MLCC to Polymer Webinar

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20th April 2018

KEMET Webinar Schedule 2018

May 7, 2018	New Snap In Aluminum Electrolytic Capacitors
May 28, 2018	Properly Measuring Capacitor Properties
June 4, 2018	New Aluminum Box Capacitors
June 11, 2018	KO-CAP: 0805 and 1206 Higher Rated Voltages
June 18, 2018	Axial Leaded Aluminum Electrolytic Capacitors
June 18, 2018	Technology Differences in Common Mode Chokes

Check out: go.kemet.com/emeawebex

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KOCAP Polymer Capacitors

- KEMET Polymer General Information
- Polymer Overview
- Features & Benefits
- Application Examples
- Parameters to consider

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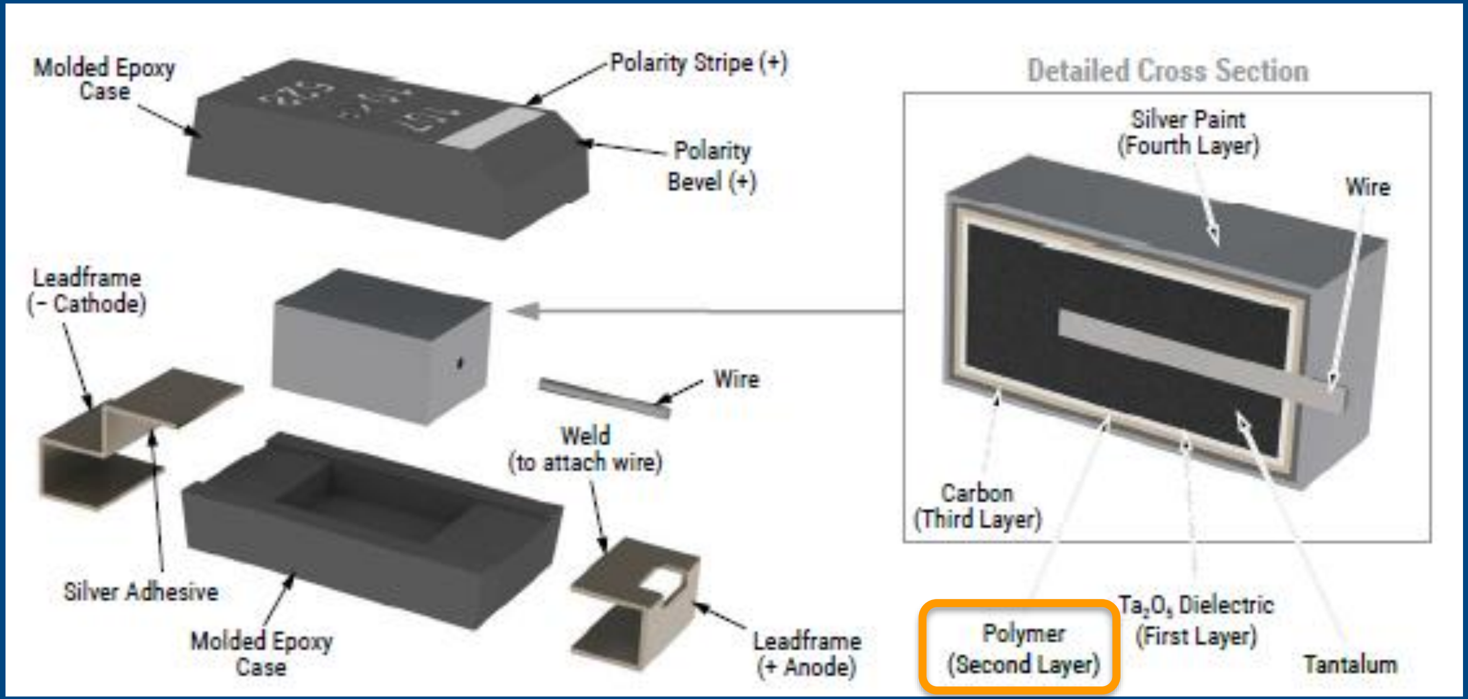
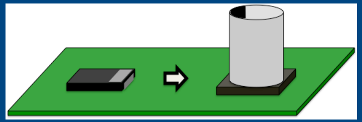
Why Polymer?

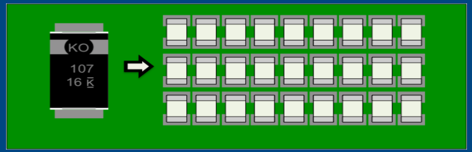
Polymer is the successor of Tantalum MnO_2 Capacitors

- PEDT as cathode counter electrode material
- Low oxygen index - no ignition failure mode
- Single digit ESR in mili-Ω range - less self heating!
- Cost saving potential



