VC707 Si570 Programming

October 2012

Revision History

Date	Version	Description
10/23/12	4.0	Recompiled for 14.3. Added AR52368.
07/25/12	3.0	Recompiled for 14.2. Added ChipScope Frequency Monitor. Added AR50886.
05/25/12	2.1	Added FMC Si570.
05/08/12	2.0	Recompiled for 14.1.
04/12/12	1.1	Minor updates.
03/09/12	1.0	Initial version for 13.4.

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VC707 Si570 Programming Overview

❯ **Xilinx VC707 Board**

❯ **Software Requirements**

❯ **Setup for the VC707 Si570 Programming**

❯ **Programming the Si570**

❯ **Correcting the Frequency**

❯ **Programming the FMC Si570**

❯ **References**

Note: This presentation applies to the VC707

VC707 Si570 Programming Overview

> **Description**

- – The VC707 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.

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Xilinx VC707 Board

ISE Software Requirements

> **Xilinx ISE 14.3 software**

  – Apply AR52368

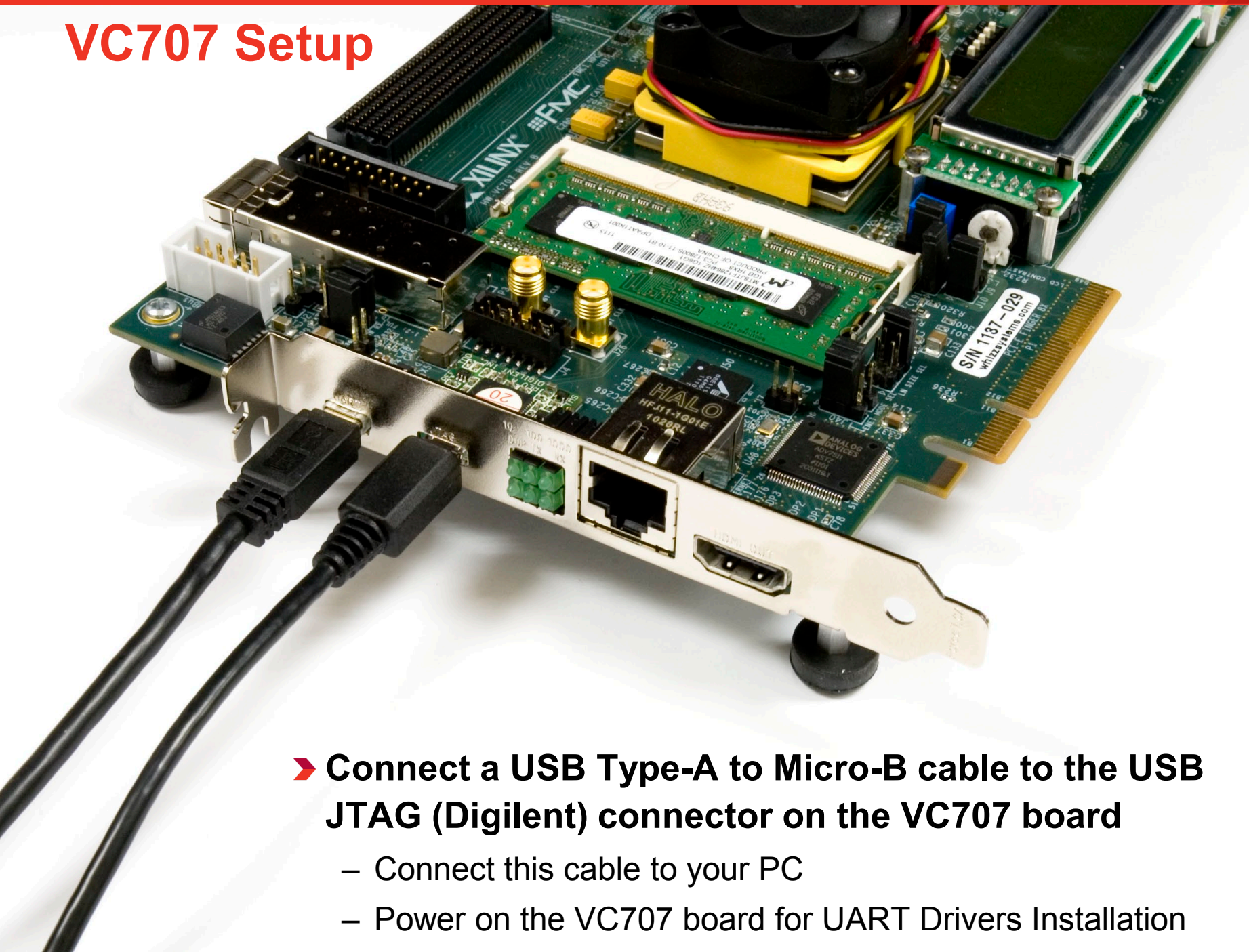# ChipScope Pro Software Requirement

❯ **Xilinx ChipScope Pro 14.3 software**

ChipScope Pro Analyzer

Release Version: 14.3
Application Version: P.40xd (Build 14300.12.277.1394)
Copyright (c) 1995-2012 Xilinx, Inc.
All rights reserved.
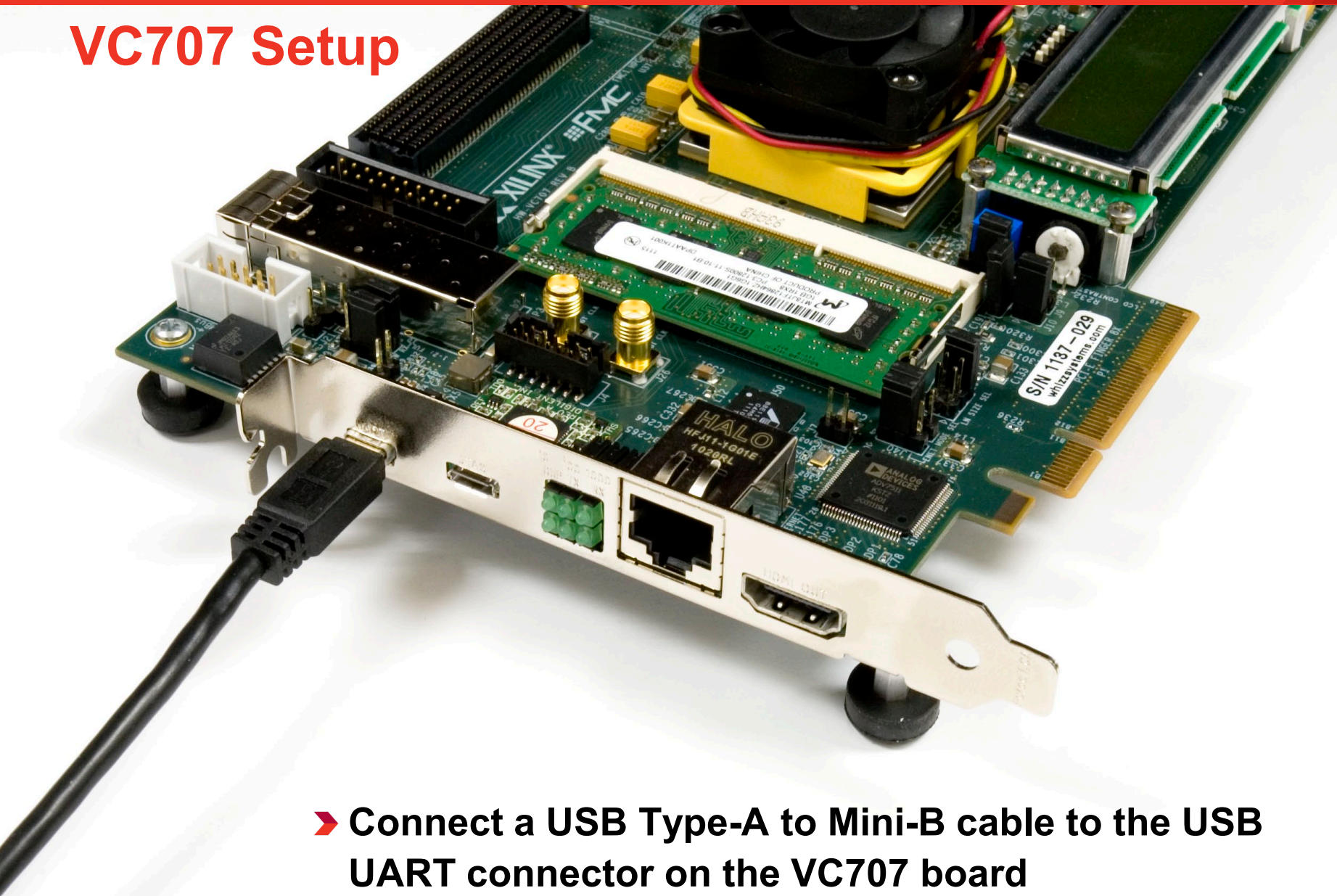
> **Connect a USB Type-A to Mini-B cable to the USB UART connector on the VC707 board**
  – Connect this cable to your PC
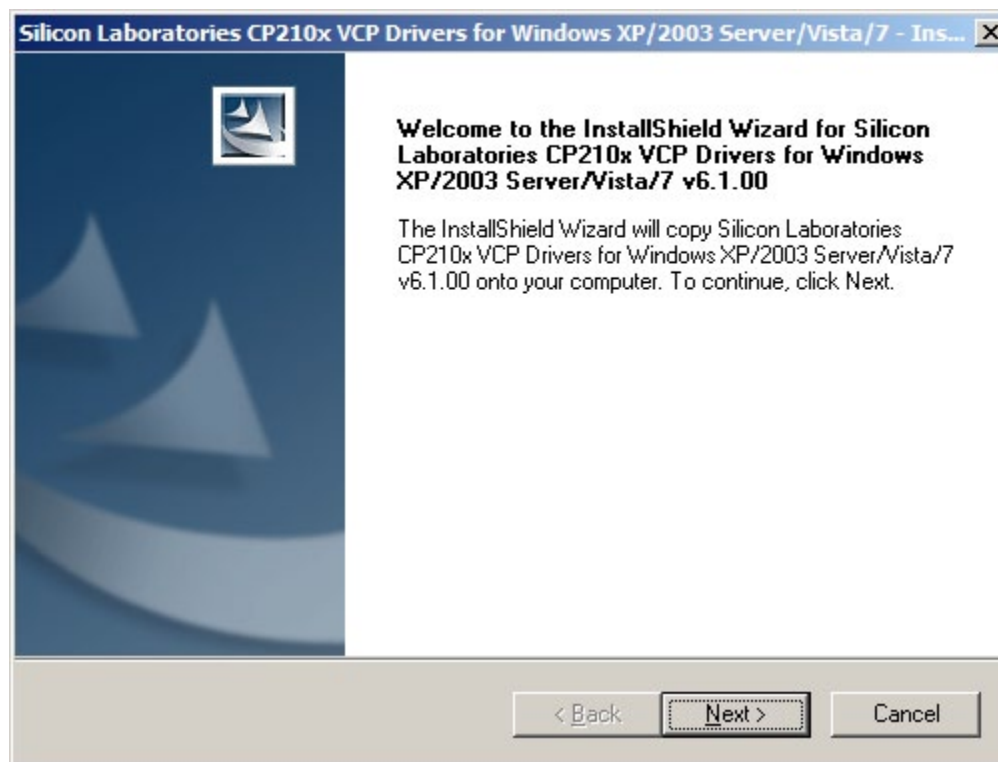
VC707 Setup

> **Connect a USB Type-A to Micro-B cable to the USB JTAG (Digilent) connector on the VC707 board**
> - Connect this cable to your PC
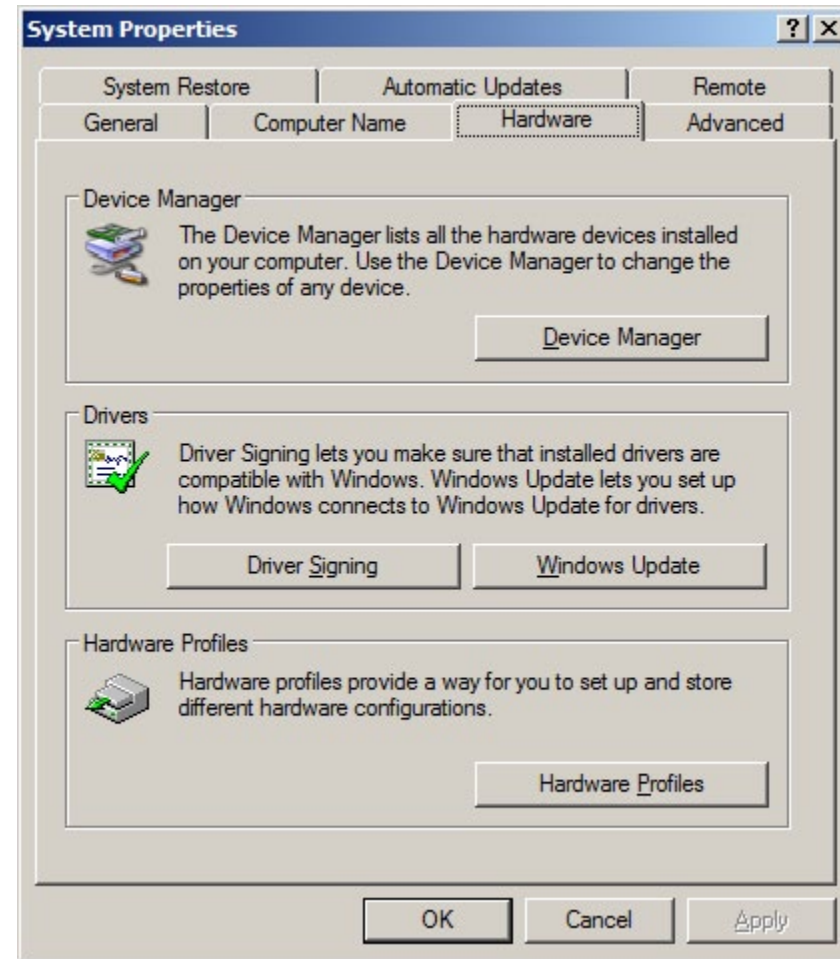> - Power on the VC707 board for UART Drivers Installation

