ZC702 Si570 Programming

June 2014

XTP181

Revision History

Date	Version	Description
06/09/14	10.0	Recompiled for 2014.2.
04/16/14	9.0	Recompiled for 2014.1.
12/18/13	8.0	Recompiled for 2013.4.
10/23/13	7.0	Recompiled for 2013.3.
06/19/13	6.0	Recompiled for Vivado 2013.2.
06/18/13	5.2	Minor Update.
04/16/13	5.1	Added AR54225.
04/03/13	5.0	Recompiled for 14.5.
12/18/12	4.0	Recompiled for 14.4.
10/23/12	3.0	Recompiled for 14.3. Added AR52580.
07/25/12	2.0	Recompiled for 14.2. Added AR47530.
05/25/12	1.0	Initial version for 14.1.

ZC702 Si570 Programming Overview

- Xilinx ZC702 Board
- Software Requirements
- Setup for the ZC702 Si570 Programming
- Programming the Si570
- Calibrating the Frequency
- References

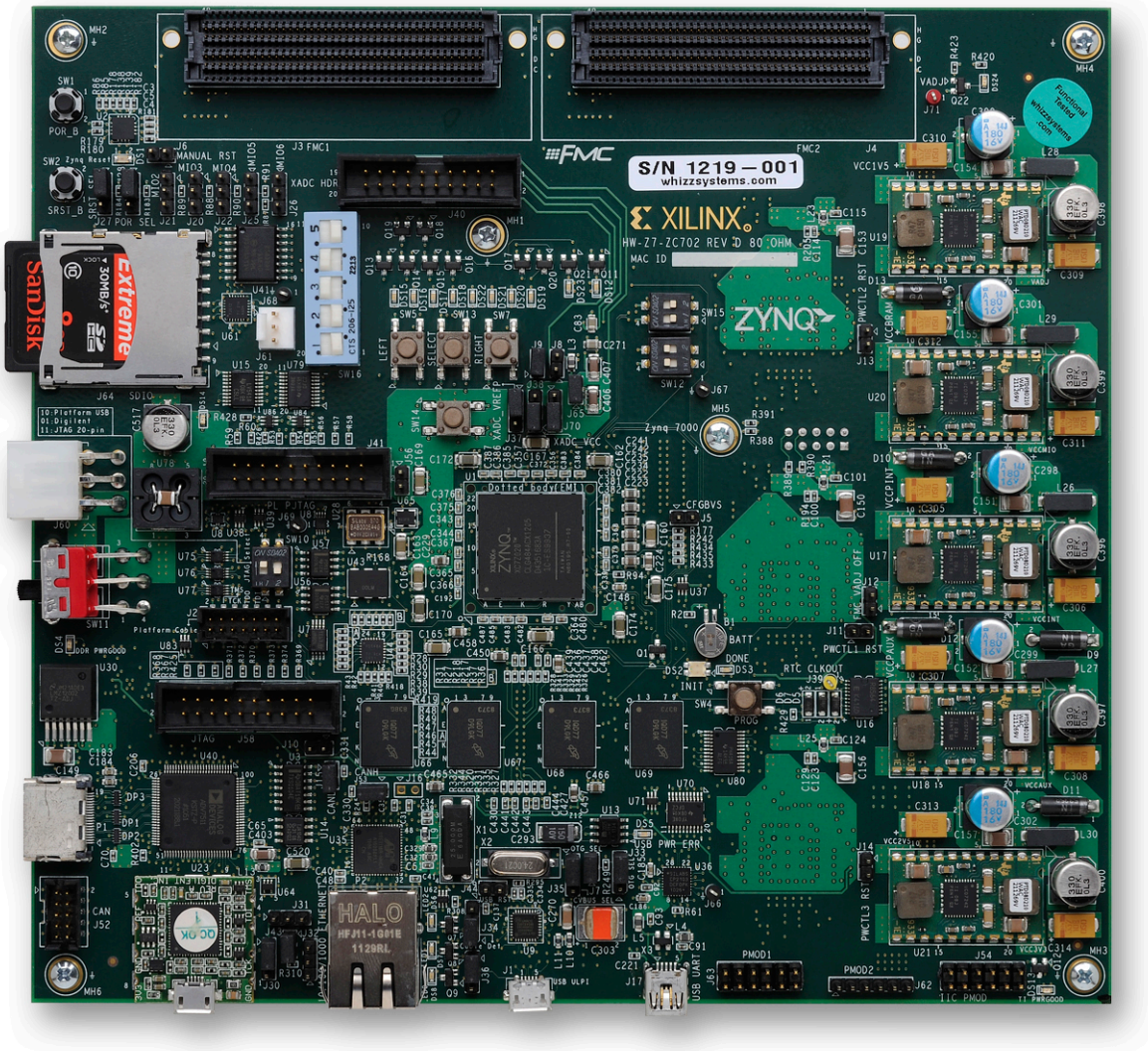
Note: This presentation applies to the ZC702

ZC702 Si570 Programming Overview

- **Description**
  - The ZC702 board has a Silicon Labs Si570 Programmable Oscillator that defaults to 156.25 MHz. Via the IIC bus, the frequency of this device can be changed. This tutorial shows how to change the output frequency of this device.

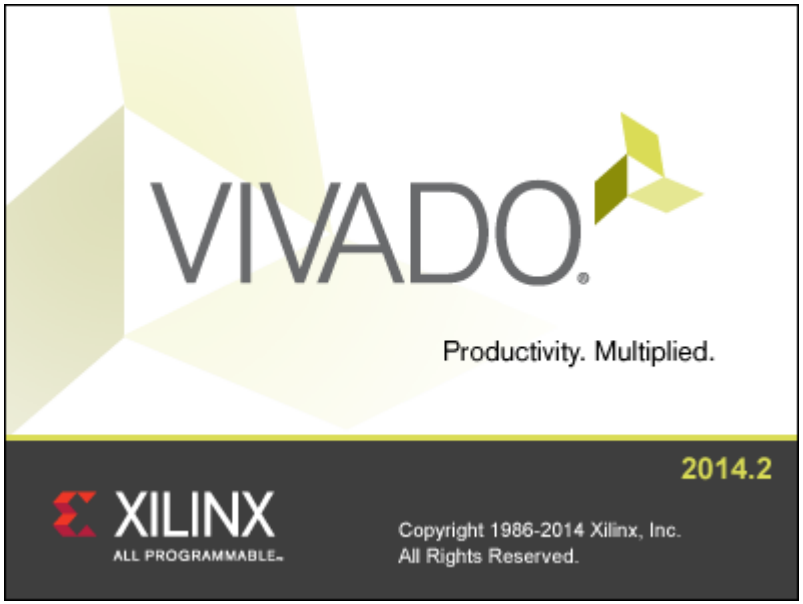
Note: Presentation applies to the ZC702

Xilinx ZC702 Board



Vivado Software Requirements

- **Xilinx Vivado Design Suite 2014.2, Design Edition + SDK**
  - Combined installer



Note: Presentation applies to the ZC702

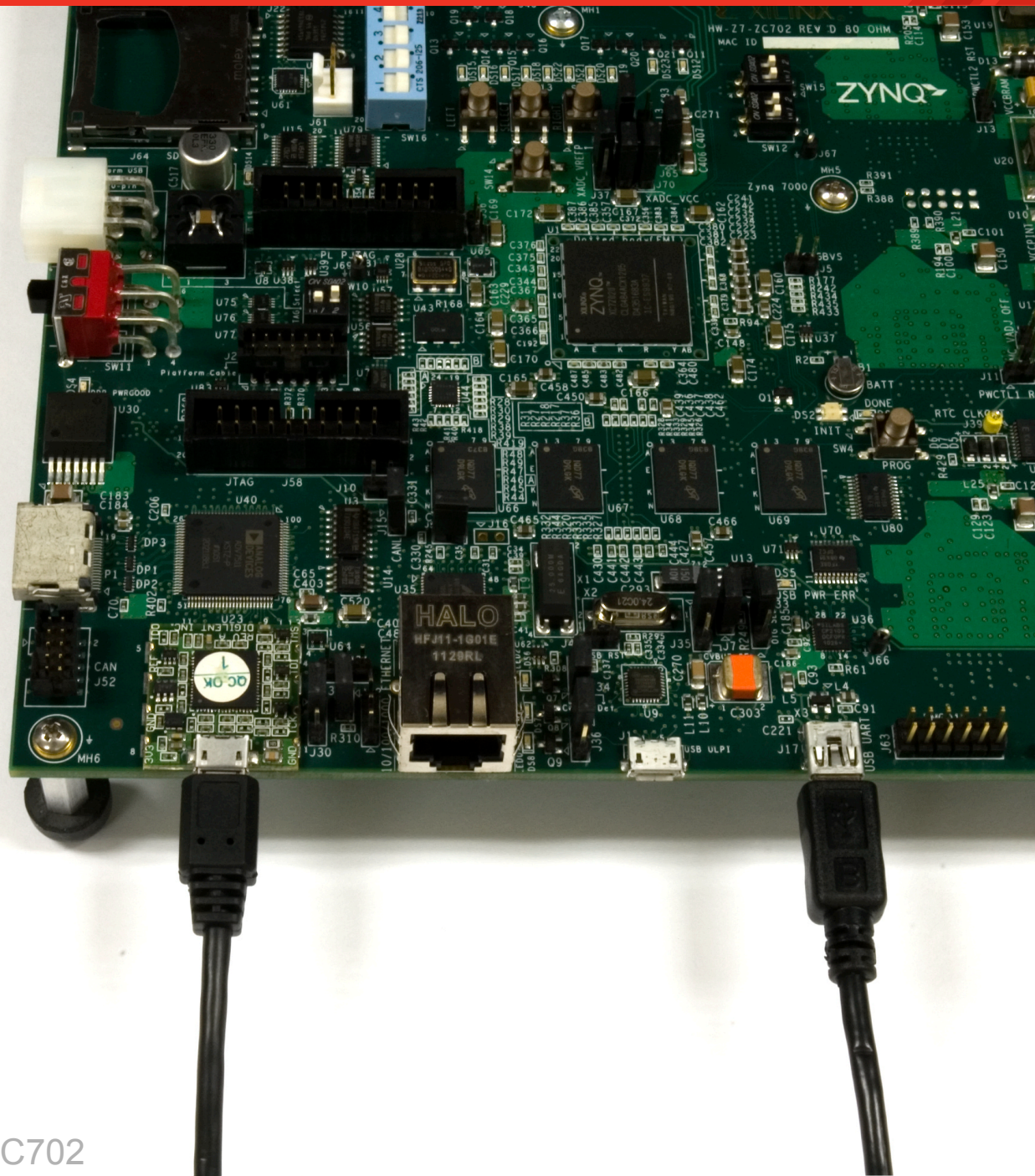
ZC702 Setup

- **Connect a USB Type-A to Micro-B cable to the USB JTAG (Digilent) connector on the ZC702 board**
  - Connect this cable to your PC
  - Set the JTAG Select Switch, SW10, to **01**
  - If using a Platform Cable USB (II) JTAG Cable, set SW10 to **10**

