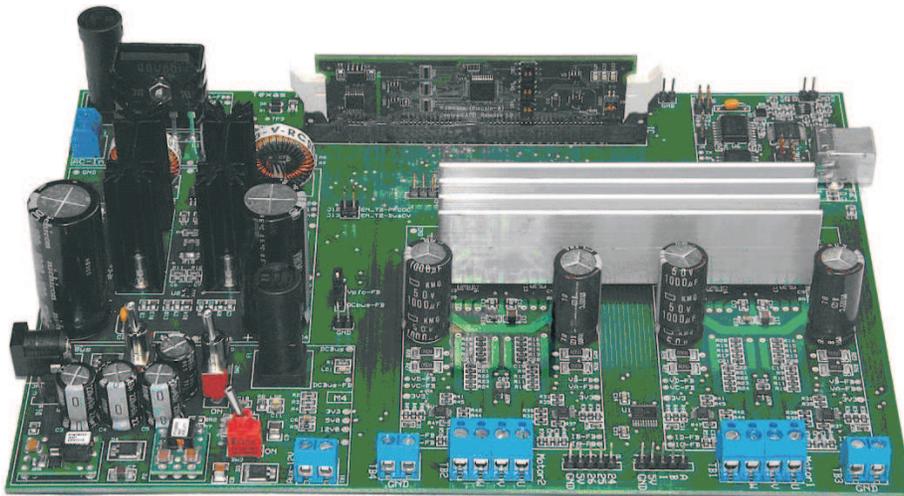


Motor Control and PFC Developer's Kit Quick Start Guide



The Motor Control and PFC Developer's Kit provides a great way to begin learning about digital motor control. The kit contains a motherboard that can accept any of the C2000 series controlCARDS. This board is divided into a power factor correction (PFC) stage and two identical three-phase inverter stages.

Features of the Motor Control and PFC Developer's Kit board include:

- Sensorless field-oriented control of two permanent magnet motors using the Texas Instruments DRV8402 IPM module
- PFC provides current-shaping of the AC input and regulates the DCbus
- Closed-loop digital control with feedback using the C2000's on-chip PWM and ADC peripherals
- Onboard isolated JTAG emulation
- Over-current and over-voltage protection for the PFC stage and over-current protection for each inverter section
- Isolated USB to serial communication available for host-control
- Hardware developer's package which includes schematics, bill of materials, Gerber files, etc.