VC707 Setup

❯ **Install USB UART Drivers**

– CP210x_VCP_Win_XP_S2K3_Vista_7.exe

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VC707 Setup

❯ **Reboot your PC if necessary**

❯ **Right-click on My Computer and select Properties**

– Select the Hardware tab

– Click on Device Manager

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VC707 Setup

> **Expand the Ports Hardware**

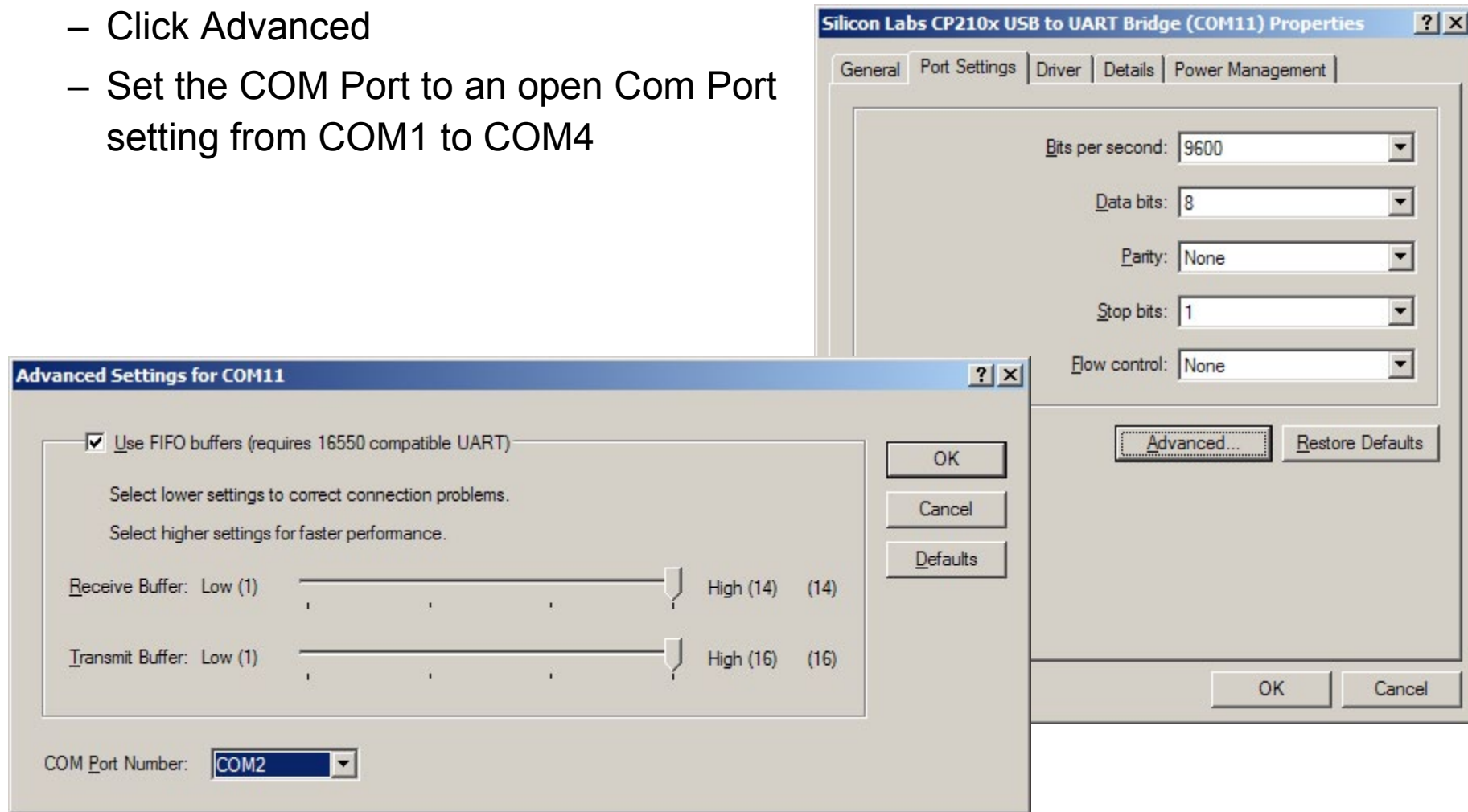– Right-click on Silicon Labs CP210x USB to UART Bridge and select Properties

XILINX ➤ ALL PROGRAMMABLE™
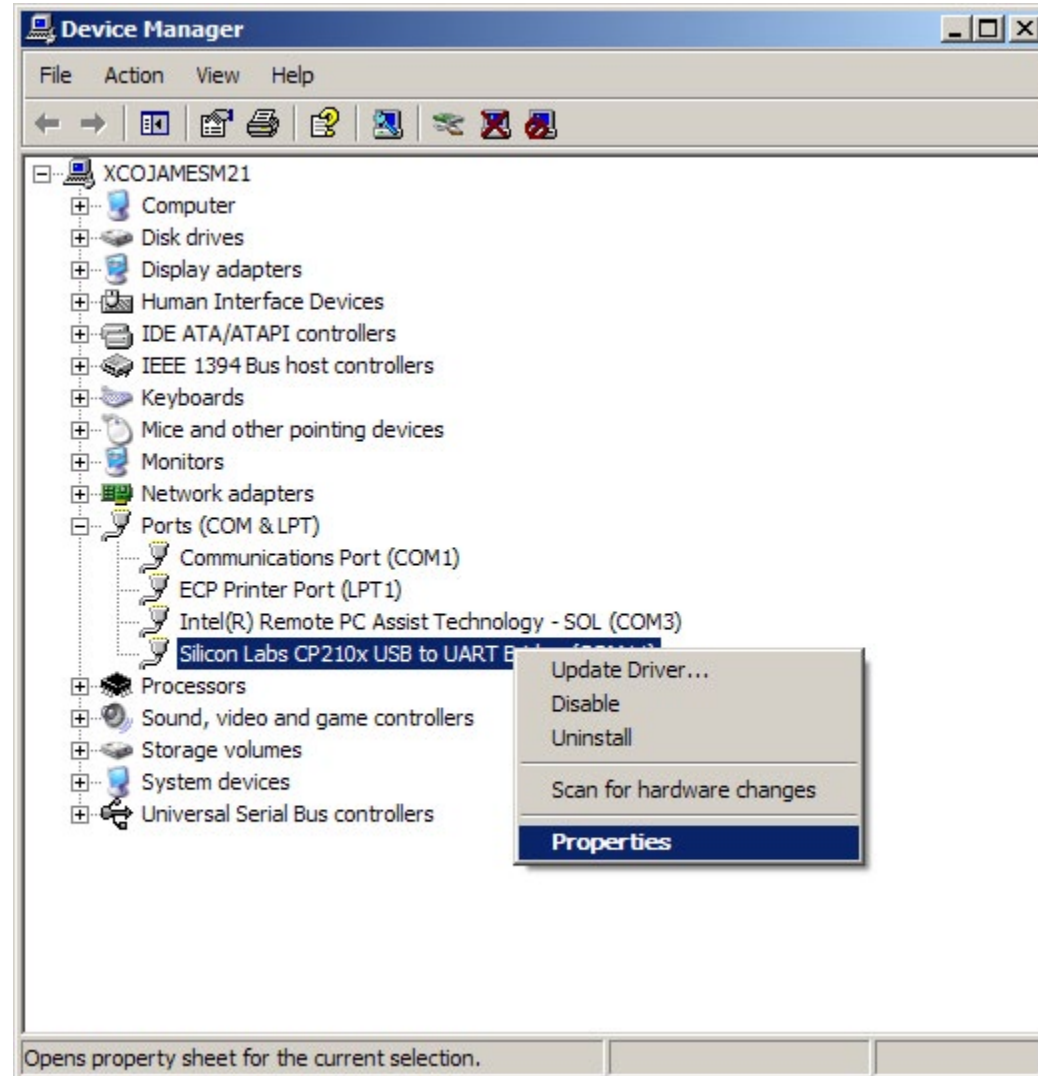
VC707 Setup

❯ **Under Port Settings tab**

– Click Advanced

– Set the COM Port to an open Com Port setting from COM1 to COM4

Silicon Labs CP210x USB to UART Bridge (COM11) Properties ? ✕

| General | Port Settings | Driver | Details | Power Management |

Bits per second: 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

Advanced...   Restore Defaults

OK   Cancel

Advanced Settings for COM11 ? ✕

☑ Use FIFO buffers (requires 16550 compatible UART)

Select lower settings to correct connection problems.

Select higher settings for faster performance.

Receive Buffer: Low (1) ——————————— High (14)   (14)

Transmit Buffer: Low (1) ——————————— High (16)   (16)

OK

Cancel

Defaults

COM Port Number: COM2

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VC707 Setup

> **Board Power must be on before starting Tera Term**

> **Start the Terminal Program**

- – Select your USB Com Port
- – Set the baud to 9600
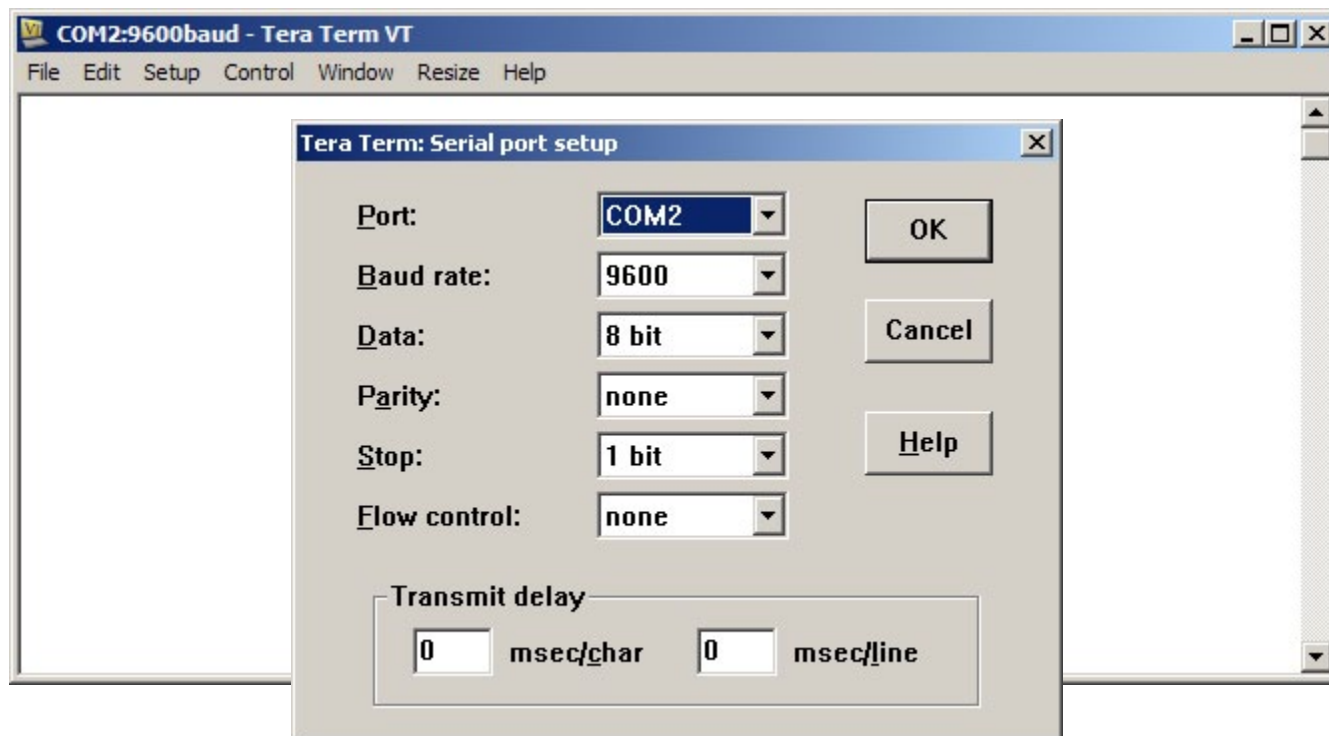
Si Labs Programmable Oscillator Calculator

❯ **Download [ProgOscillatorSwInstall.zip](#)**

   – Install "ProgOscSwInstall3.0.1.exe" only

€ XILINX ❯ ALL PROGRAMMABLE™
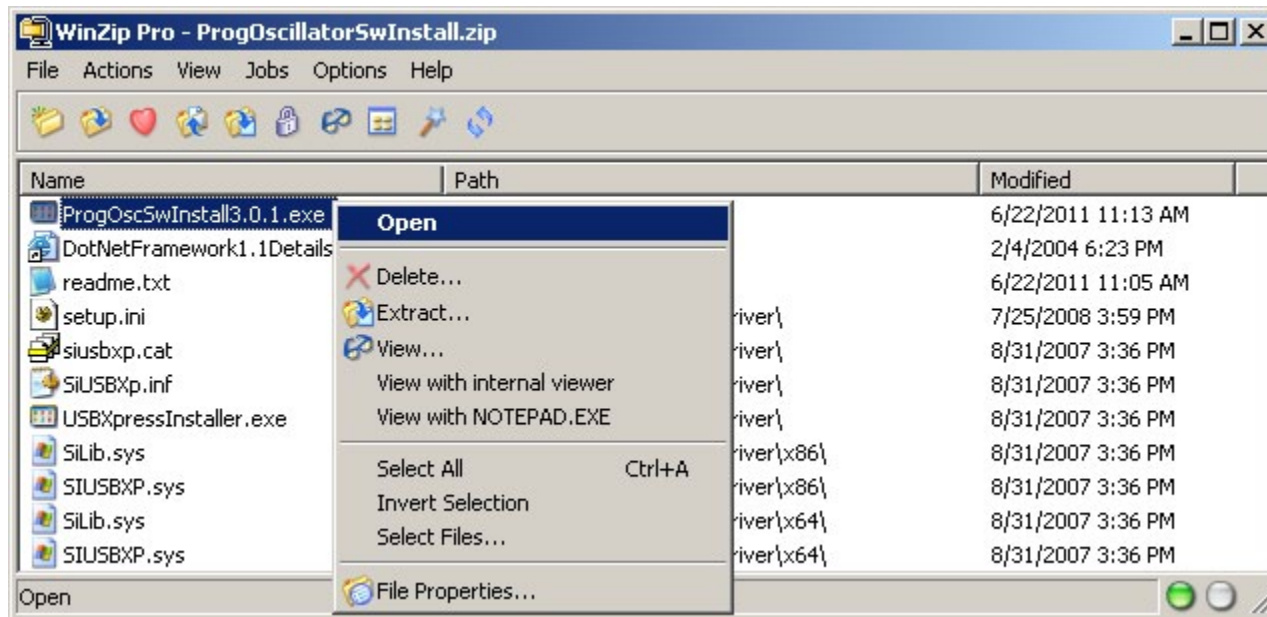
Setup for VC707 Si570 Programming

