

MNEAA

**EV Basic Sensors and
Solid State Switches**

Dale Berndt

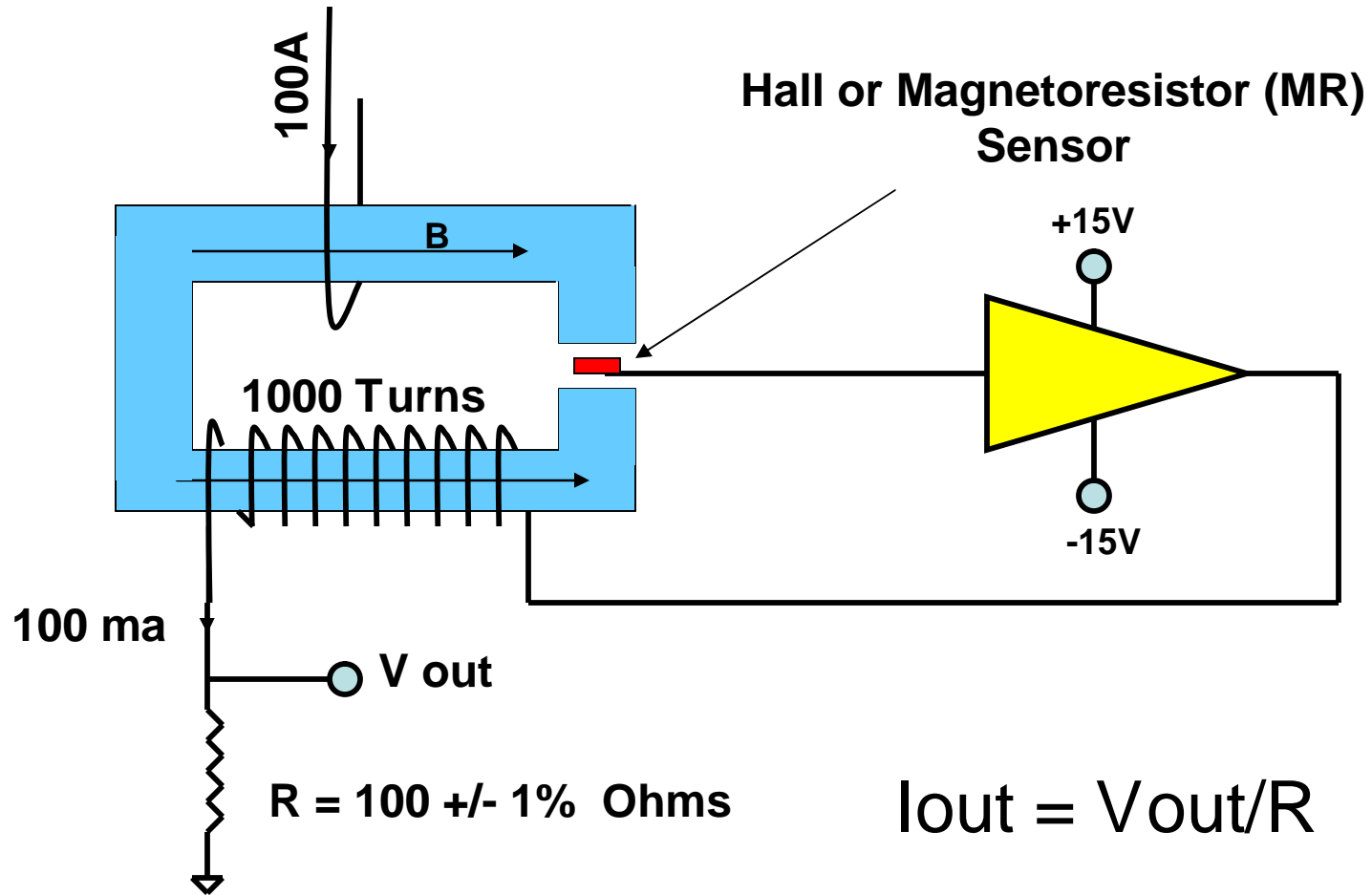
Basic Electrical Building Blocks

- **Current Sensor**
 - **Current Shunts vs. Magnetic or Hall Closed Loop**
- **Temperature Sensor**
 - **Thermistors vs. Constant Current (Band Gap)**
- **Solid State Switches**
 - **Isolated AC switches**
 - **Isolated DC switches**
 - » **Mono or bidirectional**
 - » **Slow or Fast**

