PHASE CHANGE MATERIAL TRANSIENT HEATSINK FOR POWER SEMICONDUCTOR

Midterm Presentation II

Team 9:

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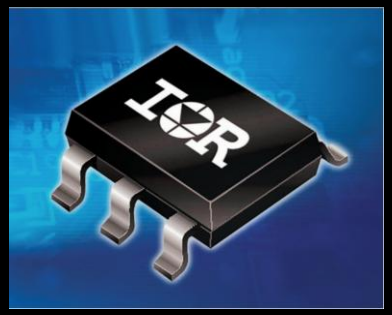
MOTIVATION

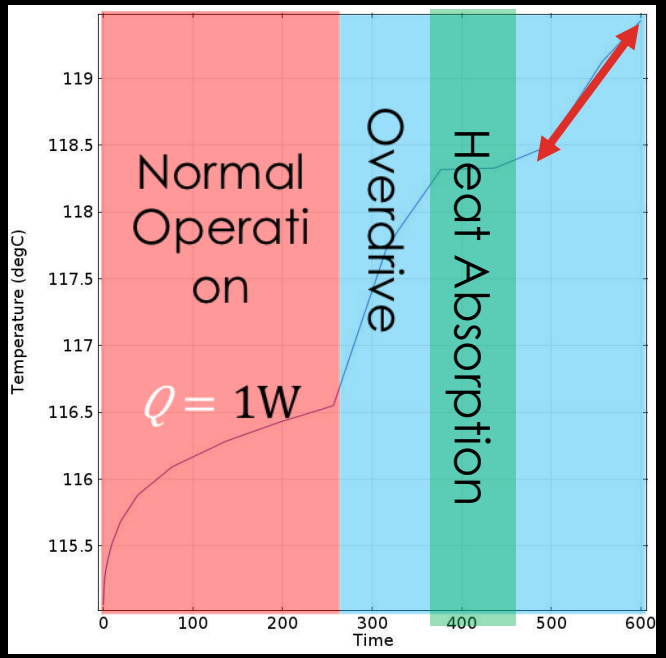


- New solutions for electronics cooling
- Power Semiconductors
  - Found in jet engine's ignition units and power regulators
- Customer's need
  - Highly reliable, low-weight heat dissipation solution for these power semiconductors

OBJECTIVES & PROGRESS

- Identify ideal PCM for heatsink
  - Given operating temperature range 115-125°C
- Numerical model to test heatsink performance
  - Design parameters
  - Prototype geometry
- An experimental rig for validation of the model
  - Design for manufacturing

52In-48Sn



PROCUREMENT

Material/Equipment	Vendor	Amount	Unit Cost (USD)	Total Cost (USD)
MP9100 resistor	Digi-Key	1 pc.	10.90	10.90
52In-48Sn solder	IndiumCorp	3 ft	**265.00**	795.00
Aluminum tape	eBay	1 spool	40.00	40.00
Hi-Flow 300P*	Orion	1 pc.	48.00	48.00
NI 9211*	National Instruments	1 pc.	351.00	**351.00**
cDAQ 9174*	National Instruments	1 pc.	762.00	**762.00**
LabView Full	National Instruments	1 license	2699.00	**2699.00**
DC power supply*	Digi-Key	1 pc.	489.00	**489.00**
Lab oven*	Mellen	1 pc.	2499.99	**2499.99**
Type K thermocouple*	Omega	4 pcs.	30.00	120.00
Aluminum bar*	Various	26 cu. in.	5.00	5.00
Thermal contact tape*	eBay	1 spool	4.50	4.50
Machining*	N/A	2 hours	20.00	40.00
			Remaining Budget (including starred items):	**-5864.39**
			Remaining Budget (excluding starred items):	**1154.10**

