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Data Acquisition and Storage Solutions for Industry and Science

Discussion Topics: CF2, RTC, better accuracy
Date: February 2007 (revised 2-19-09)

Question

Can you discuss the interaction of the 68332 and the MSP430 in maintaining the real time clock on the CF2? What is the accuracy of the real time clock? How can I improve it?

Discussion (Theory of operation is true since PicoDOS 2.28r1 (2003))

The CF2 uses a Citizen CM250S40.000KAZFT 40kHz crystal

http://www.citizencrystal.com/images/pdf/ks-cm200s.pdf

connected to the XIN/XOUT pins of the MSP430F123 supervisor which acts as a low-power oscillator and feeds the buffered 40kHz square wave to the 68332 EXTAL and T2CLK inputs. The crystal itself has the typical parabolic temperature curve associated with flexure mode resonators with specifications of:

Frequency tolerance:	+/-30ppm at 25 Deg C
Temperature coefficient:	-0.04ppm/Deg C^2
Aging(first year):	+/5ppm max

The CF2 specifications on page 21 of the Getting Started Guide are more conservative. We call out and screen for +/-100ppm at 25 Deg C in case of possible procurement problems associated with close tolerance crystals with lower-popularity frequency and industrial temperature range operation. As of this writing, all CF2s have been built with the Citizen parts.

The CF2 uses a dual RTC system. The MSP430 maintains the master CF2 real time clock, generated from its oscillator using the 40KHz crystal. The MSP430 also buffers and outputs that 40KHz to the 68332 EXTAL input which clocks the PIT and the phase-lock loop clock generator that produces the high speed clocks. TPU channel 0 is reserved by PicoDOS as a local real time clock (TLC) for fast time access. The TLC stops during reset, suspend or LPStop and is automatically synchronized to the master MSP430 RTC on the first subsequent time reference. Due to this design, drift of the crystal affects all the CF2 operations equally. PIT chores will stay relative to the CF2 time. There is a tiny bit of jitter introduced by the 68332 PLL generator stepping the 40KHz up to the system clock frequency, but it is not a cumulative error and it is still synchronized with the 40KHZ time base.

The 40KHz crystal CAN NOT be replaced by a 32.768KHz crystal.

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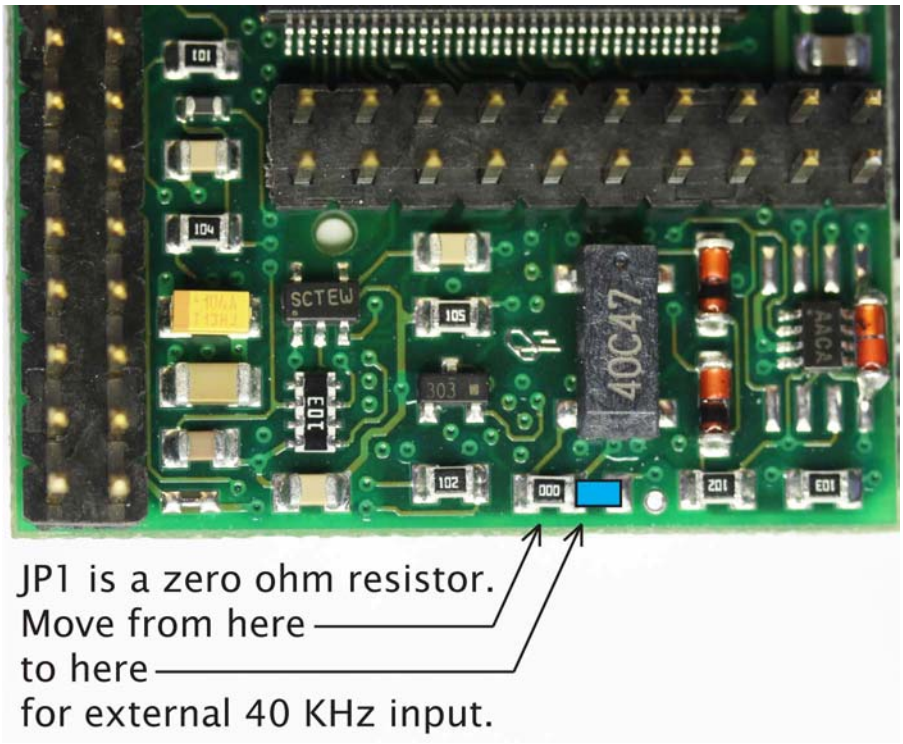
An external oscillator can be used to produce better time accuracy. For the CF2 to run you will need to feed in a 40KHz 0 to VBAK square wave. To keep the RTC running when power is removed and during suspend, you will have to continuously provide the 40kHz signal.

JP1 (U7 in the Getting Started Guide Block Diagram), is a surface mount zero-ohm resistor. It has to be de-soldered and moved to connect your external clock to the MSP430 and disconnect the onboard crystal. This disconnects the 40kHz crystal from the circuit and provide a path to the MSP430 XIN input from CLKIN pin B20 of the DATA connector.



We have used a MAXIM DS4000 +/- 1PPM TCXO oscillator with success but, as of this writing, it appears that Maxim has stopped sourcing the part. You may be able to acquire this part from a broker of excess inventory. The Maxim DS4026 +/- 1PPM 3.3 volt 10MHz TCXO oscillator appears to be a similar part but we have not studied the data sheet or used the part. In either case, the frequency of the TCXO would have to be divided down to the 40KHz necessary for proper operation of the CF2.