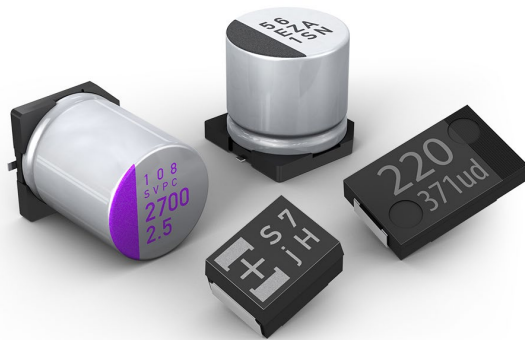


Panasonic Polymer Capacitors

A technology to overcome the MLCC crisis?



1. Panasonic Brief Introduction
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

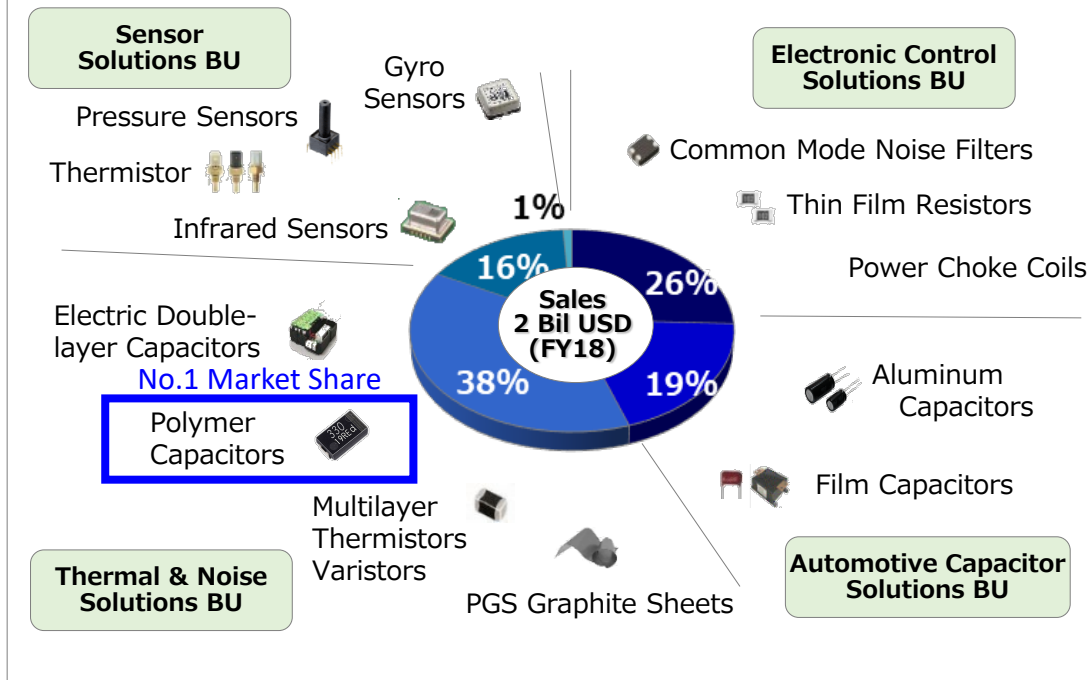


Wide & Solution based Product Range

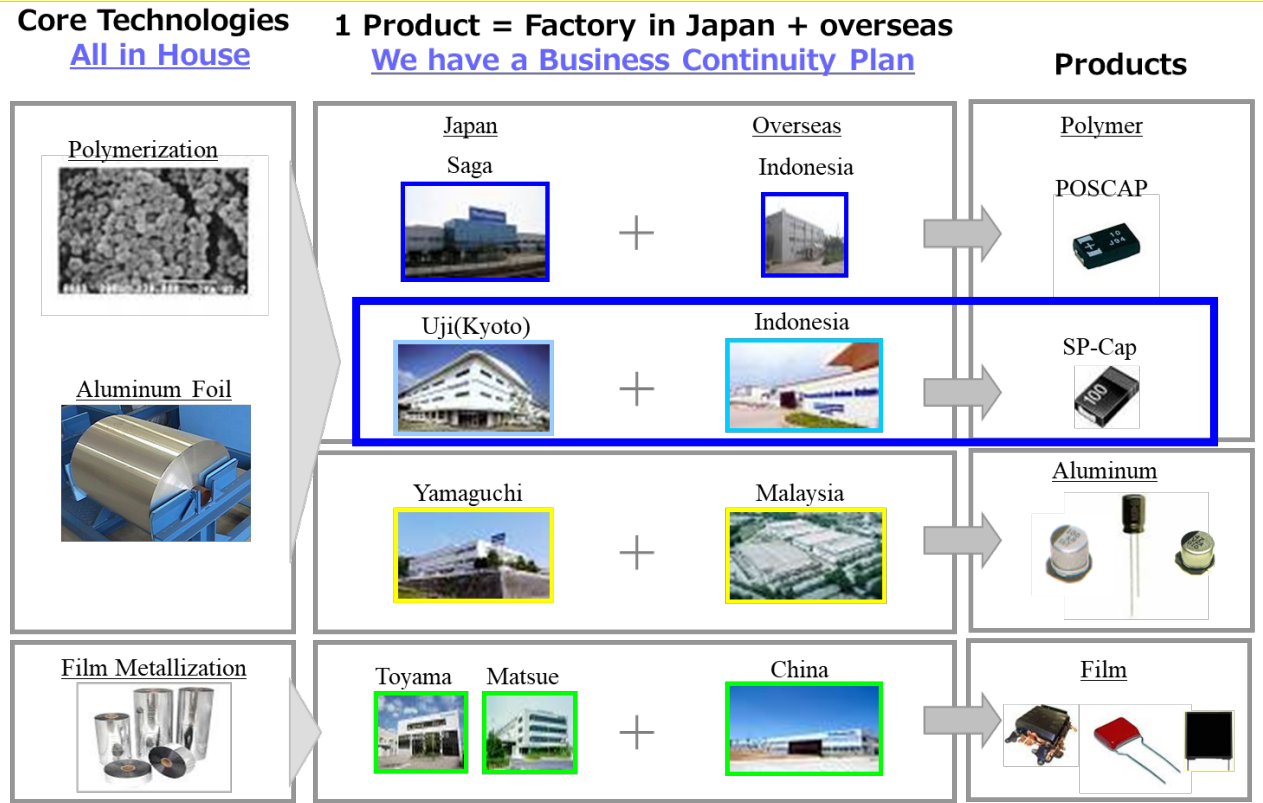
BCP considered factory design (1 product = Mother factory in Japan + factory in overseas)

