

EPCOS Application Guide 2012

Automotive

Electronic Components for Powertrain Applications



EPCOS Components for Powertrain Applications



Powertrain applications place above-average demands on electronic components. A wide range of operating temperatures, high shock resistance and vibrational strength, high reliability and long-term stability are required. Lifetimes of significantly longer than ten years are a must – even under harsh operating conditions.

Building on our long-standing experience in developing and improving components for automotive electronics, we meet these high demands with a wide portfolio of products. Customer benefit from our EPCOS aluminum electrolytic capacitors, for example, which feature a vibrational strength of up to 40 g. Moreover, most EPCOS product families feature components that are designed for continuous temperatures of up to 150 °C.

On the following pages you will find further special features that distinguish our products and solutions for use in powertrain applications.

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Special Features



Aluminum Electrolytic Capacitors

- High reliability
- High ripple current capability
- Operating temperature up to +150 °C
- Low ESR
- High vibration resistance
- Compact design
- Capacitors with AEC-Q200 qualification available

Ceramic Transient Voltage Suppressors (CTVS) - MLVs

- Reliable ESD protection up to 25 kV for high-speed data buses
- Highly rugged on extreme thermal cycles and repetitive pulses
- Nickel barrier series acc. to AEC-Q200

Film Capacitors (medium power)

- Long-term stability
- High pulse strength
- High peak and RMS current handling capability
- High contact reliability
- Low fire hazard due to liquid-free technology
- Standard and customized designs
- Qualified acc. to AEC-Q200

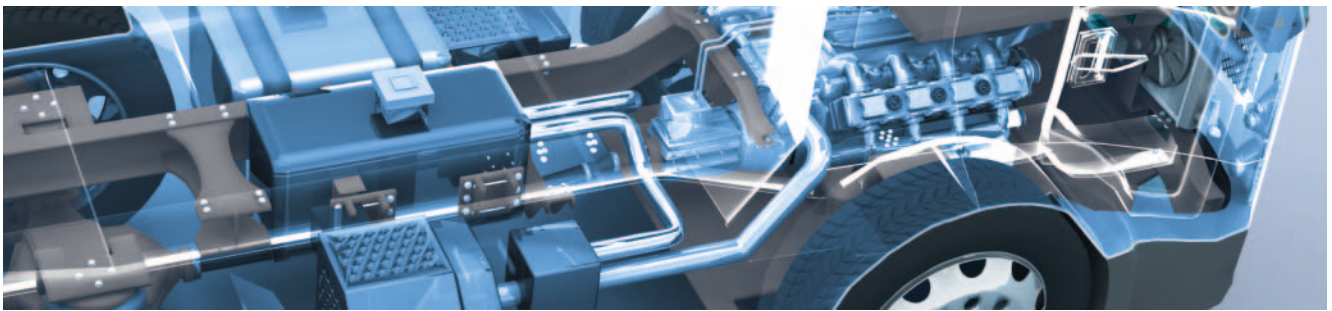
Inductors

- Wide temperature range from -55 °C to +150 °C
- Miniaturized versions
- High mechanical strength
- Suitable for lead-free soldering profiles acc. to JEDEC J-STD 020D
- Qualified acc. to AEC-Q200

NTC Thermistors

- High measuring accuracy and long-term stability
- Short response time
- Temperature measurement up to +260 °C
- Heat resistant and highly stable
- Rugged design
- Compact dimensions
- Overmolded package
- Cable-bound or integrated connector versions
- Humidity resistant
- Customer-specific designs
- SMD NTCs are qualified acc. to AEC-Q200

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Piezo Components

for diesel and gasoline injection systems

- Short response time and outstanding precision
- Customer-specific designs

Pressure Sensors

- Piezo-resistive dies and transmitters
- Small dimensions
- Long-term stability
- High media resistance

PTC Thermistors

- Self-regulating heating elements
- Self-protecting, no overheating
- No overtemperature sensing required

