Degaussing Watch Winder

Andrew James, Richard Kern, Vishal Mahabir, Yonas Sengal

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, UNIVERSITY OF CENTRAL FLORIDA, ORLANDO, FLORIDA, 32816

***ABSTRACT* — A PROJECT THAT INTEGRATES MECHANICAL WATCH WINDING, INDUCED MAGNETIC FIELD SENSING, AND INDUCED MAGNETIC FIELD DEGAUSSING INTO ONE DEVICE. THE PROJECT RESULTED IN A CUSTOM PCB ASSEMBLY THAT USES STEPPER MOTORS DRIVEN BY AN ONBOARD MOTOR DRIVER CHIP TO ROTATE THE WATCH FULL 360 DEGREES BIDIRECTIONALLY EFFECTIVELY CHARGING A MECHANICAL WATCH BY WINDING THE INTERNAL SPRING OF THE MECHANICAL WATCH. THE DEVICE FEATURES A DEGAUSSING CIRCUIT DESIGNED TO REDUCE INDUCED MAGNETIC FIELDS ASSOCIATED WITH THE WATCH TO LEVELS BELOW 200 MICRO TESLA. A MIKROCLICK MODULE IS INSTALLED ON THE DEVICE TO SUPPORT ADDITIONAL FEATURE EXPANSION SUCH AS MAGNETIC FIELD SENSING. AN ONBOARD MICROCONTROLLER CONTROLS THE DEGAUSSER AND MOTOR DRIVER AND IS PROGRAMMABLE BY THE USER USING A KEYPAD MOUNTED ON OUR ASSEMBLY. THES CRITICAL COMPONENTS AND SUBSYSTEMS ARE INTEGRATED TOGETHER TO FORM A MULTIPURPOSE WATCH WINDER FOR AUTOMATIC WATCHES. THE GOAL OF THIS PROJECT IS TO COMBINE THESE ACCESSORIES INTO ONE VERSATILE PRODUCT.**

***INDEX TERMS* — RELAY, DEGAUSSER COIL, THERMISTOR, POWER SUPPLY, MICROCONTROLLER**

I. INTRODUCTION

The intent of this project is to design a watch winder containing a coil degausser. Watch winders have become an essential accessory amongst watch collectors. Watches have become increasingly accessible across the economic classes. Collaborations with companies such as Omega and Swatch have shown this to be true. Omega watches start around 6,000 USD whereas the average cost of a Swatch is 200 USD. The Omega x Swatch Bioceramic MoonSwatch collection cost 260 USD. The growing interest of watches and their accessibility has sparked interest in the market for watch accessories. Currently, the market sells degaussers and watch winders as two separate accessories with no current devices that integrate the two. The standard design of a watch winder consists of a box that holds and winds an automatic watch to prevent the power reserve from expanding when the watch is not worn. This will ensure a watch winder's goal in maintaining a high-quality watch as a watch winder will preserve the correct time and dates after it has been worn. Watch winders are however not compatible with manual, or quartz watches as manual watches are hand operated and quartz watches are wound from the battery it contains.

The function and operation of a coil degausser is to correct a watch's magnetism by its coils. When a watch is worn often, there is a great amount of energy, magnetism, being stored within the watch's spring creating an overwound watch. When a watch is overwound the hands of the watch move faster or slower. This causes an inaccurate measurement and display of time. To correct the watch's accuracy, the watch must undergo demagnetization. The degausser relieves the excessive energy, magnetism, stored in the spring resulting in an accurate timepiece.

The project will explore the best combination between types of motors, microcontrollers, motor drivers, degaussers, relays, gaussmeters, power supplies, displays, and keypads in hopes of creating a multipurpose watch winder for automatic watches. The goal of this project is to combine these two accessories, a watch winder and degausser, into one versatile product.

