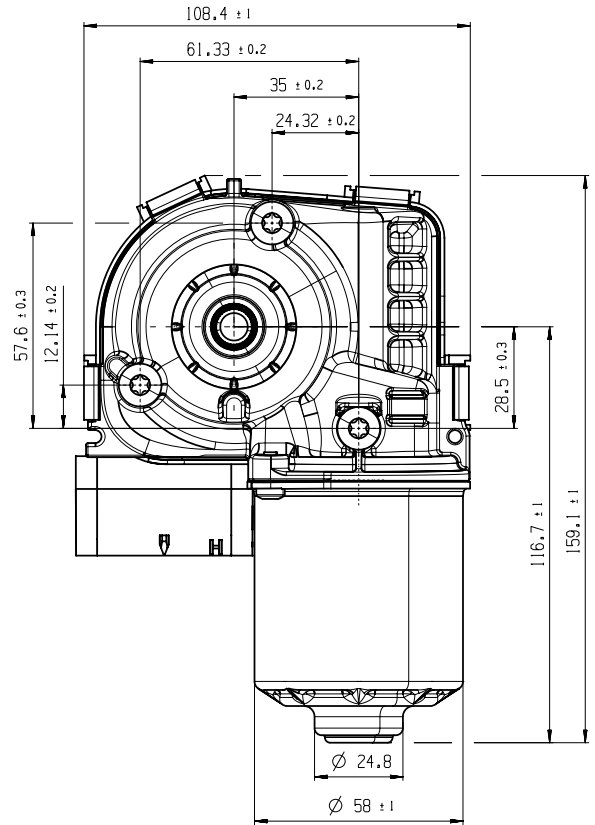
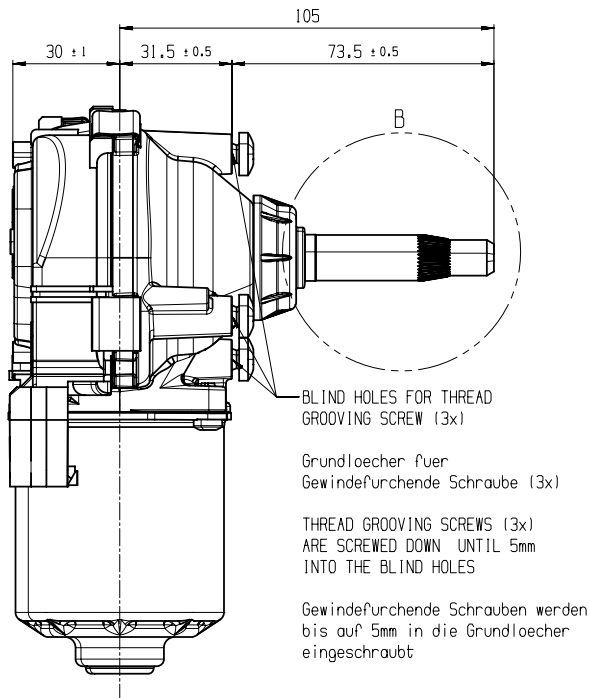
Order number **F02U.B01.350-01**

Dimensions

5



Offer Drawing Version Short Shaft 85 mm



SHAFT ACCORDING TO DIN 72783-A1-13-M10 (6h) - 37  
Wellengeometrie nach DIN 72783-A1-13-M10 (6h) - 37

Offer Drawing Version Long Shaft 105 mm



<b>Air Pressure</b>	<b>214</b>
<b>Fluid Pressure</b>	<b>221</b>
<b>Knock</b>	<b>236</b>
<b>Lambda</b>	<b>243</b>
<b>Pressure &amp; Temperature</b>	<b>256</b>
<b>Rotary Position</b>	<b>270</b>
<b>Speed</b>	<b>272</b>
<b>Steering Wheel Angle</b>	<b>291</b>
<b>Temperature</b>	<b>293</b>
<b>Vehicle Dynamics</b>	<b>306</b>

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## Overview

**Pressure Sensor Air PS-AA**



- Application: 0.1 to 1.15 bar or 0.2 to 2.5 bar
- Response time: 1 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 20 g

**Pressure Sensor Air PS-AS**



- Application: 0.2 to 3.0 bar
- Response time: 1 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 21 g

**Pressure Sensor Air PSA-N**



- Application: 0.1 to 1.15 bar
- Response time: 0.1 ms
- Pressure reference type: Absolute
- Power supply: 11 to 16 V
- Weight: 21 g

## Pressure Sensor Air PS-AA



### Features

- ▶ Application: 0.1 to 1.15 bar or 0.2 to 2.5 bar
- ▶ Response time: 1 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 5 V
- ▶ Weight: 20 g

This sensor is designed to measure absolute air pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and electronic systems for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal. Two different pressure ranges are available (0.1 to 1.15 bar or 0.2 to 2.5 bar).

### Application

Application	Please see variations
Pressure reference type	absolute
Max. pressure	5 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Variations

	PS-AA (0.1 to 1.15 bar)	PS-AA (0.2 to 2.50 bar)
Tolerance (FS) at $U_s = 5$ V	$\pm 0.016$ bar	$\pm 0.034$ 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	$12.05 \pm 0.8$ mm
Weight w/o wire	20 g
Sealing	O-ring 7.59 x 2.62 mm

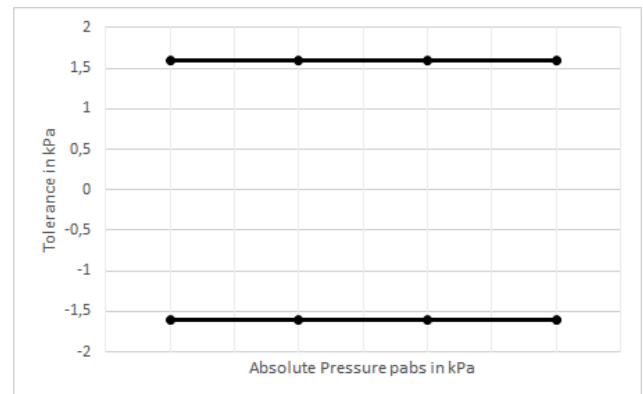
#### Electrical Dat

Power supply $U_s$	4.75 to 5.25 V
Max. power supply	16 V
Full scale output $U_A$ at 5 V	0.4 to 4.65 V
Current $I_s$	9 mA

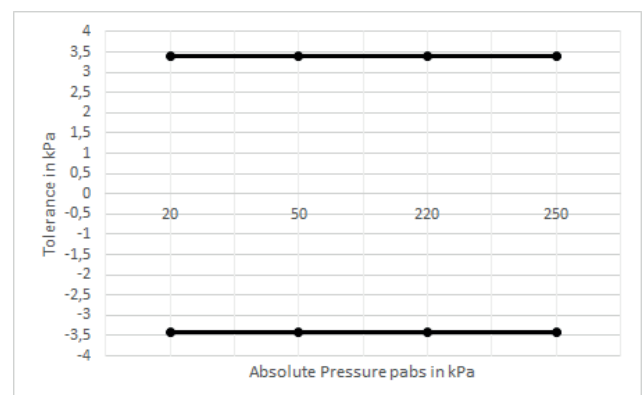
#### Characteristic

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5$ V	Please see variations
Tolerance (FS)	Please see variations
Sensitivity	Please see variations
Offset	Please see variations

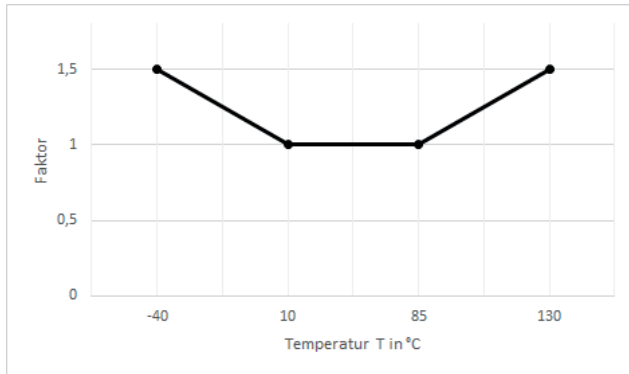
#### Tolerance 0.1 to 1.15 bar



#### Tolerance 0.2 to 2.5 bar



## Expansion of Tolerance



## Connectors and Wires

Connector	RB-COMP 1.1a/3P/Kod.1
Mating connector	D261.205.366-01
Pin 1	U <sub>s</sub>
Pin 2	Gnd
Pin 3	Sig

Various motorsport and automotive connectors are available on request.

## Installation Notes

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

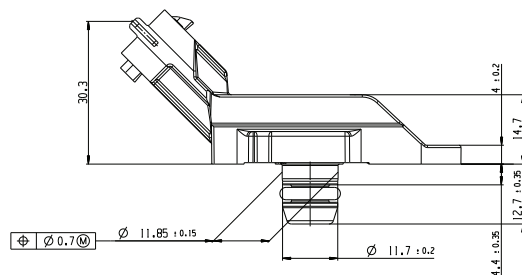
The sensor can be connected directly to most control units.

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

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

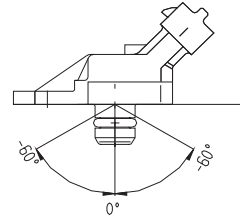
Avoid miss-pinning (max. 5 minutes at I = 0.3 A).

## 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 +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.

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

**Pressure Sensor Air PS-AA**

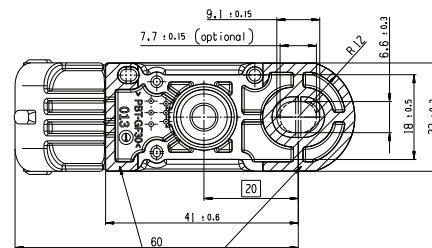
0.1 to 1.15 bar

Order number **0261.230.216**

**Pressure Sensor Air PS-AA**

0.2 to 2.5 bar

Order number **0261.230.284**



Auflageflaeche des Sensors.  
In diesem Bereich vollflaecheige Unterstuetzung vorsehen.  
SUPPORTING AREA OF SENSOR.  
THIS AREA SHOULD BE SUPPORTED BY A COHERENT PLANE SURFACE.

## Pressure Sensor Air PS-AS



### Features

- ▶ Application: 0.2 to 3.0 bar
- ▶ Response time: 1 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 5 V
- ▶ Weight: 21 g

This sensor is designed to measure absolute air-pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and an electronic for signal-amplification and temperature compensation. The output of the sensor is an analog, ratio metric signal.

### Application

Application	0.2 to 3 bar (a)
Pressure reference type	absolute
Max. pressure	5 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Mechanical Data

Mounting	M6
Fitting	12.05 ± 0.8 mm
Weight w/o wire	21 g
Sealing	O-ring 7.59 x 2.62 mm

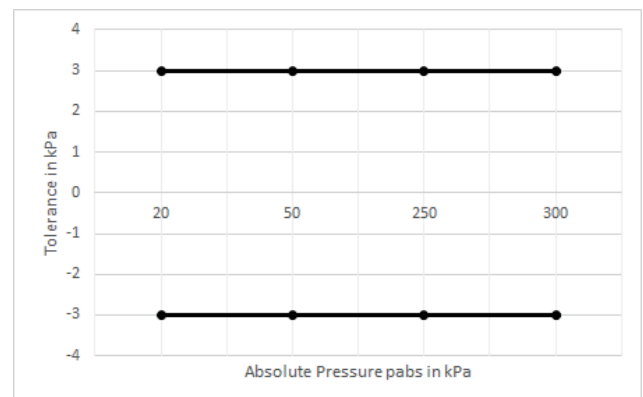
#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$ at 5 V	0.4 to 4.65 V
Current $I_s$	9 mA

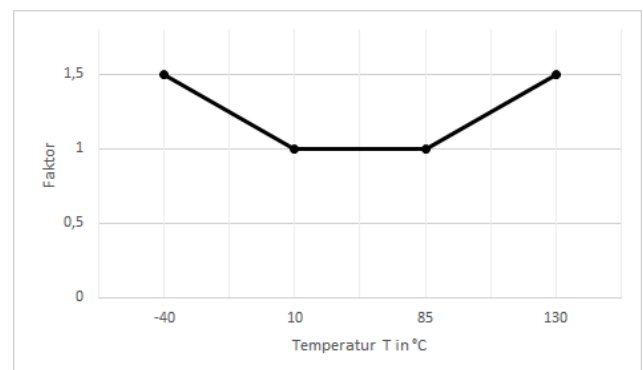
#### Characteristic

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5$ V	± 0.030 bar
Tolerance (FS)	± 1.07 %
Sensitivity	1,518 mV/bar
Offset	96 mV

#### Tolerance



#### Expansion of Tolerance



#### Connectors and Wires

Connector	RB-COMP 1.1a/3P/Kod.1
Mating connector	D261.205.366-01
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig

Various motorsport and automotive connectors are available on request.

#### Installation Notes

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

The sensor can be connected directly to most control units.

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

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at  $I = 0.3 \text{ A}$ ).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $+60^\circ$ .

### Safety Note

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

### Legal Restrictions

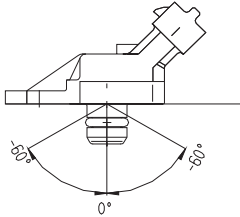
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

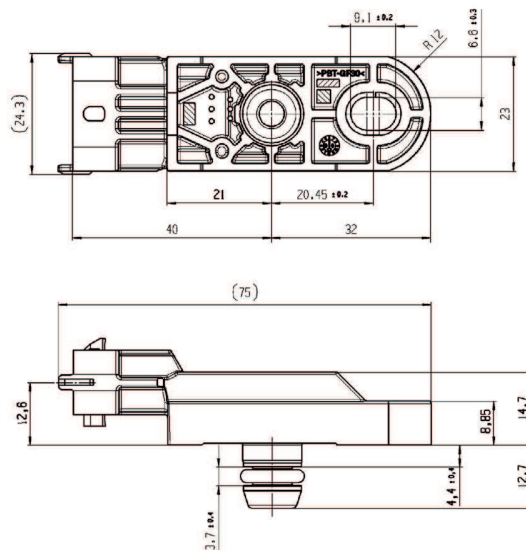
#### Pressure Sensor Air PS-AS

Order number **0281.002.996**

6



### Dimensions



## Pressure Sensor Air PSA-N



### Features

- ▶ Application: 0.1 to 1.15 bar
- ▶ Response time: 0.1 ms
- ▶ Pressure reference type: Absolute
- ▶ Power supply: 11 to 16 V
- ▶ Weight: 21 g

This sensor is designed to measure absolute air-pressure, especially the air box pressure of gasoline or Diesel engines.

An integrated circuit combines a piezo-resistive sensor element and electronics for signal-amplification and temperature compensation. The output of the sensor is analog.

### Application

Application	0.1 to 1.15 bar
Pressure reference type	absolute
Max. pressure	5 bar
Operating temp. range	-40 to 125°C
Media temp. range	-40 to 125°C
Storage temp. range	-40 to 130°C
Max. vibration	0.19 mm at 100 to 200 Hz 250 m/s <sup>2</sup> at 200 to 500 Hz

### Technical Specifications

#### Mechanical Data

Mounting	2 x #4-40 screws
Fitting	Flat O-ring boss
Weight w/o wire	21 g
Sealing	O-ring 4.5 x 1.5 mm

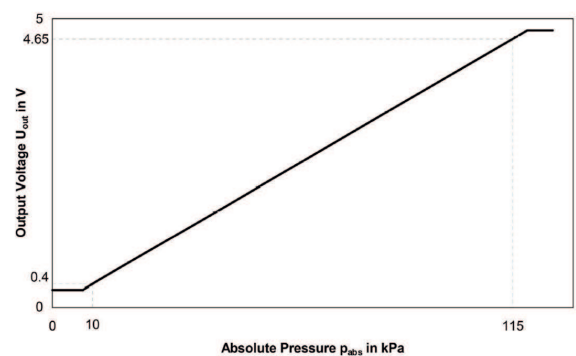
#### Electrical Data

Power supply $U_S$	11 to 16 V
Full scale output $U_A$	0.5 to 4.7 V
Typical current $I_S$	9 mA

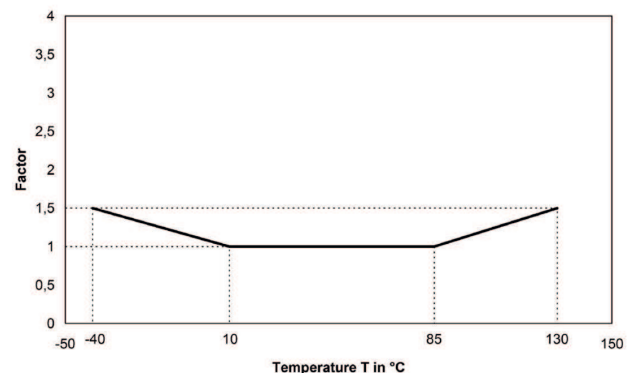
#### Characteristic

Response time 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	ASL606-05PC-HE	
Mating connector	F02U.000.228-01	
ASL006-05SC-HE		
Pin	Function	Wire color
1	$U_S$	WHT/ORG
2	Gnd	WHT/BLU
3	Sig	WHT
4	-	
5	-	

Various motorsport and automotive connectors are available on request.

Sleeve	DR-25
Wire size	AWG 24
Wire length L	64.5 cm

## Installation Notes

The PSA-N is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

To avoid noise, an ECU-input circuit with a RC-low pass filter (tau 0.2 ms) is recommended.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at  $I = 0.3 \text{ A}$ ).

Surface finish of the mounting surface should not exceed 0.8 micrometers RMS.

Surface flatness tolerance at sensor mount interface must not exceed  $\pm 0.025 \text{ mm}$  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.

## Fullfilled Legal Standards/Legal Requirements

EMC Requirement	UNECE10
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## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

### Pressure Sensor Air PSA-N

AS terminated

Order number **F02U.V0U.197-03**

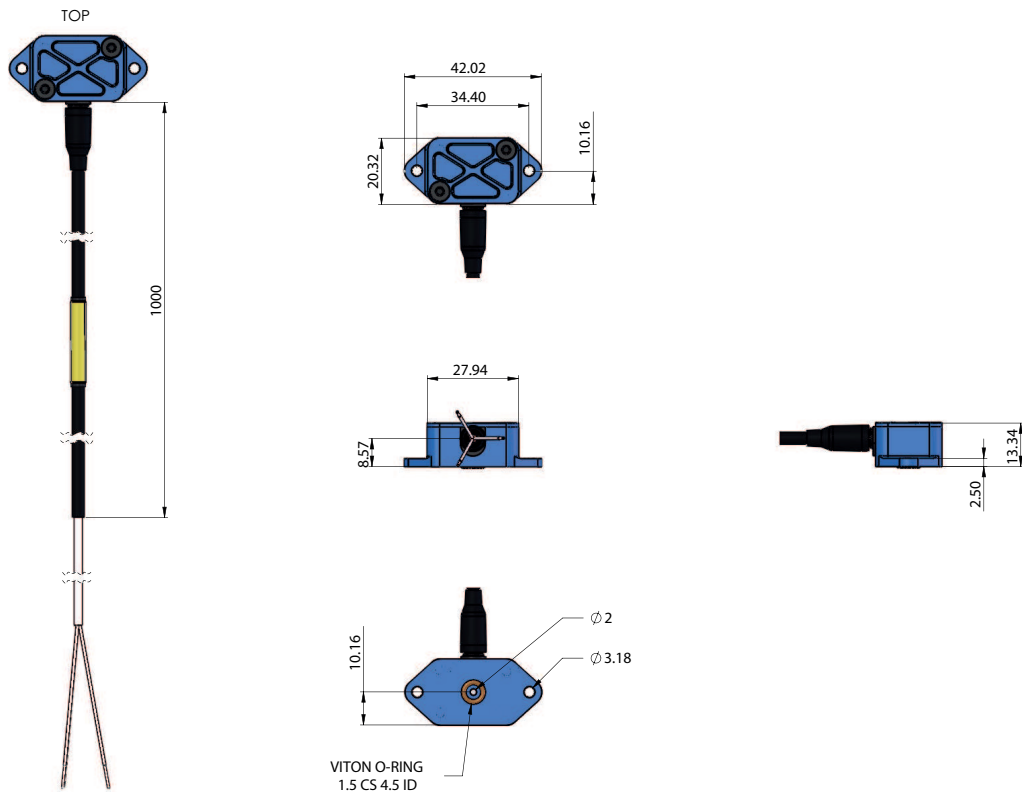
### Pressure Sensor Air PSA-N

Flying Lead

Order number **F02U.V0U.197-91**

6

## Dimensions



## Overview

### Pressure Sensor Fluid PSC-260



- Application: 0 to 260 bar
- Response time: 2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 35 g

### Pressure Sensor Fluid PSS-10



- Application: 1 to 11 bar
- Response time: 1.5 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 45 g

### Pressure Sensor Fluid PSS-140



- Application: 0 to 140 bar
- Response time: 2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 35 g

### Pressure Sensor Fluid PSS-250R



- Application: 0 to 250 bar
- Response time: 1.5 ms
- Pressure reference type: Relative
- Power supply: 5 V
- Weight: 45 g

### Pressure Sensor Fluid PSS-260



- Application: 0 to 260 bar
- Response time: 2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 35 g

### Pressure Sensor Fluid PSS-420



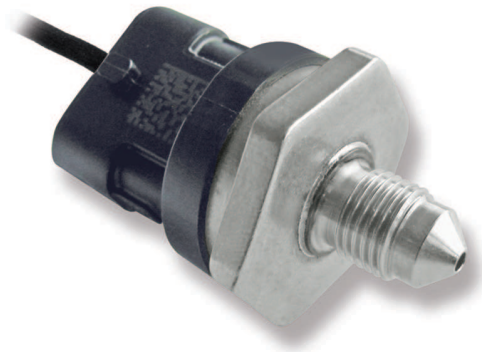
- Application: 0 to 420 bar
- Response time: 2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 35 g

### Pressure Sensor Fluid PSS-600



- Application: 0 to 600 bar
- Response time: 2 ms
- Pressure reference type: Absolute
- Power supply: 5 V
- Weight: 35 g

## Pressure Sensor Fluid PSC-260



6

### Features

- ▶ Application: 0 to 260 bar
- ▶ Response time: 2 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 35 g

The PSC-260 is specially designed to measure absolute pressure in gasoline direct injection applications. This sensor is also compatible with other kind of fluids e.g. Diesel, engine oil, transmission oil or brake fluid.

The sensor uses a thin layer technique to achieve high accuracy pressure measurements. The stainless steel measuring cells with piezoresistive bridges are hermetically welded with stainless steel pressure ports. The internal reference ensures ambient pressure independent measurements.

The main benefits of this sensor are its high accuracy, its wide measurement range and its robust and compact design.

### Application

Application	0 to 260 bar (a)
Pressure reference type	absolute
Max. pressure	320 bar
Operating temp. range	-40 to 130°C (140°C)
Media temp. range	-40 to 130°C (140°C)
Storage temp. range	-30 to 60°C
Max. vibration	560 m/s <sup>2</sup> at 800 to 900 Hz 350 m/s <sup>2</sup> at 1.000 to 2.500 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10 x 1
Wrench size	27 mm
Installation torque	22 ± 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 $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	10 to 90 % $U_s$ ratio metric
Current $I_s$	12 mA

#### Characteristic

Load capacity	10 nF
Output resistance	10 Ohm
Tolerance (FS)	+ 1 % (0 to 100°C) + 1.5 % (-40 to 0°C and 100 to 130°C)
Sensitivity	15.38 mV/bar at $U_s = 5$ V
Offset	500 mV at $U_s = 5$ V

#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01 ASL006-05SC-HE
Pin 1	-
Pin 2	Gnd
Pin 3	Sig
Pin 4	$U_s$
Pin 5	-

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

Sleeve	DR-25
Wire length L	13 to 95 cm

### Installation Notes

The PSC-260 can be connected directly to most control units. Please consider the TCI for the electrical connection of the sensor.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

Please consider using the adapter F02U.002.711-01.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

### Safety Note

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Pressure Sensor Fluid PSC-260**

Order number **F02U.V00.990-03**

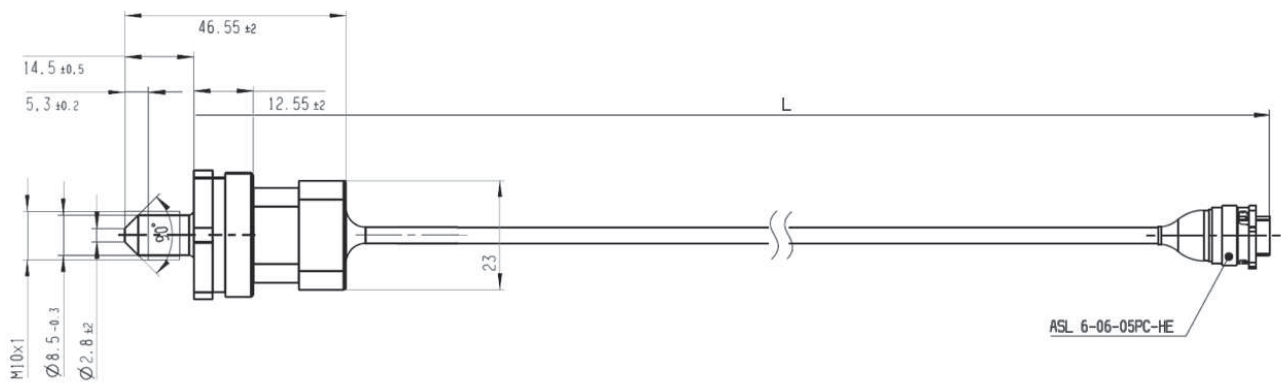
### Accessories

**Adapter**

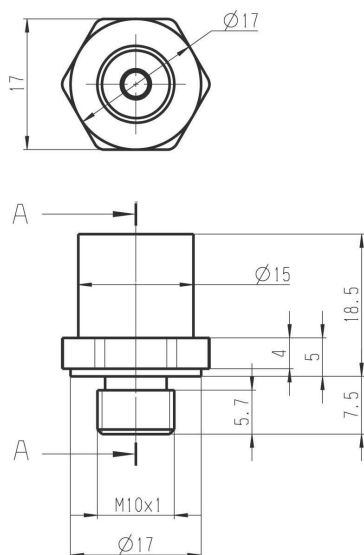
Order number **F02U.002.711-01**

6

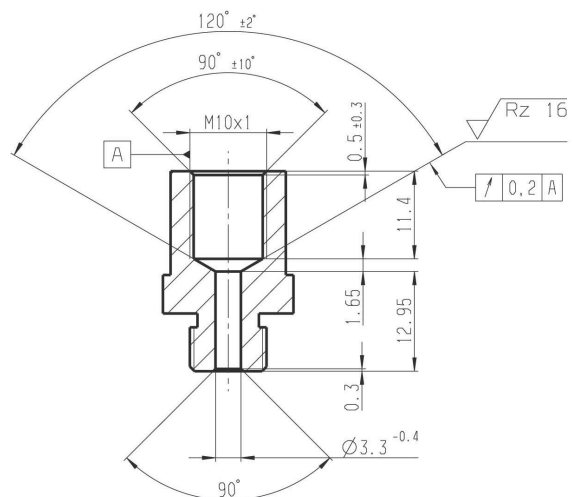
### Dimensions



Sensor



Adapter



## Pressure Sensor Fluid PSS-10



6

### Features

- ▶ Application: 1 to 11 bar
- ▶ Response time: 1.5 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 45 g

This sensor is designed to measure absolute pressure of various kinds of media e.g. Diesel, gasoline, water, engine oil, transmission oil or air.

The sensor uses stainless steel measuring cells with piezo-resistive measuring bridges in thin layer technique. These are hermetically welded together with stainless steel pressure ports. This guarantees a complete media compatibility.

The main benefit of this sensor is the high quality of a production part at a low price.

### Application

Application	1 to 11 bar (a)
Pressure reference type	absolute
Max. pressure	20 bar
Operating temp. range	-40 to 125°C (140°C)
Media temp. range	-40 to 125°C (140°C)
Storage temp. range	-20 to 50°C
Bio fuel compatibility	E 85 / M 100
Max. vibration	100 m/s <sup>2</sup> rms at 10 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Wrench size	17 mm

Installation torque	15 Nm
Weight w/o wire	45 g
Sealing	O-ring 7.65 x 1.63 mm

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	± 30 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
Current $I_s$	8 mA

#### Characteristic

Response time T10/90	1.5 ms
Compensated range	0 to 90°C
Tolerance (FS) at $U_s = 5$ V	± 0.1 bar
Tolerance (FS)	± 1 %
Sensitivity	400 mV/bar at $U_s = 5$ V
Offset	100 mV at $U_s = 5$ V

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.339-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$
Pin 4	-
Pin 5	-

### Installation Notes

The PSS-10 can be connected directly to most control units.

The sensor has a protection for over voltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

#### Safety Note

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

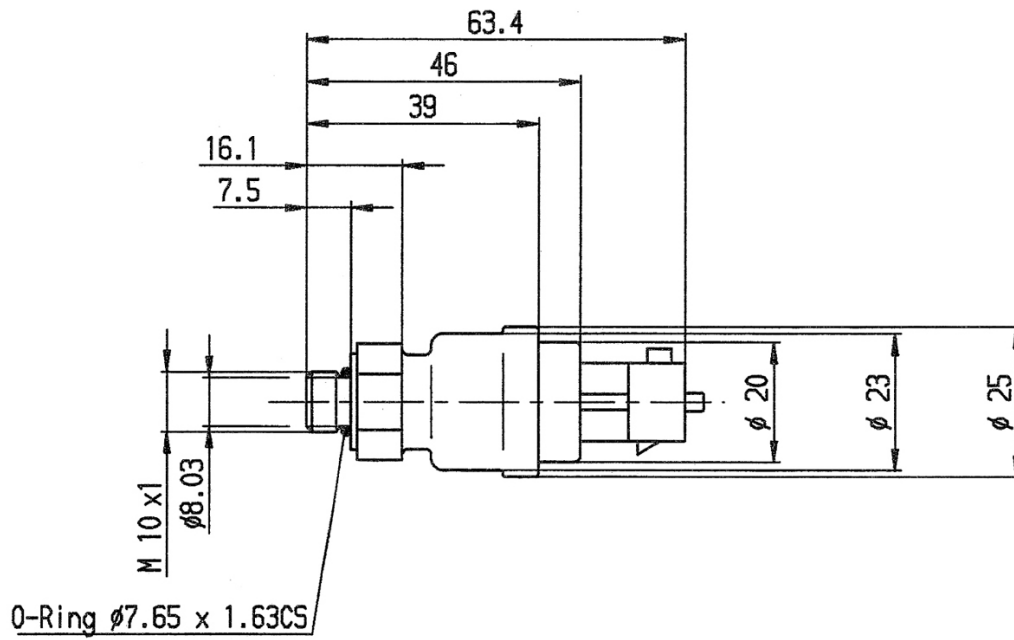
### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

Pressure Sensor Fluid PSS-10  
Order number B261.209.341-01

## Dimensions



## Pressure Sensor Fluid PSS-140



6

### Features

- ▶ Application: 0 to 140 bar
- ▶ Response time: 2 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 35 g

The PSS is specially designed to measure absolute pressure in gasoline direct injection applications. This sensor is also compatible with other kind of fluids e.g. Diesel, engine oil, transmission oil or brake fluid.

The sensor uses a thin layer technique to achieve high accuracy pressure measurements. The stainless steel measuring cells with piezoresistive bridges are hermetically welded with stainless steel pressure ports. The internal reference ensures ambient pressure independent measurements.

The main benefits of this sensor are its high accuracy, its wide measurement range and its robust and compact design.

