

KCU116 System Controller – GUI Tutorial

May 2019



Revision History

| Date | Version | Description |
|----------|---------|---|
| 07/17/19 | 8.1 | Minor update to several files. |
| 05/29/19 | 8.0 | Updated for 2019.1. Updated to BoardUI GUI; added Recovered Clock capability. |
| 12/10/18 | 7.0 | Updated for 2018.3. |
| 06/18/18 | 6.0 | Updated for 2018.2. |
| 04/09/18 | 5.0 | Updated for 2018.1. |
| 12/20/17 | 4.0 | Updated for 2017.4. |
| 10/26/17 | 3.0 | Updated for 2017.3.1. |
| 06/20/17 | 2.0 | Updated for 2017.2. |
| 04/19/17 | 1.0 | Initial version. |

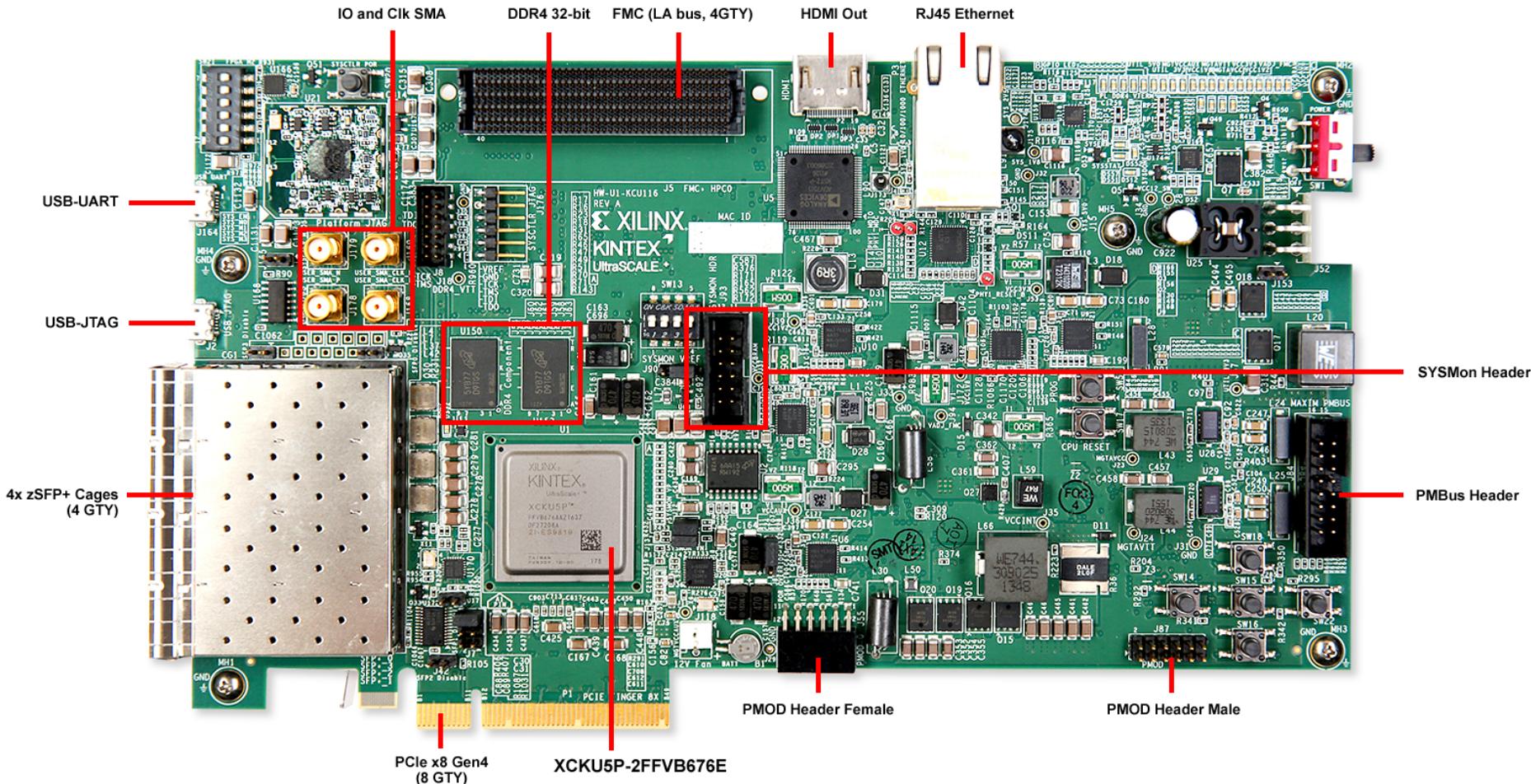
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Overview

- > **Xilinx KCU116 Board**
- > **KCU116 SCUI**
 - » Clocks
 - » Voltages
 - » Power
 - » FMC
 - » EEPROM Data
 - » About
- > **Board Boot-Up Initialization**
- > **References**

Xilinx KCU116 Board



Note: Presentation applies to the KCU116

KCU116 Software Install and Board Setup

- > Refer to XTP464 – KCU116 Software Install and Board Setup for details on:

- » Software Requirements
 - » KCU116 Board Setup

- > Note: This tutorial uses a new System Controller GUI

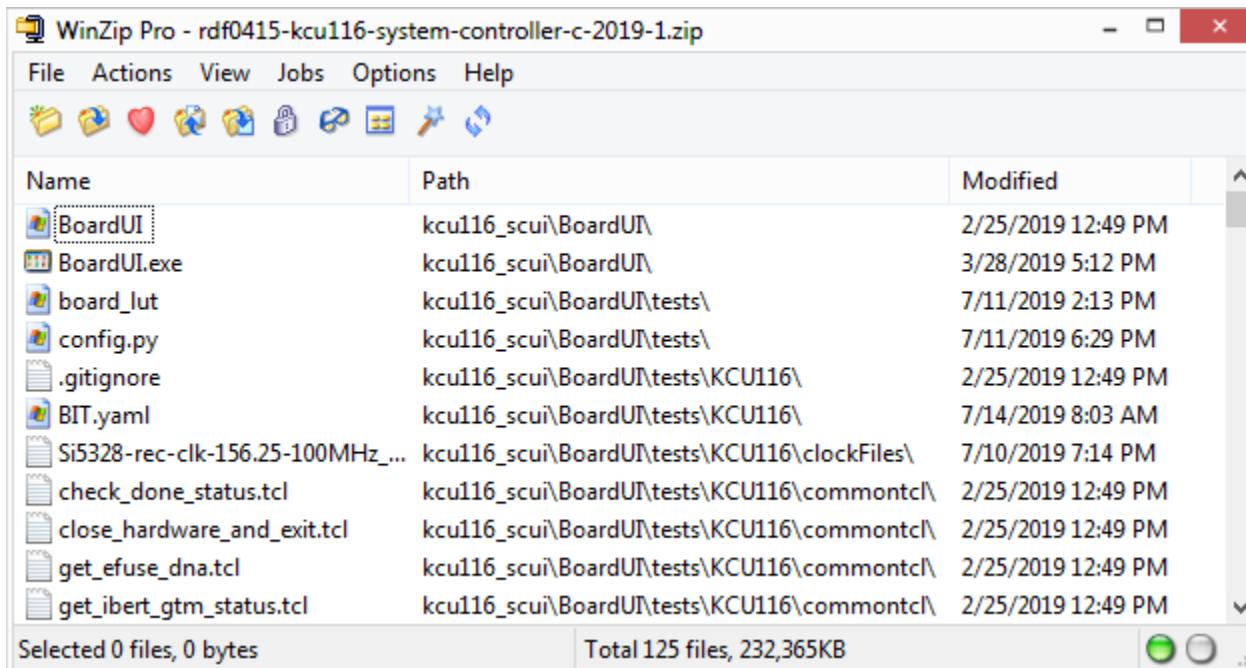
- » Adds the ability to use SiLabs generated register files for the Si5328
 - » To fully use this GUI, you must install latest firmware
 - » See Programming Firmware at the end of this tutorial
 - » If retaining the old firmware, use the 2018.3 version of XTP465



KCU116 System Controller

- > Open the RDF0415 – KCU116 System Controller GUI (2019.1 C) ZIP file

» Extract these files to your C:\ drive



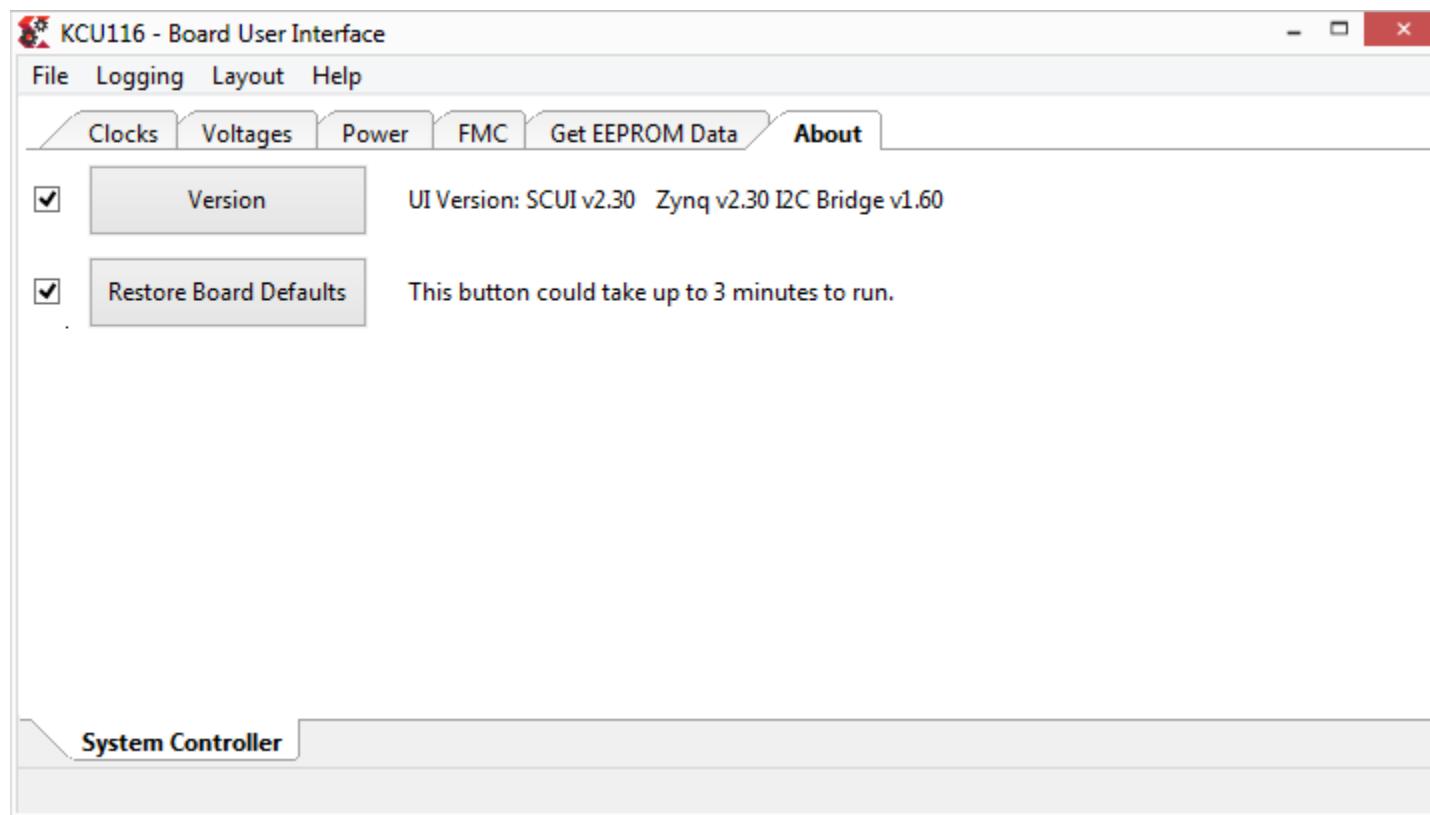
Running the Board Interface Test

- > From C:\kcu128_scui\BoardUI, double click on BoardUI.exe



Verify firmware version and set Board Defaults

- > Select the About tab
- > Verify the correct version of firmware for this tutorial
 - » Zynq v2.30 I2C Bridge v1.60
- > The first time after updating the firmware, run Restore Board Defaults