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

Panasonic Device Business Overview



Manufacturing various products supported by internal cutting edge technologies



Market Trend Supply Chain : MLCC's tight situation will be continued

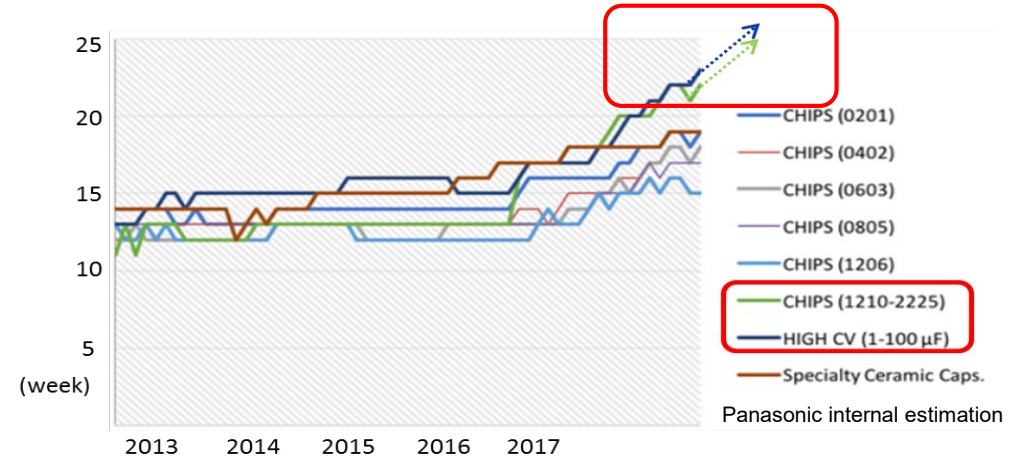
Parts counts continuously increasing

High reliability MLCC



	<<2011>>	<<2017>>
HV/PHV shipment:	3.5mil	→ 10mil
MLCC per car(pcs):	1000	→ 5000
	(conventional)	(HV/PHV)

