

Stellaris® Brushless DC (BLDC) Motor Control RDK with Ethernet and CAN

Stellaris motor control reference design kits (RDKs) from Texas Instruments accelerate product development by providing ready-to-run hardware, a typical motor, and comprehensive documentation including hardware design files. Using the Brushless DC (BLDC) Motor RDK, designers without prior motor-control experience can successfully implement a sophisticated motor control system. Integrated 10/100 Ethernet and CAN connects the BLDC RDK to an array of network options—from dedicated industrial networks to worldwide control and monitoring over the internet.

Installing and Using the BLDC Motor Control RDK

Kit Contents

The RDK includes the following items:

- BLDC motor control board
- BLDC motor (15 V or 24 V, see *RDK-BLDC User's Manual* for motor specifications)
- Wall adapter 24 V_{dc} 15 W with plug adapters for US, UK, EU, and AUST
- JTAG debug adapter (20-pin to 10-pin)
- Retractable Ethernet cable
- CD containing User's Manual, RDK GUI, source code, and data sheet
- This Quickstart guide



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Step 1: Running the Motor

You can start the BLDC without using the graphical user interface (GUI).

1. The control board ships with the BLDC motor already connected; however, before you power the board, verify the motor connections in case one of the wires came loose during shipping. The diagram that follows shows the connections between the motor and the control board.

Figure 1. Wiring for BL3056 Brushless DC Motor

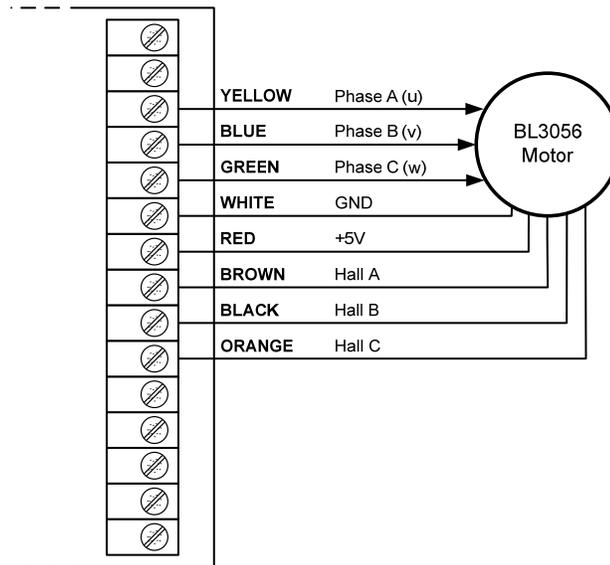
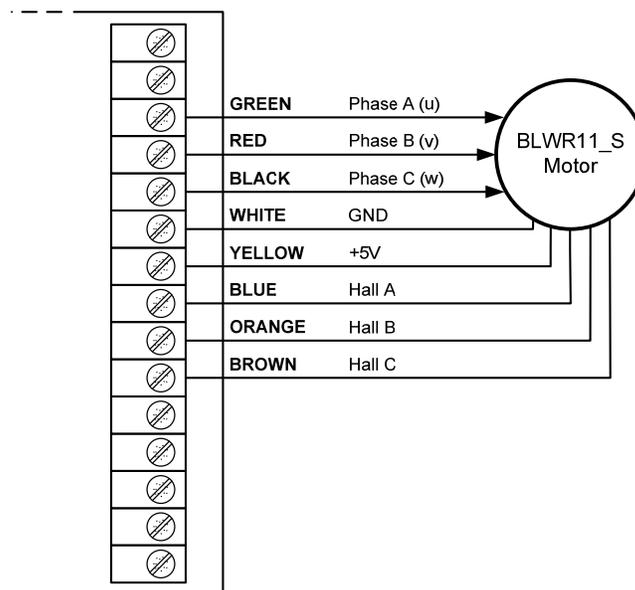


