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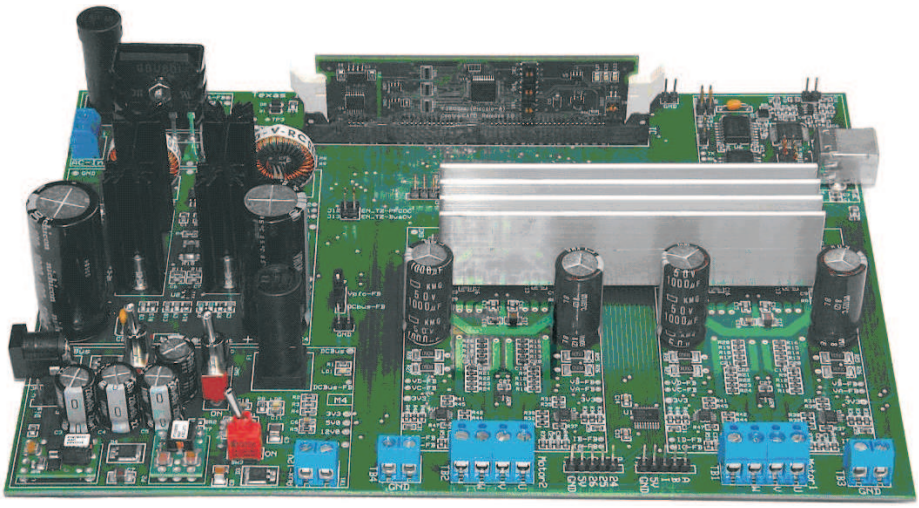
TMDS1MTRPFCKIT

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.

