

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	<i>QORVO</i>	Date Submitted	<i>04/05/2019</i>
Project Title	<i>RF – 3 port Automated Calibration Box</i> QORVO_BOX	Planned Starting Semester	Fall 2019

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	1	Electrical	3
Computer	1	Systems	
Other ()			

Company and Project Overview:

Qorvo was formed in 2015 with the merger of the companies formerly known as RF Micro Devices and TriQuint Semiconductor. Qorvo Inc. is an industry leader in wireless communications and connectivity with annual sales of approximately \$3B and over 8000 employees in 17 different countries. We specialize in RF, microwave, and millimeter wave products for mobile devices along with a large portfolio of products specializing in defense and infrastructure. Throughout our history, our mission has remained the same: to drive connectivity, no matter the technology.

At Qorvo, we are driven by the possibility of discovery — of new technologies and advancements in design, manufacturing and communications that make the world a better, more connected place. We've been working on that for more than 30 years, both as innovators and as stewards of our global community. And we are just getting started.



Within our characterization engineering team, we design and build highly complex RF/microwave test systems to enable complete analysis of Qorvo mobile products' performance throughout the design phase.

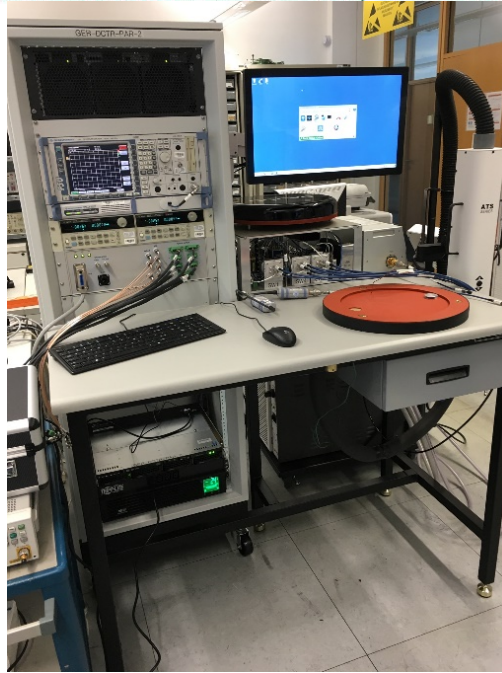
These test systems consist of:

- RF inputs 10
- RF outputs 10
- RF Aux ports 6



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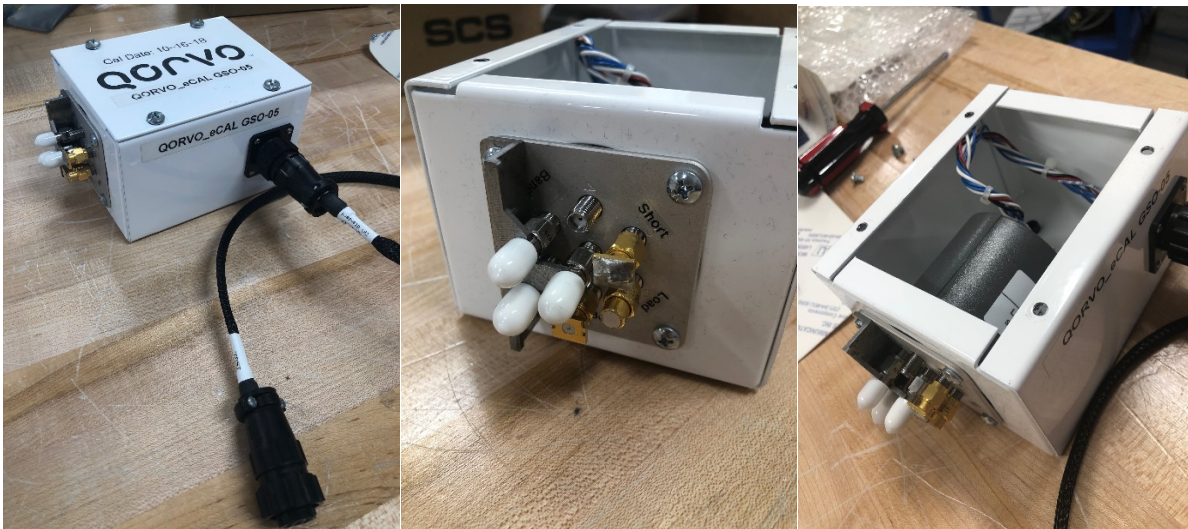
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RF vector calibration of this system is a difficult and time-consuming effort. Currently, the vector calibration uses a custom solution which needs to be improved. This project will design and build a replacement switched vector calibration standard for Qorvo test systems.

Project Requirements:

The existing solution within Qorvo is based on an electromechanical multi-throw RF switch with handmade load impedances controlled by parallel logic lines. The size is approximately 4" x 5" x 3".



Required upgrades:

Replace mechanical switch with solid-state components



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LAN interface
Utilization of off-the-shelf components
Compact size

This project aims to design and build a solid-state vector calibration standard with the following requirements:

1. Full 1 port vector correction for RF input ports
2. Must support 2 RF through paths
3. Solid-state design that can switch between at least 3 different load impedances
5. Frequency Range: 10 MHz – 6 GHz
6. Phase convergence less than 5° between an RF short and RF open
7. Full PCB design
8. Fully packaged and connectorized including an ergonomic connector layout
9. LAN communication with control from some object-oriented programming language
10. Max RF input power = 0 dBm

Expected Deliverables/Results:

- 1 fully operational calibration standard that meets all specifications
- 1 full report detailing mathematical solutions and characterization data
 - Full mathematical solution for the 3 single port error terms to vector correct the reflectometer located in the test system (test system provided at project kick-off)
 - a. Directivity Error (E_D)
 - b. Reflection Tracking Error (E_{RT})
 - c. Source Match Error (E_S)
 - load impedance data
 - phase convergence data

Disposition of Deliverables at the End of the Project:

Qorvo expects to receive the completed calibration standard and all modeling, layout, BOM, and simulation information.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Basic RF and electromagnetic understanding including RF switching, transmission lines, impedances, interconnects, etc.
- Serial Logic understanding for LAN control
- Mechanical understanding for enclosure and connectors
- Soldering
- CAD for PCB layout
- RF Simulation software