Figure 2. Wiring for BLWR110S-15 and BLWR111S-24 Brushless DC Motors

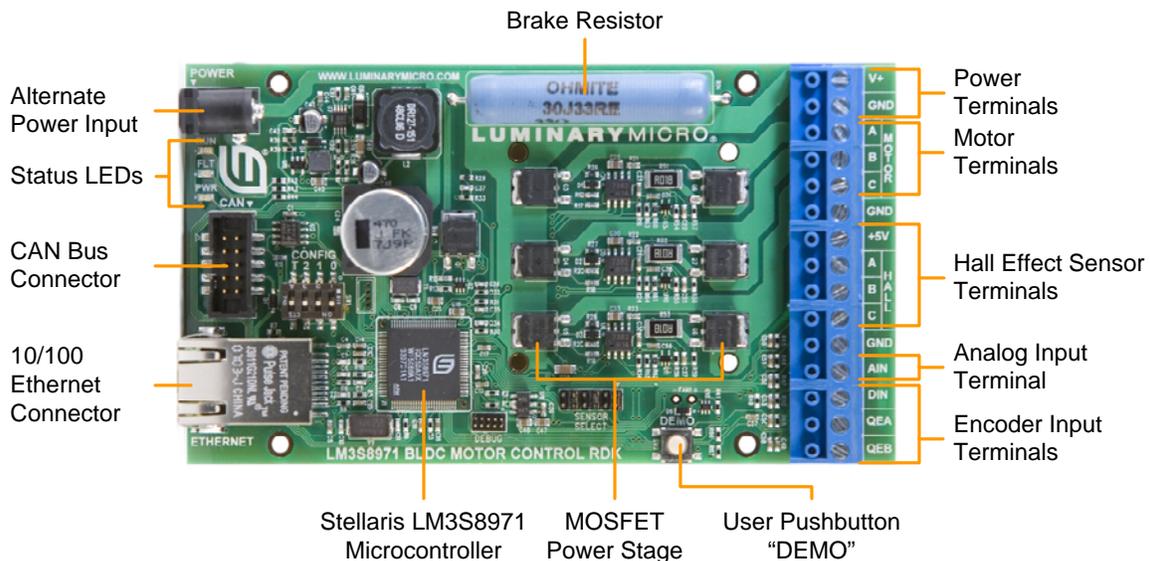


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2. Apply power by selecting the appropriate plug adapter (the RDK includes plugs for most countries) and slide it into the wall adapter. If necessary, the adapter can be removed by pressing the release latch.
3. Plug the DC plug into the socket labeled POWER on the control board.
4. Connect the wall adapter to a standard AC electrical outlet (115 V or 230 V). The green power LED (PWR) illuminates.

Controlling the Motor using the DEMO push-button

1. Press and release the DEMO button to start the motor in the forward direction (~3000 rpm).
2. Press the DEMO button again to stop the motor.
3. A third press starts the motor in the reverse direction (~3000 rpm).
4. Continue pressing the DEMO button to cycle through these steps.



Installing and Using the RDK GUI Software

Using the RDK GUI provides a greater level of control than the on-board interface. Through the RDK GUI, you can set specific values for speed, modulation, and acceleration, as well as a number of other parameters to tune the operation of the motor. The RDK GUI program communicates with the RDK board using a network connection over Ethernet.

Features

- Real-time display of control board parameters
- Control motor speed and direction
- Configure over dozens of parameters to customize operation for specific applications
- Requires a PC, with wired network capabilities, running Microsoft® Windows 98, 2000, XP, Vista, or 2003

Software Installation Requirements

- Completion of the steps for “Installing and Using the BLDC Motor” from page 1 of this Quickstart document.
- A computer with a USB interface, running Microsoft® Windows 98, 2000, XP, or 2003
- The BLDC RDK documentation and software CD-ROM

Step 1: Insert CD

1. Insert the RDK Documentation and Software CD into the CD-ROM drive of your computer. If Autoplay is enabled on your PC, the index.htm file automatically opens in your default web browser. If not, use Windows Explorer or other browser to open the index.htm file manually.
2. From the CD menu, select the Software button to open a page from which you will be able to download the GUI software and RDK firmware.

To install the GUI software and RDK firmware, you will perform the following steps:

Install the GUI software

Review documentation and other tools on the CD

Install the firmware development package (optional, not required to run the motor or GUI out of the box)

Step 2: Install the GUI software

1. Click the [RDK-BLDC GUI Software](#) link. Your web browser prompts you to save a zip archive containing the GUI software to your PC. Once downloaded, extract the contents of this file to a convenient location (for example, your Desktop).

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2. Within the extracted SW-RDK-BLDC-gui-`nnn` directory, double-click `setup.exe`. Installation of the GUI software begins.
3. The first screen of the installer allows you to select the installation path for the target application and Run-Time Engine. If you are satisfied with the default location, click "Next".
4. After selecting the installation location, the installer assumes you accept the license agreement and continues. When the installer completes, complete the installation by clicking "Finish."