The goal and objective of this project is to design and build a watch winder that records turn per day (TPD), rotation direction, a degausser, and read magnetic fields using a gaussmeter. The function of a watch winder is to keep an automatic watch fully wound while the function of a degausser is to demagnetize a watch that has been over-wound. Usually when an automatic watch is worn, the motion of the individual wearing it, provides energy to wind the mainspring. This in turn makes manual winding obsolete. Once the watch is fully wound, there is ample energy in the mainspring to keep the watch ticking approximately 12 to 48 hours. However, if the watch is not worn everyday it can be placed in a watch winder. A watch winder will slowly rotate the watch in a case. Rotation count can be set between 400 to 1200 TPD depending on the watch's need. Including rotation direction will deliver the option of a watch to be set clockwise, counterclockwise, or bidirectional. The benefit of having a watch winder is that it prevents a watch from draining the stored energy, which can lead to damage to the timepiece. This is ideal for individuals who own multiple automatic watches.

II. OVERVIEW OF DESIGN

Microcontroller

The microcontroller is the brains of the project, interpreting the input created by the magnetic sensor and keypad, and driving the logic signals for the motor stepper, relay, and the display.

The primary differences in microcontrollers are the programming interfaces and the peripherals supported by the devices, the device's manufacturer also matters as some companies are better at supplying development tools and documentation for working with their specific chips. Popularity is an important trait regarding microcontrollers as the more popular a platform is, the more resources tend to be available online, in turn making development and troubleshooting significantly easier.

The particular microcontroller we chose for this project is the ATUC256L3U-AUT chip from Atmel, now Microchip. The power and functionality present in the chip far exceeds what was necessary for the final device, originally more features were meant to be implemented and thus necessitating the additional peripheral technologies and GPIO pins.

Relay

Most industrial application devices have relays for their effective working. Relays are simple switches which use electromechanical or electronic mechanisms to control an electrical circuit by opening and closing the contacts. The main operation of a relay can be in places where a low power signal is used to control the circuit. It is also used in different places where only one signal is used to control a lot of circuits for example, in substations and power distribution centers for sensing faults and operating the circuit breaker. Relay technologies can be classified according to their performance, switch contact, durability and cost. The three most frequently used types of relays are:

In solid-state relay devices, the switching can be achieved by field effect transistors. They are usually the smallest in size of all relays. They come with a wide range of current ratings. From a few micro-amps for low powered packages up to 100 amps for high power packages. Solid-state relays have a long operating lifespan, faster switching system and increased reliability because they have no moving parts.

Reed relays are made up of a reed switch and an electromagnetic coil with a diode for back EMF. A reed switch is made up of two ferromagnetic metal blades sealed in a glass tube which also supports the metal blades. The coil is energized, the ferromagnetic metal blades attract each other and form a closed path and it has fast switching time which is 0.2 to 0.5 milliseconds. As there is no moving armature there is no contact wear out problem. The glass tube is also filled with inert gas which helps to prolong its life.

This type of relay has an electromagnetic coil and a mechanical movable contact. When the coil is energized it produces a magnetic field. This magnetic field attracts the armature movable contact. When the coil is demagnetized, the coil loses the magnetic field and a spring retracts the armature to its normal position. So, physical contact is established to connect the electrical circuit. The electromechanical relay has switching performance of 5ms to 15ms, durability of up to one million cycles, and is considered to be fair in price.

It is advantageous to use solid state relay and reed relay over electromechanical relay but, when wearing occurs contact points can be replaced in electromechanical relay. In solid-state and reed relays if failure occurs, we must replace the entire relay. Therefore, the electromechanical relay is our best choice for this project.

ELECTROMECHANICAL RELAY

Based on their contact configuration, the electromechanical relays can be described as:

Single-Pole Single-Throw (SPST): This type of relay has a total of four terminals. Out of these four terminals, the two terminals can be connected or disconnected. The other two terminals are connected to the coil.

Single-Pole Double-Throw (SPDT): This type of relay has a total of five terminals. Out of these five terminals, these two terminals are the coil terminals. A common terminal is also included which connects to either of two other terminals.

Double-Pole Single-Throw (DPST):

This type of relay has a total of six terminals. These terminals are further divided into two pairs. Therefore, they can act as two SPST which are actuated by a single coil. Out of the six terminals, two of them are coil terminals.