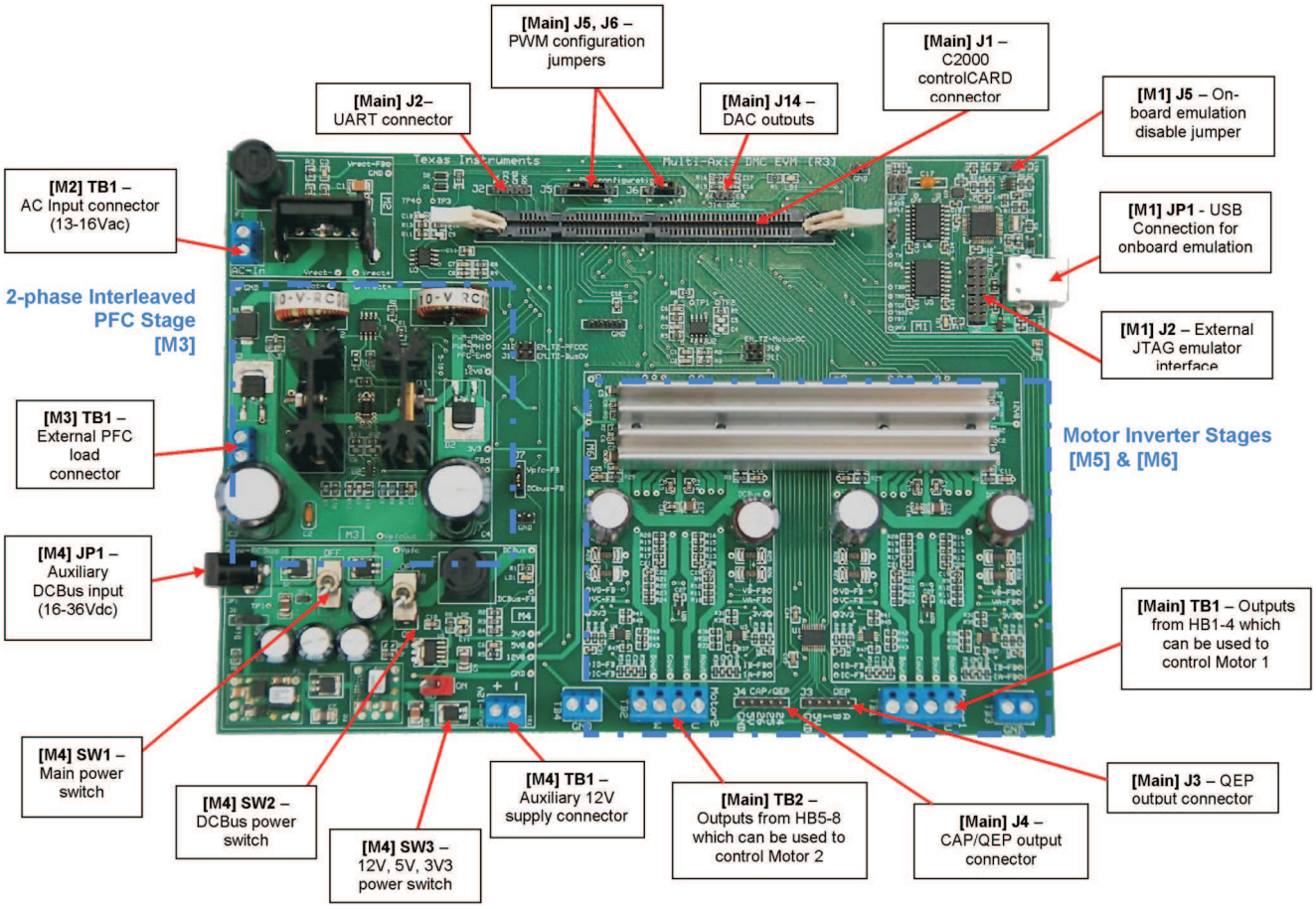
WARNING

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

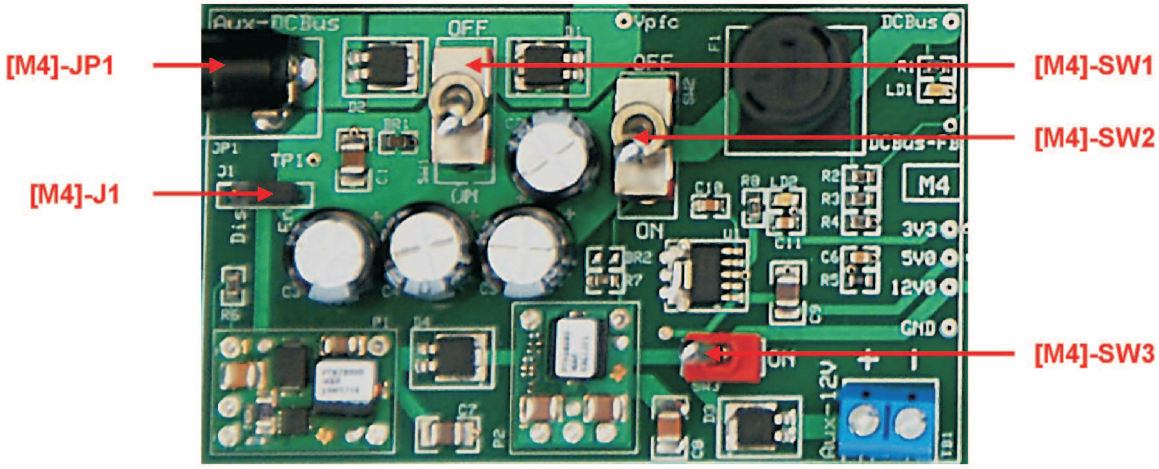


2 Hardware Setup

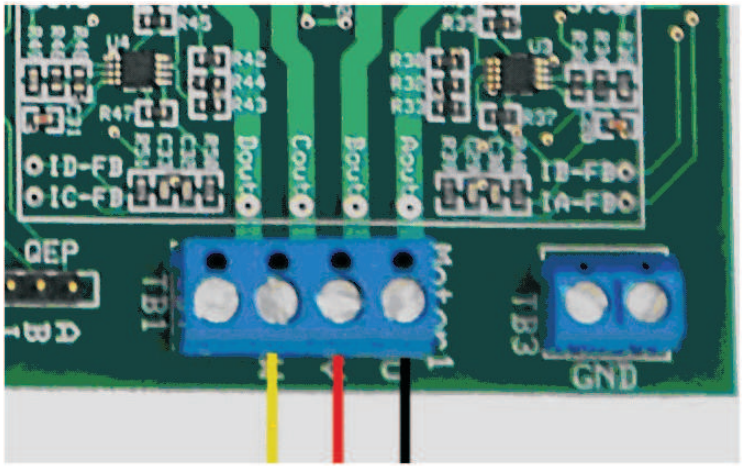
The multi-axis DMC kit is separated into multiple function-specific macro blocks. Components shown below will be referred to with their macro number in brackets. For example, [M3]-C1 refers to the C1 located in the macro M3.

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.

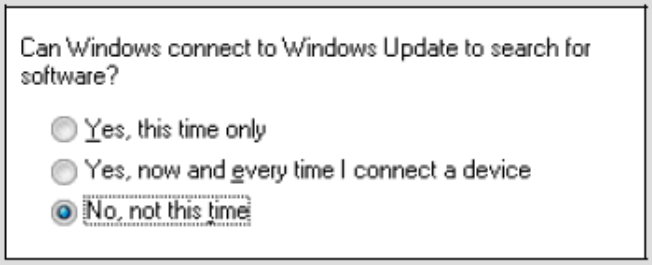


7. Connect 24Vdc supply to [M4]-JP1.
