

# KC705 Si570 Programming

**March 2012**

# Revision History

Date	Version	Description
03/02/12	13.4	Initial version.

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# KC705 Si570 Programming Overview

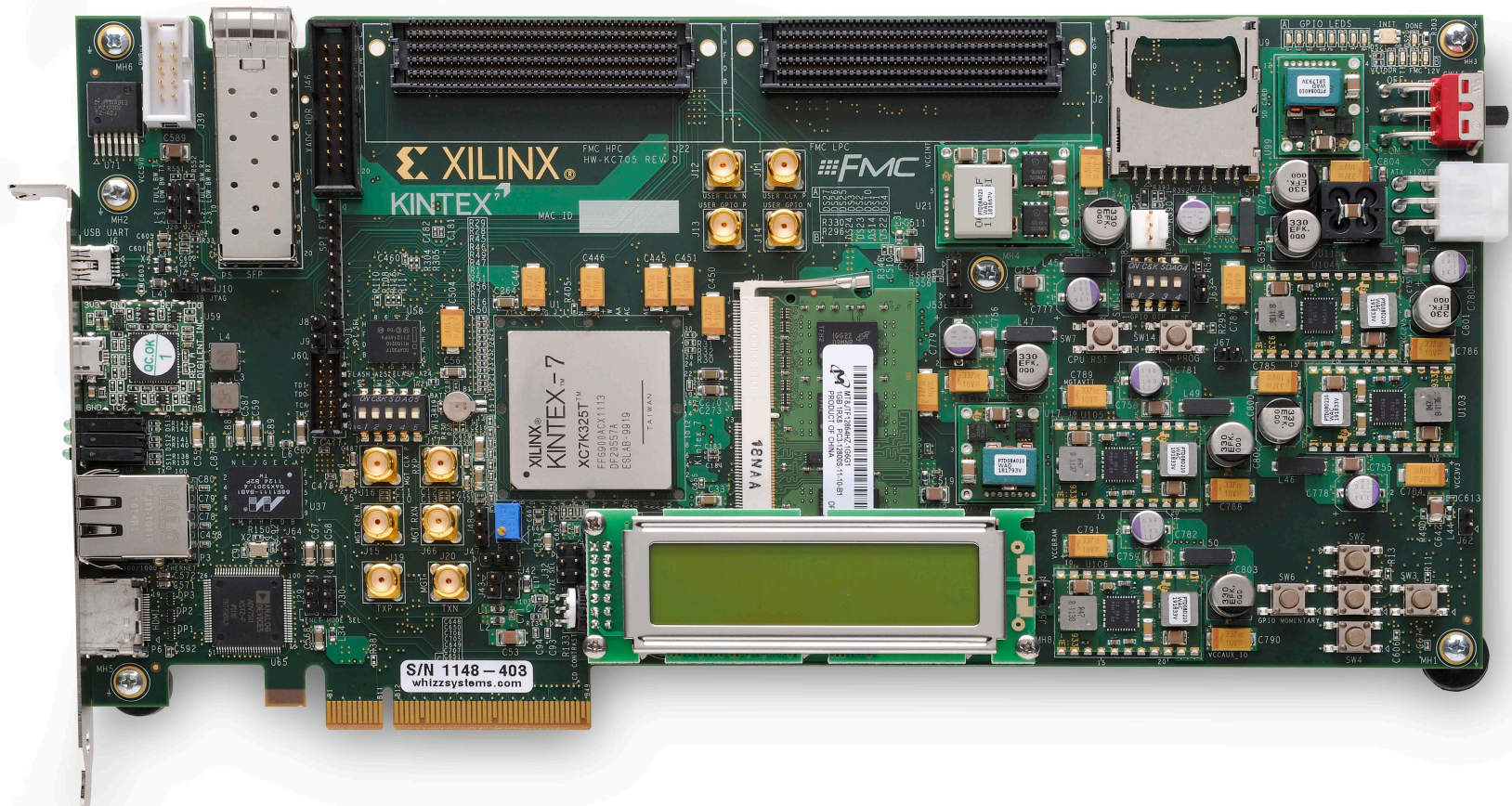
- **Xilinx KC705 Board**
- **Software Requirements**
- **Setup for the KC705 Si570 Programming**
- **Programming the Si570**
- **Correcting the Frequency**
- **References**

# KC705 Si570 Programming Overview

## ▪ Description

- The KC705 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 KC705 Board



Note: Presentation applies to the KC705

# ISE Software Requirements

- **Xilinx ISE 13.4 software**

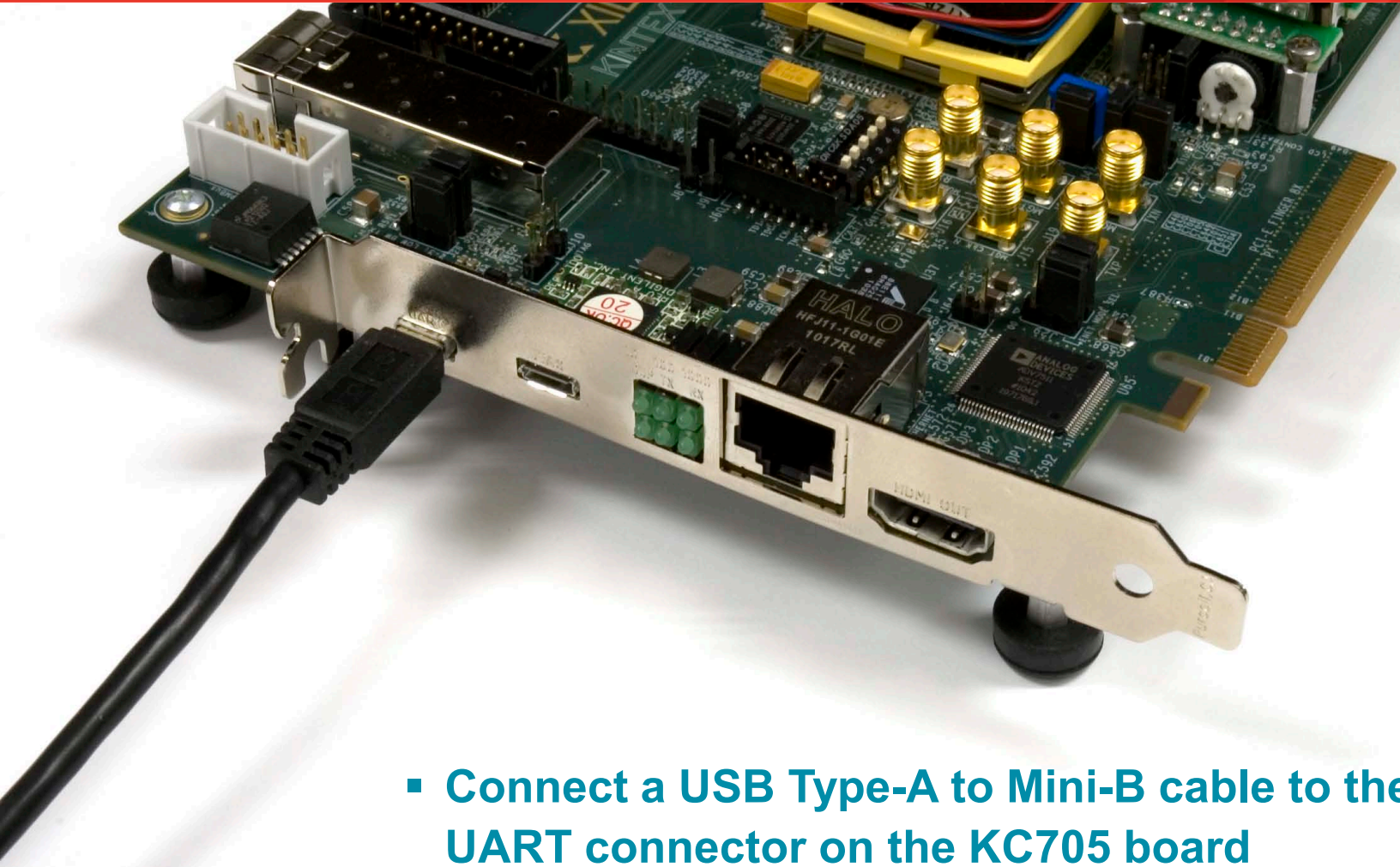


# ChipScope Pro Software Requirement

- **Xilinx ChipScope Pro 13.4 software**



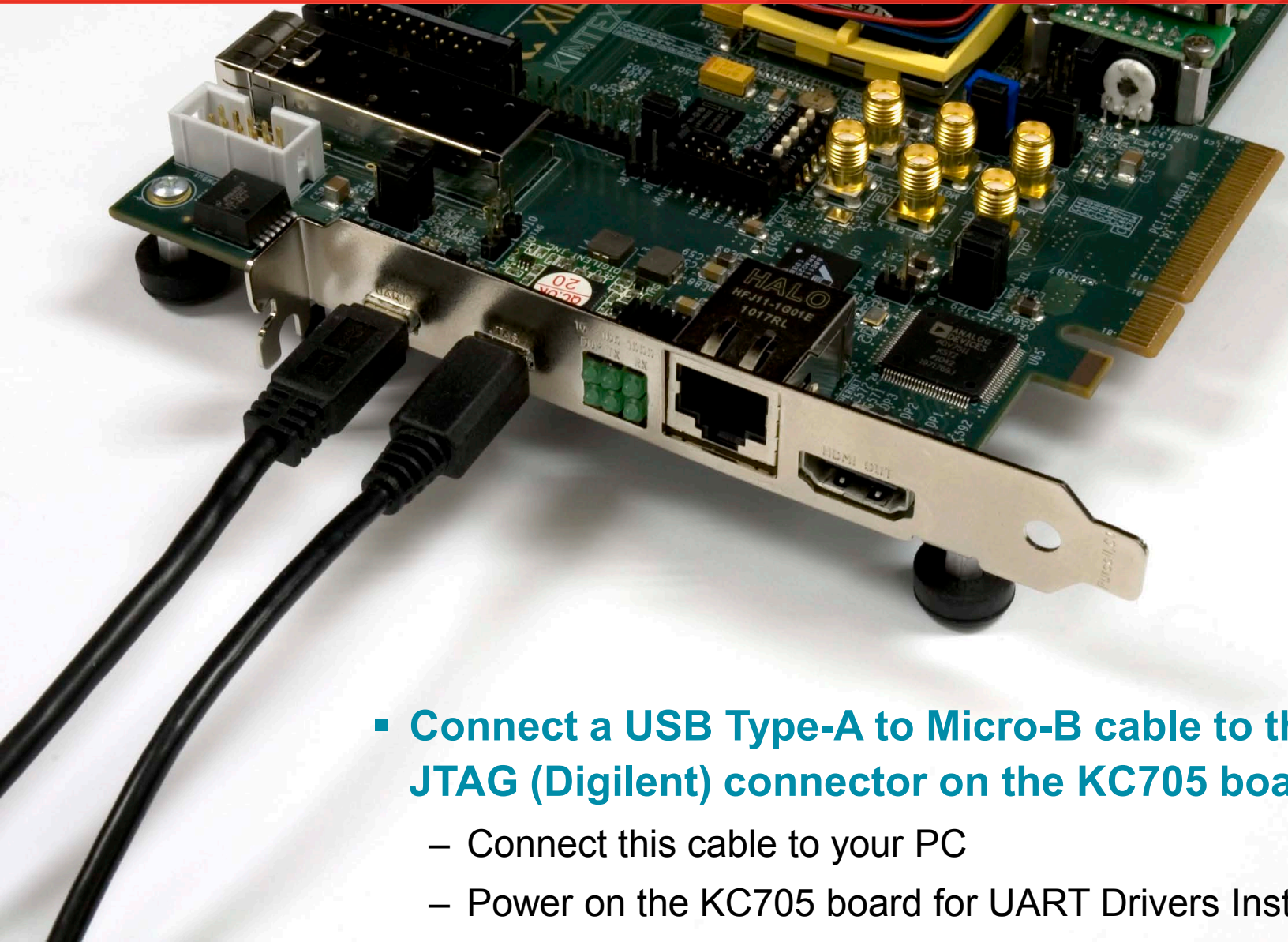
# KC705 Setup



- **Connect a USB Type-A to Mini-B cable to the USB UART connector on the KC705 board**
  - Connect this cable to your PC



