

# Bosch Motorsport Equipment for High Performance Vehicles

Edition 2007/3



# BOSCH





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# Engine Control Units

## Motronic MS 2.9

The MS 2.9 engine management system contains 12 ignition power stages and 24 independent injection power stages. All internal power stages are designed with a diagnosis interface. Various engine and chassis parameters can be measured and logged in the integrated flash card memory. Eight vibration sensor inputs allow knock detection and knock control. Four independent wide range lambda circuits allow lambda closed loop engine control.



### Functionality

|                        |
|------------------------|
| Injection timing       |
| Ignition timing        |
| Lambda control         |
| Boost control (option) |
| Knock control          |
| Data acquisition       |
| Telemetry              |

### Mechanical data

|                                       |                    |
|---------------------------------------|--------------------|
| Dust and waterproof aluminium housing |                    |
| Connectors in military technology     |                    |
| Each pin individually filtered        |                    |
| Vibration damped circuit boards       |                    |
| Flexible housing fixation points      |                    |
| Size                                  | 194 x 245x 72,1 mm |
| Weight                                | 2280 g             |

### Conditions for use

|                        |                                              |
|------------------------|----------------------------------------------|
| ECU temperature        | -40 ... 65°C                                 |
| Max. power consumption | 18 W at 14 V                                 |
| Max. vibration         | 15 g sinus<br>at 20 Hz ... 2 kHz for t < 5 h |

### Electronic data

#### In general

|                                                                             |
|-----------------------------------------------------------------------------|
| 9 microcontrollers with 16 bit organisation,<br>calculator capacity 70 MIPS |
| Real time clock                                                             |

### Inputs

|                                                               |
|---------------------------------------------------------------|
| 4 inputs for Ni-Cr-Ni exhaust gas temperature sensors         |
| 4 lambda LSM 11 interfaces                                    |
| 4 inputs for inductive wheel speed sensors<br>(Hall optional) |
| 42 universal inputs 0 ... 5 V                                 |
| 6 differential inputs $\pm 5$ V                               |
| 1 input for inductive or Hall crankshaft sensor               |
| 1 input for inductive or Hall camshaft sensor                 |
| 8 knock sensor inputs                                         |

### Outputs

|                                                                  |
|------------------------------------------------------------------|
| All power stages short circuit protected                         |
| 12 peak and hold injection power stages with diagnosis interface |
| 12 switched injection power stages with diagnosis interface      |
| 12 ignition power stages with diagnosis interface                |
| 3 high current power stages (12 A)                               |
| 12 high speed power stages (2 A)                                 |
| 3 sensor supply 5 V/100 mA                                       |
| 3 sensor supply 10 V/200 mA                                      |

### Communication interfaces

|                                                                          |
|--------------------------------------------------------------------------|
| 2 RS232 interface for telemetry and laptrigger                           |
| 1 2-Mbaud interface for memory and data read out or high speed telemetry |
| 3 CAN interfaces                                                         |

### Memory

|                                                |
|------------------------------------------------|
| Compact Flash Card memory for data acquisition |
|------------------------------------------------|

## Motronic MS 2.9.1

The MS 2.9.1 engine management system contains 12 ignition power stages and 12 independent injection power stages. All internal power stages are designed with a diagnosis interface. Various engine and chassis parameters can be measured and logged in the integrated flash card memory. Four vibration sensor inputs allow knock detection and knock control. Four independent wide range lambda circuits allow lambda closed loop engine control.



| Functionality          |  |
|------------------------|--|
| Injection timing       |  |
| Ignition timing        |  |
| Lambda control         |  |
| Boost control (option) |  |
| Knock control          |  |
| Data acquisition       |  |
| Telemetry              |  |

| Mechanical data                       |                    |
|---------------------------------------|--------------------|
| Dust and waterproof aluminium housing |                    |
| Connectors in military technology     |                    |
| Each pin individually filtered        |                    |
| Vibration damped circuit boards       |                    |
| Flexible housing fixation points      |                    |
| Size                                  | 194 x 245x 72,1 mm |
| Weight                                | 2280 g             |

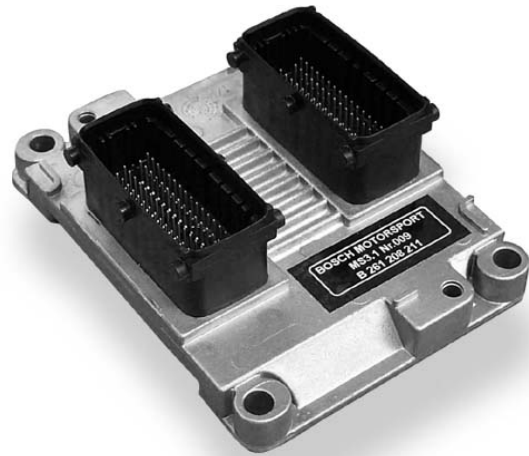
| Conditions for use     |                                              |
|------------------------|----------------------------------------------|
| ECU temperature        | -40 ... 65°C                                 |
| Max. power consumption | 18 W at 14 V                                 |
| Max. vibration         | 15 g sinus<br>at 20 Hz ... 2 kHz for t < 5 h |

| Electronic data                                                          |  |
|--------------------------------------------------------------------------|--|
| In general                                                               |  |
| 8 microcontrollers with 16 bit organisation, calculator capacity 50 MIPS |  |
| Real time clock                                                          |  |

| Inputs                                                                   |  |
|--------------------------------------------------------------------------|--|
| 4 inputs for Ni-Cr-Ni exhaust gas temperature sensors                    |  |
| 4 lambda LSM 11 interfaces                                               |  |
| 4 inputs for inductive wheel speed sensors (Hall optional)               |  |
| 42 universal inputs 0 ... 5 V                                            |  |
| 6 differential inputs $\pm 5$ V                                          |  |
| 1 input for inductive or Hall crankshaft sensor                          |  |
| 1 input for inductive or Hall camshaft sensor                            |  |
| 4 knock sensor inputs                                                    |  |
| Outputs                                                                  |  |
| All power stages short circuit protected                                 |  |
| 12 peak and hold injection power stages with diagnosis interface         |  |
| 12 ignition power stages with diagnoses interface                        |  |
| 3 high current power stages (12 A)                                       |  |
| 3 sensor supply 5 V/100 mA                                               |  |
| 3 sensor supply 10 V/200 mA                                              |  |
| Communication interfaces                                                 |  |
| 2 RS232 interface for telemetry and laptrigger                           |  |
| 1 2-Mbaud interface for memory and data read out or high speed telemetry |  |
| 3 CAN interfaces                                                         |  |
| Memory                                                                   |  |
| Compact Flash Card memory for data acquisition                           |  |

## Motronic MS 3 Sport

The MS 3 Sport is the first Bosch engine management system in full hybrid technique and for engines up to 6 cylinders. Two independent circuits are available for vibration knock detection and knock control. Injection time, injection end timing and ignition timing are calculated from basic maps and can be corrected by different engine parameters. Also two closed loop wide range lambda circuits are available. An external data logger or a DDU can be connected via CAN interface. The MS 3 Sport is developed with “EasyHandling” software.



### Mechanical data

|                                                             |                  |
|-------------------------------------------------------------|------------------|
| Extremely small and flat aluminium pressure casting housing |                  |
| Connectors with high pin density                            |                  |
| Extremely shock and vibration proof hybrid technology       |                  |
| Four housing fixation points                                |                  |
| Size                                                        | 120 x 90 x 40 mm |
| Weight                                                      | 250 g            |

### Functionality

|                                                  |
|--------------------------------------------------|
| Asymmetric injection timing possible             |
| Asymmetric ignition timing possible              |
| Dual lambda control                              |
| Knock control (optional)                         |
| Traction control(optional)                       |
| Electronic throttle control (optional)           |
| Support of 60-2 and 36-2 ignition trigger wheels |

### Conditions for use

|                        |                                              |
|------------------------|----------------------------------------------|
| ECU temperature        | -40 ... 125°C                                |
| Max. power consumption | 10 W at 14 V                                 |
| Max. vibration         | 50 g sinus<br>at 20 Hz ... 2 kHz for t < 5 h |

### Electronic data

#### Inputs

|                                                        |
|--------------------------------------------------------|
| 2 inputs for exhaust gas temperature sensors           |
| 2 lambda interfaces LSU                                |
| 4 inputs for Hall effect wheel speed sensors           |
| 1 input for inductive or Hall effect crankshaft sensor |
| 15 universal inputs 0 ... 5 V                          |
| 2 inputs for vibration knock sensors                   |
| 6 digital inputs                                       |

#### Outputs

|                                          |
|------------------------------------------|
| 6 injection power stages                 |
| 6 ignition power stages                  |
| 16 power stages (2 A/1 A; low side; PWM) |
| 2 power stages for lambda heater         |
| 1 H-bridge (5 A)                         |
| 2 sensor supply 5 V/100 mA               |

#### Communication interfaces

|                                             |
|---------------------------------------------|
| 1 K-line serial interfaces                  |
| 1 CAN interfaces for external communication |

**Communication interfaces**

1 CAN interface  
1 K-Line interface

**Cable harness connectors**

Part numbers: **D 261 205 139**  
**D 261 205 140**

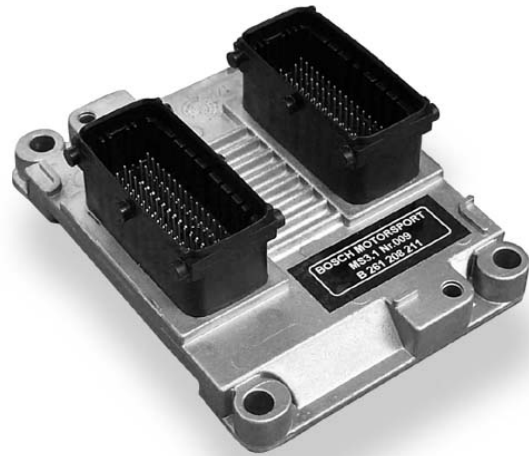
**Necessary equipment**

KIC2-standard connector **B 261 206 859**  
KIC2-diagnosis connector with  
ignition bridge **B 261 206 866**  
KIC2-diagnosis connector without  
ignition bridge **B 261 206 867**

**Part number****F 01T A20 067**

## Motronic MS 3.1

The MS 3.1 is the first Bosch engine management system in full hybrid technique and for engines up to 6 cylinders. Two independent circuits are available for vibration knock detection and knock control. Injection time, injection end timing and ignition timing are calculated from basic maps and can be corrected by different engine parameters. Also two closed loop wide range lambda circuits are available. An external data logger or a DDU can be connected via CAN interface.



| Functionality                                          |  |
|--------------------------------------------------------|--|
| Engine management system for 4- and 6-cylinder engines |  |
| Sequential fuel injection                              |  |
| Ignition timing                                        |  |
| Lambda control                                         |  |
| Knock control                                          |  |
| Fuel cut off                                           |  |
| Component diagnosis                                    |  |

| Mechanical data                                             |                  |
|-------------------------------------------------------------|------------------|
| Extremely small and flat aluminium pressure casting housing |                  |
| Connectors with high pin density                            |                  |
| Extremely shock and vibration proof hybrid technology       |                  |
| Four housing fixation points                                |                  |
| Size                                                        | 120 x 90 x 40 mm |
| Weight                                                      | 250 g            |

| Conditions for use     |                                              |
|------------------------|----------------------------------------------|
| ECU temperature        | -40 ... 125°C                                |
| Max. power consumption | 10 W at 14 V                                 |
| Max. vibration         | 50 g sinus<br>at 20 Hz ... 2 kHz for t < 5 h |

| Electronic data                                                                             |            |
|---------------------------------------------------------------------------------------------|------------|
| <b>In general</b>                                                                           |            |
| 2 microcontrollers with 16 bit organisation<br>calculation capacity 20 MIPS                 |            |
| <b>Inputs</b>                                                                               |            |
| 2 lambda LSU4 interfaces                                                                    |            |
| 3 analogous inputs 0 ... 5 V for water temperature, oil temperature, intake air temperature |            |
| 3 analogous inputs 0 ... 5 V for oil pressure, fuel pressure, ambient pressure              |            |
| 1 analogous input 0 ... 5 V for throttle position sensor                                    |            |
| 1 digital input for lap trigger                                                             |            |
| 1 digital input for wheel speed sensor                                                      |            |
| 1 input for inductive crankshaft sensor                                                     |            |
| 1 input for hall camshaft sensor                                                            |            |
| 2 knock sensor interfaces                                                                   |            |
| <b>Outputs</b>                                                                              |            |
| 6 injection power stages with diagnosis interface                                           |            |
| 2 high current power stages (8 A) with diagnosis interface for LSU heating                  |            |
| 6 ignition power stages                                                                     |            |
| Sensors supply output                                                                       | 5 V/100 mA |
| Separate supply output for throttle position sensor                                         | 5 V/100 mA |
| 2 power stages (1 A) for main relay and fuel pump relay control                             |            |

**Communication interfaces**

|                    |
|--------------------|
| 1 CAN interface    |
| 1 K-Line interface |

**Cable harness connectors**

|                      |
|----------------------|
| <b>D 261 205 139</b> |
| <b>D 261 205 140</b> |

**Necessary equipment**

|                                                  |                      |
|--------------------------------------------------|----------------------|
| KIC2-standard connector                          | <b>B 261 206 859</b> |
| KIC2-diagnosis connector with ignition bridge    | <b>B 261 206 866</b> |
| KIC2-diagnosis connector without ignition bridge | <b>B 261 206 867</b> |

**Part numbers**

|                                 |                      |
|---------------------------------|----------------------|
| MS 3.1 incl. Modas for notebook | <b>B 261 208 245</b> |
|---------------------------------|----------------------|

## Motronic MS 4 Sport

The MS 4 Sport is a highly sophisticated engine management system for high performance engines. The system contains 8 ignition drivers for external power stages and 8 independent injection power stages. Two independent wide range lambda circuits allow lambda closed loop engine control. Various engine parameters can be measured with different input channels and transferred via CAN interface to an optional flash card data logger. The MS 4 Sport is developed with “EasyHandling” software.



| Mechanical data                          |                   |
|------------------------------------------|-------------------|
| Sheet-metal housing                      |                   |
| Each connector pin individually filtered |                   |
| Vibration damped circuit boards          |                   |
| Size                                     | 180 x 162 x 46 mm |
| Weight                                   | 430 g             |

| Functionality                                    |  |
|--------------------------------------------------|--|
| Asymmetric injection timing possible             |  |
| Asymmetric ignition timing possible              |  |
| Dual lambda control                              |  |
| Knock control (optional)                         |  |
| Traction control(optional)                       |  |
| Turbo functionality                              |  |
| Electronic throttle control (optional)           |  |
| Support of 60-2 and 36-2 ignition trigger wheels |  |

| Conditions for use     |                                             |
|------------------------|---------------------------------------------|
| Temperature range      | -40 ... 75°C                                |
| Max. power consumption | 30 W at 14 V                                |
| Max. vibration         | 15 g sinus at 20 Hz ...2 kHz<br>for t < 5 h |

| Electronic data                                        |  |
|--------------------------------------------------------|--|
| Inputs                                                 |  |
| 2 inputs for exhaust gas temperature sensors           |  |
| 2 lambda interfaces LSU                                |  |
| 4 inputs for Hall effect wheel speed sensors           |  |
| 1 input for inductive or Hall effect crankshaft sensor |  |
| 16 universal inputs 0 ... 5 V                          |  |
| 2 inputs for vibration knock sensors                   |  |
| 7 digital inputs                                       |  |
| Outputs                                                |  |
| 8 injection power stages                               |  |
| 8 ignition drivers                                     |  |
| 20 power stages (2,7 A/0,6 A; low side; PWM)           |  |
| 2 power stages for lambda heater                       |  |
| 1 H-bridge (5 A)                                       |  |
| 2 sensor supply 5 V/100 mA                             |  |
| Communication interfaces                               |  |
| 1 K-line serial interfaces                             |  |
| 2 CAN interfaces for external communication            |  |

| Part number |                      |
|-------------|----------------------|
| MS 4 Sport  | <b>F 01T A20 049</b> |

## Motronic MS 4.0

The MS 4.0 is a highly sophisticated engine management system for high performance engines. The system contains 8 ignition drivers for external power stages and 8 independent injection power stages. Two vibration sensor inputs allow knock detection and knock control. Two independent wide range lambda circuits allow lambda closed loop engine control. Various engine parameters can be measured with different input channels and transferred via CAN interface to an optional flash card data logger.



| Mechanical data                          |                   |
|------------------------------------------|-------------------|
| Sheet-metal housing                      |                   |
| Each connector pin individually filtered |                   |
| Vibration damped circuit boards          |                   |
| Size                                     | 180 x 162 x 46 mm |
| Weight                                   | 430 g             |

| Functionality       |  |
|---------------------|--|
| Injection timing    |  |
| Ignition timing     |  |
| Lambda control      |  |
| Knock control       |  |
| Traction control    |  |
| Turbo functionality |  |

| Conditions for use     |                                             |
|------------------------|---------------------------------------------|
| Temperature range      | -40 ... 75°C                                |
| Max. power consumption | 30 W at 14 V                                |
| Max. vibration         | 15 g sinus at 20 Hz ...2 kHz<br>for t < 5 h |

| Electronic data                                        |  |
|--------------------------------------------------------|--|
| <b>Inputs</b>                                          |  |
| 2 inputs for exhaust gas temperature sensors           |  |
| 2 lambda interfaces LSU                                |  |
| 4 inputs for Hall effect wheel speed sensors           |  |
| 1 input for inductive or Hall effect crankshaft sensor |  |
| 16 universal inputs 0 ... 5 V                          |  |
| 2 inputs for vibration knock sensors                   |  |
| 7 digital inputs                                       |  |
| <b>Outputs</b>                                         |  |
| 8 injection power stages                               |  |
| 8 ignition drivers                                     |  |
| 20 power stages (2,7 A/0,6 A; low side; PWM)           |  |
| 2 power stages for lambda heater                       |  |
| 1 H-bridge (5 A)                                       |  |
| 2 sensor supply 5 V/100 mA                             |  |
| <b>Communication interfaces</b>                        |  |
| 1 K-line serial interfaces                             |  |
| 2 CAN interfaces for external communication            |  |

| Part number        |                      |
|--------------------|----------------------|
| MS 4.0 incl. Modas | <b>B 261 208 300</b> |

## Motronic MS 4.2

The MS 4.2 is a highly sophisticated engine management system for high performance engines. The system contains 8 ignition drivers for external power stages and 16 independent injection power stages. Various engine and chassis parameters can be measured with the different input channels and logged on the compact flash card data logger. Two vibration sensor inputs allow knock detection and knock control. Two independent wide range lambda circuits allow lambda closed loop engine control.



### Mechanical data

|                                                           |                   |
|-----------------------------------------------------------|-------------------|
| Dust and waterproof aluminium housing                     |                   |
| 3 connectors in military technology with high pin density |                   |
| 165 pins, each pin individually filtered                  |                   |
| Vibration damped circuit boards                           |                   |
| 8 flexible housing fixation points                        |                   |
| Size                                                      | 192 x 162 x 52 mm |
| Weight                                                    | 1240 g            |

### Conditions for use

|                        |                                              |
|------------------------|----------------------------------------------|
| Temperature range      | -40 ... 75°C                                 |
| Max. power consumption | 30 W at 14 V                                 |
| Max. vibration         | 15 g sinus at 20 Hz ... 2 kHz<br>for t < 5 h |

### Functionality

|                     |
|---------------------|
| Injection timing    |
| Ignition timing     |
| Lambda control      |
| Knock control       |
| Data acquisition    |
| Telemetry           |
| Traction control    |
| Turbo functionality |

### Electronic data

#### Inputs

|                                                        |
|--------------------------------------------------------|
| 2 inputs for exhaust gas temperature sensors           |
| 2 lambda interfaces LSU                                |
| 4 inputs for Hall effect wheel speed sensors           |
| 1 input for inductive or Hall effect crankshaft sensor |
| 31 universal inputs 0 ... 5 V                          |
| 2 inputs for vibration knock sensors                   |
| 7 digital inputs                                       |

#### Outputs

|                                              |
|----------------------------------------------|
| 16 injection power stages                    |
| 8 ignition drivers                           |
| 26 power stages (2,7 A/0,6 A; low side; PWM) |
| 2 power stages for lambda heater             |
| 1 H-bridge (5 A)                             |
| 2 sensor supply 5 V/100 mA                   |

#### Communication interfaces

|                                                |
|------------------------------------------------|
| 1 RS232 serial interface                       |
| 2 K-line serial interfaces                     |
| 2 CAN interfaces for external communication    |
| 1 SPI                                          |
| Compact Flash Card memory for data acquisition |

### Part number

|                    |                      |
|--------------------|----------------------|
| MS 4.2 incl. Modas | <b>F 01E B01 638</b> |
|--------------------|----------------------|

## Motronic MS 4.4 Sport

The MS 4.4 Sport is a highly sophisticated engine management system for high performance engines. The system contains 10 ignition drivers for external power stages and 10 independent injection power stages. Various engine and chassis parameters can be measured with the different input channels and logged on the external data logger. Four vibration sensor inputs allow knock detection and knock control. Two independent wide range lambda circuits allow lambda closed loop engine control. The MS 4.4 Sport is developed with “EasyHandling” software.



| Mechanical data                                           |                       |
|-----------------------------------------------------------|-----------------------|
| Dust and waterproof aluminium housing                     |                       |
| 3 connectors in military technology with high pin density |                       |
| 165 pins, each pin individually filtered                  |                       |
| Vibration damped circuit boards                           |                       |
| Size                                                      | 174 x 133 x 39(23) mm |
| Weight                                                    | 859 g                 |

| Functionality                                    |  |
|--------------------------------------------------|--|
| Asymmetric injection timing possible             |  |
| Asymmetric ignition timing possible              |  |
| Dual lambda control                              |  |
| Knock control (optional)                         |  |
| Traction control(optional)                       |  |
| Turbo functionality                              |  |
| Electronic throttle control (optional)           |  |
| Support of 60-2 and 36-2 ignition trigger wheels |  |

| Conditions for use     |                                            |
|------------------------|--------------------------------------------|
| Temperature range      | -40 ... 75°C                               |
| Max. power consumption | 20 W at 14 V                               |
| Max. vibration         | 15 g sinus at 20 Hz ... 2 kHz<br>for t<5 h |

| Electronic data                                                   |  |
|-------------------------------------------------------------------|--|
| Inputs                                                            |  |
| 1 input for inductive crankshaft sensor                           |  |
| 4 inputs for camshaft control                                     |  |
| 4 inputs for Hall effect wheel speed sensors                      |  |
| 2 lambda interfaces LSU 4.9                                       |  |
| 39 inputs 0 ... 5 V (20 with switchable pullup)                   |  |
| 4 inputs for vibration knock sensors                              |  |
| 8 digital inputs                                                  |  |
| Outputs                                                           |  |
| 10 injection power stages (2.2A)                                  |  |
| 10 ignition drivers for external power stages                     |  |
| 21 power stages (2,7 A/0,6 A; low side)                           |  |
| 2 power stages for lambda heater                                  |  |
| 1 H-bridge (7A)                                                   |  |
| 3 sensor supply 5 V/600 mA                                        |  |
| Communication interfaces                                          |  |
| 1 K-line serial interface                                         |  |
| 2 CAN interfaces for external communication                       |  |
| External Memory                                                   |  |
| external memory from 128 MB up to 1024 MB<br>for data acquisition |  |

| Part number          |
|----------------------|
| <b>F 01T A20 068</b> |

## Motronic MS 4.4

The MS 4.4 is a highly sophisticated engine management system for high performance engines. The system contains 10 ignition drivers for external power stages and 10 independent injection power stages. Various engine and chassis parameters can be measured with the different input channels and logged on the external data logger. Four vibration sensor inputs allow knock detection and knock control. Two independent wide range lambda circuits allow lambda closed loop engine control.



| Mechanical data                                           |                       |
|-----------------------------------------------------------|-----------------------|
| Dust and waterproof aluminium housing                     |                       |
| 3 connectors in military technology with high pin density |                       |
| 165 pins, each pin individually filtered                  |                       |
| Vibration damped circuit boards                           |                       |
| Size                                                      | 174 x 133 x 39(23) mm |
| Weight                                                    | 859 g                 |

| Conditions for use     |                                            |
|------------------------|--------------------------------------------|
| Temperature range      | -40 ... 75°C                               |
| Max. power consumption | 20 W at 14 V                               |
| Max. vibration         | 15 g sinus at 20 Hz ... 2 kHz<br>for t<5 h |

| Functionality                                    |  |
|--------------------------------------------------|--|
| Asymmetric injection timing possible             |  |
| Asymmetric ignition timing possible              |  |
| Dual lambda control                              |  |
| Knock control                                    |  |
| Traction control                                 |  |
| Turbo functionality                              |  |
| Electronic throttle control (optional)           |  |
| Support of 60-2 and 36-2 ignition trigger wheels |  |

| Electronic data                                                |  |
|----------------------------------------------------------------|--|
| Inputs                                                         |  |
| 1 input for inductive crankshaft sensor                        |  |
| 4 inputs for camshaft control                                  |  |
| 4 inputs for Hall effect wheel speed sensors                   |  |
| 2 lambda interfaces LSU 4.9                                    |  |
| 39 inputs 0 ... 5 V (20 with switchable pullup)                |  |
| 4 inputs for vibration knock sensors                           |  |
| 8 digital inputs                                               |  |
| Outputs                                                        |  |
| 10 injection power stages (2.2 A)                              |  |
| 10 ignition drivers for external power stages                  |  |
| 21 power stages (2,7 A/0,6 A; low side)                        |  |
| 2 power stages for lambda heater                               |  |
| 1 H-bridge (7 A)                                               |  |
| 3 sensor supply 5 V/600 mA                                     |  |
| Communication interfaces                                       |  |
| 1 K-line serial interfaces                                     |  |
| 2 CAN interfaces for external communication                    |  |
| External Memory                                                |  |
| external memory from 128 MB up to 1024 MB for data acquisition |  |

| Part number          |  |
|----------------------|--|
| <b>F 01T A20 040</b> |  |

## Motronic MS 5

The MS5 is a 1 to 12 cylinder gasoline engine control for engine speeds up to 20.000 rpm. Design is based on our new digital core with a very high computing power and a high-end FPGA for additional performance and flexibility. The new software development process for this unit allows fast response times to algorithm changes. All software functions are designed, tested and simulated with MATLAB/Simulink. Code and documentation are generated automatically. The integration of individual customer functions is possible. The systems flexibility allows the support of any unusual engine configuration or chassis functionality.



| Mechanical data                                           |                    |
|-----------------------------------------------------------|--------------------|
| Dust and waterproof aluminium housing                     |                    |
| 4 connectors in military technology with high pin density |                    |
| 220 pins, each pin individually filtered                  |                    |
| Vibration damped circuit boards                           |                    |
| Size                                                      | 200 x 170 x 36,5mm |
| Weight (approx.)                                          | 1250g              |

| Conditions for use                                                      |              |
|-------------------------------------------------------------------------|--------------|
| Temp. range (at internal sensors):                                      | -20 ... 85°C |
| Approx. power cons. (w/o loads):                                        | 10 W at 14 V |
| Power Supply:                                                           |              |
| full operation                                                          | 6,5 to 18 V  |
| recommended                                                             | 11 to 14 V   |
| absolute maximum                                                        | 6 to 24 V    |
| Vibration:                                                              |              |
| meets standard motorsport requirements, please ask for our test profile |              |

| Basic functionality                             |
|-------------------------------------------------|
| Injection timing                                |
| Ignition timing                                 |
| Lambda control with adaptation function         |
| Knock control                                   |
| Traction control                                |
| Launch control                                  |
| Gearcut function                                |
| Calibration interface: CCP or XCP over Ethernet |
| Interface to BOSCH data logging system          |

**Electronic data****Inputs**

2 thermocouple exhaust gas temperature sensors  
2 lambda interfaces (LSU 4.9)  
1 crankshaft sensor (2-wire, inductive or hall-effect)  
1 camshaft sensor (2-wire, inductive or hall-effect)  
2 turbo speed sensors (2-wire, inductive or hall-effect)  
4 wheel speed sensors (inductive or hall-effect)  
2 gearbox speed sensors (inductive or hall-effect)  
45 universal analogue inputs 0 ... 5 V; 12 Bit  
14 analogue inputs (angle synchronous or time  
synchronous triggering up to 250 ksps, 12 Bit)  
4 inputs for vibration knock sensors  
1 laptrigger input

**Outputs**

12 injection power stages (peak & hold)  
12 ignition drivers (up to 20A)  
16 power stages (2 A; low side; PWM)  
4 power stages (4 A; low side; PWM)  
4 H-bridge valve driver (+/- 100 mA)  
2 H-bridge (5 A)  
3 sensor supplies 5 V/400 mA and 1x 10 V/100 mA  
6 diagnostic outputs with selectable internal signals  
12 outputs with configurable function (FPGA)  
1 timebase synch-in/out

**Communication interfaces**

2 x 100Mbps Ethernet interfaces  
1 x RS232 serial interface  
4 x 1Mbps CAN interfaces

## Motronic MS 15.1

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



| Mechanical data                                                     |                   |
|---------------------------------------------------------------------|-------------------|
| Dust and waterproof aluminium housing                               |                   |
| 4 connectors in military technology with high pin density, 187 pins |                   |
| Vibration damped circuit boards                                     |                   |
| 8 flexible housing fixation points                                  |                   |
| Size                                                                | 210 x 186 x 36 mm |
| Weight                                                              | 1780 g            |

| Conditions for use        |                                            |
|---------------------------|--------------------------------------------|
| Temperature range         | -40 ... 75°C                               |
| Typical power consumption | 140 W at 14 V                              |
| Max. vibration            | 15 g sinus at 20 Hz ... 2 kHz<br>for t<5 h |

| Functionality                                                      |  |
|--------------------------------------------------------------------|--|
| Injection timing:                                                  |  |
| 2 pilot injections                                                 |  |
| 2 main injection                                                   |  |
| 1 post injection                                                   |  |
| Lambda measurement                                                 |  |
| Data acquisition, external Logger C55                              |  |
| Telemetry (external unit FM40 in combination with data logger C55) |  |
| Traction control (optional)                                        |  |
| Basic functionality for up to two turbochargers in parallel mode   |  |
| Gear cut for sequential gearbox                                    |  |
| Speed limiter                                                      |  |
| Optional function packages available                               |  |

| Electronic design                                                    |  |
|----------------------------------------------------------------------|--|
| Inputs                                                               |  |
| 2 inputs for thermocouple exhaust gas temp. sensors                  |  |
| 2 lambda interfaces LSU                                              |  |
| 4 inputs for wheel speed sensors; basic design for inductive sensors |  |
| 4 inputs for turbo speed sensors; basic design for inductive sensors |  |
| 1 input for inductive crankshaft sensor                              |  |
| 1 input for hall effect camshaft sensor                              |  |
| 3 system inputs 0 ... 5 V                                            |  |
| 13 universal inputs 0 ... 5 V, fixed pullup                          |  |
| 27 universal inputs 0 ... 5 V, switchable pullup                     |  |
| 3 digital inputs                                                     |  |
| Outputs                                                              |  |
| 8 injection power stages                                             |  |
| 12 power stages (low side)                                           |  |
| 2 power stages for lambda heater                                     |  |
| 2 H-bridge                                                           |  |
| 2 sensor supply 5 V/ system use                                      |  |
| 3 sensor supply 5 V/300 mA                                           |  |
| 3 sensor supply 10 V/100 mA                                          |  |
| Communication interfaces                                             |  |
| 1 RS232 serial interface                                             |  |
| 1 K-line serial interfaces                                           |  |
| 3 CAN interfaces (dash, application, customer use)                   |  |
| 2 firewire interfaces for external communication                     |  |

| Part number               |                      |
|---------------------------|----------------------|
| MS 15.1 solenoid injector | <b>F 01T A20 022</b> |

## Motronic MS 15.2

The MS 15.2 is an ECU for Diesel engines with up to 6 cylinders. It is developed for the combination with Bosch piezo injectors.



| Mechanical data                                                     |                   |
|---------------------------------------------------------------------|-------------------|
| Dust and waterproof aluminium housing                               |                   |
| 4 connectors in military technology with high pin density, 187 pins |                   |
| Vibration damped circuit boards                                     |                   |
| 8 flexible housing fixation points                                  |                   |
| Size                                                                | 210 x 186 x 36 mm |
| Weight                                                              | 1780 g            |

| Conditions for use        |                                              |
|---------------------------|----------------------------------------------|
| Temperature range         | -40 ... 75°C                                 |
| Typical power consumption | 140 W at 14 V                                |
| Max. vibration            | 15 g sinus at 20 Hz ... 2 kHz<br>for t < 5 h |

| Functionality                                                      |  |
|--------------------------------------------------------------------|--|
| Injection timing:                                                  |  |
| 2 pilot injections                                                 |  |
| 1 main injection                                                   |  |
| 1 post injection                                                   |  |
| Lambda measurement                                                 |  |
| Data acquisition, external Logger C55                              |  |
| Telemetry (external unit FM40 in combination with data logger C55) |  |
| Traction control (optional)                                        |  |
| Basic functionality for up to two turbochargers in parallel mode   |  |
| Gear cut for sequential gearbox                                    |  |
| Speed limiter                                                      |  |
| Optional function packages available                               |  |

| Electronic design                                                    |  |
|----------------------------------------------------------------------|--|
| <b>Inputs</b>                                                        |  |
| 2 inputs for thermocouple exhaust gas temp. sensors                  |  |
| 2 lambda interfaces LSU                                              |  |
| 4 inputs for wheel speed sensors; basic design for inductive sensors |  |
| 4 inputs for turbo speed sensors; basic design for inductive sensors |  |
| 1 input for inductive crankshaft sensor                              |  |
| 1 input for hall effect camshaft sensor                              |  |
| 3 system inputs 0 ... 5 V                                            |  |
| 13 universal inputs 0 ... 5 V, fixed pullup                          |  |
| 27 universal inputs 0 ... 5 V, switchable pullup                     |  |
| 3 digital inputs                                                     |  |
| <b>Outputs</b>                                                       |  |
| 6 injection power stages                                             |  |
| 12 power stages (low side)                                           |  |
| 2 power stages for lambda heater                                     |  |
| 2 H-bridge                                                           |  |
| 2 sensor supply 5 V/ system use                                      |  |
| 3 sensor supply 5 V/300 mA                                           |  |
| 3 sensor supply 10 V/100 mA                                          |  |
| <b>Communication interfaces</b>                                      |  |
| 1 RS232 serial interface                                             |  |
| 1 K-line serial interfaces                                           |  |
| 3 CAN interfaces (dash, application, customer use)                   |  |
| 2 firewire interfaces for external communication                     |  |

| Part number            |                      |
|------------------------|----------------------|
| MS 15.2 Piezo injector | <b>F 01E A20 023</b> |

# Displays

## Display DDU Sport

The DDU Sport is a light and compact dashboard unit with a high contrast display. Customised display configurations can be programmed to suit individual customer requirements. All illuminated components are dimmable.

For enhanced flexibility the DDU Sport can be interfaced to a range of stand-alone I/O modules that provide the driver with additional information or alternatively enable the driver to interface with multiple vehicle functions.



| Mechanical data |                   |
|-----------------|-------------------|
| Dimensions      | 160 x 110 x 26 mm |
| Weight          | 433 g             |

| Display                            |                |
|------------------------------------|----------------|
| LCD-Display / LED background light |                |
| Active area                        | 91 x 56 mm     |
| Resolution                         | 240 x 128      |
| Dot size                           | 0,38 x 0,41 mm |

| Conditions for use |                      |
|--------------------|----------------------|
| Vibration          | 15 g/20 Hz ... 2 kHz |
| Temperature        | -10 ... 65 °C        |

| Mounting                   |  |
|----------------------------|--|
| 4 x M5 threads on backside |  |

| Switches                                                                                        |  |
|-------------------------------------------------------------------------------------------------|--|
| 4 internal Switches for operation (pages, mode, setting), available also on backside connectors |  |

| Electronic data                          |  |
|------------------------------------------|--|
| 7 sequential shift-LEDs                  |  |
| 64 Mbyte Data logger                     |  |
| 4 Analog Input (0-5 V) 10 bit Resolution |  |
| 4 Digital input (HL = 2,5 – 32 V)        |  |
| Real Time Clock                          |  |
| 2 x CAN-Bus                              |  |
| 1 x RS232                                |  |
| 1 x 100Mbit LAN                          |  |
| Voltage supply range: 7,5 – 35 V         |  |
| Sensor supply: 5 V, 500mA                |  |

| Connector  |  |
|------------|--|
| Binder 712 |  |

| Part number          |  |
|----------------------|--|
| <b>F 01T A20 050</b> |  |

## Display DDU 4

The DDU 4, exclusively developed for Bosch Motorsport ECUs, is a light and compact dashboard unit with a high contrast colour display. Up to 12 customised display configurations can be programmed to suit individual customer requirements. All illuminated components are dimmable.

For enhanced flexibility the DDU 4 can be interfaced to a range of stand-alone I/O modules that provide the driver with additional information or alternatively enable the driver to interface with multiple vehicle functions.



### Mechanical data

|            |                   |
|------------|-------------------|
| Dimensions | 164 x 117 x 37 mm |
| Weight     | 753 g             |

### Display

|                                                               |                  |
|---------------------------------------------------------------|------------------|
| 1x active matrix TFT high contrast colour display Active area | 111 x 83 mm      |
| Resolution                                                    | 320 x 240        |
| Dot size                                                      | 0,116 x 0,348 mm |

### Conditions for use

|                                                                                                     |                       |
|-----------------------------------------------------------------------------------------------------|-----------------------|
| Vibration                                                                                           | 18 g/20 Hz ... 20 kHz |
| Temperature                                                                                         | -10 ... 75°C          |
| Display panel with optical double-sided antiglare coating for highest contrast and display accuracy |                       |

### Electronic data

|                                                                                                  |
|--------------------------------------------------------------------------------------------------|
| 1 x CAN interface for communication with ECU via CCP and free configurable for any ECUs messages |
| 1 x CAN interface for communication with network                                                 |
| 1x RS 232 interface for display programming                                                      |
| 5 LED shift indicators (5 drivers, open collector, 2,2 A)                                        |
| 10 LED multi purpose indication lights                                                           |
| 8 inputs 0 ... 5 V (analogue/digital)                                                            |
| 2 x 0,5 A universal outputs                                                                      |
| Dedicated battery voltage measurement                                                            |

### Holders

|              |                      |
|--------------|----------------------|
| Aluminium    | <b>F 01E B01 457</b> |
| Carbon fibre | <b>F 01E B01 458</b> |

### Switches

|                                                                        |                      |
|------------------------------------------------------------------------|----------------------|
| External switches for display position and dimming of display and LEDs | <b>B 261 209 659</b> |
|------------------------------------------------------------------------|----------------------|

### Part number

|                                   |                      |
|-----------------------------------|----------------------|
| DDU 4 incl. cable, without holder | <b>F 01E B01 461</b> |
|-----------------------------------|----------------------|

## Display DDU 6

The DDU 6, exclusively developed for Bosch Motorsport ECUs, is a light and compact, steering wheel mounted dashboard unit. It is equipped with a high contrast colour display. Up to 12 customised display configurations can be programmed to suit individual customer requirements. All illuminated components are dimmable.

For enhanced flexibility the DDU 6 can be interfaced to a range of stand-alone I/O modules that facilitate multiple functions like switching, light indication, car and race information display.



### Mechanical data

|            |                   |
|------------|-------------------|
| Dimensions | 165 x 104 x 32 mm |
| Weight     | 342 g             |

### Display

|                                                               |            |
|---------------------------------------------------------------|------------|
| 1x active matrix TFT high contrast colour display Active area | 54 x 72 mm |
| Resolution                                                    | 240 x 320  |

### Conditions for use

|             |                      |
|-------------|----------------------|
| Vibration   | 15 g/20 Hz ... 2 kHz |
| Temperature | -10 ... 65°C         |

### Electronic data

|                                                                                                  |
|--------------------------------------------------------------------------------------------------|
| 1 x CAN interface for communication with ECU via CCP and free configurable for any ECUs messages |
| 1 x CAN interface for communication with network                                                 |
| 1 x RS 232 interface for display programming                                                     |
| 5 LED shift indicators                                                                           |
| 4 LED warning lights                                                                             |
| 6 inputs 0 ... 5 V (analog/digital)                                                              |

### Part number

**F 01E B01 459**

# Communication

# Data Logging and Signal Processing

## Data Logger C Sport

The data logger C Sport is a device used for data acquisition. It is developed to read in analogue and digital signals. The measured data are stored on an internal 64 MB memory. The data are transmitted with RaceLab via Ethernet to the data logger C Sport.



| Mechanical data                              |                  |
|----------------------------------------------|------------------|
| Size                                         | 102 x 62 x 27 mm |
| Weight                                       | 210 g            |
| Required power supply                        | 7,5 ... 35 V     |
| Dust and splashwater proof aluminium housing |                  |
| Flexible housing fixation points             |                  |

| Conditions for use     |                                              |
|------------------------|----------------------------------------------|
| Temperature range      | -20 ... 65°C                                 |
| Max. power consumption | 4 W at 14 V                                  |
| Max. vibration         | 11 g sinus<br>at 20 Hz ... 2 kHz for t < 5 h |

| Electrical data                                         |  |
|---------------------------------------------------------|--|
| 1 CAN Bus link (ECU)                                    |  |
| 1 CAN Bus link (to cascade C Sport or attach DDU Sport) |  |
| 1 Ethernet connector (for PC connection)                |  |
| 64 MB internal memory                                   |  |
| Real time clock                                         |  |
| Total calculation capacity approximately 10 MIPS        |  |

| Options                                          |  |
|--------------------------------------------------|--|
| 4 digital inputs                                 |  |
| 4 analogue single ended inputs 16 bit resolution |  |
| 4 analogue differential inputs 16 bit resolution |  |
| 1 digital output                                 |  |

| Connector      |  |
|----------------|--|
| 4 x Binder 712 |  |

| Part number          |  |
|----------------------|--|
| <b>F 01T A20 061</b> |  |

## CardMemory C40 / C40 Plus

The CardMemory is a device used for data logging. The basic model C40 is designed for data transfer via CAN for MS3.x and MS4.x ECUs. The extended model C40 Plus is developed to read in additional 15 analogous signals and 1 rev signal. The measured data are stored on a compact flash card.



| Mechanical data                              |                   |
|----------------------------------------------|-------------------|
| Dust and splashwater proof aluminium housing |                   |
| Flexible housing fixation points             |                   |
| Connector                                    | with 5 or 40 pins |
| Size                                         | 150 x 90 x 22 mm  |
| Weight                                       | 330 g             |

| Conditions for use     |                                              |
|------------------------|----------------------------------------------|
| ECU temperature        | -40 ... 75°C                                 |
| Max. power consumption | 7 W at 14 V                                  |
| Max. vibration         | 15 g sinus<br>at 20 Hz ... 2 kHz for t < 5 h |

| Electrical data                                  |  |
|--------------------------------------------------|--|
| 1 microcontroller with 16 bit organisation       |  |
| 1 CAN interface                                  |  |
| Real time clock                                  |  |
| Non volatile flash card memory                   |  |
| Total calculation capacity approximately 10 MIPS |  |

| Options                                                                              |                           |
|--------------------------------------------------------------------------------------|---------------------------|
| 15 analogous inputs with 10 bit resolution and 5 ms sample rate time (only C40 Plus) |                           |
| 1 inductive crankshaft sensor interface                                              |                           |
| Sensor supply outputs                                                                | 5 V/100 mA<br>10 V/100 mA |
| Calibration functions are realised with an additional software tool                  |                           |

| Necessary equipment |                         |
|---------------------|-------------------------|
| Flash card 128 MB   | <b>F 01E B01 105_0B</b> |
| Flash card 256 MB   | <b>F 01E B01 106_0B</b> |
| Flash card 512 MB   | <b>F 01E B01 107_0B</b> |
| Flash card 1024 MB  | <b>F 01E B01 108_0B</b> |
| Flash card 2048 MB  | <b>F 01E B01 109_0B</b> |
| Memory adapter      | <b>B 261 206 864</b>    |
| C40 adapter cable   | <b>B 261 209 433</b>    |

| Connector                        |              |
|----------------------------------|--------------|
| Cable harness connector C40      | AS0-14-35 SN |
| Cable harness connector C40 Plus | AS0-14-35 SN |

| Part numbers                  |                      |
|-------------------------------|----------------------|
| C40                           | <b>F 01T A20 403</b> |
| C40 Plus                      | <b>B 261 206 860</b> |
| C40 Plus incl. chassis adjust | <b>B 261 206 880</b> |
| Upgrade C40 to C40 Plus       | <b>on request</b>    |
| Software chassis adjust       | <b>on request</b>    |

## Accessories

Compact flash cards, adapters and drivers are necessary to use the Card memory. For some optional functions additional cables and software are on offer.

Compact flash cards are offered with a storage capacity of up to 2048 MB. The compact flash card adapter is used to insert the card to the PCMCIA slot of the PC for data download and card formatting.

In conjunction with the memory C40 Plus, a software tool for additional calibration functions is offered. Together with an individual cable harness it is possible to calibrate further sensors for chassis data logging. To connect memory C40 to the vehicle cable harness the special C40 adapter cable is necessary.



| Conditions for use    |                             |
|-----------------------|-----------------------------|
| Operating temperature | -40 ... 84°C                |
| Humidity              | 5 % to 95 %, non condensing |
| Vibration             | 15 g peak to peak           |
| Shock                 | max. 2,0 g                  |

| Part numbers            |                         |
|-------------------------|-------------------------|
| Flash card 128 MB       | <b>F 01E B01 105_0B</b> |
| Flash card 256 MB       | <b>F 01E B01 106_0B</b> |
| Flash card 512 MB       | <b>F 01E B01 107_0B</b> |
| Flash card 1024 MB      | <b>F 01E B01 108_0B</b> |
| Flash card 2048 MB      | <b>F 01E B01 109_0B</b> |
| Memory adapter          | <b>B 261 206 864</b>    |
| Flash card adapter      | <b>B 261 205 814</b>    |
| Software Chassis Adjust | <b>B 261 206 870</b>    |
| C40 adapter cable       | <b>B 261 209 433</b>    |

# Data Logging System DLS

## System

The Data Logging System (DLS) is a many-sided and flexible measuring system for acquisition and recording of sensor data in a race car. The measuring channels in the DLS can be administered comfortably and can be adapted individually for every race car. The DLS is a modular system that consists of different hard- and software components.

## Hardware

The hardware serves the data acquisition and the recording of physical data in the vehicle. The data logger (CardMemory) and the data acquisition (MSI devices) which delivers the sensor data to the data logger belong to the hardware components. Additional data transfer takes place via burst or via online telemetry.

## Software

The software allows the real configuration and consequently the adjustment of the system. It enables you to create measuring projects, to check data, to record measuring channels and to analyse the measuring channels.

| DLS components             |                                                                         |
|----------------------------|-------------------------------------------------------------------------|
| Datalogger, System manager | C55                                                                     |
| Burst telemetry            | BT55, BR55                                                              |
| Online telemetry           | FM40                                                                    |
| Modular Sensor Interface   | MSI55                                                                   |
| Extended CAN Modules       | EM-50, EM-100, EM-I4<br>EM-L5, EM-O5, EM-C, EM-D8, EM-D1, EM-A6, EM-H4, |
| DLS configuration Software | DLS-Desk                                                                |
| System Software            | WinDCP, Modas, WinDarab                                                 |

| Technical details                                                                                |
|--------------------------------------------------------------------------------------------------|
| High measuring accuracy by 12 bits of analogue / digital transformation and tenfold oversampling |
| High recording rate up to 1 ms                                                                   |
| High recording duration by CF card up to 2 GB                                                    |
| High-linear analogue filtering and digital filtering for the removal of interference signals.    |
| Flexibly with the extensibility of the components and measuring channels                         |
| Temporal synchronisation between the different measuring channels                                |
| Connectivity and data transfer via telemetry                                                     |
| Free and individual application by special software                                              |

## CardMemory C 55

The CardMemory C 55 is a device used for data logging and DLS system management. The measured data are stored on a compact flash card with a maximum capacity of 1024 MB.



### Mechanical data

|                                              |                  |
|----------------------------------------------|------------------|
| Size                                         | 157 x 92 x 30 mm |
| Weight                                       | 500 g            |
| Dust and splashwater proof aluminium housing |                  |

### Conditions for use

|                        |                                      |
|------------------------|--------------------------------------|
| ECU temperature        | -20 ... 65°C                         |
| Max. power consumption | 20 W at 14 V                         |
| Max. vibration         | 15 g sinus<br>at 1200 Hz for t < 5 h |

### Electrical data

|                                |
|--------------------------------|
| 1 CAN interface                |
| 2 Fire wire interfaces         |
| 2 Ethernet interfaces          |
| Real time clock                |
| Non volatile flash card memory |

### Necessary equipment

|                    |                         |
|--------------------|-------------------------|
| Flash card 256 MB  | <b>F 01E B01 106_0B</b> |
| Flash card 512 MB  | <b>F 01E B01 107_0B</b> |
| Flash card 1024 MB | <b>F 01E B01 108_0B</b> |
| Memory adapter     | <b>B 261 206 864</b>    |

### Documents

|                 |                       |
|-----------------|-----------------------|
| Dimension sheet | <b>Y261A25051.pdf</b> |
| 3D_modell       | <b>Y261A25051.stp</b> |
| Data sheet      | <b>F01EB01630.xls</b> |

### Part number

**F 01E B01 630**

## Modular Sensor Interface MSI 55

MSI 55 is a high quality data acquisition of analogue and digital sensors.

The MSI 55 offers 16 configurable analogue inputs, 4 frequency inputs, 2 digital I/O and a freely configurable 1 MBit CAN Bus. Data is sent via FireWire interface to the C-55 datalogger.



| Mechanical data                                                          |                   |
|--------------------------------------------------------------------------|-------------------|
| Size                                                                     | 120 x 117 x 38 mm |
| Weight                                                                   | 600 g             |
| Dust and water proof aluminium housing                                   |                   |
| Filtered connectors of military design with high pin density (MIL-38999) |                   |
| Vibration damped printed circuit boards                                  |                   |

| Conditions for use     |                                   |
|------------------------|-----------------------------------|
| ECU temperature        | -20 ... 65°C                      |
| Max. power consumption | 20 W at 14 V                      |
| Max. vibration         | 15 g sinus at 1200 Hz for t < 5 h |

| Electronic data                                                                               |            |
|-----------------------------------------------------------------------------------------------|------------|
| 16 bit digital signal process organisation, calculation power 150 MIPS                        |            |
| Required power supply                                                                         | 8 ... 18 V |
| 4 differential analogue inputs with switchable amplifier and switchable pullup resistor       |            |
| 12 single analogue inputs with switchable pullup resistor                                     |            |
| All analogue inputs offer analogue and digital anti-aliasing filter and 12 bit A/D resolution |            |
| 4 frequency inputs 0 ... 25,5 kHz switchable inductive sensor / hall-effect sensor            |            |
| 2 digital I/O                                                                                 |            |
| 2 PWM outputs 100 mA                                                                          |            |
| 5 V sensor power supply                                                                       |            |
| 3 ... 10 V configurable sensor power supply                                                   |            |
| 12 V sensor power supply                                                                      |            |

| Documents       |                |
|-----------------|----------------|
| Dimension sheet | Y261A21876.pdf |
| 3D-modell       | Y261A21876.stp |
| Data sheet      | F01TA20024.xls |

| Part number |               |
|-------------|---------------|
|             | F 01T A20 024 |

## Burst Telemetry Transmitter BT 55

The burst telemetry system BT 55 / BR 55 adds high speed burst telemetry transmission to a DLS-based data acquisition system. Each time the car passes the pit lane, up to 6 MByte of C 55 measurement data can be transmitted to the Pit network via a WiFi band high speed wireless link.



| Mechanical data                                 |                  |
|-------------------------------------------------|------------------|
| Size                                            | 168 x 92 x 30 mm |
| Weight                                          | 540 g            |
| Dust and waterproof housing with LED indicators |                  |

| Conditions for use     |                                |
|------------------------|--------------------------------|
| Vibration              | 15 g sinus at 1200 Hz for t<5h |
| Temperature range      | -20 ... 65°C                   |
| Max. power consumption | 20 W at 14 V                   |
| International standard | IEEE 802.11b                   |

| Electronic data                         |                     |
|-----------------------------------------|---------------------|
| Full duplex radio modem (bidirectional) |                     |
| Transmission power                      | 100 mW              |
| Frequency range                         | 2,4 GHz<br>ISM Band |
| Data rate                               | max. 11 MBit / s    |
| Required power supply                   | 8 ... 18 V          |
| Max. current                            | < 2,5 A             |

| Documents       |                                |
|-----------------|--------------------------------|
| Dimension sheet | <a href="#">A261208899.pdf</a> |
| 3D-modell       | <a href="#">A261208899.stp</a> |
| Data sheet      | <a href="#">B261208899.xls</a> |

| Part number |                     |
|-------------|---------------------|
|             | <b>B261 208 899</b> |

## Speed Box 2

This box determines the speed signals of two wheels and passes the higher value on. This enables the logging of vehicle speed even with one wheel locked.



| Mechanical data |                 |
|-----------------|-----------------|
| Size            | 40 x 40 x 38 mm |
| Weight          | 89 g            |
| Environmental   | IP65            |

| Conditions for use    |             |
|-----------------------|-------------|
| Operating temperature | 10 ... 60°C |

| Connectors |                     |
|------------|---------------------|
| Input      | 2 x KPSE 120061-28  |
| Output     | 1 x KPSE 6E8-3AP-DN |

| Electronic data |            |
|-----------------|------------|
| Supply voltage  | 6 ... 18 V |
| Supply current  | 4 mA       |

| Part numbers                    |                      |
|---------------------------------|----------------------|
| Speed Box 2 incl. cable harness | <b>B 261 208 281</b> |
| Speed Box 2                     | <b>B 261 208 284</b> |
| Cable harness                   | <b>B 261 208 285</b> |

## Speed Box 4

This box determines the speed signals of four wheels and converts them into a CAN-message. The message includes the time between each tooth-gap. The box is optimized for the MS 3-use.



| Mechanical data |                 |
|-----------------|-----------------|
| Size            | 70 x 40 x 19 mm |
| Weight          | 90 g            |

| Conditions for use    |             |
|-----------------------|-------------|
| Operating temperature | 10 ... 60°C |

| Connector |             |
|-----------|-------------|
|           | AS0-10-35PN |

| Electronic data     |                |
|---------------------|----------------|
| Power supply        | 4 ... 18 V     |
| Current consumption | 120 mA at 12 V |
| Channels            | 4 Speed        |
| Channel input       | 1 ... 150 V    |

| Part number |                      |
|-------------|----------------------|
| Speed Box 4 | <b>B 261 208 286</b> |

# Telemetry

## Telemetry Unit FM 40

The FM 40 is a real-time telemetry system used to get always actual data from the car out on the track. It fits most of the Bosch Motorsport management systems and is designed to transmit many various car and engine data due to its high speed data rate.

