MultiMotor Series Development Kit

Quick Start Guide QS009103-0616

MultiMotor Series

Introduction

This quick start guide describes how to set up Zilog's MultiMotor Series Development Kit (ZMULTIMC100ZCOG) and how to use it to evaluate your motor control designs and applications.

The MultiMotor Series Development Kit features a 3-phase MultiMotor Series Development Board which provides screw terminals for attaching several different types of motors such as BLDC, PMSM, ACIM, and includes the attachment points for an optional external power supply to accommodate bus voltages up to 48V.

Note: This version of the MultiMotor Series Development Kit does not include a MultiMotor Series MCU Module, which must be purchased separately to use this kit. Each of Zilog's MultiMotor Series MCU modules features a different Zilog MCU capable of motor control and contains a debug connector to connect the board to a host development PC via an opto-isolated USB SmartCable.

This document guides the user through the following tasks:

- How to connect and configure the MultiMotor Series hardware
- How to run the kit's preloaded application code in Standalone Mode
- How to connect the kit hardware to your development PC
- Running the application code in Zilog Developer System II (ZDSII) Debug Mode

Kit Contents

The MultiMotor Series Development Kit consists of the following items:

- 3-phase MultiMotor Series Development Board
- 24V/30W/3200RPM BLDC motor
- 24V AC/DC universal power adapter
- Opto-isolated UART-to-USB adapter (includes adapter and Type A USB extension cable)

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Also required is at least one of the following MCU modules, which must be ordered separately:

- For ZNEO32! MCU-based development, use the Z32F1280100MODG MCU Module
- For Z16FMC-based development, use the Z16FMC00100MODG MCU Module
- For Z8FMC16100-based development, use the Z8FMC000100MODG MCU Module
- For Z8051 MCU-based development, use the Z51F3200100MODG MCU Module

To program your MultiMotor Series MCU Module, use Zilog's Opto-Isolated USB Smart-Cable (ZUSBOPTSC01ZACG), which is available in the Zilog Store.

Caution: Zilog highly recommends using the Opto-Isolated SmartCable due to the higher voltages present on the MultiMotor Series Development Board which could be detrimental to a host computer.

Figure 1 shows the hardware required to fully utilize the MultiMotor Series Development Kit.

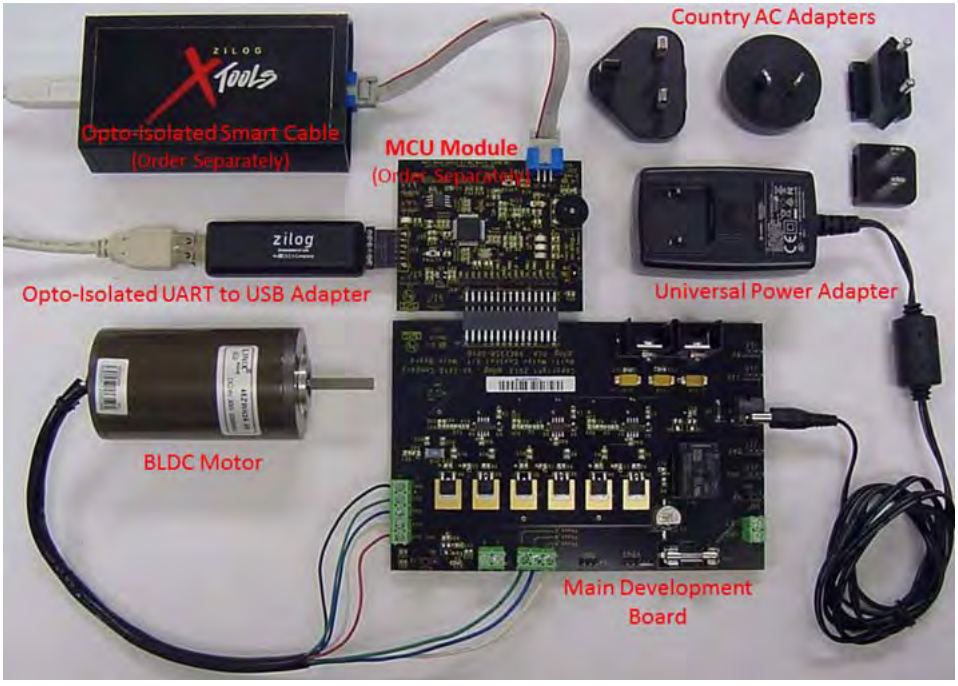

Figure 1. A Fully Assembled MultiMotor Series Development Kit

Caution: Always use a grounding strap to prevent damage resulting from electrostatic discharge (ESD).

