



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.

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ZC702 Si570 Programming Overview

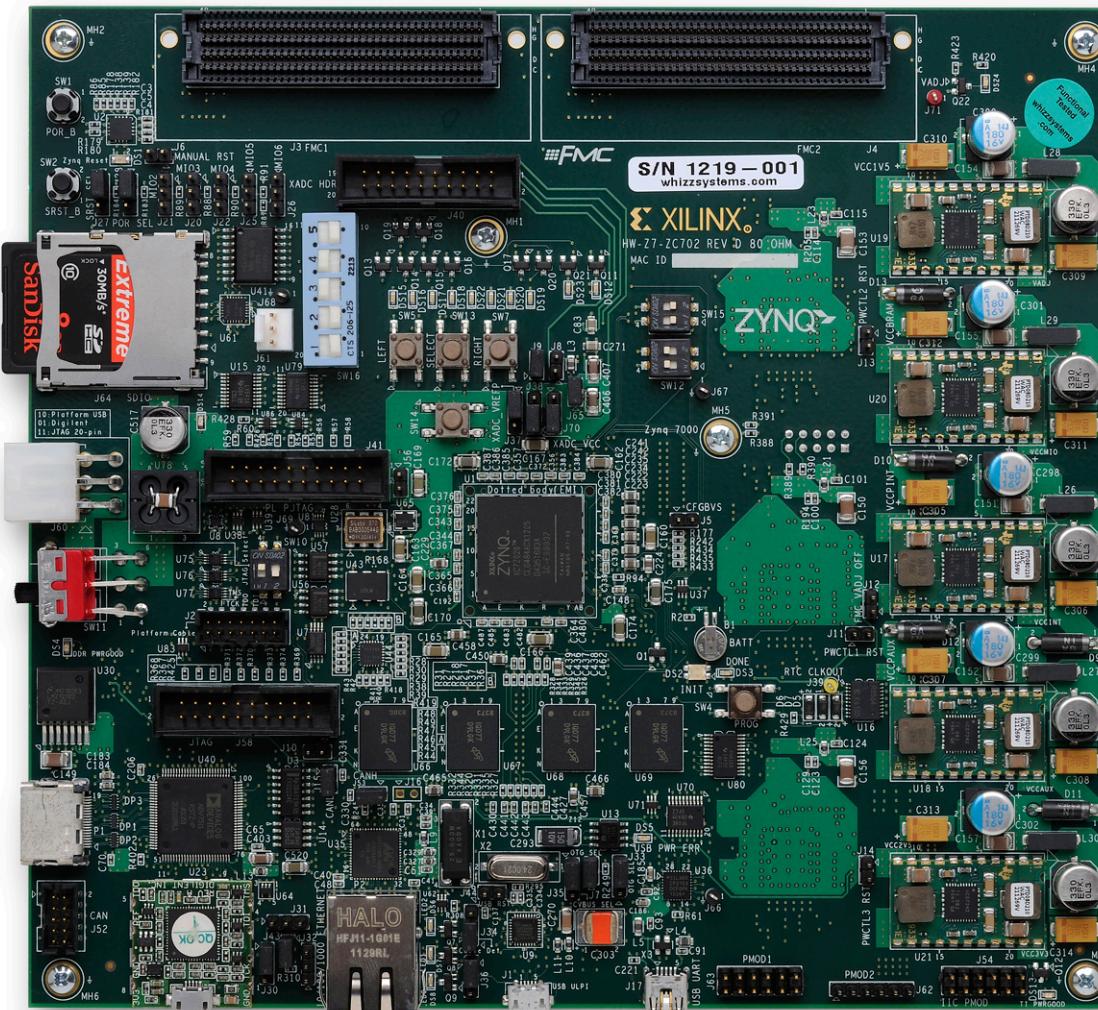
- Xilinx ZC702 Board
- Software Requirements
- Setup for the ZC702 Si570 Programming
- Programming the Si570
- Calibrating the Frequency
- References

ZC702 Si570 Programming Overview

► Description

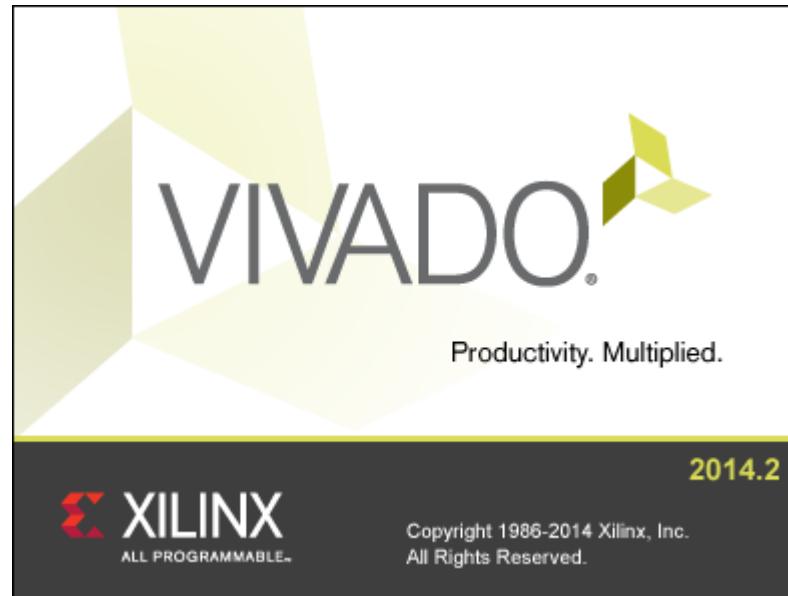
- The ZC702 board has a Silicon Labs Si570 Programmable Oscillator that defaults to 156.25 MHz. Via the IIC bus, the frequency of this device can be changed. This tutorial shows how to change the output frequency of this device.

Xilinx ZC702 Board



Vivado Software Requirements

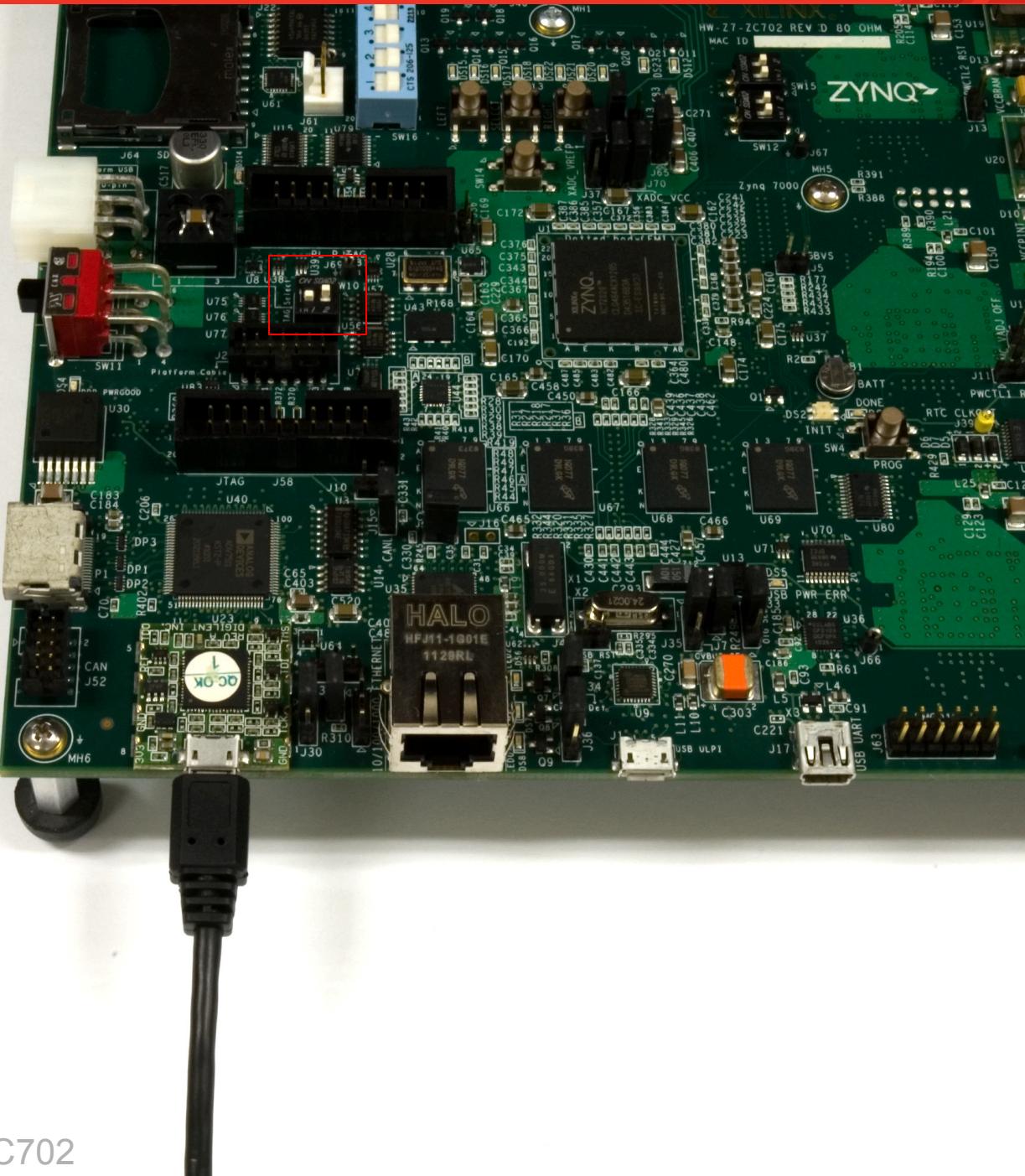
- Xilinx Vivado Design Suite 2014.2, Design Edition + SDK
 - Combined installer



ZC702 Setup

► Connect a USB Type-A to Micro-B cable to the USB JTAG (Digilent) connector on the ZC702 board