In typical applications data are sent from the car to the receiving station. With the optional software for bi-directional transmission, data can be sent in both directions.



| Mechanical data                                            |                   |
|------------------------------------------------------------|-------------------|
| Size                                                       | 151 x 138 x 28 mm |
| Weight                                                     | 720 g             |
| Dust and waterproof housing with LED indicators            |                   |
| Car antenna compatible to existing Bosch telemetry systems |                   |

| Conditions for use     |                                     |
|------------------------|-------------------------------------|
| Vibration              | 6 g/20 Hz ... 2 kHz                 |
| Temperature range      | 0 ... 60°C                          |
| Max. power consumption | 25 W at 14 V                        |
| International standard | I-ETS 300 220<br>ETS 300 113<br>FCC |

| Electronic data                              |                                                                   |
|----------------------------------------------|-------------------------------------------------------------------|
| Semi duplex radio modem (bidirectional)      |                                                                   |
| Internal data buffer and protocol management |                                                                   |
| Transmission power                           | 1 ... 10 W                                                        |
| Frequency range                              | 430 ... 470 MHz<br>(hardware adjustable)                          |
| Receiver sensitivity                         | -116 dBm<br>error detection and<br>forward error correction (FEC) |
| Data rate                                    | max. 19200 bps                                                    |
| Required power supply                        | 10 ... 18 V                                                       |
| Max. current                                 | < 2,5 A                                                           |

| Connectors   |                 |
|--------------|-----------------|
| RF           | BNC female      |
| Power / data | CGK SOT 8N35 PN |

| Part number |                      |
|-------------|----------------------|
|             | <b>B 261 208 885</b> |

## Telemetry Accessories

### FM 40 Tester

The FM 40 Tester is a tool for checking the performance of the installed telemetry transmitter FM 40 in connection with the RF-cable and the car antenna. Measured parameters are the transmission power as well as the matching of the antenna together with the RF-cables.



| Measurement range  |                 |
|--------------------|-----------------|
| Transmission power | 1 ... 15 (60) W |
| VSWR               | 1 ... 6         |
| Frequency band     | VHF / UHF       |

| Connectors |                   |
|------------|-------------------|
| RF         | BNC male / female |

| Part number |                      |
|-------------|----------------------|
|             | <b>B 261 208 894</b> |

### Telemetry Antenna Dummy Load

The telemetry antenna dummy load replaces the telemetry car antenna when running the FM40 transmitter in a garage in order to prevent high RF power radiation.



| Measurement range |           |
|-------------------|-----------|
| RF power          | 15 W      |
| VSWR              | 1.1       |
| Frequency band    | VHF / UHF |

| Connectors |                   |
|------------|-------------------|
| RF         | BNC male / female |

| Part number |                      |
|-------------|----------------------|
|             | <b>B 261 208 890</b> |

## Telemetry (Dual Band) Car Antenna



| Parameter                    |           |
|------------------------------|-----------|
| <b>Car Antenna</b>           |           |
| Frequency band               | UHF       |
| Length                       | 150 mm    |
| <b>Dual Band Car Antenna</b> |           |
| Frequency band               | VHF / UHF |
| Length                       | 440 mm    |

| Connectors |          |
|------------|----------|
| RF         | BNC male |

| Part number           |                      |
|-----------------------|----------------------|
| Car Antenna           | <b>B 261 208 888</b> |
| Dual Band Car Antenna | <b>B 261 208 862</b> |

## Antenna Cable Kit For car mounting



| Measurement range |                            |
|-------------------|----------------------------|
| Length            | max. 2 m (tbd.)            |
| Attenuation       | max. 0.7 dB @ 2 m, 450 MHz |

| Connectors |                   |
|------------|-------------------|
| RF         | BNC male / female |

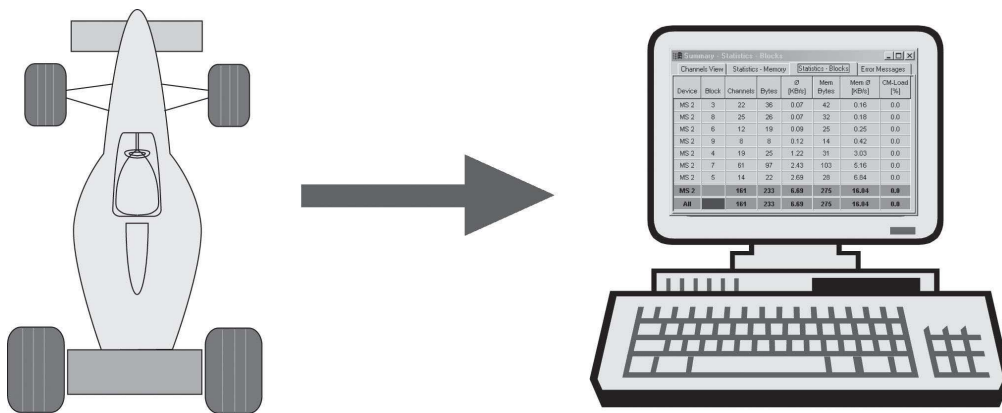
| Part number |                      |
|-------------|----------------------|
|             | <b>B 261 209 490</b> |

# Analysing

## WinDarab

### Data Recording, Analysing and Influencing

WinDarab is an evaluation tool for monitoring and analysing of logged data. It is Windows-based and specially designed for motorsport use. Depending on the functionality the software is available in two different versions, WinDarab-Light and WinDarab-Expert. For selection of monitored data channels and setting of sample rates the integrated configuration tool WinDCP is used.



#### Data evaluation

- Auto load and auto store
- Adjustable axis: time or distance
- Direct read in of memory data without reader
- Graphic display of all measured and stored channels
- Various displays available (analogous and digital)
- Number of displays available
- Various display set-ups selectable and storable
- Laptrigger signal included

#### Functionality

- Creating of race tracks
- Several segments adjustable for each race track
- Lap reports and lap comparison
- Inform displays
- Data extract and export

#### Functions

- Min/max-calculations
- Histograms
- Mathematical functions
- Filter functions incl. FFT
- x/y-plots

#### Data comparison

- Calculation of differences lap by lap

#### Part numbers

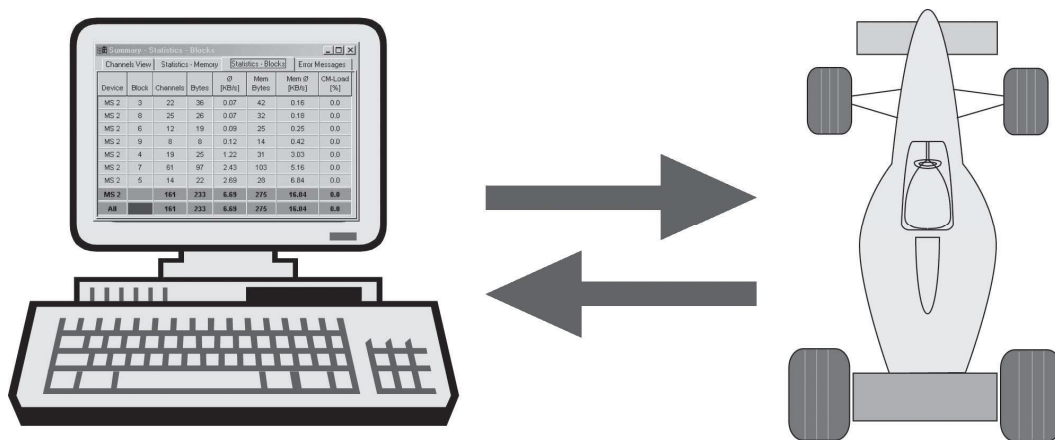
- WinDarab-Light incl.** **F 01E B01 402**  
Configuration tool WinDCP
- WinDarab-Expert incl.** **F 01E B01 401**  
Configuration tool WinDCP
- Upgrade**  
**WinDarab-Light to**  
**WinDarab-Expert** **on request**

# Application

## INCA-MSD

INCA is a software tool for measuring and calibrating of defined engine parameters. According to different levels of functionality INCA is available in two different versions:

- The basic version INCA-Light is made for the quick use.
- The highly sophisticated version INCA-Expert is made for calibration and optimization.



### Performance description

**INCA-MSD is a combination of:**

- **Project management:**

Visualization, processing and management of calibration, measurement and documentation data.

- **Programming system:**

Programming and management of program (code) and calibration data.

- **Measuring system:**

Acquisition, visualization, documentation and evaluation of measurement data.

- **Calibration system:**

Visualization and manipulation of parameters (calibration data).

- **Diagnosis system:**

Visualization, processing, documentation and evaluation of diagnosis data.

### General functions

Online measurement and calibration

Basic configuration of a number of views

User-configurable menus of the diagnostic services and the displays on the screen

Easy switch between the configured views

Universal use for different ECUs

Controlled by mouse or menu, fast grip via keyboard and shortcuts

Data acquisition via central main window

### Measurement system function

The measurements can be displayed in various ways: e.g. oscilloscopes, vertical or horizontal bar charts, numerical displays for numerical values or bit displays for binary values.

The oscilloscope allows you to have several scalar or binary measured signals displayed simultaneously.

Once measuring has been completed, you can complete the evaluation of the data either directly or in detail evaluation programs, such as the VS 100 program provides.

INCA processes characteristics and measured signals in the form of variables. These are structured alphabetically according to the DAMOS/ASAP 2 definition, but are also available in an additional hierarchical display.

Using an editor, you define individual functions and so react in this way to different application tasks, such as the integration of different external data sources (thermo-scan, lambda display).

Free selection of measuring cells.

### Calibration system function

INCA provides you with various editors for different characteristics, e.g. the tabular editor for processing curves and maps.

These curves and maps can be spread over several windows so that all values can be displayed at the same time.

To evaluate the data, use either the provided VSW program or copy the data to a spreadsheet program using the Windows buffer.

Free selection of calibration cells.

Functionality of potentiometer board: up to 12 pots with individually configuration.

### Evaluation function

Calibration comparison function

A lot of auxiliary functions are supporting the user during the period of working in.

### Required hardware components

#### PC:

IBM PC/AT compatible, 586 processor or higher, 166 MHz

Approx. 64 MB RAM

Approx. 30 MB harddisc space

VGA monitor

#### Operating systems:

Windows 98, 2000, NT and XP

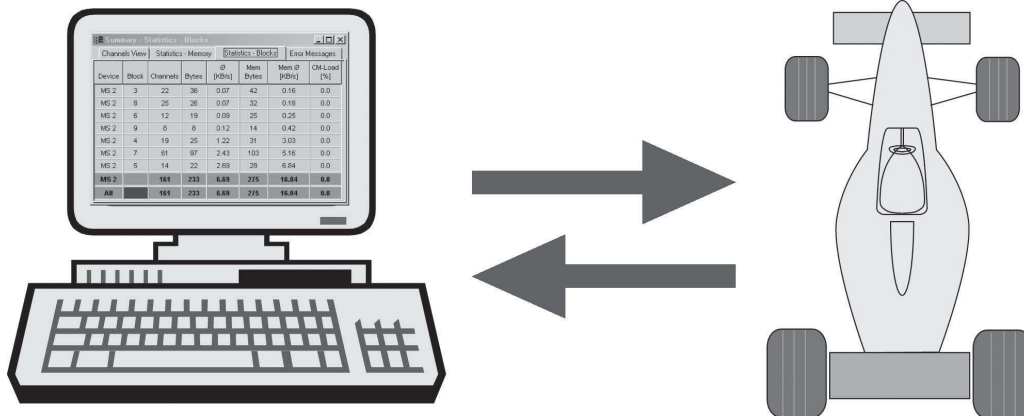
### Part number

INCA-Expert

**B 261 206 423**

## Modas

Modas is a software tool for measuring and calibrating defined engine values and curves. It is specially designed for race track use. Developing Modas we set great store by easy handling and quick access to the ECU.



### General functions

Online measurement and calibration

Universal use for different ECUs

Modas facilitates operating and working in by using the Windows standard. In the office Modas is controlled by mouse or menu. If Modas is used in a mobile way a fast grip is possible by keyboard and shortcuts.

### Required hardware components:

#### PC:

IBM PC/AT compatible, 586 processor or higher, 166 MHz

Approx. 64 Mbyte of RAM

Approx. 30 Mbyte harddisc space

VGA monitor

#### Operating systems:

Windows 98, 2000, NT and XP

### Performance description

#### Modas is a combination of

- **Project (Data) management:**

Visualisation, processing and management of calibration, measurement and documentation data

- **Programming system:**

Programming and management of calibration data

- **Calibration system:**

Visualisation and manipulation of parameters

(Calibration data)

- **Diagnosis system:**

Visualisation, processing, documentation and evaluation of diagnosis data

### Part number

**B 261 206 441**

## KIC 2

### (K-Line Interface Compact)

KIC 2 is part of the INCA module family. Within this family, the KIC 2 is the low cost unit for PC-supported application on the serial diagnosis interface of an ECU.

KIC 2 is coupled to the PC via the parallel printer interface. This ensures a powerful and universal link to all common PCs. The coupling to the ECU is effected via the K-line of the diagnosis interface. The functionality of KIC 2 is essentially determined by the operating programs of the PC.



| Details                                                                                  |  |
|------------------------------------------------------------------------------------------|--|
| Compact design                                                                           |  |
| Fully suitable for motor vehicle use                                                     |  |
| Power supply through the connection to the ECU from board mains with galvanic separation |  |
| All inputs and outputs to the PC galvanically separated                                  |  |
| Firmware update possible via PC                                                          |  |
| According to ISO 9141-2 for diagnosis tester                                             |  |
| Up to 250 kBaud transfer rate                                                            |  |
| Plug suitable for motor vehicles (VS 20)                                                 |  |
| Protocols: McMess, KP 2000, Keyword 71                                                   |  |

| Mechanical data |                 |
|-----------------|-----------------|
| Size            | 17 x 60 x 78 mm |

| Electronic data               |                     |
|-------------------------------|---------------------|
| Input voltage                 | 6 ... 30 V          |
| Power consumption             | typ. 1 W at 13,5 V  |
| Power consumption in stand by | 30 mW at 13,5 V     |
| Processor                     | μP 87C520, 12 kByte |
| Flash Eeprom                  | 2 x 48 kByte        |
| Centronics linterface         | 40 g/5Hz ... 2kHz   |
| Temperature range             | -30 ... 70°C        |
| Control P-module output       |                     |
| Output voltage                | 0 ... 4,096 V       |
| Quantisation                  | ΔV=1,0 mV           |
| Resolution                    | 12 bit              |

| Part numbers                                       |                      |
|----------------------------------------------------|----------------------|
| KIC 2, standard connector                          | <b>B 261 206 859</b> |
| KIC 2, diagnosis connector with ignition bridge    | <b>B 261 206 866</b> |
| KIC 2, diagnosis connector without ignition bridge | <b>B 261 206 867</b> |

## K-Line Extension Set

The K-Line Extension Set is an extension for KIC 2 and therefore also a part of the INCA module family. Within this family, the KIC 2 is the low cost unit for PC-supported application on the serial diagnosis interface of an ECU. The K-Line Extension Set enables a much longer distance than the KIC 2 can.

The set consists of three parts: The PC-Printer port adapter, the K-Line adapter and the extension cable (length is user defined). The user can handle the set in the same way like a standard K-Line interface.



| Details                                                                                  |  |
|------------------------------------------------------------------------------------------|--|
| Long distance K-Line function                                                            |  |
| Compact design                                                                           |  |
| Fully suitable for motor vehicle use                                                     |  |
| Power supply through the connection to the ECU from board mains with galvanic separation |  |
| All inputs and outputs to the PC galvanically separated                                  |  |
| Firmware update possible via PC                                                          |  |
| According to ISO 9141-2 for diagnosis tester                                             |  |
| Up to 250 kBaud transfer rate                                                            |  |
| Plug suitable for motor vehicles (VS 20)                                                 |  |
| Protocols: McMess, KP 2000, Keyword 71                                                   |  |

| Mechanical data           |                  |
|---------------------------|------------------|
| Size Printer Port Adapter | 17 x 60 x 78 mm  |
| Size Converter            | 35 x 115 x 60 mm |
| Size Extension Cable      | 10/25/50 m       |

| Electronic data               |                    |
|-------------------------------|--------------------|
| Input voltage                 | 6 ... 30 V         |
| Power consumption             | typ. 1 W at 13,5 V |
| Power consumption in stand by | 30 mW at 13,5 V    |
| Max. extension cable length   | 200 m              |
| Temperature range             | -30 ... 70°C       |

| Part numbers         |                                |
|----------------------|--------------------------------|
| K-Line Extension Set | <b>F 01E B01 641</b>           |
| Converter            | <b>F 01T A20 041</b>           |
| Extension Cable      | <b>F01T A21 003_10/_25/_50</b> |
| Printer Port Adapter | <b>F 01T A20 042</b>           |

## MSA-Box (K-Line / CAN Interface)

The MSA-Box is the low cost unit for PC-supported application with MODAS on K-Line or CAN interface of an ECU.

The MSA-Box 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 K-Line or CAN of the diagnosis interface.



| Mechanical data        |                 |
|------------------------|-----------------|
| Size                   | 84 x 33 x 20 mm |
| Diagnosis cable length | 0,5 m           |
| USB cable length       | 2 m             |

| Conditions for use |            |
|--------------------|------------|
| Temperature range  | 0 ... 70°C |

| Electronic data                      |                                 |
|--------------------------------------|---------------------------------|
| Input voltage (vehicle side)         | 8 ... 32 V                      |
| Power consumption (powered from USB) | typ. 0,5 W                      |
| Processor                            | ATMEL AT91SAM7X256              |
| Flash Eprom                          | 256 kByte                       |
| RAM                                  | 64 kByte                        |
| USB                                  | USB 2.0, full speed (12 Mbit/s) |
| K-Line                               | 300 Bd ... up to 320 kBd        |
| CAN                                  | 10 kBit/s ... 1 MBit/s          |

| Operating system |  |
|------------------|--|
| Windows 2000     |  |
| Windows XP       |  |

| Details                                                                                  |  |
|------------------------------------------------------------------------------------------|--|
| Compact design                                                                           |  |
| Fully suitable for motor vehicle use                                                     |  |
| Power supply through the connection to the ECU from board mains with galvanic separation |  |
| All inputs and outputs to the PC galvanically separated                                  |  |
| According to ISO 9141-2 for diagnosis tester                                             |  |
| Up to 300 kBaud transfer rate (K-Line) and up to 1 MBit/s transfer rate (CAN)            |  |
| Plug suitable for motor vehicles (VS 20)                                                 |  |
| Protocols: KWP 2000, CCP                                                                 |  |

| Part number |                      |
|-------------|----------------------|
| MSA-Box     | <b>B 261 208 015</b> |

# Handheld Test Devices

## Lambda Tester

This tester simulates the output signals of the lambda sensor in a quick and comfortable way. It allows you to check the function of the lambda control loop's hardware and software just before installing it into the vehicle.



| Technical data              |                   |
|-----------------------------|-------------------|
| Power supply                | 9 V               |
| Output signals              | 40 / 800 / 900 mV |
| Internal resistance         | 10 / 50 / 100 Ω   |
| Representable lambda values | 0,65 ...1,08      |

| Function                                          |  |
|---------------------------------------------------|--|
| High precious simulation of various lambda values |  |
| Part number                                       |  |
| <b>B 261 206 879</b>                              |  |

## RS 2000

With RS 2000 you can simulate crankshaft-, camshaft- and wheel-speed-signals quickly and comfortably.



### Functions

Infinitely variable simulation of Hall- and inductive signal

Compatible with all Bosch-Motorsport-ECUs from MS 1.9 to MS 4.1

Adjustable on cylinder numbers from 4 to 12

Usable for increment- and segment-systems

### Electronic data

Power supply 12 V

### Part numbers

**B 261 206 862**

Cable harness connector **B 261 206 451**

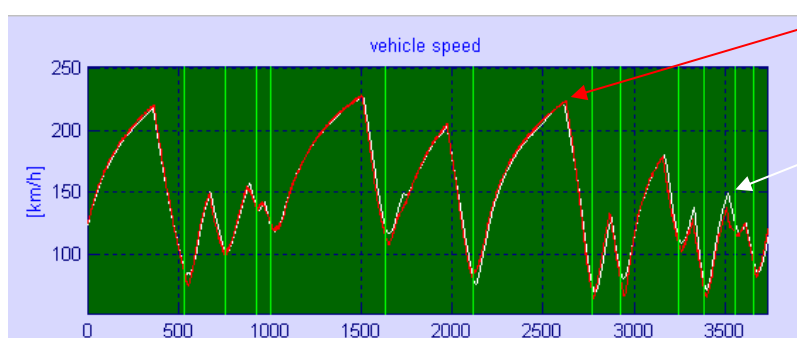
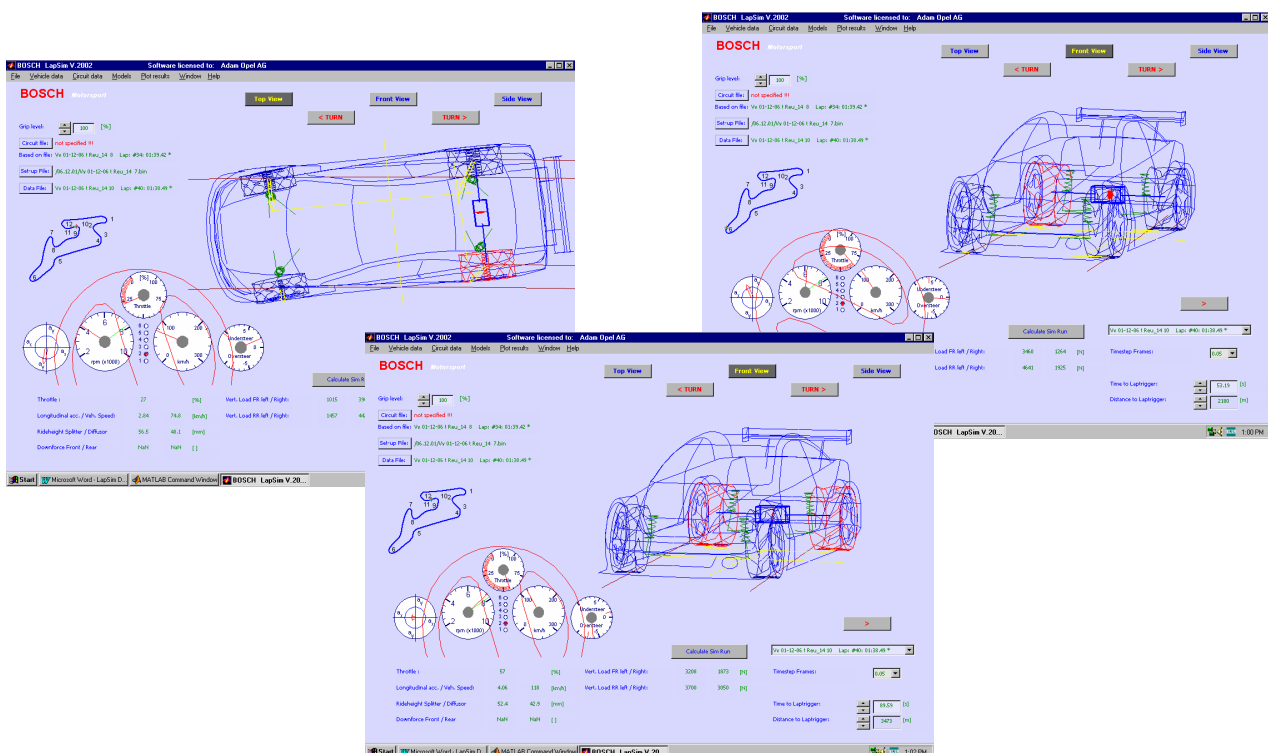
# Simulation

## LapSim

### Data Analysis, Vehicle Identification and Setup Optimisation

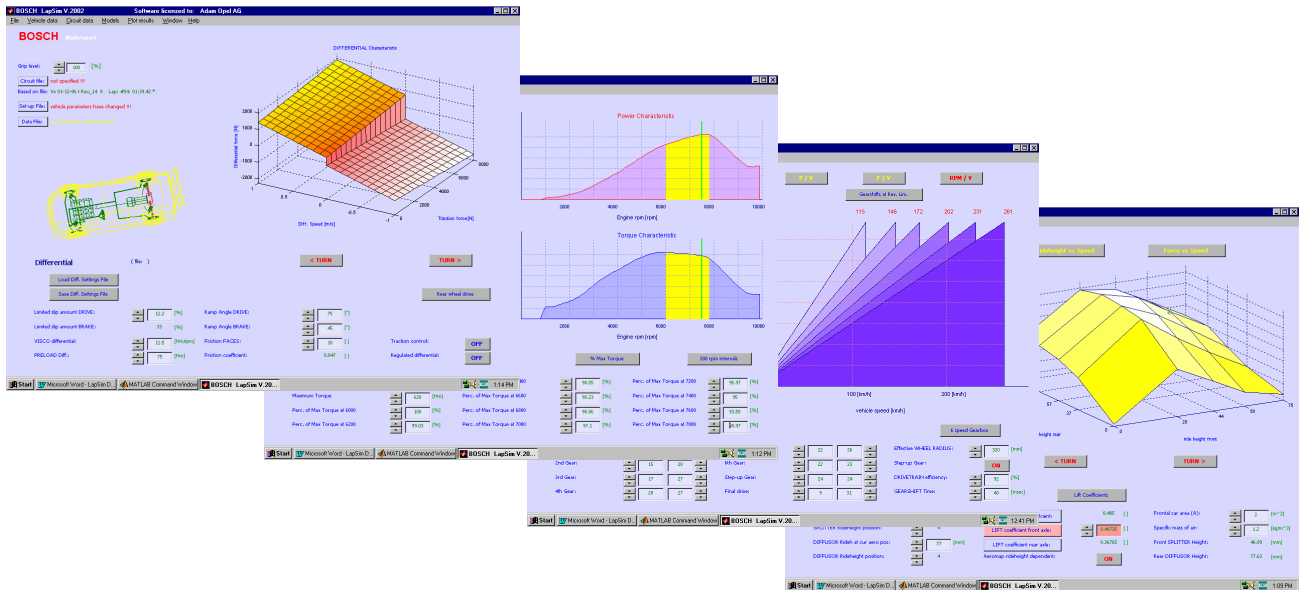
LapSim is both an analysis tool as well as a vehicle simulation program. By further processing the on-car recorded data, using parts of the simulation models, a much more profound analysis of the on-car recorded data can be gained.

Due to the direct link with the simulation model, vehicle parameters can be validated like aerodynamics, tyre behaviour, engine power, as well as driver performance. The visualisation of the vehicle behaviour creates a much easier and better understanding of the influence of several vehicle parameters on the performance independent of the technical background of the user.



Real Car

Simulation Model



## Data analysis

Post processing of the on-car recorded data with simulation models. Calculating vehicle handling state, aerodynamics, differential function, etc.

Determination of tyre parameters out of on-car recorded data. Possibility to analyse tyre performance over the laps

Direct comparison between several outings and/or simulation model

3D Animation of vehicle behaviour for a better and more thorough understanding

By comparing recorded data with simulation data a validation possibility of vehicle parameters and vehicle functioning is made.

LapSim software adds all vehicle parameters to Win-Darab Files → creates automatic database

## Data comparison

Calculation of differences lap by lap

## Functions

Min/max-calculations

Histograms

Mathematical functions

Filter functions incl. FFT

x/y-plots

## Simulation model

Practical Pacjeka Tyre model. Tyre parameters can easily be determined out of on-car recorded data. No Tyre data required.

Full vehicle model including limited slip (or visco-) differential

3D Aeromaps, ride height dependent suspension kinematics.

Calculation time 1 to 1 to real car

(PIII - 1 GHz)

Automatic set-up optimisation

Useful vehicle parameter menus for rideheight versus speed, shift points, spring characteristics, etc.

## Part numbers

LapSim Basic Version

for free

LapSim Expert

B 261 206 432

# Laptrigger Systems

## Laptrigger IR-02

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

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

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



| Mechanical data                       |                 |
|---------------------------------------|-----------------|
| IR-02-Receiver                        |                 |
| Size                                  | 42 x 20 x 10 mm |
| Weight                                | 39 g            |
| Dust and waterproof aluminium housing |                 |
| IR-02-Transmitter                     |                 |
| Size with diode                       | 90 x 40 x 28 mm |
| Weight                                | 124 g           |
| Dust and waterproof aluminium housing |                 |

| Conditions for use                                     |              |
|--------------------------------------------------------|--------------|
| Working range                                          | 15 m         |
| Ambient temperature                                    | -25 ... 70°C |
| Same height between receiver and transmitter           |              |
| Visibility connection between receiver and transmitter |              |
| Avoid direct exposure to sunlight                      |              |

| Electronic data   |                                           |
|-------------------|-------------------------------------------|
| IR-02-Receiver    |                                           |
| Frequency codes   | 16                                        |
| Supply voltage    | 8 ... 16 V                                |
| Output voltage    | 5 V                                       |
| IR-02-Transmitter |                                           |
| Frequency codes   | 16 plus 16 offset codes for section times |
| Supply voltage    | 8 ... 16 V                                |

| Part numbers        |                      |
|---------------------|----------------------|
| IR-02-Receiver      |                      |
| KPSE 6E8 3AP DN A34 | <b>B 261 206 884</b> |
| ASL-6-06-05PD-HE    | <b>B 261 206 887</b> |
| KPTA 6E6-4P-C-DN    | <b>B 261 206 888</b> |
| IR-02-Transmitter   |                      |
|                     | <b>B 261 206 890</b> |

## Laptrigger HF 24

This Laptrigger HF 24 system consists of a high frequency transmitter station and a receiver which is installed in the car.

The system allows an exact laptime measurement. Section time measurement for comparison of different car setups is also available if several transmitters are used. We offer optionally a tripod for mounting the transmitter anywhere along the race track.



| Mechanical data                       |                   |
|---------------------------------------|-------------------|
| <b>HF 24-Receiver</b>                 |                   |
| Size                                  | 125 x 37 x 28 mm  |
| Weight                                | 130 g             |
| Internal antenna with radome          |                   |
| Dust and waterproof aluminium housing |                   |
| <b>HF 24-Transmitter</b>              |                   |
| Size                                  | 290 x 118 x 93 mm |
| Weight                                | 1880 g            |
| Dust and waterproof                   |                   |
| <b>Tripod</b>                         |                   |
| Maximum height:                       | ~ 150 cm          |
| Minimum height:                       | ~ 65 cm           |
| Weight                                | 1370 g            |

| Conditions of use                   |              |
|-------------------------------------|--------------|
| Working range                       | up to 50 m   |
| Ambient temperature                 | -10 ... 85°C |
| Power consumption HF 24-Receiver    | 0,8 W        |
| Power consumption HF 24-Transmitter | 1 W          |

| Electronic data                                                       |                            |
|-----------------------------------------------------------------------|----------------------------|
| <b>System</b>                                                         |                            |
| RF wideband chirp transmission with a narrow beam transmitter antenna |                            |
| Working frequency band                                                | (2,40 ... 2,47) GHz        |
| User codes                                                            | 16                         |
| <b>HF 24-Receiver</b>                                                 |                            |
| Sensitivity                                                           | -92 dBm @ BER 10-3; 1 Mbps |
| Supply voltage                                                        | (6,5 ... 30) V             |
| Connectortype                                                         | ASL 606-05PD-HE            |
| Pin 1                                                                 | +12 V                      |
| Pin 2                                                                 | GND                        |
| Pin 3                                                                 | Trigger Out                |
| Mechanical drawing                                                    | Y 261 A25 087              |
| <b>HF 24-Transmitter</b>                                              |                            |
| Transmission power                                                    | 10 dBm                     |
| Supply voltage                                                        | (10 ... 30) V              |
| Selection main / sub trigger                                          |                            |
| Low battery detection                                                 |                            |
| Mechanical drawing                                                    | Y 261 A25 038              |

| Part numbers      |                      |
|-------------------|----------------------|
| HF 24-Receiver    | <b>B 261 206 894</b> |
| HF 24-Transmitter | <b>B 261 206 895</b> |
| Tripod            | <b>B 261 206 897</b> |

## Application hints

### HF 24-Transmitter

Before setting the main switch to ON, select the code and the working mode (main / sub trigger).

The transmitter reads the switches for code and main / sub trigger only once at power up.

After setting the main switch to ON the transmitter executes a 10 sec. self test and then the transmitter indicator begins to flash green, e.g. the transmitter is running.

The battery condition is permanently checked. If the battery level becomes critical, the "low bat indicator" becomes red. When the battery level drops below 10 V the transmitter stops working. The green transmitter indicator stops flashing.

The transmitter should be placed at the border of the lane in a height of about 1,5 ... 2,0 m.

### HF 24-Receiver

Before switching on the DC power the code has to be selected.

After switching ON the receiver executes a 10 sec. self test and then it is in the working mode.

When a trigger is detected the output pin goes low for a certain time:

-20 msec low @ main trigger

-40 msec low @ sub trigger

Standard output configuration: switching stage with 3.3 kOhm to +5 VDC  
(can be modified according to user demands)

The white antenna radome must be turned to the transmitter side and should not be mounted behind metallic covers or carbon fiber filled elements.

Green indicator flashes when detect a trigger condition.

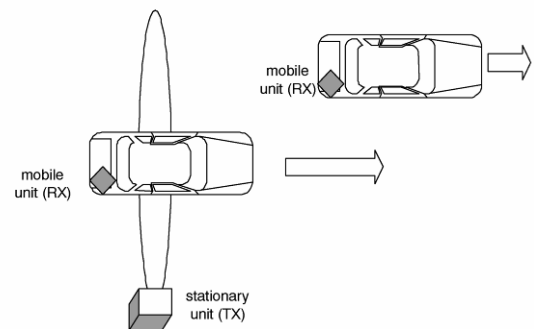
## Function description

The transmitter sends via the directional antenna coded signals across the race track.

The receiver at the race car checks permanently the team code and the signal parameters. If the trigger condition is detected the receiver generates the appropriate output signal (main/sub trigger).

The trigger point is located at broadside of the transmitter antenna.

After detecting the trigger point and releasing the trigger signal the receiver is passive for a period of two seconds avoiding a multiple trigger signal.



## **Diesel Systems Components**

## Diesel System Components



Injector CRI 2



HP fuel pump CP3



Rail



Pressure sensor RDS



Pressure control valve DRV

| Component                   | Specification                                                           |
|-----------------------------|-------------------------------------------------------------------------|
| Injector CRI 2              | 6 - 8 holes, 900 ... 1500 ccm/min at 100 bar                            |
| High pressure fuel pump CP3 | Pump with control valve and optional gear pump, 0,677 ... 1,087 ccm/rev |
| Pressure control valve DRV  | Pressure range: 100 ... 2000 bar                                        |
| Pressure sensor RDS         | Pressure range: 0 ... 2000 bar                                          |
| Rail                        | Common rail for up to 6 cylinders                                       |

Further special versions and part numbers on request.

## Sensors

# Pressure Sensors Air

## Absolute Pressure Sensor PS-10

Pressure range: 10 x 0,2 ... 1,15 bar nominal

The pressure box is designed for measuring air pressure and specially modified for motorsport use. With its 10 analogous outputs it can take 10 measurements simultaneously.



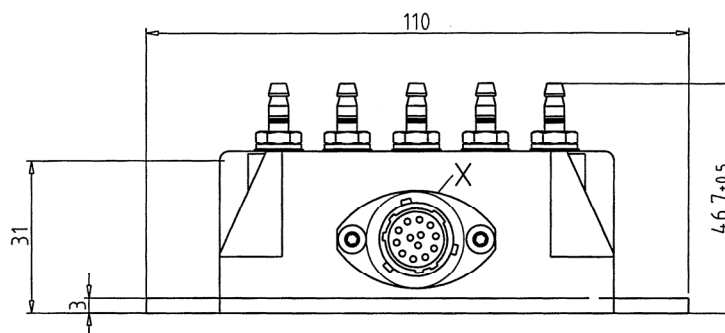
| Mechanical data        |                               |
|------------------------|-------------------------------|
| Measurement transducer | piezoresistive                |
| Pressure range         | 10 x 0,2 ... 1,15 bar nominal |
| Max. pressure          | 10 bar nominal                |
| Weight                 | 185 g                         |
| Dimensions             | 110 x 87 x 47 mm              |
| Sensor connector       | 3 mm                          |

| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | -40 ... 125°C       |
| Max. vibration     | 15 g /30 ... 200 Hz |

| Characteristic                                            |             |
|-----------------------------------------------------------|-------------|
| Sensitivity                                               | 4470 mV/bar |
| Offset                                                    | -490 mV     |
| Sensitivity and offset will be delivered with each sensor |             |

| Electronic data          |                |
|--------------------------|----------------|
| Power supply             | 12 V           |
| Compensated range        | 20 ... 85°C    |
| Non linearity            | 1,00 %         |
| Therm. zero point drift  | < 1,00 %       |
| Therm. sensitivity drift | < 1,00 %       |
| Long time drift          | < 1,00 %       |
| Full scale output        | 0,4 ... 4,65 V |
| Time of reaction         | 1 ms (90 %)    |

| Part number   |                      |
|---------------|----------------------|
| AS 0-10-35PN  | <b>B 261 206 865</b> |
| Offer drawing | <b>A 261 206 865</b> |





# Absolute Pressure Sensor PSA-C

Pressure range: 0,2 ... 1,05 / 2,5 bar nominal

A piezoresistive pressure sensor for ambient air pressure measurement.



| Mechanical data        |                |
|------------------------|----------------|
| Measurement transducer | piezoresistive |
| Max. pressure          | 5 bar          |
| Thread                 | M6             |
| Weight                 | 40 g           |

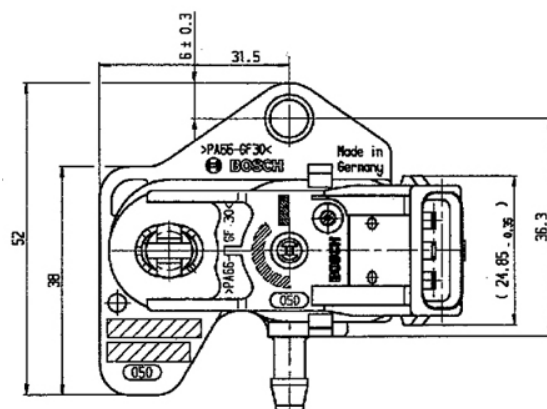
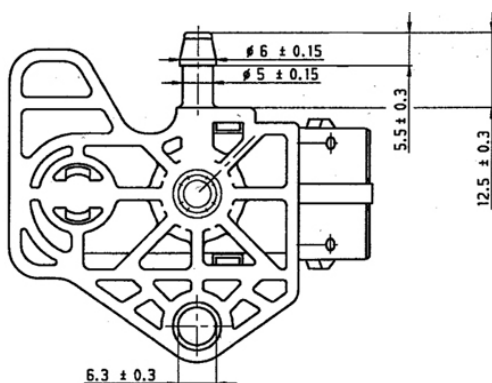
| Conditions for use     |                      |
|------------------------|----------------------|
| Temperature range      | -40 ... 125°C        |
| Max. temp. of location | 130°C                |
| Max. vibration         | 15 g / 30 ... 200 Hz |

| Characteristic           |             |
|--------------------------|-------------|
| <b>0,2 ... 1,05 bar:</b> |             |
| Sensitivity              | 5000 mV/bar |
| Offset                   | -600 mV     |
| <b>0,2 ... 2,5 bar:</b>  |             |
| Sensitivity              | 1532 mV/bar |
| Offset                   | 724 mV      |

| Electronic data   |                 |
|-------------------|-----------------|
| Power supply      | 4,75 ... 5,25 V |
| Full scale output | 0,4 ... 4,65 V  |
| Time of reaction  | 10 ms (90%)     |
| Max. current      | < 12,5 mA       |
| Resistance        | > 50 kΩ         |

| Connector               |               |
|-------------------------|---------------|
| Cable harness connector | D 261 205 289 |

| Part numbers             |                      |
|--------------------------|----------------------|
| <b>0,2 ... 1,05 bar:</b> | <b>0 261 230 037</b> |
| <b>0,2 ... 2,5 bar:</b>  | <b>0 281 002 389</b> |
| Offer drawing            | <b>A 261 260 143</b> |



# Absolute Pressure Sensor PSB-2

Pressure range: 0,1 ... 2 bar nominal

An absolute pressure sensor modified for precision air pressure measurement, especially boost pressure. It is manufactured in a DR-25 sleeve, various connector options are available.



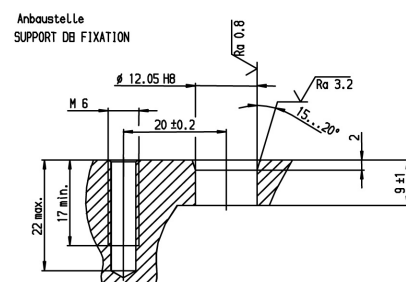
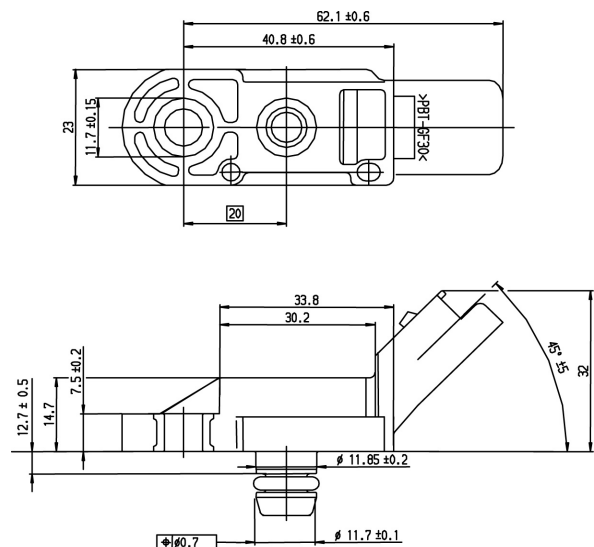
| Mechanical data |                    |
|-----------------|--------------------|
| Max. pressure   | 3 bar              |
| Fitting         | 11,85 mm           |
| Weight          | 45 g               |
| Sealing         | O-ring 7,59 x 2,62 |

| Conditions for use     |                       |
|------------------------|-----------------------|
| Temperature range      | -40 ... 125°C         |
| Max. temp. of location | 130°C                 |
| Max. vibration         | 250 g /200 ... 500 Hz |

| Characteristic                                             |  |
|------------------------------------------------------------|--|
| Sensitivity and offset will be delivered with each sensor. |  |

| Electronic data          |                |
|--------------------------|----------------|
| Power supply             | 5 V            |
| Compensated range        | 40 ... 130°C   |
| Non linearity            | 0,25 %         |
| Therm. zero point drift  | < 0,5 %        |
| Therm. sensitivity drift | < 0,5 %        |
| Long time drift          | < 0,5 %        |
| Full scale output        | 0,4 ... 4,65 V |
| Max. current             | 12 mA          |

| Part number       |                      |
|-------------------|----------------------|
| ASL 6-06-05PC-HE  | <b>B 261 209 337</b> |
| Offer drawing     | <b>A 261 209 337</b> |
| ASU 6-03-05-PC-HE | <b>B 261 209 959</b> |
| Offer drawing     | <b>A 261 209 959</b> |



# Absolute Pressure Sensor PSB-4

Pressure range: 0,5 ... 4 bar nominal

An absolute pressure sensor modified for precision air pressure measurement, especially boost pressure. It is manufactured in a DR-25 sleeve, various connector options are available.



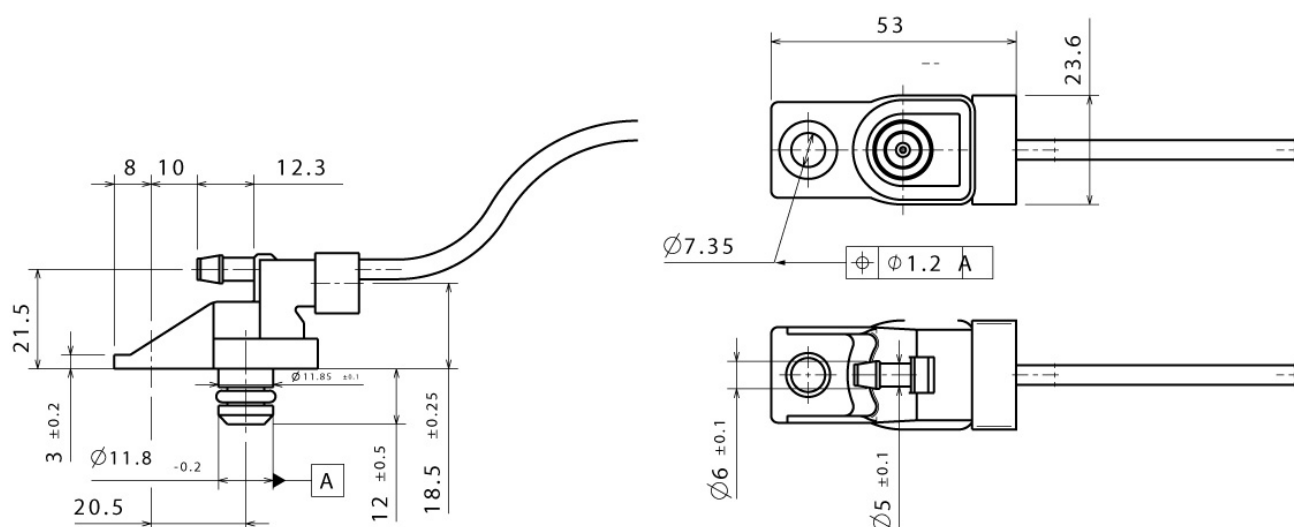
| Mechanical data |                    |
|-----------------|--------------------|
| Max. pressure   | 4,5 bar            |
| Fitting         | 11,85 mm           |
| Weight          | 45 g               |
| Sealing         | O-ring 7,59 x 2,62 |

| Conditions for use     |                     |
|------------------------|---------------------|
| Temperature range      | -40 ... 80°C        |
| Max. temp. of location | 80°C                |
| Max. vibration         | 2 g /10 ... 1000 Hz |

| Characteristic                                             |  |
|------------------------------------------------------------|--|
| Sensitivity and offset will be delivered with each sensor. |  |

| Electronic data         |               |
|-------------------------|---------------|
| Power supply            | 5 V           |
| Compensated range       | 0 ... 80°C    |
| Accuracy of measurement | +/- 4 mbar    |
| Full scale output       | 0,5 ... 4,5 V |
| Max. current            | 12 mA         |

| Part number      |                      |
|------------------|----------------------|
| ASL 6-06-05PC-HE | <b>B 261 209 348</b> |
| Offer drawing    | <b>A 261 209 348</b> |
| ASU 6-03-05PN-HE | <b>B 261 209 954</b> |
| Offer drawing    | <b>A 261 209 954</b> |



# Absolute Pressure Sensor PSP

Pressure range: 0,2 ... 3 bar nominal

An absolute pressure sensor modified for precision air pressure measurement.



