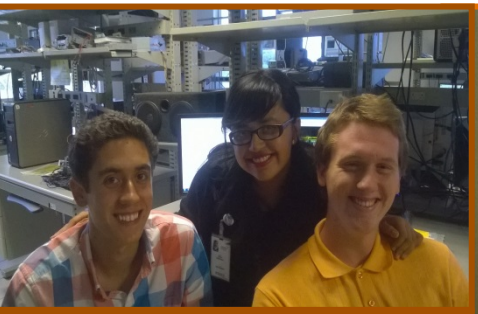
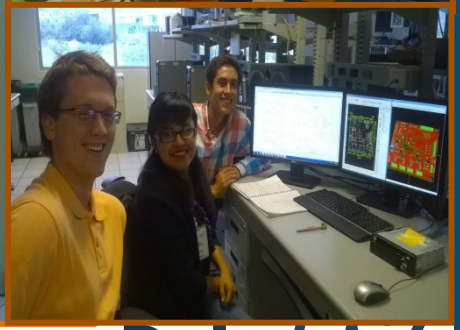




SOFIA PONCE VELA
ARIEL SANCHEZ PADILLA
JOSEPH THOMAS KOTULA
(INTERNS)

MIGUEL SANTIAGO VILLAFUERTE
SOFTWARE ENGINEER
(PROJECT SUPERVISOR)

HARDWARE TOOLS FOR SW INTEGRATION TESTING

31st, 2015

(week 8)

Abstract

In this presentation, there is a detailed discussion of the processes and methodology for designing Hardware Tools for Software (SW) Integration Testing (Modules A, D, F, and E). The modules displayed are based on calculations and simulations to make sure their function at the desired level. Additionally, the Module cases and roofs can take into account the organization of wires. The components that were chosen are the most efficient for space, utility, and price.

Background

Software team Testing

- New software release is needed
- To fix a product in the works

Specific Tests

- Connecting & Disconnecting Inputs& Outputs
- Simulating audio inputs to test Functionality

Testing is done to avoid glitches from appearing within further stages of product development.

Currently the demand for faster testing is rising within the industry as more radios are developed with more complicated functions.

Current situation

Engineers run tests to test code or other modifications

- Unit tests
- Functional tests (test functionality of product)
- Regression Tests
- Static Tests

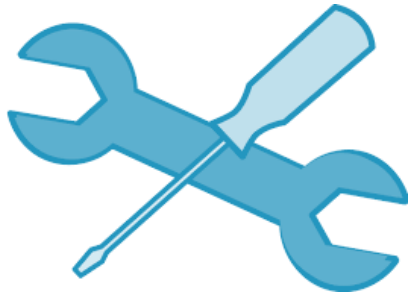
Setbacks of Function and Regression Testing

- Long
- No consistent way to measure results

General objectives

To develop some tools that will help CIDEC-Delphi in the following manner:

- Reduce the time that a SW (Software) engineer takes to test his/her code.
- Improve the test results and make them more reliable by measuring /generating signals with the correct tools.
- Reduce the cost for hardware by developing our own hardware tools.



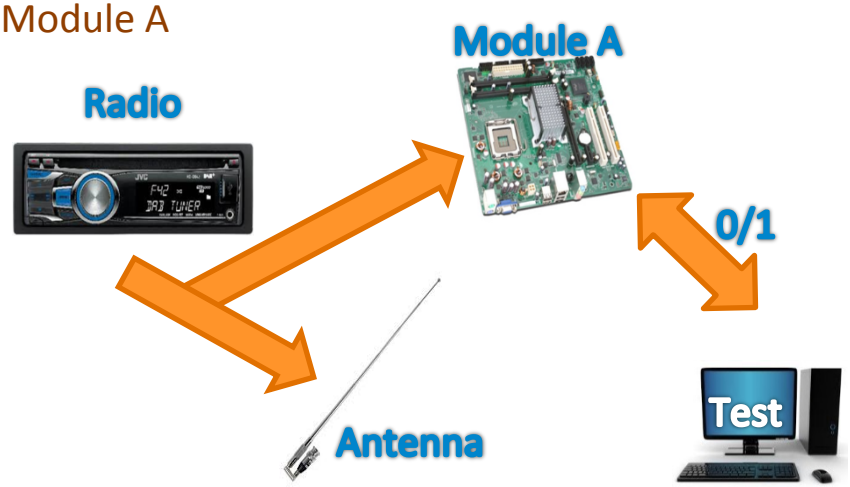
Initial Project Objectives

Develop ***the schematics for only one*** of the next modules:

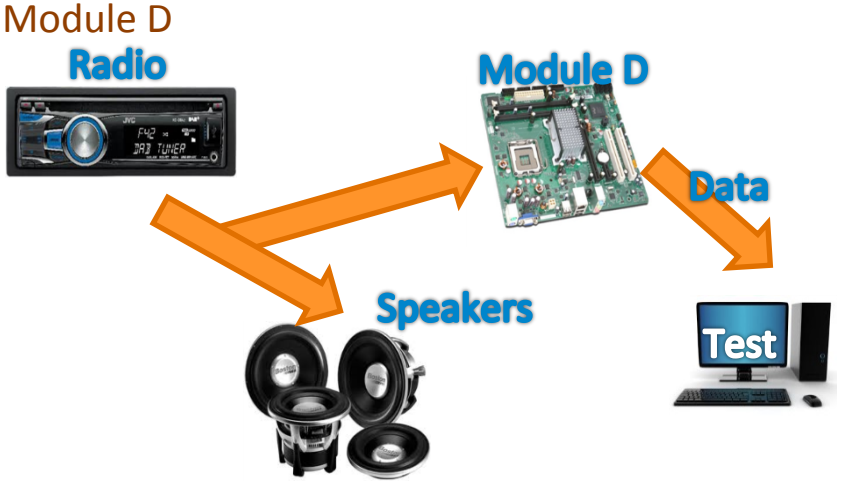
- Module A. Digital Input Monitor.
- Module D. Analog Input Monitor.
- Module E. Digital High Speed USB Multiplexor.
- Module F. ASWC (Analog Steering Wheel Control) Electronic Simulator.

Module descriptions

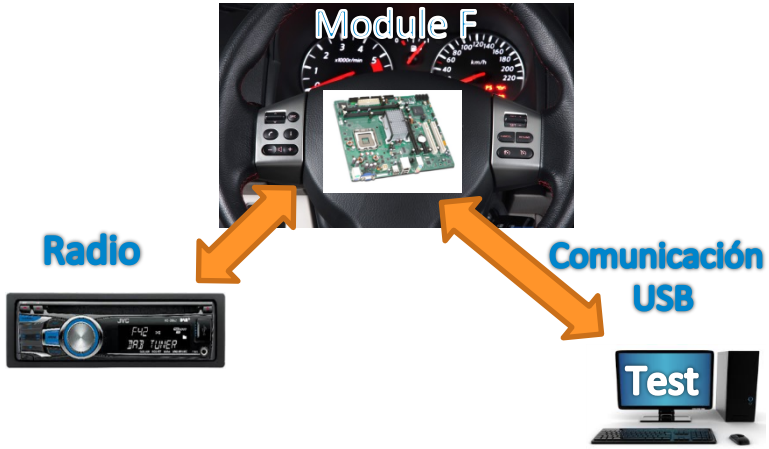
Module A

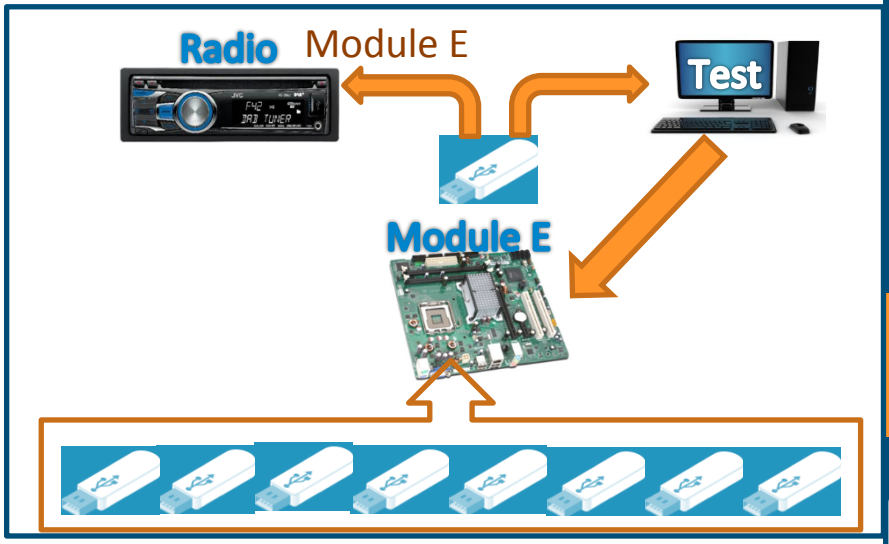


Module D



Module F





Key Engineering Issues

- The design and development of tools of industry.
- The efficient and cost effective design.
- Keeping safe the user from harm.
- Numerically calculating desired outputs of the devices.
- Maintaining a schedule of events to “stay on top of things”.