# KC705 Setup

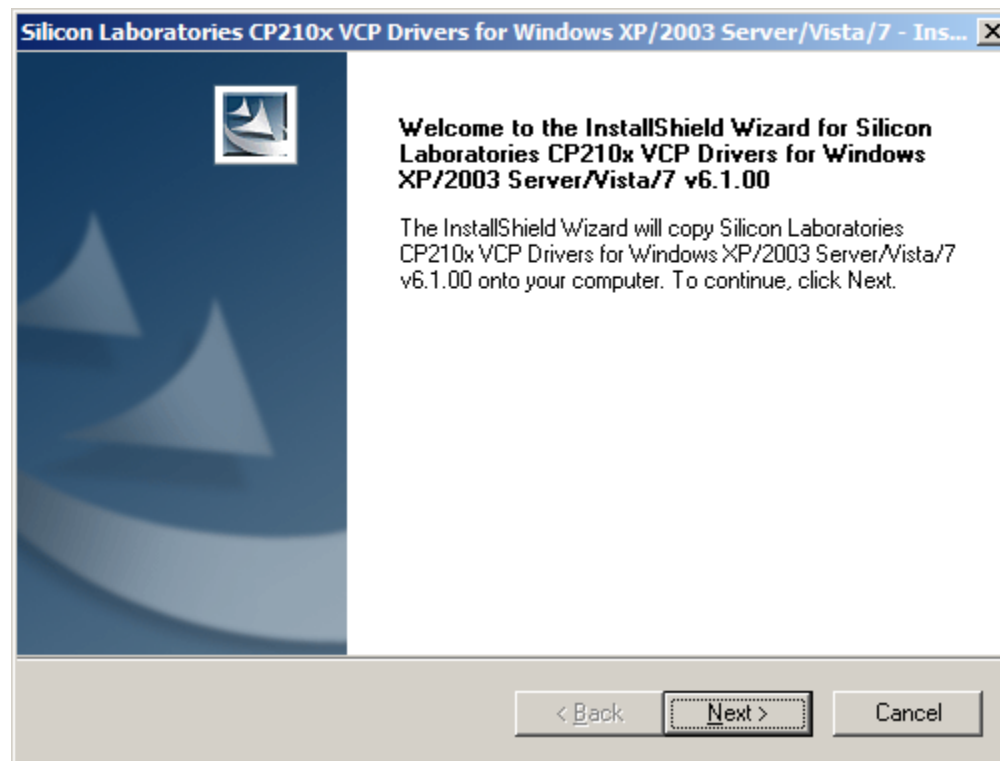


- **Connect a USB Type-A to Micro-B cable to the USB JTAG (Digilent) connector on the KC705 board**
  - Connect this cable to your PC
  - Power on the KC705 board for UART Drivers Installation

# KC705 Setup

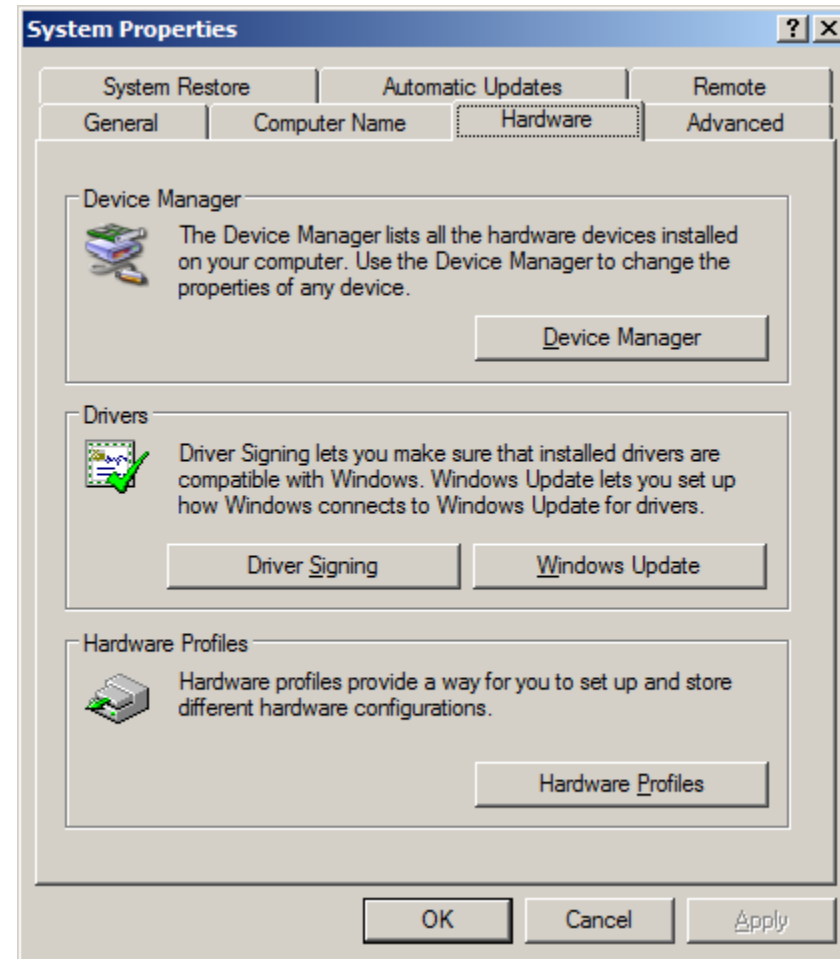
## ▪ Install USB UART Drivers

- [CP210x VCP Win XP S2K3 Vista 7.exe](#)



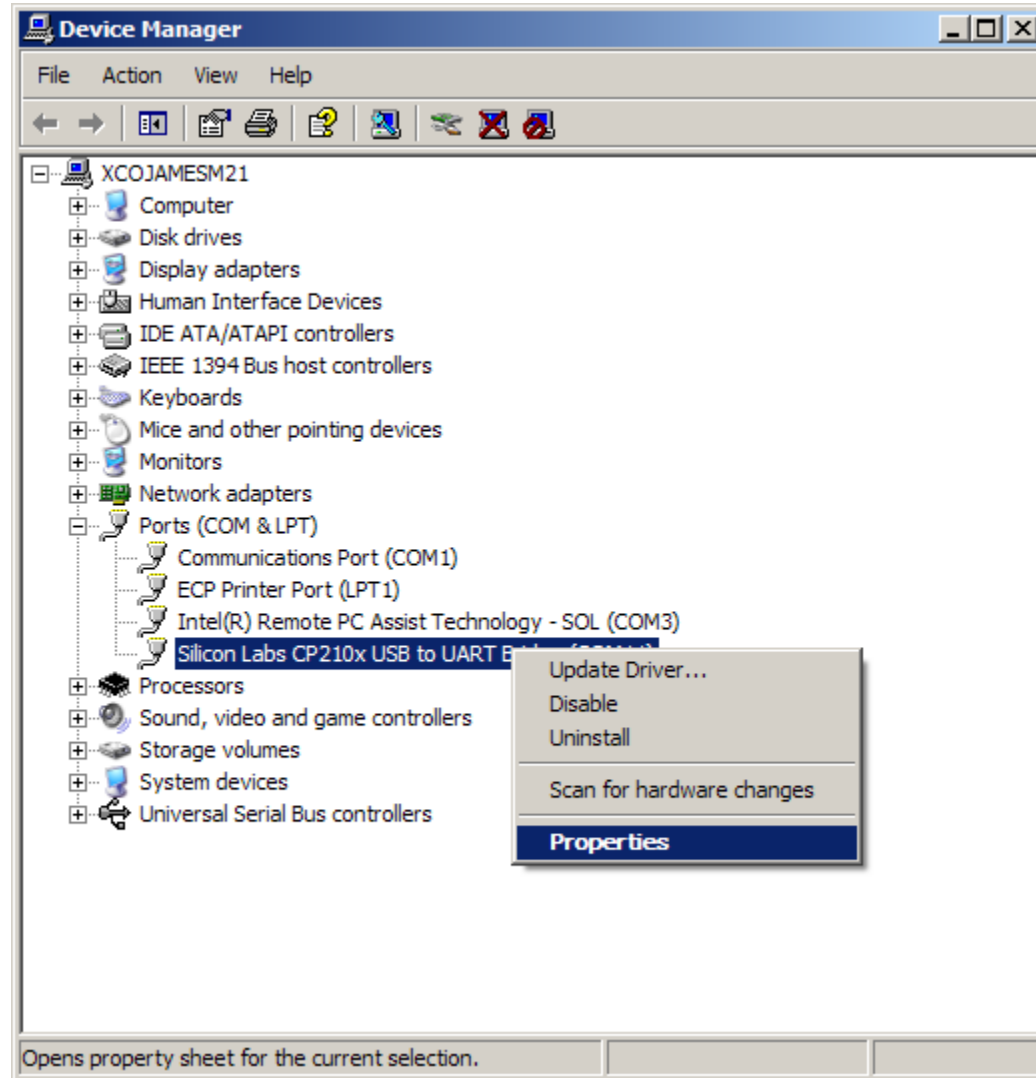
# KC705 Setup

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



# KC705 Setup

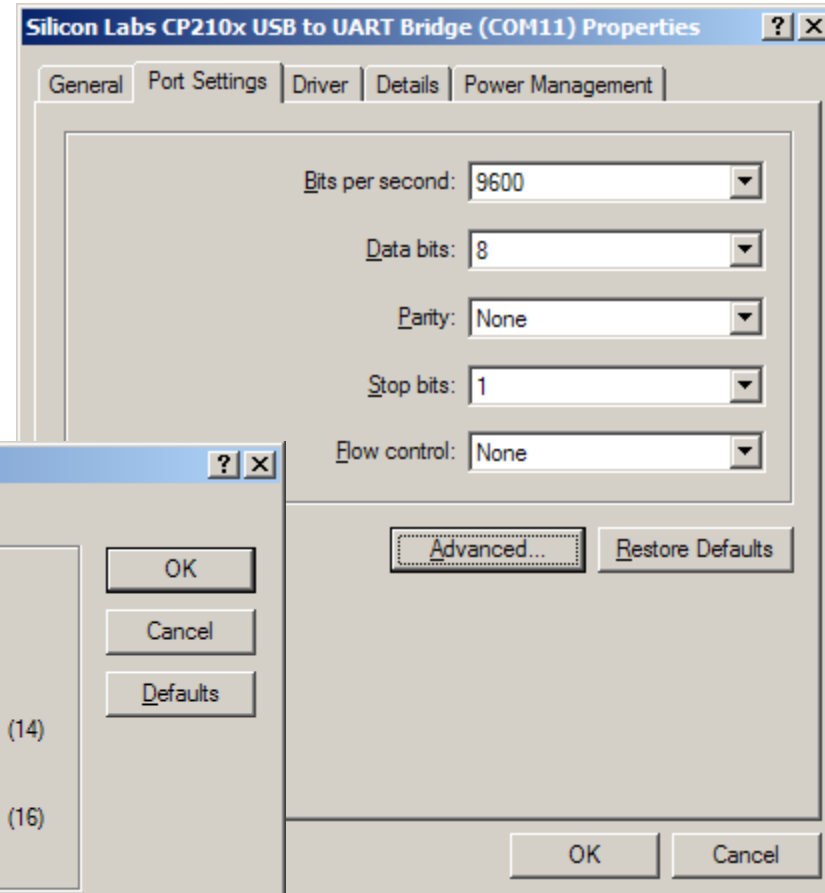
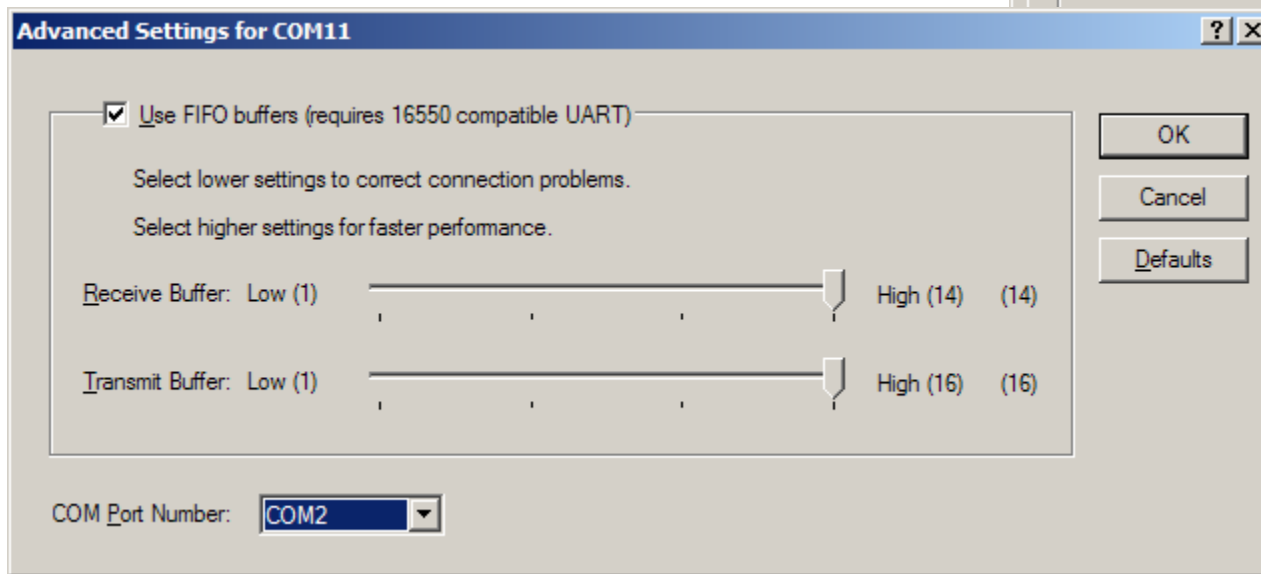
- **Expand the Ports Hardware**
  - Right-click on **Silicon Labs CP210x USB to UART Bridge** and select Properties