8. Turn [M4]-SW1 on. This enables power to be sent to the other two switches in [M4].
9. Turn on [M4]-SW2. This will enable DC power to be sent into the inverter stages. [M4]-LD1 should turn on.
10. Turn on [M4]-SW3. This will enable generation of the 12V, 5V, and 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

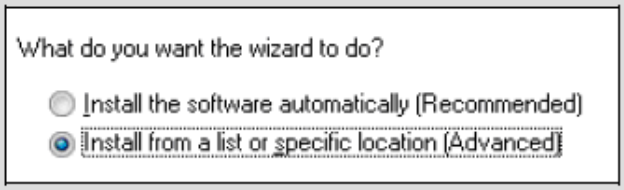
the controlCARD should start blinking.

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.

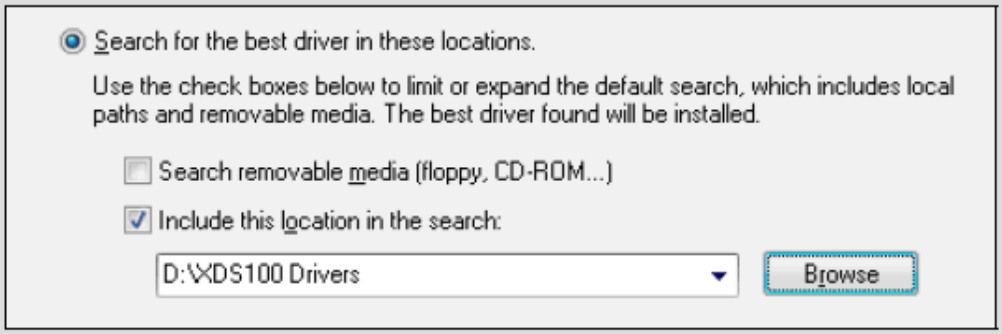
1) When Windows asks to search Windows Update, select "No, not at this time" and click Next



