

INTRO Zumo Robot

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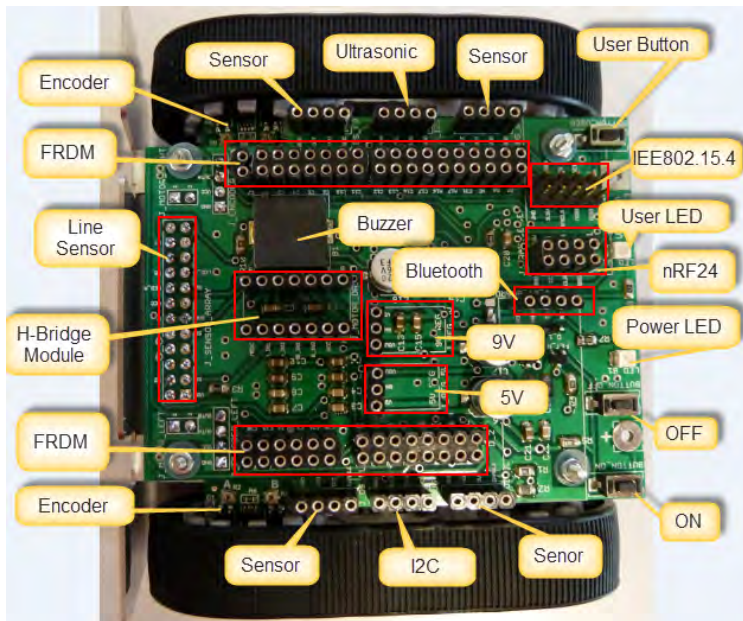
October 5, 2013

- ▶ FRDM Board and Interface
- ▶ Power
- ▶ Actuators
 - ▶ LED
 - ▶ Buzzer
 - ▶ Motors
- ▶ Sensors
 - ▶ Button
 - ▶ Ultrasonic
 - ▶ Reflectance sensor
 - ▶ User sensor
 - ▶ I²C, Accelerometer
- ▶ Communication
 - ▶ Bluetooth
 - ▶ nRF24
 - ▶ IEEE802.15.4

Schematic

- FRDM-KL25Z Header
- FRDM-KL25Z Power
- Base Board Power Supply
- Voltage Stabilization
- Power On/Off
- User Button
- User LED
- Buzzer
- Position Encoder
- Motor Driver
- Ultrasonic Sensor
- Reflectance Sensor Array
- Bluetooth
- MC1320x Transceiver
- nRF24L01+ Transceiver
- User Sensors
- I2C Connector
- Summary

Zumo Base PCB Overview

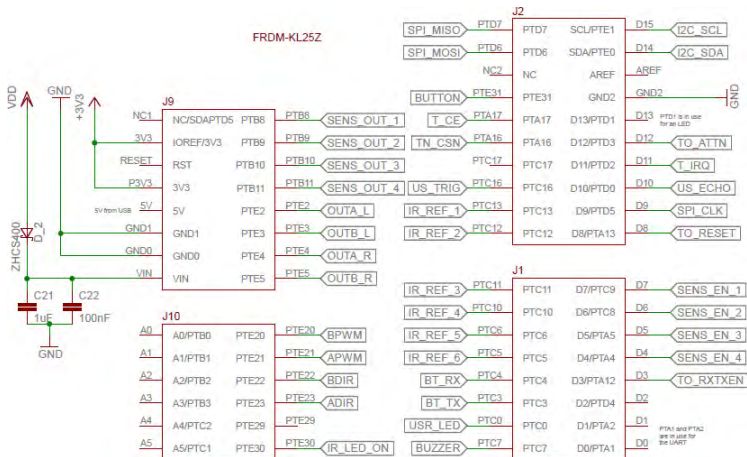


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FRDM-KL25Z Header

- ▶ Dual row headers to FRDM board
- ▶ FRDM does not provide 5V from V_IN (Battery)

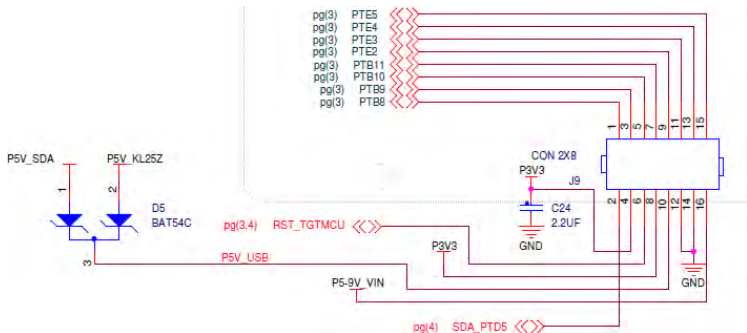


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FRDM-KL25Z Power

- ▶ 4 connectors for Arduino Shields
- ▶ Outer Row 'Arduino compatible', but 3.3V
- ▶ 5V provided to header from USB plugs
- ▶ P5-9V_IN: coming from Shield



