



ZNEO CPU-Based Motor Control

MultiMotor Series Development Kit

User Manual

UM026204-0616

**MultiMotor
Series**



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Revision History

Each instance in the Revision History table below reflects a change to this document from its previous version.

Date	Revision Level	Description	Page No
Jun 2016	04	Added Z32F128 Module description and features	5 , 9 , 11 , 14 , 30 , 31
Jan 2015	03	Corrected footer in Appendix.	26-33
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Introduction

Zilog's MultiMotor Series Development Kit (ZMULTIMC100ZCOG) aids in the development of motor control applications using an assortment of Zilog MCUs aimed at the motor control environment. It provides an application-specific platform for creating a design using a Zilog motor control MCU. This development platform features a 3-phase MultiMotor Series Development Board connected to a Zilog MCU Module, which is available separately.

A 24V DC/3200RPM 3-phase motor is included with the Kit. Several motor types are supported, including BLDC, PMSM, and ACIM. Control algorithms including sensored, trapezoidal, sinusoidal, Field Oriented Control (FOC), and sensorless block commutation are also supported in this MultiMotor Series.

► **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.

Kit Features

The key features of the MultiMotor Series Development Kit include:

- 3-phase MultiMotor Series Development Board capable of driving multiple motor types
- Multiple MCU modules using different Zilog microcontrollers designed specifically for motor control (must be ordered separately)
- 3-phase, 24V DC, 30W, 3200RPM motor with Internal Hall Sensors capable of running in Sensored or Sensorless modes
- UART-to-USB adapter with opto-isolator
- Universal 24V AC/DC power supply
- USB SmartCable with opto-isolator (must be ordered separately)

For MultiMotor Series Development Kit installation and setup instructions, refer to the [MultiMotor Series Development Kit Quick Start Guide \(QS0091\)](#). This document is available free for download from zilog.com.



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.

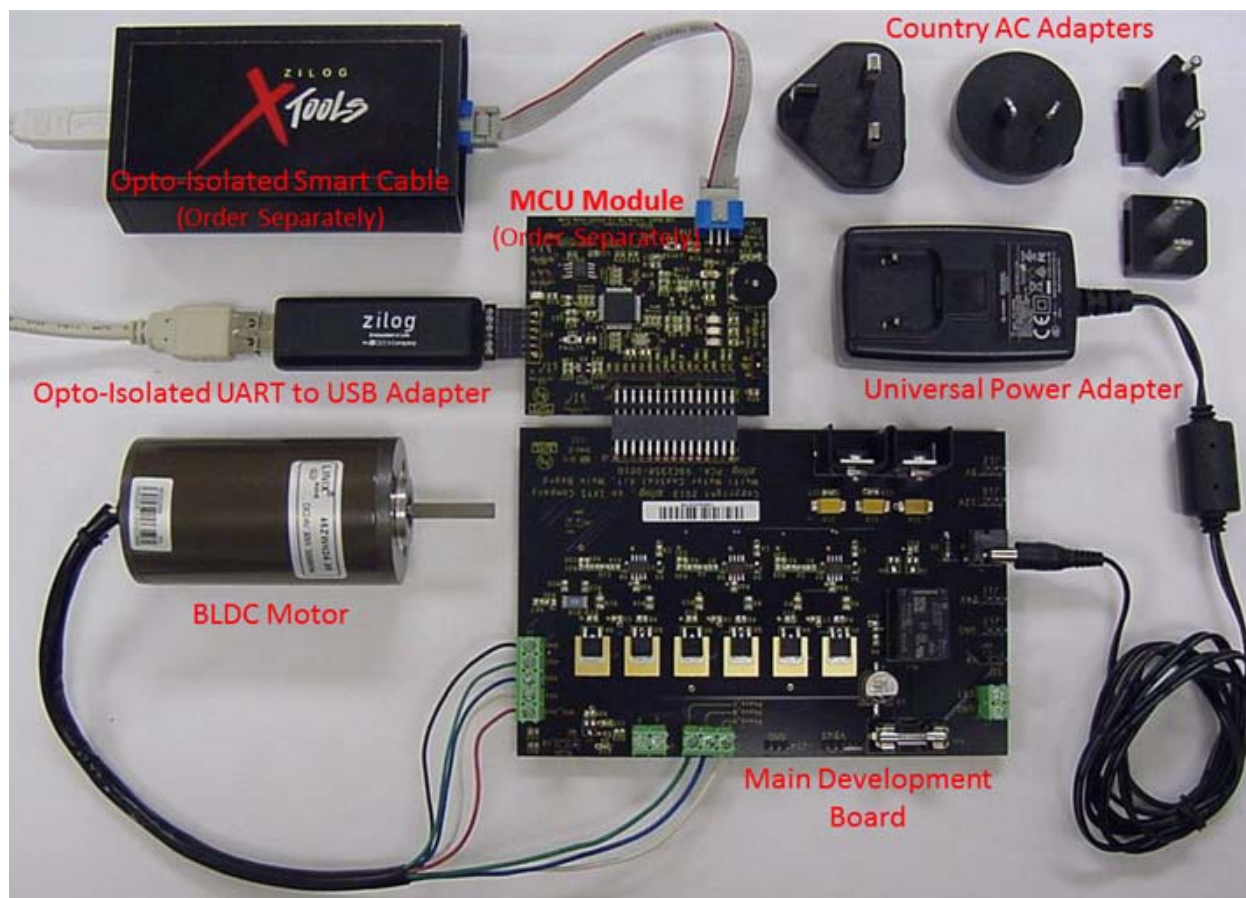


Figure 1. A Fully Assembled MultiMotor Series Development Kit

Figure 2 presents a basic block diagram of the MultiMotor Series Development Board and its companion MCU Module.

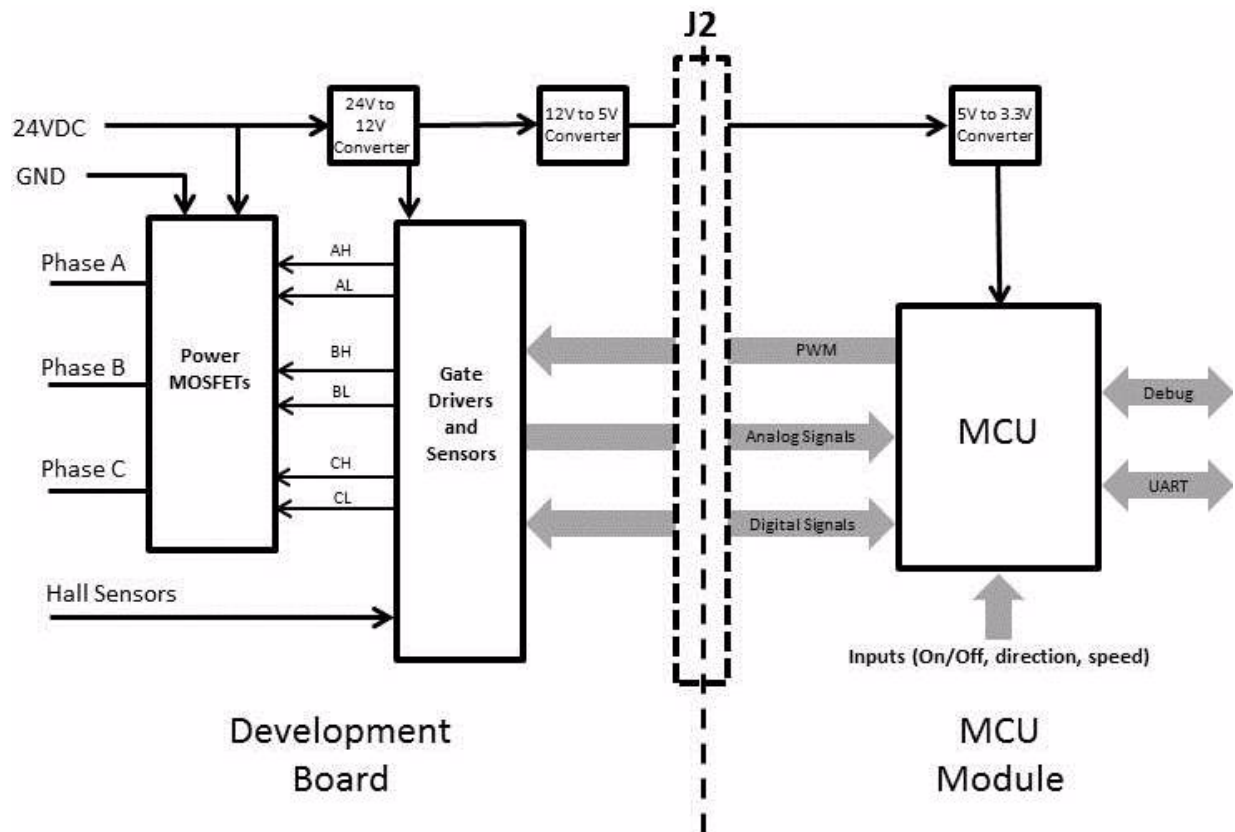


Figure 2. MultiMotor Series Motor Control Development Kit Block Diagram

MCU Module

Each Motor Control MCU Module features a Zilog MCU and measures approximately 2.5" x 3.0" as shown in Figure 3. It provides circuitry that interfaces the chip to an external development PC running the Zilog Developer Studio II (ZDSII) Integrated Development Environment (IDE), and to the 3-Phase MultiMotor Series Development Board.