Large size MLCC still continues longer L/T

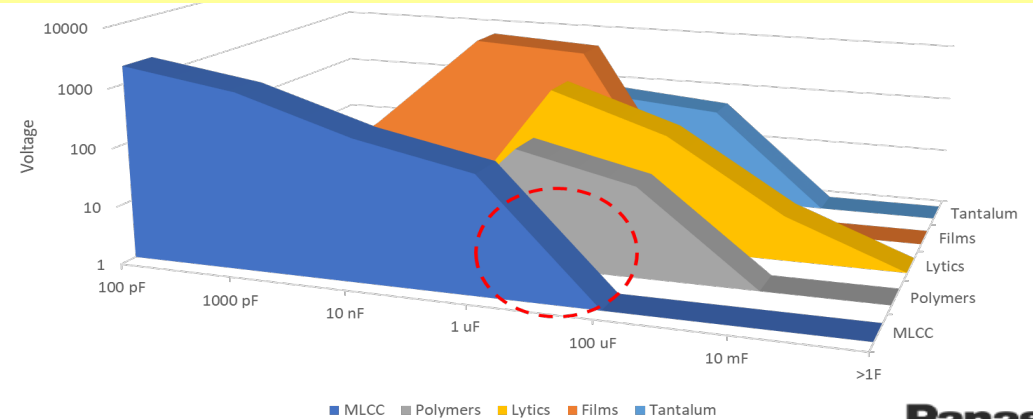


Very small & precise MLCC

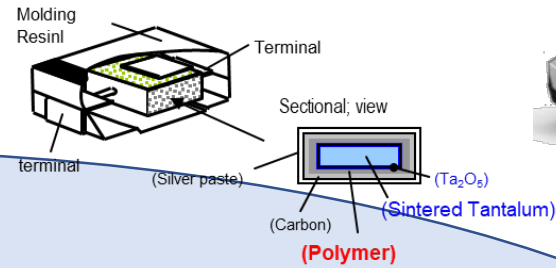
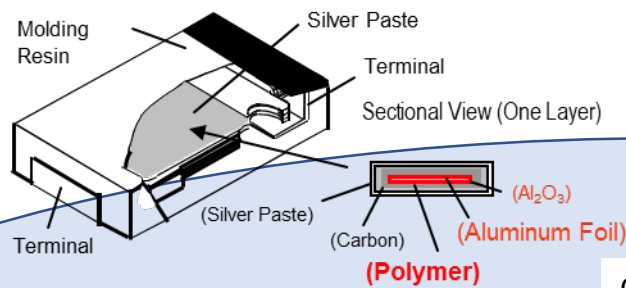


	<<2011>>	<<2017>>
Smart phone shipment :	5mil	→ 15mil
MLCC per iPhone(pcs) :	500	→ 1000

Panasonic Polymer Capacitors will be a good solution to replace low voltage & high capacitance MLCCs !!



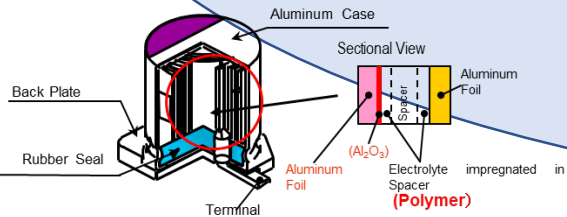
Panasonic Polymer Capacitors : Wide product coverage



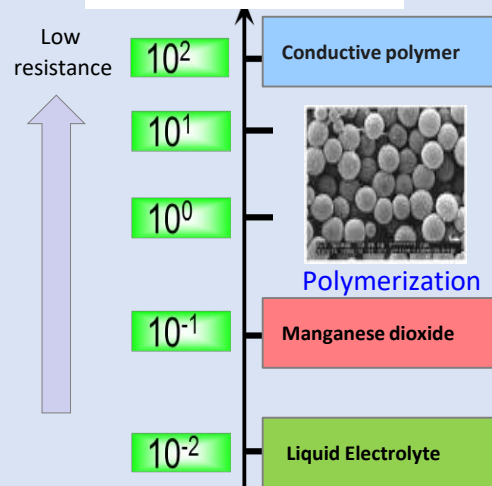
Polymerization

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

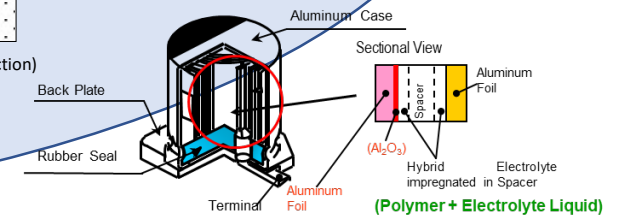
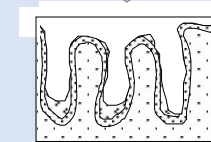
1. Low resistance by conductive polymer (1/1000 vs standard tantalum)
2. High capacitance Al foil etching



Conductivity (S/cm)



High Cap Al Foil



**Panasonic is the only supplier
which offers 4 types of polymer products**

Panasonic Polymer Capacitors : Technical characteristics



Anode: Aluminum
Electrolyte: Polymer

Low ESR

Low Profile

High Ripple

SP-Cap

Voltage range	2 to 8 VDC
Capacitance Range	Up to 820 μ F
Temperature range	-55°C/+105°C, -55°C/+125°C
endurance	2000h@105°C/ @125°C
ESR	Down to 3m Ω
Ripple current	up to 10.2Arms
Size	7.3x4.3mm
Height	1mm to 4.2mm

Low ESR

Small Case Size

Large Cap.

