We propose the best products for our customers, based on application, size and a variety of other design needs.

Note: Please confirm product development details with your dealer.

Customer

Planning of new model
Study
Request for circuit design estimate
Evaluation and approval of verification testing, registration of standards
Ordering decision, agreement

Response: manufacturing departments, sales locations
Response: Factory technology departments, sales locations
Response: Factory technology departments, sales locations
Response: Factory technology departments, sales locations
Response: Factory technology departments, sales locations

NICHICON CORPORATION

HEAD OFFICE
Kansaihon-ko, Naka-ku, Osaka, Japan 530-8751
TEL.81-6-2732-2700 FAX.81-6-2732-3353

NICHICON (CHINA) CO., LTD.
Room 1301, 26/F, China World Trade Center, No.3, 1st Ring Road, Chaoyang District, Beijing, China 100022
TEL.86-10-5824-5018 FAX.86-10-5824-5019

NICHICON (AMERICA) CORP.
927 East Orange Parkway, Schenectady, NY 12308, U.S.A.
TEL.1-518-493-7500 FAX.1-518-493-7501

NICHICON (MALAYSIA) SDN. BHD.
G-101, Persiaran 13A, Cyberjaya 63000, Selangor, Malaysia
TEL.60-3-5567-1702 FAX.60-3-5567-1703

NICHICON (HONG KONG) LTD.
Unit 2, 6th Floor, Raffles Tower, Central, Hong Kong
TEL.852-2531-8989 FAX.852-2531-8978

Standard Process for Developing Custom Products

Automotive Application Catalog
2018.1

Automotive Application

CAUTION FOR SAFETY

NOTE
**Powertrain Solution**

- Chip type
  - Chip type
  - Chip type
- Vibration Resistance
- Lead type
  - Lead type
- Film capacitors
  - Film capacitors
- Large can type
  - Large can type

**Chassis & Safety Solution**

- Chip type
  - Chip type
  - Chip type
- Vibration Resistance
- Lead type
  - Lead type
- Electric steering
  - Electric steering
- Hybrid
  - Hybrid

**Recommended series for electric power steering circuits.**

- Aluminum electrolytic capacitors
  - Aluminum electrolytic capacitors
- Film capacitors
  - Film capacitors
- Snubber film capacitors
  - Snubber film capacitors
- Smoothing aluminum electrolytic capacitors
  - Smoothing aluminum electrolytic capacitors
- Smoothing film capacitors
  - Smoothing film capacitors

- Engine cooling fan
  - Engine cooling fan
- Engine control unit
  - Engine control unit
- DC/DC-converter
  - DC/DC-converter
- Hybrid electric vehicle
  - Hybrid electric vehicle
- Pump control unit
  - Pump control unit
- Transmission control unit
  - Transmission control unit

**Recommended series for motor drive inverter circuits.**

- Chip type
  - Chip type
- Vibration Resistance
- Lead type
- Electric steering
  - Electric steering
- Hybrid
  - Hybrid

- Camera & radar systems
  - Camera & radar systems
- Telematics
  - Telematics
- Airbag control
  - Airbag control
- ABS & traction control
  - ABS & traction control
- Power steering
  - Power steering

- Airbag control
  - Airbag control
- Breaking unit
  - Breaking unit
- DC/DC-converter
  - DC/DC-converter
- Breaking unit
  - Breaking unit
Recommended series for audio DC-DC converters circuits.

Recommended series for LED headlight circuits.
High Vibration Resistance

- Smaller and higher ripple current and Anti-vibration structure
- Suited for automobile electronics where heavy duty services are indispensable
- Compliant to the RoHs directive (2011/65/EU)

Vibration test result

<table>
<thead>
<tr>
<th>Vibration test conditions</th>
<th>X direction 2 hours</th>
<th>Y direction 2 hours</th>
<th>Z direction 2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration direction</td>
<td>10 to 2,000G</td>
<td>10 to 2,000G</td>
<td>10 to 2,000G</td>
</tr>
<tr>
<td>Amplitude</td>
<td>1,000 ± 5%</td>
<td>1,000 ± 5%</td>
<td>1,000 ± 5%</td>
</tr>
<tr>
<td>Acceleration</td>
<td>20G/60Hz</td>
<td>20G/60Hz</td>
<td>20G/60Hz</td>
</tr>
<tr>
<td>Test time</td>
<td>2,000G/60Hz</td>
<td>2,000G/60Hz</td>
<td>2,000G/60Hz</td>
</tr>
</tbody>
</table>

Points to improve vibration resistance

- Current product
- Slits supposed pin (file move)
- Stress concentrated at the root of the tab (= risk of lead breaking)
- Slits (grooves) are formed on the case side (anneal annealed). Suppress the element shake under vibration by reducing the gap between element and case.