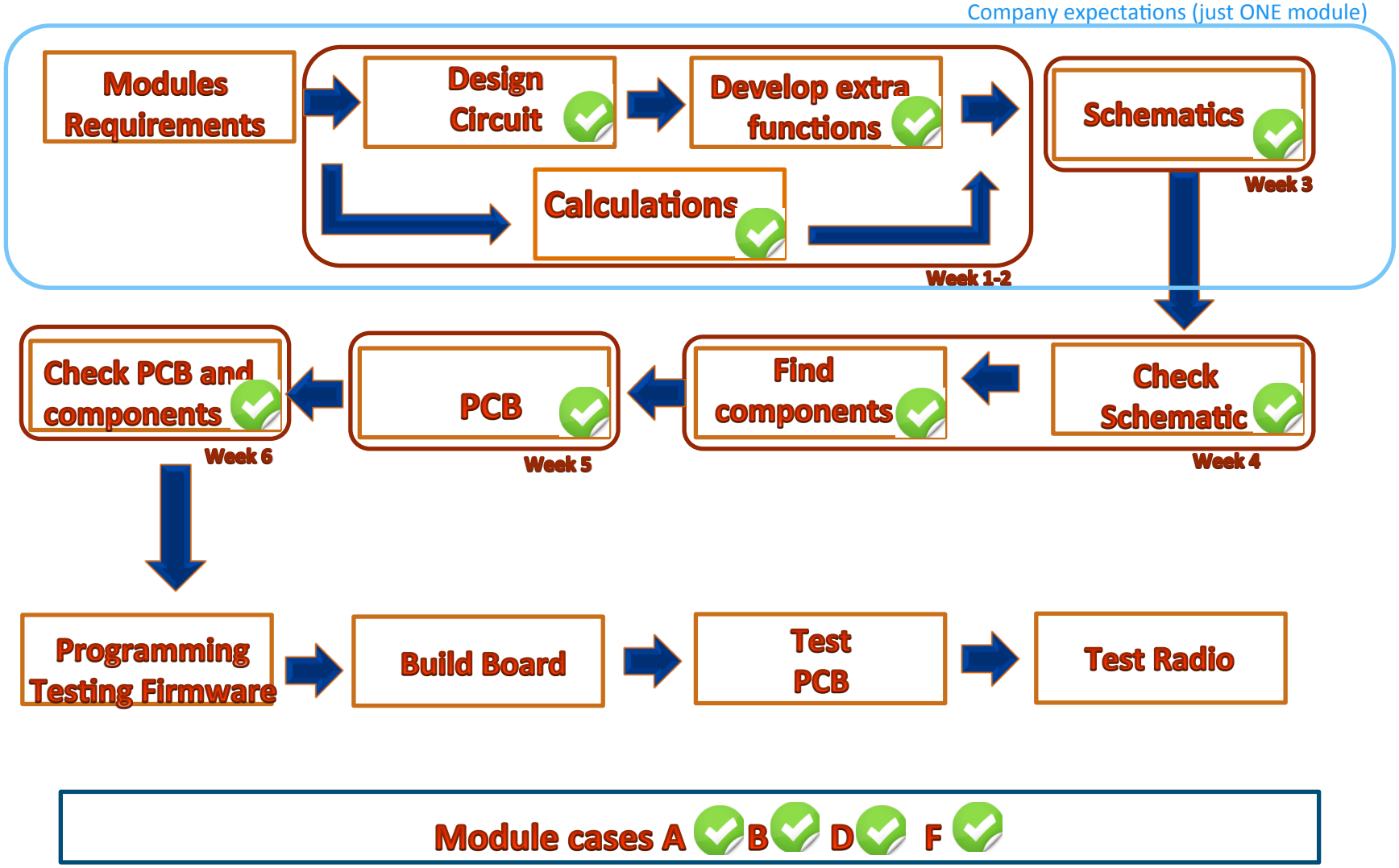
Chronogram

Activity	Person in charge	Time line
		WEEK 1 / WEEK 2 / WEEK 3 / WEEK 4 / WEEK 5 / WEEK 6 / WEEK 7 / WEEK 8
Understanding the project	All	
Making a Plan	All	
Searching for information	All	
Practicing with kicad	All	
Understanding electronic components	All	
Comparing different electronic components	All	
Developing additional functions	S & A	
Finishing schematics A and D	S & A	
Design the PCB layouts	S & A	
Designing PCB cases Module B	J	
Building case for Module B 3D printer	J	
Design cases for Module A & D	J	
Send layouts Module A & D to the manufacturer	Manufacturer	
Research Module E	S & A	
Design the schematic for Module E	S & A	
Programming Testing Firmware for Module A & D	S & A	
Building cases 3D printer	J	
Test cases and dimensions	J	
Assemble the electronic components	S & A	
Test Module A & D	S & A	

S	Sofia
A	Ariel
J	Joseph
All	S & A & J
New activities	
Delayed	

Activity	Person in charge	Time line
		WEEK 1 / WEEK 2 / WEEK 3 / WEEK 4 / WEEK 5 / WEEK 6 / WEEK 7 / WEEK 8
Understanding the project	All	
Making a Plan	All	
Searching for information	All	
Practicing with kicad	All	
Understanding electronic components	All	
Comparing different electronic components	All	
Developing additional functions	S & A	
Finishing schematics A and D	S & A	
Designing PCB cases Module B	J	
Design the PCB layouts	S & A	
Reviewing schematics	S & A	
Simulation	All	
Finding the best components and request them	S & A	
Building case for Module B 3D printer	J	
Designing schematic for module F	J	
Designing layout for module F	J	
Designing cases for Module A & D	J	
Designing proposals bases	J	
Send layouts Module A & D to the manufacturer	Manufacturer	
Research Module E	S & A	
Final review	All	
Design the schematic for Module E	S & A	
Programming Testing Firmware for Module A & D	S & A	
Building cases 3D printer	J	
Test cases and dimensions	J	
Assemble the electronic components	S & A	
Test Module A & D	S & A	
Final reports, presentations, and poster		

Scheme for the development of a card



Modules Requirements

- Module A. with various digital inputs with custom I/O voltage levels
- Module D. with 1 analog differential input to probe audio signals with 24 bits and 48kSps
- Module E. with 8 USB High speed ports which can be multiplexed
- Module F. Simulation of button pressing with varied outputs

Design circuit

MODULE A Voltage divider. It is used to scale down the input voltage from 24v to 4.096v.

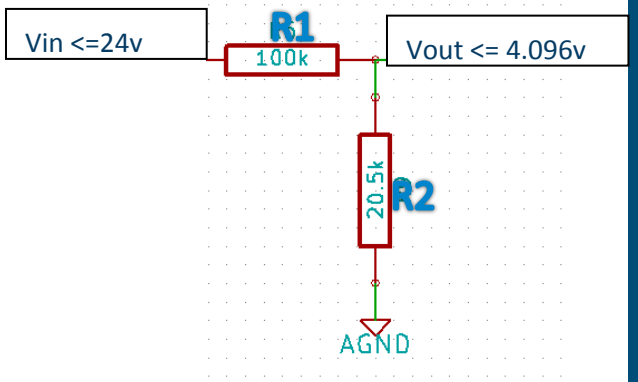
$$V\downarrow out = R\downarrow 2 \,/ R\downarrow 2 + R\downarrow 1 \; * V\downarrow in \quad (Ec.1)$$
$$R\downarrow 2 = R\downarrow 1 \; V\downarrow out \,/ V\downarrow in \,/ 1 - V\downarrow out \,/ V\downarrow in$$

Substitute values (R1 = 100kΩ; $Vin = 24v$; $Vout = 4.096$)...

$$R\downarrow 2 = 100k\Omega * 4.09v / 24v \,/ 1 - 4.09v / 24v$$

$$R\downarrow 2 = 20.542k\Omega$$

$$R\downarrow 2 = 20.5k\Omega$$



$V\downarrow out = Output\ Voltage$
$V\downarrow in = Input\ Voltage$
$R\downarrow 1\ and\ 2 = Resistors$

Develop Extra Functions

MODULE A Pulse-Width modulation (PWM) Converts an alternating current into a direct current

Filter low pass.

$$F\downarrow c = 1/2\pi * R * C$$

$$R = 1/2\pi * F\downarrow c * C$$

$$F\downarrow C = Cut\ frecuency$$

$$C = Capacitor$$

$$R = Resistor$$

$$\pi = 3.1416$$

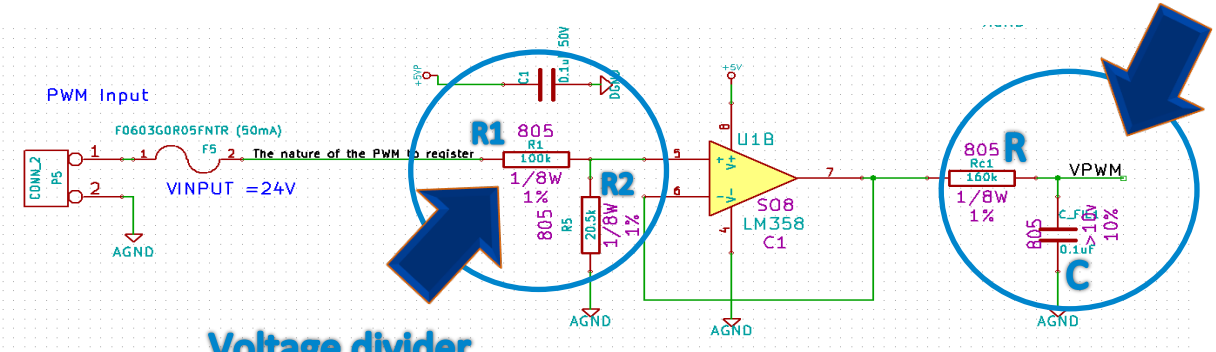
Substitute values (Fc = 10Hz; C = 0.1uF)…

