Panasonic Polymer Capacitors
A technology to overcome the MLCC crisis?
Agenda

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2. Market Trend Supply Chain
3. Panasonic Polymer Capacitors
   a. Product family, Wide product range
   b. Technology comparison with others
   c. How to proceed MLCC replacement & examples
   d. Reference designs & Support tools
4. Conclusions
Panasonic Brief Introduction: As a Cutting Edge Passive Solution Provider

Wide & Solution based
Product Range

We are manufacturing capacitors since 1938 (81 years)!!

Panasonic Device Business Overview

Manufacturing various products supported by internal cutting edge technologies

BCP considered factory design
(1 product = Mother factory in Japan + factory in overseas)
**Market Trend Supply Chain:** MLCC’s tight situation will be continued

### Parts counts continuously increasing

- **High reliability MLCC**
  - Pref 2011: 3.5mil → 10mil
  - Pref 2017: 1000 → 5000
  - HV/PHV shipment: 3.5mil → 10mil
  - MLCC per car (pcs): 1000 → 5000
  - (conventional) (HV/PHV)

### Very small & precise MLCC

- Pref 2011: 5mil → 15mil
- Pref 2017: 500 → 1000
- Smart phone shipment: 5mil → 15mil
- MLCC per iPhone (pcs): 500 → 1000

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**Panasonic Polymer Capacitors will be a good solution to replace low voltage & high capacitance MLCCs!!**
Panasonic Polymer Capacitors: Wide product coverage

In-house polymerization (Integrated Electrolytic Polymerization, not Chemical)

1. Low resistance by conductive polymer (1/1000 vs standard tantalum)
2. High capacitance Al foil etching

Panasonic is the only supplier which offers 4 types of polymer products.
### Panasonic Polymer Capacitors: Technical characteristics

#### Voltage range
- 2 to 8 VDC
- 2 to 35 VDC
- 25 to 80 VDC
- 2 to 100 VDC
- 3.3 to 2700 µF
- 10 to 560uF
- 10 to 560uF

#### Capacitance Range
- Up to 820 µF
- 3.9 to 1500 µF
- 10 to 560µF
- 3.3 to 2700 µF
- 10 to 560uF

#### Temperature range
- -55°C/+105°C, -55°C/+125°C
- -55°C/+105°C, -55°C/+125°C
- -55°C/+145°C
- -55°C/+105°C, -55°C/+125°C

#### Endurance
- 2000h@105°C /@125°C
- 2000h@105°C, 2000h@125°C
- 10000h@105°C to 2000h@145°C
- 10000h@105°C to 2000h@145°C

#### ESR
- Down to 3mΩ
- Down to 5mΩ
- Down to 20mΩ
- Down to 5mΩ

#### Ripple current
- up to 10.2Arms
- up to 4.4Arms
- up to 7.2Arms
- up to 4Arms

#### Size
- 7.3x4.3mm
- 2.0x1.25mm to 7.3x4.3mm
- Ø4mm to 10mm
- Ø5mm to 10mm

#### Height
- 1mm to 4.2mm
- 0.9mm to 3.8mm
- 5.5mm to 13mm
- 5.8mm to 10.2mm

#### AEC-Q200 qualified series are available

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**Legend:**
- **Low ESR**
- **Low Profile**
- **High Ripple**
- **Low ESR**
- **Small Case Size**
- **Large Cap.**
- **High Ripple**
- **High Voltage**
- **High Capacity**
- **Low ESR**
- **Very Robust**
- **Low Leakage**

**Anode:** Aluminum
**Electrolyte:** Polymer

**Anode:** Tantalum
**Electrolyte:** Polymer

**Anode:** Aluminum
**Electrolyte:** Polymer + Liquid
Panasonic Polymer Capacitors: Comparison with other technologies

**Stable vs. DC Bias aging**

- Polymer are not affected by DC bias.

**Stable vs. frequency**

- Polymer can sustain mechanical stress where MLCC fails.

**Stable vs. temperature**

- Polymer will not suffer from piezo effect when a rectangular shaped signal is applied.