Miniturization & Extended Life





Board Space and Pick&Place Reduction

Non catastrophic Ignition failure mode due to lower O_2 index

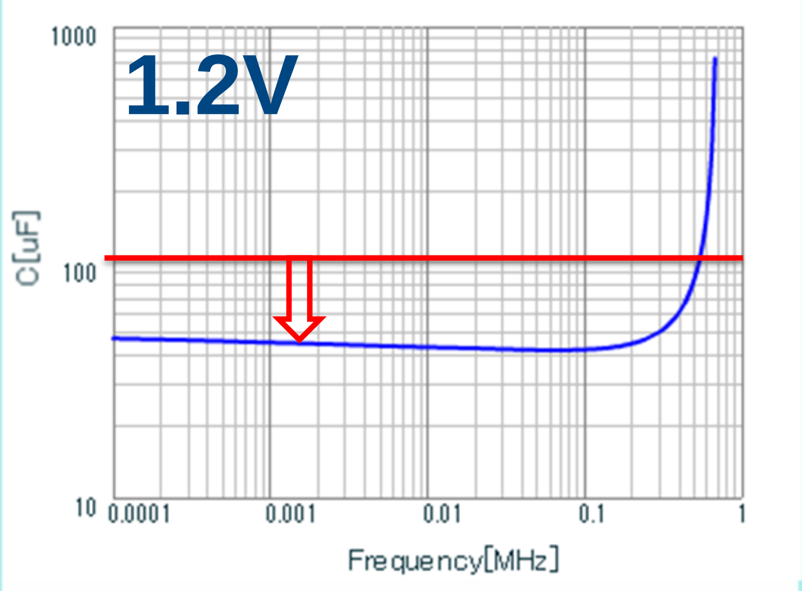
KEMET Polymer Capacitors

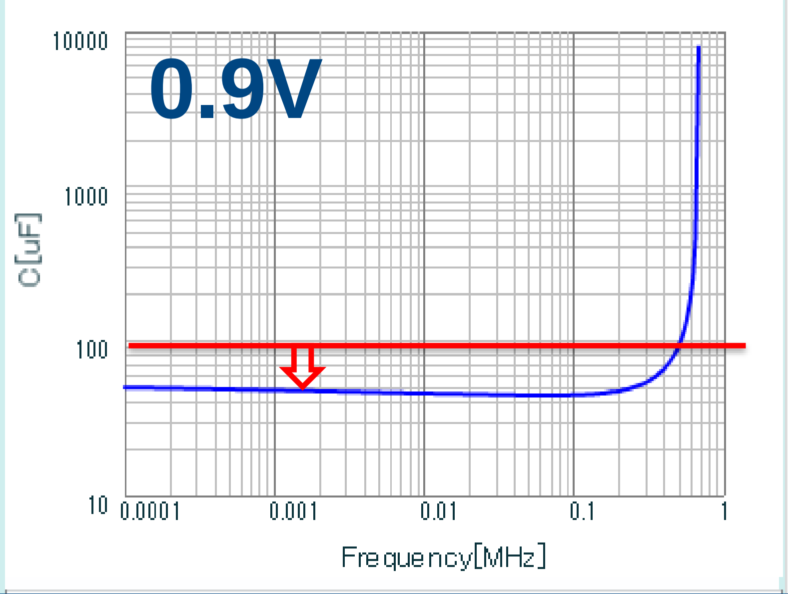
Capacitance Solution for 3 different Voltage Levels

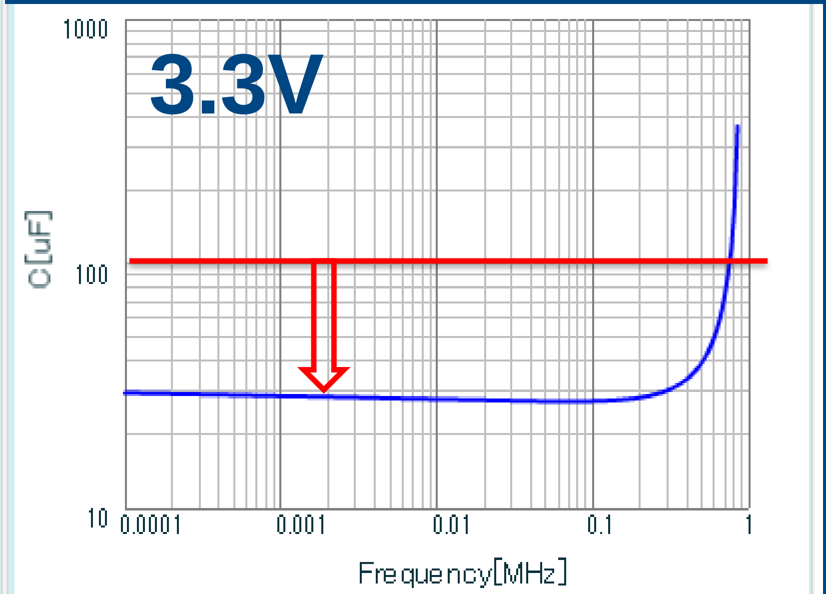
KEMET CHARGED.