Comparison of Current Sensors

	Current Shunts	Magnetic Current Sensors
Isolation	No	Yes
Power Dissipation	High	Low
Location	Usually in the return path	Anywhere in the circuit
Zero Offset	Lower	Low
Cost	100A (60mV) \$37 200A (60mV) \$49 500A (60mV) \$70	HON CL +/-56A \$20.67 LEM CL +/-100A \$30.75 Tamura OL +/- 600A \$17.75 F. W. Bell OL+/-1,000A \$54.77 HON CL +/- 1,275 A \$111.20

Closed Loop Magnetic Current Sensors Rebalance Circuit



Current Sensor References

- Honeywell Current Sensors Line Guide
- http://sensing.honeywell.com/index.cfm?Ne=2308&ci_id=154317&N=3027&la_id=1
- Click On: Download complete line guide.
- Digikey: Honeywell Magnetoresistive (MR) Closed Loop Current Sensor +/-56A
- http://search.digikey.com/scripts/DkSearch/dksus.dll?lang=en&site=US&WT.z_header=search_go&lang=en&site=us&keywords=csnx25
- Mouser: CSNA111 +/- 70A
- <http://www.mouser.com/ProductDetail/Honeywell/CSNA111/?qs=NdpYyUm6Jo7CTUGyo9cYHQ%3D%3D>
- Digikey: LEM USA Inc. Closed Loop Current Sensor +/-100A
- http://search.digikey.com/scripts/DkSearch/dksus.dll?WT.z_header=search_go&lang=en&site=us&keywords=398-1011-ND