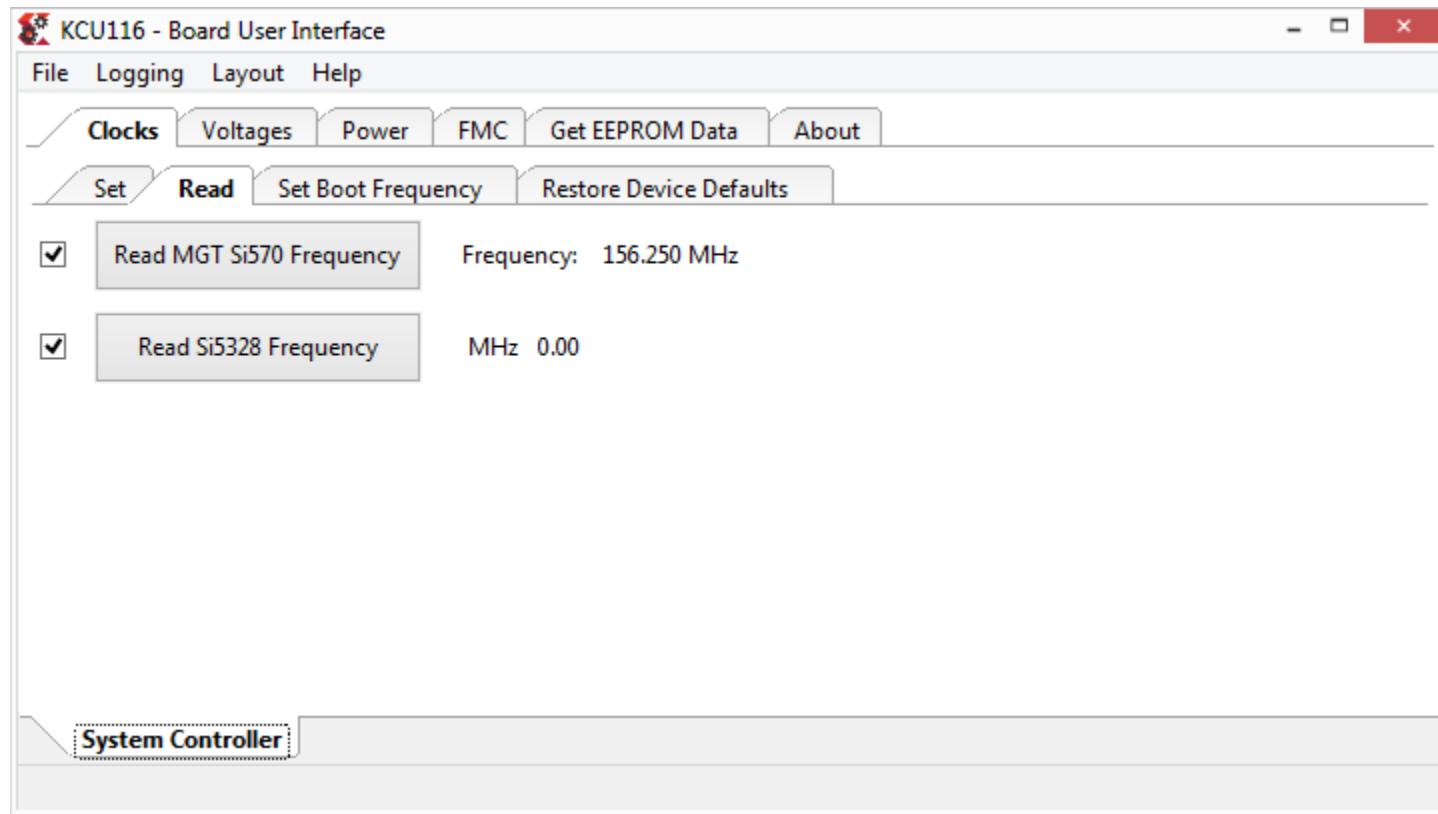


Clocks



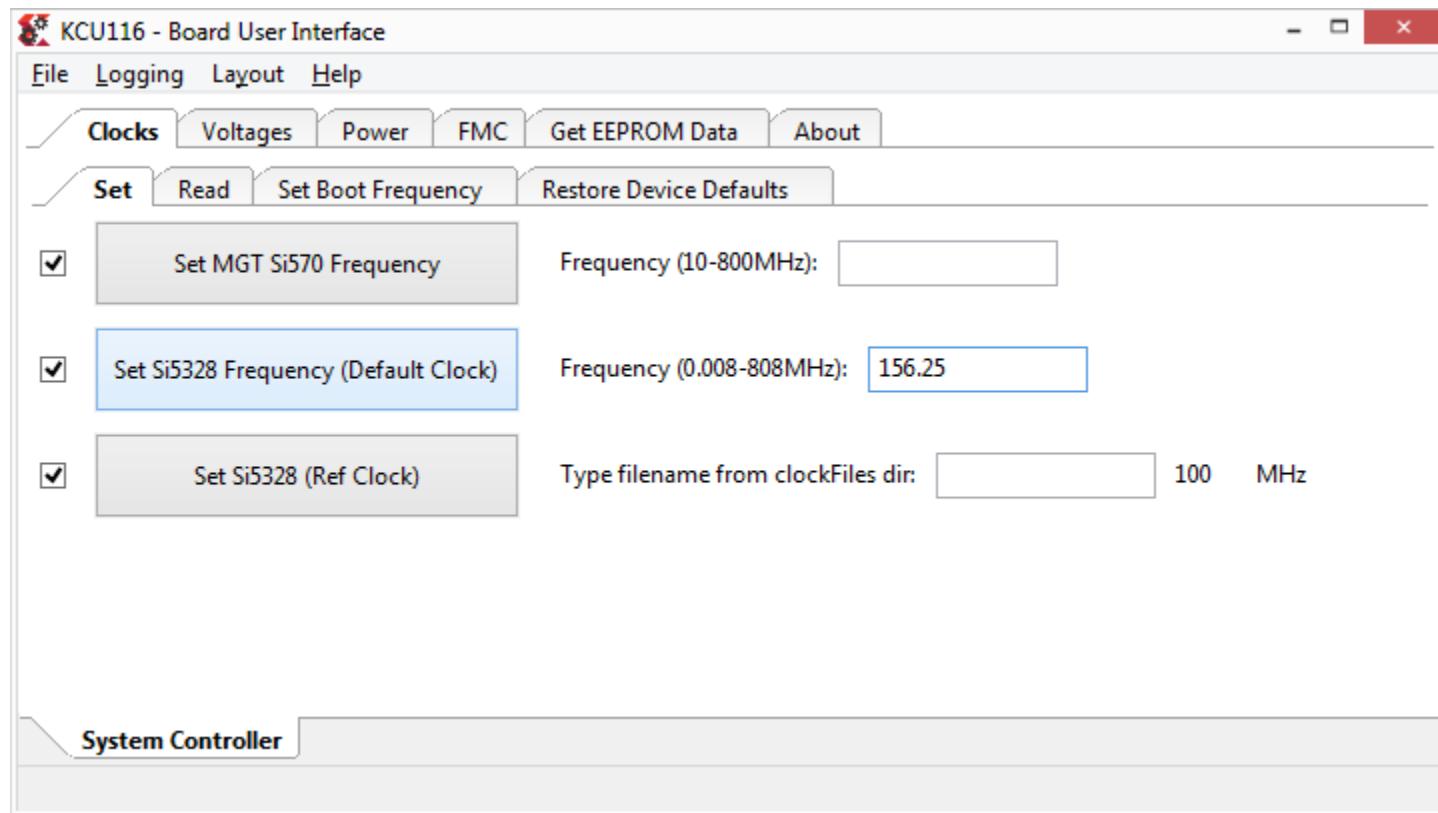
Reading the clocks

- > Select the Read tab underneath the Clocks tab
- > Click each of the Read buttons and verify the frequencies are set as shown



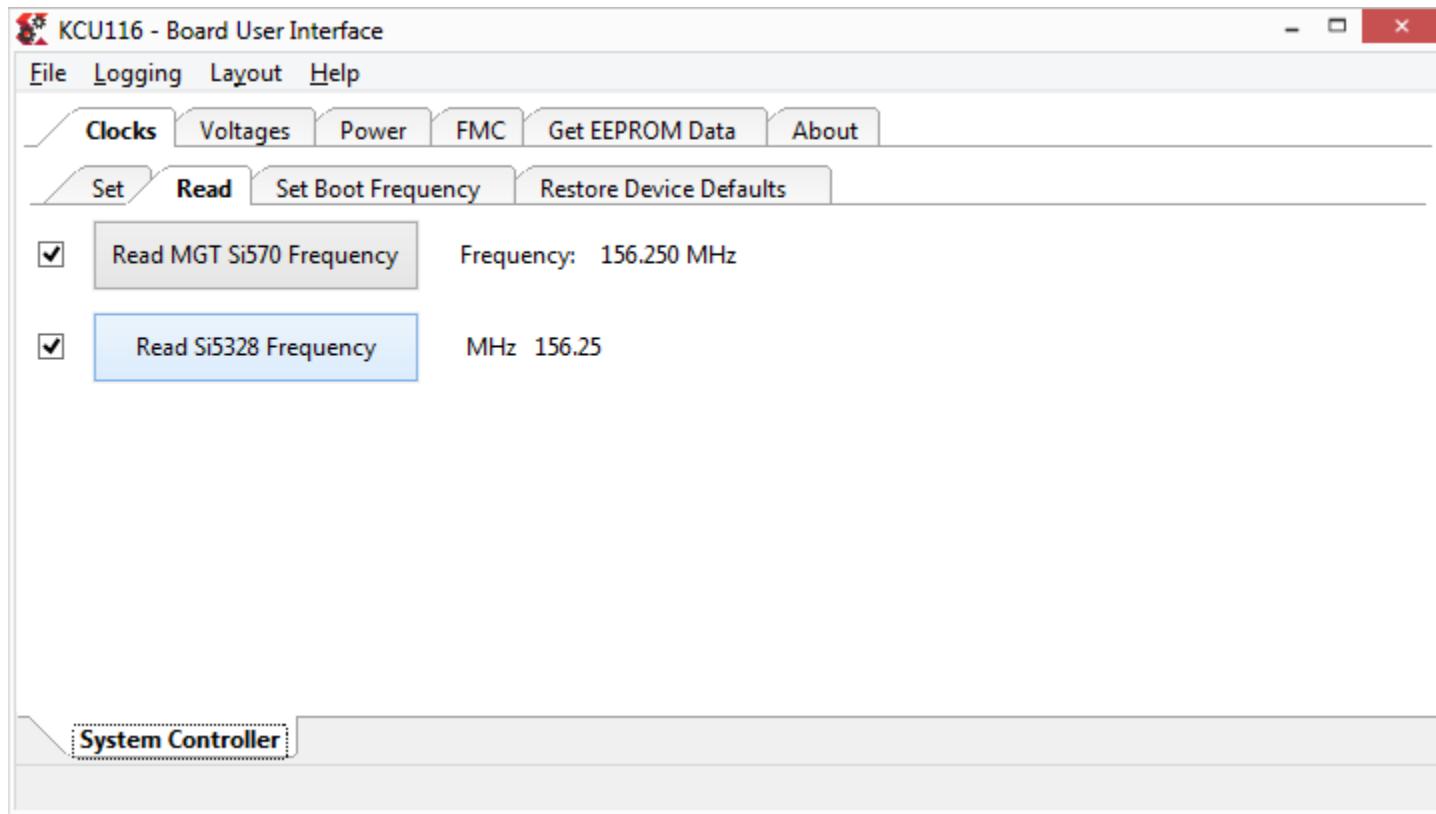
Setting the clocks

- > Select the Set tab
- > Enter 156.25 for the Si5328 and click the Set Si5328 Frequency (Default Clock) button



