

EE-365

Notes on Output Capacitor Selection

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AVAILABLE CAPACITOR MODELS

Package size

- In case of ceramic SMD capacitors, choose among packages: 0805, 1206, 1210.
- In case of electrolytic, choose among radius sizes: 5 mm, 6.3 mm, 8 mm, 10 mm.

Capacitor model selection

- Datasheets for ceramic and electrolytic are available in **follow-up material** on moodle.
- Ceramic – use "*Capacitors - ceramic 6.3-250V 0402-2225.pdf*" datasheet.
- Electrolytic – use "*Capacitors - electrolytic with HF ripple rating.pdf*" datasheet.

CAPACITOR AVAILABILITY CONFIRMATION

Capacitor availability confirmation

- To be able to actually order the selected capacitor and build the converter in the second part of the course, **you must check whether it is "In stock" at Digi-Key**, the shop we will use for component ordering.
- As an example, let's suppose you are looking for the following.
 - Ceramic model.
 - 50 V rated voltage.
 - 4.7 μ F capacitance.
 - 1206 package size.
- Take a look at the "Ordering information" on page 2 of the ceramic capacitors datasheet – see 1. A similar table exists in all datasheets, and tells you how to form a component order code based on the component capacitance, rated voltage, case size etc.
- For the values we want, the order code begins with: *C1206C475K5R....*
- On Digi-Key portal, <https://www.digikey.ch/>, type partial or entire order code that you have generated from the datasheet – see 2.
- Filter the results by "In-stock" – see 3.
- Choose one of the components with *Minimum order quantity* of 1 piece – see 4.
- Make note of the unique *Digi-Key Part number*, which you will need later to create *Bill of Material (BOM)* for ordering in the end of component selection. – see 5.

CERAMIC CAPACITOR DE-RATING

Ceramic capacitor de-rating using manufacturer's resources

- For the ceramic capacitors produced by *Kemet*, found in the provided datasheets, manufacturer offers comprehensive models on the "K-SIM" platform.
- You can access the models from the direct links provided on Digi-Key, once you select a specific capacitor – see 5.
- Alternatively, you can access the tool at <http://ksim.kemet.com/>, and enter the part number.

Capacitor de-rating data from K-SIM

- De-rating for the operating frequency, i.e. actual capacitance for the operating frequency, can be read by selecting the appropriate plot in K-SIM – see 6.
- De-rating for the DC voltage bias, i.e. percentage of actual capacitance drop for the applied DC bias, can be read by selecting the appropriate plot in K-SIM – see 7.
- Capacitor ESR at the operating frequency can be read by selecting the appropriate plot in K-SIM – see 8.

Ordering Information

C	1206	C	106	M	4	R	A	C	TU
Ceramic	Case Size (L" x W")	Specification/ Series ¹	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/ Grade (C-Spec)
	0402	C = Standard	Two significant digits and number of zeros.	J = ±5% K = ±10% M = ±20%	9 = 6.3 8 = 10 4 = 16 3 = 25 6 = 35 5 = 50 1 = 100 2 = 200 A = 250	R = X7R	A = N/A	C = 100% Matte Sn	See "Packaging C-Spec Ordering Options Table"
	0603								
	0805								
	1206								
	1210								
	1808								
	1812								
	1825								
	2220								
	2225								

¹ Flexible termination option is available. Please see FT-CAP product bulletin C1013_X7R_FT-CAP_SMD.

² Additional termination finish options may be available. Contact KEMET for details.

Fig. 1: Order code composition guide in the datasheet.