Design of vibration resistant structure by simulation

Simulation of slit number comparison (g=18kHz, assumption)

- 3 Slits: 100%
- 6 Slits: 39%
- 9 Slits: 27%
- 12 Slits: 21%

Optimization of slit number using simulation technology

- Stress values tend to saturate when slit number is 6 or more.
- Consideration of case structure.

Vibration test result

- New!
- gri (18kHz) to g=18kHz
- 392 m/s² (40G)
- All amplitude 1.5mm or 10 to 2,000Hz
- Frequency 10 to 2,000Hz
- Vibration direction X, Y, Z, each 2 hours

<table>
<thead>
<tr>
<th>Product size</th>
<th>New!</th>
<th>N/A</th>
<th>Clear</th>
</tr>
</thead>
<tbody>
<tr>
<td>X direction 2 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y direction 2 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z direction 2 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Excellent ESR Impedance characteristics

- Excellent ESR characteristics in high frequency range
- Excellent ESR characteristics in low temperature range

- The conductive polymer hybrid aluminum electrolytic capacitors have the same frequency characteristics as the conductive polymer aluminum solid electrolytic capacitors, and the ESR values in the high frequency and low temperature ranges are considerably reduced compared with the aluminum electrolytic capacitors.

Conductive Polymer Hybrid Aluminum Electrolytic Capacitors

- 10ºC to 25ºC
- 2.33V or 3.5V
- 0.01 to 100μF
- Impedance (Ω)

- Aluminium Electrolytic Capacitors
- Conductive Polymer Aluminum Solid Electrolytic Capacitors
- Conductive Polymer Hybrid Aluminum Electrolytic Capacitors

- Conductor Polymer Aluminum Solid Electrolytic Capacitors
- Conductive Polymer Hybrid Aluminum Electrolytic Capacitors

- Electrolyte solution + Conductive polymer
- Electrolyte: Electrolyte solution
- Conductive polymer: Conductive polymer
- Aluminum Electrolytic Capacitors
- Conductive Polymer Aluminum Solid Electrolytic Capacitors
- Conductive Polymer Hybrid Aluminum Electrolytic Capacitors

- 1,000 hours longer lifetime
- More than 4 times higher ripple current
- Leakage current reduced to 1/5
- Industry’s highest level

- Temperature: 125ºC
- Temperature: 4,000h guaranteed product
- Temperature: 12ºC
Nichicon Automotive Application Catalog

Electronic Control Solutions

Engine ECU Pattern Diagram

Low temperature ESR

Vibration resistance

High temperature

ESR Time Degradation Ratio (125°C Durability Test)

ECU, DC-DC converters, inverters, headlight ballast secondary, automotive water pumps, automotive oil pumps

UCX

135°C-guaranteed low ESR specification

Vibration-resistant

- Added ESR specification after the test at -40°C
- Endurance: 125°C 2,000 hours
- Capacitance: 47 to 5,300μF
- Compliance to the RoHS directive (2011/65/EU)

Applications
- ECUs, DC-DC converters, inverters, headlight ballast secondary, automotive water pumps, automotive oil pumps

<table>
<thead>
<tr>
<th>Product size</th>
<th>ESR (Ω)</th>
<th>Initial</th>
<th>Guaranteed time</th>
<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3×10L</td>
<td>0.23</td>
<td>—</td>
<td>3.0</td>
<td>—</td>
</tr>
<tr>
<td>8×10L</td>
<td>0.28</td>
<td>—</td>
<td>3.5</td>
<td>—</td>
</tr>
<tr>
<td>10×10L</td>
<td>0.40</td>
<td>—</td>
<td>3.0</td>
<td>—</td>
</tr>
</tbody>
</table>

UCZ

High reliability, low ESR specification

Vibration-resistant

- Added ESR specification after the test at -40°C
- Endurance: 125°C 1,000 hours
- Capacitance: 10 to 3,300μF
- Compliance to the RoHS directive (2011/65/EU)

Applications
- ECUs, DC-DC converters, inverters, headlight ballast secondary, automotive water pumps, automotive oil pumps