► **Note:** The Z32F128 ARM Cortex MCU development is supported with third party development tools Keil MDK, IAR, and GCC for ARM Embedded. All of Zilog's development for the Z32F128 MCU was accomplished with Keil MDK version 5.20.

The Z8051 MCU development was performed with the Keil C8051 development environment.

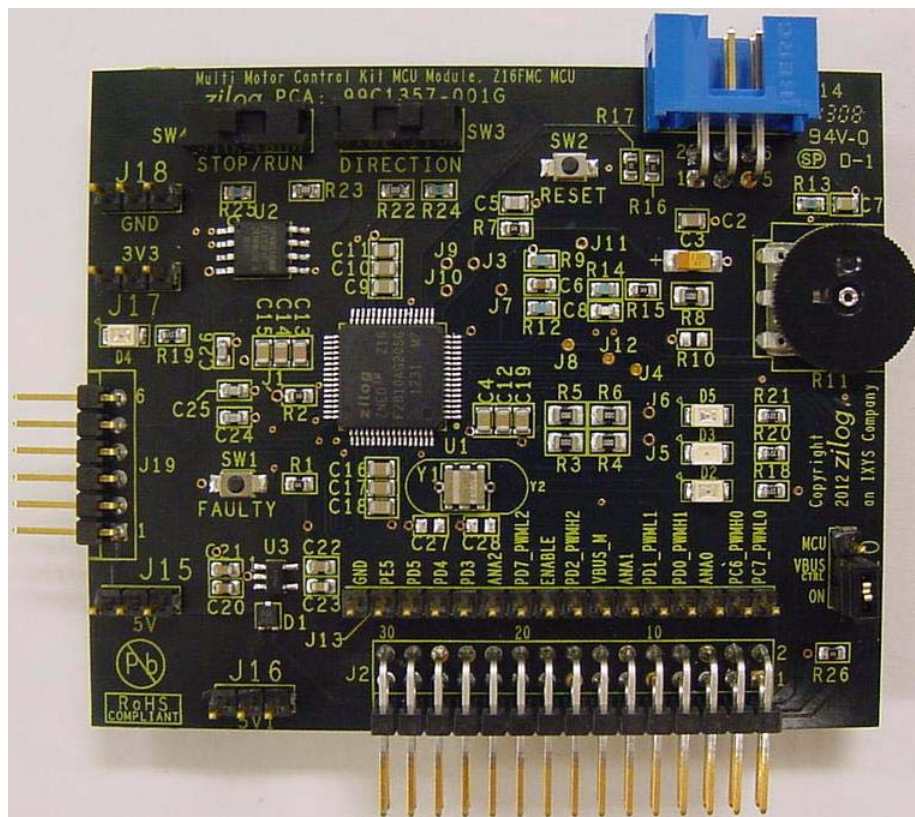


Figure 3. A Zilog Z16FMC MCU Module

MCU Module Features

The features of the MCU Module include:

- A Zilog MCU specifically designed for motor control applications
- Two SPDT switches to control DIRECTION and STOP/RUN
- One 5K potentiometer to control SPEED
- Green LED (illuminates when power is applied to the Board)
- General-purpose LEDs
- UART port
- 6-pin DBG interface
- Spansion SPI 32MB Flash Memory for datalogging on some modules
- 30-pin header for connecting to the 3-phase MultiMotor Series Development Board
- Multiple headers to allow easy access to all pertinent signals

Z32F128 MCU

The Z32F128 MCU, a member of the ZNEO32! Family of microcontrollers, is a cost-effective and high-performance 32-bit microcontroller. The Z32F128 MCU provides 3-phase PWM generator units which are suitable for inverter bridges, including motor drive systems. The two built-in channels of these generators control two inverter motors simultaneously. The key features of the Z32F128 MCU include:

- High performance low-power Cortex-M3 core
- 128 KB code Flash memory with cache function
- 12 KB SRAM
- 3-Phase Motor PWM with ADC triggering function
 - 2 channels
- 1.5Msps high-speed ADC with burst conversion function
 - 2 or 3 units with 16 channel input
- Built-in Programmable Gain Amplifier (PGA) for ADC inputs
 - 4 channels
- Built-in analog comparator
 - 4 channels
- System fail-safe function by clock monitoring
- XTAL OSC fail monitoring

- Precision internal oscillator clock (20MHz $\pm$ 3%, and up to 80 MHz using PLL)
- Watchdog timer
- Six general purpose timers
- Quadrature encoder counter
- External communication ports: 4 UARTs, 2 I2Cs, 2 SPIs
- High current driving port for UART photo couplers
- Debug and emergency stop function
- Real-time monitoring function support for more effective development
- JTAG and Serial Wire Debug (SWD) in-circuit debugger
- Various memory size and package options
 - LQFP-80, LQFP-64
- Industrial grade operating temperature (-40 ~ +85°C)

To learn more about the Z32F128 MCU, refer to the [Z32F128 MCU Product Specification \(PS0345\)](#).

Z16FMC Series MCUs

The Z16FMC Series Flash microcontroller is based on Zilog's advanced ZNEO 16-bit CPU core. Optimized for motor control applications, these devices support the control of single- and multi-phase variable-speed motors. Target applications are large appliances, small appliances, and HVAC. The key features of the Z16FMC MCU include:

- 20MHz, 16-bit optimized single-cycle CISC core
- Up to 128KB of in-circuit programmable Flash memory
- 4KB internal RAM with 16-bit access
- Highly integrated digital/analog peripherals:
 - 12-bit PWM module with three complementary pairs or six independent PWM outputs
 - Fast 12-channel, 10-bit Analog-to-Digital Converter (ADC) for current sampling and back-EMF detection
 - Three standard 16-bit timers with capture, compare, and PWM capability
 - Analog comparator for current limiting or overcurrent shutdown
 - Operational amplifier
 - 4-channel DMA Controller

- Flexible communication interface including a UART with LIN and IrDA, I²C, and ESPI
- Oscillator supports either internal IPO or external crystals and ceramic resonators
- Up to 46 General-Purpose Input/Output (GPIO) pins
- Voltage Brown-Out/Power-On Reset (VBO/POR)
- Watchdog Timer (WDT) with internal RC oscillator
- Single-pin on-chip debugger

To learn more about the Z16FMC MCU, refer to the [Z16FMC Series Motor Control Product Specification \(PS0287\)](#) or the [Z16FMC Series Flash Microcontroller Product Brief \(PB0229\)](#). Each of these documents is available free for download from zillog.com.

Z8FMC16100 Series MCUs

The Z8FMC16100 Series Flash microcontrollers, a part of the Z8 Encore! MC™ family of motor control devices are based on Zilog's advanced eZ8 8-bit CPU core. Optimized for motor control applications, these devices support the control of single and multi-phase variable-speed motors. Target applications are large appliances, small appliances, and HVAC. The key features of the Z8FMC16100 MCU include:

- 20MHz Zilog eZ8 CPU core
- Up to 16KB Flash program memory
- 512B Register SRAM
- Highly-integrated digital/analog peripherals:
 - 12-bit pulse-width modulator (PWM) module with three complementary pairs or six independent PWM outputs with dead-band generation and fault trip input
 - 8-channel 10-bit Analog-to-Digital Converter (ADC) for current sampling and back-EMF detection
 - 16-bit timer with capture, compare, and PWM capability
 - Analog comparator for current limiting or overcurrent shutdown
 - Operational amplifier
 - Flexible communication interface including a UART with LIN and IrDA, I²C, and ESPI
- Oscillator supports either internal IPO or external crystals and ceramic resonators
- Up to 17 General-Purpose Input/Output (GPIO) pins

- Voltage Brown-Out/Power-On Reset (VBO/POR)
- Watchdog Timer (WDT) with internal RC oscillator
- Single-pin on-chip debugger

To learn more about the Z8FMC16100 MCU, refer to the [Z8FMC16100 Series Product Specification \(PS0246\)](#) or the [Z8FMC16100 Series Product Brief \(PB0166\)](#). Each of these documents is available free for download from zilog.com.

Z51F3220 MCU

The Z51F3220 MCU, a member of Zilog's new Z8051 product family, is an advanced CMOS 8-bit microcontroller with 32KB of Flash memory. This powerful microcontroller provides a highly flexible and cost-effective solution to many embedded control applications, including motor control. The key features of the Z51F3220 MCU include:

- 16MHz high-performance 8-bit CISC core
- Up to 32KB Flash program memory
- Highly-integrated digital/analog peripherals:
 - 10-bit pulse-width modulator (PWM) module with three complementary pairs of PWM outputs
 - 16-channel 12-bit Analog-to-Digital Converter (ADC) for current sampling and back-EMF detection
 - 16-bit timer with capture, compare, and PWM capability
 - Flexible communication interface including a UART, I²C, and SPI
 - LCD driver (21 segments/8 common)
- Oscillator supports either internal RC oscillator or external crystals and ceramic resonators
- Up to 42 General-Purpose Input/Output (GPIO) pins
- Voltage Brown-Out/Power-On Reset (VBO/POR)
- Watchdog Timer (WDT) with internal RC oscillator
- Two-wire on-chip debugger

To learn more about the Z51F3220 MCU, refer to the [Z51F3200 Series Product Specification \(PS0299\)](#) or the [Z51FM3220MCU Series Product Brief \(PB0239\)](#). Each of these documents is available free for download from zilog.com.