# KC705 Setup

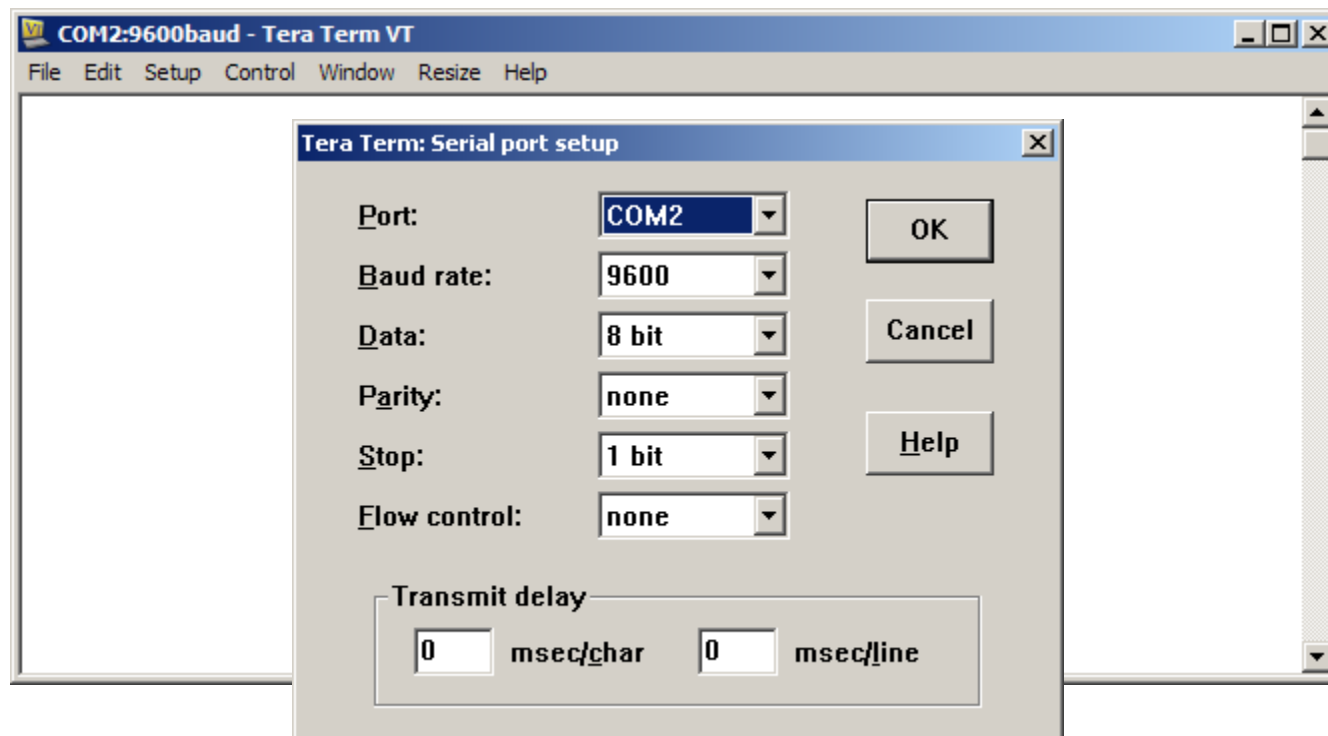
## ■ Under Port Settings tab

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



# KC705 Setup

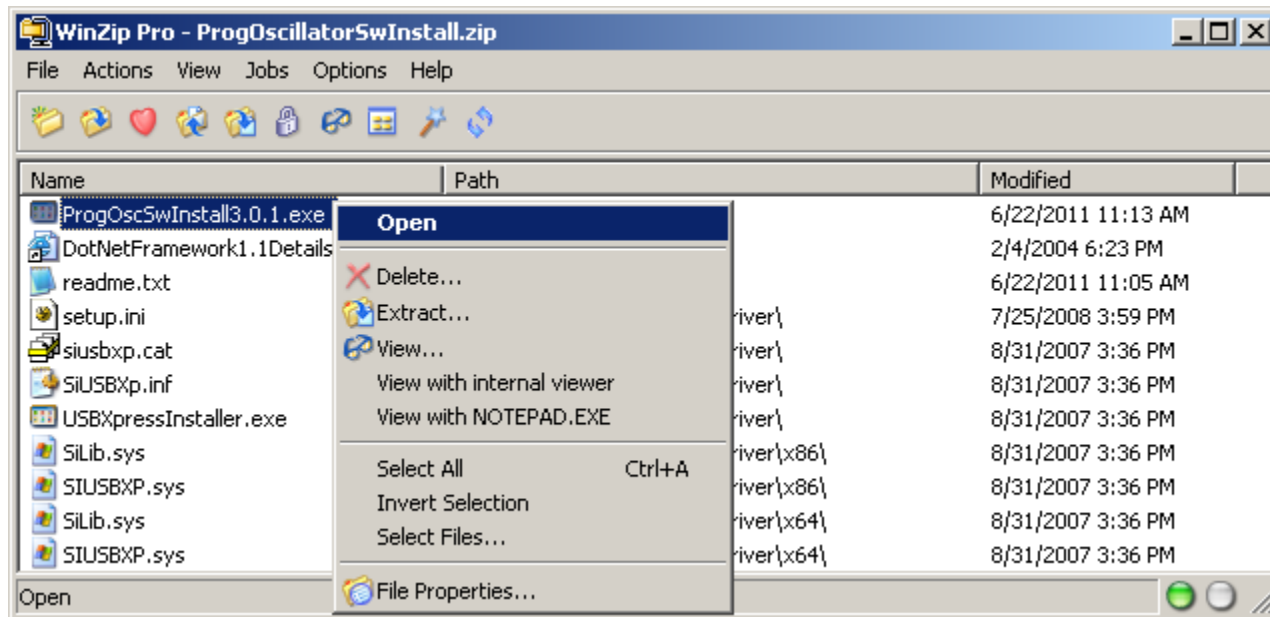
- **Board Power must be on before starting Tera Term**
- **Start the Terminal Program**
  - Select your USB Com Port
  - Set the baud to 9600



**Note:** Tera Term may need to be restarted if board power is cycled

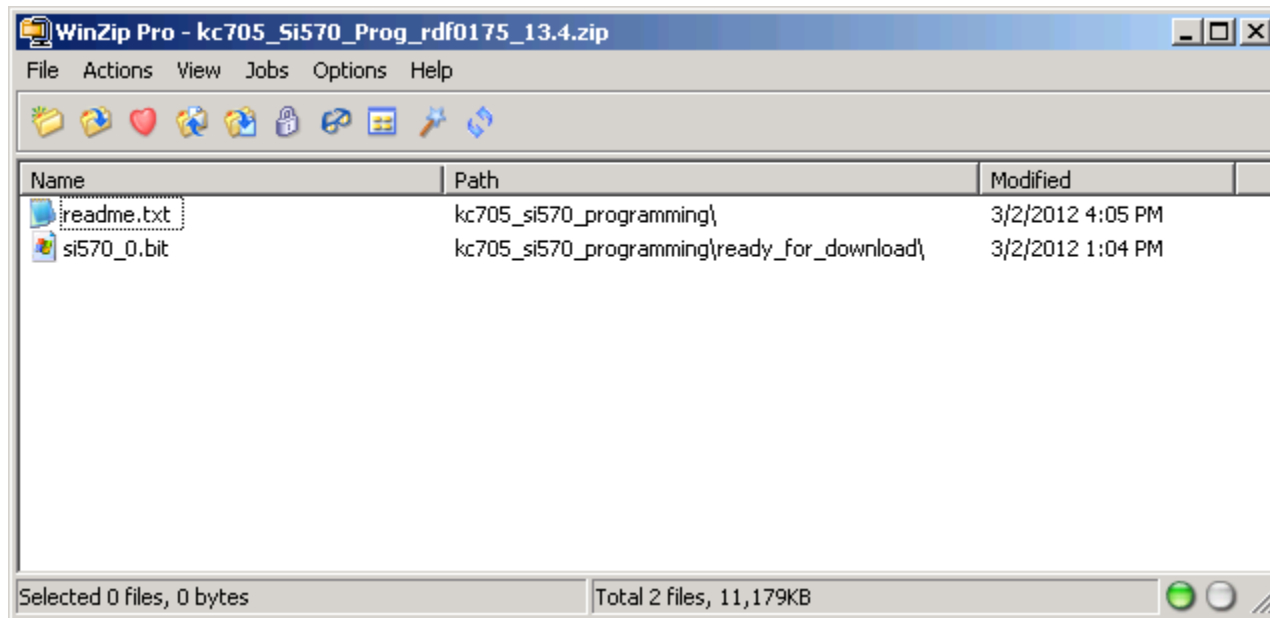
# Si Labs Programmable Oscillator Calculator

- Download [ProgOscillatorSwInstall.zip](#)
  - Install “ProgOscSwInstall3.0.1.exe” only