## Mechanical data

|               |           |
|---------------|-----------|
| Max. pressure | 5 bar     |
| Fitting       | Ø 11,8 mm |
| Weight        | 17 g      |
| Sealing       | O-ring    |

## Conditions for use

|                        |                       |
|------------------------|-----------------------|
| Temperature range      | -40 ... 125 °C        |
| Max. vibration         | 25,5 g/100 ... 500 Hz |
| Max. temp. of location | 130 °C                |

## Characteristic

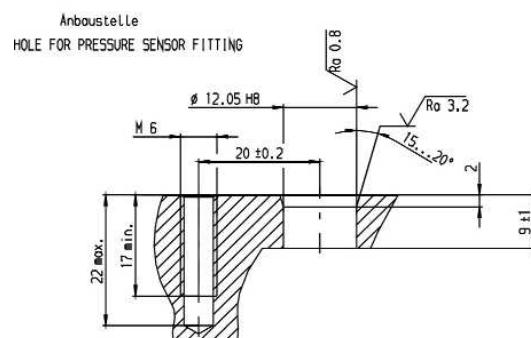
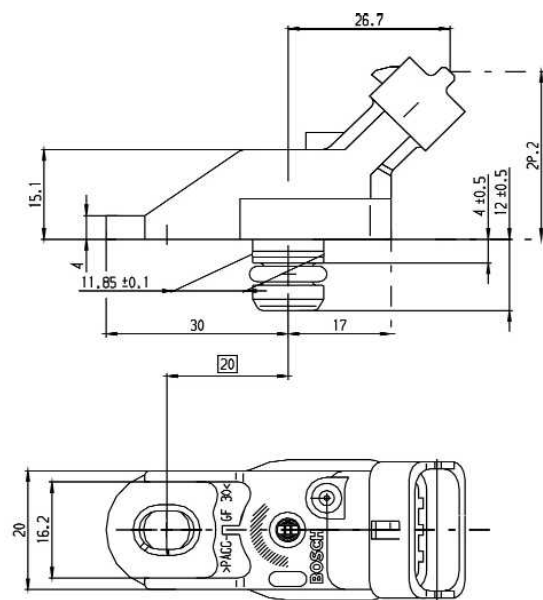
|             |             |
|-------------|-------------|
| Sensitivity | 1517 mV/bar |
| Offset      | 96 mV       |

## Electronic data

|                          |                 |
|--------------------------|-----------------|
| Power supply             | 5 V             |
| Compensated range        | -40 ... 125°C   |
| Non linearity            | 0,25 %          |
| Therm. zero point drift  | < 0,5 %         |
| Therm. sensitivity drift | < 0,5 %         |
| Long time drift          | < 0,5 %         |
| Full scale output        | 0,35 ... 4,85 V |
| Max. current             | 12 mA           |

## Part number

|                  |                      |
|------------------|----------------------|
| ASL 6-06-05PC-HE | <b>B 261 209 690</b> |
| Offer drawing    | <b>A 261 260 139</b> |



# Absolute Pressure Sensor PST

## Pressure range: 0,1 ... 1,15 bar nominal

An absolute pressure sensor with integrated temperature sensor for ambient air and various fluid pressure measurements.



| Mechanical data |                    |
|-----------------|--------------------|
| Max. pressure   | 5 bar              |
| Characteristic  | 20°C/2,5 kΩ        |
| Fitting         | Ø 17,6 mm          |
| Weight          | 35 g               |
| Sealing         | O-ring 7,65 x 1,63 |

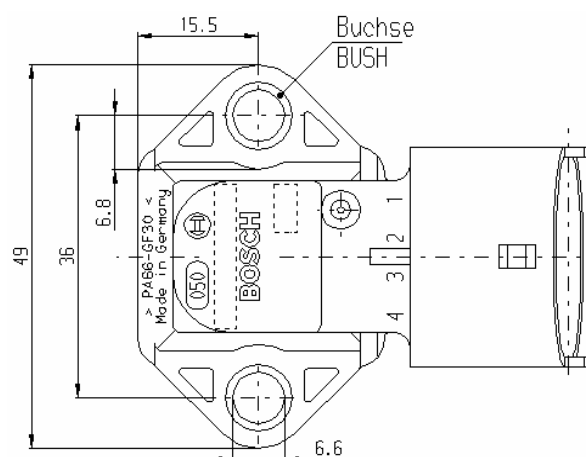
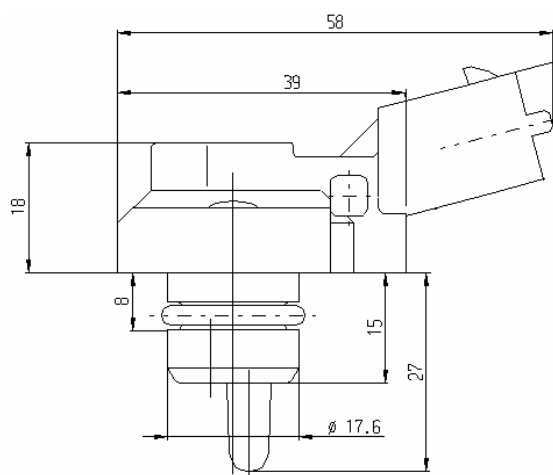
| Conditions for use     |                       |
|------------------------|-----------------------|
| Temperature range      | -40 ... 125°C         |
| Vibration              | 25,5 g/200 ... 500 Hz |
| Max. temp. of location | 130°C                 |

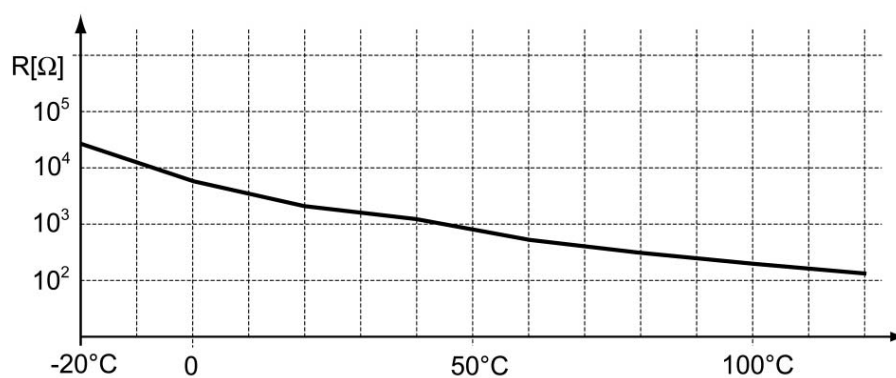
| Characteristic |             |
|----------------|-------------|
| Sensitivity    | 4047 mV/bar |
| Offset         | -4,3 mV     |

| Electronic data          |                |
|--------------------------|----------------|
| Power supply             | 5 V            |
| Compensated range        | 10 ... 85°C    |
| Non linearity            | 0,25 %         |
| Therm. zero point drift  | < 0,5 %        |
| Therm. sensitivity drift | < 0,5 %        |
| Long time drift          | < 0,5 %        |
| Full scale output        | 0,4 ... 4,65 V |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 336</b> |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 261 230 022</b> |
| Offer drawing | <b>A 261 260 253</b> |
| ASL 6-06-05PE | <b>B 261 209 717</b> |
| Offer drawing | <b>A 261 209 717</b> |





| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| -40                | 45 313      |
| -35                | 34 281      |
| -30                | 26 114      |
| -25                | 20 003      |
| -20                | 15 462      |
| -15                | 12 002      |
| -10                | 9 397       |
| -5                 | 7 415       |
| 0                  | 5 896       |
| 5                  | 4 712       |
| 10                 | 3 792       |
| 15                 | 3 069       |
| 20                 | 2 500       |
| 25                 | 2 057       |
| 30                 | 1 707       |
| 35                 | 1 412       |
| 40                 | 1 175       |
| 45                 | 987,6       |
| 50                 | 833,9       |
| 55                 | 702,8       |
| 60                 | 595,5       |

| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| 65                 | 508,3       |
| 70                 | 435,7       |
| 75                 | 374,2       |
| 80                 | 322,5       |
| 85                 | 279,6       |
| 90                 | 243,2       |
| 95                 | 212,7       |
| 100                | 186,6       |
| 105                | 163,8       |
| 110                | 144,2       |
| 115                | 127,3       |
| 120                | 112,7       |
| 125                | 100,2       |
| 130                | 89,30       |
| 135                | 79,65       |
| 140                | 71,20       |
| 145                | 63,86       |
| 150                | 57,41       |
| 155                | 51,82       |
| 160                | 46,88       |

# Pressure Sensor Fluid

## Absolute Pressure Sensor PSC-10

Pressure range: 0 ... 10 bar nominal

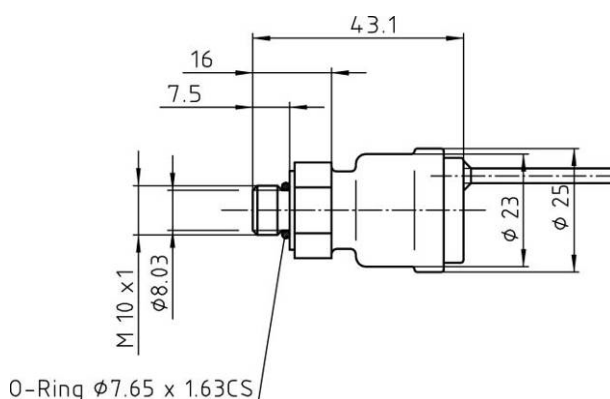
A M10 x 1 sensor for various fluid pressure measurement. The sensor range covers pressure measurement up to 10 bar. It is manufactured in a DR-25 sleeve, various connector options are available. Gauge and absolute pressure sensors are available.



| Mechanical data        |                    |
|------------------------|--------------------|
| Measurement transducer | piezoresistive     |
| Max. pressure          | 20 bar             |
| Thread                 | M10 x 1            |
| Tightening torque      | 10 Nm              |
| Wrench size            | 17 mm              |
| Weight                 | 70 g               |
| Sealing                | O-ring 7,65 x 1,63 |

| Conditions for use |                    |
|--------------------|--------------------|
| Temperature range  | -40 ... 125°C      |
| Max. vibration     | 15 g/30 ... 200 Hz |

| Characteristic |            |
|----------------|------------|
| Sensitivity    | 400 mV/bar |
| Offset         | 100 mV     |



| Electronic data          |                      |
|--------------------------|----------------------|
| Power supply             | 5 ... 6 V/8 ... 16 V |
| Compensated range        | 25 ... 85 °C         |
| Current supply           | 8 ... 16 mA          |
| Non linearity            | 1 %                  |
| Therm. zero point drift  | < 1 %                |
| Therm. sensitivity drift | < 1 %                |
| Long time drift          | < 1 %                |
| Full scale output        | 0,5 ... 4,5 V        |
| Time of reaction         | 1 ms (90 %)          |

| Part numbers             |                      |
|--------------------------|----------------------|
| <b>5 ... 6 V supply</b>  |                      |
| KPTA 6E6-4P-C-DN         | <b>B 261 209 342</b> |
| Offer drawing            | A 261 209 342        |
| <b>8 ... 16 V supply</b> |                      |
| KPTC 6E8-4P-C-DN         | <b>B 261 209 063</b> |
| Offer drawing            | A 261 209 063        |
| AS 6-06-05PN             | <b>B 261 209 068</b> |
| Offer drawing            | A 261 209 068        |
| KPTA 6E6-4P-C-DN         | <b>B 261 209 069</b> |
| Offer drawing            | A 261 209 069        |
| AS 6-08-98PN             | <b>B 261 209 077</b> |
| Offer drawing            | A 261 209 077        |
| ASL 6-06-05PC-HE         | <b>B 261 209 079</b> |
| Offer drawing            | A 261 209 079        |
| ASU 6-03-05-PD-HE        | <b>B 261 209 958</b> |
| Offer drawing            | A 261 209 958        |

# Absolute Pressure Sensor PSC-250

Pressure range: 0 ... 250 bar nominal

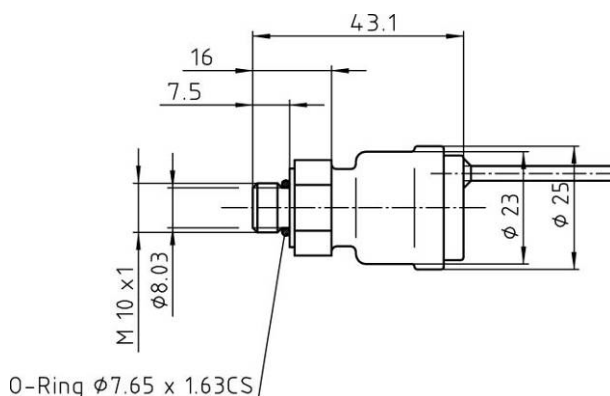
A M10 x 1 sensor for various fluid pressure measurement. The sensor range covers pressure measurement from 0 to 250 bar. It is manufactured in a DR-25 sleeve, various connector options are available. Gauge and absolute pressure sensors are available.



| Mechanical data        |                    |
|------------------------|--------------------|
| Measurement transducer | piezoresistive     |
| Max. pressure          | 500 bar            |
| Thread                 | M10 x 1            |
| Tightening torque      | 10 Nm              |
| Wrench size            | 17 mm              |
| Weight                 | 70 g               |
| Sealing                | O-ring 7,65 x 1,63 |

| Conditions for use |                    |
|--------------------|--------------------|
| Temperature range  | -40 ... 125°       |
| Max. vibration     | 15 g/30 ... 200 Hz |

| Characteristic |           |
|----------------|-----------|
| Sensitivity    | 16 mV/bar |
| Offset         | 500 mV    |



| Electronic data          |               |
|--------------------------|---------------|
| Power supply             | 8 ... 16 V    |
| Compensated range        | 25 ... 85°C   |
| Current supply           | 8 ... 16 mA   |
| Non linearity            | 1 %           |
| Therm. zero point drift  | < 1 %         |
| Therm. sensitivity drift | < 1 %         |
| Long time drift          | < 1 %         |
| Full scale output        | 0,5 ... 4,5 V |
| Time of reaction         | 1 ms (90 %)   |

| Part numbers     |                      |
|------------------|----------------------|
| KPTC 6E8-4P-C-DN | <b>B 261 209 066</b> |
| Offer drawing    | A 261 209 066        |
| KPTA 6E6-4P-C-DN | <b>B 261 209 076</b> |
| Offer drawing    | A 261 209 076        |
| AS 6-08-98PN     | <b>B 261 209 078</b> |
| Offer drawing    | A 261 209 078        |

# Absolute Pressure Sensor PSM

Pressure range: 0 ... 2 / 12 / 250 bar nominal

A miniature M10 x 1 absolute pressure sensor for universal precision pressure measurement. It is manufactured in a DR-25 sleeve, various connector options are available. Detailed calibration sheet included.



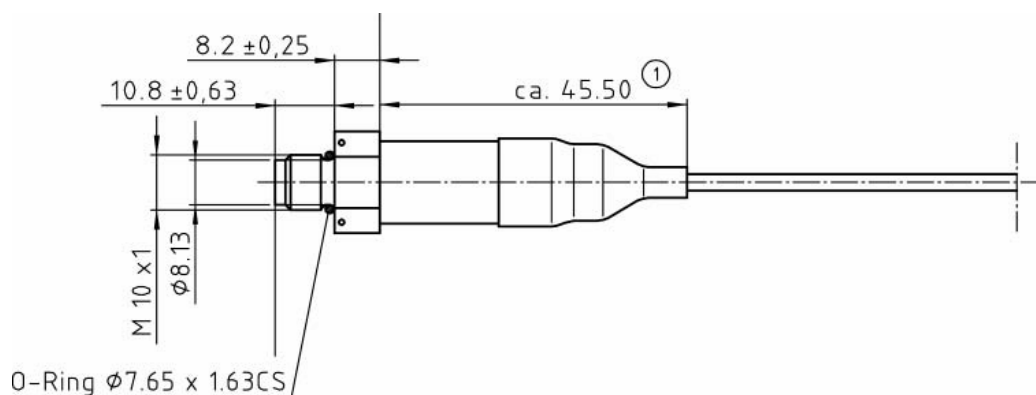
| Mechanical data   |                    |
|-------------------|--------------------|
| Max. pressure     | 2 x nominal        |
| Thread            | M10 x 1            |
| Tightening torque | 10 Nm              |
| Wrench size       | 16 mm              |
| Weight            | 55 g               |
| Sealing           | O-ring 7,65 x 1,63 |

| Conditions for use |                       |
|--------------------|-----------------------|
| Temperature range  | -20 ... 125°C         |
| Vibration          | 80 g/5 Hz ... 2,5 kHz |

| Characteristic                                             |  |
|------------------------------------------------------------|--|
| Sensitivity and offset will be delivered with each sensor. |  |

| Electronic data          |             |
|--------------------------|-------------|
| Power supply             | 8 ... 16 V  |
| Compensated range        | 20 ... 80°C |
| Non linearity            | 0,25 %      |
| Therm. zero point drift  | < 0,5 %     |
| Therm. sensitivity drift | < 0,5 %     |
| Long time drift          | < 0,5 %     |
| Full scale output        | 0 ... 5 V   |

| Part numbers    |                      |
|-----------------|----------------------|
| AS 6-06-05PC-HE |                      |
| 2 bar           | <b>B 261 209 335</b> |
| Offer drawing   | A 261 209 330        |
| 12 bar          | <b>B 261 209 331</b> |
| Offer drawing   | A 261 209 331        |
| 250 bar         | <b>B 261 209 332</b> |
| Offer drawing   | A 261 209 332        |



# Absolute Pressure Sensor PSS

Pressure range: 0 ... 10 / 100 / 250 bar nominal

A M10 x 1 pressure sensor for measuring various fluid pressure. Gauge and absolute pressure sensors are available.



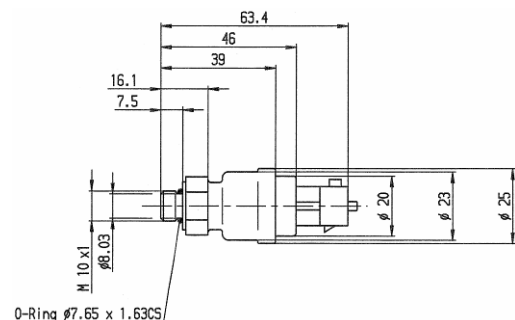
| Mechanical data        |                    |
|------------------------|--------------------|
| Measurement transducer | piezoresistive     |
| Max. pressure          | 2 x nominal        |
| Thread                 | M10 x 1            |
| Tightening torque      | 10 Nm              |
| Wrench size            | 17 mm              |
| Weight                 | 65 g               |
| Sealing                | O-ring 7,65 x 1,63 |

| Conditions for use |                    |
|--------------------|--------------------|
| Temperature range  | -40 ... 125°C      |
| Vibration          | 15 g/30 ... 200 Hz |

| Characteristic     |           |
|--------------------|-----------|
| <b>Sensitivity</b> |           |
| 10 bar             | 400mV/bar |
| 100 bar            | 40 mV/bar |
| 250bar             | 16 mV/bar |
| <b>Offset</b>      |           |
| 10 bar             | 100 mV    |
| 100 bar            | 500 mV    |
| 250 bar            | 500 mV    |

| Electronic data          |                       |
|--------------------------|-----------------------|
| Power supply             | 5 ... 6 V/ 8 ... 16 V |
| Compensated range        | 20 ... 85°C           |
| Current supply           | 8 ... 16 mA           |
| Non linearity            | 1 %                   |
| Therm. zero point drift  | < 1 %                 |
| Therm. sensitivity drift | < 1 %                 |
| Long time drift          | < 1 %                 |
| Full scale output        | 0,5 ... 4,5 V         |
| Time of reaction         | 1 ms (90%)            |

| Part numbers               |                      |
|----------------------------|----------------------|
| 5 ... 6 V supply, 10 bar   | <b>B 261 209 341</b> |
| Offer drawing              | A 261 209 341        |
| 8 ... 16 V supply, 10 bar  | <b>B 261 209 064</b> |
| Offer drawing              | A 261 209 064        |
| 5 ... 6 V supply, 100 bar  | <b>B 261 209 347</b> |
| Offer drawing              | A 261 209 347        |
| 8 ... 16 V supply, 250 bar | <b>B 261 209 067</b> |
| Offer drawing              | A 261 209 067        |



# Pressure Sensors Differential

## Differential Pressure Sensor DP-A

Pressure range: 0 ... 100 mbar differential

This miniature differential pressure sensor is used for precision air pressure measurement. It is typically combined with a pitot tube.



| Mechanical data   |                 |
|-------------------|-----------------|
| Dimensions        | 37 x 28 x 19 mm |
| Fixing            | 2 x M3          |
| Tightening torque | 2 Nm            |
| Weight            | 28 g            |

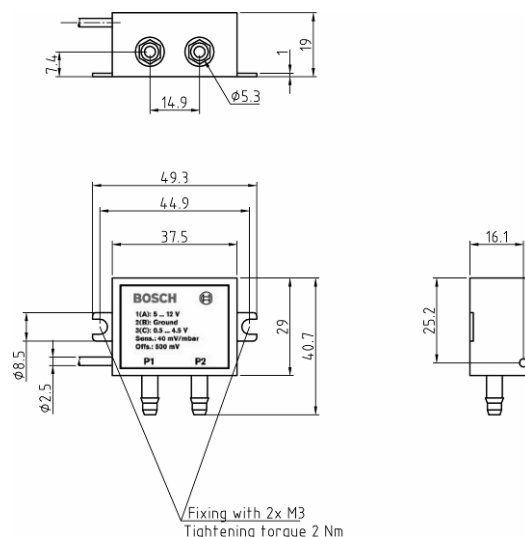
| Conditions for use |              |
|--------------------|--------------|
| Temperature range  | -20 ... 70°C |

| Characteristic |            |
|----------------|------------|
| Sensitivity    | 40 mV/mbar |
| Offset         | 500 mV     |

| Electronic data          |               |
|--------------------------|---------------|
| Power supply             | 4,8 ... 15 V  |
| Output current           | 10 mA         |
| Compensated range        | 0 ... 50°C    |
| Non linearity            | 0,5 %/FSO     |
| Therm. zero point drift  | 0,05 %/FSO/°C |
| Therm. sensitivity drift | 0,05 %/FSO/°C |
| Long time drift          | ± 0,20 %/FSO  |
| Full scale output        | 0,5 ... 4,5 V |

| Accessories |                      |
|-------------|----------------------|
| Pitot tube  | <b>B 261 209 700</b> |

| Part numbers    |                      |
|-----------------|----------------------|
| AS 0-06-05PC-HE | <b>B 261 209 696</b> |
| Offer drawing   | A 261 209 696        |



# Differential Pressure Sensor DP-B

Pressure range: 0 ... 100 mbar differential

This miniature differential pressure sensor is used for precision air pressure measurement. It is typically combined with a pitot tube.



| Mechanical data   |                 |
|-------------------|-----------------|
| Dimensions        | 38 x 28 x 19 mm |
| Fixing            | 2 x M3          |
| Tightening torque | 2 Nm            |
| Weight            | 28 g            |

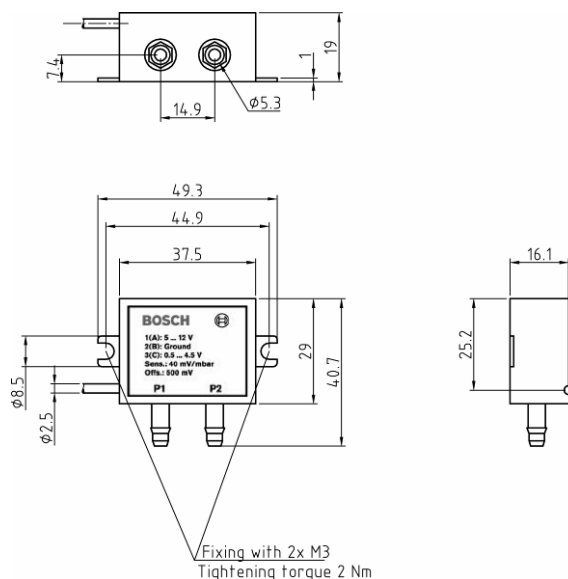
| Conditions for use |              |
|--------------------|--------------|
| Temperature range  | -20 ... 70°C |

| Characteristic |            |
|----------------|------------|
| Sensitivity    | 40 mV/mbar |
| Offset         | 500 mV     |

| Electronic data          |               |
|--------------------------|---------------|
| Power supply             | 4,8 ... 15 V  |
| Output current           | 10 mA         |
| Compensated range        | 0 ... 50°C    |
| Non linearity            | 0,5 %/FSO     |
| Therm. zero point drift  | 0,05 %/FSO/°C |
| Therm. sensitivity drift | 0,05 %/FSO/°C |
| Long time drift          | ± 0,20 %/FSO  |
| Full scale output        | 0,5 ... 4,5 V |

| Accessories |                      |
|-------------|----------------------|
| Pitot tube  | <b>B 261 209 700</b> |

| Part number     |                      |
|-----------------|----------------------|
| AS 0-06-05PC-HE | <b>B 261 209 697</b> |
| Offer drawing   | A 261 209 697        |



# Differential Pressure Sensor DP-C

Pressure range: 0 ... 100 mbar differential

This low cost miniature differential pressure sensor is used for precision air pressure measurement. It is typically combined with a pitot tube.



| Mechanical data   |                       |
|-------------------|-----------------------|
| Dimensions        | 35 x 25 x 11 mm       |
| Pressure ranges   | 100 mbar differential |
| Fixing            | 2 x M2,5              |
| Tightening torque | 10 Ncm                |
| Weight            | 28 g                  |

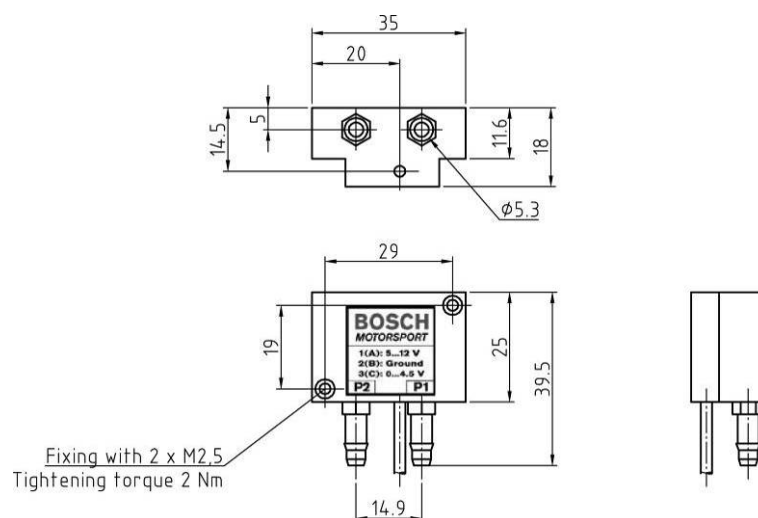
| Conditions for use |              |
|--------------------|--------------|
| Temperature range  | -20 ... 70°C |

| Characteristic |            |
|----------------|------------|
| Sensitivity    | 35 mV/mbar |
| Offset         | 500 mV     |

| Electronic data          |               |
|--------------------------|---------------|
| Power supply             | 4,8 ... 15 V  |
| Output current           | 10 mA         |
| Compensated range        | 0 ... 50°C    |
| Non linearity            | 0,5 %/FSO     |
| Therm. Zero point drift  | 0,05 %/FSO/°C |
| Therm. sensitivity drift | 0,05 %/FSO/°C |
| Long time drift          | ± 0,20 %/FSO  |
| Full scale output        | 0,5 ... 4 V   |

| Accessories |                      |
|-------------|----------------------|
| Pitot tube  | <b>B 261 209 700</b> |

| Part number      |                      |
|------------------|----------------------|
| ASL 0-06-05PC-HE | <b>B 261 209 701</b> |
| Offer drawing    | A 261 209 701        |



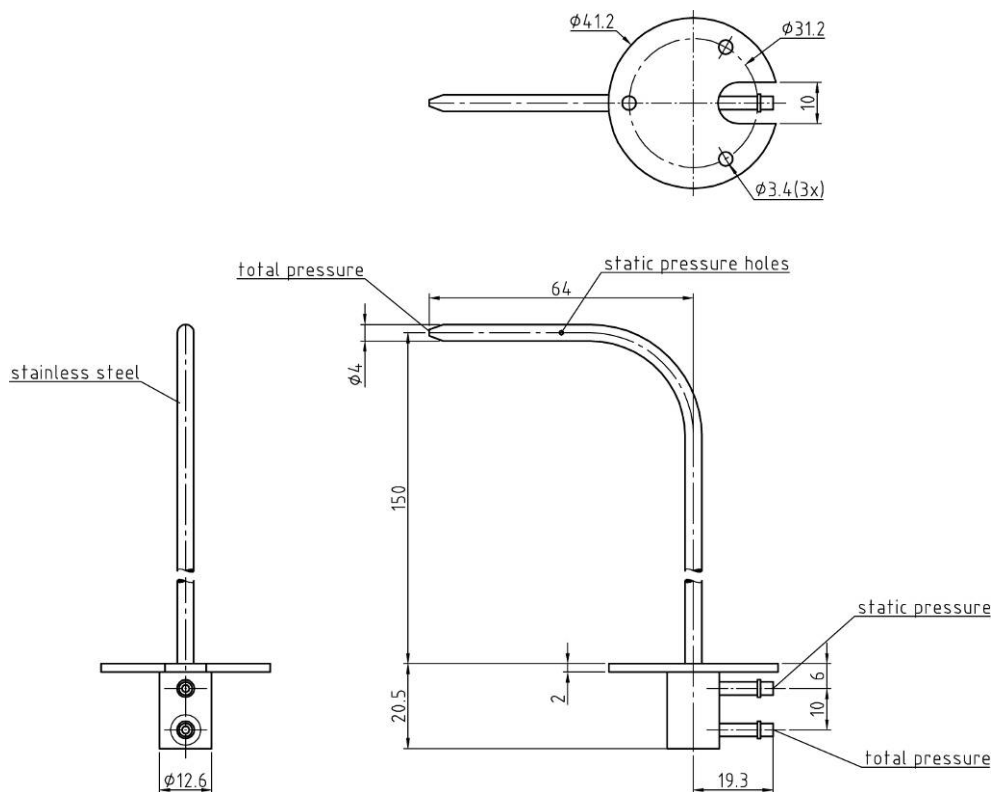
## Pitot Static Tube PT

The pitot static tube consists basically of two concentric tubes, with the end turned through a right angle so that the tip can be faced into the air stream after insertion through the duct wall. The modified ellipsoidal nose form has a single forward facing hole for sensing total pressure and a ring of side holes for sensing the static pressure. Both these inlets are individually connected to tapping outlets at the tail of the unit. A direction pointer is provided so that the pitot tube can be accurately aligned within the duct.



| Mechanical data |        |
|-----------------|--------|
| Weight          | 50 g   |
| Height          | 150 mm |
| Tube diameter   | 4 mm   |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 261 209 700</b> |
| Offer drawing | A 261 209 700        |



$$\text{total pressure} = \text{static pressure} + \text{velocity pressure}$$

## Air Velocity Calculations using S.I. Scales

The Standard formula for calculating velocity from velocity pressure is:

$$V = 1.291 \sqrt{P_v}$$

This is only correct for an air density of 1.2 kg/m<sup>3</sup>. For non-standard air conditions, this equation becomes:

$$V = 1.291 \sqrt{\frac{1013.25}{B} * \frac{T}{293} * \frac{100000}{100000 + P_s} * P_v}$$

$V$  = velocity m/s

$B$  = barometric pressure mbar

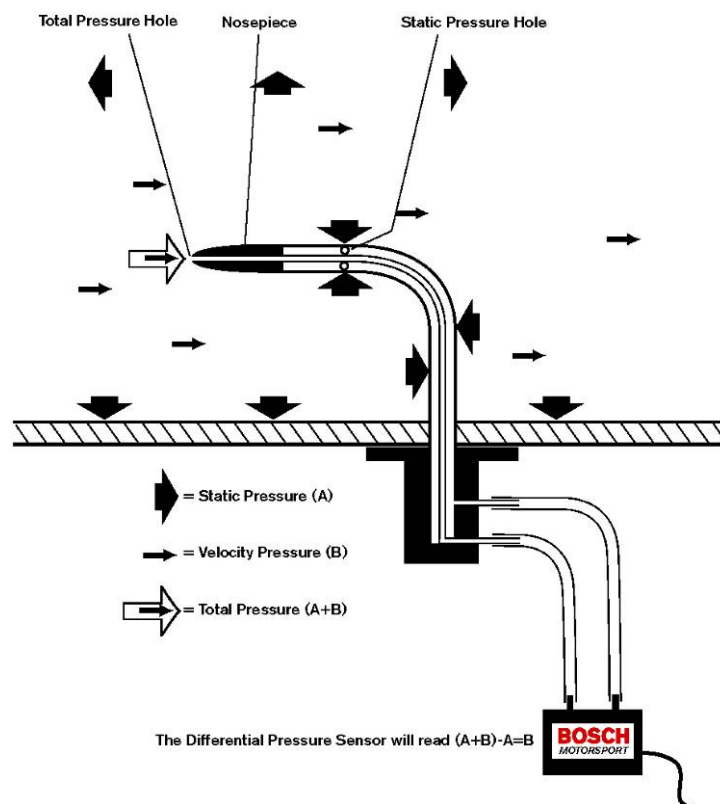
$T$  = absolute temperature K (=  $t^{\circ}\text{C} + 273$  where  $t$  is airstream temperature)

$P_s$  = static pressure Pa

$P_v$  = velocity pressure Pa

The expression  $\frac{100000}{100000 + P_s}$  is a correction for the static pressure in the duct and may normally be ignored if  $P_s$  is less than 2500 Pa

## Principle of Operation



# Temperature Sensors

## Temperature Sensors TI-16 / TI-100

These infrared temperature sensors can be used to measure the surface temperature of various applications, such as tires, brake discs, and cylinder heads.

The main features of these sensors are their compact size, robust design, and high signal quality at a low cost. In addition, they offer the ability to change the temperature range and emissivity by request.



### Mechanical data

|                        |                |
|------------------------|----------------|
| Dimensions             | M12 x 1, SW 14 |
| Weight incl. cable 1 m | 42 g           |
| Optical resolution     | 10:1           |

### Electronic data

|                    |            |
|--------------------|------------|
| Power supply $U_s$ | 5 ... 28 V |
| Full scale output  | 0 ... 5 V  |
| Current $I_s$      | 9 mA       |

### Application

|                   |              |
|-------------------|--------------|
| TI-16 r (rubber)  | 0 ... 160°C  |
| TI 16 s (steel)   | 0 ... 160°C  |
| TI-100 s (steel)  | 0 ... 1000°C |
| TI-100 c (carbon) | 0 ... 1000°C |

### Emissivity (pre defined)

|                   |      |
|-------------------|------|
| TI-16 r (rubber)  | 0,95 |
| TI-16 s (steel)   | 0,8  |
| TI-100 s (steel)  | 0,8  |
| TI-100 c (carbon) | 0,75 |

### Conditions for use

|                             |                |
|-----------------------------|----------------|
| Operating temperature range | -20 ... 120 °C |
|-----------------------------|----------------|

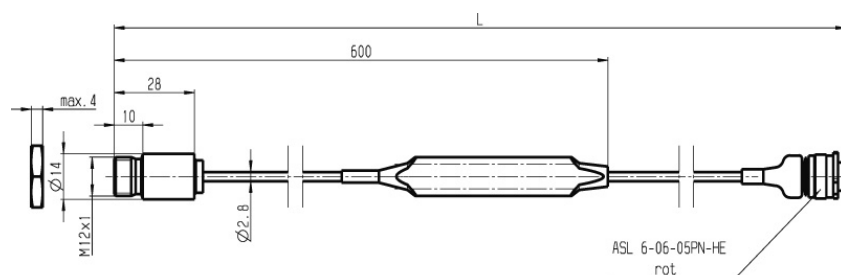
### Connector

|                         |                   |
|-------------------------|-------------------|
| Cable harness connector | ASL 6-06-05-PN-HE |
|-------------------------|-------------------|

### Part numbers

|                   |                      |
|-------------------|----------------------|
| TI-16 r (rubber)  | <b>F 01T A21 207</b> |
| TI-16 s (steel)   | <b>F 01T A21 209</b> |
| TI-100 s (steel)  | <b>F 01T A21 210</b> |
| TI-100 c (carbon) | <b>F 01T A21 211</b> |

### Dimensions



## Temperature Sensor NTC M6

Temperature range: 0 ... 200°C

A miniature M6 x 1 NTC sensor for fast response temperature measurement. It is manufactured in a DR-25 sleeve, various connector options are available.



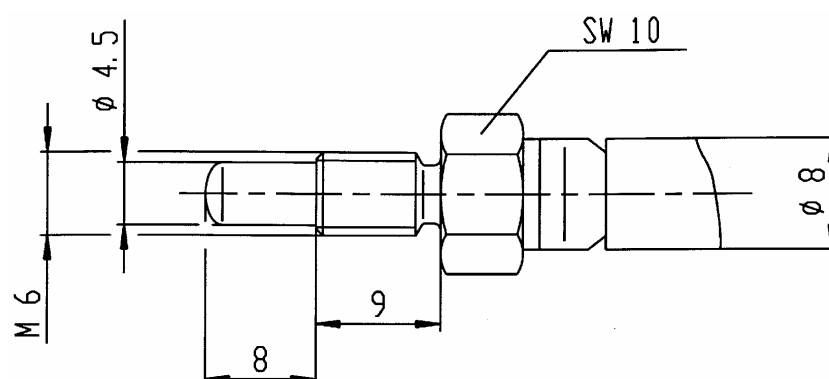
| Mechanical data   |                    |
|-------------------|--------------------|
| Thread            | M6 x 1             |
| Tightening torque | 3 Nm               |
| Wrench size       | 10 mm              |
| Sealing           | Viton 4,47 x 1, 78 |
| Weight            | 45 g               |

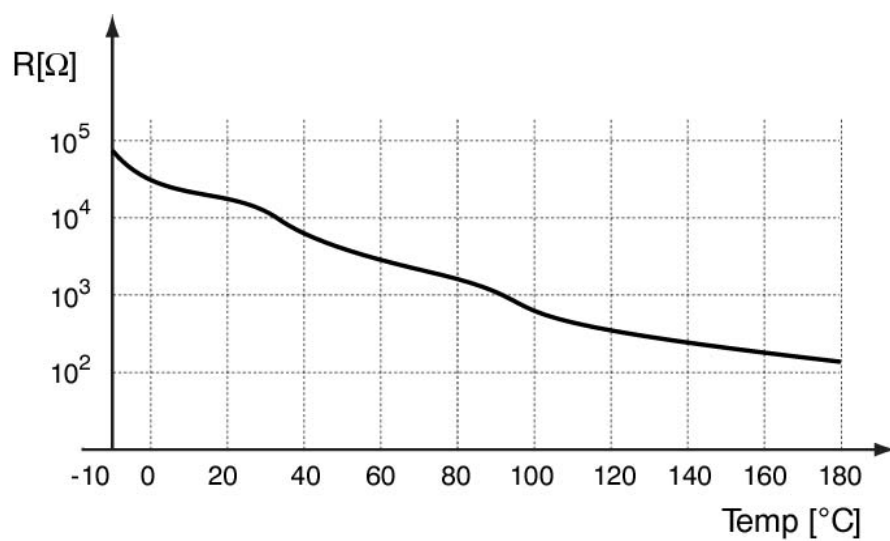
| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -30 ... 200°C     |
| Vibration          | 80 g/5 ... 500 Hz |

| Characteristic |  |
|----------------|--|
| NTC 15 kΩ      |  |

| Electronic data    |             |
|--------------------|-------------|
| Nominal resistance | 15 kΩ/25°C  |
| Measuring range    | 0 ... 200°C |
| Accuracy           | ± 1,0 K     |
| Response time 90 % | < 7 s       |

| Part numbers     |                      |
|------------------|----------------------|
| KPTA 6E6-4P-C-DN | <b>B 261 209 172</b> |
| Offer drawing    | A 261 209 172        |
| ASL 6-06-05PN-HE | <b>B 261 209 386</b> |
| Offer drawing    | A 261 209 386        |
| ASU 6-03-03PN-HE | <b>B 261 209 982</b> |
| Offer drawing    | A 261 209 982        |





| °C  | R(Ω)    |
|-----|---------|
| -10 | 83317,5 |
| 0   | 49254,0 |
| 10  | 29959,5 |
| 20  | 18732,0 |
| 30  | 12012,0 |
| 40  | 7893,0  |
| 50  | 5356,5  |
| 60  | 3651,0  |
| 70  | 2544,0  |
| 80  | 1804,5  |

| °C  | R(Ω)   |
|-----|--------|
| 90  | 1305,5 |
| 100 | 945,0  |
| 110 | 703,5  |
| 120 | 526,5  |
| 130 | 400,5  |
| 140 | 309,0  |
| 150 | 240,0  |
| 160 | 187,5  |
| 170 | 148,5  |
| 180 | 120,0  |

## Temperature Sensor NTC M6-H

Temperature range: 0 ... 300°C

A miniature M6 x 1 NTC sensor for fast response temperature measurement. It is manufactured in a DR-25 sleeve, various connector options are available.



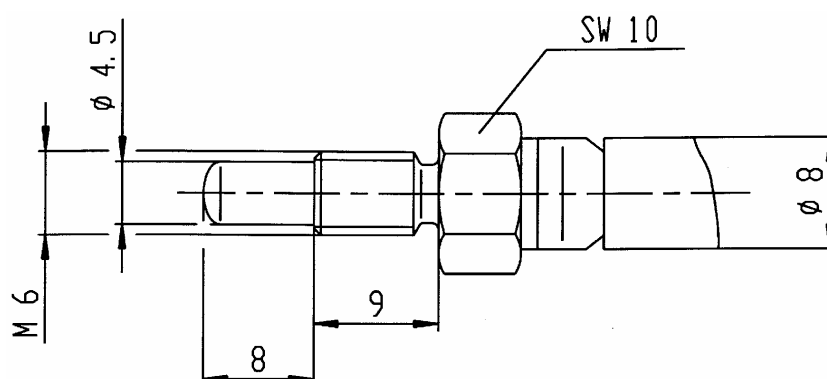
| Mechanical data   |                   |
|-------------------|-------------------|
| Thread            | M6 x 1            |
| Tightening torque | 3 Nm              |
| Wrench size       | 10 mm             |
| Sealing           | Viton 4,47 x 1,78 |
| Weight            | 45 g              |

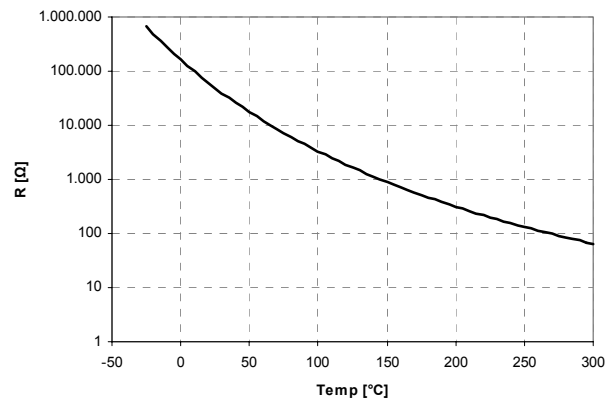
| Electronic data    |             |
|--------------------|-------------|
| Nominal resistance | 49 kΩ/25°C  |
| Measuring range    | 0 ... 300°C |
| Accuracy           | ± 1,0 K     |
| Response time 90 % | < 7 s       |

| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -30 ... 300°C     |
| Vibration          | 80 g/5 ... 500 Hz |

| Part number    |                      |
|----------------|----------------------|
| ASU 6-03-PB-HE | <b>B 261 209 980</b> |
| Offer drawing  | A 261 209 980        |

| Characteristic |  |
|----------------|--|
| NTC 49 kΩ      |  |





| °C  | R(Ω)    |
|-----|---------|
| -25 | 657.350 |
| -20 | 487.370 |
| -15 | 365.040 |
| -10 | 276.060 |
| -5  | 210.690 |
| 0   | 162.210 |
| 5   | 125.780 |
| 10  | 98.322  |
| 15  | 77.454  |
| 20  | 61.465  |
| 25  | 49.120  |
| 30  | 39.517  |
| 35  | 31.996  |
| 40  | 26.065  |
| 45  | 21.358  |
| 50  | 17.599  |
| 55  | 14.579  |
| 60  | 12.140  |
| 65  | 10.159  |
| 70  | 8.541,5 |
| 75  | 7.214,2 |
| 80  | 6.119,8 |
| 85  | 5.213,4 |
| 90  | 4.459,1 |
| 95  | 3.828,8 |
| 100 | 3.300   |
| 105 | 2.854,5 |
| 110 | 2.477,7 |
| 115 | 2.157,9 |
| 120 | 1.885,5 |
| 125 | 1.652,6 |
| 130 | 1.452,9 |
| 135 | 1.281,1 |

| °C  | R(Ω)    |
|-----|---------|
| 140 | 1.132,7 |
| 145 | 1.004,3 |
| 150 | 892,79  |
| 155 | 795,7   |
| 160 | 710,92  |
| 165 | 636,7   |
| 170 | 571,55  |
| 175 | 514,32  |
| 180 | 463,67  |
| 185 | 418,96  |
| 190 | 379,35  |
| 195 | 344,16  |
| 200 | 312,85  |
| 205 | 284,92  |
| 210 | 259,96  |
| 215 | 237,61  |
| 220 | 217,55  |
| 225 | 199,52  |
| 230 | 183,29  |
| 235 | 168,64  |
| 240 | 155,41  |
| 245 | 143,43  |
| 250 | 132,57  |
| 255 | 122,7   |
| 260 | 113,73  |
| 265 | 105,55  |
| 270 | 98,098  |
| 275 | 91,286  |
| 280 | 85,054  |
| 285 | 79,344  |
| 290 | 74,106  |
| 295 | 69,295  |
| 300 | 64,870  |

## Temperature Sensor NTC M8

Temperature range: 0 ... 200°C

This standard fluid temperature sensor combines temperature response with fine mechanical properties. It is manufactured in a DR-25 sleeve, various connector options are available.



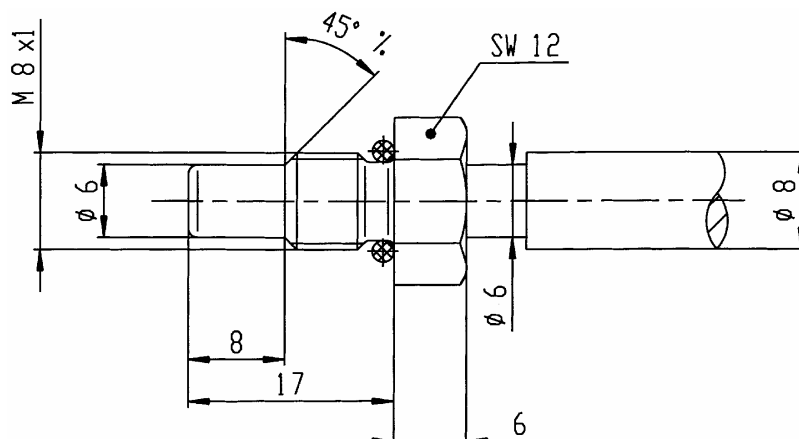
| Mechanical data   |                   |
|-------------------|-------------------|
| Thread            | M8 x 1            |
| Tightening torque | 3 Nm              |
| Wrench size       | 12 mm             |
| Sealing           | Viton 6,35 x 1,78 |
| Weight            | 45 g              |

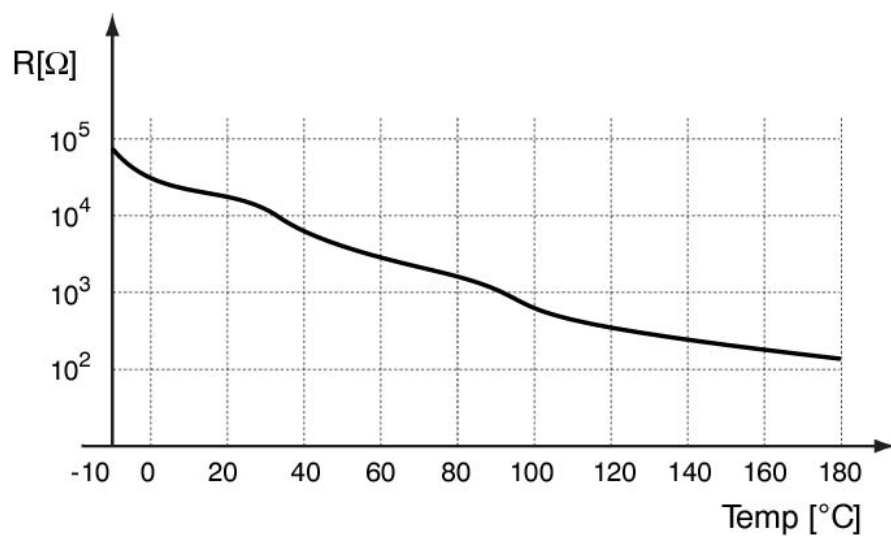
| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -30 ... 200°C     |
| Vibration          | 80 g/5 ... 500 Hz |

| Characteristic |  |
|----------------|--|
| NTC 15 kΩ      |  |

| Electronic data    |             |
|--------------------|-------------|
| Nominal resistance | 15 kΩ/25°C  |
| Measuring range    | 0 ... 200°C |
| Accuracy           | ± 1,0 K     |
| Response time 90 % | < 10 s      |

| Part numbers      |                      |
|-------------------|----------------------|
| KPSE 6E8-33P-DN   | <b>B 261 209 167</b> |
| Offer drawing     | A 261 209 167        |
| KPSE 6E8-3AP-DN   | <b>B 261 209 173</b> |
| Offer drawing     | A 261 209 173        |
| ASL 6-06-05PN-HE  | <b>B 261 209 384</b> |
| Offer drawing     | A 261 209 384        |
| Without connector | <b>B 261 209 176</b> |
| Offer drawing     | A 261 209 176        |
| ASU 6-03-03PA-HE  | <b>B 261 209 978</b> |
| Offer drawing     | A 261 209 978        |
| ASU 6-03-03PN-HE  | <b>B 261 209 977</b> |
| Offer drawing     | A 261 209 977        |





| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| -10                | 83317,5     |
| 0                  | 49254,0     |
| 10                 | 29959,5     |
| 20                 | 18732,0     |
| 30                 | 12012,0     |
| 40                 | 7893,0      |
| 50                 | 5356,5      |
| 60                 | 3651,0      |
| 70                 | 2544,0      |
| 80                 | 1804,5      |

| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| 90                 | 1305,5      |
| 100                | 945,0       |
| 110                | 703,5       |
| 120                | 526,5       |
| 130                | 400,5       |
| 140                | 309,0       |
| 150                | 240,0       |
| 160                | 187,5       |
| 170                | 148,5       |
| 180                | 120,0       |

## Temperature Sensor NTC M8-F

Temperature range: 0 ... 200°C

The NTC M8-F is a development based on the NTC M8. It is created for very fast response air temperature measurement.



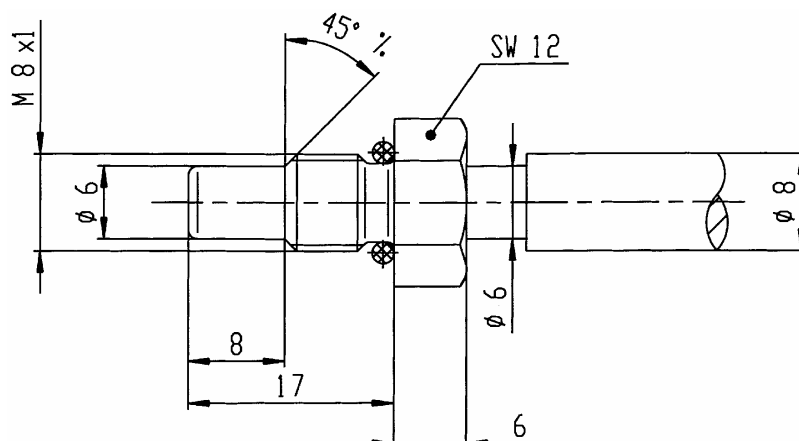
| Mechanical data   |                   |
|-------------------|-------------------|
| Thread            | M8 x 1            |
| Tightening torque | 3 Nm              |
| Wrench size       | 12 mm             |
| Sealing           | Viton 6,35 x 1,78 |
| Weight            | 45 g              |

| Electronic data    |                      |
|--------------------|----------------------|
| Nominal resistance | 6,8 k $\Omega$ /25°C |
| Measuring range    | 0 ... 100°C          |
| Accuracy           | $\pm 1,0$ K          |
| Response time 90 % | < 5 s                |

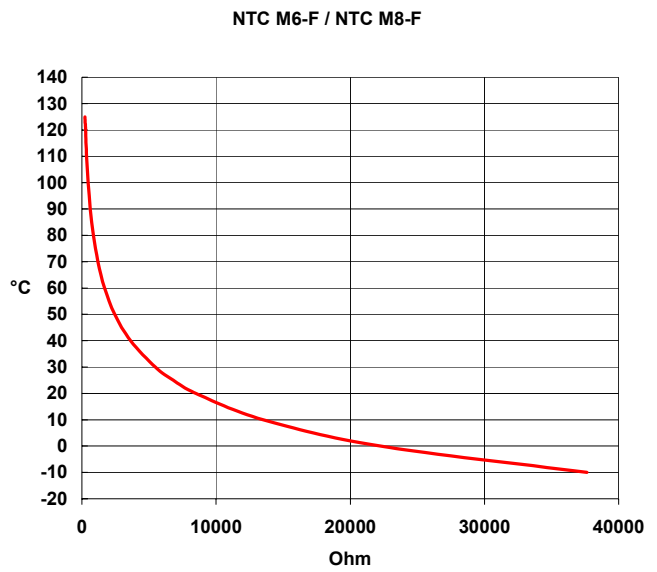
| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -30 ... 100°C     |
| Vibration          | 80 g/5 ... 500 Hz |

| Part number     |                      |
|-----------------|----------------------|
| AS 6-06-05PN-HE | <b>B 261 209 818</b> |

| Characteristic     |  |
|--------------------|--|
| NTC 6,8 k $\Omega$ |  |



| °C  | R(Ω)  |
|-----|-------|
| -20 | 66115 |
| 10  | 37645 |
| 0   | 22209 |
| 10  | 13533 |
| 20  | 8495  |
| 30  | 5479  |
| 40  | 3624  |
| 50  | 2452  |
| 60  | 1695  |
| 70  | 1195  |
| 80  | 858,2 |
| 90  | 626,7 |
| 100 | 464,8 |
| 110 | 350,4 |
| 120 | 267,1 |



# Temperature Sensor NTC M12

Temperature range: -30 ... 130°C

A shockproof sensor for measurements under pressure up to 25 bar. Good thermal conductivity allows fast response temperature measurement. The integrated connector provides a low-cost connection for automotive applications.

General fields of application: oil-, fuel-, water temperature measurement.



| Mechanical data   |           |
|-------------------|-----------|
| Thread            | M12 x 1,5 |
| Tightening torque | 25 Nm     |
| Wrench size       | 19 mm     |
| Weight            | 30 g      |

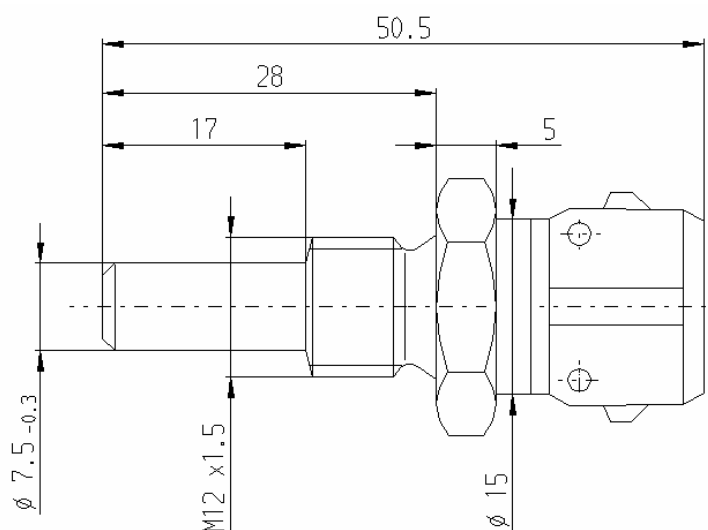
| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -30 ... 130°C     |
| Vibration          | 60 g/5 ... 250 Hz |

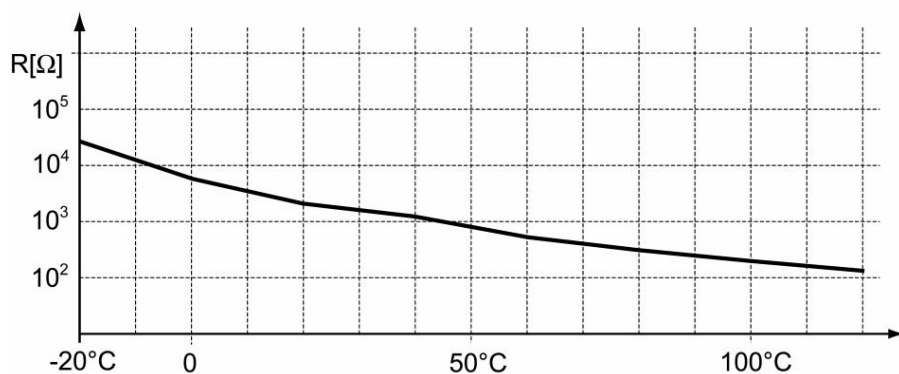
| Characteristic |  |
|----------------|--|
| NTC 2,5 kΩ     |  |

| Electronic data    |               |
|--------------------|---------------|
| Nominal resistance | 2,5 kΩ/20°C   |
| Measuring range    | -30 ... 130°C |
| Accuracy           | ± 1,5 K       |
| Response time 90 % | < 10 s        |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 331</b> |

| Part numbers    |                      |
|-----------------|----------------------|
| D 261 205 331   | <b>0 280 130 026</b> |
| KPSE 6E8-33P-DN | <b>B 261 209 160</b> |
| Offer drawing   | A 261 209 160        |





| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| -40                | 45 313      |
| -35                | 34 281      |
| -30                | 26 114      |
| -25                | 20 003      |
| -20                | 15 462      |
| -15                | 12 002      |
| -10                | 9 397       |
| -5                 | 7 415       |
| 0                  | 5 896       |
| 5                  | 4 712       |
| 10                 | 3 792       |
| 15                 | 3 069       |
| 20                 | 2 500       |
| 25                 | 2 057       |
| 30                 | 1 707       |
| 35                 | 1 412       |
| 40                 | 1 175       |
| 45                 | 987,6       |
| 50                 | 833,9       |
| 55                 | 702,8       |
| 60                 | 595,5       |

| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| 65                 | 508,3       |
| 70                 | 435,7       |
| 75                 | 374,2       |
| 80                 | 322,5       |
| 85                 | 279,6       |
| 90                 | 243,2       |
| 95                 | 212,7       |
| 100                | 186,6       |
| 105                | 163,8       |
| 110                | 144,2       |
| 115                | 127,3       |
| 120                | 112,7       |
| 125                | 100,2       |
| 130                | 89,30       |
| 135                | 79,65       |
| 140                | 71,20       |
| 145                | 63,86       |
| 150                | 57,41       |
| 155                | 51,82       |
| 160                | 46,88       |

Temperature range: -40 ... 150°C

A shockproof sensor for measurements under pressure up to 25 bar. Good thermal conductivity allows fast response temperature measurement. The integrated connector provides a low-cost connection for automotive applications.