Starred items obtained at no cost

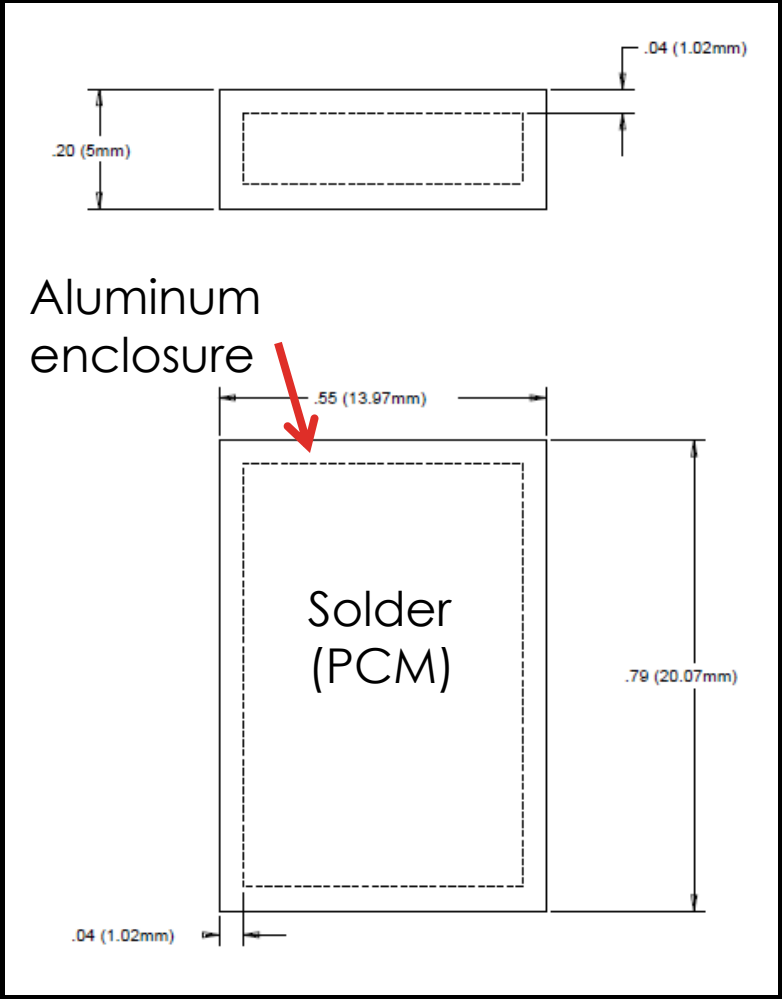
- Allocated budget was $2,000
  - Majority of cost would be incurred in purchasing testing equipment: One-time capital investments
  - Still well under-budget (excluding starred items) and do not anticipate any other major purchases

FINAL DESIGN RECAP

The heatsink comprises of two parts:

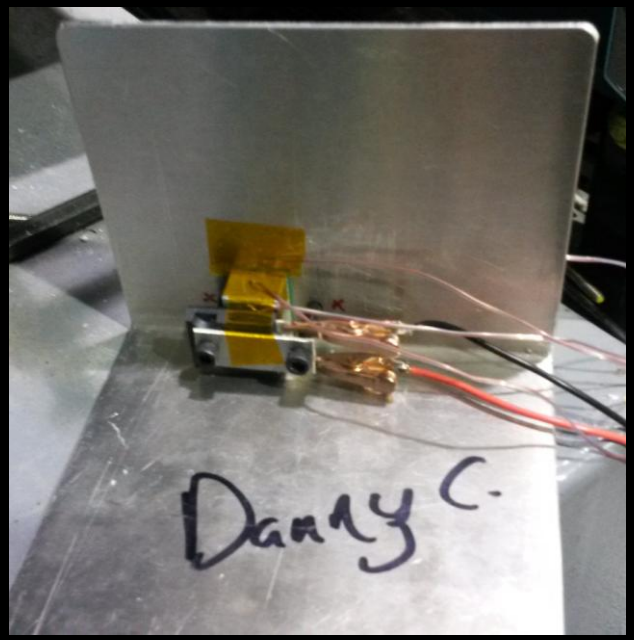
1 - The PCM
Special In-Sn solder will serve as the PCM. At 118°C it melts, using latent heat to absorb and store thermal energy.

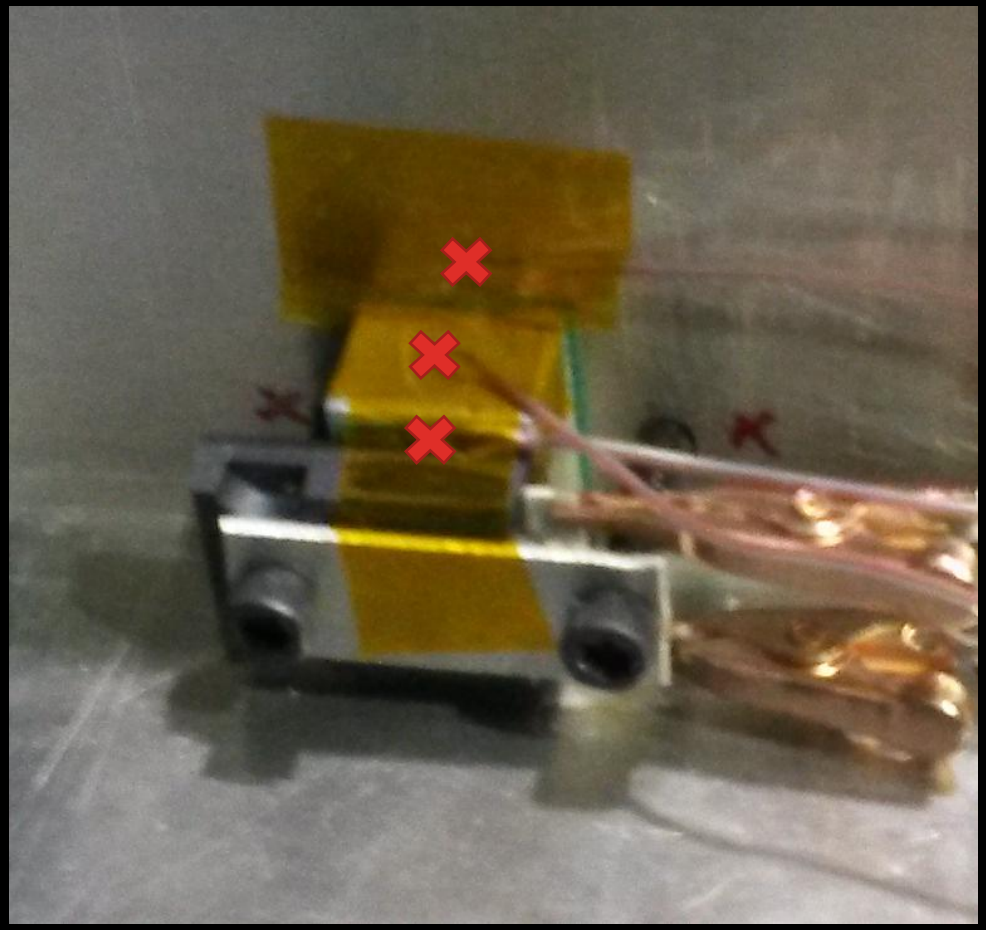
2 – The Enclosure
An aluminum enclosure keeps the PCM from escaping when melted.