# Setup for KC705 Si570 Programming

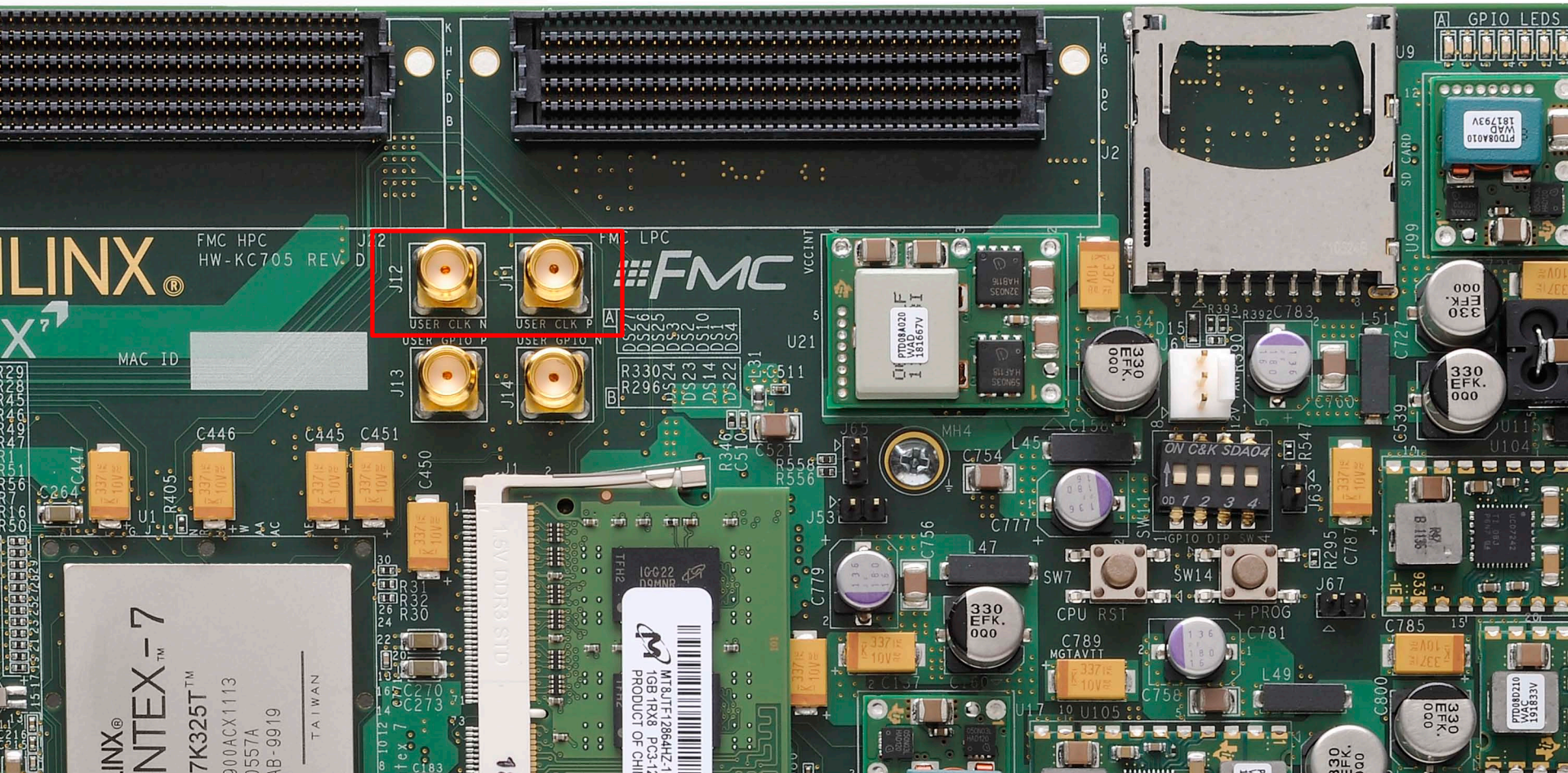
- **Unzip the KC705 Si570 Programming Design Files (13.4 CES) to your C:\ drive**
  - Available through <http://www.xilinx.com/kc705>





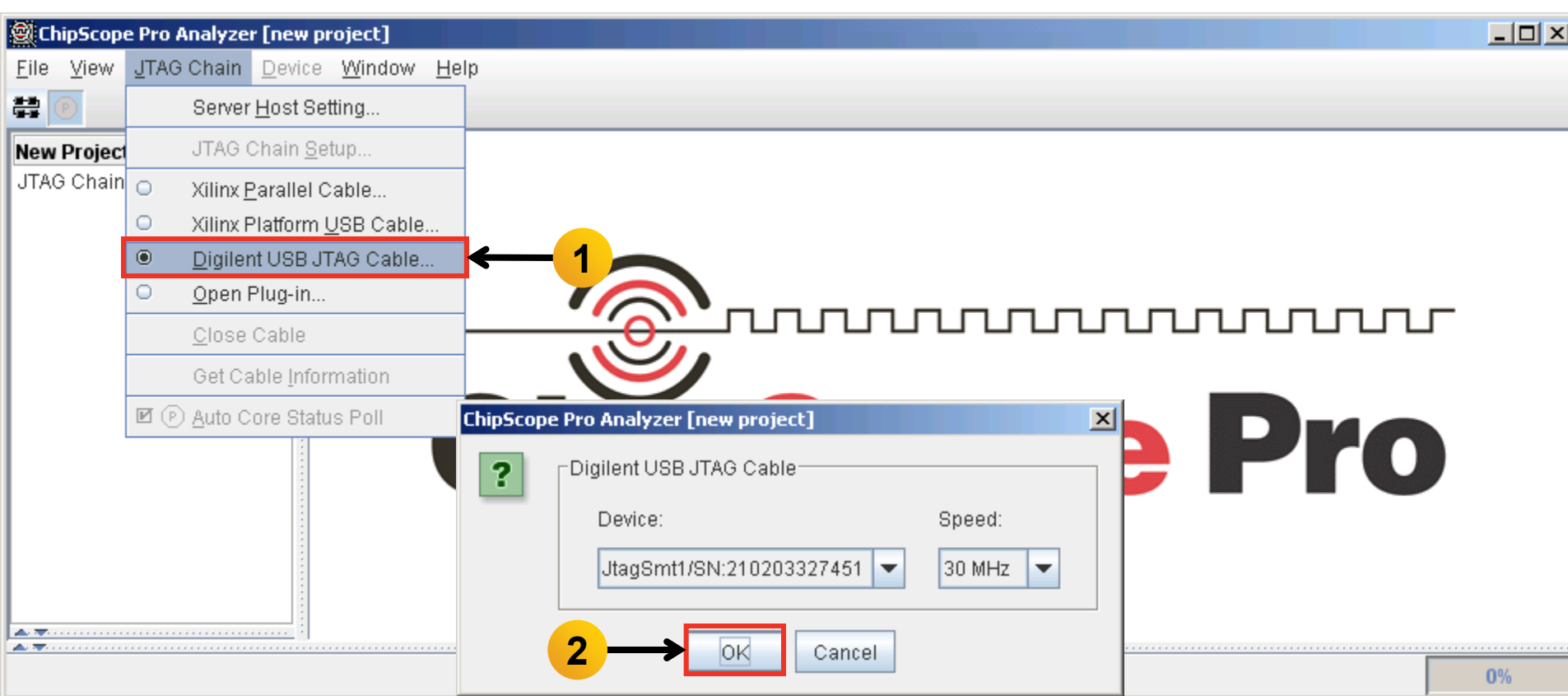
# KC705 Si570 Programming

- Connect a scope to J11 and J12 to measure the frequency
- Power on frequency is 156.25 MHz



# KC705 Si570 Programming

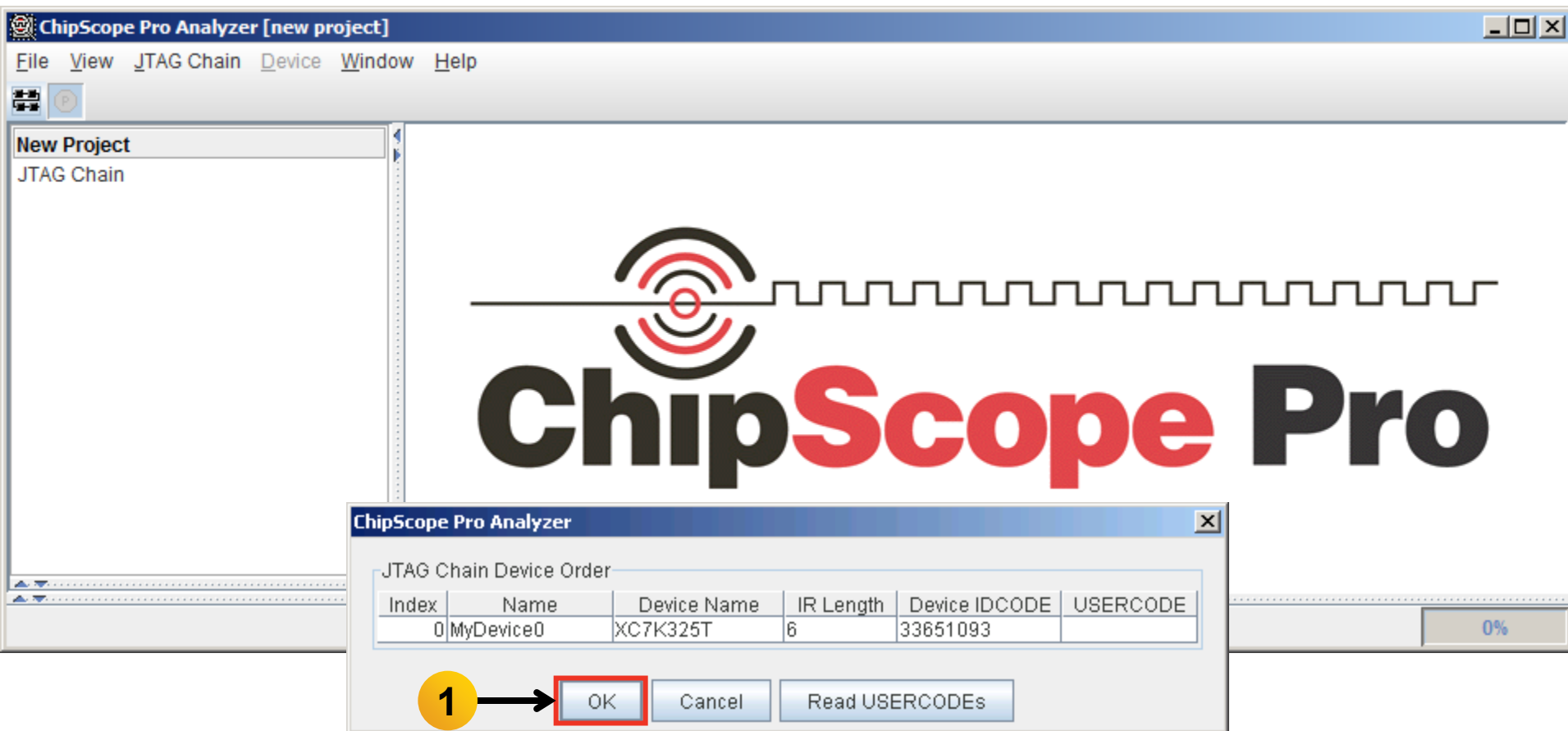
- Open ChipScope Pro and select JTAG Chain -> Digilent USB Cable... (1)
- Verify 30 MHz operation and click OK (2)



Note: Presentation applies to the KC705

# KC705 Si570 Programming

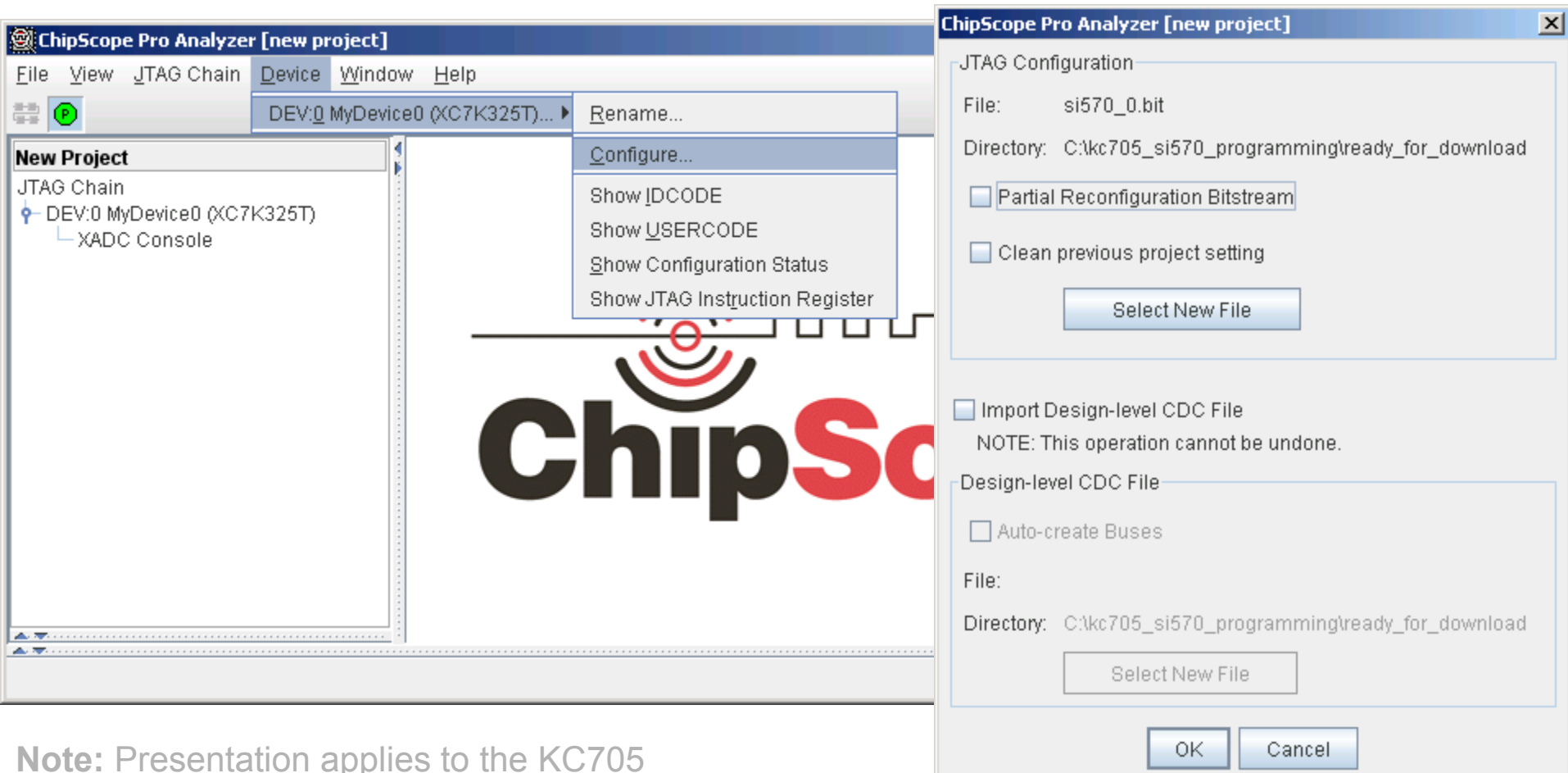
- Click OK (1)



Note: Presentation applies to the KC705

# KC705 Si570 Programming

- **Select Device** → **DEV:0 MyDevice0 (XC7K325T)** → **Configure...**
- **Select** <Design Path>\ready\_for\_download\si570\_0.bit



**ChipScope Pro Analyzer [new project]**

File View JTAG Chain **Device** Window Help

DEV:0 MyDevice0 (XC7K325T) ...

