1. **Specifications -** (*Includes Technical and Product Specifications)* We need to include the actual expected specs and how much did we get them in the performance. Make a comparative and statistical study of it.

**Technical Specifications -**

|  |  |  |  |
| --- | --- | --- | --- |
| **Specification** | **Speed** | **Accuracy** | **Safety Considerations** |
| Low Voltage (<5V) | This is limited by the rate at which we are able to change Vref: the time-constant to CHANGE Vref is $3\*10^{4}\* 20\*10^{-9} = 60\*10^{-5}sec$ or **600 microseconds**. |

|  |  |
| --- | --- |
| **Actual** | **Measured** |
| 100mV | 100mV |
| 500mV | 510mV |
| 1.00V | 1.02V |
| 1.75V | 1.77V |
| 2.51V | 2.57V |
| 3.63V | 3.69V |
| 4.86V | 4.93V |

$$Error=\frac{Actual-Measured}{Actual}=1.1\%$$ | We implemented a High Voltage alert for when the voltage approaches 5V, and we were sure to keep the low voltage probe separate from the high voltage probe. |
| High Voltage (5V+) | This is also limited by the ADC. |

|  |  |
| --- | --- |
| **Actual** | **Measured** |
| 2.77V | 2.77V |
| 5.35V | 5.35V |
| 7.04V | 7.13V |
| 10.00V | 10.20V |
| 12.81V | 12.99V |
| 14.19V | 14.44V |
| 19.60V | 19.89V |

$$Error=\frac{Actual-Measured}{Actual}=1.58\%$$ | We used a voltage divider on this line to ensure the MCU never received anything close to 5V. |
| Frequency | You get to the limits of the timer at 45KHz+, and you have overflow below 30Hz. |

|  |  |
| --- | --- |
| **Actual** | **Measured** |
| 99Hz | 99Hz |
| 10KHz | 10KHz |
| 45KHz | 45KHz |

$$Error=\frac{Actual-Measured}{Actual}<0.1\%$$ |  |
| Resistance | Again, this is mainly limited by the speed of the ADC input, and also by the time it takes to find the proper resistance for autoranging (this is usually done on a couple of iterations after the ADC is complete, on the order of us). |

|  |  |
| --- | --- |
| **Actual** | **Measured** |
| 100 Ohm | 104.2 Ohm |
| 1.00M | 1.00M |
| 50 Ohm | 50 Ohm |
| 10.0K | 10.0K |
| 75 | 76.7 |
| 51K | 53K |
| 100K | 101K |

$$Error=\frac{Actual-Measured}{Actual}= 0.6\%$$ |  |
| Capacitance | Like Frequency, this is limited by the 16 bit timer in the Timer1 Capture Register. This can be helped by simulating a 32 bit timer with an overflow count, and it can be helped by autoranging. |

|  |  |
| --- | --- |
| **Actual** | **Measured** |
| 180pf | 200pf |
| 1uf | 1.02uf |
| 10uf | 9.72uf |
| 5uf | 5.07uf |
| 17.3nf | 16.7nf |

$$Error=\frac{Actual-Measured}{Actual}= 13\%$$ |  |

**Usability**

Clearly our design is quite accurate for the most part, and is easy to use with the intuitive user interface. This design makes one handed-operation possible unlike conventional multimeters, and therefore may be useful to people who only have the use of one hand. This also allows great dexterity and control as opposed to conventional probes, which may be useful to those suffering from arthritis. In general, LabGloves© could potentially make working in the lab easier—to the extent people may forget they are even wearing them—until they need a voltage measurement of course!

**Product Specifications –**

* + - 1. Capacitance – 200 pF to 150 uF
			2. Resistance – 25 Ohms to 10 MΩ
			3. Frequency – 30 Hz to 45 KHz
			4. Voltage – 0.1 V to 20 V (tested) / 50 V (ideal)
			5. Temperature - 0.2 C to 120 C
			6. Transistor – PNP and NPN transistor
			7. Diode – VF of 0.7 – 0.9 V