

2017-2018 Senior Design Project with RLE Technologies: Automated PCB 1st Semester Checkpoint



The Team:

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Mechanical Engineer

Mechanical Engineer

Electrical Engineer

Electrical Engineer

Computer Engineer

RLE Technologies

RLE creates Leak Detection Devices. We are tasked with designing RLE an automated, highly efficient testing fixture.

Current testing setup →



LD5200 PCB



Goals

- Reduce time spent on setting up and testing PCB boards (< 1 hour per board)
- Test multiple units concurrently/serially (6)
- Create test system configurable for multiple products (LD5200 and LD2100)
- Create test system that emulates at least three different lengths for leakage occurrence

Time Budget

Activity		Time Required (minutes/board)	
Manual	Automated	Budgeted	Actual (avg)
Plug in each boards		1	
	Power Boards	1	
Load bootloader to each board		5	
	Internals Test		27.1741 s
	Leakage Test		
	Alarm Test		
	Microphone Test		
	Fault Test		
	Contamination Test	4	
	Firmware installation	1	
Manual LCD testing	User feedback with active cable	5	
Detach each board		2	
Total		19	< 1 min
Maximum Time Accepted		60	

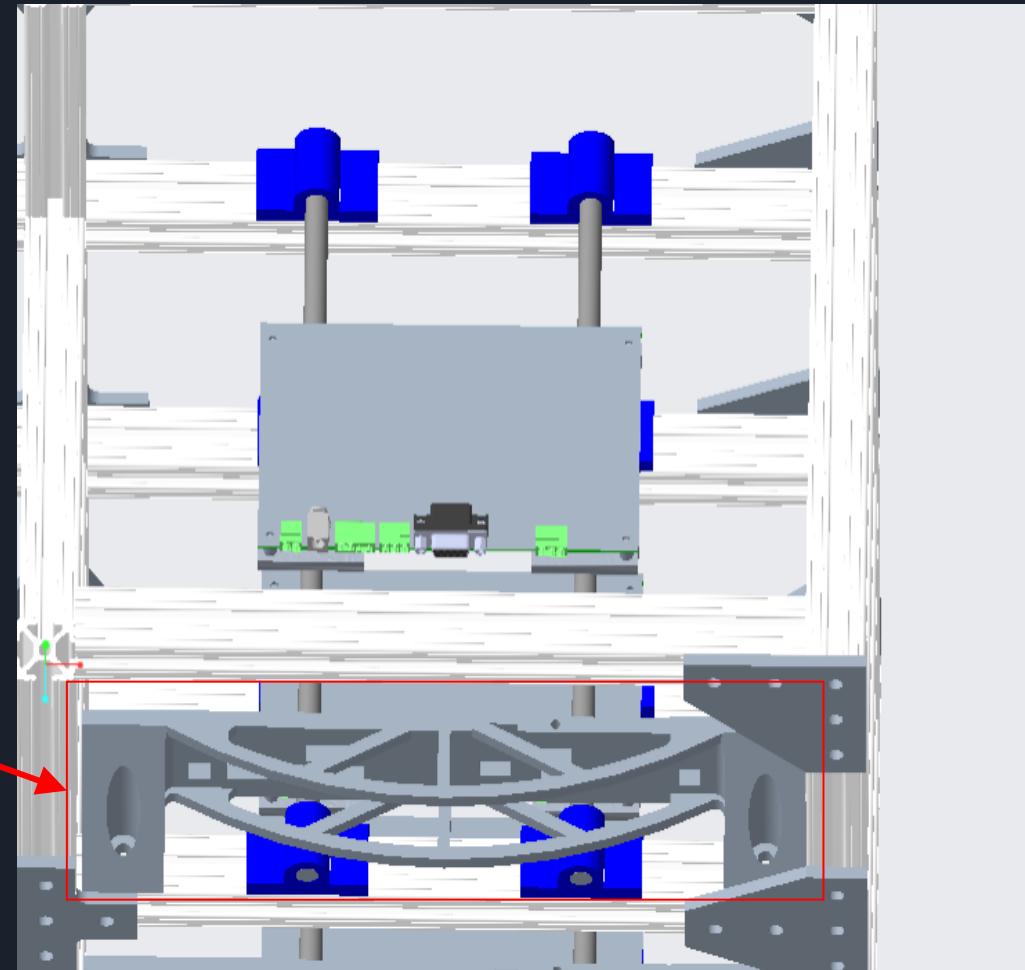
Size and Weight budget

	LD5200 Fixture	LD2100 Fixture	Hardware on Top		Total
Width (in)	14	14	0	0	28
Depth (in)	12	12	0	6	30
Height (in)	22	22	10	0	32
				Volume:	15.5*ft^3
				Surface area on top:	4.66*ft^2