- Rename...
- Configure...**
- Show IDCODE
- Show USERCODE
- Show Configuration Status
- Show JTAG Instruction Register

**JTAG Configuration**

File: si570\_0.bit

Directory: C:\kc705\_si570\_programming\ready\_for\_download

Partial Reconfiguration Bitstream

Clean previous project setting

Select New File

Import Design-level CDC File

NOTE: This operation cannot be undone.

**Design-level CDC File**

Auto-create Buses

File:

Directory: C:\kc705\_si570\_programming\ready\_for\_download

Select New File

OK Cancel

**ChipScope**

**Note:** Presentation applies to the KC705

# KC705 Si570 Programming

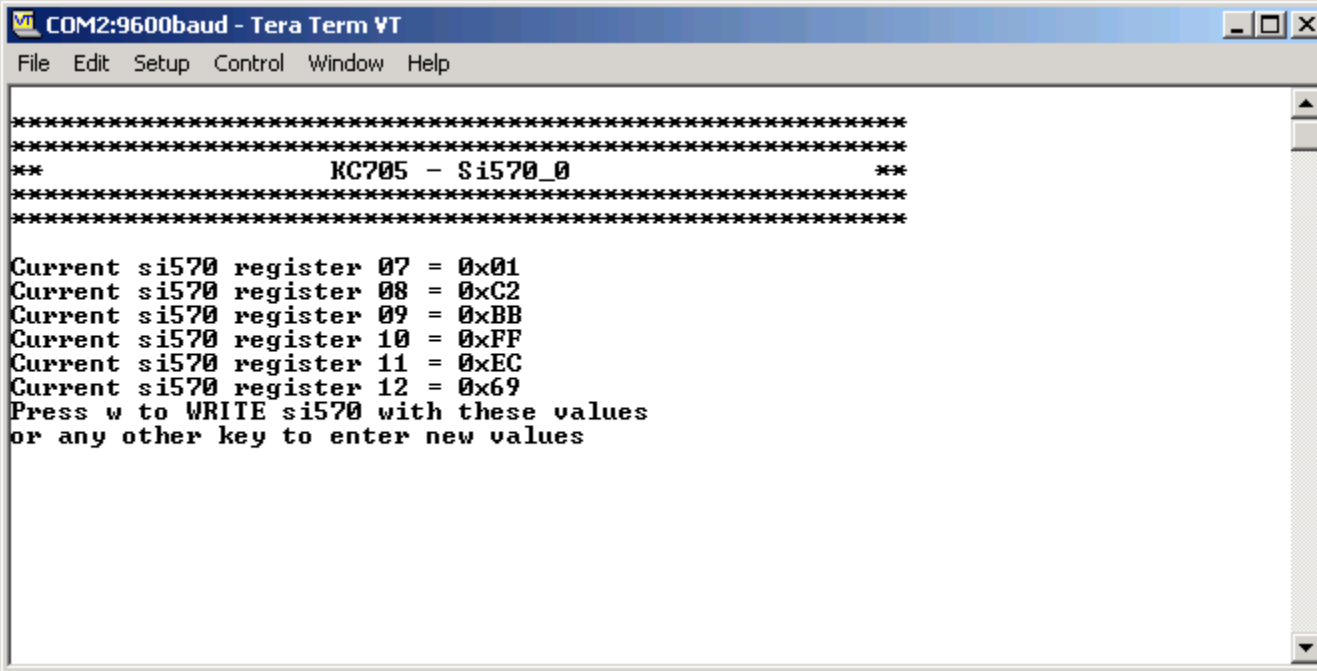
- **For this example, Si570\_0 will be reprogrammed from 156.25 to 200 MHz**
  - This requires use of the SiLabs Programmable Oscillator Calculator
- **To use the SiLabs calculator, the correct  $f_{XTAL}$  value for each Si570 must be determined, using this equation:**

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

- **For this equation,**
  - $F_{out} = 156.25$ , the preprogrammed frequency of the Si570s on the KC705
- **We need to determine:**
  - RFREQ
  - HSDIV
  - N1
- **These can be found by reading back the registers on the Si570**

# KC705 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 0x01C2BBFFEC69



```
COM2:9600baud - Tera Term VT
File Edit Setup Control Window Help
*****
*****
**                KC705 - Si570_0                **
*****
*****
Current si570 register 07 = 0x01
Current si570 register 08 = 0xC2
Current si570 register 09 = 0xBB
Current si570 register 10 = 0xFF
Current si570 register 11 = 0xEC
Current si570 register 12 = 0x69
Press w to WRITE si570 with these values
or any other key to enter new values
```

**Note:** The values for your board will vary

# KC705 Si570 Programming

- The value, 0x01C2BBFFEC69, 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]							

# KC705 Si570 Programming

- Extract the HS\_DIV and N1 values from 0x01C2BBFFEC69 :
- 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]	<p><b>DCO High Speed Divider.</b></p> <p>Sets value for high speed divider that takes the DCO output <math>f_{OSC}</math> as its clock input.</p> <p>000 = 4            001 = 5            010 = 6            011 = 7            100 = Not used.            101 = 9            110 = Not used.            111 = 11</p>
4:0	N1[6:2]	<p><b>CLKOUT Output Divider.</b></p> <p>Sets value for CLKOUT output divider. Allowed values are [1] and [2, 4, 6, ..., <math>2^7</math>]. 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.</p> <p>0000000 = 1            1111111 = <math>2^7</math></p>



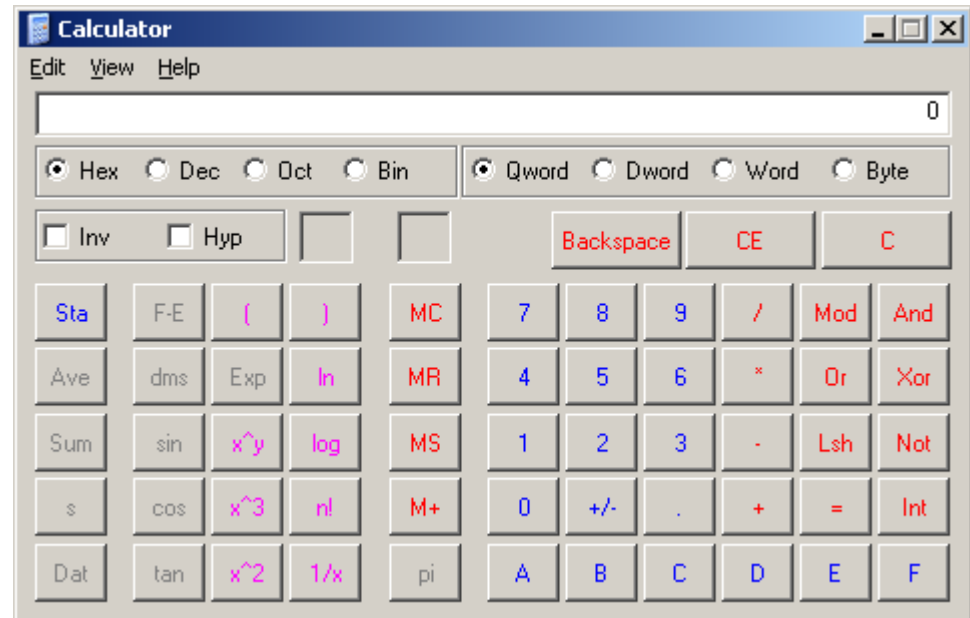
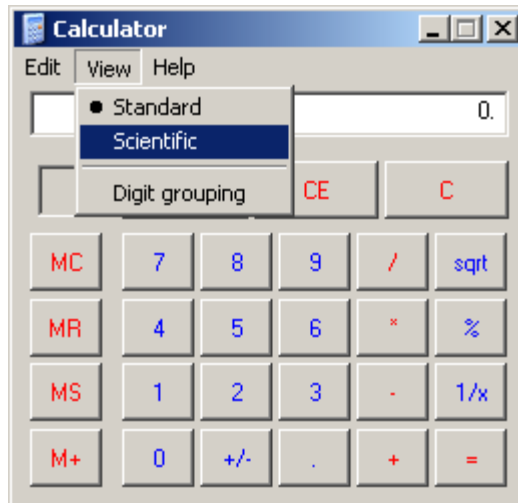
# KC705 Si570 Programming

- Extract the RFREQ value from 0x01C2BBFFEC69:
  - 02BBFFEC69

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]							