Running the Motor in Standalone Mode

This section presents a series of steps for setting up the Kit and running the application code under hardware control in Standalone Mode. Each of the MCU modules used with the MultiMotor Series Development Kit is shipped with motor control firmware preloaded into the MCU's internal Flash memory.

Step 1: Connect the 3-Phase Motor to the MultiMotor Series Development Board

(a) The 24V BLDC 3-phase motor included with the Kit features two sets of wires:

- Three 20-gauge wires labeled *Driver* that provide power to the motor
- Five 22-gauge wires labeled *Sensor* that are connected to the motor's Hall sensors

(b) Connect the three Driver wires to Jumper J1 on the Development Board, as follows:

- Phase_A: White wire
- Phase_B: Blue wire
- Phase_C: Green wire

(c) Connect the five Sensor wires to J3 on the Development Board as follows:

- VCC_3v3: Red wire
- HSA: White wire
- HSB: Blue wire
- HSC: Green wire
- GND: Black wire

Figure 2 shows the motor connections to the Development Board.

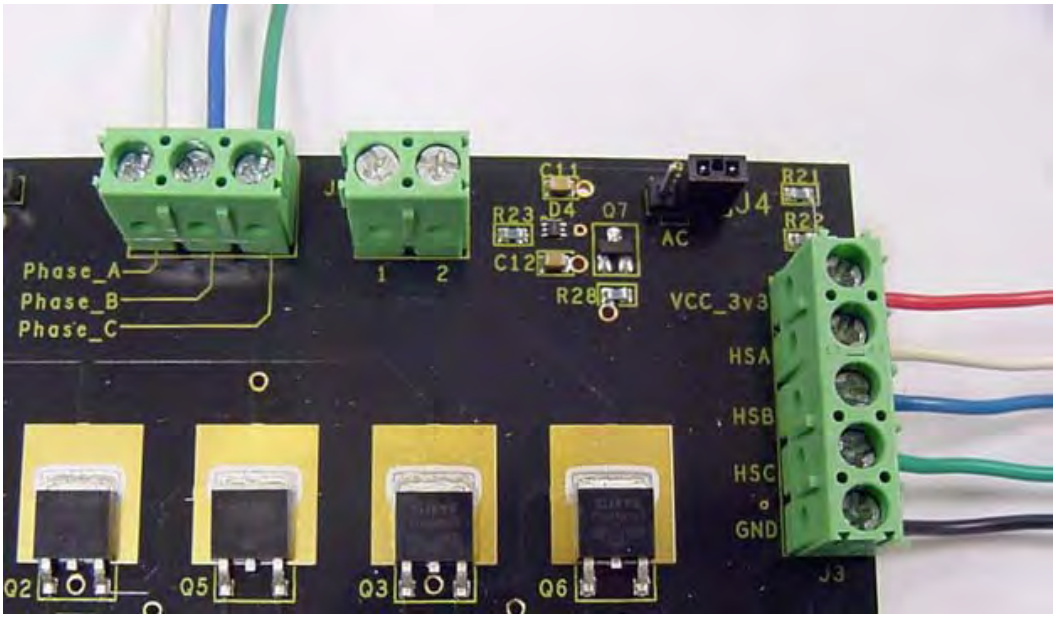

Figure 2. Motor Connections to the Development Board

Caution: Ensure that the wires are securely in place after tightening the individual connector screws. To prevent stripping these screws, do not over-tighten.

Step 2: Connect the MCU Module to the Development Board

On a flat surface, align the 30-pin connector (J2) on the MultiMotor Series MCU Module with the 30-pin connector (J2) on the Development Board. Gently slide these connectors together until fully inserted.

Figure 3 shows this attachment of the MCU Module to the Development Board.

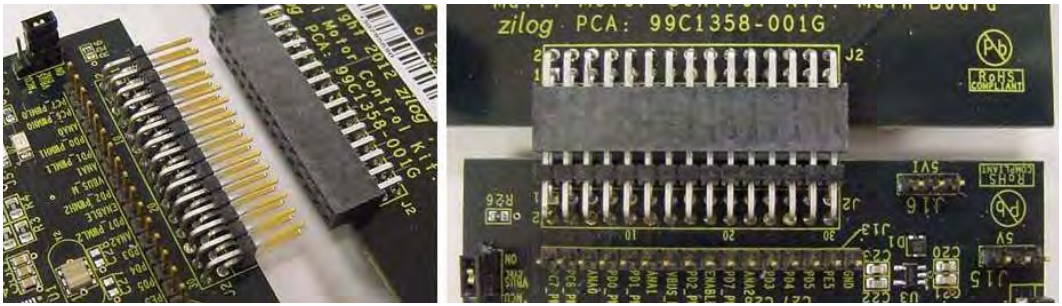

Figure 3. Attaching the MCU Module to the Development Board

Step 3: Set Switches and Jumpers

For initial setup, configure the jumpers and switches as indicated in the following settings.