Step 3: Review documentation and other tools on the CD

On the Software page of the CD, you will find links to the user's guides for the RDK-BLDC Firmware Development Package, the StellarisWare® Peripheral Driver Library, and the boot loader. You will also find a link for installing the LM Flash Programmer tool.

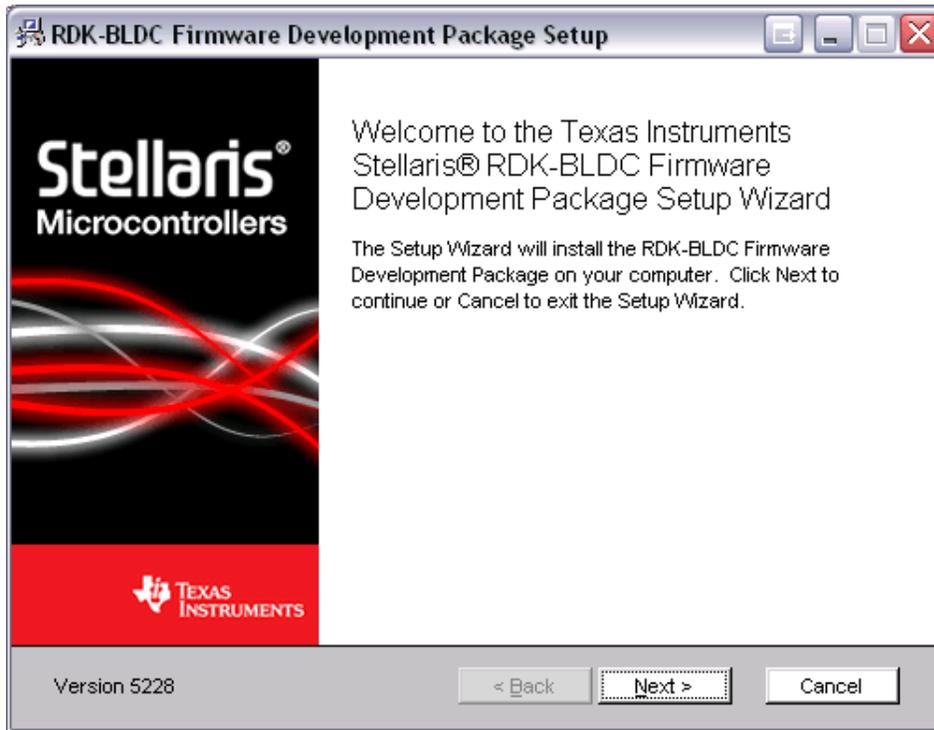
On the Documentation page of the CD, you will find detailed documentation for the RDK board, including a board user's manual, schematics, and other design files. There are also data sheets for the Stellaris microcontroller and other devices used in the RDK design. You will also find documentation for the ARM® Cortex™-M3.

Optional Step: Install the firmware development package

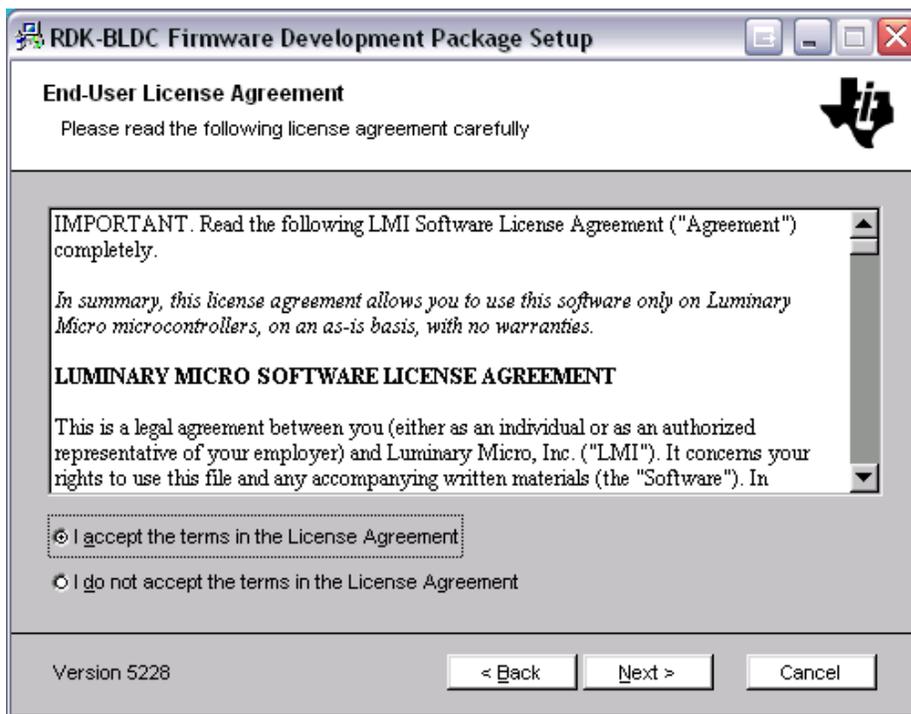
Installing the firmware development package is not required to run the motor or the GUI out of the box.