### Application

Application	0 to 140 bar
Max. pressure	180 bar
Sensitivity at $U_s = 5\text{ V}$	28.57 mV/bar
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

#### 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 $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
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	Please see Variations
Offset	500 mV at $U_s = 5\text{ V}$

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.366-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$

### Installation Notes

The PSS- can be connected directly to most control units. Please consider the TCI for the electrical connection of the sensor.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

Please consider using the adapter F02U.002.711-01.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

#### Safety Note

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

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

### Pressure Sensor Fluid PSS-140

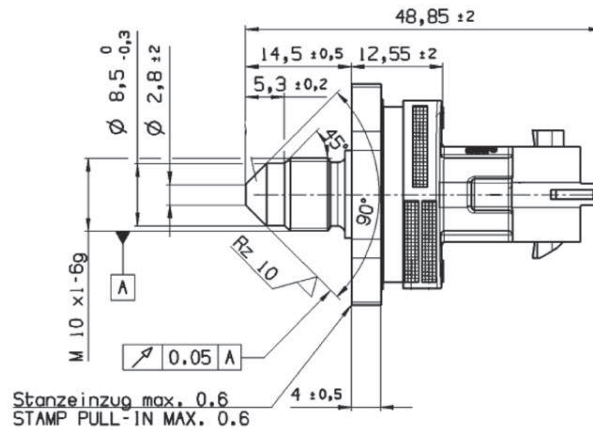
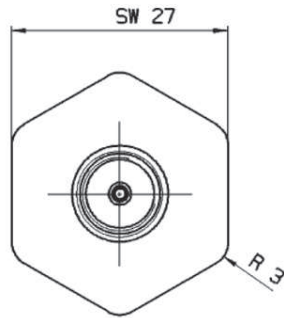
Order number **0261.545.053**

### Accessories

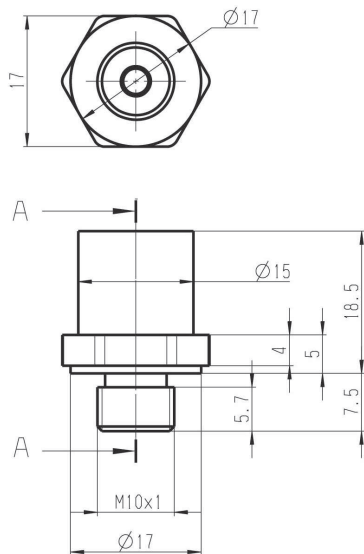
#### Adapter

Order number **F02U.002.711-01**

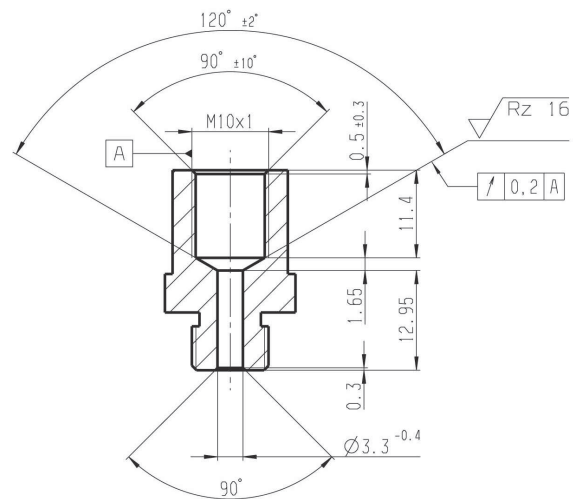
## Dimensions



Sensor



Adapter



## Pressure Sensor Fluid PSS-250R



6

### Features

- ▶ Application: 0 to 250 bar
- ▶ Response time: 1.5 ms
- ▶ Pressure reference type: Relative
- ▶ Power supply: 5 V
- ▶ Weight: 45 g

This sensor is designed to measure the pressure of media in relation to the ambient pressure (e.g. Diesel, gasoline, water, engine oil, transmission oil or air). The sensor is available for two different supply voltage ranges.

The sensor uses stainless steel measuring cells with piezo-resistive measuring bridges in thin layer technique, which are hermetically welded together with stainless steel pressure ports. This guarantees a complete media compatibility.

The main benefit of this sensor is the high quality of a production part at a low price

### Application

Application	0 to 250 bar (r)
Pressure reference type	relative
Max. pressure	500 bar
Operating temp. range	-40 to 125°C (140°C)
Media temp. range	-40 to 125°C (140°C)
Storage temp. range	-20 to 50°C
Bio fuel compatibility	E 85 / M 100
Max. vibration	100 m/s <sup>2</sup> rms at 10 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Wrench size	17 mm
Installation torque	15 Nm
Weight w/o wire	45 g
Sealing	O-ring 7.65 x 1.63 mm

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	± 30 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
Current $I_s$	8 mA

#### Characteristic

Response time T10/90	1.5 ms
Compensated range	0 to 90°C
Tolerance (FS)	± 2.5 bar
Tolerance (FS)	± 1 %
Sensitivity	16 mV/bar at $U_s = 5$ V
Offset	500 mV at $U_s = 5$ V

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.339-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$
Pin 4	-
Pin 5	-

### Installation Notes

The PSS-250R can be connected directly to most control units.

The sensor has a protection for over voltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

#### Safety Note

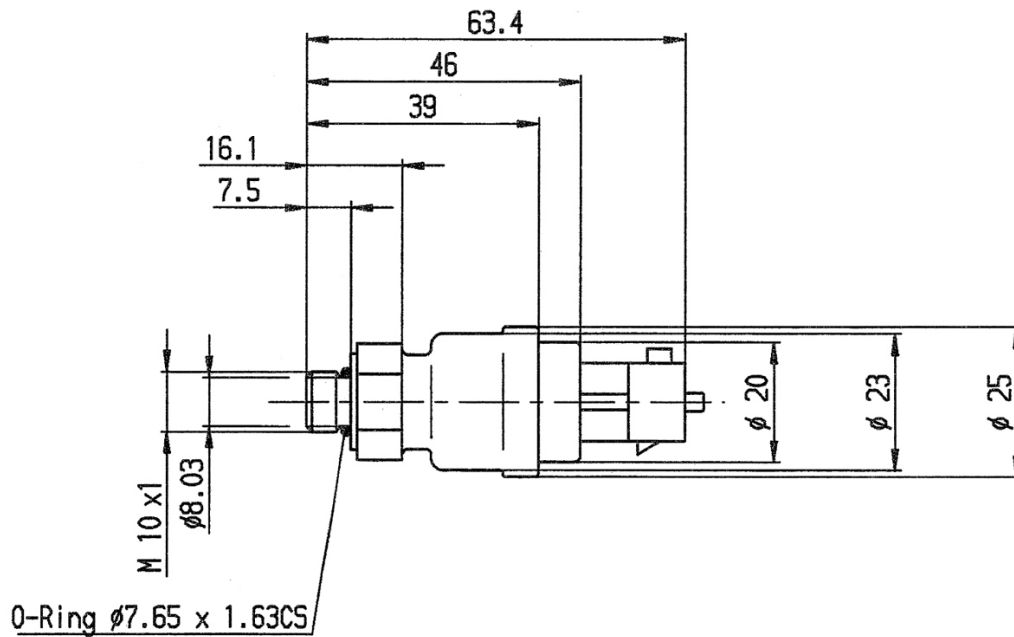
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information****Pressure Sensor Fluid PSS-250R**

4.75 to 5.25 V

Order number **B261.209.965-01****Dimensions**

## Pressure Sensor Fluid PSS-260



6

### Features

- ▶ Application: 0 to 260 bar
- ▶ Response time: 2 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 35 g

The PSS is specially designed to measure absolute pressure in gasoline direct injection applications. This sensor is also compatible with other kind of fluids e.g. Diesel, engine oil, transmission oil or brake fluid.

The sensor uses a thin layer technique to achieve high accuracy pressure measurements. The stainless steel measuring cells with piezoresistive bridges are hermetically welded with stainless steel pressure ports. The internal reference ensures ambient pressure independent measurements.

The main benefits of this sensor are its high accuracy, its wide measurement range and its robust and compact design.

### Application

Application	0 to 260 bar
Max. pressure	320 bar
Sensitivity at $U_s = 5\text{ V}$	15.38 mV/bar
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

#### 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 $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
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	Please see Variations
Offset	500 mV at $U_s = 5\text{ V}$

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.366-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$

### Installation Notes

The PSS- can be connected directly to most control units. Please consider the TCI for the electrical connection of the sensor.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

Please consider using the adapter F02U.002.711-01.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

#### Safety Note

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

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

### Pressure Sensor Fluid PSS-260

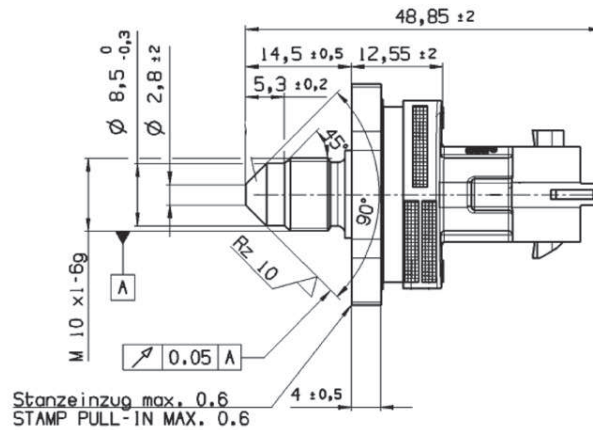
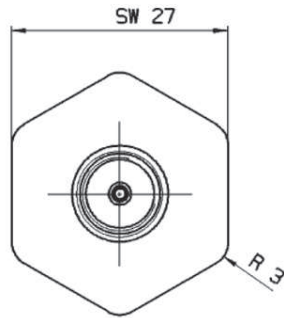
Order number **0261.545.040**

### Accessories

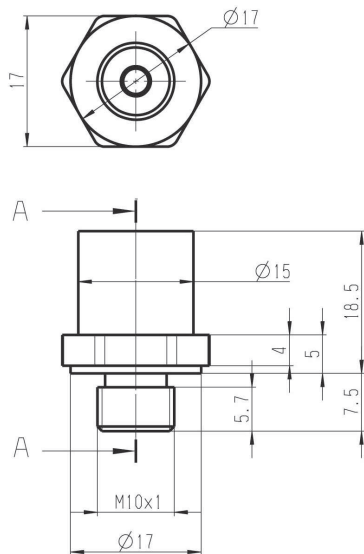
#### Adapter

Order number **F02U.002.711-01**

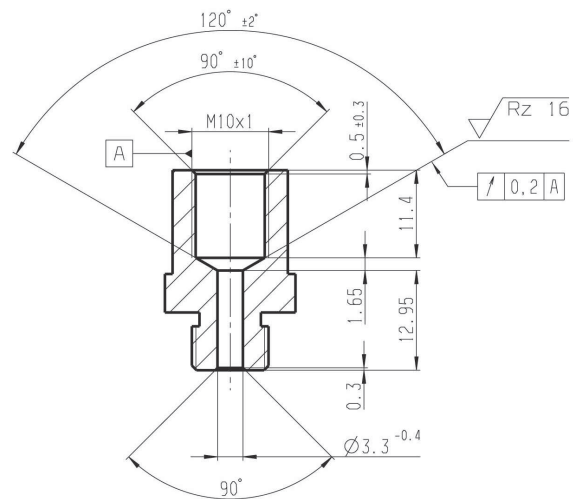
## Dimensions



Sensor



Adapter



## Pressure Sensor Fluid PSS-420



6

### Features

- ▶ Application: 0 to 420 bar
- ▶ Response time: 2 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 35 g

The PSS is specially designed to measure absolute pressure in gasoline direct injection applications. This sensor is also compatible with other kind of fluids e.g. Diesel, engine oil, transmission oil or brake fluid.

The sensor uses a thin layer technique to achieve high accuracy pressure measurements. The stainless steel measuring cells with piezoresistive bridges are hermetically welded with stainless steel pressure ports. The internal reference ensures ambient pressure independent measurements.

The main benefits of this sensor are its high accuracy, its wide measurement range and its robust and compact design.

### Application

Application	0 to 420 bar
Max. pressure	560 bar
Sensitivity at $U_s = 5\text{ V}$	9.52 mV/bar
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

#### 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 $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
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	Please see Variations
Offset	500 mV at $U_s = 5\text{ V}$

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.366-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$

### Installation Notes

The PSS- can be connected directly to most control units. Please consider the TCI for the electrical connection of the sensor.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

Please consider using the adapter F02U.002.711-01.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

#### Safety Note

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Pressure Sensor Fluid PSS-420

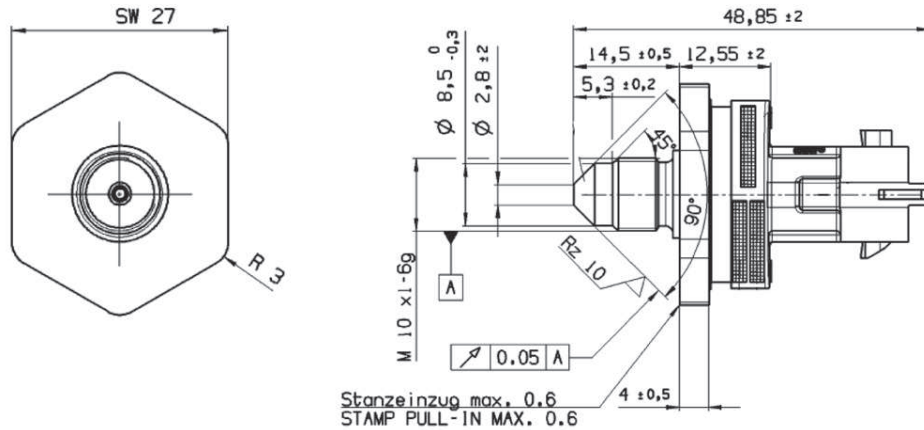
Order number **0261.545.136**

#### Accessories

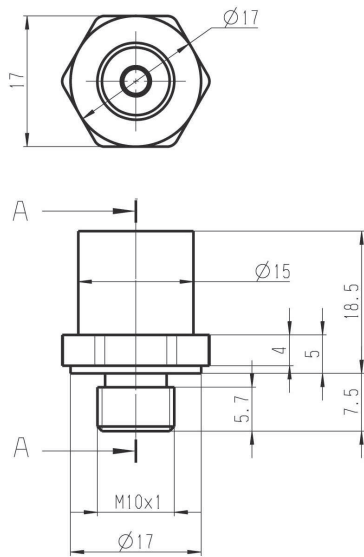
##### Adapter

Order number **F02U.002.711-01**

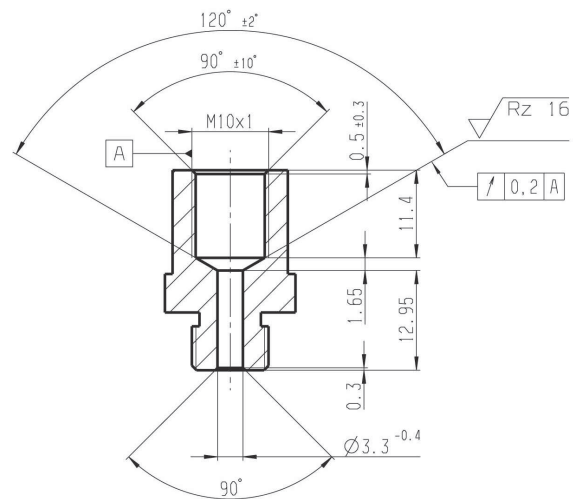
### Dimensions



Sensor



Adapter



## Pressure Sensor Fluid PSS-600



6

### Features

- ▶ Application: 0 to 600 bar
- ▶ Response time: 2 ms
- ▶ Pressure reference type: Absolut
- ▶ Power supply: 5 V
- ▶ Weight: 35 g

The PSS is specially designed to measure absolute pressure in gasoline direct injection applications. This sensor is also compatible with other kind of fluids e.g. Diesel, engine oil, transmission oil or brake fluid.

The sensor uses a thin layer technique to achieve high accuracy pressure measurements. The stainless steel measuring cells with piezoresistive bridges are hermetically welded with stainless steel pressure ports. The internal reference ensures ambient pressure independent measurements.

The main benefits of this sensor are its high accuracy, its wide measurement range and its robust and compact design.

### Application

Application	0 to 600 bar
Max. pressure	660 bar
Sensitivity at $U_s = 5\text{ V}$	6.67 mV/bar
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

#### 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 $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	10 to 90 % $U_s$ ratiometric
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	Please see Variations
Offset	500 mV at $U_s = 5\text{ V}$

#### Connectors and Wires

Connector	Bosch Compact
Mating connector	3-pole Compact D261.205.366-01
Pin 1	Gnd
Pin 2	Sig
Pin 3	$U_s$

### Installation Notes

The PSS- can be connected directly to most control units. Please consider the TCI for the electrical connection of the sensor.

The sensor has a protection for overvoltage, reverse polarity and short-circuit.

Please do not fix the sensor directly to the engine block to avoid undesired strong vibrations.

Each mounting orientation is possible.

Please consider using the adapter F02U.002.711-01.

The sensor meets all EMV, EMC and ESD automotive standards.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

#### Safety Note

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

## Legal Restrictions

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## Ordering Information

### Pressure Sensor Fluid PSS-600

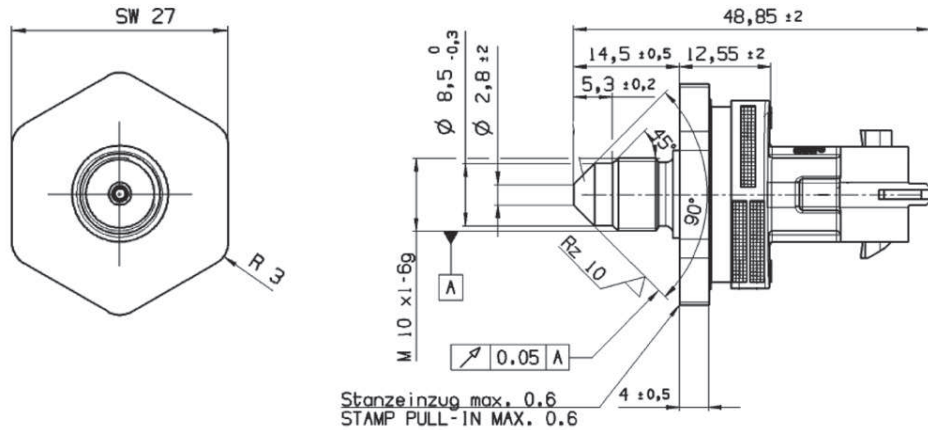
Order number **0261.B23.789-07**

### Accessories

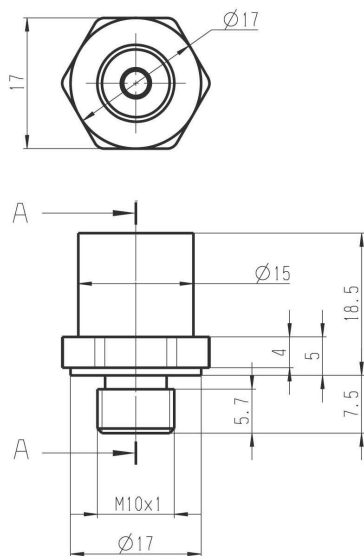
#### Adapter

Order number **F02U.002.711-01**

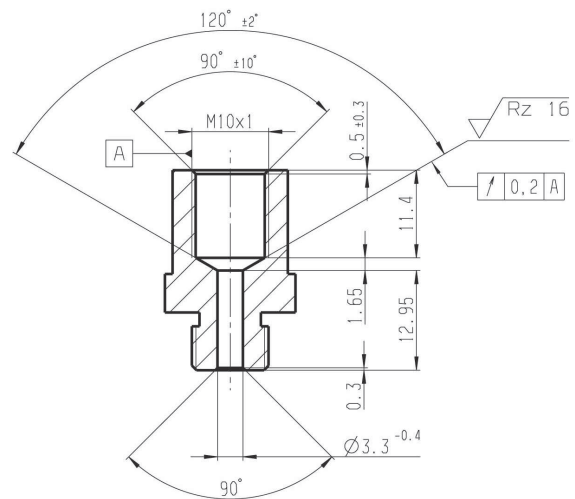
## Dimensions



Sensor



Adapter



## Overview

**Knock Sensor KS4-P**

- Frequency: 3 to 25 kHz
- Weight: 48 g
- Height sensor head: 18 mm

**Knock Sensor KS4-R**

- Frequency: 3 to 25 kHz
- Weight: 82 g
- Height sensor head: 18 mm

**Knock Sensor KS4-R2**

- Frequency: 3 to 30 kHz
- Weight: 60 g
- Height sensor head: 14 mm

## Knock Sensor KS4-P



### Features

- ▶ Frequency: 3 to 25 kHz
- ▶ Weight: 48 g
- ▶ Height sensor head: 18 mm

This sensor is used for detecting structural born vibrations in spark ignition engines due to uncontrolled combustion. This sensor is suitable for operation in extreme conditions.

Due to the inertia of the seismic mass, the sensor moves in correlation to the engine block vibration; this motion results in a compressive force which is converted into a voltage signal via a piezoceramic sensor element. As a result, upper and lower voltage thresholds can be defined directly correlating to an acceleration magnitude.

The main benefits of this sensor are its robust mechanical design, compact housing and precise determination of structure-related noise. The small packaging is accomplished by integrating the connector directly to the sensor.

### Application

Application	3 to 25 kHz
Operating temperature range	-40 to 150°C
Storage temperature range	-30 to 60°C
Max. vibration	≤ 800 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Male thread (for cast)	M8x25
Male thread (for Al)	M8x30
Installation torque	20±5 Nm
Weight w/o wire	48 g
Protection	IP X9K

#### Electrical Data

Range of frequency	3 to 25 kHz
Sensitivity at 5 kHz	26 ± 8 mV/g
Max. sensitivity changing (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

Mating connector 2-pole	2-Pin RB-Kp.1 (F02U.B00.966-01) or 2-Pin Jetronic (D261.205.288-01)
Pin 1	Sig+
Pin 2	Sig-

#### Installation Notes

The KS4-P can be connected to all Bosch Motorsport ECUs featuring knock control

The sensor must rest directly on the brass compression sleeve during operation.

To ensure low-resonance coupling of the sensor to the measurement location, the contact surface must be clean and properly machined to provide a secure flush mounting.

Please route the sensor wire in a way that prevents resonance vibration.

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

#### Safety Note

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

#### Legal Restrictions

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Ordering Information

**Knock Sensor KS4-P**

Mating Connector: 2-Pin RB-Kp.1

Order number **0261.231.173**

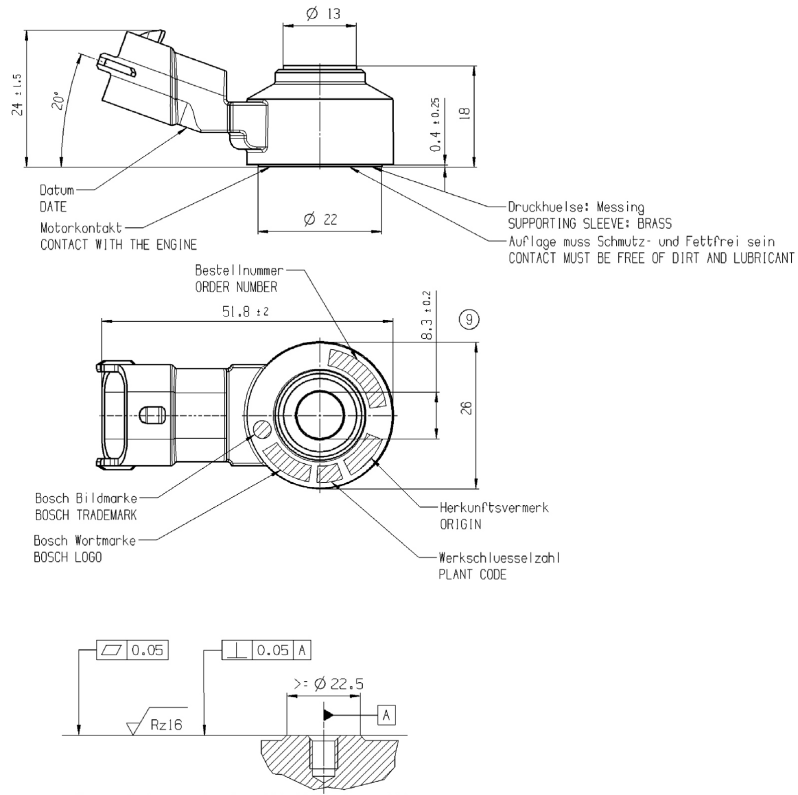
**Knock Sensor KS4-P**

Mating Connector: 2-Pin Jetronic

Order number **0261.231.188**

Dimensions

6



## Knock Sensor KS4-R



### Features

- ▶ Frequency: 3 to 25 kHz
- ▶ Weight: 82 g
- ▶ Height sensor head: 18 mm

This sensor is used for detecting structural born vibrations in spark ignition engines due to uncontrolled combustion. This sensor is suitable for operation in extreme conditions.

Due to the inertia of the seismic mass, the sensor moves in correlation to the engine block vibration; this motion results in a compressive force which is converted into a voltage signal via a piezoceramic sensor element. As a result, upper and lower voltage thresholds can be defined directly correlating to an acceleration magnitude.

The main benefits of this sensor are its robust mechanical design, compact housing and precise determination of structure-related noise. Connection to this sensor can be tailored to customer requirements through specified wire lengths and various connector options.

### Application

Application	3 to 25 kHz
Operating temperature range	-40 to 130°C
Storage temperature range	-30 to 60°C
Max. vibration	≤ 800 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Male thread (for cast)	M8x25
Male thread (for Al)	M8x30
Installation torque	20 ± 5 Nm
Weight w/o wire	82 g

Protection	IP 54
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#### Electrical Data

Range of frequency	3 to 25 kHz
Sensitivity at 5 kHz	28.8 mV/g
Max. sensitivity changing (lifetime)	-17 %
Linearity between 5 to 15 kHz (from 5 kHz value)	-10 to 10 %
Linearity between 15 to 20 kHz (linear increasing with freq)	20 to 50 %
Main resonance frequency	> 30 kHz
Impedance	> 1 MOhm
Temperature dependence of sensitivity	0.04 mV/g°C
Capacity field	1,150 ± 200 pF

#### Connectors and Wires

Connector	A261.230.252
Mating connector 2-pole	2-Pin RB-Kp.1 (D261.205.337-01)
Pin 1	Sig +
Pin 2	Sig -
Sleeve	PUR
Wire size	0.5 mm <sup>2</sup>
Wire length L	530 mm

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.

#### Legal Restrictions

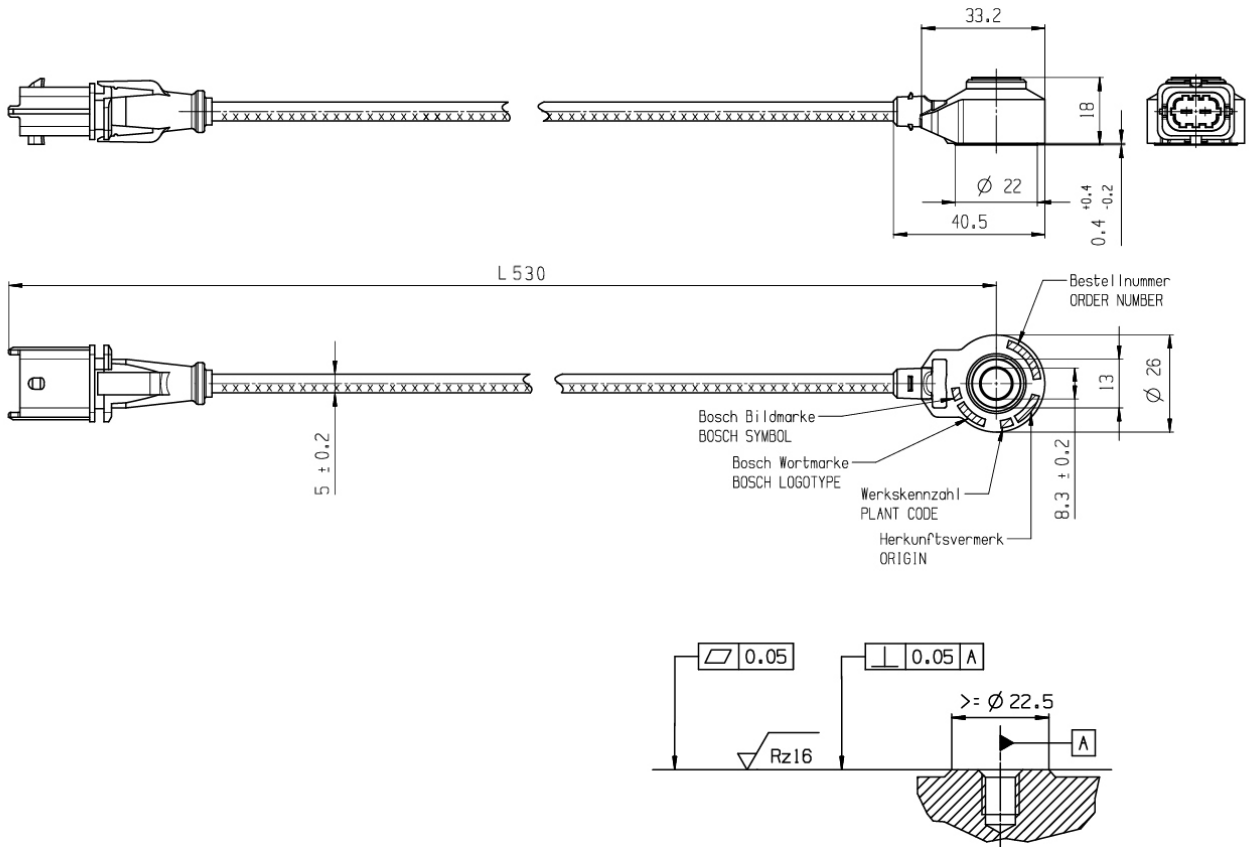
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

Ordering Information

**Knock Sensor KS4-R**  
 Order number **0261.231.218**

Dimensions

6



## Knock Sensor KS4-R2



### Features

- ▶ Frequency: 3 to 30 kHz
- ▶ Weight: 60 g
- ▶ Height sensor head: 14 mm

This sensor is used for detecting structural born vibrations in spark ignition engines due to uncontrolled combustion. This sensor is suitable for operation in extreme conditions.

Due to the inertia of the seismic mass, the sensor moves in correlation to the engine block vibration; this motion results in a compressive force which is converted into a voltage signal via a piezoceramic sensor element. As a result, upper and lower voltage thresholds can be defined directly correlating to an acceleration magnitude.

The main benefits of this sensor are its robust mechanical design, compact housing and precise determination of structure-related noise. This version is an optimized part for Motorsport applications based on a series application development. Compared to the previous version, the advantage of this new modification is that this product has an extended frequency and higher operating temperature rating.

### Application

Application	3 to 30 kHz
Operating temperature range	-40 to 150°C
Storage temperature range	-30 to 60°C
Max. vibration	≤ 800 m/s <sup>2</sup> at 0 to 24 kHz ≤ 4,000 m/s <sup>2</sup> at 5 to 24 kHz (short-term)

### Technical Specifications

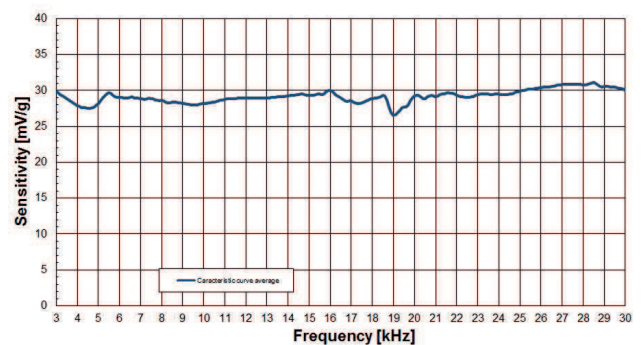
#### Mechanical Data

Fixing screw for cast iron	M8x25
----------------------------	-------

Fixing screw for aluminum	M8x30
Installation torque	20 + 5 Nm
Weight w/o Connector	60 g
Protection	IP 54

#### Electrical Data

Range of frequency	3 to 30 kHz
Max. sensitivity changing (lifetime)	-17 %
Linearity between 5 to 15 kHz (from 5 kHz value)	-10 to 10 %
Linearity between 15 to 20 kHz (linear increasing with freq)	20 to 50 %
Main resonance frequency	> 30 kHz



Ratio of frequency and sensitivity

Impedance	> 1 MOhm
Temperature dependence of sensitivity	0.04 mV/g°C
Capacity field	1,150 ± 200 pF

#### Connectors and Wires

Connector	ASX602-03PC-HE
Mating connector	F02U.002.840-01
ASX002-03SC-HE	
Pin 1	Sig
Pin 2	Gnd
Pin 3	Scr
Sleeve	Elastomer
Wire size	0.5 mm <sup>2</sup>
Wire length L	150 to 450 mm

Various motorsport and automotive connectors on request.

#### Installation Notes

The KS4-R2 can be connected to all Bosch Motorsport ECUs featuring knock control.

The sensor must rest directly on the brass compression sleeve during operation.

To ensure low-resonance coupling of the sensor to the measurement location, the contact surface must be clean and properly machined to provide a secure flush mounting.

Please route the sensor wire in a way that prevents resonance vibration.