Double-Pole Double-Throw (DPDT):

This type of relay is the biggest of all types. It has mainly eight relay terminals. Out of these eight terminals, two rows are designed to be changed over terminals. They are designed to act as two SPDT relays which are actuated by a single coil.

Since our goal is to control only the degausser circuit, based on the number of contact and speed of operation, we selected SPST relay that has total of four terminals. Out of these four terminals, the two terminals can be connected or disconnected and the other two terminals are connected to the coil. Moreover, its price is cheap, maximum operating time is 10ms non latching and also the current and voltage rating is perfect for our project.

Degausser

Practically everything around, us like televisions, cellphones, sound systems and tablets have magnetic fields. Magnetism affects watches and especially the components found inside the watch called hairspring. Hairspring or balance spring is a spring attached to the balance wheel to oscillate with a resonant frequency. This magnetism causes the hairspring to stick together which results in the watch not working accurately. Therefore, there is a solution to fix such a problem with a device called a degausser. A degausser is a machine that disrupts and eliminates magnetic fields stored on watches, tapes and disk media.

Based on research in electromagnetic and permanent magnet technology, there are different types of degausser technologies that have been developed. Both types can generate powerful magnetic fields such as: Coil degausser, Impulse degausser and Permanent magnet degausser.

The coil degausser is a simple form of degausser powered by alternating current line voltage. It is lightweight and its duration of demagnetization takes 30 seconds. This rapidly alternating magnetic field tends to overcome magnetism that is present in mechanical watches. With coil degaussing, magnetic field elimination can be achieved by placing the watch on the top of the coil producing the alternating magnetic field until the amplitude of the current that produces the magnetic field collapses to zero. However, Impulse degaussers also demagnetized objects in a fraction of a second without having to move them away. Impulse degaussers use a large capacitor that is charged to a high direct current voltage using power from an alternating current line. When a button on a device is pressed, the capacitor is disconnected from the power source and connected to a coil. The capacitor’s high voltage produces a high current in the coil which produces a strong initial magnetic field. The energy keeps the current flowing in the same direction which charges the capacitor and the capacitor discharges into the coil again until the coil and the capacitor form a resonant circuit. This produces a magnetic field that reduces exponentially in amplitude over a period of a fraction of a second. Any object near the coil is demagnetized without moving it. Unlike coil degausser or impulse degausser technology, the permanent magnet degausser uses strong and natural magnets. They do not generate heat, some do not require electricity to operate, and never require technical upgrades. Permanent magnet degausser is very big in size and less portable.

Therefore, based on these advantages and disadvantages, we decided to build the degausser using an alternating current coil degausser. The reason is that the demagnetizing performance is less than 30 seconds which is excellent, it is portable and requires 110 v and 0.65 A power source.

Stepper Motor

When strategizing a design there are several motors to consider. An electric motor converts electricity into mechanical energy. It is known for electric motors to be utilized in a magnetic field. Motors can be powered by either AC and or DC sources. As technology has developed and electricity is available in many parts of the world, electric motors make up fifty percent of the earth’s electricity.

There are many factors that must be considered when choosing the most suitable stepper motor for the intended application. Factors include the stepper motors noise level and the cost of the stepper motor as the prices do significantly vary. Over the decades, technology has become increasingly advanced making it very difficult and sometimes overwhelming to choose a suitable stepper motor for a desired application. It is useful to understand that stepper motors produce their maximum torque at low speeds allowing them to be especially useful in high precision applications. The longevity of stepper motors can reach approximately 10,000 hours or 5 years of life when they are not run continuously.

Stepper motors are user friendly and extremely cost effective. There are different stepper motors and different ways to drive them to attain different goals. Specifically, we picked the Adafruit 324 hybrid bipolar stepper motor to achieve our goals. This motor helps us achieve our goals with the design as it is precise and reliable.

