Senior Design – Project Plan

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.

Purpose

The purpose of this document is to outline the technical project plan to design a magnetic polarity detection device to be used by Honeywell during the wiring of a magnetic core at their facility in Kansas City, Kansas.

Scope

The resulting device should accurately assess whether the magnetic coil has been wound correctly. Verification will be accomplished by checking the polarity of the magnetic field produced by an energized coil.

Goals

Our goal is to design a detection device for Honeywell that will allow technicians to efficiently and effectively confirm the correct wiring of a magnetic coil as a part of a larger device during the production stages. It is imperative that our design be user friendly and provide definitive output to the technician.

System Description

We are to design a device that checks the polarity of a “transformer” for Honeywell. Our device needs to supply power to the inductive coil being tested and subsequently read the polarity. The device needs to be easy to understand with a simple output on the polarity. The device needs to be easy to operate with simple input hookups and an easy to understand connector to check the polarity. The system we are designing needs to be able to work around other devices within the vicinity of the transformer. The core of the coil sticks through the top of the device and is covered by a set of potting caps. The polarity can be read over the top of the caps, or the caps may be removed to get a better reading. A rechargeable battery will be used to power the device. This will provide the greatest functionality, allowing for portability and ease of use. FIgure 1 outlines the concept of our device and how it functions.

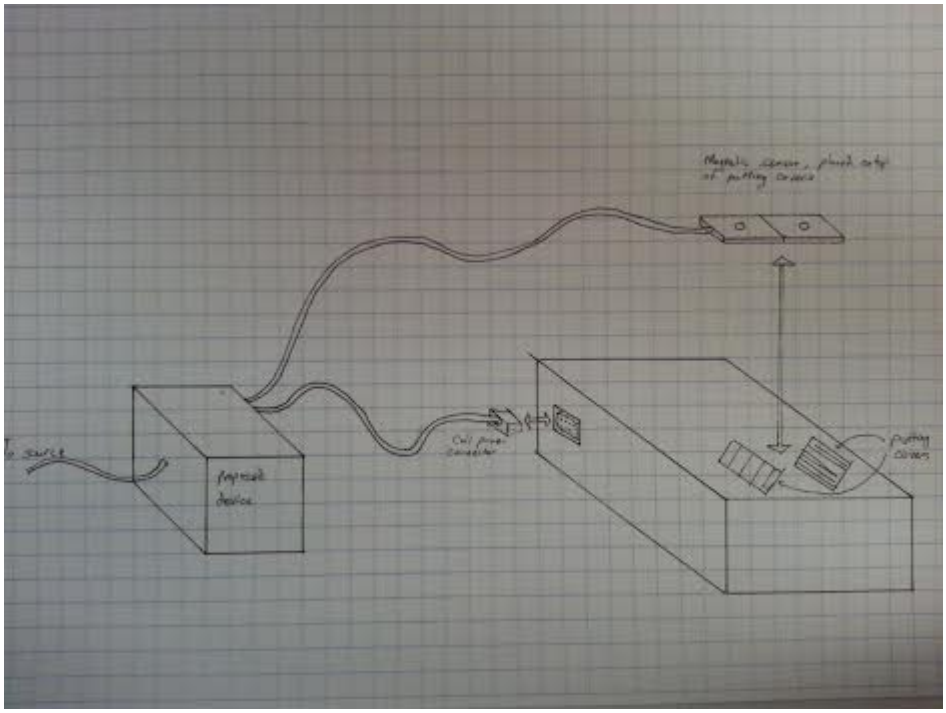


Figure 1: Concept Sketch

The case for the transformers is 2x3x1 inches in size, with the actual coil being .5x.75x.5 inches in size. The size device is fairly small, which is a major consideration in the design of our device. Shown in figure 2 and 3 is the base of the device from Honeywell. Shown in figure 4 is the device with the base, coils, top and potting caps.