1. Click the "Install" link next to "StellarisWare RDK-BLDC Firmware Development Package". Your web browser prompts you to save an executable file containing the Firmware Development Package to your PC.
2. Find the location where the SW-RDK-BLDC-`nnnn.exe` file was saved (for example, your Desktop), and double-click the file name. The installer should run and show you the opening screen. Click the Next button.

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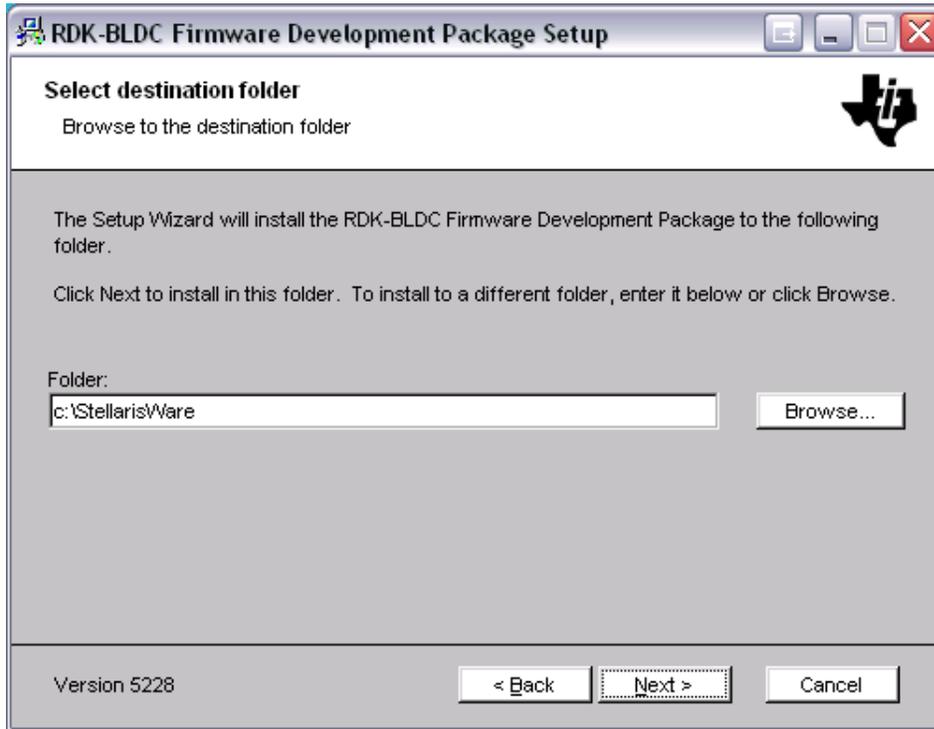