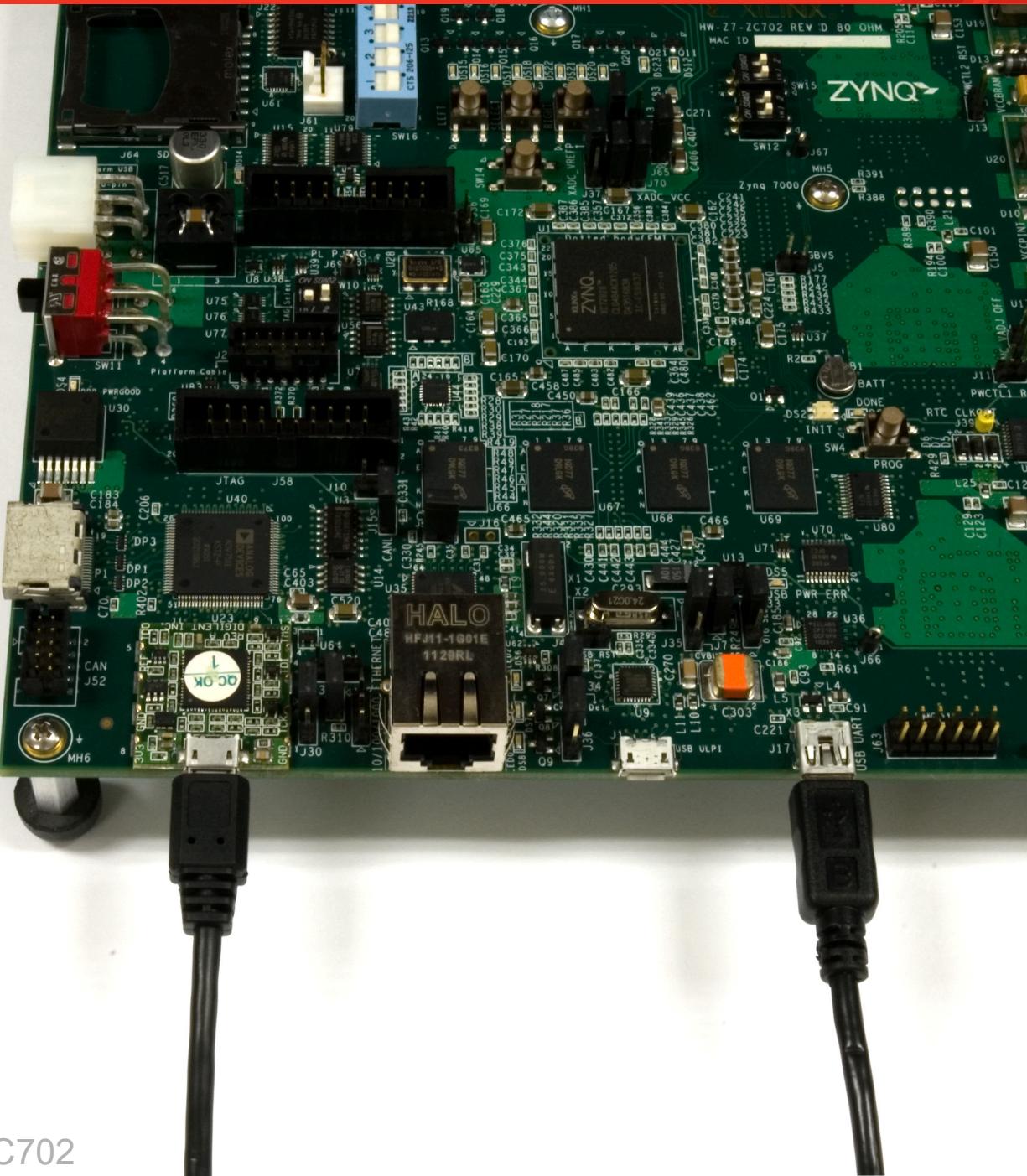
- Connect this cable to your PC
- Set the JTAG Select Switch, SW10, to **01**
- If using a Platform Cable USB (II) JTAG Cable, set SW10 to **10**



ZC702 Setup

► Connect a USB Type-A to Mini-B cable to the USB UART connector on the ZC702 board

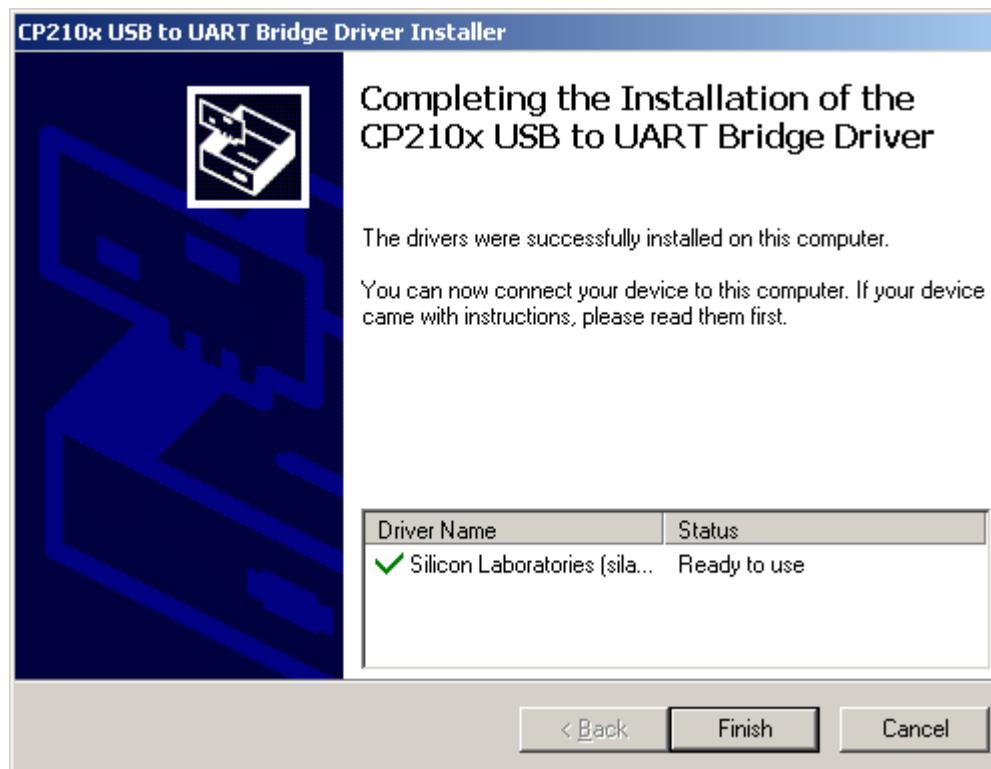
- Connect this cable to your PC
- Power on the ZC702 board for UART Drivers Installation