General fields of application: oil-, fuel-, water temperature measurement.

| Mechanical data   |           |
|-------------------|-----------|
| Thread            | M12 x 1,5 |
| Tightening torque | 18 Nm     |
| Wrench size       | 19 mm     |
| Weight            | 30 g      |

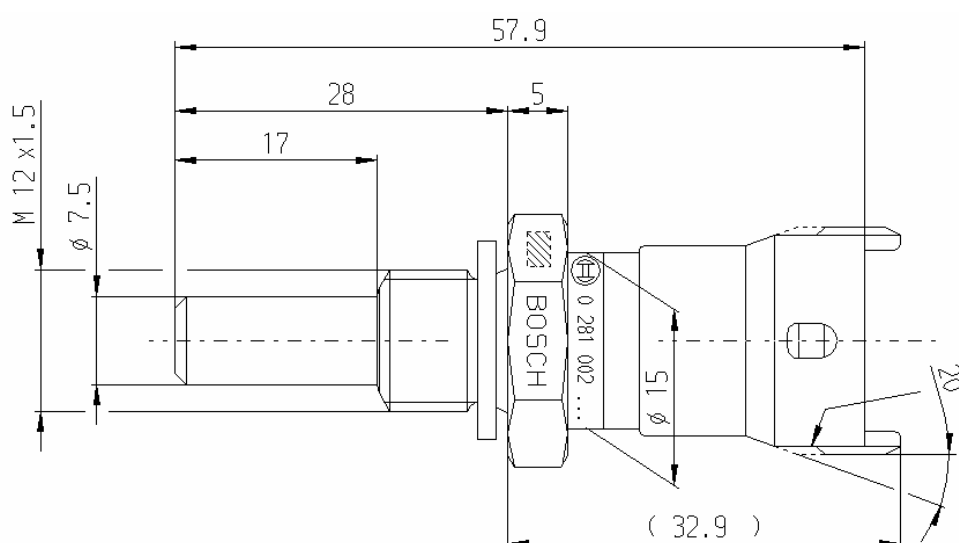
| Electronic data    |                |
|--------------------|----------------|
| Nominal resistance | 2,5 kΩ/20°C    |
| Measuring range    | -40 ... +150°C |
| Accuracy           | ± 1,5 K        |
| Response time 90 % | < 10 s         |

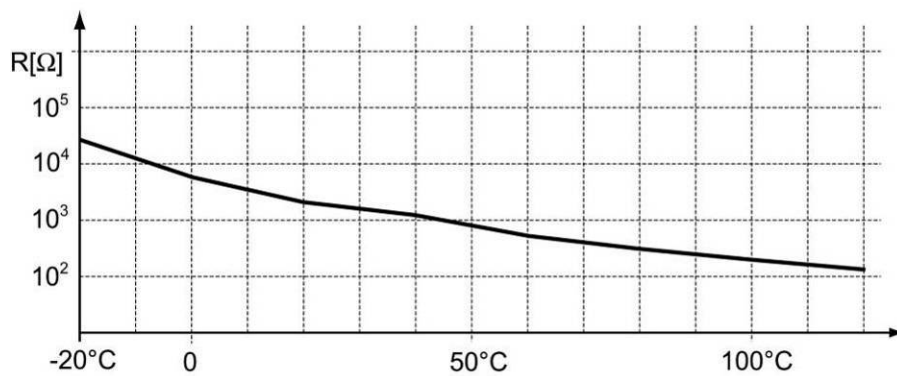
| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -40 ... 150°C     |
| Vibration          | 30 g/5 ... 250 Hz |

|                         |                      |
|-------------------------|----------------------|
| Connector               |                      |
| Cable harness connector | <b>D 261 205 337</b> |

| Characteristic     |
|--------------------|
| NTC 2.5 k $\Omega$ |

|               |                      |
|---------------|----------------------|
| Part number   |                      |
|               | <b>0 281 002 170</b> |
| Offer drawing | A 280 130 110        |





| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| -40                | 45 313      |
| -35                | 34 281      |
| -30                | 26 114      |
| -25                | 20 003      |
| -20                | 15 462      |
| -15                | 12 002      |
| -10                | 9 397       |
| -5                 | 7 415       |
| 0                  | 5 896       |
| 5                  | 4 712       |
| 10                 | 3 792       |
| 15                 | 3 069       |
| 20                 | 2 500       |
| 25                 | 2 057       |
| 30                 | 1 707       |
| 35                 | 1 412       |
| 40                 | 1 175       |
| 45                 | 987,6       |
| 50                 | 833,9       |
| 55                 | 702,8       |
| 60                 | 595,5       |

| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| 65                 | 508,3       |
| 70                 | 435,7       |
| 75                 | 374,2       |
| 80                 | 322,5       |
| 85                 | 279,6       |
| 90                 | 243,2       |
| 95                 | 212,7       |
| 100                | 186,6       |
| 105                | 163,8       |
| 110                | 144,2       |
| 115                | 127,3       |
| 120                | 112,7       |
| 125                | 100,2       |
| 130                | 89,30       |
| 135                | 79,65       |
| 140                | 71,20       |
| 145                | 63,86       |
| 150                | 57,41       |
| 155                | 51,82       |
| 160                | 46,88       |

# Temperature Sensor NTC M12-L

Temperature range: -30 ... 130°C

A shockproof sensor for measurements under pressure up to 25 bar. Good thermal conductivity allows fast response temperature measurement. The integrated connector provides a low-cost connection for automotive applications.



General fields of application: oil-, fuel-, air temperature measurement

| Mechanical data   |           |
|-------------------|-----------|
| Thread            | M12 x 1,5 |
| Tightening torque | 15 Nm     |
| Wrench size       | 19 mm     |
| Weight            | 26 g      |

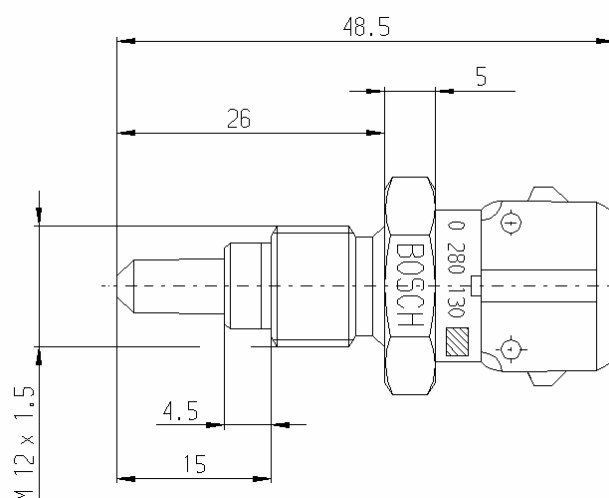
| Electronic data    |               |
|--------------------|---------------|
| Nominal resistance | 2,5 kΩ/20°C   |
| Measuring range    | -30 ... 130°C |
| Accuracy           | ± 1,5 K       |
| Response time 90 % | < 10 s        |

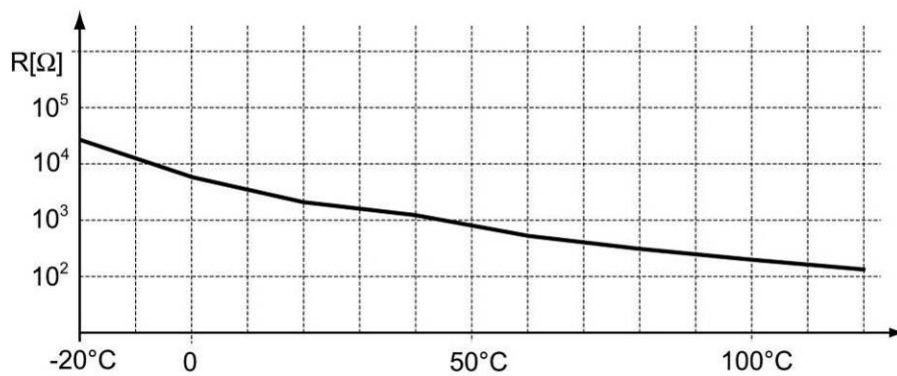
| Conditions for use |                    |
|--------------------|--------------------|
| Temperature range  | -30 ... 130°C      |
| Vibration          | 60 g/50 ... 250 Hz |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 288</b> |

| Characteristic |  |
|----------------|--|
| NTC 2,5 kΩ     |  |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 280 130 039</b> |
| Offer drawing | A 280 130 206        |





| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| -40                | 45 313      |
| -35                | 34 281      |
| -30                | 26 114      |
| -25                | 20 003      |
| -20                | 15 462      |
| -15                | 12 002      |
| -10                | 9 397       |
| -5                 | 7 415       |
| 0                  | 5 896       |
| 5                  | 4 712       |
| 10                 | 3 792       |
| 15                 | 3 069       |
| 20                 | 2 500       |
| 25                 | 2 057       |
| 30                 | 1 707       |
| 35                 | 1 412       |
| 40                 | 1 175       |
| 45                 | 987,6       |
| 50                 | 833,9       |
| 55                 | 702,8       |
| 60                 | 595,5       |

| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| 65                 | 508,3       |
| 70                 | 435,7       |
| 75                 | 374,2       |
| 80                 | 322,5       |
| 85                 | 279,6       |
| 90                 | 243,2       |
| 95                 | 212,7       |
| 100                | 186,6       |
| 105                | 163,8       |
| 110                | 144,2       |
| 115                | 127,3       |
| 120                | 112,7       |
| 125                | 100,2       |
| 130                | 89,30       |
| 135                | 79,65       |
| 140                | 71,20       |
| 145                | 63,86       |
| 150                | 57,41       |
| 155                | 51,82       |
| 160                | 46,88       |

## Temperature Sensor PT 100 M14

Temperature range: -50 ... 300°C

A shockproof sensor for measurements under pressure up to 25 bar. Good thermal conductivity allows fast response temperature measurement. The integrated connector provides a low cost connection for automotive applications.



| Mechanical data   |           |
|-------------------|-----------|
| Thread            | M14 x 1,5 |
| Tightening torque | 15 Nm     |
| Wrench size       | 19 mm     |
| Weight            | 25 g      |

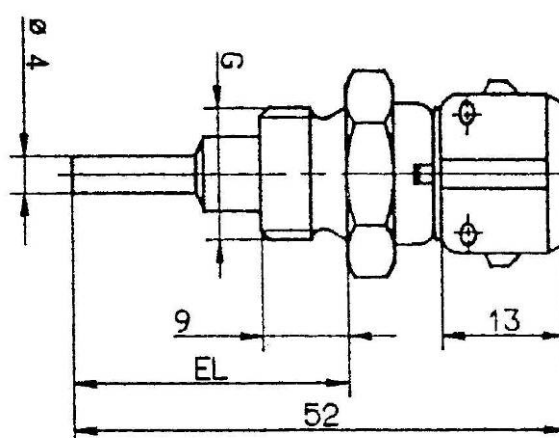
| Electronic data    |                   |
|--------------------|-------------------|
| Nominal resistance | 100 $\Omega$ /0°C |
| Measuring range    | -50 ... 300°C     |
| Accuracy           | $\pm 3,0$ K       |
| Response time 90 % | < 10 s            |

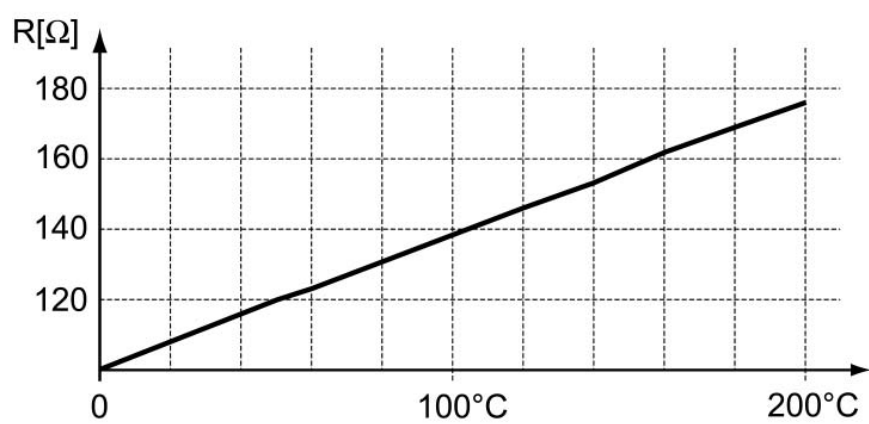
| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -50 ... 300°C     |
| Vibration          | 40 g/5Hz ... 2kHz |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 288</b> |

| Characteristic     |  |
|--------------------|--|
| PT 100 DIN/IEC 751 |  |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 261 209 174</b> |
| Offer drawing | A 261 209 174        |





| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| 0                  | 100,00      |
| 10                 | 103,90      |
| 20                 | 107,79      |
| 30                 | 111,67      |
| 40                 | 115,54      |
| 50                 | 119,40      |
| 60                 | 123,24      |
| 70                 | 127,07      |
| 80                 | 130,89      |
| 90                 | 134,70      |
| 100                | 138,50      |

| $^{\circ}\text{C}$ | $R(\Omega)$ |
|--------------------|-------------|
| 110                | 142,29      |
| 120                | 146,06      |
| 130                | 149,82      |
| 140                | 153,58      |
| 150                | 157,31      |
| 160                | 161,04      |
| 170                | 164,76      |
| 180                | 168,46      |
| 190                | 172,16      |
| 200                | 175,84      |

# Thermocouple Probes

## Thermocouple Probe TCP-K

Temperature range: 32 ... 1300°C

A flexible K-type thermocouple for measuring exhaust-gas temperatures. The installation fitting allows an adjustable gas-tight mounting at the exhaust pipe. It is manufactured in a DR-25 sleeve, various connector options are available. The sensor length can be modified on request.



| Mechanical data   |        |
|-------------------|--------|
| Thread            | M8 x 1 |
| Tightening torque | 12 Nm  |
| Wrench size       | 13 mm  |
| Weight            | 18 g   |

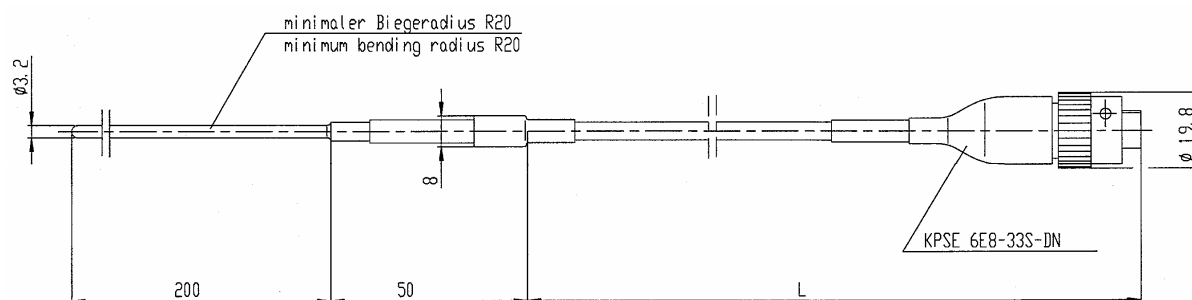
| Cutting ring      |        |
|-------------------|--------|
| Tightening torque | 2,5 Nm |
| Wrench size       | 11 mm  |

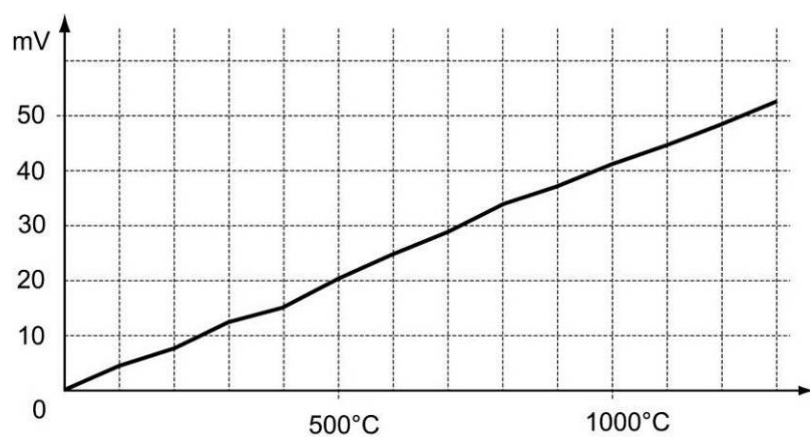
| Electronic data |         |
|-----------------|---------|
| Thermocouple    | NiCr-Ni |

| Characteristic |  |
|----------------|--|
| DIN IEC 584    |  |

| Sensor data |                   |
|-------------|-------------------|
| Vibration   | 80 g/5 ... 500 Hz |
| Length L    | 150 ... 740 mm    |
| Weight      | 60 g              |

| Part numbers         |                      |
|----------------------|----------------------|
| KPTA 6E6-4SW-C-DN    | <b>B 261 209 169</b> |
| Offer drawing        | A 261 209 169        |
| AS 6-06-98PN         | <b>B 261 209 179</b> |
| Offer drawing        | A 261 209 179        |
| AS 6-06-05PD-HE      | <b>B 261 209 385</b> |
| Offer drawing        | A 261 209 385        |
| ASU 6-03-03-SD-HE    | <b>B 261 209 979</b> |
| Offer drawing        | A 261 209 979        |
| Installation fitting | <b>B 261 209 159</b> |
| Offer drawing        | A 261 209 159        |





| Input °C | Output mV |
|----------|-----------|
| 0        | 0         |
| 100      | 4,095     |
| 200      | 8,137     |
| 300      | 12,207    |
| 400      | 16,395    |
| 500      | 20,640    |
| 600      | 24,902    |

| Input °C | Output mV |
|----------|-----------|
| 700      | 29,128    |
| 800      | 33,277    |
| 900      | 37,325    |
| 1000     | 41,269    |
| 1100     | 45,108    |
| 1200     | 48,828    |
| 1300     | 52,398    |

# Thermocouple Probe TCP-N / TCP-NF

Temperature range: -40 ... 1000°C

A flexible N-type thermocouple for measuring of exhaust-gas temperatures.

TCP-NF is used in FIA F3 since 2005.



| Mechanical data   |         |
|-------------------|---------|
| Thread            | M12 x 1 |
| Tightening torque | 15 Nm   |
| Wrench size       | 17 mm   |
| Length            | 630 mm  |
| Weight            | 60 g    |

| Conditions for use |                   |
|--------------------|-------------------|
| Vibration          | 80 g/5 ... 500 Hz |
| DIN EN 60584       |                   |
| Temperature range  | -40 ... 115°C     |

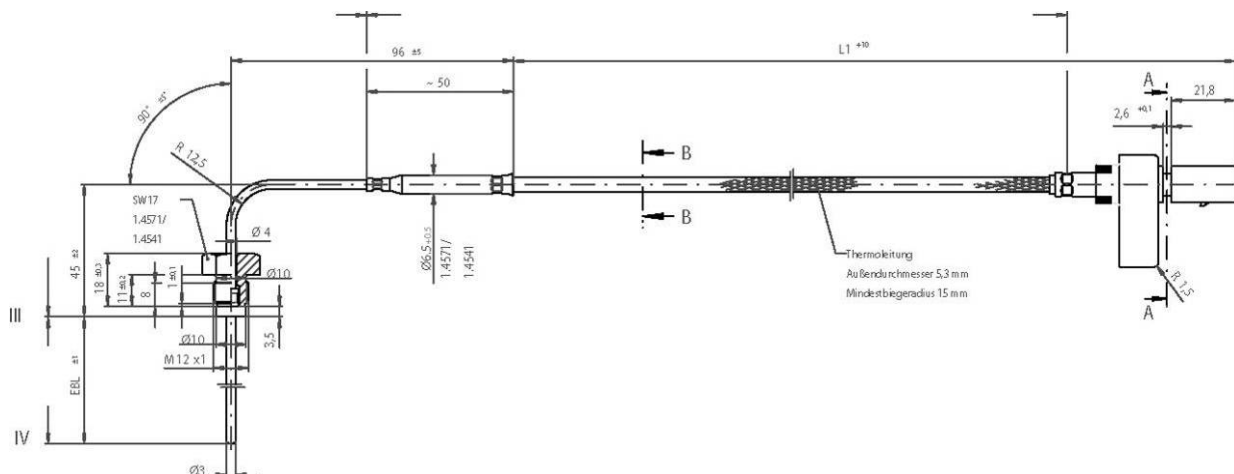
| Characteristic |  |
|----------------|--|
| DIN IEC 584    |  |

| Electronic data       |                |
|-----------------------|----------------|
| Power supply          | 12 V           |
| Full scale output     | 0,5 ... 4,5 V  |
| Thermocouple          | NiCrSi-NiSi    |
| Measuring range       | -40 ... 1100°C |
| <b>Response time:</b> |                |
| TCP-N                 | 20 s           |
| TCP-NF                | 33 s           |

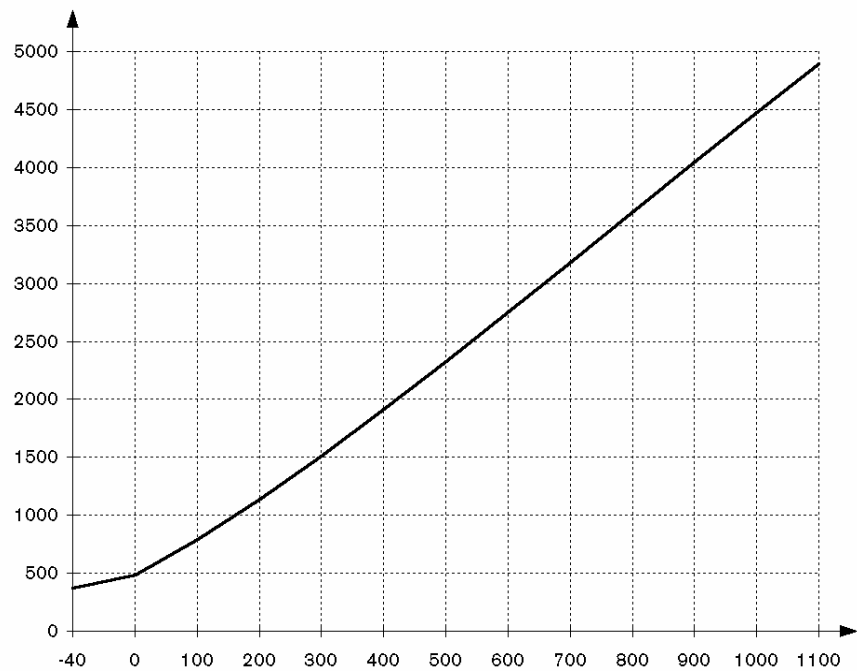
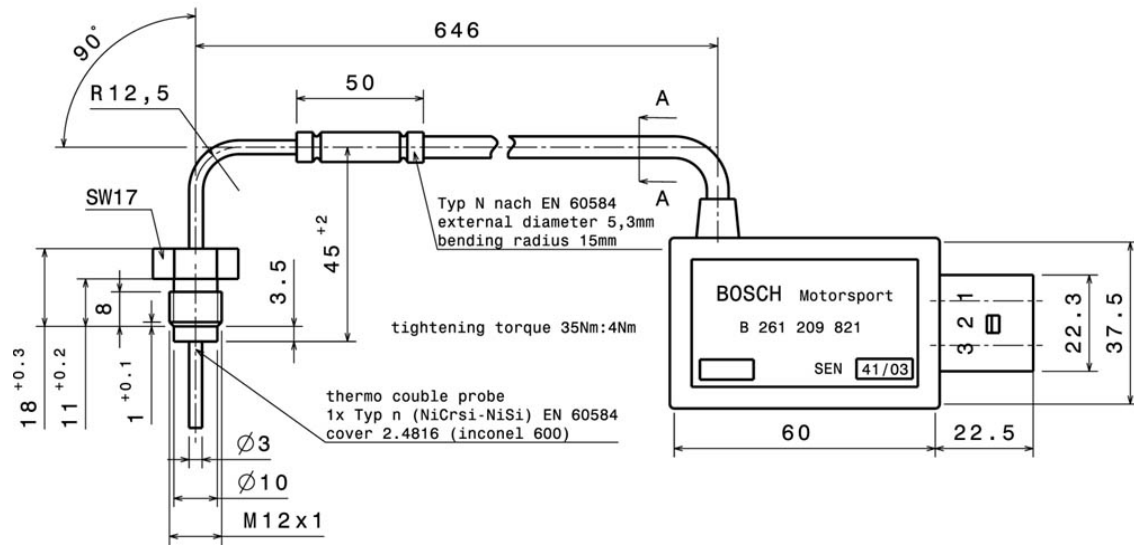
| Connector |               |
|-----------|---------------|
| TCP-N     | 1-J0973-70    |
| TCP-NF    | D 261 205 357 |

| Part numbers  |                      |
|---------------|----------------------|
| TCP-N         | <b>B 261 209 387</b> |
| Offer drawing | A 261 209 387        |
| TCP-NF        | <b>B 261 209 821</b> |
| Offer drawing | A 261 209 821        |

## Design TCP-N



## Design TCP-NF



| Input °C | Output mV |
|----------|-----------|
| -40      | 372       |
| 0        | 485       |
| 100      | 790       |
| 200      | 1135      |
| 300      | 1513      |
| 400      | 1912      |
| 500      | 2327      |

| Input °C | Output mV |
|----------|-----------|
| 600      | 2752      |
| 700      | 3183      |
| 800      | 3615      |
| 900      | 4046      |
| 1000     | 4473      |
| 1100     | 4845      |

# Speed Sensors Inductive

## Inductive Speed Sensor IA

This sensor is designed for incremental measurement of revolutions and angles at engine and chassis applications. It is available in a DR-25 sleeve with various connector options and different installation depths.

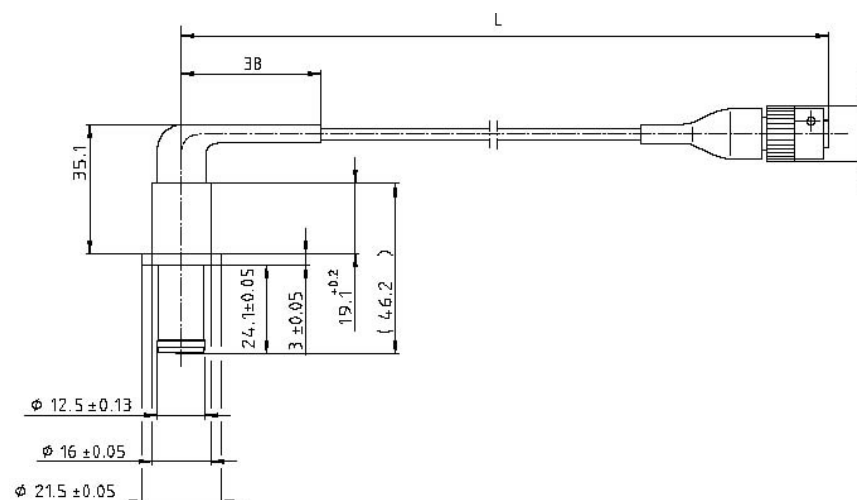


| Mechanical data       |                        |
|-----------------------|------------------------|
| Magnetic pole         | round                  |
| Drill diameter        | 12,9 mm                |
| Tightening torque     | 8 Nm                   |
| Weight                | 70 g                   |
| Installation depth L2 | 13,2/24,1/32,2/41,5 mm |

| Conditions for use |                |
|--------------------|----------------|
| Temperature range  | -40 ... 230°C  |
| Vibration          | 80 g/max. 80 h |

| Electronic data     |                    |
|---------------------|--------------------|
| Electrical strength | 1200 V/max. 3 sec. |
| Resistance          | Ri = 1200 Ω        |
| Inductance          | max. 400 mH        |

| Part numbers        |                      |
|---------------------|----------------------|
| <b>L2: 24, 1 mm</b> |                      |
| KPTA 6E6-4SW-C-DN   | <b>B 261 209 500</b> |
| Offer drawing       | A 261 209 500        |
| KPSE 6E8-3AS-DN     | <b>B 261 209 023</b> |
| Offer drawing       | A 261 209 023        |
| <b>L2: 32,2 mm</b>  |                      |
| AS 6-06-05SN-HE     | <b>B 261 209 519</b> |
| Offer drawing       | A 261 209 519        |
| KPSE 6E8-3AS-DN     | <b>B 261 209 022</b> |
| Offer drawing       | A 261 209 022        |



# Inductive Speed Sensor IA-C

This sensor is designed for incremental measurement of revolutions at engine applications.



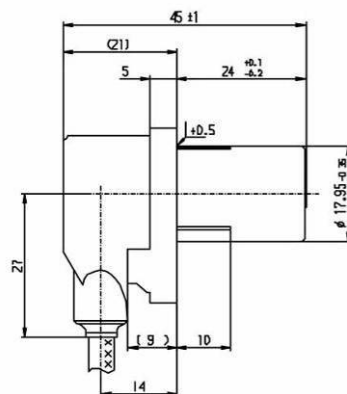
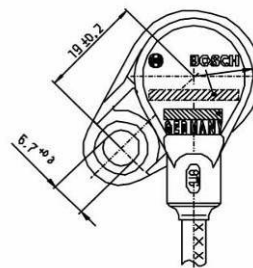
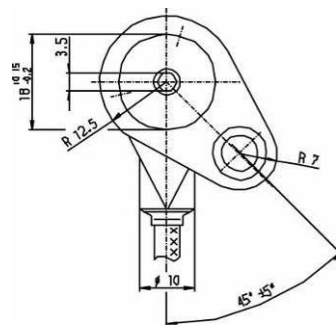
| Mechanical data    |         |
|--------------------|---------|
| Magnetic pole      | round   |
| Fixing             | M6 x 12 |
| Length             | 510 mm  |
| Tightening torque  | 8 Nm    |
| Weight             | 80 g    |
| Installation depth | 24 mm   |

| Electronic data |                              |
|-----------------|------------------------------|
| Resistance      | 860 $\Omega$ /20° $\pm$ 10 % |
| Inductance      | 370 $\pm$ 60 mH/1 kHz        |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 334</b> |

| Conditions for use |                |
|--------------------|----------------|
| Temperature range  | -40 ... 130°C  |
| Vibration          | 80 g/max. 80 h |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 261 210 136</b> |
| Offer drawing | A 265 461 845        |



## Inductive Speed Sensor IS

This sensor is designed for incremental measurements of revolutions and angles at engine and chassis applications. It is available in a DR-25 sleeve with various connector options and different installation depths.

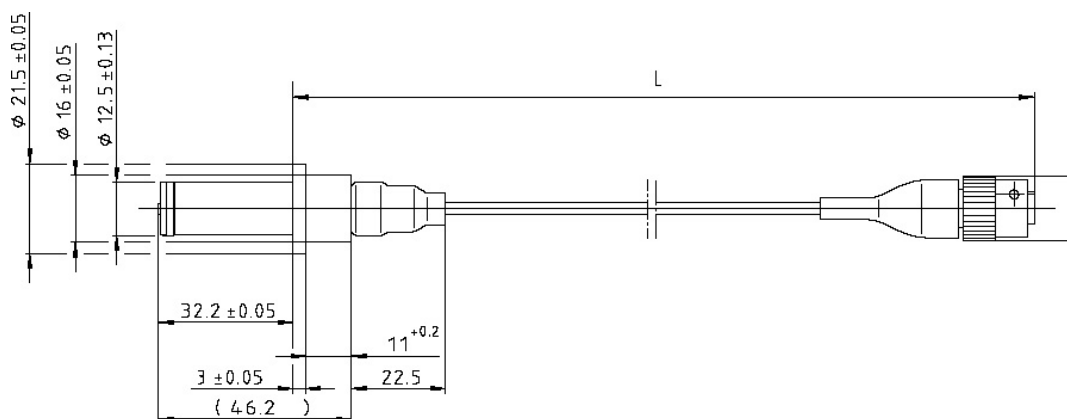


| Mechanical data       |                   |
|-----------------------|-------------------|
| Magnetic pole         | round             |
| Drill hole            | 12,9 mm           |
| Tightening torque     | 8 Nm              |
| Weight                | 70 g              |
| Installation depth L2 | 13,2/24,1/32,2 mm |

| Conditions for use |                |
|--------------------|----------------|
| Temperature range  | -40 ... 230°C  |
| Vibration          | 80 g/max. 80 h |

| Electronic data     |                     |
|---------------------|---------------------|
| Electrical strength | 1200 V/max. 3 sec.  |
| Resistance          | $R_i = 1200 \Omega$ |
| Inductance          | max. 400 mH         |

| Part numbers       |                      |
|--------------------|----------------------|
| <b>L2: 24,1 mm</b> |                      |
| KPTA 6E6-4SW-C-DN  | <b>B 261 209 509</b> |
| Offer drawing      | A 261 209 509        |
| <b>L2: 32,2 mm</b> |                      |
| AS6-06-05SN-HE     | <b>B 261 209 517</b> |
| Offer drawing      | A 261 209 517        |
| KPTA 6E6-4SW-C-DN  | <b>B 261 209 501</b> |
| Offer drawing      | A 261 209 501        |
| KPSE 6E8-3AS-DN    | <b>B 261 209 021</b> |
| Offer drawing      | A 261 209 021        |



## Inductive Speed Sensor IS-C

This sensor is designed for incremental measurement of revolutions at chassis applications. We manufacture one version with a metric thread and a second version with an inch thread. The sensor is available in a DR-25 sleeve with various connector options.

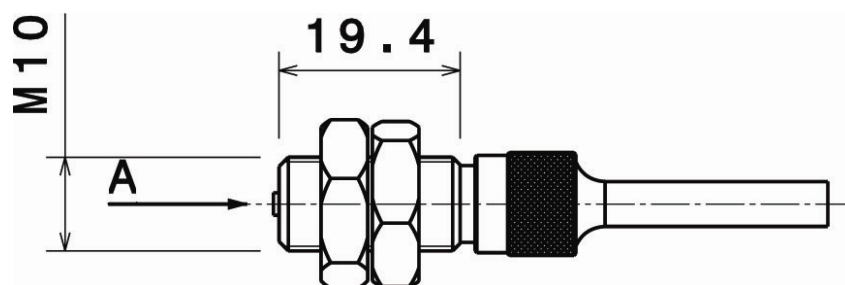


| Mechanical data  |                                    |
|------------------|------------------------------------|
| Magnetic pole    | round                              |
| Drill hole<br>or | M10 x 1<br>3/8-24 UNF-2A THD (USA) |
| Mounting torque  | 10 Nm (7.3 ft-lb) maximum          |
| Weight           | 16 g                               |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -40 ... 150°C |

| Electronic data |                                    |
|-----------------|------------------------------------|
| Resistance      | $R_i = 340 \, \Omega \pm 20 \, \%$ |
| Inductance      | $64 \, \text{mH} \pm 20 \, \%$     |

| Part numbers             |                      |
|--------------------------|----------------------|
| <b>M10 x 1</b>           |                      |
| KPTA 6E6-4SW-C-DN        | <b>B 261 209 624</b> |
| Offer drawing            | A 261 209 624        |
| <b>3/8-24 UNF-2A THD</b> |                      |
| AS 6-06-05 SN-HE         | <b>B 261 209 609</b> |
| Offer drawing            | A 261 209 609        |



## Inductive Speed Sensor IS-T

This sensor is designed for incremental measurements of revolutions at turbochargers. It is available in a DR-25 sleeve with various connector options.



| Mechanical data   |                                         |
|-------------------|-----------------------------------------|
| Magnetic pole     | round                                   |
| Fixing            | not defined                             |
| Drill diameter    | 250-40UNS-2ATHD                         |
| Length            | 150 ... 600 mm                          |
| Wrench size       | 8 mm                                    |
| Tightening torque | 1,4 Nm                                  |
| Weight            | 14 g                                    |
| Air gap           | 0,5 mm, 2 k $\Omega$ load, 0,75 V pk-pk |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -54 ... 230°C |

| Electronic data |                      |
|-----------------|----------------------|
| Resistance      | 140 ... 190 $\Omega$ |
| Inductivity     | 2,6 mH (typical)     |

| Part numbers     |                      |
|------------------|----------------------|
| AS 6-06-05SN-HE  | <b>B 261 209 662</b> |
| Offer drawing    | A 261 209 662        |
| ASU 603 03-SB-HE | <b>B 261 209 665</b> |
| Offer drawing    | A 261 209 665        |

# Speed Sensors Hall-effect

## Speed Sensor HA-M

This sensor is designed for incremental measurement of revolutions and angles at engine and chassis applications. It is available in a DR-25 sleeve with various connector options.



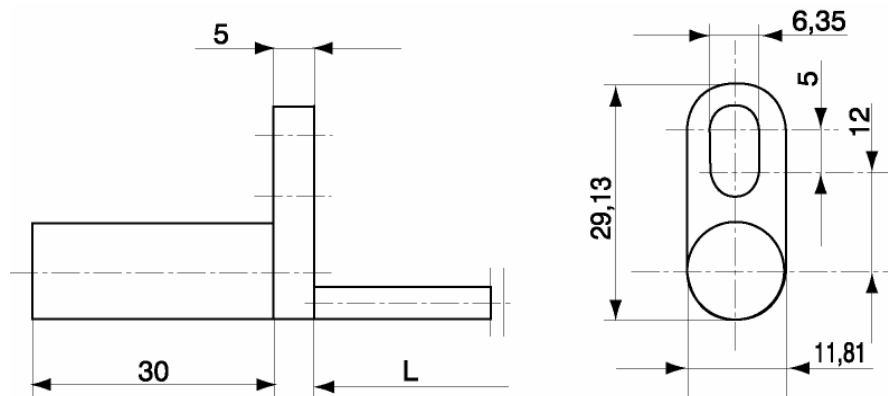
| Mechanical data   |         |
|-------------------|---------|
| Fixing            | M6      |
| Drill hole        | 11,8 mm |
| Max. distance     | 1,2 mm  |
| Tightening torque | 6 Nm    |
| Weight            | 12 g    |

| Conditions for use |                |
|--------------------|----------------|
| Temperature range  | -40 ... 150°C  |
| N min              | 0 rpm (CAM)    |
| N max              | 4500 rpm (CAM) |

| Please notice                                                                             |  |
|-------------------------------------------------------------------------------------------|--|
| Stray magnetic fields have an influence on the switching behaviour of the sensor element. |  |

| Electronic data          |            |
|--------------------------|------------|
| Power supply             | 5 ... 18 V |
| Input current            | 5,6 mA     |
| Signal output high level | 4,2 V      |
| Signal output low level  | 0,52 V     |

| Part number      |                      |
|------------------|----------------------|
| ASU 6-03-03PN-HE | <b>B 261 209 283</b> |
| Offer drawing    | A 261 209 283        |



## Speed Sensor HA-P

This sensor is designed for incremental measurement of revolutions and angles at engine and chassis applications.



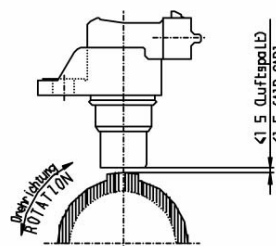
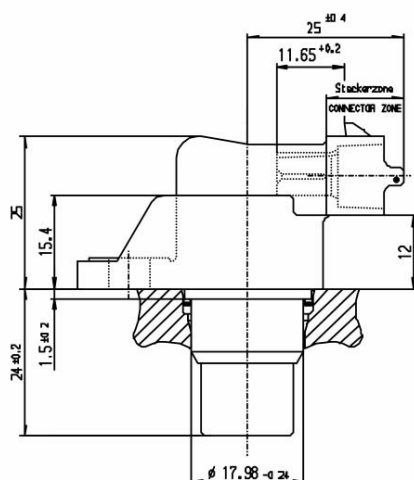
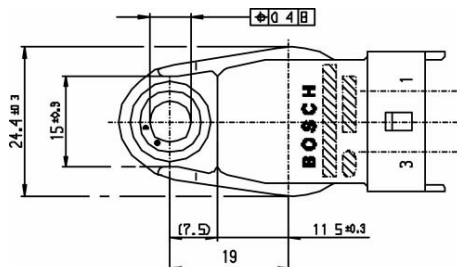
| Mechanical data         |         |
|-------------------------|---------|
| Fixing                  | M6      |
| Drill hole              | 18 mm   |
| Max. distance           | 1,52 mm |
| Tightening torque       | 6 Nm    |
| Weight                  | 70 g    |
| Installation dimensions | 30 mm   |

| Conditions for use |                       |
|--------------------|-----------------------|
| Temperature range  | -30 ... 130°C         |
| Vibration          | 100 g/10 Hz ... 2 kHz |
| Air gap            | max. 1,5 mm           |

| Electronic data        |                        |
|------------------------|------------------------|
| Power supply           | 4,5 ... 24 V           |
| Input current          | 10 mA typ., 20 mA max. |
| Signal output (active) | 0,4 V max.             |
| Output current         | 20 mA max.             |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 335</b> |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 232 103 037</b> |
| Offer drawing | A 232 090 314        |



# Lambda Sensors

## Lambda Sensor LSM 11

A lambda LSM 11 standard production sensor, manufactured in a DR-25 sleeve with a series connector.



| Mechanical data   |                     |
|-------------------|---------------------|
| Length            | 250 ... 1390 mm     |
| Thread            | M18 x 1,5           |
| Tightening torque | 60 Nm               |
| Wrench size       | 22 mm               |
| Weight            | 160 g               |
| Vibration         | 30 g/5 Hz ... 2 kHz |

| Fuel additives   |         |
|------------------|---------|
| Sulphur (weight) | 0,2 %   |
| Lead             | 0,6 g/l |

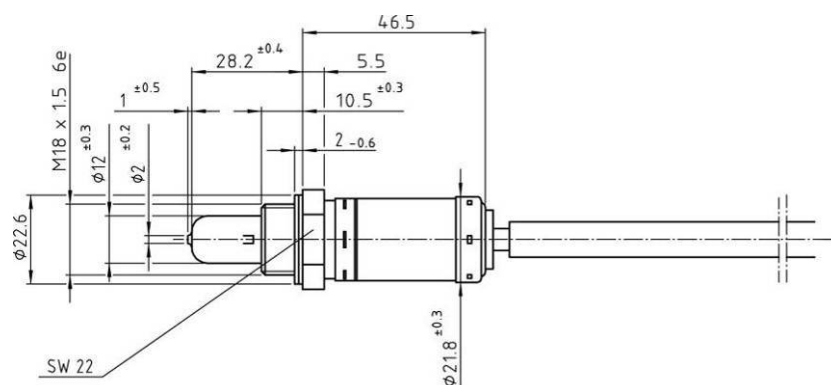
| Temperature ranges |               |
|--------------------|---------------|
| Ceramic tip        | 250 ... 850°C |
| Hexagon nut        | < 570°C       |
| Cable duct         | < 250°C       |
| Connector          | < 130°C       |

| Electronic data        |                                            |
|------------------------|--------------------------------------------|
| Heater supply voltage  | 12 ... 14 V                                |
| Heater power           | 18 W                                       |
| Sensor element         | ZrO <sub>2</sub> (Zirconium-Oxide-Ceramic) |
| Lambda measuring range | 0,68 ... 1,32                              |
| Accuracy at lambda < 1 | < 1,5 %                                    |

| Installation instructions                                 |  |
|-----------------------------------------------------------|--|
| Please observe the installation instructions on page 106. |  |

| Connectors |                      |
|------------|----------------------|
|            | <b>1 284 485 110</b> |
|            | <b>1 224 485 018</b> |

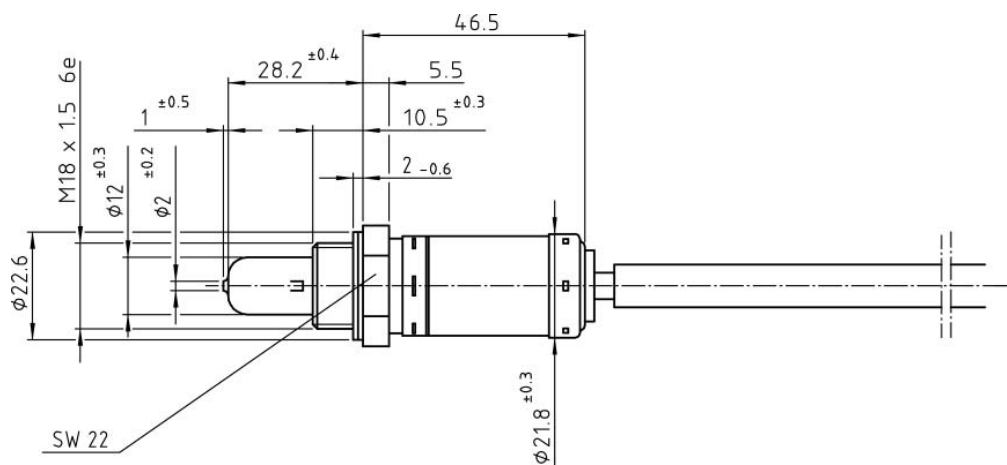
| Part number   |                      |
|---------------|----------------------|
|               | <b>0 258 104 002</b> |
| Offer drawing | A 258 104 002        |



A lambda LSM 11 standard production sensor, manufactured in a DR-25 sleeve , various connector options are available.



|                  |                      |
|------------------|----------------------|
| Part number      |                      |
| KPTC 6E8-4P-C-DN | <b>B 261 209 105</b> |
| Offer drawing    | A 261 209 105        |



## Lambda Sensor LSM 11-RM

An individually selected wide-band LSM 11 lambda sensor. It is specially modified for motorsport use, manufactured in a Viton sleeve. Various connector options are available.



| Mechanical data   |                     |
|-------------------|---------------------|
| Length            | 250 ... 1390 mm     |
| Thread            | M18 x 1,5           |
| Tightening torque | 60 Nm               |
| Wrench size       | 22 mm               |
| Weight            | 160 g               |
| Vibration         | 70 g/5 Hz ... 2 kHz |

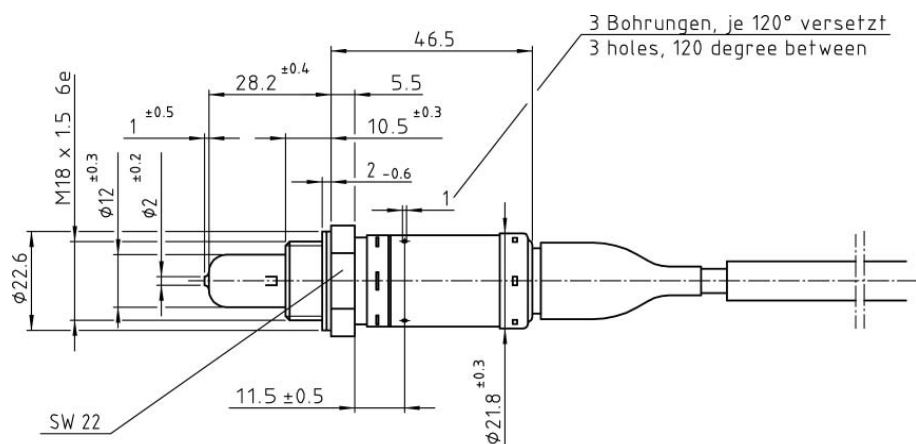
| Fuel additives   |         |
|------------------|---------|
| Sulphur (weight) | 0,2 %   |
| Lead             | 0,6 g/l |

| Temperature ranges |               |
|--------------------|---------------|
| Ceramic tip        | 250 ... 850°C |
| Hexagon nut        | < 570°C       |
| Cable duct         | < 250°C       |
| Connector          | < 130°C       |

| Electronic data        |                                            |
|------------------------|--------------------------------------------|
| Heater supply voltage  | 12 ... 14 V                                |
| Heater power           | 18 W                                       |
| Sensor element         | ZrO <sub>2</sub> (Zirconium-Oxide-Ceramic) |
| Lambda measuring range | 0,68 ... 1,32                              |
| Accuracy at lambda < 1 | < 1,5 %                                    |

| Installation instructions                                 |  |
|-----------------------------------------------------------|--|
| Please observe the installation instructions on page 106. |  |

| Part number      |                      |
|------------------|----------------------|
| KPTC 6E8-4P-C-DN | <b>B 261 209 101</b> |
| Offer drawing    | A 261 209 101        |



## Lambda Sensor LSU 4.2

The wide-band lambda sensor LSU 4.2 is a planar  $\text{ZrO}_2$  dual cell limiting current sensor with integrated heater. It is used to measure the oxygen content and the lambda value of engine exhaust gases. Its output signal in the range of  $\lambda = 0,7$  to air makes the LSU capable to be used as an universal sensor for  $\lambda = 1$  measurement as well as for other lambda ranges.

The connector module carries a trimming resistor, which defines the characteristics of the sensor and is necessary for the sensor function. The wide band sensor LSU operates only in conjunction with a special control unit.



| Mechanical data   |                     |
|-------------------|---------------------|
| Length            | 460 mm/600 mm       |
| Thread            | M18 x 1,5           |
| Tightening torque | 60 Nm               |
| Wrench size       | 22 mm               |
| Weight            | 120 g               |
| Vibration         | 30 g/5 Hz ... 2 kHz |

| Fuel additives                                                          |  |
|-------------------------------------------------------------------------|--|
| In accordance with DIN EN 228 for commercially available unleaded fuel. |  |

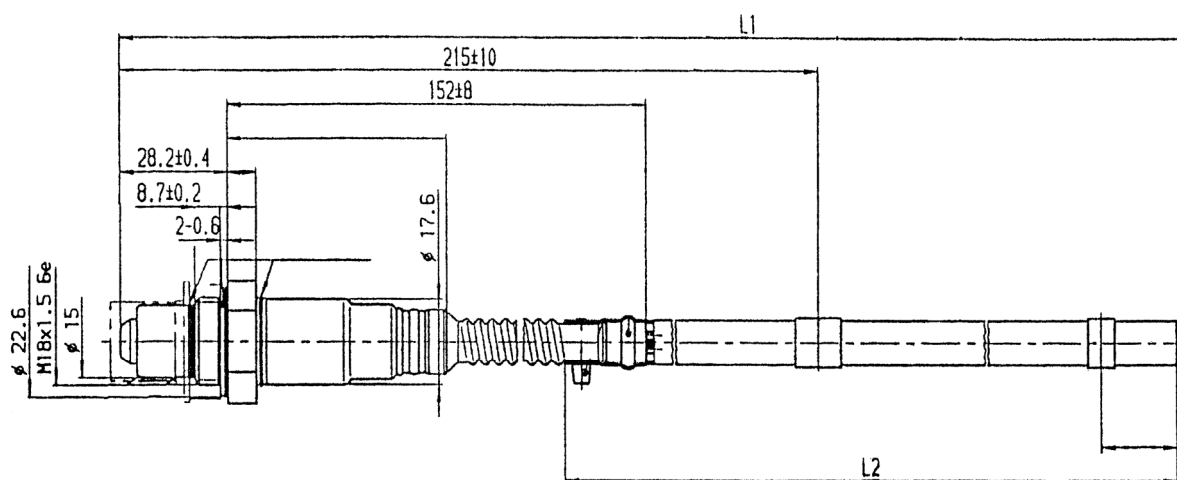
| Temperature ranges                |         |
|-----------------------------------|---------|
| Exhaust gas at sensor element     | 850°C   |
| Hexagon of the sensor housing     | < 570°C |
| Cable grommet (PTFE formed house) |         |
| -Sensor side                      | < 250°C |
| -Cable side                       | < 200°C |
| Cable and protection sleeve       | < 250°C |
| Connector                         | < 120°C |

| Electronic data        |                                          |
|------------------------|------------------------------------------|
| Heater supply voltage  | 9 V                                      |
| Heater power           | 10 W                                     |
| Sensor element         | $\text{ZrO}_2$ (Zirconium-Oxide-Ceramic) |
| Lambda measuring range | 0,70 ... $\infty$                        |

| Installation instructions                                 |  |
|-----------------------------------------------------------|--|
| Please observe the installation instructions on page 106. |  |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 138</b> |

| Part numbers  |                      |
|---------------|----------------------|
| L: 460 mm     | <b>0 258 006 066</b> |
| L: 600 mm     | <b>0 258 006 065</b> |
| Offer drawing | A 258 400 021        |



## Lambda Sensor LSU 4.9

This wide-band lambda is a planar  $\text{ZrO}_2$  dual cell limiting current sensor with integrated heater. It is especially designed for high vibration and ambient temperature applications. Its output signal in the range of  $\lambda = 0,65$  to air makes the LSU capable to be used as an universal sensor for  $\lambda = 1$  measurement as well as for other lambda ranges.