$$R = 1/2\pi * 10Hz * 0.1uF$$

$$R = 159.154k\Omega$$

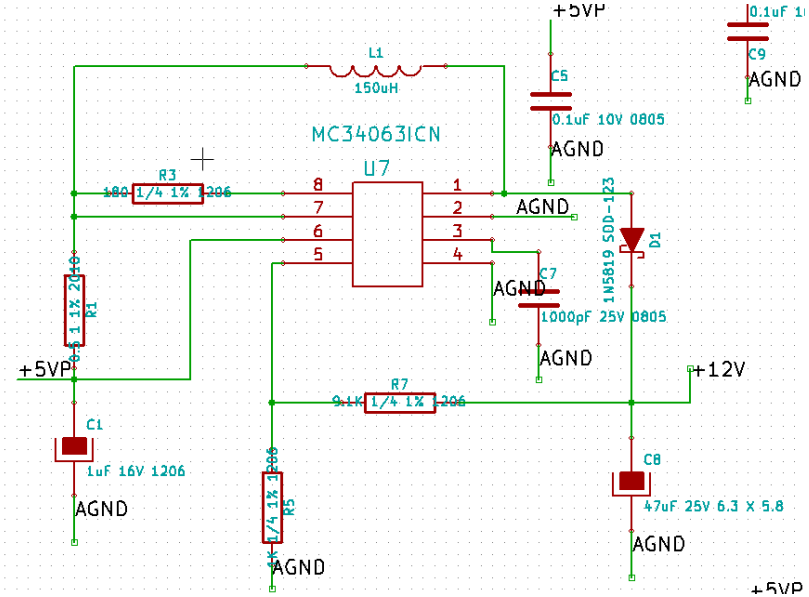
$$R = 160k\Omega$$

Filter low pass

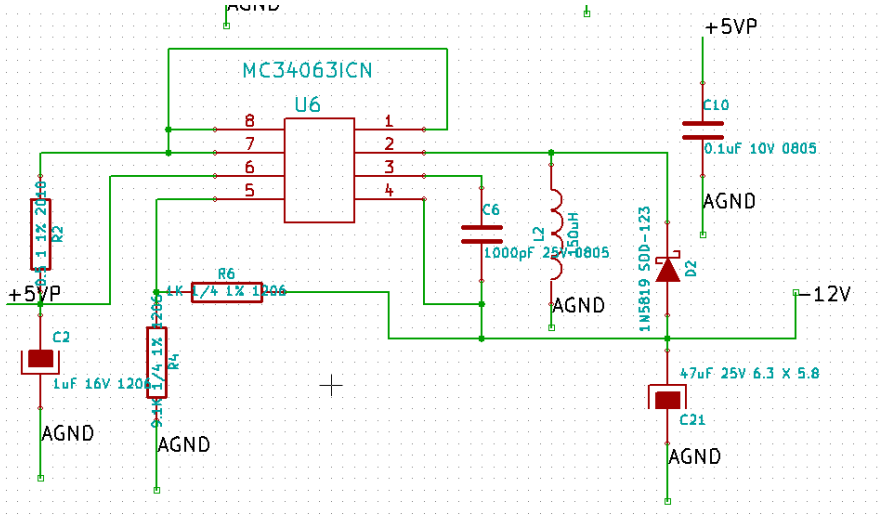


Voltage divider

Develop Extra Functions



Step up switching power supply (Module D)



Voltage - Inverting switching power supply (Module D)

Develop Extra Functions

MC34063A, MC33063A, NCV33063A

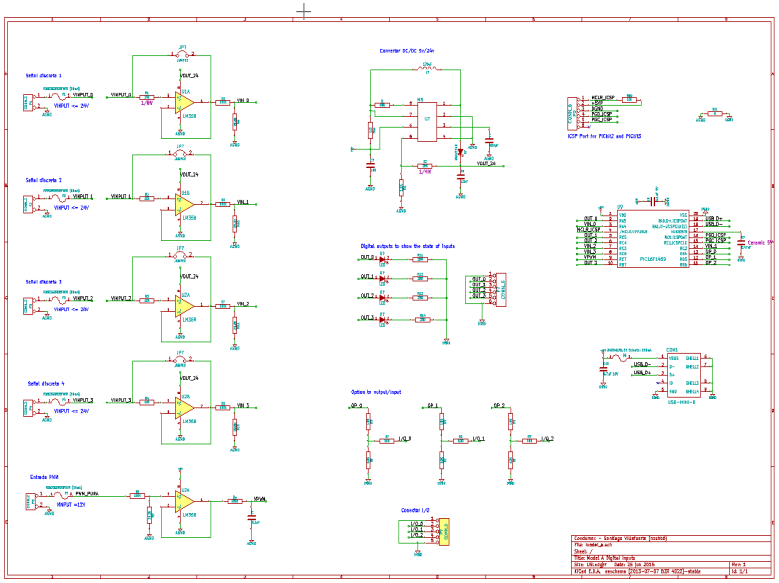
Calculation	Step−Up	Step−Down	Voltage−Inverting
t_{on}/t_{off}	$\frac{V_{out} + V_F - V_{in(min)}}{V_{in(min)} - V_{sat}}$	$\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$	$\frac{\lvert V_{out}\rvert + V_F}{V_{in} - V_{sat}}$
$(t_{on} + t_{off})$	$\frac{1}{f}$	$\frac{1}{f}$	$\frac{1}{f}$
t_{off}	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$
t_{on}	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$
C_T	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$
$I_{pk(switch)}$	$2I_{out(max)}\left(\frac{t_{on}}{t_{off}} + 1\right)$	$2I_{out(max)}$	$2I_{out(max)}\left(\frac{t_{on}}{t_{off}} + 1\right)$
R_{sc}	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$
$L_{(min)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}}\right) t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat} - V_{out})}{I_{pk(switch)}}\right) t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}}\right) t_{on(max)}$
C_O	$9\frac{I_{out}t_{on}}{V_{ripple(pp)}}$	$\frac{I_{pk(switch)}(t_{on} + t_{off})}{8V_{ripple(pp)}}$	$9\frac{I_{out}t_{on}}{V_{ripple(pp)}}$

V_{sat} = Saturation voltage of the output switch.
V_F = Forward voltage drop of the output rectifier.

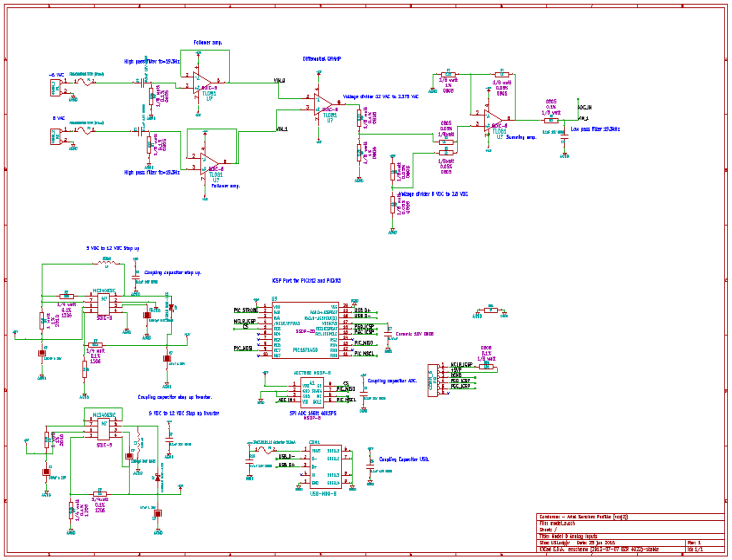
The following power supply characteristics must be chosen:

V_{in} − Nominal input voltage.
V_{out} − Desired output voltage, $\lvert V_{out}\rvert = 1.25\left(1 + \frac{R2}{R1}\right)$
I_{out} − Desired output current.
f_{min} − Minimum desired output switching frequency at the selected values of V_{in} and I_O.
$V_{ripple(pp)}$ − Desired peak−to−peak output ripple voltage. In practice, the calculated capacitor value will need to be increased due to its equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it will directly affect the line and load regulation.

