

sdmay18-13: Measuring Voltage and Wire Continuity

Week 7 Report

October 15 - October 21

Team MembersAaron Eaton — *Chief Engineer*Mohamed Almansoori — *Report Manager*Christopher Williams — *Test Engineer*Samuel Kline — *Meeting Facilitator*Matthew Kelly — *Meeting Scribe***Summary of Progress this Report**

Voltage: Zener diode circuit solution looks promising, although it needs some changes as described in the pending issues section. Capacitor voltage divider appears more useful to us as it prevents any DC current and has increased impedance for smaller capacitor values.

Wire continuity: learned what ethernet over power is and some ideas about how we can use it to solve wire continuity. Found an equation that can help measure wire continuity if we find a way to measure reflections

Pending Issues

Voltage: Must be able to read DC voltage. Research how much impedance is really needed in voltage reading circuits. Will look into using a three phase rectifier to measure voltage.

Wire continuity: need to learn more about how we can send signals over power lines and how we receive those signals. Need to find out how or if we can measure a signal's reflection.

Plans for Upcoming Reporting Period

Voltage: Research possible three phase rectifier for use in circuit.

Wire continuity: read through power line communication book and look for any ways to test for wire continuity. Specifically look for inductive coupling and ways to measure a signal's reflection.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Aaron Eaton	Found out ethernet over power is used to send high frequency signals over power wires that do not interfere with the power being sent over the wires. Learned that we should use a narrowband signal because it is lower power cost but has a higher penetration into a signal which is what we need. Found a book about power line communications. Found an equation that relates reflection coefficient to	4	50

	<p>wire impedance and signal sending impedance, so if we find a way to measure a signal's reflection we can use this equation to measure the wires impedance which we can use to determine the wire length. I will continue to research ethernet over power and ways to send a signal and measure the signals reflection.</p>		
Mohamed Almansoori	<p>Researched about different cable testers and tried to understand how it works. In general, cable tester checks for insulation losses and crossed wiring. I couldn't find a useful cable tester that will works in our case. So, I emailed Mark to look into options for wire continuity testers. I found out that there is handheld ethernet cable tester is used to show the distance to a broken wire and what we need to do is to check whether the wire is broken or not. Mark thinks that we could detect wire continuity by analyzing the battery operated device like the handheld Ethernet cable tester. I will keep researching on handheld Ethernet cable tester and finding info on how it works.</p>	4	46
Christopher Williams	<p>Designed a circuit to read voltage which clipped the input with a zener diode. Mathematically it worked for reading AC voltages, but required components with extreme values (1 giga ohm resistor). Talking to Mark via email it was decided that the device must also be able read any DC voltage in the wire when the system was turned off. Will look into fixing this circuit so it doesn't need resistors of that size and doesn't rely on a resistor voltage divider. It was proposed that we use a schmitt trigger in the circuit, which could keep the output of the comparator circuit steady even when the input voltage is near the comparator circuit's threshold. Additionally, I will look into a three phase rectifier circuit to see if that could work better than what we are currently using.</p>	4	53
Samuel Kline	<p>Drew capacitor divider circuit and calculated several conversion ratios that would be needed to convert voltages over our input range (3V-600V) down to a safe level for the arduino (~2.4V-6.4V before rectifier). The</p>	3	43.5

	<p>lower bound of the conversion range needs to be high enough that the arduino can distinguish it from no voltage after the wave rectifier, but low enough that not to many conversion ratios are needed. This range would need 6 dividers. Installed and started learning how to use PLECS simulation tool by constructing and simulating some basic circuits.</p>		
Matthew Kelly	<p>I looked at how a zener diode could be used to clip an AC voltage to a sine wave clipped at a voltage depending on the zener diode. This could be done by pairing two zener diodes parallel to the output where the two diodes were facing each other rather than facing the same direction. A zener diode only allows a negative voltage drop up to the zener voltage, V_z. Zener diodes with a zener voltage of greater than 5.6V typically used tunnelling breakdown whereas the 5.6V and lower zener diodes use avalanche to make this possible. For next week, I will be more productive and design a circuit using capacitor voltage divider because it can handle the high input voltage and consumes no power.</p>	3	46