Anode: Tantalum
Electrolyte: Polymer

POSCAP



Voltage range	2 to 35 VDC
Capacitance Range	3.9 to 1500 μ F
Temperature range	-55°C/+105°C, -55°C/+125°C
Lifetime	2000h@105°C ,2000h@125°C
ESR	Down to 5m Ω
Ripple current	up to 4.4Arms
Size	2.0x1.25mm to 7.3x4.3mm
Height	0.9mm to 3.8mm
AEC-Q200 qualified series are available	



Anode: Aluminum
Electrolyte: Polymer

High Ripple

High Voltage

High Capacity

OS-CON

Voltage range	2 to 100 VDC
Capacitance Range	3.3 to 2700 μ F
Temperature range	-55°C/+105°C, -55°C/+125°C
endurance	2000h@105°C (-20°C -> x10)
ESR	Down to 5m Ω
Ripple current	up to 7.2Arms
Size	\varnothing 4mm to 10mm
Height	5.5mm to 13mm
AEC-Q200 qualified series are available	

Low ESR

Very Robust

Low Leakage

Anode: Aluminum
Electrolyte: Polymer + Liquid

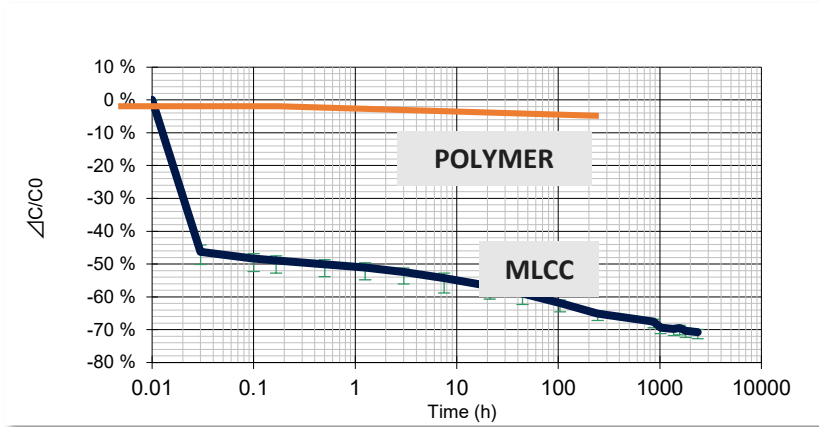
Hybrid



Voltage range	25 to 80 VDC
Capacitance Range	10 to 560 μ F
Temperature range	-55°C/+105°C, -55°C/+145°C
Lifetime	10000h@105°C to 2000h@145°C
ESR	Down to 20m Ω
Ripple current	up to 4Arms
Size	\varnothing 5mm to 10mm
Height	5.8mm to 10.2mm
All values are AEC-Q200 qualified	

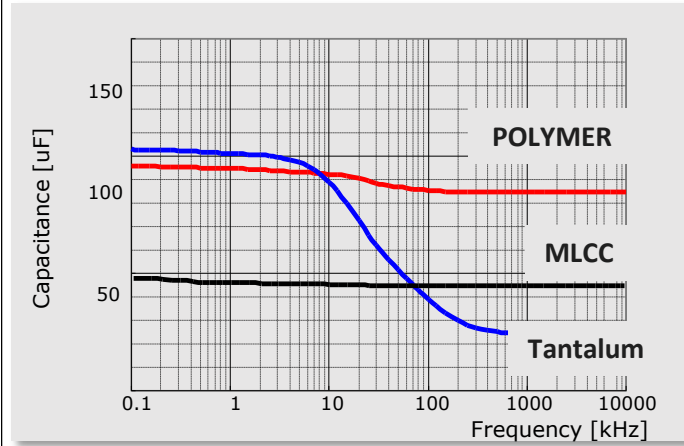
Panasonic Polymer Capacitors : Comparison with other technologies