Connectors, Headers, Jumpers, and Switches

Multiple connectors, controls, and monitoring points are included on each MCU Module to allow easy monitoring and modification to fit user requirements. Table 1 identifies signal names and descriptions for each of these MCU modules.

Table 1. MCU Module Connectors, Jumpers, and Controls

Signal Name	MCU Module				Description
	Z32F128	Z16FMC	Z8FMC16100	Z51F3220	
Fault0	NMI	J1	J1	N/A	Input to the MCU (active Low).
Development Board Connector	J4	J2	J23	J1	30-pin connector between the MCU Module and the Development Board.
CS1+	PA3	J3	J3	J4	Current Sense 1: Positive.
CS1–	N/A	J4	J4	J5	Current Sense 1: Negative.
CS2+	J2	J5	N/A	N/A	Current Sense 2: Positive.
CS2–	J2	J6	N/A	N/A	Current Sense 2: Negative.
V _{REF}	CREF 1&2	J7	J23	N/A	ADC reference voltage.
Temperature	PA1	J8	J5	J7	Temperature reference signal.
COMPOUT	N/A	J9	N/A	J12	Comparator output.
CPINN	N/A	J10	N/A	N/A	Comparator input: Negative.
CPINP	PA0, PA1, PA2	J11	J8	N/A	Comparator input: Positive.
OPOUT	N/A	J12	J9	J9	Op-amp output.
Signal Header	J13	J13	J10	J8	Provides access to various signals.
Debug Connector	J1	J14	J14	J10	Debug.
5V	J7	J15	N/A	J14	5V DC header.
5V _{IN}	J7	J16	J16	J13	Independent 5V input.
3.3V	J3	J17	J17	N/A	3.3V DC header.
Ground	J9	J18	J18	J17, J19	Ground header.
UART Connector	J10	J19	J19	J18	Serial communication.
V _{BUS} Control Select	PA9	J20	J20	J6	Jumper: Manual or MCU V _{BUS} Enable.
Speed Potentiometer	R18	R11	R11	R12	To adjust motor speed.
Fault1	N/A	SW1	N/A	N/A	Switch to simulate a system fault.

Table 1. MCU Module Connectors, Jumpers, and Controls (Continued)

Signal Name	MCU Module				Description
	Z32F128	Z16FMC	Z8FMC16100	Z51F3220	
Reset	nReset PC10	SW2	SW2	SW1	MCU reset.
Direction Switch	SW5	SW3	SW3	SW2	Controls motor direction.
Stop/Run Switch	SW6	SW4	SW4	SW3	Controls motor on/off.
PC0	N/A	N/A	J6	N/A	Port C0.
UART/Flash Select	N/A	N/A	J21	N/A	Jumper: UART or Flash operation.
Sensor Select	SH2, SH3, SH4	N/A	J22	J2	Jumper.
LCD Connector	N/A	N/A	N/A	J15, J16	Optional LCD connector.
I ² C Connector	N/A	N/A	N/A	J20	4 pins for I ² C communication.

MultiMotor Series Development Board Connector

A 30-pin header connects I/O from the MCU Module to the 3-Phase MultiMotor Series Development Board. Figure 4 shows the header pin layout for the Z16FMC MCU Module. Figure 5 shows the header pin layout for the Z32F128 MCU Module.

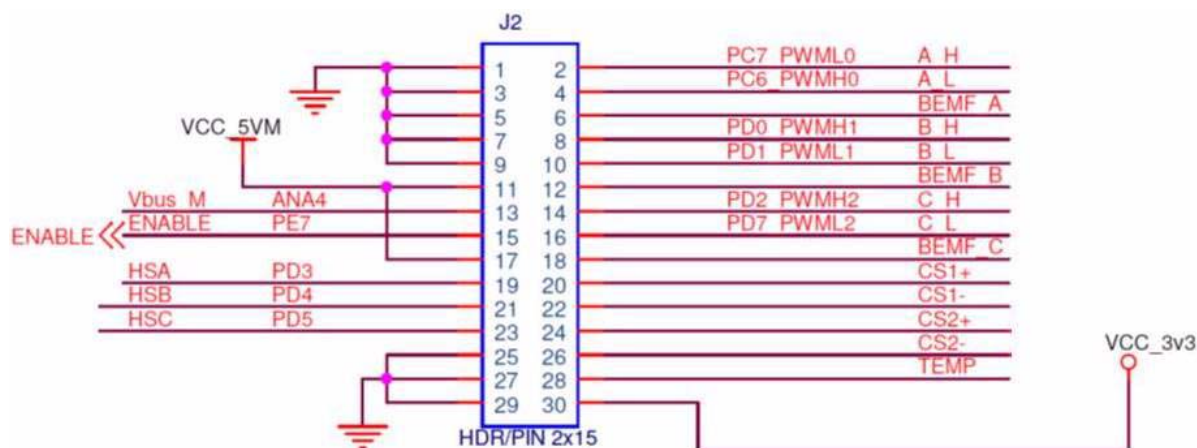


Figure 4. MultiMotor Series Development Board Connector, Z16FMC MCU Module

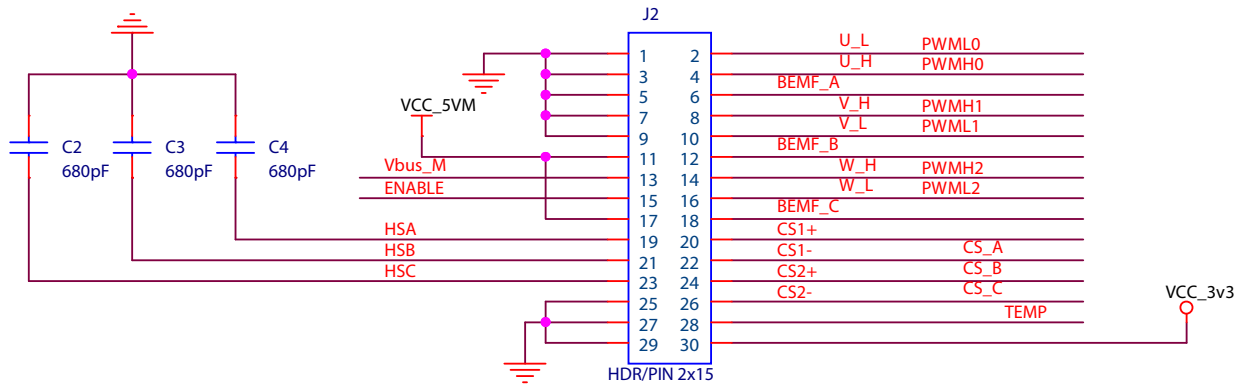


Figure 5. MultiMotor Series Development Board Connector, Z32F128 MCU Module

Table 2 identifies the 30-pin header signals and their functions as they relate to the Z16FMC MCU Module.

Table 2. MultiMotor Series Development Board Signals to the Z16FMC MCU Module

Signal	Pin	Direction (With Respect To MCU)	Description
GND	1	N/A	Ground.
PWML0	2	O	PWM Low output.
GND	3	N/A	Ground.
PWMH0	4	O	PWM High output.
GND	5	N/A	Ground.
BEMF A	6	I	Analog input to the ADC related to motor position when operating in Sensorless Mode.
GND	7	N/A	Ground.
PWMH1	8	O	PWM High output.
GND	9	N/A	Ground.
PWML1	10	O	PWM Low output.
V _{CC_5VM}	11	N/A	5V DC power to the MCU Module.
BEMF B	12	I	Analog input to the ADC related to motor position when operating in Sensorless Mode.
V _{BUS_M}	13	I	Analog input to the ADC proportional to the V _{BUS} voltage.
PWNH2	14	O	PWM High output.
ENABLE	15	O	Enables the V _{BUS} relay.

Table 2. MultiMotor Series Development Board Signals to the Z16FMC MCU Module (Continued)

Signal	Pin	Direction (With Respect To MCU)	Description
PWML2	16	O	PWM Low output.
V _{CC_5VM}	17	N/A	5V DC power to MCU Module.
BEMF C	18	I	Analog input to the ADC related to motor position when operating in Sensorless Mode.
HSA	19	I	Input to the MCU related to motor position when operating in Sensorless Mode.
CS1+	20	I	Analog input to the ADC related to monitoring motor current.
HSB	21	I	Input to the MCU related to motor position when operating in Sensorless Mode.
CS1-	22	I	Analog input to the ADC related to monitoring motor current.
HSC	23	I	Input to the MCU related to motor position when operating in Sensorless Mode.
CS2+	24	I	Analog input to the ADC: not generally used.
GND	25	N/A	Ground.
CS2-	26	I	Analog input to the ADC: not generally used.
GND	27	N/A	Ground.
Temperature	28	I	Analog input to the ADC proportional to the temperature on the Development Board.
GND	29	N/A	Ground.
V _{CC_3v3}	30	N/A	3.3V DC power supplied to the Development Board.

Signal Header

Multiple signals are available on the MCU Modules's signal headers. Figure 6 shows the signal header pin layout for the Z16FMC MCU Module. Figure 7 shows the signal header pin layout for the Z32F128 MCU Module.