Note: Presentation applies to the ZC702

ZC702 Setup

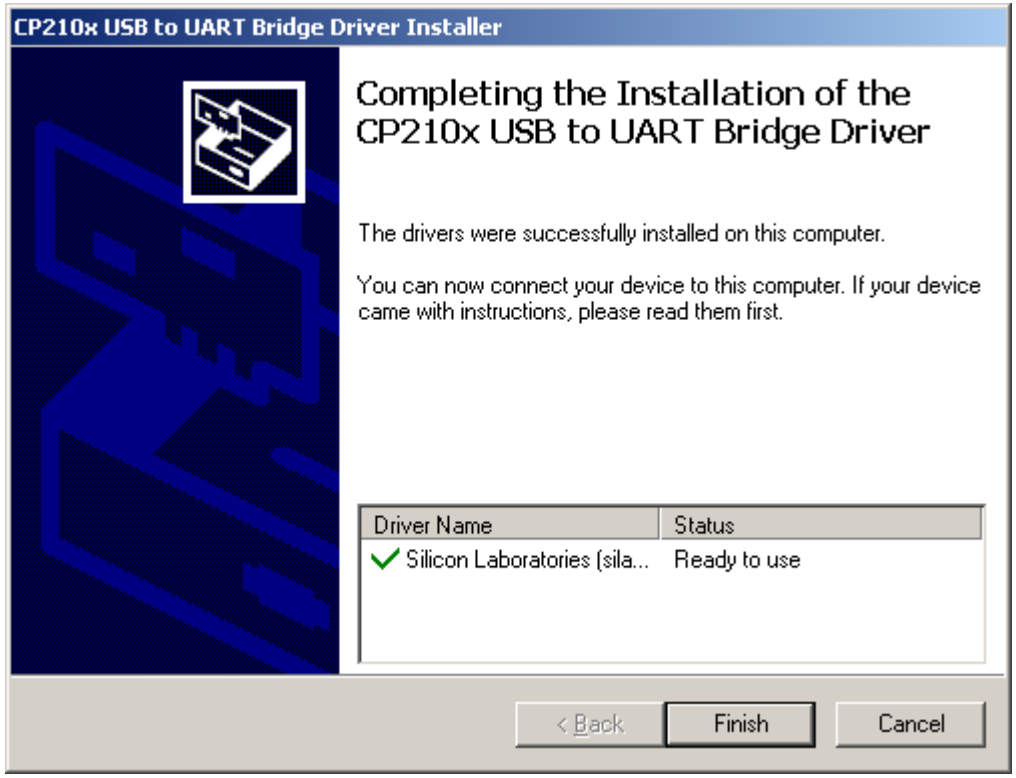
- **Connect a USB Type-A to Mini-B cable to the USB UART connector on the ZC702 board**
  - Connect this cable to your PC
  - Power on the ZC702 board for UART Drivers Installation



Note: Presentation applies to the ZC702

ZC702 Setup

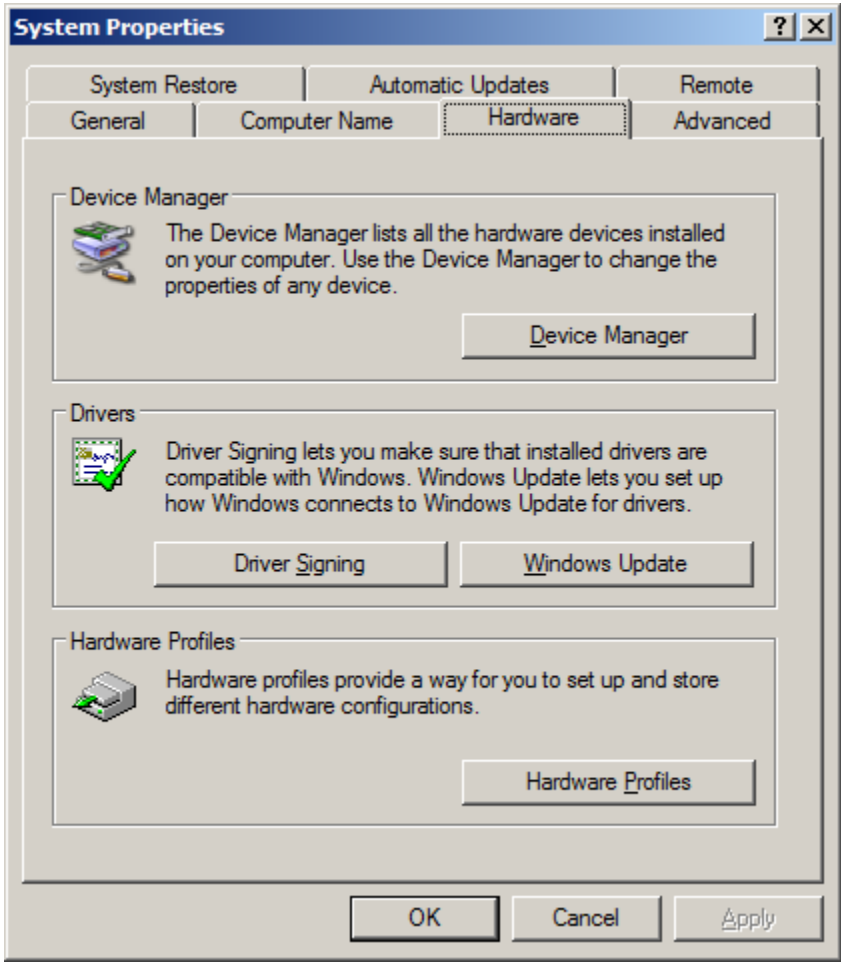
- **Install USB UART Drivers**
  - Refer to UG1033 for details on installing the USB to UART Drivers



Note: Presentation applies to the ZC702

ZC702 Setup

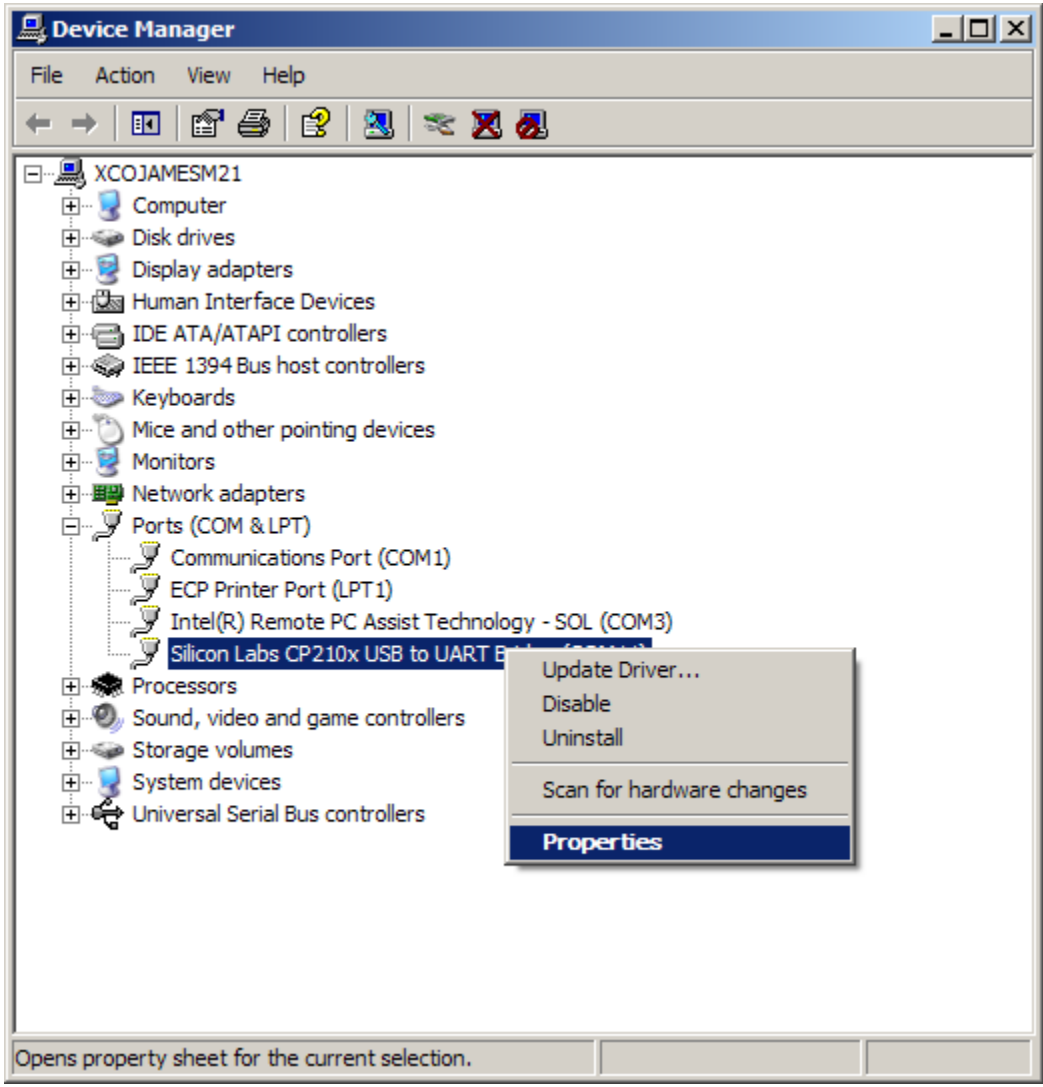
- Reboot your PC if necessary
- Right-click on My Computer and select Properties
  - Select the Hardware tab
  - Click on Device Manager



Note: Presentation applies to the ZC702

ZC702 Setup

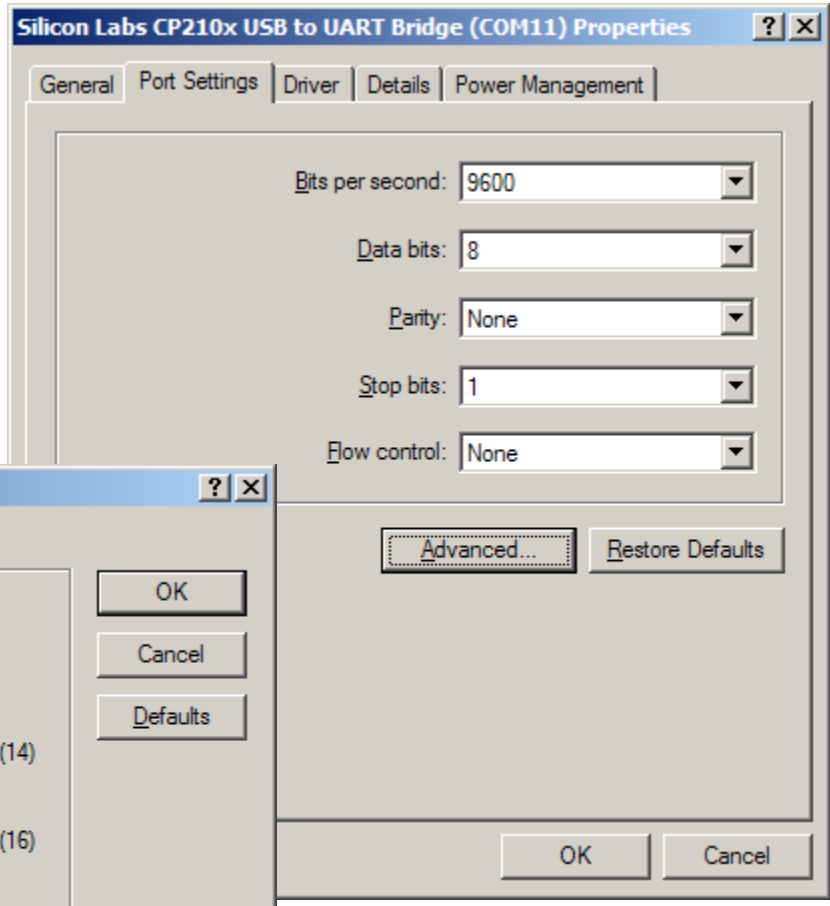
- **Expand the Ports Hardware**
  - Right-click on **Silicon Labs CP210x USB to UART Bridge** and select Properties