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

**Safety Note**

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

**Legal Restrictions**

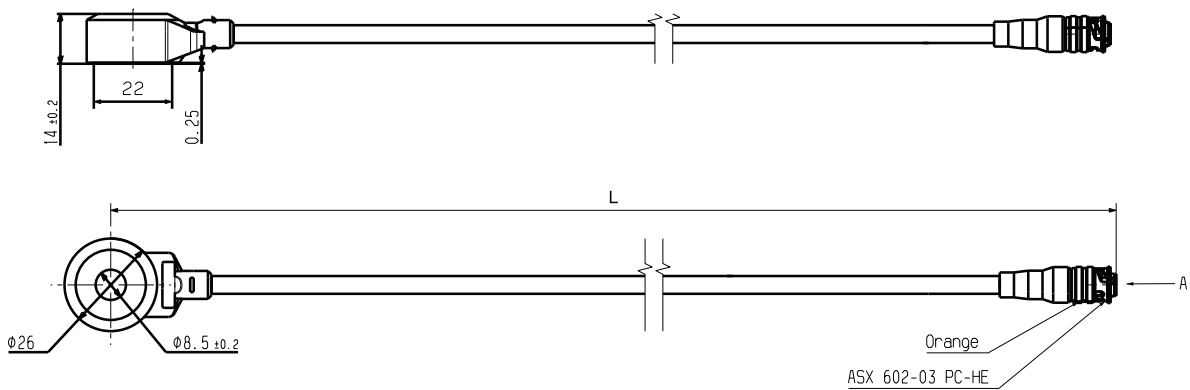
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

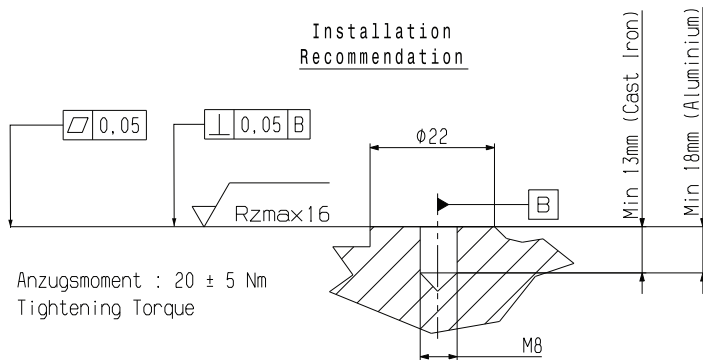
**Knock Sensor KS4-R2**  
Order number **F02U.V01.884-01**

**Dimensions**

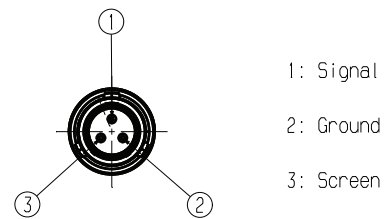
6



**Installation Recommendation**



**Detail A Electrical Connection**



## Overview

### Lambda Sensor Mini-LSU 4.9



- Application: lambda 0.65 to  $\infty$
- Exhaust gas temperature: 930°C (1,030 for a short time)
- Hexagon temperature: 700°C
- Thread: M16x1.5
- Weight w/o wire: 34 g

### Lambda Sensor LSU 4.9



- Application: lambda 0.65 to  $\infty$
- Exhaust gas temperature: 930°C (1,030 for a short time)
- Hexagon temperature: 600°C
- Thread: M18x1.5
- Weight w/o wire: 75 g

### Lambda Sensor LSU ADV



- Application: lambda 0.65 to  $\infty$
- Exhaust gas temperature: 930°C (1,030 for a short time)
- Hexagon temperature: 650°C
- Thread: M18x1.5
- Weight w/o wire: 75 g

### Lambda Sensor LSU ADV pre Turbo



- Application: lambda 0.65 to  $\infty$
- Exhaust gas temperature: 980°C (1,030 for a short time)
- Hexagon temperature: 650°C
- Thread: M18x1.5
- Weight w/o wire: 75 g

## Lambda Sensor Mini-LSU 4.9



6

### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Exhaust gas temperature: 930°C (1,030 for a short time)
- ▶ Hexagon temperature: 700°C
- ▶ Thread: M16x1.5
- ▶ Weight w/o wire: 34 g

This sensor is designed to measure the proportion of oxygen in exhaust gases of automotive engines (gasoline or Diesel).

The wide band lambda sensor Mini-LSU 4.9 is a planar ZrO<sub>2</sub> 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	≤ 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	≤ 700°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	1928.404.682 (Series production type, not available from Bosch Motorsport)
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Mating connector	D261.205.356-01
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Wire length L	950 mm
---------------	--------

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

Connector	AS607-35PN
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Mating connector	AS007-35SN
------------------	------------

Wire length L	200 to 1,400 mm
---------------	-----------------

#### Mechanical Data

Weight w/o wire	34 g
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Thread	M16x1.5
--------	---------

Wrench size	17 mm
-------------	-------

Tightening torque	60 Nm
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#### Electrical Data

Power supply H+ nominal	7.5 V
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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 $\mu$ A
-----------------------------------	-------------

#### Characteristic

Signal output	I <sub>p</sub> meas
---------------	---------------------

Accuracy at lambda 0.8	0.80 ± 0.01
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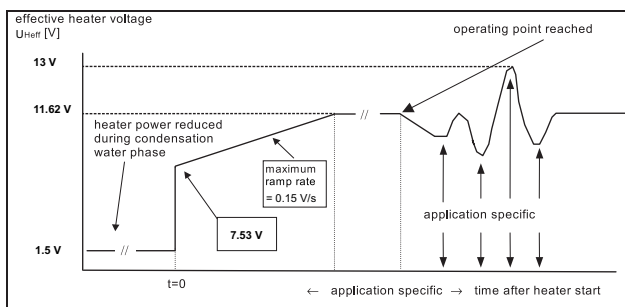
Accuracy at lambda 1	1.016 ± 0.007
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Accuracy at lambda 1.7	1.70 ± 0.05
------------------------	-------------

$I_p$ [mA]	lambda	$U_A$ [V], v=17	$U_A$ [V], v=8
-2.000	0.650	-	0.510
-1.602	0.700	-	0.707
-1.243	0.750	0.192	0.884
-0.927	0.800	0.525	1.041
-0.800	0.822	0.658	1.104
-0.652	0.850	0.814	1.177
-0.405	0.900	1.074	1.299
-0.183	0.950	1.307	1.409
-0.106	0.970	1.388	1.448
-0.040	0.990	1.458	1.480
0	1.003	1.500	1.500
0.015	1.010	1.515	1.507
0.097	1.050	1.602	1.548
0.193	1.100	1.703	1.596
0.250	1.132	1.763	1.624
0.329	1.179	1.846	1.663
0.671	1.429	2.206	1.832
0.938	1.701	2.487	1.964
1.150	1.990	2.710	2.069
1.385	2.434	2.958	2.186
1.700	3.413	3.289	2.342
2.000	5.391	3.605	2.490
2.150	7.506	3.762	2.565
2.250	10.119	3.868	2.614

**Please note:**  $U_A$  is not an output signal of the lambda sensor, but the output of the evaluation circuit. Only  $I_p$  correlates with the oxygen content of the exhaust gas. Amplification factor  $v=17$  is typically used for lean applications ( $\lambda > 1$ ), amplification factor  $v=8$  is typically used for rich applications ( $\lambda < 1$ ).

### Heater Strategy



### Resistance/LSU Temperature

R (Ohm)	Temp (°C)
80	1030
150	888
200	840
250	806
300 [operating point]	780
350	761

400	744
450	729
550	703
650	686
800	665
1000	642
1200	628
2500	567

### Connectors and Wires

Connector	Please see variations
Mating connector	Please see variations
Sleeve	fiber glass / silicone coated
Pin 1	Pump current APE / IP
Pin 2	Virtual ground IPN / VM
Pin 3	Heater voltage H- / Uh-
Pin 4	Heater voltage H+ / Uh+
Pin 5	Trim resistor RT / IA
Pin 6	Nernst voltage UN / RE
Wire length	Please see variations

Various motorsport and automotive connectors are available on request.

### Installation Notes

This lambda sensor operates only in combination with a special LSU-IC, used in most Bosch Motorsport ECUs and lambda control units like LT4. You'll find this unit and more on our homepage at Accessories/Expansion Modules.

The lambda sensor should be installed at point which permits the measurement of a representative exhaust-gas mixture and which does not exceed the maximum permissible temperature.

Install at a point where the gas is as hot as possible.

Observe the maximum permissible temperature.

Sensors should be installed as close to vertical as possible (wire upwards).

The sensor is not to be fitted near to the exhaust pipe outlet, so that the influence of the outside air can be ruled out.

The exhaust system up stand and surrounding the sensor must be sealed in order to avoid the effects of leakage air.

Protect the sensor against condensation water. The sensor is not to be painted, nor is wax to be applied or any other forms of treatment. Use only the recommended grease for lubricating the thread.

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

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

**Safety Note**

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

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

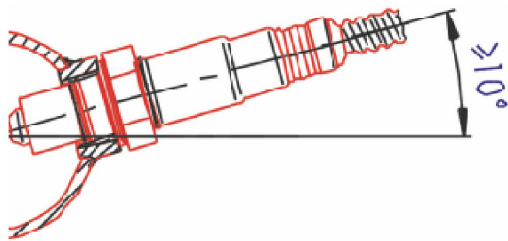
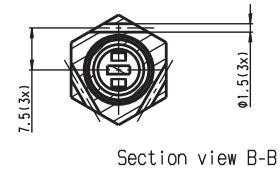
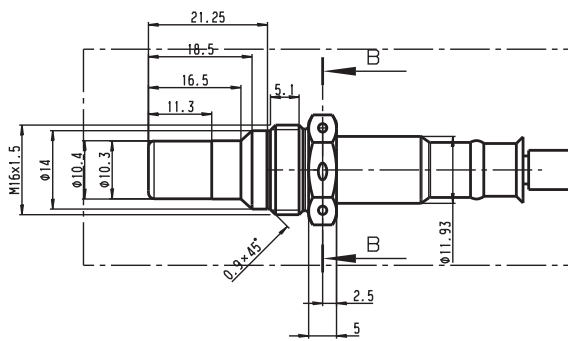
**Ordering Information**

**Lambda Sensor Mini-LSU 4.9**  
 With automotive connector  
 Order number **B258.490.103-30**

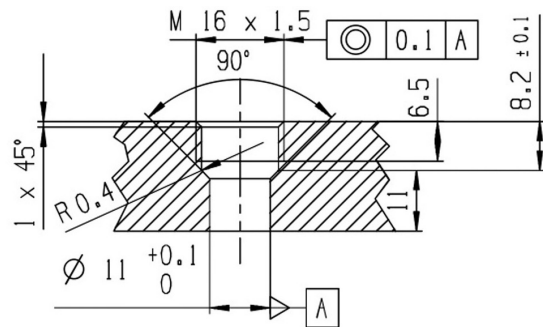
**Lambda Sensor Mini-LSU 4.9**  
 With motorsport connector  
 Order number **F02U.V02.227-02**

**Dimensions**

6



Mounting recommendation



WRENCH SIZE / Schlüsselweite: 17  
 TIGHTENING TORQUE / Anzugsmoment: 60Nm

## Lambda Sensor LSU 4.9



### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Exhaust gas temperature: 930°C (1,030 for a short time)
- ▶ Hexagon temperature: 600°C
- ▶ Thread: M18x1.5
- ▶ Weight w/o wire: 75 g

This sensor is designed to measure the proportion of oxygen in exhaust gases of automotive engines (gasoline or Diesel).

The wide band lambda sensor LSU 4.9 is a planar  $ZrO_2$  dual cell limiting current sensor with integrated heater. Its monotonic output signal in the range of lambda 0.65 to air makes the LSU 4.9 capable of being used as a universal sensor for lambda 1 measurement as well as for other lambda ranges. The connector module contains a trimming resistor, which defines the characteristic of the sensor.

The main benefit of the LSU 4.9 is the robust design combined with the high Bosch production quality standard.

This lambda sensor operates only in combination with a special LSU-IC, used in most Bosch Motorsport ECUs and lambda control units like LT4. You'll find this unit and more on our homepage at Electronics/Sensor Interfaces.

### Application

Application	lambda 0.65 to $\infty$
Fuel compatibility	gasoline/Diesel/E85
Exhaust gas pressure	$\leq 2.5$ bar (higher with decrease accuracy)
Exhaust gas temperature range (operating)	$< 930^\circ\text{C}$

Exhaust gas temperature range (max.) for short time	$< 1,030^\circ\text{C}$
Hexagon temperature	$< 600^\circ\text{C}$
Wire and protective sleeve temperature	$< 250^\circ\text{C}$
Connector temperature	$< 140^\circ\text{C}$
Storage temperature range	$-40$ to $100^\circ\text{C}$
Max. vibration (stochastic peak level)	$300 \text{ m/s}^2$

### Technical Specifications

#### Variations

##### LSU 4.9 with automotive connector

Connector	1928.404.687 (Series production type, not available from Bosch Motorsport)
-----------	-------------------------------------------------------------------------------

Mating connector	D261.205.356-01
------------------	-----------------

Wire length L	95.0 cm
---------------	---------

##### LSU 4.9 with motorsport connector

Connector	AS607-35PN
-----------	------------

Mating connector	AS007-35SN
------------------	------------

Wire length L	20.0 to 90.0 cm
---------------	-----------------

#### Mechanical Data

Weight w/o wire	75 g
-----------------	------

Thread	M18x1.5
--------	---------

Wrench size	22 mm
-------------	-------

Tightening torque	40 to 60 Nm
-------------------	-------------

#### Electrical Data

Power supply H+ nominal	7.5 V
-------------------------	-------

System supply voltage	10.8 V to 16.5 V
-----------------------	------------------

Heater power steady state	7.5 W
---------------------------	-------

Heater control frequency	$\geq 100$ Hz
--------------------------	---------------

Nominal resistance of Nernst cell	300 Ohm
-----------------------------------	---------

Max current load for Nernst cell	250 $\mu\text{A}$
----------------------------------	-------------------

#### Characteristic

Signal output	$I_p$ meas
---------------	------------

Accuracy at lambda 0.8	$0.80 \pm 0.01$
------------------------	-----------------

Accuracy at lambda 1	$1.016 \pm 0.007$
----------------------	-------------------

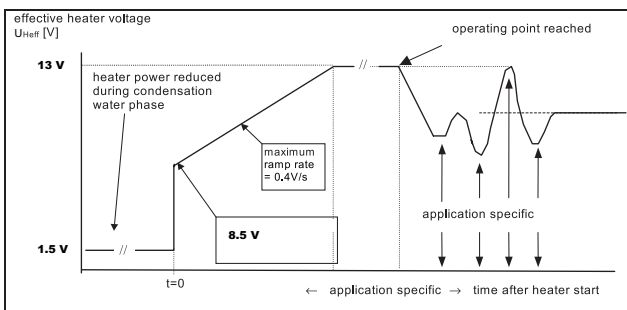
Accuracy at lambda 1.7	$1.70 \pm 0.05$
------------------------	-----------------

$I_p$ [mA]	lambda	$U_A$ [V], v=17	$U_A$ [V], v=8
-2.000	0.650	-	0.510
-1.602	0.700	-	0.707
-1.243	0.750	0.192	0.884
-0.927	0.800	0.525	1.041
-0.800	0.822	0.658	1.104

-0.652	0.850	0.814	1.177
-0.405	0.900	1.074	1.299
-0.183	0.950	1.307	1.409
-0.106	0.970	1.388	1.448
-0.040	0.990	1.458	1.480
0	1.003	1.500	1.500
0.015	1.010	1.515	1.507
0.097	1.050	1.602	1.548
0.193	1.100	1.703	1.596
0.250	1.132	1.763	1.624
0.329	1.179	1.846	1.663
0.671	1.429	2.206	1.832
0.938	1.701	2.487	1.964
1.150	1.990	2.710	2.069
1.385	2.434	2.958	2.186
1.700	3.413	3.289	2.342
2.000	5.391	3.605	2.490
2.150	7.506	3.762	2.565
2.250	10.119	3.868	2.614

**Please note:**  $U_A$  is not an output signal of the lambda sensor, but the output of the evaluation circuit. Only  $I_p$  correlates with the oxygen content of the exhaust gas. Amplification factor  $v=17$  is typically used for lean applications ( $\lambda > 1$ ), amplification factor  $v=8$  is typically used for rich applications ( $\lambda < 1$ ).

### Heater Strategy



### Connectors and Wires

Connector	Please see variations
Mating connector	Please see variations
Sleeve	fiber glass / silicone coated
Pin 1	Pump current APE / IP
Pin 2	Virtual ground IPN / VM
Pin 3	Heater voltage H- / Uh-
Pin 4	Heater voltage H+ / Uh+
Pin 5	Trim resistor RT / IA

Pin 6	Nernst voltage UN / RE
Wire length	Please see variations
Various motorsport and automotive connectors are available on request.	

### Installation Notes

This lambda sensor operates only in combination with a special LSU-IC, used in most Bosch Motorsport ECUs and lambda control units like LT4. You'll find this unit and more on our homepage at Accessories/Expansion Modules.

The lambda sensor should be installed at point which permits the measurement of a representative exhaust-gas mixture, which does not exceed the maximum permissible temperature.

Install at a point where the gas is as hot as possible.

Observe the maximum permissible temperature.

As far as possible install the sensor vertically (wire upwards).

The sensor is not to be fitted near to the exhaust pipe outlet, so that the influence of the outside air can be ruled out.

The exhaust-gas passage opposite the sensor must be free of leaks in order to avoid the effects of leak-air.

Protect the sensor against condensation water.

The sensor is not to be painted, nor is wax to be applied or any other forms of treatment. Use only the recommended grease for lubricating the thread.

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

### Safety Note

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

### Legal Restrictions

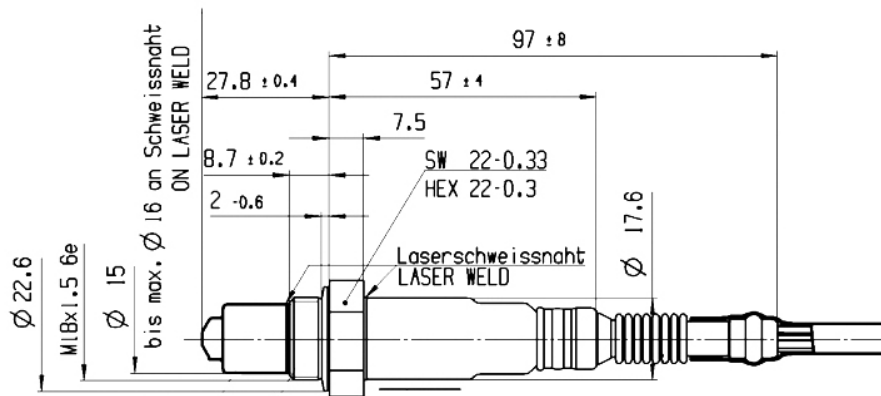
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

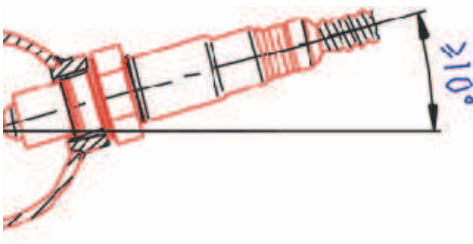
**Lambda Sensor LSU 4.9**  
With automotive connector  
Order number **0258.017.025**

**Lambda Sensor LSU 4.9**  
With motorsport connector  
Order number **B261.209.358-03**

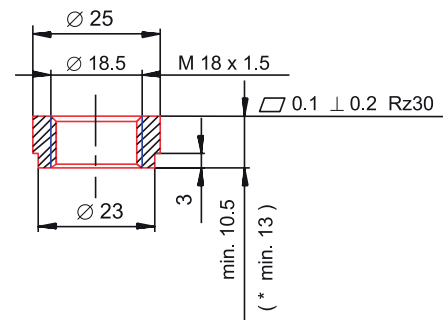
## Dimensions



Mounting recommendation



Recommended design of the mating thread in the exhaust pipe:  
 THexagon > 600°C  
 or TGas > 930°C



## Lambda Sensor LSU ADV



6

### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Exhaust gas temperature: 930°C (1,030 for a short time)
- ▶ Hexagon temperature: 650°C
- ▶ Thread: M18x1.5
- ▶ Weight w/o wire: 75 g

This sensor is designed to measure the proportion of oxygen in exhaust gases of automotive engines (gasoline or Diesel).

The wide band lambda sensor LSU 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)	$\leq 930^\circ\text{C}$
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 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

#### Mechanical Data

Weight w/o wire	75 g
Thread	M18x1.5
Wrench size	22 mm
Tightening torque	40 to 60 Nm

#### Electrical Data

Power supply H+ nominal	7.5 V
System supply voltage	10.8 V to 16.5 V
Heater power steady state	8.7 W
Heater control frequency	$\geq 100$ Hz
Nominal resistance of Nernst cell	300 Ohm
Max current load for Nernst cell	$\leq 80$ $\mu\text{A}$
Switch-on time	$\leq 5$ s

#### Characteristic

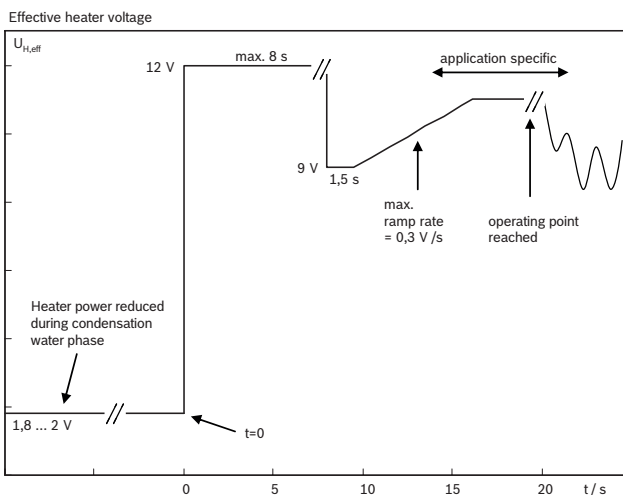
Signal output	$I_p$ meas
Accuracy at lambda 0.8	$-0.652 \pm 0.032$ mA
Accuracy at lambda 1	$-0.018 \pm 0.008$ mA
Accuracy at lambda 1.7	$0.515 \pm 0.022$ mA

$I_p$ [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

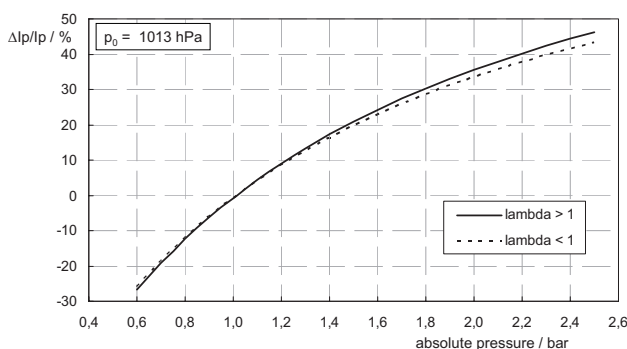
0.03278	1.050	1.534	1.516
0.06444	1.080	1.568	1.532
0.08556	1.100	1.590	1.542
0.17000	1.180	1.679	1.584
0.23080	1.260	1.743	1.614
0.36000	1.430	1.879	1.678
0.40148	1.500	1.922	1.699
0.52000	1.700	2.047	1.758
0.54740	1.780	2.076	1.771
0.77000	2.430	2.310	1.881
1.40000	5.000	2.973	2.193

**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

#### LSU ADV with automotive connector

Connector	1 928 404 669 (Series production type, not available from Bosch Motorsport)
Mating connector	F02U.B00.725-01
Pin 1	IP/APE
Pin 2	VM/IPN

Pin 3	Uh-/H-
Pin 4	Uh+ / H+
Pin 5	nc
Pin 6	UN/RE
Wire length L	95.0 cm
Please specify the required wire length with your order.	
Sleeve	fiber glass / silicone coated
Various motorsport and automotive connectors are available on request.	

### Installation Notes

This lambda sensor operates only in combination with a special evaluation unit used in lambda control unit LT4 ADV. You'll find this unit and more on our homepage at Accessories/Expansion Modules.

The lambda sensor should be installed at a 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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

Ordering Information

**Lambda Sensor LSU ADV**

Automotive connector, wire length 95 cm  
 Order number **0258.027.010**

**Lambda Sensor LSU ADV**

Motorsport connector, wire length customer specific (max. 90 cm)  
 Order number **F02U.V01.861-01**

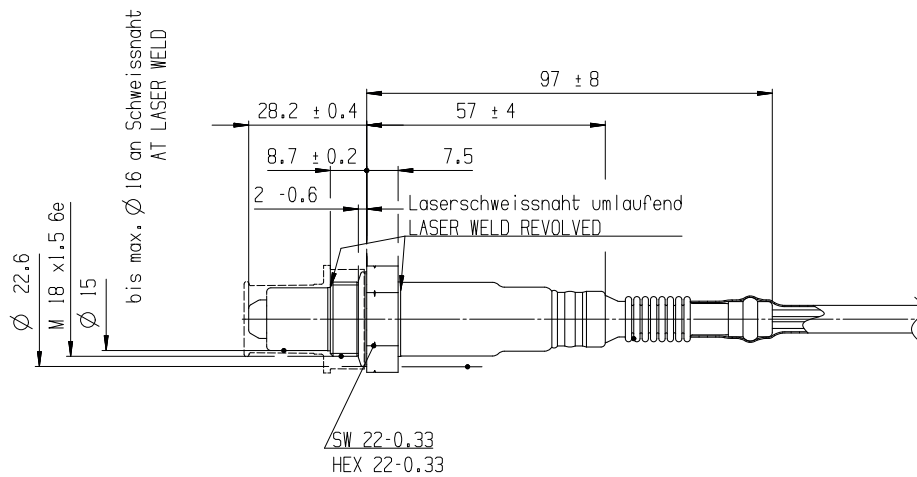
**Lambda Sensor LSU ADV pre Turbo**

Automotive connector, wire length 65 cm  
 Order number **0258.027.00F**

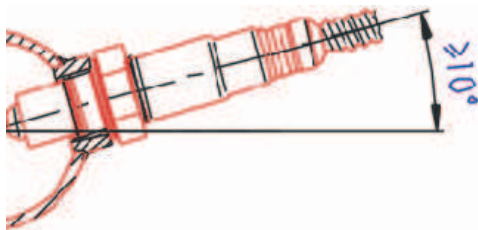
**Lambda Sensor LSU ADV pre Turbo**

Motorsport connector, wire length 33 cm  
 Order number **F02U.V02.908-02**

Dimensions

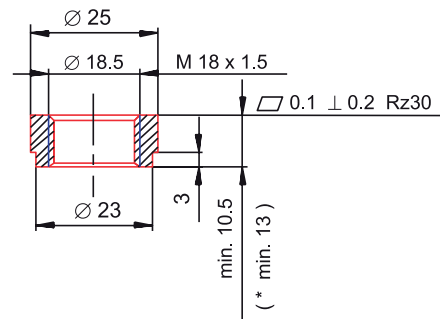


Mounting recommendation



Recommended design of the mating thread in the exhaust pipe

\*: THexagon > 600°C or  
 TGas > 930°C



## Lambda Sensor LSU ADV pre Turbo



### Features

- ▶ Application: lambda 0.65 to  $\infty$
- ▶ Exhaust gas temperature: 980°C (1,030 for a short time)
- ▶ Hexagon temperature: 650°C
- ▶ Thread: M18x1.5
- ▶ Weight w/o wire: 75 g

This sensor is designed to measure the proportion of oxygen in exhaust gases of automotive engines (gasoline or Diesel). It has a protection tube of Inconel for pre-turbo-(supercharger) mounting.

The wide band lambda sensor LSU ADV pre Turbo 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 pre Turbo capable of being used as a universal sensor for lambda 1 measurement as well as for other lambda ranges.

The LSU ADV pre Turbo has no trimming resistor inside the connector what results in just 5 connector pins. Compared to LSU 4.9, the LSU ADV pre Turbo has a wider working temperature range.

LSU ADV pre Turbo 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)	$\leq 980^\circ\text{C}$
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	$\leq 820^\circ\text{C}$
Max. temperature difference between hexagon and welding seam	$\leq 330^\circ\text{C}$
Wire and protective sleeve temperature	$\leq 250^\circ\text{C}$
Connector temperature	$\leq 140^\circ\text{C}$
Storage temperature range	$-40$ to $100^\circ\text{C}$
Max. vibration (stochastic peak level)	$300 \text{ m/s}^2$

### Technical Specifications

#### Mechanical Data

Weight w/o wire	75 g
Thread	M18x1.5
Wrench size	22 mm
Tightening torque	40 to 60 Nm

#### Electrical Data

Power supply H+ nominal	7.5 V
System supply voltage	10.8 V to 16.5 V
Heater power steady state	8.7 W
Heater control frequency	$\geq 100$ Hz
Nominal resistance of Nernst cell	300 Ohm
Max current load for Nernst cell	$\leq 80 \mu\text{A}$
Switch-on time	$\leq 5$ s

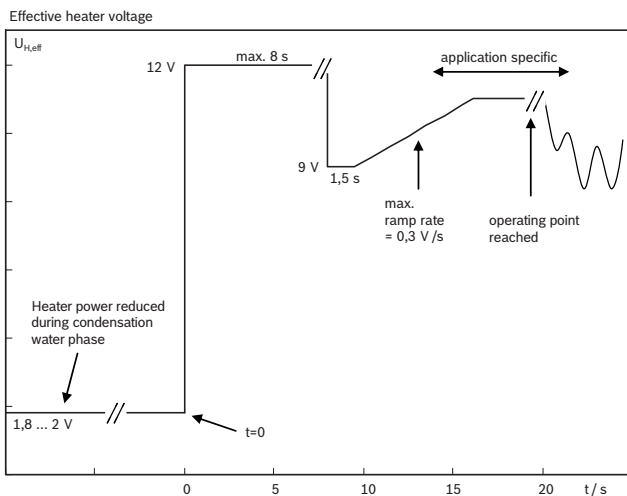
#### Characteristic

Signal output	$I_p$ meas		
Accuracy at lambda 0.8	$-0.652 \pm 0.032 \text{ mA}$		
Accuracy at lambda 1	$-0.018 \pm 0.008 \text{ mA}$		
Accuracy at lambda 1.7	$0.515 \pm 0.022 \text{ mA}$		
$I_p$ [mA]	lambda	$U_A$ [V], v=17	$U_A$ [V], v=8
-1.38000	0,650	0,048	0,817
-1.11000	0.700	0.332	0.950
-0.88000	0.750	0.574	1.064
-0.65000	0.800	0.816	1.178
-0.47500	0.850	1.000	1.265
-0.37000	0.880	1.111	1.317

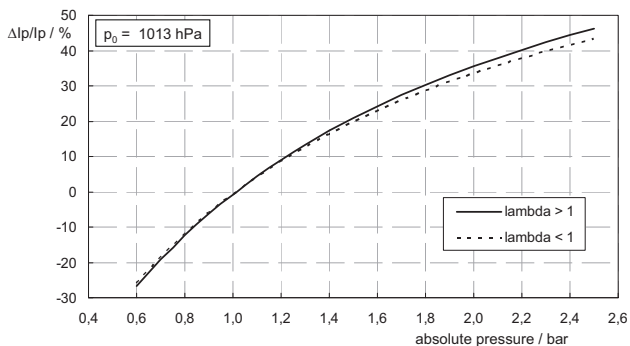
-0.30000	0.900	1.184	1.351
-0.16000	0.950	1.332	1.421
-0.07600	0.980	1.420	1.462
-0.04800	0.990	1.449	1.476
-0.02000	1.000	1.479	1.490
0.01167	1.030	1.512	1.506
0.03278	1.050	1.534	1.516
0.06444	1.080	1.568	1.532
0.08556	1.100	1.590	1.542
0.17000	1.180	1.679	1.584
0.23080	1.260	1.743	1.614
0.36000	1.430	1.879	1.678
0.40148	1.500	1.922	1.699
0.52000	1.700	2.047	1.758
0.54740	1.780	2.076	1.771
0.77000	2.430	2.310	1.881
1.40000	5.000	2.973	2.193

**Please note:** UA is not an output signal of the lambda sensor, but the output of the evaluation circuit. Only IP correlates with the oxygen content of the exhaust gas. Amplification factor  $v=17$  is typically used for lean applications ( $\lambda > 1$ ), amplification factor  $v=8$  is typically used for rich applications ( $\lambda < 1$ ).

### Heater Strategy



### Pressure Compensation



### Connectors and Wires

#### LSU ADV pre Turbo with automotive connector

Connector	1254.488.136 (Series production type, not available from Bosch Motorsport)
Mating connector	F02U.B00.937-01
Pin 1	IP/APE
Pin 2	VM/IPN
Pin 3	Uh- / H-
Pin 4	Uh+ / H+
Pin 5	UN / RE

#### LSU ADV pre Turbo with motorsport connector

Connector	AS607-35PA
Mating connector	AS007-35SA
Pin 1	Uh+ / H
Pin 2	Uh- / H-
Pin 3	IP / APE
Pin 4	VM / IPN
Pin 5	UN / RE
Pin 6	nc

Please specify the required wire length with your order.

Sleeve fiber glass / silicone coated

Various motorsport and automotive connectors are available on request.

### Installation Notes

This lambda sensor operates only in combination with a special evaluation unit used in lambda control unit LT4 ADV. You'll find this unit and more on our homepage at Accessories/Expansion Modules.

The lambda sensor should be installed at a 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.

