



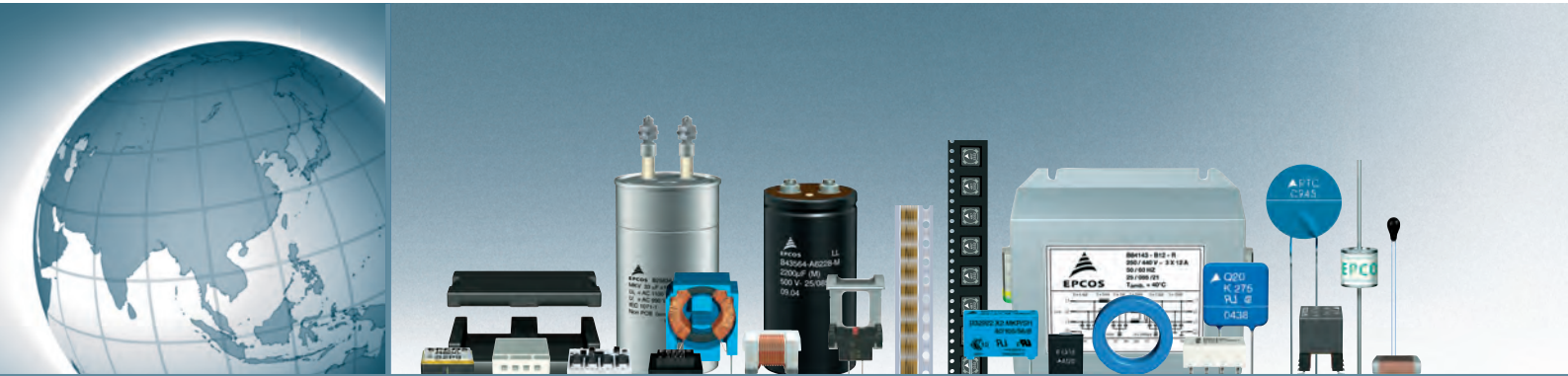
Application Guide 2008



# Automotive

Electronic Components for  
Powertrain Applications

## Welcome to the World of Electronic Components and Modules

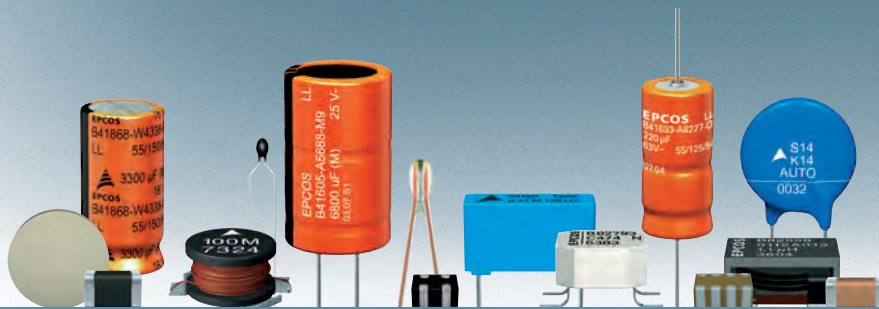


EPCOS is a leading manufacturer of electronic components and modules and provides one-stop shopping for a comprehensive range of products. Our portfolio includes capacitors and inductors, ceramic components, arresters, and surface and bulk acoustic wave components. As an innovative technology-driven company, EPCOS focuses on fast-growing and technologically demanding markets in the areas of information and communications technology, automotive, industrial, and consumer electronics. We offer our customers both standard components as well as application-specific solutions.

EPCOS has design, manufacturing and marketing facilities in Europe, Asia and the Americas. Increasingly, we are expanding our global research and development network by intensifying R&D activities at our production locations, primarily in Eastern Europe, China and India. With our global presence we are able to provide our customers with local development know-how and support in the early phases of their projects.

EPCOS is continually improving its processes and thus the quality of its products and services. The Group is ISO/TS 16949 certified and remains committed to constantly reviewing and systematically improving its quality management system.

## 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 its long-standing experience in developing and improving components for automotive electronics, EPCOS meets these high demands with a wide portfolio of products. EPCOS has developed, for example, capacitors with a vibrational strength of up to 40 g. Moreover, most product families offered by EPCOS 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.

