Robert Havener – Cape Ann Radio Controlled Model Club - MOSFET switch for LiPo batteries

How do you connect your big, scary, freshly charged LiPo battery to your model? Do you lean over the prop and push the connectors together. Do you cringe when the connector sparks and sticks while making the connection? Have you ever had a surprise when the model powers up?

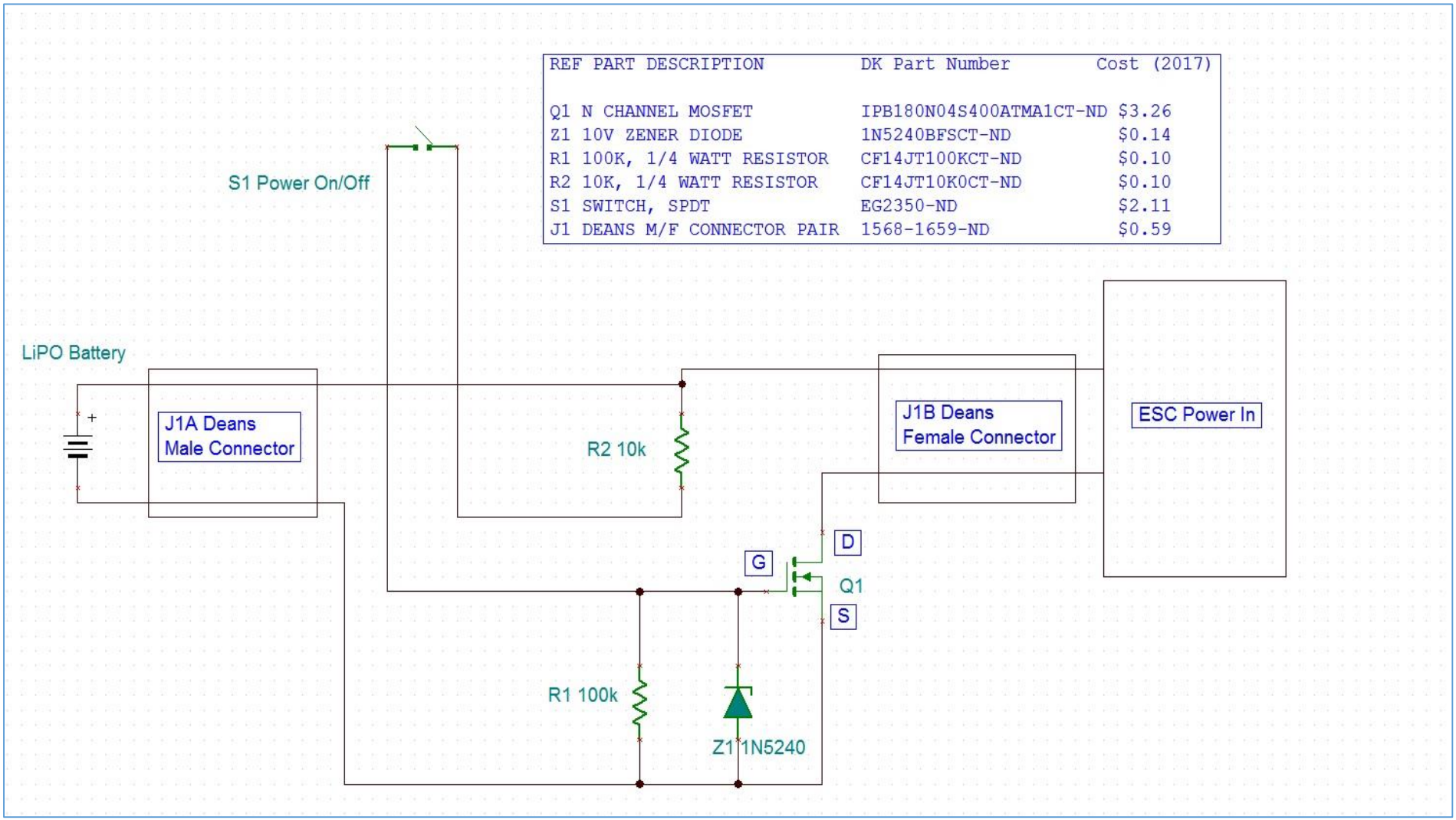
Here's a circuit for a MOSFET on/off switch. It is currently installed in an electric plane with 6s 5000ma/hr LiPo batteries. When the switch is off, the circuit effectively disconnects the LiPo battery from the ESC (Electronic Speed Control) and any other electrical devices in the model. The design uses a modern MOSFET semiconductor device that has an off resistance of 40,000,000 ohms. When you are ready to go, a small switch (accessible from the outside of the model) activates the MOSFET and connects the battery to the ESC with an on resistance of 0.00098 ohms. The MOSFET is rated for 40 volts, with a peak current rating of 180 Amps. The assembly is designed to handle a continuous current of 50 amps. The circuit is designed for LiPo packs from 2s – 8s. No more sparks when the battery is connected! You can wait to safely power up when the model is completely assembled and ready to go. No need to unplug the battery if you're going to use it again before recharging, just switch to the off position.