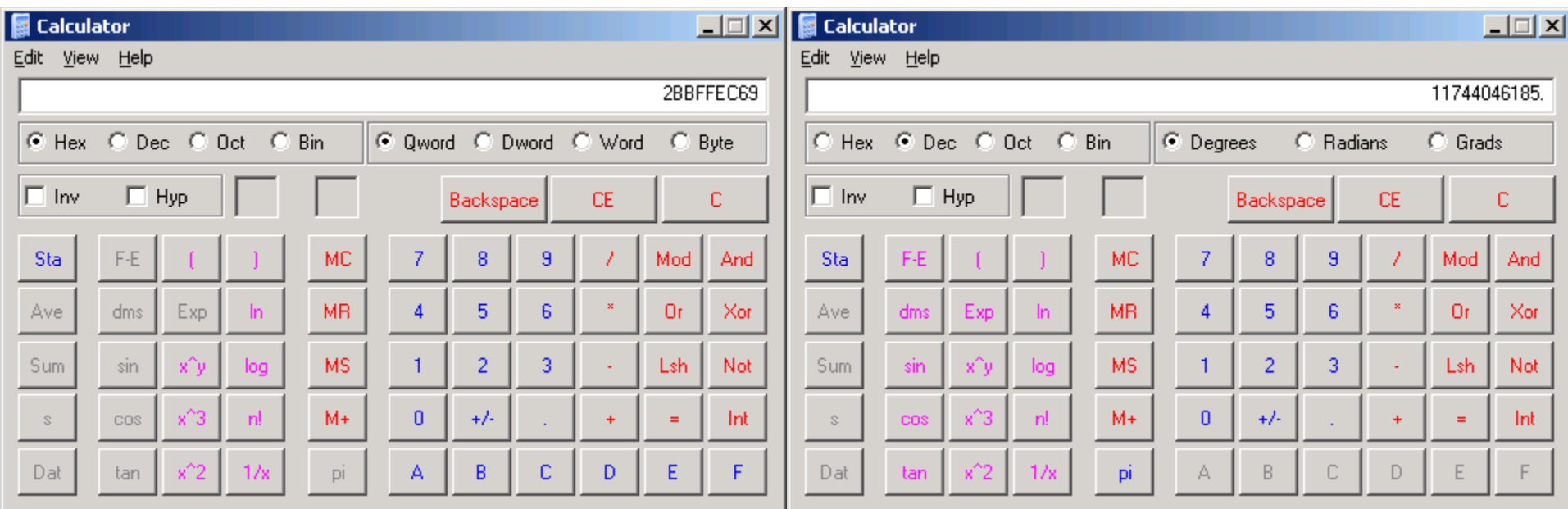
# KC705 Si570 Programming

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



# KC705 Si570 Programming

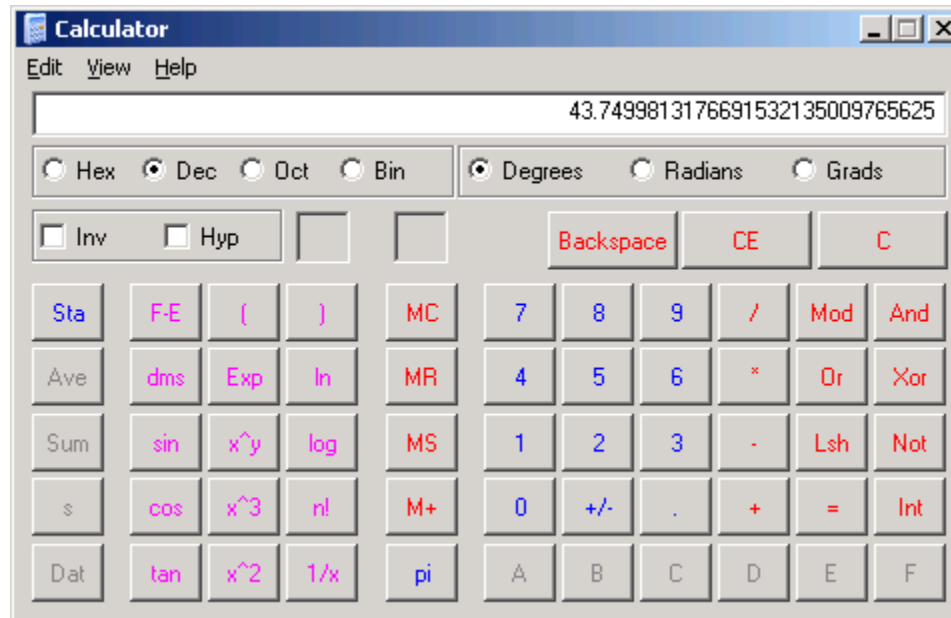
- Enter or paste the RFREQ value, 02BBFFEC69:
- Convert it to Decimal



**Note:** Presentation applies to the KC705

# KC705 Si570 Programming

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



# KC705 Si570 Programming

- **For this equation,**

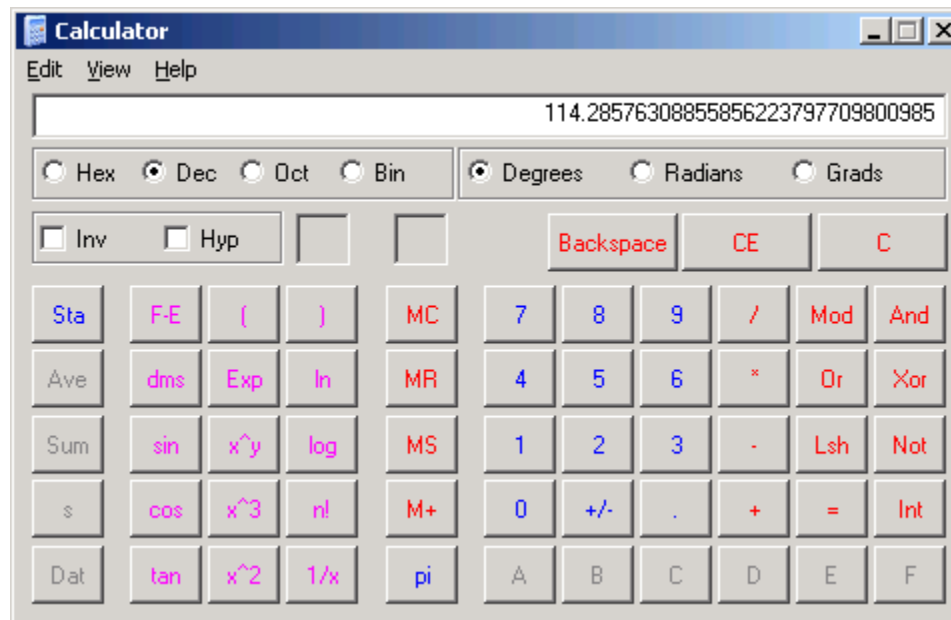
- $F_{\text{out}} = 156.25$
- $\text{RFREQ} = 43.7499813176691532135009765625$
- $\text{HSDIV} = 4$
- $\text{N1} = 8$
- $F_{\text{out}} \times \text{HSDIV} \times \text{N1} = 5000$
- $f_{\text{XTAL}} = 5000 / \text{RFREQ}$

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

# KC705 Si570 Programming

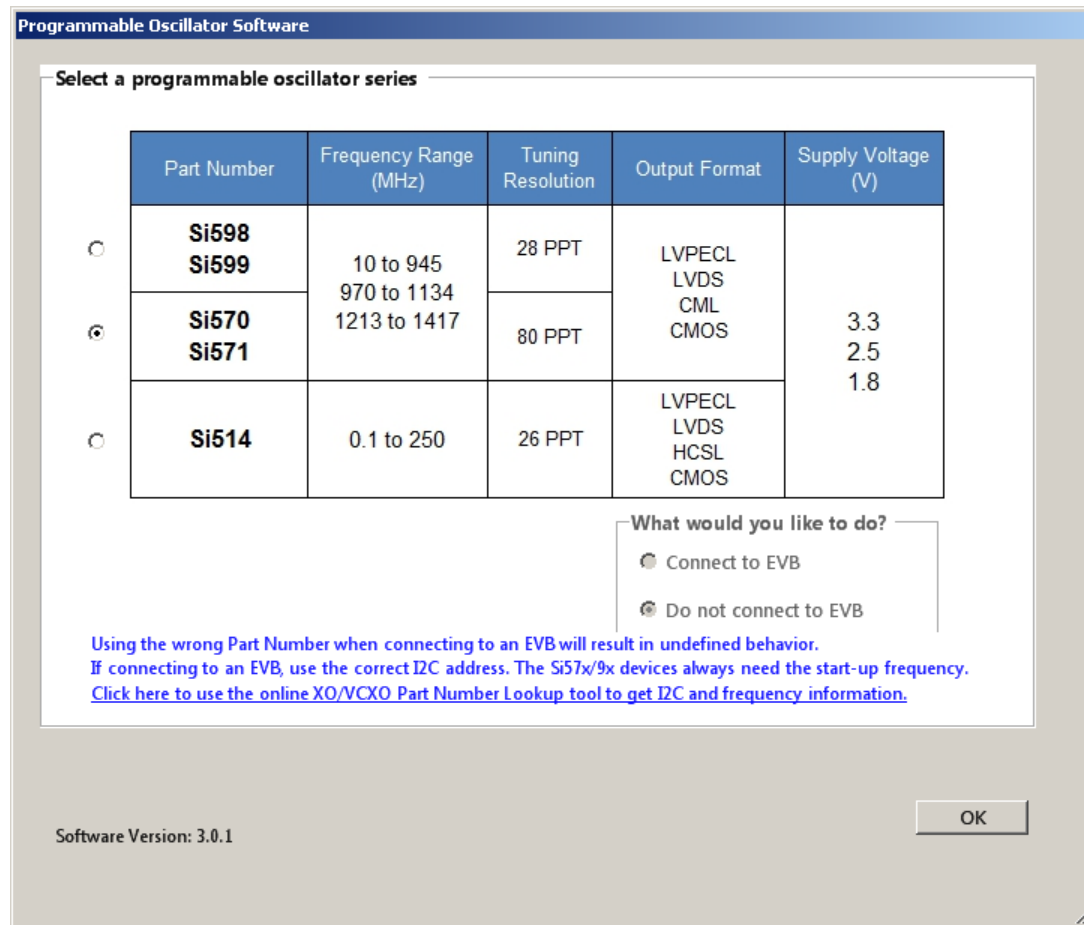
- **For this equation,**

- Divide 43.7499813176691532135009765625 by 5000
- Take the reciprocal
- $f_{\text{XTAL}} = 114.28576308855856223797709800985$
- Ctrl-C to copy this value



# KC705 Si570 Programming

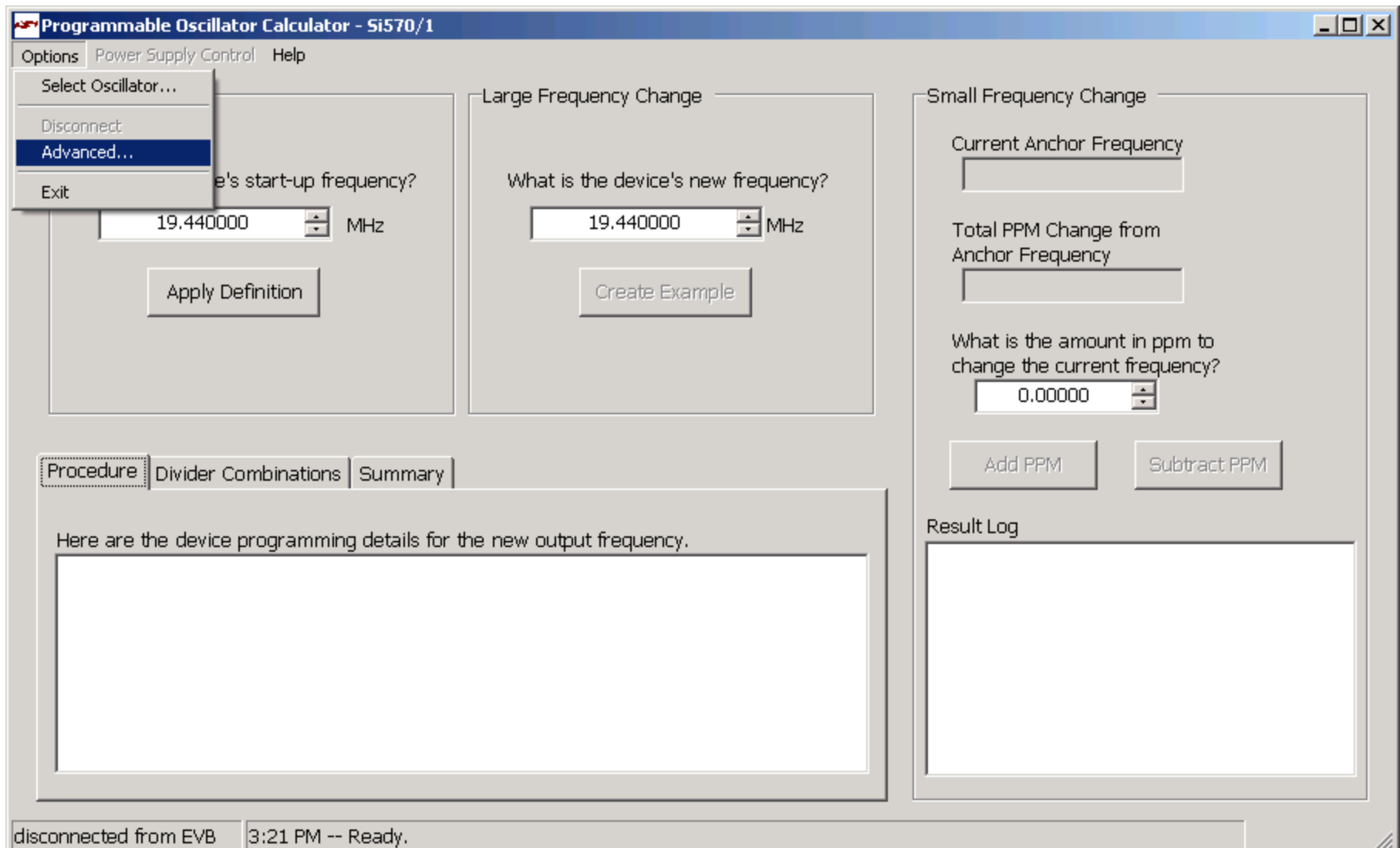
- Open the SiLabs Programmable Oscillator Calculator
  - Select the Si570 and click OK