- Development Board:
  - Motor selection: (J4) Jumper in the BLDC position
  - External V_{BUS}: (J9) Jumper in the 24V/internal position
- Z32F128 MCU Module:
  - VBUS control jumper (J5) in the ON position
  - Stop/Run switch (SW6) to the STOP position
  - Direction switch (SW5) in either position
  - Speed thumbwheel potentiometer (R28) to its midpoint
  - Sensor Select jumpers (J13) in positions 2-3, 5-6, and 8-9 (HSx) for sensored operations
  - SCLK Out (J11) is shunted
  - Comparator Reference (J12) is shunted
- Z16FMC MCU Module:
  - V_{BUS} control jumper (J20) in the ON position
  - Stop/Run switch (SW4) to the STOP position
  - Direction switch (SW3) in either position
  - Speed thumbwheel potentiometer (R11) to its midpoint
- Z8FMC16100 MCU Module:
  - V_{BUS} control jumper (J20) in the ON position
  - Stop/Run switch (SW4) to the STOP position

  - Direction switch (SW3) in either position
  - Speed thumbwheel potentiometer (R11) to its midpoint
  - UART/Flash Select jumpers (J21) in positions 3-4 and 7-8 for UART operation
  - Sensor Select jumpers (J22) in positions 1-2, 3-4, and 5-6 (HSx) for sensored operation
- Z51F3220 MCU Module:
  - V_{BUS} control jumper (J6) in the VCC_5V position
  - Stop/Run switch (SW3) to the STOP position
  - Direction switch (SW2) in either position
  - Speed thumbwheel potentiometer (R12) to its midpoint
  - Sensor Select jumpers (J2) in positions 1-2, 3-4, and 5-6 (HSx) for sensored operation

Figure 4 indicates the location of the jumpers and switches on both the Development Board and the Z16FMC MCU Module.