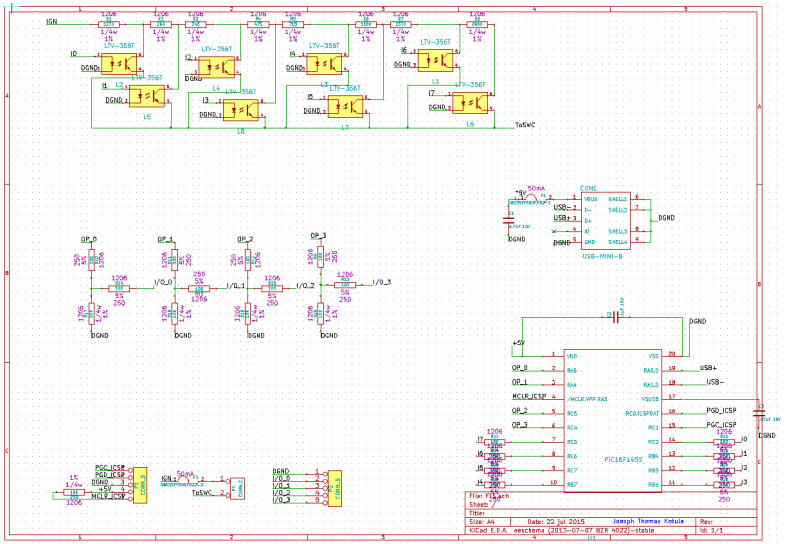
Schematics



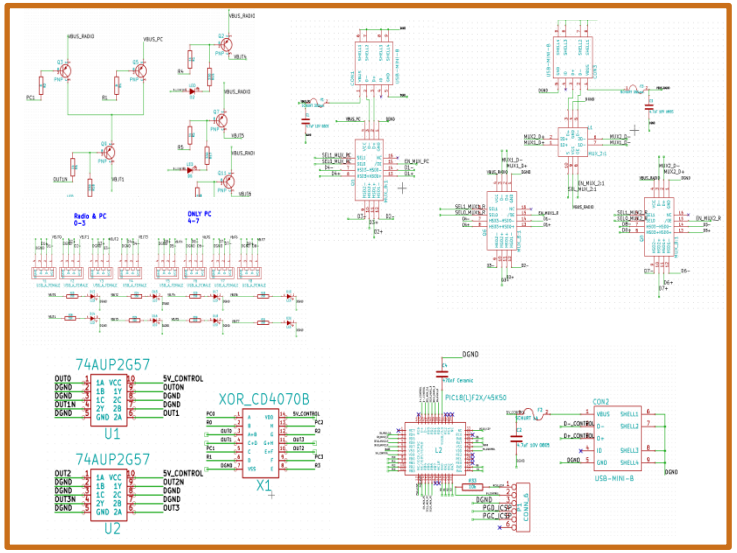
Schematics Module A (company expectations*)



Schematics Module D (company expectations*)



Schematics Module F (company expectations*)



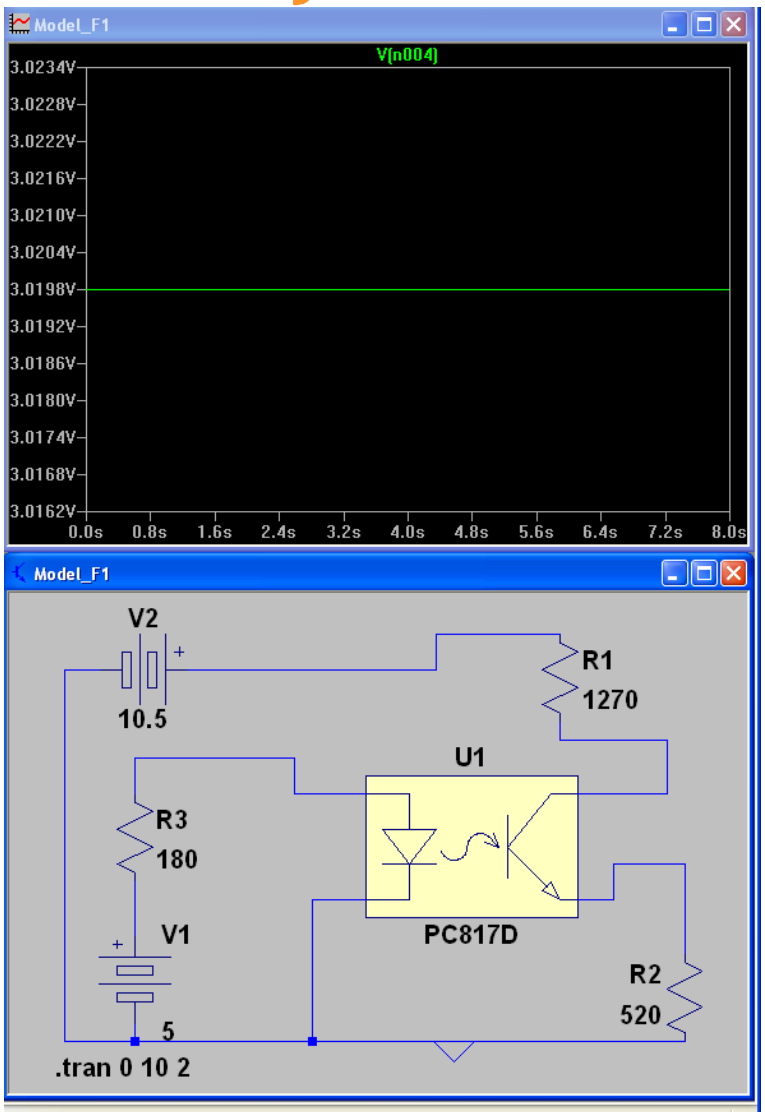
Schematics Module E (company expectations*)

*Develop the schematics for only one of the Modules

Checking the Schematics (Simulation)

- Simulated using Similar Circuits

- Made revisions to designs after simulations



Model F Simulation

*Develop the schematics for only one of the Modules

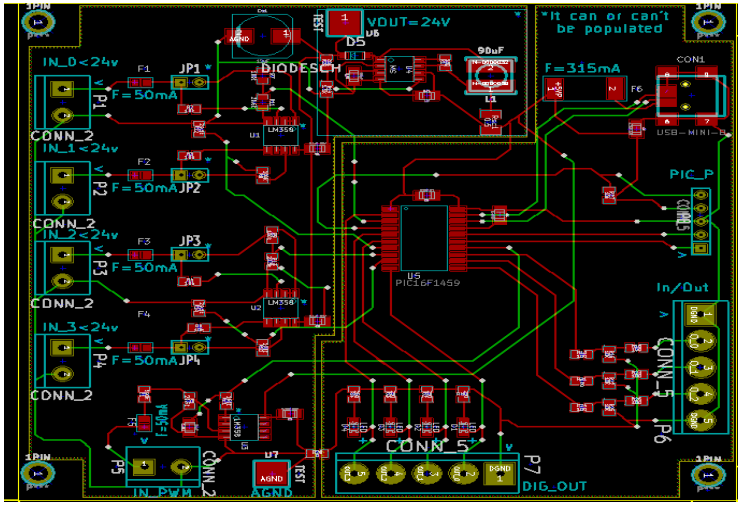
Finding Components

- The designs utilized many components.
- These components had to be found online and met the requirements for each module.

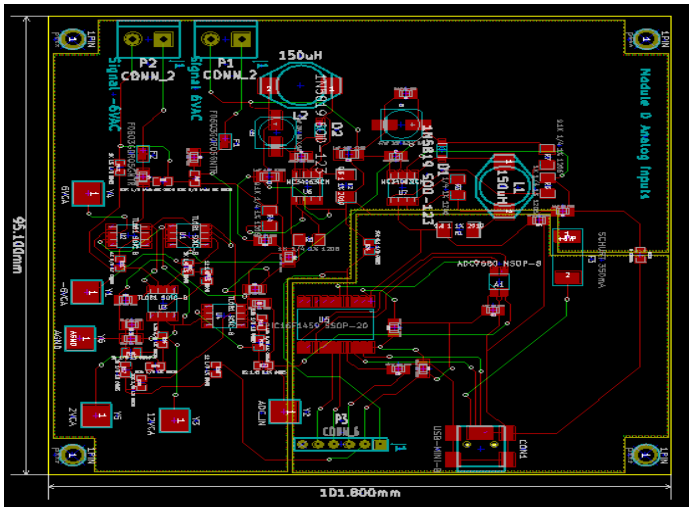
Detalle de los productos			N.º de artículo del cliente:	Cantidad pedida	Precio (USD)	Ext. (USD)
Mouser N.º:	77-VJ0805A391JXAAC	QuickView		1	$0.13	$0.13
Fabricante N.º:	VJ0805A391JXAAC			Opción de embalaje: Cinta cortada		
Fabricante:	Vishay			Disponibilidad 1 Se envía ahora		
Desc.:	Capacitores cerámicos de capas múltiples (MLCC) - SMD/SMT 390pF 50volts C0G 5%					
RoHS:	En conformidad con la RoHS					
Mouser N.º:	652-SRR5018-9R0Y	QuickView		1	$0.845	$0.85
Fabricante N.º:	SRR5018-9R0Y			Opción de embalaje: Cinta cortada		
Fabricante:	Bourns			Disponibilidad 1 Se envía ahora		
Desc.:	Inductores fijos 9uH 30% SMD 5018					
RoHS:	En conformidad con la RoHS					
Mouser N.º:	603-RL1210FR070R5L	QuickView		1	$0.767	$0.77
Fabricante N.º:	RL1210FR-070R5L			Opción de embalaje: Cinta cortada		
Fabricante:	Yageo			Disponibilidad 1 Se envía ahora		
Desc.:	Resistores de detección de corriente - SMD 0.5ohm 1% 1/2W					
RoHS:	En conformidad con la RoHS por exención					

Sample of BOM (Bill of materials)