Actual Solution	Parallel of:	CAP (uF) 300kHz	Effective Cap. (uF)	Ripple requirement (A)
1v2 rail at 3A – 3x 100uF/6.3V ceramic X5R, 1206	3	51	150	0,9
0v9 rail at 6A – 4x 100uF/6.3V ceramic X5R, 1206	4	54	200	1,8
3v3 rail at 2A - 3x 100uF/6.3V ceramic X5R, 1206	3	30	90	0,6

DC Bias Impact on Capacitance







KEMET Polymer capacitors

Capacitance Solution for 3 different Voltage Levels

KEMET CHARGED.®

Possible Savings of 26-36%

1v2 rail at 3A – 3x 100uF/6.3V ceramic X5R, 1206

Case Size	CAP (uF)	V	PN	Ripple Capability @ 100kHz (A)	CAP. At 300kHz (uF)	CAP. At 500kHz (uF)
B (3528-21)	330	2.5	T520B337M2R5ATE018	2.7	152	110

0v9 rail at 6A – 4x 100uF/6.3V ceramic X5R, 1206

Case Size	CAP (uF)	V	PN	Ripple Capability @ 100kHz (A)	CAP. At 300kHz (uF)	CAP. At 500kHz (uF)
V(7343-19)	470	2,5	T520V477M2R5ATE012	3.9	340	235

3v3 rail at 2A - 3x 100uF/6.3V ceramic X5R, 1206

Case Size	CAP (uF)	V	PN	Ripple Capability @ 100kHz (A)	CAP. At 300kHz (uF)	CAP. At 500kHz (uF)
B (3528-21)	150	4	T520B157M004ATE018	2.7	136	104

Pricing

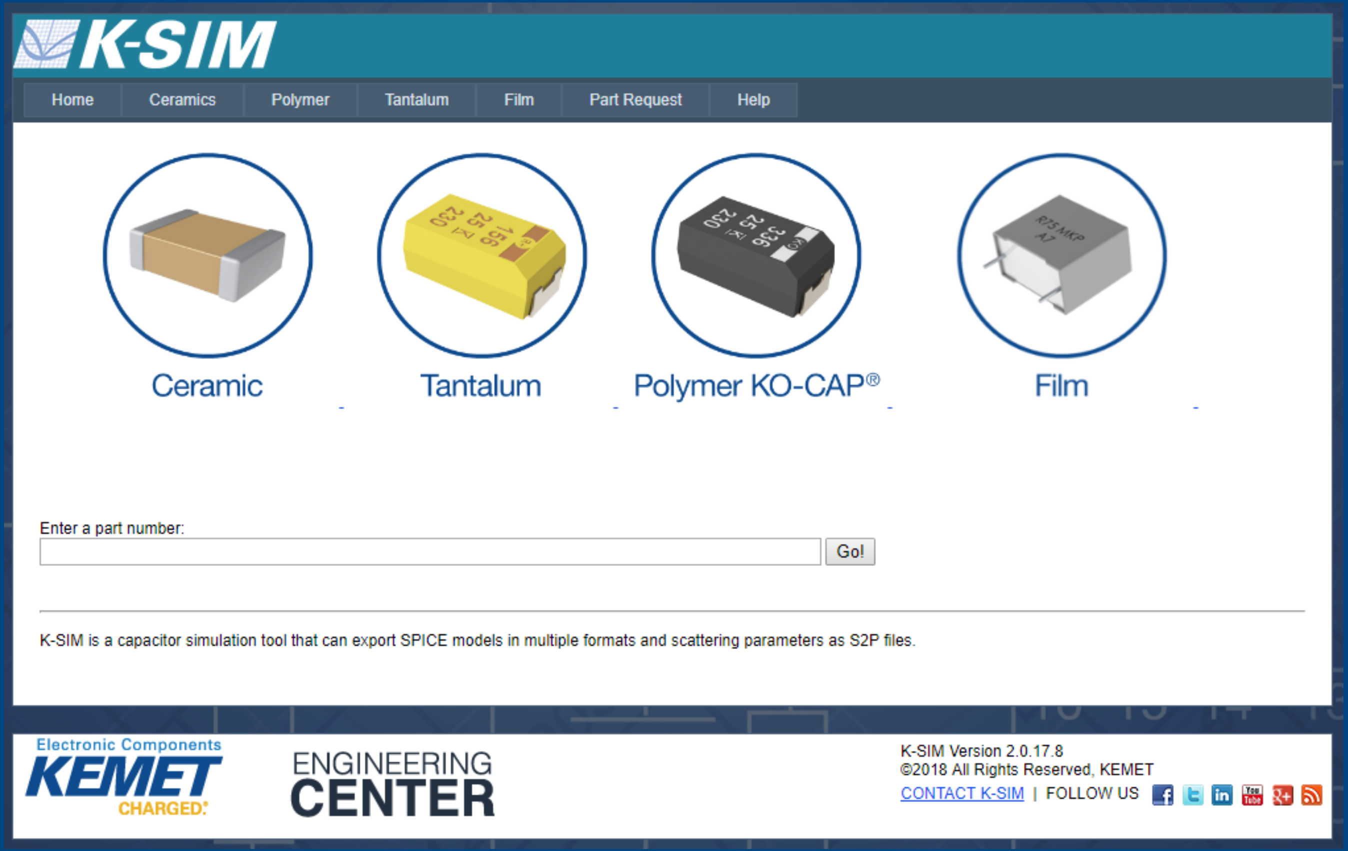
1.2V Rail	No of Caps	Cap (µF) 300kHz	Effective Cap (µF)	Ripple Capability (Arms)	ASP/1 in EUR (Octopart)	ASP/Cap Solution in EUR (Octopart)	Saving
C1206C107M9PACTU	3	51	150	0.9	0.2500	0.7500	
T520B337M2R5ATE018	1	152	152	2.7	0.4789	0.4789	0.2711 EUR / 36%