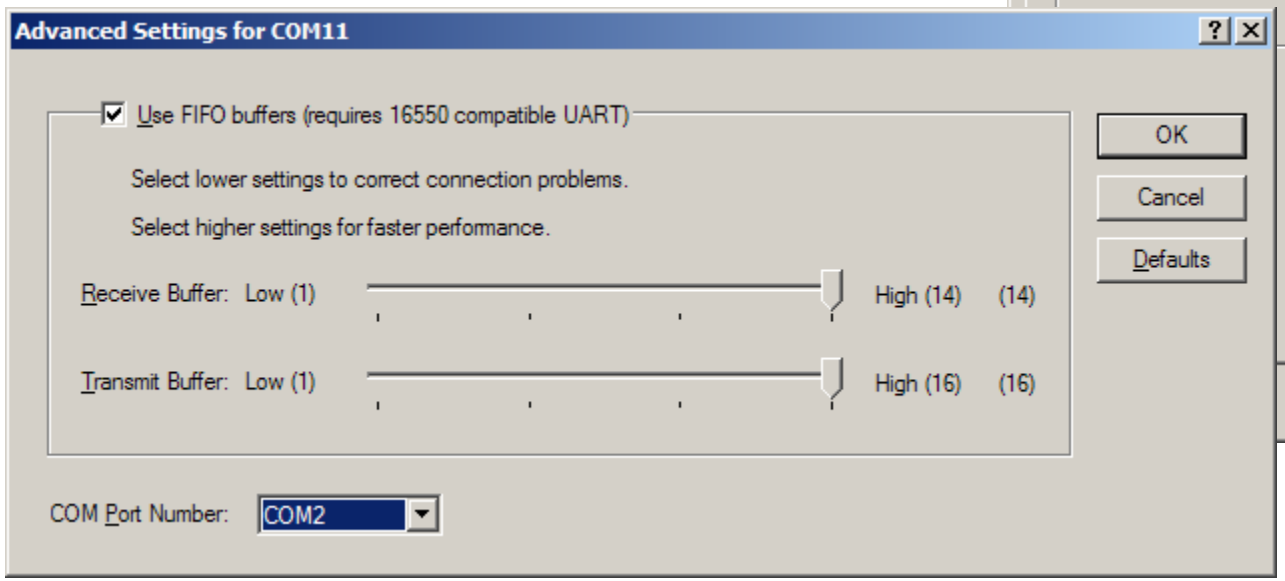


Note: Presentation applies to the ZC702

ZC702 Setup

- **Under Port Settings tab**
  - Click Advanced
  - Set the COM Port to an open Com Port setting from COM1 to COM4

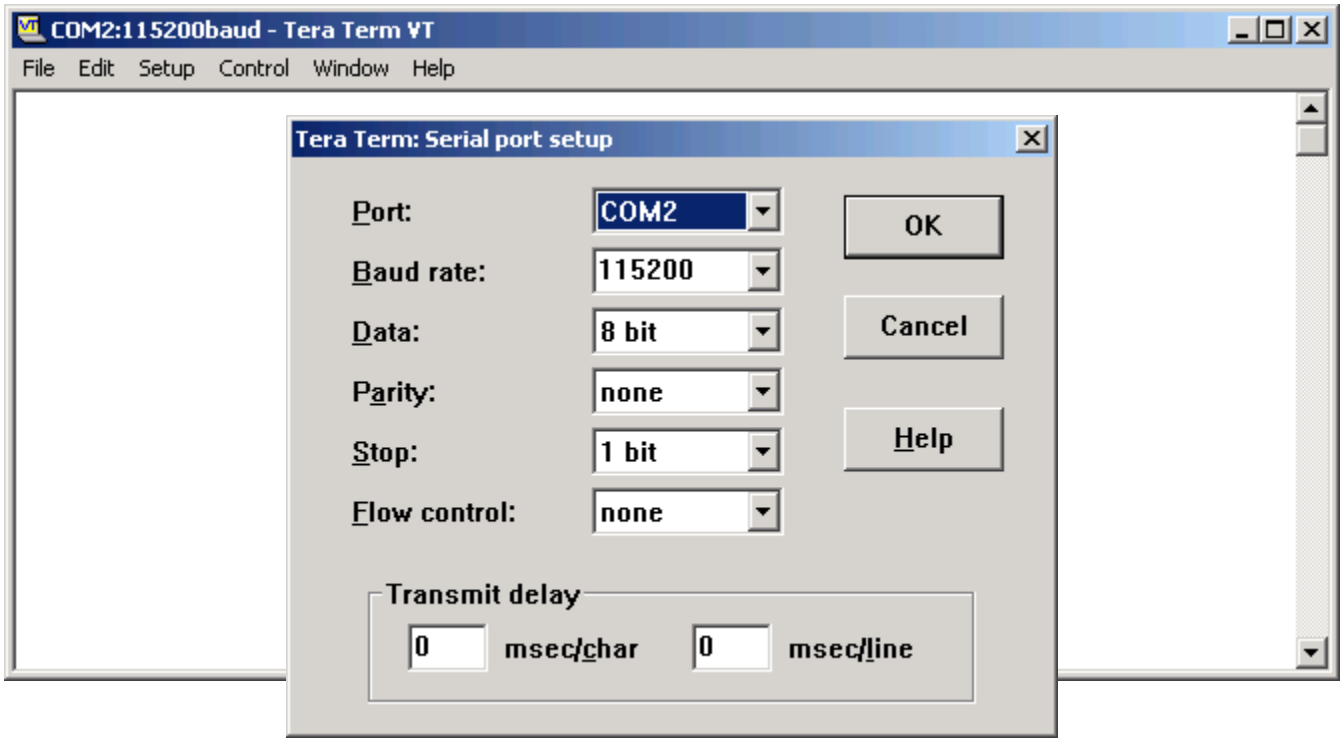




Note: Presentation applies to the ZC702

ZC702 Setup

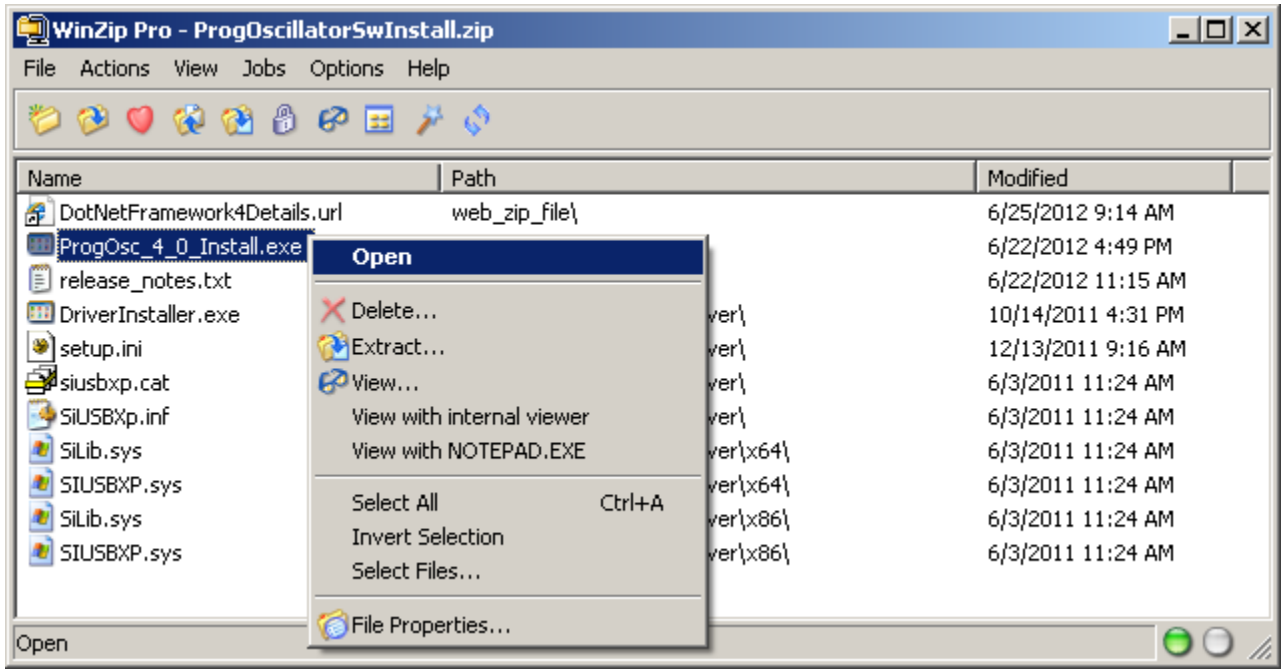
- Refer to UG1036 regarding Tera Term installation
- Board Power must be on before starting Tera Term
- Start the Terminal Program
  - Select your USB Com Port
  - Set the baud to **115200**



Note: Presentation applies to the ZC702

Si Labs Programmable Oscillator Calculator

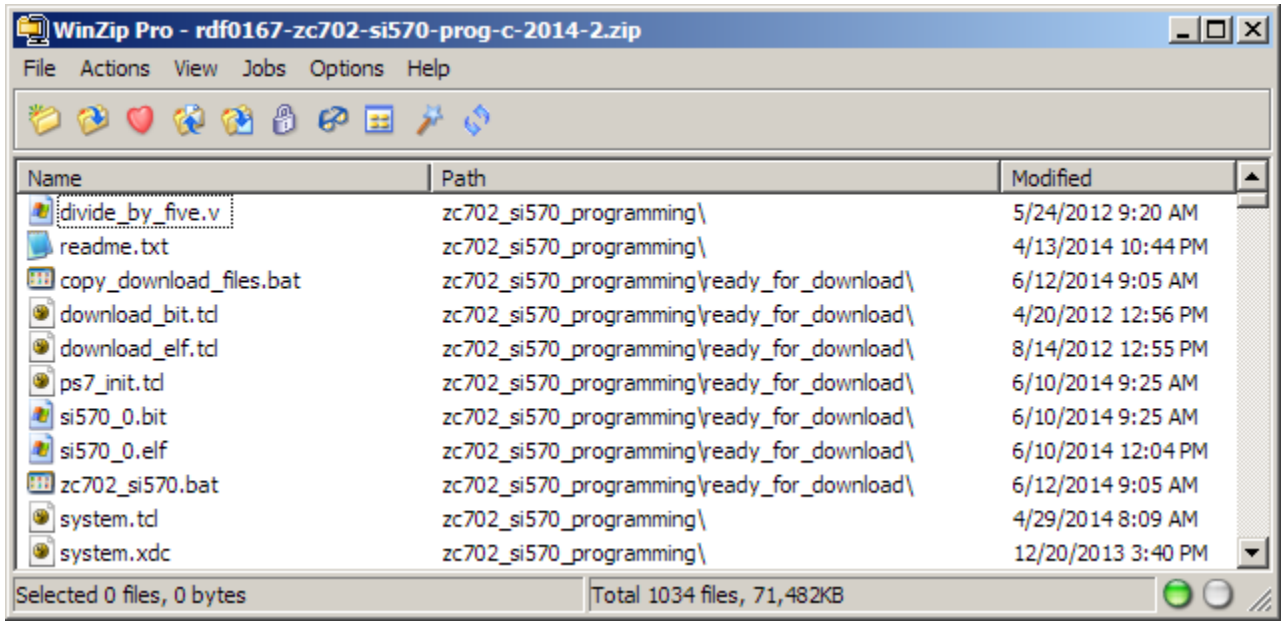
- **Download** ProgOscillatorSwInstall.zip
  - Install "**ProgOsc_4_0_Install.exe**" only