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

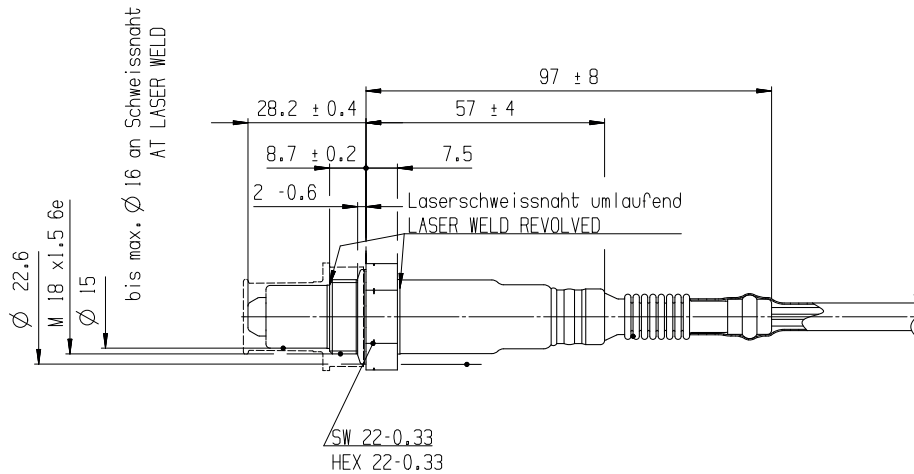
### Lambda Sensor LSU ADV pre Turbo

Automotive connector, wire length 65 cm  
Order number **0258.027.00F**

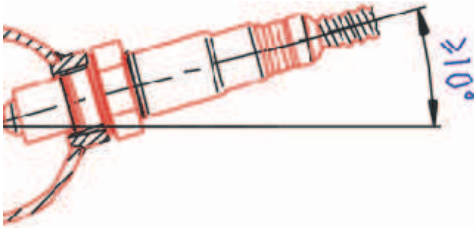
### Lambda Sensor LSU ADV pre Turbo

Motorsport connector, wire length 33 cm  
Order number **F02U.V02.908-02**

## Dimensions

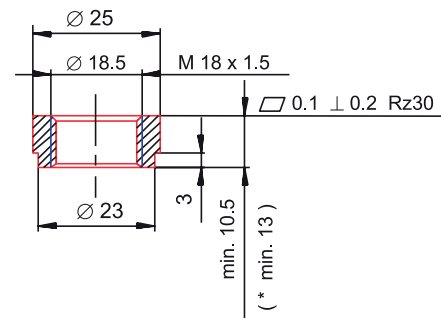


## Mounting recommendation



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

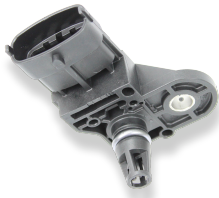
\*: THexagon  $> 600^{\circ}\text{C}$  or  
TGas  $> 930^{\circ}\text{C}$



## Overview

6

### Pressure Sensor Combined PST 1



- Pressure: 0.1 to 1.15 bar
- Temperature: -40 to 130°C
- Power supply: 5 V
- Weight: 24 g

### Pressure Sensor Combined PST 3



- Pressure: 0.2 to 3 bar
- Temperature: -40 to 130°C
- Power supply: 5 V
- Weight: 24 g

### Pressure Sensor Combined PST 4



- Pressure: 0.4 to 4 bar
- Temperature: -40 to 130°C
- Power supply: 5 V
- Weight: 22 g

### Pressure Sensor Combined PST-F 1



- Pressure: 0 to 10 bar
- Temperature: -40 to 150°C
- Power supply: 5 V
- Weight: 38 g

### Pressure Sensor Combined PST-F 2 280 bar



- Pressure: 0 to 280 bar
- Temperature: -40 to 140°C
- Power supply: 5 V
- Weight: 36 g

### Pressure Sensor Combined PST-F 2 350 bar



- Pressure: 0 to 350 bar
- Temperature: -40 to 140°C
- Power supply: 5 V
- Weight: 36 g

## Pressure Sensor Combined PST 1



### Features

- ▶ Pressure: 0.1 to 1.15 bar
- ▶ Temperature: -40 to 130°C
- ▶ Power supply: 5 V
- ▶ Weight: 24 g

This sensor is designed to measure absolute air pressure, especially the air box pressure of gasoline or Diesel engines plus temperature.

An integrated circuit combines a piezo-resistive sensor element and electronic systems for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal.

### Application

Application 1	0.1 to 1.15 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

#### Mechanical Data

Mounting	M6
Fitting	12.05 ± 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

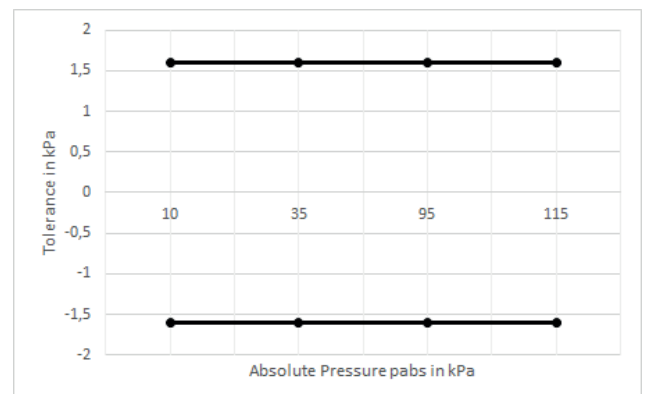
#### Characteristic 1

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5 V$	± 0.016 bar
Tolerance (FS)	± 1.52 %
Sensitivity	4,048 mV/bar
Offset	-4.76 mV

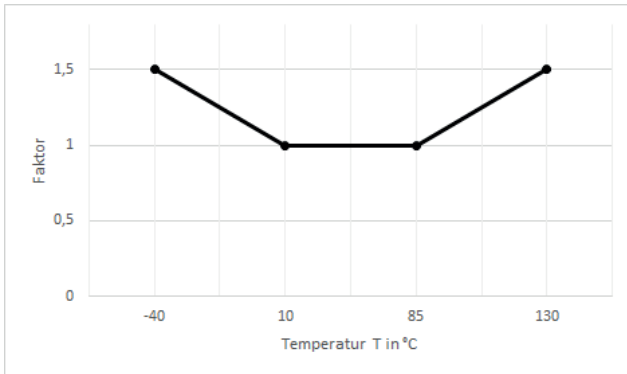
#### Characteristic 2

T [°C]	R [Ohm]
-40	45,303
-30	26,108
-20	15,458
-10	9,395
0	5,895
10	3,791
20	2,499
25	2,056
30	1,706
40	1,174
50	833.8
60	595.4
70	435.6
80	322.5
90	243.1
100	186.6
110	144.2
120	112.7
130	89.28

#### Tolerance



## Expansion of Tolerance



## Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.360-01
Pin 1	Ground
Pin 2	Temperature Signal
Pin 3	Power Supply
Pin 4	Pressure Signal

Various motorsport and automotive connectors are available on request.

## Installation Notes

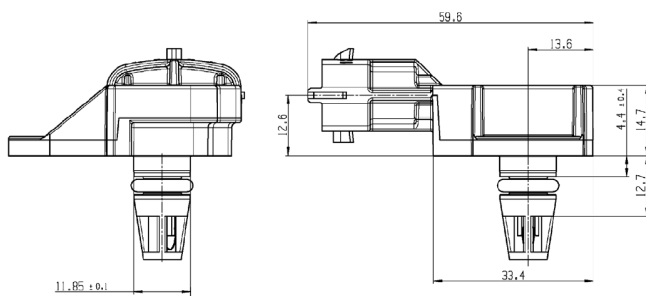
This sensor is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

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).

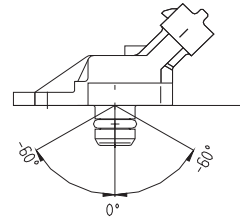
## Dimensions



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.

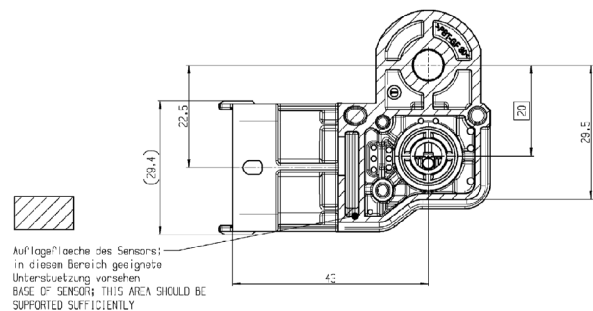
## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

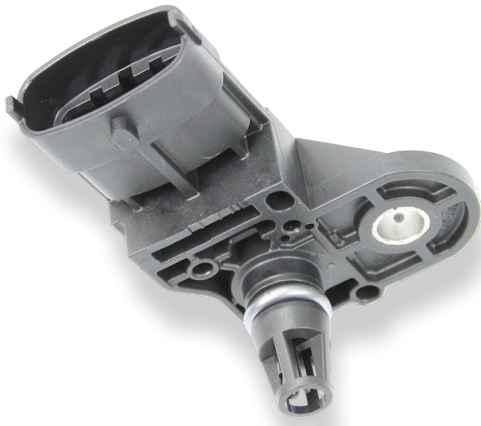
## Ordering Information

### Pressure Sensor Combined PST 1

Order number **0261.230.333**



## Pressure Sensor Combined PST 3



### Features

- ▶ Pressure: 0.2 to 3 bar
- ▶ Temperature: -40 to 130°C
- ▶ Power supply: 5 V
- ▶ Weight: 24 g

This sensor is designed to measure absolute air pressure, especially the air box pressure of gasoline or Diesel engines plus temperature.

An integrated circuit combines a piezo-resistive sensor element and electronic systems for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal.

### Application

Application 1	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

#### Mechanical Data

Mounting	M6
Fitting	12.05 ± 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

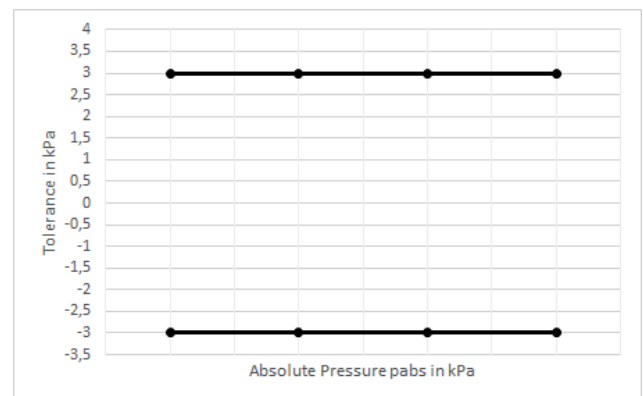
#### Characteristic 1

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5 V$	± 0.030 bar
Tolerance (FS)	± 1.07 %
Sensitivity	1,518 mV/bar
Offset	96.43 mV

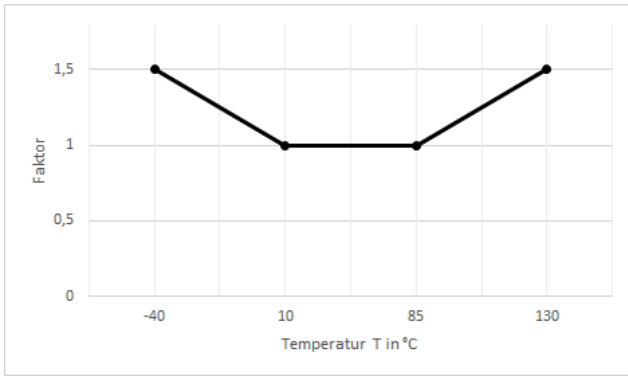
#### Characteristic 2

T [°C]	R [Ohm]
-40	45,303
-30	26,108
-20	15,458
-10	9,395
0	5,895
10	3,791
20	2,499
25	2,056
30	1,706
40	1,174
50	833.8
60	595.4
70	435.6
80	322.5
90	243.1
100	186.6
110	144.2
120	112.7
130	89.28

#### Tolerance



**Expansion of Tolerance**



**Connectors and Wires**

Connector	Bosch Compact
Mating connector	D261.205.360-01
Pin 1	Ground
Pin 2	Temperature Signal
Pin 3	Power Supply
Pin 4	Pressure Signal

Various motorsport and automotive connectors are available on request.

**Installation Notes**

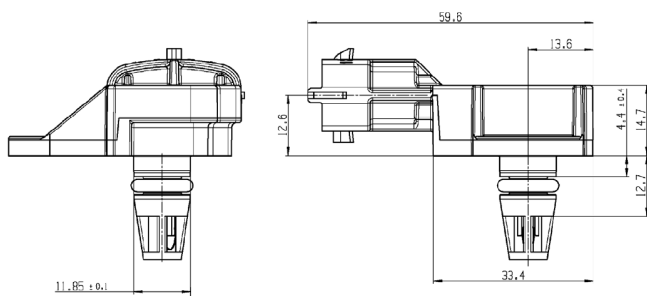
This sensor is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

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

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

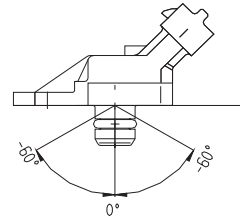
**Dimensions**



Avoid miss-pinning (max. 5 minutes at  $I = 0.3 \text{ A}$ ).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $\pm 60^\circ$ .



**Safety Note**

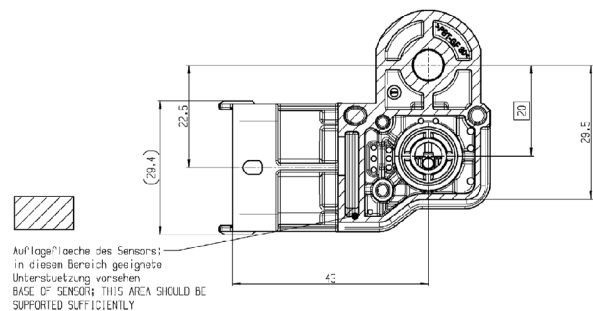
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Legal Restrictions**

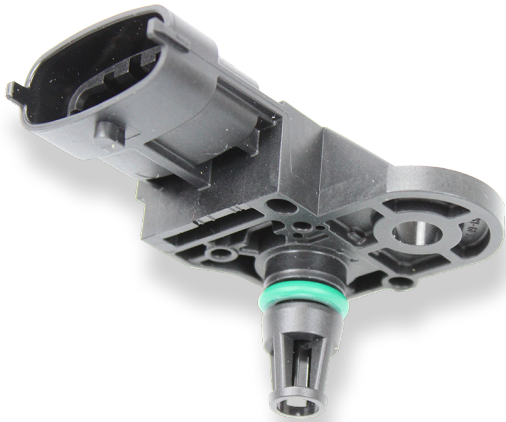
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Pressure Sensor Combined PST 3**  
Order number **0261.230.280**



## Pressure Sensor Combined PST 4



### Features

- ▶ Pressure: 0.4 to 4 bar
- ▶ Temperature: -40 to 130°C
- ▶ Power supply: 5 V
- ▶ Weight: 22 g

This sensor is designed to measure absolute air pressure, especially the air box pressure of gasoline or Diesel engines plus temperature.

An integrated circuit combines a piezo-resistive sensor element and electronic systems for signal-amplification and temperature-compensation. The output of the sensor is an analog, ratio metric signal.

### Application

Application 1	0.4 to 4 bar (a)
Application 2	-40 to 130°C
Reference	Absolute
Max. pressure	6 bar
Operating temp. range	-40 to 130°C
Media temp. range	-40 to 130°C
Storage temp. range	0 to 40°C
Max. vibration	According to ISO 16750-3

### Technical Specifications

#### Mechanical Data

Mounting	M6 + Washer
Weight without wire	22 g
Fitting	12.05 ± 0.8 mm
Sealing	O-ring 7.59 x 2.62 mm

#### Electrical Data

Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V
Full scale output $U_A$	0.386 to 4.5 V
Current $I_s$	12 mA

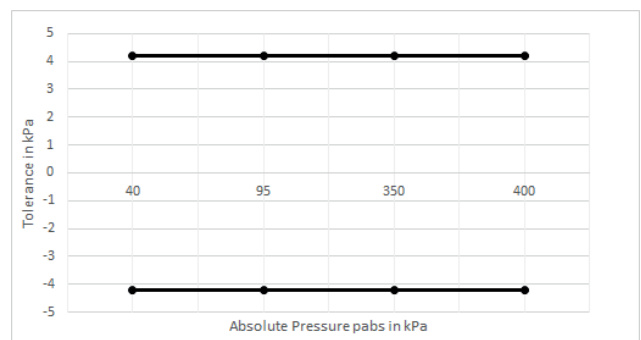
#### Characteristic 1

Response time T10/90	1 ms
Compensated range	10 to 85°C
Tolerance (FS) at $U_s = 5$ V	0.042 bar
Sensitivity	1,143 mV/bar
Offset	-71.43 mV

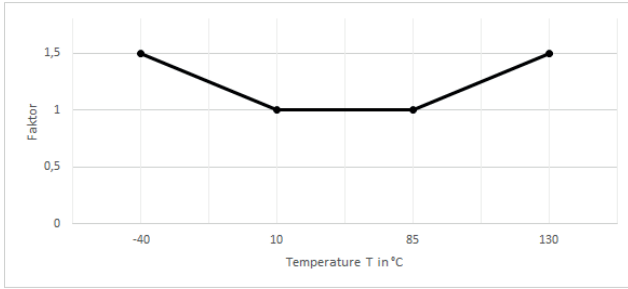
#### Characteristic 2

T [°C]	R [Ohm]
-40	45,303
-30	26,108
-20	15,458
-10	9,395
0	5,895
10	3,791
20	2,499
25	2,056
30	1,706
40	1,174
50	833.8
60	595.4
70	435.6
80	322.5
90	243.1
100	186.6
110	144.2
120	112.7
130	89.28

#### Tolerance



**Expansion of Tolerance**



**Connectors and Wires**

Connector	Bosch Compact
Mating connector	D261.205.360-01
Pin 1	Ground
Pin 2	Temperature Signal
Pin 3	Power Supply
Pin 4	Pressure Signal

**Installation Notes**

The PST 4 is designed for engines using ROZ95, ROZ98, M15, E22 and Diesel.

The sensor can be connected directly to most control units.

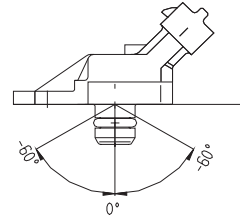
To avoid noise, an ECU-input circuit with a RC-low pass filter ( $\tau = 2 \text{ ms}$ ) is recommended.

Use engine oil (5W40) as O-Ring grease (no silicone based grease).

Avoid miss-pinning (max. 5 minutes at  $I = 0.3 \text{ A}$ ).

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

To avoid damage caused by condensate the maximum mounting position from vertical is  $\pm 60^\circ$ .



**Safety Note**

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

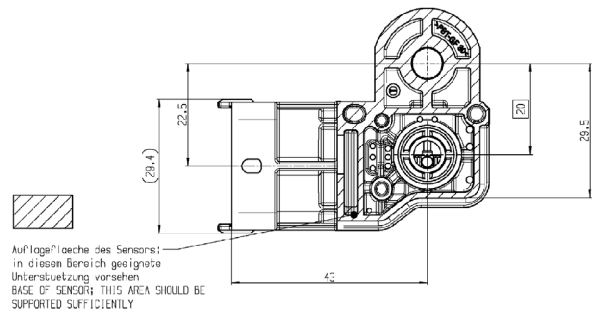
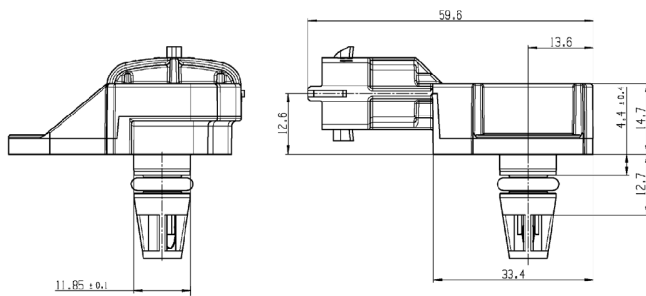
**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Pressure Sensor Combined PST 4**  
Order number **0261.230.423**

**Dimensions**



## Pressure Sensor Combined PST-F 1



### Features

- ▶ Pressure: 0 to 10 bar
- ▶ Temperature: -40 to 150°C
- ▶ Power supply: 5 V
- ▶ Weight: 38 g

This sensor is designed to measure relative gasoline pressure and gasoline temperature in port injection systems.

The pressure measurement of the sensor is by means of a piezoresistive element which is acted on by a silicon diaphragm in contact with the fluid being measured. The reference (relative) pressure is provided via an opening in the sensor housing and acts on the active upper side of the silicon diaphragm.

### Application

Application 1	0 to 10 bar (rel)
Application 2	-40 to 150°C
Reference	Relative
Max. pressure	20 bar max 15 min
Burst pressure (static)	40 bar
Operating temp. range	-40 to 150°C (160°C max 250 h)
Storage temp. range	-30 to 60°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
Vibration testing	according to DIN EN ISO 60068-2-6 (2008-10)
Amplitude of deflection	s=0,35 mm at 70 to 147 Hz

Amplitude of acceleration a	a=300 m/s <sup>2</sup> at 147 to 2,000Hz
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### Technical Specifications

#### Mechanical Data

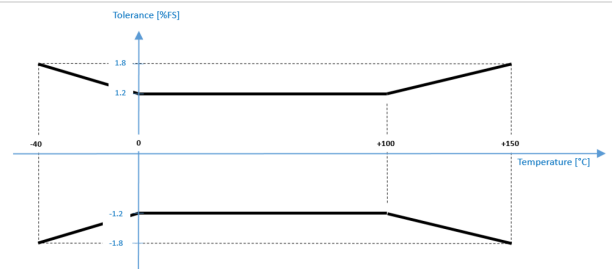
Male thread	M10x1
Weight without wire	38 g
Wrench size	27 mm
Installation torque	24 Nm
Sealing	Sealed cone

#### 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, 1 h max)
Full scale output U <sub>A</sub>	0.5 to 4.5 V U <sub>S</sub> ratiometric
Current I <sub>S</sub>	12.5 mA

#### Characteristic 1

Response time U <sub>out</sub> when U <sub>S</sub> is switched-on t <sub>10/90</sub>	2.0 ms
Jump response time to pressure changes U <sub>out</sub>	0.8 ms
Compensated range	-40 to 150°C
Tolerance (FS) at U <sub>S</sub>	+/-1.2 % at 0 to 100°C

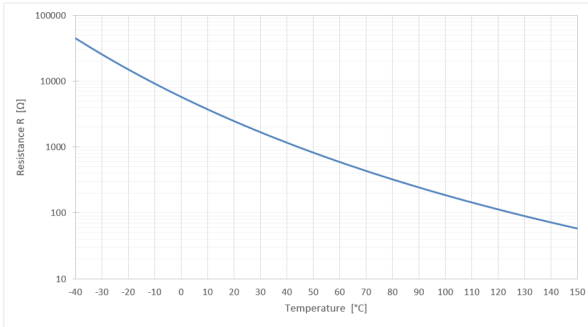


Sensitivity	400 mV/bar at U <sub>S</sub> = 5 V
Offset	500 mV at U <sub>S</sub> = 5 V

#### Characteristic 2

Response time t <sub>10/90</sub>	9 s (meas. in oil, 20 to 100°C)
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

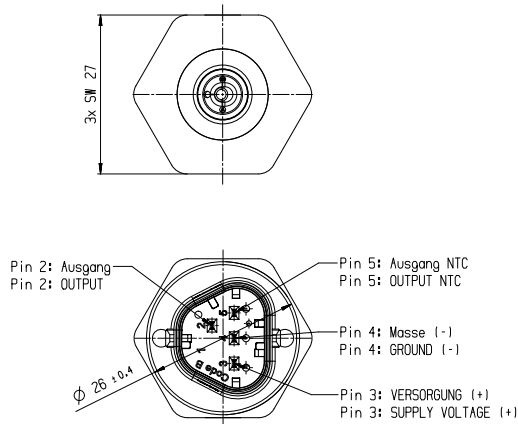
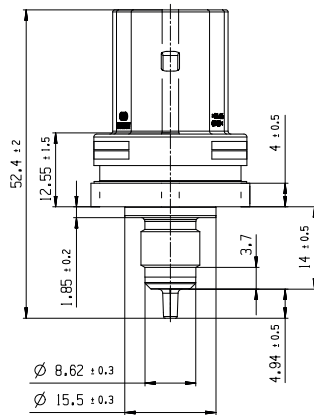
90	244
100	186.6
110	144.5
120	113.3
130	89.9
140	71.9
150	58.1



**Connectors and Wires**

Connector	Bosch Trapezoid
Mating connector	F02U.B00.751-01
Pin 2	Pressure Signal
Pin 3	Power Supply
Pin 4	Ground
Pin 5	Temperature Signal

**Dimensions**



**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**

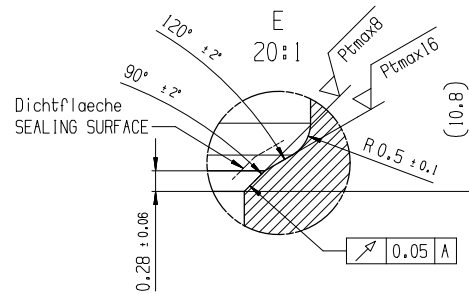
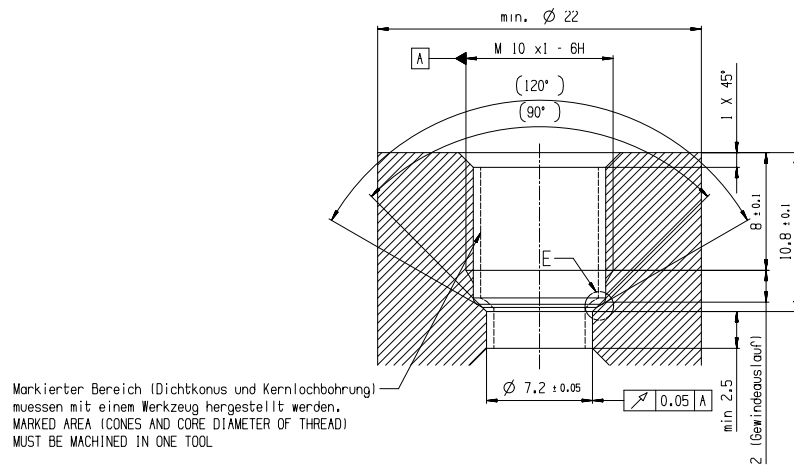
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Pressure Sensor Combined PST-F 1**  
Order number **0261.544.01F**



## Pressure Sensor Combined PST-F 2 280 bar



6

### Features

- ▶ Pressure: 0 to 280 bar
- ▶ Temperature: -40 to 140°C
- ▶ Power supply: 5 V
- ▶ Weight: 36 g

This sensor is designed to measure absolute gasoline pressure and gasoline temperature in direct injection systems.

The pressure measurement is based on the expansion of a steel diaphragm, where strain gauges are placed to a Wheatstone bridge. The measured signal is proportional to the pressure and is processed in an application specific integrated circuit.

The temperature measurement is conducted by an NTC thermistor. The main feature of this sensor is its compact design and the integration of two functions (temperature and pressure measurements) in a common housing.

### Application

Application 1	0 to 280 bar
Reference	Absolute
Max. pressure	340 bar
Application 2	-40 to 140°C
Resistance at 25°C	10 kOhm
Operating temp. range	-40 to 140°C
Media temp. range	-40 to 140°C
Storage temp. range	-40 to 60°C
Biofuel compatibility	E26, E85
Max. vibration	210 m/s <sup>2</sup> RMS at 147 to 1,350 Hz 175 m/s <sup>2</sup> RMS at 1,350 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Weight without wire	36 g
Wrench size	27 mm
Installation torque	37.5 ± 2.5 Nm
Sealing	Sealed cone

#### Electrical Data

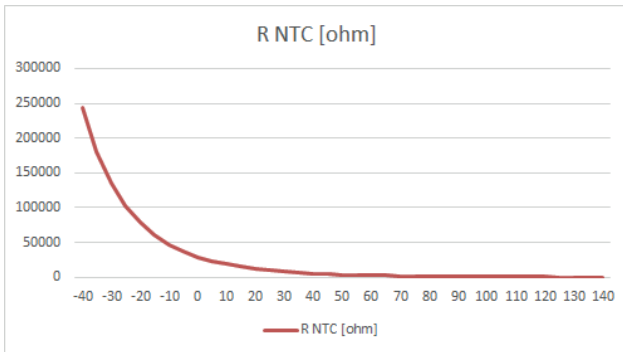
Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V (18 V for max. 1 h)
Full scale output $U_A$	0.5 to 4.5 V $U_s$ ratiometric
Current $I_s$	12 mA

#### Characteristic 1

Response time T <sub>10/90</sub>	Pressure: 0.2 to 0.8 ms Temperature: 9 s (response time of temperature signal in oil dip bath 20 to 100°C)
Compensated range	-40 to 130°C
Tolerance (FS) at $U_s$	+/- 1 % at 0 to 100°C +/- 1.5 % at -40 to 0°C and 100 to 130°C
Sensitivity at $U_s = 5$ V	14.3 mV/bar
Offset	500 mV at $U_s = 5$ V

#### Characteristic 2

T [°C]	R [Ohm]
-40	243,241
-30	135,753
-20	78,716
-10	47,258
0	29,287
10	18,684
20	12,240
25	10,000
30	8,218
40	5,642
50	3,955
60	2,826
70	2,055
80	1,519
90	1,141
100	868.4
110	669.9
120	523.2
130	413.3
140	330.0



### Connectors and Wires

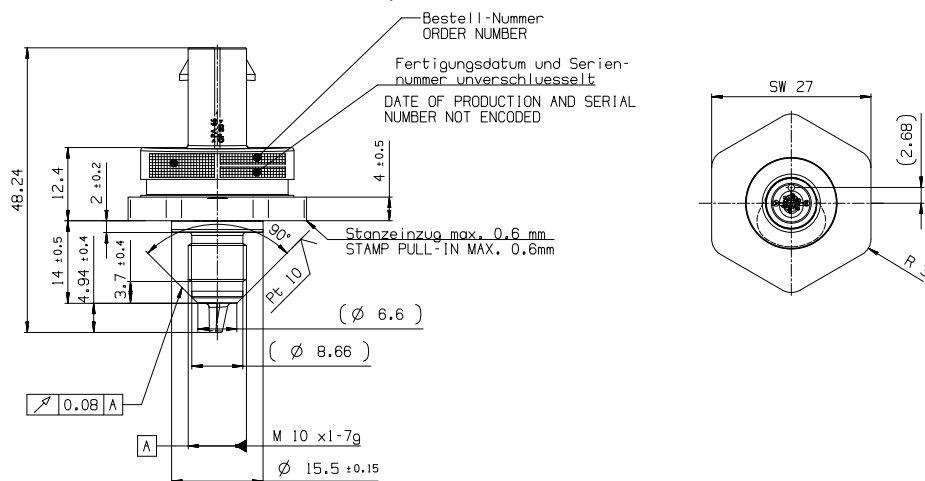
Connector	Hirschmann
Mating connector	F02U.B00.596-01
Pin 1	Ground
Pin 2	Pressure Signal
Pin 3	Temperature Signal
Pin 4	Power Supply

Various motorsport and automotive connectors are available on request.

### Installation Notes

The sensor can be connected directly to most control units.

### Dimensions



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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Pressure Sensor Combined PST-F 2 280 bar**  
Order number **0261.545.115**

## Pressure Sensor Combined PST-F 2 350 bar



6

### Features

- ▶ Pressure: 0 to 350 bar
- ▶ Temperature: -40 to 140°C
- ▶ Power supply: 5 V
- ▶ Weight: 36 g

This sensor is designed to measure absolute gasoline pressure and gasoline temperature in direct injection systems

The pressure measurement is based on the expansion of a steel diaphragm, where strain gauges are placed to a Wheatstone bridge. The measured signal is proportional to the pressure and is processed in an application specific integrated circuit.

The temperature measurement is conducted by an NTC thermistor. The main feature of this sensor is its compact design and the integration of two functions (temperature and pressure measurements) in a common housing.

### Application

Application 1	0 to 350 bar
Reference	Absolute
Max. pressure	390 bar
Application 2	-40 to 140°C
Resistance at 25°C	2 kOhm
Operating temp. range	-40 to 140°C
Media temp. range	-40 to 140°C
Storage temp. range	-40 to 60°C
Biofuel compatibility	E26, E85
Max. vibration	210 m/s <sup>2</sup> RMS at 147 to 1,350 Hz 175 m/s <sup>2</sup> RMS at 1,350 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Male thread	M10x1
Weight without wire	36 g
Wrench size	27 mm
Installation torque	37.5 ± 2.5 Nm
Sealing	Sealed cone

#### Electrical Data

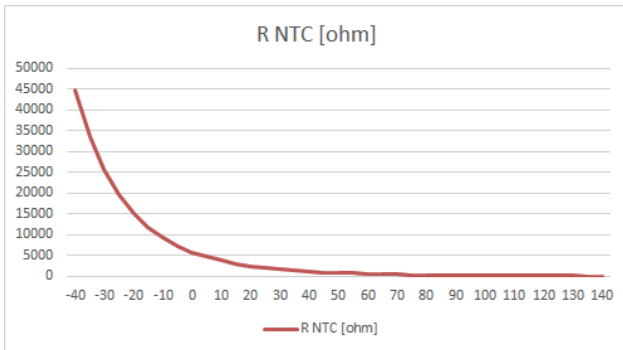
Power supply $U_s$	4.75 to 5.25 V
Max power supply $U_s$ max	16 V (18 V for max. 1 h)
Full scale output $U_A$	0.5 to 4.5 V $U_s$ ratiometric
Current $I_s$	12 mA

#### Characteristic 1

Response time T10/90	Pressure: 0.2 to 0.8 ms Temperature: 9 s (response time of temperature signal in oil dip bath 20 to 100°C)
Compensated range	-40 to 130°C
Tolerance (FS) at $U_s$	+/- 1 % at 0 to 100°C +/- 1.5 % at -40 to 0°C and 100 to 130°C
Sensitivity at $U_s = 5$ V	11.43 mV/bar
Offset	500 mV at $U_s = 5$ V

#### Characteristic 2

T [°C]	R [Ohm]
-40	44,864
-30	25,524
-20	15,067
-10	9,195
0	5,784
10	3,740
20	2,480
25	2,038
30	1,683
40	1,167
50	825
60	594
70	434,9
80	323,4
90	244
100	186,6
110	144,5
120	113,3
130	89,8
140	71,9



### Connectors and Wires

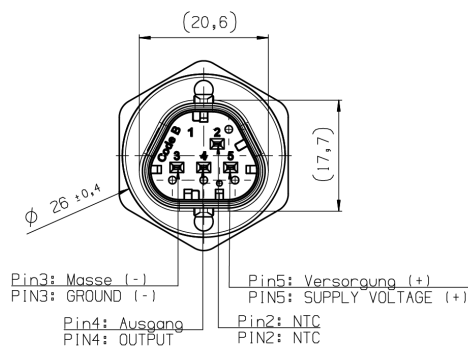
Connector	Bosch Trapezoid
Mating connector	F02U.B00.751-01
Pin 1	-
Pin 2	Temperature Signal
Pin 3	Ground
Pin 4	Pressure Signal
Pin 5	Power Supply

Various motorsport and automotive connectors are available on request.