Motor Driver

A motor driver operates a motor acting as a median between a microcontroller and the motor. The motor driver uses a microcontroller to control a motor as both motor and microcontroller function on different current levels. For example, a motor is prescribed to work on a higher level of current compared with a microcontroller that requires a substantially lower amount of current. The motor drivers are the device that makes these two incompatible devices, the motor and microcontroller, compatible with one another by taking steps up or down to balance low and high current signals. When a motor driver receives a low current signal from a microcontroller, the driver surges the low current signal to a high current signal for the motor to be driven. The STSPIN820 motor driver is the most compatible motor driver for the watch winder’s design. The STSPIN820 contains a plethora of options. Its features include but are not limited to short-circuit protection, full protection set, overcurrent protection, and overtemperature protection. After much deliberation the STSPIN820 was selected as the motor driver for the hybrid bipolar stepper motor that has been selected.

III. POWER BLOCK DIAGRAM

To ensure our system has the appropriate power supplies for each device we decided to create a power block diagram. The power block diagram is an essential tool at the systems level of product development, without a proper power block diagram and accompanying power budget the end design could potentially attempt to consume more power than the supplies can source. The power block diagram represents each power supply in the design in a block diagram fashion and shows what each supply is sourced from and what each supply sources. Each supply block is labeled with its respective topology (ac/dc converter, linear voltage regulator, switching dc/dc regulator, ect.) to inform the reader of important features that might be characteristic of each topology. Each supply box is also labeled with its output voltage to make it clear and easy to see the power flow of our design. Each supply box additionally has the manufacturer listed and the unique manufacturer part number for each device. Between the blocks that represent each power supply the arrows show the flow of the power system. The voltage of the power rail is denoted on each line and if the supply supplies multiple supplies the voltage level text might be displayed multiple times for convenience. The current available on each power rail is also shown in text on that rail. Each major sub circuit is detailed in the block diagram with a box to represent it. For each major sub system the input voltages are listed on its respective block to aid in identifying any holes that exist within the power system of the design. With the power systems design presented in a block diagram fashion it makes it easy to visually confirm if there is a device that does not have a voltage supply that can power it and that the current a power supply can source is greater than the current that that circuit will consume. Taking the time to develop this visual tool in the early stages of development can save a team big time in the end. Our power block diagram is shown in the figure below and detailed in the following text.

The high level flow of our power system is as follows; AC voltage is sourced from the power grid and introduced into our system. The AC power is immediately split into two different AC to DC converters and transformed into stable 12V and 5V DC voltages capable of supplying 1.25A and 3A respectively. The 12V supply is used to power the relay coil and the stepper motor. The 5V rail is fed into two separate 3.3V regulators, one exclusively powers the microcontroller and the other powers the gaussmeter circuit and motor driver circuit.