ZC702 Setup

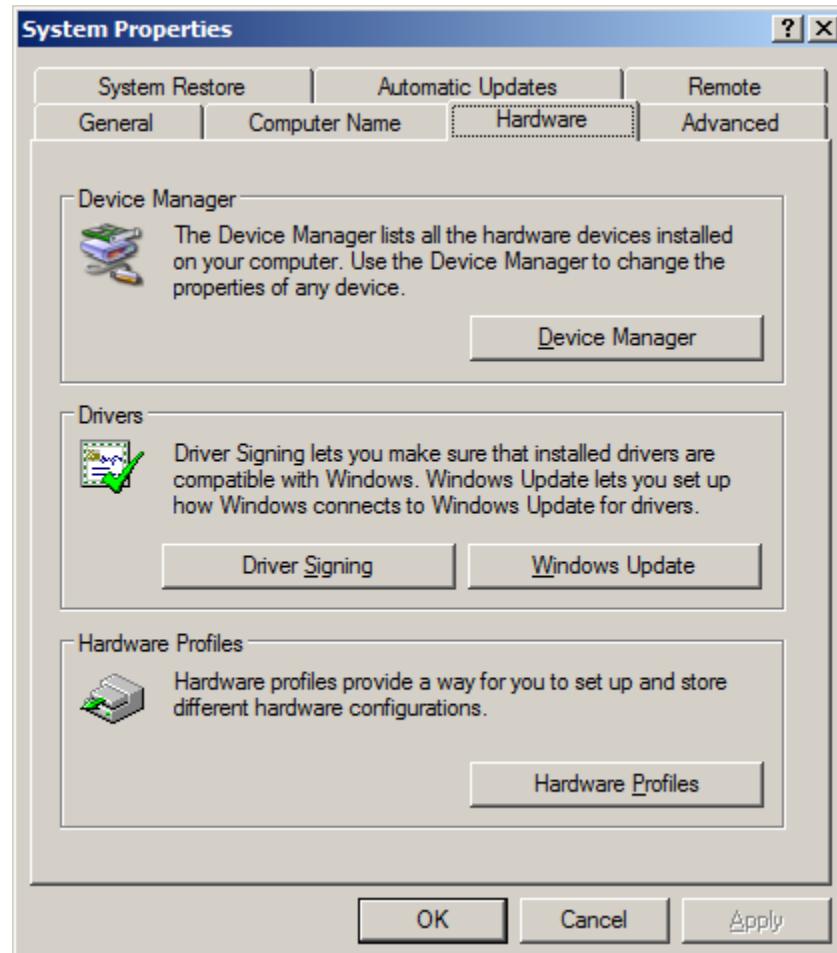
➤ Install USB UART Drivers

- Refer to [UG1033](#) for details on installing the USB to UART Drivers



ZC702 Setup

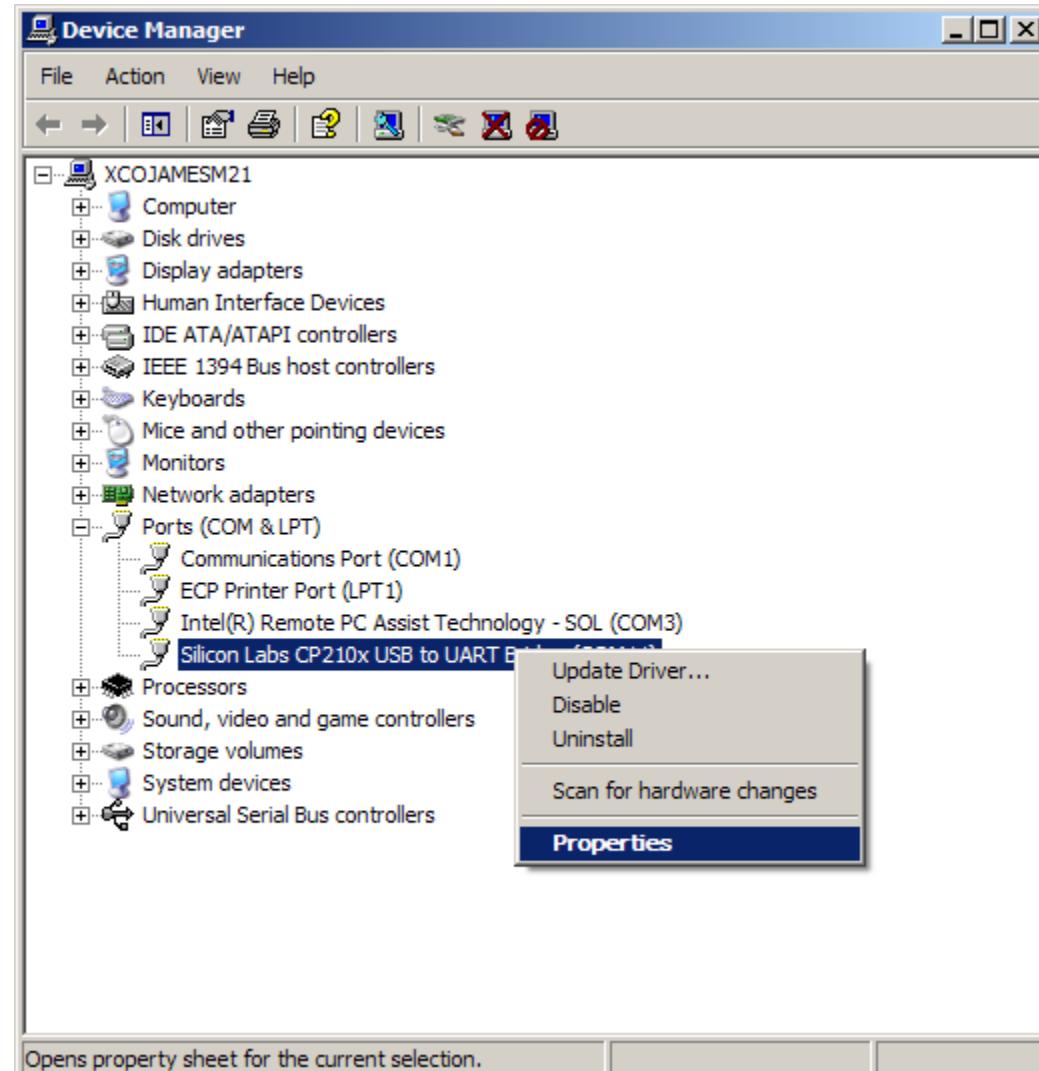
- Reboot your PC if necessary
- Right-click on My Computer and select Properties
 - Select the Hardware tab
 - Click on Device Manager



ZC702 Setup

► Expand the Ports Hardware

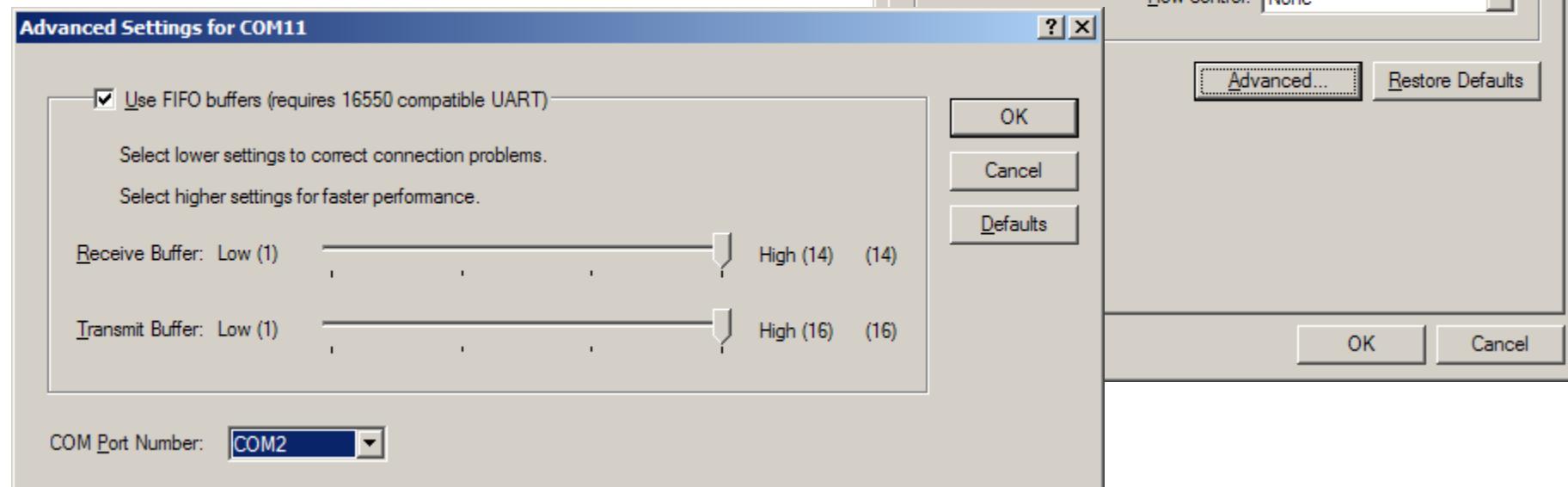
- Right-click on **Silicon Labs CP210x USB to UART Bridge** and select Properties



ZC702 Setup

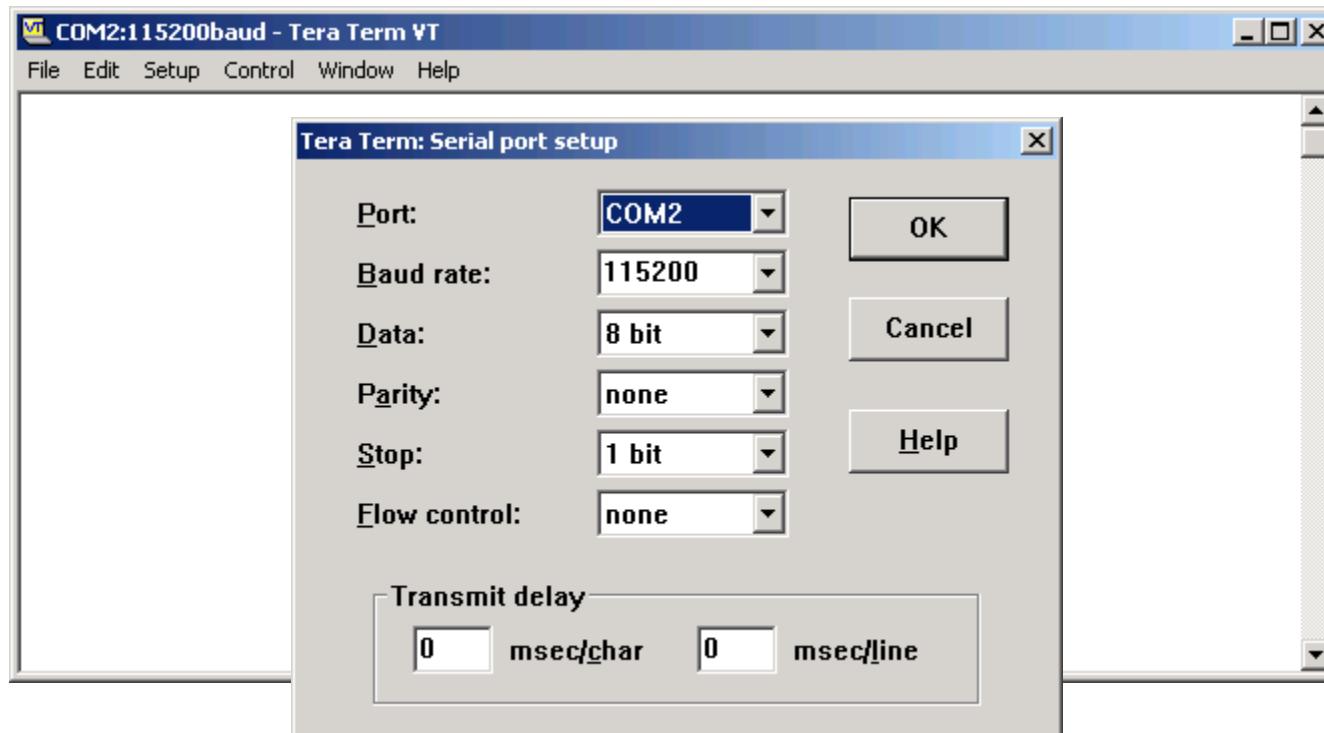
► Under Port Settings tab

- Click Advanced
- Set the COM Port to an open Com Port setting from COM1 to COM4