The connector module carries a trimming resistor, which defines the characteristics of the sensor and is necessary for the sensor function. The wide band sensor LSU operates only in conjunction with a special control unit.



| Mechanical data   |                     |
|-------------------|---------------------|
| Length            | 1000 mm             |
| Thread            | M18 x 1,5           |
| Tightening torque | 60 Nm               |
| Wrench size       | 22 mm               |
| Weight            | 120 g               |
| Vibration         | 30 g/5 Hz ... 2 kHz |

| Temperature ranges            |                                         |
|-------------------------------|-----------------------------------------|
| Exhaust gas at sensor element | 930°C                                   |
| Hexagon of the sensor housing | < 570°C                                 |
| Cable grommet cable side      | < 250°C permanent<br>< 200°C short time |
| Cable and protection sleeve   | < 250°C                                 |
| Connector                     | < 150°C                                 |

| Electronic data        |                   |
|------------------------|-------------------|
| Heater supply voltage  | 7,5 V             |
| Heater power           | 7,5 W             |
| Sensor element         | $\text{ZrO}_2$    |
| Lambda measuring range | 0,65 ... $\infty$ |

| Installation instructions                                 |
|-----------------------------------------------------------|
| Please observe the installation instructions on page 106. |

| Fuel additives                                                         |
|------------------------------------------------------------------------|
| In accordance with DIN EN 228 for commercially available unleaded fuel |

| Part number                                         |
|-----------------------------------------------------|
| 1 928 404 687 serial connector <b>0 258 017 025</b> |

## Installation instructions

The Lambda sensor should be installed at a point which permits the measurement of a representative exhaust-gas mixture, and which does not exceed the maximum permissible temperature. The sensor is screwed into a mating thread and tightened with 50 ... 60 Nm.

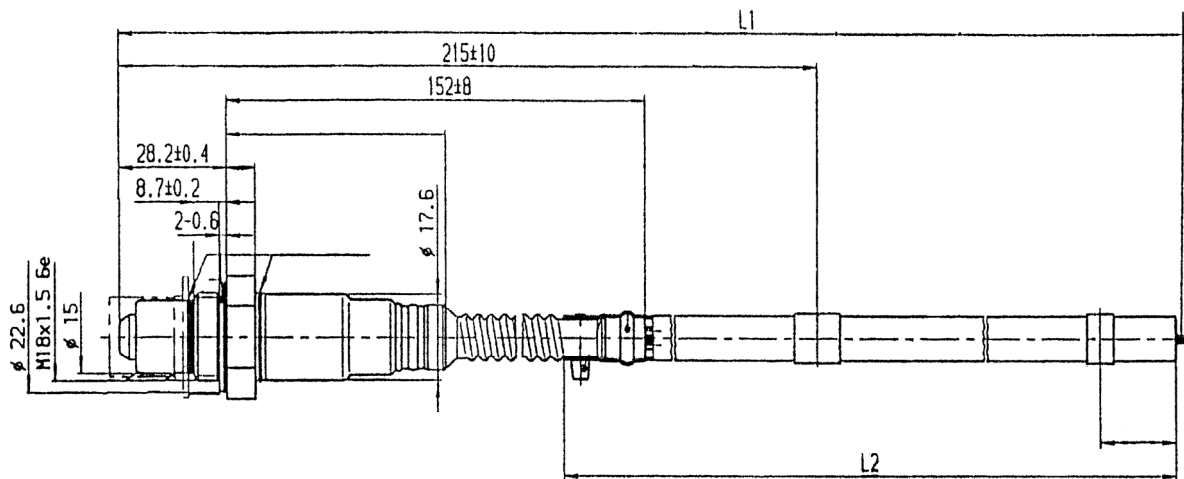
- Install at a point where the gas is as hot as possible.
- Observe the maximum permissible temperatures.
- As far as possible install the sensor vertically, whereby the electrical connections should point upwards.
- The sensor is not to be fitted near to the exhaust outlet so that the influence of the 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 body must be ventilated from the outside in order to avoid overheating.
- The sensor is not to be painted, nor is wax to be applied or any other forms of treatment. Only the recommended grease is to be used for lubricating the threads.
- The sensor receives the reference air through the connection cable. This means that the connector must be clean and dry. Contact spray, and anti-corrosion agents etc. are forbidden.

The connection cable must not be soldered. It must only be crimped, clamped, or secured by screws.

## Connector pinout

For connector 1 928 404 687

| Pin | Name        | Description           |
|-----|-------------|-----------------------|
| 1   | IP          | Pump current          |
| 2   | VM          | Virtual ground        |
| 3   | Gnd heater  | Ground for heater     |
| 4   | Ubat heater | External power supply |
| 5   | RT          | Trim Resistor         |
| 6   | UN          | Nernst voltage        |



## Lambda Sensor Mini-LSU 4.9

This wide-band lambda is a planar  $ZrO_2$  dual cell limiting current sensor with integrated heater. It is especially designed for high vibration and ambient temperature applications. Its output signal in the range of  $\lambda = 0,65$  to air makes the LSU capable to be used as an universal sensor for  $\lambda = 1$  measurement as well as for other lambda ranges.

The connector module carries a trimming resistor, which defines the characteristics of the sensor and is necessary for the sensor function. The wide band sensor LSU operates only in conjunction with a special control unit.



| Mechanical data   |         |
|-------------------|---------|
| Length            | 60 mm   |
| Thread            | M16x1,5 |
| Tightening torque | 30 Nm   |
| Wrench size       | 17 mm   |
| Weight            | 28 g    |

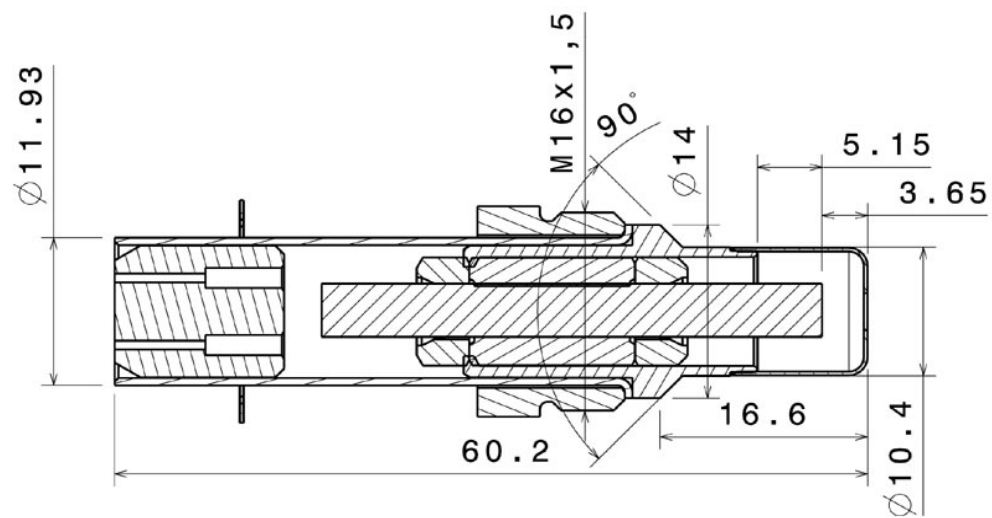
| Temperature ranges            |                                        |
|-------------------------------|----------------------------------------|
| Exhaust gas at sensor element | 850°C                                  |
| Hexagon of the sensor housing | < 570°C                                |
| Cable grommet cable side      | < 310°C pemanent<br>< 500°C short time |
| Cable and protection sleeve   | < 250°C                                |
| Connector                     | < 120°C                                |

| Fuel additives                                                         |  |
|------------------------------------------------------------------------|--|
| In accordance with DIN EN 228 for commercially available unleaded fuel |  |

| Electronic data        |                   |
|------------------------|-------------------|
| Heater supply voltage  | 7,5 V             |
| Heater power           | 7,5 W             |
| Sensor element         | $ZrO_2$           |
| Lambda measuring range | 0,65 ... $\infty$ |

| Connector Pin out                            |             |                       |
|----------------------------------------------|-------------|-----------------------|
| For connectors 1 928 404 682 and AS 007-35PN |             |                       |
| Pin                                          | Name        | Description           |
| 1                                            | IP          | Pump current          |
| 2                                            | VM          | Virtual ground        |
| 3                                            | Gnd heater  | Ground for heater     |
| 4                                            | Ubat heater | External power supply |
| 5                                            | RT          | Trim Resistor         |
| 6                                            | UN          | Nernst voltage        |

| Part numbers                   |                      |
|--------------------------------|----------------------|
| 1 928 404 682 serial connector | <b>B 258 490 103</b> |
| AS 007-35PN                    | <b>B 261 209 353</b> |



## AWS\_LSU 4.9

The AWS\_LSU 4.9 is used in combination with the lambda sensor Mini-LSU 4.9. The box supplies two LSU 4.9 lambda probes. It includes two heaters and converts each specific sensor signal into two separate lambda signals. Further more, the temperature of the sensor, the duty cycle of the heater and diagnosis of the probe is available. The signal output is via CAN-message.



| Mechanical data |                 |
|-----------------|-----------------|
| Weight          | 80 g            |
| Size            | 38 x 43 x 16 mm |
| Cable length    | 150 mm          |

| Conditions for use    |             |
|-----------------------|-------------|
| Operating temperature | 10 ... 60°C |

| Diagnosis                           |                                               |
|-------------------------------------|-----------------------------------------------|
| $\lambda_{\text{Value}} = 0,0069$ : | failed sensor<br>(short cut or not connected) |
| $\lambda_{\text{Value}} = 0,0686$ : | probe did not reach 600°C<br>(up to 30 sec)   |
| $\lambda_{\text{Value}} = 0,1373$ : | heating periode                               |

| Electronic data  |                                                            |
|------------------|------------------------------------------------------------|
| Power supply     | 5 ... 20V                                                  |
| Rent consumption | 120 mA at 12 V<br>+ heater current<br>(max. 2 A per probe) |
| Channels         | 2 A/F                                                      |
| Resolution       | 0,01                                                       |
| Sampling rate    | 100 Hz per channel                                         |

CAN-ID

For each probe, the following CAN-IDs will receive the A/F value as 16-bit unsigned Integer and the heating value and the temperature values as 8-bit unsigned byte (Motorola-type):

| CAN-ID | Byte 0 | Byte 1 | Byte 2 | Byte 3 | Byte 4 | Byte 5 | Byte 6 | Byte 7 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0x290  | A/F1   |        | A/F2   |        | Temp1  | Temp2  | Heat1  | Heat2  |

A/FValue

= 0,001 \* A/Fx

$\lambda$ Value

= A/FValue / 14,57  
= A/F<sub>Digits</sub> / 14570  
= A/F<sub>Digits</sub> \* 0,00006863418

Heiz-Temp

= Temp<sub>x</sub><sub>Digits</sub> \* 2 + 496,9°C

| Part number          |
|----------------------|
| <b>F 01E B01 622</b> |

# Knock Sensors

## Knock Sensor KS-P

This sensor is designed to measure the structure borne noise resulted from irregular engine combustion. The robust sensor is suitable for use under extreme conditions.



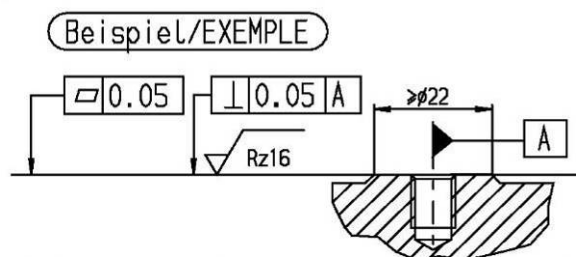
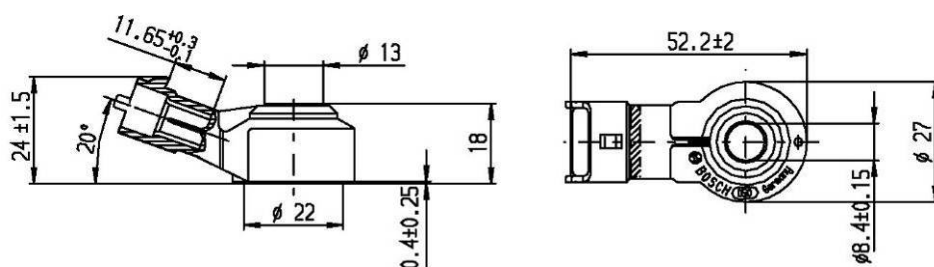
| Mechanical data   |                                                                      |
|-------------------|----------------------------------------------------------------------|
| Thread            | M8 x 30 (aluminium engine block)<br>M8 x 25 (cast iron engine block) |
| Weight            | 48 g                                                                 |
| Tightening torque | 15 ... 25 Nm                                                         |
| Mounting position | random                                                               |

| Conditions for use  |               |
|---------------------|---------------|
| Temperature range   | -40 ... 150°C |
| Vibration, constant | ≤ 80 g        |
| Vibration, short    | ≤ 400 g       |

| Electronic data          |               |
|--------------------------|---------------|
| Main resonance frequency | > 20 kHz      |
| Impedance R:             | > 1MΩ         |
| C                        | 1100 ± 300 pF |
| Measuring range          | 0,1 ... 400 g |
| Sensitivity at 5 kHz     | 26 ± 8 mV/g   |
| Range of frequency       | 1 ... 20 kHz  |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 337</b> |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 261 231 120</b> |
| Offer drawing | A 261 230 170        |



Sensor darf nur auf seinen Metall-  
fläachen aufliegen (keine Sicherungs-  
scheiben verwenden)  
ONLY THE METALLIC PART OF THE  
SENSOR MAY HAVE CONTACT WITH THE  
ENGINE (NO WASHERS ARE TO BE USED)

Auflagefläache soll rotationssymmetrisch zur Gewindebohrung bearbeitet werden.  
THE CONTACT SURFACE MUST BE MACHINED ROTATIONALLY SYMMETRICAL TO THE THREADED BORE.

# Knock Sensor KS-R

This sensor is designed for knock detection and control. It is also available in a DR-25 sleeve with various connector options. Other sensors are available on request.



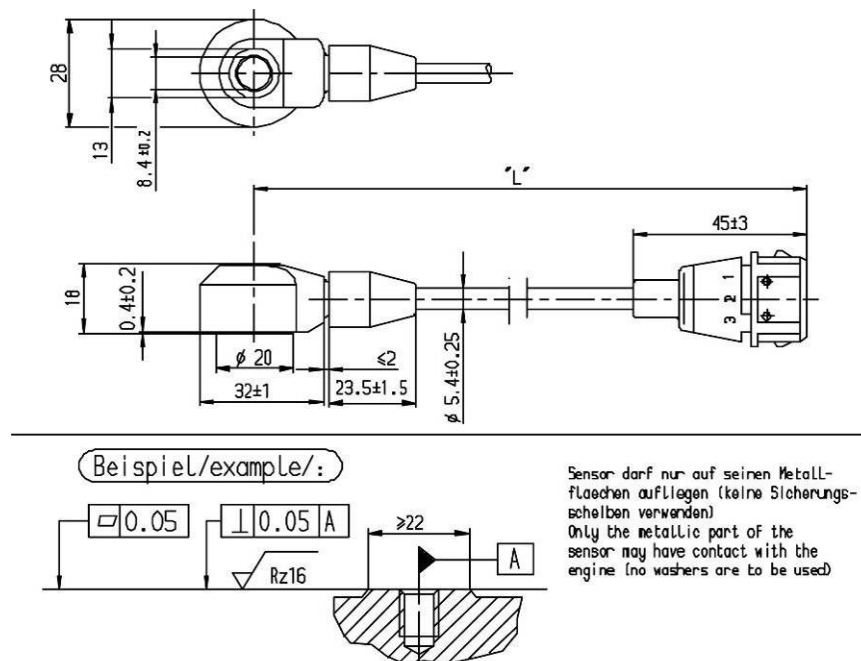
| Mechanical data   |                                                                      |
|-------------------|----------------------------------------------------------------------|
| Thread            | M8 x 30 (aluminium engine block)<br>M8 x 25 (cast iron engine block) |
| Weight            | 82 g                                                                 |
| Tightening torque | 15 ... 25 Nm                                                         |
| Length            | 100 ... 500 mm                                                       |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -40 ... 180°C |

| Electronic data          |                 |
|--------------------------|-----------------|
| Main resonance frequency | > 25 kHz        |
| Impedance R:             | > 1MΩ           |
| C                        | 1200 ± 400 pF   |
| Measuring range          | 0,1 ... 400 g   |
| Sensitivity at 5 kHz     | 26 + 8 - 5 mV/g |
| Range of frequency       | 1 ... 20 kHz    |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 289</b> |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 261 231 047</b> |
| Offer drawing | A 261 230 073-03     |



Auflagefläche soll rotationssymmetrisch zur Gewindebohrung bearbeitet werden.  
The contact surface must be machined rotationally symmetrical to the threaded bore.

# Rotary Potentiometers

## Rotary Potentiometer RP 55

Possible range: 55°

This sensor is designed to measure throttle position, chassis data acquisition and more. The sensor is manufactured in an aluminium housing. Various range and connector options are available on request.

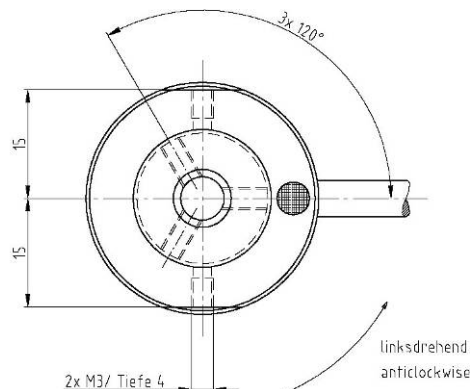
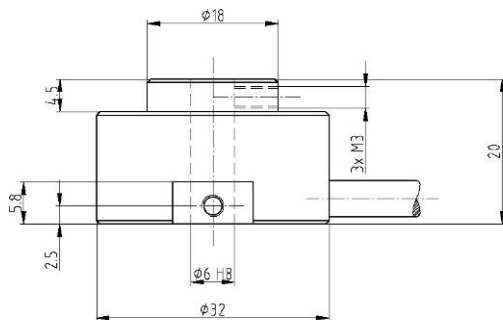


| Mechanical data   |                                  |
|-------------------|----------------------------------|
| Mounting          | 2 x M3                           |
| Standard shaft    | 6 mm                             |
| Length            | 160 ... 300 mm                   |
| Mech. range       | 360°                             |
| Tightening torque | 0,5 Nm                           |
| Weight            | 41 g                             |
| Life expectancy   | > 50 x 10 <sup>6</sup> rotations |

| Electronic data      |          |
|----------------------|----------|
| Nominal resistance   | 5 kΩ     |
| Resistance tolerance | 20 %     |
| Linearity            | ± 0,25 % |
| Temp. coefficient    | 5 ppm/°C |
| Max. current         | 10 mA    |
| Max. power supply    | 50 V     |
| Usual power supply   | 5 V      |

| Conditions for use |                    |
|--------------------|--------------------|
| Temperature range  | -25 ... 75°C       |
| Vibration          | 10 g/30 ... 500 Hz |

| Part number      |                      |
|------------------|----------------------|
| ASL-6-06-05PA-HE | <b>B 261 209 578</b> |
| Offer drawing    | A 261 209 578        |



# Rotary Potentiometer RP 86

Possible range: 86°

This sensor is designed to measure rotational movement, especially throttle positions. Each sensor is individually laser-calibrated.



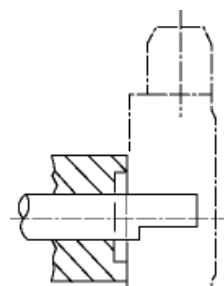
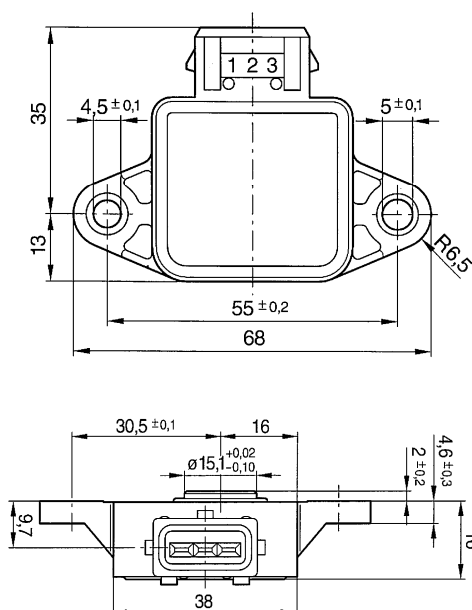
| Mechanical data     |                                 |
|---------------------|---------------------------------|
| Mounting            | 2 x M4                          |
| Length              | 160 ... 300 mm                  |
| Mech. range         | < 86°                           |
| Max. rotation speed | 120 x 1/min                     |
| Tightening torque   | 1,5 ... 2,5 Nm                  |
| Weight              | 60 g                            |
| Life expectancy     | > 2 x 10 <sup>5</sup> rotations |

| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | -40 ... 130°C       |
| Vibration          | 40 g/5 Hz ... 2 kHz |

| Electronic data      |            |
|----------------------|------------|
| Nominal resistance   | 2,5 kΩ     |
| Resistance tolerance | 20 %       |
| Non-linearity        | 0,9 %      |
| Repetitive accuracy  | 0,01 %     |
| Temp. coefficient    | < 5 ppm/°C |
| Max. power supply    | 42 V       |
| Usual power supply   | 5 V        |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 334</b> |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 280 122 016</b> |
| Offer drawing | A 280 121 252        |



# Rotary Potentiometer RP 100

Possible range: 100°

This sensor is designed to measure rotational movement. Each sensor is individually laser-calibrated. It is manufactured in a DR-25 sleeve, various connector options are available.

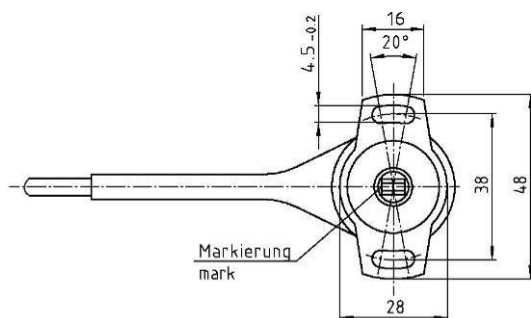


| Mechanical data     |                                  |
|---------------------|----------------------------------|
| Mounting            | 2 x M4                           |
| Length              | 160 ... 300 mm                   |
| Mech. range         | 360°                             |
| Max. rotation speed | 120 x 1/min                      |
| Tightening torque   | 0,5 Nm                           |
| Weight              | 60 g                             |
| Lifetime            | > 50 x 10 <sup>5</sup> rotations |

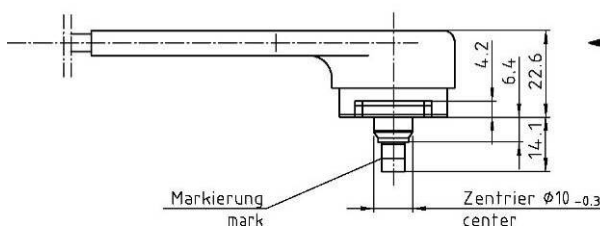
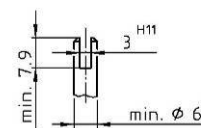
| Electronic data      |            |
|----------------------|------------|
| Nominal resistance   | 3 kΩ       |
| Resistance tolerance | 20 %       |
| Non-linearity        | 0,9 %      |
| Repetitive accuracy  | 0,01 %     |
| Temp. coefficient    | < 5 ppm/°C |
| Max. power supply    | 42 V       |
| Usual power supply   | 5 V        |

| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | -20 ... 150°C       |
| Vibration          | 40 g/5 Hz ... 2 kHz |

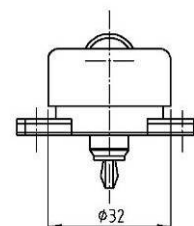
| Part number      |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 127</b> |
| Offer drawing    | A 261 209 127        |



- Abmessungen der Antriebsseite  
- dimension of driveshaft



Ansicht B  
view



## Rotary Potentiometer RP 100 twin

Possible range: 2 x 100°

The Rotary Potentiometer RP 100 twin is used in applications where redundant signals are necessary to ensure that the system runs failsafe. A typical field of application are electronic throttle control systems where angle movement is measured by the RP 100 twin.

The sensor is manufactured in a DR-25 sleeve. Various connector options are available.



| Mechanical data     |                                  |
|---------------------|----------------------------------|
| Mounting            | 2 x M4                           |
| Length              | 160 ... 300 mm                   |
| Mech. range         | ± 360°                           |
| Max. rotation speed | 120 x 1/min                      |
| Tightening torque   | 0,5 Nm                           |
| Weight              | g                                |
| Lifetime            | > 50 x 10 <sup>5</sup> rotations |
| Protection          | IP 65                            |

| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | -40 ... 150°C       |
| Vibration          | 20 g/5 Hz ... 2 kHz |

| Electronic data      |            |
|----------------------|------------|
| Nominal resistance   | 3 kΩ       |
| Resistance tolerance | 20 %       |
| Non-linearity        | ±1 %       |
| Repetitive accuracy  | ≤ 0,01 %   |
| Temp. coefficient    | < 5 ppm/°C |
| Max. power supply    | 42 V       |
| Usual power supply   | 5 V        |

| Part numbers         |                      |
|----------------------|----------------------|
| <b>Anticlockwise</b> |                      |
| AS 6-07-35PN         | <b>B 261 209 594</b> |
| Offer drawing        | <b>A 261 209 594</b> |
| <b>Clockwise</b>     |                      |
| AS 6-07-35PN         | <b>B 261 209 591</b> |
| Offer drawing        | <b>A 261 209 591</b> |

# Rotary Potentiometer RP 130

Possible range: 130°

This sensor is designed to measure rotational movement. Each sensor is individually laser-calibrated. It is manufactured in a DR-25 sleeve, various connector options are available.

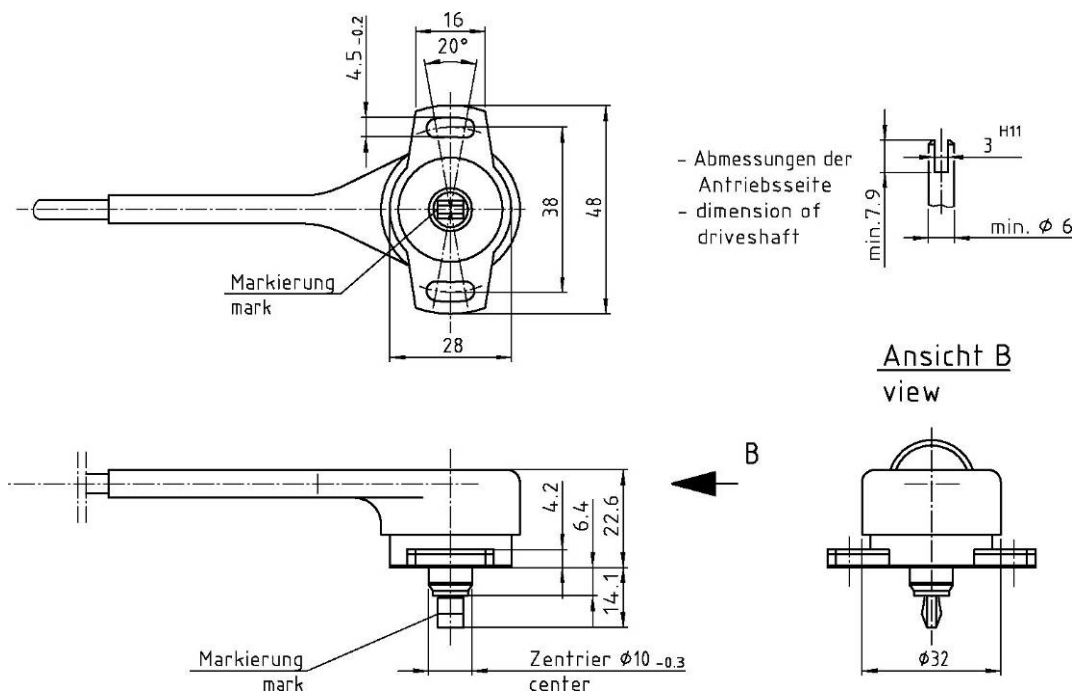


| Mechanical data     |                                  |
|---------------------|----------------------------------|
| Mounting            | 2 x M4                           |
| Length              | 160 ... 300 mm                   |
| Mech. range         | 360°                             |
| Max. rotation speed | 120 x 1/min                      |
| Tightening torque   | 0,5 Nm                           |
| Weight              | 60 g                             |
| Lifetime            | > 50 x 10 <sup>5</sup> rotations |

| Electronic data      |            |
|----------------------|------------|
| Nominal resistance   | 3 kΩ       |
| Resistance tolerance | 20 %       |
| Non-linearity        | 0,9 %      |
| Repetitive accuracy  | 0,01 %     |
| Temp. coefficient    | < 5 ppm/°C |
| Max. power supply    | 42 V       |
| Usual power supply   | 5 V        |

| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | -20 ... 150°C       |
| Vibration          | 40 g/5 Hz ... 2 kHz |

| Part number      |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 128</b> |
| Offer drawing    | A 261 209 128        |



# Rotary Potentiometer RP 130-M

Possible range: 130°

This sensor is designed to measure rotational movement. Each sensor is individually laser-calibrated. It is manufactured in a DR-25 sleeve, various connector options are available. Metal housing.

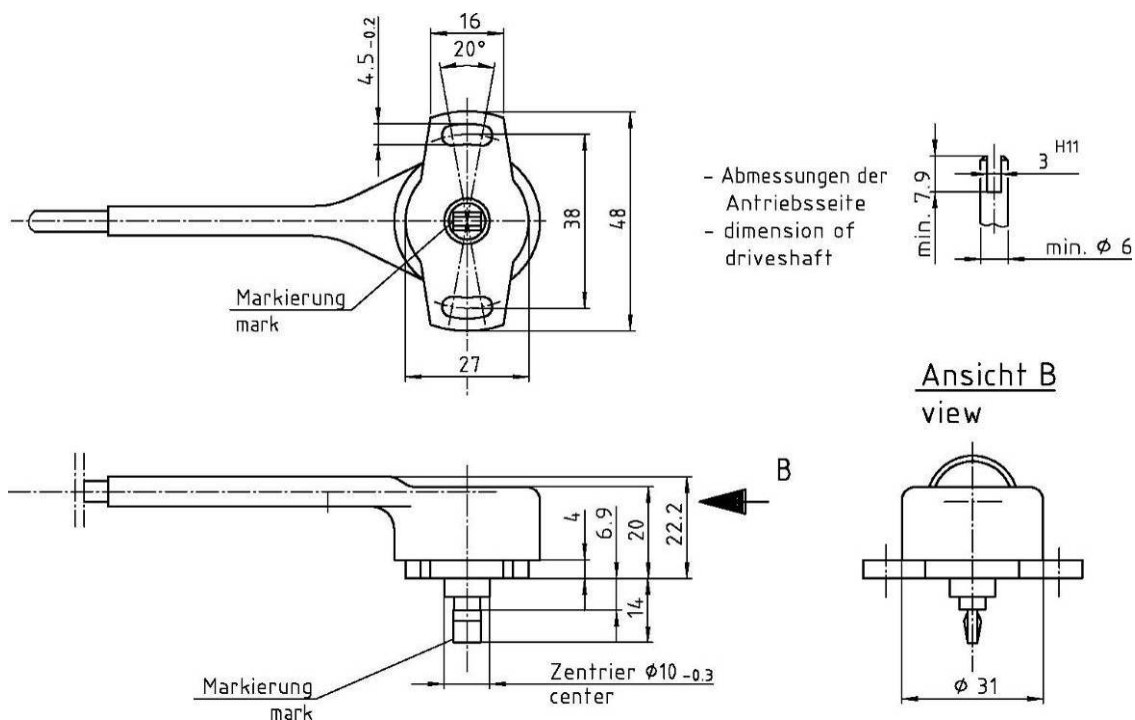


| Mechanical data     |                                  |
|---------------------|----------------------------------|
| Mounting            | 2 x M4                           |
| Length              | 160 ... 300 mm                   |
| Mech. range         | 360°                             |
| Max. rotation speed | 120 x 1/min                      |
| Tightening torque   | 0,5 Nm                           |
| Weight              | 60 g                             |
| Lifetime            | > 50 x 10 <sup>5</sup> rotations |

| Electronic data      |            |
|----------------------|------------|
| Nominal resistance   | 3 kΩ       |
| Resistance tolerance | 20 %       |
| Non-linearity        | 0,9 %      |
| Repetitive accuracy  | 0,01 %     |
| Temp. coefficient    | < 5 ppm/°C |
| Max. power supply    | 42 V       |
| Usual power supply   | 5 V        |

| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | -55 ... 125°C       |
| Vibration          | 40 g/5 Hz ... 2 kHz |

| Part number      |                      |
|------------------|----------------------|
| KPTA 6E6-4P-C-DN | <b>B 261 209 576</b> |
| Offer drawing    | A 261 209 576        |



# Rotary Potentiometer RP 308

Possible range: 308°

This sensor is designed to measure rotational movement. Each sensor is individually laser-calibrated. It is manufactured in a DR-25 sleeve, various connector options are available.

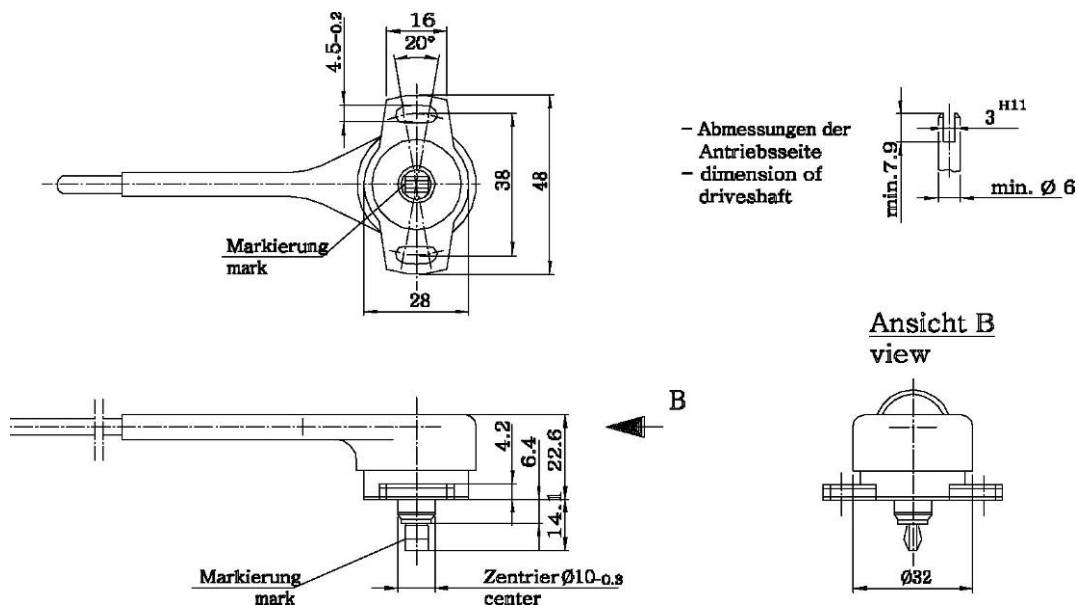


| Mechanical data     |                              |
|---------------------|------------------------------|
| Mounting            | 2 x M4                       |
| Length              | 160 ... 300 mm               |
| Mech. range         | $\pm 360^\circ$              |
| Max. rotation speed | 120 x 1/min                  |
| Tightening torque   | 0,5 Nm                       |
| Weight              | 60 g                         |
| Lifetime            | $> 50 \times 10^5$ rotations |

| Electronic data      |                             |
|----------------------|-----------------------------|
| Nominal resistance   | 5 k $\Omega$                |
| Resistance tolerance | 20 %                        |
| Non-linearity        | 0,9 %                       |
| Repetitive accuracy  | 0,01 %                      |
| Temp. coefficient    | $< 5$ ppm/ $^\circ\text{C}$ |
| Max. power supply    | 42 V                        |
| Usual power supply   | 5 V                         |

| Conditions for use |                              |
|--------------------|------------------------------|
| Temperature range  | -20 ... 150 $^\circ\text{C}$ |
| Vibration          | 40 g/5 Hz ... 2 kHz          |

| Part number      |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 570</b> |
| Offer drawing    | <b>A 261 209 570</b> |



# Rotary Potentiometer RP 350-M

Possible range: 350°

This sensor is designed to measure rotational movement. Each sensor is individually laser-calibrated. It is manufactured in a DR-25 sleeve, various connector options are available. Metal housing.

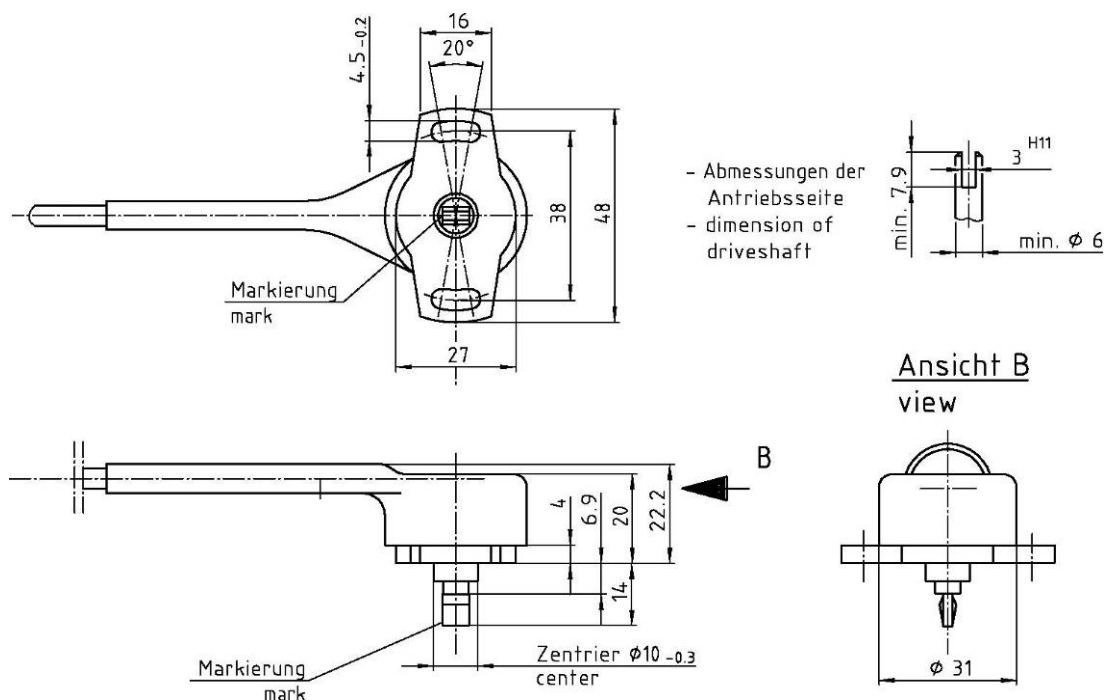


| Mechanical data     |                                  |
|---------------------|----------------------------------|
| Mounting            | 2 x M4                           |
| Length              | 160 ... 300 mm                   |
| Mech. range         | 360°                             |
| Max. rotation speed | 120 x 1/min                      |
| Tightening torque   | 0,5 Nm                           |
| Weight              | 60 g                             |
| Lifetime            | > 50 x 10 <sup>5</sup> rotations |

| Electronic data      |            |
|----------------------|------------|
| Nominal resistance   | 6 kΩ       |
| Resistance tolerance | 20 %       |
| Non-linearity        | 0,9 %      |
| Repetitive accuracy  | 0,01 %     |
| Temp. coefficient    | < 5 ppm/°C |
| Max. power supply    | 42 V       |
| Usual power supply   | 5 V        |

| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | -55 ... 125°C       |
| Vibration          | 40 g/5 Hz ... 2 kHz |

| Part number      |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 577</b> |
| Offer drawing    | A 261 209 577        |



# Linear Potentiometers

## Linear Potentiometer LP 10

Possible mechanical range: 10 mm

This sensor is designed to measure stabilizer movement. It is manufactured in a DR-25 sleeve. Various connector options are available.



### Mechanical data

|              |                 |
|--------------|-----------------|
| Mounting     | 2 x M3          |
| Cable length | 150 ... 1000 mm |
| Weight       | 70 g            |

### Conditions for use

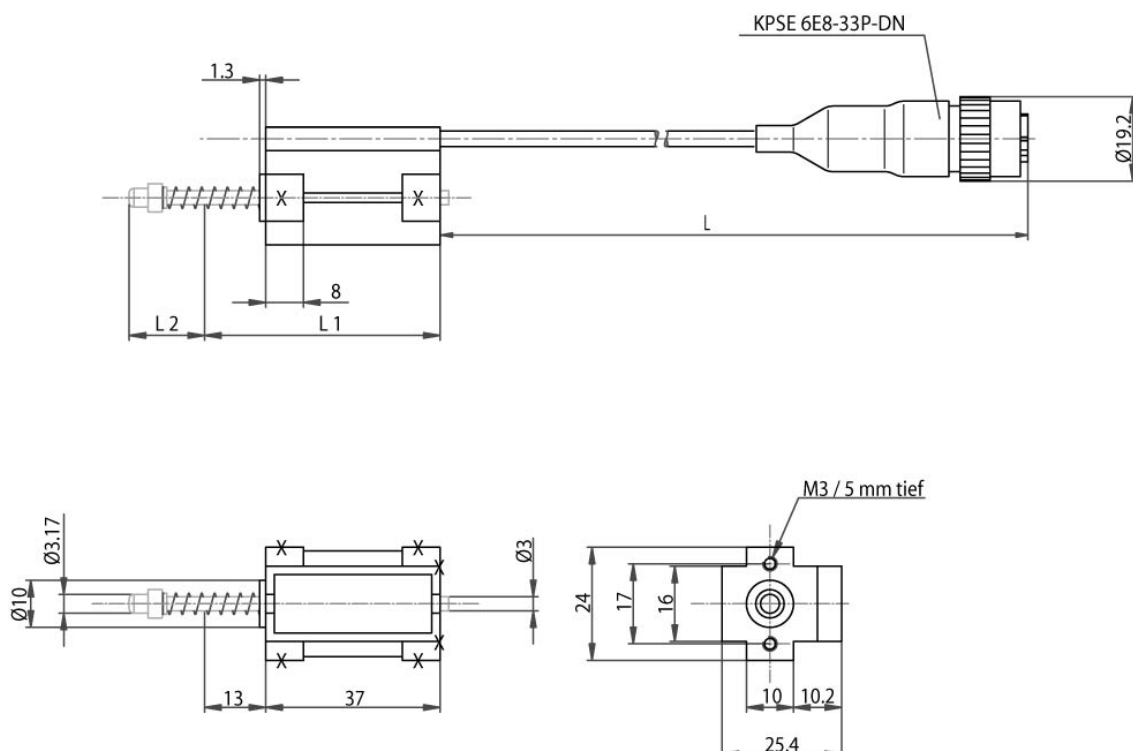
|                   |              |
|-------------------|--------------|
| Temperature range | -25 ... 75°C |
|-------------------|--------------|

### Electronic data

|                    |                         |
|--------------------|-------------------------|
| Nominal resistance | 1 k $\Omega$ $\pm$ 20 % |
| Max. current       | 1 mA                    |
| Non-linearity      | 1 %                     |
| Usual power supply | 5 V                     |
| Power consumption  | 0,3 W                   |

### Part number

|                 |                      |
|-----------------|----------------------|
| KPSE 6E8-33P-DN | <b>B 261 209 535</b> |
| Offer drawing   | <b>A 261 209 535</b> |



# Linear Potentiometer LP 25 twin

## Possible mechanical range: 25 mm

The Linear Potentiometer LP 25 twin is used in applications where redundant signals are necessary to ensure that the system runs failsafe. A typical field of application are electronic throttle control systems. Various connector options are available.

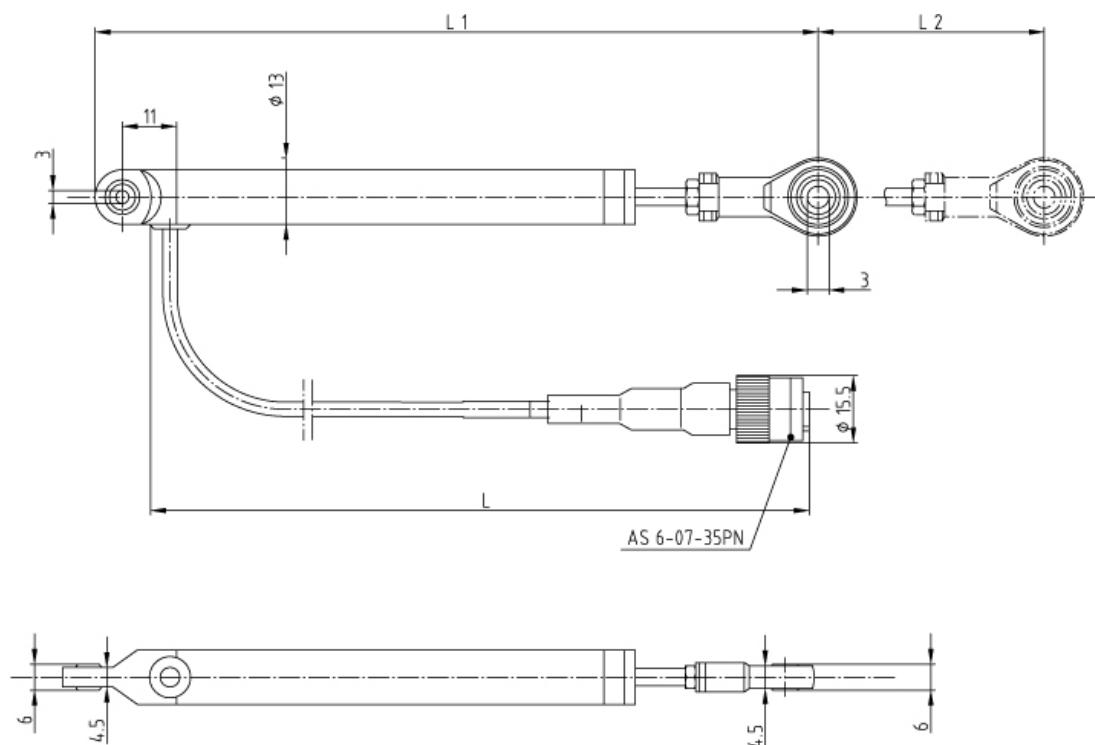


| Mechanical data           |                 |
|---------------------------|-----------------|
| Possible mech. range [L2] | 50 mm           |
| Min. length [L1]          | 120 mm          |
| Cable length [L]          | 150 ... 1000 mm |
| Mounting hole             | Ø 3 mm          |
| Protection                | IP 66           |
| Max. shaft velocity       | 10 m/sec        |
| Weight                    | approx. 50 g    |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -30 ... 100°C |

| Electronic data                   |        |
|-----------------------------------|--------|
| Nominal resistance [25 ... 50 mm] | 1 kΩ   |
| Non-linearity                     | 0,25 % |
| Usual power supply                | 5 V    |
| Max. power supply                 | 45 V   |

| Part number   |                      |
|---------------|----------------------|
| AS 6-07-35PN  | <b>B 261 209 858</b> |
| Offer drawing | A 261 209 858        |



# Linear Potentiometer LP 50

## Possible mechanical range: 50 mm

This sensor is designed to measure gear position, throttle position or suspension movement. It is manufactured in a DR-25 sleeve, various connector options are available.

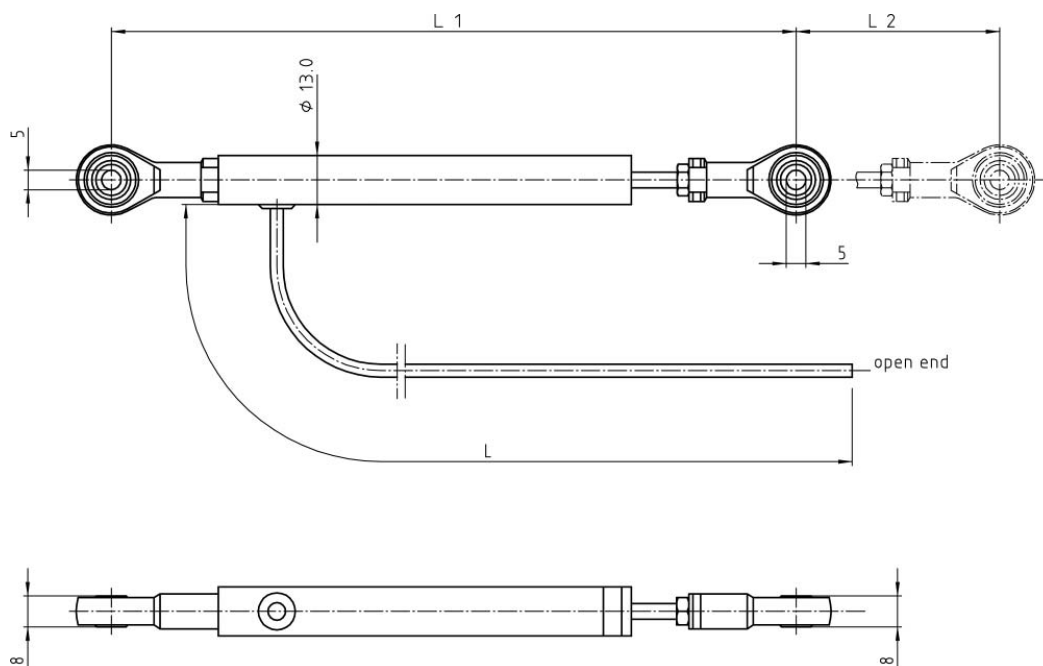


| Mechanical data           |                   |
|---------------------------|-------------------|
| Possible mech. range [L2] | 50 mm             |
| Min. length [L1]          | 172 mm            |
| Cable length [L]          | 150 ... 1000 mm   |
| Mounting                  | 2 x M5            |
| Sealing                   | O-ring shaft seal |
| Tightening torque         | 10 Nm             |
| Max. shaft velocity       | 1000 mm/sec       |
| Weight [25 ... 150 mm]    | 90 ... 150 g      |

| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -20 ... 85°C      |
| Vibration          | 10 g/5 ... 500 Hz |
| Shock              | 30 g/11 ms        |

| Electronic data                    |        |
|------------------------------------|--------|
| Nominal resistance [25 ... 150 mm] | 2 kΩ   |
| Max. current                       | < 1 mA |
| Non-linearity                      | 0,25 % |
| Usual power supply                 | 5 V    |
| Max. power supply                  | 42 V   |

| Part number      |                      |
|------------------|----------------------|
| KPTA 6E6-4P-C-DN | <b>B 261 209 136</b> |
| Offer drawing    | A 261 209 136        |



# Linear Potentiometer LP 50 twin

## Possible mechanical range: 50 mm

The Linear Potentiometer LP 50 twin is used in applications where redundant signals are necessary to ensure that the system runs failsafe. A typical field of application are electronic throttle control systems. Various connector options are available.

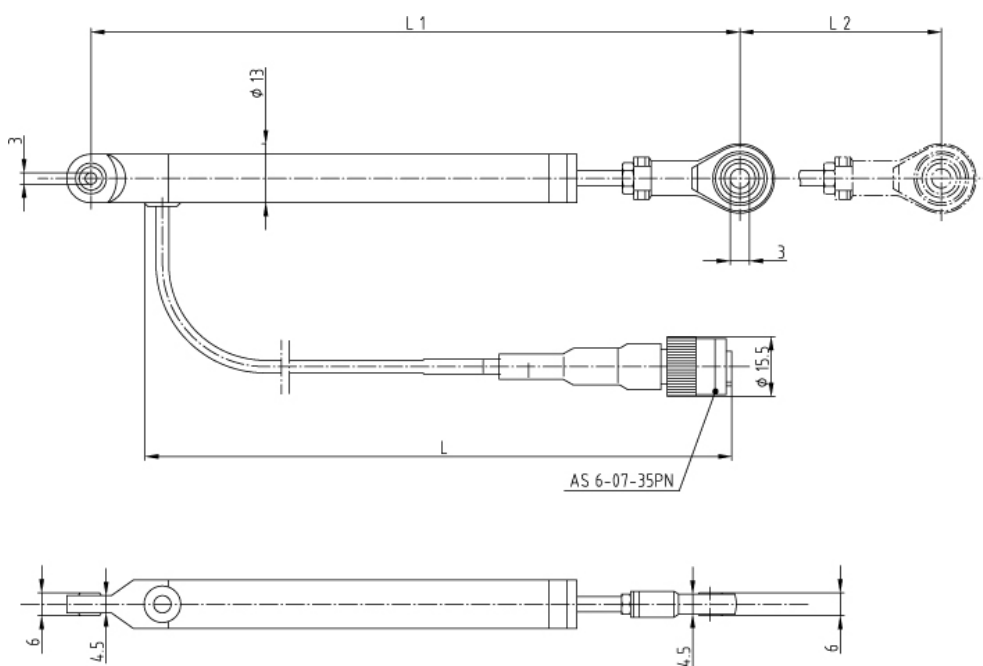


| Mechanical data           |                 |
|---------------------------|-----------------|
| Possible mech. range [L2] | 50 mm           |
| Min. length [L1]          | 120 mm          |
| Cable length [L]          | 150 ... 1000 mm |
| Mounting hole             | Ø 3 mm          |
| Protection                | IP 66           |
| Max. shaft velocity       | 10 mm/sec       |
| Weight                    | approx. 60 g    |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -30 ... 100°C |

| Electronic data                   |        |
|-----------------------------------|--------|
| Nominal resistance [25 ... 50 mm] | 2 kΩ   |
| Non-linearity                     | 0,25 % |
| Usual power supply                | 5 V    |
| Max. power supply                 | 45 V   |

| Part number   |                      |
|---------------|----------------------|
| AS 6-07-35N   | <b>B 261 209 859</b> |
| Offer drawing | A 261 209 859        |



# Linear Potentiometer LP 75

## Possible mechanical range: 75 mm

This sensor is designed to measure gear position, throttle position or suspension movement. It is manufactured in a DR-25 sleeve, various connector options are available.