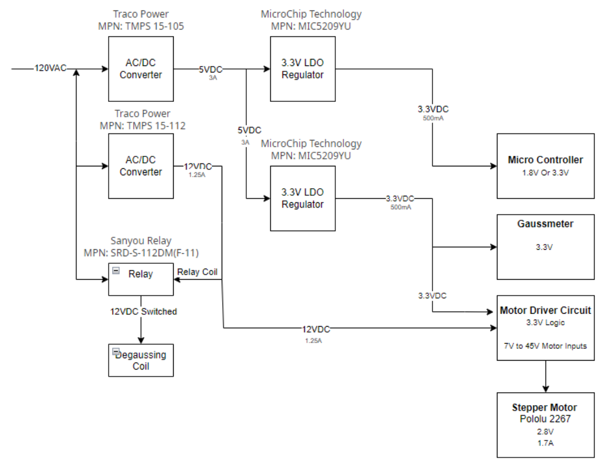

Fig. 1

IV. AC to DC Converter Design

Our overall power architecture is to bring in 120VAC and use the Traco Power TMPS 15-112 to convert to both 12V and 5V DC voltages. We do this using two separate AC to DC converters, both are the same family of Traco Power TMPS15 15W converters. The 5V AC to DC Converter will supply Linear Dropout regulators to output voltages to supply our discrete circuits. We chose the Traco Power TMPS 15-105 for multiple reasons. The first appealing part of the TMPS 15-105 is that 5V DC is a good intermediate voltage that can be stepped down reasonably to logic levels using simple LDO's. The TMPS 15 series are 15W outputs and the TMPS 15-105 would be 15W at 5V so 3A of current available, this would be sufficient for all our digital circuitry. The 12V DC voltage will supply the motor driver circuit and the stepper motor, and supply the SPST relay coil, We like the idea of having a barrel connector on our PCB that can feed into the 12V rail by populating a resistor that was previously DNP, giving the option of a back op offboard AC/DC converter if we need more output power. This would give us the capability of running more than one watch winder at a time. Converters that would fit this need are very common and come in multiple output power options. Another good feature is the TMPS 15-112 is a part of a large family of similar regulators that are footprint compatible, furthering the robustness of our designs power section.

V. LINEAR DROPOUT REGULATOR DESIGN

To power our Microcontroller, Gaussmeter, and motor driver circuit we need 3.3V DC power. We choose to get our 3.3V rails from linear dropout regulators for multiple reasons that will be described in this section. The power provided to these regulators inputs will be the 5 volt DC voltage output from our TMPS 15-105 AC to DC converter. This 5V voltage will be regulated down to 3.3 volts to source the devices listed previously. The 5 volt rail is a decent level to use a linear regulator to regulate down to 3.3V rail and is one of the reasons it was selected. Linear dropout voltage regulators burn off extra energy as heat and the larger the voltage difference between the input and the output the more energy that will be dissipated as heat into the PCB. Using the 5 volt rail we only need to drop 1.7 volts to achieve 3.3 volts as opposed to the 8.7 volt difference that would occur if we used our 12 volt supply rail. Careful consideration was also placed to make sure that the regulator's dropout voltage was less than the difference between the output and input voltages. In our design we are choosing to use the MIC5209YU linear voltage regulator manufactured by MicroChip Corp. The MIC5209YU is an adjustable single output linear voltage regulator in a surface mount TO263-5 package. Some notable feature of the MIC5209YU include a wide voltage input range of up to 16 volts DC, wide adjustable output range of 2.5 - 15 volts DC, Overcurrent Protection, Over temperature protection, extremely tight load and line regulation, low maximum dropout voltage of 500mV at full load, and ultra low output noise. One key feature we liked is the MIC5209YU is capable of supplying 500mA of current, this should be plenty to source our devices when we use two of these regulators. According to the datasheet the maximum dropout voltage of the regulator is 500mV and as stated before we have a 1.7 volt difference between our 5 volt and 3.3 volt rails so we have plenty of headroom for dropout voltage.

The pinout of the MIC5209YU is a very common pinout scheme within devices using the TO263-5 package and has many footprint compatible replacements available. Pin 1 of the device is the regulator enable function. Driving the enable pin high enables the regulator, we have no need for this regulator to ever be off so we tied the enable pin to the input voltage as recommended in the datasheet. The input voltage gets applied to pin 2 of the device, the datasheet recommends placing a 0.1uF capacitor between the input pin and ground so that is what we did. Pin three of the device is the output voltage, the output voltage feeds the resistor divider network used to set the adjustment pin (pin 4). The datasheet for the device highlights one of the MIC5209YU features and that is “Ultra low noise mode” and states that voltage ripple output is 300nVpp, much smaller than our 120mVpp ripple noise on our AC to DC converter. To put the device in “ultra low noise mode” the datasheet recommends adding an additional 470pF capacitor between the adjustment pin and ground, we chose to use this option and designed the 470pF capacitor. The adjustment pin also connects to the common node on the resistor divider setting the output voltage. The adjust pin works by inputting the signal on that pin to the non inverting pin of an internal operational amplifier; the inverting pin of that amplifier is connected to the Vout line. A The figure below shows the internal workings of the regulator.