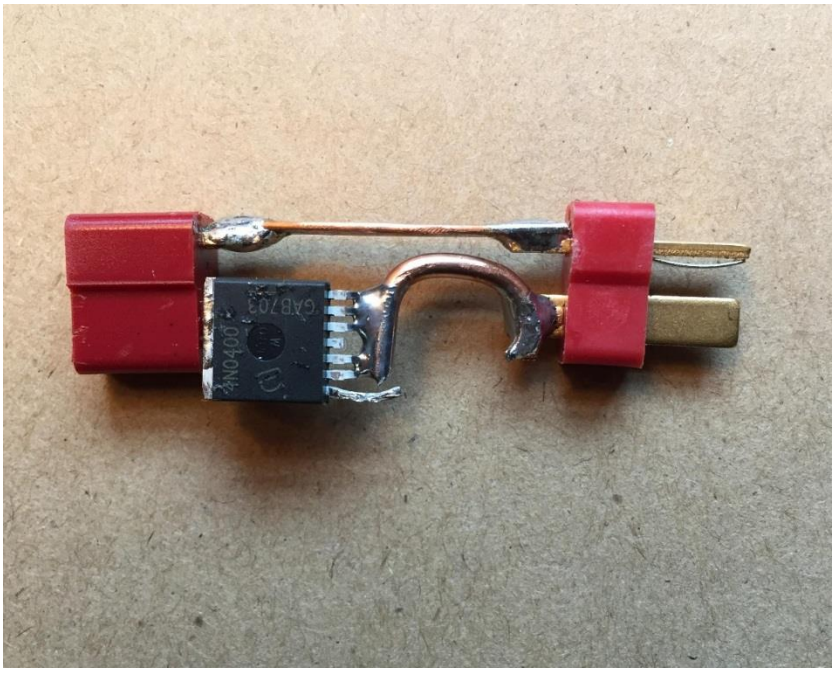
The sparks that occur if you plug your battery directly to the ESC are not a trivial matter. The electrical contacts of the plugs must be very clean to carry the high currents required for today's performance electric airplanes. The pitting and scorching of the connector pins will make for poor contact. Look up LiPos in Wikipedia and you'll find "The high discharge currents do damage the switch contacts due to arcing (causing the contacts to oxidize and often deposit carbon), so it is advised to either use a solid-state MOSFET switch or clean the trigger contacts regularly."

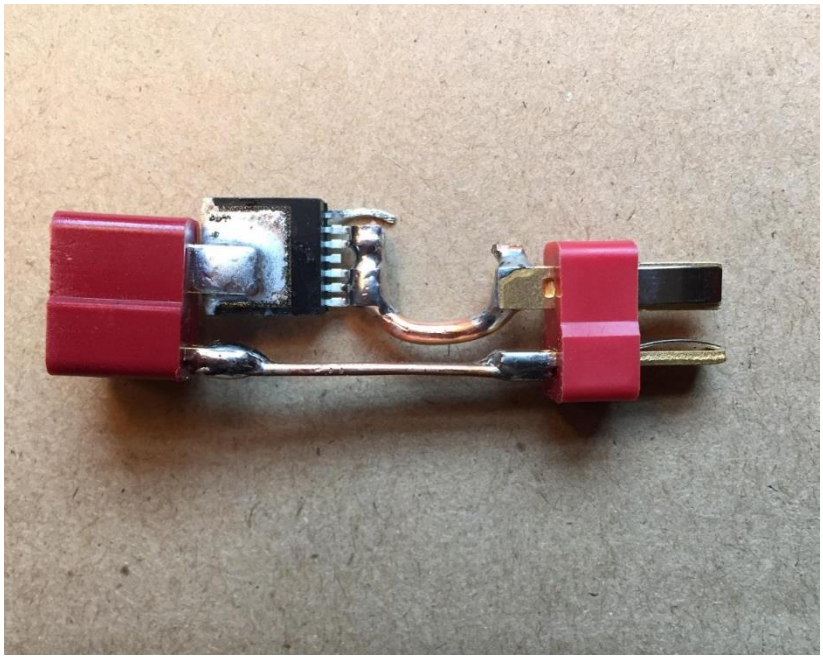
The circuit works as follows: when the external switch is open, R1 will bring the MOSFET (Q1) gate voltage (Vgs) to zero and the MOSFET will disconnect the negative lead of the battery. The model cannot take any energy from the battery when the negative lead is open. When the external switch is closed, R2 will provide positive voltage to the gate (Vgs limited to +10V by Zener diode Z1) and the MOSFET will turn on, connecting the battery negative lead to the model with a resistance of less than 0.001 Ohms.