3. Read the license agreement. Select the button that says "I accept ..." and then click the Next button.

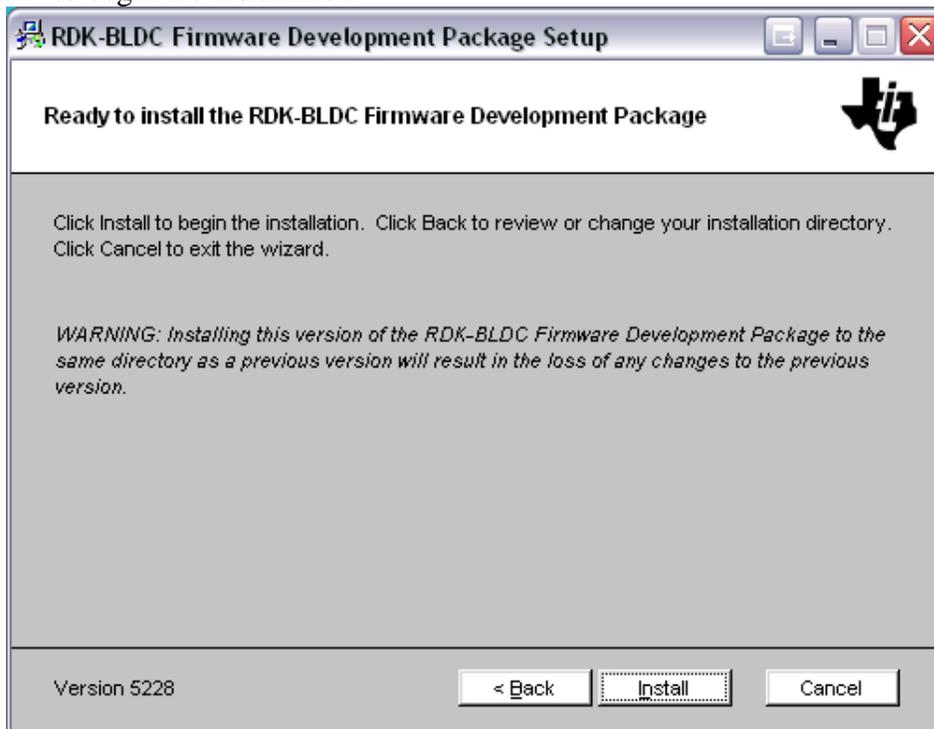


4. The installation path for the RDK firmware package displays. You can use the suggested path or change it. When you are satisfied with the location, click the Next button.

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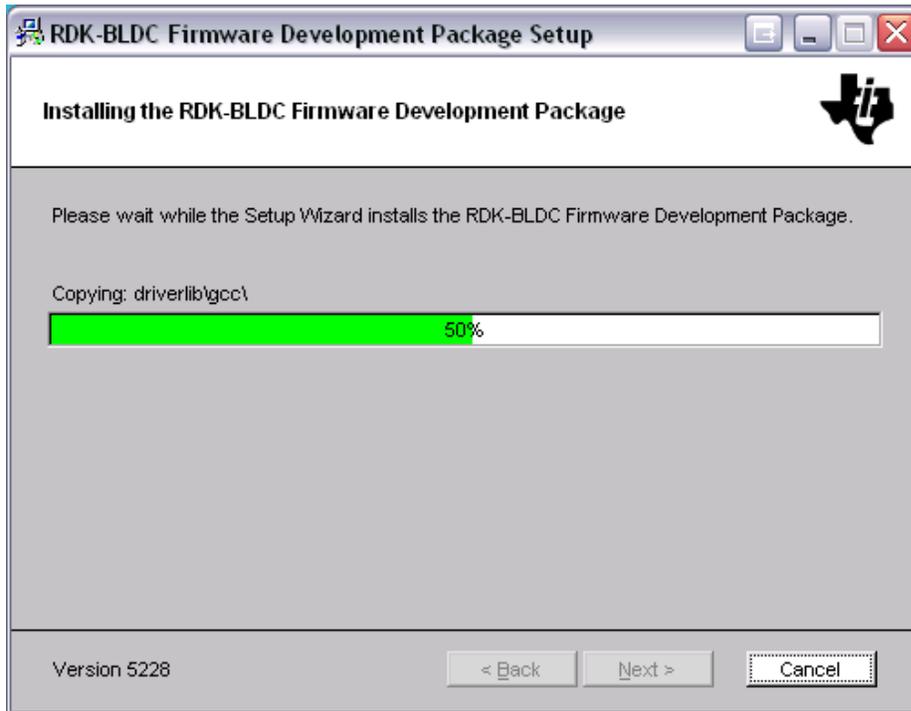