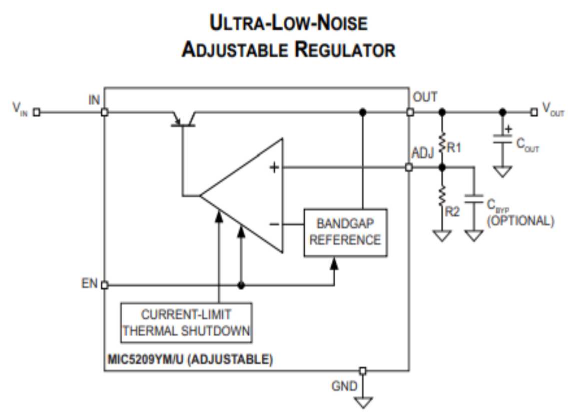

Fig. 2

As mentioned before the MIC5209YU is an adjustable output regulator and requires two external resistors to set the output voltage. The datasheet for the MIC5209YU gives a formula for setting the output voltage in the Adjustable Regulator Applications section. The formula provided by the data sheet is

$$\text{Vout} = 1.242\left(1+\frac{R2}{R1}\right) \quad (1)$$

We wish to output 3.3 volts so we began by rearranging the formula and solving for R2. Initially choosing a value of 1K Ohm for R1 and solving for R2 resulted in a value of 1.65K Ohm for R2, resulting in a calculated output voltage of 3.29 volts. Similarly to the AC to DC converters this linear regulator is very simple and requires only the output adjustment resistors and input and output filter capacitors to operate. The figure below shows our schematic of this regulator used to regulate 5 volts to 3.3 volts in “Ultra low noise mode”.

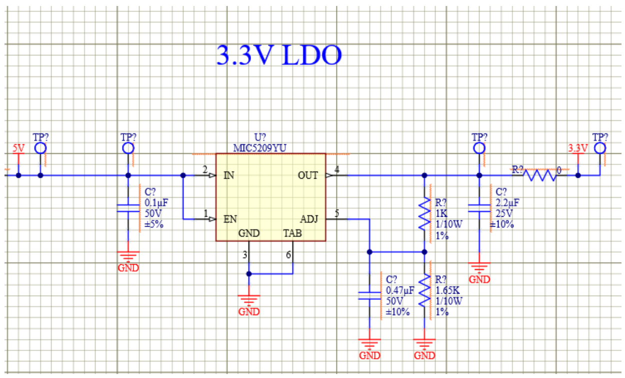

Fig. 3

VI. SPST Relay Design

A simple electromagnetic relay consists of a coil of wire wrapped around an iron core which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts.

We are going to use a 12v dc power supply for the relay that can control the degausser circuit. This 12 v power supply will come from the microcontroller. In addition, 0 to 3.3 volt logic signals are going to be used through the NPN transistor base from the microcontroller.

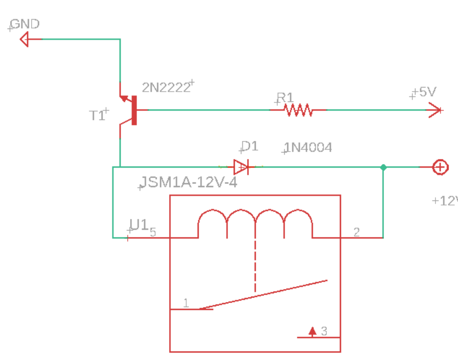

Fig. 4

When the resistor is at 3.3 volt, then current is going to flow from the base to the emitter and that is going to turn the transistor on and if the base voltage is 0v, no current is going to flow and the transistor will be off. For this particular circuit since we are switching a coil it is actually very important we add a clamp diode in parallel to the relay. The diode is pointing into the voltage source and when the transistor is turned off, all of that current that was flowing through this coil has created a magnetic field in the coil and when the transistor turns off that magnetic field collapses and the voltage goes up. If the coil has a lot of inductance, the voltage could get high enough that could blow out the circuit, so it is extremely important for safety issues to put diodes in it.