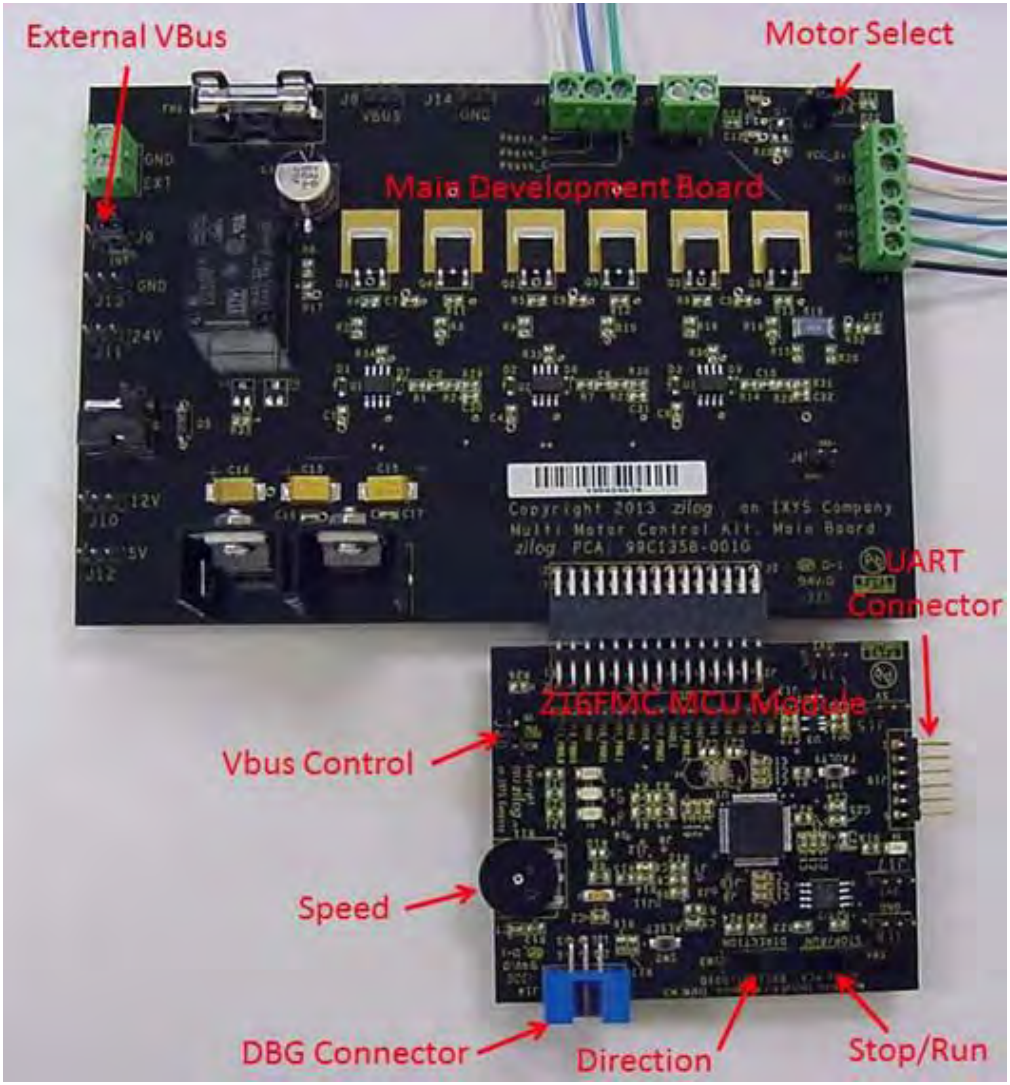

Figure 4. Locations of Jumpers and Switches

Step 4: Configure the Universal 24V DC Power Adapter

The universal power adapter contained within this kit includes interchangeable AC blades to allow the kit to be used in various countries with different plug configurations, AC line voltages, and frequencies. This adapter will accept 100–240V AC and 50–60Hz, and convert these values to the 24V DC required by the kit hardware.

Select the AC plug adapter appropriate for your locale. Insert the top (flat) side into the slot on the AC adapter, then press the bottom into the unit until it snaps into place.

Step 5: Connect the 24V DC Power Supply to the Development Board

Connect the 24V DC power supply to the Development Board at connector P1, then plug the supply into an electrical outlet. The green LED (D4) on the MultiMotor Series MCU Module illuminates when power is applied. An audible click may occur when the V_{BUS} relay (RL1) is energized.

Step 6: Turn on the Motor

The preloaded application code causes the Stop/Run SW4 to turn the motor OFF and ON, the Direction SW3 to change the direction of motor spin, and Speed Potentiometer R11 to change the motor speed.

Experiment with these switches to see how simple it is to control the motor in Standalone Mode using the MultiMotor Series Development Kit.

Step 7: Power Down the Motor and Development Board

After you observe how the code operates, stop the motor by moving the Stop/Run switch to the STOP position and unplug the 24V DC power supply from the Development Board. To learn more, refer to the appropriate MultiMotor Series Application Note available on Zilog.com.

Running the Motor Using UART Control

The firmware that ships preloaded in the MultiMotor Series MCU modules also allows the motor to be controlled from a PC using the UART interface built into the hardware. All that is required is a UART-to-USB adapter and a cable to run from the Development Board to a USB port on the PC; both of these items are included in the Kit.

This section describes a series of steps for setting up the Kit and running it in UART Control Mode so that the motor can be operated from a PC console program.

Step 1: Configure the Hardware

Before proceeding, follow Steps 1 through 4 in the Running the Motor in Standalone Mode section on page 3.

Step 2: Connect the Opto-Isolated UART-to-USB Adapter to a PC

Using the cable provided, connect one end to the standard USB connector on the adapter and the other end to your PC. The PC should recognize the new hardware and drivers for this device, but if necessary, the drivers can be downloaded from http://www.ftdichip.com/FTDrivers.htm for the operating system being used.

After the PC recognizes the new hardware (and/or the drivers have been properly installed), connect the adapter to the MultiMotor Series MCU Module by placing both of these items on a flat surface, then aligning the 6-pin connector of the optoisolated UART-to-USB adapter to the 6-pin connector (J19) on the MCU Module. Ensure that Pin 1 on each of these connectors aligns as designated by the number 1 (or a square solder pattern). Gently slide these two connectors together until they are fully inserted.

Figure 5 indicates how the optoisolated USB connects to the UART adapter.