Transformers

- Material class $-40\text{ }^{\circ}\text{C}$ to $+155\text{ }^{\circ}\text{C}$
- High power density
- Advanced thermal behaviour
- Platform designs qualified acc. to AEC-Q200

Varistors

Leaded disk varistors



- Automotive grade ratings (load-dump, jump-start)
- Stable protection level
- Minimum leakage current
- Qualified acc. to AEC-Q200

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Overview															
	Air flow sensors	Battery control units	ECU		Electrical injection	Electronic motor drives (fuel pump, fan, water pump, compressor)	Fan control units	Fuel pumps, diesel filters	NOx reduction	Pressure measurement (diesel particle filter, exhaust gases, fuel supply)	Starter generators	Start/Stop systems	Temperature measurement (ambient, engine, oil, fuel tank, exhaust gases)	Transmission control units	Water pumps
Aluminum electrolytic capacitors															
Axial-lead		•	•	•		•	•	•			•	•		•	•
Large size		•									•				
Single-ended		•	•	•		•	•	•				•		•	•
Ceramic transient voltage suppressors (CTVS) - MLVs															
Automotive series	•	•	•	•	•		•			•	•		•	•	
Low-capacitance, controlled-capacitance, high-temperature series	•	•	•	•	•	•	•	•		•	•	•		•	•
High-speed series		•	•	•						•	•	•		•	•
Film capacitors (medium power)															
MKT			•	•			•				•	•			
Inductors															
CAN-/ FlexRay bus chokes		•	•	•			•	•		•	•			•	•
E core chokes			•	•								•		•	
Power inductors		•	•	•	•						•	•		•	
SIMID 0603 ... 2220		•	•	•		•	•	•		•	•	•		•	•
NTC thermistors															
Glass-encapsulated NTCs	•	•				•		•	•		•	•	•		•
Leaded NTCs	•	•	•	•		•	•	•	•		•	•	•		•
SMD NTCs		•	•	•	•	•	•	•	•	•	•	•	•	•	•
Temperature probes		•											•		
Piezo components															
Multilayer actuators					•										
Pressure sensors															
Pressure die C29, 2.2 × 2.7 mm	•		•	•				•	•	•					
Pressure die C32, 1.65 × 1.65 mm	•		•	•				•	•	•					
Pressure die C33, 1 × 1 mm	•		•	•						•					
PTC thermistors															
Heating elements								•	•						
Transformers															
EPT platform (EHP, EHR series)			•	•										•	
Varistors															
S07 ... S20 AUTO (D1)			•	•		•								•	












EPCOS Components for Powertrain Applications



Characteristics				
Series	Technical data	Features	Ordering code/ type	
Aluminum electrolytic capacitors				
Axial-lead and soldering star		Low voltage: V_R : 25 ... 100 V DC C_R : 100 ... 10000 μ F High voltage: V_R : 250 V DC C_R : 22 ... 130 μ F	Low voltage Useful life up to +150 °C, 2000 h High voltage Useful life up to +125 °C, 2500 h Different mechanical construction available Soldering star for horizontal and vertical mounting Vibration resistance up to 40 g RoHS-compatible versions available Whisker mitigation solutions available Shelf life up to 15 years for low voltage (≤ 100 V)	B41690/B41790 B41691/B41791 B41692/B41792 B41693/B41793 B41694/B41794 B41695/B41795 B41696/B41796 B43693/B43793
				Large size
Single-ended		Low voltage: V_R : 10 ... 75 V DC C_R : 22 ... 10000 μ F High voltage: V_R : 250 V DC C_R : 33 ... 140 μ F	Low voltage Useful life up to +150 °C, 1000 h High voltage Useful life up to +125 °C, 4000 h Different lead configurations available, e.g. J leads, crimped leads, bent 90° leads RoHS-compatible versions available Whisker mitigation solutions available Shelf life up to 15 years for low voltage (≤ 75 V)	B41866 B41868 B41888 B41896 B43896
				Single-ended