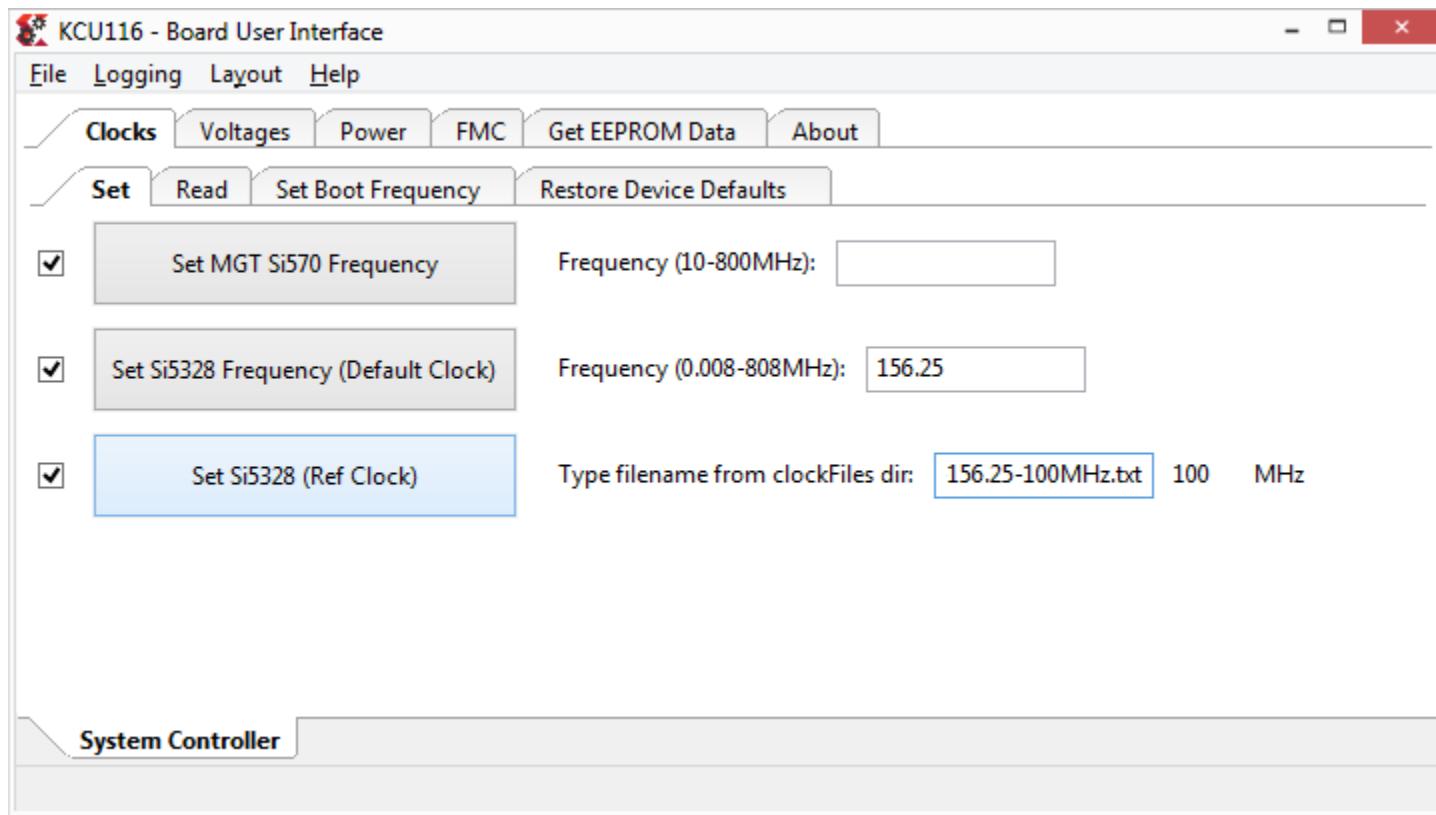
Reading the clocks

- > Select the Read tab
- > Read the Si5328 Frequency



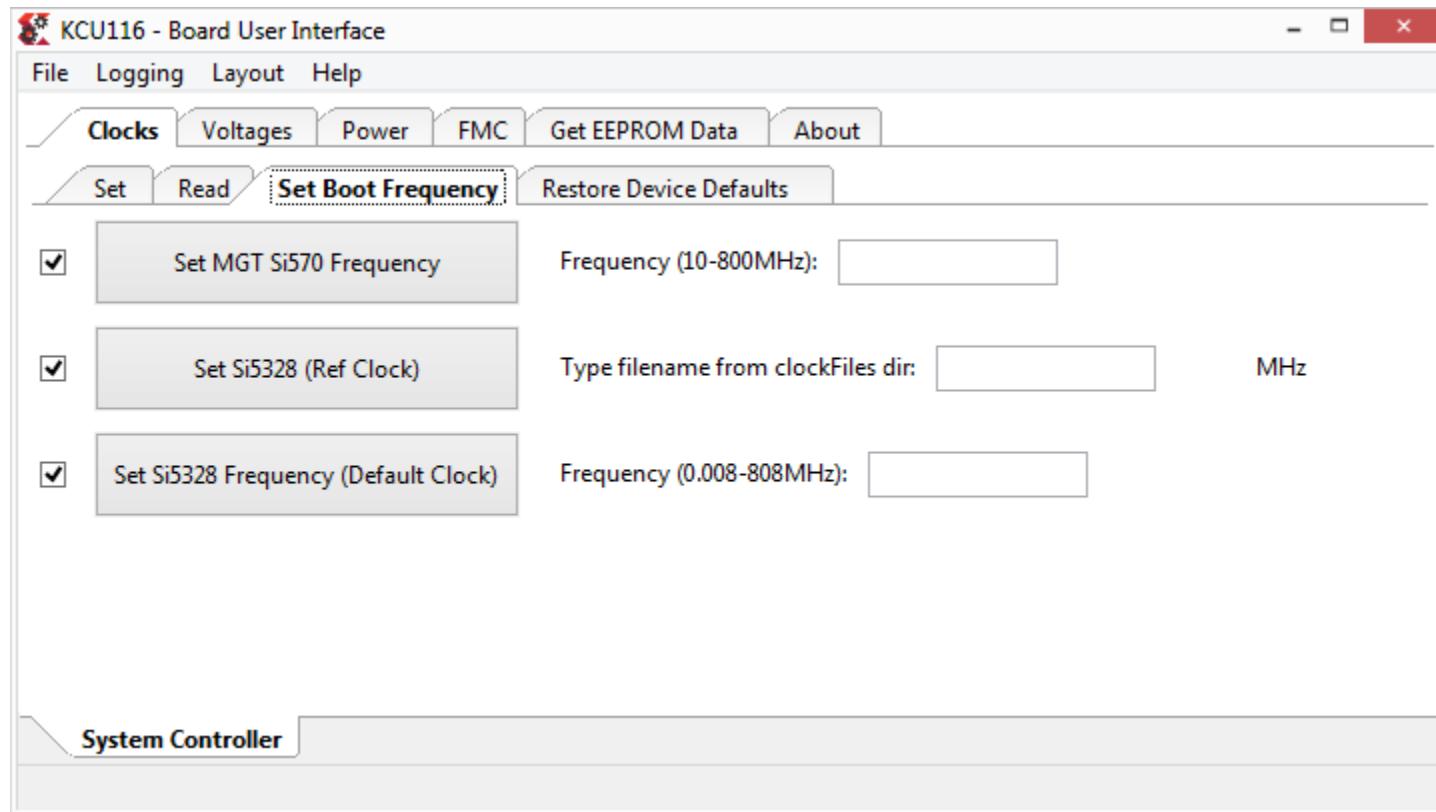
Setting the clocks

- > Select the Set tab
- > Enter the filename “Si5328-rec-clk-156.25-100MHz.txt” and click the Set Si5328 (Ref Clock) button
- > This reads in the contents of this sample register file



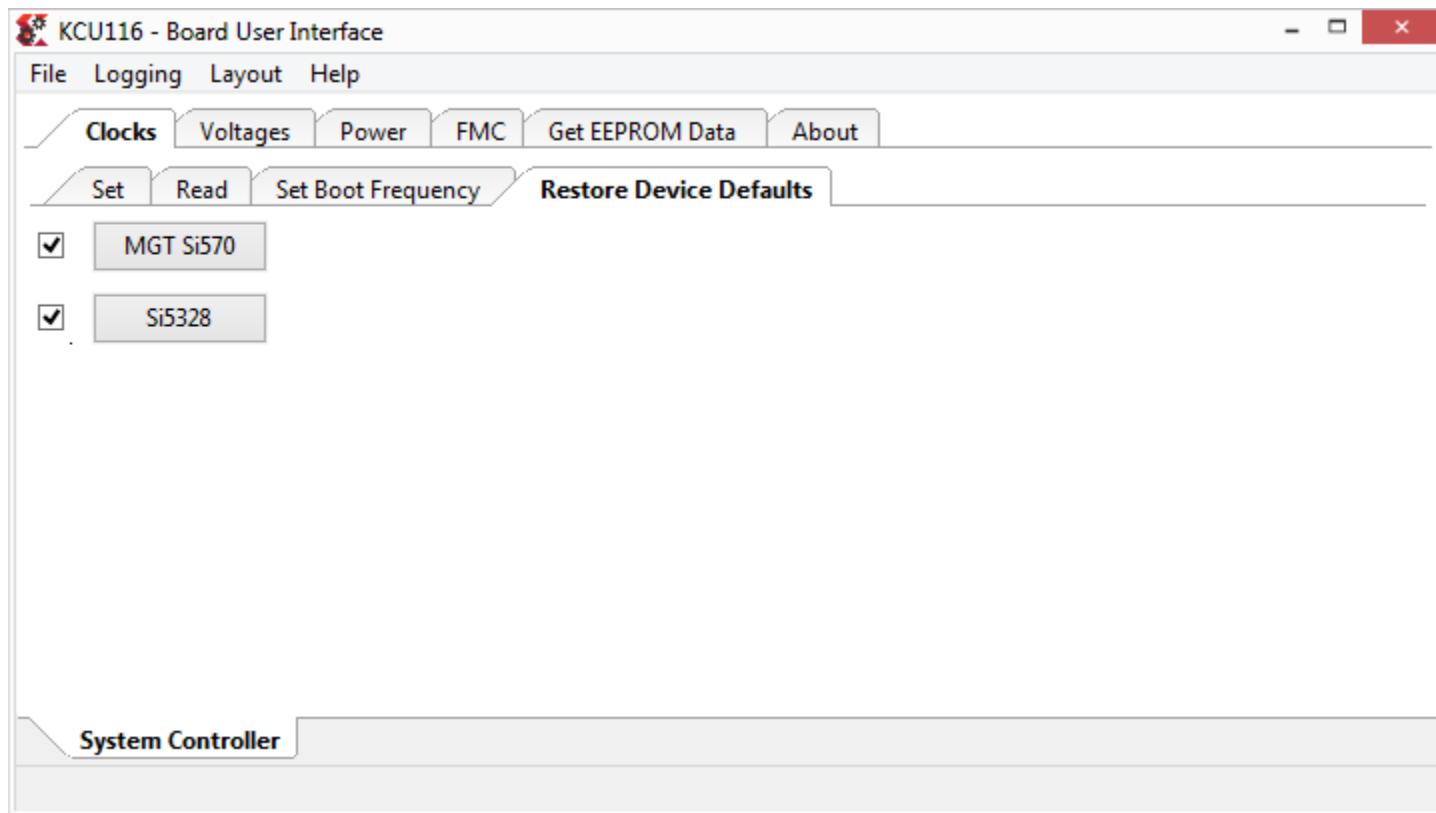
Setting the clock's boot-up frequency

- > Select the Set Boot Frequency tab
- > Type in your desired boot-up frequency (or register file) and click the corresponding Set button



Restore clock's default settings

- > Select the Restore Device Defaults tab
- > Restore the defaults by clicking the button associated with the clock you want to restore (156.25 MHz, and 0 MHz)
- > This doesn't affect Boot settings; use the Restore Board Defaults instead