Weight Budget					Last Updated:	By: JLD	On:12/1/2017
Material	Density (lbs/in^3)	Volume (in^3)	Weight(lb)	Quantity	Total / side	Total	
1 Rods	0.1	1.3246875	0.13246875	6	0.7948125		
2 Tray Plate	0.1	3.5	0.35	12	4.2		
3 Plate Mounts	0.04	2.25	0.09	18	1.62		
4 T Slot 12"	0.1	5.2	0.52	28	14.56		
5 T Slot 6"	0.1	2.6	0.26	18	4.68		
6 LD5200	N/A	N/A	0.5	3	1.5		
			Total		27.3548125	54.709625	
			Maximum Weight Accepted			100	

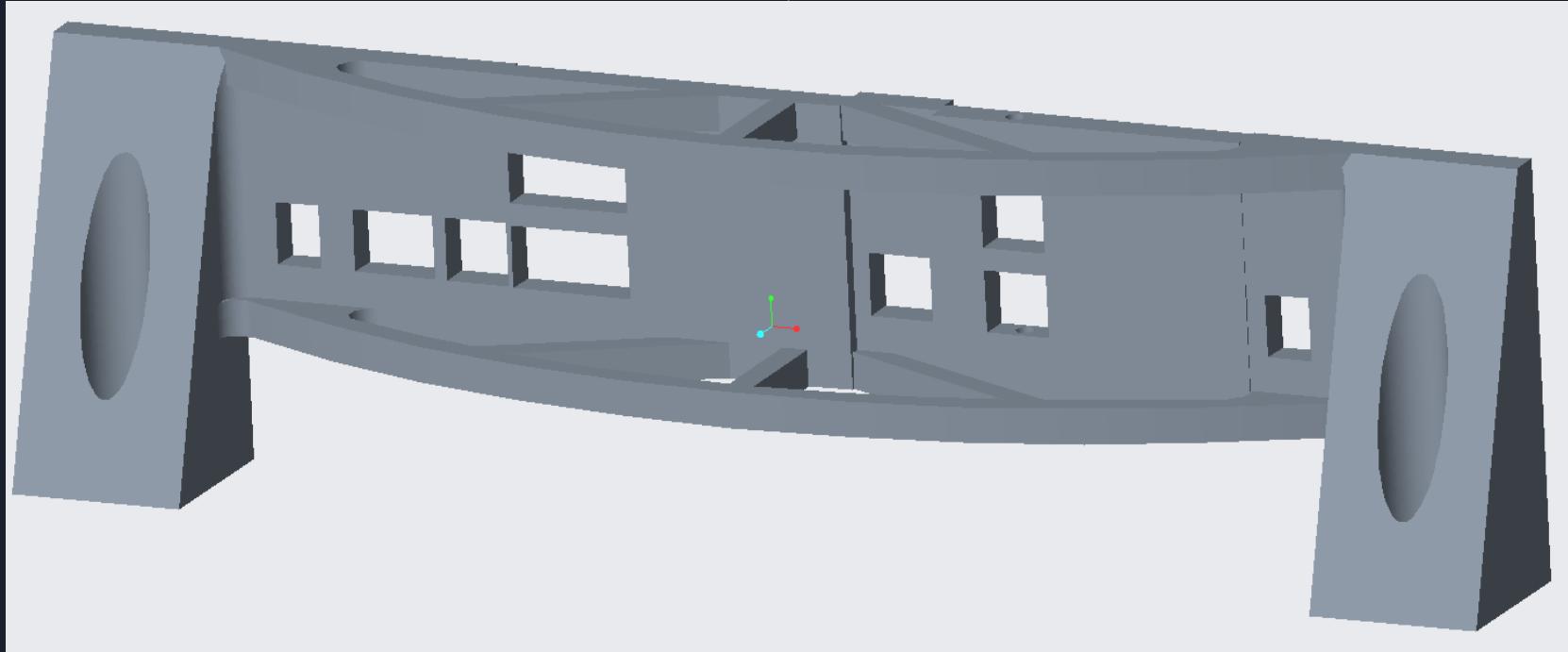
Current Work -Mechanical

- PCB Will rest on sliding tray
- PCB will slide into “backplate” to make all connections