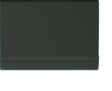

EPCOS Components for Powertrain Applications



Characteristics				
Series		Technical data	Features	Ordering code/ type
Ceramic transient voltage suppressors (CTVS) - MLVs				
SMD				
Automotive series		Temperature range up to +125 °C V_R : 15 ... 34 V DC C_R : 10 pF ... 10 µF V_{RMS} : 14 ... 30 V AC W_{LD} : 1 ... 25 J Case sizes: 0603, 0805, 1206, 1210, 1812, 2220	Load-dump and/ or jump-start pulse protection	B72500T...
		Temperature range up to +150 °C V_R : 16 ... 56 V DC C_R : 10 pF ... 10 µF V_{RMS} : 14 ... 40 V AC W_{LD} : 1.2 ... 12 J Case sizes: 0402, 0603, 0805, 1206, 1812, 2220		B72510T...
Controlled-capacitance series		V_R : 22 ... 31 V DC C_R : 33 ... 1200 pF V_{RMS} : 17 ... 25 V AC Case sizes: 0508, 0603, 0805, 1206	Application-specific capacitance tolerances	B72520T...
		V_R : 16 ... 32 V DC C_R : 3 ... 30 pF V_{RMS} : 14 ... 25 V AC Case sizes: 0402, 0504, 0508, 0603, 0612		B72714A...
High-speed series		V_R : 16 ... 32 V DC C_R : 3 ... 30 pF V_{RMS} : 14 ... 25 V AC Case sizes: 0402, 0504, 0508, 0603, 0612	Low capacitance value to avoid signal distortion at high-speed data rates	B72500T...
		Temperature range up to +150 °C V_R : 16 ... 31 V DC C_R : 32 ... 120 pF V_{RMS} : 14 ... 25 V AC Case sizes: 0603, 0805, 1210		B72510H...
High-temperature series		V_R : 22 ... 31 V DC C_R : 50 ... 100 pF V_{RMS} : 17 ... 25 V AC Case sizes: 0603, 0805, 1206, 1210, 1812, 2220	Highly stable ESD protection Very low inductance	B72530H...
		V_R : 22 ... 31 V DC C_R : 50 ... 100 pF V_{RMS} : 17 ... 25 V AC Case sizes: 0603, 0805, 1206, 1210, 1812, 2220		B72500T...
Standard/ low-capacitance series		V_R : 22 ... 31 V DC C_R : 50 ... 100 pF V_{RMS} : 17 ... 25 V AC Case sizes: 0603, 0805, 1206, 1210, 1812, 2220	Highly stable ESD protection Very low inductance	B72510T...
		V_R : 22 ... 31 V DC C_R : 50 ... 100 pF V_{RMS} : 17 ... 25 V AC Case sizes: 0603, 0805, 1206, 1210, 1812, 2220		B72520T...
Film capacitors (medium power)				
MKT		V_R : 63 ... 630 V DC C_R : 1 nF ... 220 µF	Good pulse handling capability Low ESR Flexible terminal solutions: – multi pin – flat terminals	B32520 ... B32529