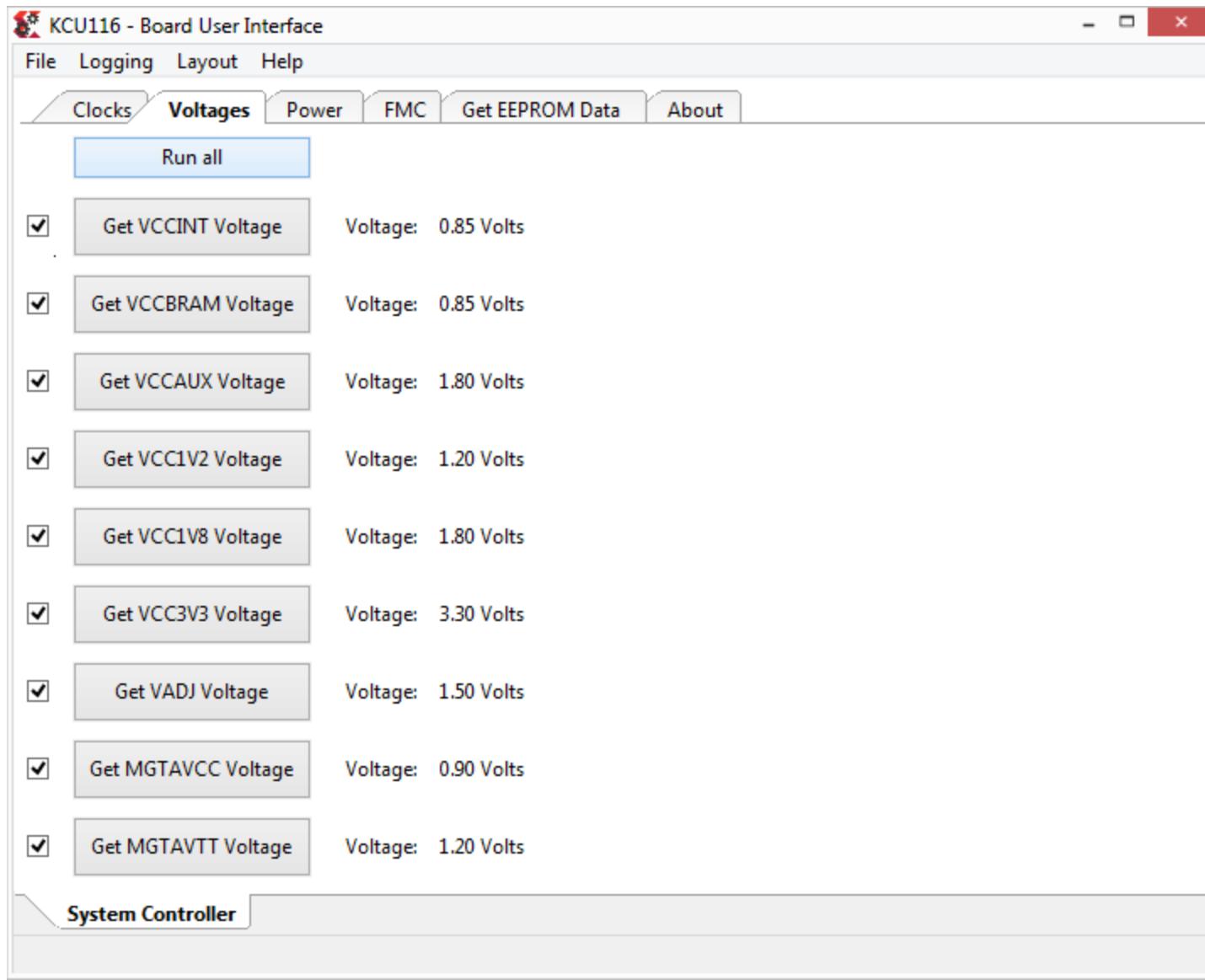


Voltages



Reading onboard KCU116 voltages

- > Select the Voltages tab and Click the Get All Voltages button

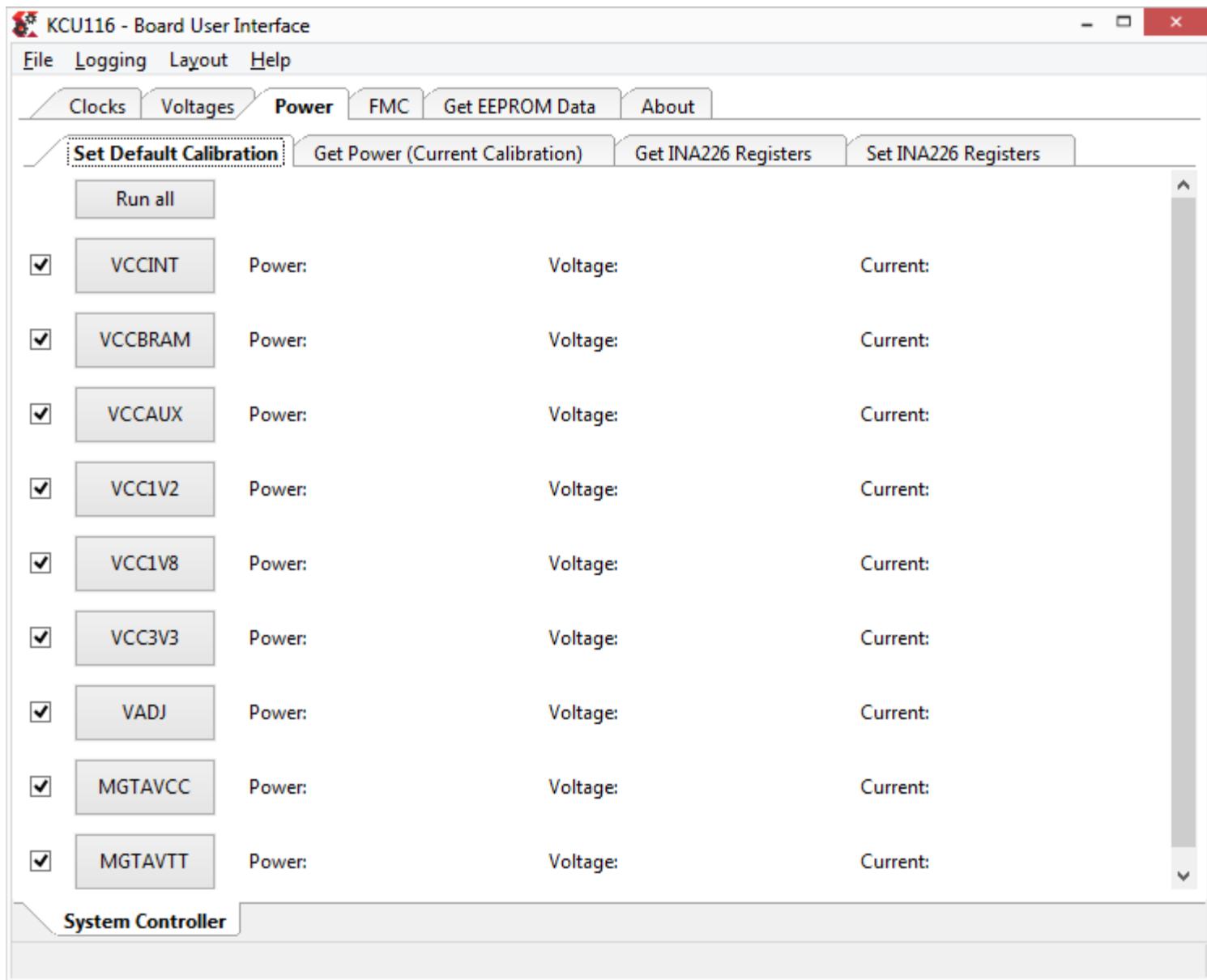


Power



Set Power Default Calibration

> Select the Set Default Calibration tab and click Run All



Set Power Default Calibration

- > INA226 calibration values will be reset to their defaults

The screenshot shows the KCU116 - Board User Interface software window. The title bar reads "KCU116 - Board User Interface". The menu bar includes "File", "Logging", "Layout", and "Help". The top navigation bar has tabs: "Clocks", "Voltages", "Power" (which is selected), "FMC", "Get EEPROM Data", and "About". Below the tabs are four buttons: "Set Default Calibration", "Get Power (Current Calibration)", "Get INA226 Registers", and "Set INA226 Registers". A "Run all" button is located above a list of power supply nodes. The list contains the following entries:

| Node | Power: Watts | Voltage: Volts | Current: Amps |
|---------|--------------|----------------|---------------|
| VCCINT | 0.79 Watts | 0.85 Volts | 0.93 Amps |
| VCCBRAM | 0.16 Watts | 0.85 Volts | 0.19 Amps |
| VCCAUX | 0.81 Watts | 1.79 Volts | 0.45 Amps |
| VCC1V2 | 0.34 Watts | 1.20 Volts | 0.28 Amps |
| VCC1V8 | 0.06 Watts | 1.80 Volts | 0.03 Amps |
| VCC3V3 | 0.13 Watts | 3.30 Volts | 0.04 Amps |
| VADJ | 0.06 Watts | 1.50 Volts | 0.04 Amps |
| MGTAVCC | 0.11 Watts | 0.90 Volts | 0.13 Amps |
| MGTAVTT | 1.31 Watts | 1.20 Volts | 1.09 Amps |

At the bottom left, there is a "System Controller" button.

Reading Power Values

> Run and view the Power with the Current Calibration

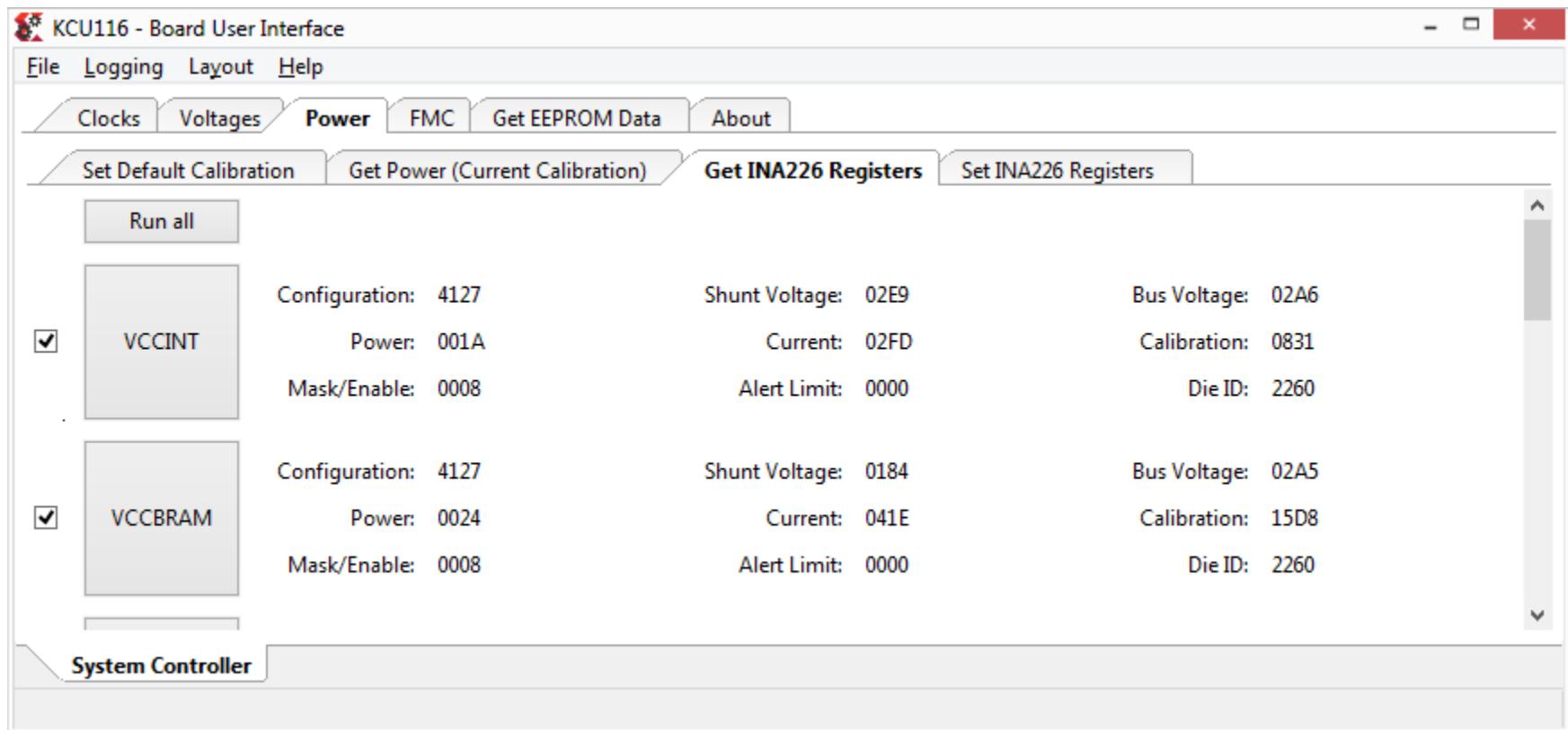
The screenshot shows the KCU116 - Board User Interface window. The menu bar includes File, Logging, Layout, Help, Clocks, Voltages, Power (which is selected), FMC, Get EEPROM Data, and About. Below the menu is a toolbar with buttons for Set Default Calibration, Get Power (Current Calibration) (which is highlighted), Get INA226 Registers, and Set INA226 Registers. A large table lists power consumption for various voltage rails:

| Voltage Rail | Power: Watts | Voltage: Volts | Current: Amps |
|--------------|--------------|----------------|---------------|
| VCCINT | 0.79 Watts | 0.85 Volts | 0.94 Amps |
| VCCBRAM | 0.16 Watts | 0.85 Volts | 0.19 Amps |
| VCCAUX | 0.81 Watts | 1.79 Volts | 0.45 Amps |
| VCC1V2 | 0.34 Watts | 1.20 Volts | 0.28 Amps |
| VCC1V8 | 0.06 Watts | 1.80 Volts | 0.03 Amps |
| VCC3V3 | 0.13 Watts | 3.30 Volts | 0.04 Amps |
| VADJ | 0.06 Watts | 1.50 Volts | 0.04 Amps |
| MGTAVCC | 0.11 Watts | 0.90 Volts | 0.13 Amps |
| MGTAVTT | 1.32 Watts | 1.20 Volts | 1.10 Amps |

At the bottom left, there is a System Controller tab.