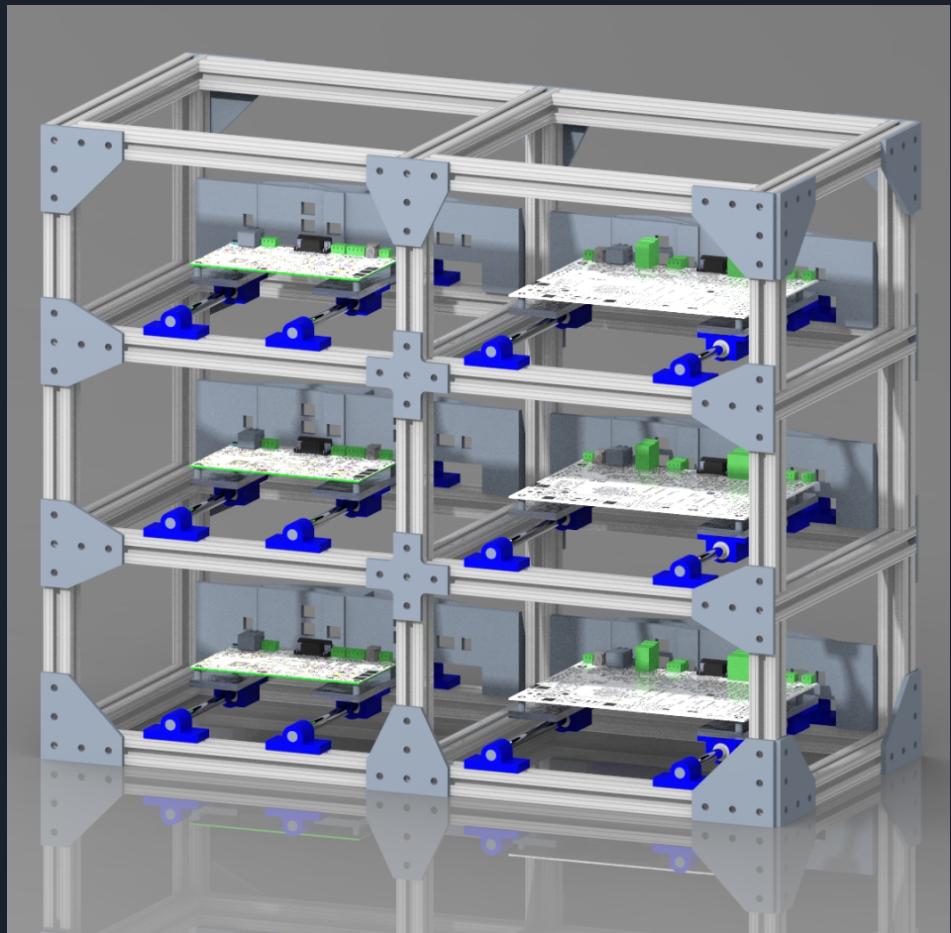
Current Work
-Mechanical

Backplate
Design



Current Work -Mechanical

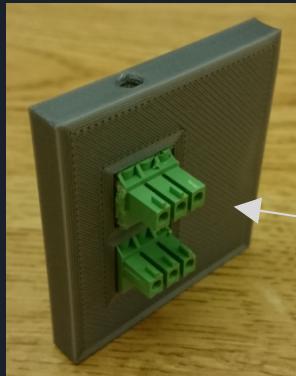
- Fixture will have slots for 3 LD2100 and 3 LD5200



Plans for Next Semester -Mechanical (ME)