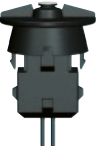

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Characteristics				
Series		Technical data	Features	Ordering code/ type
Inductors SMD				
CAN-/ FlexRay bus chokes		L_R : 5 μ H ... 4.7 mH I_R : up to 1.2 A	Miniaturized types ACT45B, B82789 in size 1812 Bifilar and sector winding Temperatures up to +150 °C For reflow soldering and gluing	ACT45B (B82787...) B82789C0... B82789S0... B82793C0... B82793S0...
E core chokes		L_R : 0.5 ... 10 μ H I_{peak} : > 25 A	High saturation currents High ripple currents Low losses	B78336...
Power inductors		L_R : 0.82 ... 1000 μ H I_R : up to 11 A Case sizes: 6 x 6 ... 12 x 12 mm	Shielded and unshielded versions Low DC resistance Temperatures up to +150 °C Qualified acc. to AEC-Q200	B82462A... B82462G... B82464A... B82464G... B82464P... B82472P... B82473M... B82475M... B82477P...
SIMID 0603-C		L_R : 1 ... 220 nH I_R : 110 ... 1800 mA Case size: 0603	Copper plated ceramic core Laser cut winding Epoxy coated	B82496C...
SIMID 0805-F		L_R : 2.7 ... 820 nH I_R : 180 ... 1000 mA Case size: 0805	Cubic coil with ceramic core Epoxy molded flat top for vacuum pickup Winding ends welded to the terminals	B82498F...
SIMID 1210-H		L_R : 0.1 ... 680 μ H I_R : 61 ... 2050 mA Case size: 1210	Ferrite drum core Laser welded winding Flame retardant molding	B82422H...
SIMID 1812-T/C		L_R : 1 ... 1000 μ H I_R : 55 ... 1300 mA Case size: 1812	Ferrite drum core Laser welded winding Flame retardant molding	B82432C... B82432T...
SIMID 2220		L_R : 1 μ H ... 10 mH I_R : 25 ... 3510 mA Case size: 2220	Ferrite drum core Laser welded winding Flame retardant molding	B82442...


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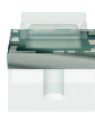


Characteristics				
Series		Technical data	Features	Ordering code/ type
NTC sensors				
Glass-encapsulated NTCs G1541 G1551 G1561		Temperature range: -55 ... +260 °C (G1541: +250 °C) Rated resistance at +25 °C: 2 ... 100 kΩ Resistance tolerance: ±1% ... ±3% Insulation resistance: > 100 MΩ 500 V DC (1 s)	High-temperature resistant Insulated wires with high insulation voltage Non-standard wire configurations	B57541G1... B57551G1... B57561G1...
Leaded NTCs M891		Temperature range: -40 ... +125 °C Rated resistance at +25 °C: 1 ... 470 kΩ Resistance tolerance: ±5%, ±10%	Robust design Cost-effective Wide resistance range Lead spacing 2.5 mm Taped versions for automated processing	B57891M...
S86* S87* S88* S964 S971 S981 K1150 K220		Temperature range: -55 ... +155 °C Rated resistance at +25 °C: 2 ... 100 kΩ Resistance tolerance: ±1% ... ±5%	Nonstandard lead configurations Taped versions for automatic processing Lead spacing 2.5 and 5.0 mm (S87*, S88*) UL approval (S86*) Leadless types (K1150, K220)	B5786*S... B5787*S... B5788*S... B579**S... B57150K1... B57220K...
SMD NTCs		Temperature range: -40 ... +150 °C Rated resistance at +25 °C: 4.7 ... 100 kΩ Case sizes: 0402, 0603, 0805 Resistance tolerance: ±3%, ±5% (±1% for selected types) B-tolerance: ±3% (±1% for selected types)	Qualified acc. to AEC-Q200 Operating temperatures up to +150 °C	B57***V5...
Temperature probes Surface temperature sensor for battery temperature		Temperature range: -40 ... +125 °C	Robust design Easy mounting Short response time	Upon request
Ambient temperature sensor		Temperature range: -40 ... +85 °C IP6K6, IPX9K for 30 s	Water immersion test: 2000 h/ +80 °C Thermal cycling: 480 cycles with applied voltage 120000 cycles on/off Thermal shock: 200 cycles in air transition time < 30 s	Upon request

