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## Test Plan for

# ATVs (All-terrain vehicles) Anti-rolling System

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## Test plan

Each of the individual electrical components will initially be tested separately before integrated into control and feedback module. After that, the software control will be verified by measuring the voltage of GPIO pins. On the other hand, the hardware mechanical protection design will be tested in terms of safety and reliability. Finally, by interconnecting the electrical module and hardware module, the operation of the complete system will be tested and verified. The tests listed must be passed multiple times during different phases of the development cycle.

## Software Design Testing

### Electric Level Sensors

**Input:**

Power is plugged in with sufficient charge. Set the sensing level manually, and change the sensor to different angles.

**Expected output:**

Using DMM, it is possible to see there is a significant voltage change on the output pins once the sensor over the pre-set sensing level in any direction. Also, one of the four led lights on the sensor board will show up, indicating the direction of over limit direction.

### LEDs and Relay

**Input:**

Power is plugged in with sufficient charge and connected to level sensor and relay.

**Expected output:**

Once the level sensor reach the manual pre-set angle, the low voltage signal from the output pins will trigger relay to connect LEDs to the battery. LEDs lights will turn on, vice versa.

## Arduino UNO

### **Input:**

Power is plugged in with sufficient charge and connect to level sensor. Changing the sensor to different angles.

### **Expected output:**

According to our designed program, we can see from the DMM that there are two voltage signals coming out from the different Arduino GPIO pin 0.5 second and 2 second after the sensor reach the sensing level respectively.

## Hardware Design Testing

### Hardware Mechanical Protection Bar

### **Input:**

Press the bar all the way down till it locked first, and then power the electromagnet on the lower supporting bar.

### **Expected output:**

Once the electromagnet is on, the pressed protection bar will launch immediately with fast speed. And when there is a barrier in the middle of launching path, the inner lock design will stop the bar as well as preventing it from following back.

## Unit Testing

By combining all individual parts, the final product will be tested.

### **Input:**

Power is plugged in with sufficient charge for all components. Varying the angle of level sensors.

**Expected output:**

When the angle reach the pre-set warning level, the first level sensor will send a signal to turn on the warning LEDs indicators. As the angle keep climbing and reach the second pre-set level. The second sensor will send a signal to the microcontroller, which depending on the situation, will launch the protection bar in 0.5 second and disconnect the electromagnet in 2 second.

## Field testing

**Input:**

Assembly both hardware and software, bring the final modified ATV to the real field and test drive.

**Expected output:**

The anti-rolling protection system will be easy to install and preform the same job as indicated on the unit testing. Moreover, all the casing and wiring of our product is firm and waterproofed. The skin touching area is insulated. Finally, the whole system will be easy to reset and will not affect driver's driving experience.