Products for Automotive

- Powertrain
- Infotainment
- Body & Chassis
- Safety
- Powertrain
In order to meet the high demands of the automotive electronics market and the industrial equipment market, we have introduced a new high quality category in our lineup of electronic parts, including multilayer ceramic capacitors, inductors, and noise suppression components.

Taiyo Yuden’s High-reliability Parts

Optimal Materials

Optimal Design

Follow Automotive Standards

Automatic

- Long life
- Line failure rate

Industrial

- Compact
- High capacity

AEC-Q000

IATF16949

Capacitors

- Multilayer ceramic capacitors
- Conductive polymer hybrid aluminum electrolytic capacitors

Inductors and EMC Suppression Components

- Metal power inductors
- Ferrite power inductors
- Bead inductors

Engine ECU

- Cruise control unit
- Automatic transmission
- Power steering
- HEV/PHEV/EV core control (battery, inverter, DC-DC)
- On-board vehicle locator (vehicle position information system)

Control

-ABS (anti-lock braking system)
-ESC (electronic stability control)
-Airbags
-ADAS (systems for direct control of accelerating, steering, and stopping)

Safety

Body

- Wipers
- Automatic doors
- Power windows
- Keyless entry
- Power side mirrors
- In-car lighting
- LED headlights
- TPMS (tire pressure monitoring system)
- Anti-theft system (immobilizer)

Information

- Car infotainment device
- ITS/telematics device
- Instrument cluster
- ADAS (equipment unconnected to sensors, safety systems, and powertrain)

Car infotainment device

- Information

- Control

- Safety

- Body

On-board vehicle locator (vehicle position information system)
Soft Termination Multilayer Ceramic Capacitors

Structure

- Ceramic body
- Nickel/tin plating
- Conductive resin
- External electrode
- Internal electrode

Characteristics

- The external electrode includes a conductive resin. The resin layer reduces stress from board flex, preventing parts from breaking, as well as reducing solder degradation from thermal shock by absorbing the difference in the thermal expansion rates of the circuit board and components through the resin layer’s flexibility.

Applications: ECU, headlight control circuits

Suppressing cracks caused by circuit board deflection

- (Board Flex Endurance)

- Text sample: 100V/1/uni03BCF
- 3225(1210)

- Improvement
  - Soft termination: Survival rate 120%

- Anchoring strength
  - Initial: 1000 cycles
  - After testing

- Measuring the deflection during crack occurrence

- LW reversal decoupling capacitors (LWDC™)

Suppressing solder degradation caused by thermal shock

- (Temperature Cycling Endurance)

- After testing

- Electrodes and resin electrodes are separated

Medium-high voltage multilayer ceramic capacitors

- (Temperature compensating type)

High frequency/medium-high voltage multilayer ceramic capacitors

Multilayer ceramic capacitors

- (High dielectric type)
Conductive Polymer Hybrid Aluminum Electrolytic Capacitors

Enabling electrolyte with low ESR, high withstand voltage, and long life through hybrid technology that utilizes solid conductive polymers and electrolytic solution.

Vibration Resistant Type

<table>
<thead>
<tr>
<th>Vibration resistance</th>
<th>Leaded</th>
<th>Chip type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum electrolytic</td>
<td>Aluminum electrolytic</td>
<td>Conductive polymer hybrid aluminum electrolytic</td>
</tr>
<tr>
<td>30G</td>
<td>RPK (135°C)</td>
<td>R/T (105°C)</td>
</tr>
<tr>
<td>40G</td>
<td>RKF (135°C)</td>
<td>—</td>
</tr>
</tbody>
</table>

**Advantages**

- **Safety Control Body Information**
  - Vibration prevention
  - Increased adhesive strength

**Polymer MLCC Hybrid Polymer Aluminum**

**Product**
- **Capacitor map**
  - Adaptive voltage [V]: 10V, 50V, 100V, 500V, 1K, 10K, 100K, 1M, 10M
  - Adaptive frequency [Hz]: 1, 10, 100, 1K, 10K, 100K

**Hybrid aluminum electrolytic structure**

- Electrolyte (polymer + electrolytic solution)
- Dielectric film (Al2O3)
- Separator
- Aluminum foil (anode)
- Aluminum foil (cathode)

**Features**
- ESR (at 20°C 100kHz): 70mΩ, 30mΩ, 20mΩ
- Leakage current (μA): 0.01CV 115, 0.5CV 1750, 0.01CV 94
- Rated ripple current (mA rms): 1190, 3500, 2500
- High frequency characteristics at low temperatures: No good, Good, Good
- Guaranteed lifetime: 105°C 2000 hours, 105°C 2000 hours, 105°C 5000 hours