# EPCOS Components for Powertrain Applications



## Special Features

### Aluminum Electrolytic Capacitors

- Long-term stability
- High ripple current capability
- Operating temperature up to +150 °C
- Low ESR
- High vibration resistance up to 40 g
- Compact design

### Film Capacitors

- Power capacitor chips (PCC) for DC-link function
- Long-term stability
- High pulse handling capability
- High peak and RMS current handling capability
- High overvoltage strength up to twice the rated voltage
- Very low inductance max. 20 nH
- Low fire hazard due to liquid-free technology
- Standard and customized designs
- Tested acc. to AEC-Q200

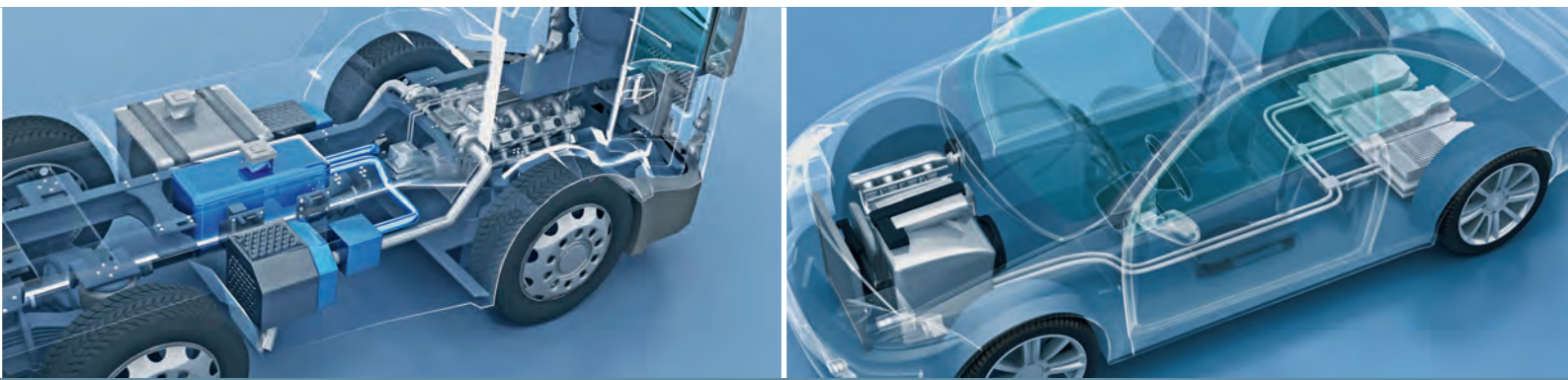
### Inductors

- 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 020C
- Qualified acc. to AEC-Q200

### Multilayer Ceramic Capacitors Multilayer Serial Capacitors

- Long-term stability
- High ripple current capability
- Low ESR, low ESL
- Operating temperature –55 °C to +125 °C, X8R –55 °C to +150 °C
- Suitable for lead-free soldering
- Termination for glue mounting available
- Qualified acc. to AEC-Q200

# EPCOS Components for Powertrain Applications



## Special Features

### 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 version
- Humidity resistant
- Customer-specific designs

### Piezo Components

for diesel and gasoline injection systems

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

### PTC Thermistors

- Long-term stability
- Self-regulating heating elements
- No glowing parts
- Suitable for clamp contacting

### Transformers

- Suitable for lead-free soldering
- High power efficiency
- Material class from -40 °C to +155 °C

### Varistors

#### Multilayer varistors

- Reliable ESD protection up to 25 kV for high-speed data buses
- Highly rugged on extreme thermal cycles and repetitive pulses

#### Leaded disk varistors

- Automotive grade ratings (load dump, jump start)
- Stable protection level
- Minimum leakage current
- Operating temperature up to +125 °C


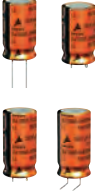








# EPCOS Components for Powertrain Applications

Portfolio overview														
	Air flow sensor	Battery control unit	DC/DC converter & inverter	Electrical injection	Engine control unit (ECU)	Fuel pump, diesel filter control unit	NOx reduction	Radiator cooling fan control unit	Radiator temperature sensor	Starter generator	Temperature measurement (ambient, engine, oil, fuel tank, exhaust gases)	Throttle control valve	Transmission control unit	Water pump
<b>Aluminum electrolytic capacitors</b>														
Soldering star and axial-lead		●	●		●	●		●					●	●
Single-ended		●	●		●	●		●					●	●
Large size		●	●											
<b>Film capacitors</b>														
Y2, X2			●											
MKP			●											
MKT						●				●				
PCC µP						●				●				
PCC LP			●											
<b>Inductors</b>														
CAN-/FlexRay bus chokes		●	●		●	●		●		●		●	●	●
SIMID 0805 ... 2220	●	●	●		●			●		●		●	●	●
Power inductors		●	●		●			●		●		●	●	●
E core chokes		●	●		●			●		●		●	●	●
<b>Multilayer ceramic capacitors</b>														
Standard, Advanced and HighCV		●	●	●	●	●	●	●		●	●	●	●	●
MLSC		●	●	●	●	●	●	●		●	●	●	●	●
Hybrid				●	●		●	●			●		●	
Arrays	●	●	●		●	●	●	●	●	●	●	●	●	●
Feedthrough	●	●	●		●		●		●		●			
<b>NTC thermistors</b>														
V*		●	●		●		●	●			●		●	
S8*, S9*, K*, M*	●	●	●			●	●	●	●	●	●			●
G5*	●	●	●			●	●	●	●	●	●		●	●
Temperature probes		●	●				●			●	●			
<b>Piezo components</b>														
Actuators				●										
<b>PTC thermistors</b>														
Heating elements						●	●							
<b>Transformers</b>														
EHP			●		●								●	
<b>Varistors</b>														
LC <sup>1</sup> , CC <sup>2</sup> , HT <sup>3</sup>	●	●	●		●	●		●		●		●	●	●
HS <sup>4</sup>		●	●		●			●		●		●	●	●
Leaded disk					●								●	

