Senior Design – Design Document

DEC14-10

Honeywell Reverse Polarity Detection Device

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Introduction

Problem Statement

Honeywell has expressed a need for a tool to be used by technicians in their production facility to confirm correct wiring of a magnetic coil early in the fabrication process to prevent errors and potential damage to the equipment that could result from incorrect wiring.

Deliverables

Our senior design project team has been asked to build a polarity-checking device that Honeywell can use to check the polarity of an inductive device. Honeywell would like to ensure that electromagnetic cores are installed with the correct polarity. These issues are not discovered until much later in the process, and by that time, it is costly and time consuming to fix the issue. Using the device developed by our team, Honeywell's production of these devices will be much more efficient.

Specifications

This device should serve as a power source to the coil to be tested, read the magnetic field, and provide a "fool-proof" output to the technician to confirm correct polarity.

System Level design

Functional Requirements

- Less than 10 V, DC
- Less than 100 mA, DC
- Easy to calibrate
- Operate at room temp. 75 deg F
- Should not be affected by the earth's magnetic field or local sources ie. normal manufacturing equipment
- Easy user interface Good/Bad
- Will not damage product during contact
- Bench top set up
- Use a battery (lithium ion) that can connect to a charging circuit
- Indicates battery level

Non-Functional Requirements

- Easy to keep clean
- Portable
- Light and easy to handle
- Utilize commercially available devices
- Can be custom fit to various product configurations

NEED

Functional Decomposition

System Analysis

Block Diagrams of the concept

Detailed Description

Input and Output Specifications

Honeywell requires the polarity device to be very easy to use. When the cores are correctly energyzed through the provided DB9 connection (Figure 1), the output should essentially be a simple yes or no answer. The testing device will employ red and green LEDs to achieve this. There are 5 pins that connect to the coils with a power limits of 10 volts and 100 mAmps. The polarity detecting device will utilized a rechargeable battery to support portability and simplicity.

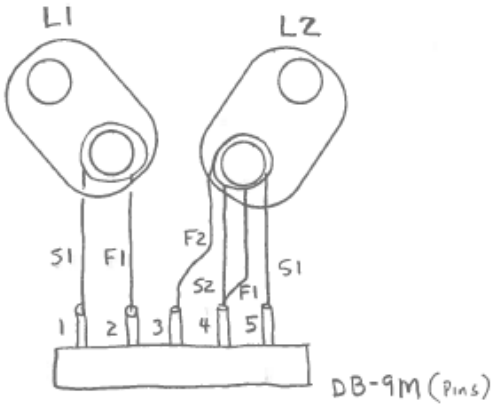

Figure 1: DB9 connection

Interface Specifications

The device will consist of a main unit, which will contain the circuity, and a testing wand that will be wired to the main unit. The wand will test the polarity using magnetic sensors and the main unit will interpret and display the signals received from the magnetic sensors.

Parts List

Part	Cost
Resistors	Free (available in parts shop)
Wire	Free (available in parts shop)
LEDs	Free (available in parts shop)
Capacitor	Free (available in parts shop)
Diode	Free (available in parts shop)
N Channel MOSFET	Free (available in parts shop)
DB9 Connector	$3.99
Battery	$49.95
Digital Compass (HMC1053)	$60.95

Modeling

The circuitry component of the unit is comprised of 3 parts. The first is a DC to DC booster that is connected to the DB9 plug (bottom right). The second is a voltage/current divider and switch set for the output LEDs. The last part is a voltage/current divider to power the magnetic sensor. The switches for the LED's will be triggered from the sensor and display the output.