**Auxiliary terminal**
- Increased adhesive strength
### Inductors

<table>
<thead>
<tr>
<th>Type</th>
<th>Power Inductors</th>
<th>Case Size</th>
<th>Inductance (µH)</th>
<th>Frequency (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal power inductors</td>
<td>MD series</td>
<td>0.3–10µH</td>
<td>0.63–7.8[A]</td>
<td>SK series (P)</td>
</tr>
<tr>
<td></td>
<td>NS series</td>
<td>1.5–7.0µH</td>
<td>0.45–13.5[A]</td>
<td>FB series (T)</td>
</tr>
<tr>
<td>Ferrite power inductors</td>
<td>ES series</td>
<td>1.5–7.0µH</td>
<td>0.45–13.5[A]</td>
<td>FB series (M)</td>
</tr>
<tr>
<td>Standard inductors</td>
<td>HK series</td>
<td>1.5–7.0µH</td>
<td>0.45–13.5[A]</td>
<td>GS series (T)</td>
</tr>
<tr>
<td>High frequency inductors</td>
<td>NR series</td>
<td>1.5–7.0µH</td>
<td>0.45–13.5[A]</td>
<td>GS series (M)</td>
</tr>
</tbody>
</table>

### EMC Suppression

**Ferrite Bead Inductors**

**Application of Ferrite Beads**

Converting noise to heat (thermal loss)

- **EMC Suppression**
  - Ferrite Bead Inductors
  - Material design
  - Frequency characteristic control
  - Compact

- **Safety**
  - Low Rdc
  - Large current

- **Control**
  - Large current
  - High impedance

- **Body Information**
  - Electrical Impedance
  - Z=R+jX

- **Impedance**
  - Z=R+jX

- **Frequency (MHz)**
  - 1GHz

- **Noise Suppression Frequency**
  - 4GHz

- **Rated Current (A)**
  - 4
  - 1
  - 0.1
  - 1
  - 10
  - 100
  - 1000

- **Impedance**
  - 1 10 100 1000 10000

- **Temperature**
  - 125°C
  - 150°C

- **Zn:R+jX**
  - Component X is main → Reflection is main
  - Component R is main → thermal loss is main
Energy Devices

<table>
<thead>
<tr>
<th>Energy Devices</th>
<th>Taiyo Yuden electric double-layer capacitor</th>
<th>Taiyo Yuden lithium ion capacitor</th>
<th>Competitors’ lithium ion batteries</th>
<th>LITHOSION®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal resistance</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>2.7–4.0V</td>
<td>2.8–4.0V</td>
<td>3.0–3.6V</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>40–85°C</td>
<td>40–85°C</td>
<td>40–85°C</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>100</td>
<td>50</td>
<td>5 to 5</td>
<td></td>
</tr>
<tr>
<td>Discharge/charge cycles</td>
<td>100 to 1K cycles</td>
<td>100 to 1K cycles</td>
<td>100 to 1K cycles</td>
<td></td>
</tr>
<tr>
<td>Self-discharge</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Necessity of voltage monitoring</td>
<td>Not required</td>
<td>Required</td>
<td>Required</td>
<td></td>
</tr>
</tbody>
</table>

**Backup power application**

- Power provided by main power supply
- Surplus power charged to the capacitor
- Required power discharged from the capacitor

**Peak assist application**

- Power required by the load

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**FBAR/SAW Devices & Multiplexers**

- Filter
- Duplexer/Quadplexer

**Multilayer Ceramic Devices**

- Multiplexer
- Band Pass Filter
- Dual Low Pass Filter
- Coupler
- Low/High Pass Filter
- Antenna

**Wireless Modules**

- Bluetooth® low energy
- WLAN: 802.11 CPU Embedded

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**Piezoelectric Actuators**

**Functional element with high displacement function and low power consumption**

**Backup power application**

**Peak assist application**

**Piezoelectric actuator business model**

**Optimal shape suggestions**

**Optimal implementation suggestions**

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**Energy Devices RF Solution Products for Telematics**

- Piezoelectric Actuators
- Communication products
- Steering wheel with warning function
- Haptics technology
- Fuel injection
- High-speed damper

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**Taiyo Yuden electric double-layer capacitor**

- Low
- Medium
- High

**Taiyo Yuden lithium ion capacitor**

- 2.7–4.0V
- 2.8–4.0V
- 3.0–3.6V

**Competitors’ lithium ion batteries**

- 3.0–3.6V
- 4.5–6.0V
- 5.0–6.0V

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**Necessity of voltage monitoring**

- Not required
- Required
- Required

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**LITHOSION®** is a trademark and brand of TAIYO YUDEN CO., LTD.

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**Necessity of voltage monitoring**

- Not required
- Required
- Required

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