0.9V Rail	No of Caps	Cap (µF) 300kHz	Effective Cap (µF)	Ripple Capability (Arms)	ASP/1 in EUR (Octopart)	ASP/Cap Solution in EUR (Octopart)	Saving
C1206C107M9PACTU	4	54	200	1.8	0.2500	1.0000	
T520V477M2R5ATE012	1	340	340	3.9	0.6369	0.6369	0.2631 EUR / 26%

3.3V Rail	No of Caps	Cap (µF) 300kHz	Effective Cap (µF)	Ripple Capability (Arms)	ASP/1 in EUR (Octopart)	ASP/Cap Solution in EUR (Octopart)	Saving
C1206C107M9PACTU	3	30	90	0.6	0.2500	0.7500	
T520B157M004ATE018	1	136	136	2.7	0.4979	0.4979	0.2521 EUR / 34%

How to Determine a Capacitor’s Performance

K-SIM: KEMET’s primary component simulation tool



Navigate to **ksim.kemet.com** in any browser (even mobile!)

Determine:

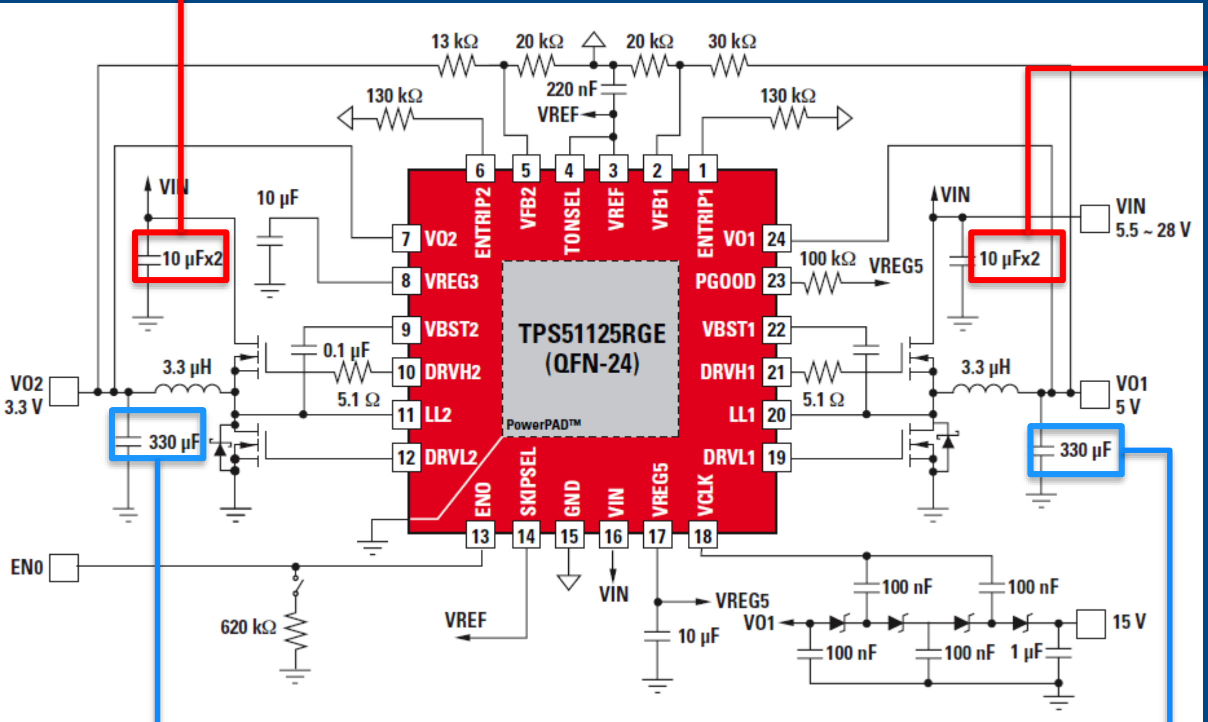
- Impedance and ESR
- Capacitance and Inductance
- Cap vs V(DC)
- Current and Voltage
- Temperature Rise
- Scattering Parameters
- SPICE Model
- Effect of Combined Impedances
- Export of SPICE Models

KO-CAP Applications

Voltage Regulator Input

KOCAP Polymer Capacitors

KOCAP can be used in both input or output



TPS51125 typical application diagram.

10uFx2

Input Capacitor
(5.5V~28V)