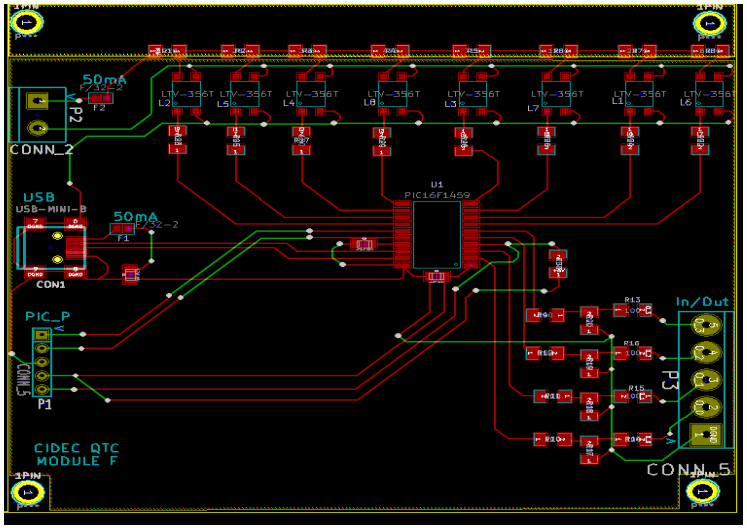
Design PCB



Layout Module A

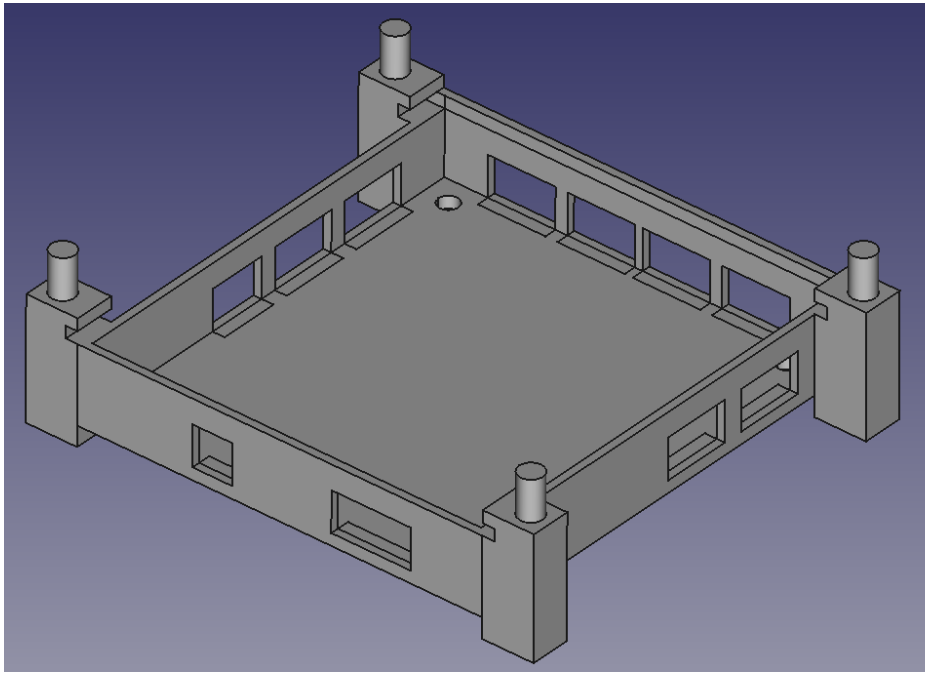


Layout Module D

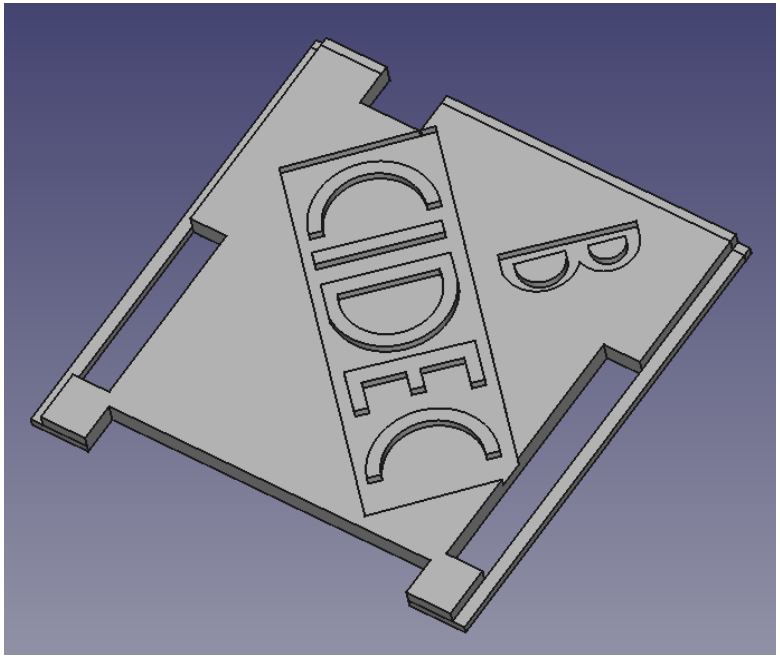


Layout Module F

Contenedores Salvadores



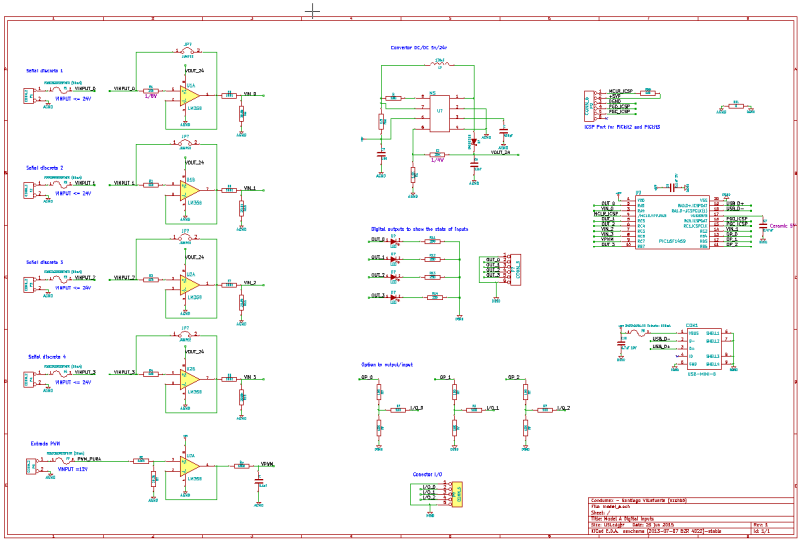
General Base for Module B



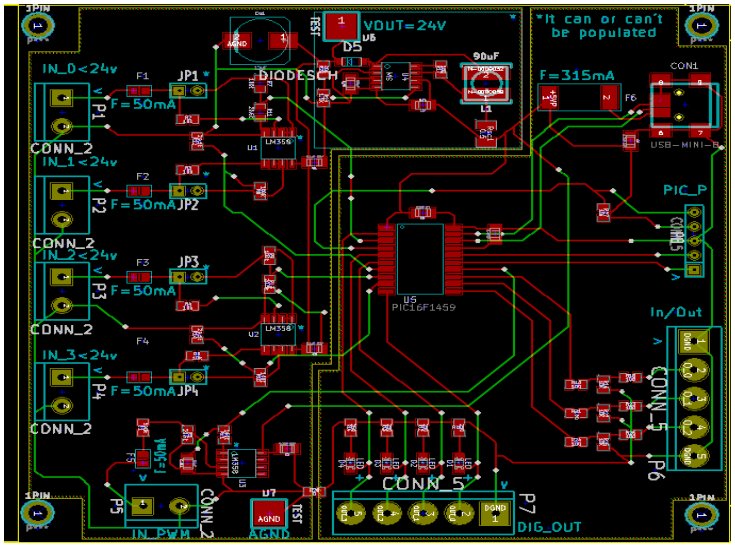
Roof for Module B

Results

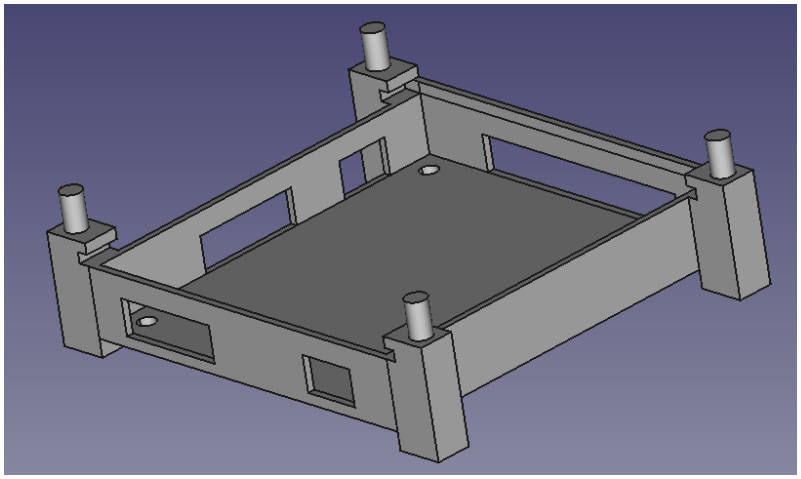
Module A



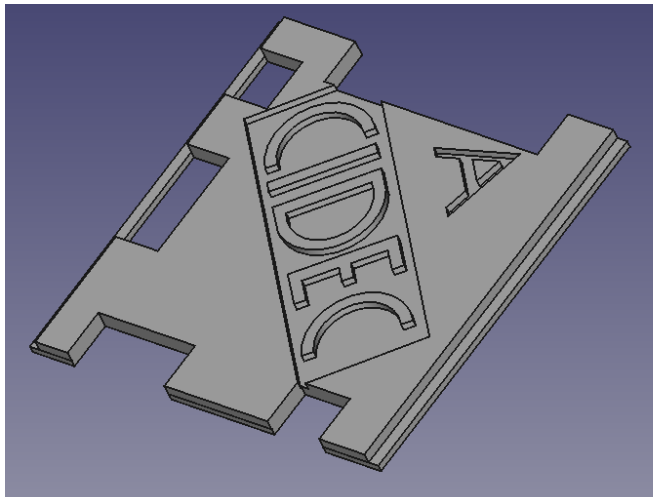
Schematics Module A (company expectations*)