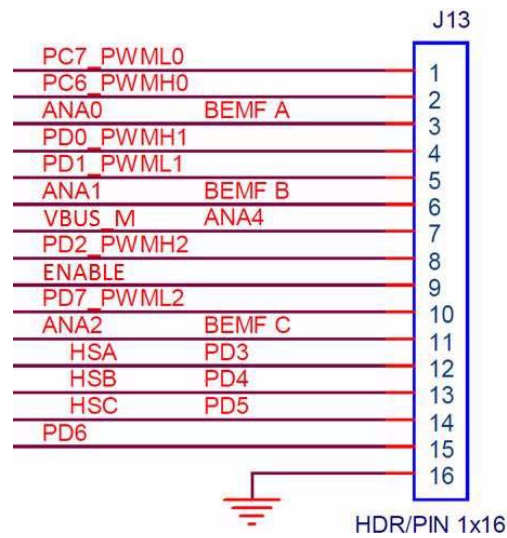


Figure 6. Signal Header, Z16FMC MCU Module

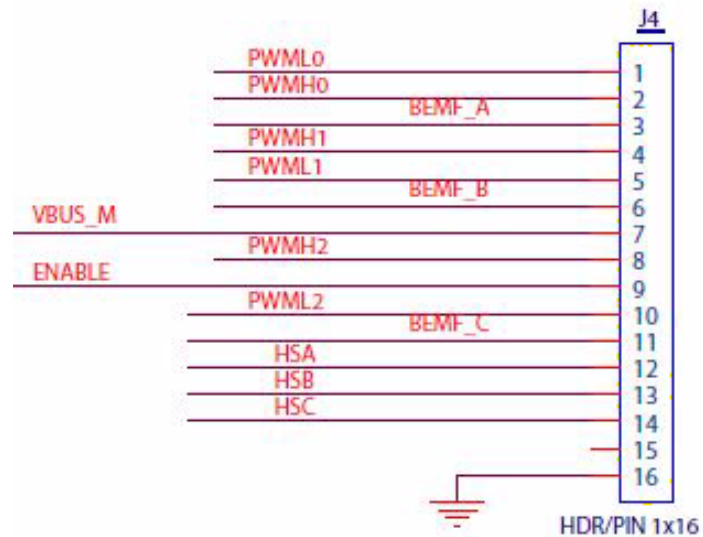


Figure 7. Signal Header, Z32F128 MCU Module

Table 3 identifies the signals headers and their pin functions for each MCU Module.

Table 3. Signal Header Pin Outputs

Pin	Z32F128 (J4)	Z16FMC (J13)	Z8FMC16100 (J10)	Z51F3220 (J8)
1	PWML0	PWML0	PWML0	PWML0
2	PWMH0	PWMH0	PWMH0	PWMH0
3	BEMF_A	BEMF_A	BEMF_A	BEMF_A
4	PWMH1	PWMH1	PWMH1	PWMH1
5	PWML1	PWML1	PWML1	PWML1
6	BEMF_B	BEMF_B	BEMF_B	BEMF_B
7	VBUS_M	V _{BUS} _M	V _{BUS} _M	V _{BUS} _M
8	PWMH2	PWMH2	PWMH2	PWMH2
9	ENABLE	ENABLE	ENABLE	ENABLE
10	PWML2	PWML2	PWML2	PWML2
11	BEMF_C	BEMF_C	BEMF_C	BEMF_C
12	HSA	HSA	HSA	HSA
13	HSB	HSB	HSB	HSB
14	HSC	HSC	HSC	HSC
15	N/A or NC	PD6	NC	TEMP
16	GROUND	GROUND	GROUND	GROUND

Debug Connector

A 6-pin debug connector is used in conjunction with the opto-isolated USB SmartCable included with the MultiMotor Series Development Kit. This debug connector is used in conjunction with ZDSII for programming and debug operations on the MCU Modules. Figure 8 shows the debug connector's pin layout for the Z16FMC MCU Module.

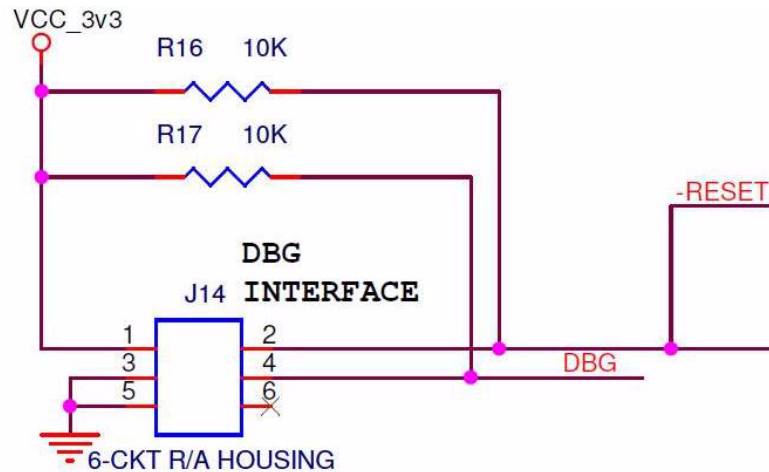


Figure 8. Debug Connector, Z16FMC MCU Module

Table 4 identifies the debug connector signals and their functions.

Table 4. Debug Connector Signal Descriptions

Signal	Pin	Direction (With Respect To The MCU)	Description
V _{CC_3v3}	1	N/A	3.3V DC Power.
RESET	2	N/A	Active Low.
GND	3	N/A	Ground.
DBG	4	I/O	Debug.
GND	5	N/A	Ground.
NC	6	N/A	No Connect.

UART Connector

A 6-pin UART connector is used in conjunction with the opto-isolated UART-to-USB adapter included with the MultiMotor Series Development Kit to allow the monitoring and control of the motor from a PC. Figure 9 shows the UART connector pin layout for the Z16FMC MCU Module.

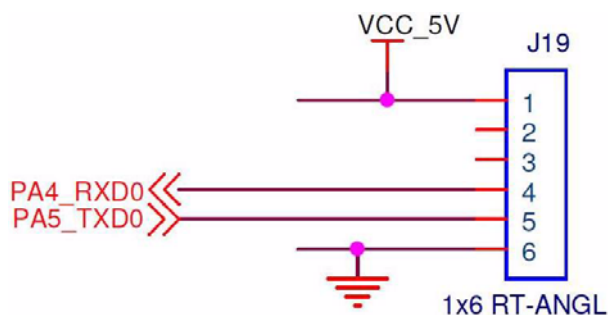


Figure 9. UART Connector, Z16FMC MCU Module

Table 5 identifies the UART connector pin signals and their functions.

Table 5. UART Connector

Signal	Pin	Direction (With Respect To The MCU)	Description
V _{CC} _5V	1	N/A	5V DC power.
NC	2	N/A	No connect.
NC	3	N/A	No connect.
RXD	4	I	Receive.
TXD	5	O	Transmit.
GND	6	N/A	Ground.

I²C Connector

On some MCU modules, a 4-pin connector is provided to access the I²C functions of the MCU. Figure 10 shows the I²C connector pin layout for the Z51F3220 MCU Module.

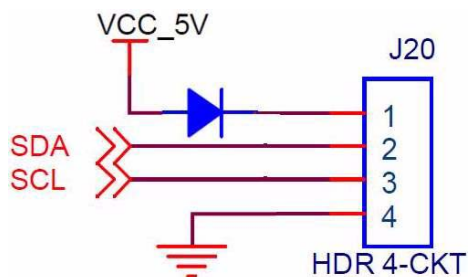


Figure 10. I²C Connector, Z51F3220 MCU Module

Table 6 identifies the I²C connector pin signals and their functions.

Table 6. I²C Connector

Signal	Pin	Direction (With Respect To The MCU)	Description
V _{CC} 5V	1	N/A	5V DC power.
SDA	2	I/O	Data.
SCL	3	I/O	Clock.
GND	4	N/A	Ground.

5V_{IN} Connector

For programming and debugging purposes, each MCU Module can be powered using a bench power supply without being attached to the MultiMotor Series Development Board. To power up the MCU Module in this manner, connect 5V DC to the 5V_{IN} connector and ground, as indicated in [Table 1](#) on page 9.

Jumper and Switch Settings

This section presents multiple settings for the MCU Modules' jumpers and switches.

V_{BUS} Control Select Jumper

Under standard conditions, the V_{BUS} Control Select jumper should be in the ON position (1-2) to force the ENABLE signal High and cause the V_{BUS} relay on the MultiMotor Series Development Board to turn ON, thereby supplying bus voltage to the MOSFETs. If the jumper is in the MCU position (2-3), the ENABLE signal will be controlled by a GPIO from the MCU, as indicated in Table 7.

Table 7. V_{BUS} Enable Jumper

Jumper Position	1-2	2-3
ON	X	
MCU		X

Table 8 shows which GPIO controls this ENABLE signal, depending on the MCU Module being used. Using this ENABLE signal from the MCU serves to meet IEC 60730 Class B compliance requirements because the bus voltage can be turned off almost immediately if an error is detected.