### Installation Notes

The sensor can be connected directly to most control units.

### Dimensions



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

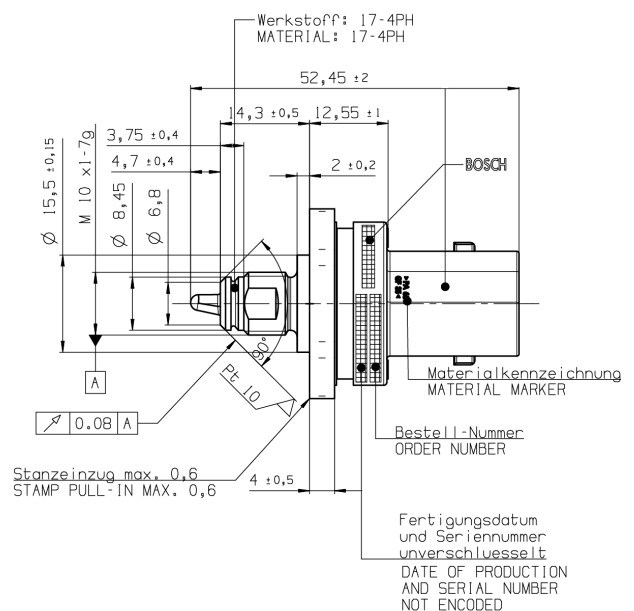
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Pressure Sensor Combined PST-F 2 350 bar**  
 Order number **0261.B35.596-02**



## Rotary Position Sensor RPS-F



6

### Features

- ▶ Rotational movement measurement
- ▶ Hall effect technology
- ▶ Measurement range: 0 to 360° possible
- ▶ Analog output 0.2 to 4.8 V
- ▶ Dual output, fully redundant possible

This sensor is designed to measure rotational movement of throttle position.

The electrical circuit is designed with a magnetic rotary sensor using a Hall element and digital signal processing; sensor output is ratiometric. The angular position is provided by a two pole magnet integrated in the sensor shaft.

The main benefit of this sensor is its contactless Hall effect technology and its robust design for motorsport applications which includes fully redundant power and ground.

### Application

Application	0 to 360° possible
Operating temperature range	0 to 150°C
Max. vibration	200 m/s <sup>2</sup> at 5 to 2,000 Hz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	< 36 g
Protection class	IP58
Mounting	2 x M4 screw
Lifetime	5 x 10 <sup>6</sup> operations of ±65°
Housing	Aluminum

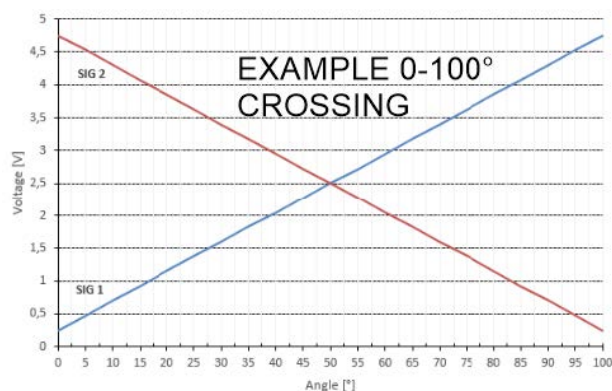
#### Electrical Data

Power supply U <sub>s</sub>	5 ± 0.5 V regulated
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Max. overvoltage	24 V
Half voltage tolerance	± 2°
Supply current	< 12.5 mA
Resolution	< 0.1°
Output voltage range	Ratiometric analog
Output load	> 10 kOhm

#### Characteristic

Max. rotation speed	600 <sup>RPM</sup>
Temp. coefficient	± 0.008° Rotation/°C 30°C nominal
Direction of rotation	Both
Redundancy	Yes



#### Flying lead and Wires

Red	U <sub>s</sub> 1
Blue	Gnd 1
White	Sig 1
Orange	U <sub>s</sub> 2
Green	Gnd 2
Yellow	Sig 2
Sleeve	DR-25
Wire size	AWG 26
Wire length L	100 cm

#### Installation Notes

The products of the RP series can be connected directly to most control units.

The sensor is designed with contactless Hall effect technology.

Any mounting orientation is possible.

Sensor is at mid point of electrical angle when shaft and wire exit are aligned as shown in the offer drawing.

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

#### Safety Note

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

**Fulfilled Legal Standards/Legal Requirements**

EMC Requirement	UNECE10
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**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information****Rotary Position Sensor RPS-F**

Single output, 360° range  
Order number **F02U.V0U.400-02**

**Rotary Position Sensor RPS-F**

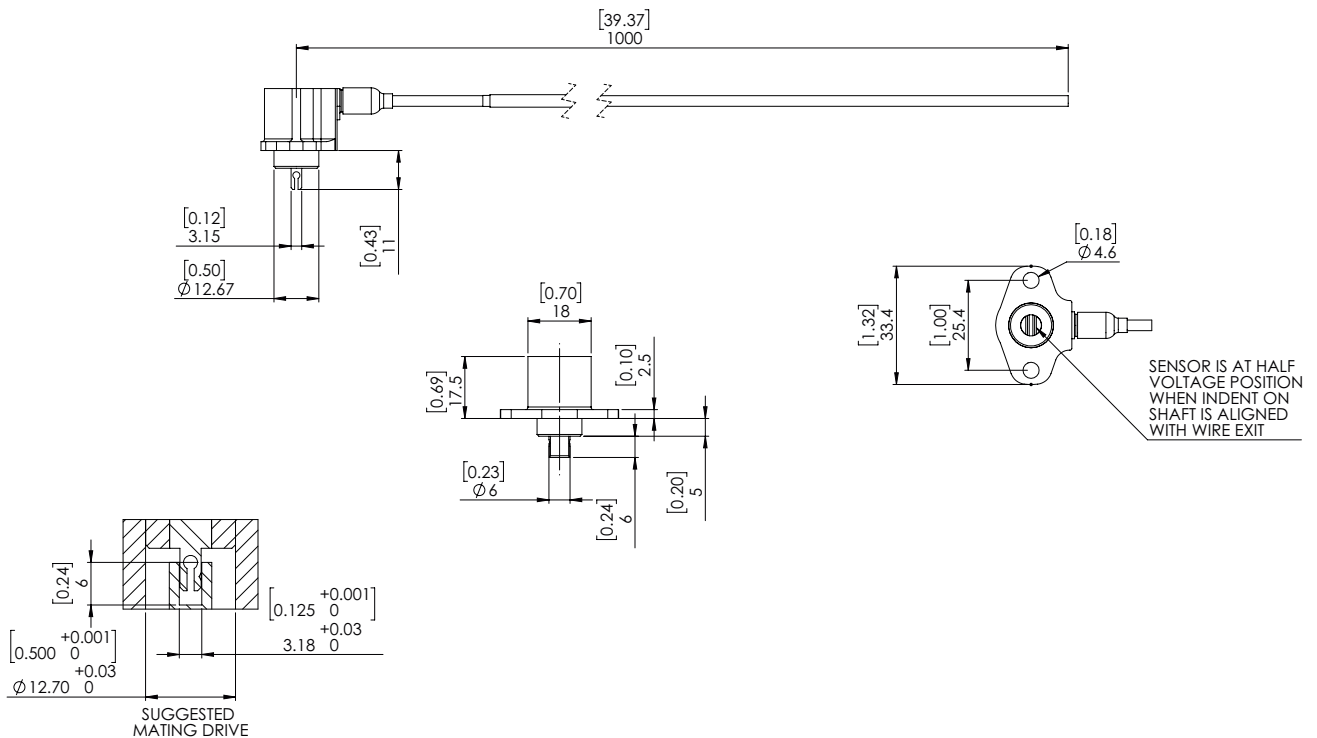
Dual output, 100° range, crossing signals (throttle)  
Order number **F02U.V0U.401-02**

**Rotary Position Sensor RPS-F**

Dual output, 40° range, second signal 50 % of first (pedal)  
Order number **F02U.V0U.402-02**

**Rotary Position Sensor RPS-F**

Dual output, 100° range, second signal 50 % of first (pedal)  
Order number **F02U.V0U.403-02**

**Dimensions**

## Overview

**Speed Sensor Hall-Effect HA-D 90**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.4 to 1.0 mm
- Bore diameter: 11.8 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 12 g

**Speed Sensor Hall-Effect HA-Di**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.4 to 1.0 mm
- Bore diameter: 12 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 12 g

**Speed Sensor Hall-Effect HA-M**



- Max. frequency:  $\leq 4.2$  kHz
- Air gap: 0.5 to 1.0 mm
- Bore diameter: 11.8 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 12 g

**Speed Sensor Hall-Effect HA-N**



- Max. frequency:  $\leq 4.2$  kHz
- Air gap: 0.4 to 1.5 mm
- Bore diameter: 10 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 8 g

**Speed Sensor Hall-Effect Mini-HA-P**



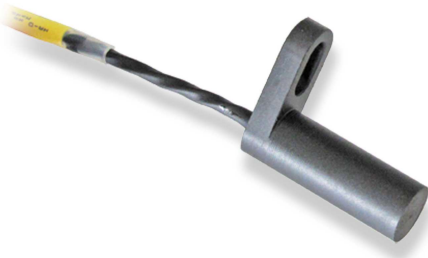
- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.2 to 1.5 mm
- Bore diameter: 11.5 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 20 g

**Speed Sensor Hall-Effect Mini-HA-P sealed**



- Max. frequency:  $\leq 10$  kHz
- Air gap: 0.2 to 1.5 mm
- Bore diameter: 16 mm
- Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- Weight w/o wire: 20 g

## Speed Sensor Hall-Effect HA-D 90



### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.4 to 1.0 mm
- ▶ Bore diameter: 11.8 mm
- ▶ Max. vibration: 1,200 m/s<sup>2</sup> at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 12 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft\*, crankshaft or wheel speed), but it is not a “true power-on” sensor.

Due to the rotation of a ferromagnetic target wheel in front of the HA-D 90, the magnetic field is modulated at the place of the Hall probe.

The main feature and benefit of this sensor is a very good detection of the falling edge, due to a differential measuring method. This sensor is a combination of a high quality production part and robust design with a small housing.

\*: see Installation Notes

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap AG	0.4 to 1.0 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
Output type	Active high
External magnetic fields	$\leq 50$ mT
Max. vibration	1,200 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 I <sub>S</sub>	20 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	< 1.0 % ( $\leq 6$ kHz) < 1.5 % ( $\leq 10$ kHz)
Signal output	0.52 V to < U <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	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	
Pin 1	U <sub>s</sub>
Pin 2	Gnd
Pin 3	Sig
Pin 4	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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

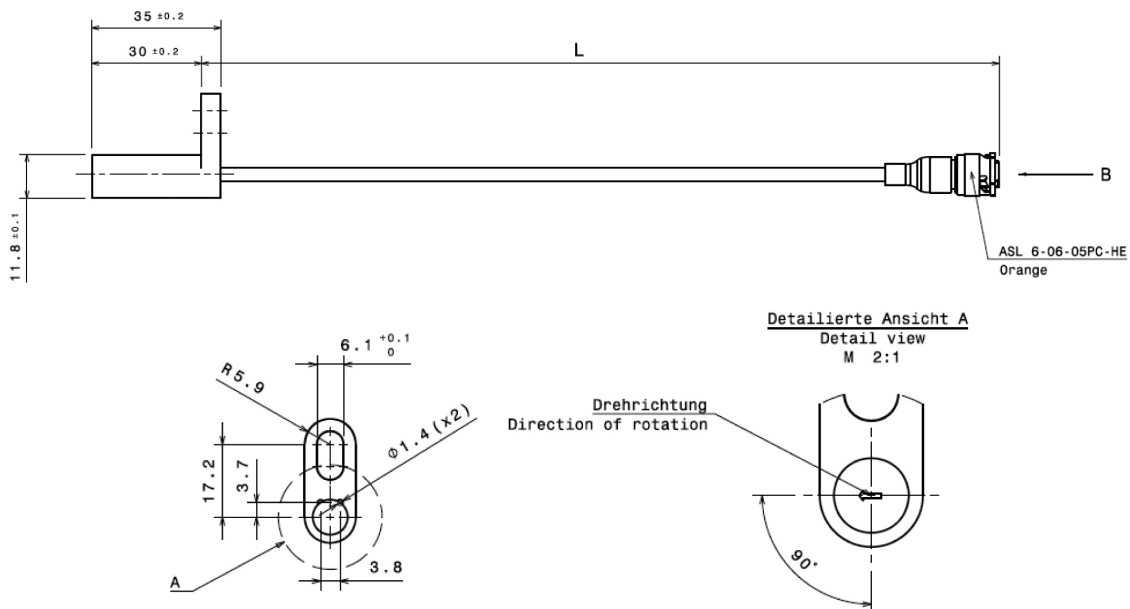
### Ordering Information

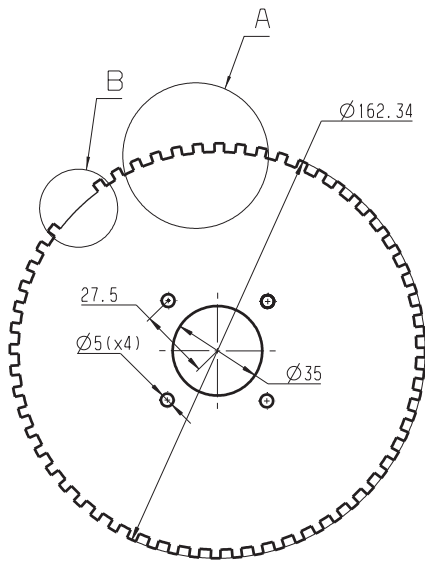
**Speed Sensor Hall-Effect HA-D 90**

Order number **F02U.V00.334-01**

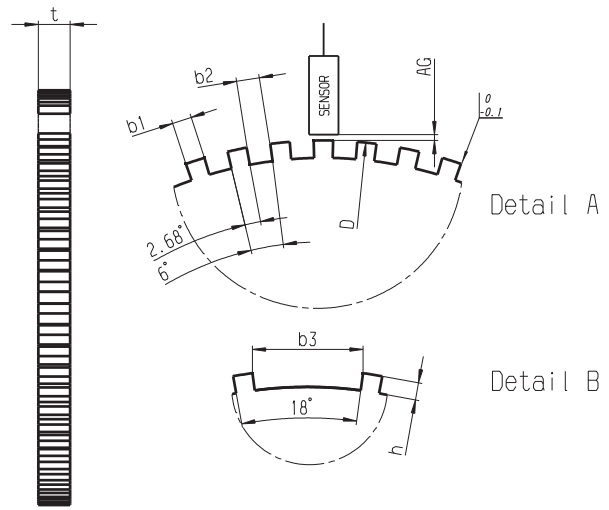
## 6

### Dimensions





60-2Teeth



Left view

## Speed Sensor Hall-Effect HA-Di



6

### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.4 to 1.0 mm
- ▶ Bore diameter: 12 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 12 g

This sensor is designed for incremental measurement of rotational speed (e.g. crankshaft or wheel speed).

Due to the rotation of a ferromagnetic target wheel in front of the HA-Di, the magnetic field of the built-in magnet is modulated at the place of the sensors diff.

The main feature and benefit of this sensor is the detection of the rotational direction.

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz forward $\leq 6$ kHz backward
Target wheel air gap AG	0.4 to 1.0 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
External magnetic fields	$\leq 100$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/o wire	12 g
Mounting	Screw 1 x M5
Bore diameter	$12 \pm 0.2$ mm
Installation depth L2	30 mm

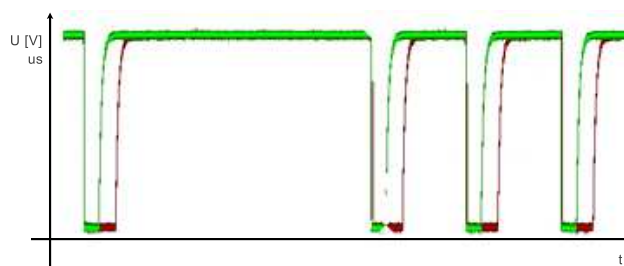
Tightening torque	6 Nm
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#### Electrical Data

Power supply	5 to 16 V (24 V for max. 5 min.)
Current $I_S$	$< 20$ mA
Power-on time	1 ms

#### Characteristic

Signal output width forward	37 to 53 $\mu\text{s}$ (45)
Signal output width backward	75 to 105 $\mu\text{s}$ (90)
Accuracy (tolerance)	$\pm 1.5^\circ$ (for forward direction)
Signal output	0.52 V to $< U_S$



Signal output width (forward: green, backward: red)

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h	3.4 mm
Number of teeth	60-2

#### Alternative Target Wheel

Target wheel diameter	118 to 370 mm
Width of teeth b1	2.2 to 3.8 mm
Width of gap b2	$\geq 4$ mm
Depth of teeth h	$\geq 4$ mm
Target wheel width	$\geq 5$ mm
Relative magnetic permeability	$\mu(r) \geq 1000$

#### Connectors and Wires

Connector	ASL606-05PC-HE
Mating connector	F02U.000.228-01
ASL006-05SC-HE	
Pin 1	$U_S$
Pin 2	Gnd
Pin 3	Sig
Pin 4	Nc
Pin 5	Nc
Various motorsport and automotive connectors available on request.	
Sleeve	DR-25
Wire size	AWG 24

Wire length L	15 to 100 cm
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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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Speed Sensor Hall-Effect HA-Di 0

Order number **F02U.V01.802-02**

#### Speed Sensor Hall-Effect HA-Di 90

Order number **F02U.V01.803-02**

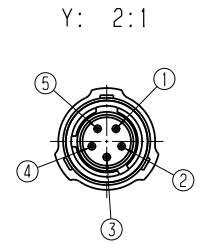
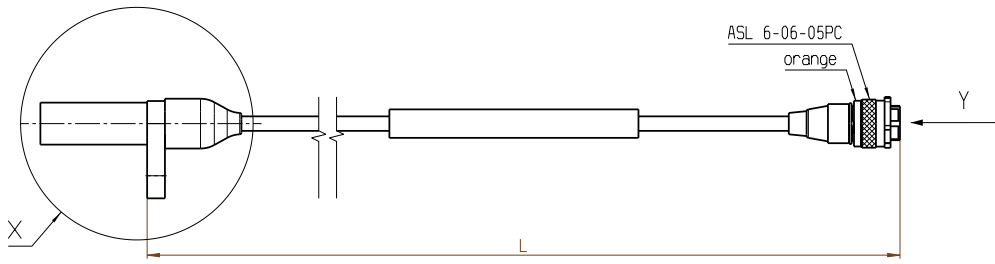
#### Speed Sensor Hall-Effect HA-Di 180

Order number **F02U.V01.804-02**

#### Speed Sensor Hall-Effect HA-Di 270

Order number **F02U.V01.805-02**

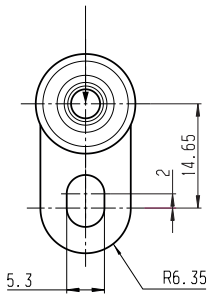
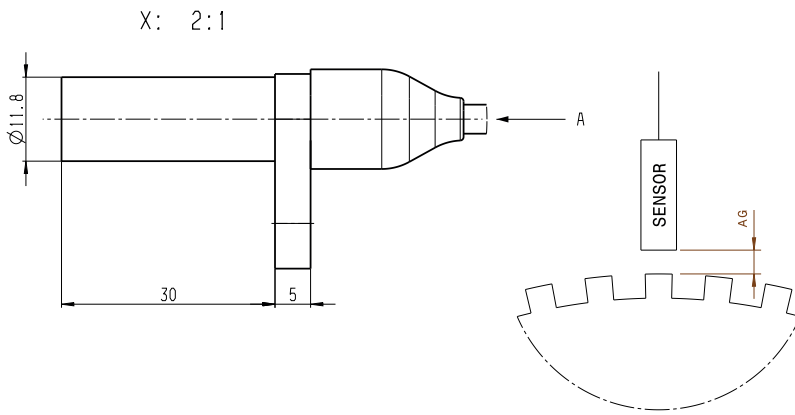
Dimensions



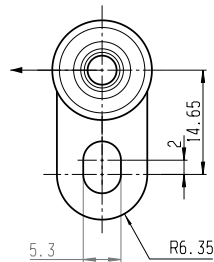
ASL 6-06-05PC

- 1: Supply
- 2: Ground
- 3: Signal
- 4: Not connected
- 5: Not connected

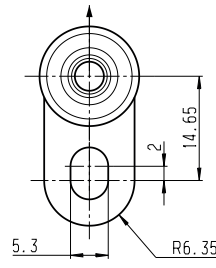
6



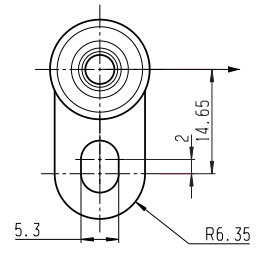
HA-DI 0



HA-DI 90

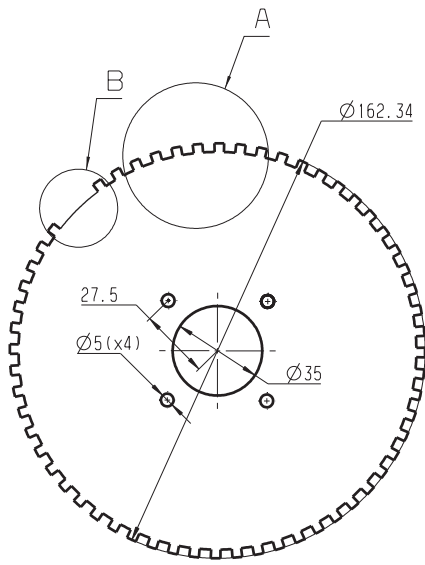


HA-DI 180

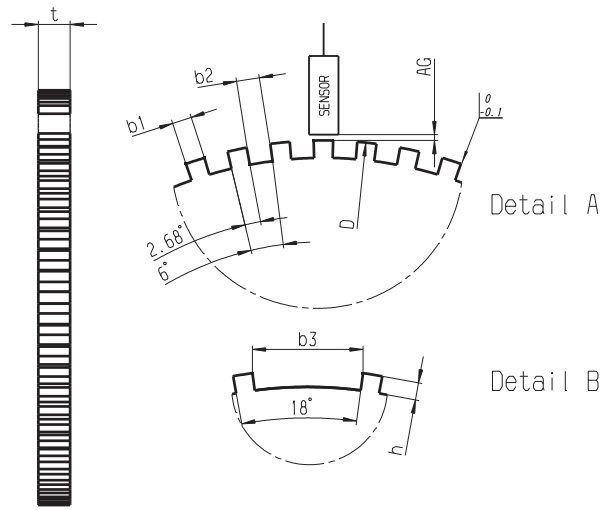


HA-DI 270

Direction of rotation of the target wheel, View A



60-2Teeth



Left view

## Speed Sensor Hall-Effect HA-M



6

### Features

- ▶ Max. frequency:  $\leq 4.2$  kHz
- ▶ Air gap: 0.5 to 1.0 mm
- ▶ Bore diameter: 11.8 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 12 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft or wheel speed).

Due to the rotation of a ferromagnetic target wheel in front of the HA-M, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal. We offer this sensor with two different types of output: Active high and Active low.

The main feature and benefit of this sensor is the combination of a high quality production part and robust design with metal housing and motorsport connectors.

### Application

Application	Speed
Max. frequency	$\leq 4.2$ kHz
Target wheel air gap	0.5 to 1.5 mm
Temperature range	-40 to 160°C
Output circuit	Open collector for 1 kOhm
Output type	Please see Ordering Information
External magnetic fields	$< 1$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

##### Active low with connector / active high with connector

Connector	ASU603-03PN-HE
Mating connector	F02U.000.199-01
ASU003-03SN-HE	
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig

##### Active high, without connector

Red	$U_s$
Black	Gnd
Green	Sig

#### Mechanical Data

Weight w/o wire	12 g
Mounting	1 x M6
Bore diameter	11.8 mm
Installation depth L2	30 mm
Tightening torque	6 Nm

#### Electrical Data

Power supply	5 to 18 V
Current $I_s$	5.6 to 18 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	$< 4\%$ ( $\leq 4.2$ kHz)
Signal output	0.52 V to $< U_s$

#### Connectors and Wires

Various motorsport and automotive connectors available on request.

Pin layout	Please see Variations
Sleeve	DR-25
Wire size	AWG 24
Wire length L	10 to 100 cm

Please specify the required wire length with your order.

### Installation Notes

The HA-M can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

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

### Safety Note

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Speed Sensor Hall Effect HA-M

Active low

Order number **B261.209.283-01**

#### Speed Sensor Hall Effect HA-M

Active high

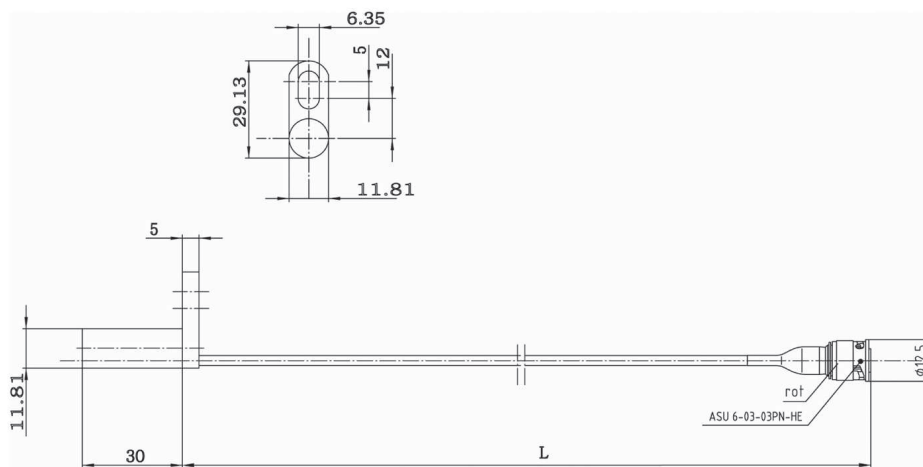
Order number **B261.209.295-01**

#### Speed Sensor Hall Effect HA-M

Active high, without connector

Order number **F02U.V00.627-01**

### Dimensions



## Speed Sensor Hall-Effect HA-N



6

### Features

- ▶ Max. frequency:  $\leq 4.2$  kHz
- ▶ Air gap: 0.4 to 1.5 mm
- ▶ Bore diameter: 10 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 8 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft or wheel speed). Due to the rotation of a ferromagnetic target wheel in front of the HA-N, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The HA-N combines a robust sensing element with a lightweight aluminum housing that is well suited for motorsport use. The sensor element used was specifically selected for its resistance to demagnetization at high temperatures and is programmed for an active low output. This sensor element is approved for NASCAR competition as a camshaft speed sensor.

### Application

Application	Rotational speed
Max. frequency	$\leq 4.2$ kHz
Target wheel air gap AG	0.5 to 1.5 mm
Temperature range	-40 to 160°C
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$< 1$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Mechanical Data

Weight w/ wire	13 g w/ 254 mm cable length and AS connector 28.5 g w/ 1,000 mm cable length flying lead
Bore diameter	10 mm
Installation depth L2	14 mm
Tightening torque	6 Nm

#### Electrical Data

Power supply	5 to 18 V
Current IS	5.6 to 18 mA

#### Characteristic

Accuracy repeatability of the falling edge tooth	$< 4\%$ ( $\leq 4.2$ kHz)
Signal output	$0.52 \text{ V to } V_s$

#### Connectors and Wires

##### Sensor AS connector

Connector	ASL606-05PA-HE
Mating connector	ASL006-05SA-HE
Pin 1	$V_s$
Pin 2	GND
Pin 3	Signal
Pin 4	Not used
Pin 5	Not used
Shrink sleeve	DR-25
Wire size	AWG 24
Wire length L	254 mm

##### Sensor Flying lead

WHT/ORG	$V_s$
WHT/BLU	GND
WHT	Signal
Shrink sleeve	DR-25
Wire size	AWG 24
Wire length L	1,000 mm

### Installation Notes

The HA-N can be directly connected to most control units and data logging systems.

If a trigger wheel with different dimensions is used (see Environment), the technical function must be tested.

#### Safety Note

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

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

### Speed Sensor Hall-Effect HA-N

Sensor AS connector

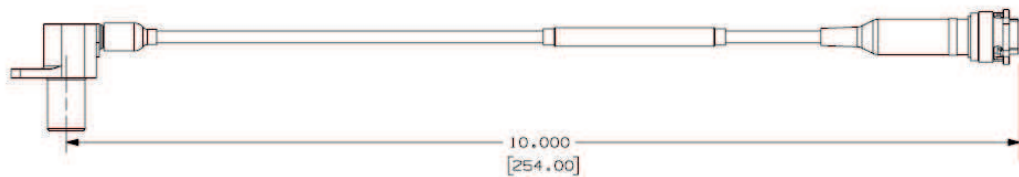
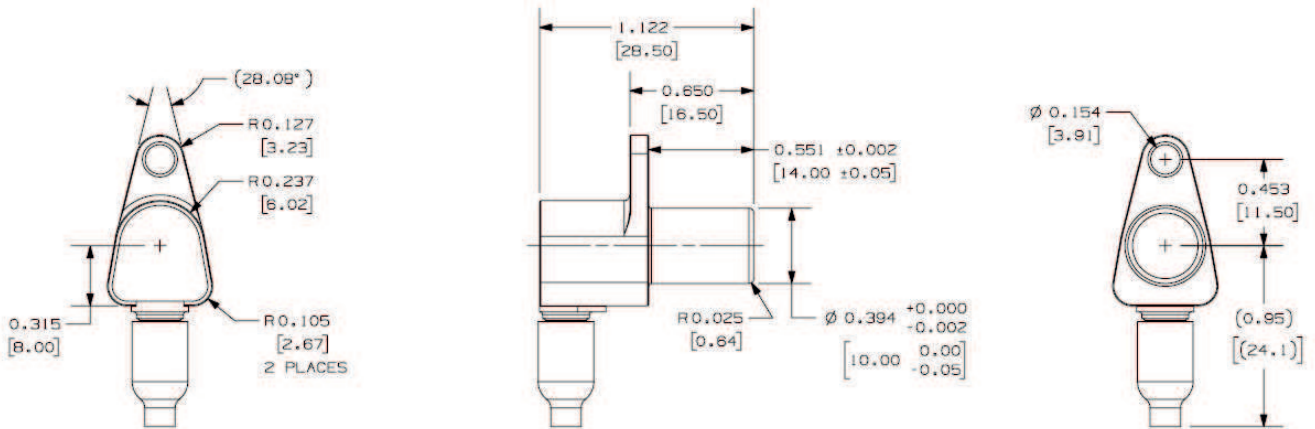
Order number **F02U.V0U.714-01**

### Speed Sensor Hall-Effect HA-N

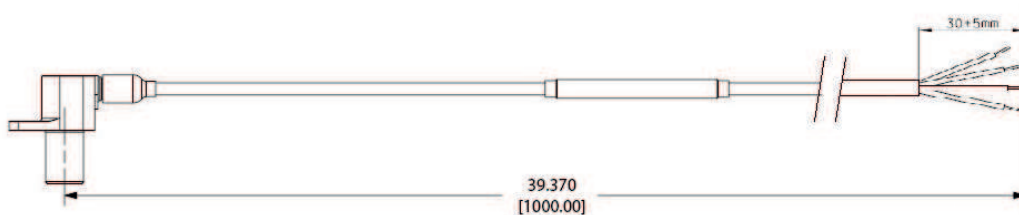
Sensor Flying lead

Order number **F02U.V0U.714-90**

## Dimensions



Sensor AS connector



Sensor Flying lead

## Speed Sensor Hall-Effect Mini-HA-P



6

### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.2 to 1.5 mm
- ▶ Bore diameter: 11.5 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 20 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft or wheel speed).

Due to the rotation of a ferromagnetic target wheel in front of the Mini-HA-P, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The main feature and benefit of this sensor is the combination of a high quality production part and robust design with a very small housing.