ZC702 Setup

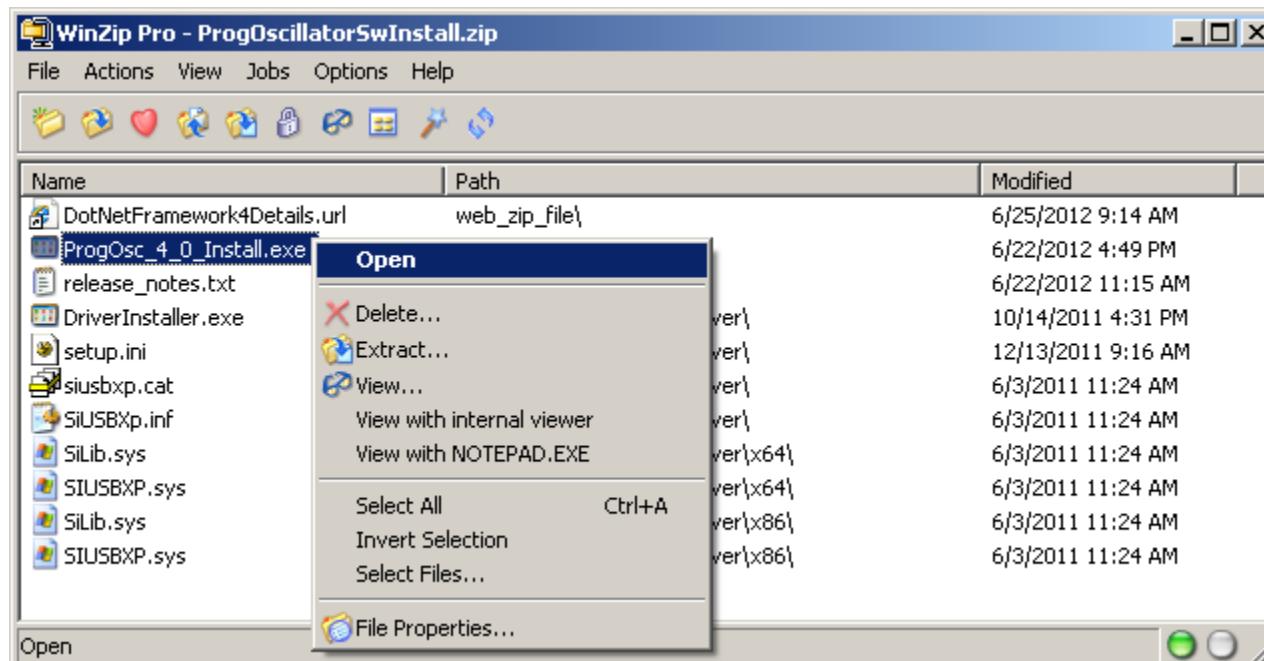
- Refer to [UG1036](#) regarding Tera Term installation
- Board Power must be on before starting Tera Term
- Start the Terminal Program
 - Select your USB Com Port
 - Set the baud to **115200**



Si Labs Programmable Oscillator Calculator

► Download [ProgOscillatorSwInstall.zip](#)

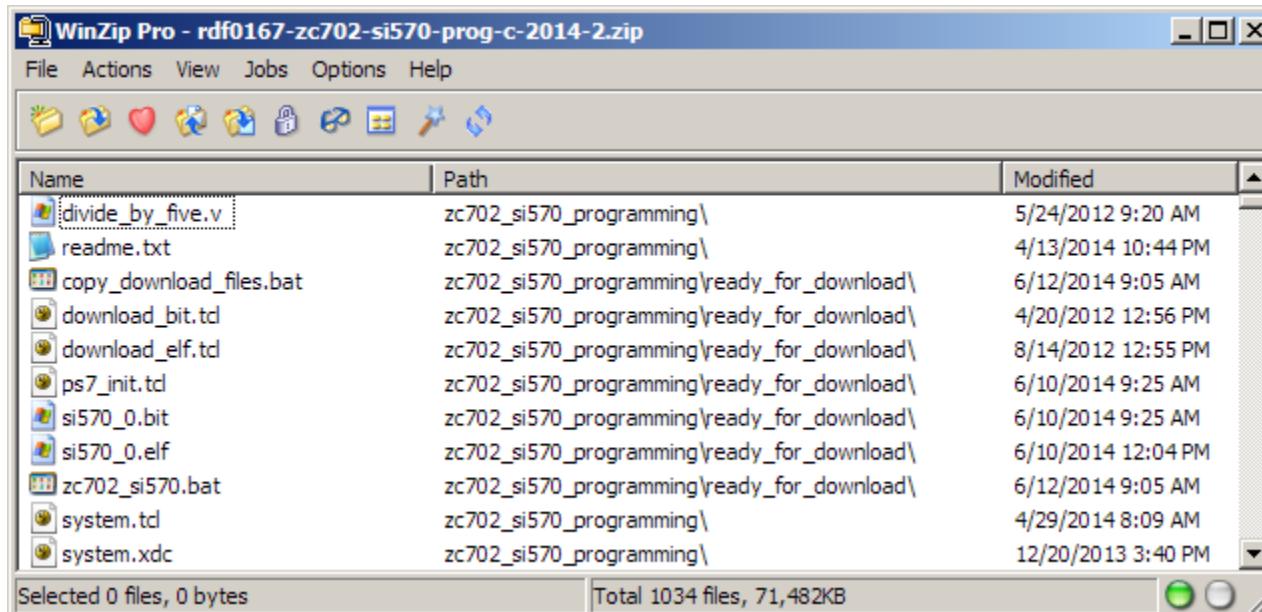
- Install “**ProgOsc_4_0_Install.exe**” only



Setup for ZC702 Si570 Programming

► Unzip the ZC702 Si570 Programming Design Files (2014.2 C) to your C:\ drive

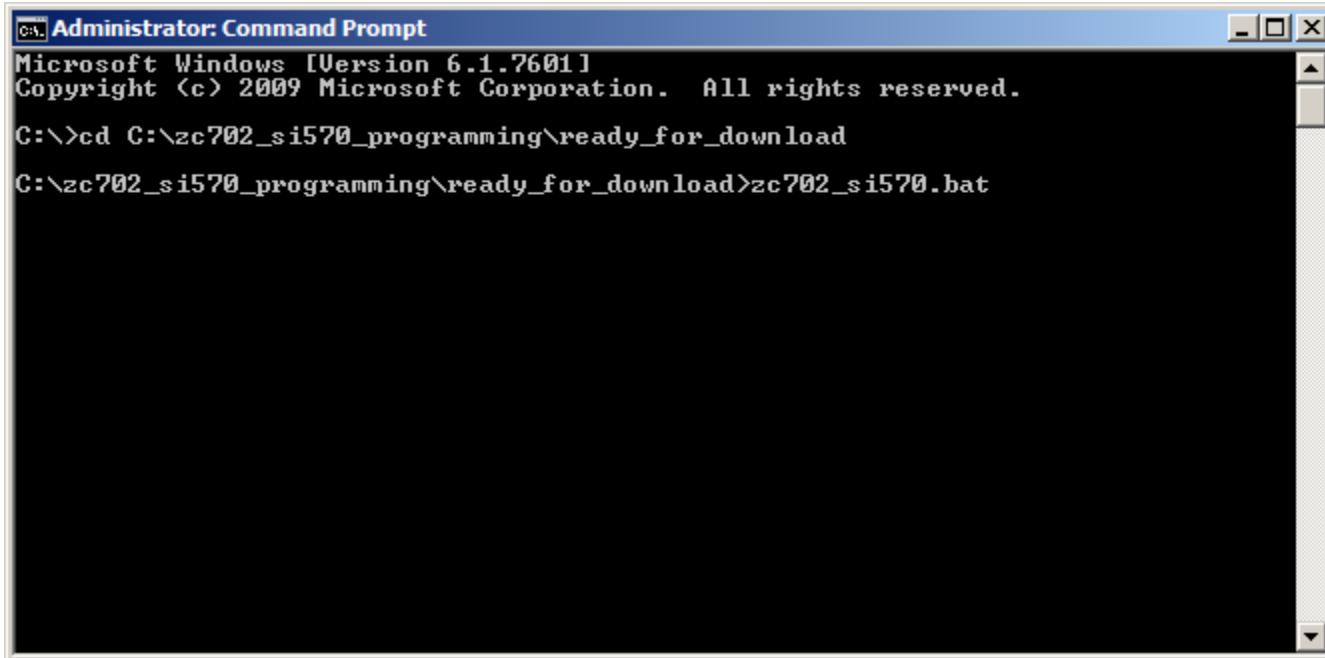
- Available through <http://www.xilinx.com/zc702>
- It is recommended to unzip these design files to **C:** for SDK compatibility



ZC702 Si570 Programming

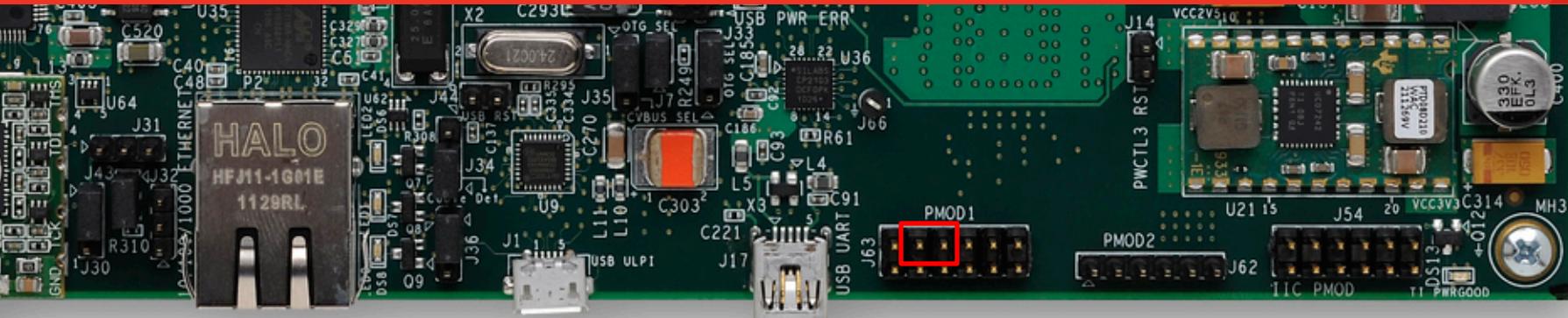
- Download the Si570 bitstream and ELF files
- In a Windows CMD prompt type:

```
cd C:\zc702_si570_programming\ready_for_download  
zc702_si570.bat
```



The screenshot shows a Windows Command Prompt window titled "Administrator: Command Prompt". The window displays the following text:

```
Administrator: Command Prompt  
Microsoft Windows [Version 6.1.7601]  
Copyright © 2009 Microsoft Corporation. All rights reserved.  
  
C:\>cd C:\zc702_si570_programming\ready_for_download  
C:\zc702_si570_programming\ready_for_download>zc702_si570.bat
```



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

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:

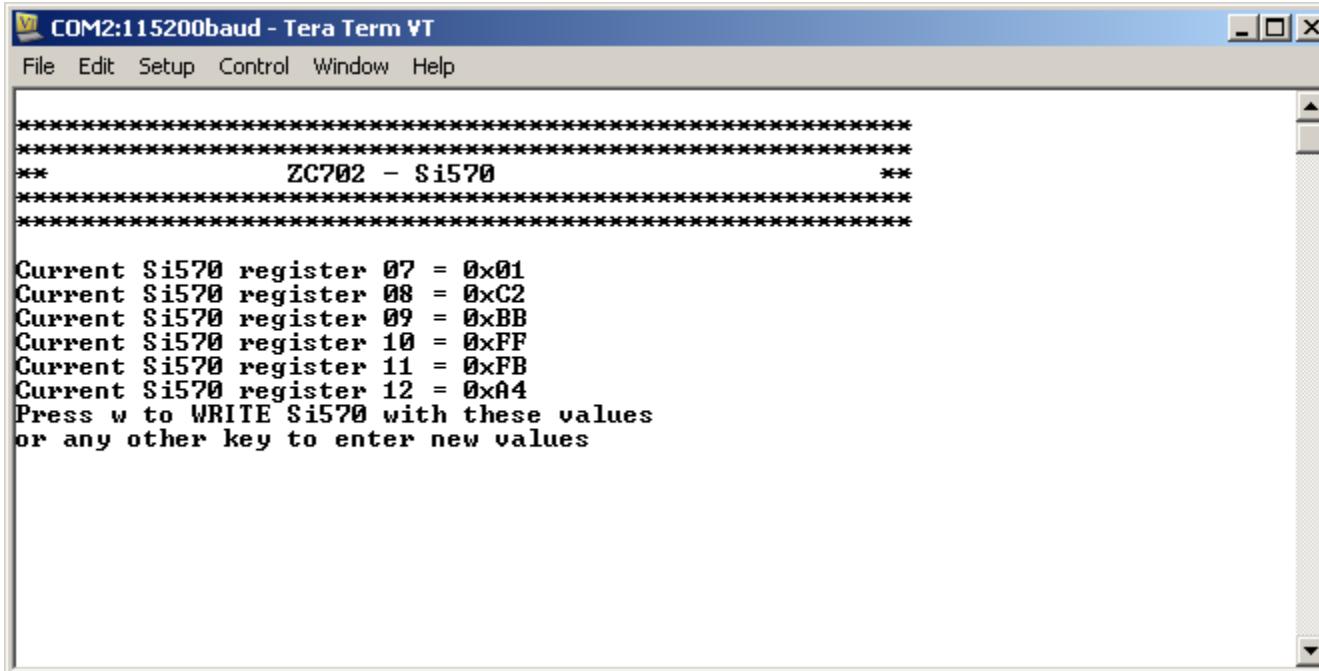
$$f_{XTAL} = \frac{F_{out} \times HSDIV \times N1}{RFREQ}$$

- For this equation,
 - $F_{out} = 156.25$, 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

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**



The screenshot shows a terminal window titled "COM2:115200baud - Tera Term VT". The window displays the following text:

```
*****
** ZC702 - Si570 **
*****
Current Si570 register 07 = 0x01
Current Si570 register 08 = 0xC2
Current Si570 register 09 = 0xBB
Current Si570 register 10 = 0xFF
Current Si570 register 11 = 0xFB
Current Si570 register 12 = 0xA4
Press w to WRITE Si570 with these values
or any other key to enter new values
```

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]							

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

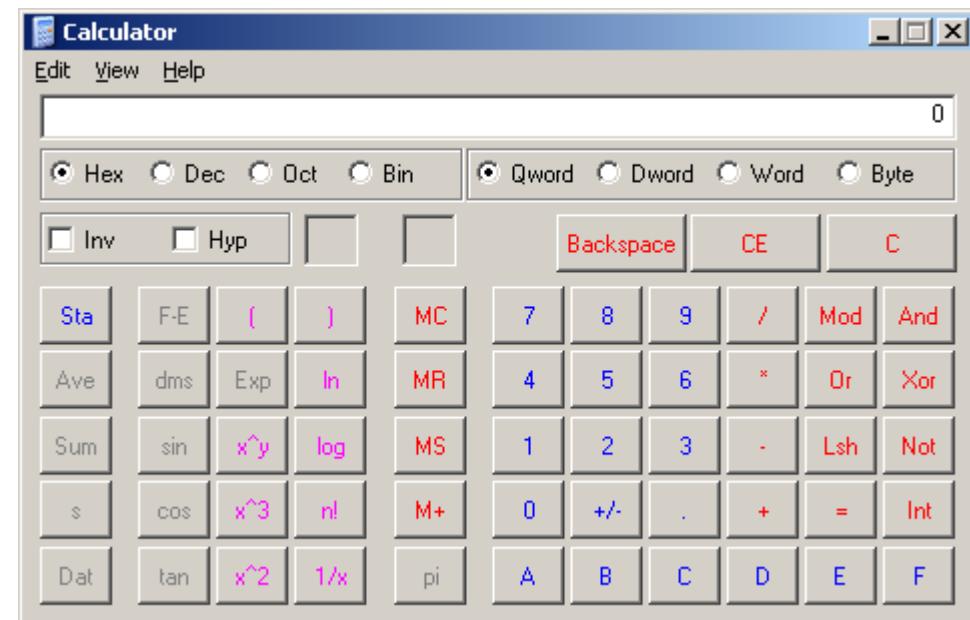
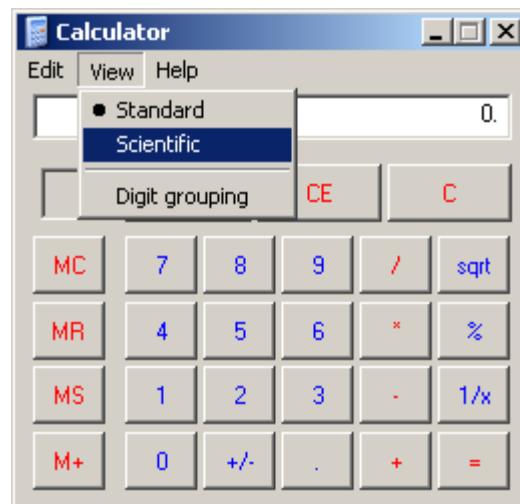
ZC702 Si570 Programming

- 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]							