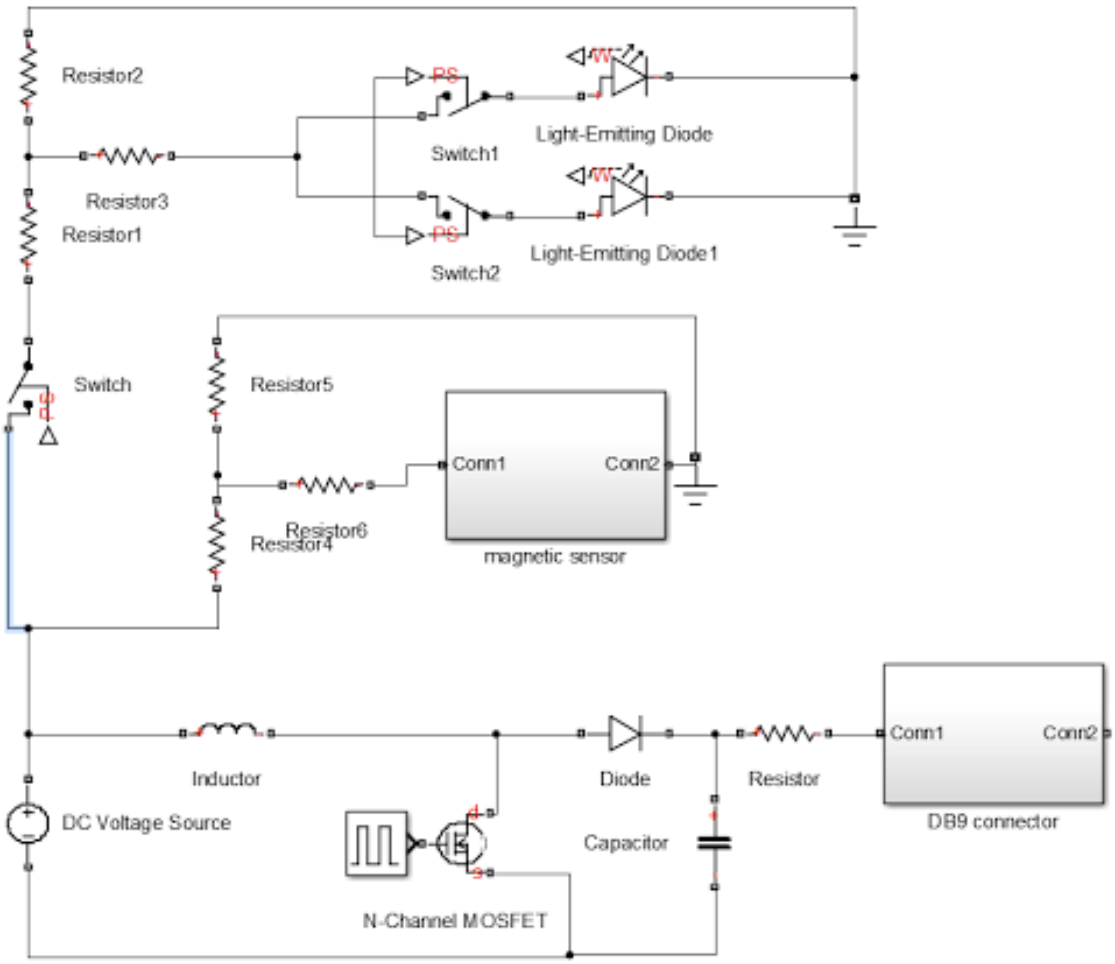

Figure 2: Circuit schematic

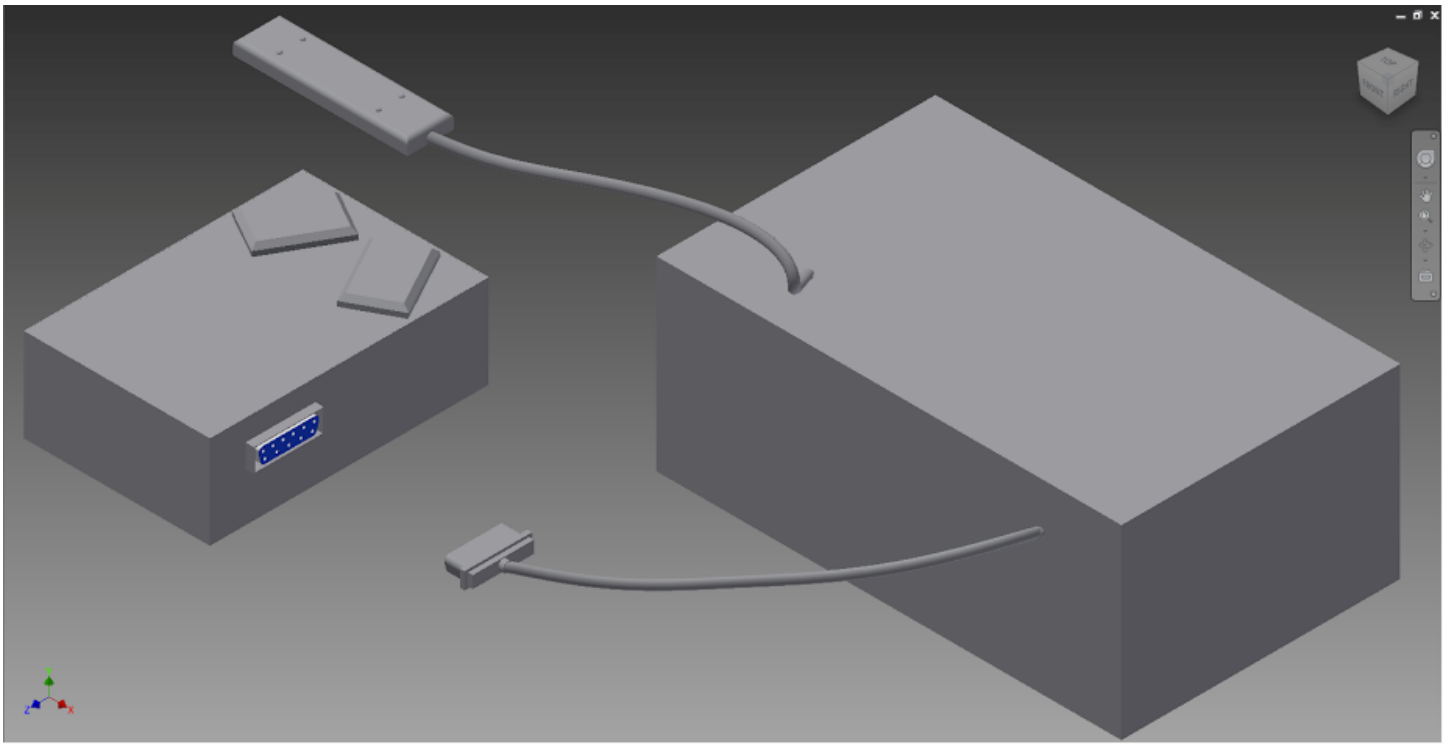

Figure 3: CAD representation of Honeywell unit (left) and test unit (right)

Implementation Issues

The Honeywell unit consists of two magnetic coils. These coils are shielded from each other, however, specific information has not yet been provided. This may interfere with the When the actual Honeywell unit is received, we may

Testing Procedures

The current testing plan is to have Honeywell test the device. They are unable to send us the coils, so we will send them the device instead. However, Honeywell is trying to make a mock up device that will have similar behavior to their coils. We will be able to use this for our own basic testing but it will not be a representation of the actual coils. This will prove to be a challenge as we may have to go back and forth several times with honeywell. This could be a lengthly process so we must plan accordingly.

Other Documents

PCB

PCB will be used to build certain parts or the whole circuit and connect essential electric parts. We will use the PCB to connect the diodes and PNP bipolar transistors, which will eventually amplify current for the electromagnet and ensure the unidirectionness of the current. The PCB will also be used to connect LEDs, which act as an indicator for polarity.

Mechanical CAD

Our ultimate goal is to make a prototype of a portable polarity detector; therefore, we will make a mechanical CAD of the device. However, with the lack of adequate information, we could not make it at this point. We will do it in the next version.

Conclusion

As you can see from our research and design ideas from above, we have developed what we believe to be a viable solution to Honeywell's issue. Our circuit design utilizes many techniques that, through our studies, we know to be very reliable and practical to implement. We also believe it would be easy to transpose our circuit into a small casing that would have a simple user interface. This device will use LED's and possibly warning tones to confirm the polarity of the inductors is correct and the technician may proceed with the installation process. Thank you for taking the time to read our design document, and feel free to contact any member of our team if you have any further questions.