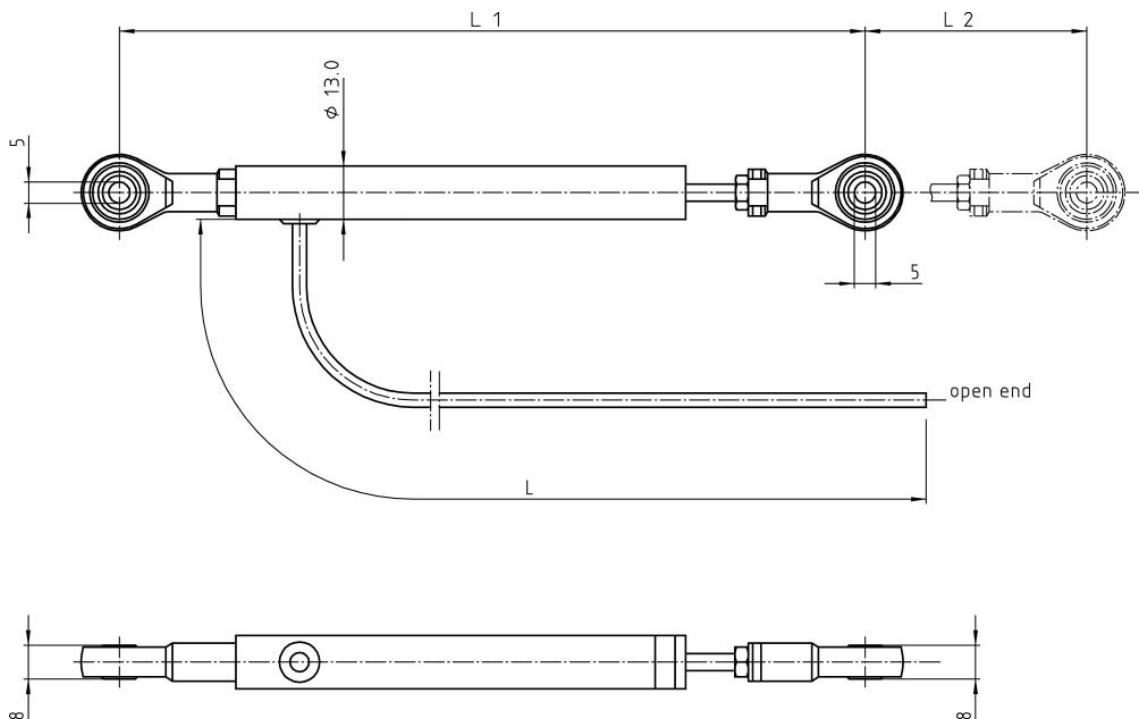


| Mechanical data           |                   |
|---------------------------|-------------------|
| Possible mech. range [L2] | 75 mm             |
| Min. length [L1]          | 197 mm            |
| Cable length [L]          | 150 ... 1000 mm   |
| Mounting                  | 2 x M5            |
| Sealing                   | O-ring shaft seal |
| Tightening torque         | 10 Nm             |
| Max. shaft velocity       | 1000 mm/sec       |
| Weight [25 ... 150 mm]    | 90 ... 150 g      |

| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -20 ... 85°C      |
| Vibration          | 10 g/5 ... 500 Hz |
| Shock              | 30 g/11 ms        |

| Electronic data                    |        |
|------------------------------------|--------|
| Nominal resistance [25 ... 150 mm] | 3 kΩ   |
| Max. current                       | < 1 mA |
| Non-linearity                      | 0,15 % |
| Usual power supply                 | 5 V    |
| Max. power supply                  | 42 V   |

| Part number     |                      |
|-----------------|----------------------|
| KPSE 6E8-33P-DN | <b>B 261 209 530</b> |
| Offer drawing   | A 261 209 530        |



# Linear Potentiometer LP 75F

## Possible mechanical range: 75 mm

This sensor is designed to measure gear position, throttle position or suspension movement. It is manufactured in a DR-25 sleeve, various connector options are available. Optionally a protective sleeve for the telescopic shaft can be ordered.

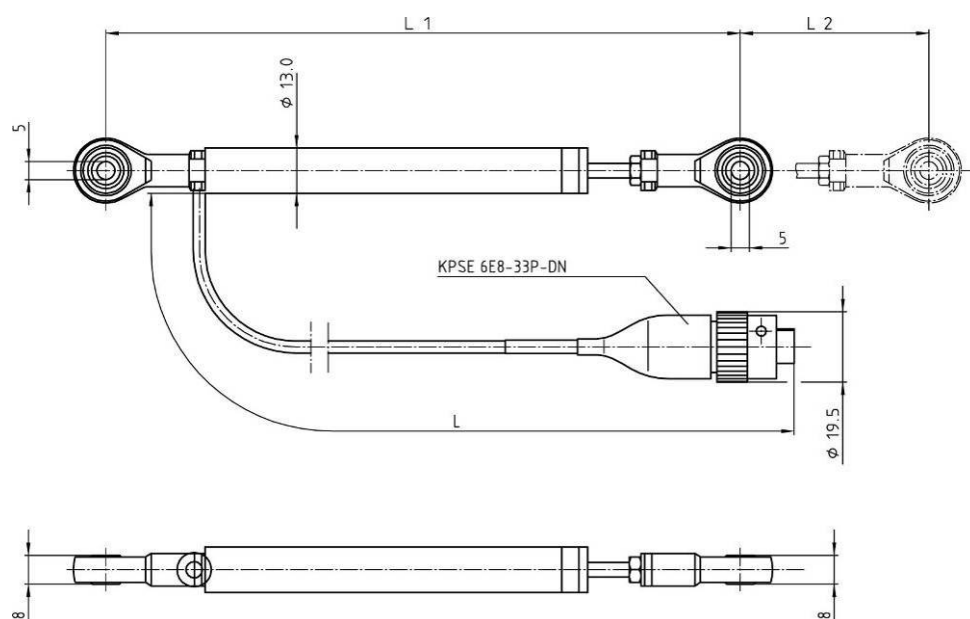


| Mechanical data         |                   |
|-------------------------|-------------------|
| Cable length L          | 150 ... 1000 mm   |
| Min. length L1          | 220 mm            |
| Possible mech. range L2 | 79 mm             |
| Mounting                | 2 x M5            |
| Sealing                 | O-ring shaft seal |
| Max. shaft velocity     | 10 m/sec          |
| Weight                  | 52 g              |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -30 ... 100°C |

| Electronic data    |        |
|--------------------|--------|
| Nominal resistance | 3 kΩ   |
| Max. current       | < 1 mA |
| Non-linearity      | 0,15 % |
| Usual power supply | 5 V    |
| Max. power supply  | 47 V   |

| Part number     |                      |
|-----------------|----------------------|
| KPSE 6E8-33P-DN | <b>B 261 209 852</b> |
| Offer drawing   | A 261 209 852        |



# Linear Potentiometer LP 100

Possible mechanical range: 100 mm

This sensor is designed to measure gear position, throttle position or suspension movement. It is manufactured in a DR-25 sleeve, various connector options are available.

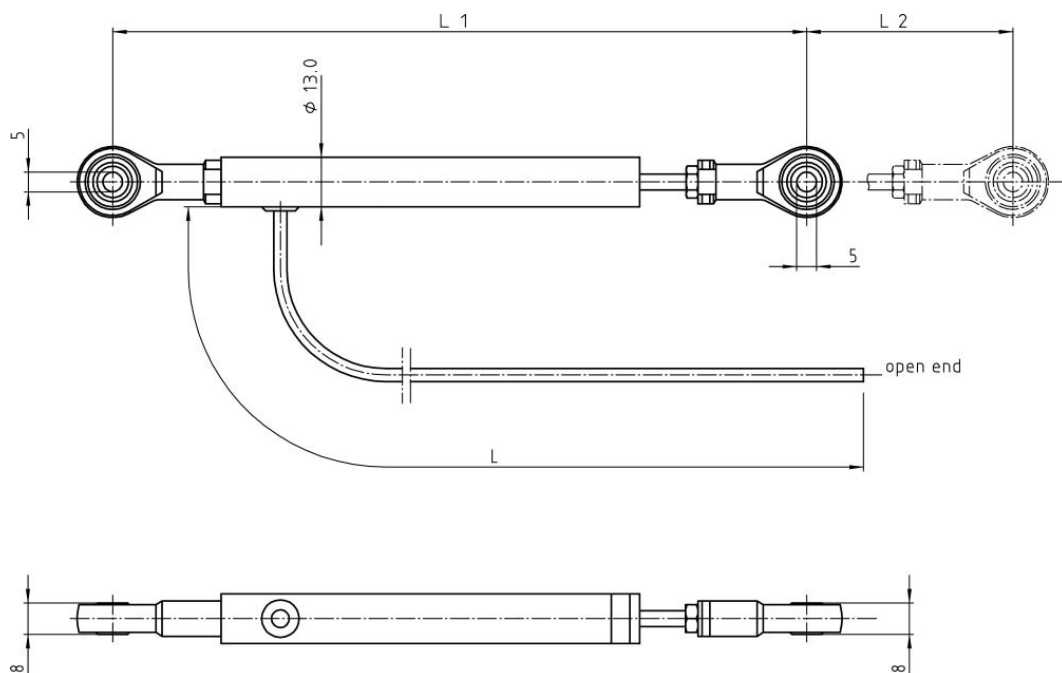


| Mechanical data           |                   |
|---------------------------|-------------------|
| Possible mech. range [L2] | 100 mm            |
| Min. length [L1]          | 220 mm            |
| Cable length [L]          | 150 ... 1000 mm   |
| Mounting                  | 2 x M5            |
| Tightening torque         | 10 Nm             |
| Sealing                   | O-ring shaft seal |
| Max. shaft velocity       | 1000 mm/sec       |
| Weight [25 ... 150 mm]    | 90 ... 150 g      |

| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -20 ... 85°C      |
| Vibration          | 10 g/5 ... 500 Hz |
| Shock              | 30 g/11 ms        |

| Electronic data                    |        |
|------------------------------------|--------|
| Nominal resistance [25 ... 150 mm] | 4 kΩ   |
| Max. current                       | < 1 mA |
| Non-linearity                      | 0,15 % |
| Usual power supply                 | 5 V    |
| Max. power supply                  | 42 V   |

| Part numbers     |                      |
|------------------|----------------------|
| KPSE 6E8-33P-DN  | <b>B 261 209 134</b> |
| Offer drawing    | A 261 209 134        |
| KPTA 6E6-4P-C-DN | <b>B 261 209 137</b> |
| Offer drawing    | A 261 209 137        |



# Linear Potentiometer LP 100F

Possible mechanical range: 100 mm

This sensor is designed to measure gear position, throttle position or suspension movement. It is manufactured in a DR-25 sleeve, various connector options are available. Optionally a protective sleeve for the telescopic shaft can be ordered.

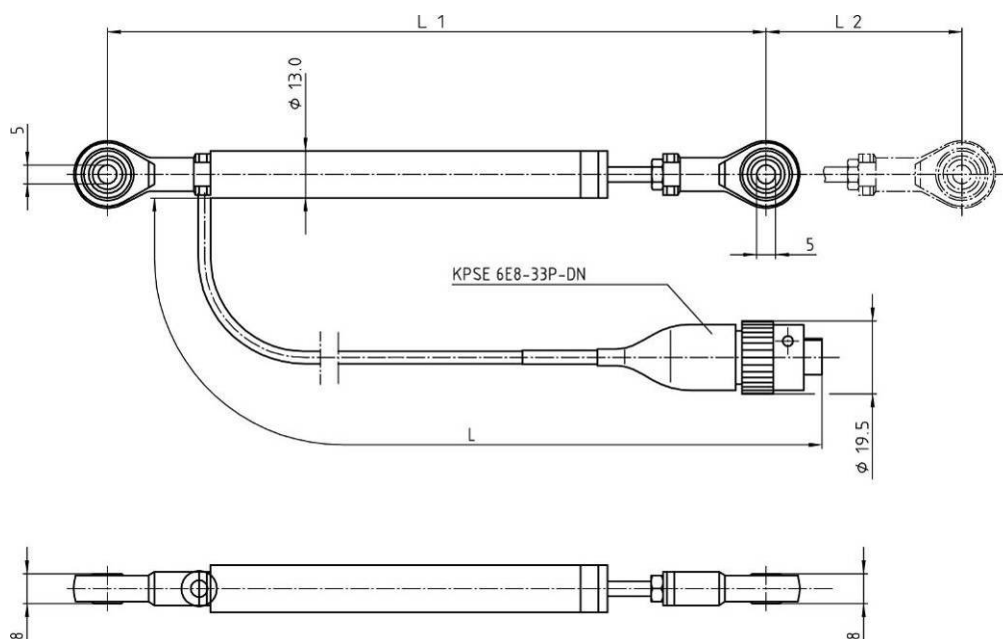


| Mechanical data         |                   |
|-------------------------|-------------------|
| Cable length L          | 150 ... 1000 mm   |
| Min. length L1          | 244 mm            |
| Possible mech. range L2 | 104 mm            |
| Mounting                | 2 x M5            |
| Sealing                 | O-ring shaft seal |
| Max. shaft velocity     | 10 m/sec          |
| Weight                  | 62 g              |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -30 ... 100°C |

| Electronic data    |        |
|--------------------|--------|
| Nominal resistance | 4 kΩ   |
| Max. current       | < 1 mA |
| Non-linearity      | 0,15 % |
| Usual power supply | 5 V    |
| Max. power supply  | 74 V   |

| Part number     |                      |
|-----------------|----------------------|
| KPSE 6E8-33P-DN | <b>B 261 209 853</b> |
| Offer drawing   | A 261 209 853        |



# Linear Potentiometer LP 150

Possible mechanical range: 150 mm

This sensor is designed to measure gear position, throttle position or suspension movement. It is manufactured in a DR-25 sleeve, various connector options are available.

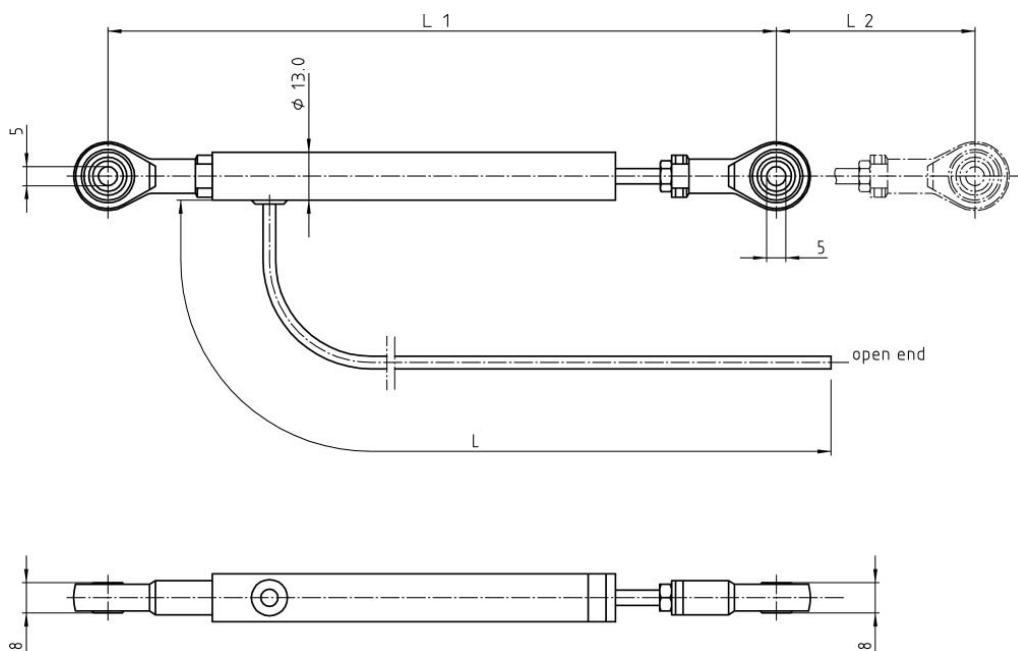


| Mechanical data           |                   |
|---------------------------|-------------------|
| Possible mech. range [L2] | 150 mm            |
| Min. length [L1]          | 278 mm            |
| Cable length [L]          | 150 ... 1000 mm   |
| Mounting                  | 2 x M5            |
| Sealing                   | O-ring shaft seal |
| Tightening torque         | 10 Nm             |
| Max. shaft velocity       | 1000 mm/sec       |
| Weight [25 ... 150 mm]    | 90 ... 150 g      |

| Conditions for use |                   |
|--------------------|-------------------|
| Temperature range  | -20 ... 85°C      |
| Vibration          | 10 g/5 ... 500 Hz |
| Shock              | 30 g/11 ms        |

| Electronic data                    |        |
|------------------------------------|--------|
| Nominal resistance [25 ... 150 mm] | 6 kΩ   |
| Max. current                       | < 1 mA |
| Non-linearity                      | 0,15 % |
| Usual power supply                 | 5 V    |
| Max. power supply                  | 42 V   |

| Part numbers     |                      |
|------------------|----------------------|
| KPTA 6E6-4P-C-DN | <b>B 261 209 138</b> |
| Offer drawing    | A 261 209 138        |
| AS 6-06-05PA-HE  | <b>B 261 209 534</b> |
| Offer drawing    | A 261 209 534        |



# Wire Potentiometers

## Wire Potentiometer WP 35

Possible mechanical range: 35 mm

Wire sensors are suitable for measuring linear and non-linear motions. The compact style allows flexible and easy installation. Due to the small size, precise measurement is possible even in difficult applications.

Various connector options available.



| Mechanical data      |                                |
|----------------------|--------------------------------|
| Possible mech. range | 38,1 mm                        |
| Mounting             | 2 x 2-56 THD                   |
| Cable length         | 150 ... 450 mm                 |
| Tightening torque    | 1,5 ... 2,5 Nm                 |
| Weight               | 15 g                           |
| Life expectancy      | 50 x 10 <sup>6</sup> rotations |
| Protection           | IP 54                          |
| Dimensions           | 19 x 19 x 9,7 mm               |

| Conditions for use      |                         |
|-------------------------|-------------------------|
| Temperature range       | -65 ... 125°C           |
| Max. cable acceleration | 15 g                    |
| Max. cable tension      | 1,7 N                   |
| Shock                   | 100 g for 6 ms          |
| Vibration               | 10 Hz ... 2 kHz at 15 g |

| Accessories |  |
|-------------|--|
| Holder      |  |

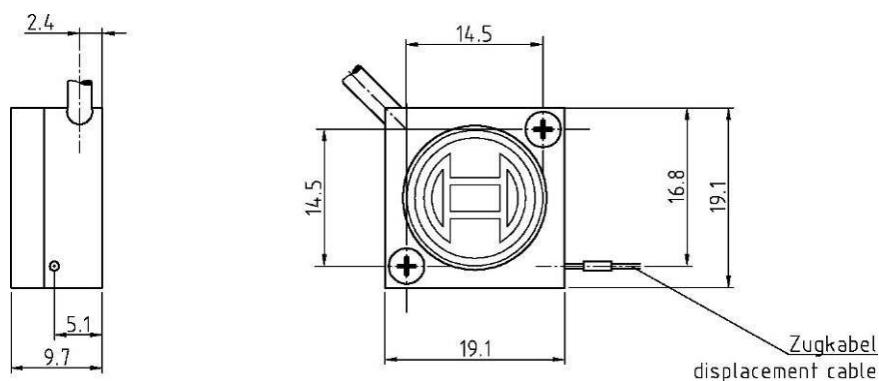
| Electronic data    |               |
|--------------------|---------------|
| Nominal resistance | 5,0 kΩ ± 10 % |
| Non-linearity      | ± 0,5 %       |
| Usual power supply | 5 V           |
| Max. power supply  | 50 V          |

| Part numbers     |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 541</b> |
| Offer drawing    | A 261 209 541        |
| Holder           | <b>B 261 209 864</b> |

### ! Caution !

#### User, please observe the following:

- Ensure electrical connections are performed according to the enclosed Position Transducer User's Guide.
- Do not allow the cable to snap back (freely retract). This will cause damage and void the warranty. Tension must be maintained on the cable at all times.



# Wire Potentiometer WP 50

Possible mechanical range: 50 mm

Wire sensors are suitable for measuring linear and non-linear motions. The compact style allows flexible and easy installation. Due to the small size, precise measurement is possible even in difficult applications.

Various connector options available. We offer repair service for this product.



| Mechanical data      |                                |
|----------------------|--------------------------------|
| Possible mech. range | 50,8 mm                        |
| Mounting             | 2 x 2-56 THD                   |
| Cable length         | 150 ... 450 mm                 |
| Tightening torque    | 1,5 ... 2,5 Nm                 |
| Weight               | 28 g                           |
| Life expectancy      | 50 x 10 <sup>6</sup> rotations |
| Protection           | IP 54                          |
| Dimensions           | 24,4 x 11,4 mm                 |

| Conditions for use      |                         |
|-------------------------|-------------------------|
| Temperature range       | -65 ... 125°C           |
| Max. cable acceleration | 40 g                    |
| Max. cable tension      | 3,3 N                   |
| Shock                   | 100 g for 6 ms          |
| Vibration               | 10 Hz ... 2 kHz at 15 g |

| Accessories |  |
|-------------|--|
| Holder      |  |

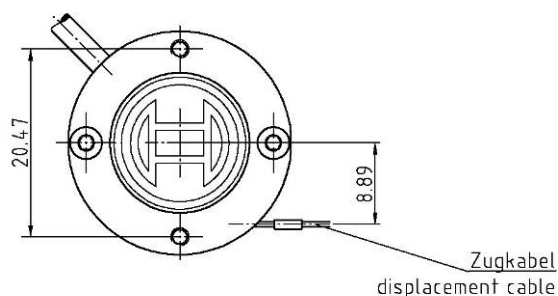
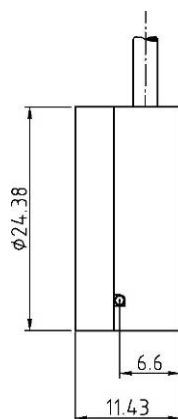
| Electronic data    |               |
|--------------------|---------------|
| Nominal resistance | 5,0 kΩ ± 10 % |
| Non-linearity      | ± 0,5 %       |
| Usual power supply | 5 V           |
| Max. power supply  | 50 V          |

| Part numbers     |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 542</b> |
| Offer drawing    | <b>A 261 209 542</b> |
| Holder           | <b>B 261 209 864</b> |

## ! Caution !

### User, please observe the following:

- Ensure electrical connections are performed according to the enclosed Position Transducer User's Guide.
- Do not allow the cable to snap back (freely retract). This will cause damage and void the warranty. Tension must be maintained on the cable at all times.



# Wire Potentiometer WP 75

## Possible mechanical range: 75 mm

Wire sensors are suitable for measuring linear and non-linear motions. The compact style allows flexible and easy installation. Due to the small size, precise measurement is possible even in difficult applications.

Various connector options available. We offer repair service for this product.



| Mechanical data      |                                |
|----------------------|--------------------------------|
| Possible mech. range | 76,2 mm                        |
| Mounting             | 2 x 2-56 THD                   |
| Cable length         | 150 ... 450 mm                 |
| Tightening torque    | 1,5 ... 2,5 Nm                 |
| Weight               | 28 g                           |
| Life expectancy      | 50 x 10 <sup>6</sup> rotations |
| Protection           | IP 54                          |
| Dimensions           | 32,5 x 11,4 mm                 |

| Conditions for use      |                         |
|-------------------------|-------------------------|
| Temperature range       | -65 ... 125°C           |
| Max. cable acceleration | 17 g                    |
| Max. cable tension      | 3,3 N                   |
| Shock                   | 100 g for 6 ms          |
| Vibration               | 10 Hz ... 2 kHz at 15 g |

| Accessories |  |
|-------------|--|
| Holder      |  |

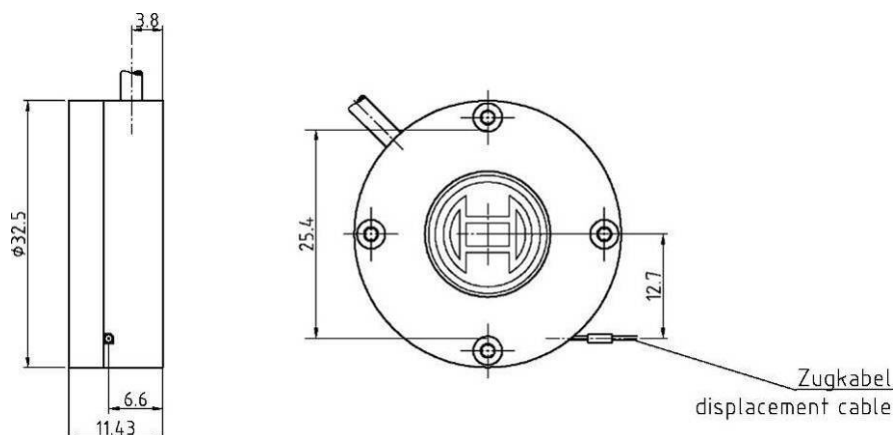
| Electronic data    |               |
|--------------------|---------------|
| Nominal resistance | 5,0 kΩ ± 10 % |
| Non-linearity      | ± 0,5 %       |
| Usual power supply | 5 V           |
| Max. power supply  | 38 V          |

| Part numbers     |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 543</b> |
| Offer drawing    | A 261 209 543        |
| Holder           | <b>B 261 209 865</b> |

### ! Caution !

#### User, please observe the following:

- Ensure electrical connections are performed according to the enclosed Position Transducer User's Guide.
- Do not allow the cable to snap back (freely retract). This will cause damage and void the warranty. Tension must be maintained on the cable at all times.



# Wire Potentiometer WP 100

Possible mechanical range: 100 mm

Wire sensors are suitable for measuring linear and non-linear motions. The compact style allows flexible and easy installation. Due to the small size, precise measurement is possible even in difficult applications.

Various connector options available. We offer repair service for this product.



| Mechanical data      |                                |
|----------------------|--------------------------------|
| Possible mech. range | 101,6 mm                       |
| Mounting             | 2 x 2-56 THD                   |
| Cable length         | 150 ... 450 mm                 |
| Tightening torque    | 1,5 ... 2,5 Nm                 |
| Weight               | 57 g                           |
| Life expectancy      | 50 x 10 <sup>6</sup> rotations |
| Protection           | IP 54                          |
| Dimensions           | 43,3 x 12,5 mm                 |

| Conditions for use      |                         |
|-------------------------|-------------------------|
| Temperature range       | -65 ... 125°C           |
| Max. cable acceleration | 9 g                     |
| Max. cable tension      | 2,8 N                   |
| Shock                   | 100 g for 6 ms          |
| Vibration               | 10 Hz ... 2 kHz at 15 g |

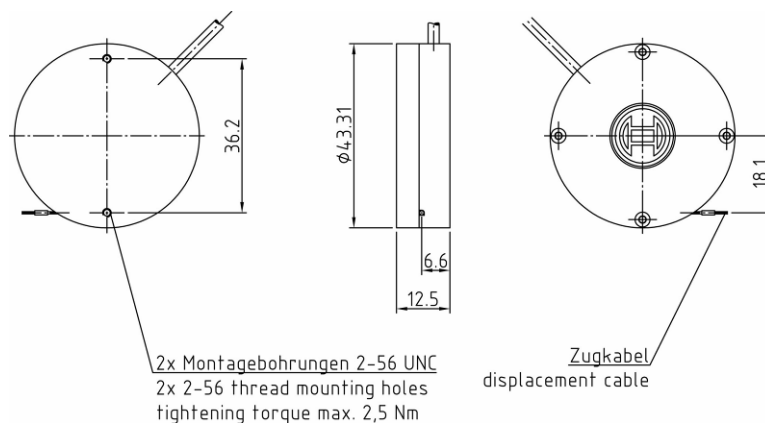
| Electronic data    |               |
|--------------------|---------------|
| Nominal resistance | 5,0 kΩ ± 10 % |
| Non-linearity      | ± 0,5 %       |
| Usual power supply | 5 V           |
| Max. power supply  | 38 V          |

| Part numbers     |                      |
|------------------|----------------------|
| KPTA 6E6-4P-C-DN | <b>B 261 209 863</b> |
| Offer drawing    | A 261 209 863        |
| Holder           | <b>B 261 209 866</b> |

## ! Caution !

### User, please observe the following:

- Ensure electrical connections are performed according to the enclosed Position Transducer User's Guide.
- Do not allow the cable to snap back (freely retract). This will cause damage and void the warranty. Tension must be maintained on the cable at all times.



## Wire Potentiometer WP 120

Possible mechanical range: 120 mm (96 mm on request)

Wire sensors are suitable for measuring linear and non-linear motions. The compact style allows flexible and easy installation. Due to the small size, precise measurement is possible even in difficult applications.

Manufactured in a DR-25 sleeve, various connector options available.



| Mechanical data      |                               |
|----------------------|-------------------------------|
| Possible mech. range | 120 mm                        |
| Mounting             | 2 x M3                        |
| Cable length         | 150 ... 1000 mm               |
| Tightening torque    | 1,5 ... 2,5 Nm                |
| Weight               | 90 g                          |
| Life expectancy      | 1 x 10 <sup>6</sup> rotations |

| Conditions for use |              |
|--------------------|--------------|
| Temperature range  | -15 ... 60°C |
| Max. moving speed  | 10 m/s       |

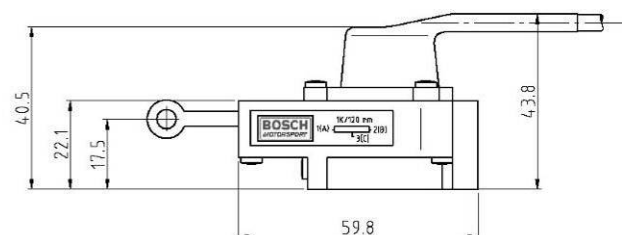
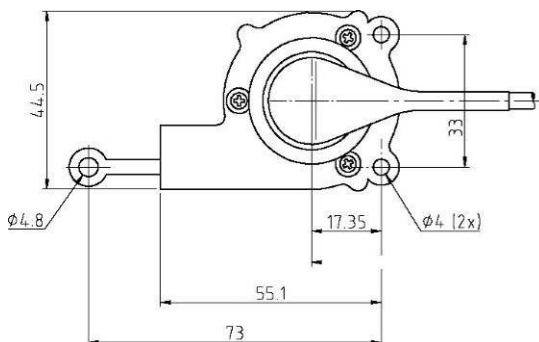
| Electronic data    |        |
|--------------------|--------|
| Nominal resistance | 1,0 kΩ |
| Non-linearity      | ± 1 %  |
| Usual power supply | 5 V    |
| Max. power supply  | 25 V   |

| Part numbers     |                      |
|------------------|----------------------|
| <b>120 mm</b>    |                      |
| KPTA 6E6-4P-C-DN | <b>B 261 209 536</b> |
| Offer drawing    | A 261 209 536        |
| <b>96 mm</b>     | <b>on request</b>    |

### ! Caution !

#### User, please observe the following:

- Ensure electrical connections are performed according to the enclosed Position Transducer User's Guide.
- Do not allow the cable to snap back (freely retract). This will cause damage and void the warranty. Tension must be maintained on the cable at all times.



# Wire Potentiometer WP 125

Possible mechanical range: 125 mm

Wire sensors are suitable for measuring linear and non-linear motions. The compact style allows flexible and easy installation. Due to the small size, precise measurement is possible even in difficult applications.

Various connector options available. We offer repair service for this product.



| Mechanical data      |                                |
|----------------------|--------------------------------|
| Possible mech. range | 127,5 mm                       |
| Mounting             | 2 x 2-56 THD                   |
| Cable length         | 150 ... 450 mm                 |
| Tightening torque    | 1,5 ... 2,5 Nm                 |
| Weight               | 85 g                           |
| Life expectancy      | 50 x 10 <sup>6</sup> rotations |
| Protection           | IP 54                          |
| Dimensions           | 50,5 x 13,2 mm                 |

| Conditions for use      |                         |
|-------------------------|-------------------------|
| Temperature range       | -65 ... 125°C           |
| Max. cable acceleration | 8 g                     |
| Max. cable tension      | 2,5 N                   |
| Shock                   | 100 g for 6 ms          |
| Vibration               | 10 Hz ... 2 kHz at 15 g |

| Accessories |  |
|-------------|--|
| Holder      |  |

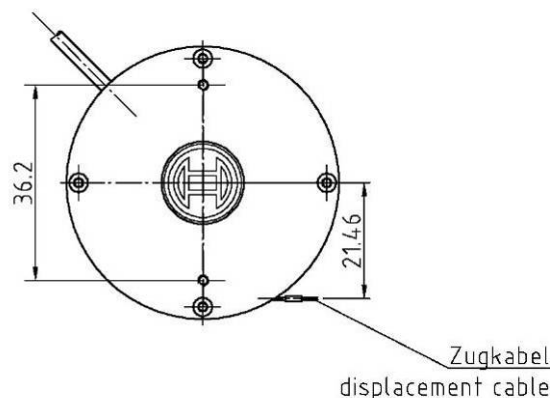
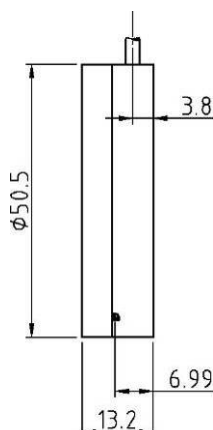
| Electronic data    |               |
|--------------------|---------------|
| Nominal resistance | 5,0 kΩ ± 10 % |
| Non-linearity      | ± 0,5 %       |
| Usual power supply | 5 V           |
| Max. power supply  | 38 V          |

| Part numbers     |                      |
|------------------|----------------------|
| ASL 6-06-05PA-HE | <b>B 261 209 545</b> |
| Offer drawing    | A 261 209 545        |
| Holder           | <b>B 261 209 866</b> |

## ! Caution !

### User, please observe the following:

- Ensure electrical connections are performed according to the enclosed Position Transducer User's Guide.
- Do not allow the cable to snap back (freely retract). This will cause damage and void the warranty. Tension must be maintained on the cable at all times.



# Acceleration Sensor

## Accelerometer AM 600

These accelerometers are available to measure up to three axes in a single, robust package. With reference to its fitting position, longitudinal, transversal and horizontal acceleration up to 4,5 g can be measured.

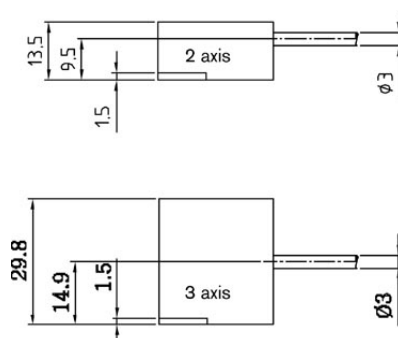
Manufactured in DR-25 sleeve; various connector options available.



| Mechanical data   |                   |
|-------------------|-------------------|
| Weight 2 axes     | 30 g              |
| 3 axes            | 50 g              |
| Length            | 150 ... 1000 mm   |
| Measuring range   | $\pm 4,5$ g       |
| Overload          | $\pm 600$ g       |
| Dimensions        |                   |
| <b>2 axes</b>     | 24 x 27 x 13,5 mm |
| <b>3 axes</b>     | 24 x 27 x 29,8 mm |
| Fixing            | 2 x M3            |
| Tightening torque | 2 Nm              |

| Conditions for use |              |
|--------------------|--------------|
| Temperature range  | -40 ... 85°C |

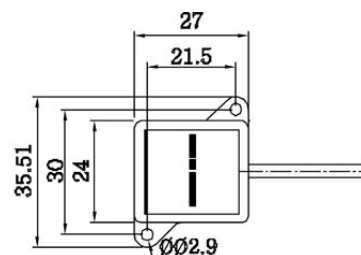
| Characteristic      |              |
|---------------------|--------------|
| Offset x, y, z      | 2,5 V at 0 g |
| Sensitivity x, y, z | 440 mV/g     |



| Electronic data              |                       |
|------------------------------|-----------------------|
| Supply voltage               | 5 V DC                |
| Max. supply voltage          | 6 V DC                |
| Signal output                | 2,5 V = 0 g; 440 mV/g |
| Supply current               | 7 mA                  |
| Max. current                 | 12 mA                 |
| Tolerance of sensitivity     | $\pm 3$ %             |
| Non-linearity of sensitivity | $\pm 2$ %             |

| Connector               |                  |
|-------------------------|------------------|
| Cable harness connector | ASL 6-06-05PA-HE |

| Part numbers  |                      |
|---------------|----------------------|
| <b>2 axes</b> | <b>B 261 209 311</b> |
| Offer drawing | A 261 209 311        |
| <b>3 axes</b> | <b>B 261 209 313</b> |
| Offer drawing | A 261 209 313        |



# Gear Shift Sensors

## Gear Shift Sensor GSS

This sensor is specially designed for precision gear shift force measurement. It can be integrated into the gear shift lever of a sequential gear box. It is manufactured in a DR-25 sleeve, various connector options are available.



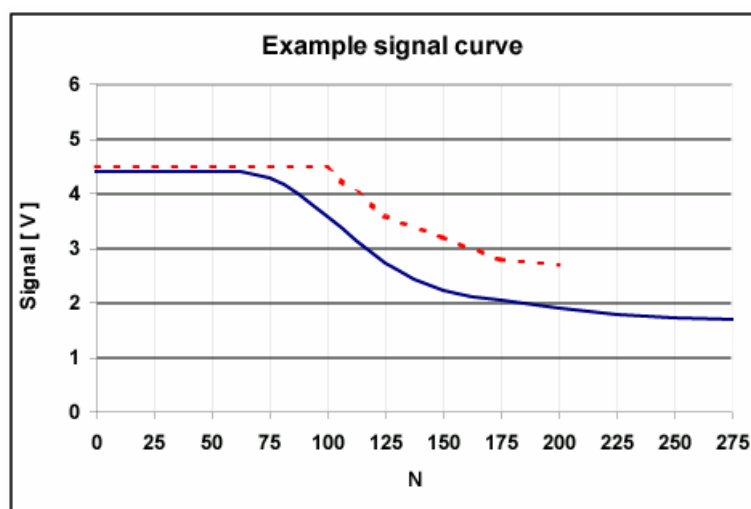
| Mechanical data   |                          |
|-------------------|--------------------------|
| Weight            | 90 g                     |
| Max. deviation    | $\pm 10^\circ$           |
| Fixing            | 2 x M10 x 1              |
| Tightening torque | 16 Nm                    |
| Dimensions        | 22 x 22 x 50 mm          |
| Mech. Range       | programmable up to 150 N |

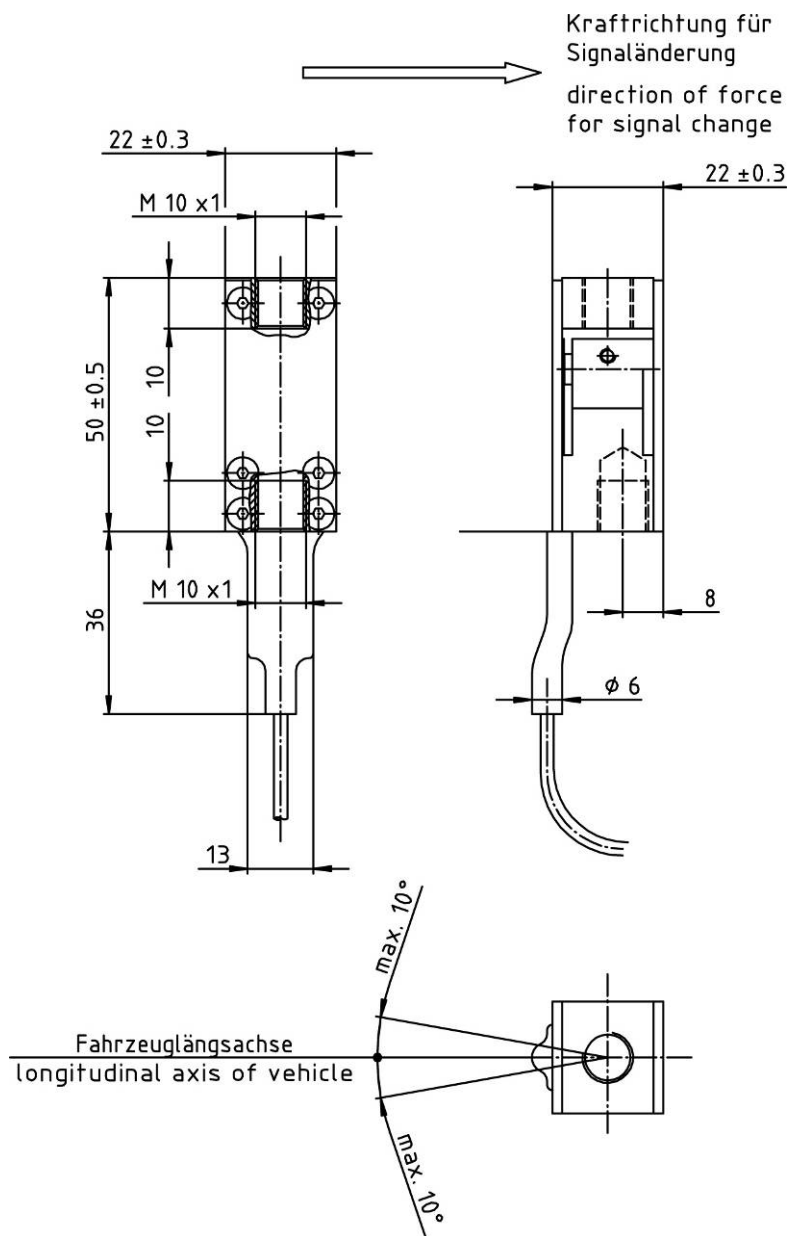
| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | 0 ... 80°C          |
| Vibration          | 80 g/5 Hz ... 2 kHz |

| Characteristic                                                |  |
|---------------------------------------------------------------|--|
| Individual characteristic will be delivered with each sensor. |  |

| Electronic data |                       |
|-----------------|-----------------------|
| Supply voltage  | 10 V                  |
| Input current   | < 1 mA                |
| Signal output   | 1 ... 4 V $\pm 0,5$ V |
| Zero output     | 4 V $\pm 0,3$ V       |

| Part numbers     |                      |
|------------------|----------------------|
| KPSE 6E8-33P-DN  | <b>B 261 209 222</b> |
| Offer drawing    | A 261 209 222        |
| KPTA 6E6-4P-C-DN | <b>B 261 209 224</b> |
| Offer drawing    | A 261 209 224        |
| AS-6-06-05PC-HE  | <b>B 261 209 225</b> |
| Offer drawing    | A 261 209 225        |





## Gear Shift Sensor GSS-2

This sensor is specially designed for precision gear shift force measurement. It can be integrated into the gear shift lever of a sequential gear box. It is manufactured in a DR-25 sleeve, various connector options are available.



| Mechanical data   |                          |
|-------------------|--------------------------|
| Weight            | 90 g                     |
| Max. deviation    | $\pm 10^\circ$           |
| Fixing            | 2 x M10 x 1              |
| Tightening torque | 16 Nm                    |
| Dimensions        | 65 x 16 x 16 mm          |
| Mech. range       | programmable up to 450 N |
| Fmax              | 800 N                    |
| Mech. load limit  | 1800 N                   |

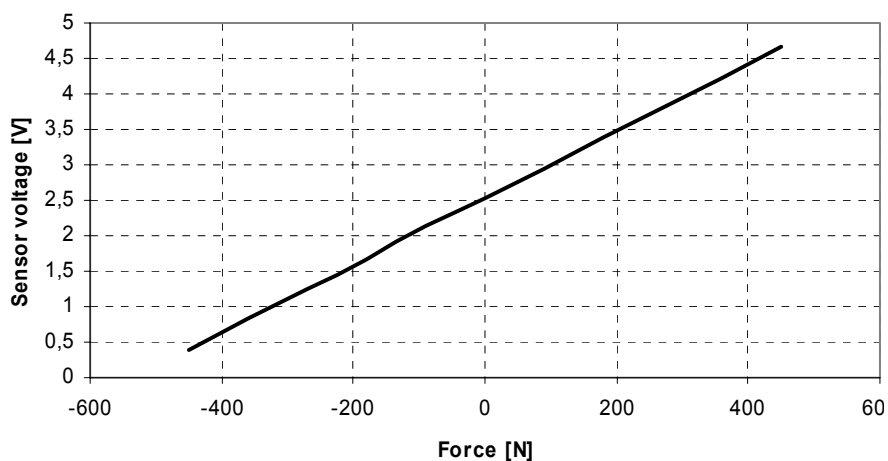
| Electronic data |               |
|-----------------|---------------|
| Supply voltage  | 12 V          |
| Signal output   | 0,5 ... 4,5 V |
| Zero output     | 2,5 V         |

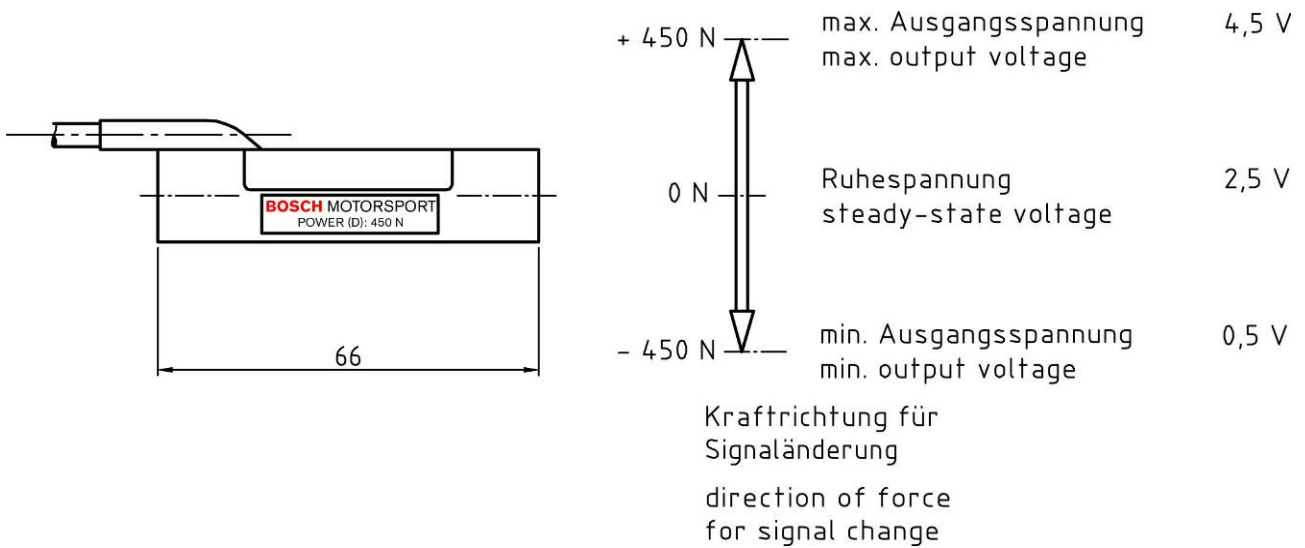
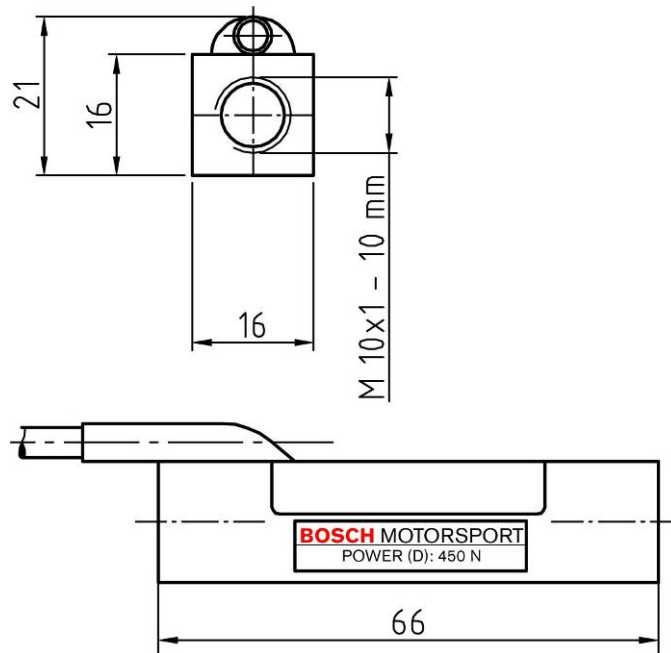
| Conditions for use |                     |
|--------------------|---------------------|
| Temperature range  | 0 ... 80°C          |
| Vibration          | 80 g/5 Hz ... 2 kHz |

| Characteristic                                                |  |
|---------------------------------------------------------------|--|
| Individual characteristic will be delivered with each sensor. |  |

| Part number      |                      |
|------------------|----------------------|
| ASL-6-06-05PC-HE | <b>B 261 209 227</b> |
| Offer drawing    | A 261 209 227        |

| Force [N] | Voltage [V] |
|-----------|-------------|
| 450       | 4,673       |
| 360       | 4,225       |
| 270       | 3,797       |
| 180       | 3,397       |
| 90        | 2,941       |
| 0         | 2,538       |
| -90       | 2,141       |
| -180      | 1,672       |
| -270      | 1,255       |
| -360      | 0,820       |
| -450      | 0,402       |





# Ride Height System

## Ride Height System RHS

This infrared sensor is designed to measure chassis adjust like vehicle ride height, pitch and roll. The sensor is available in a DR-25 sleeve with various connector options on request.



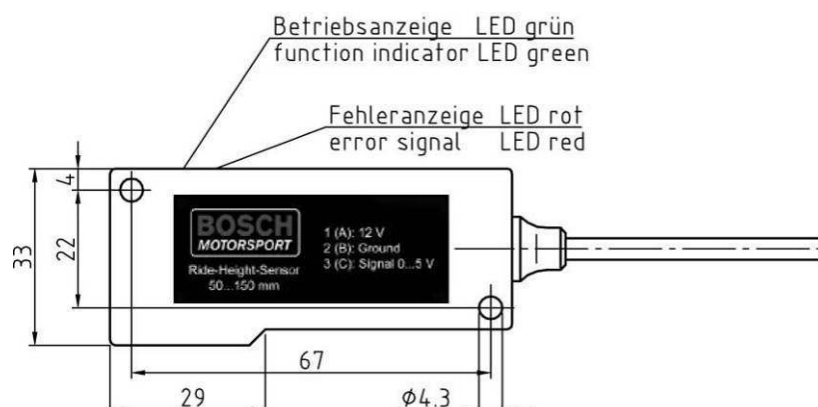
| Mechanical data  |                     |
|------------------|---------------------|
| Weight           | 105 g               |
| Measuring range  | 60 ... 140 mm       |
| Dimensions       | 75 x 33 x 18 mm     |
| Housing          | plastic, fibreglass |
| Protection class | IP 67               |

| Conditions for use |              |
|--------------------|--------------|
| Temperature range  | -10 ... 60°C |

| Characteristic             |             |
|----------------------------|-------------|
| Light source               | IR          |
| Max. allowed ambient light | < 10000 lux |
| Wave length                | 660 nm      |

| Electronic data |                 |
|-----------------|-----------------|
| Supply voltage  | 12 ... 24 V     |
| Signal output   | 0,25 ... 4,75 V |
| Alarm output    | PNP             |
| Response time   | 5 ms            |
| Resolution      | 0,5 ... 1 mm    |
| Linearity       | 2 % FS          |

| Part numbers     |                      |
|------------------|----------------------|
| KPTA 6E6-4P-C-DN | <b>B 261 209 671</b> |
| Offer drawing    | A 261 209 671        |
| ASL 6-06-05PD-HE | <b>B 261 209 672</b> |
| Offer drawing    | A 261 209 672        |



# Yaw Rate Sensor

## Yaw Rate Sensor YRS 2

This sensor is designed to measure the yaw rate and lateral acceleration of the vehicle. In order to achieve this, the sensor features both a measuring element for yaw rate and one for lateral acceleration, with one appropriate circuit. The measuring element for yaw rate is built using surface and bulk micromachining technology. Two surface micromachined accelerometers are located on two out of phase oscillating seismic masses.



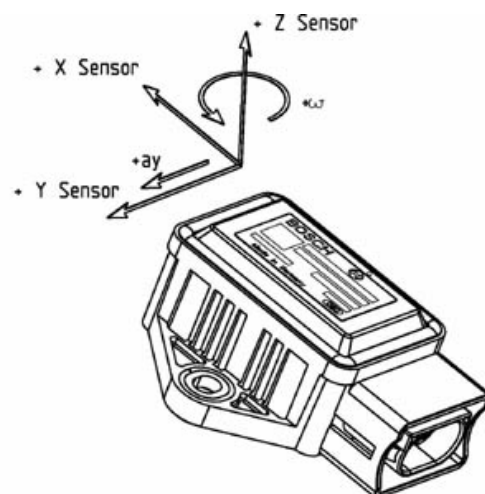
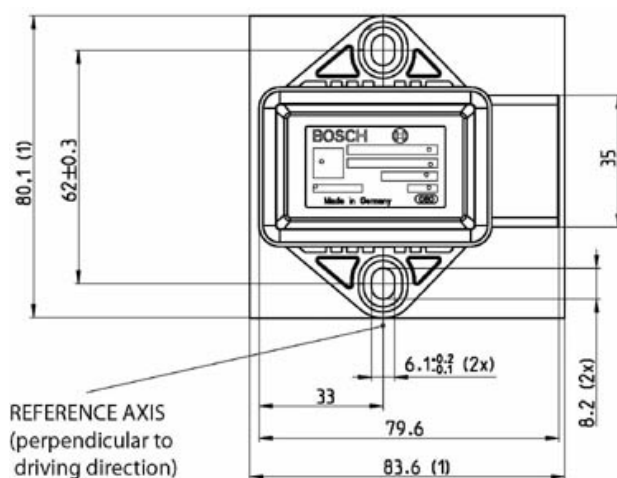
| Mechanical data |         |
|-----------------|---------|
| Measuring range | 100°/s  |
| Overload        | 1000°/s |
| Weight          | 90 g    |

| Conditions for use |              |
|--------------------|--------------|
| Temperature range  | -40 ... 85°C |
| Shock              | 300 g        |

| Connector               |               |
|-------------------------|---------------|
| Cable harness connector | D 261 205 358 |

| Electronic data     |                            |
|---------------------|----------------------------|
| Supply voltage      | 8,0 ... 16 V               |
| Current consumption | < 75 mA                    |
| Output range        | 0,5 ... 4.5 V              |
| Reference voltage   | 2,5 V                      |
| Sensitivity         | 18 mVs/° [-100 ... 100°/s] |
| Non linearity       | < 4 %                      |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 265 005 262</b> |
| Offer drawing | 0 274 A00 005        |



## Vehicle Components

# Injection Valves

## Injection Valve EV 6

The development of the EV 6 took into account all the essential functional requirements which originate from injector operation in multipoint electronic fuel injection systems (EFI).