Note: Presentation applies to the ZC702

Setup for ZC702 Si570 Programming

- **Unzip the ZC702 Si570 Programming Design Files (2014.2 C) to your C:\ drive**
  - Available through http://www.xilinx.com/zc702
  - It is recommended to unzip these design files to **C:** for SDK compatibility



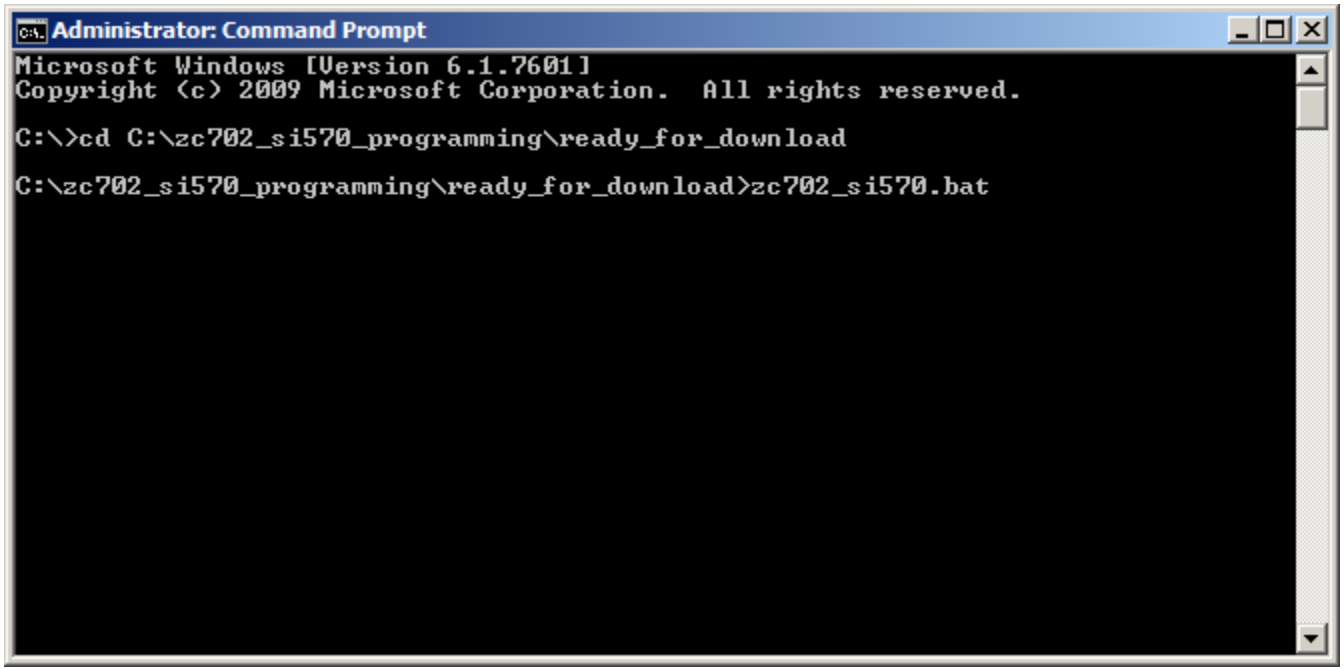
Note: Presentation applies to the ZC702

ZC702 Si570 Programming

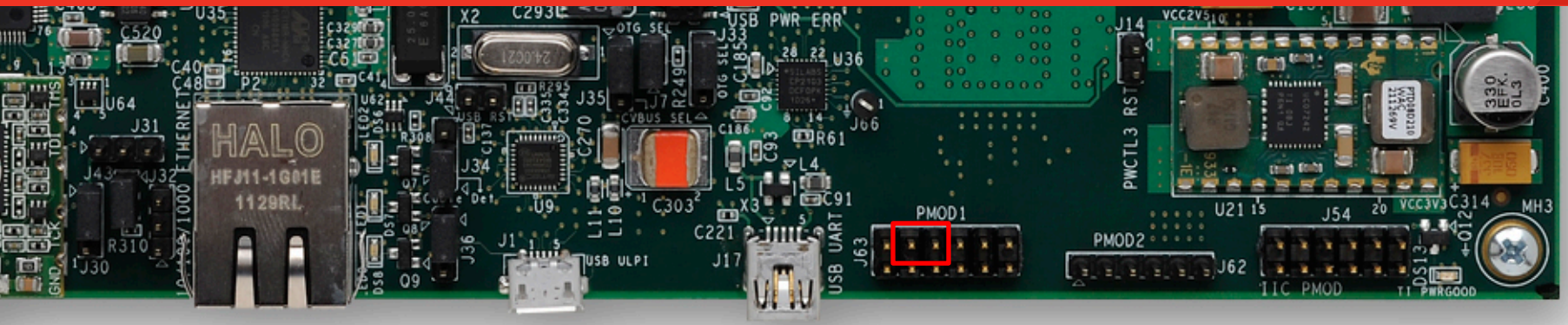
- Download the Si570 bitstream and ELF files
- In a Windows CMD prompt type:

  cd C:\zc702_si570_programming\ready_for_download

  zc702_si570.bat



Note: AR47530 has been applied to the download script



ZC702 Si570 Programming

- Connect a scope to J63 (PMOD1), pins 4 and 6 to measure the frequency
- Si570 Power on frequency is 156.25 MHz
- Frequency is divided by 10 in the Zynq PL
- Measured frequency on these two pins will be ~15.625 MHz

Note: Presentation applies to the ZC702

ZC702 Si570 Programming

- **For this example, Si570_0 will be reprogrammed from 156.25 to 200 MHz**
  - This requires use of the SiLabs Programmable Oscillator Calculator
- **To use the SiLabs calculator, the correct fXTAL value for each Si570 must be determined, using this equation:**

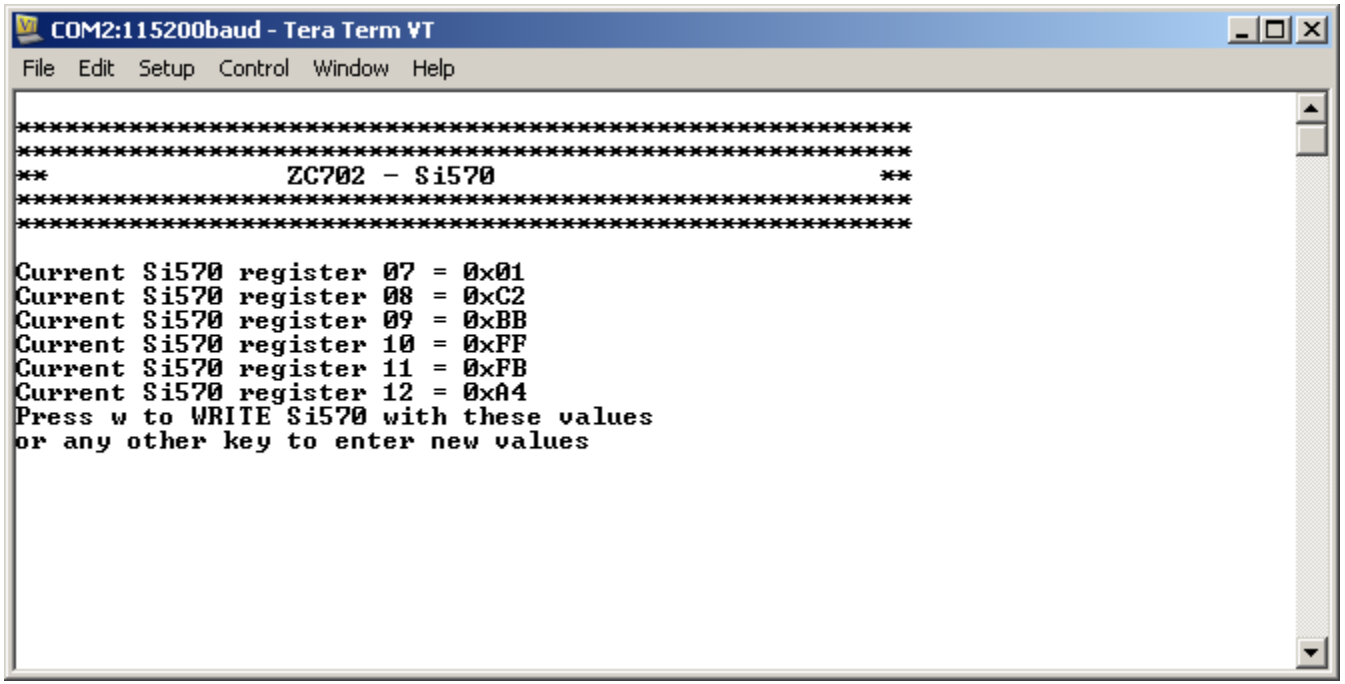
$$f_{XTAL} = \frac{F_{out} \times HSDIV \times N1}{RFREQ}$$

- **For this equation,**
  - Fout = 156.25, the preprogrammed frequency of the Si570s on the ZC702
- **We need to determine:**
  - RFREQ
  - HSDIV
  - N1
- **These can be found by reading back the registers on the Si570**

Note: Presentation applies to the ZC702

ZC702 Si570 Programming

- **The terminal window shows the current register settings for the Si570**
  - The power-on values will appear in the terminal window
  - Note the value of **0x01C2BBFFFBA4**



Note: The values reported by your Si570 may differ from those shown

ZC702 Si570 Programming

- **The value, 0x01C2BBFFFBA4, corresponds to the contents of the Si570's registers, 7 to 12:**

Register	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
7	High Speed/ N1 Dividers	HS_DIV[2:0]			N1[6:2]				
8	Reference Frequency	N1[1:0]			RFREQ[37:32]				
9	Reference Frequency	RFREQ[31:24]							
10	Reference Frequency	RFREQ[23:16]							
11	Reference Frequency	RFREQ[15:8]							
12	Reference Frequency	RFREQ[7:0]							

Note: Presentation applies to the ZC702

ZC702 Si570 Programming

- Extract the HS_DIV and N1 values from 0x01C2BBFFFBA4 :
- HS_DIV = 0b000 which corresponds to “4”
- N1 = 0b0000111 which corresponds to “8”

Bit	D7	D6	D5	D4	D3	D2	D1	D0
Name	HS_DIV[2:0]			N1[6:2]				
Type	R/W			R/W				

Bit	Name	Function
7:5	HS_DIV[2:0]	**DCO High Speed Divider.** Sets value for high speed divider that takes the DCO output f_{OSC} as its clock input. 000 = 4 001 = 5 010 = 6 011 = 7 100 = Not used. 101 = 9 110 = Not used. 111 = 11
4:0	N1[6:2]	**CLKOUT Output Divider.** Sets value for CLKOUT output divider. Allowed values are [1] and [2, 4, 6, ..., 2^7]. Illegal odd divider values will be rounded up to the nearest even value. The value for the N1 register can be calculated by taking the divider ratio minus one. For example, to divide by 10, write 0001001 (9 decimal) to the N1 registers. 0000000 = 1 1111111 = 2^7