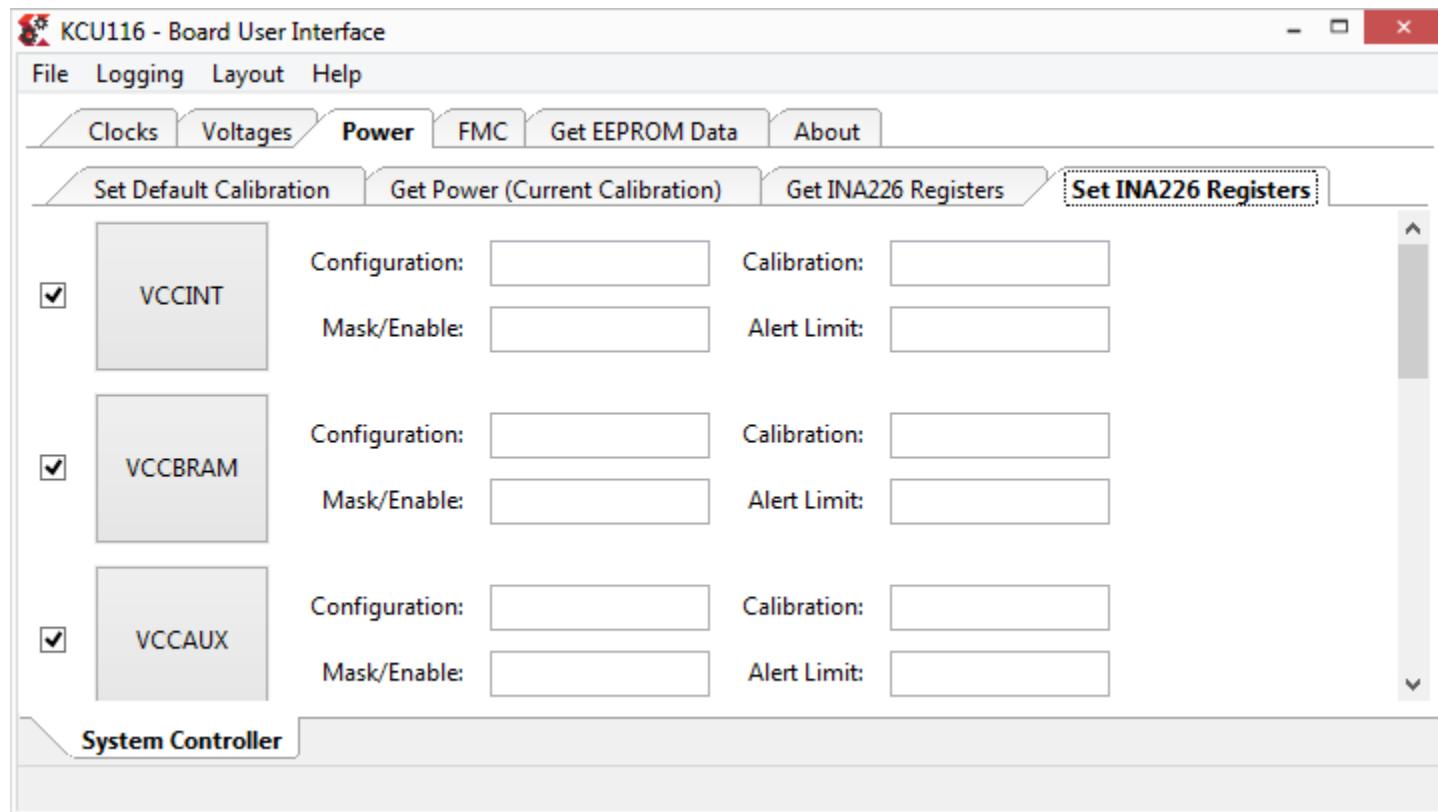
Read INA226 Registers

- > Select the Get INA226 Registers tab
- > Click Run All and observe the INA226 Registers settings



Set INA226 Registers

- > Select the Set INA226 Registers tab
- > Review [TI INA226 documentation before making changes](#)

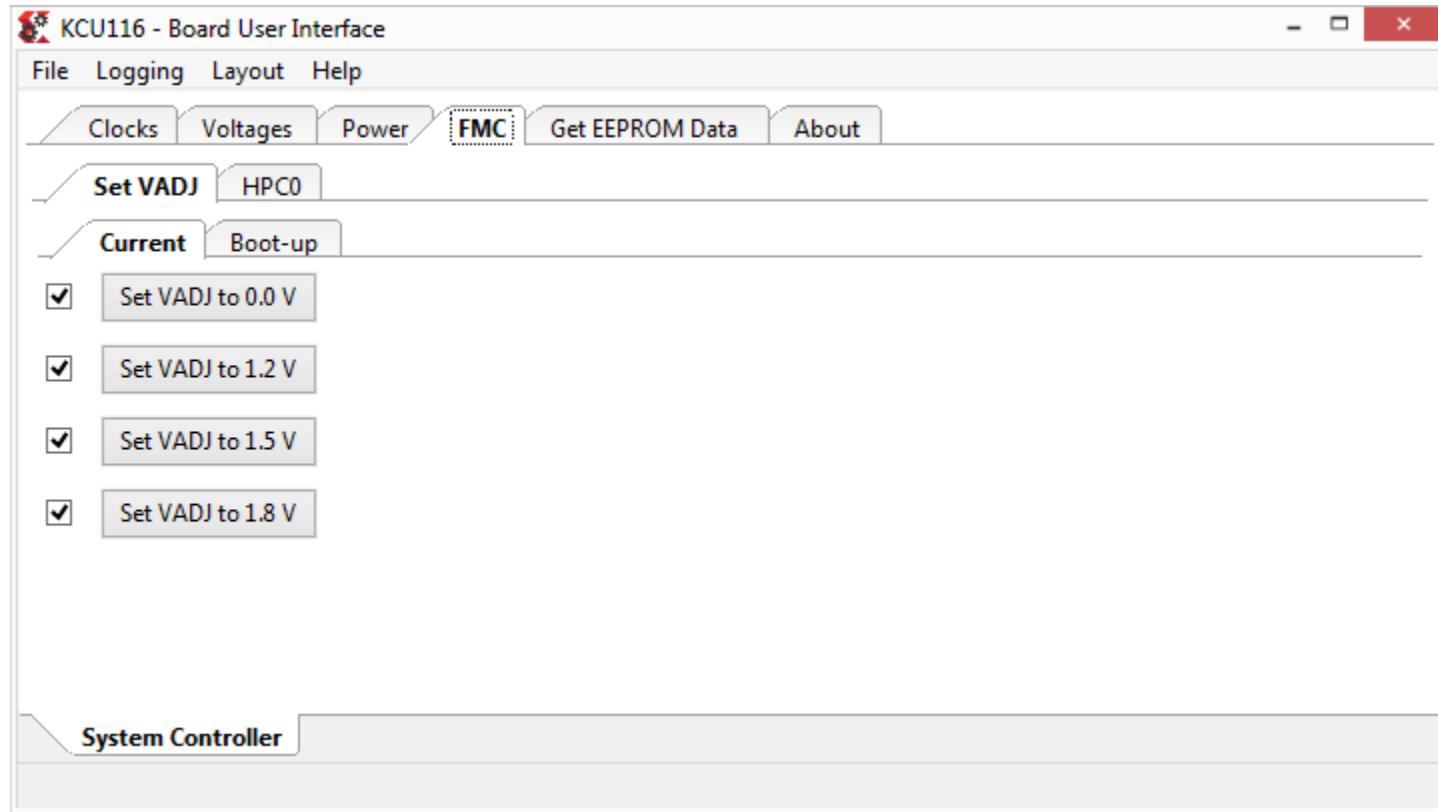


FMC



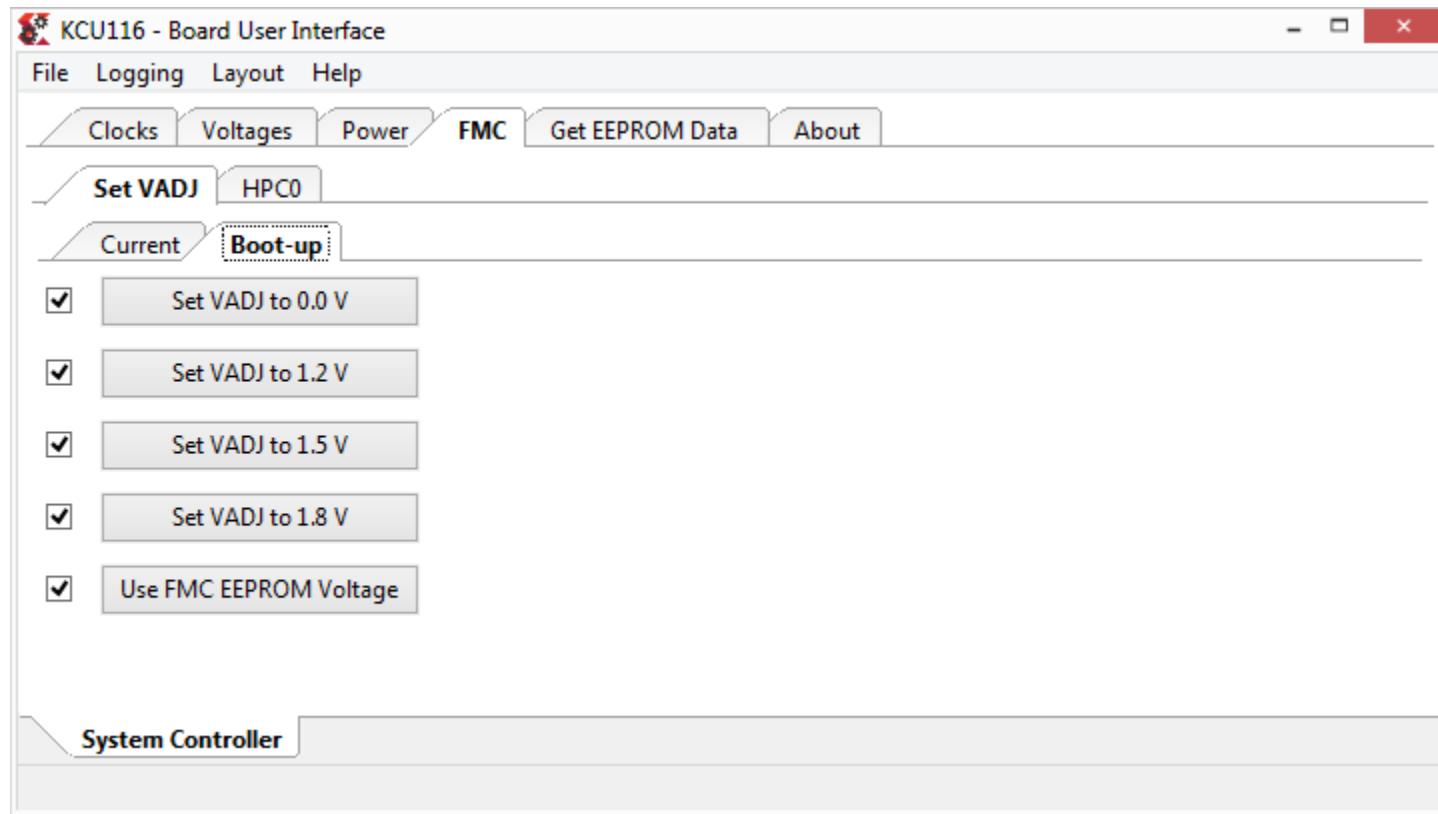
Set VADJ

- > Click the Set VADJ tab underneath the FMC tab
- > Under the Current tab, select the desired VADJ voltage
- > Some BIT tests expect 1.8 V