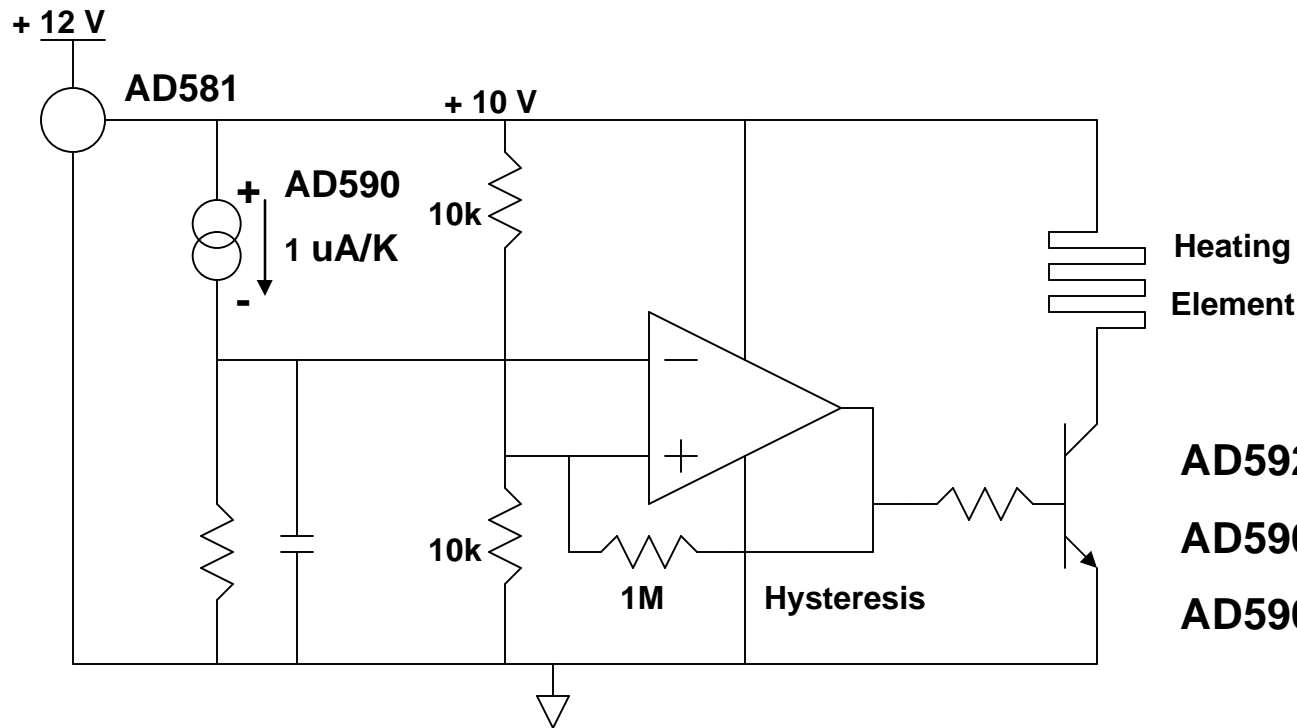
Touch Screen Display

- **Currents**
 - **Motor Current vs. Time, Used to optimizing your gear shifting.**
 - **Regeneration Current, negative Motor Current**
 - **Control Current**
 - **Battery Stack Charging Current**
 - **Car 12V Battery Charging Current**
 - **Individual 3.2V Cell Charging Current**
 - **Battery Box Heater Current**
 - **Car Interior Heater Current**
 - **Vacuum Brake Pump Current**
 - **BMS Current**
 - **A/C Current**
- **Temperatures and Voltages**
 - **Monitor Temperatures and Voltages of above devices**
- **Parameters**
 - **Select Input Charging Current 0A to 50A**
 - **Stored Energy Available, Wh**
 - **Wh/mile**
 - **Motor RPM**
 - **Speed**
 - **GPS**