Layout Module A



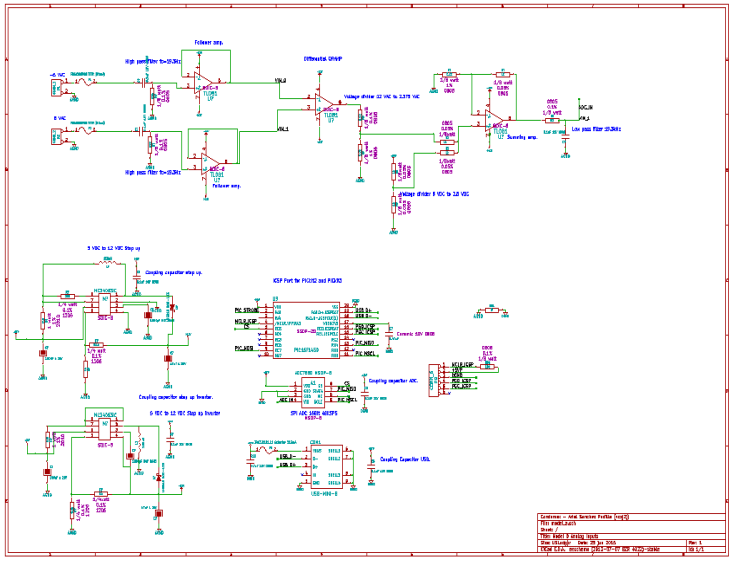
Case Module A



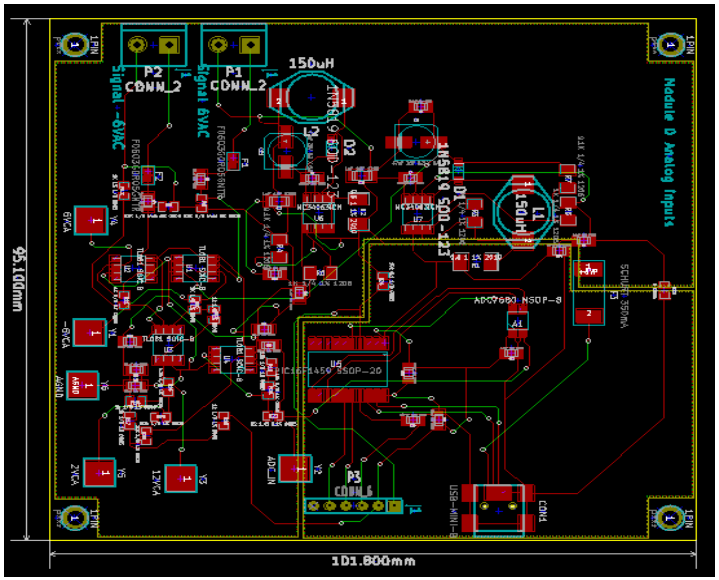
Roof case Module A

*Develop the schematics for only one of the Modules

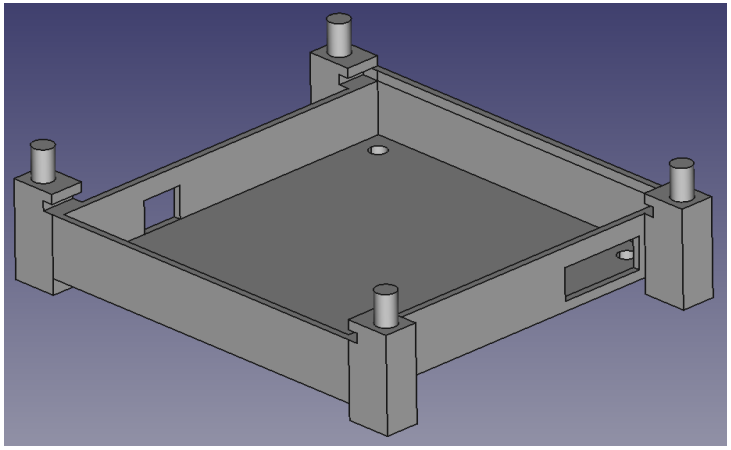
Module D



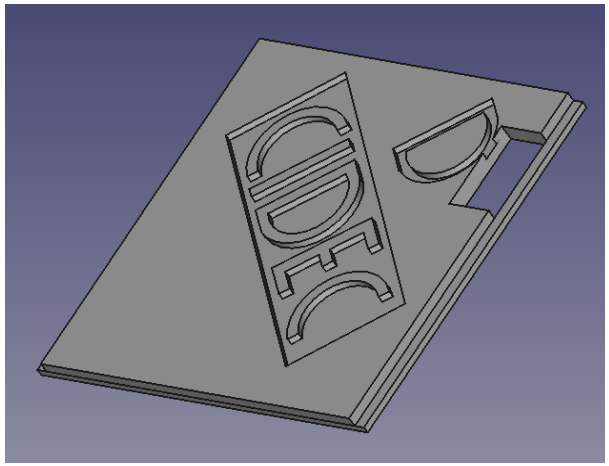
Schematics Module D (company expectations *)