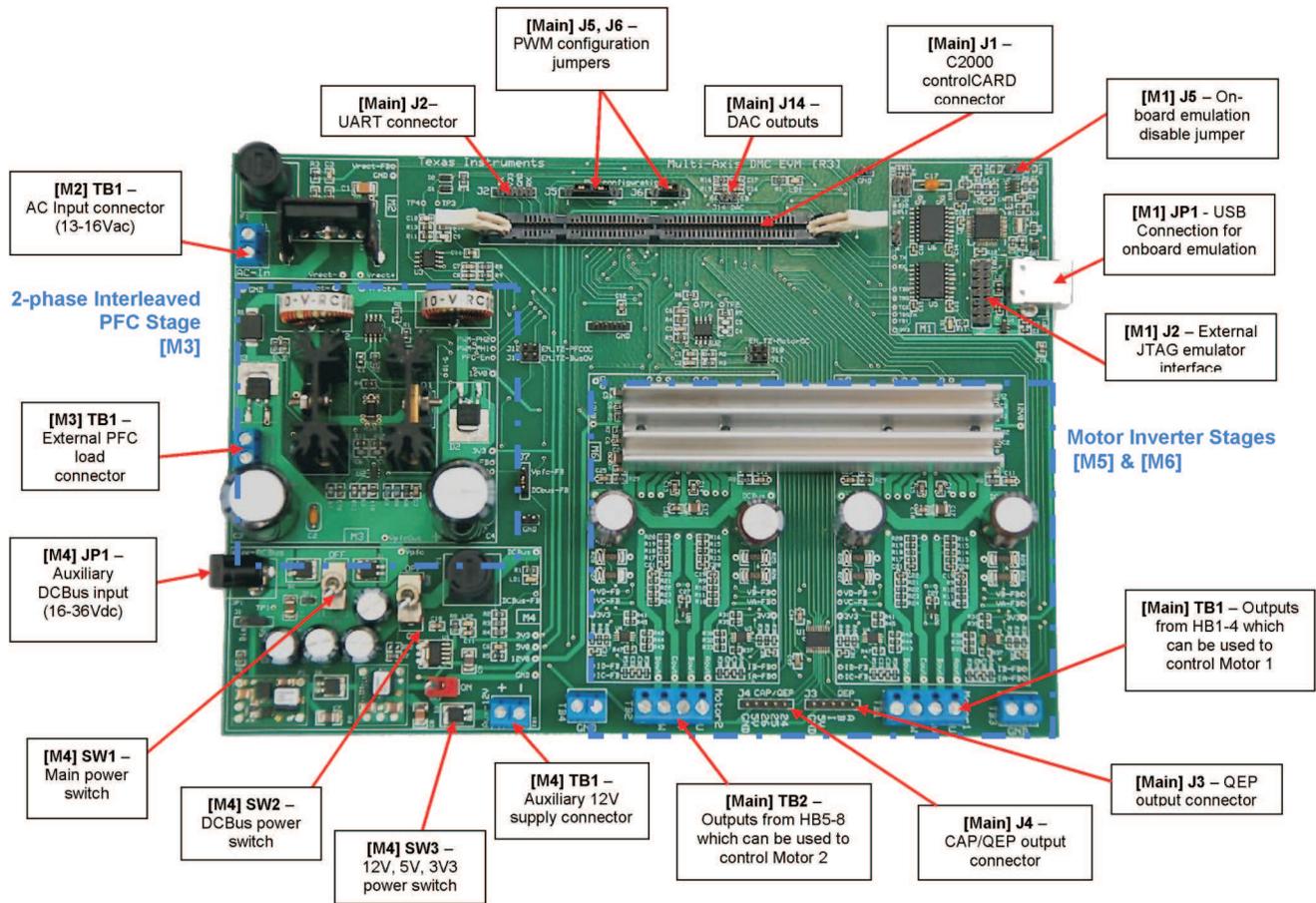
WARNING

This equipment may generate voltages and currents that can be injurious to humans, and must be used with caution. The user must employ appropriate safeguards to avoid serious injury.

1 Quick Start GUI

All of the hardware and software documentation for the Motor Control and PFC Developer's kit can be found in TI's controlSUITE software package. (www.ti.com/controlsuite) The kit also includes a USB stick with a GUI that can be used to quickly evaluate the motor control features of the kit.