V02: 3.3V

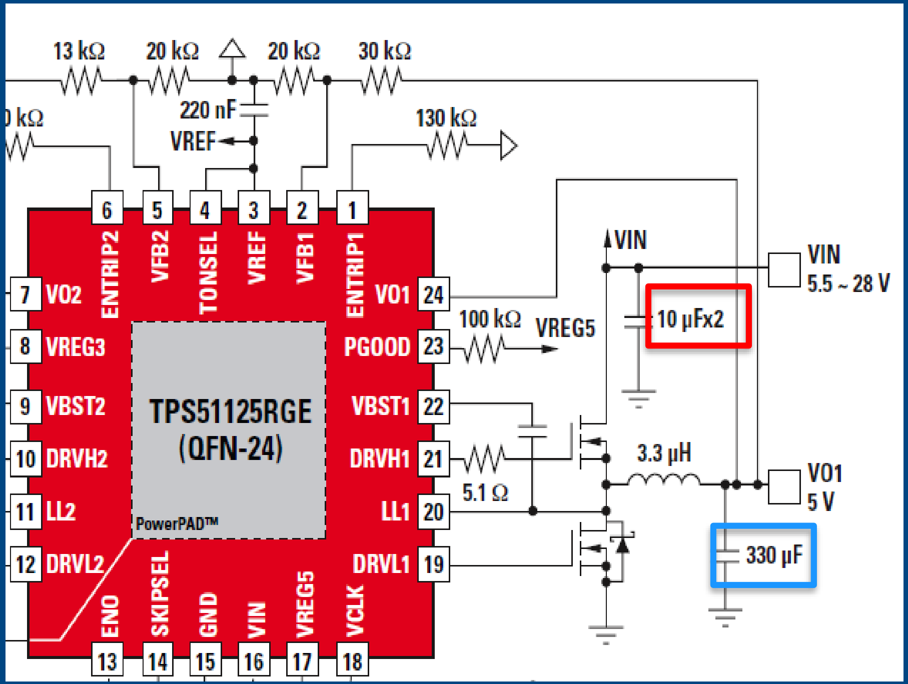
V01: 5V

330uF

Output Capacitor
(3.3V, 5V)

Source: http://www.ti.com/product/TPS51125

KO-CAP Applications
Voltage Regulator Output



Input Capacitor: 10uFx2
MLCC or KO-CAP?
- MLCC: X7R or X5R
- KOCAP: T521 series

Output Capacitor:330uF
KO-CAP or MLCC?
- KOCAP: T520
- MLCC: X5R Series

Switching Frequency Selection

The switching frequency can be set by the TONSEL pin using JP1 on the EVM. The default setting is 245 kHz for CH1 and 305 kHz for CH2.

Table 2. Switching Frequency Selection

TONSEL CONNECTION	SWITCHING FREQUENCY (kHz)	
	CH1	CH2
GND (SLOW)	200	250
VREF (MED1)	245	305
VREG3 (MED2)	300	375
VREG5 (FAST)	365	460

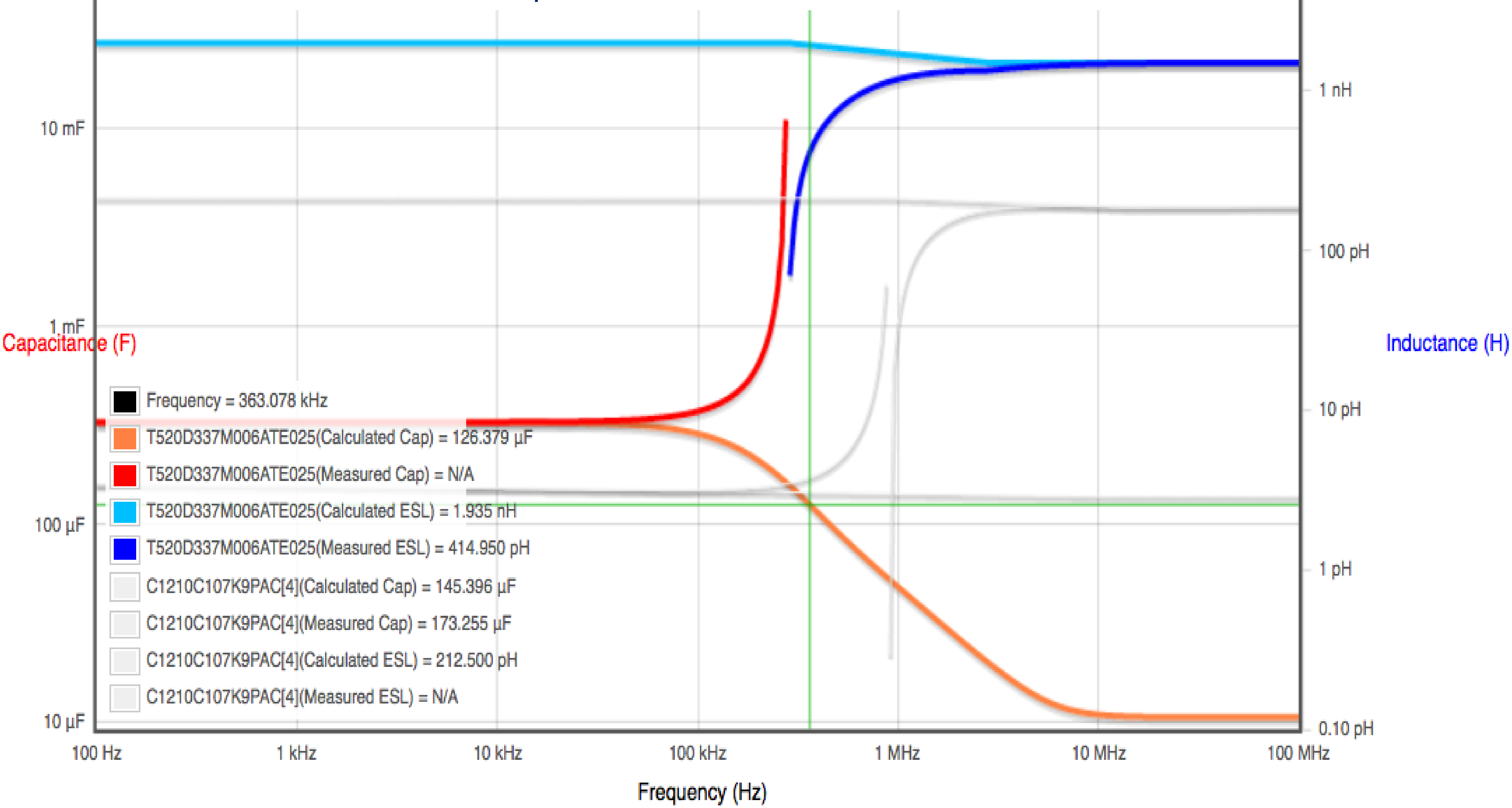
Source: http://www.ti.com/product/TPS51125