> **Unzip the VC707 Si570 Programming Design Files (14.3 CES) to your C:\ drive**
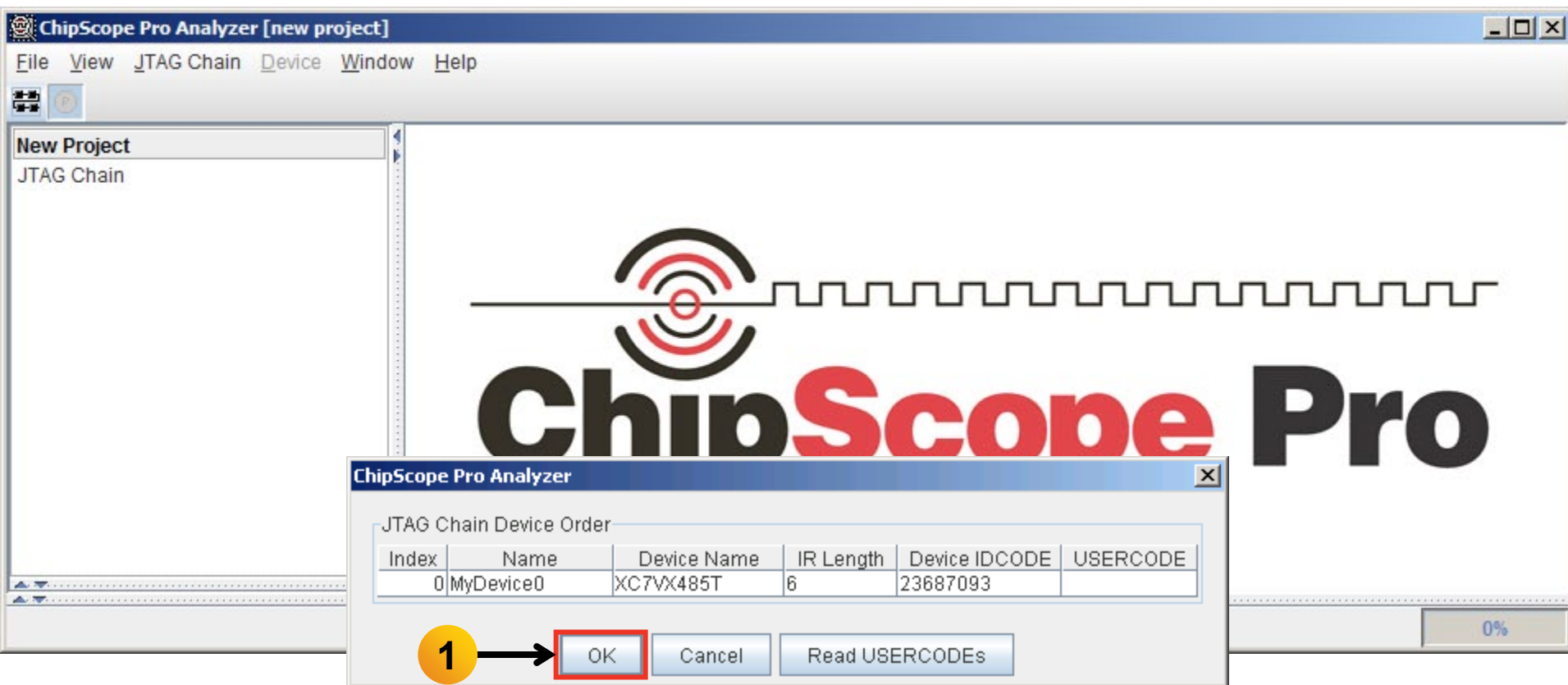
– Available through http://www.xilinx.com/vc707
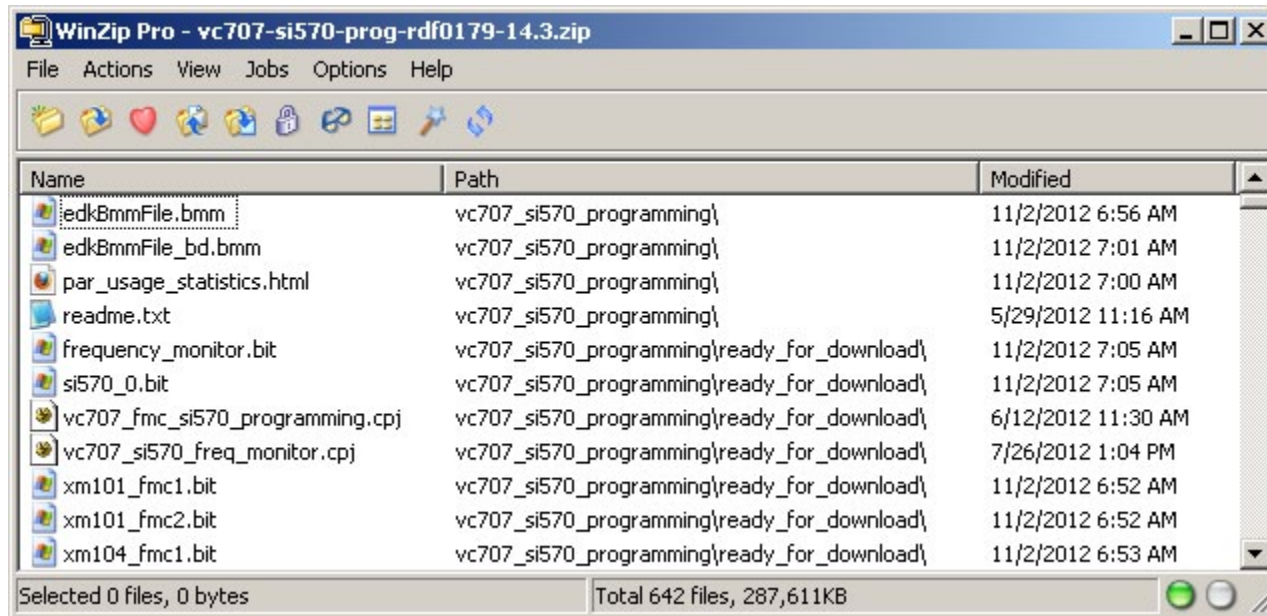
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VC707 Si570 Programming

❱ **Open ChipScope Pro and select JTAG Chain → Digilent USB Cable… (1)**

❱ **Verify 30 MHz operation and click OK (2)**

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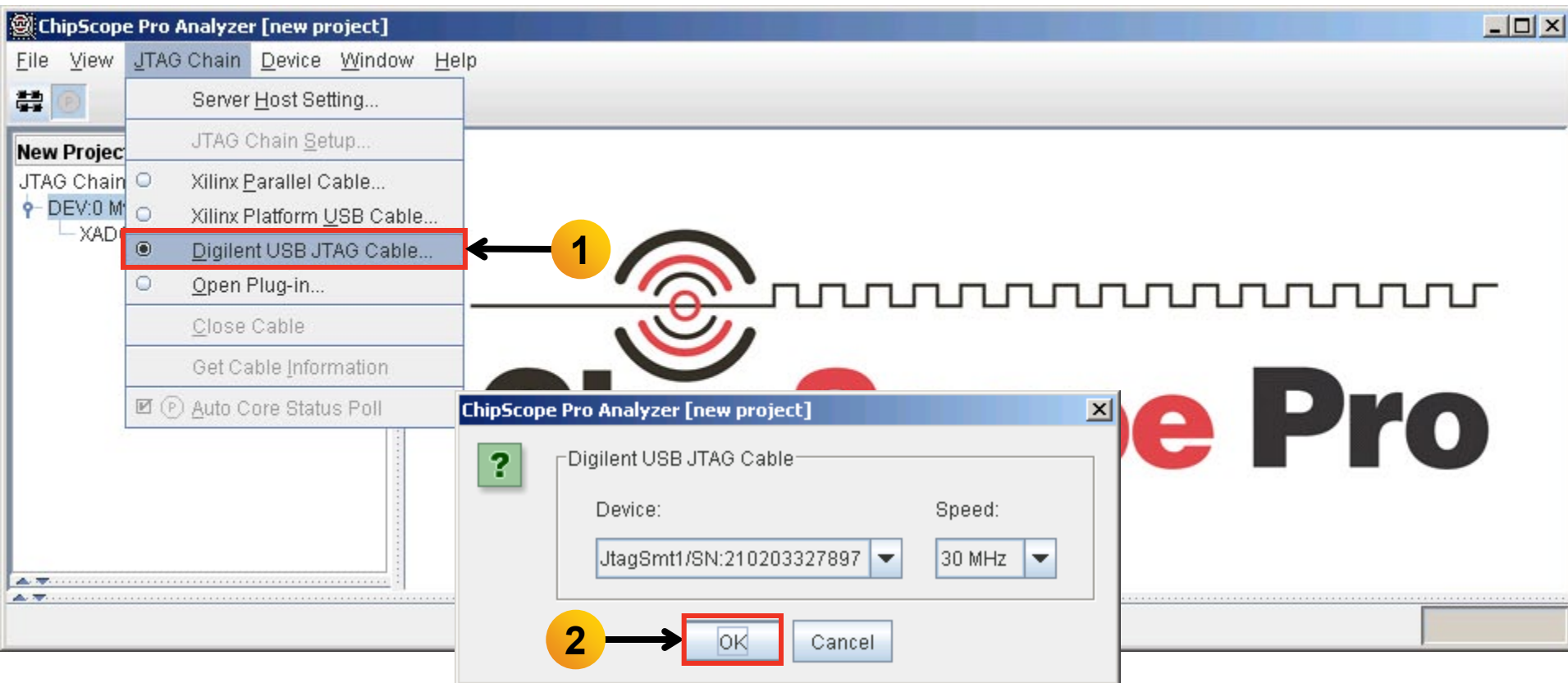
VC707 Si570 Programming