Figure 5. The Opto-Isolated USB Connection to the UART Adapter

Step 3: Enable communication using a Terminal emulation program

Using a serial terminal emulation program such as Hyperterminal, TeraTerm, or Real-Term, configure the serial port to 57600-8-N-1-N. Refer to Figure 6 on the next page for an example of the serial port setup. You may need to launch the Windows Device Manager to determine the specific COM port being used by the adapter, because the COM port may change over time depending on other devices you may have attached to the PC.

Step 4: Connect the 24V DC Universal Power Supply to the Development Board

Connect the 24V DC power supply to the Development Board at connector P1, then plug the supply into an electrical outlet. The green LED D4 illuminates when power is applied. Additionally, a menu similar to the one shown in Figure 7 should appear in the console window.

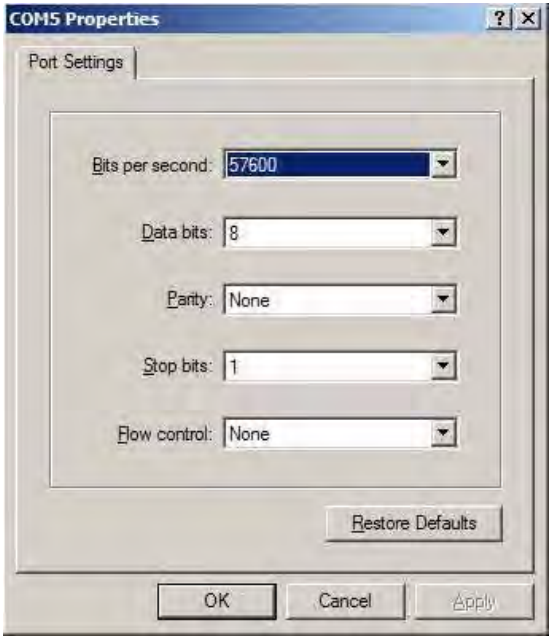

Figure 6. COM Port Configuration

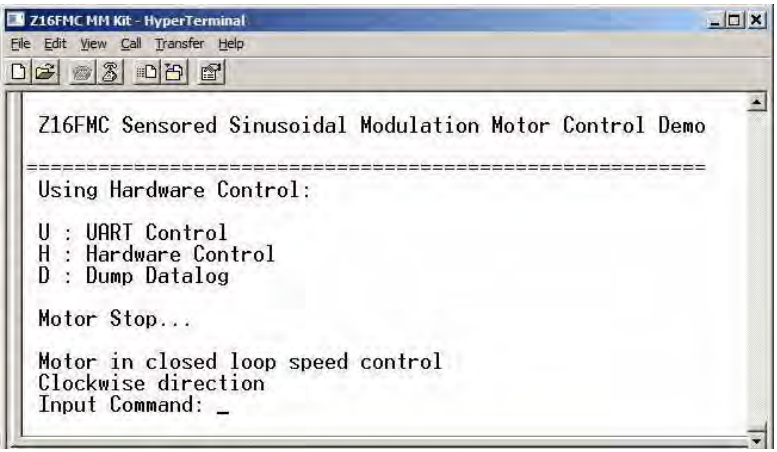

Figure 7. Console Screen Under Hardware Control

Press the U key on your keyboard (commands are not case-sensitive), then press Enter to begin UART (console) control of the motor. The screen shown in Figure 8 should appear.

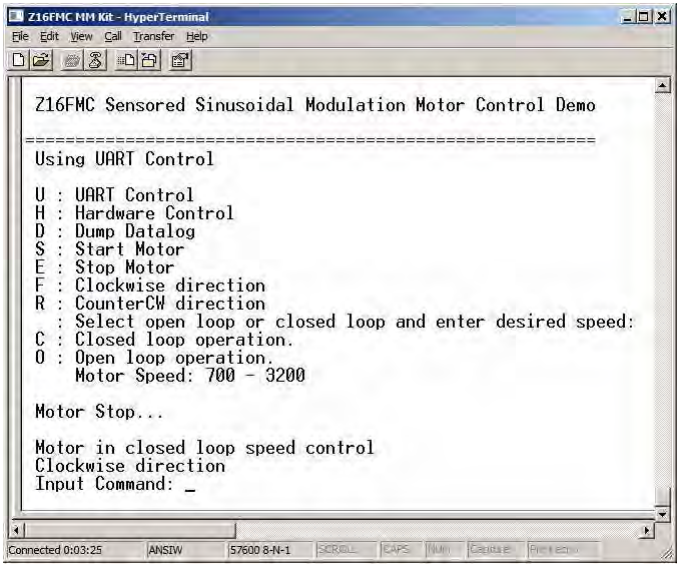

Figure 8. Console Screen Under UART Control

Step 5: Turn on the Motor

By using the console menu commands listed in Figure 8, the motor can be controlled from the keyboard by pressing the desired key (as indicated by the menu), followed by the Enter key. While under UART control, the switches on the MultiMotor Series MCU Module will have no effect unless the motor's Reset button is pressed. If you press the **H** key while the motor is under UART control, the system will revert to Hardware control, and the motor will be controlled by the switches on the MCU Module.