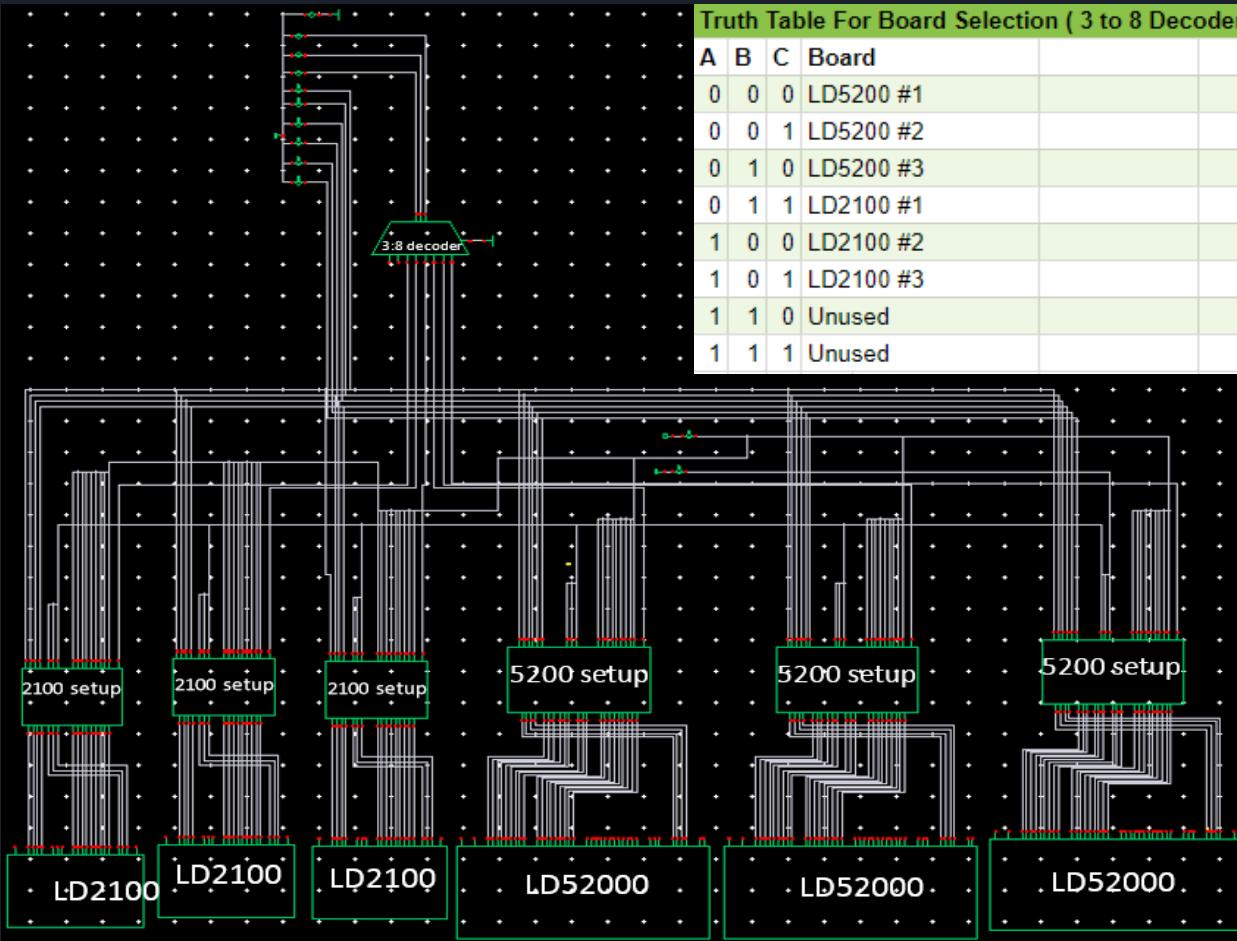
Individual Assigned	Task	Timeline		January			February			March			April			
		Week 15 (16-20)	Week 16 (21-27)	Week 17 (28-3)	Week 18 (4-10)	Week 19 (11-17)	Week 20 (18-24)	Week 21 (25-3)	Week 22 (4-10)	Week 23 (11-17)	Week 24 (18-24)	Week 25 (25-31)	Week 26 (1-7)	Week 27 (8-14)	Week 28 (15-21)	Week 29 (22-28)
JG/JD	Manufacture Fixture with specified tolerances															
JG/JD	Testing Casings for Male Connectors															
JD	Evaluation of Ports (connections)															
JG	All Connectors mesh concurrently															
JD	Analysis of benefit to latch mechanism or strip ethernet latch															
JG	Locating board on Tray and measuring tolerance															
JD	Tray slides with high precision															
JG	Tray slides without binding															
JD	Evaluating distance between Pins underneath PCB and Tray															
JG/JD	Complete Manufacturing for backplane of connections															
JG/JD	Evaluate ease of using fixture and time saved															

