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NVE Components for Safe and Efficient Power Control

Line-voltage based hot dog cookers show how NVE components can be used for applications such as power conversion, battery charging, and motor control. Hot dogs let us see and hear power transfer.

We start with a bare hot dog directly connected to line voltage, and step-by-step add safety and cooking enhancements.

Here is a playlist with the six demonstrations:



1 Uncontrolled

We show an uncontrolled, inherently dangerous hot dog connected directly to line voltage.

2 Isolated FET control

A controlled version uses DC to power the hot dog via a silicon carbide FET. We use an isolated FET driver and an isolated DC-to-DC converter to generate the gate-drive voltage. These circuits are extensible to H-bridges. We added an electrical box for the hot dog.

3 Rectified AC

We eliminated the filter capacitor and used rectified AC. This prevented startup surges and improved safety.

4 Temperature sensing

Next, we added a temperature sensor to ensure the hot dog is cooked to a safe temperature. We used an isolator between the SPI Smart Sensor and the controller because the sensor is in contact with the hot dog and therefore in contact with high voltage. The isolator also functions as a level shifter between the 3.3-volt sensor and a five-volt Arduino. The sensor allowed us to cook to the USDA-recommended 140 °F.

5 Current sensing

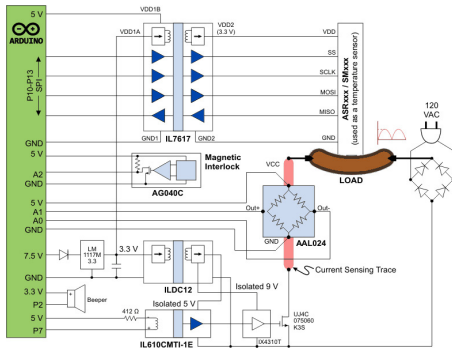
A noncontact current sensor provides overcurrent detection for improved safety. These sensors are high speed and inherently isolated. The sensor also allowed a cooking algorithm based on total applied energy, so we cooked hot dogs to a perfect 7 kilojoules.

6 Interlock switch

Finally, we add a GMR Switch and a magnet on the cover to form an interlock, allowing power to be removed when the cover is open. GMR Switches are ideal for this type of proximity sensing.

Schematic

The complete hot dog cooker schematic is here:



[\[click to enlarge\]](#)

Parts List

- [IL610CMTI-1E](#) isolator for FET drive
- [ILDC12VE](#) DC-to-DC converter for gate drive
- [AAL024-10E](#) noncontact current sensor
- [SM225-10E](#) SPI smart sensor for temperature sensing
- [IL7617VE](#) SPI isolator with integrated DC-to-DC converter
- [AG040C](#) magnetic interlock sensor board

[Typical Arduino Code »](#)

(available on our GitHub repository)

[Email us for more information »](#)

(our engineers “relish” opportunities to “ketchup” on your applications and help “cook up” circuits that “meat” your requirements).

Disclaimer: Although we add isolation and other safety features in these demonstrations, cooking hot dogs with line voltage is inherently dangerous—do it at your own risk.