This resulted in: low weight, “dry” solenoid winding, plastic encapsulation, finely matched flow-rate classes, good valve-seat sealing, excellent hot-start capabilities, close tolerances of the specified functional values, high level of corrosion resistance and long service life.



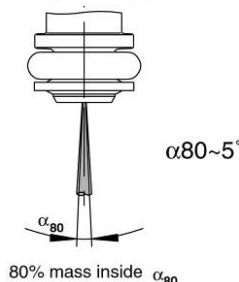
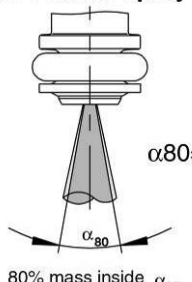
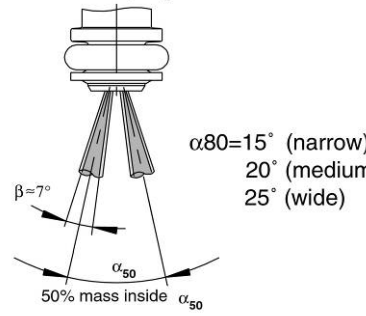
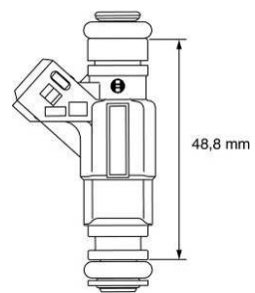
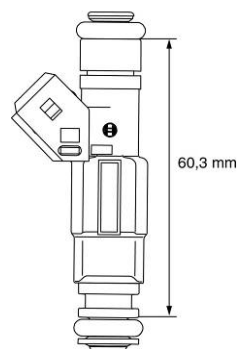
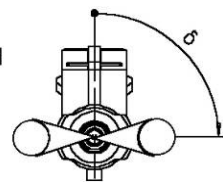
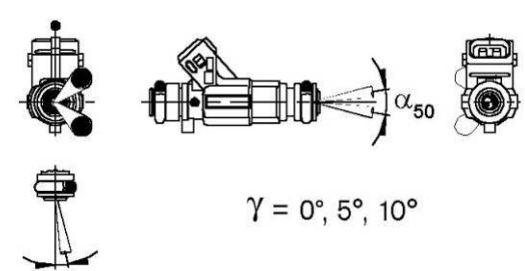
| Mechanical data |            |
|-----------------|------------|
| System pressure | max. 8 bar |
| Weight          | 45, 8 g    |

| Electrical data     |           |
|---------------------|-----------|
| Solenoid resistance | e.g. 12 Ω |
| Max. power supply   | 16 V      |

| Conditions for use                               |                  |
|--------------------------------------------------|------------------|
| Fuel input                                       | axial (top-feed) |
| Operating temperature                            | -40 ... 110°C    |
| Permissible fuel temperatures                    | ≤ 70°C           |
| Climate proofness corresponds to saline fog test | DIN 53 167       |

| Technical data          |          |           |            |                               |               |           |
|-------------------------|----------|-----------|------------|-------------------------------|---------------|-----------|
| Part numbers            | Design   | Fuel type | Spray type | Flow rate at 3 bar (N-Heptan) | Spray angle α | Impedance |
| <b>B 280 431 126</b>    | Standard | Gasoline  | C          | 261,2 g/min                   | 25°           | 12 Ω      |
| <b>B 280 431 127</b>    | Standard | Gasoline  | C          | 261,2 g/min                   | 70°           | 12 Ω      |
| <b>0 280 155 737</b>    | Long     | Gasoline  | C          | 261,2 g/min                   | 15°           | 12 Ω      |
| <b>B 280 431 128</b>    | Standard | Gasoline  | C          | 364,3 g/min                   | 25°           | 12 Ω      |
| <b>B 280 431 129</b>    | Standard | Gasoline  | C          | 364,3 g/min                   | 70°           | 12 Ω      |
| <b>B 280 431 130</b>    | Standard | Gasoline  | C          | 493,1 g/min                   | 25°           | 1,2 Ω     |
| <b>B 280 431 131</b>    | Standard | Gasoline  | C          | 493,1 g/min                   | 70°           | 1,2 Ω     |
| <b>0 280 156 012</b>    | Standard | Gasoline  | C          | 310,1 g/min                   | 20°           | 12 Ω      |
| <b>B 280 434 499_01</b> | Standard | Methanol  | C          | 658 g/min                     | 25°           | 12 Ω      |
| <b>B 280 434 499_02</b> | Standard | Gasoline  | C          | 658 g/min                     | 25°           | 12 Ω      |

Further injection valves on request.

|                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>B: Pencil Beam</b></p>  <p><math>\alpha_{80} \sim 5^\circ</math></p> <p>80% mass inside <math>\alpha_{80}</math></p> | <p><b>C: Conical Spray</b></p>  <p><math>\alpha_{80} = 15^\circ</math> (narrow)<br/> <math>20^\circ</math> (medium)<br/> <math>25^\circ</math> (wide)</p> <p>80% mass inside <math>\alpha_{80}</math></p> | <p><b>E: 2-Spray</b></p>  <p><math>\alpha_{80} = 15^\circ</math> (narrow)<br/> <math>20^\circ</math> (medium)<br/> <math>25^\circ</math> (wide)</p> <p><math>\beta = 7^\circ</math></p> <p>50% mass inside <math>\alpha_{50}</math></p> <p>70% mass of single spray inside <math>\beta</math></p>                                    |
| <p><b>standard</b></p>  <p>48,8 mm</p>                                                                                    | <p><b>long</b></p>  <p>60,3 mm</p>                                                                                                                                                                       | <p>Angel between connection and spray level (<math>\delta = \text{delta}</math>):<br/>         (only 2-spray preparation)</p> <p><math>\delta = 0^\circ - 360^\circ</math> possible</p>   <p><math>\gamma = 0^\circ, 5^\circ, 10^\circ</math></p> |

## Injection Valve EV 12

The EV 12 injector is a development based on the EV 6. Its main feature is the fact that the position of its injection point can be varied. Compared with the EV 6, the EV 12 injection point can be moved forward up to 20 mm.



### Mechanical data

|                 |            |
|-----------------|------------|
| System pressure | max. 8 bar |
| Weight          | 40 g       |

### Electronic data

|                     |                  |
|---------------------|------------------|
| Solenoid resistance | e.g. 12 $\Omega$ |
| Max. power supply   | 16 V             |

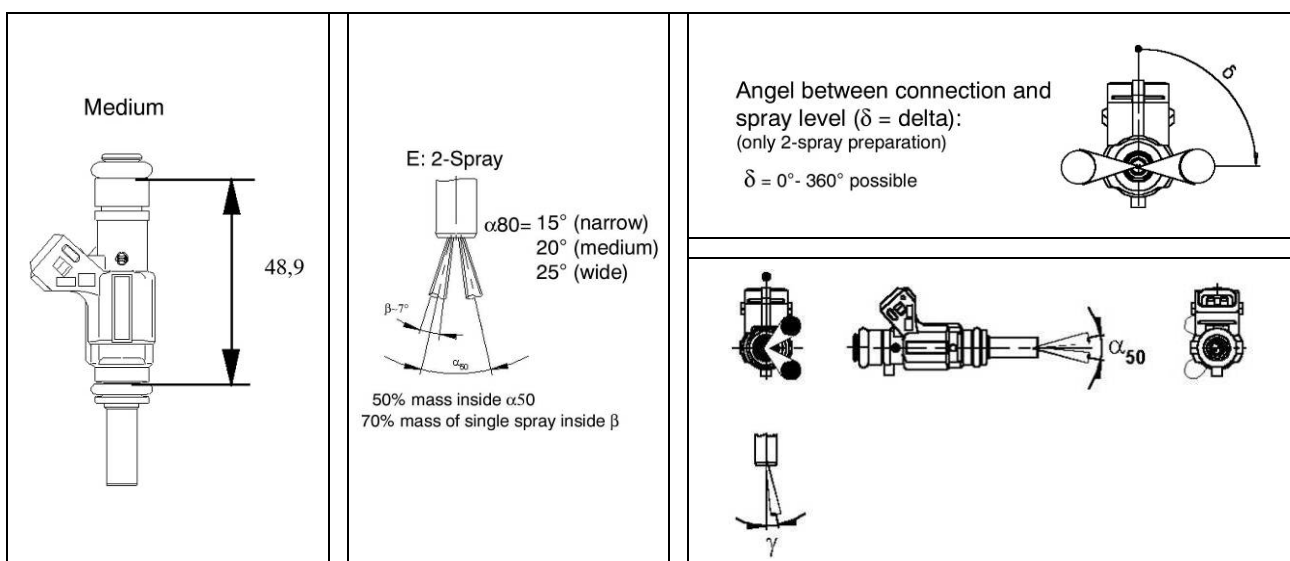
### Conditions for use

|                                                             |                         |
|-------------------------------------------------------------|-------------------------|
| Fuel input                                                  | axial (top-feed)        |
| Operating temperatures                                      | -40 ... 110°C           |
| Permissible fuel temperatures                               | $\leq 70^\circ\text{C}$ |
| Climate proofness corresponds to saline fog test DIN 53 167 |                         |

### Technical data

| Part numbers         | Design | Type | Flow rate at 3 bar<br>(N-Heptan) | $\alpha$ | Spray<br>$\beta$ | angle<br>$\gamma$ | $\delta$ | Impedance   |
|----------------------|--------|------|----------------------------------|----------|------------------|-------------------|----------|-------------|
| <b>0 280 155 892</b> | Medium | E    | 269 g/min                        | 15°      | 7°               | 10°               | 270°     | 12 $\Omega$ |
| <b>0 280 155 897</b> | Medium | E    | 217 g/min                        | 15°      | 7°               | 10°               | 270°     | 12 $\Omega$ |

Further special versions on request



## Injection Valve EV 14

The EV 14 injector is a further development based on the EV 6. It is even more compact, what allows its integration into the fuel rail.

In addition, this injector is also available with a variety of installation lengths, what makes an individual adaptation to the intake manifold possible.



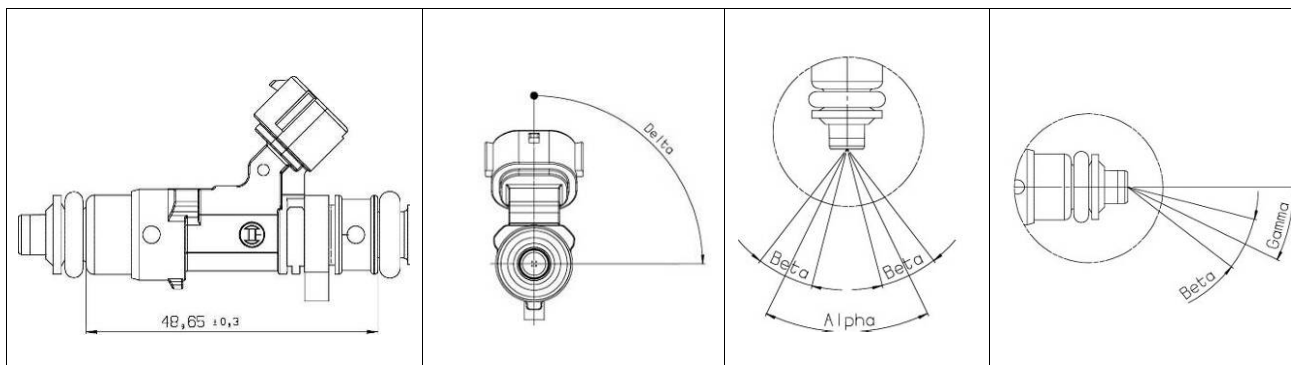
| Mechanical data |            |
|-----------------|------------|
| System pressure | max. 8 bar |
| Weight          | 25 g       |
| Spray angle     | 25° or 70° |

| Electronic data     |                  |
|---------------------|------------------|
| Solenoid resistance | e.g. 12 $\Omega$ |
| Max. power supply   | 16 V             |

| Conditions for use                                          |                         |
|-------------------------------------------------------------|-------------------------|
| Fuel input                                                  | axial (top-feed)        |
| Operating temperatures                                      | -40 ... 110°C           |
| Permissible fuel temperatures                               | $\leq 70^\circ\text{C}$ |
| Installation lengths                                        | 48,65 mm                |
| Climate proofness corresponds to saline fog test DIN 50 021 |                         |

| Technical data          |          |      |                               |                      |             |
|-------------------------|----------|------|-------------------------------|----------------------|-------------|
| Part numbers            | Design   | Type | Flow rate at 3 bar (N-Heptan) | Spray angle $\alpha$ | Impedance   |
| <b>B 280 436 038_06</b> | Standard | C    | 387,3 g/min                   | 25°                  | 12 $\Omega$ |
| <b>B 280 436 038_02</b> | Standard | C    | 503,5 g/min                   | 25°                  | 12 $\Omega$ |
| <b>B 280 436 038_05</b> | Standard | C    | 387,3 g/min                   | 70°                  | 12 $\Omega$ |
| <b>B 280 436 038_01</b> | Standard | C    | 503,5 g/min                   | 70°                  | 12 $\Omega$ |

Further special versions on request.



## HPI Valve HDEV 1.2

The HDEV 1.2 can be used in combination with direct injection systems as well as in high pressure manifold injection systems.

Its most remarkable features are the small size and weight and the freedom in defining both – spray and jet. Every jet is free definable in terms of position, flow rate and penetration. Moreover, asymmetric sprays are possible.



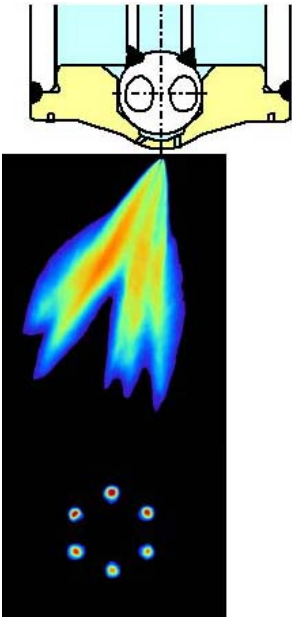
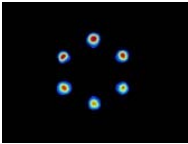
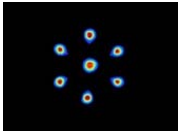
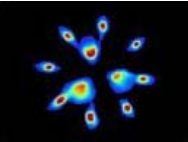
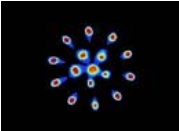
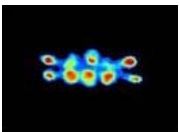
| Mechanical data |                            |
|-----------------|----------------------------|
| System pressure | max. 200 bar               |
| Flow rate       | e.g. 30 ccm/sec at 100 bar |
| Weight          | 78 g                       |
| Length          | 85 mm                      |

| Electrical data |              |
|-----------------|--------------|
| Resistance      | 0,9 $\Omega$ |
| Voltage         | 90 V         |
| Peak current    | 20 A         |

| Conditions for use            |                  |
|-------------------------------|------------------|
| Fuel input                    | axial (top-feed) |
| Operating temperatures        | -30 ... 120°C    |
| Permissible fuel temperatures | < 80°C           |

| Part number |                   |
|-------------|-------------------|
|             | <b>on request</b> |

### Examples of variations, further variations on request

|                                                                                     |                                                                                                                                                |                                                                                                                                   |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
|  |  <p>Jets on a circle</p>                                    |  <p>Jets on a circle and a middle jet</p>    |
|                                                                                     |  <p>Jets on two circles</p>                                 |  <p>Jets on two circles and a middle jet</p> |
|                                                                                     |  <p>Jet configuration regarding the spark plug position</p> |  <p>Flat jet configuration</p>               |

## HPI Valve Mini-HDEV 1.2

The Mini HDEV 1.2 can be used in high pressure manifold injection systems.

Its most remarkable features are the small size and weight and the freedom in defining both – spray and jet. Every jet is free definable in terms of position, flow rate and penetration. Moreover, asymmetric sprays are possible.



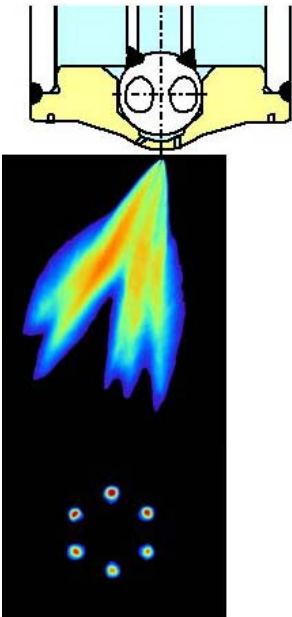
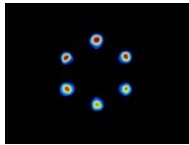
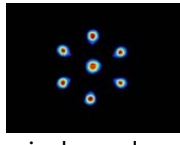
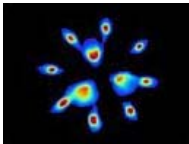
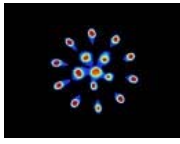
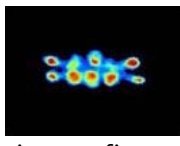
| Mechanical data |                            |
|-----------------|----------------------------|
| System pressure | max. 200 bar               |
| Flow rate       | e.g. 30 ccm/sec at 100 bar |
| Weight          | 48 g                       |
| Length          | 51 mm                      |

| Electrical data |              |
|-----------------|--------------|
| Resistance      | 1,1 $\Omega$ |
| Voltage         | 14 V         |
| Peak current    | 13,2 A       |

| Conditions for use            |                  |
|-------------------------------|------------------|
| Fuel input                    | axial (top-feed) |
| Operating temperatures        | -30 ... 120°C    |
| Permissible fuel temperatures | < 80°C           |

| Part number |                   |
|-------------|-------------------|
|             | <b>on request</b> |

### Examples of variations, further variations on request

|                                                                                     |                                                                                                                                                |                                                                                                                                   |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
|  |  <p>Jets on a circle</p>                                    |  <p>Jets on a circle and a middle jet</p>    |
|                                                                                     |  <p>Jets on two circles</p>                                 |  <p>Jets on two circles and a middle jet</p> |
|                                                                                     |  <p>Jet configuration regarding the spark plug position</p> |  <p>Flat jet configuration</p>               |

## HPI Valve Mini-HDEV LV

The Mini-HDEV LV can be used in high pressure manifold injection systems.

Its most remarkable features are the small size and weight and the freedom in defining both – spray and jet. Every jet is free definable in terms of position, flow rate and penetration. Moreover, asymmetric sprays are possible.



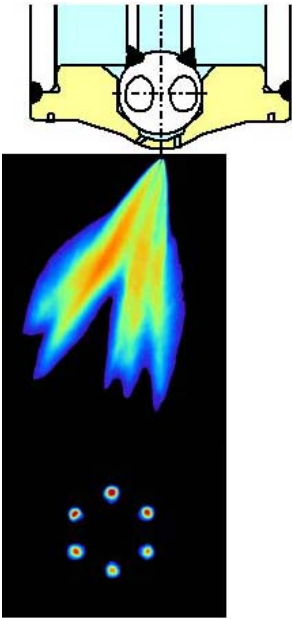
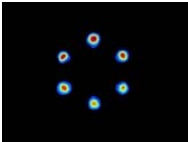
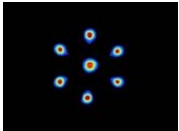
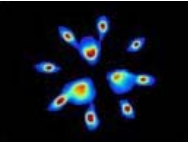
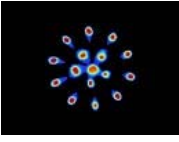
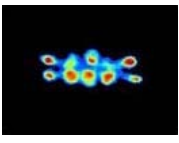
| Mechanical data |                            |
|-----------------|----------------------------|
| System pressure | max. 100 bar               |
| Flow rate       | e.g. 30 ccm/sec at 100 bar |
| Weight          | 48 g                       |
| Length          | 51 mm                      |

| Electrical data |               |
|-----------------|---------------|
| Resistance      | <0,2 $\Omega$ |
| Voltage         | 14 V          |
| Peak current    | 26 A          |

| Conditions for use            |                  |
|-------------------------------|------------------|
| Fuel input                    | axial (top-feed) |
| Operating temperatures        | -30 ... 120°C    |
| Permissible fuel temperatures | < 80°C           |

| Part number |            |
|-------------|------------|
|             | on request |

### Examples of variations, further variations on request

|                                                                                     |                                                                                                                                                |                                                                                                                                   |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
|  |  <p>Jets on a circle</p>                                    |  <p>Jets on a circle and a middle jet</p>    |
|                                                                                     |  <p>Jets on two circles</p>                                 |  <p>Jets on two circles and a middle jet</p> |
|                                                                                     |  <p>Jet configuration regarding the spark plug position</p> |  <p>Flat jet configuration</p>               |

# Power Stage Units

## HPI 1.16 LV / LVD

In combination with a Bosch Motorsport ECU the HPI 1.16 Box enables the running of high pressure injection valves. The injector current is realised by a switched current regulation with booster period, pick-up period, holding period and recharging period.

This HPI Box can be used for example in Formula 1 race cars.



## HPI 1.16 LV

| Mechanical data                                                  |                   |
|------------------------------------------------------------------|-------------------|
| Max. number of cylinders                                         | 10                |
| Dust and waterproof aluminium housing                            |                   |
| Filtered connectors in military technology with high pin density |                   |
| Vibration damped printed circuit boards                          |                   |
| Flexible housing fixation points                                 |                   |
| Size without connectors                                          | 135 x 101 x 43 mm |
| Weight                                                           | 560 g             |
| Communication interfaces                                         | 1 CAN, 1 K-Line   |

| Conditions for use  |                                                 |
|---------------------|-------------------------------------------------|
| Housing temperature | -25 ... 85 °C                                   |
| Operating voltage   | 8 ... 18 V                                      |
| Nominal voltage     | 14,0 V                                          |
| Max. vibration      | 15 g sinus and random at 20 ... 2000 Hz for 5 h |

| Electronic data                                   |        |
|---------------------------------------------------|--------|
| Optimised for Bosch injection valves Mini-HDEV LV |        |
| Max. rpm                                          | 20.000 |
| Internal voltage regulator                        | -      |

| Part number          |  |
|----------------------|--|
| <b>F 01T A20 017</b> |  |

## HPI 1.16 LVD

| Mechanical data                                                  |                   |
|------------------------------------------------------------------|-------------------|
| Max. number of cylinders                                         | 10                |
| Dust and waterproof aluminium housing                            |                   |
| Filtered connectors in military technology with high pin density |                   |
| Vibration damped printed circuit boards                          |                   |
| Flexible housing fixation points                                 |                   |
| Size without connectors                                          | 135 x 101 x 43 mm |
| Weight                                                           | 710 g             |
| Communication interfaces                                         | 1 CAN, 1 K-Line   |

| Conditions for use  |                                                 |
|---------------------|-------------------------------------------------|
| Housing temperature | -25 ... 70 °C                                   |
| Operating voltage   | 8 ... 18 V                                      |
| Nominal voltage     | 14,0 V                                          |
| Max. vibration      | 15 g sinus and random at 20 ... 2000 Hz for 5 h |

| Electronic data                                   |             |
|---------------------------------------------------|-------------|
| Optimised for Bosch injection valves Mini-HDEV LV |             |
| Max. rpm                                          | 20.000      |
| Internal voltage regulator                        | 14 ... 17 V |

| Part number          |  |
|----------------------|--|
| <b>F 01T A20 016</b> |  |

## HPI 1.16 HV / HVD

In combination with a Bosch Motorsport ECU the HPI 1.16 Box enables the running of high pressure injection valves. The injector current is realised by a switched current regulation with booster period, pick-up period, holding period and recharging period.

This HPI Box can be used for example in racing series like DTM, 24 h Le Mans, etc.



### HPI 1.16 HV

| Mechanical data                                                  |                   |
|------------------------------------------------------------------|-------------------|
| Max. number of cylinders                                         | 10                |
| Dust and waterproof aluminium housing                            |                   |
| Filtered connectors in military technology with high pin density |                   |
| Vibration damped printed circuit boards                          |                   |
| Flexible housing fixation points                                 |                   |
| Size without connectors                                          | 135 x 101 x 43 mm |
| Weight                                                           | 575 g             |
| Communication interfaces                                         | 1 CAN, 1 K-Line   |

| Conditions for use  |                                                 |
|---------------------|-------------------------------------------------|
| Housing temperature | -25 ... 85 °C                                   |
| Operating voltage   | 8 ... 18 V                                      |
| Nominal voltage     | 14,0 V                                          |
| Max. vibration      | 15 g sinus and random at 20 ... 2000 Hz for 5 h |

| Electronic data                                    |        |
|----------------------------------------------------|--------|
| Optimised for Bosch injection valves Mini-HDEV 1.2 |        |
| Max. rpm                                           | 12.500 |
| Internal voltage regulator                         | -      |

| Part number          |  |
|----------------------|--|
| <b>F 01T A20 019</b> |  |

### HPI 1.16 HVD

| Mechanical data                                                  |                   |
|------------------------------------------------------------------|-------------------|
| Max. number of cylinders                                         | 10                |
| Dust and waterproof aluminium housing                            |                   |
| Filtered connectors in military technology with high pin density |                   |
| Vibration damped printed circuit boards                          |                   |
| Flexible housing fixation points                                 |                   |
| Size without connectors                                          | 135 x 101 x 43 mm |
| Weight                                                           | 725 g             |
| Communication interfaces                                         | 1 CAN, 1 K-Line   |

| Conditions for use  |                                                 |
|---------------------|-------------------------------------------------|
| Housing temperature | -25 ... 70 °C                                   |
| Operating voltage   | 8 ... 18 V                                      |
| Nominal voltage     | 14,0 V                                          |
| Max. vibration      | 15 g sinus and random at 20 ... 2000 Hz for 5 h |

| Electronic data                                    |             |
|----------------------------------------------------|-------------|
| Optimised for Bosch injection valves Mini-HDEV 1.2 |             |
| Max. rpm                                           | 12.500      |
| Internal voltage regulator                         | 65 ... 90 V |

| Part number          |  |
|----------------------|--|
| <b>F 01T A20 018</b> |  |

# Ignition Coils

## Single Fire Coil M

This ignition coil is specially designed for motorsport use. The electronic design connects high energy output with a small housing. The coil is available in a DR-25 sleeve with different options of connectors.



| Electronic data     |                 |
|---------------------|-----------------|
| High voltage        | 35 kV           |
| I prim. (stand.)    | 10 A            |
| Inductivity (prim.) | 1,8 mH          |
| Inductivity (sec.)  | 4,7 H           |
| Resistance (prim.)  | 0,5 $\Omega$    |
| Resistance (sec.)   | 4,4 k $\Omega$  |
| Spark energy        | 33 mJ           |
| U prim. (clamp.)    | 500 V           |
| Voltage gradient    | 3,3 kV/ $\mu$ s |

| Mechanical data |                   |
|-----------------|-------------------|
| Weight          | 180 g             |
| Vibration       | 80 g/5 ... 250 Hz |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -20 ... 130°C |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 261 209 192</b> |
| Offer drawing | A 261 209 192        |

| Dwell time (ms) |      |      |      |      |  |
|-----------------|------|------|------|------|--|
| Ubatt           | 4 A  | 6 A  | 8 A  | 10 A |  |
| 8 V             | 1,30 | 2,40 | 3,20 | 4,20 |  |
| 10 V            | 1,00 | 1,60 | 2,40 | 3,40 |  |
| 12 V            | 0,80 | 1,25 | 1,80 | 2,40 |  |
| 14 V            | 0,65 | 1,05 | 1,40 | 1,80 |  |
| 16 V            | 0,55 | 0,85 | 1,18 | 1,46 |  |

## Single Fire Coil P

This coil is low cost concept for cylinder head installation.



| Electronic data     |                 |
|---------------------|-----------------|
| High voltage        | 35 kV           |
| I prim. (stand.)    | 8,5 A           |
| Inductivity (prim.) | 2,8 mH          |
| Inductivity (sec.)  | 16 H            |
| Resistance (prim.)  | 0,37 $\Omega$   |
| Resistance (sec.)   | 8,8 k $\Omega$  |
| Spark energy        | 45 ... 55 mJ    |
| U prim. (clamp.)    | 260 V           |
| Voltage gradient    | 1,6 kV/ $\mu$ s |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -40 ... 140°C |

| Mechanical data |                     |
|-----------------|---------------------|
| Weight          | 260 g               |
| Vibration       | 40 g/5 Hz ... 2 kHz |

| Connector               |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 334</b> |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 261 208 315</b> |
| Offer drawing | A 221 152 139        |

| Dwell time (ms) |      |      |      |      |      |
|-----------------|------|------|------|------|------|
| Ubatt           | 4 A  | 5 A  | 6 A  | 7 A  | 8 A  |
| 8 V             | 2,90 | 4,00 | 5,50 | 7,80 |      |
| 10 V            | 2,00 | 2,70 | 3,50 | 4,40 | 5,20 |
| 12 V            | 1,65 | 2,10 | 2,65 | 3,17 | 3,52 |
| 14 V            | 1,35 | 1,75 | 2,15 | 2,55 | 2,90 |
| 16 V            | 1,10 | 1,40 | 1,75 | 2,05 | 2,35 |

## Single Fire Coil PT

This ignition coil is low cost concept for cylinder head installation.

The Single Fire Coil PT has an integrated transistor for use in combination with ECUs without internal ignition power stages.



| Mechanical data    |                       |
|--------------------|-----------------------|
| Weight             | 197 g                 |
| Incl. HV-Connector |                       |
| Vibration          | 40 g/5 Hz ... 2,5 kHz |

| Dwell time, temperature of coil ca 50°C |         |         |
|-----------------------------------------|---------|---------|
| Ubatt                                   | 6 A     | 7A      |
| 8 V                                     | 6 ms    | 8,6 ms  |
| 10 V                                    | 3,6 ms  | 4,41 ms |
| 12 V                                    | 2,6 ms  | 3,11 ms |
| 14 V                                    | 2,08 ms | 2,41 ms |
| 16 V                                    | 1,75 ms | 1,98 ms |

| Electronic data  |           |
|------------------|-----------|
| High voltage     | 34 kV     |
| I prim. (stand.) | 7 A       |
| Spark current    | 78 mA     |
| Spark energy     | ~ 43 mJ   |
| Voltage gradient | 2,8 kV/μs |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -40 ... 140°C |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 221 604 014</b> |
| Offer drawing | A 0 221 604 014      |

## Single Fire Coil S

This ignition coil is specially designed for cylinder head mounting. The electronic design combines high energy output with a small housing. It is available in a DR-25 sleeve with different options of connectors.

Electric data and dimensions can be individually adapted to customer's requirements.

This coil is part of the higher performance segment.



| Mechanical data |                       |
|-----------------|-----------------------|
| Weight          | 148 g                 |
| Vibration       | 80 g/5 Hz ... 2,5 kHz |
| Diameter        | 22 mm                 |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -40 ... 140°C |

| Dwell time (ms), temperature of coil ca. 50°C |         |
|-----------------------------------------------|---------|
| Ubatt                                         | 12,5 A  |
| 8 V                                           | 3350 µs |
| 10 V                                          | 1750 µs |
| 12 V                                          | 1250 µs |
| 14 V                                          | 960 µs  |
| 16 V                                          | 800 µs  |

| Electronic data    |              |
|--------------------|--------------|
| High voltage       | >30 kV       |
| I prim. (stand.)   | 12 A         |
| Resistance (prim.) | 0,2 Ω        |
| Spark energy       | 33 ... 40 mJ |
| U prim. (clamp.)   | 390 V        |
| Voltage gradient   | 3,3 kV/µs    |

| Part number   |                         |
|---------------|-------------------------|
|               | <b>B 221 141 834_02</b> |
| Offer drawing | A 221 141 834_02        |

## Double Fire Coil 2x2

### 2 x 2 Sparks

This dual spark ignition coil is designed for low-cost applications in 4-cylinder engines.



#### Mechanical data

|           |                   |
|-----------|-------------------|
| Weight    | 900 g             |
| Vibration | 20 g/5 ... 250 Hz |

#### Conditions for use

|                   |               |
|-------------------|---------------|
| Temperature range | -20 ... 120°C |
|-------------------|---------------|

#### Primary connector

|                         |                      |
|-------------------------|----------------------|
| Cable harness connector | <b>D 261 205 289</b> |
|-------------------------|----------------------|

#### Electronic data

|                     |           |
|---------------------|-----------|
| High voltage        | 33 kV     |
| I prim. (stand.)    | 7,5 A     |
| Inductivity (prim.) | 3,7 mH    |
| Inductivity (sec.)  | 38 H      |
| Resistance (prim.)  | 0,5 Ω     |
| Resistance (sec.)   | 13,3 kΩ   |
| Spark energy        | 70 mJ     |
| U prim. (clamp.)    | 320 V     |
| Voltage gradient    | 1,1 kV/μs |

#### Part number

|               |                      |
|---------------|----------------------|
|               | <b>0 221 503 407</b> |
| Offer drawing | A 221 151 089        |

#### Dwell time (ms)

| Ubatt | 5 A | 6 A | 8 A  |
|-------|-----|-----|------|
| 8 V   | 6,0 | 8,5 | 12,0 |
| 10 V  | 3,8 | 4,9 | 7,0  |
| 12 V  | 2,8 | 3,5 | 5,0  |
| 14 V  | 2,3 | 2,8 | 3,9  |
| 16 V  | 2,0 | 2,4 | 3,0  |

## Double Fire Coil 3x2

### 3 x 2 Sparks

This dual spark ignition coil is designed for low-cost applications in 6-cylinder engines.



| Mechanical data |                   |
|-----------------|-------------------|
| Weight          | 1300 g            |
| Vibration       | 20 g/5 ... 250 Hz |

| Conditions for use |               |
|--------------------|---------------|
| Temperature range  | -20 ... 120°C |

| Primary connector |               |
|-------------------|---------------|
| Offer drawing     | 1 284 485 118 |

| Electronic data     |           |
|---------------------|-----------|
| High voltage        | 33 kV     |
| I prim. (stand.)    | 7,5 A     |
| Inductivity (prim.) | 3,7 mH    |
| Inductivity (sec.)  | 38 H      |
| Resistance (prim.)  | 0,5 Ω     |
| Resistance (sec.)   | 13,3 kΩ   |
| Spark energy        | 70 mJ     |
| U prim. (clamp.)    | 320 V     |
| Voltage gradient    | 1,1 kV/μs |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 221 503 002</b> |
| Offer drawing | A 221 151 810-006    |

| Dwell time (ms) |     |     |      |  |
|-----------------|-----|-----|------|--|
| Ubatt           | 5 A | 6 A | 8 A  |  |
| 8 V             | 6,0 | 8,5 | 12,0 |  |
| 10 V            | 3,8 | 4,9 | 7,0  |  |
| 12 V            | 2,8 | 3,5 | 5,0  |  |
| 14 V            | 2,3 | 2,8 | 3,9  |  |
| 16 V            | 2,0 | 2,4 | 3,0  |  |

# Spark Plugs

## Spark Plugs

The engines of competition vehicles are exposed to high thermal stress because of running them at full load most of the time.

Spark plugs for this operating conditions often have precious metal center electrodes (platinum, silver) and a short insulator base. This causes a very small heat absorption and a good heat derivation through the center electrode.

Corresponding to the various field of operations we manufacture over 1400 different types of spark plugs in production. You can get these standard spark plugs from your local Bosch-service and most spare parts dealers. The range of products includes versions with various seats and threads, thread lengths and electrode positions, the design parts air-gap, surface-gap and surface-air-gap types. You can choose between versions with one to four ground electrodes, the center electrode can be made from various materials.

Moreover we offer special versions and small batches which you should not hesitate asking for.



# Fuel Pumps

## Fuel Pump FP 100

Fuel delivery: >100 l/h, 5 bar

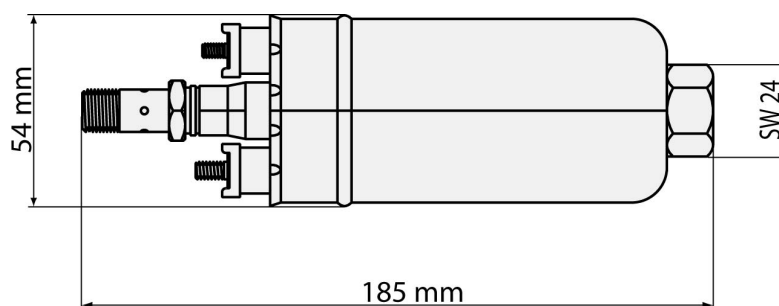


| Description                |             |
|----------------------------|-------------|
| Fuel delivery              | >100 l/h    |
| High temperature reduction | 30 l/h      |
| Supply voltage             | 13,5 V      |
| Current consumption        | 5 A (5 bar) |
| Weight                     | 725 g       |
| Non return valve           | external    |

| Accessories       |
|-------------------|
| Primary connector |

| Part number          |
|----------------------|
| <b>Y 580 701 456</b> |

| Connections   |               |
|---------------|---------------|
| Intake side   | M16 x 1,5     |
| Pressure side | M12 x 1,5     |
| Electrical    | +: M4 / -: M5 |



## Fuel Pump FP 165

Fuel delivery: >165 l/h, 5 bar

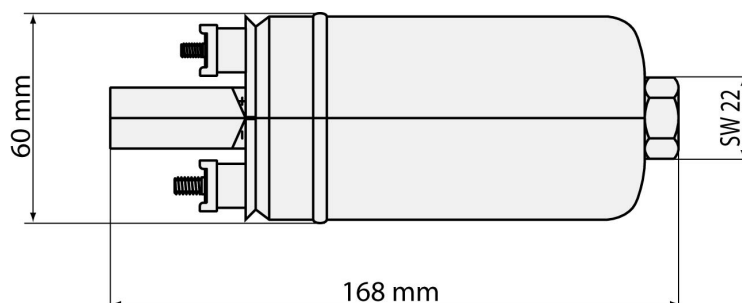


| Description                |              |
|----------------------------|--------------|
| Fuel delivery              | >165 l/h     |
| High temperature reduction | 30 l/h       |
| Supply voltage             | 13,5 V       |
| Current consumption        | 10 A (5 bar) |
| Weight                     | 980 g        |
| Non return valve           | internal     |

| Accessories       |  |
|-------------------|--|
| Primary connector |  |

| Part number   |                      |
|---------------|----------------------|
|               | <b>0 580 254 979</b> |
| Offer drawing | A 580 152 325        |

| Connections   |               |
|---------------|---------------|
| Intake side   | M14 x 1,5     |
| Pressure side | M12 x 1,5     |
| Electrical    | +: M4 / -: M5 |



## Fuel Pump FP 200

Fuel delivery: >200 l/h, 5/8 bar after a break-in period of 20 h

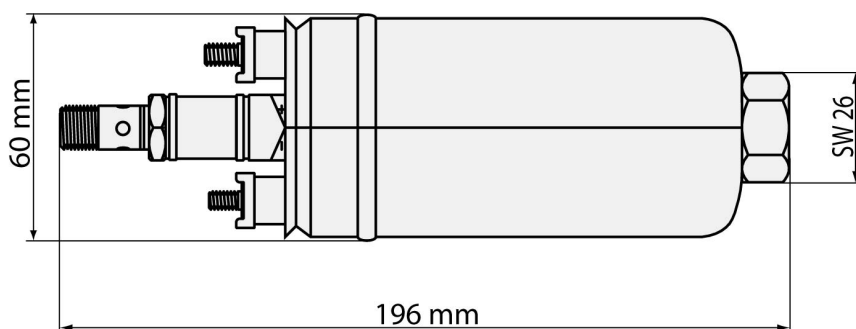


| Description                |          |
|----------------------------|----------|
| Fuel delivery              | >200 l/h |
| High temperature reduction | 30 l/h   |
| Supply voltage             | 13,5 V   |
| Current consumption        | 13 A     |
| Weight                     | 1030 g   |
| Non return valve           | external |

| Connections   |               |
|---------------|---------------|
| Intake side   | M18 x 1,5     |
| Pressure side | M12 x 1,5     |
| Electrical    | +: M6 / -: M5 |

| Accessories       |  |
|-------------------|--|
| Primary connector |  |

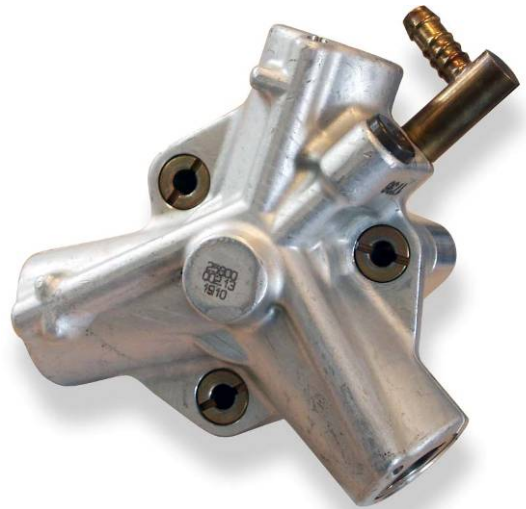
| Part numbers  |                      |
|---------------|----------------------|
| 5 bar         | <b>0 580 254 044</b> |
| 8 bar         | <b>B 261 205 413</b> |
| Offer drawing | A 580 152 519        |



## HPI Fuel Pump HDP 1

The HDP 1 is a high pressure radial pump with three pistons. Designing it we set great value on a big delivery volume, as needed in motorsport applications. Variations in bore and stroke affect different deliveries.

This type of pump was used by different 24h-Le Mans winners.



| Mechanical data              |                                         |
|------------------------------|-----------------------------------------|
| Fuel delivery                | 0,66 ccm/0,80 ccm per rotation          |
| Length                       | 76,8 mm                                 |
| Weight                       | 1000 g                                  |
| Enveloping circle            | 121,4 mm                                |
| Supply pressure              | 4 ... 6 bar                             |
| Output pressure              | 120 bar permanent<br>200 bar short time |
| Max. operating temperature   | 80°C                                    |
| Max. temperature of location | 130°C                                   |
| Max. rotation per minute     | 9000                                    |

| Connections   |                          |
|---------------|--------------------------|
| Intake side   | e.g. thread hole M10 x 1 |
| Pressure side | e.g. thread hole M10 x 1 |

| Part numbers           |                      |
|------------------------|----------------------|
| Fuel delivery 0,66 ccm | <b>B 438 172 058</b> |
| Fuel delivery 0,80 ccm | <b>B 438 172 061</b> |

## Diesel Fuel Pump DFP 300

Fuel delivery: >300 l/h, 5 bar relative

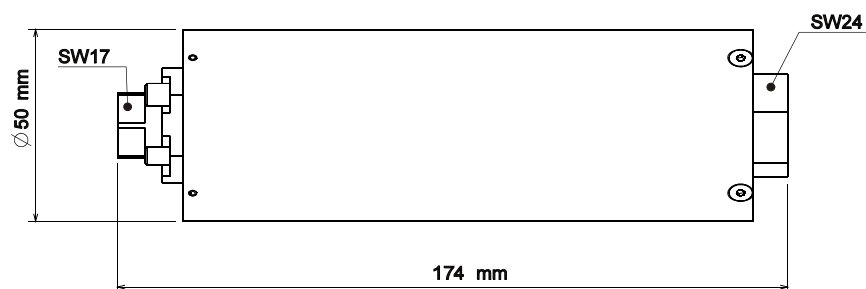
This electrical diesel fuel pump without non-ferrous metal is especially designed for diesel applications. A modified rotor provides higher fuel delivery than the series version. Its tight housing with screwed connectors fits to any intank or inline fuel circuit. This pump results in an excellent weight-to-power ratio.



| Description                                          |          |
|------------------------------------------------------|----------|
| Fuel delivery at fuel temp. < 90 °C                  | >300 l/h |
| Fuel delivery increase after break-in period of 20 h | 20 l/h   |
| Supply voltage                                       | 13,5 V   |
| Current consumption                                  | 17,2 A   |
| Weight                                               | 700 g    |
| Non return valve                                     | internal |
| Housing version                                      | inline   |
| Allowed diesel spec.                                 | EN590    |

| Connections   |               |
|---------------|---------------|
| Intake side   | M18 x 1,5     |
| Pressure side | M12 x 1,5     |
| Electrical    | +: M6 / -: M5 |

| Part number   |                      |
|---------------|----------------------|
| DFP 300l/h    | <b>B 261 205 366</b> |
| Offer drawing | <b>A 261 205 366</b> |



# Fuel Pressure Regulators

## Fuel Pressure Regulator 34

Pressure range: 3,4 bar



### Mechanical data

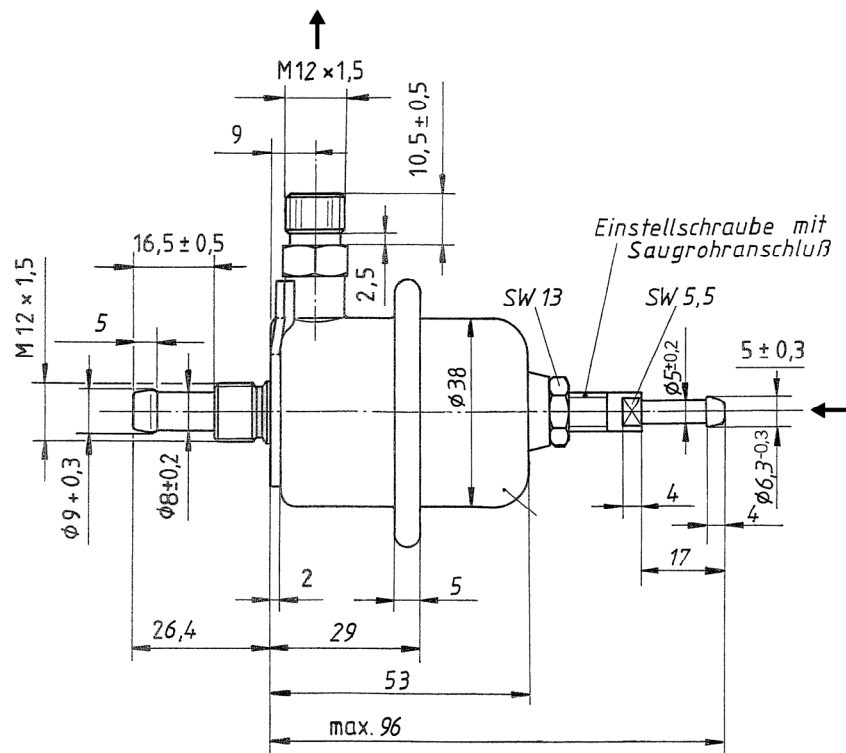
|        |                      |
|--------|----------------------|
| Supply | M12 x 1,5            |
| Reflow | 8 mm, tube connector |

### Part number

|               |                      |
|---------------|----------------------|
|               | <b>B 280 500 740</b> |
| Offer drawing | A 280 500 740        |

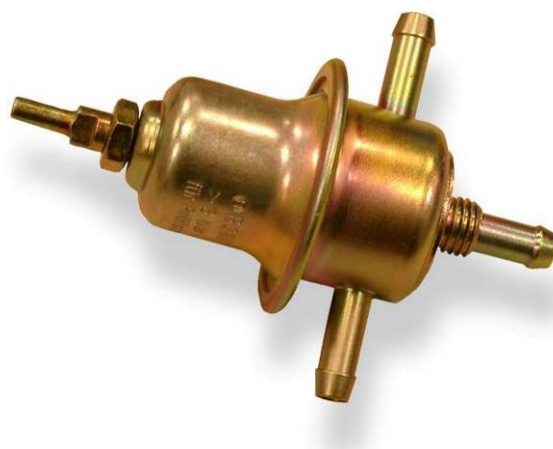
### Description

Sheet steel housing with manifold connection



## Fuel Pressure Regulator 05-40 A

Pressure range: 0,5 ... 4 bar

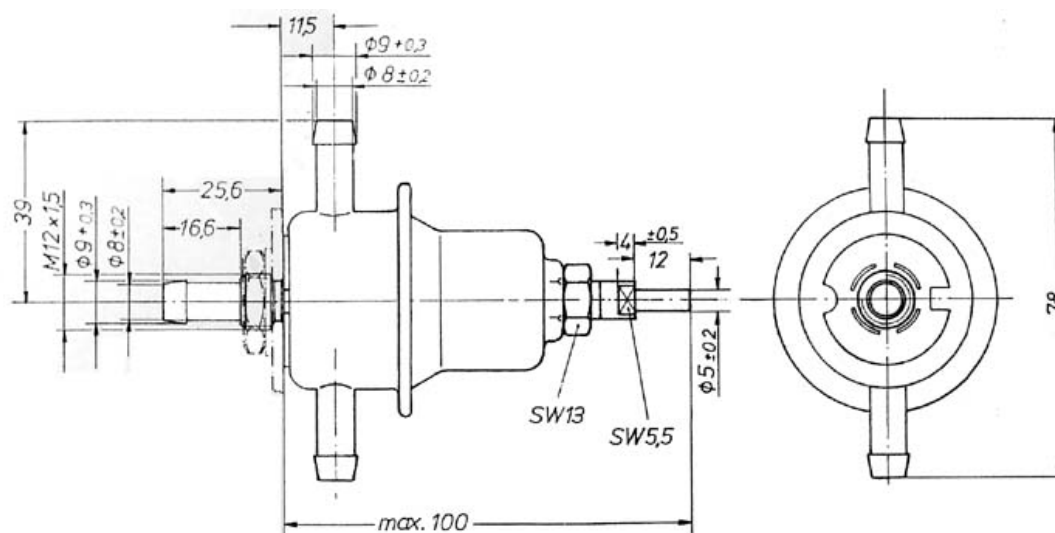


| Mechanical data |                           |
|-----------------|---------------------------|
| Supply          | 8 mm, tube connector      |
| Reflow          | 8 mm, tube connector      |
| Reflow quantity | min. 15 l/h, max. 220 l/h |

|               |                      |
|---------------|----------------------|
| Part number   |                      |
|               | <b>B 280 500 139</b> |
| Offer drawing | A 280 500 104        |

## Description

Sheet steel housing with manifold connection



# Fuel Pressure Regulator 14 x 60

Pressure range: 1,4 ... 5 bar/3,2 ... 6 bar



## Mechanical data

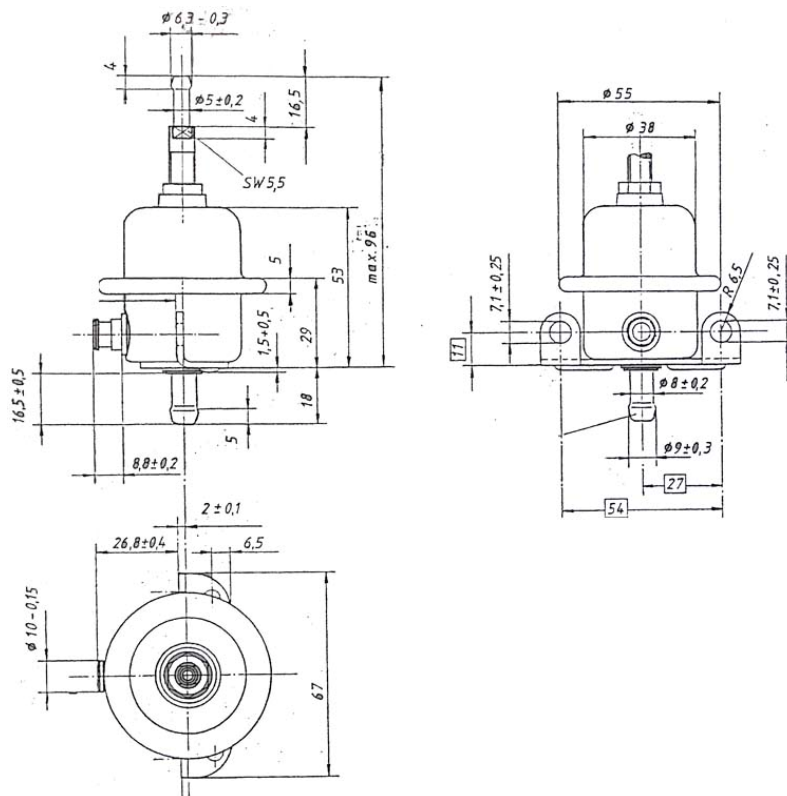
|                 |                           |
|-----------------|---------------------------|
| Supply          | 10 mm, O-ring             |
| Reflow          | 8 mm, tube connector      |
| Reflow quantity | min. 15 l/h, max. 220 l/h |