Schematic

FRDM-KL25Z Header

FRDM-KL25Z Power

Base Board Power Supply

Voltage Stabilization

Power On/Off

User Button

User LED

Buzzer

Position Encoder

Motor Driver

Ultrasonic Sensor

Reflectance Sensor Array

Bluetooth

MC1320x Transceiver

nRF24L01+ Transceiver

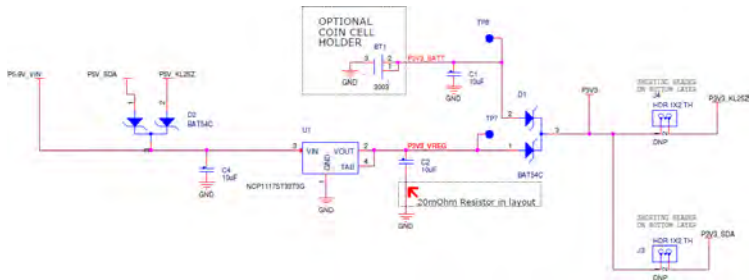
User Sensors

I2C Connector

Summary

FRDM-KL25Z Power

- ▶ 3.3V for K20 and KL25Z
- ▶ No 5V provided to Arduino header
- ▶ 5V generated on Zumo Base Board (5V DC-DC converter)

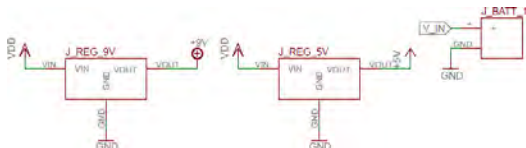


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Base Board Power Supply

- ▶ V_IN: 4 AA Batteries (4.8V - 6V)
- ▶ FRDM with V_IN to 3.3V DC/DC converter
- ▶ Two DC/DC Converters
 - ▶ 9V: Motors and reflectance array
 - ▶ 5V: Ultrasonic, Bluetooth

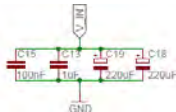
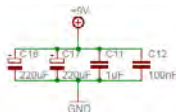
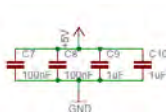
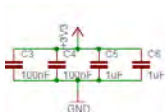


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Voltage Stabilization

- Required for voltage stabilization (Motors!)



Schematic

FRDM-KL25Z Header

FRDM-KL25Z Power

Base Board Power Supply

Voltage Stabilization

Power On/Off

User Button

User LED

Buzzer

Position Encoder

Motor Driver

Ultrasonic Sensor

Reflectance Sensor Array

Bluetooth

MC1320x Transceiver

nRF24L01+ Transceiver

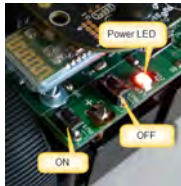
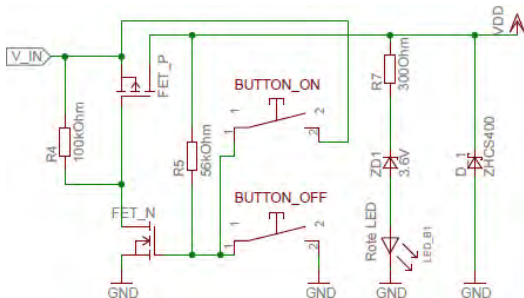
User Sensors

I2C Connector

Summary

Power On/Off

- ▶ Two buttons (On and Off)
- ▶ Press for about 1 second
- ▶ Shortcut protection

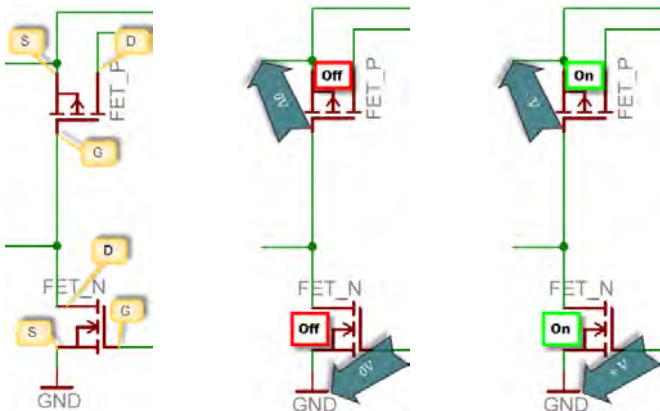


Schematic

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 Summary

Power On/Off: FET_P and FET_N

- ▶ Dotted line FET symbol: normally OFF 'enhanced' FET's
- ▶ Arrow side: Source. Other: Drain. Middle: Gate
- ▶ 0V Gate-Source Voltage: Transistor OFF
- ▶ **P-Type**: ON for a **negative** Gate-Source Voltage
- ▶ **N-Type**: ON for a **positive** Gate-Source Voltage