- Manufacturing
- Assembly
- Testing / Evaluation



3D Printed
Prototype

Current Work -Electrical



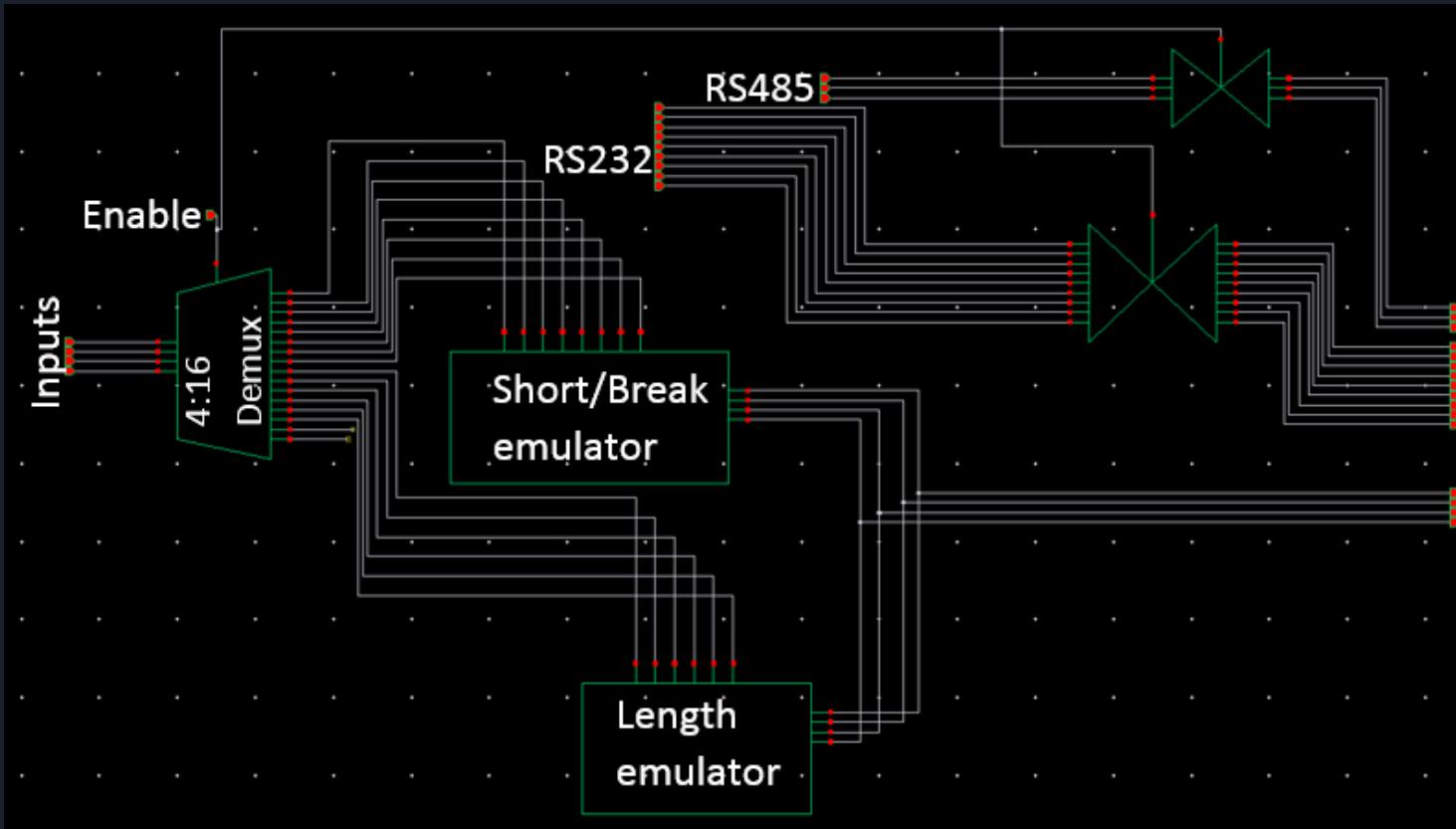
Current Work

Electrical Control

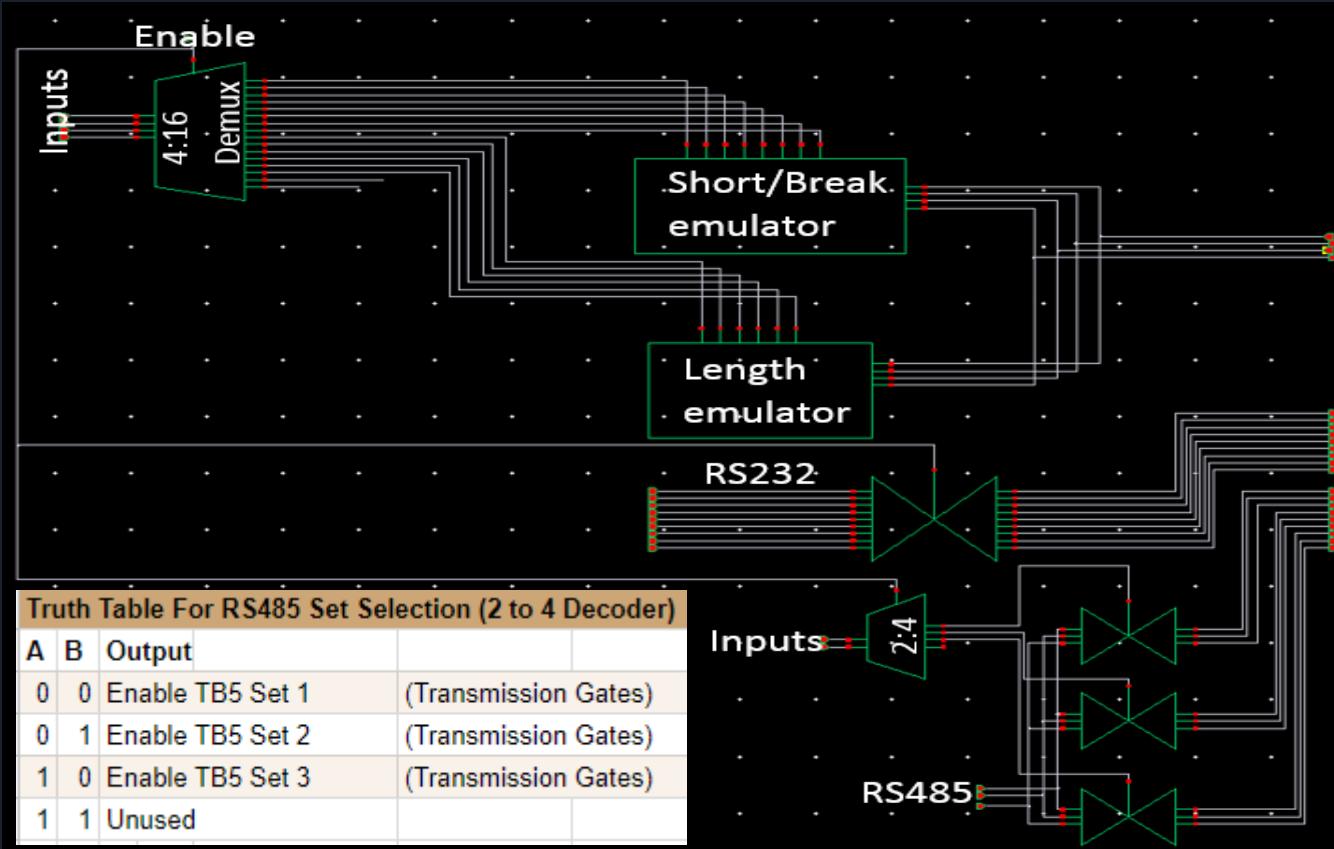
Cable Leak/Fault/Length Emulation

Truth Table For Emulator Selection (4 to 16 Decoder)							
Short / Break Emulator							
A	B	C	D	Output	Distance (ft)	Cadence R (ohms)	Actual R (ohms) = distance*2.85
0	0	0	0	Short	0	0	0
0	0	0	1	Short	357	1000	1017.45
0	0	1	0	Short	714	2000	2034.9
0	0	1	1	Short	1070	3000	3049.5
0	1	0	0	Short	1425	4000	4061.25
0	1	0	1	Short	1785	5000	5087.25
0	1	1	0	Open for Loop 1	Anywhere	Solid State Relay	
0	1	1	1	Open for Loop 2	Anywhere	Solid State Relay	
Length Emulator							
1	0	0	0		0	0	0
1	0	0	1		357	357	1017.45
1	0	1	0		714	714	2034.9
1	0	1	1		1070	1070	3049.5
1	1	0	0		1425	1425	4061.25
1	1	0	1		1785	1785	5087.25
1	1	1	0	unused			
1	1	1	1	unused			

Current Work -Electrical Setup 2100



Current Work -Electrical Setup LD5200



Plans for Next Semester -Electrical (EE)