> **Click OK (1)**

VC707 Si570 Programming

> **Right-click DEV:0 MyDevice0 (XC7VX485T) and select Configure…**

> **Select <Design Path>\ready_for_download\si570_0.bit**
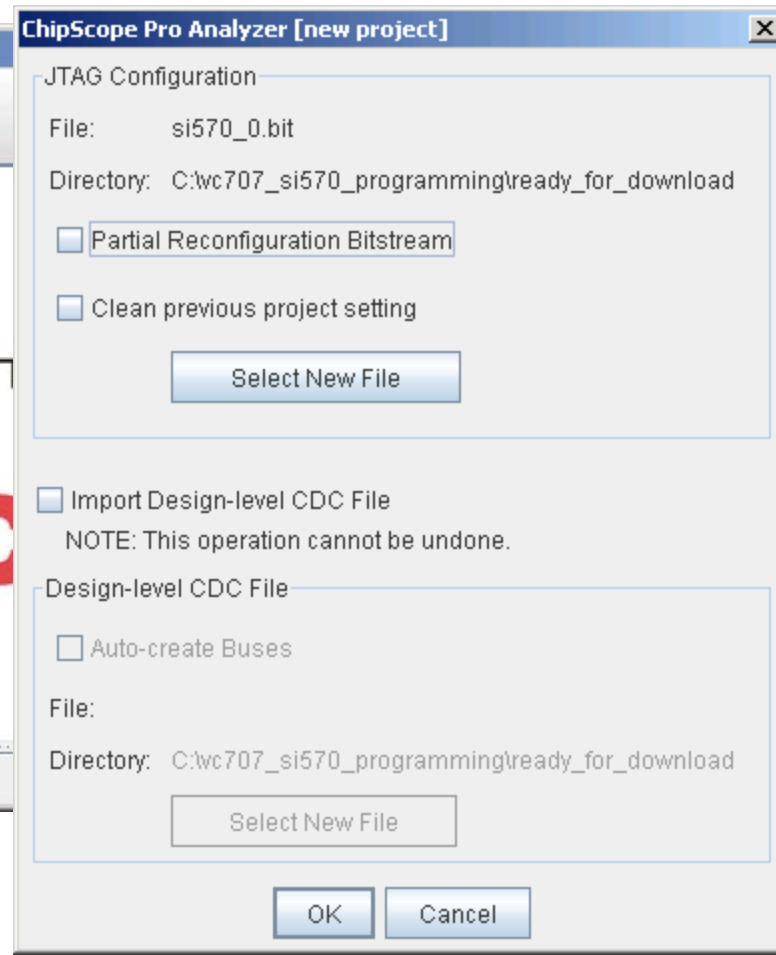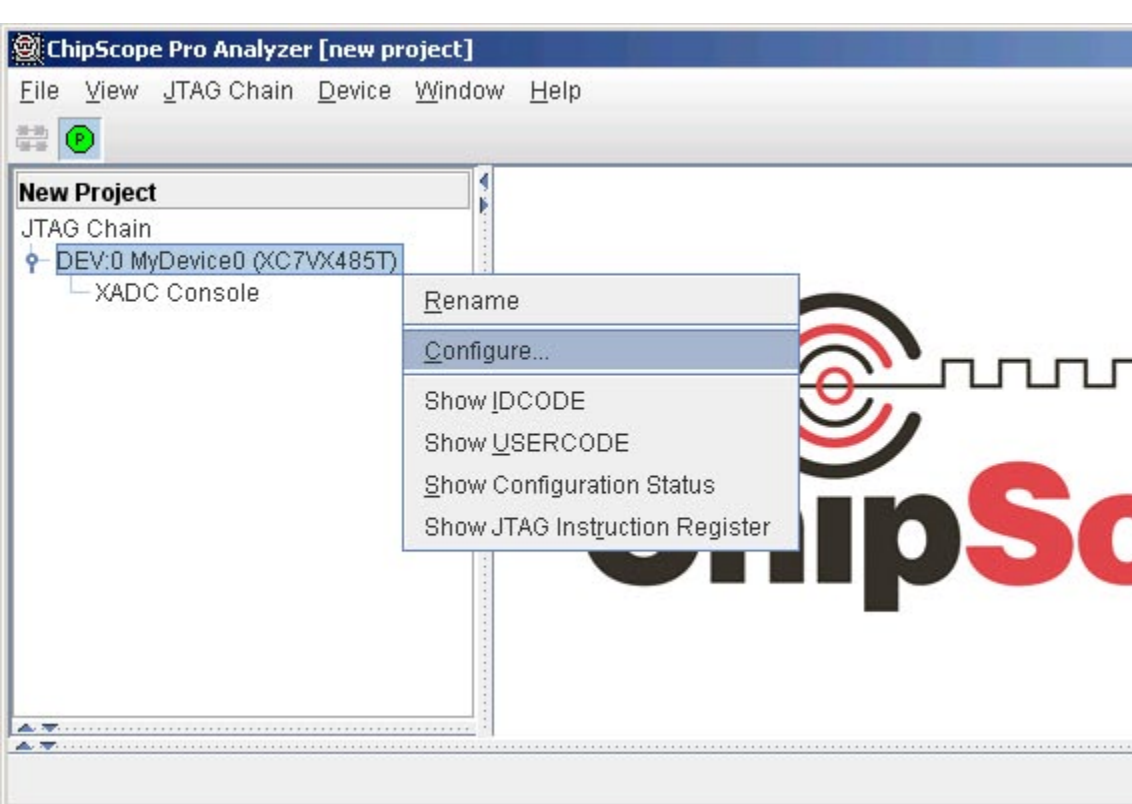
VC707 Si570 Programming
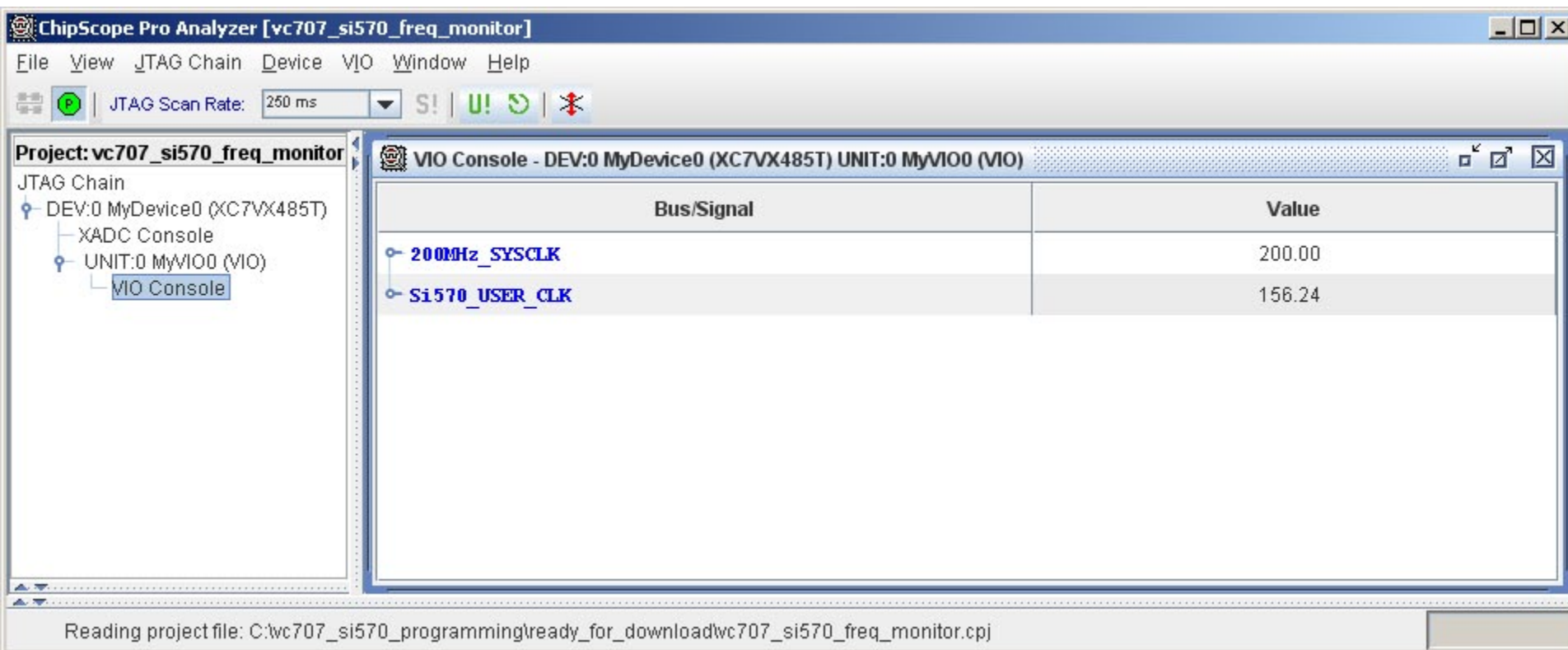
❯ **Select File → Open Project…**

❯ **Select <Design Path>\ready_for_download\
vc707_si570_freq_monitor.cpj**

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VC707 Si570 Programming

❯ **The VIO Console will now show 200 MHz for the system clock, and 156.25 MHz for the User Clock**

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VC707 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 VC707

➤ **We need to determine:**

 – RFREQ

 – HSDIV

 – N1

➤ **These can be found be reading back the registers on the Si570**

Note: Presentation applies to the VC707

VC707 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 0x01C2BBFF1718

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

VC707 Si570 Programming

> **The value, 0x01C2BBFF1718, 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]							

VC707 Si570 Programming

➤ **Extract the HS_DIV and N1 values from 0x01C2BBFF1718:**

➤ **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

VC707 Si570 Programming

❯ **Extract the RFREQ value from 0x01C2BBFF1718:**

– 02BBFF1718

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]							

VC707 Si570 Programming

❯ **Open the Window Calculator**

❯ **Set to Scientific and Hex mode:**
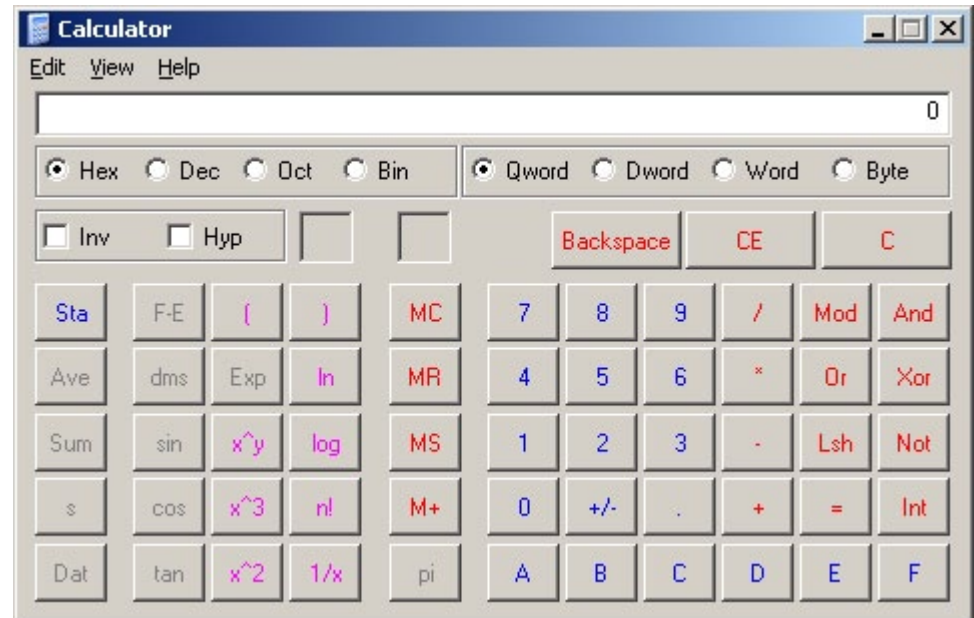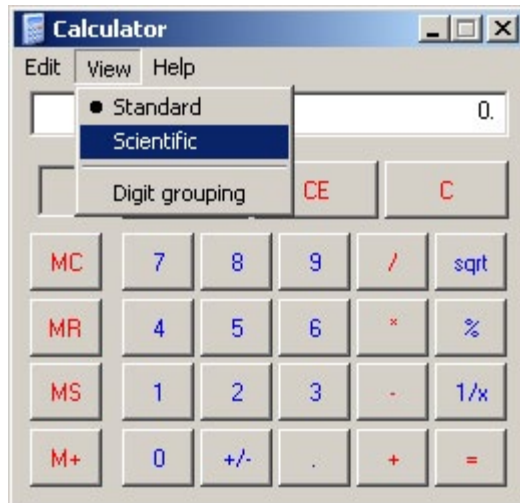
VC707 Si570 Programming

❱ **Enter or paste the RFREQ value, 02BBFF1718:**

❱ **Convert it to Decimal**

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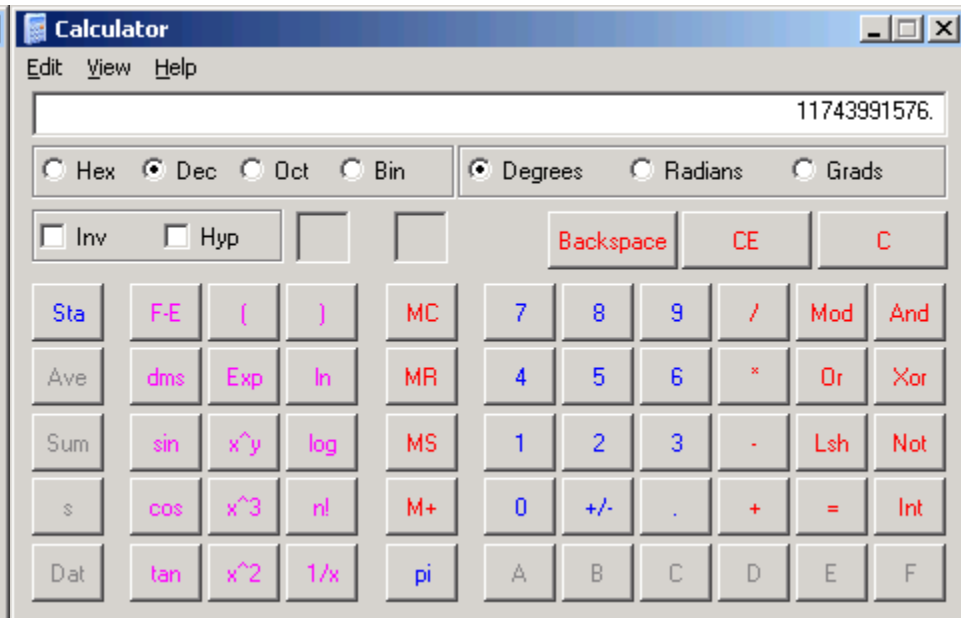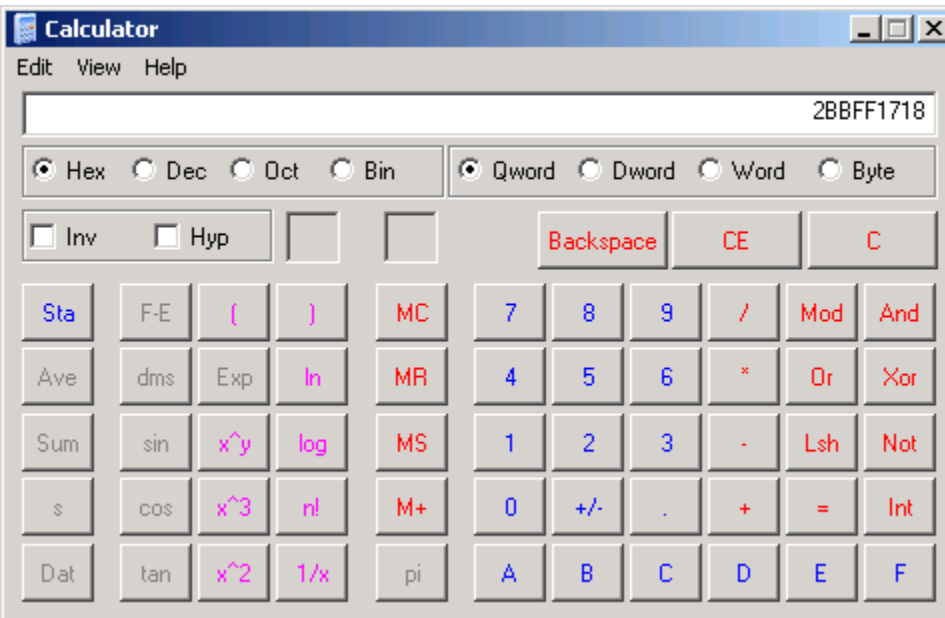
VC707 Si570 Programming