Transistor: PN2222A:
Ic = collector current;
Ib = base current; Ie = emitter current to GND;
B = beta = 100
SPST: G5LE-1A4 DC12 from datasheet
Coil resistance = 360Ω;
Coil current = 33.3 mA;
Power(P) = I^2 *R = 0.4 watt
voltage = P/I = 0.4/33.3mA = 12v

From this calculation, the transistor should handle 33.3 mA. Therefore, Ib = (3.3v-0.7v)/Rb suppose we have 1mA base current, so we can calculate the base resistor as Rb = 2.6V/1mA = 2.6kΩ. Moreover, we added a diode in parallel to the relay to prevent back spiked current.

VII. Degausser Design

Finding a suitable coil was a bit hard. The choices were to build from a scratch or to use a half transformer from other devices. Therefore, in order to make a coil that generates an alternating magnetic field, we decided to use a half transformer E laminated product. The core cross sectional area is x*y of 1.5cm by 1.3cm. The core permeability is 2.5*10^-7 H/m. As shown in the schematic below, the circuit is at the first stage and the components are a power source, relay and the coil with a core.

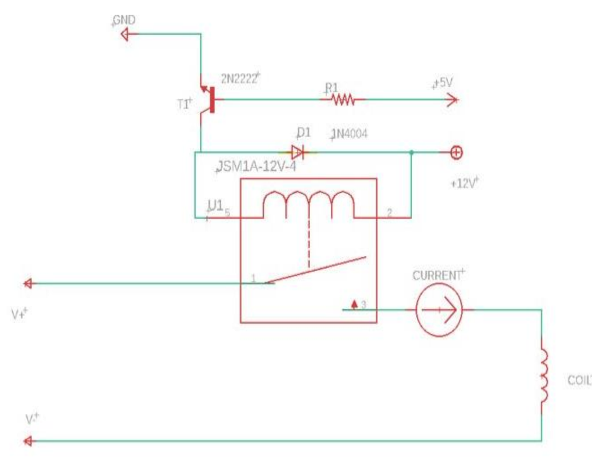

Fig. 5

In the case of a degausser coil, with the help of a degauss meter, we are able to figure out the alternating current required to produce the required alternating magnetic field.

The normal current draw is 0.21Amp and we cannot use any PTC thermistor that cannot handle this current. Then, we picked the right PTC thermistor, which is PTCCL13H321HBE because, based on the datasheet, it is rated up to 265 rms voltage and 0.8Amp to 5.5Amp maximum overload current. Also, the resistance is 2.1Ω up to 3KΩ at 25 degree celsius that can draw the required amount of current and that can operate the degausser. Then, we connected a light emitting diode with a resistor parallel to the coil to help as an indicator. Moreover, capacitors are connected to store the residual current when power is off for safety reasons. Finally, we built the degausser as shown below.

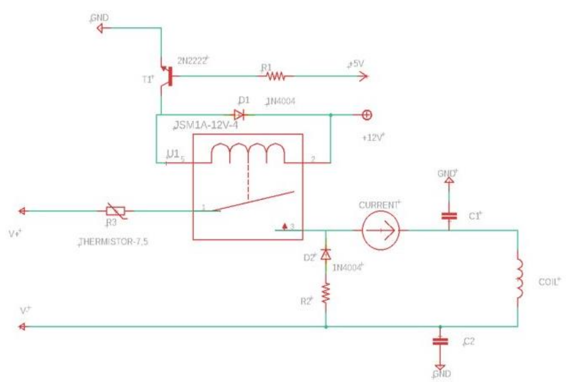

Fig. 6

Finally, based on the oscilloscope results we are able to get a decaying current due to the positive temperature coefficient thermistor (PTC). The maximum current recorded was amps and we got a back spike current maximum up to amps that was eliminated by the LED and resistor connected in parallel with the coil. In addition, with the help of a magnetometer diagram, maximum magnetic field recorded is 1000µT which is good enough to degauss any mechanical watch.