<sup>1)</sup> Low capacitance <sup>2)</sup> Controlled capacitance <sup>3)</sup> High temperature <sup>4)</sup> High speed

# EPCOS Components for Powertrain Applications







Characteristics				
Series		Technical data	Features	Ordering code / Type
Aluminum electrolytic capacitors				
Soldering star and axial-lead		Low voltage $V_R$ : 25 ... 75 V DC $C_R$ : 100 ... 6800 $\mu$ F  High voltage $V_R$ : 250 V DC $C_R$ : 22 ... 130 $\mu$ F	Low voltage Useful life up to +150 °C, 2000 h  High voltage Useful life up to +125 °C, 2500 h 1 mm wires and corrugation for increased vibration stability Shelf life up to 15 years	B41691/B41791 B41692/B41792 B41693/B41793 B41694/B41794 B41695/B41795 B41696/B41796 B43693/B43793
Single-ended		Low voltage $V_R$ : 10 ... 63 V DC $C_R$ : 1 ... 12000 $\mu$ F  High voltage $V_R$ : 160 ... 450 V DC $C_R$ : 3.3 ... 220 $\mu$ F	Different lead configurations available, e.g. J lead, crimped lead, bent 90° lead Shelf life up to 15 years	B41853 B41866 B41868 B41888 B41896 B43866 B43896
Large size		Low voltage $V_R$ : 25 ... 63 V DC $C_R$ : 800 ... 20000 $\mu$ F	Up to 40 g vibration stability thanks to rugged corrugation 1.2 mm copper leads for soldering and welding Shelf life up to 15 years	B41605 B41607
Film capacitors				
Y2		$V_R$ : 300 V AC $C_R$ : 1 nF ... 1 $\mu$ F	All necessary safety approvals (ENEC, UL, CSA)	B32021 B32022 B32023 B32024
X2		$V_R$ : 305 V AC $C_R$ : 10 nF ... 10 $\mu$ F		B32921 B32922 B32923 B32924 B32926
MKP		$V_R$ : 450 V DC $C_R$ : 30 ... 110 $\mu$ F	2-pin/4-pin Low ESR High current handling capability	B3277 ... Upon request
MKT		$V_R$ : 50 ... 630 V DC $C_R$ : 0.47 ... 220 $\mu$ F	Good pulse handling capability Low ESR Flexible terminal solutions – multi-pin – flat terminals – lead frames for reflow soldering Tested acc. to AEC-Q200	B32522 B32523 B32524 B32526
PCC $\mu$ P <u>SMD</u>		$V_R$ : 50 ... 630 V DC $C_R$ : 0.47 ... 100 $\mu$ F		B3255 ... Upon request

# EPCOS Components for Powertrain Applications

Characteristics				
Series		Technical data	Features	Ordering code / Type
Film capacitors				
PCC LP		$V_R$ : 100 ... 1000 V DC $C_R$ : 100 ... 3000 $\mu$ F Temperature range: -40 ... +105 °C Short time operation max. +125 °C	Volume fill factor of nearly 1 Low inductance max. 20 nH Long useful life approx. 10000 h Standard and customized designs	Upon request
Inductors <span style="float: right;">SMD</span>				
CAN-/FlexRay bus chokes		$L_R$ : 5 $\mu$ H ... 4.7 mH $I_R$ : up to 1.2 A	Miniaturized types B82789, B82799 in size 1812 Bifilar and sector winding Temperature up to +150 °C For reflow soldering and gluing	B82789C0/S0 ... B82790C0/S0 ... B82793C0/S0 ... B82799C0/S0 ...
SIMID 0805 ... 2220		$L_R$ : 2.7 nH ... 10 mH $I_R$ : up to 2.5 A	Sizes 1210 to 2220: laser-welded, molded Temperature up to +150 °C	B82422 B82432 B82442 B82498
Power inductors		$L_R$ : 0.82 ... 1000 $\mu$ H $I_R$ : up to 11 A	Shielded and unshielded versions Low DC resistance Temperature up to +150 °C	B82462 B82464 B8247...
E core chokes		$L_R$ : 0.1 ... 1000 $\mu$ H $I_R$ : up to 80 A	High saturation current High frequencies Low DC resistance High ripple currents Low losses	B78336 B78337 B78343 B78345 Upon request