Table 8. V_{BUS} Enable Port

Jumper	MCU Module		
	Z16FMC	Z8FMC16100	Z51F3220
V _{BUS} Control Select	PE7	PB7	P42

UART Flash Select Jumper

Due to pin limitations on some MCUs, the UART Flash Select jumper selects between access to the UART or to SPI memory, as indicated in Table 9.

Table 9. UART Flash Select Jumper Settings

	Jumper Locations			
	1-2	3-4	5-6	7-8
UART		X		X
SPI	X		X	



Caution: If the jumpers are placed in any combination other than those indicated in Table 9, the system may not function properly.

Sensor Select Jumper

Due to pin limitations on some MCUs, the Sensor Select jumper is used to select between operating in Sensored or Sensorless modes, as indicated in Table 10.

Table 10. Sensor Select Jumper Settings

Mode	Jumper Location					
	1-2	3-4	5-6	7-8	9-10	11-12
Sensored	X	X	X			
Sensorless				X	X	X



Caution: If the jumpers are placed in any combination other than those indicated in Table 10, the system may not function properly.

Reset Switch

This switch resets the MCU.

Stop/Run Switch

This switch is used to turn the 3-phase motor ON and OFF.

Direction Switch

This switch is used to change the 3-phase motor's direction of rotation.

► **Note:** This direction of rotation is determined by viewing the motor from the shaft end, and is designated as Clockwise (forward) or Counterclockwise (reverse).

Speed Potentiometer

This switch is used to adjust the 3-phase motor's number of revolutions per minute (RPM).

Fault1 Switch

Using this switch can simulate a system fault to the MCU.

MultiMotor Series Development Board

The MultiMotor Series Development Board provides circuitry that drives the 3-phase 24V DC, 3200RPM motor included with the MultiMotor Series Development Kit, as shown in Figure 11. This Board provides fused inputs for supplying power to run the motor, and interfaces the motor to the MCU Module.

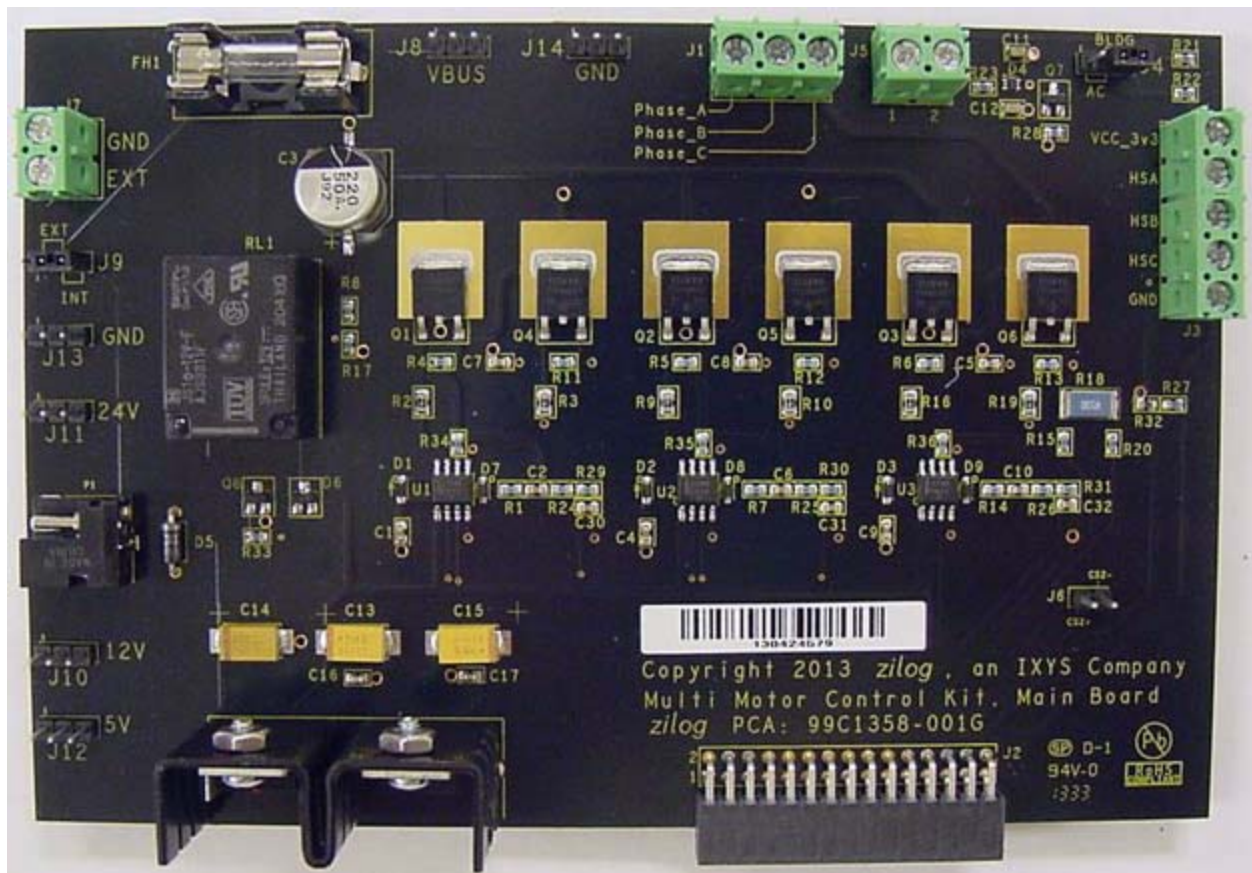


Figure 11. MultiMotor Series Development Board

MultiMotor Series Development Board Features

The features of the 3-Phase MultiMotor Series Development Board include:

- Three terminal screw connectors, one for each motor phase
- Dual power MOSFETs for each motor phase

- Electronics provided to run the motor in Sensored or Sensorless modes
- Five terminal screw connectors for the Hall sensors
- 30-pin header for connection to the MCU Module
- On-board temperature sensor
- 24 V DC, 30W universal power adapter to provide a single power supply connection (a bench-top power supply is not required for most applications)
- On-board power converters to supply proper voltages for the motor bus, gate drivers, USB, and electronics
- 2 A fuse for bus power
- Relay to enable/disable motor bus voltage
- Two terminal screw connectors for optional external bus voltage supply up to 48V
- Two terminal screw connectors for ACIM tachometer inputs for speed monitoring and control

Connectors, Headers, Jumpers, and Switches

Multiple connectors, controls, and monitoring points are included on the MultiMotor Series Development Board to allow easy monitoring and modification to fit user requirements. Table 11 lists signal names and descriptions.

Table 11. Connectors, Jumpers, and Controls on the MultiMotor Series Development Board

Signal Name	Development Board	Description
Motor Driver Connector	J1	3-phase power connections to the motor.
MCU Module Connector	J2	30-pin connector between the MCU Module and the Development Board.
Hall Sensor Connection	J3	5-terminal screw connector for motor position sensors.
Motor Select	J4	Jumper to select between BLDC and ACIM motor types.
ACIM Connection	J5	Tachometer input from an AC induction motor.
CS2	J6	Current Sense 2 connections (optional).
External Power Connector	J7	Independent external bus voltage input (<48V DC).
V _{BUS}	J8	V _{BUS} header.
External V _{BUS} Select	J9	Jumper to select bus voltage source: internal or external.
12V	J10	12V DC header.
24V	J11	24V DC header.
5V	J12	5V DC header.

Table 11. Connectors, Jumpers, and Controls on the MultiMotor Series Development Board

Signal Name	Development Board	Description
Ground	J13, J14	Ground header.
24V DC In	P1	24V DC input from AC/DC adapter.

MCU Module Connector

Connector J2 is a 30-pin header that connects I/O from the MCU Module to the MultiMotor Series Development Board. [Figure 3](#) on page 4 shows the pin layout; [Table 2](#) on page 11 identifies the signals and their functions.

Motor Phase Connector

Connector J1 is a three-terminal screw connection that allows easy joining of the motor to the MultiMotor Series Development Board. Table 12 identifies the 3-phase power connector pins and their descriptions.

Table 12. 3-Phase Power Connector

Signal	Pin	Description
Phase_A	1	Phase A motor connection.
Phase_B	2	Phase B motor connection.
Phase_C	3	Phase C motor connection.

Motor Position Sensor Connector

J3 is a 5 terminal screw connector that allows easy connection of the Hall sensors in the motor to the MultiMotor Series Development Board. Table 13 identifies the Hall sensor connector pins and their descriptions.

Table 13. Hall Sensor Connector

Signal	Pin	Description
GND	1	Ground.
HSC	2	Phase C Sensor.
HSB	3	Phase B Sensor.
HSA	4	Phase A Sensor.
V _{CC} _3v3	5	3.3V DC Supply.

Tachometer Input Connector

J5 is a two-terminal screw connector that allows easy connection of the AC induction motor tachometer to the MultiMotor Series Development Board. The interface to the MCU is a simple transistor circuit that squares off the incoming sine wave into 3.3V digital pulses.

External V_{BUS} Power Connector

J7 is a 2 terminal screw connector that allows easy connection of an external DC voltage to the motor bus for larger or different motor types that require more power than the 24 V, 30W AC/DC adapter can provide. If the Linux motor provided with this kit is being used, there is no need to use this connector, as all power is provided by the 24V DC, 30W adapter that comes with the kit and plugged into P1. Figure 12 shows the external power connector.