Note: Presentation applies to the KC705

# KC705 Si570 Programming

## ▪ Select Options -> Advanced...



**Programmable Oscillator Calculator - Si570/1**

Options | Power Supply Control | Help

- Select Oscillator...
- Disconnect
- Advanced...**
- Exit

What is the device's start-up frequency?  
19.440000 MHz  
Apply Definition

Large Frequency Change  
What is the device's new frequency?  
19.440000 MHz  
Create Example

Small Frequency Change  
Current Anchor Frequency  
Total PPM Change from Anchor Frequency  
What is the amount in ppm to change the current frequency?  
0.00000  
Add PPM | Subtract PPM

Procedure | Divider Combinations | Summary

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

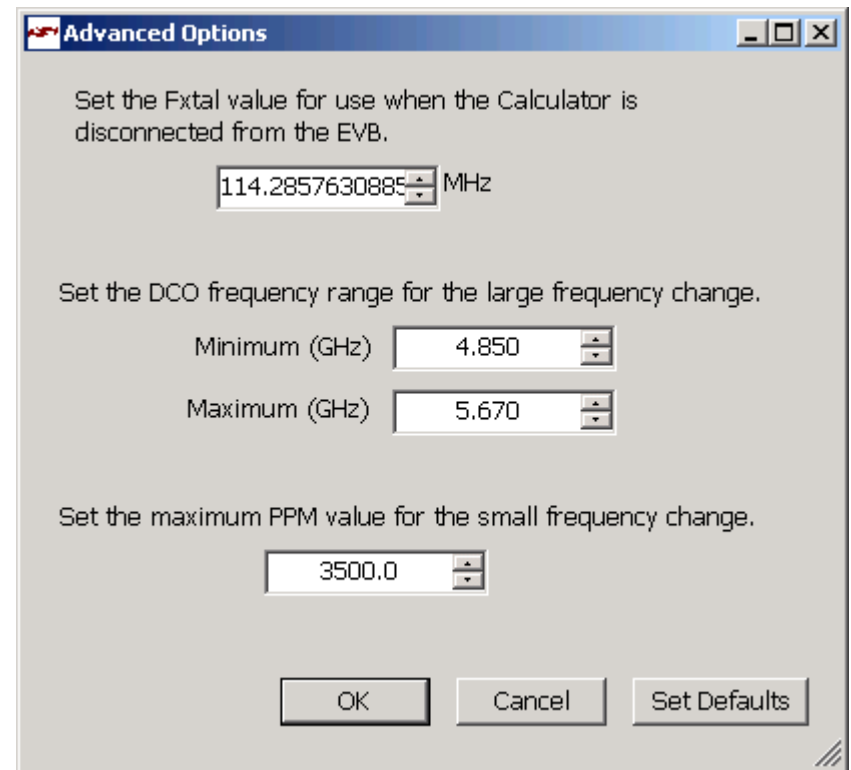
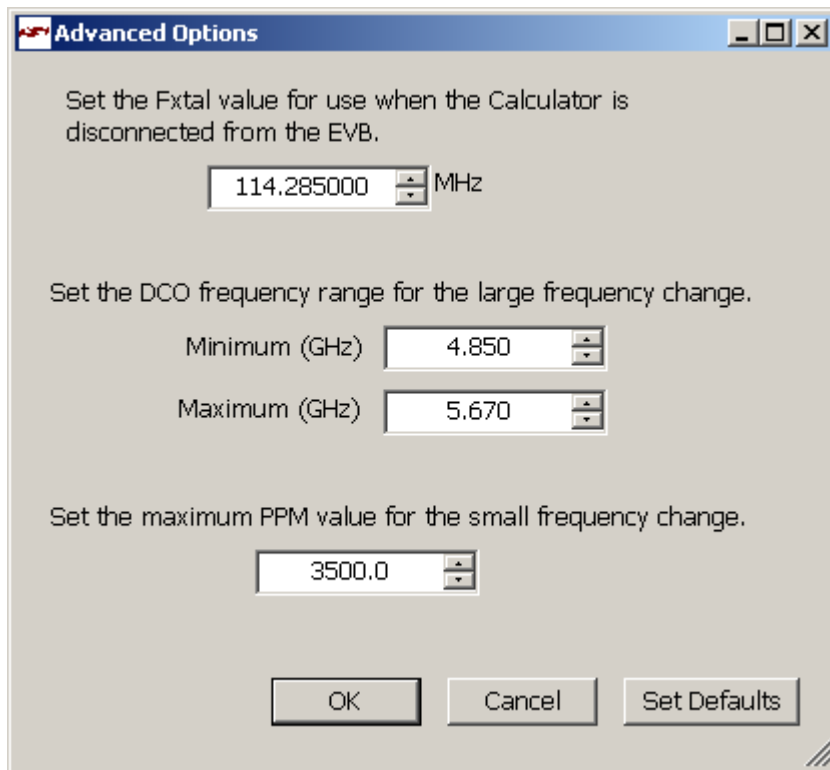
Result Log

disconnected from EVB | 3:21 PM -- Ready.



# KC705 Si570 Programming

- Paste in the value of  $f_{XTAL}$ 
  - The calculator will round the number appropriately
  - Click OK



# KC705 Si570 Programming

- Enter 156.25 and click the Apply Definition button

The screenshot shows the 'Programmable Oscillator Calculator - Si570/1' window. The interface is divided into several sections:

- Definition:** A section with the question 'What is the device's start-up frequency?'. A text box contains '156.250000' followed by 'MHz'. Below it is a button labeled 'Apply Definition'.
- Large Frequency Change:** A section with the question 'What is the device's new frequency?'. A text box contains '19.440000' followed by 'MHz'. Below it is a button labeled 'Create Example'.
- Small Frequency Change:** A section with 'Current Anchor Frequency' set to '156.250000 MHz'. Below it is 'Total PPM Change from Anchor Frequency' (empty text box). Further down is the question 'What is the amount in ppm to change the current frequency?' with a text box containing '0.00000'. At the bottom of this section are two buttons: 'Add PPM' and 'Subtract PPM'.
- Procedure:** A section with tabs for 'Procedure', 'Divider Combinations', and 'Summary'. The 'Procedure' tab is active, showing the text 'Here are the device programming details for the new output frequency.' followed by a large empty text area.
- Result Log:** A section with a large empty text area.
- Status Bar:** At the bottom left, it says 'disconnected from EVB'. In the center, it says '3:24 PM -- Apply completed'.

# KC705 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?

156.250000 MHz

Apply Definition

**Large Frequency Change**

What is the device's new frequency?

200.000000 MHz

Create Example

**Small Frequency Change**

Current Anchor Frequency

200.000000 MHz

Total PPM Change from Anchor Frequency

0.000000

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

0.00000

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

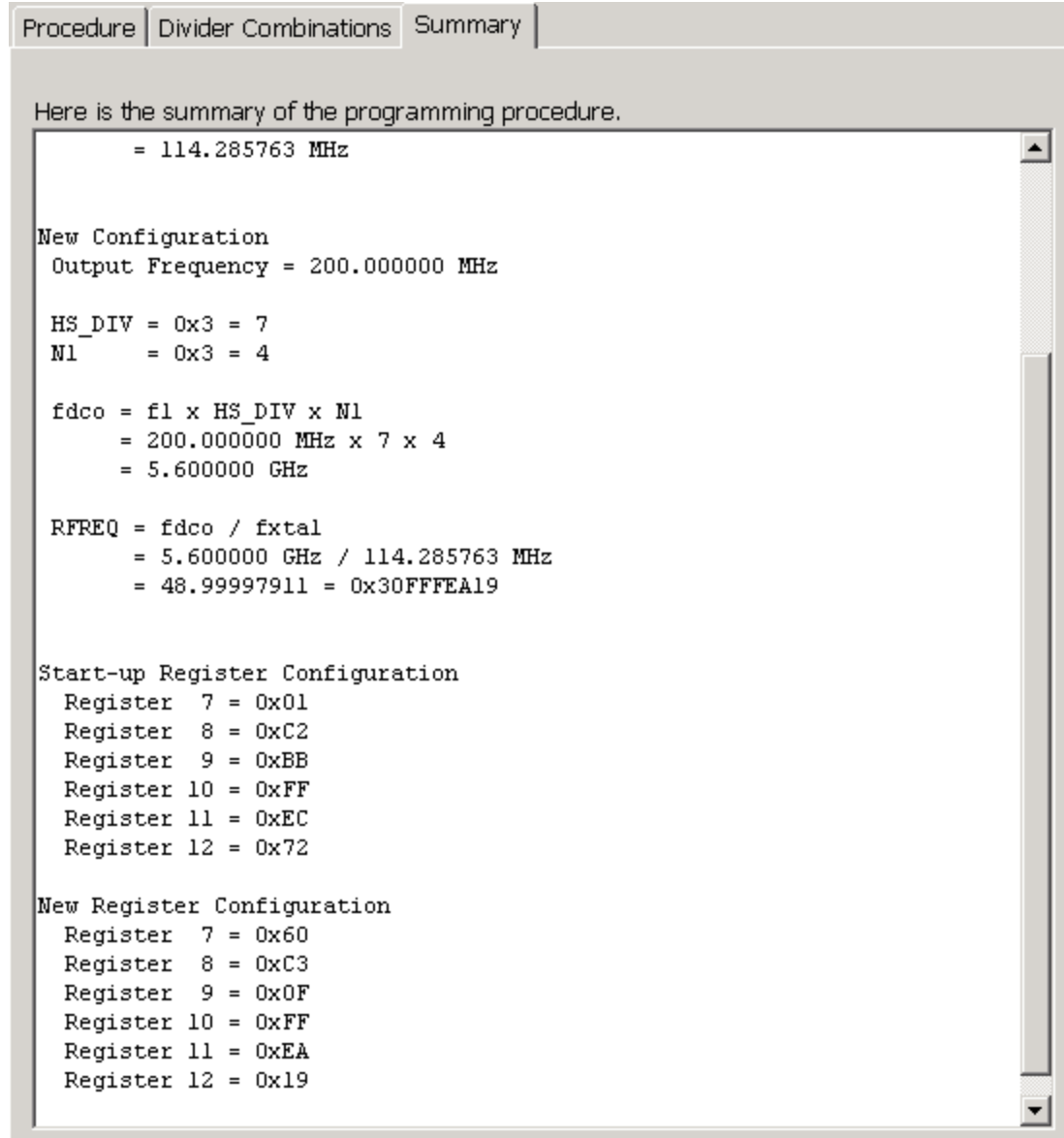
Register	Data
7	0x01
8	0xC2
9	0xBB
10	0xFF

Result Log

disconnected from EVB 3:25 PM -- Program complete!