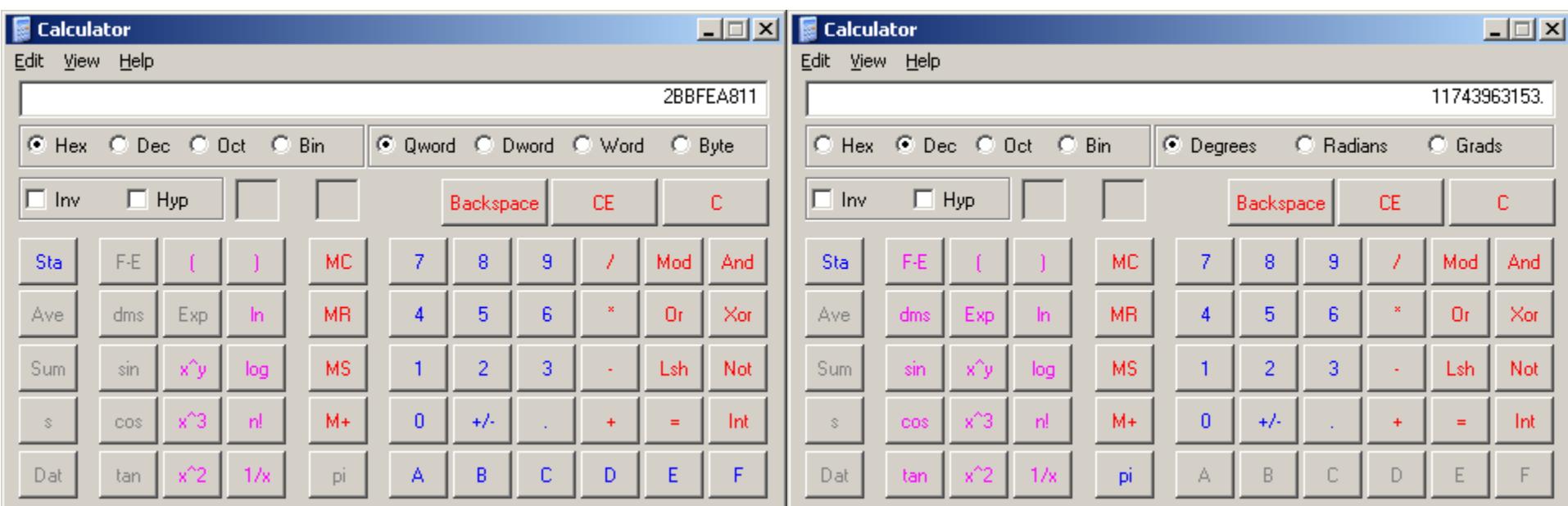
ZC702 Si570 Programming

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



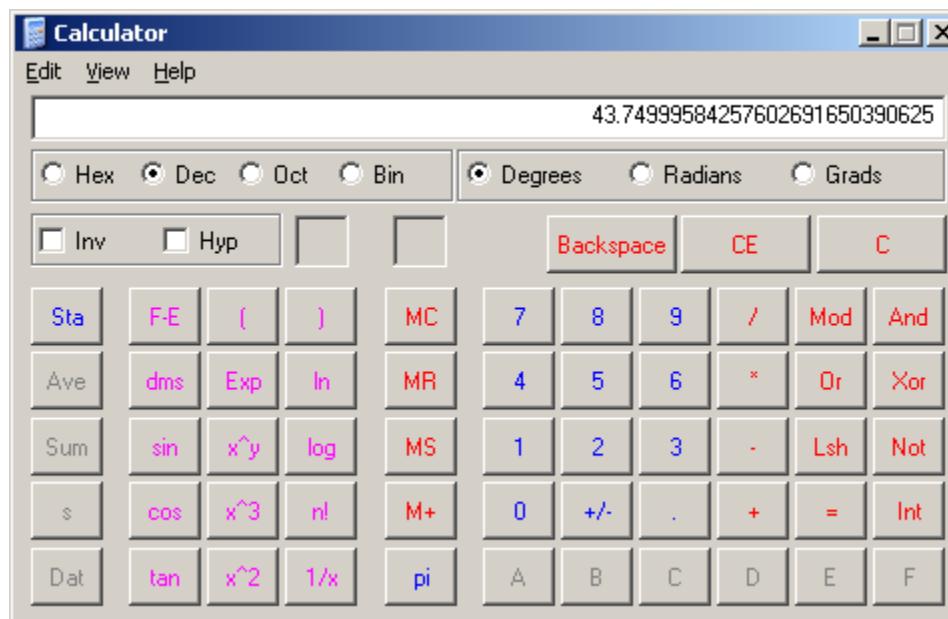
ZC702 Si570 Programming

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



ZC702 Si570 Programming

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



ZC702 Si570 Programming

► For this equation,

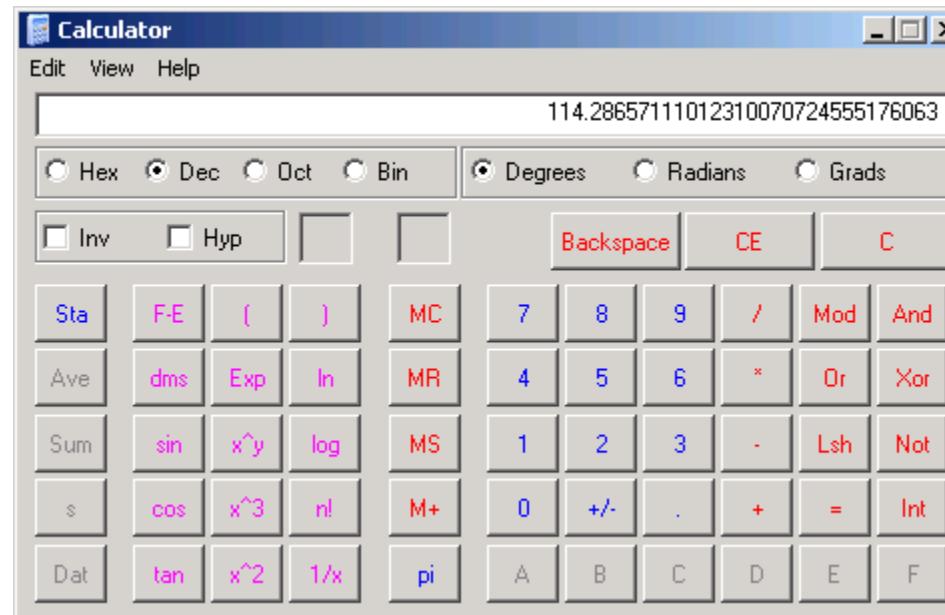
- Fout = 156.25
- RFREQ = **43.74999584257602691650390625**
- HSDIV = 4
- N1 = 8
- Fout x HSDIV x N1 = 5000
- fXTAL = 5000 / RFREQ

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

ZC702 Si570 Programming

► For this equation,

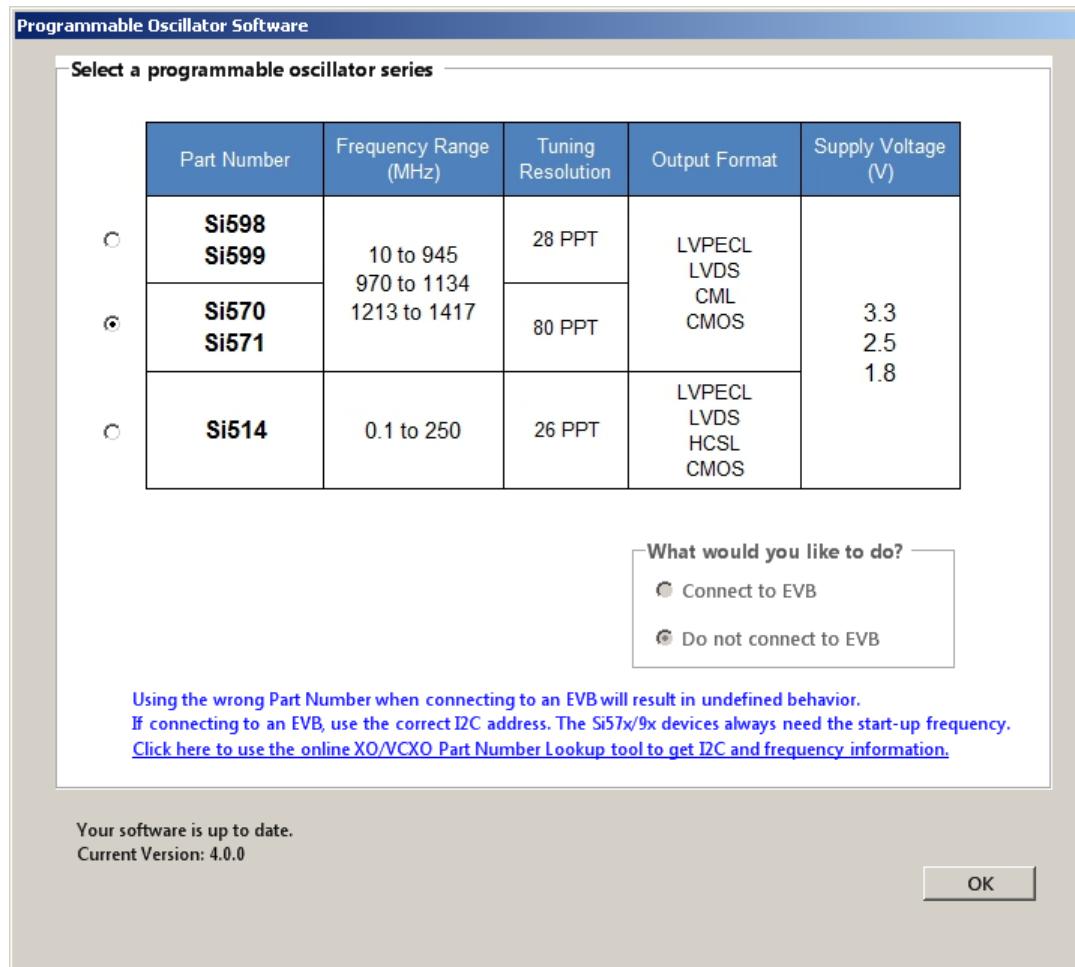
- Divide **43.74999584257602691650390625** by **5000**
- Take the reciprocal
- fXTAL = **114.28572514592488006627271464555**
- Ctrl-C to copy this value



ZC702 Si570 Programming

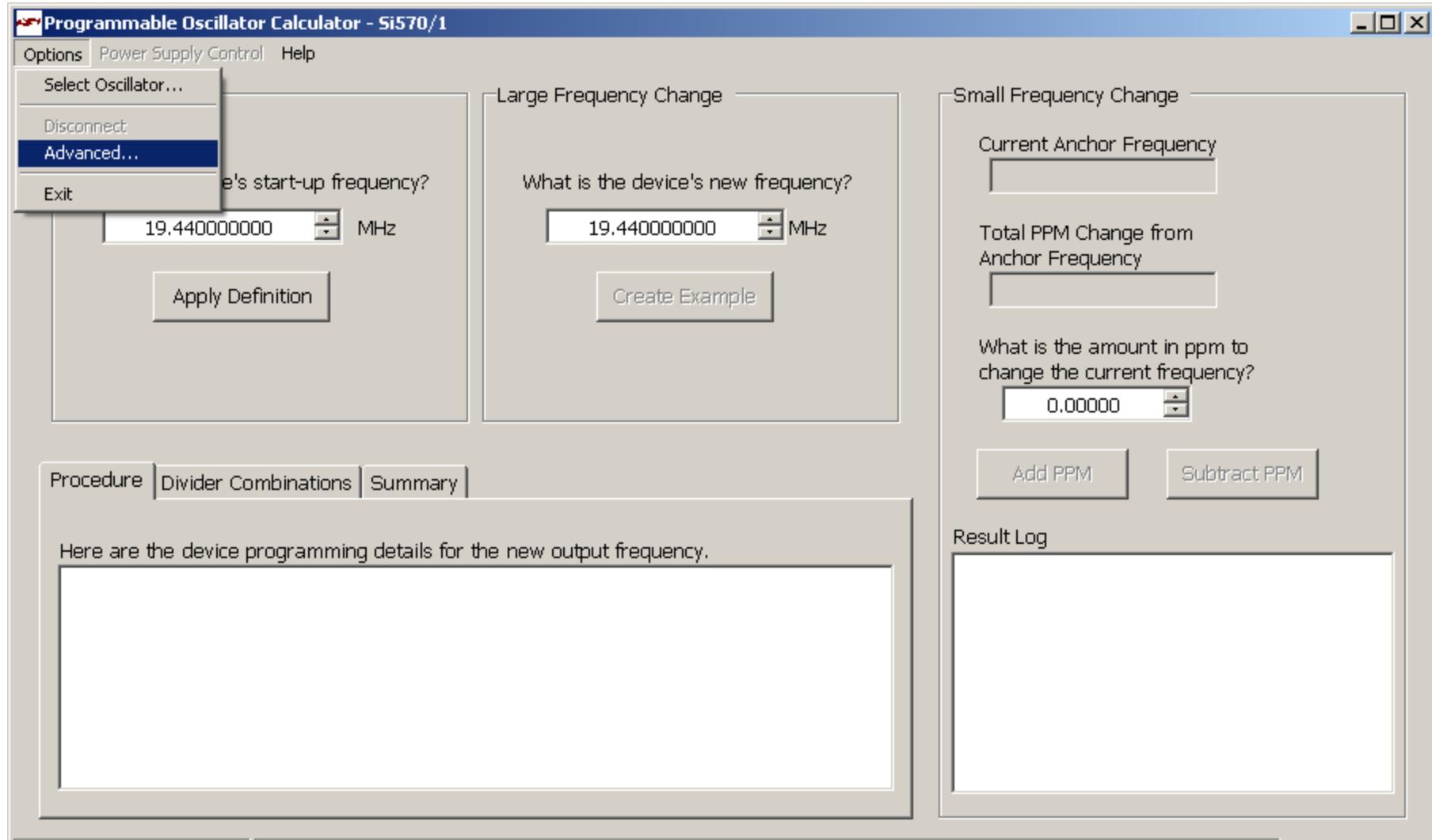
► Open the SiLabs Programmable Oscillator Calculator