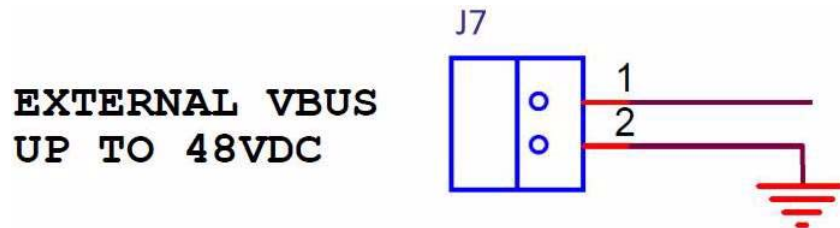


Figure 12. External Power Connector

Table 14 identifies the external V_{BUS} power connector pins and their descriptions.

Table 14. External V_{BUS} Power Connector

Signal	Pin	Description
V_{BUS}	1	24-48 Volts DC
GND	2	Ground

► **Note:** If using an external V_{BUS} power supply, 24V DC will still need to be provided to P1 or J11 in order to power the gate drivers and electronics.



Caution: Bus Voltages higher than 48V DC may damage the Board and components.



Caution: Do not use bus voltages higher than 24V DC with the Linux motor supplied with this kit.

Jumper and Switch Settings

This section describes the jumper and switch settings.

Motor Type Selection (J4)

Under standard conditions, this Motor Type Selection jumper J4 should be in the BLDC position (2-3). If you are working with an AC induction motor (ACIM), this jumper should be changed to position 1-2 to make the tachometer signal from the ACIM available to the MCU; see Table 15.

Table 15. Motor Type Jumper

Motor Type	Jumper Location	
	1-2	2-3
BLDC		X
ACIM	X	

V_{BUS} Selection: 24V (Internal) or External (J9)

Under standard conditions, the jumper should be in the 24V (Internal) position (2-3). If you are working with a motor that requires more than 24V DC bus voltage, or if the motor is rated for more than 30W, power must be supplied through J7; this jumper must be in the External position. Refer to Table 16 for details.

Table 16. V_{BUS} Selection Jumper

Jumper Position	Jumper Location	
	1-2	2-3
External	X	
24V (Internal)		X



Caution: The MultiMotor Series Development Board has been designed to be used with motors rated for current and power specifications up to 48V DC and 30W. Zilog recommends that this hardware not be used with motors that exceed these specifications.

Power MOSFETs and Gate Drivers

Each of the phase outputs on the three-terminal connector J1 are driven by a pair of power MOSFETs, one for the high side and one for the low side. A gate driver circuit is associated with each pair of power MOSFETs.

ZDSII IDE Support

The Zilog Developer Studio II (ZDSII) Integrated Development Environment (IDE) is a complete stand-alone system that provides a state-of-the-art development and debug environment. Based on the Windows[®] XP/Vista-32/Win 2000-SP4 user interfaces, ZDSII integrates a language-sensitive editor, a project manager, a C-Compiler, an assembler, linker, and librarian, and a source-level symbolic debugger that supports the Z16FMC (ZNEO) and Z8FMC16100 (Z8 Encore!) series of devices.

ZDSII can be downloaded for free from the [Zilog Store](#).

► **Note:** The Z32F128 ARM Cortex MCU development is supported with third party development tools Keil MDK, IAR, and GCC for ARM Embedded. All of Zilog's development for the Z32F128 MCU was accomplished with Keil MDK version 5.20.

The Z8051 MCU development was performed with the Keil C8051 development environment.

Linux Motor Wiring Information

The Linux 3-phase BLDC motor included with the MultiMotor Series Development Kit provides three heavy-gauge wires for phase connections and five lighter-gauge wires used to power and access internal sensors, as indicated in Table 17.

Table 17. Motor Wiring Information

Wire	Description
20 gauge white wire	Motor Phase_A connection.
20 gauge blue wire	Motor Phase_B connection.
20 gauge green wire	Motor Phase_C connection.
22 gauge red wire	Sensor Power.
22 gauge black wire	Sensor Ground.
22 gauge white wire	Sensor Signal_A connection.
22 gauge blue wire	Sensor Signal_B connection.
22 gauge green wire	Sensor Signal_C connection.

-
- **Notes:**
1. The sensor wires are slightly smaller in diameter than the motor phase wires.
 2. The Linux 45ZWN24 30W motor provided with this kit is a relatively simple, low-cost BLDC motor with Hall sensors. This motor will function with the hardware and firmware included in this kit; however, this motor may not be the best choice for all applications. If a different motor is used, the hardware and firmware may need to be optimized for that particular motor.
-

Appendix A. Schematic Diagrams

Figures 13 and 14 present schematic diagrams of the MultiMotor Series Development Board.

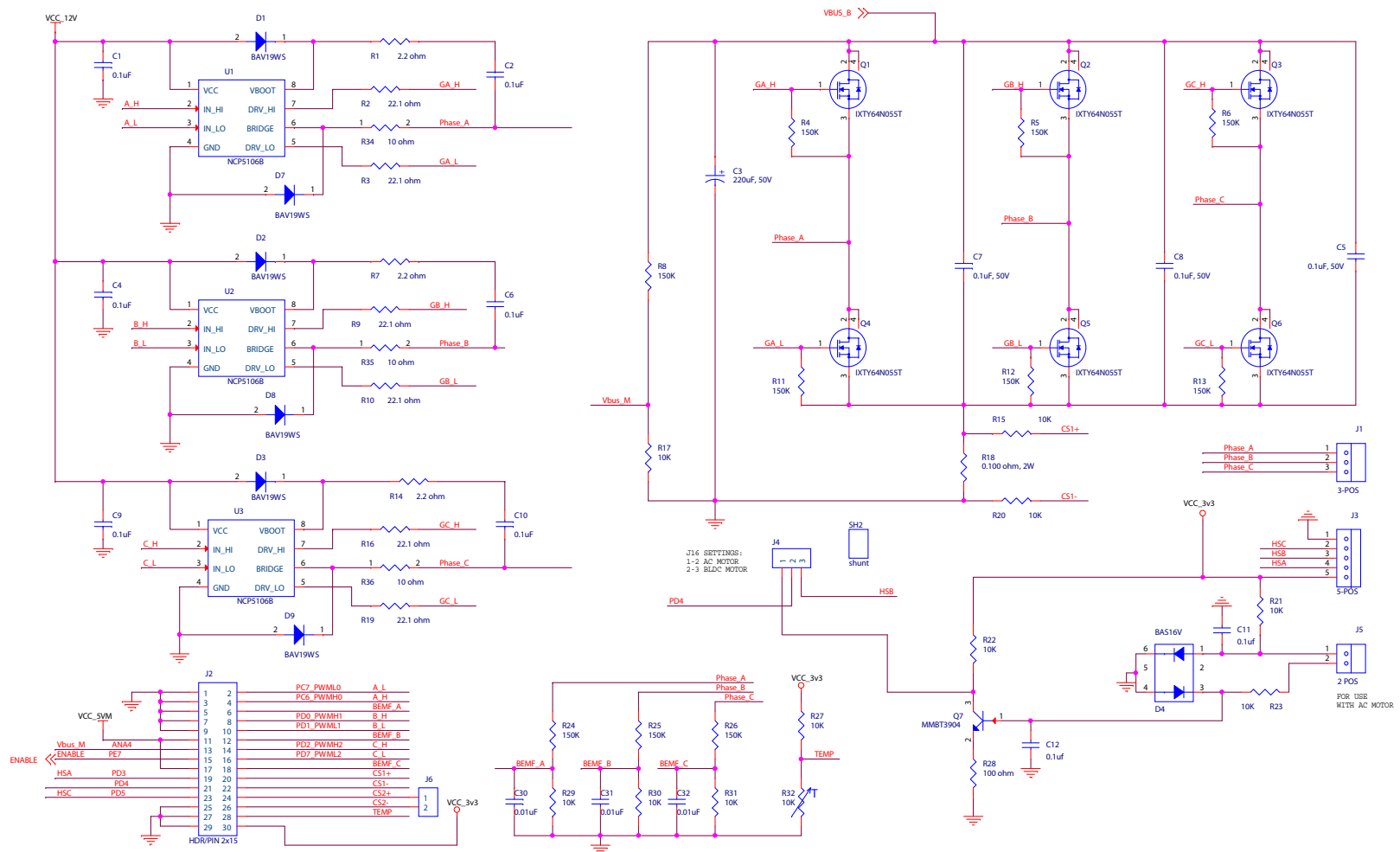


Figure 13. MultiMotor Series Development Board Schematic, #1 of 2

Figures 15 and 16 show schematic diagrams of the Z32F128 MCU Module.