Temperature Sensors

Use Bandgap based Temperature Sensors rather than Thermistors

2-Terminal IC gives 1uA/Degree Kelvin



AD592 plastic \$4.82

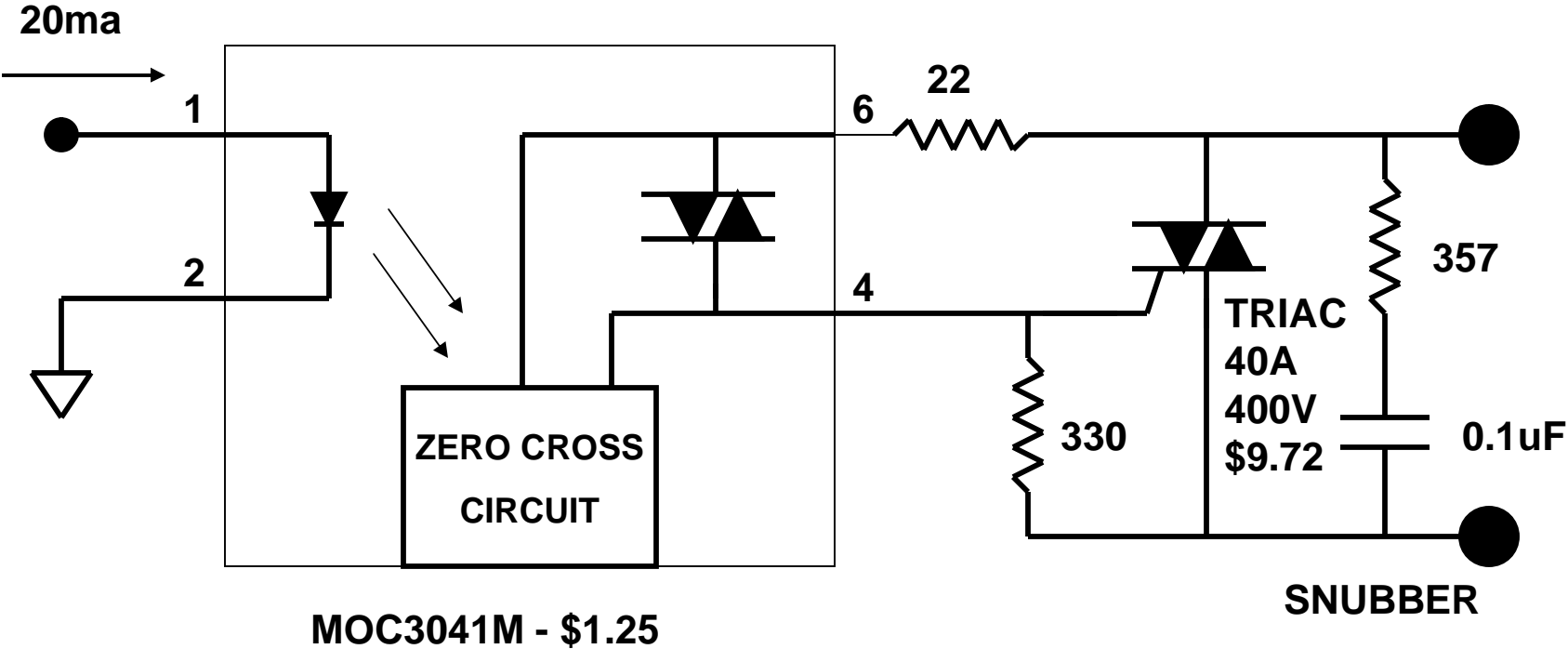
AD590 metal can \$7.98

AD590 flat pack \$16.19

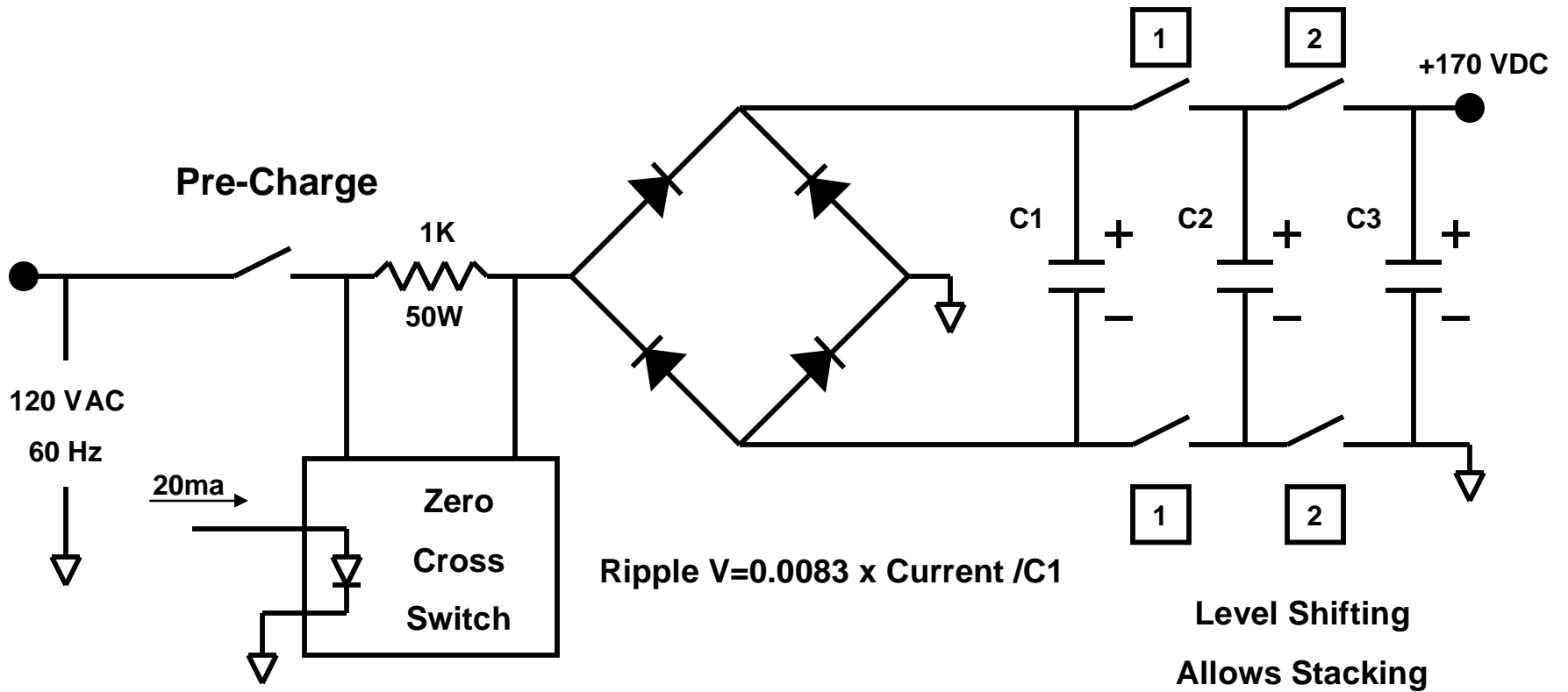
$$K = 273.2 + C$$

$$\text{At } 25\text{ C } K = 298.2 \quad V = 298.2\mu\text{A} \times 10\text{k} = 2.982\text{ Volts}$$