5. You are now ready to install the Firmware Development Package. Click the Next button to begin the installation.

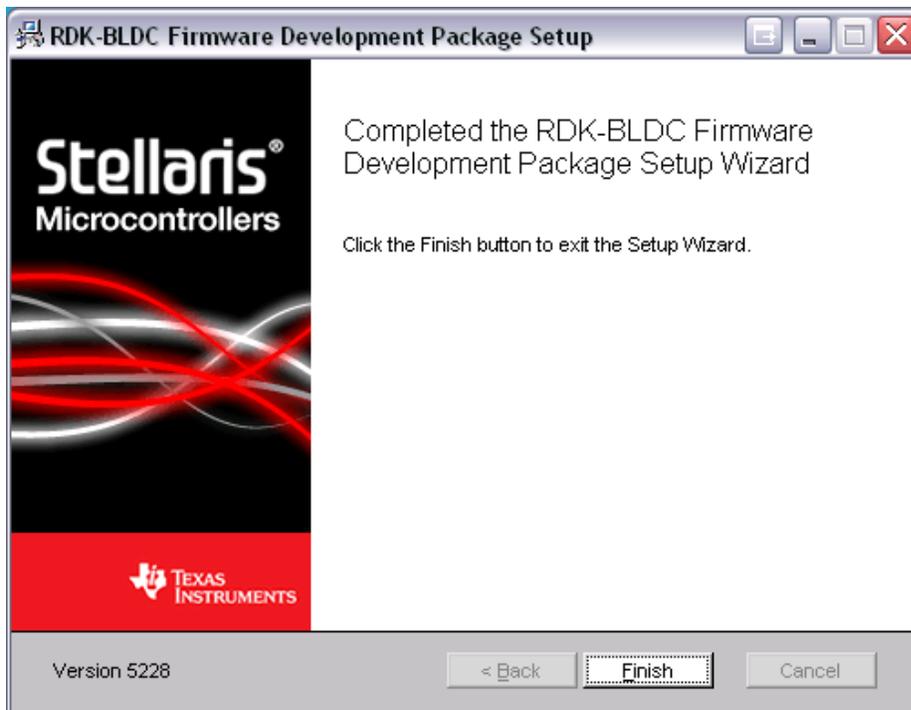


6. You will be shown a progress screen as the software is installed.

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7. When the installation is finished, click the Finish button to close the installer. The RDK firmware development package is now installed on your system.



Starting the RDK GUI

When you first power up the board, it attempts to locate a DHCP server. Because of this, you must power cycle the board before you start the RDK GUI. To do this:

1. If the power is already powered up, disconnect the power to the.
2. Connect an Ethernet cable (included in the kit) from the RJ45 connector on the motor-control board (labeled “ETHERNET”) to a LAN.
3. Reapply power to the board.

If there is a DHCP server present on the LAN, the board attempts to obtain an IP address from the DHCP server. After about a minute, if the board fails to find a DHCP server, it switches to Auto-IP and selects an address in the 169.254/16 range.

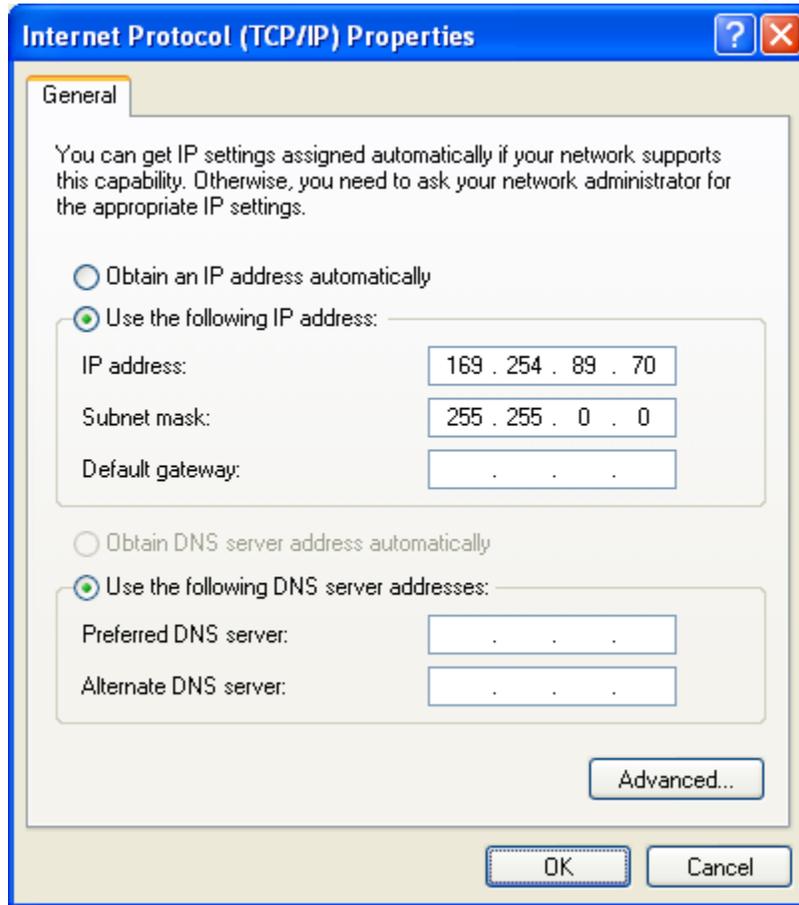
If more than one motor control board is connected to the LAN, then each board must have a unique ID on the network. You can change the ID using the “CONFIG” DIP switch on the motor control board to set this ID from 0 to 3. The GUI uses this to identify which board it is communicating with.