Figure 1. Hardware Overview

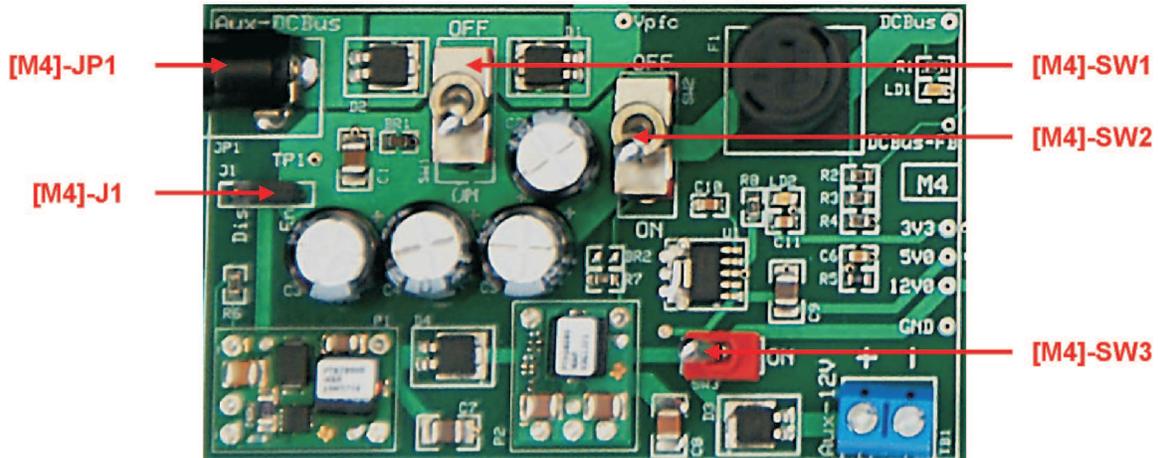


2 Hardware Setup

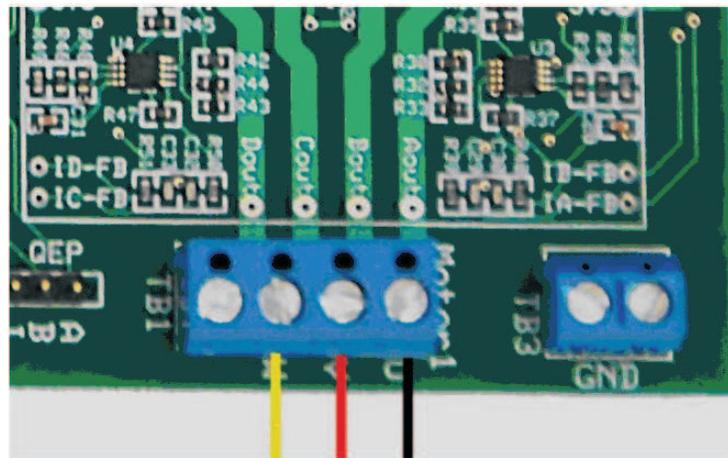
The multi-axis DMC kit is separated into multiple function-specific macro blocks. Components shown below will be referred to with their macro number in brackets. For example, [M3]-C1 refers to the C1 located in the macro M3.

The following steps explain the setup for this kit:

1. Ensure that [M4]-SW1, [M4]-SW2, and [M4]-SW3 are in the “Off” position. Ensure that [M4]-J1 is put in the “En” position.



2. Ensure that [Main]-J5 has three jumpers attached to it and [Main]-J6 has two jumpers attached to it.
3. Ensure that [Main]-J7 is jumpered in the DCbus-FB position.
4. Ensure that a jumper connects [M1]-J4.
5. On the Piccolo F28035 controlCARD ensure that SW1 is in the off position and SW2 position 1 and 2 are in the on (up) position.
6. Connect the motors to the board. Each motor will have several wires. Find the larger gauge wires of the motor (they should be yellow, black, and red) and connect the motor's power wires to the U, V, and W terminals of [Main]-TB1 & [Main]-TB2 respectively.



7. Connect 24Vdc supply to [M4]-JP1.
8. Turn [M4]-SW1 on. This enables power to be sent to the other two switches in [M4].
9. Turn on [M4]-SW2. This will enable DC power to be sent into the inverter stages. [M4]-LD1 should turn on.
10. Turn on [M4]-SW3. This will enable generation of the 12V, 5V, and 3.3V power rails, and turn on the controlCARD. [M4]-LD2 should turn on.
11. Connect a USB cable to connector [M1]-JP1. **This must be done AFTER the board is powered.** This will enable isolated JTAG emulation to the C2000 device. [M1]-LD1 should turn on and LD3 on

the controlCARD should start blinking.

NOTE: If Code Composer Studio has never been installed, it may be necessary to install drivers to make the board work correctly. If a popup comes up when the USB cable is connected from the board to the computer, have the install wizard install drivers from the XDS100v1 directory of the USB drive included with this kit.

- 1) When Windows asks to search Windows Update, select "No, not at this time" and click Next

Can Windows connect to Windows Update to search for software?

Yes, this time only
 Yes, now and every time I connect a device
 No, not this time

- 2) On the next screen select "Install from specific location" and click Next

What do you want the wizard to do?

Install the software automatically (Recommended)
 Install from a list or specific location (Advanced)

- 3) Select "Search for Best Driver", uncheck search removable media, and check include specific location and browse to [USB Drive]:\XDS100 Drivers

Search for the best driver in these locations.
 Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.