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap	0.2 to 1.5 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$\leq 0.3$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

Connector	ASL606-05PC-HE
Mating connector	ASL006-05SC-HE
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig
Pin 4	Nc
Pin 5	Nc

Connector	1234.482.092
Mating connector	F02U.B00.555-01
Pin 1	$U_s$
Pin 2	Sig
Pin 3	Gnd
Pin 4	-
Pin 5	-

#### 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 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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Speed Sensor Hall-Effect Mini-HA-P

Connector ASL606-05PC-HE

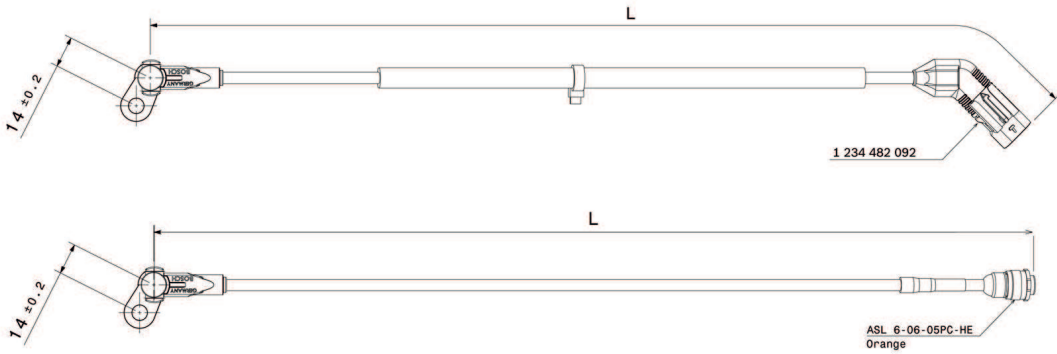
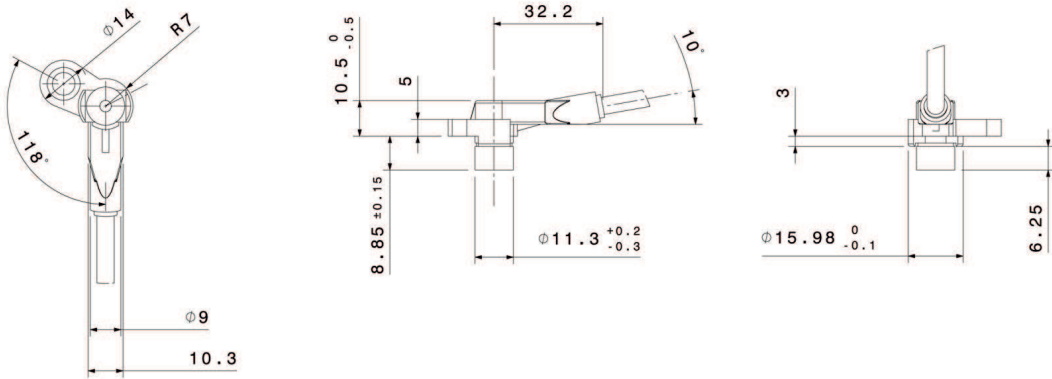
Order number **F02U.V00.564-03**

#### Speed Sensor Hall-Effect Mini-HA-P

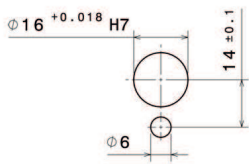
Connector 1 234 482 092

Order number **F02U.V00.566-02**

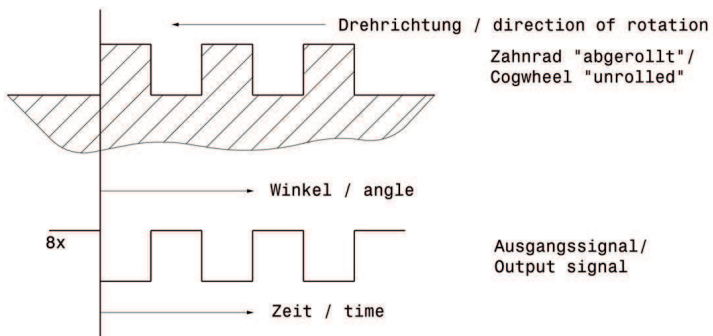
Dimensions

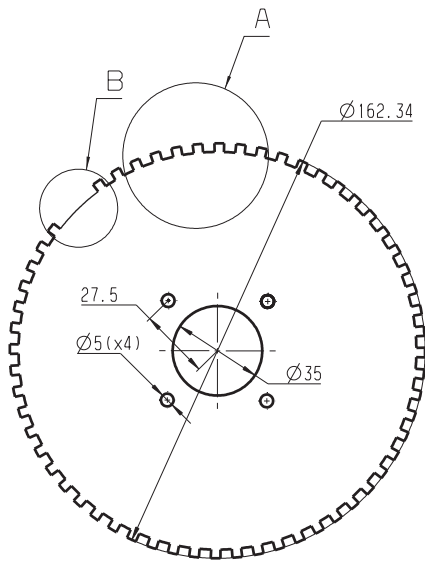


**Einbauvorschrift**  
Mounting requirement

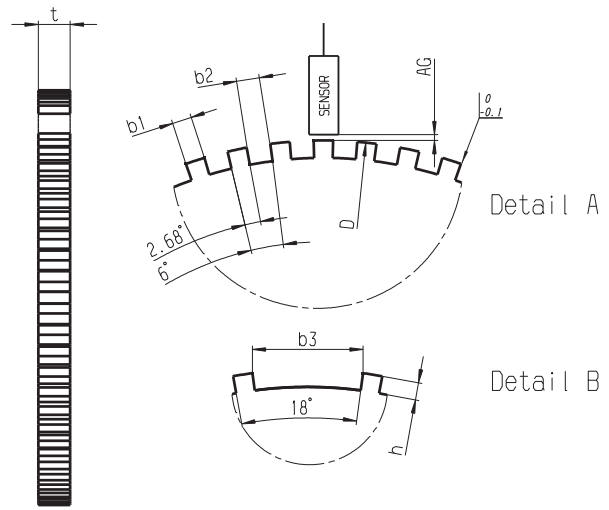


**Signal-Definition**  
Signal definition





60-2Teeth



Left view

## Speed Sensor Hall-Effect Mini-HA-P sealed



6

### Features

- ▶ Max. frequency:  $\leq 10$  kHz
- ▶ Air gap: 0.2 to 1.5 mm
- ▶ Bore diameter: 16 mm
- ▶ Max. vibration:  $1,200 \text{ m/s}^2$  at 10 Hz to 2 kHz
- ▶ Weight w/o wire: 20 g

This sensor is designed for incremental measurement of rotational speed (e.g. camshaft, crankshaft and wheelspeed).

Due to the rotation of a ferromagnetic target wheel in front of the Mini-HA-P sealed, the magnetic field is modulated at the place of the Hall probe. A Hall-effect sensor element with integrated signal conditioning circuit detects this change and generates a digital output signal.

The main feature and benefit of this sensor is the combination of a high quality production part and a robust design with a very small housing.

### Application

Application	Speed
Max. frequency	$\leq 10$ kHz
Target wheel air gap	0.2 to 1.5 mm
Temperature range	-40 to 150°C
Output circuit	Open collector for 1 kOhm
Output type	Active low
External magnetic fields	$\leq 0.3$ mT
Max. vibration	$1,200 \text{ m/s}^2$ at 10 Hz to 2 kHz

### Technical Specifications

#### Variations

Connector	ASL606-05PC-HE
Mating connector	ASL006-05SC-HE FO2U.000.228-01
Pin 1	$U_s$
Pin 2	Gnd
Pin 3	Sig
Pin 4	Nc
Pin 5	Nc
Wire length L	10 - 27 cm
Without connector	
Red	$U_s$
Green	Sig
Black	Gnd
Wire length L	27 cm

#### Mechanical Data

Weight w/o wire	19.2 g
Mounting	With screw 1 x M6
Bore diameter	16 mm
Installation depth L2	12 mm
Tightening torque	8 Nm

#### Electrical Data

Power supply	5 to 18 V
Current $I_S$	10 mA

#### Characteristic

Accuracy repeatability of the falling edge of tooth	$< 3\%$ ( $\leq 6$ kHz) $< 5\%$ ( $\leq 10$ kHz)
Signal output	$0.4 \text{ V to } < U_s$

#### Environment

Target wheel diameter D	162.34 mm
Thickness t	12.5 mm
Width of teeth b1	3.8 mm
Width of gap b2	4.7 mm
Width of sync. gap b3	20.79 mm
Depth of teeth h	3.4 mm
Number of teeth	60-2

#### Connectors and Wires

Connector	Please see Variations
Sleeve	HT wire $\varnothing 5.2$ mm
Wire size	AWG 20
Wire length L	Please see Variations

Various motorsport and automotive connectors are available on request.

Please specify the required wire length with your order.

### Installation Notes

The Mini-HA-P sealed can be connected directly to most control units and data logging systems.

Please avoid abrupt temperature changes.

For mounting please use only the integrated plug.

If a wheel with different dimensions is used (see Environment), the technical function has to be tested individually.

Please ensure that the environmental conditions do not exceed the sensor specifications.

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

### Safety Note

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

### Legal Restrictions

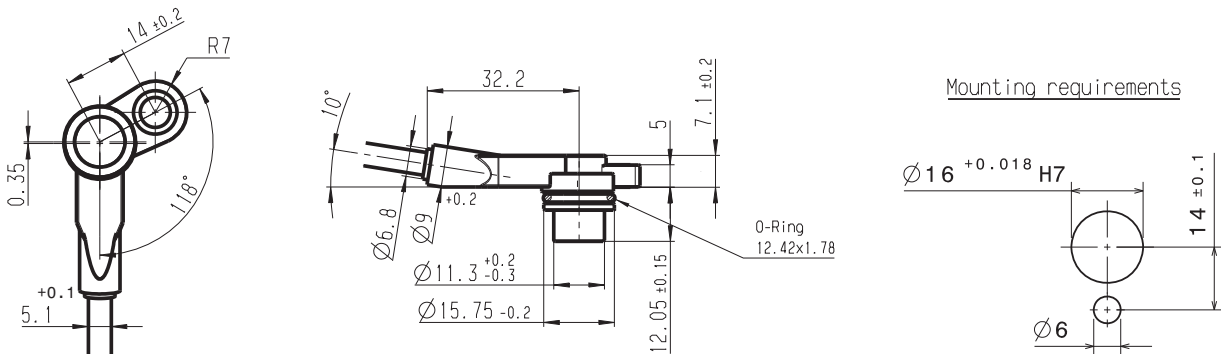
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

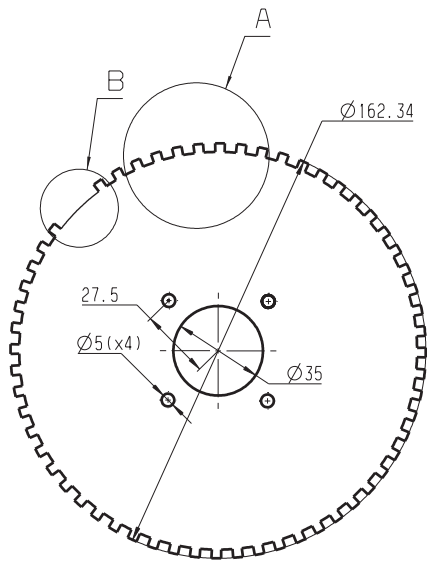
### Ordering Information

**Speed Sensor Hall-Effect Mini HA-P sealed**  
Connector ASL606-05PC-HE  
Order number **F02U.V00.500-01**

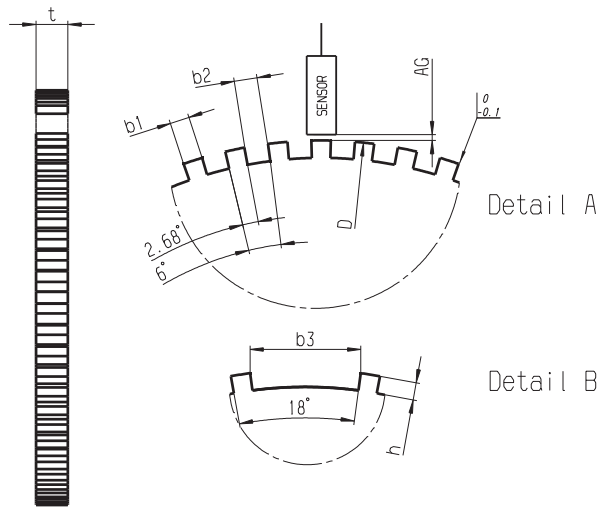
**Speed Sensor Hall-Effect Mini HA-P sealed**  
Without connector  
Order number **F02U.V00.570-01**

### Dimensions





60-2 Teeth



Left view

# Steering Wheel Angle Sensor LWS



## Features

- ▶ Steering Wheel Angle:  $\pm 780^\circ$
- ▶ Angular Speed: 0 to 1,016°/s
- ▶ 500 kbaud CAN-output

This sensor is designed to measure rotational movement and angular speed, e.g. steering wheel angle and steering wheel speed.

In order to achieve this, the sensor is using the giant magneto resistive (GMR) effect. The detection of the absolute angle is realized by means of toothed measuring gears with different ratio including small magnets. Corresponding GMR elements that change their electrical resistance according to the magnetic field direction detects the angle position of the measuring gears.

The measured voltages are A/D converted and a microcontroller performs the angle calculations. The steering angle and the steering angle speed are provided on a CAN-interface.

## Application

Steering wheel angle	$\pm 780^\circ$
Angular speed	0 to 1,016°/s
Operating temperature range	-40 to 85°C

## Technical Specifications

### Mechanical Data

Weight	Approx. 34 g
Size	83 x 60 x 21.35 mm
Protection class	IP5K0

### Electrical Data

Power supply	7 to 16 V
Max input current	< 150 mA
CAN speed	500 kbaud

### CAN Message

#### CAN ID 01 0x2B0 LWS\_Standard

Byte	Value / Bit			
	7/6/5/4/3	2	1	0
0	LWS_ANGLE			
1	LWS_ANGLE			
2	LWS_SPEED			
3	Reserved	TRIM	CAL	OK
4	Reserved			

#### CAN ID 02 0x7C0 LWS\_Config

Byte	Value / Bit			
	7/6/5/4/3	2	1	0
0	Reserved	CCW		
1	Reserved			

### Truth Table

TRIM	OK	CAL	ANGLE	SPEED	Sensor state
1	1	1	Value	Value	Sensor is calibrated and sensor information is valid.
1	1	0	7FFFh	Value	Sensor is not calibrated, speed information is valid.
1	0	0	7FFFh	FFh	Sensor is in failure mode, sensor information is not valid.
0	0	0	7FFFh	FFH	Sensor is in failure mode, sensor information is not valid.

Other combinations for TRIM, OK and CAL are not valid.

### Signal Overview

OK	Failure status
1	Sensor information valid
0	Sensor information invalid, an internal sensor fault occurred

CAL	Calibration status
1	Sensor calibrated
0	Sensor not calibrated

TRIM	Trimming Status
1	Sensor trimmed
0	Sensor not trimmed, this is handled as a sensor failure (OK = 0)

CCW	Command code word
3h	Sets the signal LWS_Angle to 0°
5h	Resets the calibration status of the angle

**Characteristics****Steering Wheel Angle**

Measuring range	$\pm 780^\circ$
Absolute physical resolution	$0.1^\circ$
Nonlinearity	$\pm 2.5^\circ$
Hysteresis	0 to $5^\circ$

**Angular Speed**

Measuring range	0 to $1,016^\circ/\text{s}$
Over range limit	$\pm 2,500^\circ/\text{s}$
Absolute physical resolution	$4^\circ/\text{s}$

**Connectors and Wires**

Connector	Bosch 7 pole
Mating connector	F02U.B00.656-01
Pin 1	Gnd
Pin 2	12 V
Pin 3	CAN High
Pin 4	CAN Low
Pin 5	Not connected
Pin 6	Not connected
Pin 7	Not connected

**CAN Parameters**

Byte order	LSB (Intel)
CAN speed	500 kbaud
CAN update rate	100 Hz / 10 ms

**Installation Notes**

The LWS can be connected directly to most control units and data logger systems via CAN bus.

Please avoid abrupt temperature changes.

Please ensure that the environmental conditions do not exceed the sensor specifications.

Please find further application hints in the offer drawing.

A zero adjustment is needed before using the sensor for the first time. To do so, reset the calibration with CCW = 5h. After resetting the calibration, a new calibration needs to be started with CCW = 3h. The sensor is now newly calibrated and can be used immediately.

Zero the sensor after every assembly.

**Safety Note**

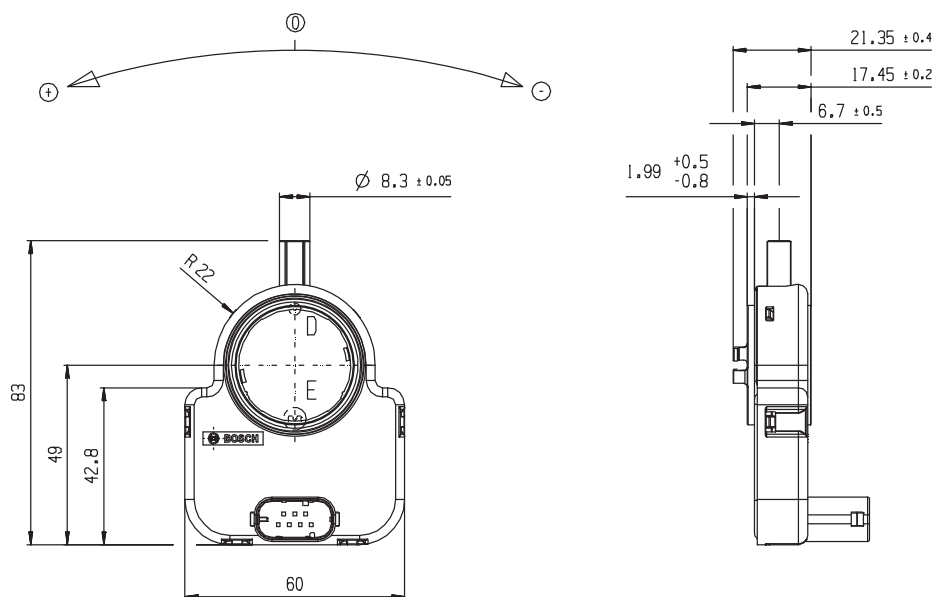
The sensor is not intended to be used for safety related applications without appropriate measures for signal validation in the application system.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information**

**Steering Wheel Angle Sensor LWS**  
Order number **F02U.V02.894-01**

**Dimensions**

Housing Size

## Overview

### Temperature Sensor NTC M5-HS



- Application: -55 to 300°C
- Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- Male thread: M5
- Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

### Temperature Sensor NTC M6-HS



- Application: -55 to 300°C
- Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- Male thread: M6 x 1
- Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

### Temperature Sensor NTC M8-HS



- Application: -55 to 300°C
- Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- Male thread: M8 x 1
- Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

### Temperature Sensor NTC M12



- Application: -40 to 130°C
- Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- Male thread: M12 x 1.5
- Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

### Temperature Sensor NTC M12-H



- Application: -40 to 130°C
- Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- Accuracy at 100°C:  $\pm 0.8^\circ\text{C}$
- Male thread: M12 x 1.5
- Nominal resistance at 20°C: 2.5 kOhm  $\pm 6\%$

### Temperature Sensor NTC M12-L



- Application: -40 to 130°C
- Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- Male thread: M12 x 1.5
- Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

## Temperature Sensor NTC M5-HS



6

### Features

- ▶ Application: -55 to 300°C
- ▶ Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- ▶ Male thread: M5
- ▶ Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

This sensor is designed to measure temperatures up to 300°C of oil, water, fuel or air. This signal is used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC-sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises and the resistance decreases. To improve a good protection against the ambient temperature, the housing is made of stainless steel and partly filled with an isolation-paste.

The main benefit of the sensor is a very compact design and its very short response time.

### Application

Application	-55 to 300°C
Storage temperature range	0 to 100°C
Bio fuel compatibility	-

### Technical Specifications

#### Mechanical Data

Male thread	M5
Wrench size	8 mm
Installation torque	8 Nm
Weight w/o wire	6 g

Sealing	O-Ring 4 x 1 mm
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#### Electrical Data

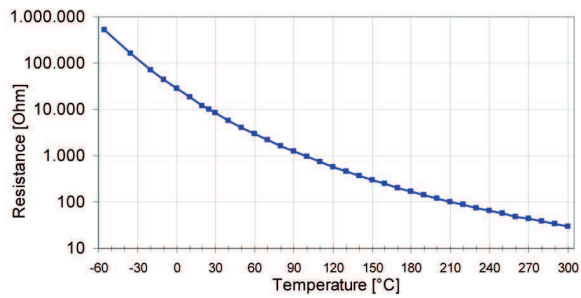
Characteristic	NTC
Nominal resistance at 25°C	10 kOhm $\pm 1\%$

#### Characteristic

Accuracy at 25°C (homogeneous cond.)	$\pm 0.3^\circ\text{C}$
Accuracy at 100°C (homogeneous cond.)	$\pm 1.3^\circ\text{C}$
Response time tau 63 in still water	< 4 s

#### Characteristic Application

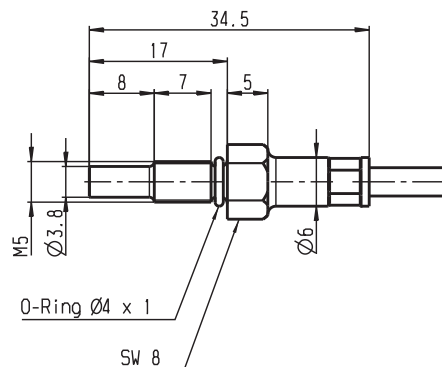
T [°C]	R [Ohm]
-55	519,910
-35	158,090
-20	71,668
-10	44,087
0	27,936
10	18,187
20	12,136
25	10,000
30	8,284
40	5,774
50	4,103
60	2,967
70	2,182
80	1,629
90	1,234
100	946.6
120	578.1
140	368.8
160	244.4
180	167.6
200	118.5
220	86.08
240	64.08
260	48.76
280	37.86
300	29.94



### Connectors and Wires

Connector	ASL606-05PN-HE
Mating connector	F02U.000.231-01
ASL006-05SN-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+
Pin 4	-
Pin 5	-
Various motorsport and automotive connectors are available on request.	
Wire size	AWG 24
Wire length L	15 to 50 cm
Please specify the required wire length with your order.	

### Dimensions



### 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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Temperature Sensor NTC M5-HS**  
Order number **F02U.V00.510-01**

## Temperature Sensor NTC M6-HS



6

### Features

- ▶ Application: -55 to 300°C
- ▶ Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- ▶ Male thread: M6 x 1
- ▶ Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

This sensor is designed to measure temperatures up to 300°C of oil, water, fuel or air. This signal is used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC-sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises and the resistance decreases. To improve a good protection against the ambient temperature, the housing is made of stainless steel and partly filled with an isolation-paste.

The main benefit of the sensor is a very compact design and its very short response time.

### Application

Application	-55 to 300°C
Storage temperature range	0 to 100°C
Bio fuel compatibility	-

### Technical Specifications

#### Mechanical Data

Male thread	M6x1
Wrench size	10 mm
Installation torque	8 Nm
Weight w/o wire	6.5 g

Sealing	O-Ring 4.47 x 1.78 mm
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#### Electrical Data

Characteristic	NTC
Nominal resistance at 25°C	10 kOhm $\pm 1\%$

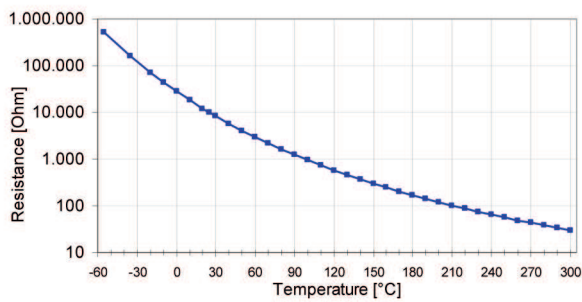
#### Characteristic

Accuracy at 25°C (homogeneous cond.)	$\pm 0.3^\circ\text{C}$
Accuracy at 100°C (homogeneous cond.)	$\pm 1.3^\circ\text{C}$
Response time tau 63 in still water	< 4 s

#### Characteristic Application

T [°C]	R [Ohm]
-55	519,910
-35	158,090
-20	71,668
-10	44,087
0	27,936
10	18,187
20	12,136
25	10,000
30	8,284
40	5,774
50	4,103
60	2,967
70	2,182
80	1,629
90	1,234
100	946.6
110	735.5
120	578.1
130	459.4
140	368.8
150	298.9
160	244.4
170	201.6
180	167.6
190	140.4
200	118.5
210	100.7
220	86.08
230	74.05
240	64.08
250	55.75
260	48.76
270	42.87

280	37.86
290	33.59
300	29.94



### Connectors and Wires

Connector	ASL606-05PN-HE
Mating connector	F02U.000.231-01
ASL006-05SN-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+
Pin 4	-
Pin 5	-

Various motorsport and automotive connectors are available on request.

Wire size	AWG 24
Wire length L	15 to 50 cm

Please specify the required wire length with your order.

### Installation Notes

The NTC M6-HS can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging at our homepage.

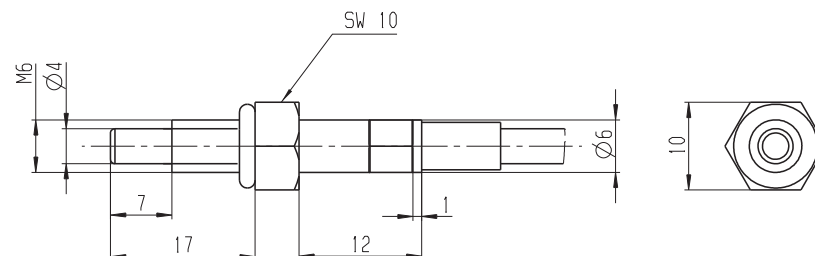
### Legal Restrictions

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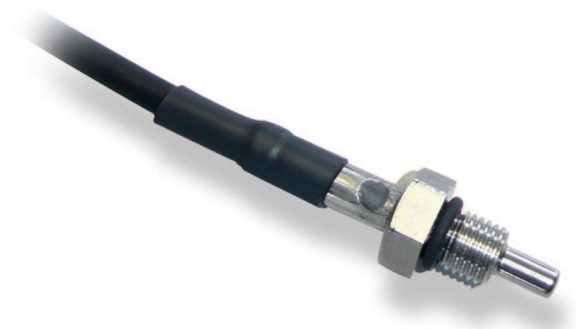
### Ordering Information

**Temperature Sensor NTC M6-HS**  
Order number **F02U.V00.486-01**

### Dimensions



## Temperature Sensor NTC M8-HS



6

### Features

- ▶ Application: -55 to 300°C
- ▶ Accuracy at 25°C:  $\pm 0.3^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 1.3^\circ\text{C}$
- ▶ Male thread: M8 x 1
- ▶ Nominal resistance: 10 kOhm  $\pm 1\%$  (at 25°C)

This sensor is designed to measure temperatures up to 300°C of oil, water, fuel or air. This signal is used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC-sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises and the resistance decreases. To improve a good protection against the ambient temperature, the housing is made of stainless steel and partly filled with an isolation-paste.

The main benefit of the sensor is a very robust design and its very short response time.

### Application

Application	-55 to 300°C
Storage temperature range	0 to 100°C
Bio fuel compatibility	-

### Technical Specifications

#### Mechanical Data

Male thread	M8x1
Wrench size	12 mm
Installation torque	8 Nm
Weight w/o wire	8 g

Sealing	O-Ring 6.35 x 1.78 mm
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#### Electrical Data

Characteristic	NTC
Nominal resistance at 25°C	10 kOhm $\pm 1\%$

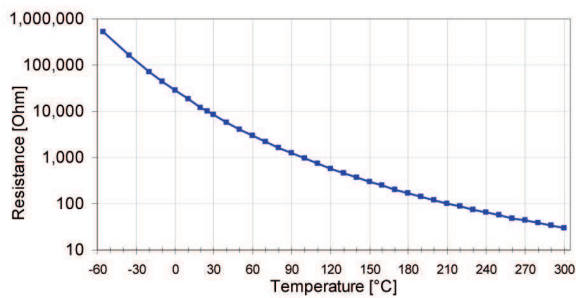
#### Characteristic

Accuracy at 25°C (homogeneous cond.)	$\pm 0.3^\circ\text{C}$
Accuracy at 100°C (homogeneous cond.)	$\pm 1.3^\circ\text{C}$
Response time tau 63 in still water	< 4 s

#### Characteristic Application

T [°C]	R [Ohm]
-55	519,910
-35	158,090
-20	71,668
-10	44,087
0	27,936
10	18,187
20	12,136
25	10,000
30	8,284
40	5,774
50	4,103
60	2,967
70	2,182
80	1,629
90	1,234
100	946.6
110	735.5
120	578.1
130	459.4
140	368.8
150	298.9
160	244.4
170	201.6
180	167.6
190	140.4
200	118.5
210	100.7
220	86.08
230	74.05
240	64.08
250	55.75
260	48.76
270	42.87

280	37.86
290	33.59
300	29.94



### Connectors and Wires

Connector	ASL606-05PN-HE
Mating connector	F02U.000.231-01
ASL006-05SN-HE	
Pin 1	-
Pin 2	Sig-
Pin 3	Sig+
Pin 4	-
Pin 5	-

Various motorsport and automotive connectors are available on request.

Wire size	AWG 24
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Wire length L	15 to 50 cm
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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.

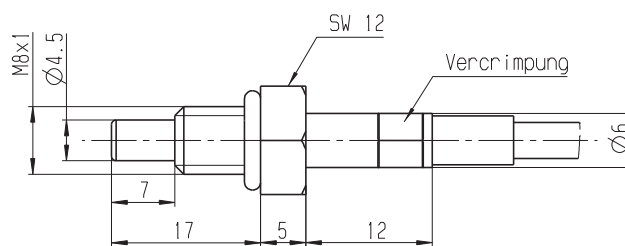
### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

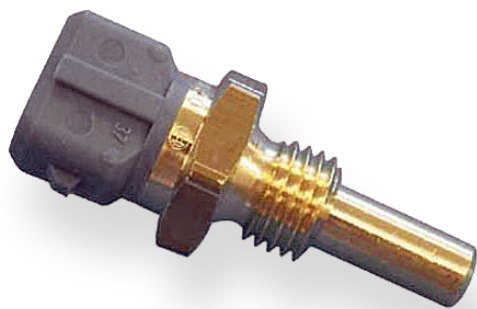
### Ordering Information

**Temperature Sensor NTC M8-HS**  
Order number **F02U.V00.509-01**

### Dimensions



## Temperature Sensor NTC M12



6

### Features

- ▶ Application: -40 to 130°C
- ▶ Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- ▶ Male thread: M12 x 1.5
- ▶ Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

This sensor is designed to measure fluid temperature e.g. oil, water or fuel. This signal may be used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises. The sensing element of the temperature sensor is made of semiconducting heavy metal oxide and oxidized mixed crystals, which are equipped with a protective housing.

The main benefit of the sensor is the combination of a high quality production part and a robust and compact design.

### Application

Application	-40 to 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
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#### Electrical Data

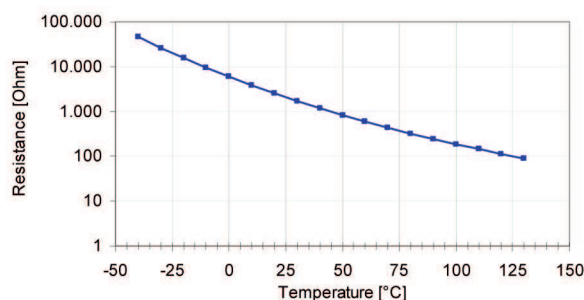
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm $\pm 5\%$

#### Characteristic

Accuracy at 25°C	$\pm 1.4^\circ\text{C}$
Accuracy at 100°C	$\pm 3.4^\circ\text{C}$
Response time tau 63 in still water	< 15 s

#### Characteristic Application

T [°C]	R [Ohm]
-40	45,313
-30	26,114
-20	15,462
-10	9,397
0	5,896
10	3,792
20	2,500
30	1,707
40	1,175
50	834
60	596
70	436
80	323
90	243
100	187
110	144
120	113
130	89



#### Connectors and Wires

Connector	Bosch Jetronic
Mating connector	D261.205.288-01
2-pole Jetronic	
Pin 1	SIG+
Pin 2	SIG-

## Installation Notes

The NTC M12 can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

Any mounting orientation is possible.

Please find further application hints in the offer drawing.  
www.bosch-motorsport.com

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.

## Legal Restrictions

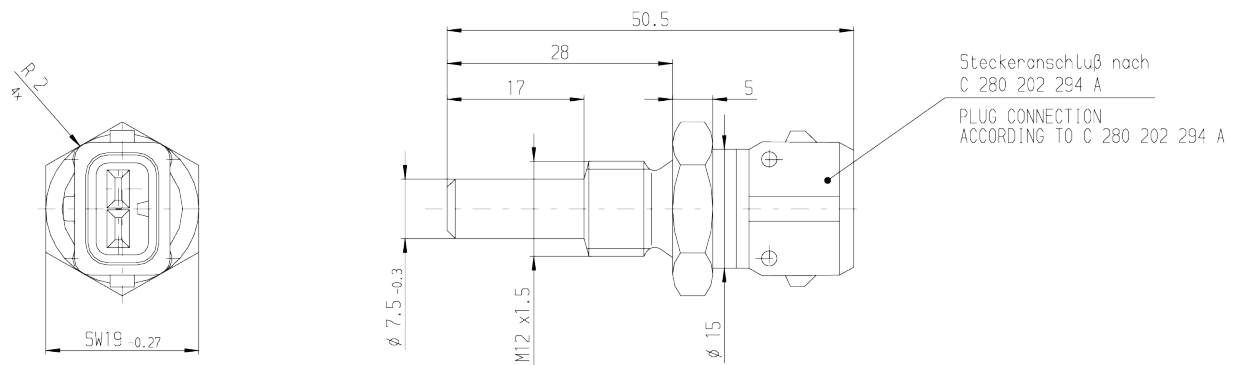
Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

**Temperature Sensor NTC M12**

Order number **0280.130.026**

## Dimensions



## Temperature Sensor NTC M12-H



6

### Features

- ▶ Application: -40 to 130°C
- ▶ Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 0.8^\circ\text{C}$
- ▶ Male thread: M12 x 1.5
- ▶ Nominal resistance at 20°C: 2.5 kOhm  $\pm 6\%$

This sensor is designed to measure fluid temperature e.g. oil, water or fuel. This signal may be used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises. The sensing element of the temperature sensor is made of semiconducting heavy metal oxide and oxidized mixed crystals, which are equipped with a protective housing.

The main benefit of the sensor is the combination of a high quality production part and a robust and compact design.