## Part numbers

|               |                      |
|---------------|----------------------|
| 1,4 ... 5 bar | <b>B 280 500 701</b> |
| 3,2 ... 6 bar | <b>B 280 500 581</b> |
| Offer drawing | A 280 500 581        |

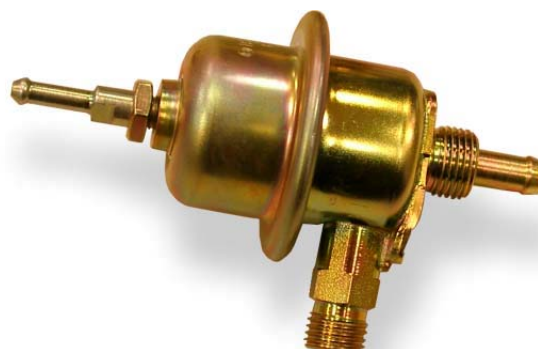
## Description

Sheet steel housing with manifold connection



# Fuel Pressure Regulator 15-50

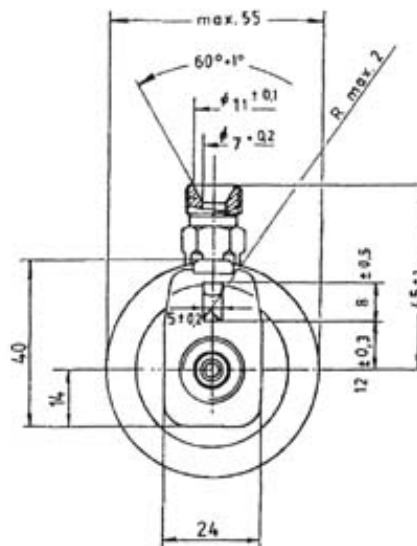
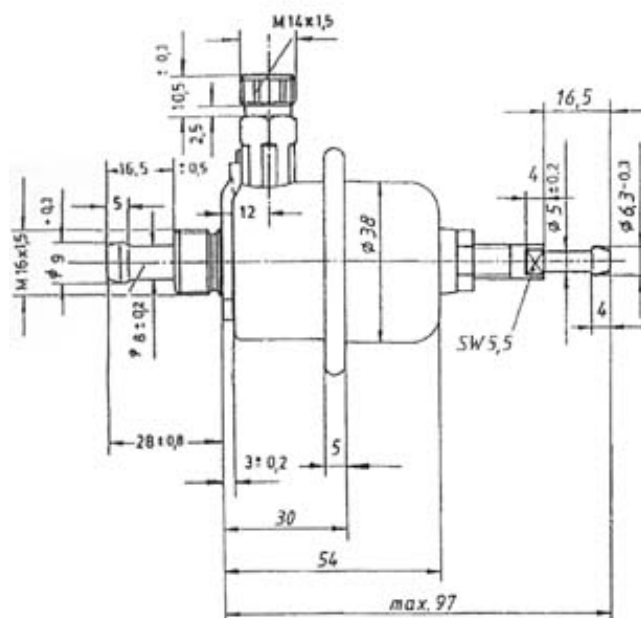
Pressure range: 1,5 ... 5 bar



| Mechanical data |                           |
|-----------------|---------------------------|
| Supply          | 8 mm, O-ring              |
| Reflow          | M14 x 1,5                 |
| Reflow quantity | min. 15 l/h, max. 220 l/h |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 280 500 743</b> |
| Offer drawing | A 280 500 743        |

| Description                                  |  |
|----------------------------------------------|--|
| Sheet steel housing with manifold connection |  |



# Fuel Pressure Regulator 19-50

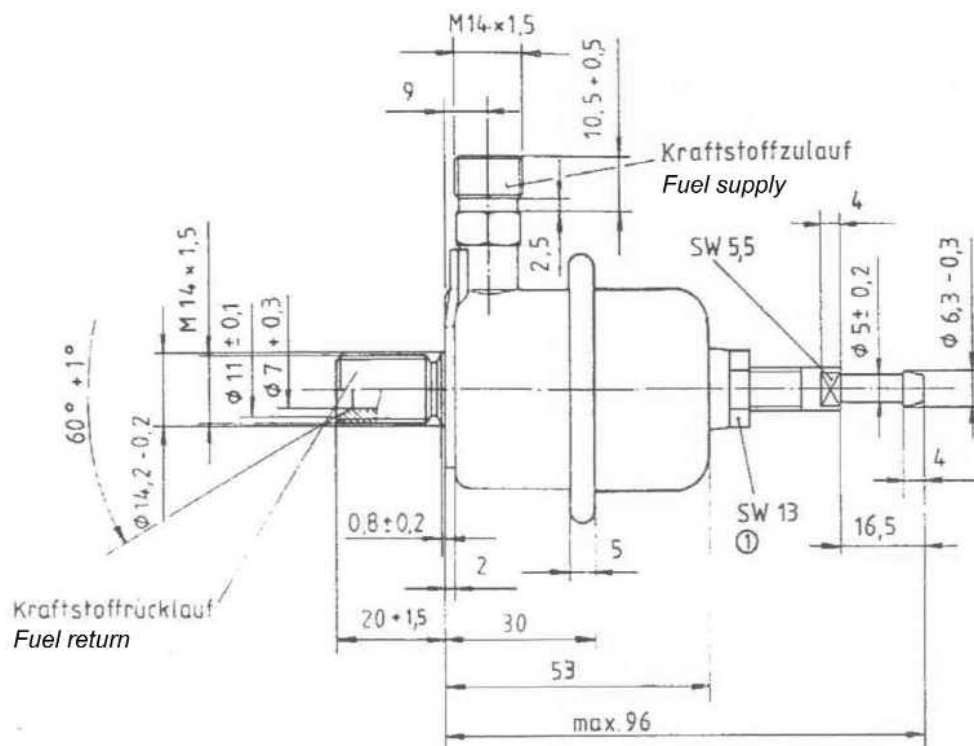
Pressure range: 1,9 ... 5 bar



| Mechanical data |                           |
|-----------------|---------------------------|
| Supply          | M14 x 1,5                 |
| Reflow          | M14 x 1,5                 |
| Reflow quantity | min. 15 l/h, max. 220 l/h |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 280 500 737</b> |
| Offer drawing | A 280 500 662        |

| Description                                  |  |
|----------------------------------------------|--|
| Sheet steel housing with manifold connection |  |



## Fuel Pressure Regulator 20x120

Pressure ranges: 2 ... 5 bar/ 3 ... 6 bar/ 4,5 ... 12 bar

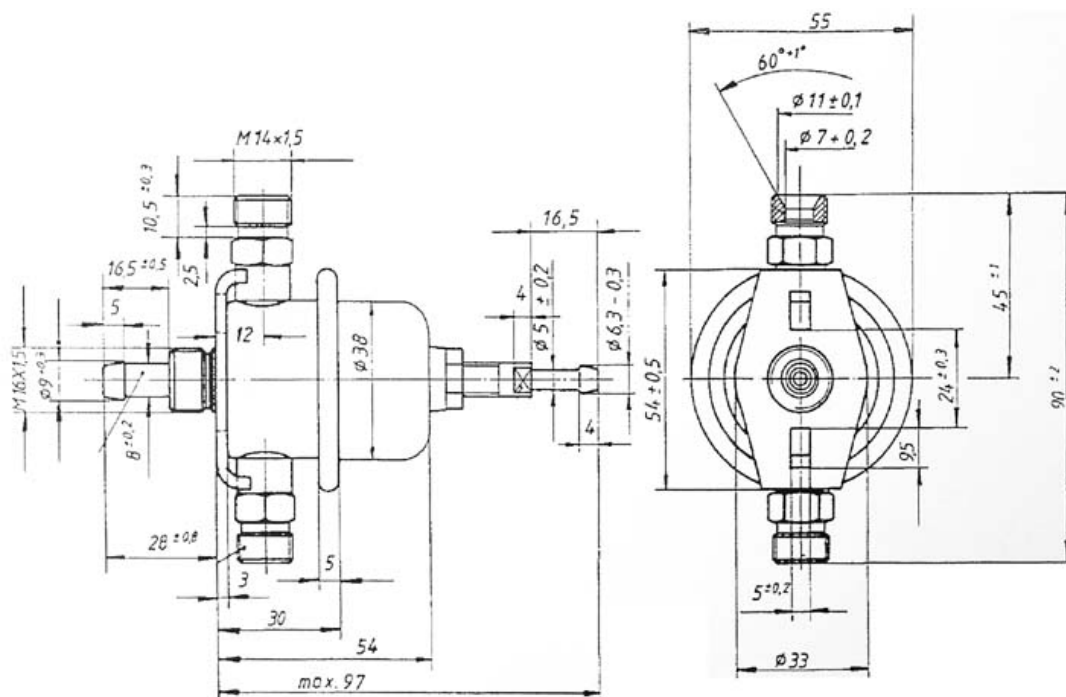


| Mechanical data |                           |
|-----------------|---------------------------|
| Supply          | 2 x M14 x 1,5             |
| Reflow          | 8 mm, tube connector      |
| Reflow quantity | min. 15 l/h, max. 220 l/h |

| Part numbers   |                      |
|----------------|----------------------|
| 2 ... 5 bar    | <b>B 280 500 741</b> |
| 3 ... 6 bar    | <b>B 280 500 714</b> |
| 4,5 ... 12 bar | <b>B 280 500 566</b> |
| Offer drawing  | A 280 500 714        |

### Description

Sheet steel housing with manifold connection





# Fuel Pressure Regulator Mini 50

Pressure range: 5,0 bar



## Mechanical data

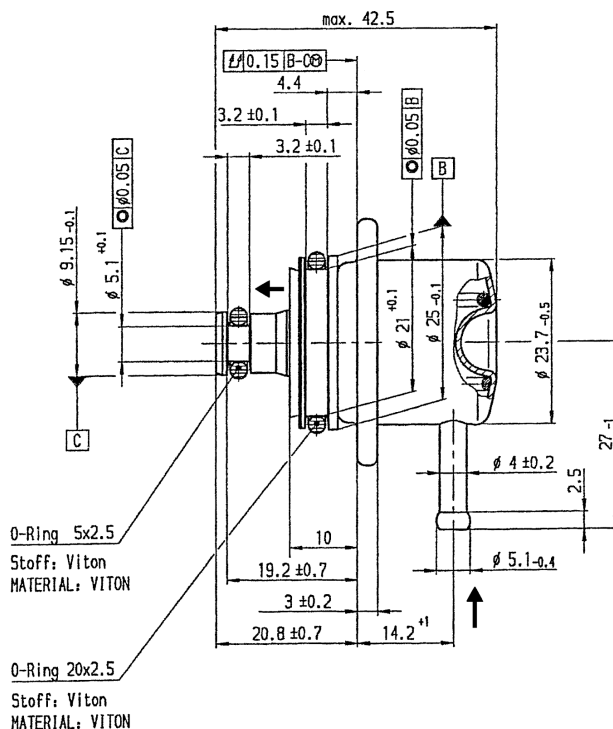
|        |                      |
|--------|----------------------|
| Supply | 4 mm, tube connector |
| Reflow | 9,15 mm, O-ring      |

### Description

### Sheet steel housing with manifold connection

## Part number

|               |                      |
|---------------|----------------------|
|               | <b>B 280 550 113</b> |
| Offer drawing | A 280 550 058        |



Erledigung durch Kunden  
*Effect by customer*

- O-Ringe leicht mit sauberem Motorenöl einölen  
*Oil O-rings lightly with clean engine oil*
- Nach der Montage an Kraftstoffzuteiler ist Dichtheitsprüfung durchzuführen  
*Leaktest after installation*
- Bei Ausbau und Wiederverwendung des Druckreglers müssen die O-Ringe überprüft werden  
*When the pressure regulator is removed and will be reused, the O-rings must be checked*
- Betrieb des Druckreglers mit Luft

# Fuel Pressure Regulator Mini A

Pressure ranges: 2,2 ... 3,5 bar/3,5 ... 5 bar

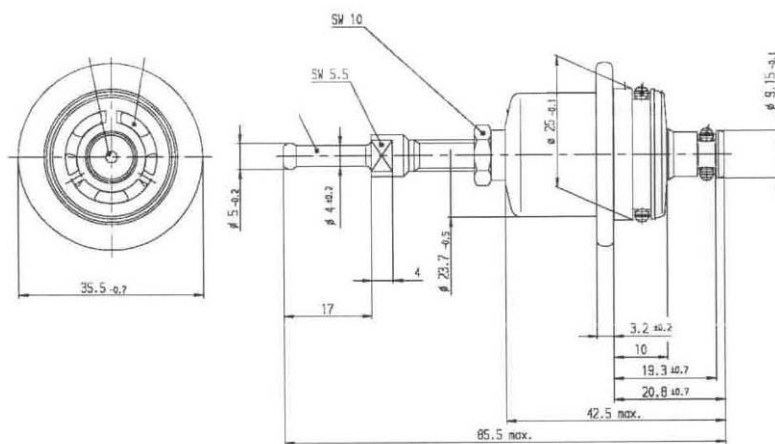


| Mechanical data |                           |
|-----------------|---------------------------|
| Supply          | 24,6 mm, O-ring           |
| Reflow          | 9,15 mm, O-ring           |
| Reflow quantity | min. 15 l/h, max. 220 l/h |
| Weight          | 58 g                      |

| Description                    |  |
|--------------------------------|--|
| Light weight aluminium housing |  |
| No manifold connection         |  |

| Accessories |                      |
|-------------|----------------------|
| Pre-filter  | <b>1 287 431 008</b> |

| Part numbers    |                      |
|-----------------|----------------------|
| 2,2 ... 3,5 bar | <b>B 280 550 340</b> |
| 3,5 ... 5 bar   | <b>B 280 550 341</b> |
| Offer drawing   | A 280 550 340        |



## Erledigung durch Kunden Effect by customer

- O-Ringe leicht mit sauberem Motorenöl einölen  
*Oil O-rings lightly with clean engine oil*
- Nach der Montage an Kraftstoffzuteiler ist Dichtheitsprüfung durchzuführen  
*Leaktest after installation*
- Bei Ausbau und Wiederverwendung des Druckreglers müssen die O-Ringe überprüft werden  
*When the pressure regulator is removed and will be reused, the O-rings must be checked*
- Betrieb des Druckreglers mit Luft ist unzulässig  
*Operation with air is not allowed*

# Fuel Pressure Regulator Mini/Mini M

Pressure range: 6/8/10 bar

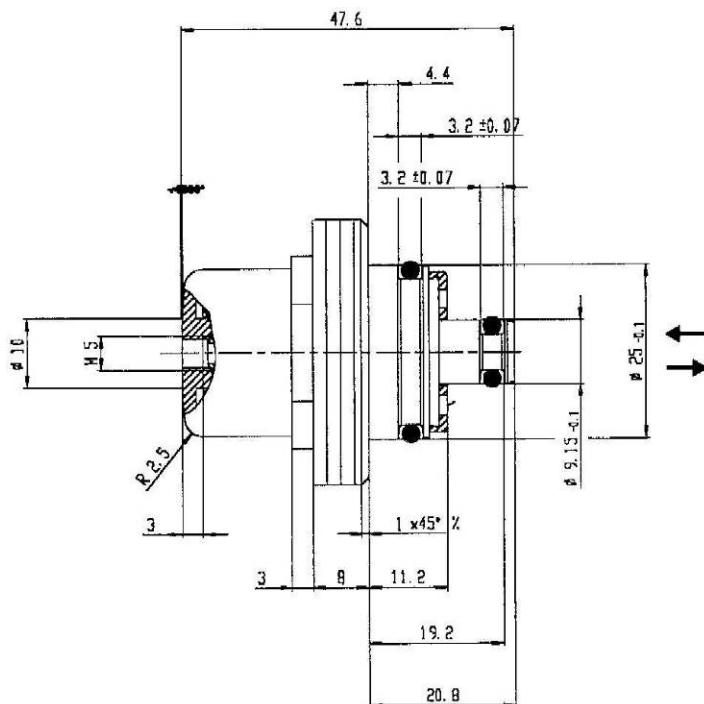
We offer this mini pressure regulator in two fuel-specific versions: the standard version for use with petrol and a M-version for use with methanol.



| Mechanical data |                           |
|-----------------|---------------------------|
| Supply          | 25 mm, O-ring             |
| Reflow          | 9,15 mm, O-ring           |
| Reflow quantity | min. 30 l/h, max. 400 l/h |

| Description                    |  |
|--------------------------------|--|
| Light weight aluminium housing |  |
| No manifold connection         |  |

| Part numbers     |                      |
|------------------|----------------------|
| Standard version |                      |
| 6 bar            | <b>B 261 208 106</b> |
| 8 bar            | <b>B 261 208 108</b> |
| 10 bar           | <b>B 261 208 109</b> |
| Methanol version |                      |
| 6 bar            | <b>B 261 208 121</b> |
| 8 bar            | <b>B 261 208 122</b> |
| 10 bar           | <b>B 261 208 123</b> |
| Offer drawing    | A 261 208 101        |



## Erledigung durch Kunden Effect by customer

- O-Ringe leicht mit sauberem Motorenöl einölen  
*Oil O-rings lightly with clean engine oil*
- Nach der Montage an Kraftstoffzuteiler ist Dichtheitsprüfung durchzuführen  
*Leaktest after installation*
- Bei Ausbau und Wiederverwendung des Druckreglers müssen die O-Ringe überprüft werden  
*When the pressure regulator is removed and will be reused, the O-rings must be checked*
- Betrieb des Druckreglers mit Luft

## HPI Control Valve DSV

The DSV is especially designed for regulation of pressure in the common rail of high pressure injection systems.



| Mechanical data              |                    |
|------------------------------|--------------------|
| Pressure range               | 4 ...120 bar       |
| Back pressure                | 4 bar              |
| Flow quantity                | max. 100 l/h       |
| Weight                       | 135 g              |
| Size                         | 32 x 54 x 56 mm    |
| Housing                      | Aluminium          |
| Operating temperature        | -20 ... 130°C      |
| Max. temperature of location | 140°C (max. 5 min) |

| Electrial data    |                            |
|-------------------|----------------------------|
| Operation voltage | 6,5 ... 18 V               |
| Operation current | $I_{\max} = 1,8 \text{ A}$ |

| Part number |                      |
|-------------|----------------------|
|             | <b>B 261 209 568</b> |

# Starters

## Starter 1,4 kW

This starter is specially constructed for motorsport demand. It is a pre-engaged drive starter in clockwise version.

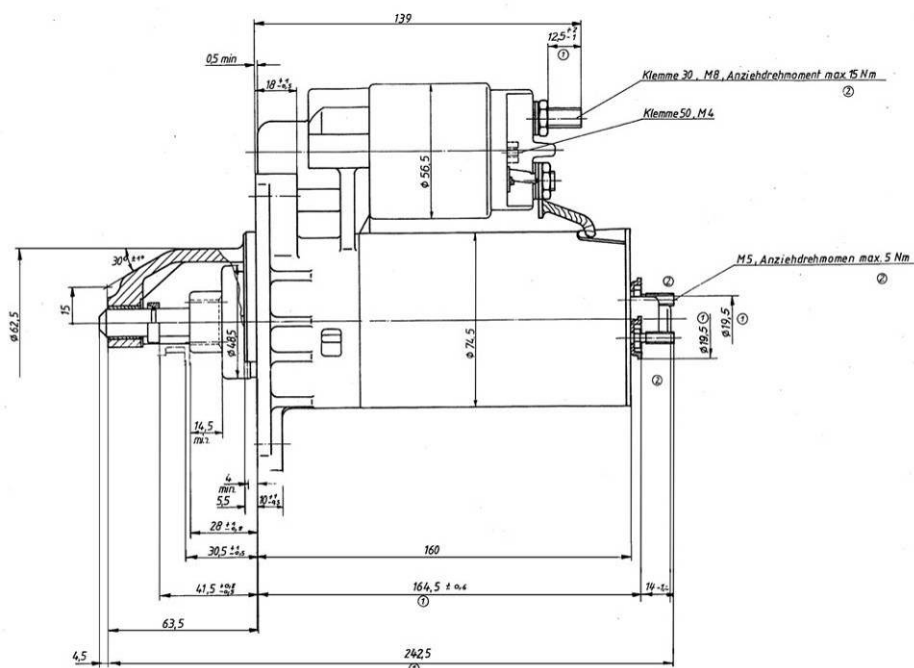


| Mechanical data |              |
|-----------------|--------------|
| Weight          | 3200 g       |
| Revolutions     | 3600 x 1/min |
| Modul           | 2/11         |

| Conditions for use |                 |
|--------------------|-----------------|
| Max. temperature   | 150°C           |
| Vibration          | high protection |

| Electrical data |        |
|-----------------|--------|
| Performance     | 1,4 kW |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 261 206 115</b> |
| Offer drawing |                      |
|               | <b>A 001 111 036</b> |



Further special versions on request.

## Starter 1,7 kW

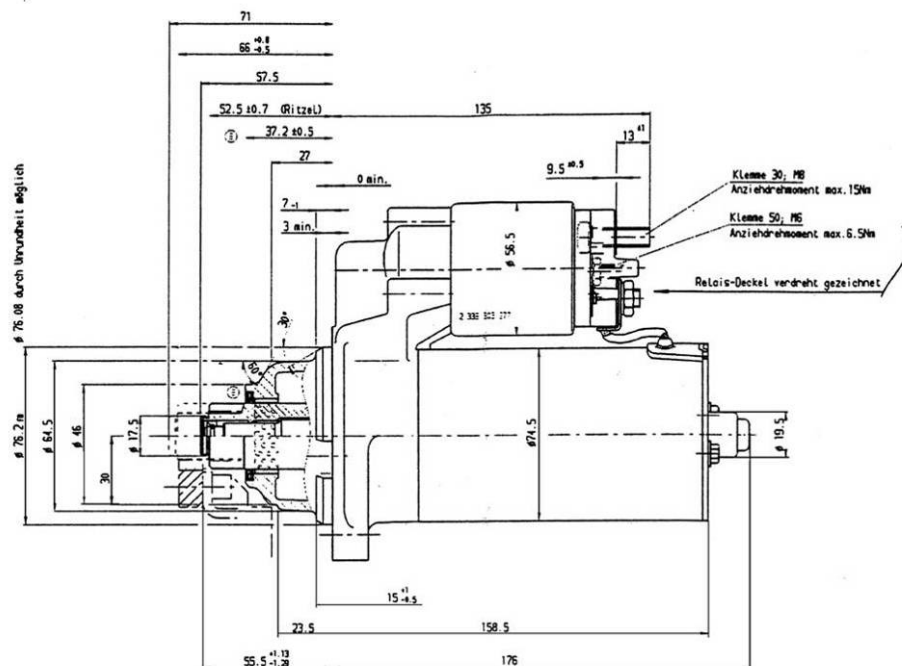
This starter is specially constructed for motorsport demand. It is a pre-engaged drive starter, we offer it in clockwise and anticlockwise version on request.



| Mechanical data    |              |
|--------------------|--------------|
| Weight             | 3700 g       |
| Revolutions        | 3600 x 1/min |
| Transmission ratio | i 5,0        |
| Modul              | 2/11         |

| Conditions for use |                 |
|--------------------|-----------------|
| Max. temperature   | 150°C           |
| Vibration          | high protection |

| Electrical data |                      |
|-----------------|----------------------|
| Performance     | 1,7 kW               |
| Part number     |                      |
|                 | <b>B 261 208 186</b> |
| Offer drawing   | A 261 208 186        |



Further special versions on request.

## Starter 2,0 kW

This starter is specially constructed for motorsport demand. It is a pre-engaged drive starter, we offer it in clockwise version.



| Mechanical data    |              |
|--------------------|--------------|
| Weight             | 4050 g       |
| Revolutions        | 4700 x 1/min |
| Transmission ratio | i 5,0        |
| Modul              | 2/11         |

| Conditions for use |                 |
|--------------------|-----------------|
| Max. temperature   | 150°C           |
| Vibration          | high protection |

| Electrical data |        |
|-----------------|--------|
| Performance     | 2,0 kW |

| Part number   |                      |
|---------------|----------------------|
|               | <b>B 001 116 174</b> |
| Offer drawing | A 001 116 174        |

# Alternators

## Alternator 90 A

This alternator is modified for motorsport demand. It is a clockwise rotation type and is series part in the Porsche Cup cars. We deliver the alternator inclusive fan and pulley. Modifications are available on request.



| Mechanical data           |               |
|---------------------------|---------------|
| Case material             | aluminium     |
| Weight                    | 5400 g        |
| Current regulator unit    | integrated    |
| Rotation                  | clockwise     |
| Max. rotations            | 17500 x 1/min |
| Dimensions                |               |
| Diameter                  | 143 mm        |
| Length without shaft stub | 144 mm        |
| Between mounting points   | 157 mm        |

| Conditions for use                   |                 |
|--------------------------------------|-----------------|
| Temperature range                    | -10 ... 90°C    |
| Vibration                            | high protection |
| Installation without rubber mounting |                 |

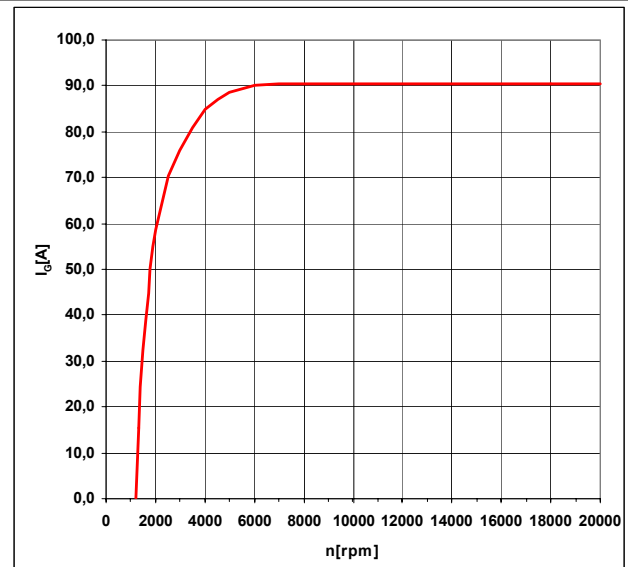
| Electric connections |                                 |
|----------------------|---------------------------------|
| Battery B+           | M8                              |
| Control lamp D+      | flat-pin connector, see drawing |

| Electronic data |              |
|-----------------|--------------|
| Rated current   | 90 A         |
| Supply voltage  | 14 V         |
| Cut-in speed    | 1300 x 1/min |
| Coupling        | screws       |

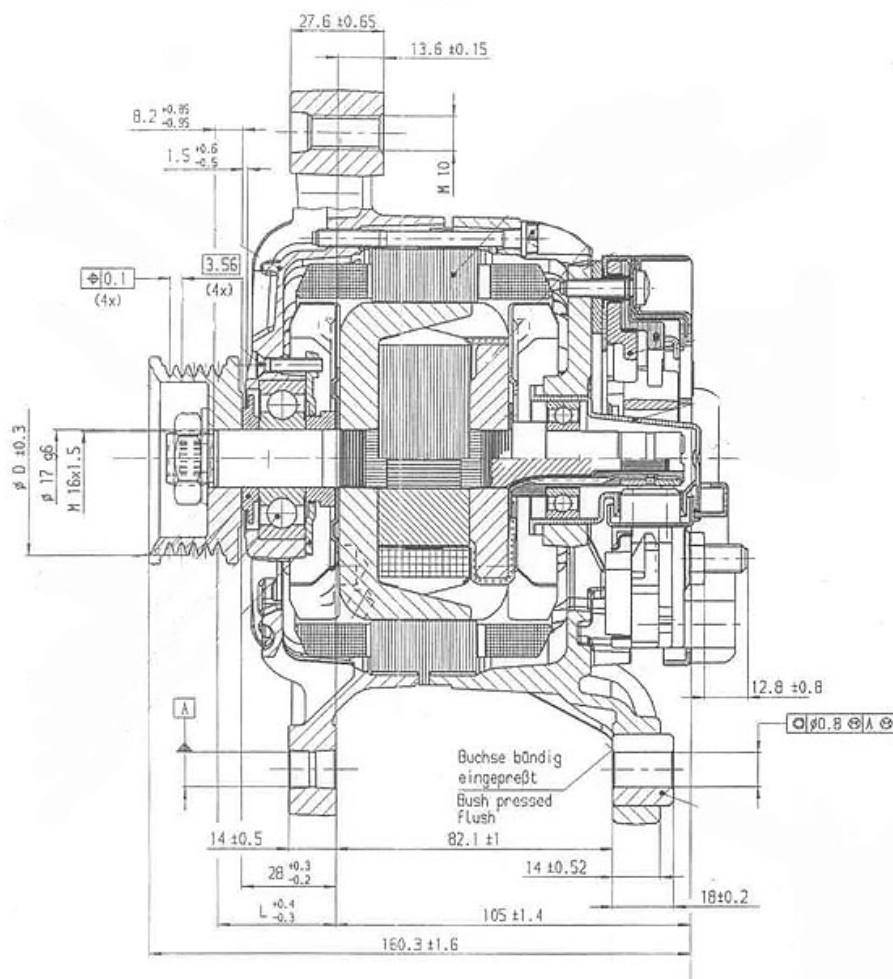
| Part number   |                      |
|---------------|----------------------|
|               | <b>B 120 416 264</b> |
| Offer drawing | A 124 315 014        |

### Characteristic

| rpm   | IG (A) 25°C |
|-------|-------------|
| 1000  | 0           |
| 1300  | 15,5        |
| 1500  | 32,5        |
| 1700  | 44,8        |
| 2000  | 58,5        |
| 3000  | 76,0        |
| 4000  | 85,0        |
| 5000  | 88,5        |
| 6000  | 90,0        |
| 7000  | 90,3        |
| 8000  | 90,5        |
| 9000  | 90,5        |
| 10000 | 90,5        |
| 15000 | 90,5        |
| 20000 | 90,5        |



### Design



# Alternator GCM1

110/130/140 A

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



| Mechanical data                  |                |
|----------------------------------|----------------|
| Case material                    | aluminium      |
| Weight                           | 3400 g         |
| Current regulator unit           | integrated     |
| Max. rotations                   | 18 000 x 1/min |
| Dimensions                       |                |
| Diameter                         | 108 mm         |
| Length without shaft stub        | 128 mm         |
| Distance between mounting points | 154 mm         |

| Conditions for use                   |                 |
|--------------------------------------|-----------------|
| Temperature range                    | -30 ... 90°C    |
| Vibration                            | high protection |
| Installation without rubber mounting |                 |

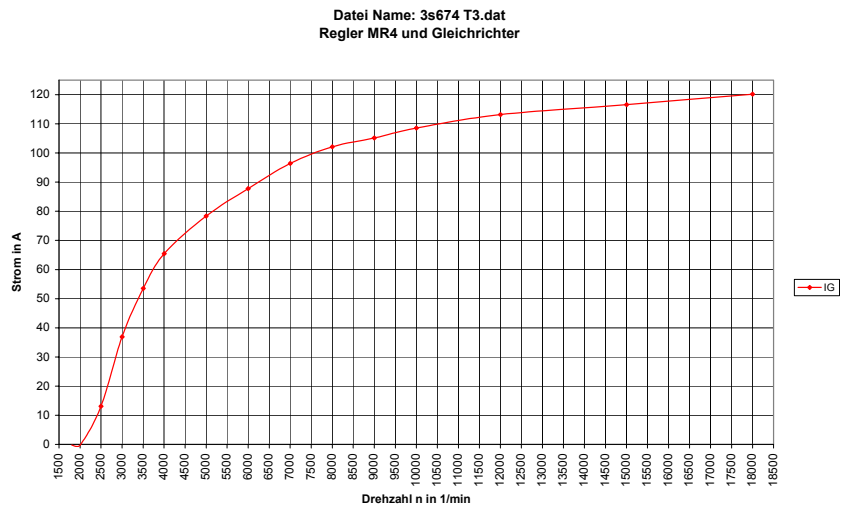
| Electric connections |                                 |
|----------------------|---------------------------------|
| Battery B+           | M6                              |
| Control lamp D+      | flat-pin connector, see drawing |

| Electronic data |               |
|-----------------|---------------|
| Rated current   | 110/130/140 A |
| Supply voltage  | 13,5 V        |
| Cut-in speed    | 3000 x 1/min  |
| Coupling        | screws        |

| Part numbers           |                      |
|------------------------|----------------------|
| <b>110 A</b>           |                      |
| Anticlockwise rotation | <b>B 261 208 606</b> |
| Clockwise rotation     | <b>B 261 208 607</b> |
| <b>130 A</b>           |                      |
| Anticlockwise rotation | <b>B 261 208 604</b> |
| Clockwise rotation     | <b>B 261 208 605</b> |
| <b>140 A</b>           |                      |
| Anticlockwise rotation | <b>B 261 208 602</b> |
| Clockwise rotation     | <b>B 261 208 603</b> |
| Offer drawing          |                      |
| 0 124 OAD 32A          |                      |

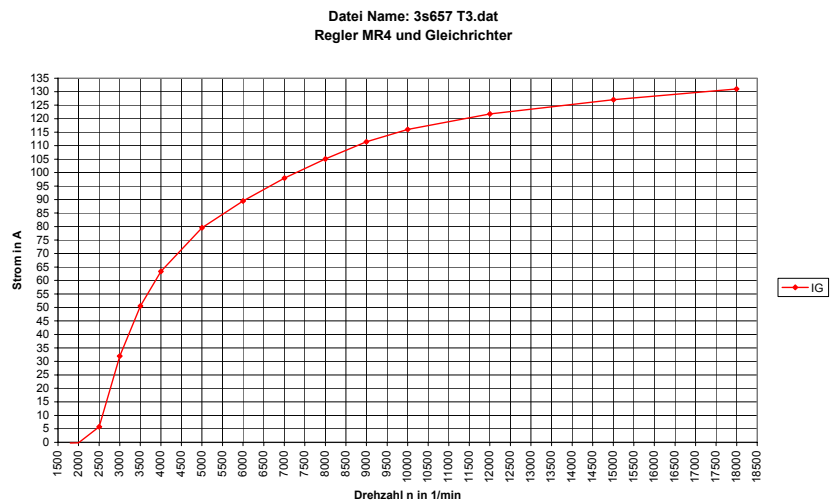
### Characteristic 110 A

| Rpm   | IG (A) at 90°C |
|-------|----------------|
| 2000  | 0              |
| 2500  | 13             |
| 3000  | 37             |
| 3500  | 54             |
| 4000  | 65             |
| 5000  | 78             |
| 6000  | 88             |
| 7000  | 96             |
| 8000  | 102            |
| 9000  | 105            |
| 10000 | 108            |
| 12000 | 113            |
| 15000 | 117            |
| 18000 | 120            |



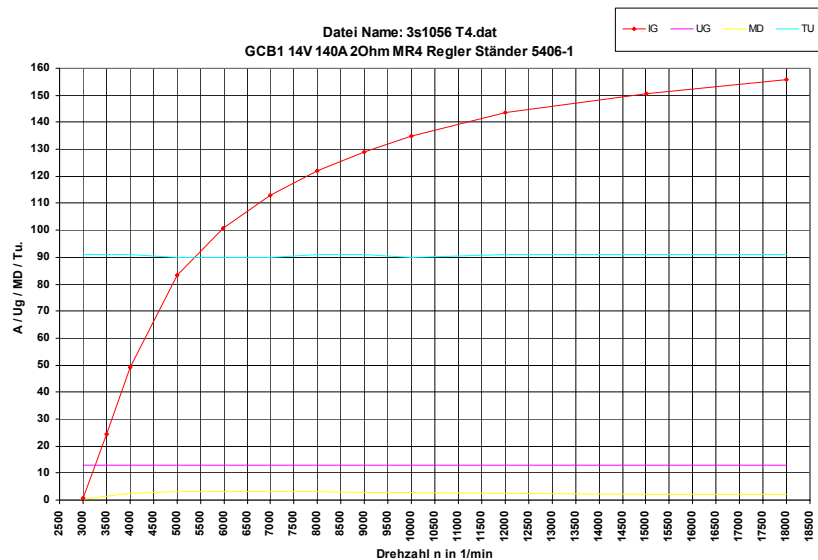
### Characteristic 130 A

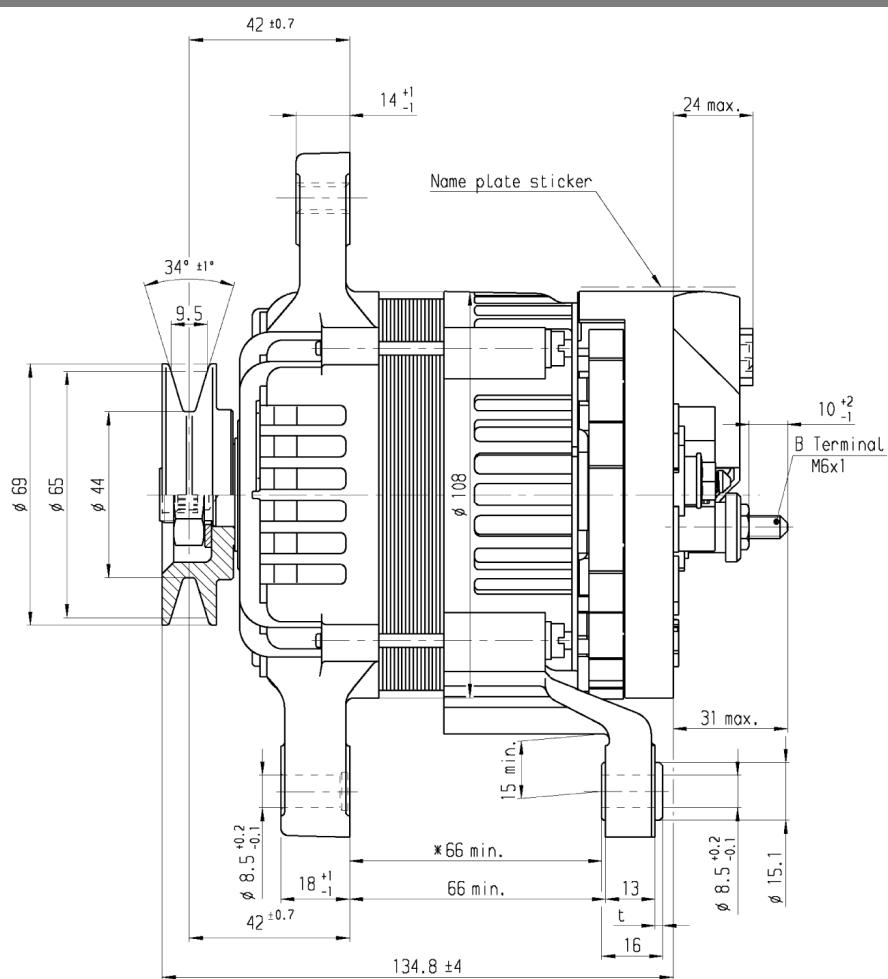
| Rpm   | IG (A) at 90°C |
|-------|----------------|
| 2000  | 0              |
| 2500  | 6              |
| 3000  | 32             |
| 3500  | 51             |
| 4000  | 63             |
| 5000  | 80             |
| 6000  | 90             |
| 7000  | 98             |
| 8000  | 105            |
| 9000  | 111            |
| 10000 | 116            |
| 12000 | 121            |
| 15000 | 127            |
| 18000 | 131            |



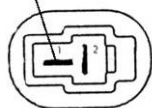
### Characteristic 140 A

| Rpm   | IG (A) at 90°C |
|-------|----------------|
| 2000  | 0              |
| 2500  | 0              |
| 3000  | 1              |
| 3500  | 25             |
| 4000  | 49             |
| 5000  | 83             |
| 6000  | 101            |
| 7000  | 113            |
| 8000  | 122            |
| 9000  | 129            |
| 10000 | 135            |
| 12000 | 144            |
| 15000 | 151            |
| 18000 | 156            |





1: D+ (Control lamp)



## Alternator F1-01

This alternator with permanent excitation is modified for motorsport demand and splash fluid protected. The stator windings are hand made. The rotor is extra fine balanced and designed for high rotation speed operation. Clockwise and anti-clockwise versions are available while modifications are available on request.



| Mechanical data        |                                |
|------------------------|--------------------------------|
| Weight                 | 890 g                          |
| Voltage regulator unit | external; separately available |
| Max. rotation speed    | 28 000 x 1/min                 |
| Cooling options        | water/oil/air                  |
| Dimensions             |                                |
| Diameter               | 73 mm                          |
| Length                 | 75 mm                          |

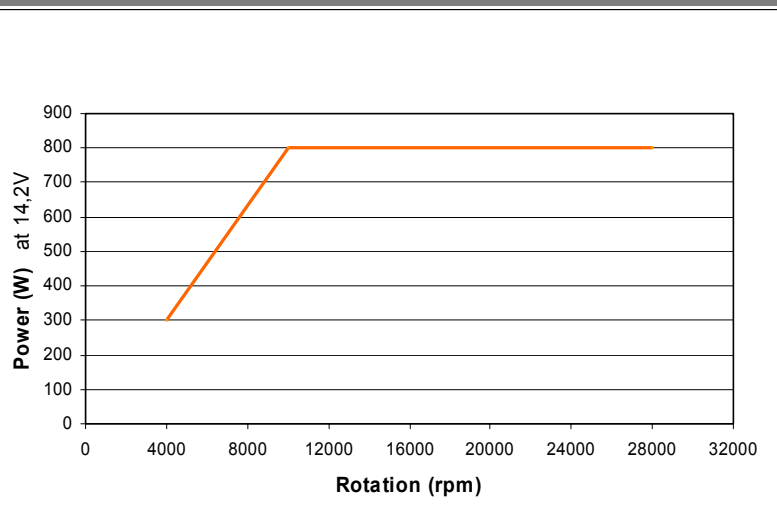
| Conditions for use |                  |
|--------------------|------------------|
| Temperature range  | - 10°C ... 180°C |
| Installation       | mounting flange  |

| Electrical connections                                |  |
|-------------------------------------------------------|--|
| Cable harness with bare wires.                        |  |
| Broad connector range available. Mounting on request. |  |

| Electrical rating<br>(with external voltage regulator unit) |            |
|-------------------------------------------------------------|------------|
| Rated current                                               | 56 A       |
| Output voltage                                              | 14,2 V     |
| Power output @10000 rpm                                     | max. 800 W |

| Part numbers                                                                         |  |
|--------------------------------------------------------------------------------------|--|
| <b>F 01E B01 861</b>                                                                 |  |
| Please specify rotation direction, cooling option and connector choice when ordering |  |

F1-01



## Alternator F1-02

This alternator with permanent excitation is modified for motorsport demand and splash fluid protected. The stator windings are hand made. The rotor is extra fine balanced and designed for high rotation speed operation. Clockwise and anti-clockwise versions are available while modifications are available on request.



| Mechanical data        |                                |
|------------------------|--------------------------------|
| Weight                 | 1190 g                         |
| Voltage regulator unit | external; separately available |
| Max. rotation speed    | 28 000 x 1/min                 |
| Cooling options        | water/oil/air                  |
| Dimensions             |                                |
| Diameter               | 73 mm                          |
| Length                 | 87 mm                          |

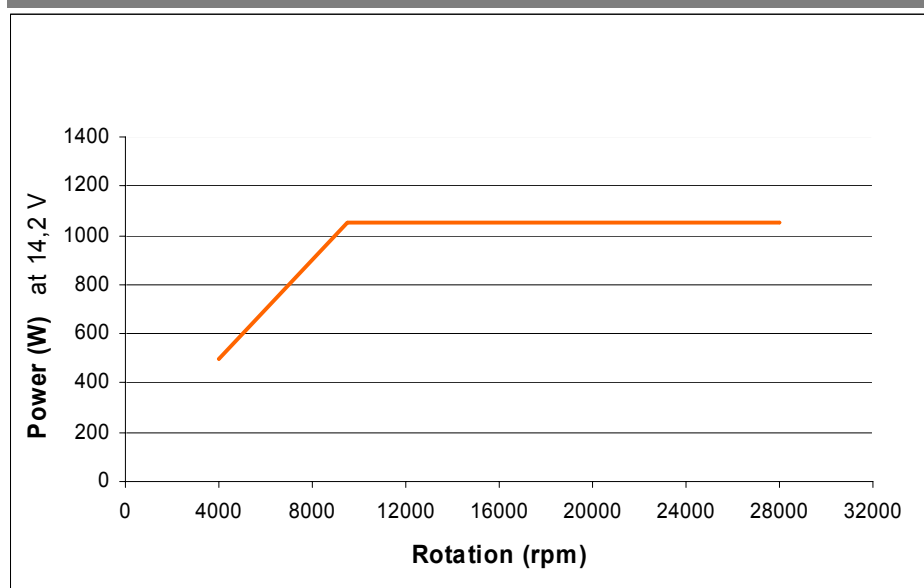
| Conditions for use |                  |
|--------------------|------------------|
| Temperature range  | - 10°C ... 160°C |
| Installation       | mounting flange  |

| Electrical connections                                |  |
|-------------------------------------------------------|--|
| Cable harness with bare wires.                        |  |
| Broad connector range available. Mounting on request. |  |

| Electrical Rating<br>(with external voltage regulator unit) |             |
|-------------------------------------------------------------|-------------|
| Rated current                                               | 74 A        |
| Output voltage                                              | 14,2 V      |
| Power Output @10000 rpm                                     | max. 1050 W |

| Part numbers                                                                         |                      |
|--------------------------------------------------------------------------------------|----------------------|
|                                                                                      | <b>F 01E B01 862</b> |
| Please specify rotation direction, cooling option and connector choice when ordering |                      |

F1-02



## Alternator F1-03

This alternator with permanent excitation is modified for motorsport demand and splash fluid protected. The stator windings are hand made. The rotor is extra fine balanced and designed for high rotation speed operation. Clockwise and anti-clockwise versions are available while modifications are available on request.



| Mechanical data        |                                |
|------------------------|--------------------------------|
| Weight                 | 1740 g                         |
| Voltage regulator unit | external; separately available |
| Max. rotation speed    | 19 000 x 1/min                 |
| Cooling options        | water/oil/air                  |
| Dimensions             |                                |
| Diameter               | 73 mm                          |
| Length                 | 97 mm                          |

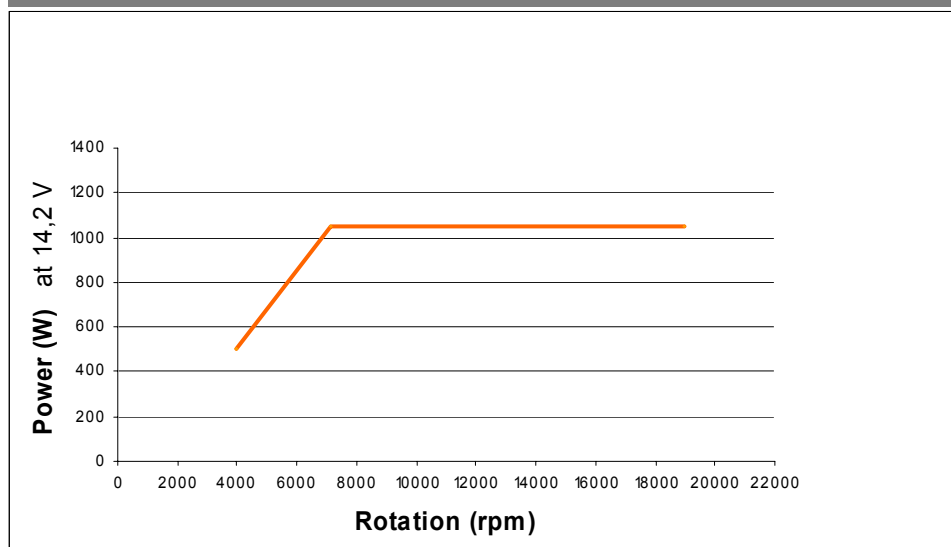
| Conditions for use |                  |
|--------------------|------------------|
| Temperature range  | - 10°C ... 160°C |
| Installation       | mounting flange  |

| Electrical connections                               |  |
|------------------------------------------------------|--|
| Cable harness with bare wires.                       |  |
| Broad connector range available. Mounting on request |  |

| Electrical Rating<br>(with external voltage regulator unit) |             |
|-------------------------------------------------------------|-------------|
| Rated current                                               | 74 A        |
| Output voltage                                              | 14,2 V      |
| Power output @8000 rpm                                      | max. 1050 W |

| Part numbers                                                                         |  |
|--------------------------------------------------------------------------------------|--|
| <b>F 01E B01 863</b>                                                                 |  |
| Please specify rotation direction, cooling option and connector choice when ordering |  |

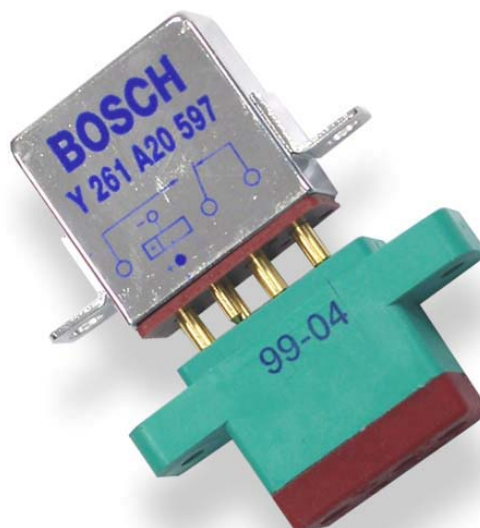
F1-03



# Relay

## Relay 25 A

A miniature DC-contactor for electrical power control. The rated current is 25 A for secondary power distribution with high inrush current like hydraulic- and fuel motor loads. The base part allows a quick change of the relay.



| Mechanical data |        |
|-----------------|--------|
| Drill hole      | 3,1 mm |
| Weight          | 61 g   |

| Conditions for use |                      |
|--------------------|----------------------|
| Temperature range  | -30 ... 125°C        |
| Vibration          | 30 g/70 Hz ... 3 kHz |
| Shock              | 100 g (11 ms)        |

| Electronic data |               |
|-----------------|---------------|
| Supply voltage  | 12 ... 14,5 V |
| Max. current    | 25 A          |
| Min. switches   | 20 000        |

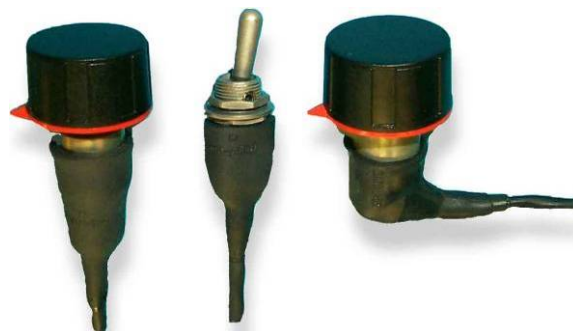
| Part numbers  |                      |
|---------------|----------------------|
| Relay         | <b>Y 261 A20 597</b> |
| Offer drawing | Y 261 A25 338        |
| Base          | <b>Y 261 A20 598</b> |
| Offer drawing | Y 261 A25 338        |

# Switches

## Switches

We offer a wide range of switches for the special demands of motorsport.

You can combine all types with every design and every connector cable equivalent to your individual requirement.



| Type                            |
|---------------------------------|
| For MAP Function                |
| For display-toggle-function     |
| 3 steps for MAP-function        |
| 4 steps                         |
| 4 steps for MAP-function        |
| 6 steps for display switch over |
| 12 steps                        |

| Connector cables |
|------------------|
| Without          |
| KPTA 6E6-4P-C-DN |
| KPTC 6E8-3P-C-DN |
| ASL 6-06-05PN-HE |

| Extras                               |
|--------------------------------------|
| With integrated resistor network     |
| Lockable                             |
| Variable number of steps             |
| Variable form of rotary waver switch |
| Without end stop                     |

| Application range   |
|---------------------|
| Motor functions     |
| Dashboard functions |
| Display switch over |
| Display dimmer      |

| Design     |
|------------|
| Straight   |
| 90° angled |

| Part numbers                               |            |                  |                      |
|--------------------------------------------|------------|------------------|----------------------|
| Model                                      | Design     | Connector        |                      |
| 12 steps                                   | Straight   | KPTC 6E8-3P-C-DN | <b>B 261 209 143</b> |
| 12 steps                                   | 90° angled | KPTC 6E8-3P-C-DN | <b>B 261 209 144</b> |
| 12 steps                                   | straight   | KPTC 6E6-4P-C-DN | <b>B 261 209 146</b> |
| 4 steps                                    | straight   | KPTC 6E6-4P-C-DN | <b>B 261 209 147</b> |
| 12 steps without                           | straight   | KPTC 6E6-4P-C-DN | <b>B 261 209 148</b> |
| 4 steps LED dimmer display                 |            | KPTC 6E8-3P-C-DN | <b>B 261 209 527</b> |
| 4 steps display dimmer DDU                 |            | KPTC 6E8-3P-C-DN | <b>B 261 209 528</b> |
| 4 steps display dimmer DDU                 | 90° angled | KPTC 6E8-4P-C-DN | <b>B 261 209 630</b> |
| 12 steps                                   | straight   | ASL 6-06-05PN-HE | <b>B 261 209 643</b> |
| for MAP function                           | straight   | ASL 6-06-05PN-HE | <b>B 261 209 644</b> |
| 4 steps display dimmer DDU                 | straight   | ASL 6-06-05PN-HE | <b>B 261 209 646</b> |
| 4 steps LED dimmer DDU                     | straight   | ASL 6-06-05PN-HE | <b>B 261 209 647</b> |
| 6 steps display dimmer and switch over DDU | straight   | ASL 6-06-05PN-HE | <b>B 261 209 659</b> |





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