SCC

Hardware Checker Phase 3 - Standalone Cable checker

ELECOMP Capstone Design Project 2022-2023

Sponsoring Company:

Vicor
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http://www.vicorpower.com

Company Overview:

Vicor Corporation designs, develops, manufactures and markets modular power components and complete power systems based upon a portfolio of patented technologies. Headquartered in Andover, Massachusetts, Vicor sells its products to the power systems market, including enterprise and high-performance computing, industrial equipment and automation, telecommunications and network infrastructure, vehicles and transportation, aerospace and defense.

Technical Directors:

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Project Motivation:

Vicor sells a large variety of ICs to consumers every year. Vicor has to test each of their parts before selling them to customers to ensure they all function the way they were designed. With each part serving differently than the next, a wide variety of test equipment is required to test each of the parts. From The test equipment, called ATE (Automated Test Equipment) all the way down to the hardware used to connect down to the DUT (Device Under Test), each piece of the puzzle must be working flawlessly in order to ensure accurate results from the testing. As ideal as this is, the world doesn't work that way, and something always goes awry. And once it has, it's the Test Engineers to determine the issue and fix it, also called debug.

In order to debug, the Test Engineer has to spend a lot of time going through, determining the cause of the issue, and then finally figuring out a solution to the issue that occurred. This is because there are many different stages that could have gone wrong during the testing of the ICs. There's the ATE, that utilizes many different resources in order perform its testing. There's all the connections made to connect the resources of the ATE to the PCB used to test the DUTs. And lastly there's the PCB that connects to the DUT that features a large amount of switches and

components needed to perform the tests required to prove out the IC. Due to there being so many parts in the whole process, a good amount of time is usually spent on Finding the issue and fixing it. Where that time could be better spent elsewhere like new parts that come down the pipeline.

To combat the time spent, we sought out designing different tools that could both speed up the process and allow others that may not know the part to be able to figure out the issue. For the past few years of Capstone, we have worked on different stages of the process and created tools to get us closer to our goal. Two years ago, the capstone students worked on creating PCB Hardware that would be able to test the ATEs resources to allow us to see if the system or resource was off that may not be caught during the ATEs Diagnostic process. Last year, the Capstone students worked on creating "Hardware Checkers" to be able to use the ATE to test the hardware on the PCBs that connect to the DUT. This year, we plan on targeting the final step of the process that usually gets overlooked, the connections from the ATE to the PCB.

The connection part of the system overall, even though it is usually overlooked, it doesn't change the fact that it's still important. The whole setup needs to be fully functioning in order to complete the testing process. When an issue arises, the cable is usually changed and then tossed in the "bad" pile due to no one taking the time to check and see what is wrong and if it is fixable. We'd like to change this and make so that it is completely transparent with the issue. This will save the company time and money with the cables of each of our testers.

The aim won't be just to help test our cables in-house but creating a tool that we will be able to send out and assist in our offsite testing as well. Due to the sheer amount of parts needing to be tested, we have contract manufacturer (CM) testing to help us keep up with demand. This helps the company tremendously; however, there are new issues that arise due to this. Not all of the CM test houses are done in our same time zone; this causes issues when a problem pops up. The Test engineer won't always be around when that happens to help fix it, especially when a majority of the communication is done via email. This usually leaves the CM down and not able to test. To be able to combat this, our debug tools are designed so that the CM technicians can use them to discover and fix the issue on their own and get it back up and running. This saves the company money on travel and the test engineers time and headaches.

Anticipated Best Outcome:

The anticipated best outcome of this project is the creation of a housed, standalone cable checker. The cable checker will house a custom-made PCB that will allow for multiple different cable connections, to be able to test a wide variety of cables.

The cable checker will use a controller to accurately test and display a visual reference to the operator that tells them if the cable is either good or a bad.

Project Details:

Overall system concept:

The "Cable Checker" is planned to be a complete standalone system, which will require the design of five sections for completion: Power, Testing Circuit, Housing, Controller, and Output Display. Each one plays its own role in the setup and functionality of the system.

With the system being completely standalone, it will need a power source. The system is planned to be a "one plug" solution. Meaning in the end, we plug it into a wall outlet and we are good to go. This will require some design decisions from the students on the path to take to achieve this. As wall outlets are typically 120V, the system will require some way to be able to cut that voltage down to a usable voltage. This voltage will need to be able to support both the testing circuit and the controller of the system.

One of the two main parts of the system will be the testing circuit. As is the name, this will be the circuit that will be used to test the cables. This testing will be done using Ohms law to be able to check connection of the cable. It will have to be able to test cables with 10 pins all the way up to a cable with 174 pins. This will pose quite the challenge of being able to test each pin to ensure connectivity.

The other main part will be the controller of the system. This will be done using a microcontroller such as an Arduino or Raspberry Pi. It will be able to control the testing done via the testing circuit while also recording and displaying the output results from the test. Using systems on the microcontroller to perform the actions will allow the system to be completely standalone and not need outside controllers to perform the testing.

The output will need to be displayed in such a way that it will be easy for the operator to understand the results. From a simple LED that shows the cable being good or bad to an LCD that will display which pin on the connector has an issue. Allowing an operator to attempt to fix the issue and not just toss the cable.

The final portion of the project will entail designing housing for the system. This will be a critical step as it will determine the final functionality of the system. With a proper housing and setup, the system can be immediately be sent to CM test house to begin cable testing, saving the company precious time that can be used for product testing.

A rough schedule is as follows:

First Semester:

- Electrical components Research
- Microcontroller Research and selection
- Design Testing circuit
- Design Visual Output
- Prototype Testing circuit
- Microcontroller integration with Testing circuit
- Power system design
- Mock-up full setup

Second Semester:

- Continue work from last semester
- Custom PCB design
- User interface Design and implementation
- Upgrade Visual output Design
- Housing Design
- Fully assembled project

Hardware/Electrical Tasks:

- Researching components
- Using Ohms law to understand the process of the testing
- Designing the circuit for testing the cables
- Designing custom PCB for the circuit
- Designing a housing system
- Designing the connectivity between all parts

Firmware/Software/Computer Tasks:

- Researching Microcontrollers
- Learning the utilities of a Microcontroller like Arduino/Rpi
- Using the Microcontroller to be able to control the designed test circuit
- Using the Microcontroller to display output information to the handler

Composition of Team:

2 Electrical Engineers & 1 Computer Engineers

Skills Required:

Electrical Engineering Skills Required:

- Basic Electrical Engineering laws (Ohms Law)
- Basic Debug skills
- Basic ability to Solder
- Schematic Capture
- Basic PCB design understanding

Computer Engineering Skills Required:

- Basic knowledge on Microcontrollers
- Basic knowledge of coding (Arduino IDE, C++, Python)
- [etc.]

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

With the creation of the standalone cable checker, we will have a tool that will be able to tell us that our cables are working before even discovering an issue while using them to test. It will also be a debugging tool that quickens the debugging process and allows for a faster solution to the problem, which in turn saves the company more time to spend on developing new parts and getting product out the door to customers.

Broader Implications of the Best Outcome on the Company's Industry:

The cable checker can be used to better facilitate low-cost off-site testing.