You can now connect your host machine directly to the motor-control board with the Ethernet cable provided in the evaluation kit. The integrated PHY on the LM3S8971 has an Auto-MDX feature that allows use of a straight-through or cross-over Ethernet cable. In many cases, the host machine also tries to obtain an IP address from a DHCP server, eventually time-out, and then set a link-local IP address based on a network address auto configuration protocol. This IP address should be similar to, but not the same as, the motor-control board.

In some cases, you must manually configure your IP address and mask subnet. To do this:

1. Disable the machine’s wireless network connection and any other Internet connections that could interfere with the network being created.
2. Select the Internet Protocol (TCP/IP) connection within the Local Area Connection Properties.
3. Click Properties.
4. Manually configure your IP address as 169.254.89.70 and your subnet mask to 255.255.0.0, as shown below. For more information, see the *Stellaris Brushless DC (BLDC) Motor Control Reference Design Kit with Ethernet and CAN User’s Manual*.

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To launch the GUI application

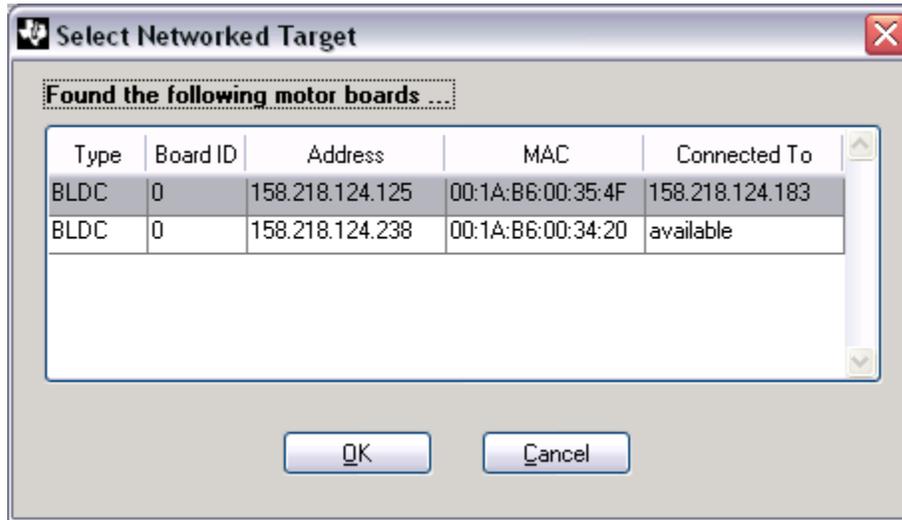
5. In the Start menu, select Program Files > Luminary Micro > BLDC.
6. Click “bldc-gui.”

If the program has not been used before, a dialog box appears where you can select the motor-control board you would like to connect to over the network.

7. Select the motor control board to which you want to connect and click OK.

If a motor control board has already been connected, the IP address of the host that it is connected to appears in the “Connected To” column. If no host is currently connected to the board, “available” appears in this column. See the example that follows.