OPTO-COUPLED AC HIGH VOLTAGE SWITCH



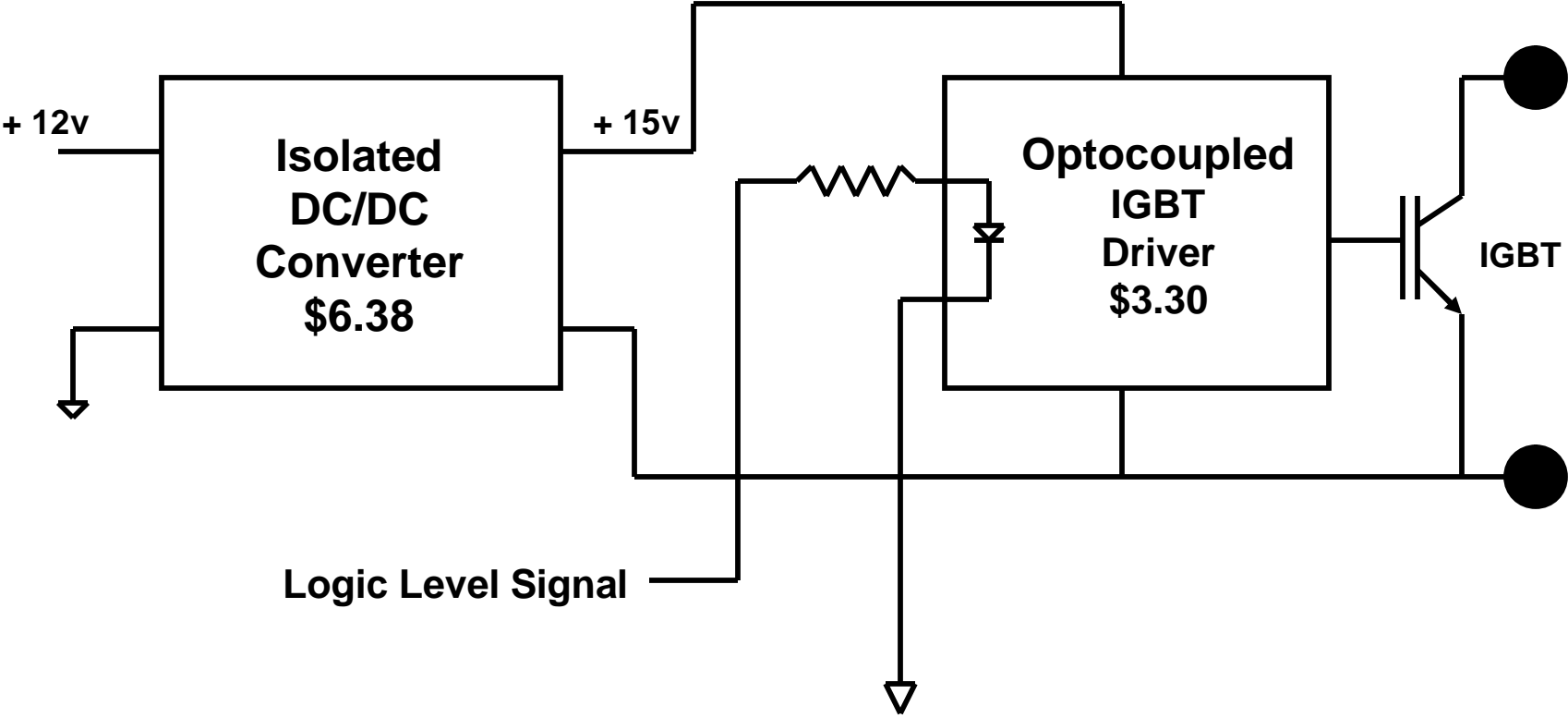
Low Cost Charging Circuit



Switches 1 and 2 use non-overlapping control.

Capacitors C2 and C3 can be 10 times smaller than C1
because switches 1 and 2 can run at 600 Hz.

Isolated High Voltage and High Speed DC Switch Monopolar



Plugless EV No Plugs Required

Energy is Transferred to Vehicle Magnetically
at 60 Hz to 1000 Hz