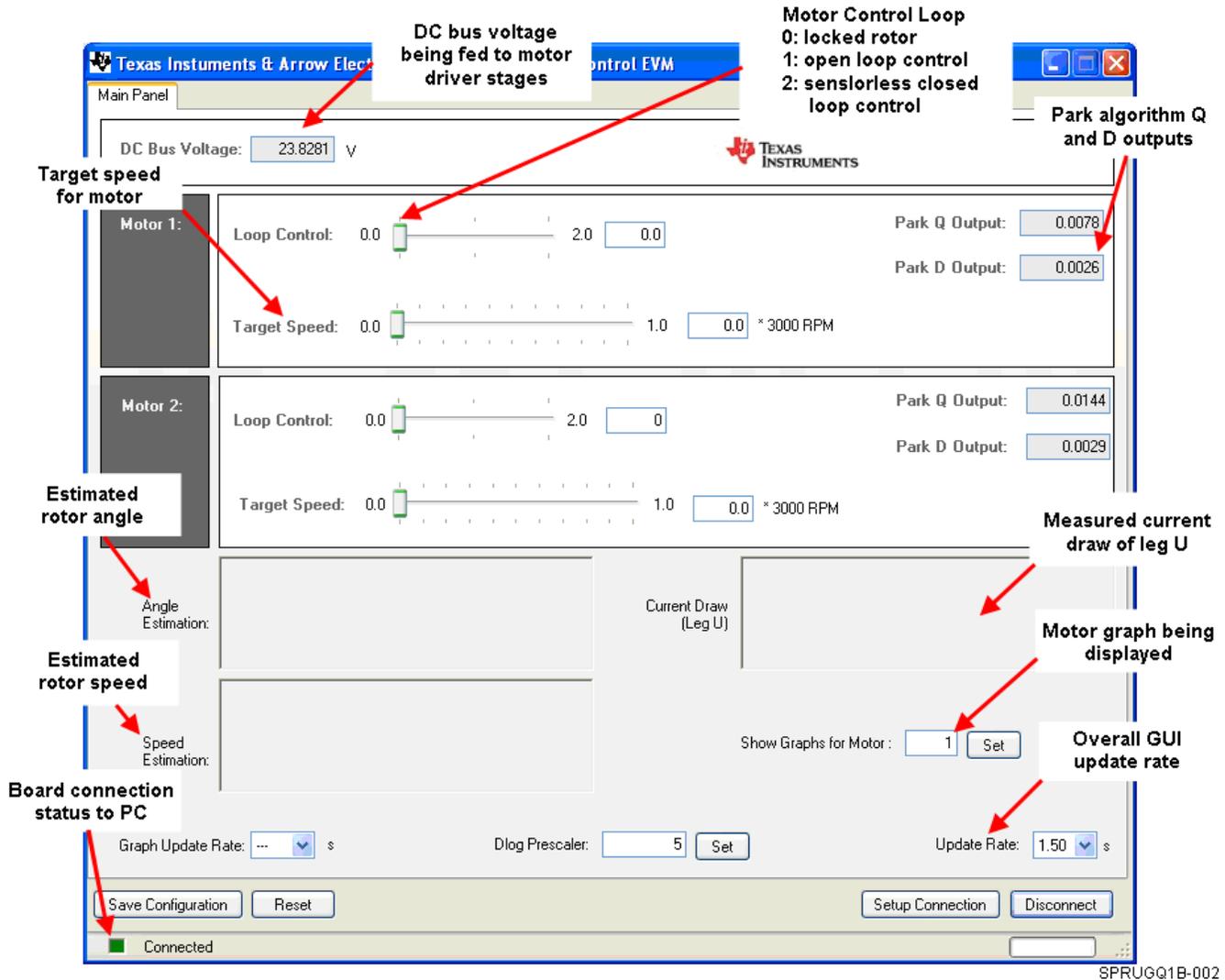
Search removable media (floppy, CD-ROM...)
 Include this location in the search:

- 4) Click next and the drivers will be installed. The driver install screen will appear three times, repeat this procedure each time.

SPRUGQ1B-001

3 Software Overview

The GUI used to conveniently evaluate the kit can be found on the USB drive that is included with this kit. It is named Lighting_DCDC.exe. this .exe is all the software necessary to do a quick evaluation of this kit. to explore deeper, the underlying reference software can be found as Code Composer Studio project within controlSUTIE.