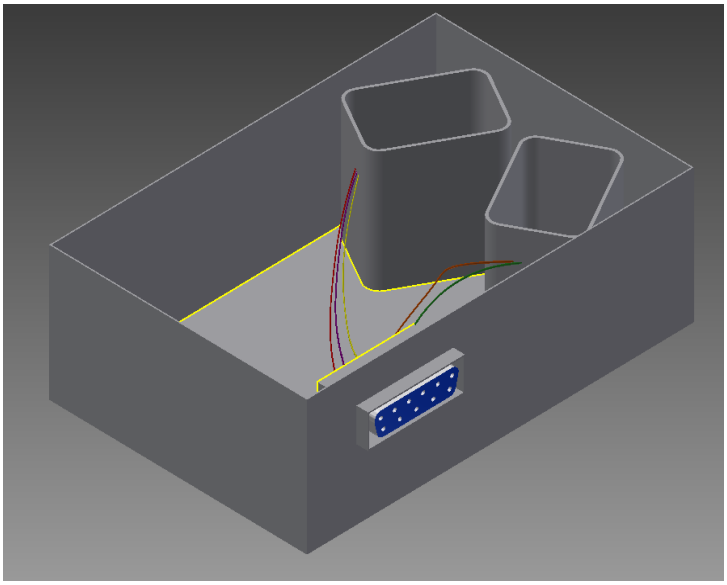


Figure 2: Base of the unit to be tested, output connection

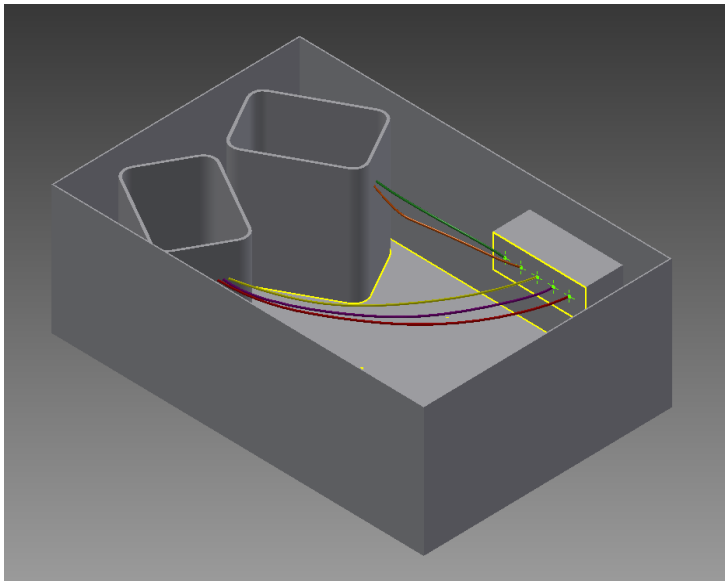


Figure 3: Base of the unit to be tested, internal wiring

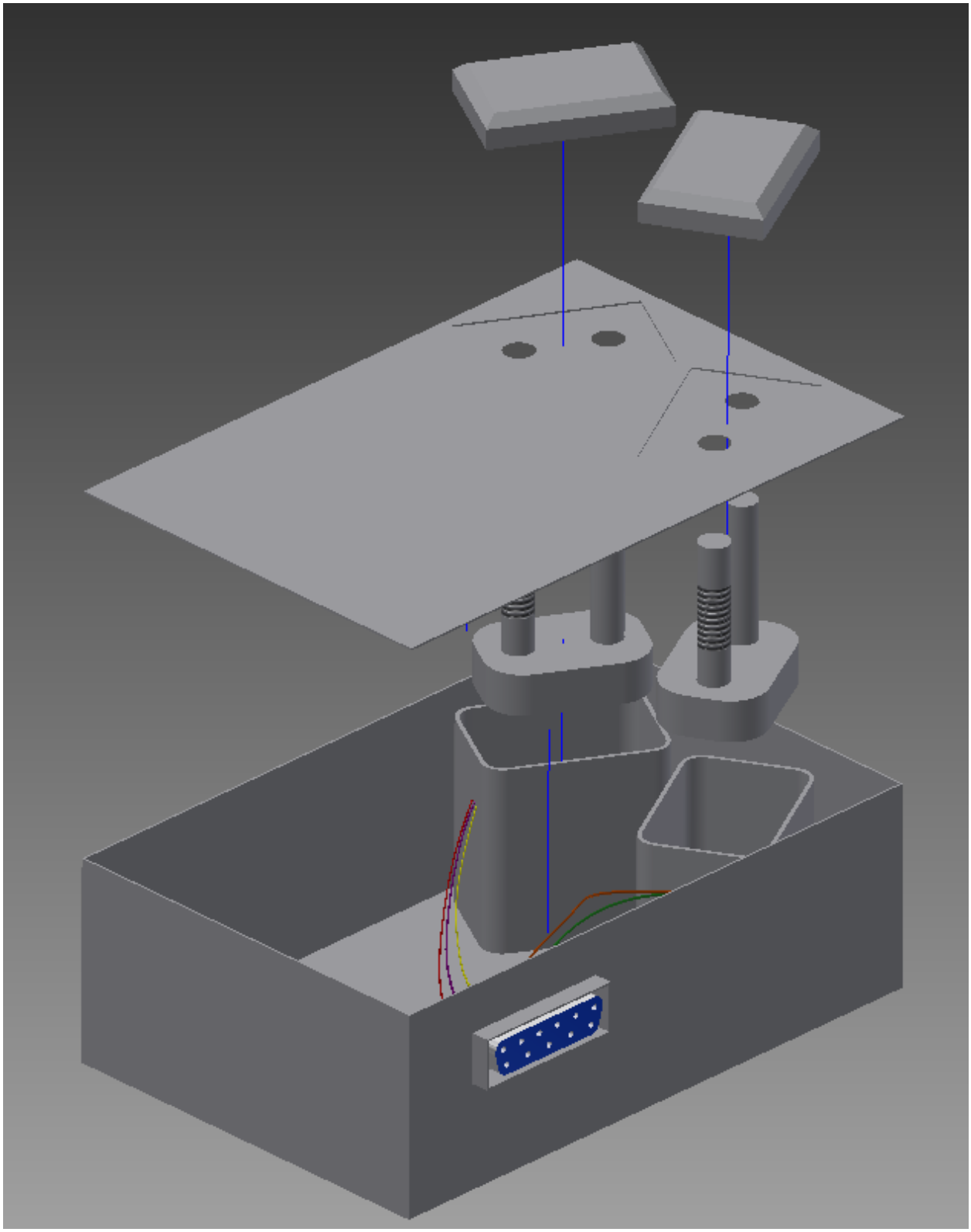


Figure 4: An exploded view of the unit to be tested

Operating Environment

The device will be used by Honeywell technicians in a clean environment, which has a presumably stable temperature and humidity. The device will be used around other electronics and will need to account for any interference that could causes false readings.

Requirements

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

Literature and Market Research

Researches into the available magnetic sensor technology and digital compasses have been conducted to help us determine the best solution to our project. Parts of the detailed survey are listed below:

Magnetic sensor technology

Hall sensor

A Hall generator is a solid state sensor which provides an output voltage proportional to magnetic flux density. As implied by its name, this device relies on the Hall effect. The Hall effect is the development of a voltage across a sheet of conductor when current is flowing and the conductor is placed in a magnetic field.

AMR sensor

An AMR sensor utilized the magnetic thin films such as nickel and iron. MR element made of Ni-Fe called perm alloy is formatted on wiring layer of the semiconductor IC.When the external magnetic field is applied to MR element, the resistant rate of MR element will change, and then voltage difference occurs. MR element has unique characteristics that the resistance rate drops when the external magnetic field is applied perpendicularly to the current. When the resistance rate drops, the neutral voltage point of the bridge circuit will change. This change is input as analog voltage signal into the IC. IC built-in amplification circuit inside judges automatically whether the input analog is higher or lower than the threshold voltage. Then ON/OFF digital output is performed.

