

The main electronics board plugs into a [MSP430 FR5969 Launchpad Kit](#) and is responsible for the following:

- Switching of an external [Crydom 100A Solid State Relay](#) to enable and disable main power to the robot when buttons on the board or an external switch is pressed
- Switching of an external [IXTN660N04T4](#) N-Channel MOSFET by driving its gate to 10V to enable and disable thrusters when a killswitch is thrown
- Providing a stable 5V rail for fans and other 5V components
- I2C communication with external devices
- UART communications through the Launchpad MicroUSB port

Schematic Descriptions

MainBoard.SchDoc

The top-level schematic contains mainly subsheets, connections between them, and headers to interface with external components. The connections are as follows:

- P11 – connection to MOSFET for thruster kill switching
- P12 – I2C header for connection to as-of-yet undefined I2C devices
- P13 – Killswitch plugs in here, when the switch is closed it delivers Vcc to the thruster control circuit, and is otherwise pulled down to ground
- P14 – 5V bank for fans and other components that need 5V
- P15 – Relay coil input – The negative side of the solid state relay input plugs in here
- P16 – Power input

Microcontroller.SchDoc

The microcontroller, an MSP430FR5969 on a Launchpad kit has two rows of headers that plug into the MEB. The MEB supplies 3.3V power and ground to its power pins, and the MSP430 has the following functions:

- P4.2 – Analog sense input for monitoring battery voltage and performing low voltage cutoff
- P4.3 – Digital killswitch input to determine whether the robot is armed or killed
- P1.3 – Digital output to keep the robot enabled – a logic high will keep the robot on and logic low will immediately turn the robot off
- P1.6 and P1.7 – SCL and SDA for I2C input

Power Control.SchDoc

This connects to our solid-state relay to control whether the robot is on or off. When there is a path to ground from SSR_IN, current is flowing through the relay input, which means that current can flow through the relay output, turning the robot on. When the SW31 button is pressed, the robot turns on. As soon as the microcontroller turns on, it sets P1.3 high, which is connected to ENABLE, which drives

the gate of the Q31 N-Channel MOSFET. When Q31 is on, current can flow through it to ground, keeping the robot on. When SW32 is pressed, it pulls the gate of Q31 directly to ground, turning off the robot. SW31 is a header for an external killswitch that are paralleled to the buttons.

PowerConditioning.SchDoc

This schematic provides reverse polarity protection to the board through a [P-FET reverse polarity protection circuit](#) and voltage regulation for Vcc down to 5V and 5V down to 3.3V. The 5V line schematic will be added.

ThrusterControl.SchDoc

The thruster control circuit drives the gate of an external [IXTN660N04T4](#) MOSFET placed in a low-side switching configuration for enabling and disabling thrusters. When Vgs is 10V, the MOSFET is enabled and current can flow through the MOSFET, turning on the thrusters. To do this, it takes input from the killswitch, shifts it down to 3.3V logic levels using a voltage divider, and uses that to drive the input of a [TC1411NEOA](#) gate driver, which converts the logic level signal to the input voltage. The input voltage is driven by a 10V low dropout regulator, since raw battery voltage to the gate of the MOSFET would damage it.