Layout Module D



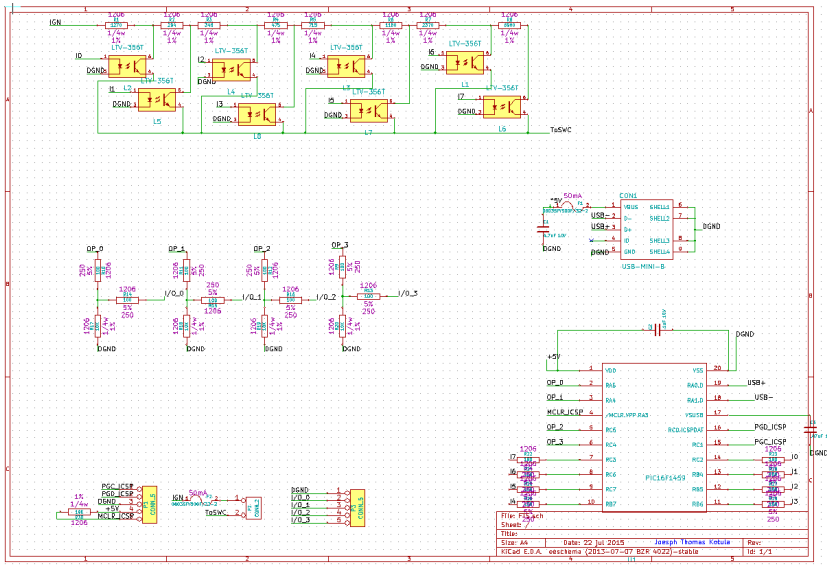
Case Module D



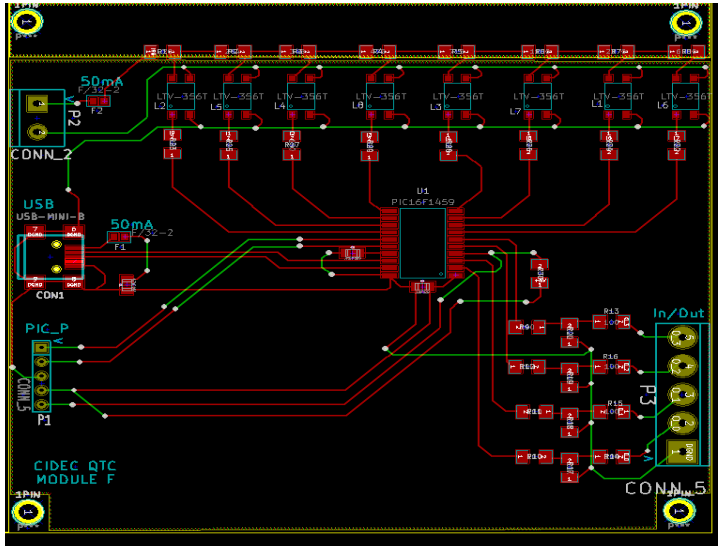
Roof case Module D

*Develop the schematics for only one of the Modules

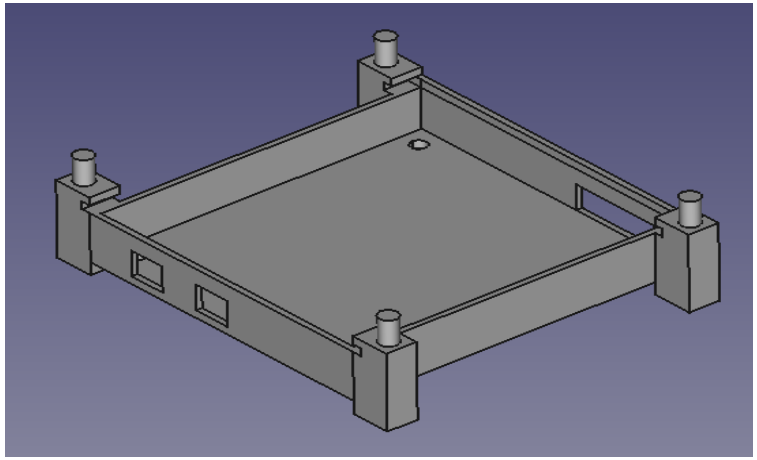
Module F



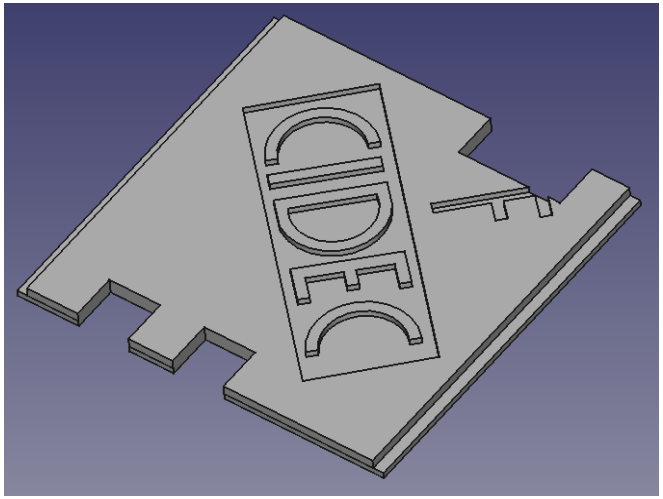
Schematics Module F (company expectations*)



Layout Module F



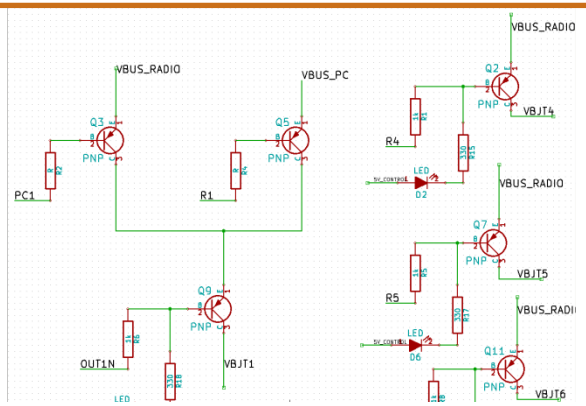
Case Module F

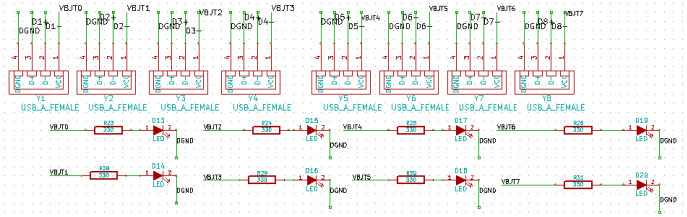


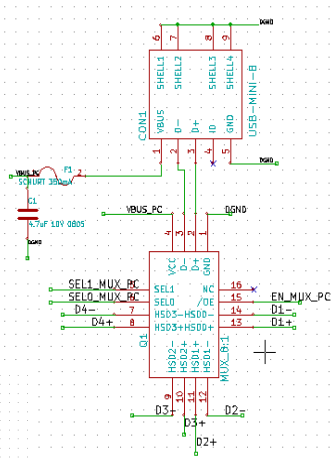
Roof case Module F

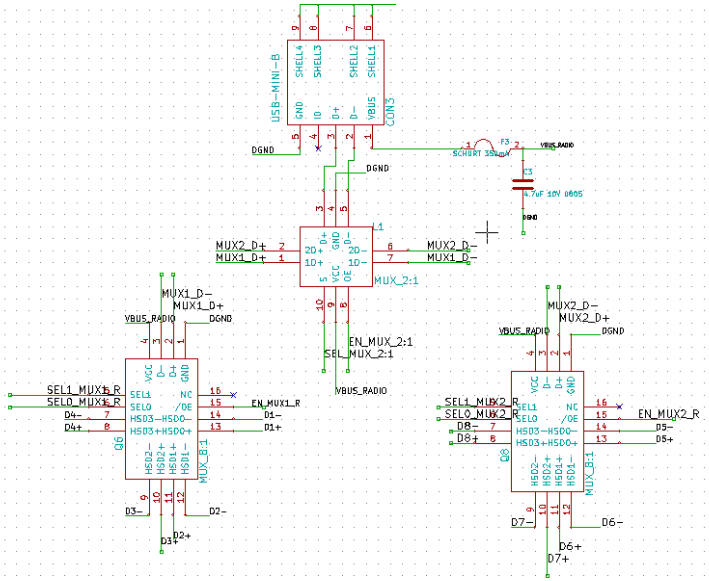
*Develop the schematics for only one of the Modules

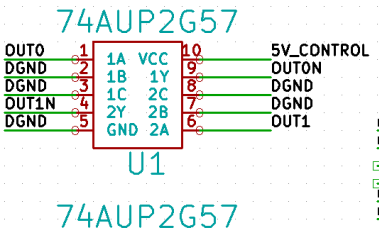
Module E

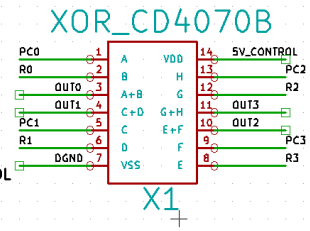


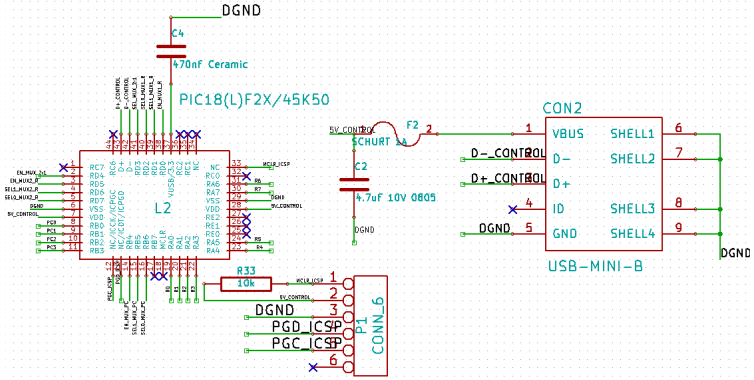






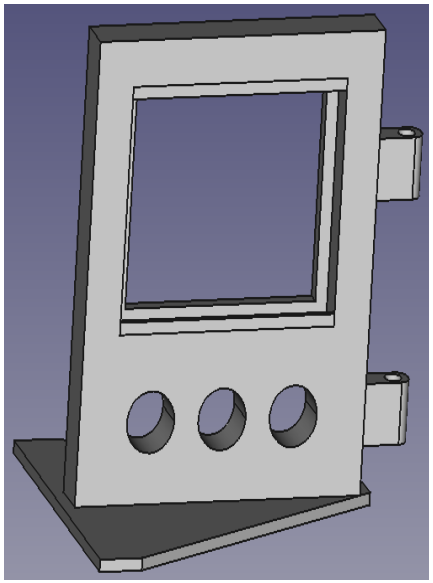


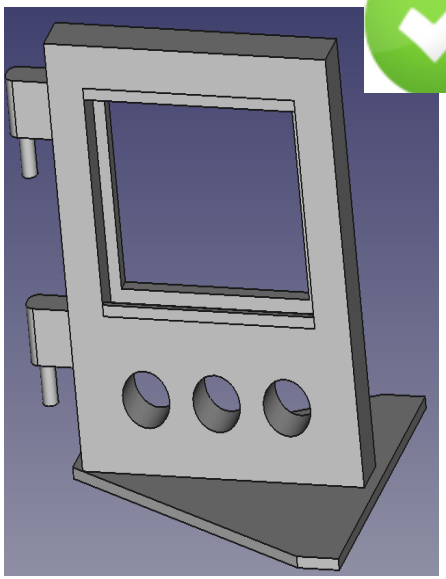




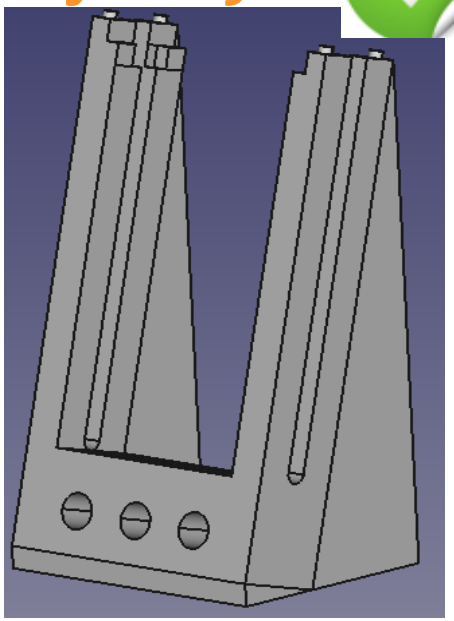
*Develop the schematics for only one of the Modules

Bases para sostener prototipo (externo al proyecto)