❯ **Divide by 2^28**

❯ **This is the value for RFREQ:**

XILINX ❯ ALL PROGRAMMABLE.
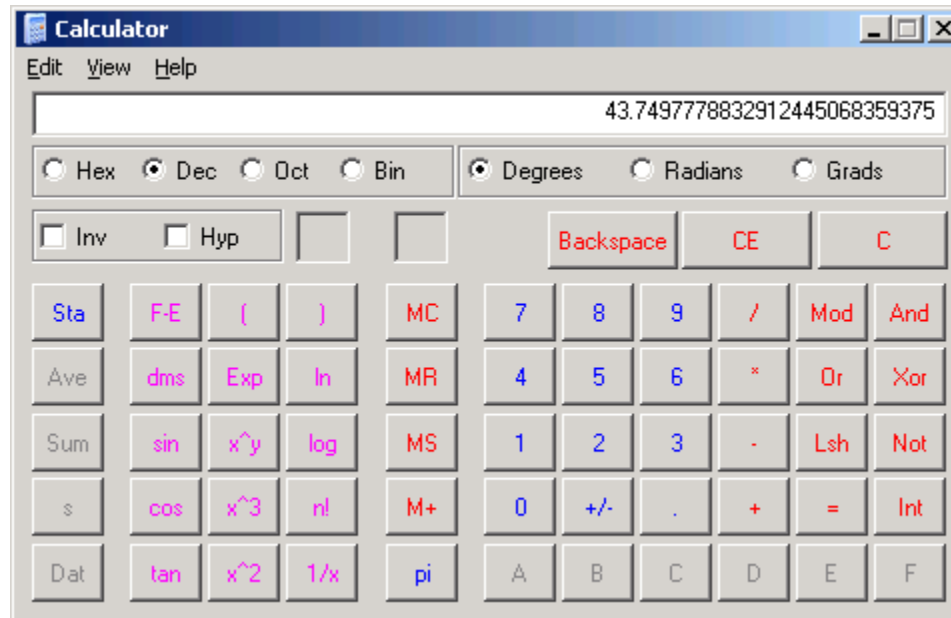
VC707 Si570 Programming

> **For this equation,**

– Fout = 156.25

– RFREQ = **43.749777883291244 5068359375**

– HSDIV = 4

– N1 = 8

– Fout x HSDIV x N1 = 5000

– fXTAL = 5000 / RFREQ

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

VC707 Si570 Programming

> **For this equation,**

- Divide **43.749777883291244506835937‌5** by **5000**
- Take the reciprocal
- fXTAL = **114.28629451189926500676161588555**
- Ctrl-C to copy this value
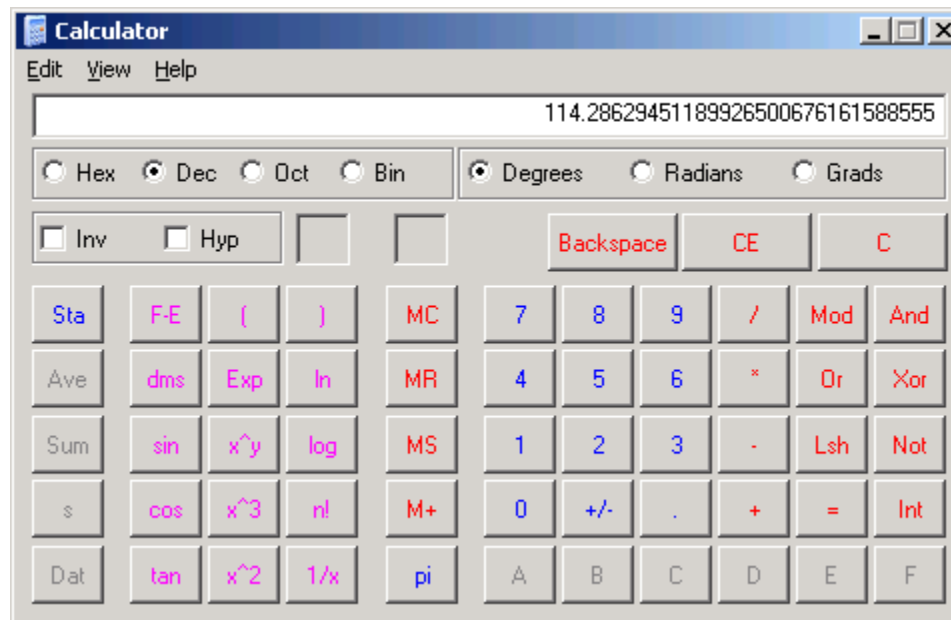
VC707 Si570 Programming

❯ **Open the SiLabs Programmable Oscillator Calculator**

– Select the Si570 and click OK

€ XILINX ❯ ALL PROGRAMMABLE.

VC707 Si570 Programming

❯ **Select Options → Advanced…**

VC707 Si570 Programming

❯ **Paste in the value of fXTAL**

– The calculator will round the number appropriately

– Click OK
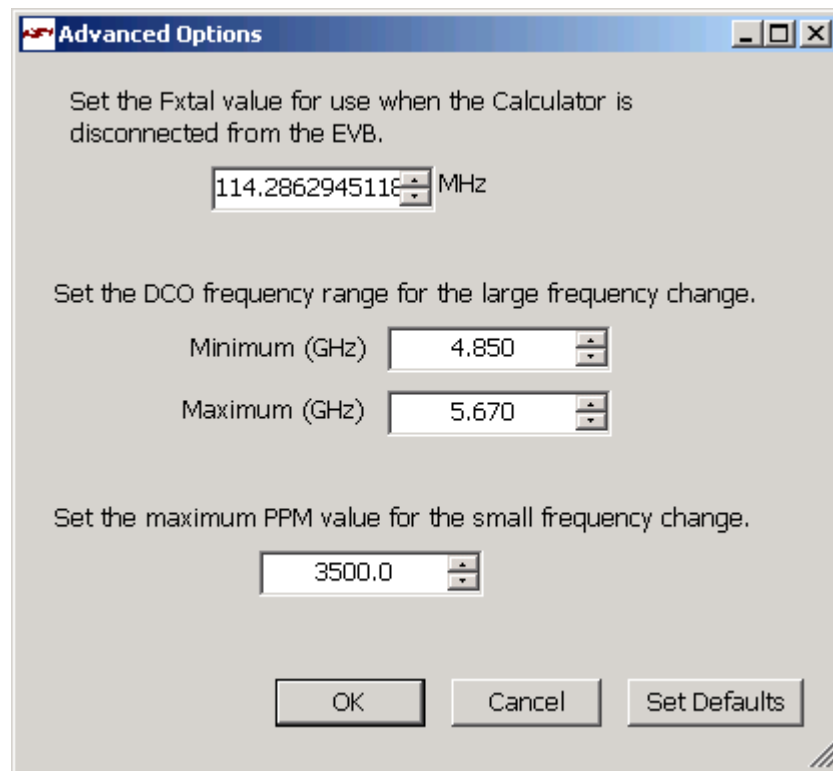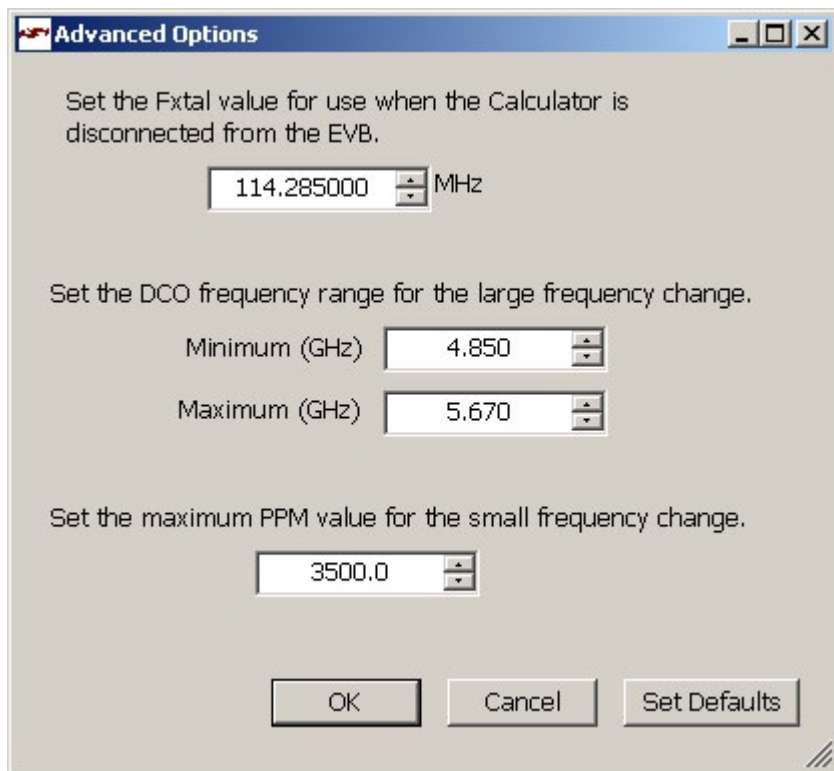
VC707 Si570 Programming

▶ **Enter 156.25 and click the Apply Definition button**

VC707 Si570 Programming

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

VC707 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**
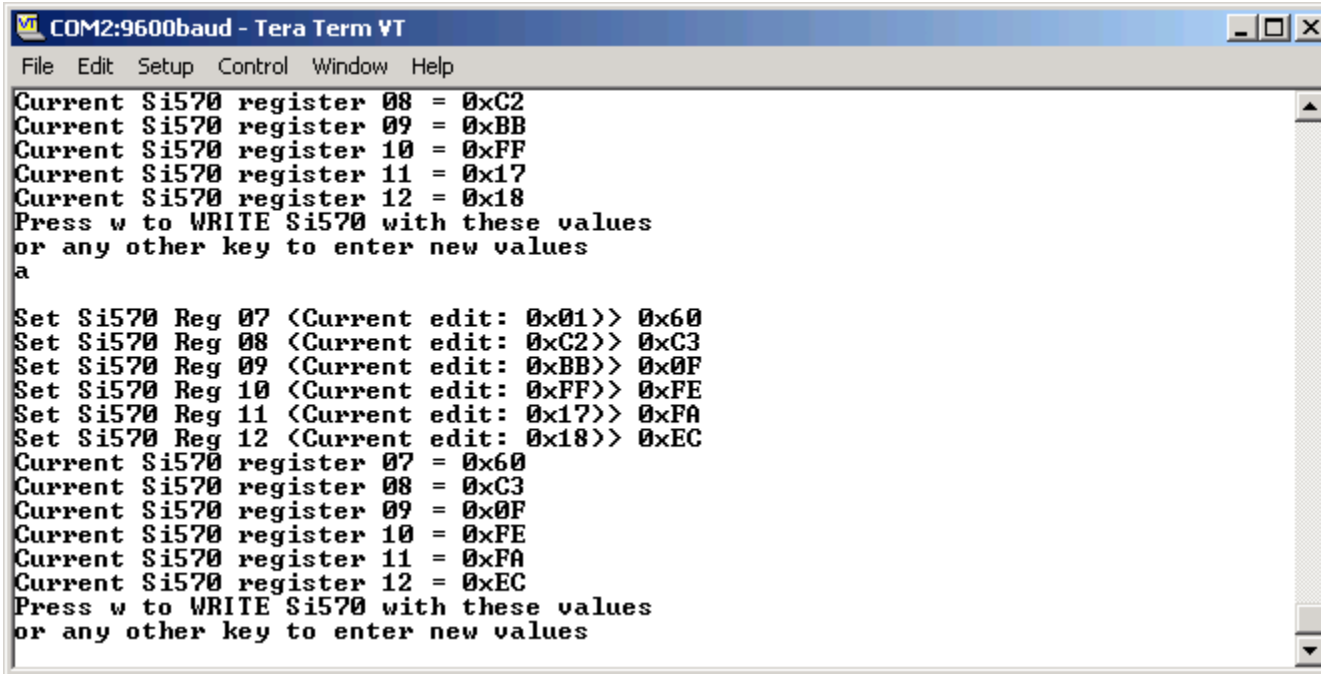
```
Procedure | Divider Combinations | Summary

Here is the summary of the programming procedure.

             = 114.286295 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 / 114.286295 MHz
       = 48.99975102 = 0x30FFEFAEC


Start-up Register Configuration
  Register  7 = 0x01
  Register  8 = 0xC2
  Register  9 = 0xBB
  Register 10 = 0xFF
  Register 11 = 0x16
  Register 12 = 0xE5

New Register Configuration
  Register  7 = 0x60
  Register  8 = 0xC3
  Register  9 = 0x0F
  Register 10 = 0xFE
  Register 11 = 0xFA
  Register 12 = 0xEC
```