Note: Presentation applies to the ZC702

ZC702 Si570 Programming

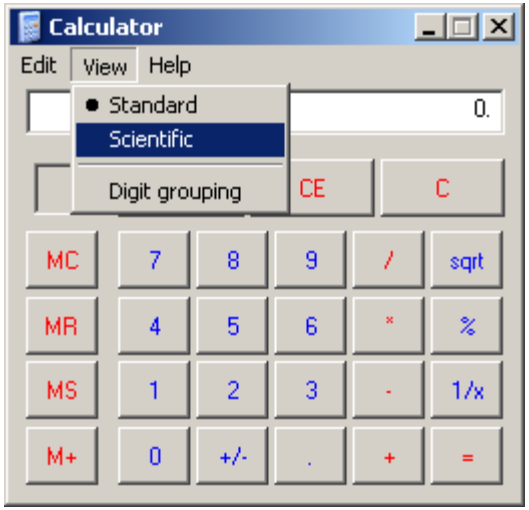
- Extract the RFREQ value from 0x01C2BBFFFBA4 :
  - 02BBFFFBA4

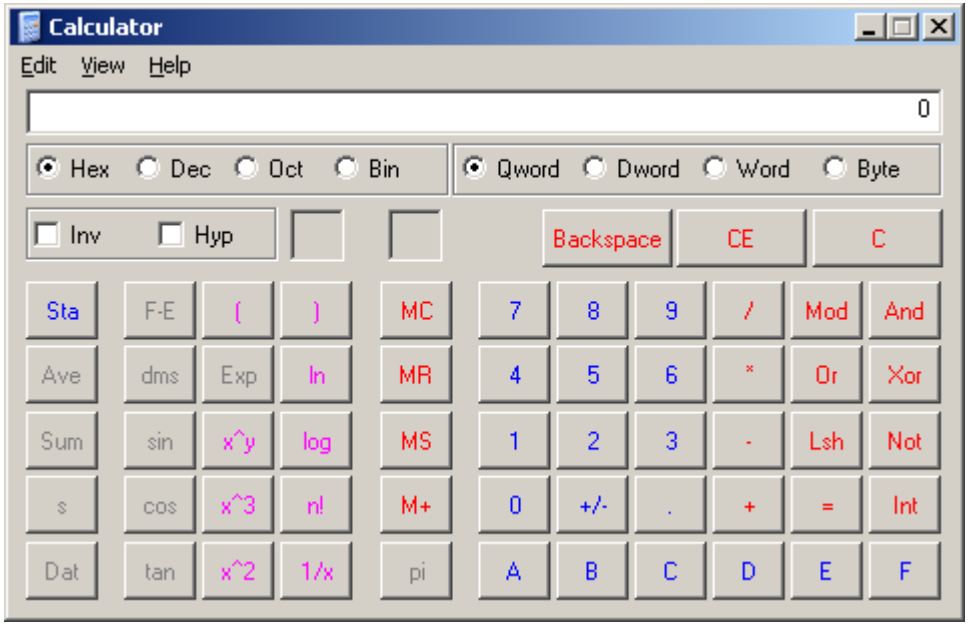
Register	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
7	High Speed/ N1 Dividers	HS_DIV[2:0]			N1[6:2]				
8	Reference Frequency	N1[1:0]			RFREQ[37:32]				
9	Reference Frequency	RFREQ[31:24]							
10	Reference Frequency	RFREQ[23:16]							
11	Reference Frequency	RFREQ[15:8]							
12	Reference Frequency	RFREQ[7:0]							

Note: Presentation applies to the ZC702

ZC702 Si570 Programming

- Open the Window Calculator
- Set to Scientific and Hex mode:

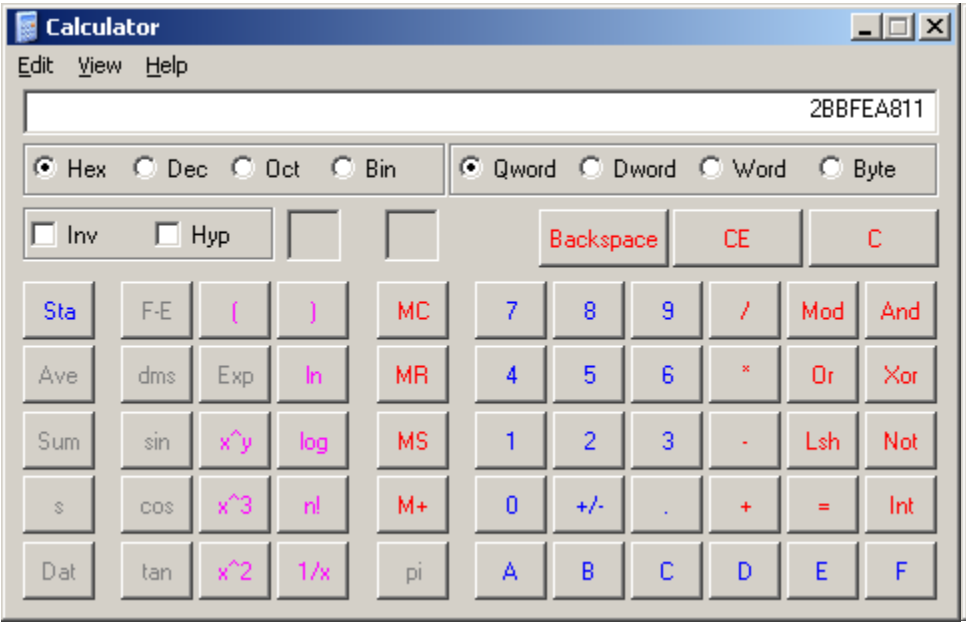


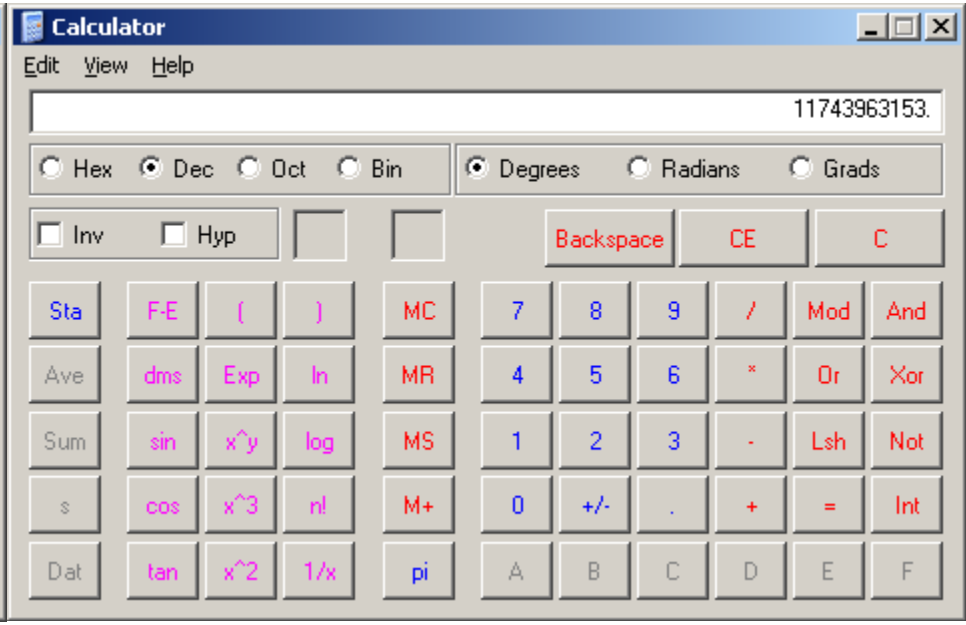


Note: Presentation applies to the ZC702

ZC702 Si570 Programming

- Enter or paste the RFREQ value, 02BBFEA811:
- Convert it to Decimal

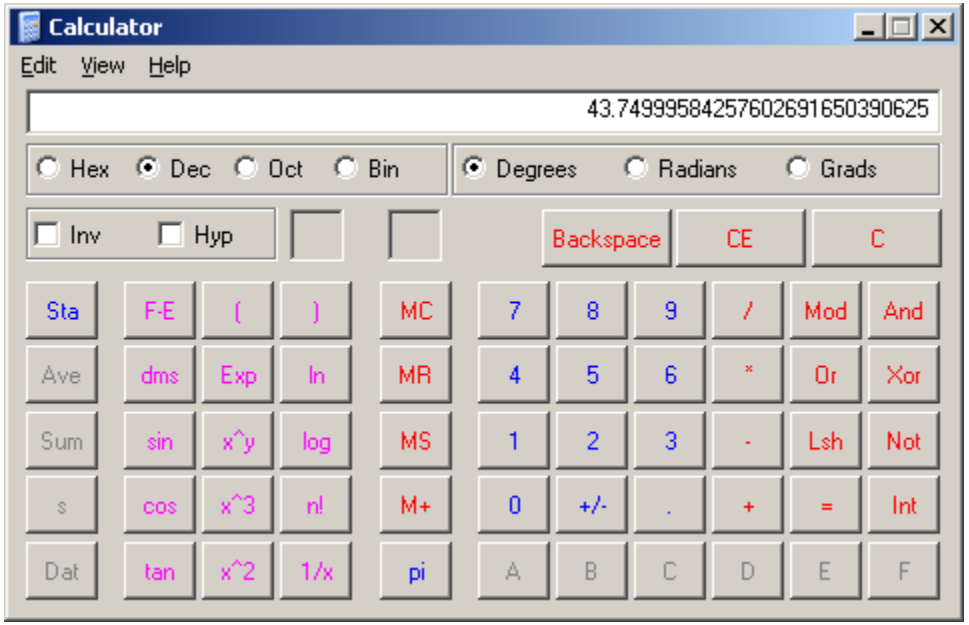




Note: Presentation applies to the ZC702

ZC702 Si570 Programming

- Divide by 2^28
- This is the value for RFREQ:



Note: Presentation applies to the ZC702

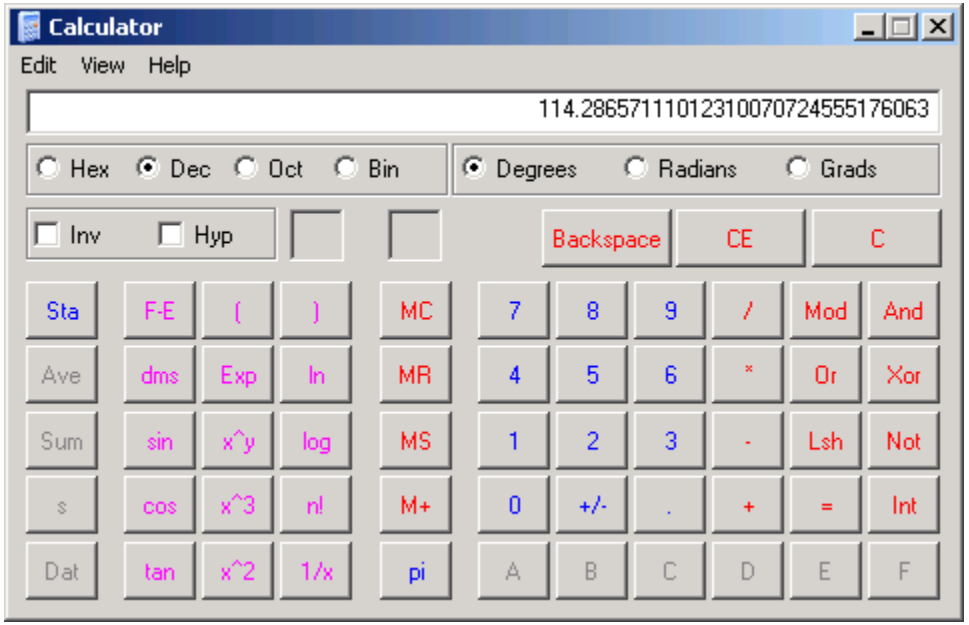
ZC702 Si570 Programming

- **For this equation,**
  - Fout = 156.25
  - RFREQ = **43.749995842576026916503906 25**
  - HSDIV = 4
  - N1 = 8
  - Fout x HSDIV x N1 = 5000
  - fXTAL = 5000 / RFREQ

$$f_{XTAL} = \frac{F_{out} \times HSDIV \times N1}{RFREQ}$$

ZC702 Si570 Programming

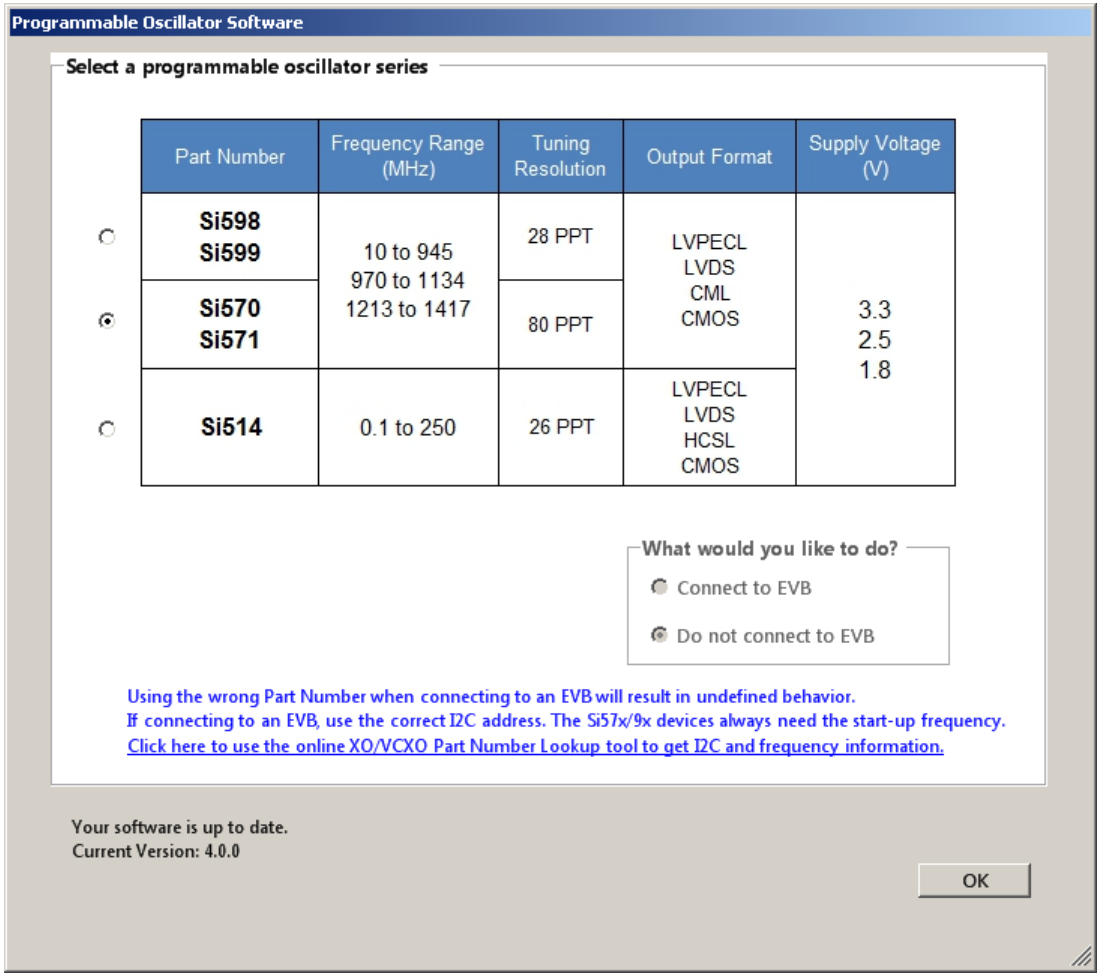
- **For this equation,**
  - Divide **43.74999584257602691650390625** by **5000**
  - Take the reciprocal
  - fXTAL = **114.28572514592488006627271464555**
  - Ctrl-C to copy this value



Note: Presentation applies to the ZC702

ZC702 Si570 Programming

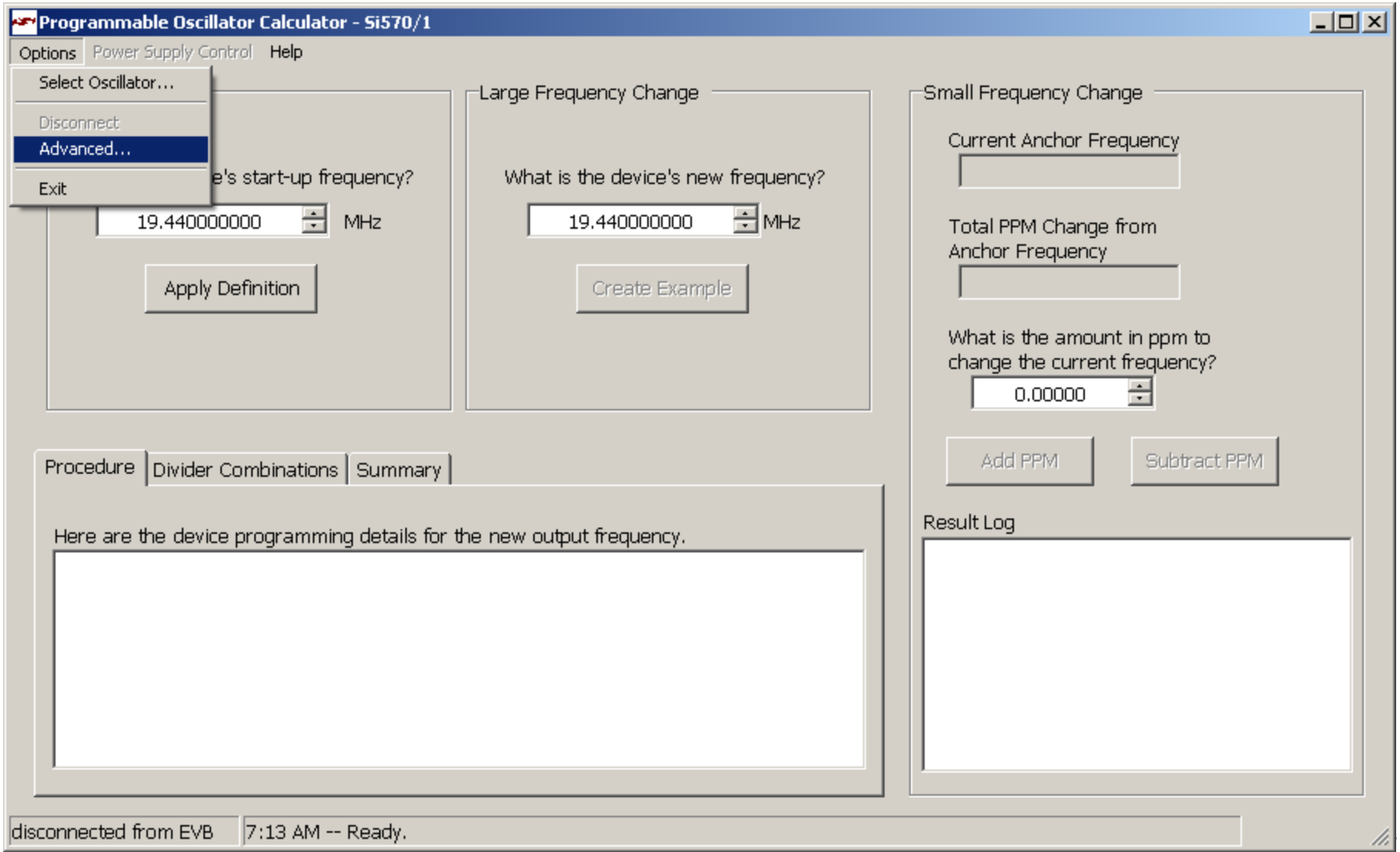
- **Open the SiLabs Programmable Oscillator Calculator**
  - Select the Si570 and click OK