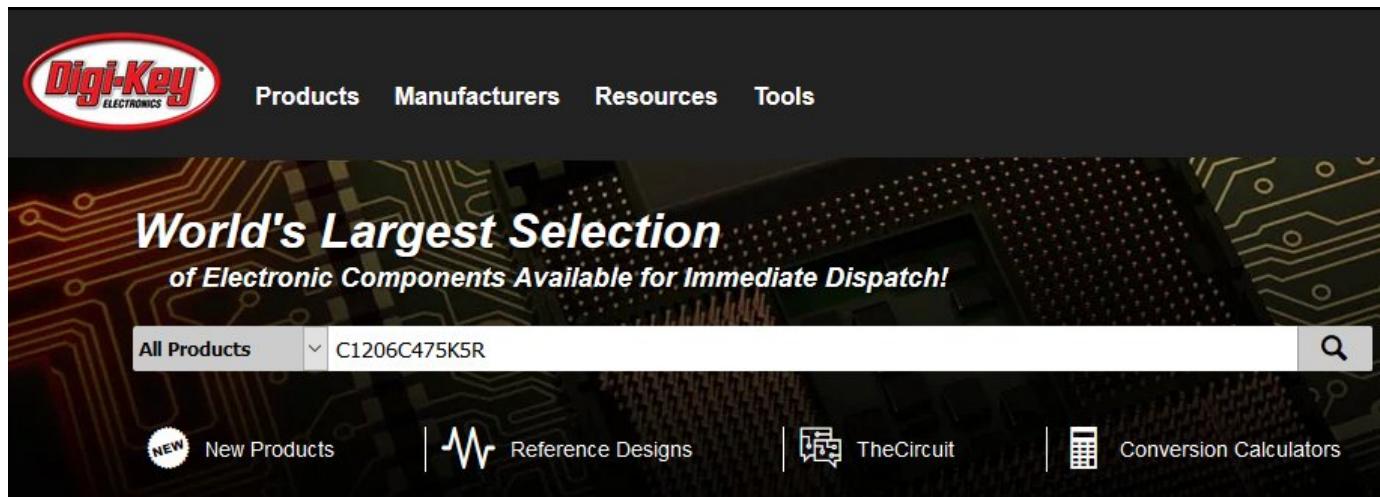


Fig. 2: Digi-Key part search.

Ceramic Capacitors

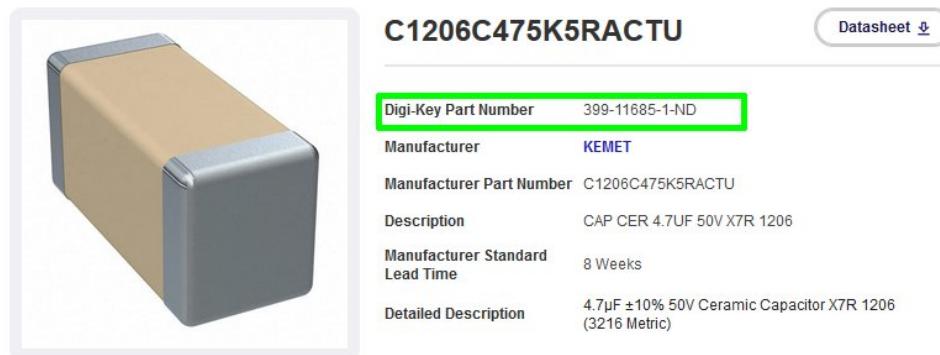
Results: 6 5 Remaining

Fig. 3: Digi-Key part search should be filtered by in-stock components.

Results per Page 25 Page 1/1

Compare Parts	Image	Digi-Key Part Number	Manufacturer Part Number	Manufacturer	Description	Quantity Available	Unit Price CHF	Minimum Quantity
<input type="checkbox"/>		399-11685-2-ND	C1206C475K5RACTU	KEMET	CAP CER 4.7UF 50V X7R 1206	180.000 - Immediate	0.09605 Fr.	2000 1
<input type="checkbox"/>		399-11685-1-ND	C1206C475K5RACTU	KEMET	CAP CER 4.7UF 50V X7R 1206	181.333 - Immediate	0.44000 Fr.	1 1
<input type="checkbox"/>		399-11685-6-ND	C1206C475K5RACTU	KEMET	CAP CER 4.7UF 50V X7R 1206	181.333 - Immediate	Digi-Reel®	1 1
<input type="checkbox"/>		399-C1206C475K5RACAUT0CT-ND	C1206C475K5RACAUT0	KEMET	CAP CER 1206 4.7UF 50V X7R 10%	671 - Immediate	0.46000 Fr.	1 1
<input type="checkbox"/>		399-C1206C475K5RACAUT0DKR-ND	C1206C475K5RACAUT0	KEMET	CAP CER 1206 4.7UF 50V X7R 10%	671 - Immediate	Digi-Reel®	1 1

Fig. 4: Among the stocked components, choose between those of minimum order quantity of 1 piece, and ignore Digi-Reel options. In this example, two options are available.