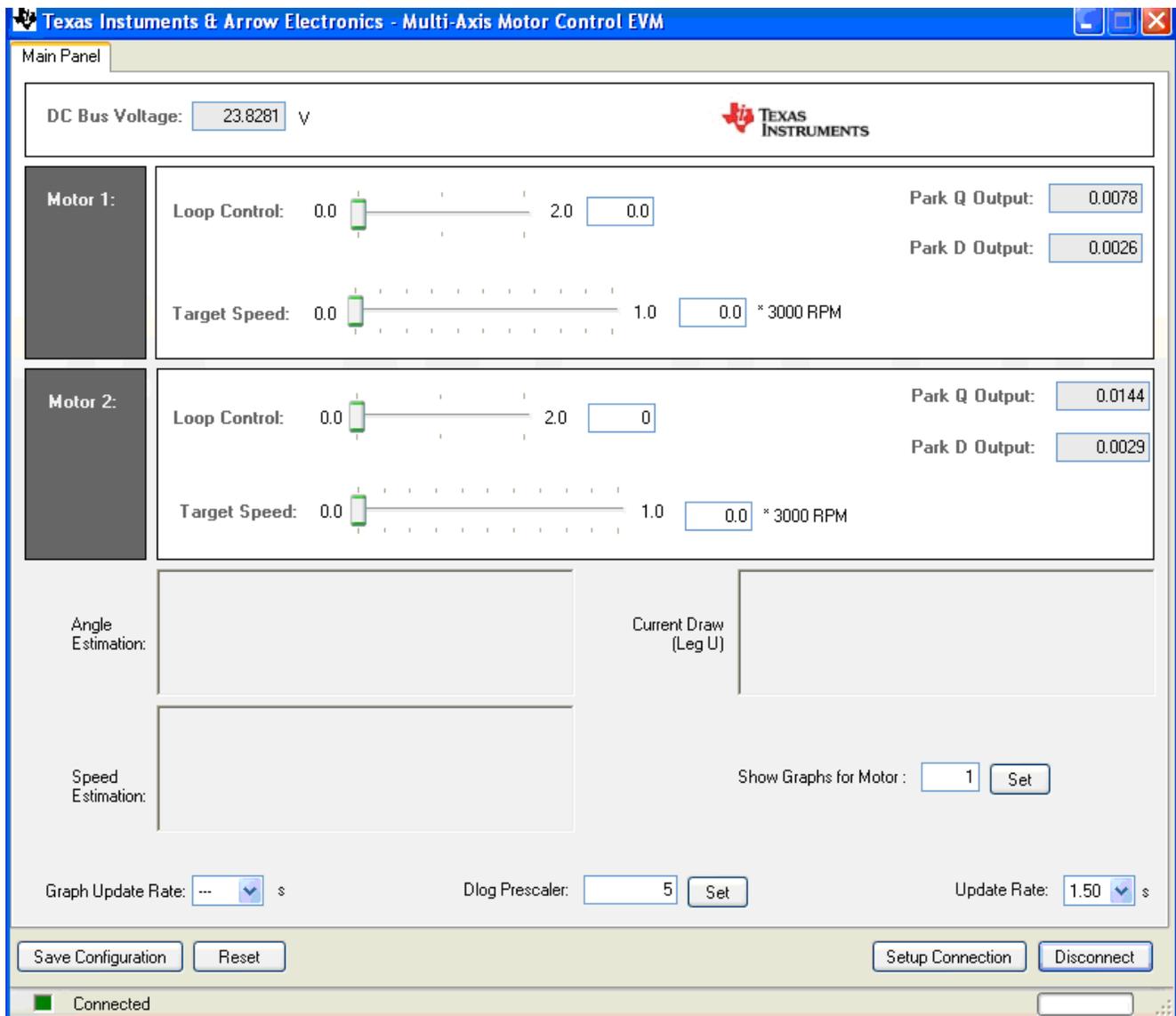


SPRUGQ1B-002

3.1 Software Setup

Note: The GUI requires Microsoft.NET framework 3.0 to run. Please ensure that this software is installed prior to running this program.