### Application

Application	-40 to 150°C
Storage temperature range	-30 to 60°C
Bio fuel compatibility	E85/M22
Max. vibration	300 m/s <sup>2</sup>

### Technical Specifications

#### Mechanical Data

Male thread	M12x1.5
Wrench size	19 mm

Installation torque	18 Nm
Weight w/o wire	28.3 g
Sealing	Al-washer

#### Electrical Data

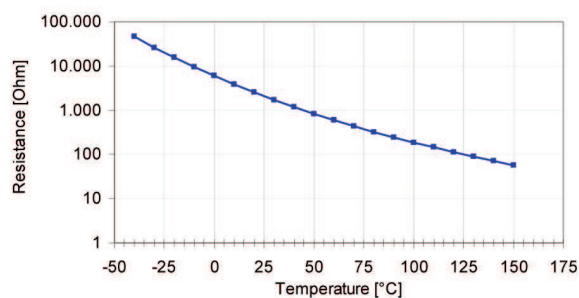
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm $\pm 6\%$

#### Characteristic

Accuracy at 25°C	$\pm 1.4^\circ\text{C}$
Accuracy at 100°C	$\pm 0.8^\circ\text{C}$
Response time tau 63 in still water	< 15 s

#### Characteristic Application

T [°C]	R [Ohm]
-40	45,313
-30	26,114
-20	15,462
-10	9,397
0	5,896
10	3,792
20	2,500
30	1,707
40	1,175
50	834
60	596
70	436
80	323
90	243
100	187
110	144
120	113
130	89
140	71
150	57



#### Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.337-01
2-pole Compact	

Pin 1	SIG+
Pin 2	SIG-

### Installation Notes

The NTC M12-H can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

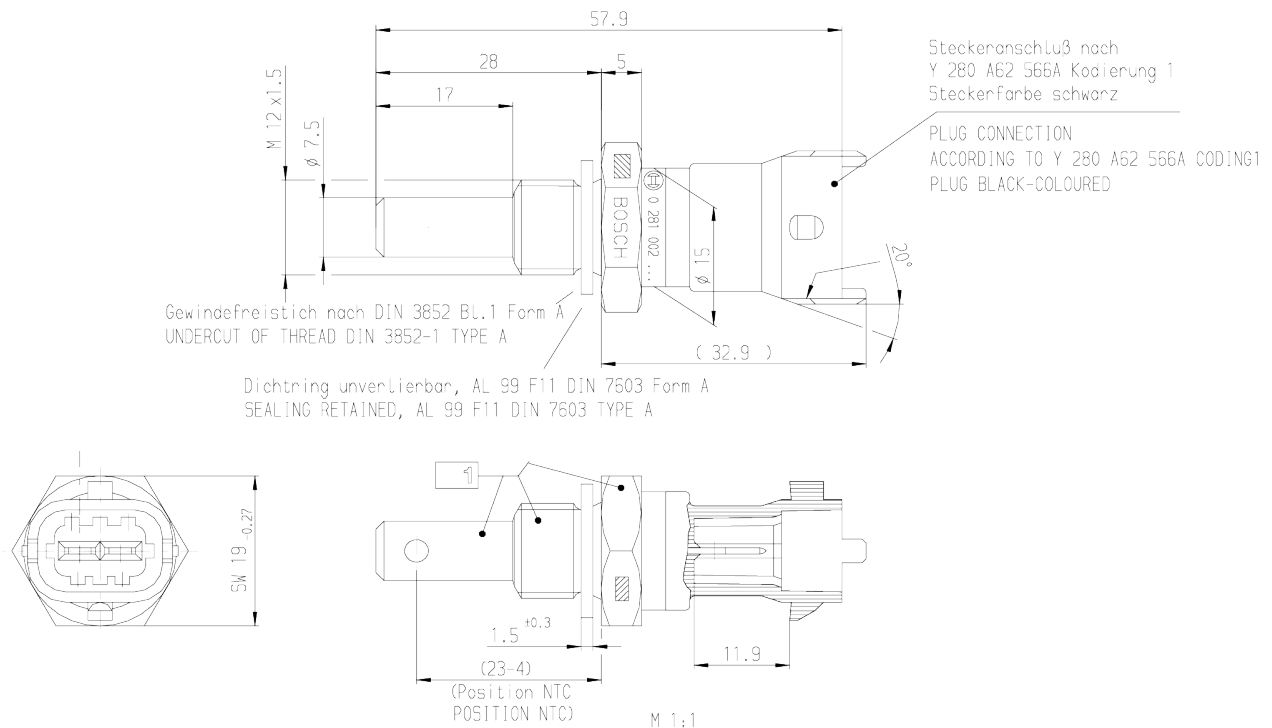
Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

### Safety Note

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

### Dimensions



### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Temperature Sensor NTC M12-H**  
Order number **0281.002.170**

## Temperature Sensor NTC M12-L



6

### Features

- ▶ Application: -40 to 130°C
- ▶ Accuracy at 25°C:  $\pm 1.4^\circ\text{C}$
- ▶ Accuracy at 100°C:  $\pm 3.4^\circ\text{C}$
- ▶ Male thread: M12 x 1.5
- ▶ Nominal resistance: 2.5 kOhm  $\pm 5\%$  (at 20°C)

This sensor is designed to measure air temperature e.g. in the air box or ambient temperature. This signal may be used as a control value for engine control units or as a measurement value which is logged in a data acquisition system.

The NTC sensing element has a negative temperature coefficient. This means, that with increasing temperature the conductivity rises. The sensing element of the temperature sensor is made of semiconducting heavy metal oxide and oxidized mixed crystals, which are equipped with a protective housing.

The main benefit of the sensor is the combination of a high quality production part and a robust and compact design.

### Application

Application	-40 to 140°C
Storage temperature 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
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#### Electrical Data

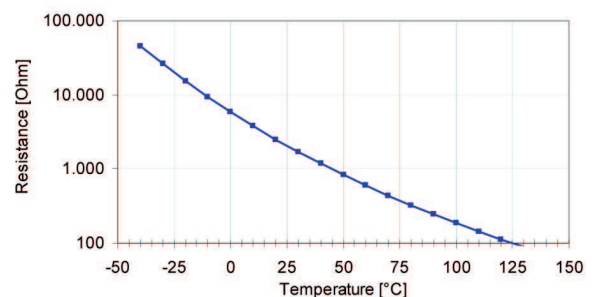
Characteristic	NTC
Nominal resistance at 20°C	2.5 kOhm $\pm 5\%$

#### Characteristic

Accuracy at 25°C	$\pm 1.4^\circ\text{C}$
Accuracy at 100°C	$\pm 3.4^\circ\text{C}$
Response time tau 63 in still water	< 10 s

#### Characteristic Application

T [°C]	R [Ohm]
-40	45,313
-30	26,114
-20	15,462
-10	9,397
0	5,896
10	3,792
20	2,500
30	1,707
40	1,175
50	834
60	596
70	436
80	323
90	243
100	187
110	144
120	113
130	89
140	71



#### Connectors and Wires

Connector	Bosch Compact
Mating connector	D261.205.288-01
2-pole Jetronic	
Pin 1	SIG+
Pin 2	SIG-

## Installation Notes

The NTC M12-L can be connected directly to most control units using a pull-up resistor (typically 1 or 3 kOhm).

Any mounting orientation is possible.

Please find further application hints in the offer drawing and free download of the sensor configuration file (\*.sdf) for the Bosch Data Logging System at our homepage.

## Safety Note

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

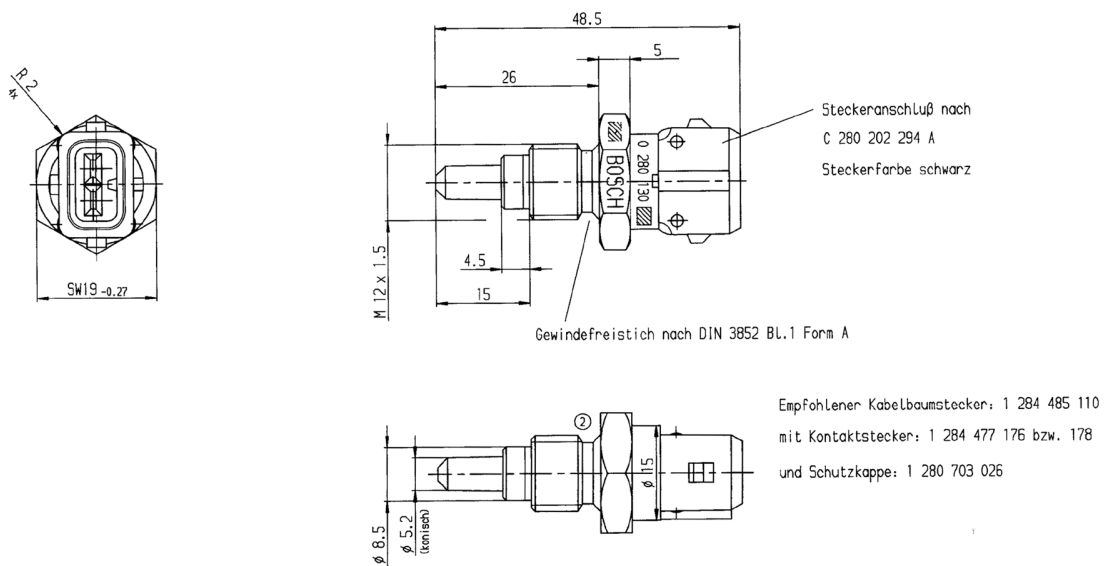
## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

**Temperature Sensor NTC M12-L**  
Order number **0280.130.039**

## Dimensions



## Inertial Measurement Unit MM7.10



6

### Features

- ▶ Application 1:  $\pm 163^\circ/\text{s}$  (roll rate / pitch rate / yaw rate)
- ▶ Application 2:  $\pm 4.2 \text{ g}$  (X, Y and Z acceleration)
- ▶ Weight w/o wire: 35 g
- ▶ Size: 80 x 56 x 23.3 mm
- ▶ Power supply: 8 to 16 V

The MM7.10 was designed to measure the physical effects of rotational and linear acceleration. In order to achieve this, the sensor includes MEMS measuring elements connected to an appropriate integrated circuit.

A rotational acceleration around the integrated sensing elements generates a Coriolis force, which changes the internal capacity of the micro machined sensing parts. Furthermore, a pure surface micro machined element is used to measure the vehicle linear acceleration in all 3 axis. This combination of rotational and linear acceleration sensors enables a precise measurement of the vehicle dynamics.

The main feature and benefit of this sensor is the combination of 3 linear and 3 rotational accelerometers and its high speed 1 Mbaud CAN-signal output.

### Application

Application I	$\pm 163^\circ/\text{s}$ (roll / pitch / yaw rate)
Application II	$\pm 4.2 \text{ g}$ (X, Y and Z acceleration)
Operating temperature range	-20 to 85°C

### Technical Specifications

#### Mechanical Data

Weight w/o wire	35 g
Size	80 x 56 x 23.3 mm

#### Electrical Data

Power supply	8 to 16 V
Max input current	100 mA at 7 V 50 mA at 14 V
CAN speed	1 Mbaud or 500 kbaud

#### CAN Message

##### CAN ID 01 0x174

Byte	Value
0	Yaw rate
1	
2	Reserved
3	
4	Acc Y-axis
5	
6	Reserved
7	Unused

##### CAN ID 02 0x178

Byte	Value
0	Roll rate
1	
2	Reserved
3	
4	Acc X-axis
5	
6	Reserved
7	Unused

##### CAN ID 03 0x17C

Byte	Value
0	Pitch rate
1	
2	Reserved
3	
4	Acc Z-axis
5	
6	Reserved
7	Unused

#### Characteristic

##### Characteristic Application I

Measuring range	$\pm 163^\circ/\text{s}$
Over range limit	$\pm 1,000^\circ/\text{s}$
Absolute physical resolution	0.1°/s

Cut-off frequency (-3 dB)	15 Hz; 30 Hz; 70 Hz
<b>Characteristic Application II</b>	
Measuring range	±4.2 g
Over range limit	±20 g
Absolute physical resolution	0.01 g
Cut-off frequency (-3 dB)	15 Hz; 30 Hz; 70 Hz
<b>Connectors and Wires</b>	
<b>Connector (1)</b>	<b>AMP 114-18063-076</b>
Mating connector (1)	F02U.B00.435-01
Pin 1	Gnd
Pin 2	CANL
Pin 3	CANH
Pin 4	UBat
<b>Connector (2)</b>	<b>ASL606-05PC-HE</b>
Mating connector (2)	ASL006-05SC-HE
Pin 1	UBat
Pin 2	Gnd
Pin 3	CANH
Pin 4	CANL
Pin 5	Not connected
Sleeve	DR-25
<b>Wire with open end (3)</b>	
Red wire	UBat
Blue wire	Gnd
White wire, shielded	CANH
Light Blue wire, shielded	CANL
Wire size with open end	2 x AWG22 (UBat, Gnd) 2 x AWG24 (CAN)
Wire length L	15 to 100 cm
<b>CAN Parameters</b>	
Byte order	LSB (Intel)
CAN speed	1 Mbaud or 500 kbaud
Bit mask	unsigned
Offset (all signals)	0x8000 hex
Quantization Roll Rate	0.005 [°/s/digit]
Quantization Pitch Rate	0.005 [°/s/digit]
Quantization Yaw Rate	0.005 [°/s/digit]
Quantization Acc X-axis	0.0001274 [g/digit]
Quantization Acc Y-axis	0.0001274 [g/digit]
Quantization Acc Z-axis	0.0001274 [g/digit]

## Installation Notes

Mounting position: The MM7.10 must not be mounted with connector pointing upwards. Other than this, Bosch has no restrictions for the mounting orientation. We recommend aligning the unit coordinate system to the vehicle coordinate system as this is the orientation that most systems will require and thus no mathematical transformation is needed.

The MM7.10 can be connected directly to most control units and data logging systems.

Avoid abrupt temperature changes.

For mounting, use only the integrated fixing holes.

Ensure that the environmental conditions do not exceed the sensor specifications.

You will find further application hints in the offer drawing at our homepage and calibration sheet.

Deliver the calibration sheet with your order placement.

Note: CAN ID 04 0x7DC, RX1 0x7DF and RX2 0x7D4 are used for configuration of the sensor (SYNC). Make sure that the CAN ID 04 0x7DC, RX1 0x7DF and RX2 0x7D4 are not used in your CAN network by any other device.

CAN DBC file on request

Standards considered on request

## Safety Note

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

## Legal Restrictions

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## Ordering Information

### Inertial Measurement Unit MM7.10

Sensor with production type connector (1)  
Order number **F02U.V03.092-01**

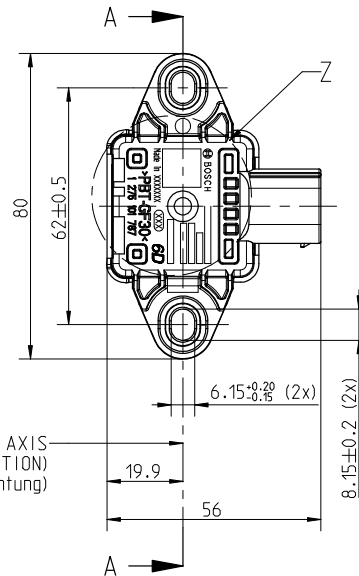
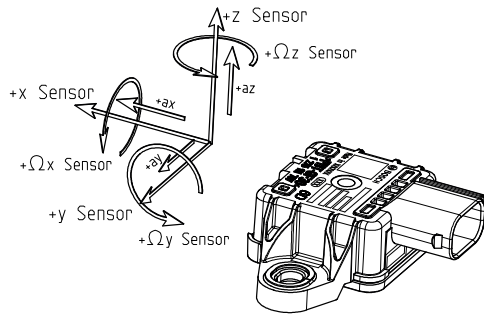
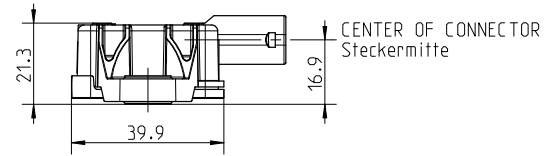
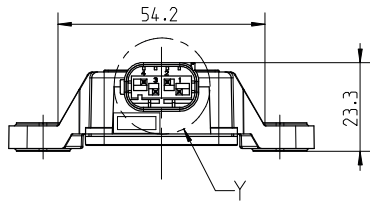
### Inertial Measurement Unit MM7.10

Wire with motorsport connector (2)  
Order number **F02U.V03.092-02**

### Inertial Measurement Unit MM7.10

Wire with open end (3)  
Order number **F02U.V03.092-90**

Dimensions



REFERENCE AXIS  
(PERPENDICULAR TO DRIVING DIRECTION)  
Referenzachse (quer zur Fahrtrichtung)

# Brake

7

**Antilock Braking Systems ABS** 310

**Electronic Brake System EBS** 318

## Overview

### ABS M5 Kit



- Suitable for front-wheel, rear-wheel and four-wheel drive vehicles

### ABS M5 Kit Clubsport



- Suitable for front-wheel, rear-wheel and four-wheel drive vehicles
- Generic wiring harness to fit all engine bay and front foot well locations for the hydraulic module
- Same ABS hardware as standard ABS M5 Kit

### ABS M5 Kit Porsche Cup



- Plug & Play ABS M5 Kit for Porsche 997 Cup and 991 Cup Gen 1 and Gen 2
- Tested and developed on racetracks like Spa and Nordschleife
- Detailed installation instruction available at our website
- 1 Mbaud CAN

## ABS M5 Kit



### Features

- Suitable for front-wheel, rear-wheel and four-wheel drive vehicles

We developed ABS M5 for the operation in front-, rear- or 4-wheel drive vehicles. A vehicle specific wiring harness is included in the Kit.

The ABS M5 is specifically adapted for motorsport use. Individual car parameters like e.g. vehicle weight, vehicle track, wheel weights, wheel circumferences, wheel base or number of increments can be calibrated with software free of charge. Please contact your Bosch Motorsport dealer for further information.

### Technical Specifications

#### Variations

Option	Kit 1	Kit 2	Clubsport
F02U.V05.2	89-01	90-01	91-01 92-01 93-01 94-01 95-01 96-01
Customized wiring loom	+	+	-
Customized ABS maps	On request	On request	-
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	+	+	+**

Option	Kit 1	Kit 2	Clubsport
Downforce depending slip regulation	+***	+***	-
Lateral acceleration slip regulation	+	+	-
Corner inside wheel slip reduction regulation	+	+	-
Tire circumferences via CAN (on request)	+****	+****	-

-\*: 12-position switch is fixed part of the Kit

+\*\*: Adjustable via Coding Plug

+\*\*\*: Enabled with customer specific calibration

+\*\*\*\*: Selection of tire circumferences via CAN, for example when changing from slicks to rain tires. Input will come from external control unit.

#### 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

Operating temperature -30 to 130°C

Max. shock 50 g less than 6 ms

Max. working speed 360 km/h = 100 m/s = 224 mph

##### Pressure Medium

DOT 4 brake fluid

DOT 5.1 brake fluid

##### Electrical Data

Supply voltage 10 to 16 V, max. 24 V for 5 min

Max. peak voltage 35 V for 200 ms

Power consumption Pump 230 W

Power consumption Relay 170 W

Power consumption Electronics 8 W

##### Inputs

4 active wheel speed DF11i, DF11S or DF11V

Brake pressure (front brake circuit / rear brake circuit)

Longitudinal acceleration, lateral acceleration, yaw rate (MM7.10 sensor)

11 adjustment settings (applicable for OEMs)

ABS function can be deactivated (Pos. 1 or Pos. 12)

**Outputs**

ABS warning light (MIL)
EBD warning light (MIL) if needed
TTL wheel speed signal FL / FR / RL / RR

**Content of Kit and Weights**

Hydraulic unit	1,910 g
2 pressure sensors	40 g/each
Yaw/acceleration sensor	60 g
12-position function switch	50 g
4 wheel speed sensors DF11 standard	50 g/each
ABS warning light (MIL)	50 g
Vehicle specific wiring harness with motorsport connectors	Depends on version
Clubsport wiring harness	1,540 g
Mounting and vibration-dampening boards	80 g
Mounting board for hydraulic unit	212 g

**Communication**

ABS and Yaw rate sensor	CAN1
Diagnostics	MSA Box II

**Installation Notes**

Maintenance Interval (brake fluid change, bleeding): 220 h or a maximum of two years. The load on the hydraulic unit in racing is much higher than in pure road operation, therefore we recommend a replacement of the unit after two years.

**Legal Restrictions**

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Ordering Information****ABS M5 Kit 1**

Order number **F02U.V05.289-01**

**ABS M5 Kit 2**

Order number **F02U.V05.290-01**

**ABS M5 Kit Clubsport**

DF11i, 500 kbaud

Order number **F02U.V05.291-01**

**ABS M5 Kit Clubsport**

DF11i, 1 Mbaud

Order number **F02U.V05.292-01**

**ABS M5 Kit Clubsport**

DF11S, 500 kbaud

Order number **F02U.V05.293-01**

**ABS M5 Kit Clubsport**

DF11S, 1 Mbaud

Order number **F02U.V05.294-01**

**ABS M5 Kit Clubsport**

DF11V, 500 kbaud

Order number **F02U.V05.295-01**

**ABS M5 Kit Clubsport**

DF11V, 1 Mbaud

Order number **F02U.V05.296-01**

## Dimensions

### ABS M5 Kit Variations

	ABS M5 Kit 1	ABS M5 Kit 2	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport
Type	Kit 1	Kit 2	1 Mbaud, DF11i	500 kbaud, DF11i	1 Mbaud, DF11S
Wiring harness	Specific	Specific	Generic	Generic	Generic
4 wheelspeed sensors DF11S	Included, with standard connectors	Included, with motorsport connectors	Not included	Not included	Included, with standard connectors
Wheel speed signal splitter	included*	Included*	included*	included*	included*
Fuses	Not included	Not included	Not included	Not included	Not included
Brake pipe fittings	Not included	Not included	Not included	Not included	Not included

	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport	ABS M5 Kit Clubsport	ABS M5 Kit Porsche 991 Cup Gen 1	ABS M5 Kit Porsche 991 Cup Gen 2
Type	500 kbaud, DF11S	500 kbaud, DF11V	1 Mbaud, DF11V	Model year 2015	Model year 2017
Wiring harness	Generic	Generic	Generic	Specific	Specific
4 wheelspeed sensors DF11S	Included, with standard connectors	Not included	Not included	Included, Porsche specific DF11S	Included, Porsche specific DF11S
Wheel speed signal splitter TTL	included*	included*	included*	Included, DF11	Included, DF11
Fuses	Not included	Not included	Not included	Included	Included
Brake pipe fittings	Not included	Not included	Not included	Included	Included

\*TTL splitter incl. in ABS Hardware, DF11 splitter optional



### Legal Restrictions

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### Ordering Information

**ABS M5 Kit Clubsport**

DF11i, 500 kbaud

Order number **F02U.V05.291-01****ABS M5 Kit Clubsport**

DF11i, 1 Mbaud

Order number **F02U.V05.292-01****ABS M5 Kit Clubsport**

DF11S, 500 kbaud

Order number **F02U.V05.293-01****ABS M5 Kit Clubsport**

DF11S, 1 Mbaud

Order number **F02U.V05.294-01****ABS M5 Kit Clubsport**

DF11V, 500 kbaud

Order number **F02U.V05.295-01****ABS M5 Kit Clubsport**

DF11V, 1 Mbaud

Order number **F02U.V05.296-01**

## ABS M5 Kit Porsche Cup



7

### Features

- ▶ Plug & Play ABS M5 Kit for Porsche 997 Cup and 991 Cup Gen 1 and Gen 2
- ▶ Tested and developed on racetracks like Spa and Nordschleife
- ▶ Detailed installation instruction available at our website
- ▶ 1 Mbaud CAN

The ABS M5 Kit Porsche Cup is a derivative of the successful ABS M5 kit and specifically designed for Porsche 997 Cup and 991 Cup. A vehicle specific wiring harness is included in the kit. Individual car parameters like e.g. vehicle weight, vehicle track, wheel weights, wheel circumferences, wheel base or number of increments can be calibrated with software free of charge. Please contact your Bosch Motorsport dealer for further information.

### Technical Specifications

#### Variations

	997 Cup (System DF11S)	991 Cup (System DF11i)
4 wheel speed sensors	Included, Porsche specific DF11S	Not included, series sensors fit
ABS warning light (MIL)	Included	Included (LED type)
Brake pipe fittings	Not included	Included
Fuses	Not included	Included
Holder for Hydraulic unit	Included, standard	Included, Porsche specific

#### Mechanical Data

##### Hydraulic unit

Vibration damped circuit board

38 pin connector	
2 hydraulic valves per wheel	
2 brake circuits (front and rear)	
2 hydraulic accumulators 5 cm <sup>3</sup> /each	
Standard fittings	2 x master cylinders M12 x 1 4 x brake cylinders M10 x 1
Size	122 x 110 x 122 mm
Weight	1,910 g
Operating temperature	-30 to 130°C
Max. shock	50 g less than 6 ms
Max. working speed	360 km/h = 100 m/s = 224 mph

#### Pressure Medium

DOT 4 brake fluid  
DOT 5.1 brake fluid

#### Electrical Data

Supply voltage	10 to 16 V, max. 24 V for 5 min
Max. peak voltage	35 V for 200 ms
Power consumption pump	230 W
Power consumption relay	170 W
Power consumption electronics	8 W

#### Inputs

4 active wheel speed DF11	
2 brake pressure (front brake circuit, rear brake circuit)	
Longitudinal acceleration	
Lateral acceleration	
12 position function switch:	<ul style="list-style-type: none"> <li>• 11 maps preconfigured</li> <li>• 1 switch position for ABS function OFF</li> </ul>

#### Outputs

ABS warning light (MIL)  
CAN channels: see manual

#### Optional Accessories

Data logger C 70	F02U.V02.302-02
Display DDU 9	F02U.V02.300-03

#### Content of Kit

##### Hydraulic unit

Holder for Hydraulic unit	See Variations
4 Wheel speed sensors	See Variations
2 pressure sensors	
MM7.10 acceleration sensor	
Vibrations damping board for acceleration sensor	
12-position function switch	
ABS warning light (MIL)	See Variations
Specific wiring harness	

Brake pipe fittings	See Variations
---------------------	----------------

Fuses	See Variations
-------	----------------

Fuse mounting bracket	
-----------------------	--

### Required Content

Brake pipes not included, available at Bosch Motorsport dealer
----------------------------------------------------------------

### Communication

CAN via Com Interface MSA-Box II
----------------------------------

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### **ABS M5 Kit Porsche 997 Cup**

Order number **F02U.V05.289-20**

#### **ABS M5 Kit Porsche 991 Cup Gen 1**

2015 Model Year

Order number **F02U.V05.289-18**

#### **ABS M5 Kit Porsche 991 Cup Gen 2**

2017 Model Year

Order number **F02U.V05.289-19**

## Electronic Brake System EBS



7

### Features

- Suitable for one axle use

We developed EBS for the operation in electric or hybrid vehicles on one axle. A vehicle specific wiring harness can be purchased (vehicle specific definition is needed).

The EBS is specifically adapted for motorsport use. Individual car parameters like e.g. brake pads friction can be calibrated with software free of charge. Please contact your Bosch Motorsport dealer for further information.

### Technical Specifications

#### Mechanical Data

##### Hydraulic unit

Serial housing, dust- and damp-proof	
Vibration damped circuit board	
38 pin connector	
6 hydraulic valves for inlet/outlet	
1 separation backup valve	
1 electric pump motor	
1 hydraulic accumulator	160 bar/90 cm <sup>3</sup>
Standard fittings	M12 x 1
Size	176 x 144 x 157 mm
Operating temperature	-30 to 130°C
Max. shock	50 g less than 6 ms
Max. working pressure	130 bar; max. recommended locking pressure 120 bar
Max. pressure gradient	up to 2,000 bar/s

#### Pressure Medium

DOT 4 brake fluid	
DOT 5.1 brake fluid	

#### Electrical Data

Supply voltage	10 to 16 V max. 24 V for 5 min
Max. peak voltage	35 V for 200 ms
Max. peak at start	<165 A
Current consumption Pump	<40 A
Current consumption Relay	<16.5 A
Power consumption Electronics	<1.5 A

#### Inputs

1 x PWM Target (Pressure or Torque)	
1 x PWM input calliper pressure	
1 x CAN1; 500 k or 1 Mb selectable	
1 x CAN1 DC (Daisy Chain)	
EBS function switch 6 positions via CAN1	

#### Outputs

EBS warning light (MIL) via CAN1	
EBS diagnostic via CAN1	

#### Required Additional

Mounting Board for Hydraulic Unit	
Pressure Sensors Fluid PSS-260	2 required
Com Interface MSA Box II	Required for communication and programming, not mandatory if available

#### Spare Parts

Mounting Rubber Elements Kit	5 sets (10 units Ø 18 mm; 5 units Ø 23 mm)
------------------------------	--------------------------------------------

#### Component Weights

Hydraulic Unit	3,630 g
Mounting Board for Hydraulic Unit	300 g
2 Pressure Sensors Fluid PSS-260	40 g/each
Vehicle specific wiring harness with motorsport connectors	Depends on version

#### Pin Configuration

1	UB_MR
...	
13	GND_MR
14	CAN1M
15	CAN1M-DC
...	
25	UB_VR
26	CAN1P
27	CAN1P-DC
28	WAU_IN





# Software

8

<b>Analysis</b>	<b>322</b>
<b>API</b>	<b>324</b>
<b>Customer Code Area</b>	<b>325</b>
<b>Licenses</b>	<b>326</b>
<b>RaceConnect</b>	<b>327</b>
<b>Scrutineering</b>	<b>328</b>
<b>Simulation</b>	<b>329</b>
<b>System Configuration</b>	<b>330</b>

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## Analysis Tool WinDarab V7



## 8

### Features

- ▶ State of the art user interface, versatile diagrams
- ▶ Numerous analysis functions
- ▶ Customizable mathematical channels and filters
- ▶ Software based license without dongle
- ▶ License Troubleshooting

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.

### Application

#### Diagrams

- Oscilloscope
- X-/Y-plot to create scatterbands
- Histogram
- 3D-diagram

#### Analysis

- Overlay of different laps
- Time or distance based analysis
- Absolute and relative values

One-touch channel statistics (min./max., avg., etc.)

Regression lines, user defined lines

Lap reports and lap based comparisons

Replay offline data in realtime

#### Advanced Analysis

User defined math channels

User defined conditions to filter data

FFT analysis

#### Racetracks

Racetrack creation based on v/acc or GPS data

Racetrack segmentation

#### Telemetry

Replay online data in realtime

Gauges for realtime visualization

#### User Interface

Flexible display setup and arrangement

Storable display setup and arrangement

Lap browser

#### Data Transmission

Direct data input without intermediate hardware

Protection/encryption of logged data files

ASCII import and export

#### License System

Dongle-free working in all WinDarab V7 variations

Activation/update via internet

Annual maintenance for up-to-date versions

#### Environment

##### PC

IBM PC Pentium/AMD Athlon compatible, min. 1.6 GHz

Min. 1 GB RAM

Min. 1 GB free HD space

VGA / WGA monitor (min. 1,024 x 768)

Recommended Operation System: Windows 10 or 11

### 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.

### Installation Notes

Yearly maintenance is recommended, no components to replace  
 Programming interface COM-API requires active maintenance

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### WinDarab Free Version

Order number **free download at our homepage**

#### WinDarab Expert

Order number **F02U.V01.308-01**

#### WinDarab Yearly Maintenance

Order number **F02U.V01.345-01**

#### Software Options

##### COM-API for WinDarab Expert

Yearly License

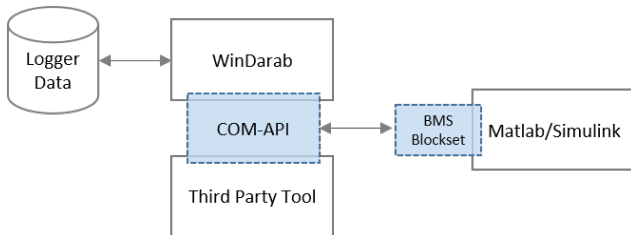
Order number **F02U.V01.682-01**

##### WinDarab Telemetry External Data Stream

Yearly License WinDarab ExtDataStream

Order number **BG02.000.066**

## COM-API for WinDarab Expert



- Marked/Tagged range

Users can also compile their application as a WinDarab Plugin. This allows custom buttons and menus on the WinDarab Ribbon. Apart from plugins, applications using COM-API are *out of process communication*.

### COM-API can create new measurement files

- A 3rd party application/plugin can use the UserDataFile class to create new measurement files with application generated channel data.
- Files created with the new API are written in WinDarab file format v2 which is supported since WinDarab v7.6.
- A brief example how to write a file can be found in the BMS2ApiSamples.Net project, see the source in CreateUserDataFile.cs.

The application of COM-API requires the Expert-version of WinDarab, it doesn't work with the Free-version.