Experiment with these commands to see how simple it is to control the motor in UART Mode using the MultiMotor Series Development Kit.

If a data log is available, press the **D** key followed by the Enter key to dump the data log. As a result, all of the motor data will be sent to the console screen. However, in some cases, this process can take a long time. To stop the data dump process, press CTRL+C. To learn more, refer to the Zilog application note titled Implementing a Data Logger with Spansion SPI Flash (AN0360).

Step 6: Power Down the Motor and Development Board

After you observe how the code operates, stop the motor by entering an **E** on your keyboard, then unplug the 24V DC power supply from the Development Board. To learn more, refer to the appropriate Application Note available on zilog.com.

Executing Application Code in Debug Mode Using Zilog's ZDSII

This section outlines the basic steps for executing the application code in Debug Mode using Zilog's ZDSII for the Z16FMC and Z8FMC16100 MCU modules.

Note: For the Z32F128 and Z51F3220 MCU modules, refer to the corresponding Application Note for instructions on using Keil Development tools:
– ZNEO32! MCU Module: BLDC Motor Control Using Sensored Sinusoidal PWM Modulation with the Z32F128 MCU (AN0380)
– Z8051 MCU Module: Three-Phase Hall Sensor BLDC Driver Using the Z51F3220 MCU (AN0371)

Step 1: Stop the Preloaded Application Code

If you have not already done so, stop the motor using the Stop/Run switch (Hardware Mode) or by pressing **E** (UART Mode) and disconnect the 24V DC universal power supply from the MultiMotor Series MCU Module.

Step 2: Install the ZDSII Integrated Development Environment for the MCU Module

1. Download the latest version of ZDSII from the Free Software category in the Zilog Store. If you have not previously visited the Zilog Store, a simple registration procedure is required prior to downloading ZDSII. The brief list below indicates the appropriate version of ZDSII for your MCU.
   - Z16FMC MCUs: download the latest version of ZDSII – ZNEO
   - Z8FMC16100 MCUs: download the latest version of ZDSII – Z8 Encore!
2. After downloading ZDSII, launch its software installation file and follow the on-screen instructions to install ZDSII. For additional help, consult the following documentation; ZDSII's Online Help feature is also a resource upon installation.
   - Z16FMC MCUs: Zilog Developer Studio II – ZNEO User Manual (UM0171)
   - Z8FMC16100 MCUs: Zilog Developer Studio II – Z8 Encore! User Manual (UM0130)

Step 3: Install the Opto-Isolated USB SmartCable Driver Software and USB SmartCable

The optoisolated USB SmartCable connects the Development Board to a high-speed or full-speed USB port on your ZDSII host system. Its internal optoisolator electrically isolates the Development Board circuitry from the host computer.

The USB SmartCable is enclosed in a black box that connects to the host PC via a USB cable (included in the Kit).

Connect one end of the USB SmartCable to the optoisolated USB SmartCable box; connect the other end to the host PC. The operating system should detect the new hardware. USB SmartCable drivers are included with ZDSII and can typically be located in the following filepath:

`Program Files` → `Zilog` → `ZDSII_ZNEO_<version_number>` → `device drivers` → `USB`

If required, refer to the Opto-Isolated USB SmartCable User Manual (UM0195) for additional details.

Step 4: Connect the Opto-Isolated USB SmartCable to the MCU Module

- Attach one end of the six-conductor ribbon cable (included in the Kit) to the USB SmartCable's six-pin DBG connector. Both ends of this ribbon cable provide keyed connectors to prevent misalignment.
- Attach the free end of the ribbon cable to the DBG connector on the MCU Module (J14).

Caution: Do not apply power to the MultiMotor Series Development Kit unless the USB SmartCable is connected to both the host PC and the MultiMotor Series MCU Module's DBG port.

Step 5: Download and Run the Application Code

Observe the following steps to open and run the appropriate ZDS II project with the MultiMotor Series Development Kit. For this example, the source code supporting the Zilog application note titled *BLDC Motor Control Using Sensored Sinusoidal PWM Modulation with the Z16FMC MCU (AN0355)* is used. Other code options are available for this kit and are outlined in the References section on page 18. These source code packages are all available free for download from zilog.com.