Note: Presentation applies to the ZC702

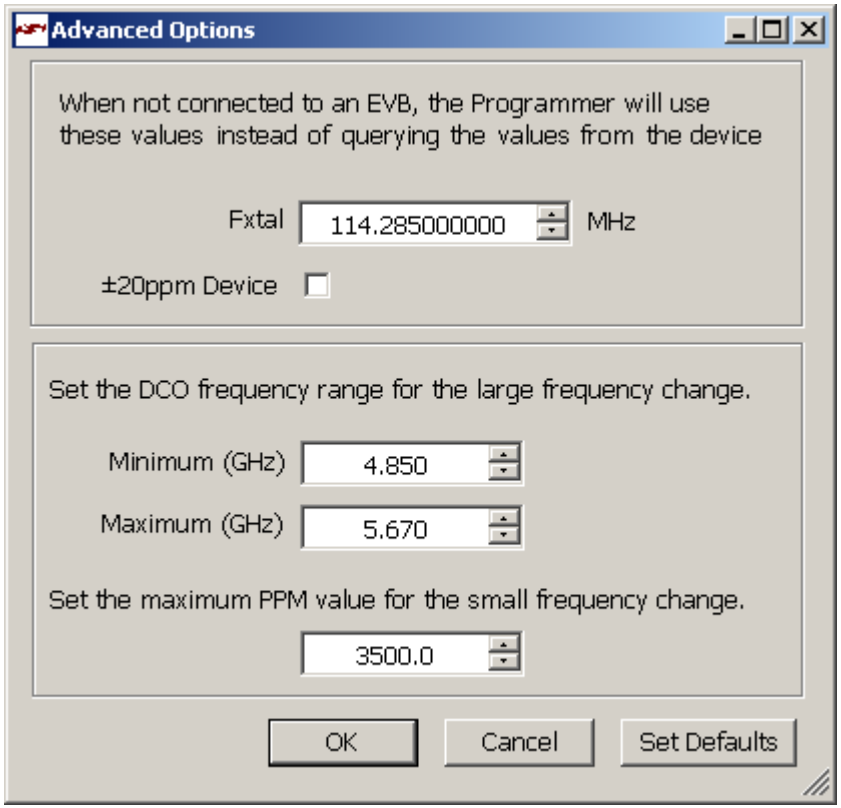
ZC702 Si570 Programming

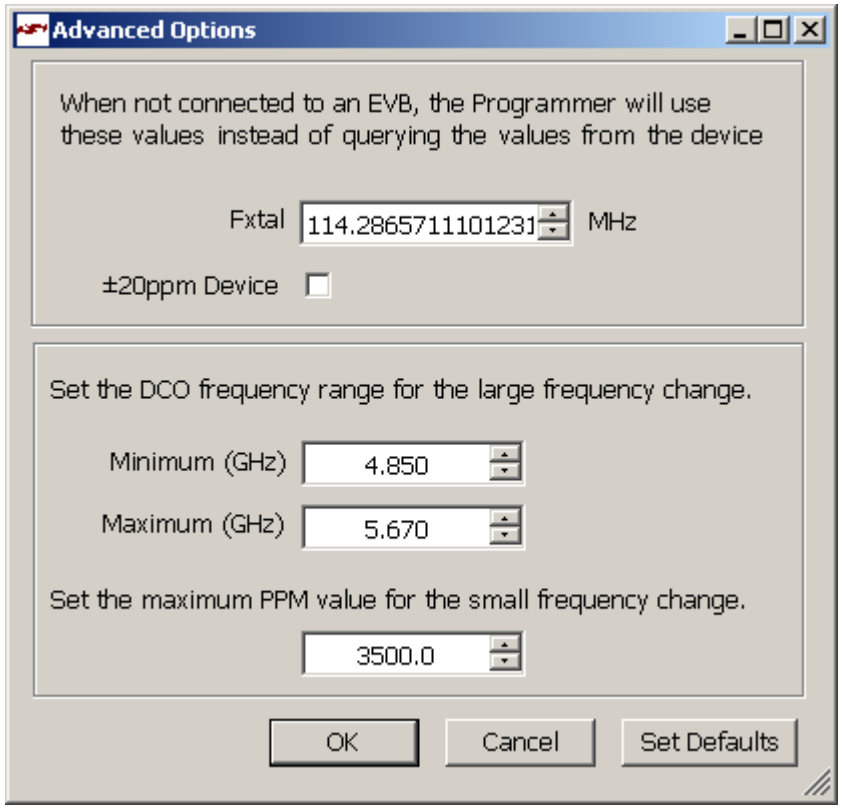
- Select Options -> Advanced…



ZC702 Si570 Programming

- **Paste in the value of fXTAL**
  - The calculator will round the number appropriately
  - This allows us to calibrate the Si570 to a new frequency
  - Click OK