CH1: 5V/ Switch Frequency: 360KHz

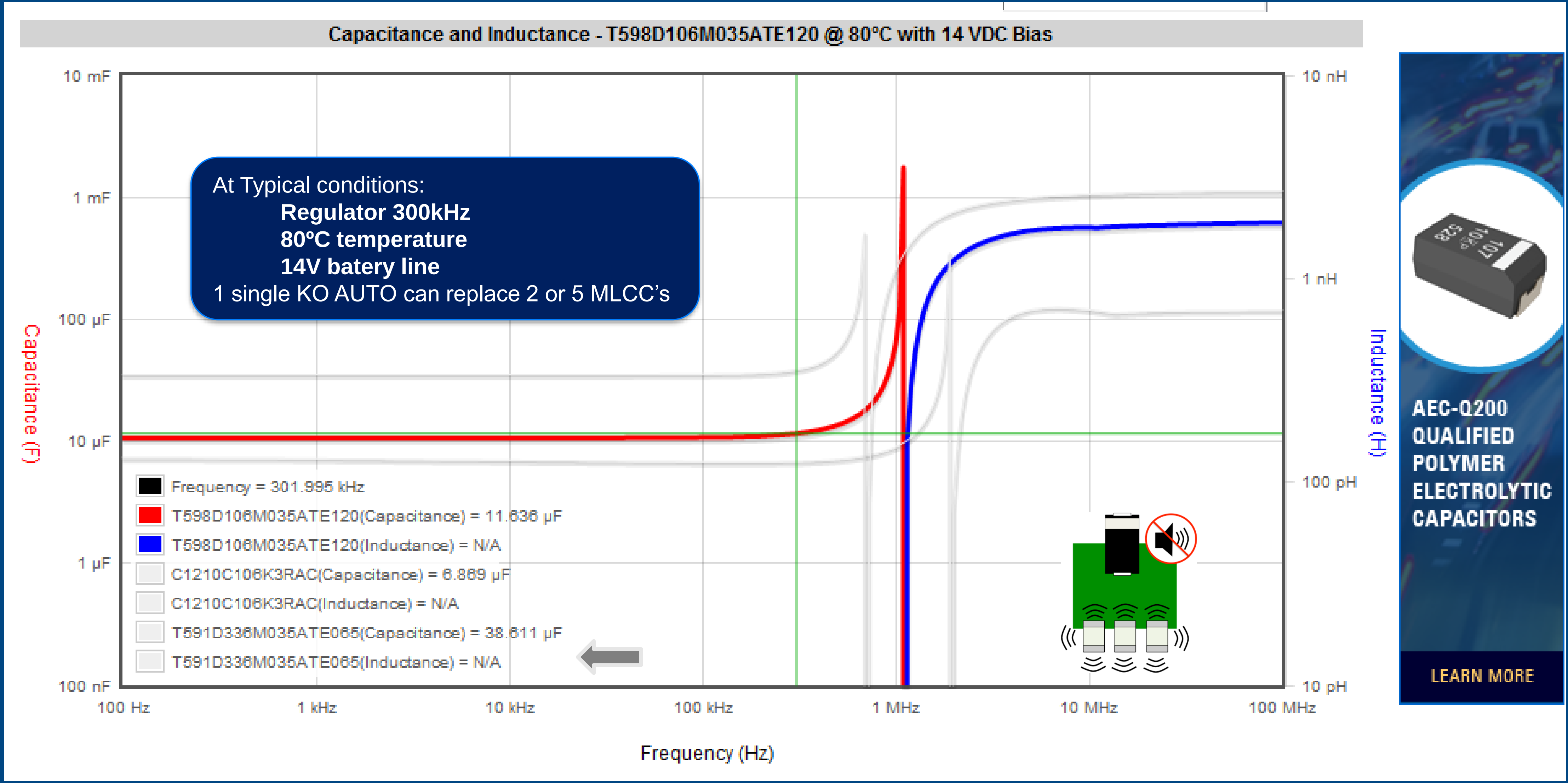
Capacitance@363KHz

KOCAP: 330uF/6.3V/E025 x 1 pcs = **126.4uF**

MLCC: 100uF/6.3V/X5R x **4** pcs = 36.3x4 = **145.3uF**



Polymer Capacitors
Cap vs Frequency (RT) – MLCC Reference

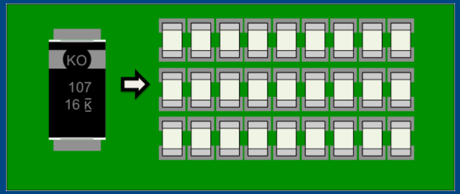


Pricing

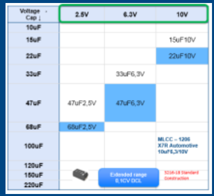
14V Rail - AUTOMOTIVE	No of Caps	Cap (μF) 300kHz	Effective Cap (μF)	ASP/1 in EUR (Octopart)	ASP/Cap Solution in EUR (Octopart)	Saving
C1210C106K3RACAUTO	2	6.89	13.7	0.5918	1.1836	
T598D106M035ATE120	1	11.6	11.6	0.8374	0.8374	0.3462 EUR / 29%