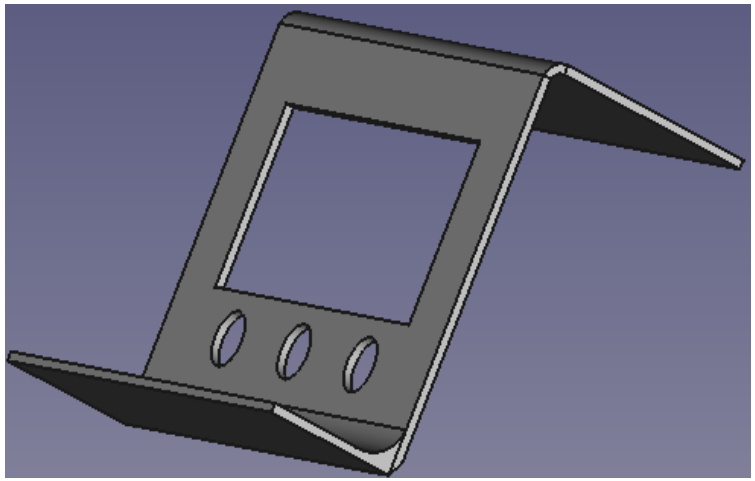




Base opción 1



Base opción 2



Base opción 3

Savings for the company (Estimation)

Complete SW Release (Month)	Engineers	Hours per day	Testing days	Cost per hour (dollar)	Total
2	2	7	7	30	$ 5,880.00

Modules	Percent reduced	Total
Modules A, B, F	-20%	$ 1,176.00
Module D	-7%	$ 411.60
Module E	-5%	$ 294.00
Total savings		$ 1,881.60

Total savings of the future from the developed modules

Total
$ 5,880.00
$1,881.60
$3,998.40

Expenses Now	$11,760
With modules	$7,996.00

Setbacks of the Project

- Old Computers
- Application troubles
- Data sheets and online sources did not have the same values for some components
- Power Outages

Recommendations

- For any following modifications to any schematic, layout, or case please refer to the descriptions laid out in the report.
- Before starting the manufacturing, check the availability of all the components online.
- Check the package of the physical components coincide with the layout designed.
- For testing make sure that the correct module is being used for the correct purposes.
- Given the complexity of the boards, it is preferable to manufacture the boards with a machine rather than by hand.

Ending Statements

- With the support of the teams work the testing process will soon be shortened substantially.
- The Project is believed to be a great success as the team managed to complete many more tasks than what were initially asked of.
- The Project added value to students by addressing global competencies in a professional environment
- With more time all advanced objectives could have been met
- The program was effective as it made students work as engineers within a global competitive company.

Sources

- http://www.microchip.com/
- http://www.freecadweb.org/ Software/Tutorials
- http://www.kicad-pcb.org/display/KICAD/Tutorials - Tutorials
- "MOSFET as a Switch - Using Power MOSFET Switching." *Basic Electronics Tutorials*. N.p., 03 Sept. 2013. Web. 7 July 2015.
- *Data Sheets of all components used*
- *Final report: Modules, A, D, E, and F*

Thank You All!!!

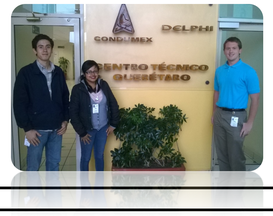
- Thanks Moms
- Thank you all for the opportunity work coincide with people from a different work place and other country.
- Special thanks to our advisors and teachers.
- Especially; Dr. Mucino, Dr. Macias, Ing. Ramirez and Sr. Olivo.
- Additionally to all our Supervisors who had to deal with all of our questions.
- Especially; Miguel Santiago, Carlos Mendivil, and Edgard Escalante.
- We would like to thank to Ian Núñez.

PROGRAMA BICULTURAL DE ALCANCE INDUSTRIAL, VERANO 2015

Hardware tools for SW Integration Testing

TEAM MEMBERS

SOFIA PONCE VELA
ARIEL SANCHEZ PADILLA
JOSEPH THOMAS KOTULA



ABSTRACT

In this poster, there is a detailed discussion of the processes and methodology for designing Hardware Tools for Software (SW) Integration Testing (Modules A, D, F, and E). The modules displayed are based on calculations and simulations to make sure they function at the desired level. Additionally, the Module cases and roofs can take into account the organization of wires. The components that were chosen are the most efficient for space, utility, and price.

OBJECTIVES

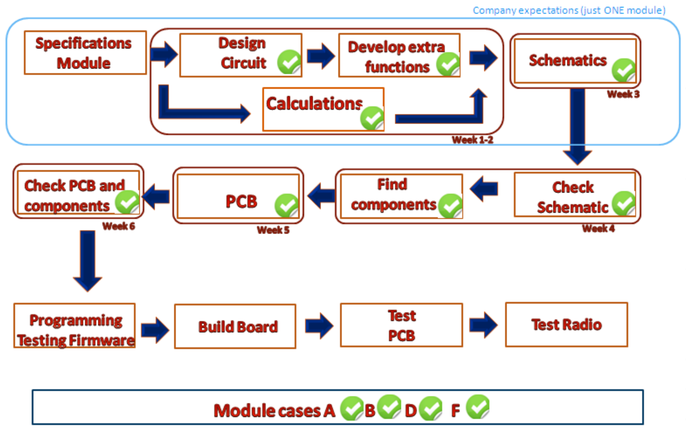
Develop the schematics for ***only one*** of the following modules:

- Module A. Digital Input Monitor.
- Module D. Analog Input Monitor.
- Module E. Digital High Speed USB Multiplexor.
- Module F. ASWC (Analog Steering Wheel Control) Electronic Simulator.

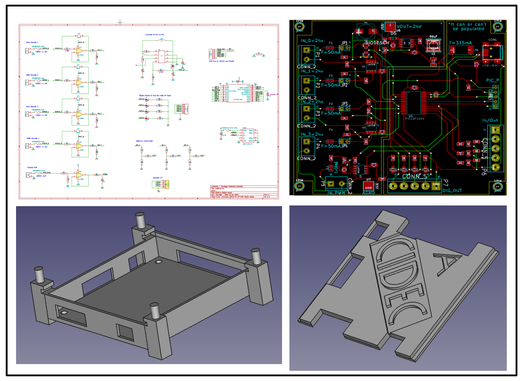
BACKGROUND

The SW team within CIDEC-Delphi performs various tasks for software testing coinciding with the new up and coming radio systems. The Software engineers do these actions whenever a new software release is needed or to fix the products that they are working on. The specific tests they run are connecting or disconnecting inputs and outputs, and by simulating audio inputs and listening to the audio outputs through the speakers to see if the software or radio functions in the way that it should. SW Testing is very important since the SW competency has to be sure that most of the product requirements are correctly fulfilled by avoiding glitches from appearing in further stages of the product development, such as Independent Testing and Verification (IT&V) or Validation. Currently the demand for faster testing is rising within the industry as more radios are developed with more complicated functions.

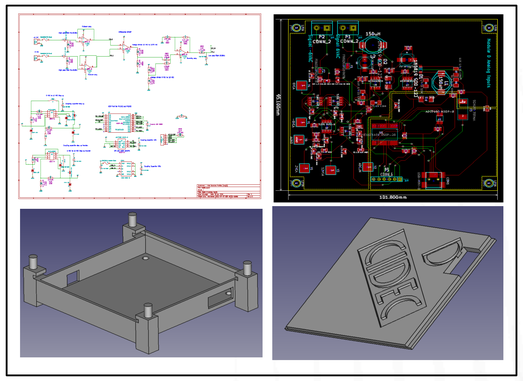
METHODS AND MATERIALS



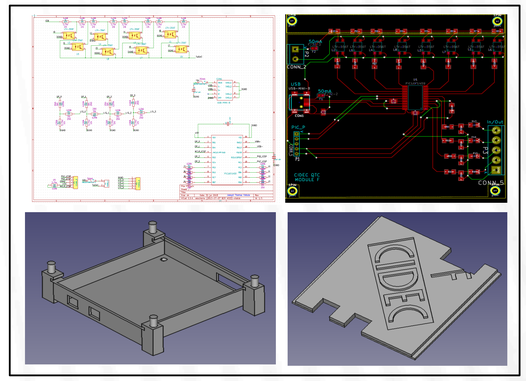
The team used a multitude of calculations to design the circuit and develop the additional functions. The Schematic was created using Kicad and was checked with LTSpice IV. Using these resulting circuits the best possible components for the best price were found. Utilizing the dimensions given from the datasheets the boards were designed using Kicad. Applying the dimensions developed from the layouts the module cases were designed using Freecad.



Module A



Module D



Module F

RESULTS

- Module A. Digital Input Monitor: The Schematics, PCB layouts and accessories (case and roof).
- Module B. Accessories.
- Module D. Analog Input Monitor: The Schematics, PCB layouts and accessories (case and roof).
- Module F. Analog Steering Wheel Control (ASWC) Electronic Simulator: The Schematics, PCB layouts and accessories (case and roof).
- Module E. Digital High Speed USB Multiplexor. The Schematics.

CONCLUSIONS

- The new modules will increase the process of testing radios and software.
- When being involved in the Software Process is important to make the most efficient project possible to allow the least amount of error within processes.
- The team learned new real world skills gaining experience applicable to future occupational uses.
- The Safe Cases keep the work place organized and prevent most circuit related accidents.
- The teams work developing the hardware tools will decrease the dependence on third party companies.

REFERENCES

- http://www.microchip.com/
- http://www.freecadweb.org/ Software
- http://www.kicad-pcb.org/display/KICAD/Tutorials - Tutorials

ACKNOWLEDGMENTS

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