- Select the Si570 and click OK



ZC702 Si570 Programming

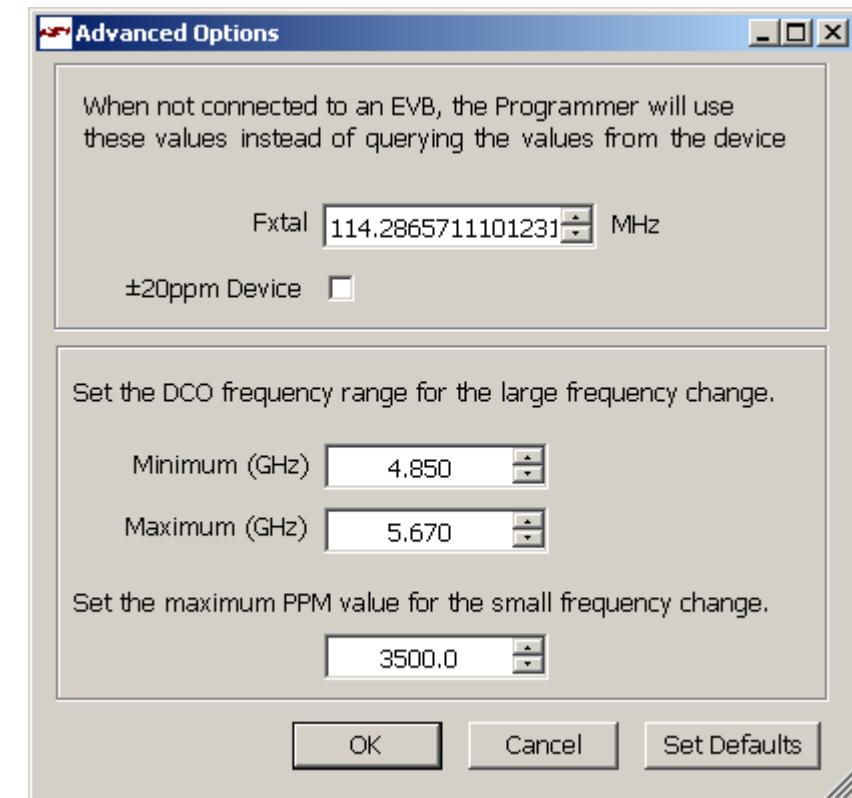
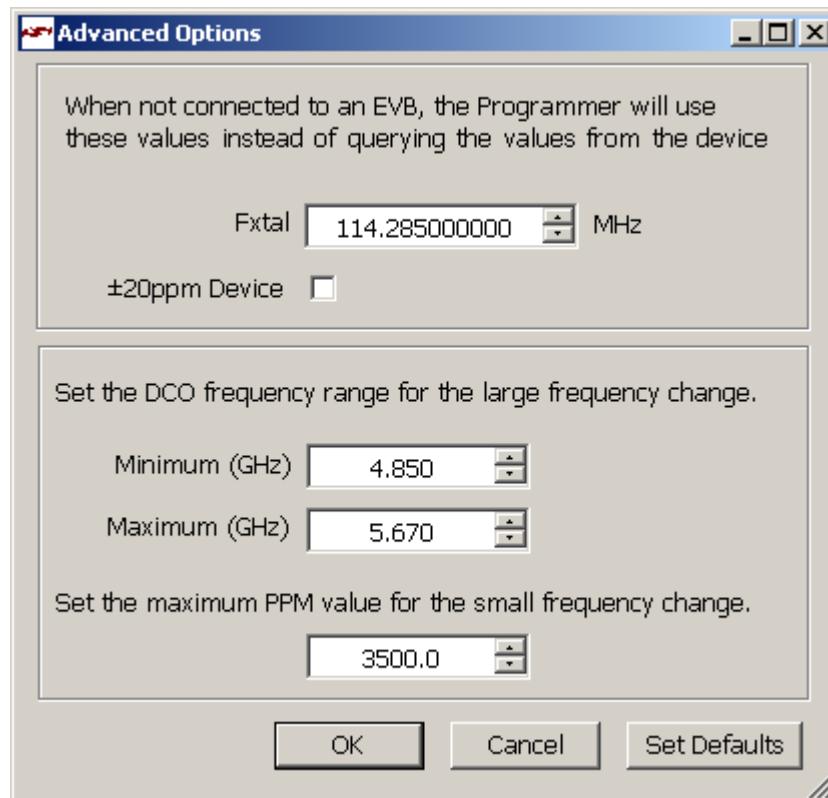
► Select Options -> Advanced...



ZC702 Si570 Programming

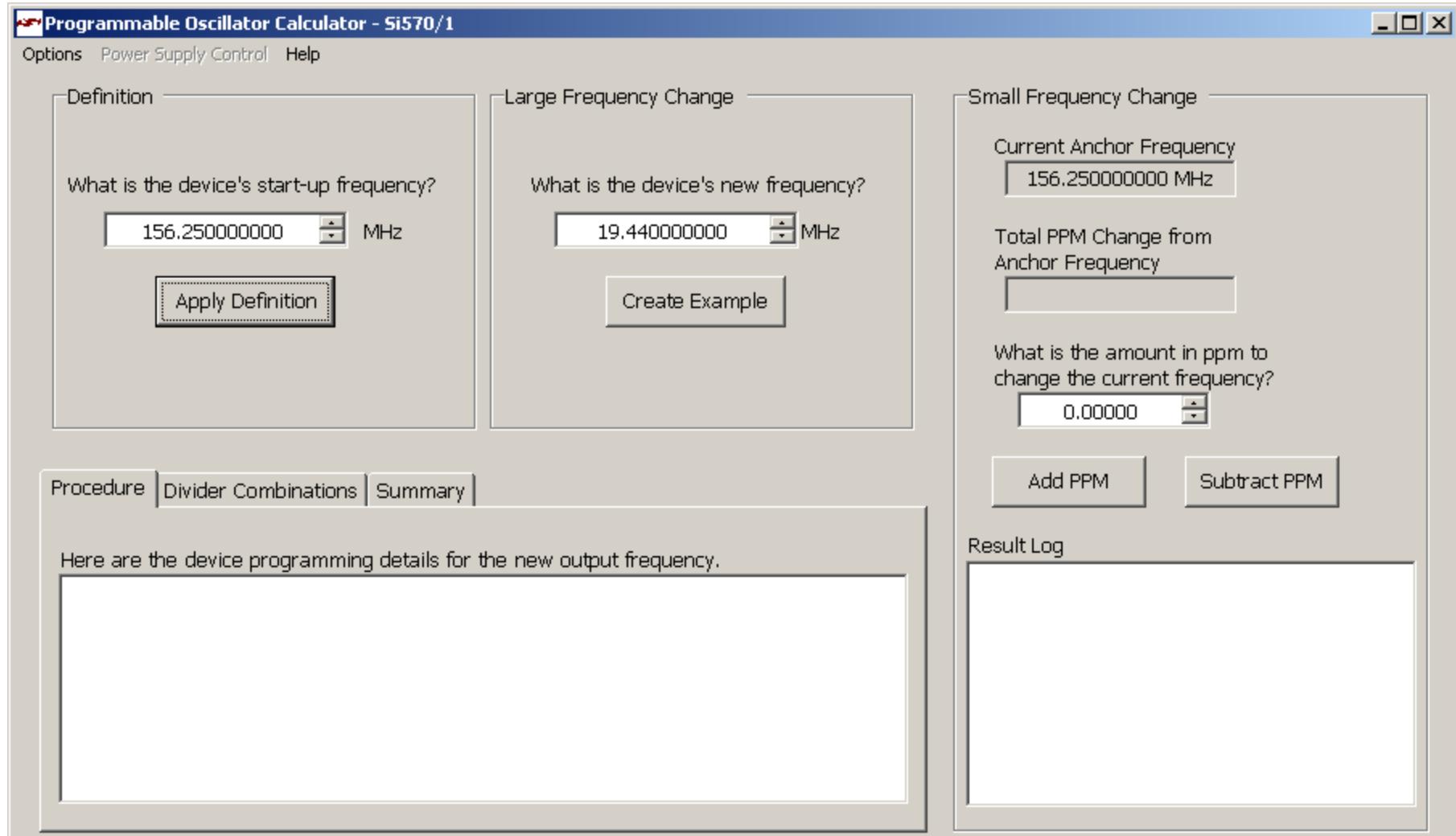
► Paste in the value of fXTAL

- The calculator will round the number appropriately
- This allows us to calibrate the Si570 to a new frequency
- Click OK



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

Programmable Oscillator Calculator - Si570/1

Options Power Supply Control Help

Definition

What is the device's start-up frequency?
156.2500000000 MHz

Apply Definition

Large Frequency Change

What is the device's new frequency?
200.0000000000 MHz

Create Example

Small Frequency Change

Current Anchor Frequency
200.0000000000 MHz

Total PPM Change from Anchor Frequency
0.000000

What is the amount in ppm to change the current frequency?
0.000000

Add PPM Subtract PPM

Procedure | Divider Combinations | Summary

Here are the device programming details for the new output frequency.

1) Read start-up frequency configuration (RFREQ, HS_DIV, and N1) from the device after power-up or register reset

Registers for the Current Configuration

Register	Data
7	0x01
8	0xC2
9	0xBB
10	0xFE

Result Log

disconnected from EVB 7:15 AM -- Program complete!