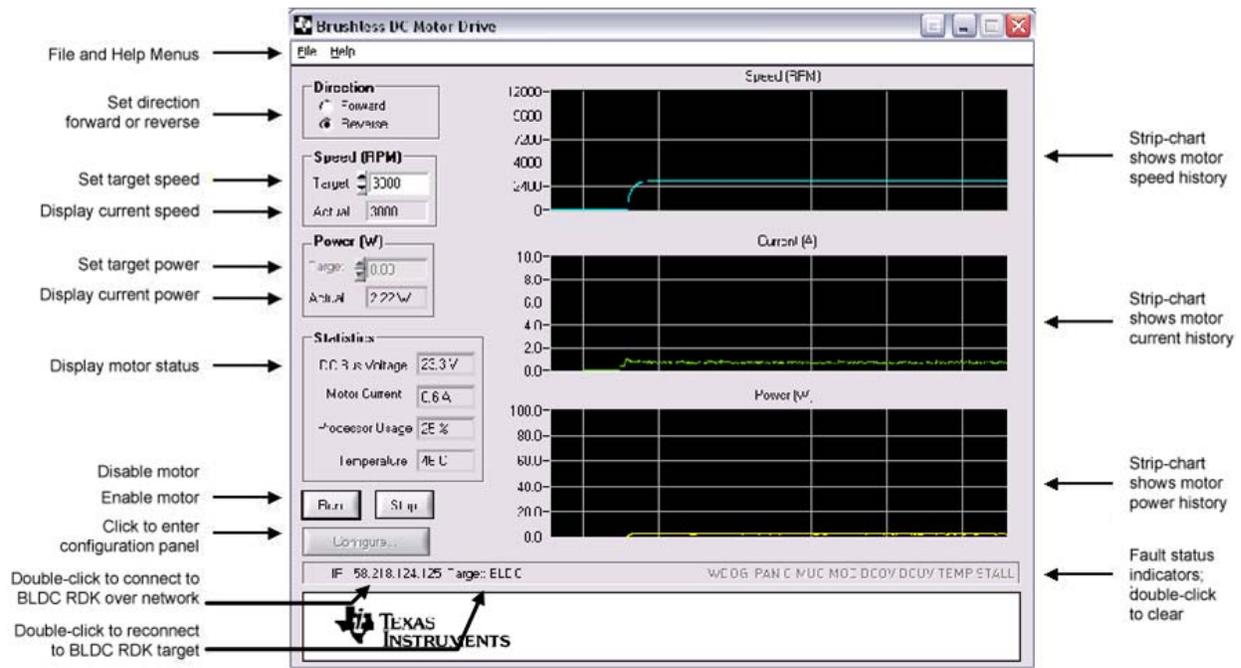
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Once you select a motor-control board, the program remembers the choice and does not ask for this information again. However, you can target a different motor-control board at any time by reopening the “Select Networked Target” dialog box. To do this, double-click the IP xxx.xxx.xxx.xxx indicator on the main window (see next figure). If the board ID or network settings have changed, you may have to reselect the motor-control board. When you start the RDK GUI program, the on-board interface on the RDK board is disabled and the DEMO push-button has no effect.

The following figure shows information about connecting to and operating the motor control using the RDK GUI. For now, use the main window for monitoring and control only. Before attempting to adjust operating parameters using the Configuration window, read the *Stellaris Brushless DC (BLDC) Motor Control Reference Design Kit with Ethernet and CAN User’s Manual*.

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For detailed explanations of other window controls, see the *Stellaris Brushless DC (BLDC) Motor Control Reference Design Kit with Ethernet and CAN User's Manual*.

Troubleshooting

Getting started with the BLDC RDK is easy, but should you encounter programs, refer to the table below for basic troubleshooting information. Additional troubleshooting information can be found in the *Stellaris Brushless DC (BLDC) Motor Control Reference Design Kit with Ethernet and CAN User's Manual*.

Problem	Possible Resolution
<ul style="list-style-type: none"> • Motor does not operate • Motor does not operate smoothly • Clicking noise can be heard • Motor runs in one direction but not the other 	<ul style="list-style-type: none"> • Check motor power wiring. • Check Hall-effect sensor wiring. • Confirm Hall-effect sensor commutation sequence is correct. It may be necessary to move Hall-effect sensor connections.
<ul style="list-style-type: none"> • GUI motor speed does not match actual motor speed 	<ul style="list-style-type: none"> • The motor has more (or less poles). Change the GUI setting to match the motor.
<ul style="list-style-type: none"> • Motor stalls or is very hot 	<ul style="list-style-type: none"> • Confirm Hall-effect sensor commutation sequence is correct. It may be necessary to move Hall-effect sensor connections. • Check that voltage and current settings match the motor's ratings.
<ul style="list-style-type: none"> • Motor begins to accelerate, then stops abruptly 	<ul style="list-style-type: none"> • Power supply may be inadequate for motor power rating, causing the DC bus to sag momentarily.

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Conclusion

If you followed the procedures in this document, you have successfully operated the BLDC motor using the RDK in both standalone and RDK GUI-controlled modes.

For an explanation of how to use the parameters accessible through the RDK GUI, see the *Stellaris Brushless DC (BLDC) Motor Control Reference Design Kit with Ethernet and CAN User's Manual*, which also contains information that can assist you with adapting the software and hardware for a specific application.

References

The BLDC Motor Control RDK documentation CD also contains the following references, which are also available for download at www.luminarymicro.com:

- *Stellaris Brushless DC (BLDC) Motor Control Reference Design Kit with Ethernet and CAN User's Manual*, publication number RDK-BLDC-UM
- *Stellaris Brushless DC (BLDC) Motor RDK Software Reference Manual*, publication number RDK-BLDC-srm

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