<table>
<thead>
<tr>
<th>Product size</th>
<th>ESR (Ω)</th>
<th>Initial</th>
<th>Guaranteed time</th>
<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.3×7.7L Initial</td>
<td>0.22</td>
<td>—</td>
<td>3.5</td>
<td>—</td>
</tr>
<tr>
<td>8×10L     Initial</td>
<td>0.32</td>
<td>—</td>
<td>3.5</td>
<td>—</td>
</tr>
<tr>
<td>10×10L    Initial</td>
<td>0.44</td>
<td>—</td>
<td>2.8</td>
<td>—</td>
</tr>
</tbody>
</table>

UCH

High reliability, low ESR specification

- Added ESR specification after the test at -40°C
- 40kHz
- Compliance to the RoHS directive (2011/65/EU)

Applications
- ECUs, DC-DC converters, inverters

<table>
<thead>
<tr>
<th>Product size</th>
<th>ESR (Ω)</th>
<th>Guaranteed time</th>
</tr>
</thead>
<tbody>
<tr>
<td>4×2×10L</td>
<td>0.50</td>
<td>—</td>
</tr>
<tr>
<td>6×3×15L</td>
<td>0.50</td>
<td>—</td>
</tr>
</tbody>
</table>

UBY

High reliability

- Application suggested high temperature, electric power steering
- Compliance to the RoHS directive (2011/65/EU)

Applications
- ECUs

<table>
<thead>
<tr>
<th>Product size</th>
<th>ESR (Ω)</th>
<th>Guaranteed time</th>
</tr>
</thead>
<tbody>
<tr>
<td>6×2×10L</td>
<td>0.70</td>
<td>—</td>
</tr>
</tbody>
</table>

UBW

High temperature, High reliability

- Products with high-temperature stability, guaranteed for 1,000 hours at 125°C
- Suited for automotive electronics where heavy-duty services are indispensable
- Compliance to the RoHS directive (2011/65/EU)

Applications
- ECUs

<table>
<thead>
<tr>
<th>Product size</th>
<th>ESR (Ω)</th>
<th>Guaranteed time</th>
<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>6×2×10L</td>
<td>0.49</td>
<td>1.3</td>
<td>3.9</td>
</tr>
</tbody>
</table>

UBX

Ultra high-temperature suited for automotive electronics (150°C)

- Laminated case series
- Products added for ultra-high-temp (150°C)
- Suited for automotive electronics where heavy-duty services are indispensable
- Compliance to the RoHS directive (2011/65/EU)

Applications
- ECUs

<table>
<thead>
<tr>
<th>Product size</th>
<th>ESR (Ω)</th>
<th>Guaranteed time</th>
<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>6×2×10L</td>
<td>0.48</td>
<td>1.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Nichicon Automotive Application Catalog

**Chip Type, Vibration Resistance, Suited for Engine Areas**

(High-Temperature Environments, Vibrations)

- **Smaller, high reliability**: Surface mounting technology, anti-vibration capabilities: 30G (10 to 2,000Hz)
- **Anti-Vibration Points**
  - Adjust height of resin seating plate carrier, control vibration of capacitor itself
  - Improved adhesion of auxiliary electrode to resin seating plate

**UBC**

- **Vibration resistance, high temperature**
  - Highly durable reliability withstands build-up of 1,000 hours at +150°C
  - Suitable for automobile electronic components
  - Compliant to the RoHS directive (2011/65/EU)

**Durability Applications**

- ECUs, automotive water pumps, automotive oil pumps

**Dimensions**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>3.2</td>
<td>4.0</td>
<td>5.4</td>
<td>6.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>10.3</td>
<td>13.0</td>
<td>17.1</td>
<td>18.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>10.3</td>
<td>13.0</td>
<td>17.1</td>
<td>18.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>4.0</td>
<td>6.3</td>
<td>8.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>10.0</td>
<td>13.5</td>
<td>16.5</td>
<td>21.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>1.1</td>
<td>1.5</td>
<td>1.0</td>
<td>1.4</td>
<td>1.0</td>
<td>1.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Note: UUE series also applies to control solution specifications.

**Mounting Examples**

- ECU, hybrid vehicle ECUs, “idle stop,” automotive water pumps, electric oil pumps

Note: For detailed specifications, please refer to Nichicon’s general catalog of electronics.