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



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



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

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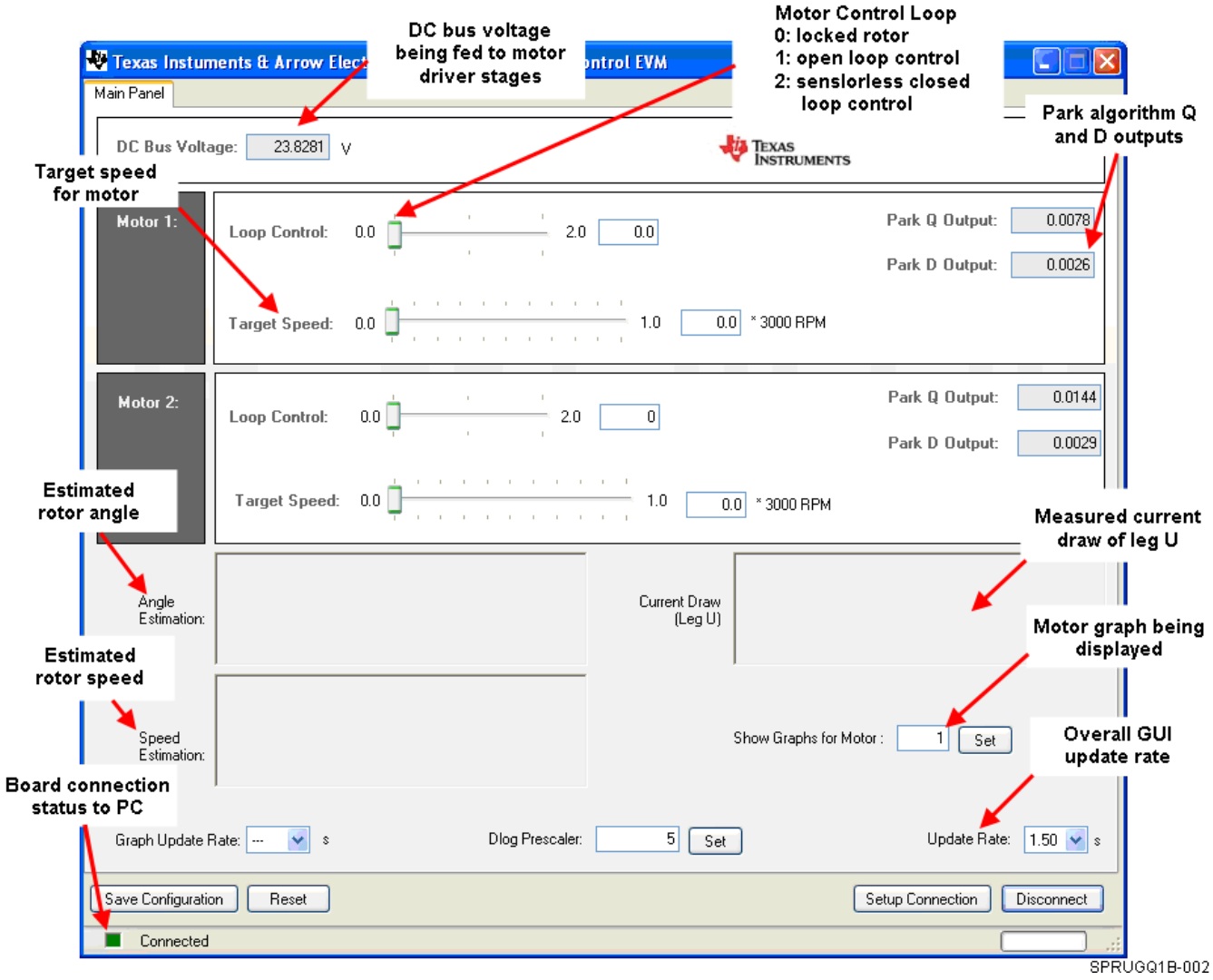
3 Software Overview