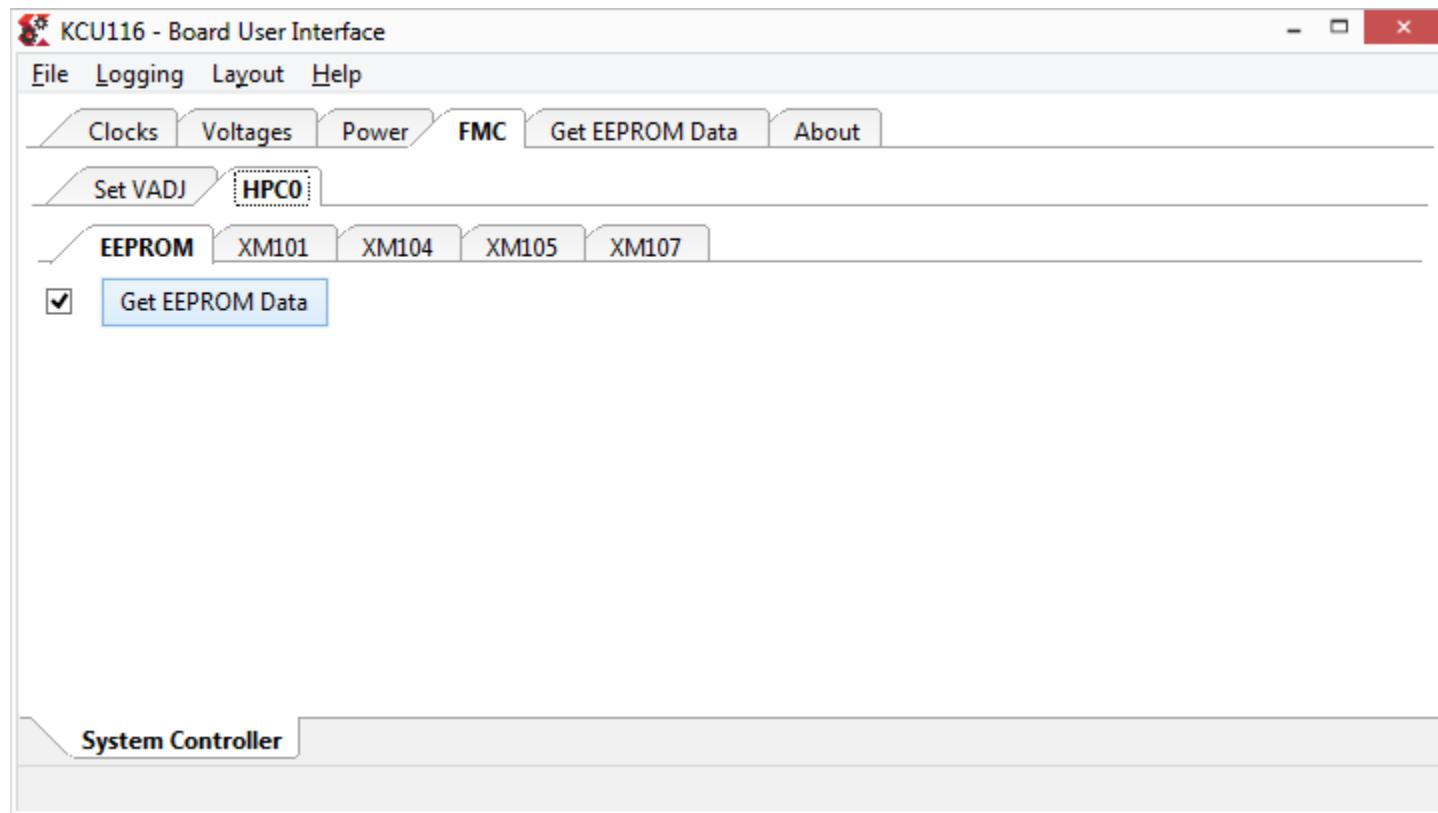
Set Boot-Up VADJ

- > Select the Boot-up tab and choose the desired power-on voltage
- > The default, Use FMC EEPROM Voltage, will set 1.8 V unless you attach an FMC card with a different setting



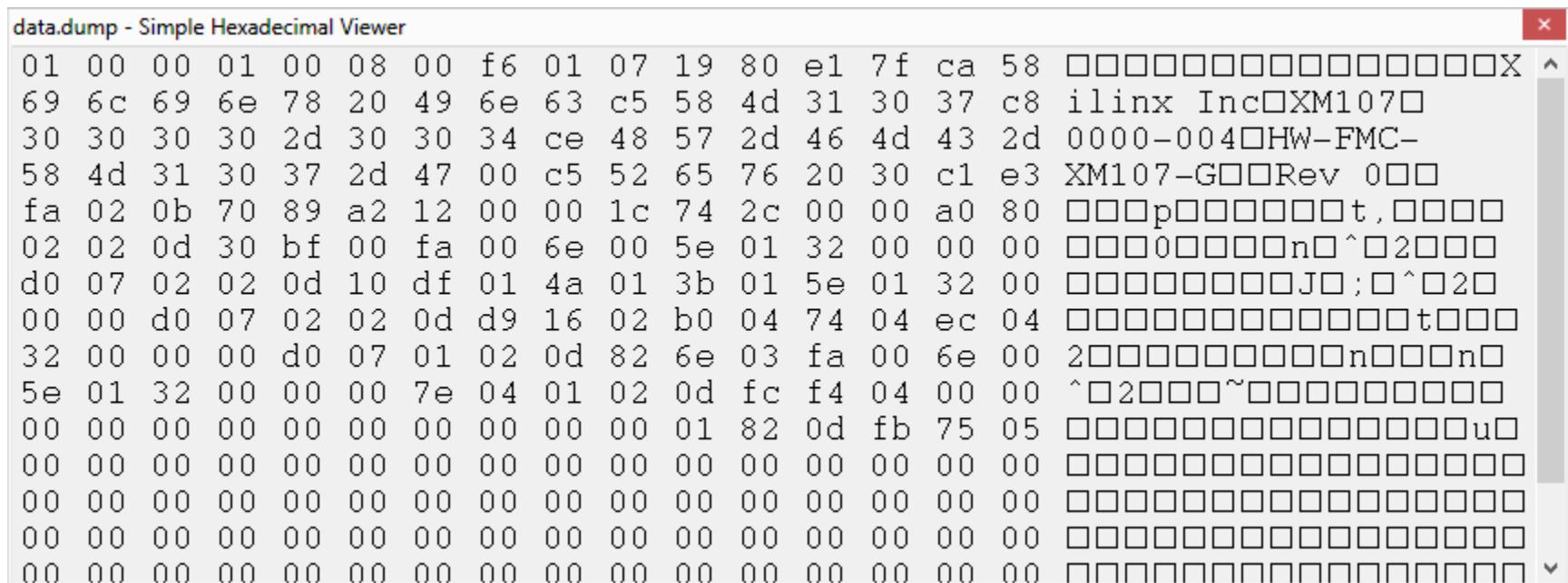
Reading FMC EEPROM

- > Select the HPC0 tab and click the Get EEPROM Data button



Reading FMC EEPROM

- > The EEPROM data will be displayed in a separate window (XM107 data shown)

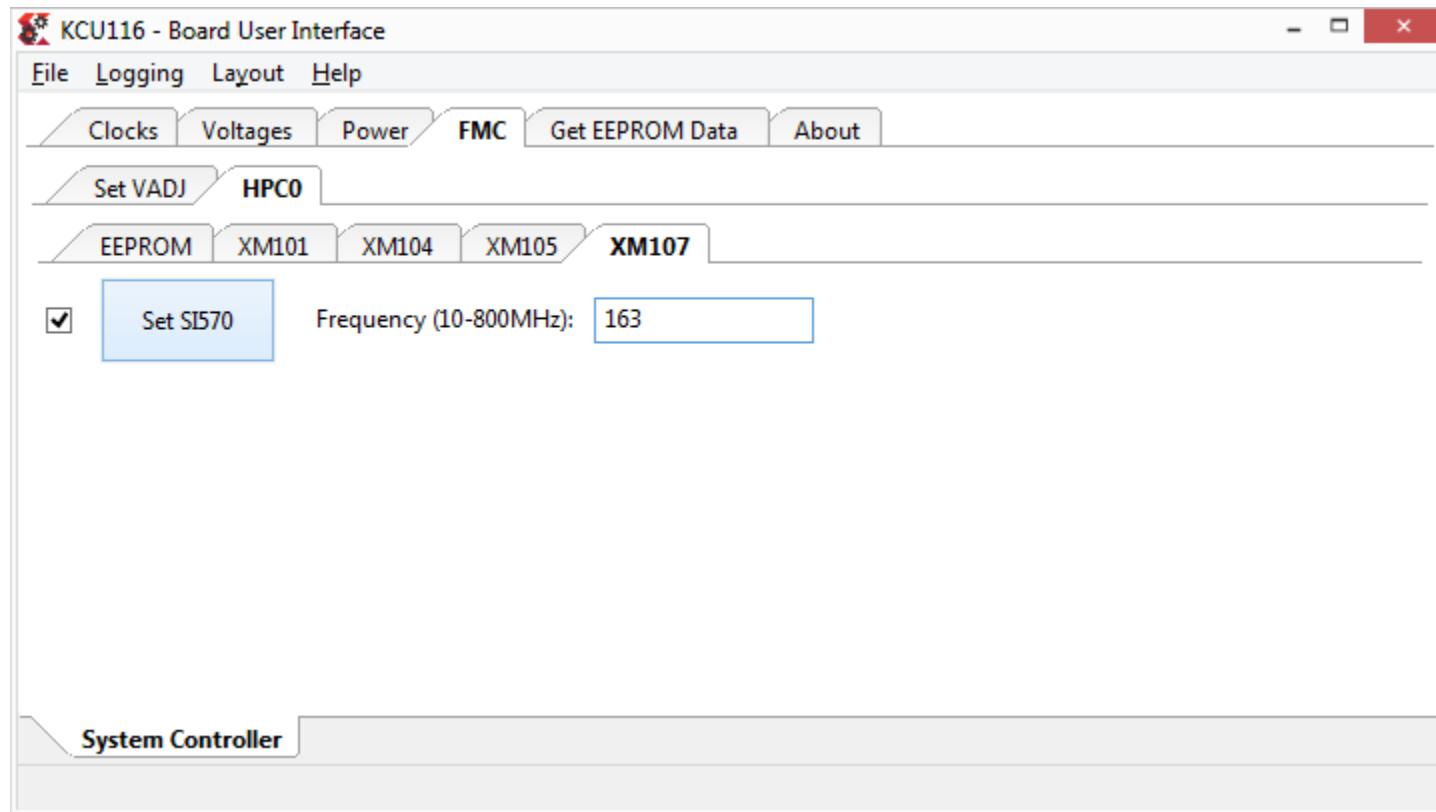


The screenshot shows a window titled "data.dump - Simple Hexadecimal Viewer". The window displays a hex dump of memory data. The data starts with some binary values (01, 00, 00, 01, 00, 08, 00, f6, 01, 07, 19, 80, e1, 7f, ca, 58) followed by ASCII characters representing the string "ilinx Inc XM107". Below this, more binary data is shown, including "0000-004 HW-FMC-", "XM107-G Rev 0", and other binary patterns. The window has scroll bars on the right and bottom.

| Hex | ASCII |
|---|--|
| 01 00 00 01 00 08 00 f6 01 07 19 80 e1 7f ca 58 | ███X |
| 69 6c 69 6e 78 20 49 6e 63 c5 58 4d 31 30 37 c8 | ilinx Inc XM107 |
| 30 30 30 30 2d 30 30 34 ce 48 57 2d 46 4d 43 2d | 0000-004 HW-FMC- |
| 58 4d 31 30 37 2d 47 00 c5 52 65 76 20 30 c1 e3 | XM107-G Rev 0 |
| fa 02 0b 70 89 a2 12 00 00 1c 74 2c 00 00 a0 80 | ████p████████████t,██████ |
| 02 02 0d 30 bf 00 fa 00 6e 00 5e 01 32 00 00 00 | ████0████████n^████ |
| d0 07 02 02 0d 10 df 01 4a 01 3b 01 5e 01 32 00 | ████████████J;^████ |
| 00 00 d0 07 02 02 0d d9 16 02 b0 04 74 04 ec 04 | ████████████████t████ |
| 32 00 00 00 d0 07 01 02 0d 82 6e 03 fa 00 6e 00 | 2████████████n████n |
| 5e 01 32 00 00 00 7e 04 01 02 0d fc f4 04 00 00 | ^████~████████████ |
| 00 00 00 00 00 00 00 00 00 01 82 0d fb 75 05 | ████████████████u |
| 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ████████████████████ |
| 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ████████████████████ |
| 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ████████████████████ |
| 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ████████████████████ |

Setting FMC HPC0 clock

- > With an optional XM107 FMC card attached, select the XM107 tab
- > For the IBERT FMC testing, set 163, and click the Set SI570 button

