B.Sc. Electronic Engineering Industrial Training Project Proposal

Power Supply Calibration Unit

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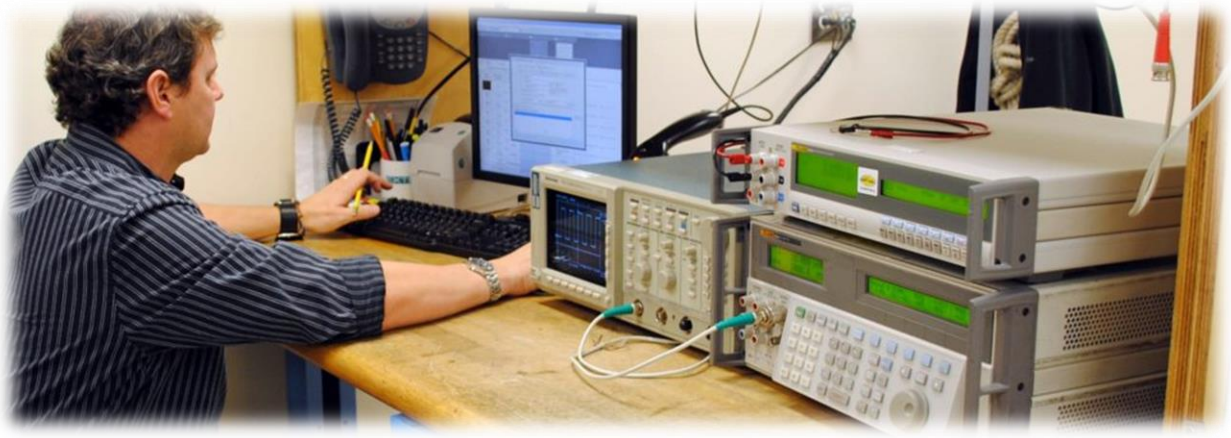
Problem Statement

The current calibration process at VARIOSYSTEMS involves a Windows application that facilitates the calibration of power supplies. During this process, the power supply and the main multimeter need to be physically connected to the computer. The software controls the power supply to output specific voltages and currents, while the multimeter measures these values. The software then compares the power supply output with the multimeter readings.



One key challenge is that the operator must manually connect the probes for voltage and current measurements. This manual intervention requires the operator to stay close to the computer throughout the entire calibration process. As a result, this process is time-consuming for the operator or engineer involved.

To address this issue, it would be beneficial to explore ways to automate or streamline the probe connection process. This could involve developing a system that automatically connects the probes based on the current or voltage measurement requirements, reducing the need for constant manual oversight. This improvement would not only save time for the operator but also enhance the overall efficiency of the calibration process.

Objectives of Project

The primary objective of this project is to enhance the efficiency and intelligence of the calibration process for power supplies at VARIOSYSTEMS. The key goals include automating the manual aspects of calibration to minimize the operator's involvement and streamlining the probe connection procedure through the introduction of an intermediate switching unit that can automatically manage and switch probes based on calibration requirements.

Efficiency improvement is a central focus, aiming to reduce the overall time required for the calibration process by eliminating manual probe connections. This will allow the operator to focus on higher-level tasks, thereby enhancing the throughput of calibration procedures and enabling a faster and more efficient workflow.

The project also aims to optimize operator resource utilization by freeing up the operator from continuous manual intervention during calibration. This shift will enable operators to engage in other productive activities while the automated system handles the probe connections and measurements.

Furthermore, the project emphasizes improving the accuracy and precision of calibration measurements by automating probe connections, minimizing the risk of human error associated with manual operations. The objective is to ensure that the calibration process consistently meets or exceeds specified tolerance criteria.