Stable vs. DC Bias aging

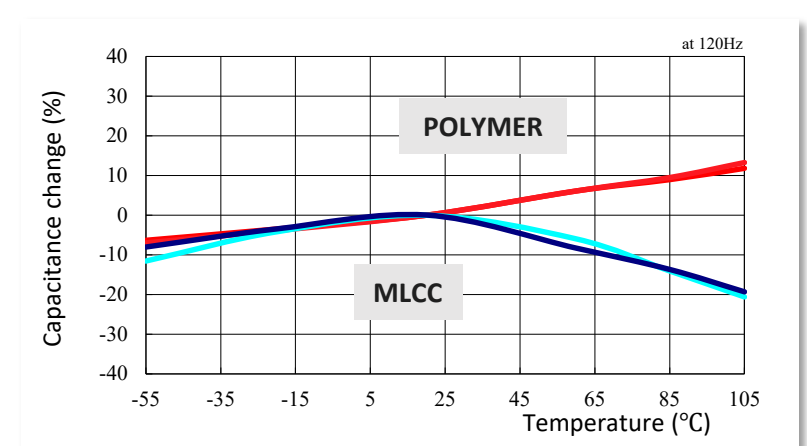


Polymer are not affected by DC bias

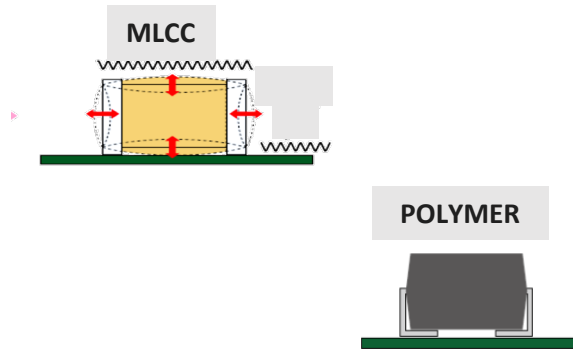
Stable vs. frequency



Stable vs. temperature



"Silent"



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

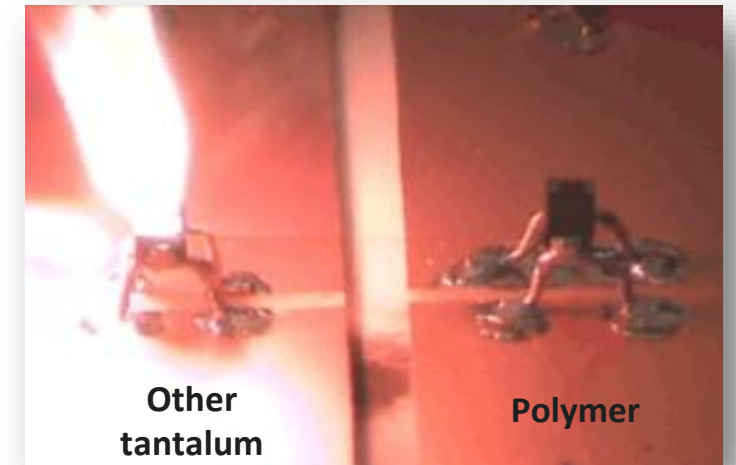
Robustness



Polymer can sustain mechanical stress where MLCC fails

Safety

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



Other tantalum

Polymer

1. Voltage

- Chips: 2-35V
- Cans: 2-100V

- Line Voltage?

✓ **No Derating for Polymers**

2. Capacitance

- Minimum: 2.2uF
- Ideally $\geq 22\mu\text{F}$

- Effective Capacitance \pm tolerance?