**“Silent”**

- "Silent" Safety
  - Polymer vs. MLCC
  - POLYMER vs. MLCC

**Robustness**

- Overvoltage stress: 30V/6A
  - 6.3V -150uF

**Safety**

- Other tantalum
  - Polymer
1. Voltage
- Chips: 2-35V
- Cans: 2-100V
- Line Voltage?
  ✓ No Derating for Polymers

2. Capacitance
- Minimum: 2.2uF
- Ideally ≥22uF
- Effective Capacitance ± tolerance?
  ✓ No DC bias in Polymers

3. Size/ Q’ty used
- Chips: Above 0805
- Cans: ≥ø5mm & H>5.8mm
- Replacement< Redesign?
  ✓ Many MLCC ↔ One Polymer

Other parameters to consider:
- Frequency of application (≥500 kHz)
- Temperature requirement (Polymers have no temp derating but stronger <105°C)
- Automotive Propose: Hybrids is the most recommendable
MLCC replacement example 1

**CPU accelerator power supply Design for Arria 10**

- **Vin** = 12V
- **Vout** = 0.9V
- **Ipeak** = 55A
- **Slew rate** = 27.5A/us
- **PS switching frequency** = 500kHz x 2ph
- **Inductance** = 0.13uH

**Power supply and Load Condition**

- **Replacement by Panasonic Polymer Capacitors**

**Enpirion**

**EC7401+2xET4040**
MLCC replacement example 1 (con.)

Reference Design

Current Design  MLCC 100uF(1206) x92  
Vp-p19mV  (-5mV, +14mV)

2V560uF, ESR3mohm, Low ESL, D size x9  
Vp-p24mV  (-11mV, +13mV)

Space saving  Cost down

-40%  -50%
MLCC replacement example 2

The SP-Cap adopted in the power supply circuit

SP-Cap
CX series
6.3V180μF
• Large Capacitance
• Low profile (Max. H2.0mm)

Solution

height limit 2mm max.

Component height 2.0mm or less (7.3x4.3x1.9mm)

2mm max.

Quantity reduction

MLCC (Ceramic capacitor)
6.3V100μF x 6pcs
Total capacity 150μF (5V)

SP-Cap
6.3V180μF x 1pc
Total capacity 180μF (5V)

Industrial machine vision camera
Panasonic Polymers are now getting common in the market as the replacement of MLCCs.
Technical Support Materials

https://eu.industrial.panasonic.com/products/capacitors/sos-short-mlccs#overlay-context=user

Web Catalogues

Polymer Capacitors: SP-Cap Polymer Aluminium

Application Guides

Simulation / CAD data

Support Tools

Sample boxes

White papers / Videos

MLCC replacement micro page

S.O.S Short on MLCCs?

Panasonic is a leading supplier for Capacitor technology, offering an extremely wide range of MLCC alternative solutions including SP-Cap, PDS0C8, CD-08, Hybrid, all of which can be commissioned FAST to replace difficult to find MLCCs.

* High voltage, high current, low ESR, and capacitance across broad temperature and frequency spectrum.

Polymer capacitors offer advantages for the following designs:

- 4 wattages in Polymer dielectric capacitors:
  - Including drop-in and hybrid types (200V K 15%
  - No degrading and DC low series R/Cs.

Physically more robust, longer lifetime and eliminates module embedding.

Drop-in Replacement for MLCCs:

- Voltage: 2 – 35V
- Capacitance: 3µF
- 6x3.2x1.7 cm size
- Very low ESL constant

2 Easy Steps to Identify your Right Fit

More info on MLCCs:

- S.O.S. Short on MLCCs? Choose Panasonic Polymer Series!
- RHcontrol on MLCC Storages

More info on Polymer Capacitors:

- Polymer Capacitors Contact Leader
- FSP4 Capacitors Leader
- Whitepaper on understanding Polymer and Hybrid Capacitors

More info on Sample boxes:

- Sample boxes

Simulation Data Libraries

Capacitor Selection Tool

CAD Data

Frequency characterized data, equivalent circuit models, and 3D parameter data can be downloaded for each individual device number.

This tool displays the characteristics (ESR, ripple current, capacitance etc.) needed for a capacitor and selects the appropriate capacitor.

CAD data can be downloaded (3D STEP)

Download

Download

Download
Why Panasonic and why polymer capacitors?

**Panasonic:**
- Widest Polymer footprint in the market
- Pioneer with the technology – longest design-in experience
- Stable leadtimes
- Increasing investment in capacity
- Every polymer family has its own:
  - Main factory & R&D in Japan
  - Overseas factory

**Polymer Capacitors:**
- No Derating
  - Voltage
  - Temperature
- No DC bias
- No Piezo Noise issues
- Not prone to cracking or mechanical stress
- Highest capacitance
- Low ESR
- Higher ripple current capability
- Part count reduction = Cost reduction
  ➢ Simply better design!
Thank you for your attention!

Question, comments, observation are welcome.

Business, of course, is always more welcome