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Characteristics		
Series	Features	Ordering code/ type
Piezo components for diesel and gasoline injection systems		
Actuators	 <p>Customer-specific actuator designs in silver/palladium as well as copper multilayer technology available.</p> <p>Design range of typical parameters:</p> <p>Length: 5 ... 80 mm</p> <p>Cross Section: 2 × 2 ... 12 × 12 mm²</p> <p>Voltage: 50 ... 250 V</p> <p>Elongation: 5 ... 120 μm</p> <p>Blocking Force: 100 ... 10000 N</p> <p>Temperature: -40 ... +150 °C</p> <p>Life time: up to 10¹⁰ cycles</p> <p>Various contacting and packaging solutions available.</p>	Upon request



Characteristics				
Series	Technical data	Features	Ordering code/ type	
Pressure sensors				
Pressure die C29	 <p>Rated pressure: 1 ... 10 bar</p> <p>Pressure measurement: absolute back side (barometric)</p> <p>Size: 2.2 × 2.7 mm</p>	<p>Single side bond pad layout</p> <p>Media resistant absolute back side pressure measurement</p> <p>Long-term stability</p> <p>Increased burst pressure upon request</p>	B58600E0410A***	
Pressure die C32	 <p>Rated pressure: 400 mbar ... 40 bar</p> <p>Pressure measurement: absolute front side (barometric), absolute back side (barometric), gauge back side</p> <p>Size: 1.65 × 1.65 mm</p>	<p>Media resistant absolute back side pressure measurement</p> <p>Long-term stability</p> <p>Increased burst pressure upon request</p> <p>Solderable layer upon request</p> <p>Gold pads available</p>	<p>Absolute back side (barometric): B58600H8400A***</p> <p>Absolute front side (barometric): B58600H8000A***</p> <p>Gauge back side: B58601H8000A***</p>	
Pressure die C33	 <p>Rated pressure: 1 ... 7 bar</p> <p>Pressure measurement: absolute front side (barometric)</p> <p>Size: 1 × 1 mm, height: 0.4 mm</p>	<p>Miniaturised size</p> <p>Long-term stability</p>	B58600I0000A001	
PTC thermistors				
Heating elements		<p>Max. operating voltage: 30 V DC</p> <p>Reference temperature: +80 ... +120 °C</p>	<p>Silver metallization</p> <p>Other voltage ratings, reference temperatures and geometries upon request</p>	B59060A0...
		<p>Max. operating voltage: 20 V DC</p> <p>Reference temperature: +80 ... +120 °C</p>	<p>Low curvature < 0.05 mm</p> <p>Silver metallization</p> <p>Other voltage ratings, reference temperatures and geometries upon request</p>	B59041R0...

EPCOS Components for Powertrain Applications



Characteristics				
Series		Technical data	Features	Ordering code/ type
Transformers				
EHP 16 EHP 19		Power: 20 ... 40 W	High frequencies up to 700 kHz High saturation currents up to 30 A Low leakage inductance, typical 50 nH	B78343 B78345
EHR 15 EHR 16 EHR 18		Power: 20 ... 50 W		B78342 B78343 B78344
Varistors				
S07... AUTO (D1)		V_{DC} : 16 V V_{RMS} : 14 V C_{typ} : 2.3 nF I_{max} 8/20 μ s: 250 A	High energy absorption, particularly in case of load dump Jump start strength Operation temperature up to +125 °C (D1)	B72207S1...
S10... AUTO (D1)		V_{DC} : 16 ... 20 V V_{RMS} : 14 ... 17 V C_{typ} : up to 5.2 nF I_{max} 8/20 μ s: 500 A		B72210S1...
S14... AUTO (D1)		V_{DC} : 16 ... 34 V V_{RMS} : 14 ... 30 V C_{typ} : up to 10 nF I_{max} 8/20 μ s: 1000 A		B72214S1...
S20... AUTO (D1)		V_{DC} : 16 ... 34 V V_{RMS} : 14 ... 30 V C_{typ} : up to 19 nF I_{max} 8/20 μ s: 2000 A		B72220S1...

Important Notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

We also reserve the right to **discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available.

The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
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