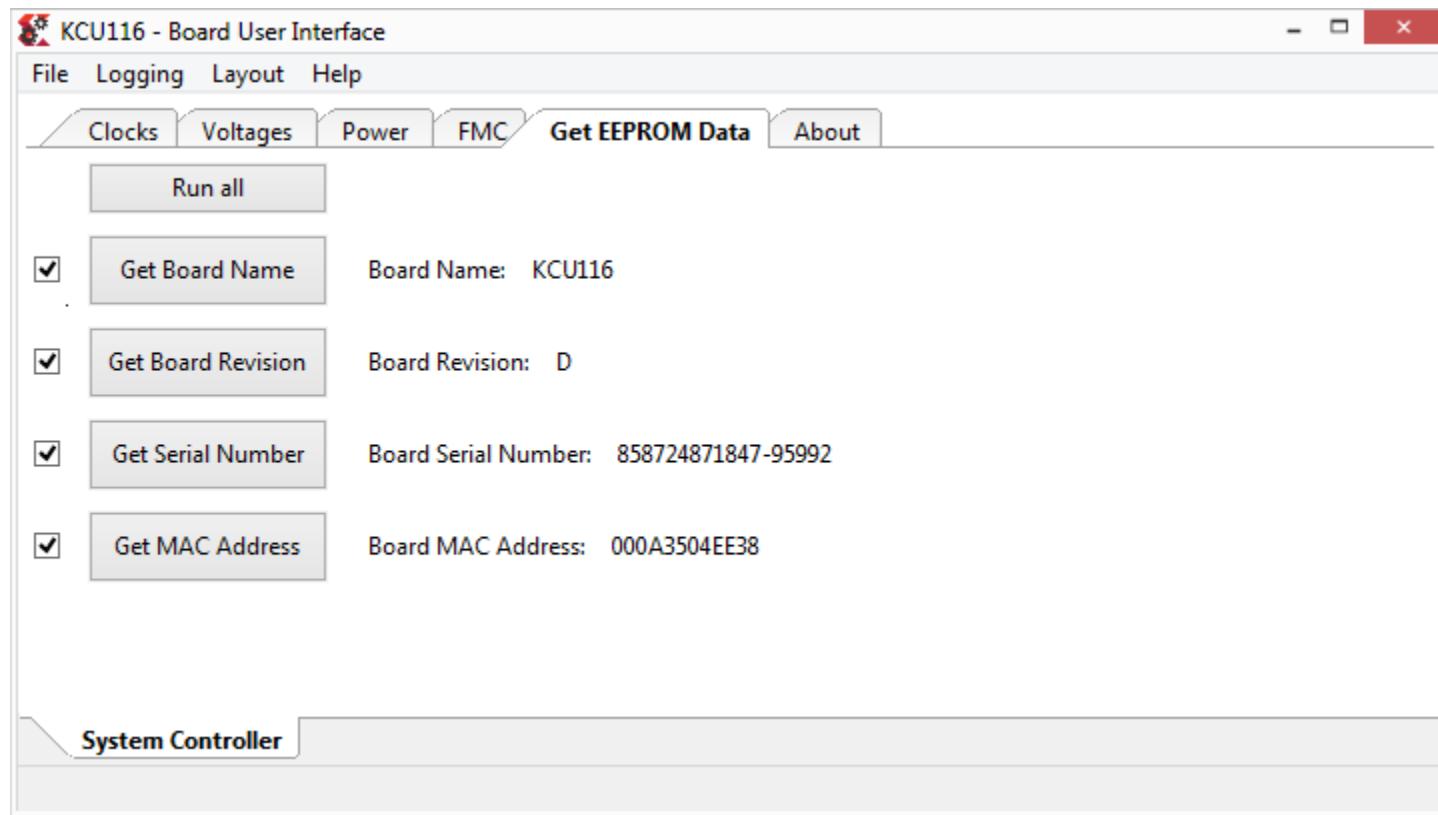


EEPROM Data



Reading the Board EEPROM Data

- > Select the EEPROM Data tab
- > Click Run All

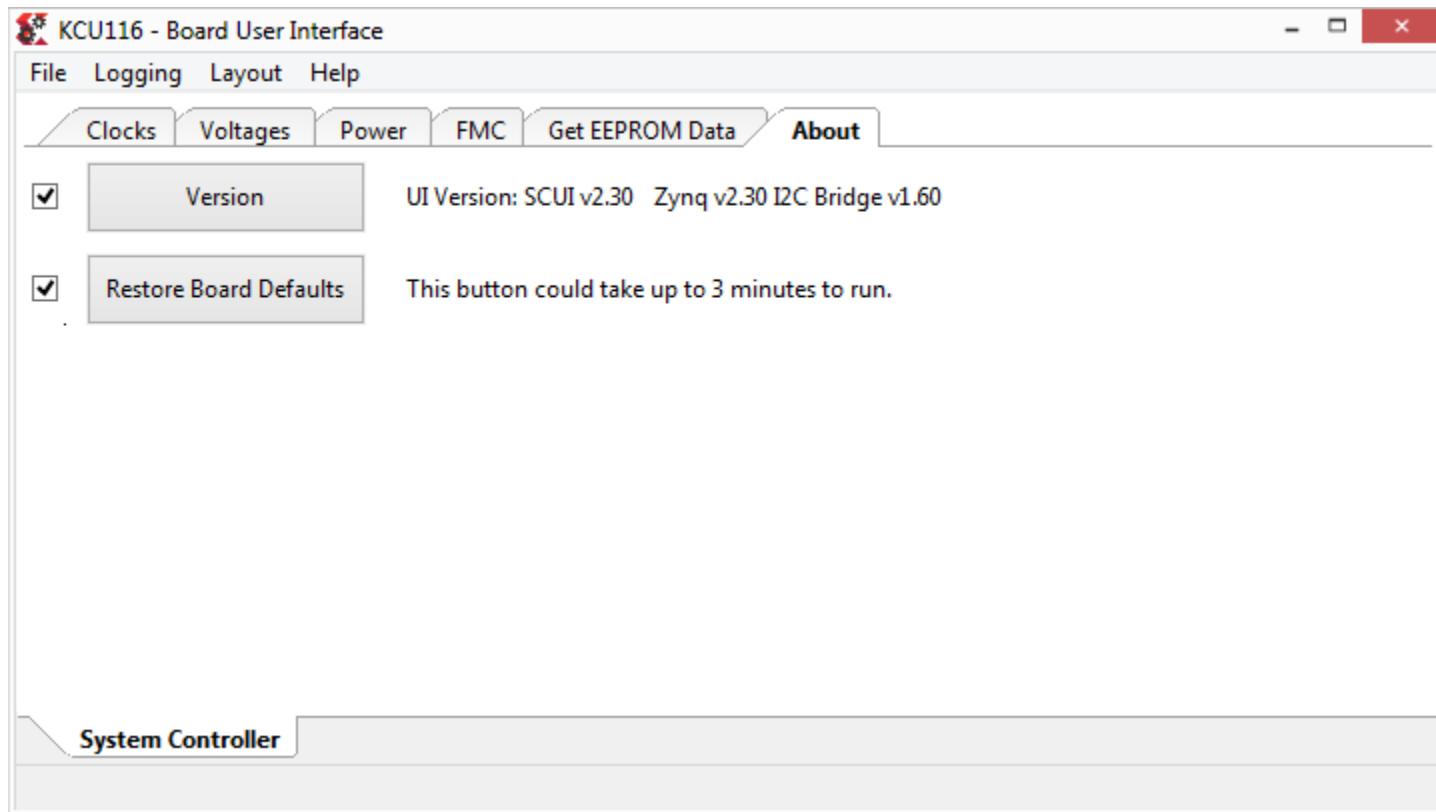


About



Reading version information

- > Select the About tab
- > Click Version button to get SCUI version information
- > Restore Board Defaults applies settings to the QSPI flash

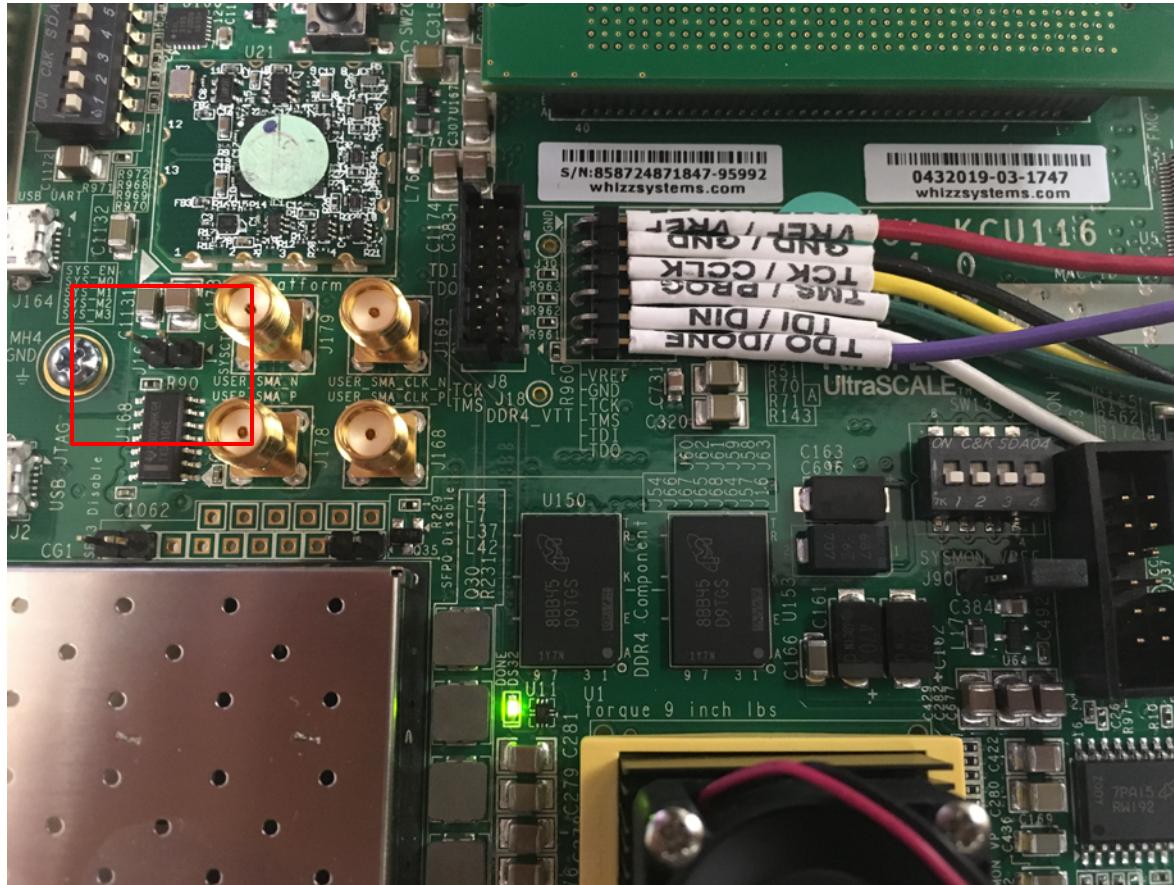


Programming Firmware



Programming Firmware

- > Connect a USB Platform Cable to J176 with the Flying Leads
- > Note the location of jumper J165



Note: Presentation applies to the KCU116

 XILINX

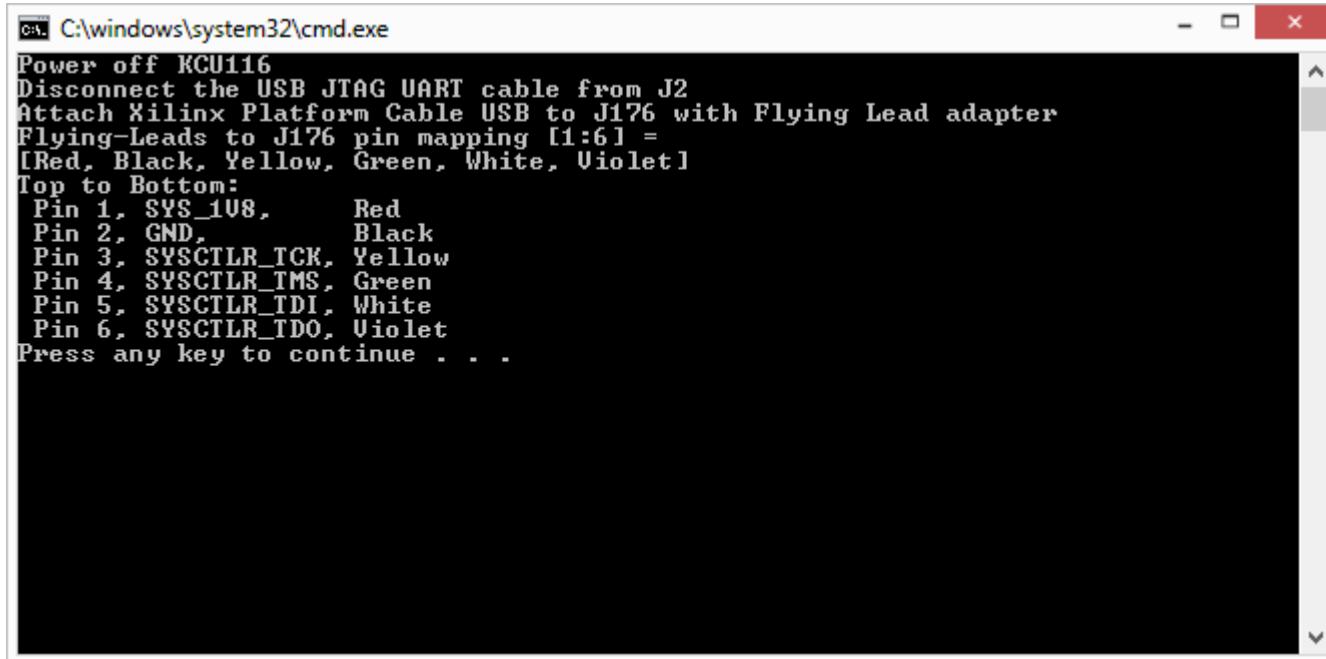
Programming Firmware

- > Script files are included to program the firmware

| | | |
|--------------------------|----------|-----------------------|
| Zynq_SC_Firmware | 14.5 ... | 7/12/2019 11:48:44 am |
| SC | 14.5 ... | 7/12/2019 5:27:07 pm |
| .Xil | 0 | 7/12/2019 5:24:00 pm |
| ■ BOOT.bin | 7.08 ... | 8/28/2018 6:47:34 pm |
| ■ BOOT_orig.bin | 7.08 ... | 5/4/2017 12:40:36 pm |
| ■ program_sysctrl.bat | 760 | 7/12/2019 5:12:58 pm |
| ■ program_sysctrl.tcl | 2,316 | 10/30/2018 3:30:38 pm |
| ■ verify_sysctrl.bat | 759 | 7/12/2019 5:12:48 pm |
| ■ verify_sysctrl.tcl | 2,321 | 7/12/2019 4:56:29 pm |
| ■ vivado.jou | 586 | 7/12/2019 5:24:03 pm |
| ■ vivado.log | 4,239 | 7/12/2019 5:27:11 pm |
| ■ zynq_1b_debug_fsbl.elf | 339 KB | 8/28/2018 6:47:34 pm |

Programming Firmware

- > The Programming BAT file will prompt you to connect the Flying Leads
- > Press any key to continue...