Individual Assigned	Task	Timeline		January			February			March			April			
		Week 15 (16-20)	Week 16 (21-27)	Week 17 (28-3)	Week 18 (4-10)	Week 19 (11-17)	Week 20 (18-24)	Week 21 (25-3)	Week 22 (4-10)	Week 23 (11-17)	Week 24 (18-24)	Week 25 (25-31)	Week 26 (1-7)	Week 27 (8-14)	Week 28 (15-21)	Week 29 (22-28)
JB	Board alarm sound tester															
JB/IH	EE / CE Integration															
JB/IH	Board LED tester															
IH/JB	Testing (Will be done throughout)															

GPIO Budget	Original Total:	Allocated By Raspberry Pi: 14	Used By Sea Lion:	9
	40			
USB Budget		Allocated By Raspberry Pi: 4	Used By Sea Lion:	5
			Total GPIO Banks Left:	-1

- Physically Integrating with software
- LED tester
- Alarm tester



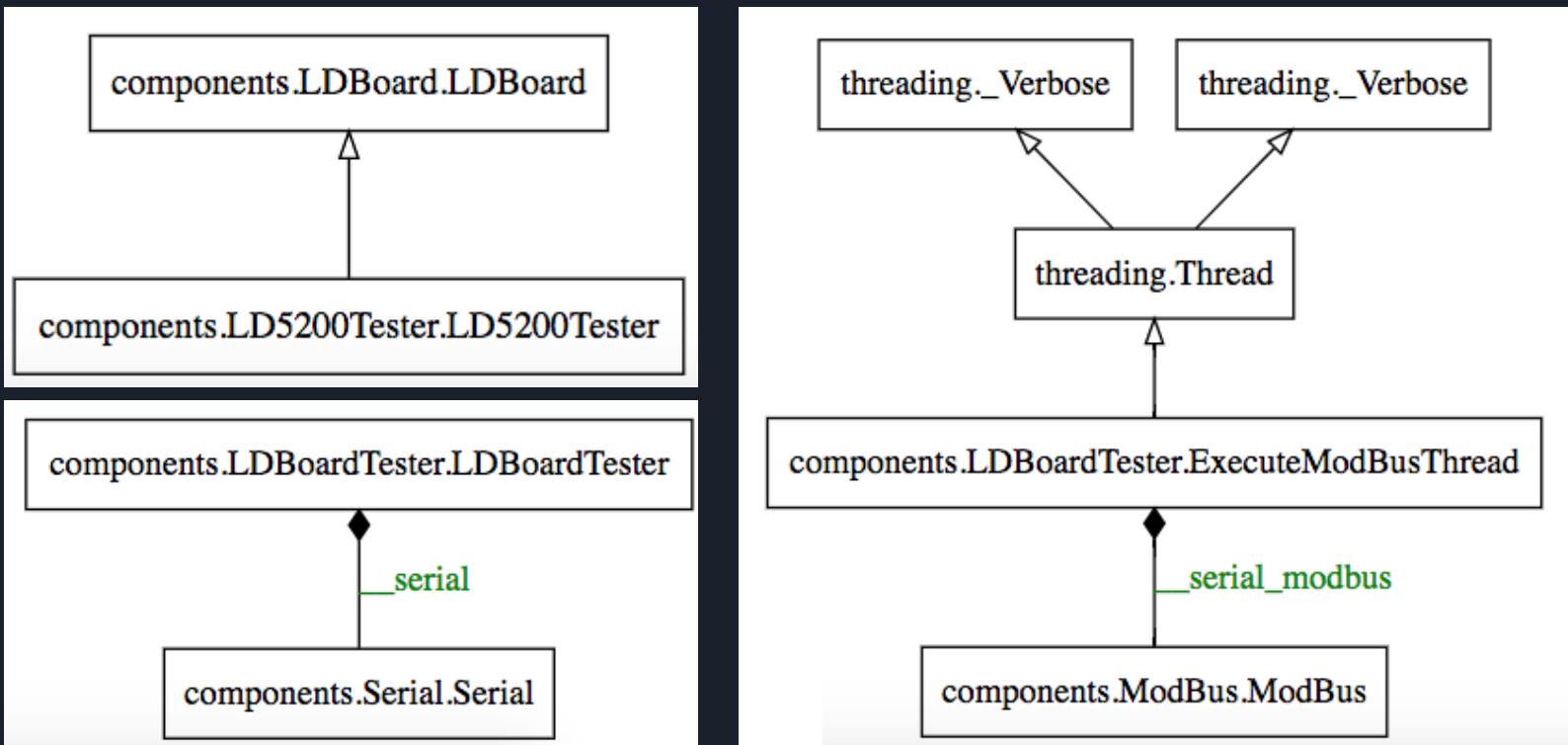
Computer Engineering

Overview of Objectives & Technologies

- Replacing manual human machine interfacing with scripting
- Verifying hardware components with digital signalling
- Serial communication over RS232 & RS485
 - 9600 baud, no parity, 8 data bits, 1 stop bit
 - ModBus RTU over RS485
- Ethernet ping validation
- Display Test Results (Pass or Fail?)