Note: Presentation applies to the VC707
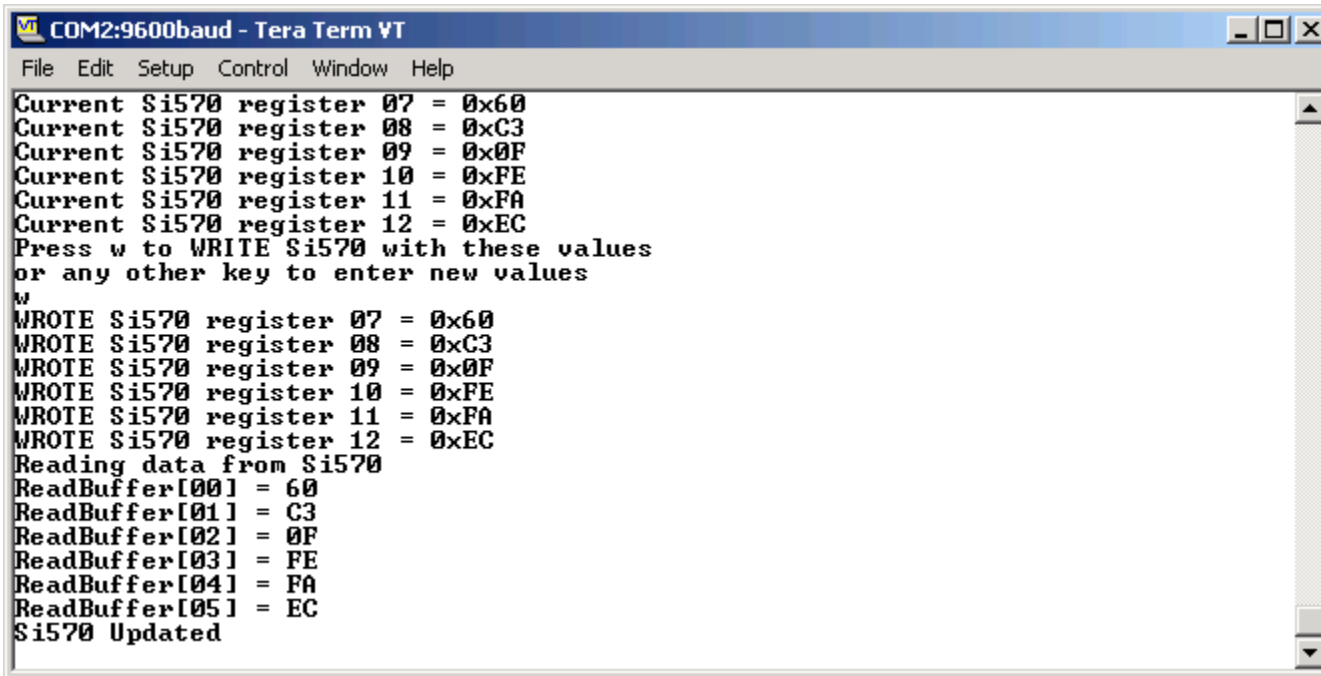
VC707 Si570 Programming

❯ **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 = 0x17
Current Si570 register 12 = 0x18
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: 0x17)> 0xFA
Set Si570 Reg 12 (Current edit: 0x18)> 0xEC
Current Si570 register 07 = 0x60
Current Si570 register 08 = 0xC3
Current Si570 register 09 = 0x0F
Current Si570 register 10 = 0xFE
Current Si570 register 11 = 0xFA
Current Si570 register 12 = 0xEC
Press w to WRITE Si570 with these values
or any other key to enter new values
```

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VC707 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 = 0xFE
Current Si570 register 11 = 0xFA
Current Si570 register 12 = 0xEC
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 = 0xFA
WROTE Si570 register 12 = 0xEC
Reading data from Si570
ReadBuffer[00] = 60
ReadBuffer[01] = C3
ReadBuffer[02] = 0F
ReadBuffer[03] = FE
ReadBuffer[04] = FA
ReadBuffer[05] = EC
Si570 Updated
```

VC707 Si570 Programming

❯ **The Si570_USER_CLK frequency should now measure ~200.00 MHz**

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VC707 Si570 Programming

> **If needed, press SW8 to reset the MicroBlaze process**
>> – Instead of reloading the bitstream; also acts as a CPU Reset
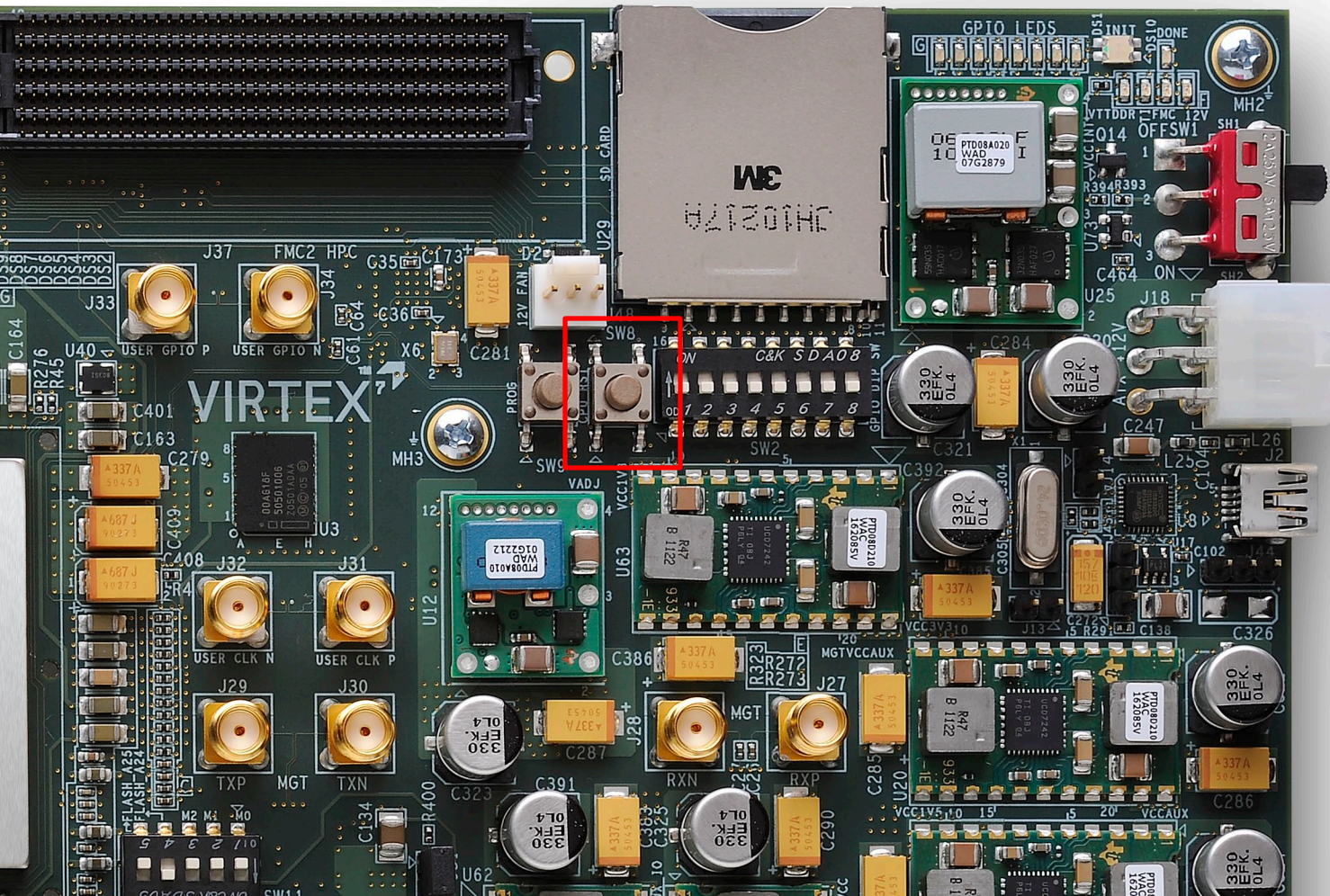
Programming the FMC Si570

VC707 FMC Si570 Programming Overview

> **Description**

  – The FMC modules, XM101, XM104, and XM105 have 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 XM101 FMC Module

➤ **The XM101 board uses an on-board IIC switch**

Xilinx XM104 FMC Module
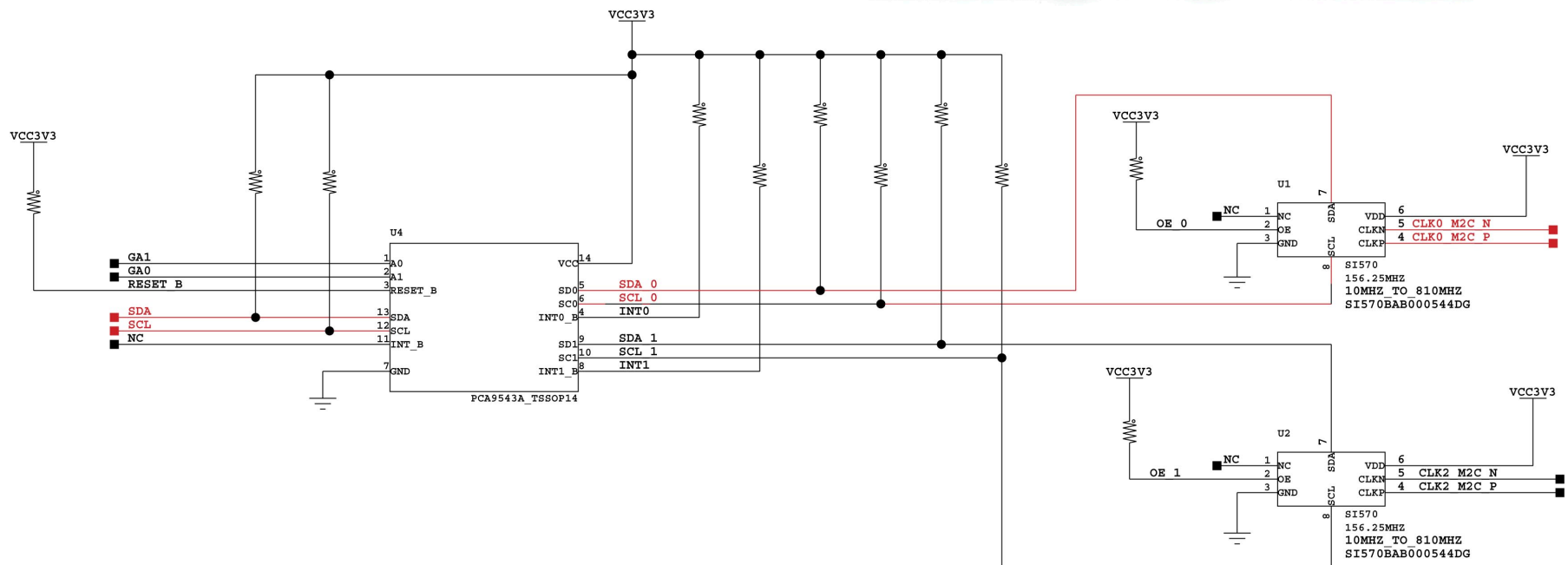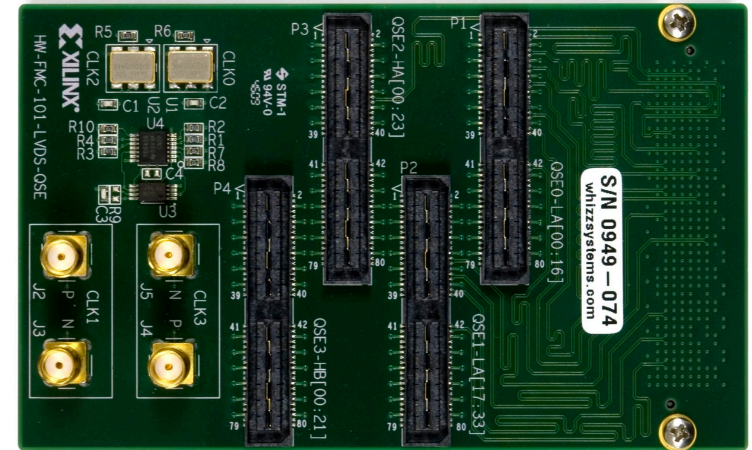
> **The XM104 board has an on-board IIC switch**
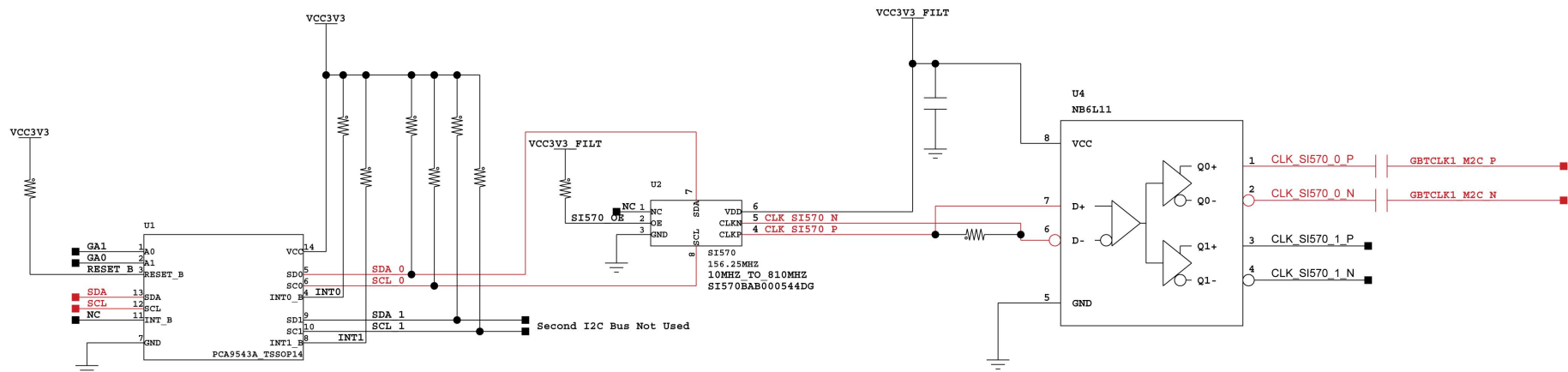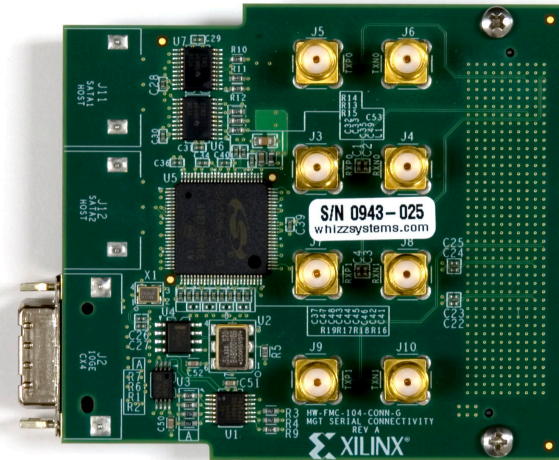
Xilinx XM105 FMC Module