Nichicon Automotive Application Catalog
Automotive Aluminum Electrolytic Capacitors

**PCV**
- High voltage, long life
- High voltage (to 125V), low ESR, high ripple current
- Long life at 3,000 hours at 105°C
- SMD type: Load free reflow soldering condition at 260°C peak correspondence
- Compliant to the RoHS directive (2011/65/EU)

**PCX**
- High reliability
- High reliability, low ESR, high ripple current
- Long life of 1,500 to 3,000 hours at 125°C
- SMD type: Load free reflow soldering condition at 260°C peak correspondence
- Compliant to the RoHS directive (2011/65/EU)

**PLV**
- High voltage, long life
- High voltage (to 100V), low ESR, high ripple current
- Long life of 3,000 hours at 125°C
- Radial lead type: Load free reflow soldering condition correspondence
- Compliant to the RoHS directive (2011/65/EU)

**PLX**
- High reliability
- High reliability, low ESR, high ripple current
- Long life of 3,000 hours at 125°C
- Radial lead type: Load free reflow soldering condition correspondence
- Compliant to the RoHS directive (2011/65/EU)

**PCR**
- High reliability with high voltage (to 80V), low ESR, high ripple current
- Long life of 4,000 hours at 125°C
- ESR after endurance at -40°C
- Compliant to the RoHS directive (2011/65/EU)

**“EverCAP®” Automotive Electric Double-Layer Capacitors**

**JUM**
- High voltage
- High voltage (3.7V)
- Suitable for quick charge and discharge
- Wide temperature range: -25 to +70°C
- Compliant to the RoHS directive (2011/65/EU)

**JUK**
- Lower resistance
- Lower resistance type of JUM series
- Lower temperature range: -40 to +70°C
- Compliant to the RoHS directive (2011/65/EU)

Positive Thermistor “Posi-R®”

The thermistor is classified into two types, one is Positive Thermistor whose resistance decreases along with temperature increasing, and the other is Negative Thermistor. Ceramic Positive thermistor (Posi-R®) is manufactured and sold by our company.

**Posi-R® used for heater “ZPD ZPS Series”**
- Worn up rapidly to the target heating temperature.
- Temperature homogeneous, without red heat, always safe.
- Excessive temperature rise is suppressed by self temperature control.
- Power saving by self temperature control.
- This desired temperature can be selected.

**Posi-R® used for over current Protection “ZPC Series”**
- Expand the current region by reducing the resistance.
- It is mainly used for automotive miniature motor protection (door motors, etc.) and air conditioner circuit protection (wave control board, etc.).

Note: For detailed specifications on the product numbers above, please refer to Nichicon’s general catalog of electronics.

---

Nichicon Automotive Application Catalog
### Aluminum Electrolytic Capacitors for Battery Management

<table>
<thead>
<tr>
<th>Capacitor</th>
<th>High Voltage</th>
<th>High Reliability</th>
<th>Long Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULR</td>
<td>High voltage</td>
<td>Load life of 3,000 hours at 105°C</td>
<td>Compliant to the RoHS directive (2011/65/EU)</td>
</tr>
<tr>
<td>ULV</td>
<td>High voltage</td>
<td>Load life of 10,000 hours at 105°C</td>
<td>Compliant to the RoHS directive (2011/65/EU)</td>
</tr>
<tr>
<td>ULT</td>
<td>High voltage</td>
<td>Load life of 2,000 hours at 125°C</td>
<td>Compliant to the RoHS directive (2011/65/EU)</td>
</tr>
<tr>
<td>ULH</td>
<td>High voltage</td>
<td>Load life of 4,000 hours at 125°C</td>
<td>Compliant to the RoHS directive (2011/65/EU)</td>
</tr>
</tbody>
</table>

#### Lineup

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>ULR</th>
<th>ULV</th>
<th>ULT</th>
<th>ULH</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>12</td>
<td>15</td>
<td>22</td>
<td>33</td>
</tr>
<tr>
<td>200</td>
<td>12</td>
<td>15</td>
<td>22</td>
<td>33</td>
</tr>
<tr>
<td>250</td>
<td>12</td>
<td>15</td>
<td>22</td>
<td>33</td>
</tr>
<tr>
<td>400</td>
<td>12</td>
<td>15</td>
<td>22</td>
<td>33</td>
</tr>
<tr>
<td>450</td>
<td>12</td>
<td>15</td>
<td>22</td>
<td>33</td>
</tr>
</tbody>
</table>