14V Rail - AUTOMOTIVE	No of Caps	Cap (μF) 300kHz	Effective Cap (μF)	ASP/1 in EUR (Octopart)	ASP/Cap Solution in EUR (Octopart)	Saving
C1210C106K3RACAUTO	5	6.89	34.5	0.5918	2.9590	
T598D336M035ATE065	1	152	38.6	0.8618	0.8618	2.0972 EUR / 71%

Ultra Small Solutions (UD)
Where Space is a concern…

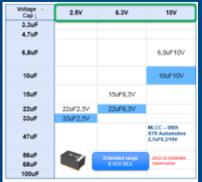


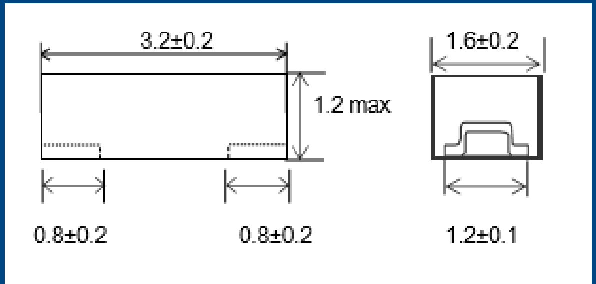
Actual
7343-31
3528-20

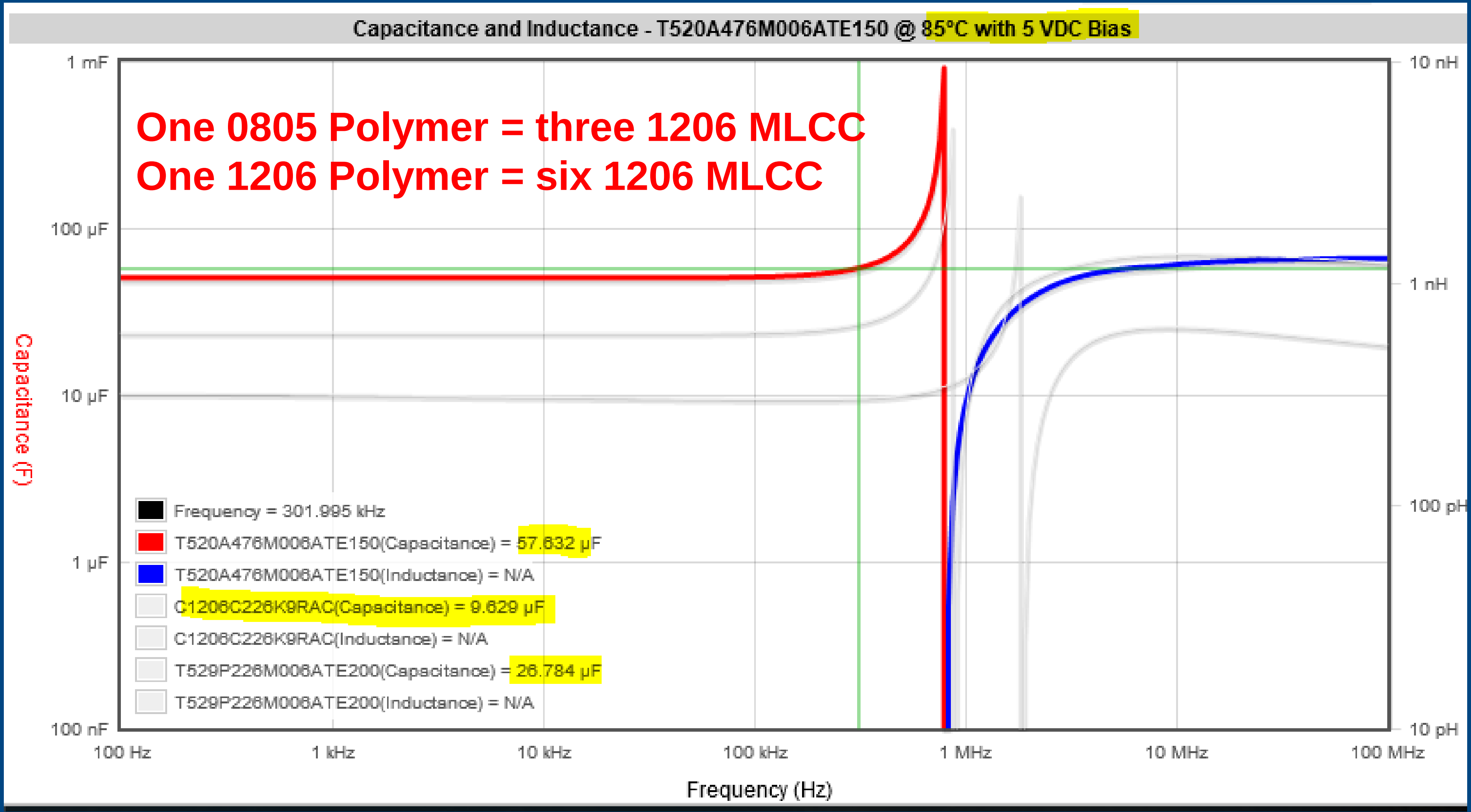


3216-12
1206
33uF6,3V
47uF6,3V
22uF10V

2012-10
0805
22uF6,3V

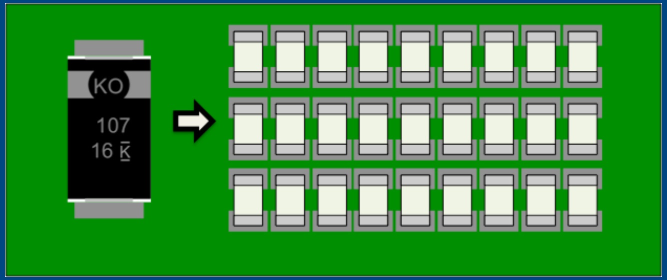






Polymer Advantages

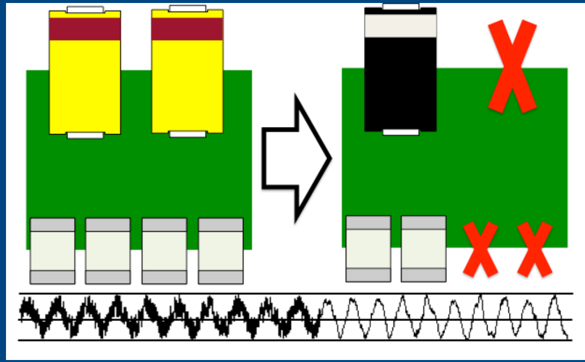
High Capacitance



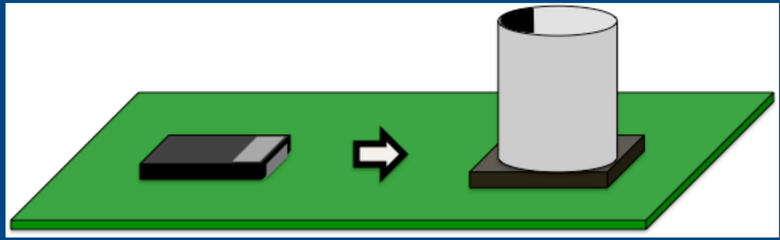
Reduce Piece Count
Miniturization
Low Profile
Humidity Capability

Low ESR

(High Cap Retention = Reduced Pc Count)

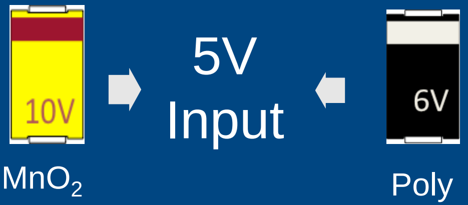


Low Profile

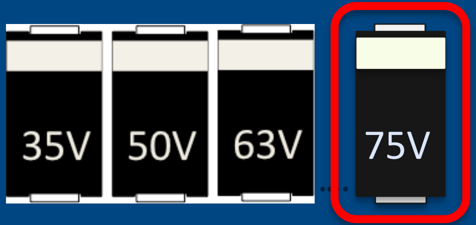


Improved Voltage Derating

MnO_2 = 50% Derating
Poly = 10-20% Derating



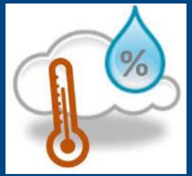
Higher Application Voltage Range



Application Voltages: 31.5V 45V 56.7V 67.5V

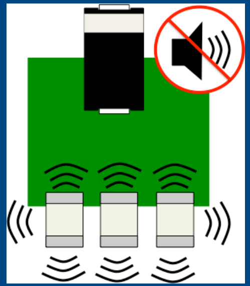
Safe Failure Mode

Temperature & Humidity Stability



85ºC/85%RH/Ur up to 1000h

Replacement MLCC Piezo Noise



MLCC to Polymer conversion: Parameters to consider (1)