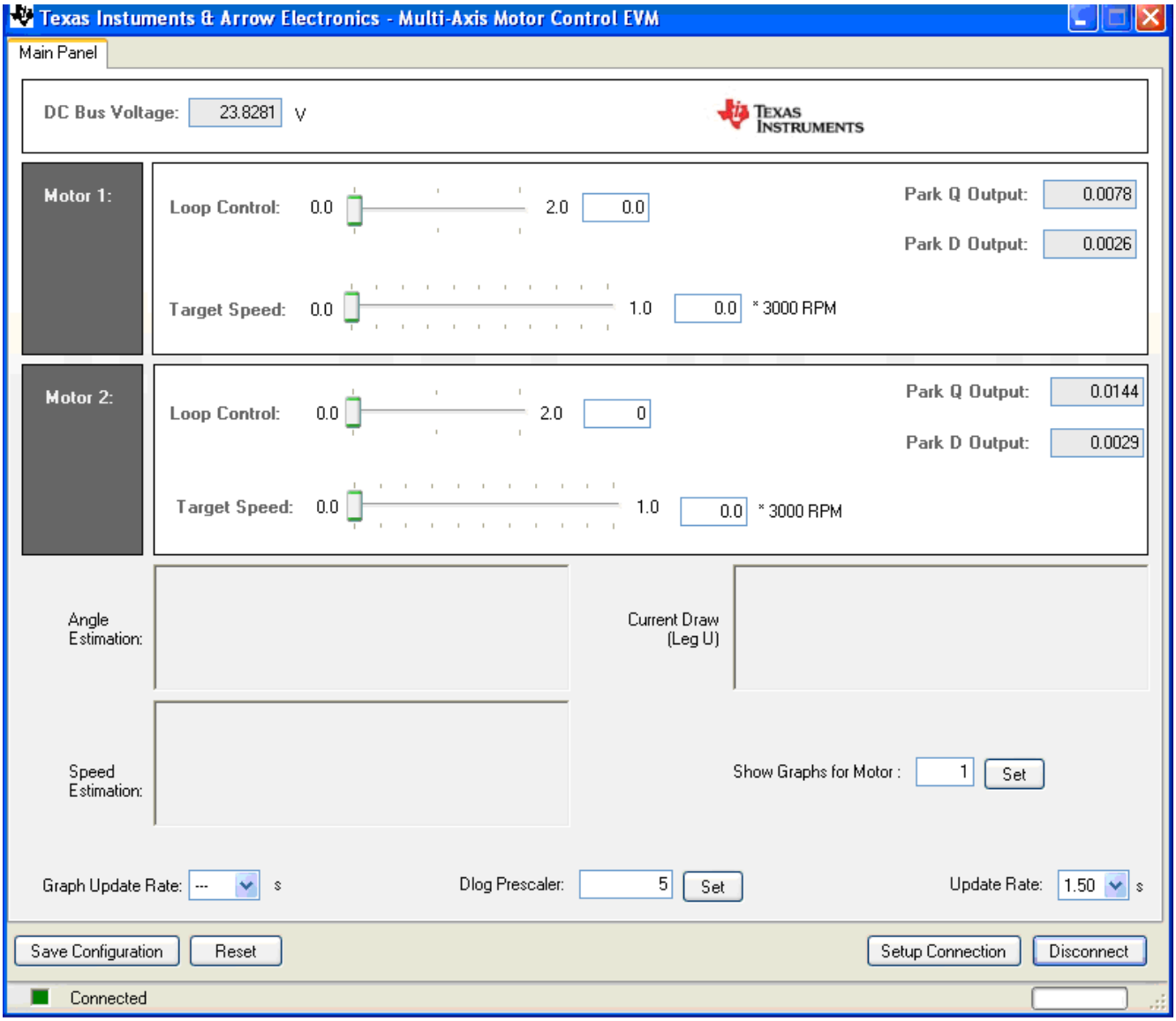
The GUI used to conveniently evaluate the kit can be found on the USB drive that is included with this kit. It is named Lighting_DCDC.exe. this .exe is all the software necessary to do a quick evaluation of this kit. to explore deeper, the underlying reference software can be found as Code Composer Studio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