# KC705 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



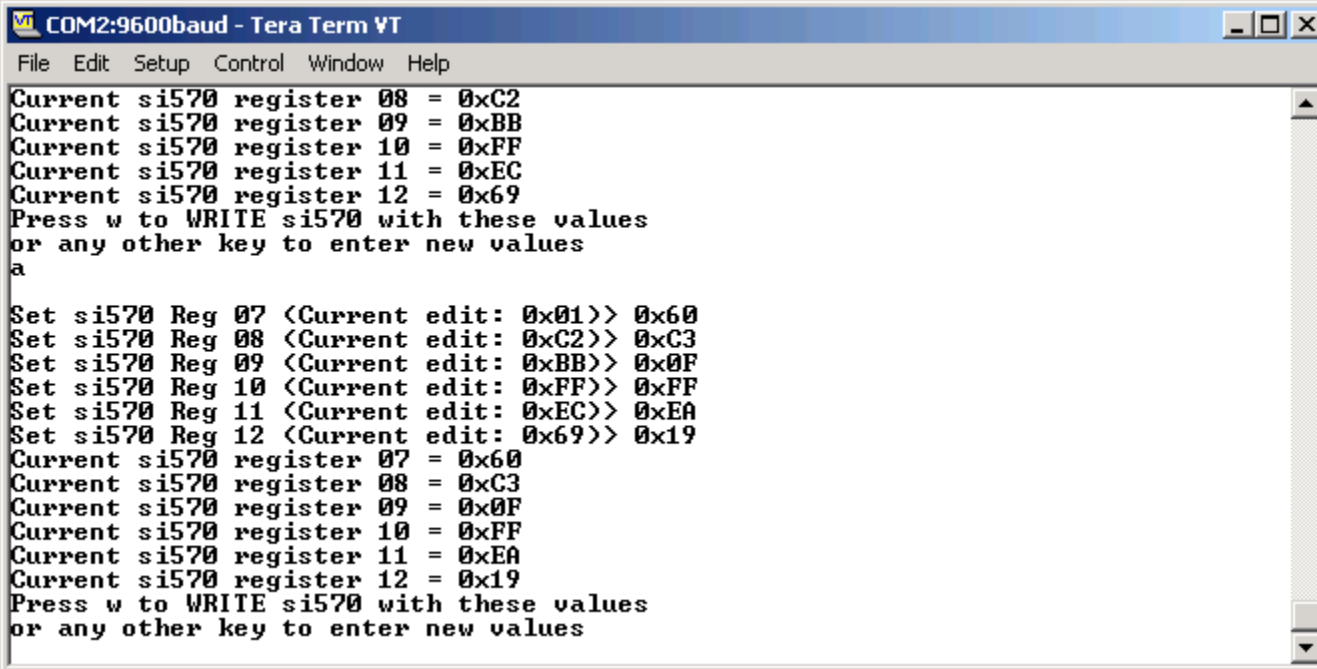
The screenshot shows a software interface with three tabs: "Procedure", "Divider Combinations", and "Summary". The "Summary" tab is active, displaying the following text:

```
Here is the summary of the programming procedure.  
  
= 114.285763 MHz  
  
New Configuration  
Output Frequency = 200.000000 MHz  
  
HS_DIV = 0x3 = 7  
N1 = 0x3 = 4  
  
fdco = f1 x HS_DIV x N1  
= 200.000000 MHz x 7 x 4  
= 5.600000 GHz  
  
RFREQ = fdco / fxtal  
= 5.600000 GHz / 114.285763 MHz  
= 48.99997911 = 0x30FFFEA19  
  
Start-up Register Configuration  
Register 7 = 0x01  
Register 8 = 0xC2  
Register 9 = 0xBB  
Register 10 = 0xFF  
Register 11 = 0xEC  
Register 12 = 0x72  
  
New Register Configuration  
Register 7 = 0x60  
Register 8 = 0xC3  
Register 9 = 0x0F  
Register 10 = 0xFF  
Register 11 = 0xEA  
Register 12 = 0x19
```

**Note:** Presentation applies to the KC705

# KC705 Si570 Programming

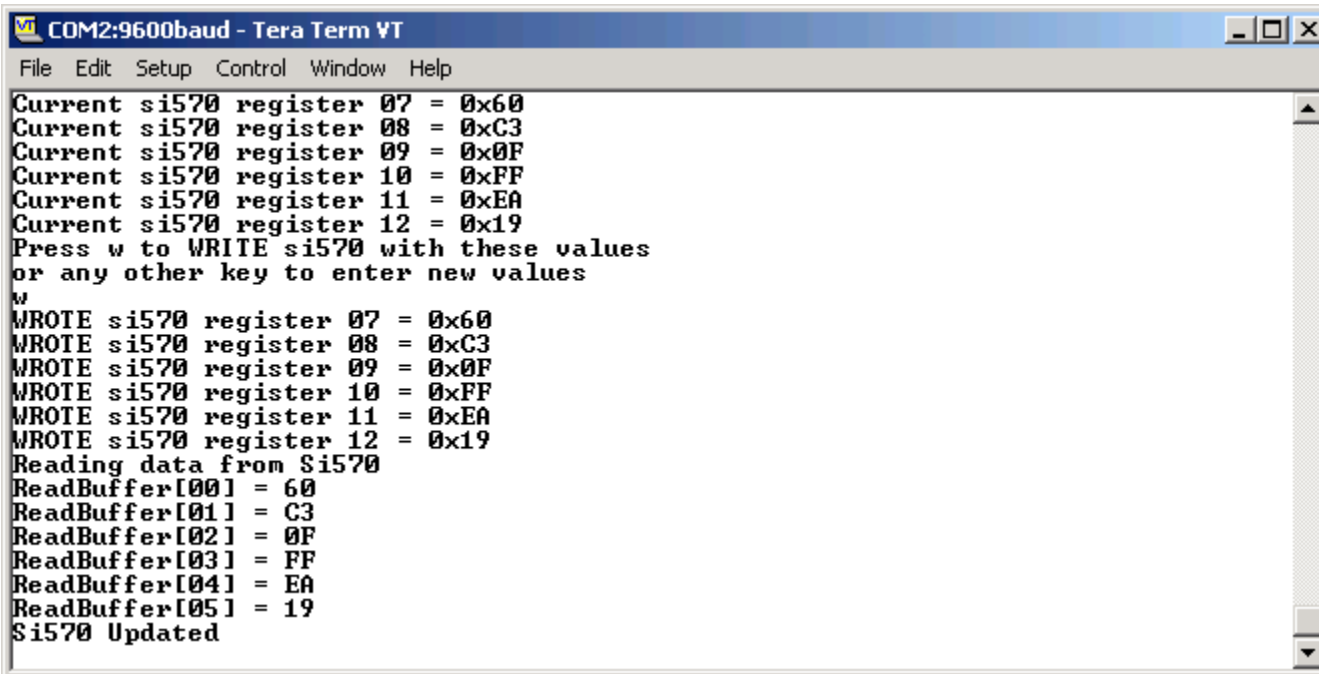
- Press a key to begin entering the newly calculated values
- When done, press “w”



```
COM2:9600baud - Tera Term VT
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 = 0xEC
Current si570 register 12 = 0x69
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>> 0xFF
Set si570 Reg 11 <Current edit: 0xEC>> 0xEA
Set si570 Reg 12 <Current edit: 0x69>> 0x19
Current si570 register 07 = 0x60
Current si570 register 08 = 0xC3
Current si570 register 09 = 0x0F
Current si570 register 10 = 0xFF
Current si570 register 11 = 0xEA
Current si570 register 12 = 0x19
Press w to WRITE si570 with these values
or any other key to enter new values
```

# KC705 Si570 Programming

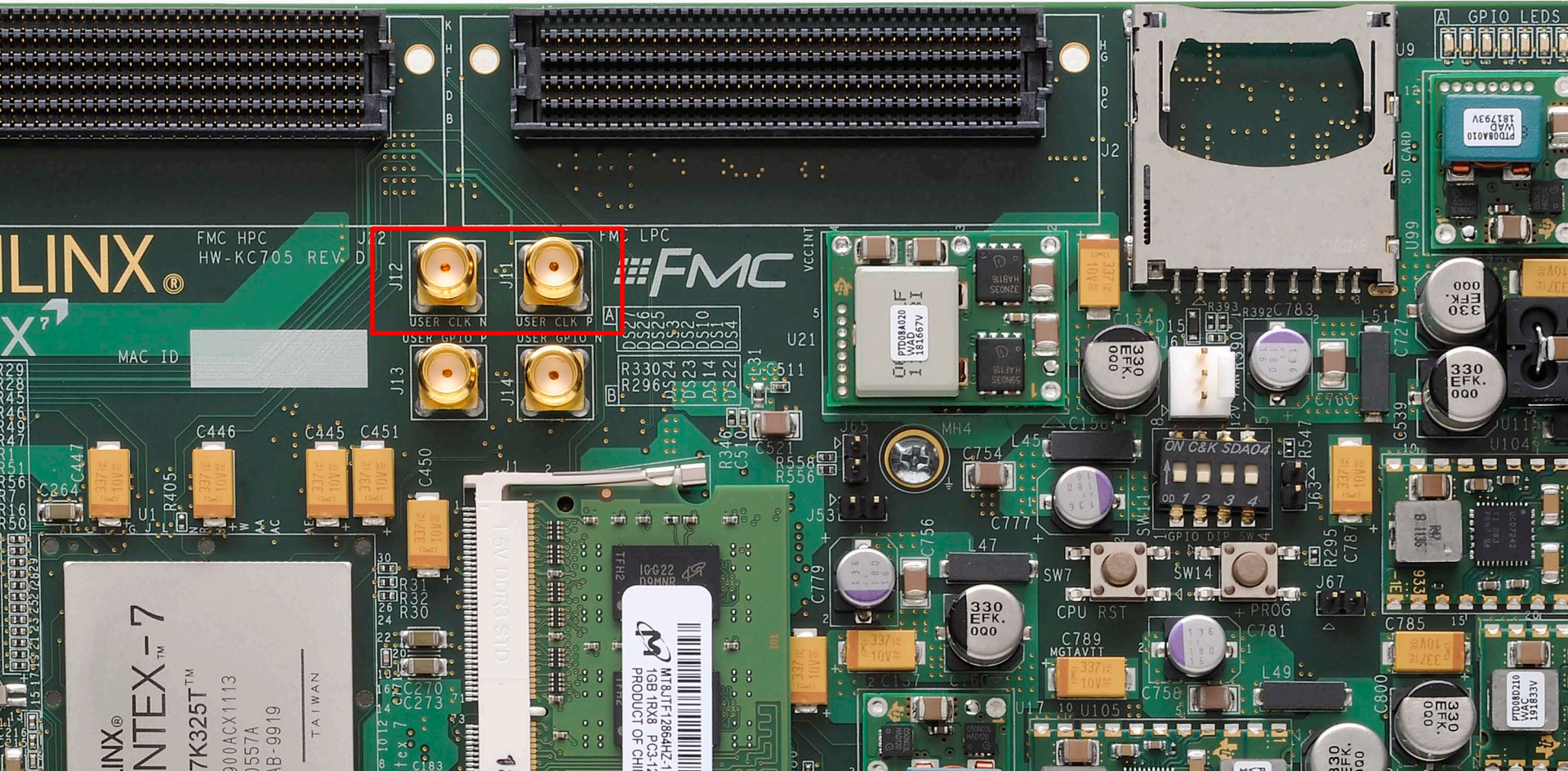
- Si570 has been successfully updated



```
COM2:9600baud - Tera Term VT
File Edit Setup Control Window Help
Current si570 register 07 = 0x60
Current si570 register 08 = 0xC3
Current si570 register 09 = 0x0F
Current si570 register 10 = 0xFF
Current si570 register 11 = 0xEA
Current si570 register 12 = 0x19
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 = 0xFF
WROTE si570 register 11 = 0xEA
WROTE si570 register 12 = 0x19
Reading data from Si570
ReadBuffer[00] = 60
ReadBuffer[01] = C3
ReadBuffer[02] = 0F
ReadBuffer[03] = FF
ReadBuffer[04] = EA
ReadBuffer[05] = 19
Si570 Updated
```

# KC705 Si570 Programming

- Frequency should now measure ~200.00 MHz







# References

# References

- **Silicon Labs**

- Si570 Data Sheet

<http://www.silabs.com/Support%20Documents/TechnicalDocs/si570.pdf>

- **ChipScope Pro**

- ChipScope Pro Software and Cores User Guide

[http://www.xilinx.com/support/documentation/sw\\_manuals/xilinx13\\_4/chipscope\\_pro\\_sw\\_cores\\_ug029.pdf](http://www.xilinx.com/support/documentation/sw_manuals/xilinx13_4/chipscope_pro_sw_cores_ug029.pdf)

# Documentation

# Documentation

## ▪ Kintex-7

- Kintex-7 FPGA Family

<http://www.xilinx.com/products/silicon-devices/fpga/kintex-7/index.htm>

## ▪ KC705 Documentation

- Kintex-7 FPGA KC705 Evaluation Kit

<http://www.xilinx.com/products/boards-and-kits/EK-K7-KC705-G.htm>

- KC705 Getting Started Guide

[http://www.xilinx.com/support/documentation/boards\\_and\\_kits/ug883\\_K7\\_KC705\\_Eval\\_Kit.pdf](http://www.xilinx.com/support/documentation/boards_and_kits/ug883_K7_KC705_Eval_Kit.pdf)

- KC705 User Guide

[http://www.xilinx.com/support/documentation/boards\\_and\\_kits/ug810\\_KC705\\_Eval\\_Bd.pdf](http://www.xilinx.com/support/documentation/boards_and_kits/ug810_KC705_Eval_Bd.pdf)

- KC705 Reference Design User Guide

[http://www.xilinx.com/support/documentation/boards\\_and\\_kits/ug845\\_Ref\\_Design.pdf](http://www.xilinx.com/support/documentation/boards_and_kits/ug845_Ref_Design.pdf)