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

Procedure | Divider Combinations | **Summary**

Here is the summary of the programming procedure.

```
= 114.286571000 MHz
```

New Configuration

```
Output Frequency = 200.000000000 MHz
```

```
HS_DIV = 0x3 = 7
N1      = 0x3 = 4
```

```
fdco = f1 x HS_DIV x N1
      = 200.000000000 MHz x 7 x 4
      = 5.600000000 GHz
```

```
RFREQ = fdco / fxtal
       = 5.600000000 GHz / 114.286571000 MHz
       = 48.99963269 = 0x30FFE7ED8
```

Start-up Register Configuration

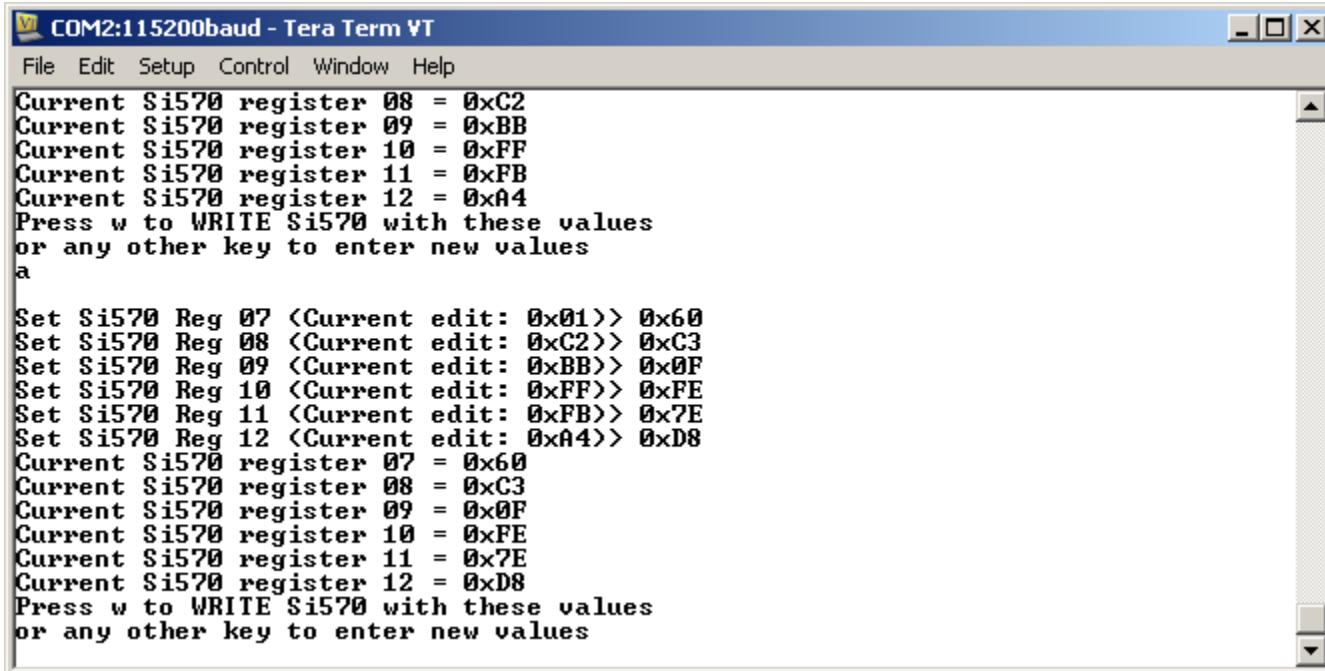
```
Register 7 = 0x01
Register 8 = 0xC2
Register 9 = 0xBB
Register 10 = 0xFE
Register 11 = 0xA8
Register 12 = 0x1C
```

New Register Configuration

```
Register 7 = 0x60
Register 8 = 0xC3
Register 9 = 0x0F
Register 10 = 0xFE
Register 11 = 0x7E
Register 12 = 0xD8
```

ZC702 Si570 Programming

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



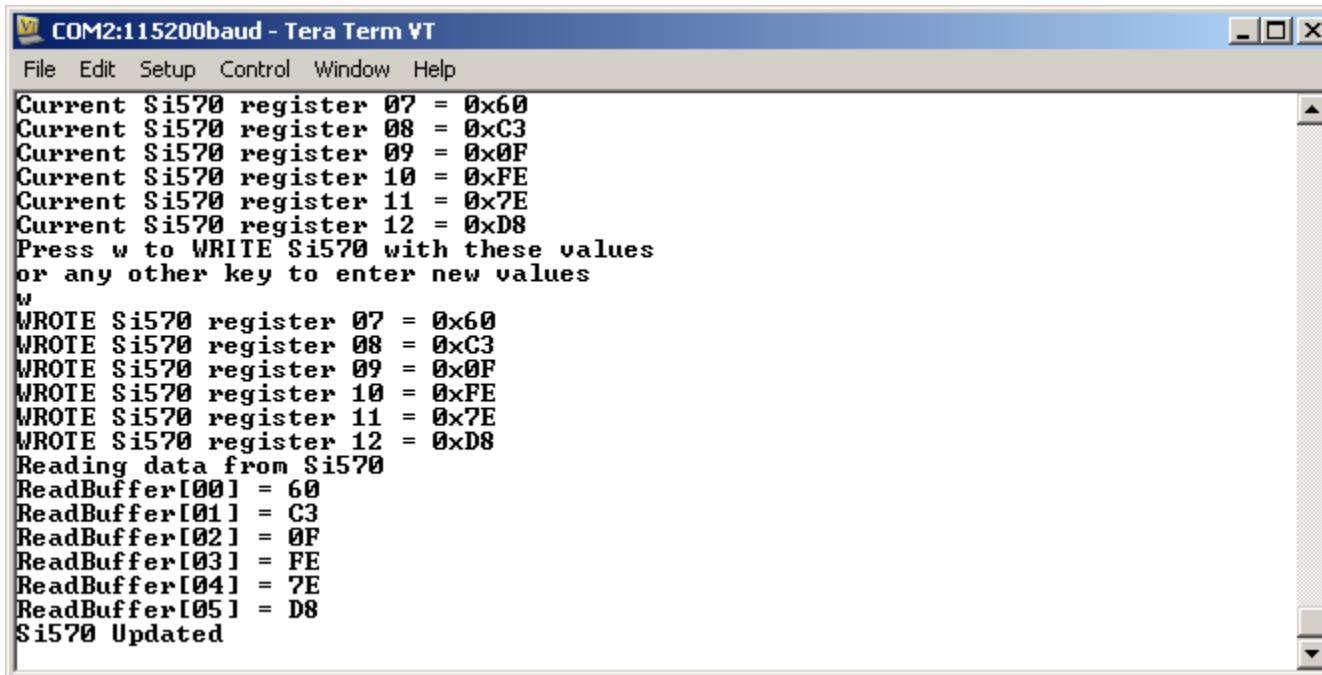
The screenshot shows a terminal window titled "COM2:115200baud - Tera Term VT". The window contains the following text:

```
File Edit Setup Control Window Help
Current Si570 register 08 = 0xC2
Current Si570 register 09 = 0xBB
Current Si570 register 10 = 0xFF
Current Si570 register 11 = 0xFB
Current Si570 register 12 = 0xA4
Press w to WRITE Si570 with these values
or any other key to enter new values
a

Set Si570 Reg 07 <Current edit: 0x01> 0x60
Set Si570 Reg 08 <Current edit: 0xC2> 0xC3
Set Si570 Reg 09 <Current edit: 0xBB> 0x0F
Set Si570 Reg 10 <Current edit: 0xFF> 0xFE
Set Si570 Reg 11 <Current edit: 0xFB> 0x7E
Set Si570 Reg 12 <Current edit: 0xA4> 0xD8
Current Si570 register 07 = 0x60
Current Si570 register 08 = 0xC3
Current Si570 register 09 = 0x0F
Current Si570 register 10 = 0xFE
Current Si570 register 11 = 0x7E
Current Si570 register 12 = 0xD8
Press w to WRITE Si570 with these values
or any other key to enter new values
```

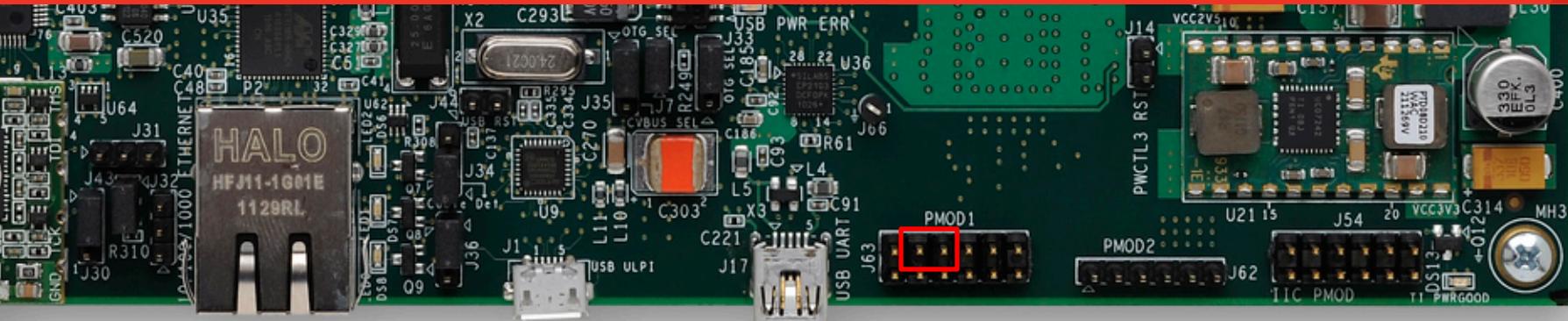
ZC702 Si570 Programming

- Si570 has been successfully updated



The screenshot shows a terminal window titled "COM2:115200baud - Tera Term VT". The window displays the following text:

```
Current Si570 register 07 = 0x60
Current Si570 register 08 = 0xC3
Current Si570 register 09 = 0x0F
Current Si570 register 10 = 0xFE
Current Si570 register 11 = 0x7E
Current Si570 register 12 = 0xD8
Press w to WRITE Si570 with these values
or any other key to enter new values
w
WROTE Si570 register 07 = 0x60
WROTE Si570 register 08 = 0xC3
WROTE Si570 register 09 = 0x0F
WROTE Si570 register 10 = 0xFE
WROTE Si570 register 11 = 0x7E
WROTE Si570 register 12 = 0xD8
Reading data from Si570
ReadBuffer[00] = 60
ReadBuffer[01] = C3
ReadBuffer[02] = 0F
ReadBuffer[03] = FE
ReadBuffer[04] = 7E
ReadBuffer[05] = D8
Si570 Updated
```



ZC702 Si570 Programming

- Measured frequency will be ~20.00 MHz

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