Asked 3 years, 5 months ago Active 9 months ago Viewed 3k times

3

2

I require a 3.3uf capacitor in a 30 VDC environment for three different purposes:

1. decoupling of precision ADC or DAC;
2. input to a regulator (linear, switching, LDO); and
3. output of any regulator for the purpose of ripple reduction.

I can either use an MLCC (Multi-Layer Ceramic Capacitors) or Tantalum capacitor. I know the main drawback of MLCCs compared to tantalums is that the effective capacitance is reduced by applying DC voltage to them. So I set off to find suitable capacitors with voltage ratings of 50 VDC (to be on the safe side). I'm looking for 3.3uf Tantalum and MLCC whose effective capacitance is 3.3uf @ 30VDC.

Results:

- **Tantalum:** 3.3uf 50 VDC costs about **$2.00**
- **MLCC** 10uf 50 VDC X7R dielectric with effective capacitance of 3.3uf @30VDC costs about **$0.70**

Is there any reason that I might have missed which would warrant using the pricier Tantalum instead of the MLCC for aforementioned three purposes (exclude the case where a MLCC would make a regulator unstable due to the extremely low ESR) ?

decoupling-capacitor bypass-capacitor ceramic tantalum

edited Mar 8 at 20:08
kebs
103 4

asked Jun 28 '16 at 6:32
hadez
417 5 11

3 The only reason to use tantalum is that it is free of microphonics. And sometimes older LDO's require the higher series resistance of tantalum for stability. But that can be fixed by actually adding a series resistor with a ceramic decoupling cap.\ – mkeith Jun 28 '16 at 6:49

I've been looking at the ceramic voltage vs capacitance issue lately and have been amazed at how little information I am finding in the datasheets. Where did you get the 3.3uf @30VDC figure? Do you have a reference? (not challenging your data) – Tut Jun 28 '16 at 10:50

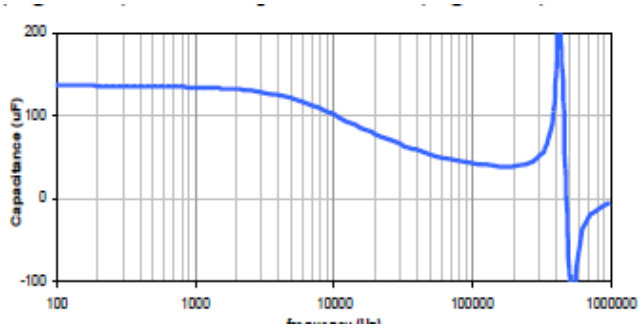
1 Answer

6

The short answer is that if you need a lot of capacitance in a small space, then tantalums (or Niobium oxide for very low voltages) become attractive.

In this case, ceramics make sense.

I do not like using dry tantalums for a number of reasons; They are prone to failure simply due to reflow even when properly derated and with a low impedance source (which is what the power supply is) they can become spectacularly pyrotechnic. In addition, they have effectively zero capacitance above perhaps 400kHz (so if you need decoupling above this frequency, tantalums are no use anyway).



There are times to use tantalums, but I only use them if I must.

In the case of low ESR causing certain regulator instabilities (primarily LDO devices and current mode bucks), I would not trust the ESR of a tantalum to save me; the manufacturer will tell you the maximum ESR, but *not the minimum*, which is just as important.

In those cases, I use a ceramic with a series resistor to guarantee the correct effective ESR across temperature.

answered Jun 28 '16 at 6:47

Peter Smith
17.6k 1 15 48

I am using this DC/DC convertor: www.minmax.com.tw/upfiles/all_/all_converter_caty01441162641.pdf It simply says use a good low ESR cap at the input (lower than 1 ohm). I don't know what series resistor to add to the MLCC if any? Do you have any suggestions? Same goes for the output where it simply states uses 3.3uf without mentioning the type of capacitor or esr. – hadez Jun 28 '16 at 7:02

2 Input capacitors with low ESR are rarely an issue, so I would simply use a ceramic and no resistor for this case. As ceramics have quite a tolerance, I would use 4.7uF to guarantee 3.3uF across all temperatures rated at 2*Vin. – Peter Smith Jun 28 '16 at 7:44