Documents & Media

Datasheets	X7R Dielectric, 6.3-250 VDC
Product Training Modules	Capacitor Basics- Typical Uses for Capacitors
Video File	Finding the Most Accurate Capacitance Measurement
Design Resources	K-SIM C1206C475K5RACTU K-SIM Simulation
Featured Product	Solutions for Energy Infrastructure
Mfg CAD Models	C1206C475K5RACTU.stp
EDA / CAD Models	C1206C475K5RACTU by SnapEDA
EDA / CAD Models	Download from Ultra Librarian

Fig. 5: Make note of the unique Digi-Key Part number, which you will need to create *Bill of Material (BOM)* for ordering in the end of component selection. For capacitor design, *Design resources* link takes you to manufacturer's model of the component.

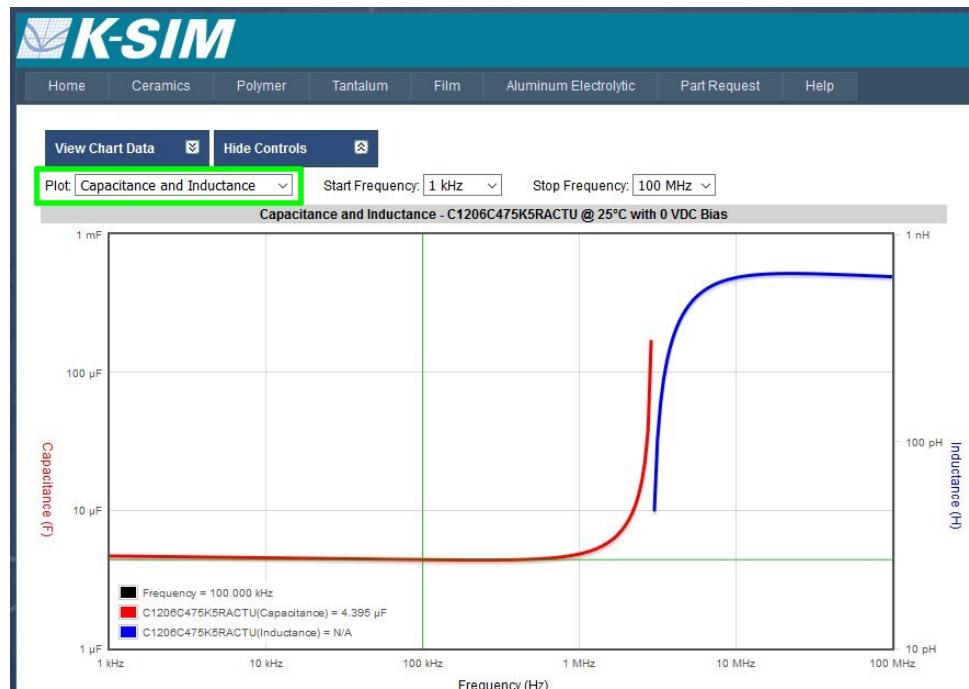


Fig. 6: Manufacturer's design resources tool – actual capacitance as the function of frequency.