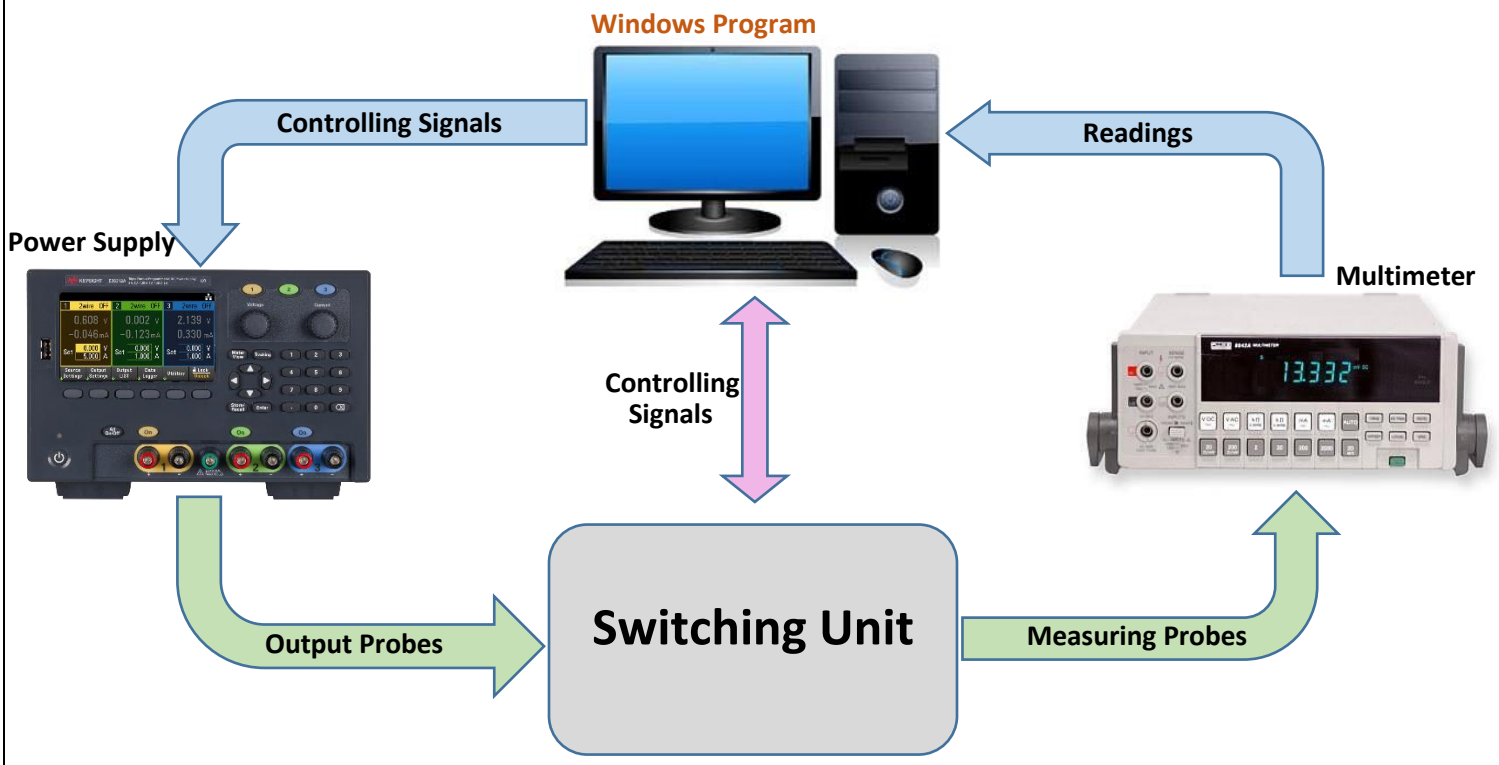
The development of a new Windows application is another key objective, with the aim of intelligently controlling the calibration process. This application will seamlessly integrate with the power supply, multimeter, and the intermediate switching unit. Smart algorithms within the software will manage the calibration sequence, adjust parameters as needed, and analyze results in real-time.

Comprehensive reporting is integral to the project, involving the generation of detailed calibration reports that include information on all tested voltage and current levels. The reports will provide a clear pass/fail status for each calibration point based on specified tolerance criteria.

Lastly, the project will enhance documentation capabilities by creating a system that automatically logs calibration results, ensuring traceability and accountability in the calibration process for quality assurance purposes. By achieving these objectives, the project aims to transform the calibration process into a more efficient, intelligent, and streamlined operation, contributing to improved product quality and reduced operational overhead.

Methodology for Implementation of Project

To address the inefficiency in the calibration process described earlier, the proposed solution involves introducing an intermediate switching unit that automates the probe connections. Additionally, a new Windows application is needed to manage the power supply, multimeter, and the intermediate switching unit while generating comprehensive calibration reports. Here's a description of the solution:



Intermediate Switching Unit:

- The intermediate switching unit acts as a mediator between the power supply, multimeter, and the computer running the calibration software.
- It is equipped with automated switching capabilities, allowing it to connect the appropriate probes for voltage and current measurements based on the calibration requirements.
- The operator's responsibility is reduced to connecting all the probes (power supply and multimeter) to the intermediate switching unit before starting the calibration process.

Windows Application:

- A new Windows application developes to control the entire calibration process.
- The software interfaces with the power supply, multimeter, and the intermediate switching unit.
- The operator initiates the calibration process by running the program and specifying calibration parameters.
- The application communicates with the intermediate switching unit to automate the probe connections, eliminating the need for manual intervention.
- It controls the power supply to output specific voltages and currents, while the multimeter measures these values.
- The software compares the power supply output with the multimeter readings and applies tolerance criteria to determine pass or fail for each voltage and current level.