➤ **The XM105 board has a direct connection to the Si570 IIC**

– Note: FMC_TDI and FMC_TDO (J5, 6 & 7) must be connected during configuration
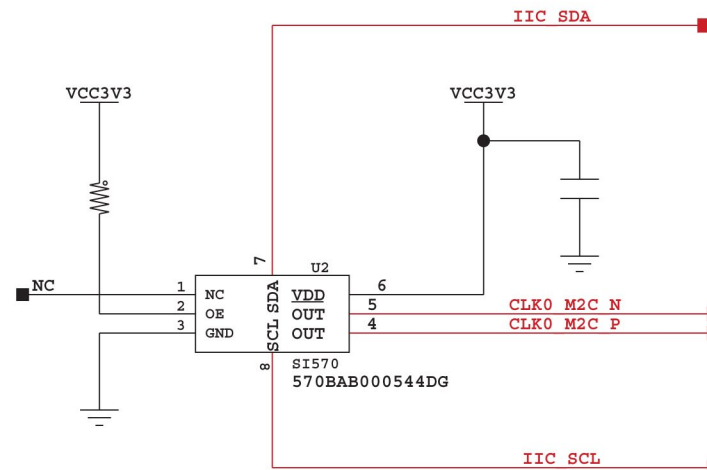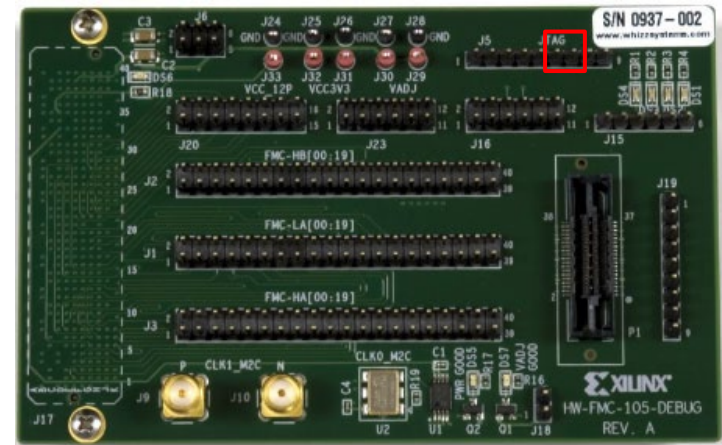
VC707 FMC Si570 Programming

❯ **Attach your FMC board (XM101, XM104, or XM105) to either the FMC1 HPC or the FMC2 HPC ports on the VC707**

– Turn VC707 power off while installing the FMC boards
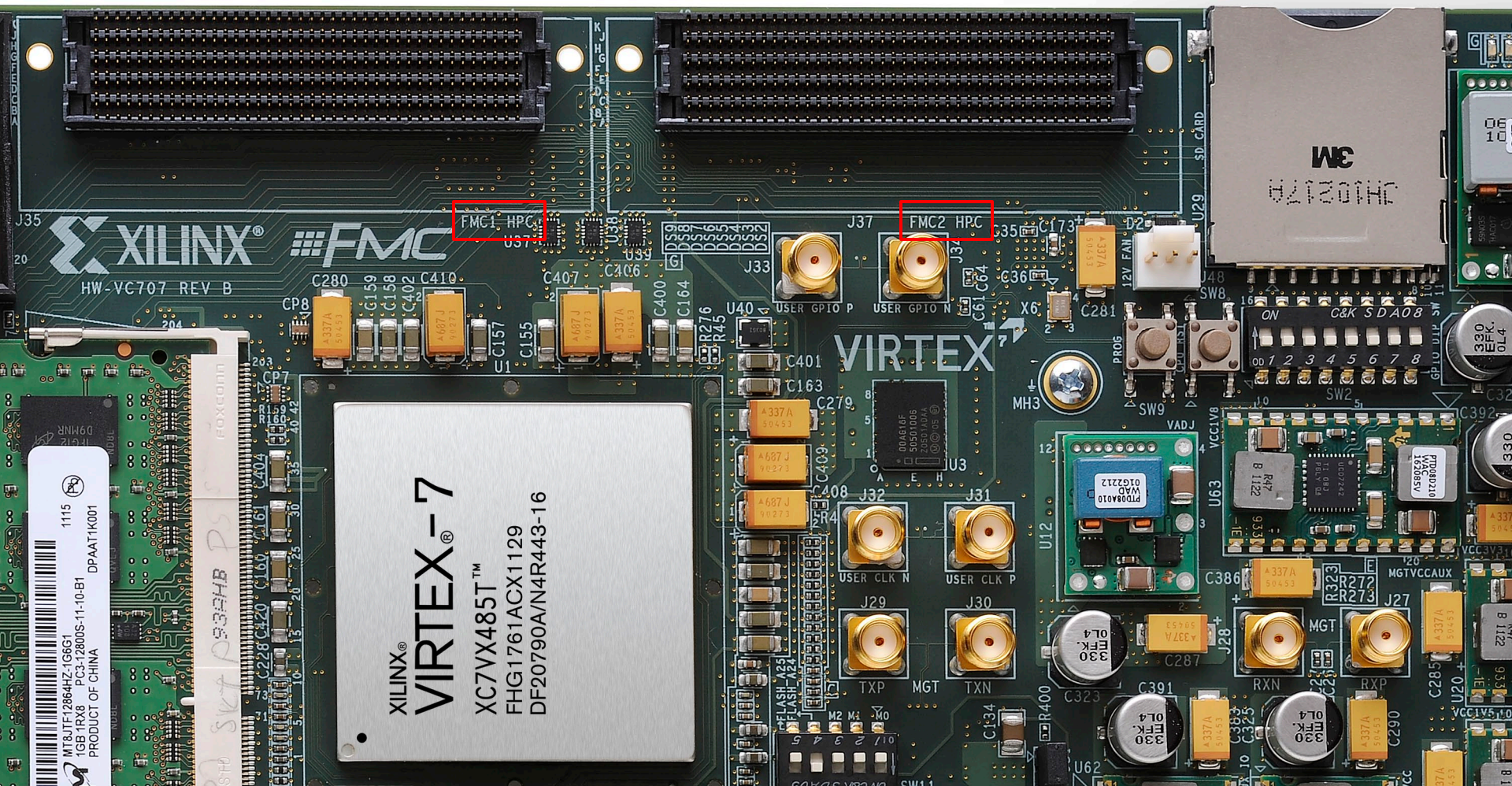
VC707 FMC Si570 Programming

❯ **Open ChipScope Pro and select JTAG Chain → Digilent USB Cable… (1)**

❯ **Verify 30 MHz operation and click OK (2)**

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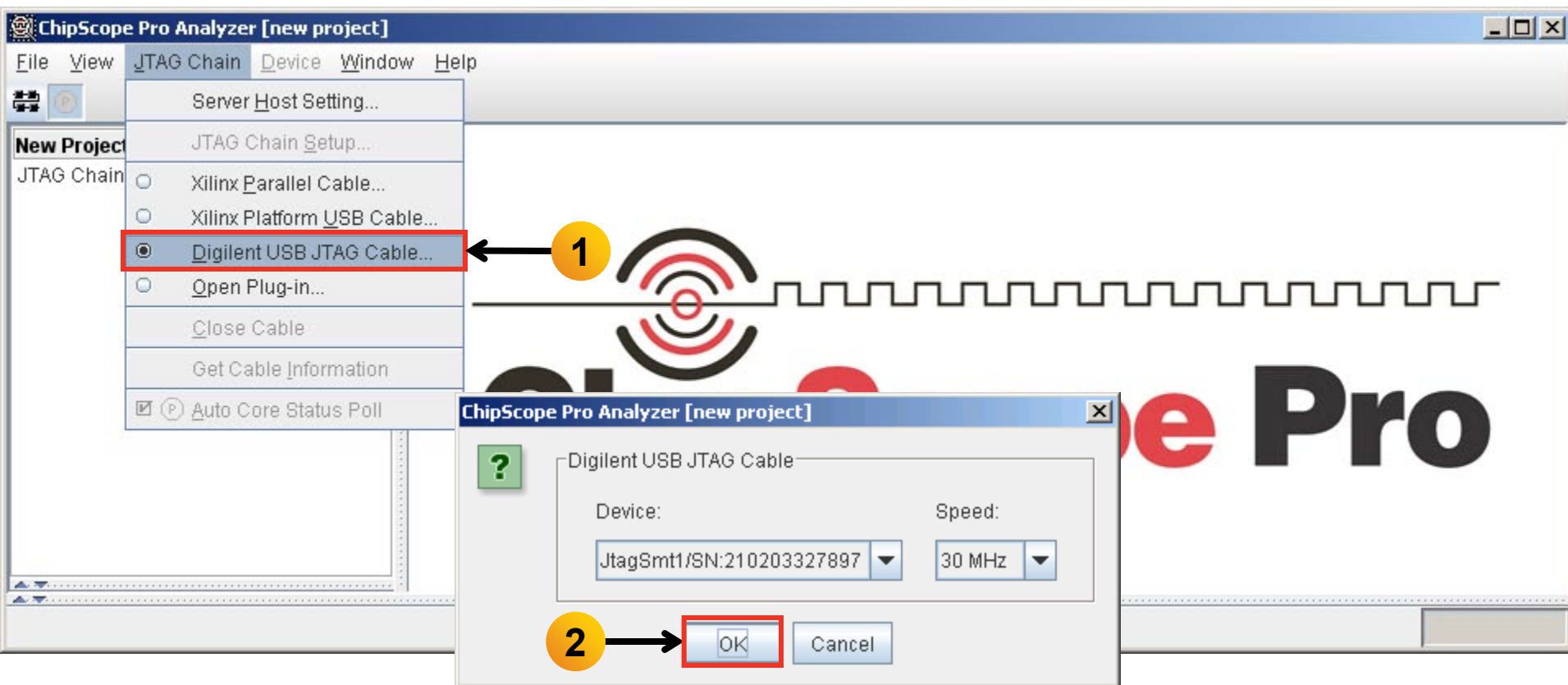
VC707 FMC Si570 Programming

> **Click OK (1)**
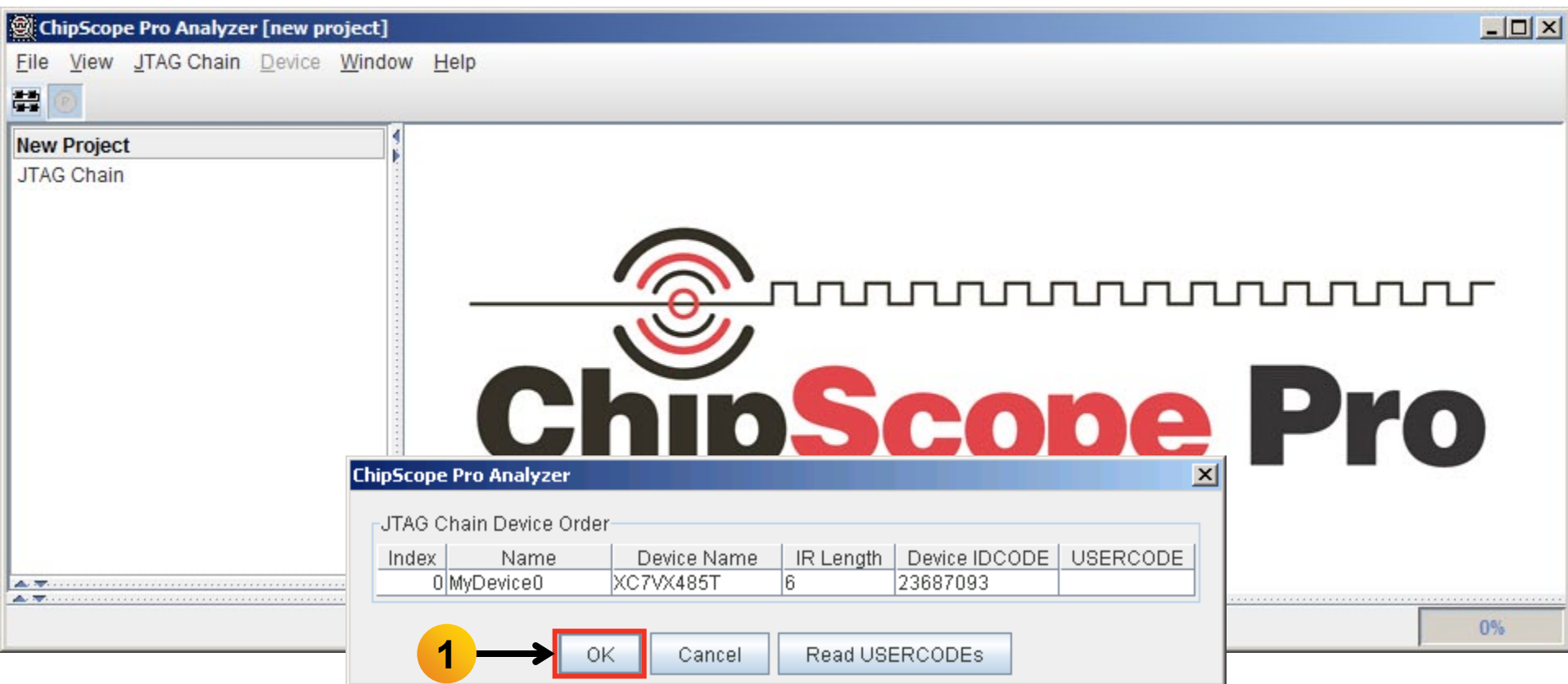
VC707 FMC Si570 Programming

❯ **Right-click DEV:0 MyDevice0 (XC7VX485T) and select Configure…**

– Select a bitstream that matches your FMC Board / FMC port configuration; e.g. **xm101_fmc1.bit**, **xm104_fmc2.bit**, etc.