Dv/Dt transformer polarity tester

The dv/dt transformer polarity tester comprises a casing shell, a direct current power source inside the shell, an indication light source, namely a unidirectional LED, a switch used for controlling output current of the DC source and two test wire sets. Due to the sudden change of dv/dt, the primary and secondary coils will produce corresponding excitation and induced electromotive force. Therefore, the momentary energy will be stored in the transformer. Based on Lenz's law, an induced electromotive force will be generated to prevent the building of the current. Since the LED is unidirectional, if the LED flashes, it means the induced current runs from the anode of the LED to its cathode.

Digital compass

The Honeywell HMR3400 is a digital compass solution designed for use in navigation and precision pointing applications. Honeywell’s magnetoresistive sensor technology is coupled with a MEMS accelerometer to provide a miniature, reliable tilt-compensated electronic compass. Using a common set of commands from the legacy HMR3300 digital compass solution, the HMR3400 is

designed to be easily integrated into host systems with a regulated 5 volt supply and a UART serial data interface.

The Honeywell HMC5843 is a surface mount multi-chip module designed for low field magnetic sensing with a digital interface for applications such as low cost compassing and magnetometry. The HMC5843 includes our state of the art 1043 series magneto-resistive sensors plus Honeywell developed ASIC containing amplification, strap drivers, offset cancellation, 12-bit ADC and an I2C serial bus interface. The HMC5843 is in a 4.0 by 4.0 by 1.3mm surface mount leadless chip carrier (LCC). Applications for the HMC5843 include Consumer Electronics, Auto Navigation Systems, Personal Navigation Devices, and Magnetometers.

Work Schedule

Team member roles

Team Leader: Jeremiah Janssen

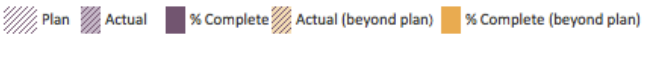
Key Idea Holders: Chen Cheng and Kailey McGuire

Communications: Tym Wood

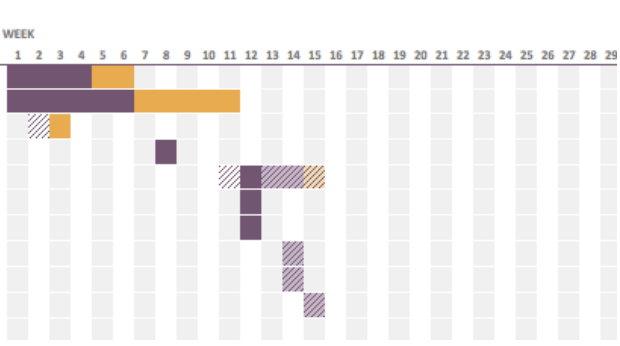
Webmaster: Tori Sorensen

First semester schedule

Project Work Schedule
Team Dec 14-10



ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Research on Current Market Products	1	4	1	6	100%
Project Idea Development	1	6	1	11	100%
Version 1 of Project Plan	2	1	3	1	100%
Version 1 of Design Document	8	1	8	1	100%
Development of prototype	11	4	12	4	35%
Version 2 of Project Plan	12	1	12	1	100%
Development of Design Visual	12	1	12	1	90%
Version 2 of Design Document	14	1	14	1	0%
Prototype testing and retouching	14	1	14	1	0%
First semester research and findings presentation	15	1	15	1	0%



Deliverables

The expected deliverable for this project is a small handheld or bench top device that easily checks the polarity of Honeywell's inductor unit. The testing and demonstration for this device will be mostly be conducted by Honeywell behind closed doors to prevent the leaking of sensitive information. Other additions or corrections to the design deliverables will appear in future editions of our project plan, and our team reserves the right to update

the definition of the project deliverables up to the time the final product is delivered to Honeywell.