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



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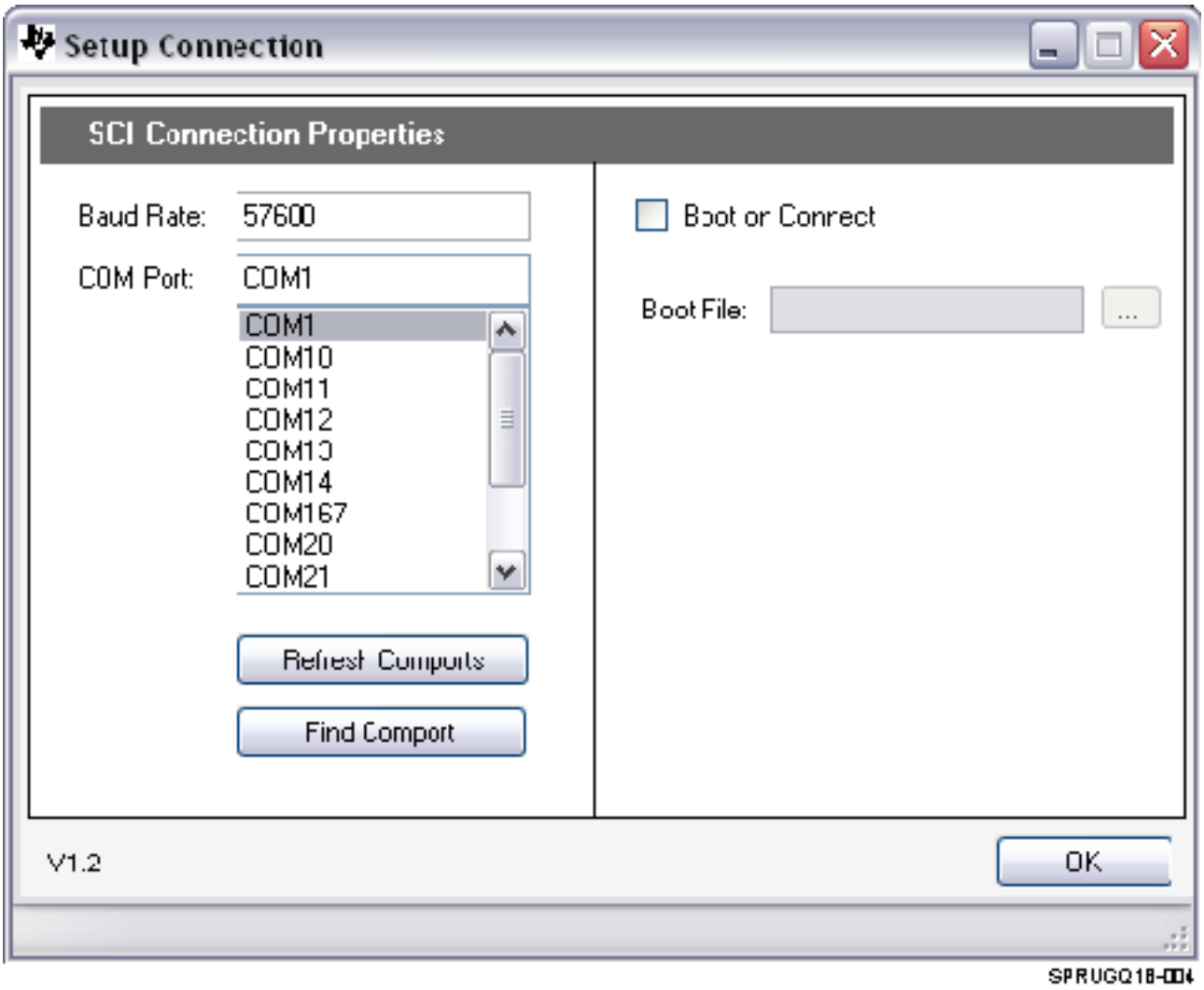
2. Click “Setup Connection” on the GUI and ensure the Baud Rate is set to 57600 and that the “Boot on Connect” Box is unchecked.



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

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