– Select <Design Path>\ready_for_download\<bitstream>
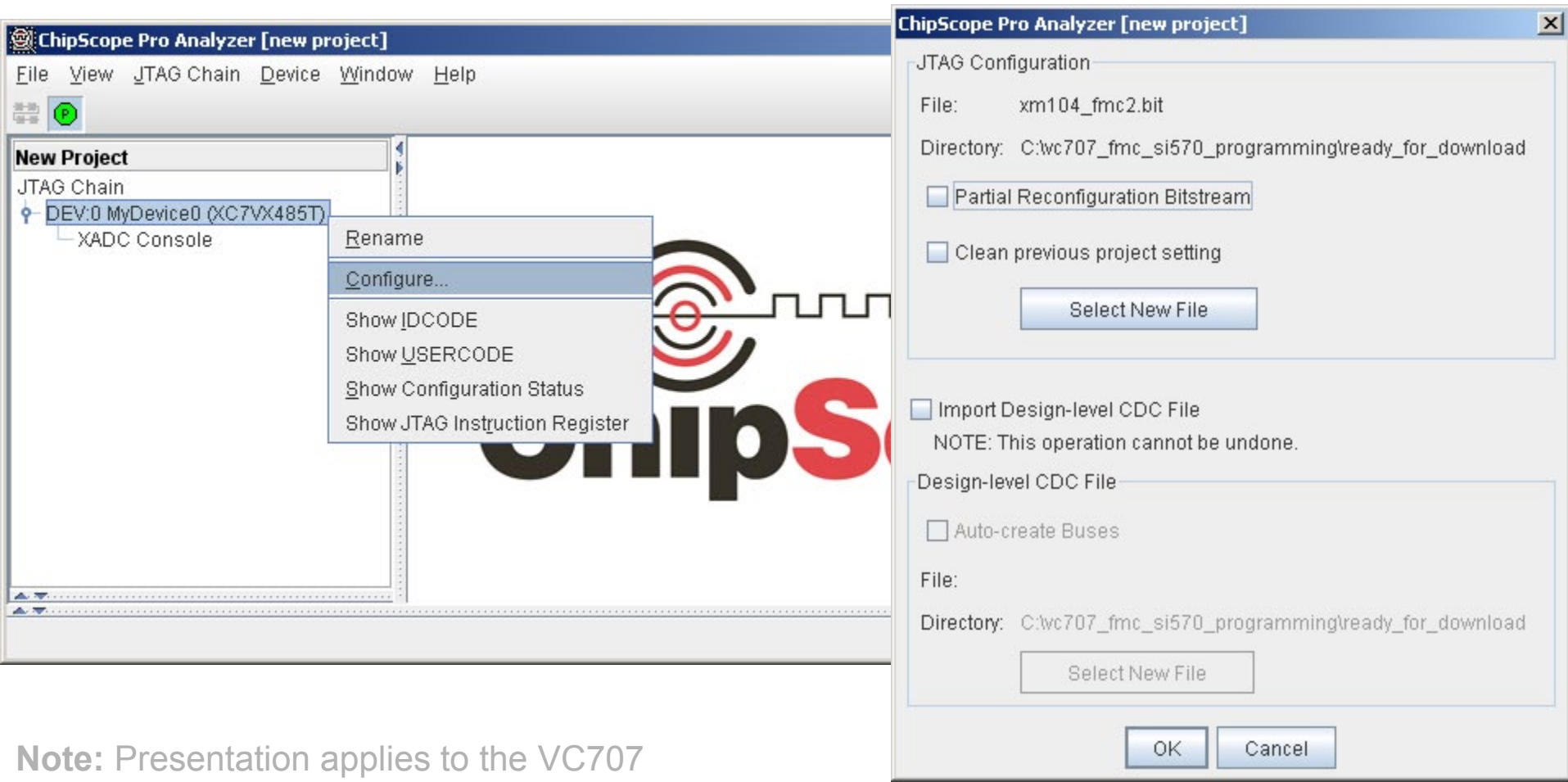
VC707 FMC Si570 Programming

❯ **Select File → Open Project…**

❯ **Select <Design Path>\ready_for_download\ vc707_fmc_si570_programming.cpj**

VC707 FMC Si570 Programming

❱ **The VIO Console will now show 200 MHz for the system clock, and 156.25 MHz for the User Clock**

❱ **An XM104 board on FMC2 HPC port shows 156.25 MHz on FMC2_GBT1**

VC707 FMC 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 **0x01C2BC21EAAC**
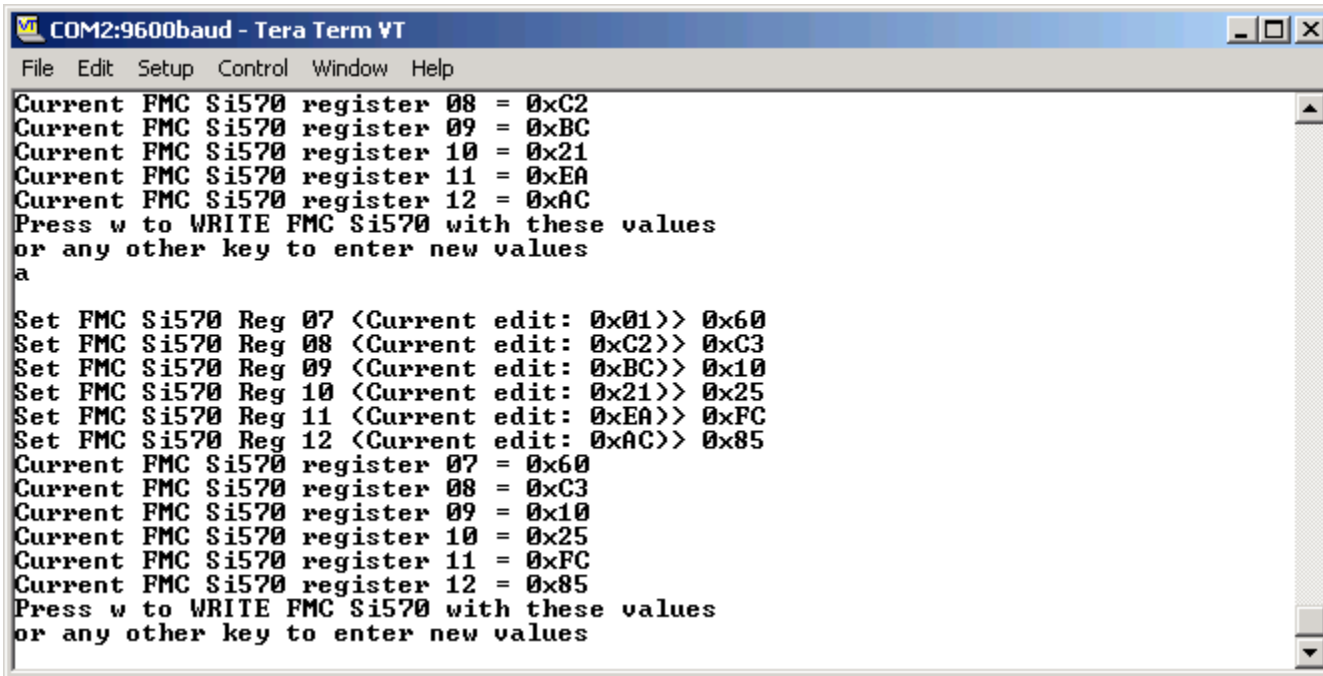
Note: The values reported by your Si570 may differ from those shown

VC707 FMC Si570 Programming

❯ **Use the Si570 Calibration procedure, noted earlier in this document to determine the values to enter**

❯ **Press a key to begin entering the newly calculated values**

❯ **When done, press "w"**

VC707 FMC Si570 Programming

› **Si570 has been successfully updated**

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VC707 FMC Si570 Programming

❯ **The XM104 board on FMC2 HPC port now shows 200 MHz**

❙ XILINX ❯ ALL PROGRAMMABLE

VC707 with FMC XM Boards

VC707 with FMC XM Boards

> **VC707 with XM101 in FMC1 HPC port**

VC707 with FMC XM Boards

> **VC707 with XM101 in FMC2 HPC port**
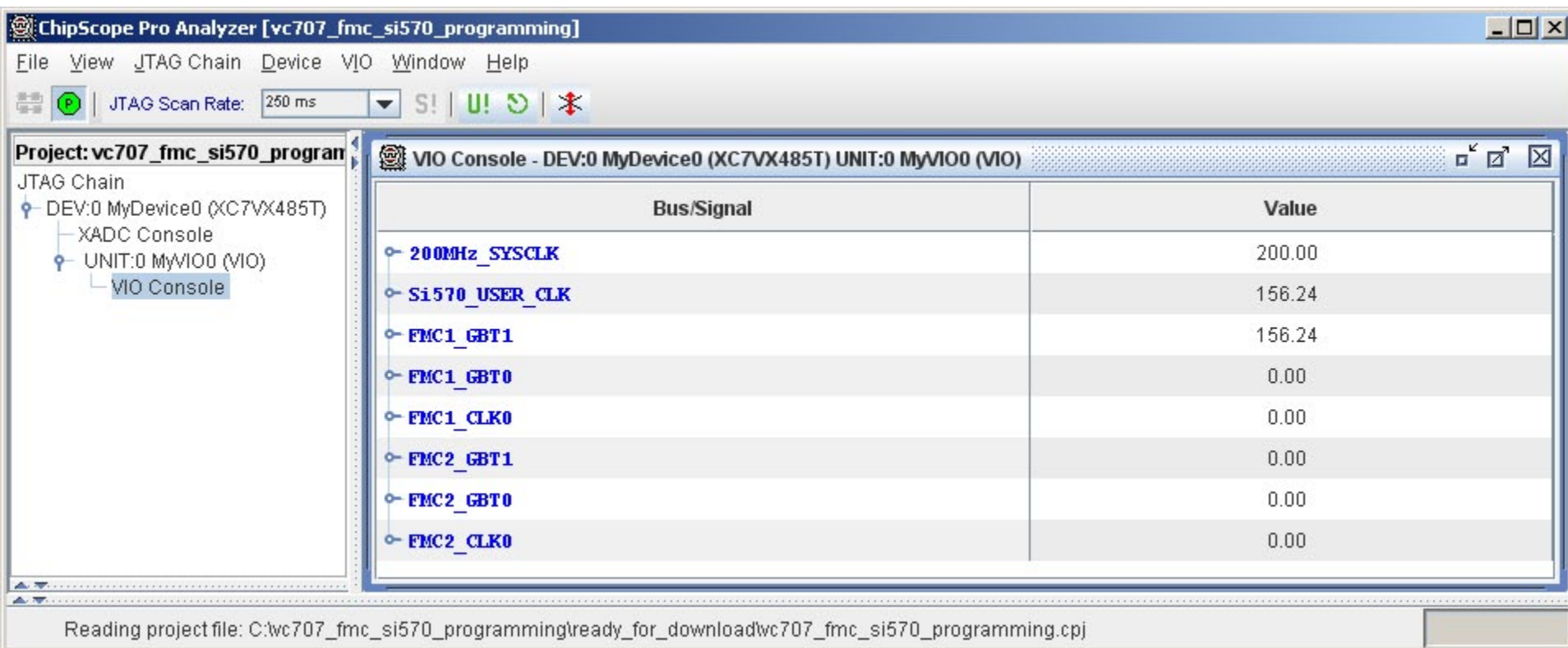
VC707 with FMC XM Boards

❯ **VC707 with XM104 in FMC1 HPC port**

VC707 with FMC XM Boards

❯ **VC707 with XM104 in FMC2 HPC port**

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VC707 with FMC XM Boards

➤ **VC707 with XM105 in FMC1 HPC port**

ChipScope Pro Analyzer [vc707_fmc_si570_programming]

File   View   JTAG Chain   Device   VIO   Window   Help

JTAG Scan Rate: 250 ms   S!   U!   ✻

Project: vc707_fmc_si570_program

JTAG Chain
- DEV:0 MyDevice0 (XC7VX485T)
  - XADC Console
  - UNIT:0 MyVIO0 (VIO)
    - VIO Console

VIO Console - DEV:0 MyDevice0 (XC7VX485T) UNIT:0 MyVIO0 (VIO)

Bus/Signal	Value
200MHz_SYSCLK	200.00
Si570_USER_CLK	156.24
FMC1_GBT1	0.00
FMC1_GBT0	0.00
FMC1_CLK0	156.24
FMC2_GBT1	0.00
FMC2_GBT0	0.00
FMC2_CLK0	0.00

Reading project file: C:\vc707_fmc_si570_programming\ready_for_download\vc707_fmc_si570_programming.cpj

⚡ XILINX ➤ ALL PROGRAMMABLE

VC707 with FMC XM Boards

❯ **VC707 with XM105 in FMC2 HPC port**

References

References

▶ **FMC XM101 Documentation**

– FMC XM101 LVDS QSE Mezzanine Card

- http://www.xilinx.com/products/boards-and-kits/HW-FMC-XM101-G.htm

– FMC XM101 LVDS QSE Mezzanine Card User Guide

- http://www.xilinx.com/support/documentation/boards_and_kits/ug538.pdf

▶ **FMC XM104 Documentation**

– FMC XM104 Connectivity Card

- http://www.xilinx.com/products/boards-and-kits/HW-FMC-XM104-G.htm

– FMC XM104 Connectivity Card User Guide

- http://www.xilinx.com/support/documentation/boards_and_kits/ug536.pdf

▶ **FMC XM105 Documentation**

– FMC XM105 Debug Card

- http://www.xilinx.com/products/boards-and-kits/HW-FMC-XM105-G.htm

– FMC XM105 Debug Card User Guide

- http://www.xilinx.com/support/documentation/boards_and_kits/ug537.pdf

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/
    xilinx14_3/chipscope_pro_sw_cores_ug029.pdf

Documentation

Documentation

❯ **Virtex-7**

  – Virtex-7 FPGA Family

     • http://www.xilinx.com/products/silicon-devices/fpga/virtex-7/index.htm

❯ **VC707 Documentation**

  – Virtex-7 FPGA VC707 Evaluation Kit

     • http://www.xilinx.com/products/boards-and-kits/EK-V7-VC707-G.htm

  – VC707 User Guide

     • http://www.xilinx.com/support/documentation/boards_and_kits/ug885_VC707_Eval_Bd.pdf