Schematic

FRDM-KL25Z Header

FRDM-KL25Z Power

Base Board Power Supply

Voltage Stabilization

Power On/Off

User Button

User LED

Buzzer

Position Encoder

Motor Driver

Ultrasonic Sensor

Reflectance Sensor Array

Bluetooth

MC1320x Transceiver

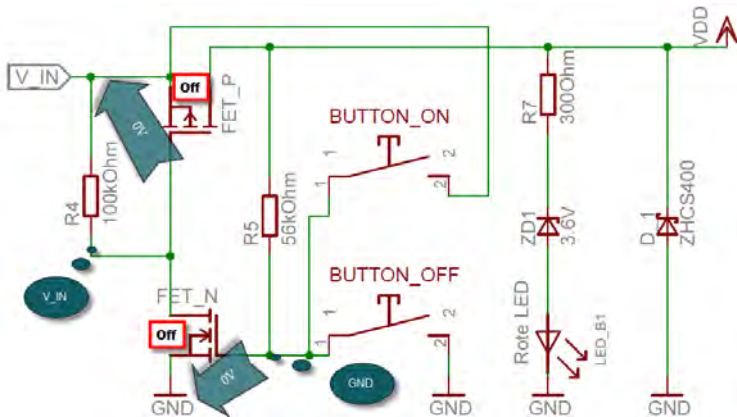
nRF24L01+ Transceiver

User Sensors

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Summary

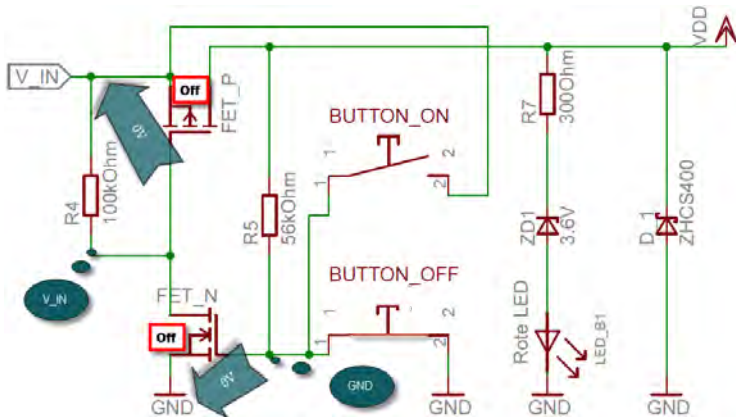
Power On/Off: Both Switch OFF



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Power On/Off: Turning OFF

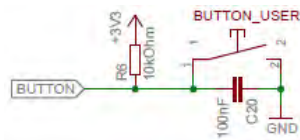


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User Button

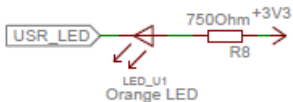
- ▶ Pull-up resistor
- ▶ Debouncing capacitor



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- ▶ Cathode on microcontroller pin

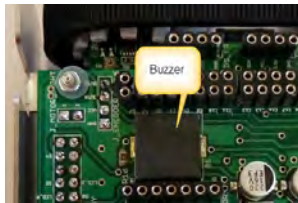
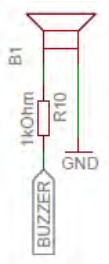


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Buzzer

- ▶ Requires PWM signal
- ▶ Resistor to reduce sound level

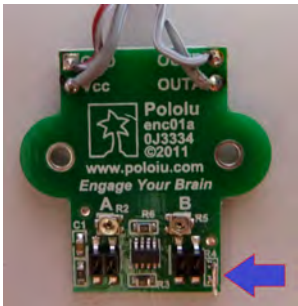
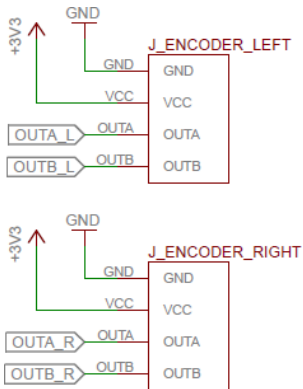


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Position Encoder

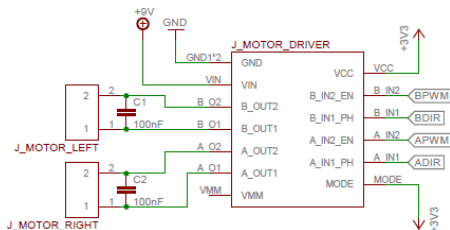
- ▶ Pololu encoder requires modification for 3.3V operation
- ▶ Sensor modification and recalibration: [Adding Quadrature Encoder to the Zumo Chassis](#)