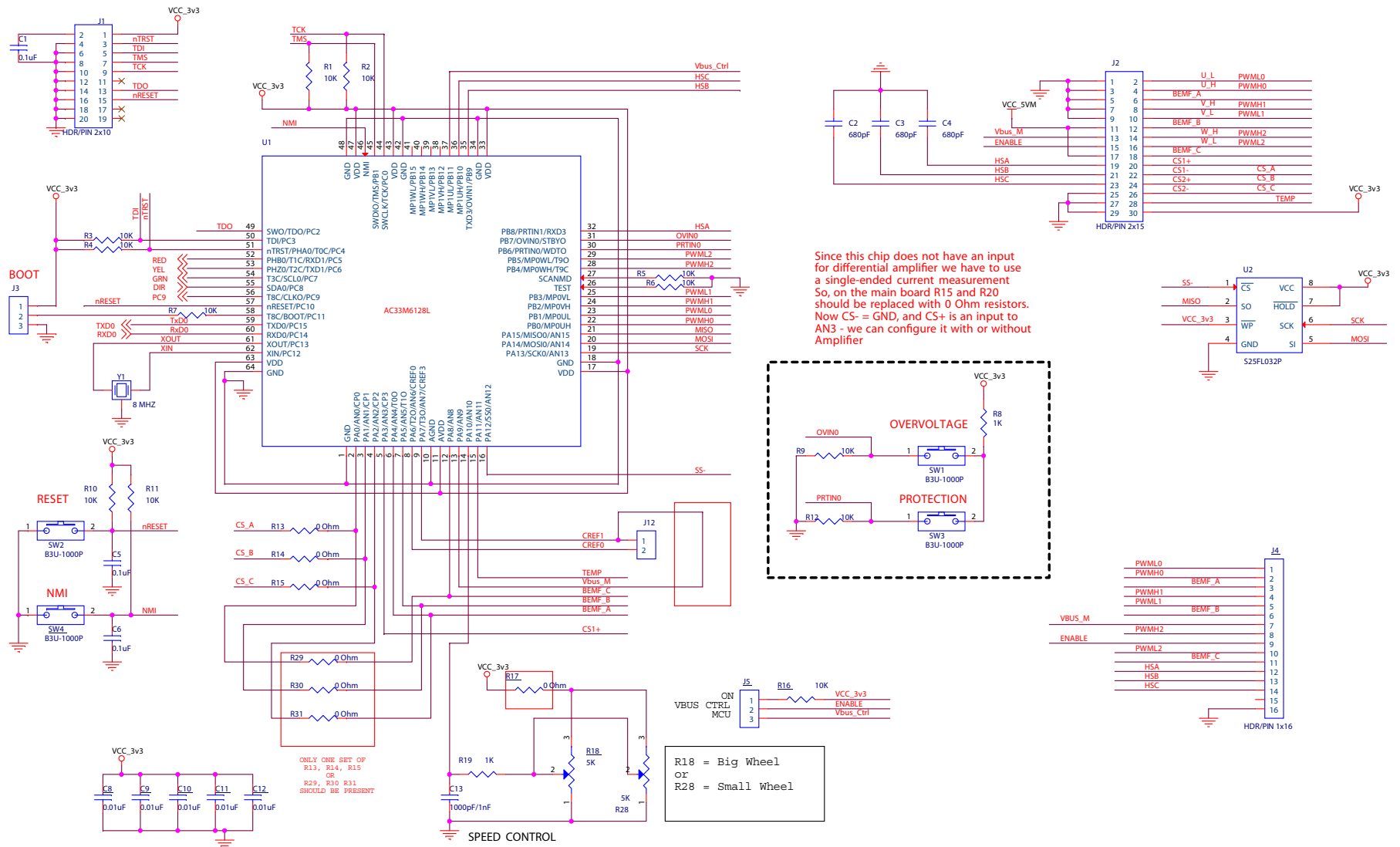


Figure 15. Z32F128 MCU Module Schematic, #1 of 2

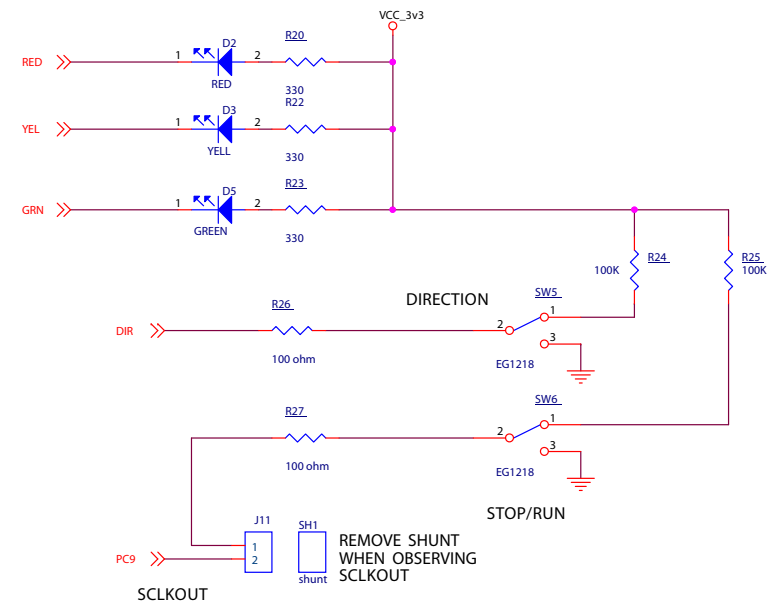
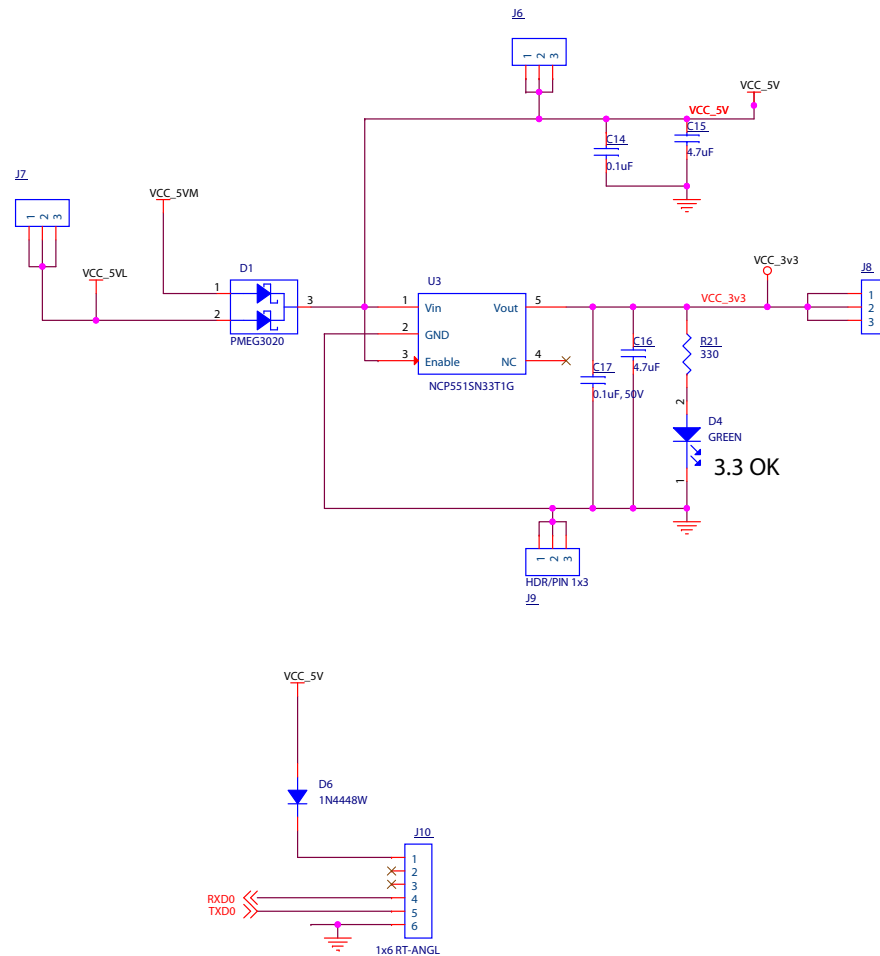


Figure 16. Z32F128 MCU Module Schematic, #2 of 2

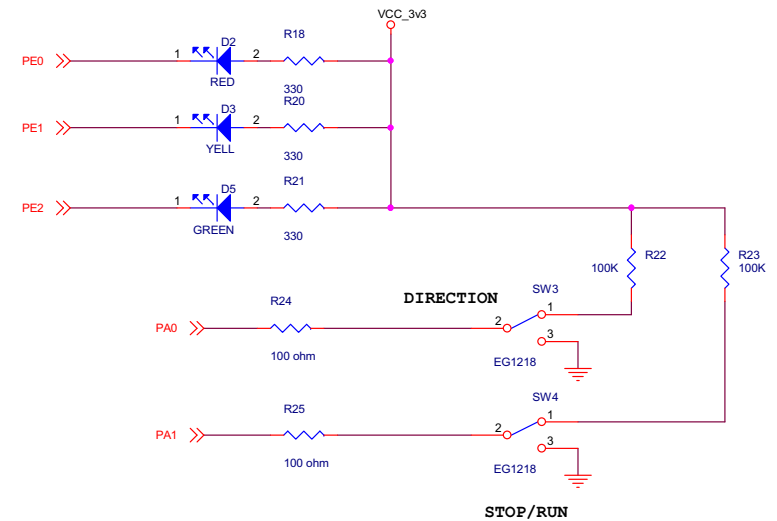
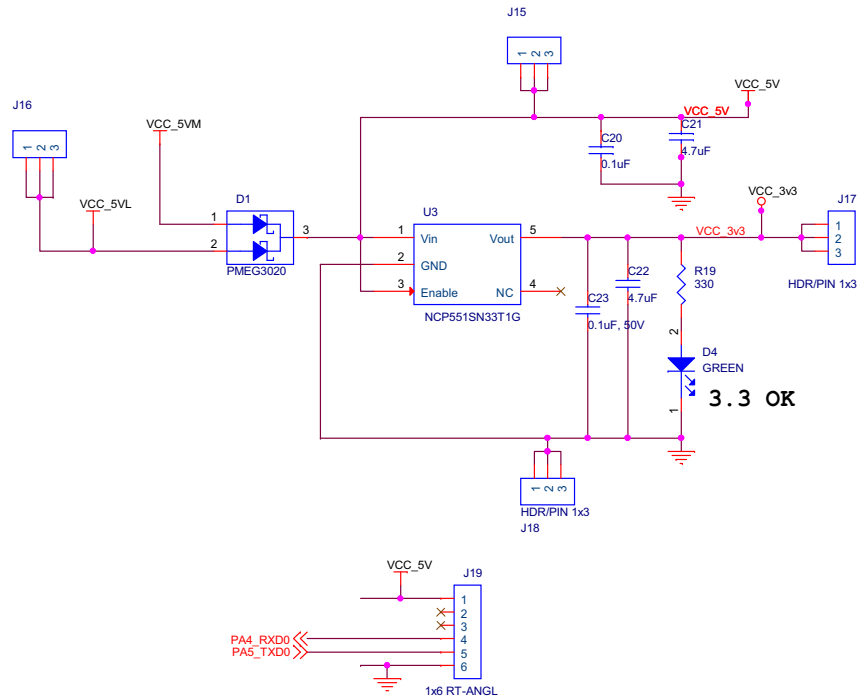