Computer Engineering

Abstractions & Object Oriented Programming



Computer Engineering

Demonstration

```
pi@tre-py:~/pcb $
```

█



Computer Engineering

Output

Passing: True

- rs232_connection: passed
- datetime_set: passed
- startup_sequence: passed
- ps_voltage: passed
- rs485_modbus: passed
- ethernet_ping: passed
- datetime_read: passed

Plans for Next Semester -Computer (CE)

Individual Assigned	Task	Timeline														
		January			February				March				April			
Week 15 (16-20)	Week 16 (21-27)	Week 17 (28-3)	Week 18 (4-10)	Week 19 (11-17)	Week 20 (18-24)	Week 21 (25-3)	Week 22 (4-10)	Week 23 (11-17)	Week 24 (18-24)	Week 25 (25-31)	Week 26 (1-7)	Week 27 (8-14)	Week 28 (15-21)	Week 29 (22-28)	Week 30 (29-5)	
ZS	Buzzer / Alarm validation design															
ZS	LED / Photoresistor validation design															
ZS	EE / CE Integration															
ZS	4-20mA validation design															
ZS	Relay validation design															
ZS	IP / MAC / Serial Database design															
ZS	Database web interface design															

- LD2100 test script
- Integration with EE team
- Design graphical user interface
- Add audible alarm, LED, current source, relay validation
- Save test results by serial number to Internet facing database

\$1,342
expected

\$276
spent

Budget

Item	For Who	Budgeted	Actual	Difference
Network Switch	ZS	\$100.00	\$68.74	\$31.26
Raspberry Pi	JB/IH/ZS	\$80.00	\$49.43	\$30.57
Discrete EE Components (See EEBOM)	JB/IH/ZS	\$220.00		
RS 232 / USB Adapter	ZS	\$69.00	\$69.00	\$0.00
RS 485 / USB Adapter	ZS	\$89.00	\$89.00	\$0.00
Stripboard	JB/IH	\$14.00		
Female Terminal Blocks	JG	\$0.00	Acquired from RLE	\$0.00
Extruded Aluminum Framing (T-Slot)	JD	\$100.00		
Aluminum Base Plates (For PCB Alignment)	JG	\$90.00		
Locating Dowel Pins	JD	\$10.00		
Rods	JG	\$80.00		
T-Slot Fasteners	JD	\$20.00		
Linear Bearings	JG	\$270.00		
Mounts	JD	\$100.00		
Unexpected Expenses	JG/JD/ZS/IH/JB	\$100.00		
Sum		\$1,342.00	\$276.17	

Budget EE Specific

Electrical Bill of Materials (EEBOM)						
Description	Units	Units Cost Low	Cost Low	Units Cost High	Cost High	
4 to 16 Decoder	6	\$0.56	\$3.36		\$2.80	\$16.80
3 to 8 Decoder	1	\$0.56	\$0.56		\$2.80	\$2.80
2 to 4 Decoder	3	\$0.56	\$1.68		\$2.80	\$8.40
1 to 2 Decoder	0	\$0.56	\$0.00		\$2.80	\$0.00
Optoisolator	12	\$0.40	\$4.80		\$1.13	\$13.56
~Photo Resistor	6	\$0.89	\$5.34		\$2.22	\$13.32
~Microphone	1	\$0.35	\$0.35		\$20.00	\$20.00
~Power Supply	1	\$6.00	\$6.00		\$10.00	\$10.00
USB Extension Bus	1	\$4.44	\$4.44			\$0.00
GPIO Extension Bus	0	\$7.04	\$0.00		\$12.99	\$0.00
Transmission Gate	90	\$0.17	\$15.30		\$0.53	\$47.70
Mosfet Transistors	96	\$0.05	\$4.80		\$0.40	\$38.40
Precision Resistors (+-.1%)	108	\$0.21	\$22.68		\$0.60	\$64.80
Total Expected Cost Design 1			\$69.31			\$235.78
Funds Left from \$220 for Unexpected Costs			\$150.69			-\$15.78



Thank You
From Team SeaLion (Automated PCB)