✓ **No DC bias in Polymers**

3. Size/ Q'ty used

- Chips: Above 0805
- Cans: $\geq \varnothing 5\text{mm}$ & $H > 5.8\text{mm}$

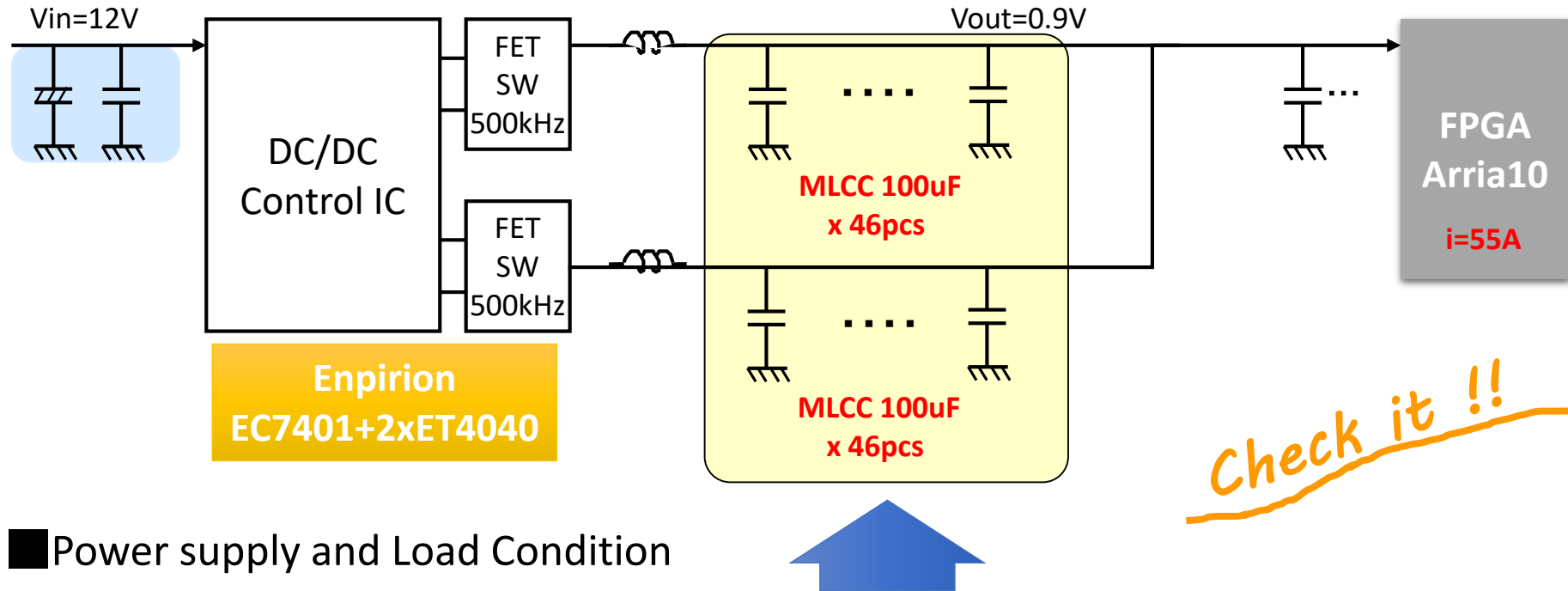
- Replacement < Redesign?

✓ **Many MLCC ↔ One Polymer**

Other parameters to consider:

- Frequency of application (≥ 500 kHz)
- Temperature requirement (Polymers have no temp derating but stronger $< 105^\circ\text{C}$)
- Automotive Propose : Hybrids is the most recommendable

CPU accelerator power supply Design for Arria 10



Power supply and Load Condition

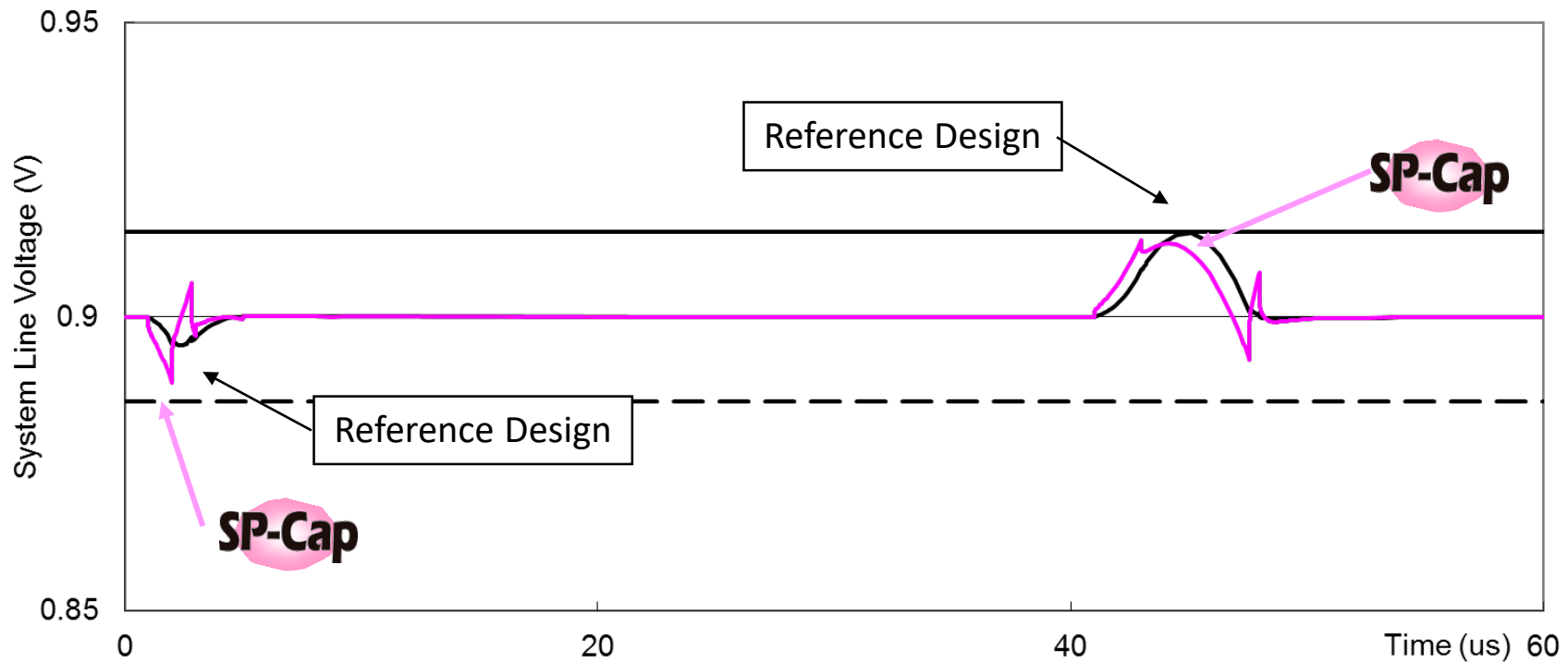
Vin	12V
Vout	0.9V
Ipeak	55A
Slew rate	27.5A/us
PS switching frequency	500kHz x 2ph
Inductance	0.13uH