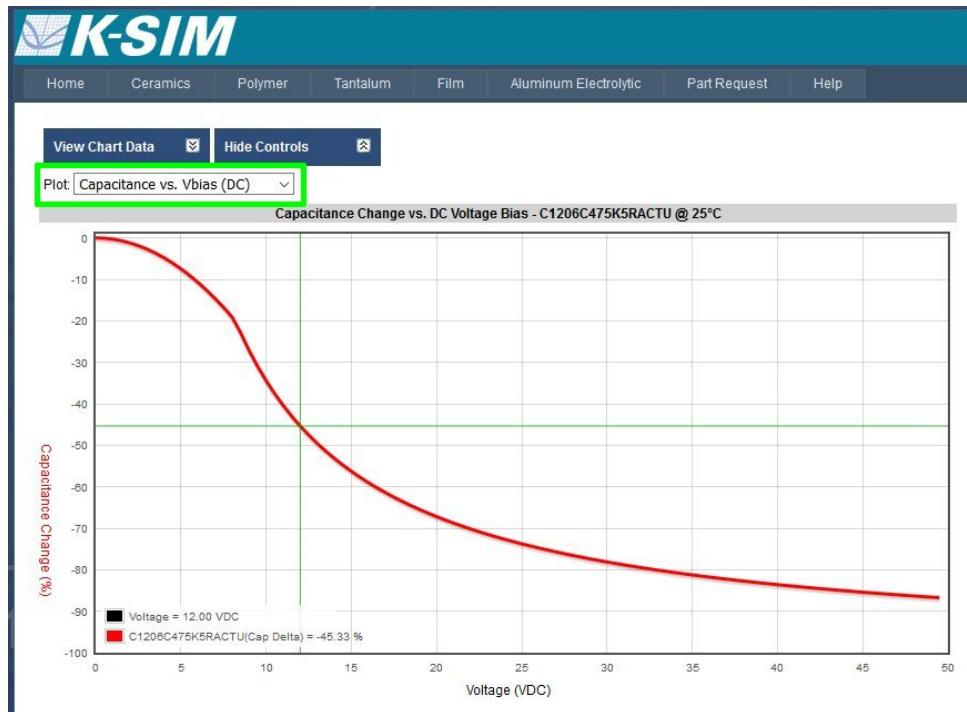


Fig. 7: Manufacurer's design resources tool – actual capacitance de-rating as the function of DC voltage bias.

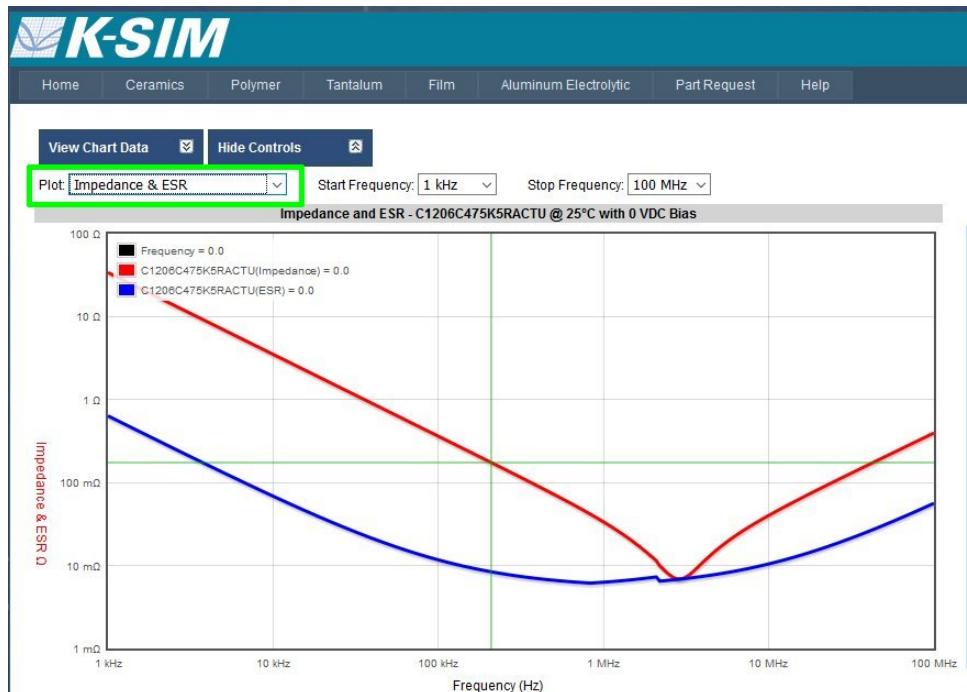


Fig. 8: Manufacurer's design resources tool – ESR as the function of frequency.