VIII. Software Design

The program is composed in the C language, utilizing Microchip Studio to manage the project files, create builds, and flash the program to the chip. The chip is programmed using the JTAG interface connected to an Atmel ICE programmer which runs to the USB port of the system used to write the software for the microcontroller.

The program utilizes interrupts to implement the various functionalities desired in the project.

- Bidirectional rotation - When the 'A' button is pressed on the 4x4 keypad, an interrupt is called that toggles the state of the GPIO pin connected to the DIR port on the motor driver circuit, which in turn allows the user to change the direction in which motor spins the watch.
- Motor power state - When the 'B' button is pressed, the GPIO pin connected to the motor driver EN port is toggled, thus either enabling or disabling the power stage of the motor driver.
- Degausser activation - When the 'C' button is pressed on the keypad, the GPIO pin connected to the gate of a transistor which eventually engages the degausser is driven high for 15 seconds to ensure the degausser can achieve its entire operation cycle.

The interrupts are triggered by the GPIO pins connected to the keypad; within the software they are programmed to register interrupts for the rising edge of a logic high signal. The chip uses multiple GPIO controllers to manage a group of pins, so the software must verify which specific pin triggered the interrupt in order for the correct behavior to trigger. Once the interrupt code for that specific input has been executed, the flag is cleared for that specific GPIO pin and the code returns to the event loop of the main function.

The motor driver circuit necessitates a clock signal on the STCK port in order to establish the timing of the steps for the motor. The ATUC256L3U-AUT features a built-in 32Khz RC clock that allows for a configurable divider and is mapped in the software to output through a GPIO pin that is multiplexed to accept a generic clock input. The divider input is an 8-bit value and is configured to its maximum value of 255. The motor possesses a resolution of 1.8°/step.

$$rotation\ speed\left(\frac{degrees}{sec}\right) = \text{RS} \qquad (2)$$

$$RS = \frac{clock\ frequency(hz)}{divider} \times resolution\left(\frac{degrees}{step}\right) \qquad (3)$$

Using (1) and (2) we find the final performance characteristic of the motor to be a rotation speed of ~225°/sec.

Conclusion

Having reached the end of the project, ultimately, we achieved the basic goals we set out to accomplish for the project, these being the unification of the degausser and watch winder functionalities into a single unit. Afforded more time we would have been able to realize the secondary functionalities of a proper user interface, utilization of the magnetometer, and possibly even our original stretch goals of web connectivity capabilities. We are nonetheless satisfied with the work we have done so far.

Overall, this project was a rewarding opportunity to apply the knowledge we obtained both in and out of the classroom, and has left us all excited to pursue such endeavors after university. Beyond the technical challenge associated with bringing the design to fruition, the project gave us the deeply fulfilling experience of coming together as a team and working towards a common goal. We all hope to be fortunate enough to replicate the experience as we advance in our own individual careers.

Biography

Richard Kern is currently a senior at the University of Central Florida and is set to graduate in December 2022 with his Bachelor of Science in Electrical Engineering. Richard has been employed at Up-Rev Inc since 2015 and has eight years' experience in product development. Richard is currently employed as an Associate Electrical Engineer at Up-Rev and during his time at Up-Rev Richard has developed his skills in circuit design, pcb design, troubleshooting, custom fabrication, and many other skills associated with full product development. Richard wishes to expand his knowledge in new technologies, product development, and circuit design to become a Sr level electrical engineer.

Andrew James is currently a senior at the University of Central Florida and plans to graduate Fall 2022 with a Bachelor of Science in Computer Engineering. He plans to join the military after college and pursue opportunities offered in the technical field.

Vishal Mahabir is currently a senior at the University of Central Florida and plans to graduate with his Bachelor of Science in Electrical Engineering with a focus in Power and Renewable Energy. He plans to join the workforce as an entry level engineer in the power industry.

Yonas Sengal is currently a senior at the University of Central Florida and is planning to graduate in December 2022 with a Bachelor of Science in Electrical Engineering. Yonas has been employed as an intern since the beginning of October as control and relay in substation at Seco Energy. He plans to pursue a career professionally in the power industry.

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