#### Rated Voltage

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>6.3-200V, 6.3-300V, 6.3-500V, 6.3-1000V, 6.3-2000V, 6.3-3000V, 6.3-5000V</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>12</td>
</tr>
<tr>
<td>200</td>
<td>12</td>
</tr>
<tr>
<td>250</td>
<td>12</td>
</tr>
<tr>
<td>400</td>
<td>12</td>
</tr>
<tr>
<td>450</td>
<td>12</td>
</tr>
</tbody>
</table>

**Note:** The same product numbers also meet automotive application specifications.

### Eco-Car Solutions

#### Applications

- EV/HV batteries, battery unit control, and monitoring
- EPSs, DCMs, airbag controls
- Gateway ECUs, DCMs, airbag controls
- Navigation, car audio, wipers, airbag controls
- Power steering, turn signals, airbag controls

### Nichicon Automotive Application Catalog

- **Safety Solutions**
  - Airbag ECU Pattern Diagram
  - Headlight ballast primary

- **Eco-Car Solutions**
  - Aluminum Electrolytic Capacitors for Battery Management
  - Burn-in test at 2,000 hours at 125°C (450V), -25 to +105°C (450V)
  - SMD type, high voltage and high reliability
  - Load life of 4,000 hours at 125°C

- **Mounting Examples**
  - Airbags, automotive cameras, Drive Recorders, ABS systems

**Note:** For detailed specifications, please refer to Nichicon’s general catalog of electronics.
**Film Capacitors for EVs/HVs/PHVs**

**Deposition electrode (SH) and Foil electrode (NH) Capacitors**

<table>
<thead>
<tr>
<th>Electrode</th>
<th>Foil electrode capacitors (Non-self Healing (SH))</th>
<th>Vapor deposition electrode capacitors (Self Healing (SH))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Metal foil (Generally insulated foil)</td>
<td>Vapor deposition metal foil on the surface of films</td>
</tr>
<tr>
<td>Deposition</td>
<td>Insulating Paper, Fiber Composite</td>
<td>Film</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Destruction mode</th>
<th>Foil electrode capacitors (SH)</th>
<th>Vapor deposition electrode capacitors (SH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The broken part in short circuit, the insulation will never be recovered.</td>
<td>The vapor and lower aluminum foil contact and short-circuit.</td>
<td></td>
</tr>
</tbody>
</table>

**Improvement of safety by SH capacitor Pattern vapor deposition**

- **Self-healing process of Pattern vapor deposition**
  - Example of vapor deposition pattern
  - Before the fuse’s operation
  - The fuse parts at the four corners are cut by overcurrent and insulation is recovered.

**Comparison of safety between Pattern vapor deposition and Flat vapor deposition.**

<table>
<thead>
<tr>
<th>Test conditions</th>
<th>Ambient temperature: room temperature</th>
<th>Voltage application time: 1 minute for each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance change by accumulation overvoltage test</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Flat vapor deposition**
  - Appearance after the test: Wrapping breakage, element elution
- **Pattern vapor deposition**
  - Appearance after the test: No abnormality

**Inverter System Diagram**

- **Integrated Design**
  - Shape freedom: enables use for smoothing and filtering

**Film Capacitors**

- **DC–DC Converter with integrated charger for EVs**
  - **Features**
    - Compatible with power sources worldwide
    - Operates using CAN communications, transmits various types of information
    - CE mark compliant
  - **Specifications**
    - **Charger**
      - Input voltage: AC100 to 240V
      - Output power: Max. 3.3kW
    - **Charging DC–DC converter**
      - Input voltage: 14V
      - Output voltage: 200 to 410V
      - Cooling system: Water cooled

**Sample Uses for Inverter with Booster Function**

- **Capacitor Module Equivalence Circuit**
  - **Features**
    - Provides Film Capacitors with superior electrical characteristics and flexible exterior and electrode configurations for use in automobiles, trains and other vehicles
    - **Specifications**
      - **High-frequency Characteristics**
        - Short high-frequency characteristics (excellent filtering effects)
        - Lower loss, energy-saving
      - **High-voltage, Safety Performance**
        - High-voltage current withstand voltage (high-current density per unit volume)
      - **Long Life**
        - Maintenance-free for 10 years or more even in challenging temperature conditions
      - **Shape Freedom**
        - Flexible exterior shapes (square, cylindrical)