Figure 18. Z16FMC MCU Module Schematic, #2 of 2

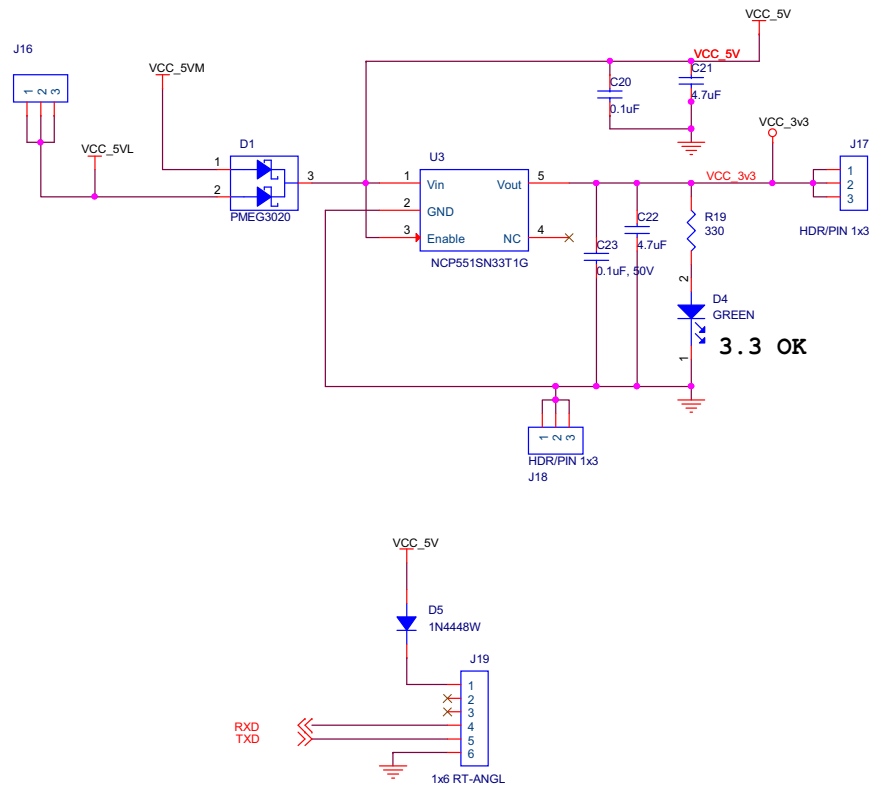
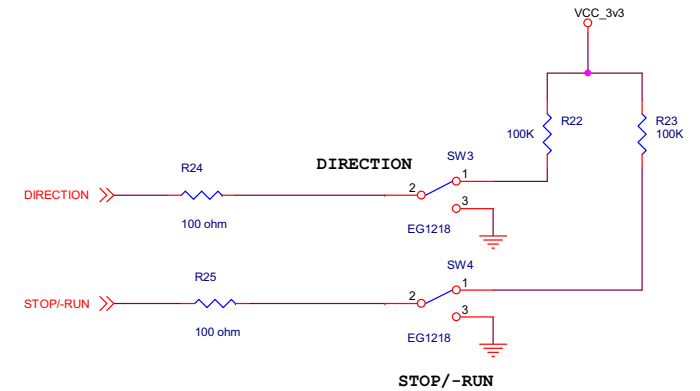


Figure 20. Z8FMC16100 MCU Module, #2 of 2



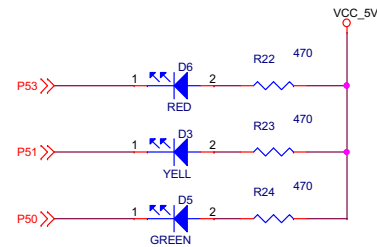
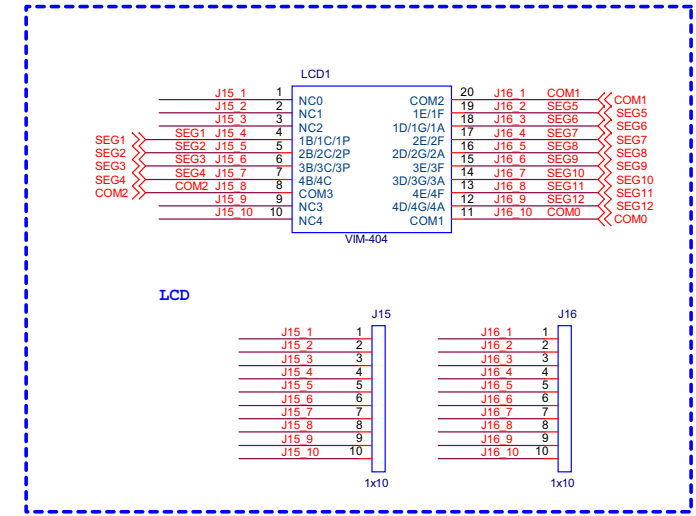
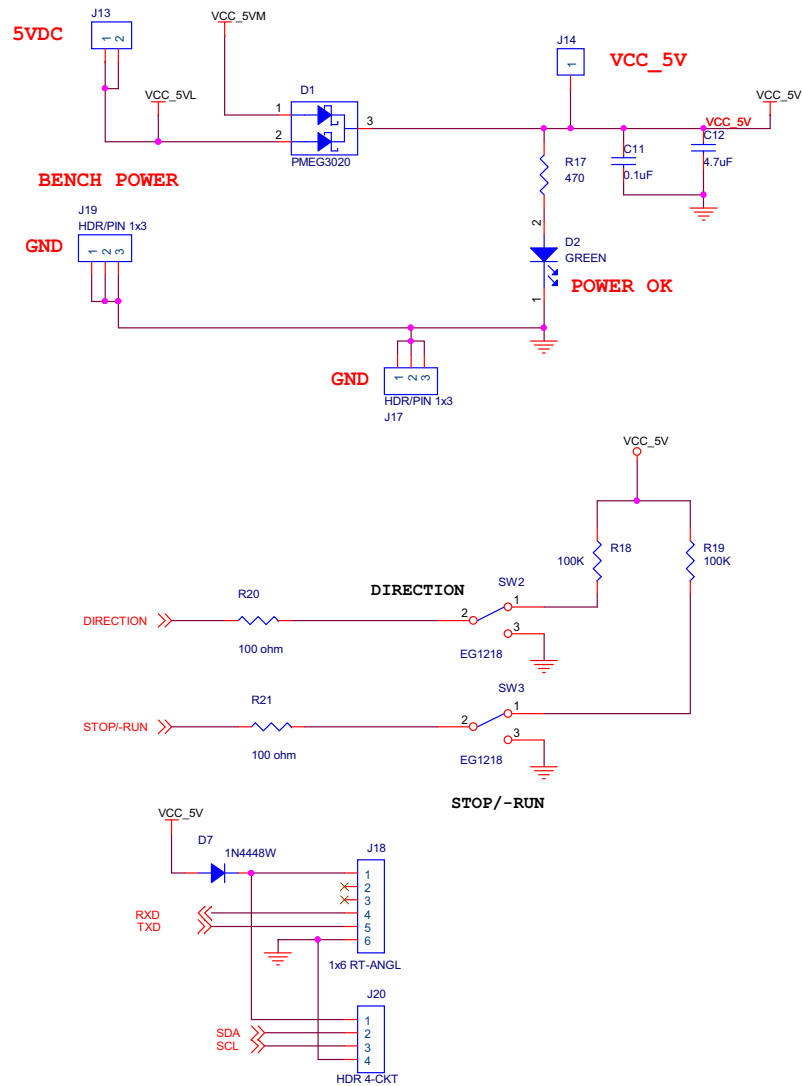


Figure 22. Z51F3220 MCU Module Schematic, #2 of 2

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