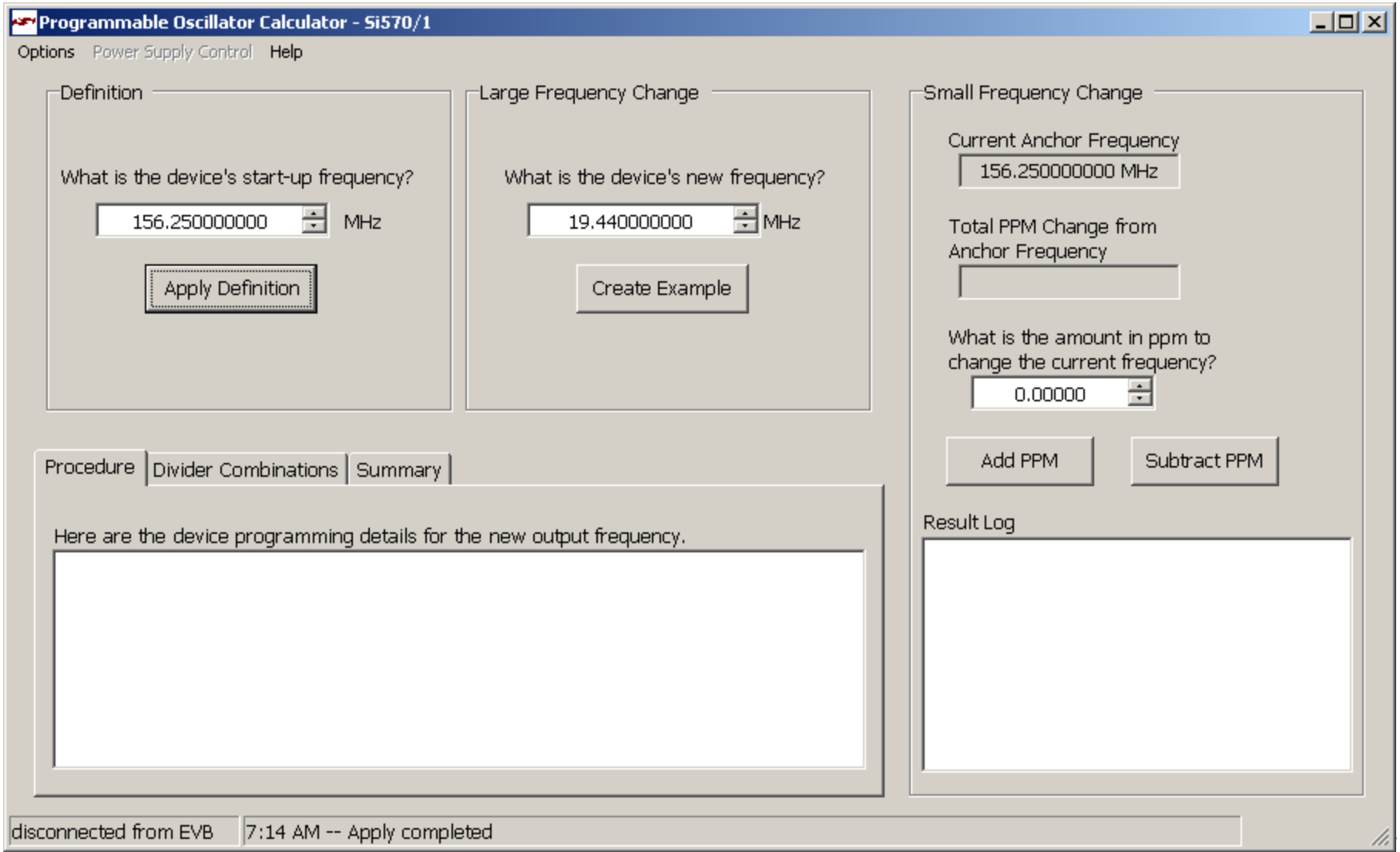




Note: Presentation applies to the ZC702

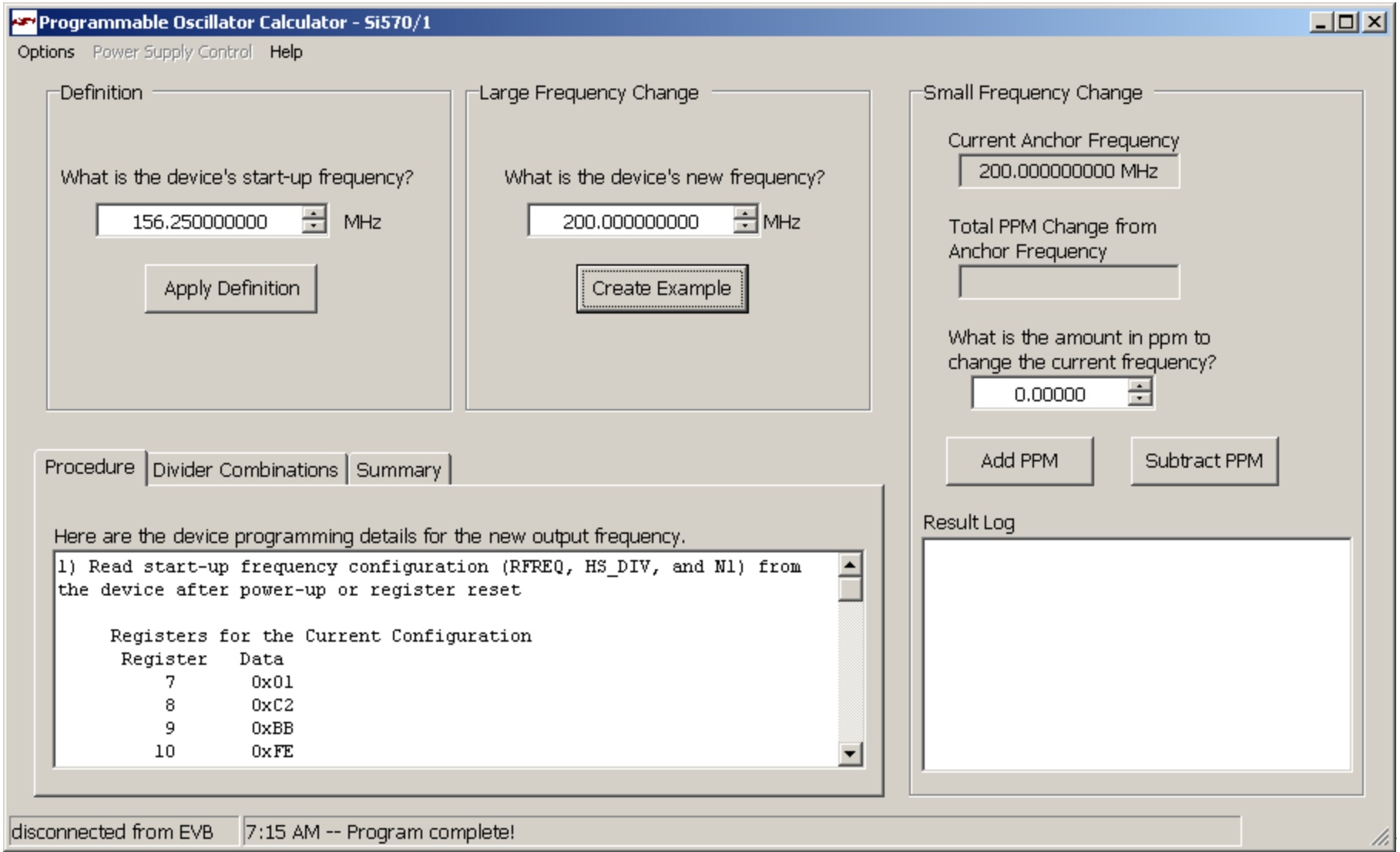
ZC702 Si570 Programming

- Enter 156.25 under Definition and click the Apply Definition button



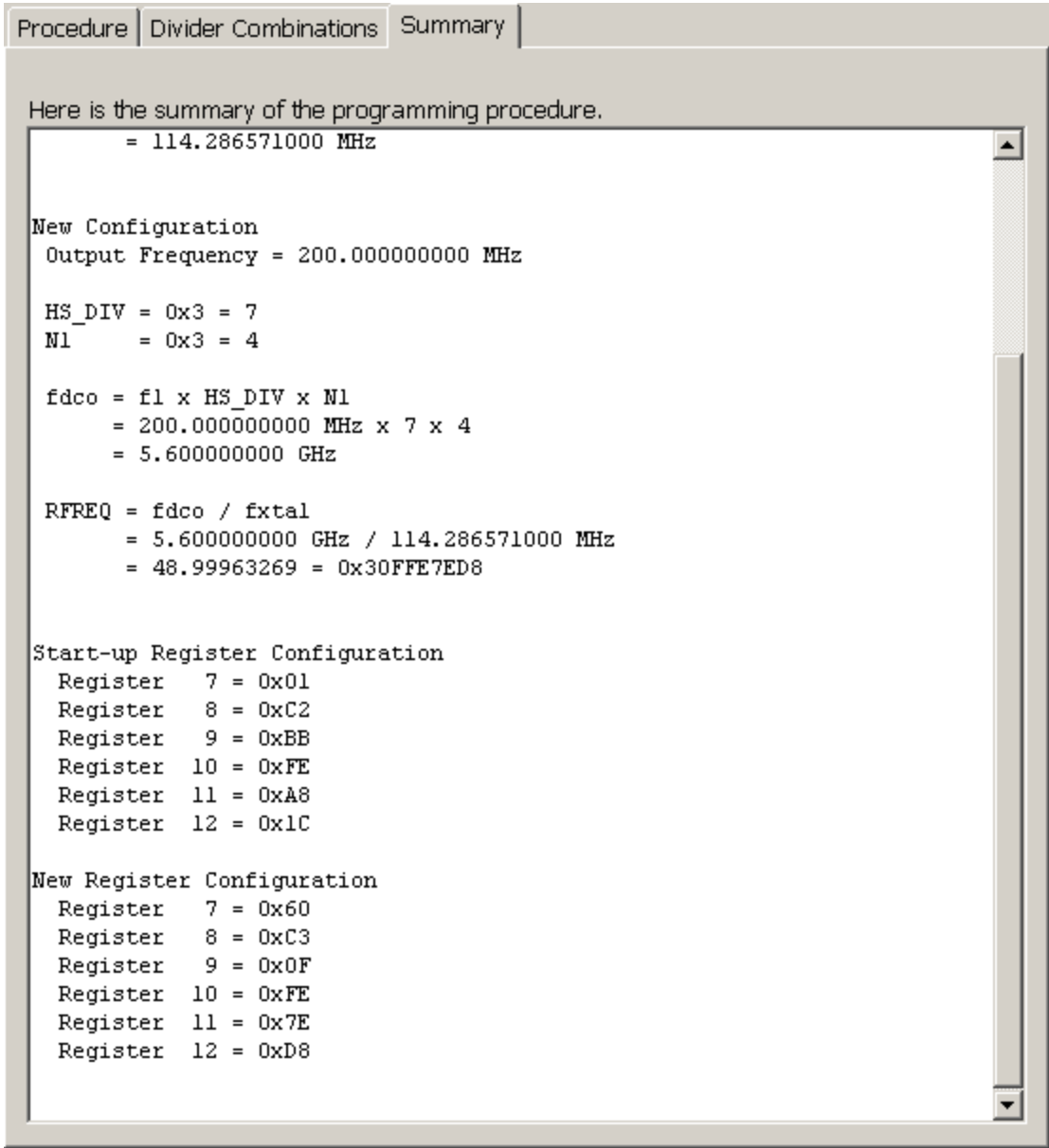
ZC702 Si570 Programming

- Set the new frequency to 200 MHz and click the Create Example button



ZC702 Si570 Programming

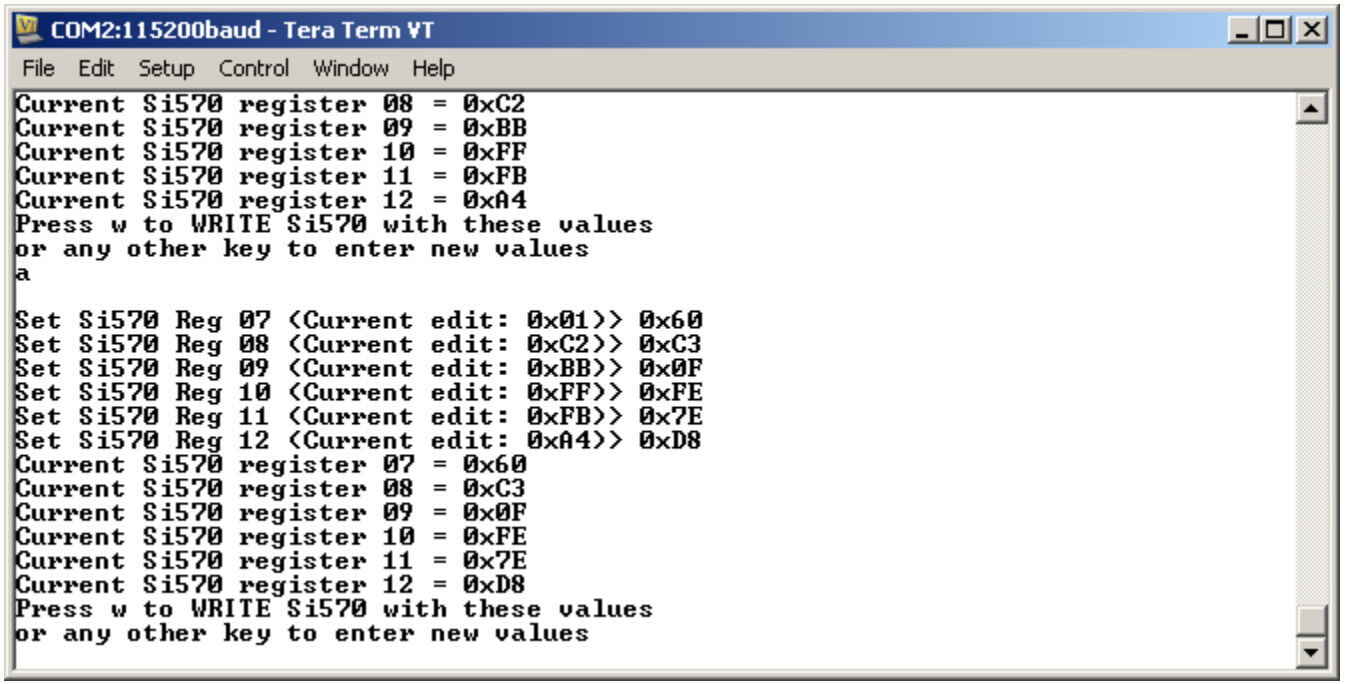
- Under the summary tab, the new register configurations are shown
- The startup register configurations will vary slightly from the actual device power-on programming



Note: Presentation applies to the ZC702

ZC702 Si570 Programming

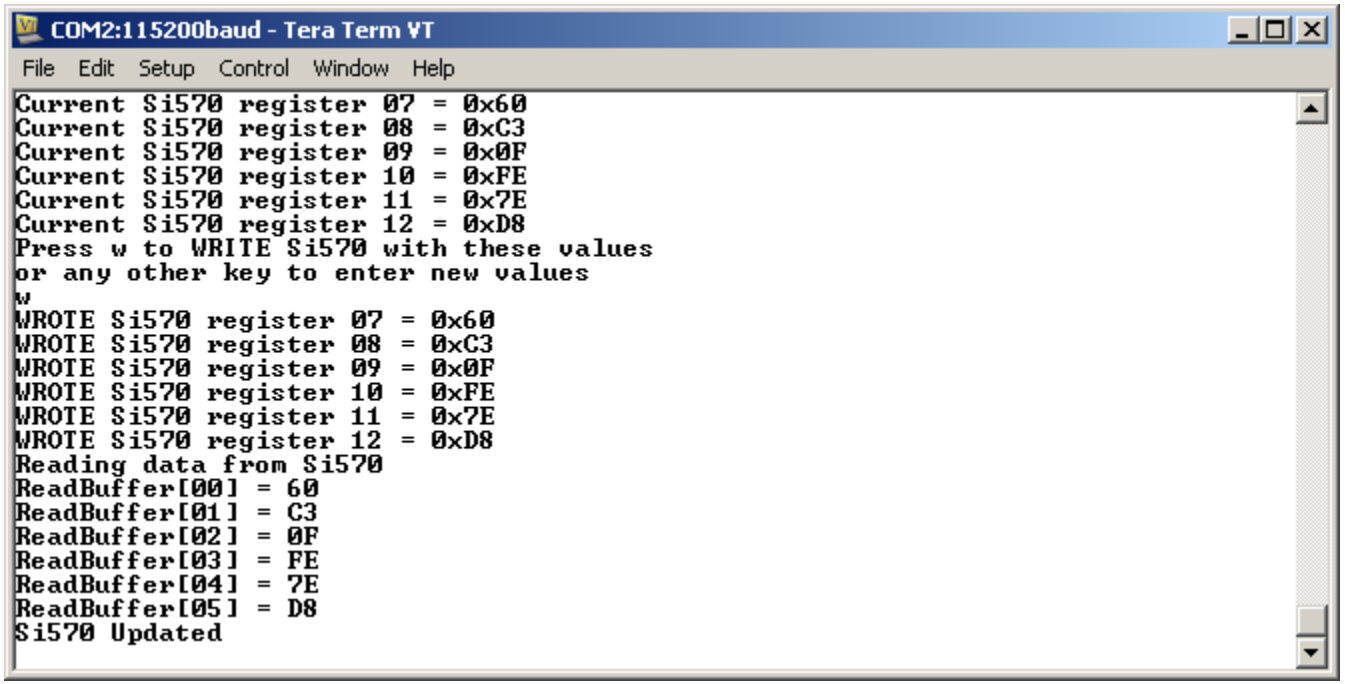
- Press a key to begin entering the newly calculated values
- When done, press “w”



Note: Presentation applies to the ZC702

ZC702 Si570 Programming

- Si570 has been successfully updated



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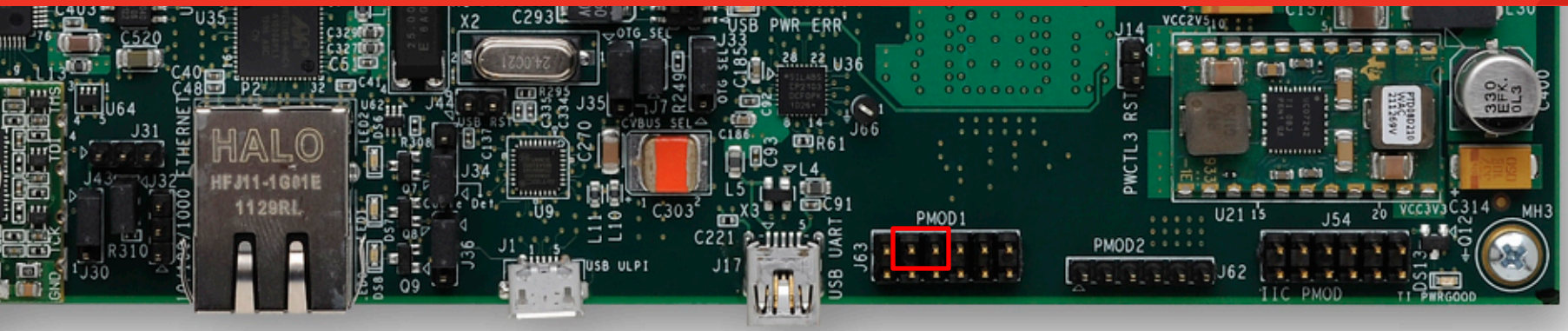

ZC702 Si570 Programming

- Measured frequency will be ~20.00 MHz

Note: Presentation applies to the ZC702

References

References

- **Silicon Labs**
  - Si570 Data Sheet
    - http://www.silabs.com/Support%20Documents/TechnicalDocs/si570.pdf

Documentation

Documentation

- **Zynq-7000**
  - Zynq-7000 All Programmable SoC
    - http://www.xilinx.com/products/silicon-devices/soc/zynq-7000/index.htm
- **ZC702 Documentation**
  - Xilinx Zynq-7000 SoC ZC702 Evaluation Kit
    - http://www.xilinx.com/products/boards-and-kits/EK-Z7-ZC702-G.htm
  - ZC702 Hardware User Guide – UG850
    - http://www.xilinx.com/support/documentation/boards_and_kits/zc702_zvic/ug850-zc702-eval-bd.pdf
  - ZC702 Getting Started Guide – UG926
    - http://www.xilinx.com/support/documentation/boards_and_kits/zynq-7000/zc702_gsg/v3_0/UG926_Z7_ZC702_Eval_Kit.pdf