Report Generation:

- The Windows application generates a detailed calibration report after completing the calibration process.
- The report includes information on each tested voltage and current level, the actual measurements from the multimeter, the power supply outputs, and whether each test passed or failed based on tolerance criteria.
- This report provides a clear overview of the calibration results and can be saved or printed for documentation purposes.

By introducing an intermediate switching unit and a dedicated software application, this solution automates the calibration process, significantly reducing the time and manual effort required from the operator. It enhances the efficiency and accuracy of the calibration procedure while providing detailed reports for quality control and documentation.

Extra Features

1) Measuring 20A Current.

As part of this project, a notable feature is the implementation of a method to measure currents up to 20A using the existing multimeter, which has a maximum capacity of 10A. This enhancement involves the integration of a shunt resistor into the measurement setup. The shunt resistor is strategically placed in series with the multimeter to divert a portion of the current, allowing accurate measurements of higher currents without exceeding the multimeter's 10A limit. This innovative solution enables the calibration system to effectively handle power supplies with current outputs reaching up to 20A, expanding the versatility and functionality of the calibration process.

2) Continuity Checking of Probes.

The project incorporates a probe continuity checking feature to ensure the successful calibration of power supplies. This feature involves an automated process to verify the quality of probe connections. Before initiating the calibration, the system will perform a continuity check on all probes to confirm a solid and reliable connection. Any issues with continuity will be promptly identified, allowing operators to address and rectify connection problems before proceeding with the calibration process. This proactive approach enhances the overall reliability of the calibration system by ensuring that accurate measurements are obtained through secure and continuous probe connections.

Project Schedule Plan

		Weeks
I.	Planning Main Functional Blocks.....	1
II.	Drawing rough sketches of the internal structure.....	1
III.	Choosing suitable components and microcontroller.....	1
IV.	Drawing schematics for the prototype.....	1
V.	Routing the layout of the prototype.....	1
VI.	Testing the prototype functionality.....	1
VII.	Developing a GUI for the Calibration Application.....	2
VIII.	Developing the code to control the equipments.....	2
IX.	Developing the code to control the relay switching.....	1
X.	Developing the code for the extra features.....	1
XI.	Developing the code for report generation.....	1
XII.	Drawing the schematic of the final PCB.....	1
XIII.	Routing the layout of the final PCB.....	1
XIV.	Completing the product with an enclosure.....	2
XV.	Final Documentation.....	1
Total number of weeks.....		18

Components

- STM32 F411RE..... 1
- IRM-15-24 Module..... 2
- ULN2803 IC..... 4
- LED..... 30
- JST connectors(20)..... 4
- JST wires(20)..... 2
- TEN -5-2411 Module..... 1
- 24V Relay..... 40
- Shunt Resistor 20A..... 1
- Colling Fan..... 1
- Power Cable..... 1

References

- Altium Playlist
  https://youtu.be/INi0JY7SxPo?si=ogqqA57oVipGeL7f

- STM32 PCB Design
  https://www.youtube.com/watch?v=PMEpQZ90f34&t=45s&pp=ygUSc3RtMzIgYm9hcmQgZGVzaWdu

- Advanced PCB Design Playlist
  https://www.youtube.com/watch?v=PMEpQZ90f34&list=PLXSyc11qLa1b9VA7nw8-DiLRXVhZ2iUN2

- C# Basics
  https://www.youtube.com/watch?v=GhQdlIFylQ8

- C# GUI Design
  - https://www.youtube.com/watch?v=PY7Ojn9Kv30
  - https://www.youtube.com/watch?v=qLNLWw82NeE&list=PLyQXlWxYAh8-TkeUrN8viS8K69lNK1pDn

- GUI for Arduino using C#
  - https://youtube.com/playlist?list=PLDxmEGn62t7indrQcJGBchHJCJqTWdGP&si=dgnbSstT3MFyN95b
  - https://www.youtube.com/watch?v=SGZ_3sybyWM
  - https://www.youtube.com/watch?v=QYm4s0Cy3mY

- Arduino IDE setup for STM32
  https://www.youtube.com/watch?v=yssEiMLGH90

- OOP concepts in C++
  https://www.youtube.com/watch?v=wN0x9eZLix4

- CSV file generation using C++
  https://www.youtube.com/watch?v=FwhfYlkm0yU&pp=ygUh4oCiCUNTViBmaWxlIGdlbmVyYXRpb24gdXNpbmcgQysr