Replacement by Panasonic Polymer Capacitors



MLCC replacement example 1 (con.)

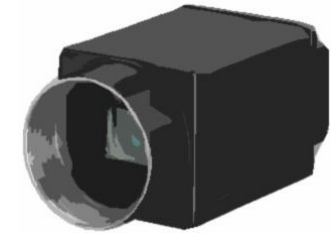
Transient Response 55A (27.5A/us, No-delay)
 Sw Power Supply L=0.13uH Vin=12V Vout=0.9V @500kHz x2phase



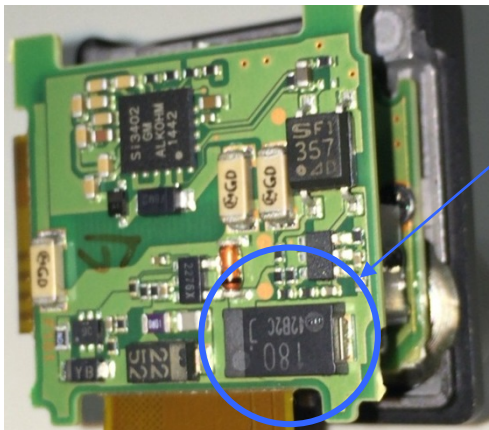
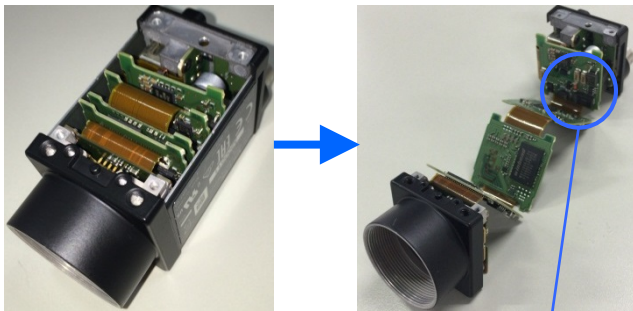
— Current Design	MLCC 100uF(1206) x92	Vp-p19mV (-5mV,+14mV)
 SP-Cap	2V560uF, ESR3mohm, Low ESL, D size x 9	Vp-p24mV (-11mV,+13mV)

Space saving	Cost down
-40%	-50%

Industrial machine vision camera



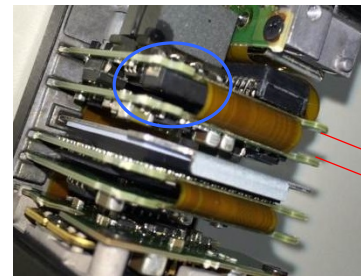
The SP-Cap adopted in the power supply circuit



SP-Cap
CX series
6.3V180 μ F
• 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)
6.3V100 μ F x **6pcs**



Total capacity
150 μ F
(5V)

SP-Cap
6.3V180 μ F x **1pc**



Total capacity
180 μ F
(5V)

Panasonic Polymers are now getting common in the market as the replacement of MLCCs.