1. Download the AN0355-SC01.zip source code file from from zilog.com and save these code files to an appropriate location on your PC.
2. Ensure that the motor and the Z16FMC MCU Module are properly connected to the Development Board as outlined in Steps 1 and 2 of the Running the Motor in Standalone Mode section on page 3.
3. Ensure that jumpers are properly set, as detailed in the appropriate application note being used. In this case, the jumpers have been set as outlined in Step 3 of the Running the Motor in Standalone Mode section.
4. Connect the 24 V DC power supply to the Development Board at connector P1, then plug this power supply into an electrical outlet. The green LED (D4) on the Z16FMC MCU Module illuminates when power is applied.

5. Launch Zilog Developer Studio II (ZDSII) for ZNEO by navigating via the Windows Start menu to the following path:

   `Program Files` → `Zilog` → `ZDSII_ZNEO_<version_number>` → `bin` → `Zds2Ide.exe`

6. In ZDSII, select **Open Project** from the **File** menu to display the **Open Project** dialog box, and browse to the directory in which the AN0355-SC01 source code is stored.
7. Select the `AN0355_SC01.zdsproj` project file and click **Open**. The initial ZDSII program screen will appear, as shown in Figure 9. To view the project source files, double-click the **Project Files** folder on left side of the IDE interface. Double-click an individual file to open it in the ZDSII file editor.

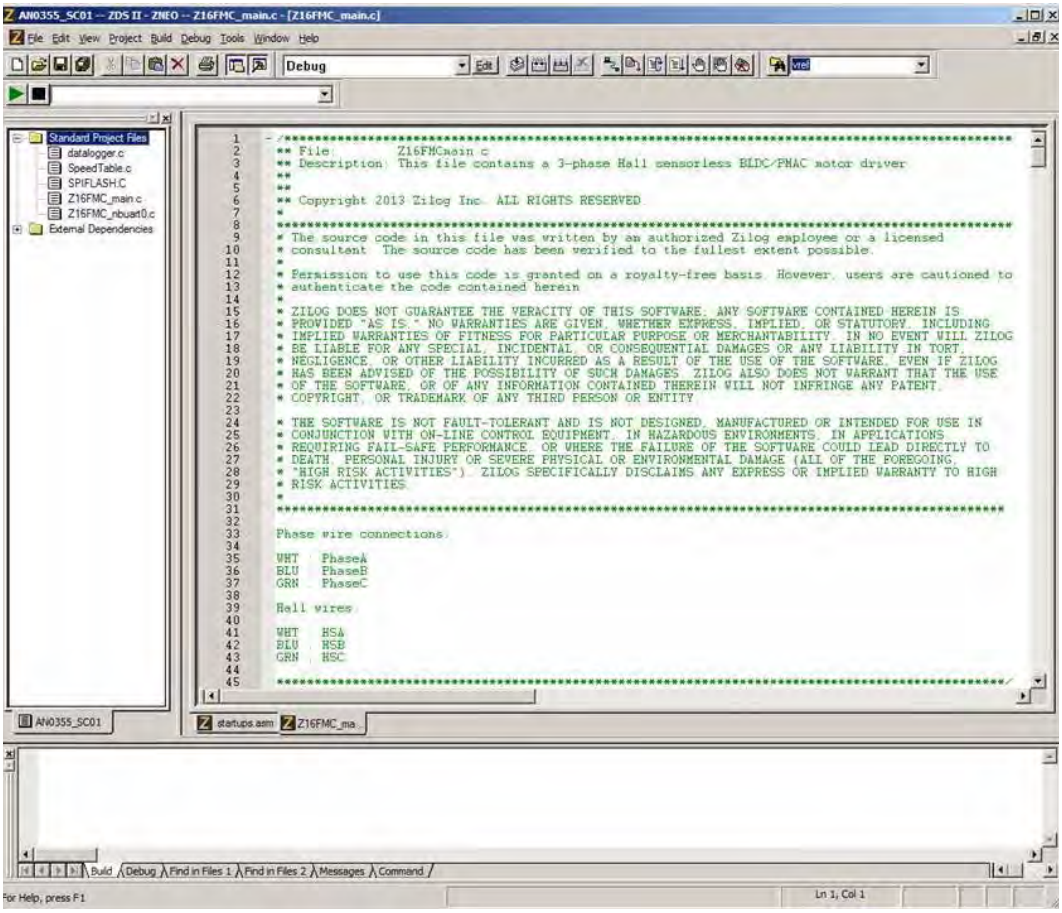

Figure 9. Zilog Developer Studio II Opening Screen

8. Compile the firmware by selecting **Build** → **Rebuild All**. Wait for the build to complete, as indicated by the `Build succeeded` confirmation in the Status window at the bottom of the screen.
9. Download the code to the Z16FMC MCU Module by selecting **Debug** → **Reset**. Wait for the download to complete, as indicated in the Status window at the bottom of the screen.