# EPCOS Components for Powertrain Applications


Characteristics						
Series		Ceramic	Size	Technical data	Features	Ordering code / Type
Multilayer ceramic capacitors, Multilayer serial capacitors (MLSC)						<b>SMD</b>
Standard, Advanced and HighCV		X7R	0603 ... 1206	V <sub>R</sub> : 16 ... 50 V DC C <sub>R</sub> : 220 pF ... 2.2 µF	Qualified acc. to AEC-Q200	B37931 B37941 B37872
		C0G	0402 ... 1206	V <sub>R</sub> : 50 ... 100 V DC C <sub>R</sub> : 1 pF ... 5.6 nF		B37920 B37930 B37940 B37871
MLSC		X7R	0603	V <sub>R</sub> : 50 V DC C <sub>R</sub> : 1 ... 10 nF	High functional reliability with savings of placement cost, due to the integrated serial connection of two capacitors in one component Qualified acc. to AEC-Q200	B37931
		X7R	0805	V <sub>R</sub> : 50 ... 100 V DC C <sub>R</sub> : 10 ... 220 nF		B37941
Hybrid <sup>1</sup>		X7R	0603 ... 1206	V <sub>R</sub> : 25 ... 100 V DC C <sub>R</sub> : 1 ... 100 nF	Termination suitable for glue mounting Qualified acc. to AEC-Q200	B37931J ... B37941J ... B37872J ...
		X8R	0603 ... 1206	V <sub>R</sub> : 50 V DC C <sub>R</sub> : 100 pF ... 100 nF		B37540 B37541 B37472
		C0G	0402 ... 1206	V <sub>R</sub> : 50 ... 100 V DC C <sub>R</sub> : 1 pF ... 5.6 nF		B37920J ... B37930J ... B37940J ... B37871J ...
Arrays	 	X7R	0405/0508/0612 2-fold, 4-fold	V <sub>R</sub> : 16 ... 50 V DC C <sub>R</sub> : 1 ... 22 nF	Space-saving EMI protection Qualified acc. to AEC-Q200	B37831R ... B37941R ... B37872R ...
		C0G	0405/0508/0612 2-fold, 4-fold	V <sub>R</sub> : 25 ... 50 V DC C <sub>R</sub> : 10 pF ... 1 nF		B37830R ... B37940R ... B37871R ...
Feedthrough		X7R	1206	V <sub>R</sub> : 50 V DC C <sub>R</sub> : 2.2 ... 10 nF	Outstanding performance for signal filtering and EMI suppression up to the GHz frequency spectrum Qualified acc. to AEC-Q200	B37872U ...





<sup>1)</sup> With silver-palladium terminations for conductive adhesion

# EPCOS Components for Powertrain Applications









Characteristics			
Series	Technical data	Features	Ordering code / Type
<b>NTC thermistors</b>			
V2 V3 V4 <b>SMD</b>	 Temperature range: -55 ... +125 °C (+150 °C) Rated resistance at 25 °C: 47 Ω ... 470 kΩ Resistance tolerance: ±3, ±5 %; ±1% on request Case sizes: 0402/0603/0805	Wide range of resistances and tolerances Multilayer SMD NTC with inner electrodes Very good long-term aging stability in high-temperature environment Very good resistance stability during soldering (change < 1%) Range for automotive series acc. to AEC-Q200-Rev. C	B572**V ... B573**V ... B574**V ...
S86 S87 S88 S962 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 ... B57962S ... B57150K1 ... B57220K ...
G541 G551 G561	 Temperature range: -55 ... +260 °C (G541: +250 °C) Rated resistance at 25 °C: 10 kΩ Resistance tolerance: ±1 ... ±5 % Insulation resistance: > 100 MΩ 500 V DC (1s)	High-temperature resistant Insulated wires with high insulation voltage Nonstandard wire configurations	B57541G ... B57551G ... B57561G ...
M891	 Temperature range: -40 ... +125 °C Rated resistance at 25 °C: 1 ... 470 kΩ Resistance tolerance: ±5, ±10%	Cost-effective Wide resistance range Lead spacing 2.5 mm Taped versions for automatic processing	B57891M ...
Temperature probes Surface temperature sensor for battery temperature		Robust design Easy mounting Fast response time	Upon request
Temperature probes Outside temperature sensor		Water immersion test: 2000 h/80 °C Thermal cycling: 480 cycles with supplied voltage 120000 cycles on/off Thermal shock: 200 cycles in air transition time < 30 s	Upon request