1. Browse to and open the program Multi-AxisGUI.exe found on the USB stick included with the kit. The following screen should appear



DC Bus Voltage: 23.8281 V

Motor 1:
 Loop Control: 0.0 [Slider] 2.0 [0.0]
 Target Speed: 0.0 [Slider] 1.0 [0.0] * 3000 RPM
 Park Q Output: 0.0078
 Park D Output: 0.0026

Motor 2:
 Loop Control: 0.0 [Slider] 2.0 [0]
 Target Speed: 0.0 [Slider] 1.0 [0.0] * 3000 RPM
 Park Q Output: 0.0144
 Park D Output: 0.0029

Angle Estimation: [Graph Area]
 Speed Estimation: [Graph Area]
 Current Draw (Leg U): [Graph Area]

Show Graphs for Motor : 1 [Set]

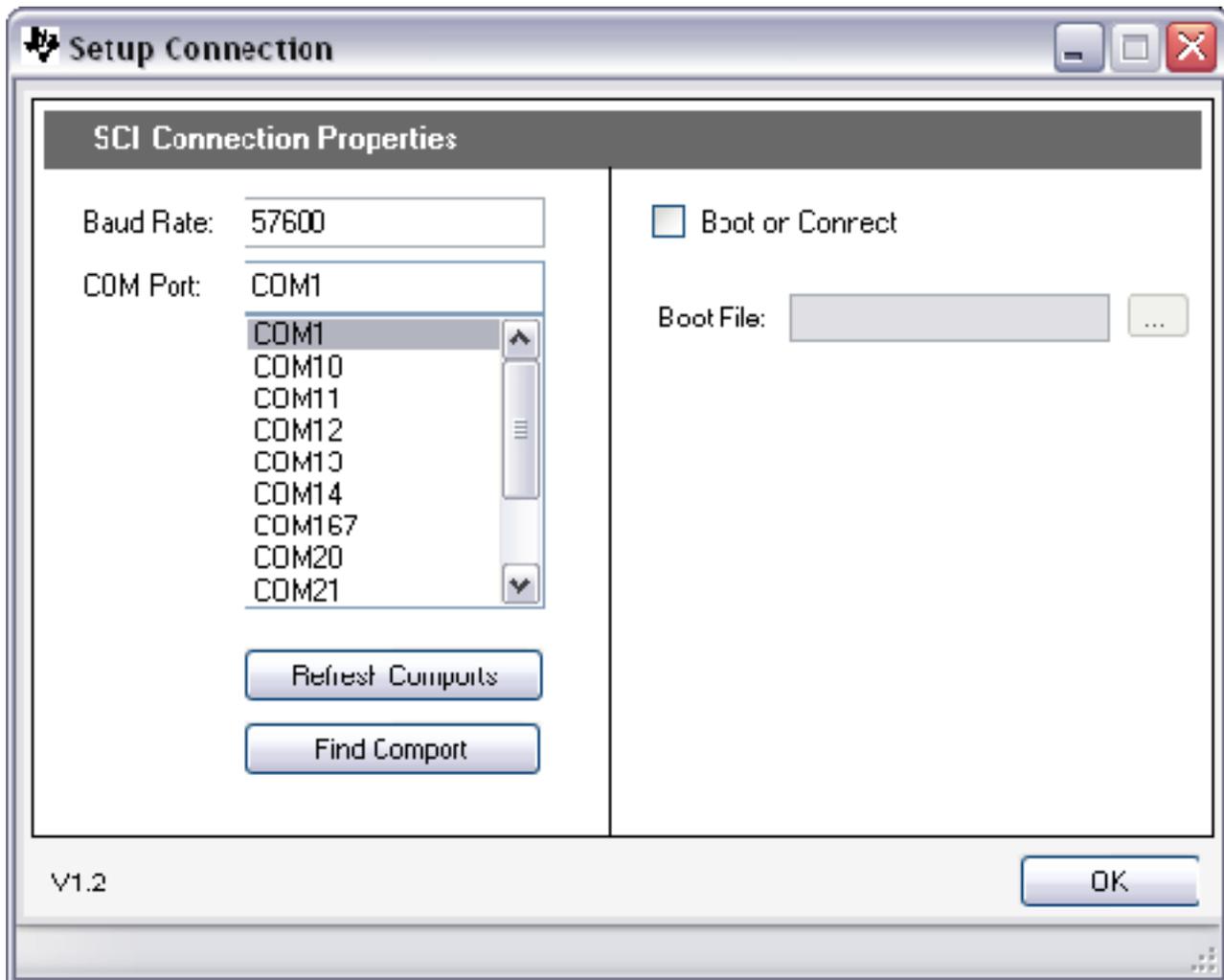
Graph Update Rate: [Dropdown] s Dlog Prescaler: 5 [Set] Update Rate: 1.50 [Dropdown] s