10. If prompted to program the Flash Option bits as shown in Figure 10, click **Yes**.

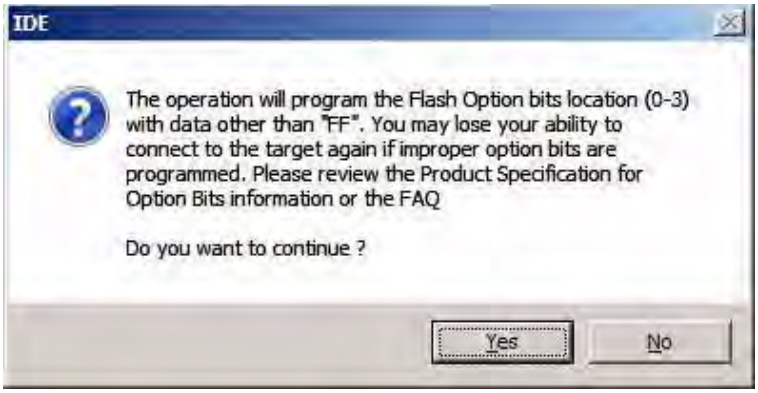

Figure 10. Flash Option Bit Programming Message

11. Start the program by selecting **Debug** → **Go**.
12. On the Z16FMC MCU Module, use the Stop/Run Switch to start and stop the motor, the Direction Switch to change the direction in which the motor spins, and the Speed Potentiometer to adjust the motor's RPM.
13. After you observe how the code operates, stop the motor by setting the Stop/Run switch to the STOP position. Next, unplug the 24V DC power supply from the Development Board. For additional details, refer to the BLDC Motor Control Using Sensored Sinusoidal PWM Modulation with the Z16FMC MCU Application Note (AN0355) or other appropriate Application Note on zilog.com.

Note: For more information about using Zilog Developer Studio II (ZDSII) and building projects for your MultiMotor Series Development Kit, refer to the Zilog Developer Studio II – ZNEO User Manual (UM0171) or Zilog Developer Studio II – Z8 Encore! User Manual (UM0130).

References

To learn more about the hardware contained in this kit and how to use it, refer to the MultiMotor Series Development Kit User Manual (UM0262). In addition, several application notes and corresponding software are currently available for use with this Kit. These application notes include:

- MultiMotor Control with Parameter Monitoring Using the Z16FMC MCU (AN0343)
- Sensorless Brushless DC Motor Control with the Z16FMC MCU (AN0353)
- Space Vector Modulation of a 3- Phase AC Induction Motor with the Z16FMC MCU (AN0354)
- BLDC Motor Control Using Sensored Sinusoidal PWM Modulation with the Z16FMC MCU (AN0355)
- Three-Phase Hall Sensor BLDC Driver Using the Z16FMC MCU (AN0356)
- Implementing a Data Logger with Spansion SPI Flash Application Note (AN0360)
- BLDC Motor Control Using Sensored Sinusoidal PWM Modulation with the Z8FMC16100 (AN0367)
- Three-Phase Hall Sensor BLDC Driver Using The Z8FMC16100 MCU (AN0368)
- Space Vector Modulation of a 3- Phase AC Induction Motor with the Z8FMC16100 MCU (AN0369)
- Sensorless Brushless DC Motor Control with the Z8FMC16100 MCU (AN0370)
- BLDC Motor Control Using Sensored Sinusoidal PWM Modulation with the Z32F128 MCU (AN0380)
- Three Phase Hall Sensor BLDC Driver Using The ZNEO32! MCU (AN0381)
- Space Vector Modulation for ACIM using the Z32F128 MCU (AN0382)
- Sensor-less Block Commutation Using ADCs for BEMF Detection (AN0383)
- Sensor-less Block Commutation Using Comparators for BEMF Detection (AN0384)
- Sensor-less Block Commutation using ADC or Comparator Peripheral (AN0386)

These documents can be downloaded for free from zilog.com.

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