# EPCOS Components for Powertrain Applications

Characteristics			
Series		Features	Ordering code / Type
Piezo components			
Actuators		<p>EPCOS provides customer-specific designs in silver/palladium as well as copper multilayer technology</p> <p>Design range of typical parameters:</p> <p>Length: 5 ... 60 mm</p> <p>Cross section: 2 x 2 ... 10 x 10 mm<sup>2</sup></p> <p>Voltage: 50 ... 250 V</p> <p>Elongation: 5 ... 90 µm</p> <p>Blocking force: 100 ... 5000 N</p> <p>Temperature: -40 ... +150 °C</p> <p>Life time: up to 10<sup>10</sup> cycles</p>	Upon request

Characteristics					
Series		Technical data		Features	Ordering code / Type
PTC thermistors					
Heating elements A60		Max. operating voltage:	30 V DC	Silver metallization	B59060A0080A010
		Reference temperature:	+80 ... +120 °C	Other voltage ratings, reference temperatures and geometries upon request	B59060A0120A010
R41		Max. operating voltage:	20 V DC	Low curvature < 0.05 mm	B59041R0080A010
		Reference temperature:	+80 ... +120 °C	Silver metallization	B59041R0120A010
				Other voltage ratings, reference temperatures and geometries upon request	
Transformers					SMD
EHP16		Power:	20 ... 35 W	High frequencies up to 700 kHz	B78343
		Dimensions l x w x h (mm):	23 x 16 x 11	High saturation currents up to 30 A	Upon request
				Low leakage inductance, typical 50 nH	
EHP19		Power:	35 ... 50 W		B78345
		Dimensions l x w x h (mm):	25 x 20.5 x 12		Upon request

# EPCOS Components for Powertrain Applications

Characteristics						
Series		Size	Technical data		Features	Ordering code / Type
Varistors						
LC		0603/0805	V <sub>R</sub> : V <sub>RMS</sub> : C <sub>R</sub> :	22 V DC 17 V AC up to 100 pF	High pulse handling capacity acc. to AEC-Q200	B72500T2 ...
					Lead-free soldering profiles acc. to JEDEC J-STD 020C	B72510T2 ...
CC		0603/0805	V <sub>R</sub> : V <sub>RMS</sub> : C <sub>R</sub> :	22 ... 31 V DC 17 ... 25 V AC 50 ... 80 pF	Types with customized capacitance and high pulse stability to provide ESD protection and integrated EMI filtering similarly to Dielectric Class 1	B72500T5 ... B72510T5 ...
HT		0603	V <sub>R</sub> : V <sub>RMS</sub> : C <sub>R</sub> :	18 ... 31 V DC 14 ... 25 V AC 10 ... 120 pF	Qualified up to +150 °C for hybrid-adhesive mounting in under-the-hood applications	B72500H ...
HS		0402/0603	V <sub>R</sub> : V <sub>RMS</sub> : C <sub>R</sub> :	16 ... 32 V DC 14 ... 25 V AC < 30 pF	Low capacitance values to provide ESD protection with- out distortion of signal in high-speed data lines	B72500T8 ... B72590T8 ...
		0405 2-fold array				B72762A ... B72766A ...
S10K... AUTO (D1)		S10	V <sub>R</sub> : V <sub>RMS</sub> : C <sub>R</sub> typ. (1 kHz):	16 ... 20 V DC 14 ... 17 V AC up to 5.2 nF	High energy absorption, particularly in case of load dump  Jump start strength  Operation temperature up to +125 °C (D1)	B72210S1...
S14K... AUTO (D1)		S14	V <sub>R</sub> : V <sub>RMS</sub> : C <sub>R</sub> typ. (1 kHz):	16 ... 34 V DC 14 ... 30 V AC up to 10 nF		B72214S1...
S20K... AUTO (D1)		S20	V <sub>R</sub> : V <sub>RMS</sub> : C <sub>R</sub> typ. (1 kHz):	16 ... 34 V DC 14 ... 30 V AC up to 19 nF		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.**
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