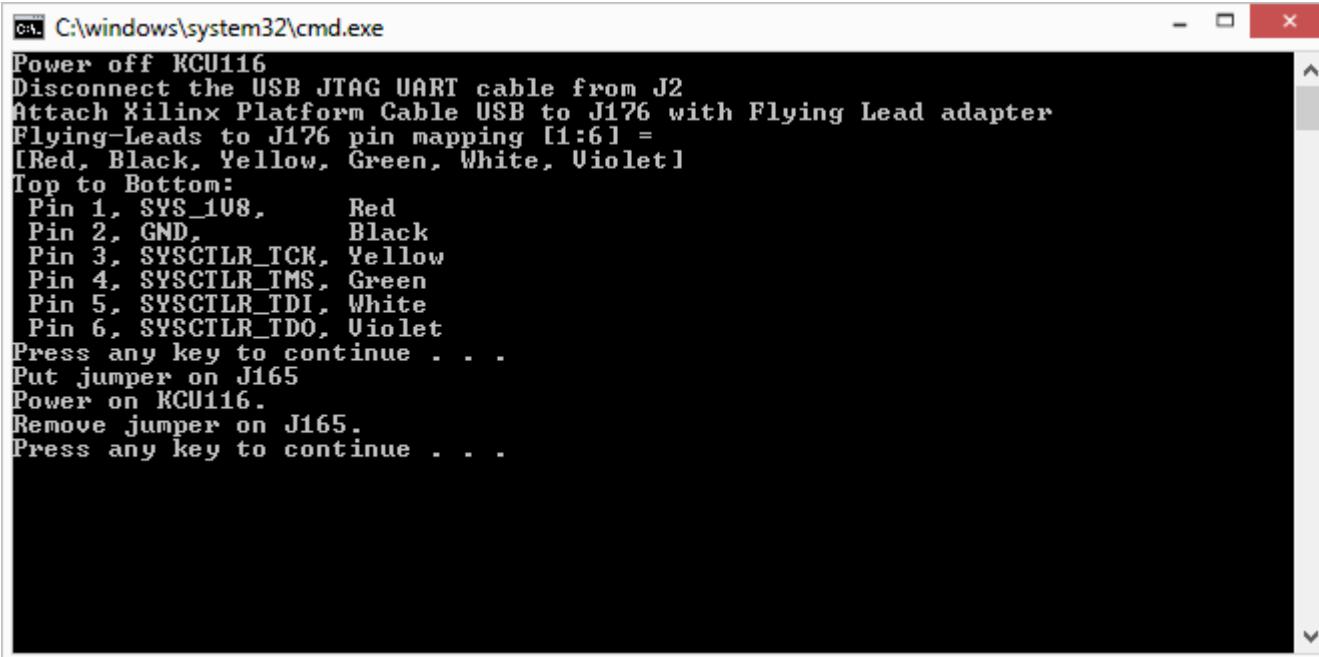
The screenshot shows a Windows Command Prompt window titled 'C:\windows\system32\cmd.exe'. The text inside the window provides instructions for programming a KCU116 device:

```
Power off KCU116
Disconnect the USB JTAG UART cable from J2
Attach Xilinx Platform Cable USB to J176 with Flying Lead adapter
Flying-Leads to J176 pin mapping [1:6] =
[Red, Black, Yellow, Green, White, Violet]
Top to Bottom:
Pin 1, SYS_1U8, Red
Pin 2, GND, Black
Pin 3, SYSCTRLR_TCK, Yellow
Pin 4, SYSCTRLR_TMS, Green
Pin 5, SYSCTRLR_TDI, White
Pin 6, SYSCTRLR_TDO, Violet
Press any key to continue . . .
```

Note: Disconnect the Micro USB from J2, if connected

Programming Firmware

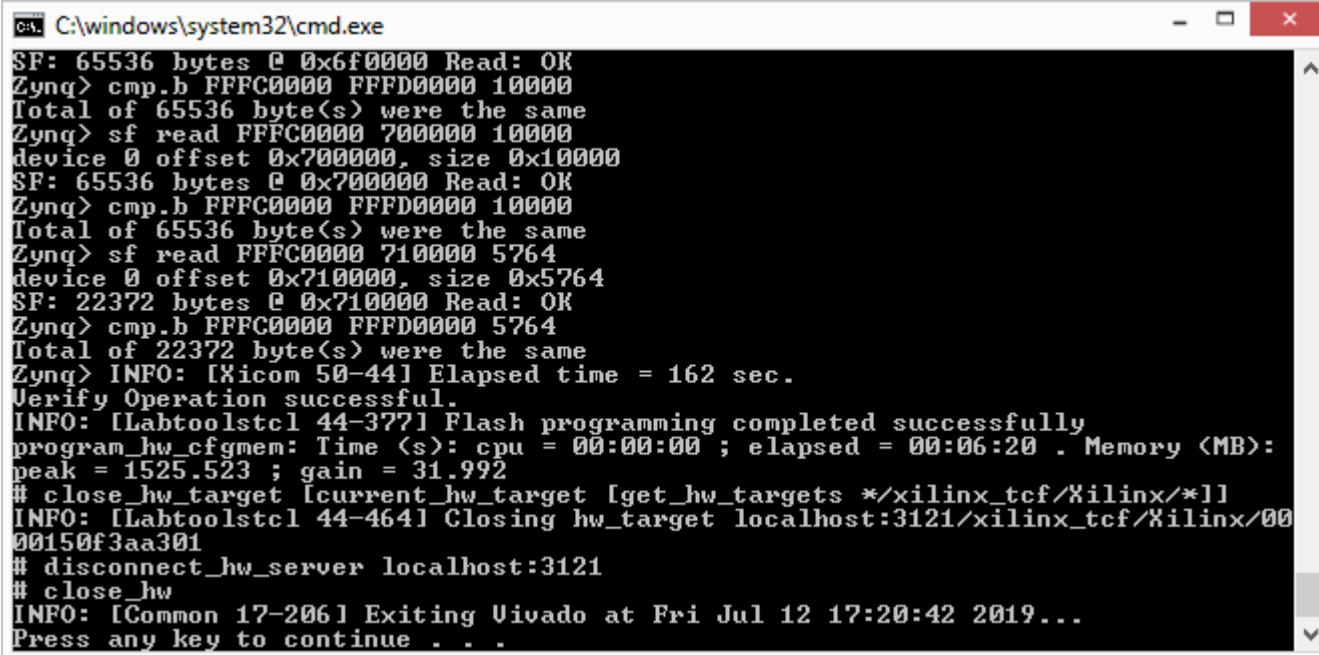
- > Important: The current System Controller must be disabled prior to programming
- > Put a jumper on J165, cycle KCU116 power, remove the jumper and press any key to continue...



```
C:\windows\system32\cmd.exe
Power off KCU116
Disconnect the USB JTAG UART cable from J2
Attach Xilinx Platform Cable USB to J176 with Flying Lead adapter
Flying-Leads to J176 pin mapping [1:6] =
[Red, Black, Yellow, Green, White, Violet]
Top to Bottom:
Pin 1, SYS_1U8, Red
Pin 2, GND, Black
Pin 3, SYSCTRLR_TCK, Yellow
Pin 4, SYSCTRLR_TMS, Green
Pin 5, SYSCTRLR_TDI, White
Pin 6, SYSCTRLR_TDO, Violet
Press any key to continue . . .
Put jumper on J165
Power on KCU116.
Remove jumper on J165.
Press any key to continue . . .
```

Programming Firmware

- > Programming finished successfully
- > Cycle KCU116 power to enable the System Controller



```
C:\windows\system32\cmd.exe
SF: 65536 bytes @ 0x6f0000 Read: OK
Zynq> cmp.b FFFC0000 FFFD0000 10000
Total of 65536 byte(s) were the same
Zynq> sf read FFFC0000 700000 10000
device 0 offset 0x700000, size 0x10000
SF: 65536 bytes @ 0x700000 Read: OK
Zynq> cmp.b FFFC0000 FFFD0000 10000
Total of 65536 byte(s) were the same
Zynq> sf read FFFC0000 710000 5764
device 0 offset 0x710000, size 0x5764
SF: 22372 bytes @ 0x710000 Read: OK
Zynq> cmp.b FFFC0000 FFFD0000 5764
Total of 22372 byte(s) were the same
Zynq> INFO: [Xicom 50-44] Elapsed time = 162 sec.
Verify Operation successful.
INFO: [Labtoolstcl 44-377] Flash programming completed successfully
program_hw_cfgmem: Time <s>: cpu = 00:00:00 ; elapsed = 00:06:20 . Memory <MB>:
peak = 1525.523 ; gain = 31.992
# close_hw_target [current_hw_target [get_hw_targets */xilinx_tcf/Xilinx/*]]
INFO: [Labtoolstcl 44-464] Closing hw_target localhost:3121/xilinx_tcf/Xilinx/00
00150f3aa301
# disconnect_hw_server localhost:3121
# close_hw
INFO: [Common 17-206] Exiting Vivado at Fri Jul 12 17:20:42 2019...
Press any key to continue . . .
```

Note: Programming takes about 6 minutes

Programming Firmware

- > Use the Verify BAT files to check the firmware in the Zynq QSPI

» Note: The Programming step includes a Verify

| Zynq_SC_Firmware | | |
|------------------|--------------------------|--------------------------------|
| L | SC | 14.5 ... 7/12/2019 11:48:44 am |
| | .Xil | 14.5 ... 7/12/2019 5:27:07 pm |
| | ■ BOOT.bin | 0 7/12/2019 5:24:00 pm |
| | ■ BOOT_orig.bin | 7.08 ... 8/28/2018 6:47:34 pm |
| | ■ program_sysctrl.bat | 7.08 ... 5/4/2017 12:40:36 pm |
| | ■ program_sysctrl.tcl | 760 7/12/2019 5:12:58 pm |
| | ■ verify_sysctrl.bat | 2,316 10/30/2018 3:30:38 pm |
| | ■ verify_sysctrl.tcl | 759 7/12/2019 5:12:48 pm |
| | ■ vivado.jou | 2,321 7/12/2019 4:56:29 pm |
| | ■ vivado.log | 586 7/12/2019 5:24:03 pm |
| | ■ zynq_1b_debug_fsbl.elf | 4,239 7/12/2019 5:27:11 pm |
| | | 339 KB 8/28/2018 6:47:34 pm |

Note: Verify will not pass after Restore Board Defaults has been run. This is the as-shipped condition. Safe to reprogram, verify, then perform Restore step.

References



References

> Vivado Release Notes

- » Vivado Design Suite User Guide - Release Notes – UG973
 - https://www.xilinx.com/support/documentation/sw_manuals/xilinx2019_1/ug973-vivado-release-notes-install-license.pdf
- » Vivado Design Suite 2019 - Vivado Known Issues
 - <https://www.xilinx.com/support/answers/72162.html>

> Vivado Programming and Debugging

- » Vivado Design Suite Programming and Debugging User Guide – UG908
 - https://www.xilinx.com/support/documentation/sw_manuals/xilinx2019_1/ug908-vivado-programming-debugging.pdf

Documentation



Documentation

> Kintex UltraScale+

- » Kintex UltraScale+ FPGA Family
 - <https://www.xilinx.com/products/silicon-devices/fpga/kintex-ultrascale-plus.html>

> KCU116 Documentation

- » Kintex UltraScale FPGA KCU116 Evaluation Kit
 - <https://www.xilinx.com/products/boards-and-kits/ek-u1-kcu116-g.html>
- » KCU116 Board User Guide – UG1239
 - https://www.xilinx.com/support/documentation/boards_and_kits/kcu116/ug1239-kcu116-eval-bd.pdf
- » KCU116 Evaluation Kit Quick Start Guide User Guide – XTP471
 - https://www.xilinx.com/support/documentation/boards_and_kits/kcu116/xtp471-kcu116-quickstart.pdf
- » KCU116 - Known Issues Master Answer Record
 - <https://www.xilinx.com/support/answers/68360.html>