## 8

### Features

- ▶ Gives external tools access to WinDarab functionalities

Using COM-API allows some control over WinDarab:

- Attaching to or creating new instances of WinDarab Application
- Data Domain (opened files and overlays)
- Cursor position – View range

### Legal Restrictions

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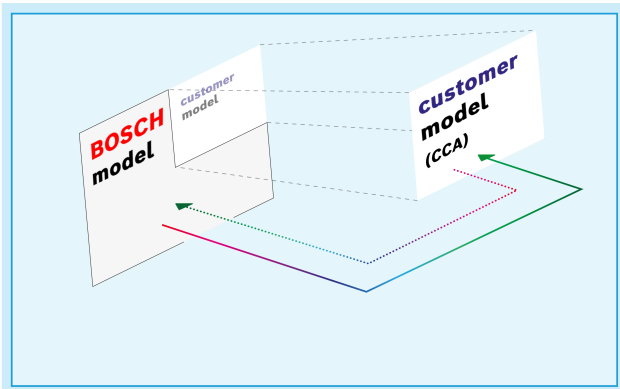
### Ordering Information

#### COM-API for WinDarab Expert

Yearly License

Order number **F02U.V01.682-01**

## CCA Development Environment



### Features

- ▶ Calculation directly in Bosch main device possible
- ▶ Communication binding via Software free cuts
- ▶ Unlimited bandwidth interfaces
- ▶ One Box Design (compact solution, no extra weight)

We provide the option to run software code on our ECUs that has been developed by the customer. This code is run in the customer code area (CCA) and is protected against access of anyone else. Within ECUs and VCUs, this feature can be run in parallel to all further functionality.

We deliver it with a full environment for Matlab/Simulink, a compiled Bosch model as library and a package of Matlab/Simulink interfaces to all I/Os.

### Technical Specifications

#### General Functions

- Support for generating executables that include algorithm, device-driver and real-time operating system
- Multitasking scheduling using time synchronous (and asynchronous) tasks, task pre-emption and temporary task overruns
- Environment for Matlab/Simulink
- Full I/O access with Bosch-Motorsport device drivers
- Full read access to all Bosch signals
- Development Environment with reduced Bosch "unit\_blockset"

Real time calibration

Calibration and measurement interface XCP via Ethernet

SW-Download via Bosch Motorsport calibration tool RaceCon

Software option for all ECUs and VCUs

Free maintenance for the first 12 month, afterwards with costs.

### System Requirements

#### MathWorks Requirements

- MATLAB R2018b
- Simulink R2018b
- MATLAB Coder
- Embedded Coder
- Simulink Coder
- Stateflow
- Compiler for Mathworks
- Microsoft Visual C++ 2017

#### Operating System

- Windows 10
- Microsoft Visual C++ 2005 Redistributable (x64)
- Microsoft Visual C++ 2008 Redistributable (x86)
- Microsoft Visual C++ 2008 Redistributable (x64)
- Microsoft .NET Framework 2.0, 3.5.1, 4.8
- Microsoft Excel 2016(32bit) or Office365(64bit)

#### DocGen

- basic-miktex-21.2-x64.exe from <https://miktex.org/download>

### Additional (not included)

#### Multi CCA for VCU

Enables the use of an extra core to utilize more computing power in the device for running a second customer model

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### CCA Development Environment

Order number **F02U.V02.370-01**

#### Multi CCA Development Environment for VCU

Order number **F02U.V03.223-01**

#### Software Options

#### CCA Hardware Upgrade per device

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

#### Multi CCA Hardware Upgrade VCU per device

Order number **F02U.V03.222-01**

## License Manager



Bosch Motorsport



Bosch Motorsport License Manager is an easy tool to manage your locally installed licenses.

- This update license feature in the tool helps you to apply a new license using the license number or with a license file which is typically used for offline purposes.
- The force update feature in the tool helps verify if there are any new updates available and guides you to install the update.
- Manage license feature guides you to Raceconnect page where license self management is done.
- Help feature in the tool guides you to Bosch Motorsport Licenses page to troubleshoot and download related tools.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## RaceConnect



### Features

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

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

### Legal Restrictions

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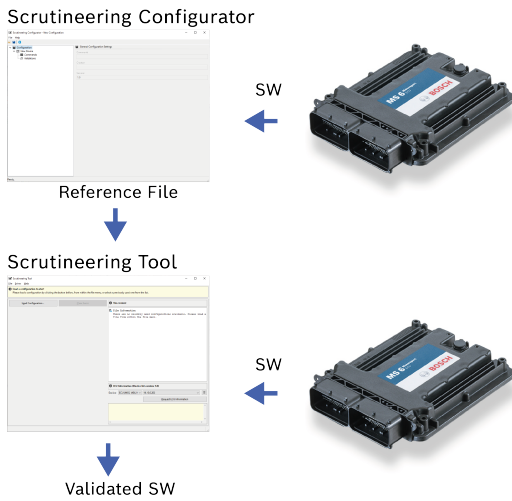
### Ordering Information

#### **RaceConnect**

Please contact us for further information.

Order number **on request**

## Scrutineering Configurator and Tool



8

### Features

- ▶ Verification of the ECU software content
- ▶ State of the art Hash algorithm SHA-256

The Scrutineering Configurator and Tool is a software package developed for teams and OEMs to validate the software content of Bosch Motorsport ECUs.

The Scrutineering Configurator creates the reference file required to check the software status of a control unit. All you need is a template file and the Bosch control unit prepared with the correct software. The template file can be configured and is provided by Bosch, please contact Bosch.

The Scrutineering Tool checks the content of a control unit against the reference file.

### Scrutineering Tool standalone

If you do not need the configurator and only want to work with the scrutineering tool (e.g. marshal or team), you can order the tool separately. You will need a license number to activate the tool, which we provide free of charge.

### Technical Specifications

#### PC Environment

IBM PC Pentium/AMD Athlon compatible, min. 1.6 GHz

Min. 2 GB RAM

Min. 1 GB free hard disc space

VGA/WGA monitor (min. 1,024 x 768)

Recommended Operation System Windows 10

#### Installation Notes

Software license valid for the duration of one year from activation. If the license is not renewed after that, further use is not possible.

Initial minimum purchase quantity is 3 licenses, after one year there is no minimum purchase quantity anymore.

#### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

#### Ordering Information

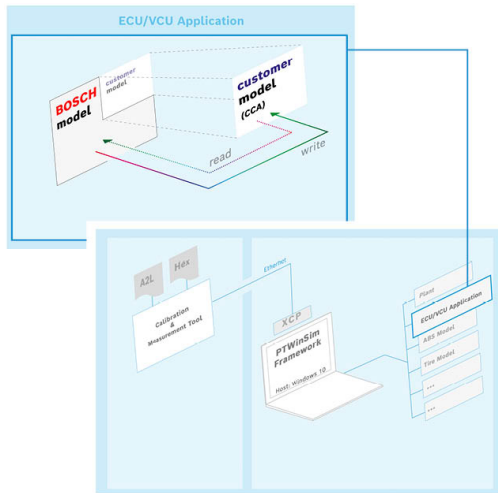
##### Scrutineering Configurator and Tool

Please contact us if you are interested:

[motorsport@bosch.com](mailto:motorsport@bosch.com)

Order number **on request**

## Simulation Packages



### Features

- ▶ Simulate Bosch model and Customer model together in the same simulation environment
- ▶ Develop Bosch Motorsport control systems (ECU/VCU) in a simulation environment with other plant models (e.g. tire, ABS)
- ▶ Enables use of Bosch models (via *PTWinSim*) in other simulation environments like rFpro
- ▶ Execute your control system faster than real-time on a Windows 10 PC
- ▶ Perform real-time analysis on telemetry streams or other data sources

These simulation packages allow customers that use Bosch Motorsport control systems to simulate the functionality without using the hardware. These packages enable the user to run Bosch Motorsport and customer code area functions within the PTWinSim® environment.

PTWinSim® provides a framework and supporting functionality enabling several applications to execute in a coherent time frame on a variety of hosts.

Applications ranging from Engine Control Unit code to vehicle system models with complex control algorithms are simply adapted for the simulation environment. Furthermore, with WinDarab COM API, Bosch Motorsport customers can use WinDarab datasets as stimuli and logging for their simulated control system.

Device Simulation Runtime provides the runtime licenses to run a Bosch Motorsport simulation package within PTWinSim®. This requires an individual and project specific simulation software, which needs to be ordered separately.

CCA Simulation Package also provides the option for users of CCA to generate their own simulation software. Device Simulation Runtime is included.

### Technical Specifications

Recommended Operation System Windows 10, min. Update Version 1803

### Required and not included Software

MathWorks Requirements	CCA S.P.*	Device S.P.*
MATLAB R2018b	x	
Simulink	x	
Real-Time Workshop	x	
Real-Time Workshop Embedded Coder	x	
Fixed-Point Toolbox	x	
Simulink Fixed-Point	x	
Stateflow	x	
Stateflow Coder	x	
Vehicle Network Toolbox	x	
Min. PTWinSim 4.09	x	x
Compiler		
Microsoft Visual Studio, Version 2017	x	x
Application tool		
RaceCon 2.7 or later	x	x

\*S.P.: Simulation Package

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### CCA Simulation Package

CCA Simulation development target to build and execute customer code.

Including 1 Device Simulation Runtime license and 1 year maintenance.

Order number **F02U.V02.893-01**

#### CCA Simulation Package Annual Maintenance

Order number **F02U.V02.892-01**

#### Device Simulation Runtime

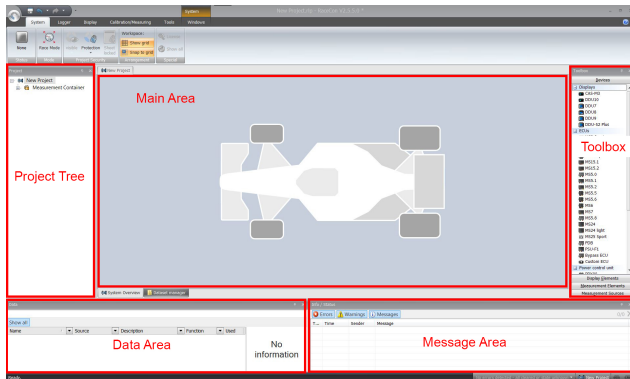
Device Simulation Runtime license to execute simulation on a PC and 1 year maintenance

Order number **Contact Bosch Motorsport**

#### Device Simulation Runtime Annual Maintenance

Order number **Contact Bosch Motorsport**

## System Configuration Tool RaceCon



## 8

### Features

- ▶ An all integrated software tool for configuration and calibration

RaceCon is an all integrated software tool for configuration and calibration of Bosch Motorsport hardware products, such as ECUs, displays, loggers. The communication is based on Bosch Motorsport MSA-Box interface.

### Application

Calibration of ECU maps and curves  
ECU data file and parameter file up- and download

Diagnostic functionality for Bosch Motorsport ECUs  
Data file / Work base management  
Integrated flash functionality and Bosch sensor database  
Configuration of Bosch Motorsport displays, data loggers, CAN modules, ...  
Communication via K-Line/CAN/Ethernet (KWP/CCP/XCP)  
CAN communication log functionality (baud rate changeable)  
Quick data access over Race Mode

### Technical Specifications

#### PC

IBM PC Pentium/AMD Athlon compatible, min. 1.6 GHz  
Min. 2 GB RAM  
Min. 1 GB free hard disc space  
VGA/WGA monitor (min. 1,024 x 768)  
Recommended Operating System: Windows 10

#### Optional Accessories

MSA-Box II F02U.V00.327-03

#### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

#### Ordering Information

**System Configuration Tool RaceCon**  
Order number **free download**

**More**

**9**

<b>Breakout Boxes</b>	<b>332</b>
<b>Communication Interface</b>	<b>338</b>
<b>Connector Opening Tool</b>	<b>341</b>
<b>Connectors</b>	<b>342</b>
<b>Vibration Profiles</b>	<b>343</b>
<b>Wiring Harnesses</b>	<b>345</b>

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## Overview

### Breakout Box BOB 66-pole



- Optimised packaging facilitates a low-profile design with compact, lightweight housing
- 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

### Breakout Box BOB MS 6



- Optimised packaging facilitates a low-profile design with compact, lightweight housing
- 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

### Breakout Box BOB MS 7



- Optimised packaging facilitates a low-profile design with compact, lightweight housing
- 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

### Breakout Box BOB PBX 90



- Optimised packaging facilitates a low-profile design with compact, lightweight housing
- 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

9

### Breakout Box BOB PBX 190



- Optimised packaging facilitates a low-profile design with compact, lightweight housing
- Robust 4 mm standard jacks for measuring leads
- Signal integrity of high-speed data links ensured by product-specific version
- No more lost jumpers due to patented 90° rotatable connectors

## Breakout Box BOB 66-pole



### Features

- ▶ Optimised packaging facilitates a low-profile design with compact, lightweight housing
- ▶ 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 facilitate the ability to open and close each individual connection without removing the jumper. All signals can be accessed and measured via the jacking points. The box is essential for development and test environments in the lab and vehicle.

### Technical Specifications

#### Mechanical Data

Size	225 x 130 x 35 mm
Weight	1,100 g

4 mm standard jacks for measuring leads	66
-----------------------------------------	----

#### Connectors and Wires

F02U.V02.295-01 code blue	
Connector on housing	AS018-35PB
Connector on wire	AS618-35SB
F02U.V02.296-01 code orange	
Connector on housing	AS018-35PC
Connector on wire	AS618-35SC
F02U.V02.297-01 code red	
Connector on housing	AS018-35PN
Connector on wire	AS618-35SN
F02U.V02.298-01 code yellow	
Connector on housing	AS018-35PA
Connector on wire	AS618-35SA
F02U.V02.299-01 code violet (universal)	
Connector on housing	AS018-35PU
Connector on wire	AS618-35SU
Wire length L (all)	Ca. 50 cm

#### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

#### Ordering Information

##### Breakout Box BOB 66-pole

Connector code: blue  
Order number **F02U.V02.295-01**

##### Breakout Box BOB 66-pole

Connector code: orange  
Order number **F02U.V02.296-01**

##### Breakout Box BOB 66-pole

Connector code: red  
Order number **F02U.V02.297-01**

##### Breakout Box BOB 66-pole

Connector code: yellow  
Order number **F02U.V02.298-01**

##### Breakout Box BOB 66-pole

Connector code: violet (universal use)  
Order number **F02U.V02.299-01**

## Breakout Box BOB MS 6



### Features

- ▶ Optimised packaging facilitates a low-profile design with compact, lightweight housing
- ▶ 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

We developed this BOB version for use with Engine Control Units MS 6 EVO and a second version for use with Engine Control Units MS 6. They differ in their internal structure and cannot be interchanged.

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

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

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

## Breakout Box BOB MS 7



### Features

- ▶ Optimised packaging facilitates a low-profile design with compact, lightweight housing
- ▶ 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 facilitate the ability to open and close each individual connection without removing the jumper. All signals can be accessed and measured via the jacking points. The box is essential for development and test environments in the lab and vehicle.

This version was especially developed for use with the LIFE connector of Engine Control Units MS 7 and Vehicle Control Unit VCU.

### Technical Specifications

#### Mechanical Data

Size	226 x 130 x 40 mm
Weight	1,180 g w/o accessories
4 mm standard jacks for measuring leads	36
Ethernet connectors	10
Ethernet wire	5 x inclusive
USB connectors	2
USB jumper	1 inclusive

#### Connectors and Wires

Wire length L	55 cm
---------------	-------

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Breakout Box BOB MS 7

Connector code: red

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

## Breakout Box BOB PBX 90



### Features

- ▶ Optimised packaging facilitates a low-profile design with compact, lightweight housing
- ▶ 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 facilitate the ability to open and close each individual connection without removing the jumper. All signals can be accessed and measured via the jacking points. 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
---------------	-----------

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Breakout Box BOB PBX 90**  
Order number **F02U.V02.292-01**

## Breakout Box BOB PBX 190



### Features

- ▶ Optimised packaging facilitates a low-profile design with compact, lightweight housing
- ▶ 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 facilitate the ability to open and close each individual connection without removing the jumper. All signals can be accessed and measured via the jacking points. 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
---------------	---------------

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

**Breakout Box BOB PBX 190**  
Order number **F02U.V02.523-01**

## Com Interface MSA-Box II



### Features

- Communication interface for PC-supported calibration on K-line, CAN or Ethernet interface

The MSA-Box II is the low cost unit for PC-supported calibration and configuration on Ethernet, K-Line or CAN interface of an ECU.

The MSA-Box II is coupled to the PC via the USB interface. This ensures a powerful and universal link to all common PCs. The coupling to the ECU is effected via Ethernet, K-Line or CAN-interface of the diagnosis interface.

### Technical Specifications

#### Mechanical Data

Size 84 x 38 x 25 mm

Temperature range 0 to 70°C

Compact design

Fully suitable for motor vehicle use

All inputs and outputs to the PC with galvanic separation

#### Electrical Data

Input voltage (vehicle side) 8 to 32 V

Power supply through the connection to the ECU from board mains with galvanic separation

Power consumption (powered by USB)	Typ. 0.5 W
USB	USB 2.0, high speed (480 MBit/sec)
Ethernet	100 MBit/sec
K-Line	300 Bd up to 320 kBd
CAN	10 kBit/s up to 1 MBit/s
Recommended Operation System Windows 10	

### Connectors and Wires

Connector AS612-35PN	F02U.000.441-01
Mating connector AS012-35SN	F02U.000.258-01
Pin 1	Terminal 30 (permanent pos)
Pin 2	Terminal 15 (switch pos)
Pin 3	GND
Pin 4	CAN_High
Pin 10	K-Line
Pin 8	RxD+
Pin 9	RxD-
Pin 11	TxD+
Pin 12	TxD-
Pin 16	CAN_Low
Pin 22	SCR
Diagnosis wire length	2 m
USB wire length	0.5 m

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Com Interface MSA-Box II

Not mandatory if available

Order number **F02U.V00.327-03**

# Ethernet Data Read Cable



## Features

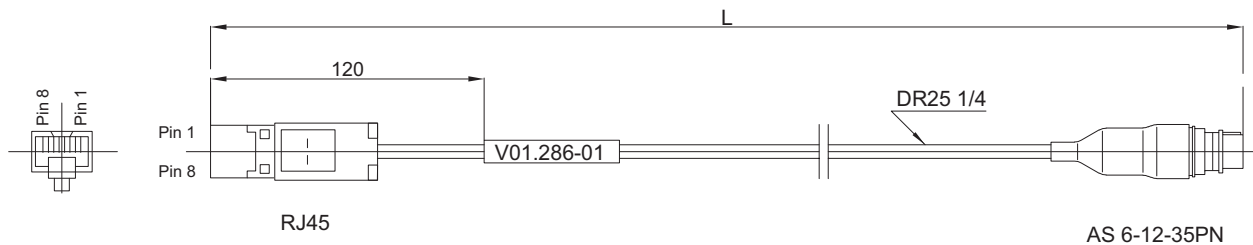
- ▶ Communication interface for PC-supported calibration on Ethernet interface
- ▶ 100 Mbit Version and 1 Gbit Version available

## Technical Specifications

### Connectors and Wires 100 Mbit Version

Connector RJ45		Connector AS612-35PN (F02U.000.441-01)	
Pin 1	Tx+	Pin 8	White / orange
Pin 2	Tx-	Pin 9	Orange
Pin 3	Rx+	Pin 11	White / green
Pin 6	Rx-	Pin 12	Green
		Pin 22	Screen

## Dimensions



100 Mbit Version

Connector RJ45		Connector AS612-35PN (F02U.000.441-01)	
		Pin 1	nc
		Pin 15	nc

### Connectors and Wires 1 Gbit Version

Connector RJ45		Connector AS612-35PN (F02U.000.441-01)	
Pin 1	Tx+	Pin 11	White / green
Pin 2	Tx-	Pin 12	Green
Pin 3	Rx+	Pin 8	White / orange
Pin 6	Rx-	Pin 9	Orange
Pin 4	D3+	Pin 19	Blue
Pin 5	D3-	Pin 20	White / blue
Pin 7	D4+	Pin 17	White / brown
Pin 8	D4-	Pin 18	Brown
Wire length L		1.500 mm	

## Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Ordering Information

### Ethernet Data Read Cable

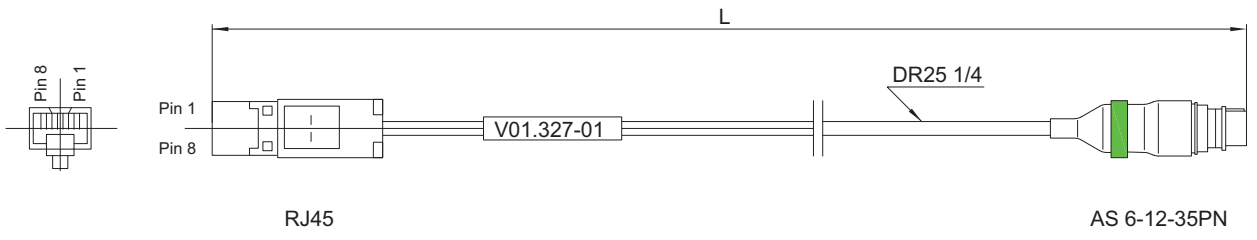
100 Mbit Version

Order number **F02U.V01.286-01**

### Ethernet Data Read Cable

1 Gbit Version

Order number **F02U.V02.327-01**



1 Gbit Version

## Connector Opening Tool for AS series



### Features

- ▶ Quick and easy opening of ECU connectors

The Connector Opening Tool helps you to open connectors of ECUs like MS 7.4.

### Technical Specifications

#### Mechanical Data

Material	Stainless steel
----------	-----------------

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

### Ordering Information

#### Opening tool for shellsize 16

Order number **F02U.V01.393-01**

#### Opening tool for shellsize 18

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

## Connectors



### Features

- ▶ Bosch Jetronic and Compact connectors inclusive contacts and sealings
- ▶ Autosport connectors from Deutsch, Tyco, etc.
- ▶ Connectors with 3 to 128 pins

Convenient to the Wiring Harnesses, we have a wide range of connectors on offer.

From single pin and Bosch series connectors above TE-connectors to Deutsch-motorsport connectors, you can choose from a big variation.

You can get from us different Deutsch-motorsport connectors of the series AS, ASL, ASU, ASX and ASDD. According to the series, these are 3 to 128-pin connectors.

At Bosch connectors you can choose from connectors of the Jetronic or Compact series. Furthermore you receive convenient contacts and sealings to our Bosch-connectors.

If you are interested, give us a call!

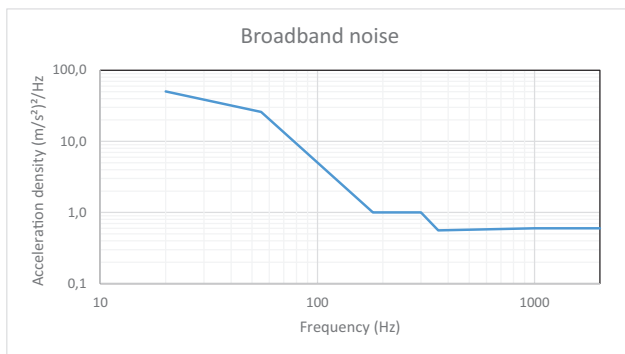
### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

## Vibration Profile 1

### Broadband noise: 8h/direction

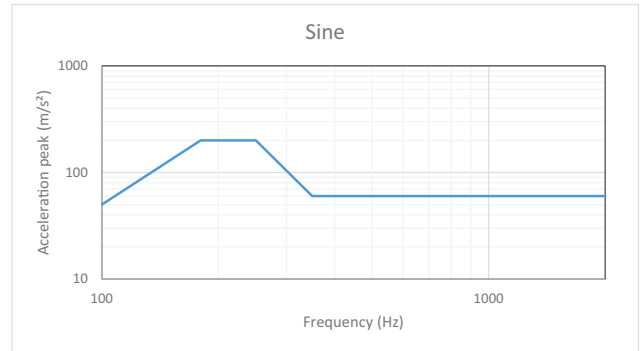
Frequency (Hz)	Acceleration density (m/s <sup>2</sup> ) <sup>2</sup> /Hz
20	50.4
55	26.0
180	1.0
300	1.0
360	0.56
1,000	0.6
2,000	0.6
Effective value $a_{\text{Eff}}$	55.4 m/s <sup>2</sup>



### Sine: 8h/direction

Alteration rate of frequency: 2.4 oct./min

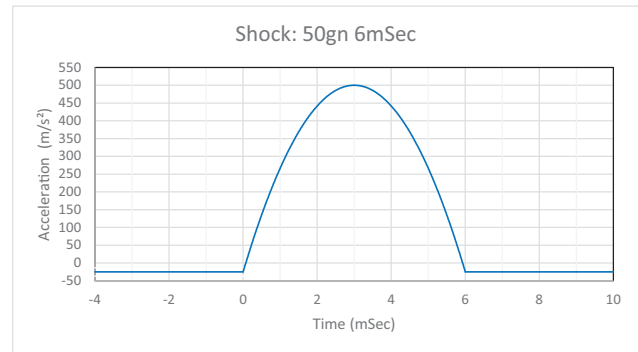
Frequency (Hz)	Acceleration peak (m/s <sup>2</sup> )
100	50
180	200
250	200
350	60
2,000	60



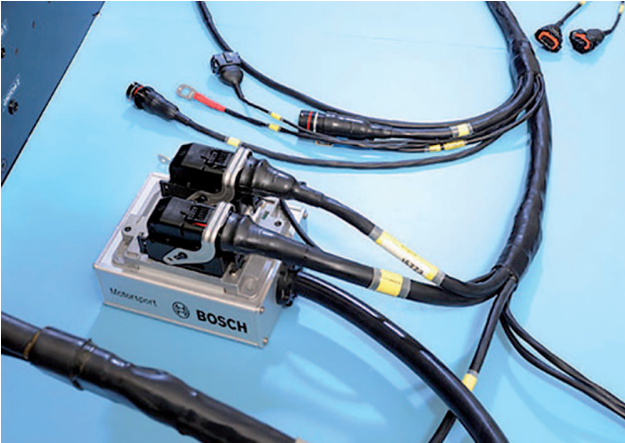
## Vibration Profile Shock

**Shock: 10 shocks (pos. and neg.) / direction**  
50gn 6mSec ISO 16750-3

Time (mSec)	Acceleration (m/s <sup>2</sup> )
-4	-25
0	-25
3	500
6	-25
10	-25



## Customized Wiring Harnesses



### Features

- ▶ One-stop-shop for consulting, manufacturing, development and service
- ▶ Manufacture of individual pieces and small batches
- ▶ Use of the highest quality materials
- ▶ Full test coverage based on the latest testing equipment for all products
- ▶ The complete package, from a single pin to a complete wiring harness

### Our expertise

Bosch Motorsport specialists have decades of experience in design and manufacture of customized wiring solutions for race cars and prototypes.

Increasing complexity in race cars necessitates a high degree of understanding in the electrical architecture of the project. We provide to you the extensive system know-how and the expertise of our specialists.

As a system supplier, we are familiar with the full spectrum of electronic requirements of the components in a racecar – from high current and high voltage applications to high-speed data networks.

### Our offer

Whether it is complete vehicle wiring, test equipment or a simple adapter – we design, plan, construct and test according to your individual requirements and requests.

If you want to build your wiring yourself, we also offer consulting and development support independently from our manufacturing services.

Give us a call!

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.



# Appendix

10

**General Information**

**348**

## 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.

### Legal Restrictions

Generally blocked are direct and indirect business involving high risk destinations, including Russia, Belarus, Cuba, Iran, North Korea, Syria, Libya, Afghanistan, and certain non-governmental controlled Ukrainian regions. This list may change as geopolitics evolve.

**Icons**

µLC Test System ..... 129

**A**

ABS M5 Kit..... 311  
 ABS M5 Kit Clubsport ..... 314  
 ABS M5 Kit Porsche Cup..... 316  
 Analysis Tool WinDarab V7..... 322

**B**

Breakout Box BOB 66-pole ..... 333  
 Breakout Box BOB MS 6 ..... 334  
 Breakout Box BOB MS 7 ..... 335  
 Breakout Box BOB PBX 190..... 337  
 Breakout Box BOB PBX 90..... 336

**C**

CAN Keypad CK-M12..... 78  
 CCA Development Environment ..... 325  
 Collision Avoidance System CAS-M light..... 83  
 Collision Avoidance System CAS-M 3 EVO ..... 86  
 Com Interface MSA-Box II ..... 338  
 COM-API for WinDarab Expert ..... 324  
 Connectivity Gateway CG 3.2 ..... 124  
 Connector Opening Tool for AS series..... 341  
 Connectors ..... 342  
 Customized Wiring Harnesses..... 345

**D**

Data Logger and Sensor Interface C 80 ..... 96, 112  
 Data Logger C 70 ..... 92  
 Display DDU 10..... 69  
 Display DDU 11..... 73

**E**

Electronic Brake System EBS..... 318  
 Electronic Throttle Body ..... 204  
 Engine Control Unit MS 6 CUP EVO ..... 13  
 Engine Control Unit MS 6.1 EVO..... 18  
 Engine Control Unit MS 6.2 EVO..... 24  
 Engine Control Unit MS 6.3 EVO..... 29  
 Engine Control Unit MS 6.4 EVO..... 35  
 Engine Control Unit MS 6.4P EVO..... 40  
 Engine Control Unit MS 7.8 ..... 46  
 Ethernet Data Read Cable..... 339  
 Expansion Board CAN-FD..... 131  
 Expansion Board Current Loop Interface ..... 132  
 Expansion Board Digital Multichannel Pot. .... 133  
 Expansion Board Digital Outputs ..... 135  
 Expansion Board E-Mobility ..... 136  
 Expansion Board FlexIO..... 138

**F**

FPR Adaptor light ..... 148  
 Fuel Pressure Regulator Mini 2 ..... 143  
 Fuel Pressure Regulator Mini 5 ..... 145  
 Fuel Pressure Regulator Mini A..... 146  
 Fuel Pump FP 165-E ..... 150

Fuel Pump FP 200-7 ..... 152  
 Fuel Pump FP 200-E ..... 154

**G**

General Information ..... 348

**H**

HP Fuel Pump HDP 5..... 156  
 HP Injection Valve HDEV 6 ..... 202

**I**

Ignition Coil C90i-E10..... 162  
 Ignition Coil C90i-E8..... 160  
 Ignition Coil C90i-pro ..... 164  
 Ignition Coil C90i-pro evo ..... 166  
 Ignition Coil C90i-WG ..... 168  
 Ignition Coil P50..... 170  
 Ignition Coil P50-M ..... 172  
 Ignition Coil P65..... 174  
 Ignition Coil P65-T ..... 176  
 Ignition Coil P65-TWG ..... 179  
 Ignition Coil P65-WG ..... 181  
 Ignition Coil P65-WS..... 183  
 Ignition Coil PS-T..... 186  
 Ignition Module IM 3.2..... 190  
 Ignition Module IM 4 ..... 193  
 Inertial Measurement Unit MM7.10..... 306  
 Injection Valve EV 14 ..... 197

**K**

Knock Sensor KS4-P ..... 237  
 Knock Sensor KS4-R ..... 239  
 Knock Sensor KS4-R2 ..... 241

**L**

Lambda Sensor LSU ADV ..... 250  
 Lambda Sensor LSU ADV pre Turbo ..... 253  
 Lambda Sensor LSU 4.9 ..... 247  
 Lambda Sensor Mini-LSU 4.9..... 244  
 Lambdatronic LT4..... 116  
 Lambdatronic LT4 ADV ..... 118  
 License Manager..... 326

**P**

PowerBox PBX 190 ..... 107  
 PowerBox PBX 90..... 103  
 Pressure Sensor Air PS-AA..... 215  
 Pressure Sensor Air PSA-N ..... 219  
 Pressure Sensor Air PS-AS..... 217  
 Pressure Sensor Combined PST 1 ..... 257  
 Pressure Sensor Combined PST 3 ..... 259  
 Pressure Sensor Combined PST 4 ..... 261  
 Pressure Sensor Combined PST-F 1 ..... 263  
 Pressure Sensor Combined PST-F 2 280 bar .... 266  
 Pressure Sensor Combined PST-F 2 350 bar .... 268  
 Pressure Sensor Fluid PSC-260 ..... 222  
 Pressure Sensor Fluid PSS-10 ..... 224  
 Pressure Sensor Fluid PSS-140 ..... 226  
 Pressure Sensor Fluid PSS-250R ..... 228

Pressure Sensor Fluid PSS-260 .....	230
Pressure Sensor Fluid PSS-420 .....	232
Pressure Sensor Fluid PSS-600 .....	234

## R

RaceConnect .....	327
Rotary Position Sensor RPS-F .....	270

## S

Scrutineering Configurator and Tool.....	328
Simulation Packages.....	329
Speed Sensor Hall-Effect HA-D 90 .....	273
Speed Sensor Hall-Effect HA-Di .....	276
Speed Sensor Hall-Effect HA-M.....	280
Speed Sensor Hall-Effect HA-N .....	282
Speed Sensor Hall-Effect Mini-HA-P .....	284
Speed Sensor Hall-Effect Mini-HA-P sealed.....	288
Steering Wheel Angle Sensor LWS.....	291
System Configuration Tool RaceCon.....	330

## T

Temperature Sensor NTC M12-H.....	302
Temperature Sensor NTC M12-L .....	304
Temperature Sensor NTC M12.....	300
Temperature Sensor NTC M5-HS .....	294
Temperature Sensor NTC M6-HS .....	296
Temperature Sensor NTC M8-HS .....	298

## U

USB Data Components .....	100
---------------------------	-----

## V

Vehicle Control Unit MS 50.4.....	51
Vehicle Control Unit MS 50.4 CAN-FD.....	59
Vehicle Control Unit MS 50.4P CAN-FD incl. CCA and Multi-CCA.....	63
Vehicle Control Unit MS 50.4P incl. CCA and Multi- CCA .....	55
Vibration Profile 1.....	343
Vibration Profile Shock .....	344

## W

Wheel Speed Signal Splitter .....	121
Wiper Direct Drive WDD2.....	208



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or send an email to  
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