Processor Design-in Examples

XILINX Zynq/Kintex/Virtex UltraScale+ (FPGA) **SP-Cap**

intel Arria/Stratix 10 (FPGA) **Hybrid POSCAP**

intel Xeon D (SoC) **SP-Cap**

IDT CPS Series (Switch ASIC) **POSCAP**

BROADCOM BCM88***/56*** (Switch ASIC) **SP-Cap**

NXP QorIQ (SoC) **OS-CON**

CAVIUM Octeon TX (SoC) **POSCAP** **OS-CON**

KeyStone I/II (DSP) **POSCAP**

Power IC Design-in Examples

LINEAR uModule **SP-Cap** uModule Backside **12Vin - 1V36A (LTM4677)**

Enpirion PowerSoC **SP-Cap** **POSCAP** **12Vin - 1V30A (EM2130)**

intersil Power Module **E-Cap** **POSCAP** **12Vin - 1V30A (ISL8274M)**

TI DC/DC Converter **E-Cap** **60Vin - 5V1A (MAX1752EVKITB)**

TI DC/DC Controller **OS-CON** **E-Cap** **60Vin - 12V5A (LM5122)**

Wolfspeed GaN Power Amplifier **E-Cap** **28V2A (CMPA601C025F)**



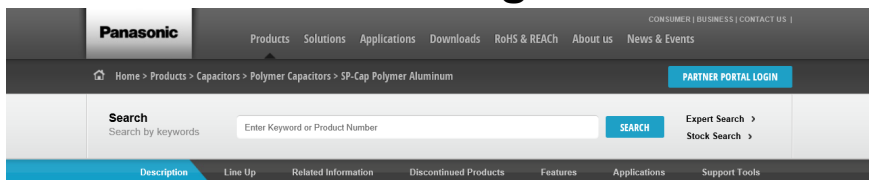
In stead of MLCCs, Polymer capacitors are chosen for much more stable characteristics

Technical Support Materials



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

Web Catalogues



Polymer Capacitors: SP-Cap Polymer Aluminum



- SP-Caps are Surface Mount Aluminum Electrolytic Capacitors as their electrolyte material.
- SP-Caps are primarily used as input and output capacitors with ultra low ESR values.
- Panasonic SP-Caps offer excellent performance for their values at low cost.

Line Up

10 matches. Items per page 15

Body shape	Series/Type	Data Sheet	Image	Category temp. range (°C)	Endurance (h)	Features	Rated voltage range (V.DC)
SMD	> CS,CT,CX			-55 to +105	2000	• High voltage: 35 V.DC max. • Low profile... Show More	2 to 35

Sample boxes



Application Guides Simulation / CAD data

Others

- LCD panel, etc.

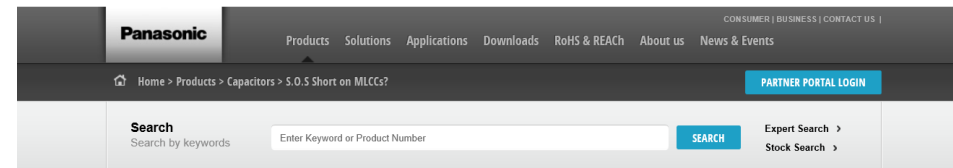
Example of Applications

COMMUNICATION INFRASTRUCTURE	SERVER
BUILT-IN BOARD	(AUTOMOTIVE) INFOTAINMENT/SENSOR, CAMERA
MONITOR CAMERA	SMART METER
SSD	LCD PANEL
POWER BANK/USB POWER	USB CHARGER
SMARTPHONE/TABLET	

Support Tools

Simulation Data Libraries	Capacitor Selection Tool	CAD Data
Frequency characteristic data, equivalent circuit models, and S-parameter data can be downloaded for each individual item number.	This tool displays the characteristic (ESR, ripple current, capacitance etc.) needed for a capacitor and automate the selection of a proper capacitor.	CAD data can be download. (3D STEP)
Download	Download	Download

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, POSCAP, OS-CON, Hybrid, all of which can be considered NOW to replace difficult-to-get MLCCs.

With higher ripple current, stable ESR and capacitance across broad temperature and frequency spectrum, Polymer capacitors offer value against Electrolytics for efficient designs.

4 variations in Polymer dielectric capacitors

- Including chip and can-type (SMD & THT).
- No derating and DC bias unlike MLCCs
- Physically more robust, longer lifetimes and safe-failure modes (no-burning)

DROP-IN REPLACEMENT FOR MLCC IF:

- Voltage 2 – 35V
- Capacitance required ≥47µF
- B and D case sizes
- Non AECQ-200 compliant



More info on MLCC Shortage:

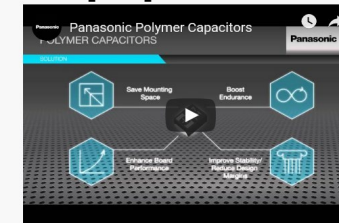
- [S.O.S. Short on MLCCs? Choose Panasonic Polymer Series!](#)
- [Whitepaper on MLCC Shortage](#)

2 EASY STEPS TO IDENTIFY YOUR RIGHT FIT

More info on Polymer:

- [Polymer Capacitors Combi Leaflet](#)
- [FGPA Capacitors Leaflet](#)
- [Whitepaper on Understanding Polymer and Hybrid Capacitors](#)
- [More on POLYMER CAPS](#)

White papers / Videos



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