- **Total NET CAPACITANCE**
  - Capacitance of 1 MLCC Capacitor under application conditions (applied voltage, frequency, aging), see also KEMET K-SIM Tool (http://ksim.kemet.com/)
  - Number of capacitors in parallel to achieve TOTAL Net capacity - Target MLCC dielectrics X5R/X7R (Class II)

- **It makes sense to consider Polymers for:**
  - **A NET CAPACITANCE** **>= 10 µF (for application voltages up to 14.4V)**
    0.68-10 µF (at application voltages of 45V and higher)
  - **Application Voltages** **up to 67.5V (60V for Harsh Conditions)**
  - **Frequencies** **up to 1MHz (higher switching frequencies contact KEMET)**

MLCC to Polymer conversion: Parameters to consider (2)

- **Application Voltage**
  - MLCC capacitors are specified at 0/1V – actual capacitance decreases with applied voltage
  - Polymer Capacitors are stable over applied voltage, but a 10/20% derating needs to be considered
- **Ripple Current Requirements**
  - Polymer capacitors can easily handle Ripple Currents up to 2 to 3 Arms (higher ripple requirements with Single Digit ESR products or stacked construction)
- **Geometry Requirements**
  - Max. PCB Board Space available
  - Max. Component Height allowance

Questions & Answers

Any Questions?

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