The circuit schematic contains a component listing, Digi-Key part numbers, and the component costs (for a quantity of 1, 2017 pricing). You can find data sheets and pinout information from the Digi-Key site. If you want to tackle the job of building one of these devices you should have a fair bit of electronic knowledge and very good soldering skills. The circuit connects directly to the power leads from the battery and we don't want any mistakes. Never work on the circuit while it is connected to the battery!

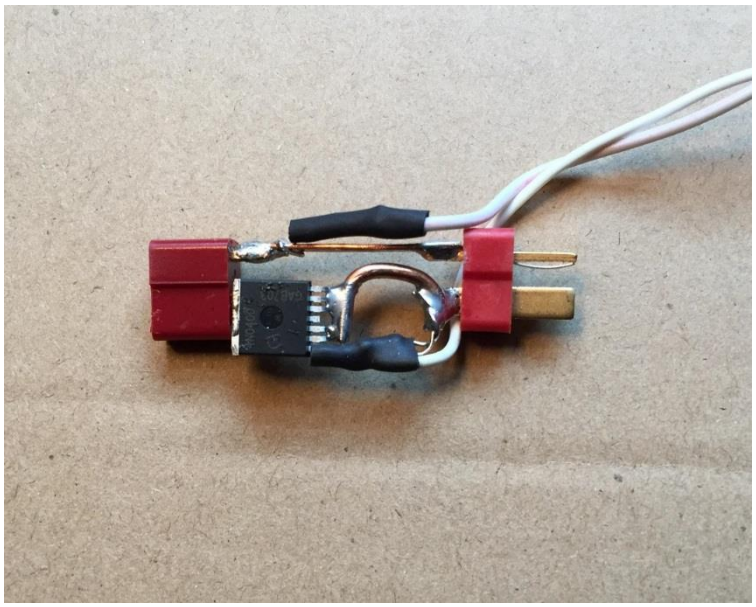
REF	PART DESCRIPTION	DK Part Number	Cost (2017)
Q1	N CHANNEL MOSFET	IPB180N04S400ATMA1CT-ND	$3.26
Z1	10V ZENER DIODE	1N5240BFSCT-ND	$0.14
R1	100K, 1/4 WATT RESISTOR	CF14JT100KCT-ND	$0.10
R2	10K, 1/4 WATT RESISTOR	CF14JT10K0CT-ND	$0.10
S1	SWITCH, SPDT	EG2350-ND	$2.11
J1	DEANS M/F CONNECTOR PAIR	1568-1659-ND	$0.59



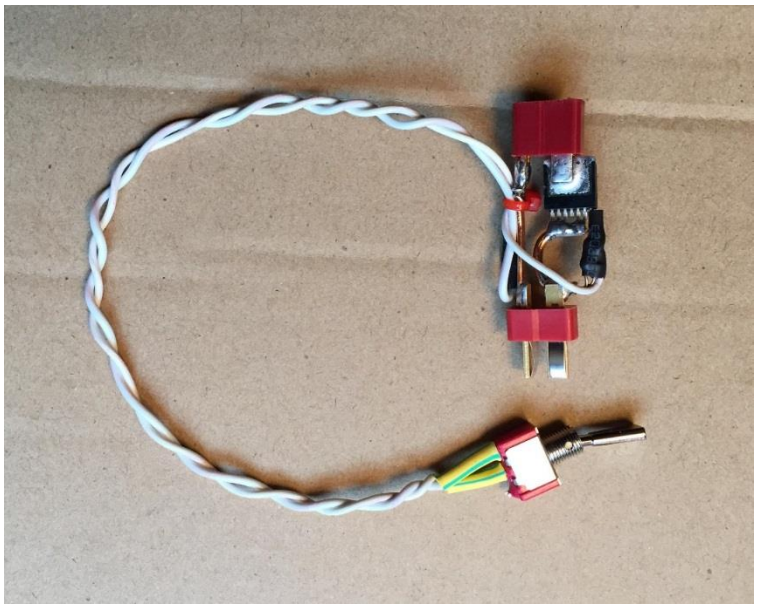




The power handling components. Top view and bottom view. The #12 awg copper conductors are stripped from 20A household wiring. Some of the conductors have been hammered into flat ribbons to better fit the connector terminals. You can see the gate terminal lifted up from the MOSFET.



All internal components have been added.



Insulation and a strain relief tie have been added.

Ready for installation.

Tiny switch, big improvement in safety and performance! Mount the switch so that the model powers up when the switch is UP. Always have the switch OFF when installing a new battery.