



MCU crystal capacitor selection

Asked 10 years, 9 months ago Modified 2 years, 1 month ago Viewed 3k times

I will be using the [AT32UC3C2512C](#), the [AVR32768 Application note](#) recommends 22pF capacitors for crystals up to 16MHz...I will be using a 20MHz crystal, should I choose a 22pF or a 15pF loading capacitor?

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EDIT:

As requested:

20MHz: [7B-20.000MEEQ-T](#)

16MHz: [ABM3B-16.000MHZ-10-1-U-T](#)

microcontroller

capacitor

avr

crystal

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edited Mar 27, 2020 at 1:09



Community Bot

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asked Aug 25, 2013 at 2:18



mFeinstein

4,333 13 47 85

can you please share the datasheets of the crystals, you are going to use, usually loading capacitor values are specified in datasheet, check this [electronics.stackexchange.com/questions/75704/...](#) – AKR Aug 25, 2013 at 3:24

Yes, I have all the values, but the formula in the MCU datasheet asks for the PCB capacitance also..which I have no clue... – mFeinstein Aug 25, 2013 at 3:30

The datasheet specifies the load cap to be 18pf for the ABM3B crystal – AKR Aug 25, 2013 at 3:38

Related/similar: [electronics.stackexchange.com/q/7807/2028](#) and [electronics.stackexchange.com/q/39103/2028](#) – JYelton Aug 25, 2013 at 4:00

Also [electronics.stackexchange.com/q/14532/2028](#) – JYelton Aug 25, 2013 at 4:09

2 Answers

Sorted by: Highest score (default)



A section on crystal oscillator characteristics is on page 1255 of the [AT32UC3C series datasheet](#) (*complete* as opposed to *summary*).

11

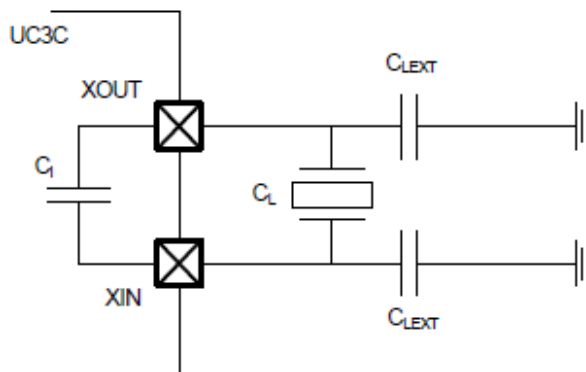


The following table describes the characteristics for the oscillator when a crystal is connected between XIN and XOUT as shown in Figure 40-2. The user must choose a crystal oscillator where the crystal load capacitance C_L is within the range given in the table. The exact value of C_L can be found in the crystal datasheet. The capacitance of the external capacitors (C_{LEXT}) can then be computed as follows:

$$C_{LEXT} = 2(C_L - C_I) - C_{PCB}$$

where C_{PCB} is the capacitance of the PCB and C_I is the internal equivalent load capacitance.

Figure 40-2. Oscillator Connection



The value of C_{LEXT} is based on the formula:

$$2(C_L - C_I) - C_{PCB}$$

The 20MHz crystal you selected, for example, has a 10pF load capacitance (C_L), denoted by the "Q" near the end of its part number (See the [part numbering reference](#)). The internal equivalent load capacitance (C_I) is 1.7 pF (per page 1256 of the AT32UC3C datasheet). This leaves just the PCB (stray) capacitance (C_{PCB}) to be determined. That can get complicated, so we'll use a "[rule of thumb](#)" of 5pF.

$$2(10 - 1.7) - 5 = 11.6pF$$

For more information see:

- Microchip: [Best Practices for PCB layout of oscillators](#)
- NXP: [Microcontroller Oscillator Circuit Design Considerations](#)

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edited May 2, 2022 at 16:13

answered Aug 25, 2013 at 4:19



JYelton

34.2k ● 34 ● 145 ● 266

A difference from 15pF to 11.6pF wont matter much right? – [mFeinstein](#) Aug 25, 2013 at 4:22

Possibly not. The stray capacitance of your board may vary by at least that amount, so you may just have to experiment. I think the Freescale document is most helpful for understanding/determining stray capacitance, but as I mentioned, it's complicated. – [JYelton](#) Aug 25, 2013 at 4:25

what are the results of a bad capacitor selection? Just inaccurate clock frequency or something else like no clock at all or erratic behaviour? – [mFeinstein](#) Aug 25, 2013 at 4:29

Frequency instability mostly, but no clock can also happen (the crystal will fail to resonate). – [JYelton](#) Aug 25, 2013 at 4:33

- 1 Based on the math and the crystal's load capacitance, I'd use 10pF. But don't quote me on that, especially if you order up a thousand production units based on this. :) – [JYelton](#) Aug 25, 2013 at 4:56
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If you are going to do this for a prototype don't even bother looking it up, either one will work.

If it's for production take a deeper look at the AT32UC3C2512C datasheet.



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answered Aug 25, 2013 at 2:24



[arthur.b](#)

381 ● 1 ● 4



I already took a deep look...can't find a straight answer there...only if I know the PCB capacitance..which I dont.. – [mFeinstein](#) Aug 25, 2013 at 2:59