Save Configuration Reset Setup Connection Disconnect

■ Connected

SPRUGQ1B-003

- Click "Setup Connection" on the GUI and ensure the Baud Rate is set to 57600 and that the "Boot on Connect" Box is unchecked.



SPRUGQ1B-004

3. Next you will need to select your serial comport. This can be found by going to: Control Panel->System->Hardware tab->Device Manager->Ports(COM & LPT) Look for the comport that is named "USB Serial Port" or similar, then select this comport in the "Setup Connection" window.
4. Click "OK." This will close the "Setup Connection" window
5. Click "Connect." When connected, the status bar at the lower left should say "Connected"
6. Once the GUI has connected set the Graph Update Rate to its slowest setting.
7. Move motor 1 and motor 2 to loop control 1 and give them both some speed. This will close the current/torque loop while using a reference (instead of actual) signal for the torque command from the outer speed loop. This "open loop" speed start-up is needed in a sensorless application to start from zero speed . The three graphs should now be displaying information about motor 1. Notice the amount of current draw.
8. Once the motors have started spinning move the loop control to 2 for both motors to enter closed loop current/torque AND speed control. You will now see a much lower current draw as the control loop regulates the current to the minimum level needed to achieve the target speed under no load. If the motor is loaded slightly (be careful as these motors can not handle very much load) you will notice that the field oriented control increases the current to maintain the reference speed.
9. When finished evaluating the GUI, click disconnect and power down the motor control board.

After running the GUI visit www.ti.com/controlsuite to download the Code Composer Studio V4 projects, source code, and hardware developer's package. Code Composer Studio V4 can be installed from the included DVD or downloaded from www.ti.com/ccs New users should also read the C2000 CCS V4 Wiki for a detailed getting started guide.

4 References

The following guides provide more information about this project.

C2000 CCS V4 Wiki – provides a detailed step by step introduction to getting started with CCS V4
<http://processors.wiki.ti.com/index.php/Category:C2000>

controlSUITE Desktop – Graphical tool for exploring the contents of controlSUITE.
C:\TI\controlSUITE\controlSUITE.exe

Sensorless FOC of 2xPM.pdf – provides detailed information on the 2xPM_Sensorless project within an easy to use lab-style format.

C:\TI\controlSUITE\development_kits\LVMultiAxis+PfcKit_v1.1\2xPM_Sensorless\~Doc

LVMultiAxis+PfcKit_HWGuidev1.1.pdf – gives more information on the hardware of the Motor Control and PFC Developer's Kit. Includes details on all the various connectors, hardware block diagrams, etc

C:\TI\controlSUITE\development_kits\LVMultiAxis+PfcKit_v1.1\~Docs

LVMulti-Axis-HWdevPkg – a folder containing various files related to the hardware on the Motor Control and PFC Developer's Kit board (schematics, bill of materials, Gerber files, PCB layout, etc).

C:\TI\controlSUITE\development_kits\LVMultiAxis+PfcKit_v1.1\~LVMultiAxis+PfcKit-HWdevPkg

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Communications and Telecom	www.ti.com/communications
DSP	dsp.ti.com	Computers and Peripherals	www.ti.com/computers
Clocks and Timers	www.ti.com/clocks	Consumer Electronics	www.ti.com/consumer-apps
Interface	interface.ti.com	Energy	www.ti.com/energy
Logic	logic.ti.com	Industrial	www.ti.com/industrial
Power Mgmt	power.ti.com	Medical	www.ti.com/medical
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Space, Avionics & Defense	www.ti.com/space-avionics-defense
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Video and Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless-apps

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2010, Texas Instruments Incorporated