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- ▶ Pololu Dual Motor Driver Module
- ▶ Two ceramic capacitors for electrical noise reduction
- ▶ 9V from DC/DC converter
- ▶ Easy: PWM and DIR

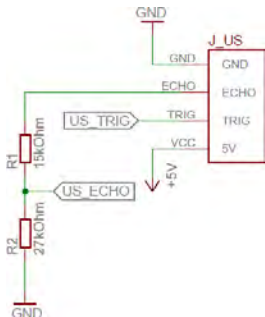


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Ultrasonic Sensor

- ▶ HC-SR04 ultrasonic sensor module
- ▶ 5V supply voltage
- ▶ Voltage divider for echo 3.3V signal
- ▶ Usage: [Tutorial: Ultrasonic Ranging with the Freedom Board](#)

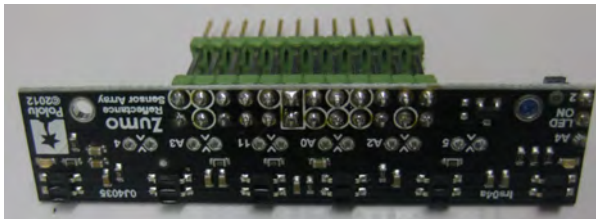
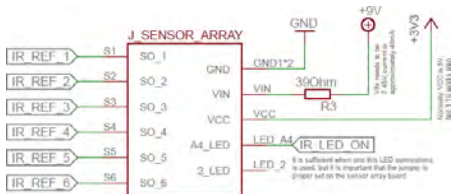


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Reflectance Sensor Array

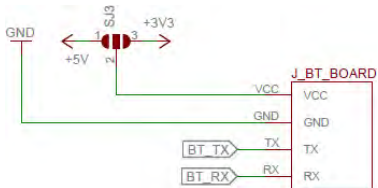
- ▶ Pololu module requires 7.45V
- ▶ IR LED on/off
- ▶ 6 digital outputs



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- ▶ Default: 5V supply voltage
- ▶ Serial-to-Bluetooth bridge
- ▶ TX: data from the transceiver to microcontroller
- ▶ RX: data from the microcontroller to transceiver
- ▶ Usage: [Using the HC-06 Bluetooth Module](#)

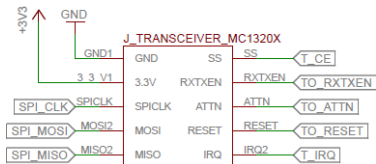


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MC1320x Transceiver

- ▶ SMAC (Simple MAC) and IEEE802.15.4/ZigBee transceiver
- ▶ SPI (CE, MISO, MOSI, CLK)
- ▶ RESET, IRQ, ATTN, RXTXEN
- ▶ Usage: **SMAC with Processor Expert**

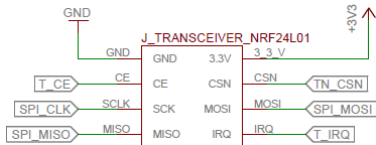


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nRF24L01+ Transceiver

- ▶ Proprietary 2.4 GHz, optional
- ▶ SPI (CSN, MISO, MOSI, SCK)
- ▶ CE (TX/RX selection) and IRQ
- ▶ Usage: [Tutorial: Ultra Low Cost 2.4 GHz Wireless Transceiver with the FRDM Board](#)

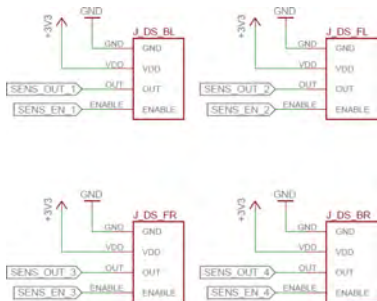


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User Sensors

- ▶ 4 connectors for digital sensors
- ▶ 3.3V, OUT,
- ▶ optional ENABLE



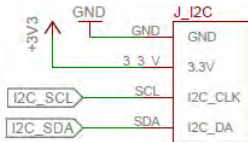
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I2C Connector

- ▶ Optional
- ▶ Connector for I²C sensor(s)
- ▶ 3.3V supply voltage
- ▶ E.g. Pololu IMU ([Pololu #1269](#))

The pull up resistors
needs to be mounted
on the external PCB

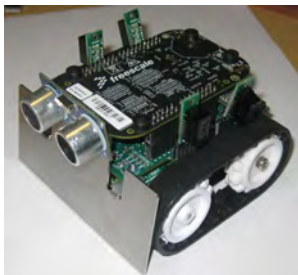


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Summary

- ▶ 3.3V, 5V, 9V
- ▶ How on/off circuit works
- ▶ Sensors for obstacle detection and line following
- ▶ Motors with position encoders
- ▶ Wireless communication



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