TEST SETUP

X – Location of thermocouple





TEST SETUP

1 – Bolt from heatsink assembly

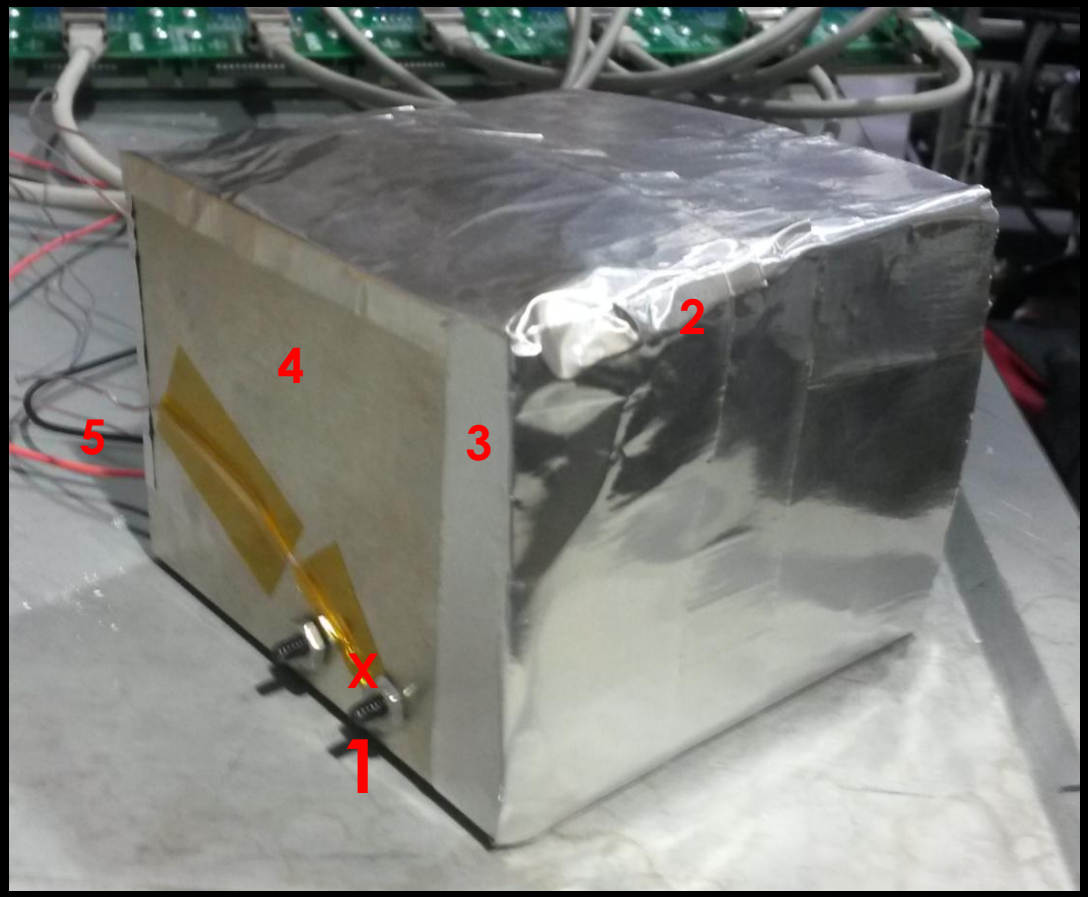
2 – Aluminum tape

3 – Insulation

4 – Wall

5 – Wire leads

X – Location of thermocouple

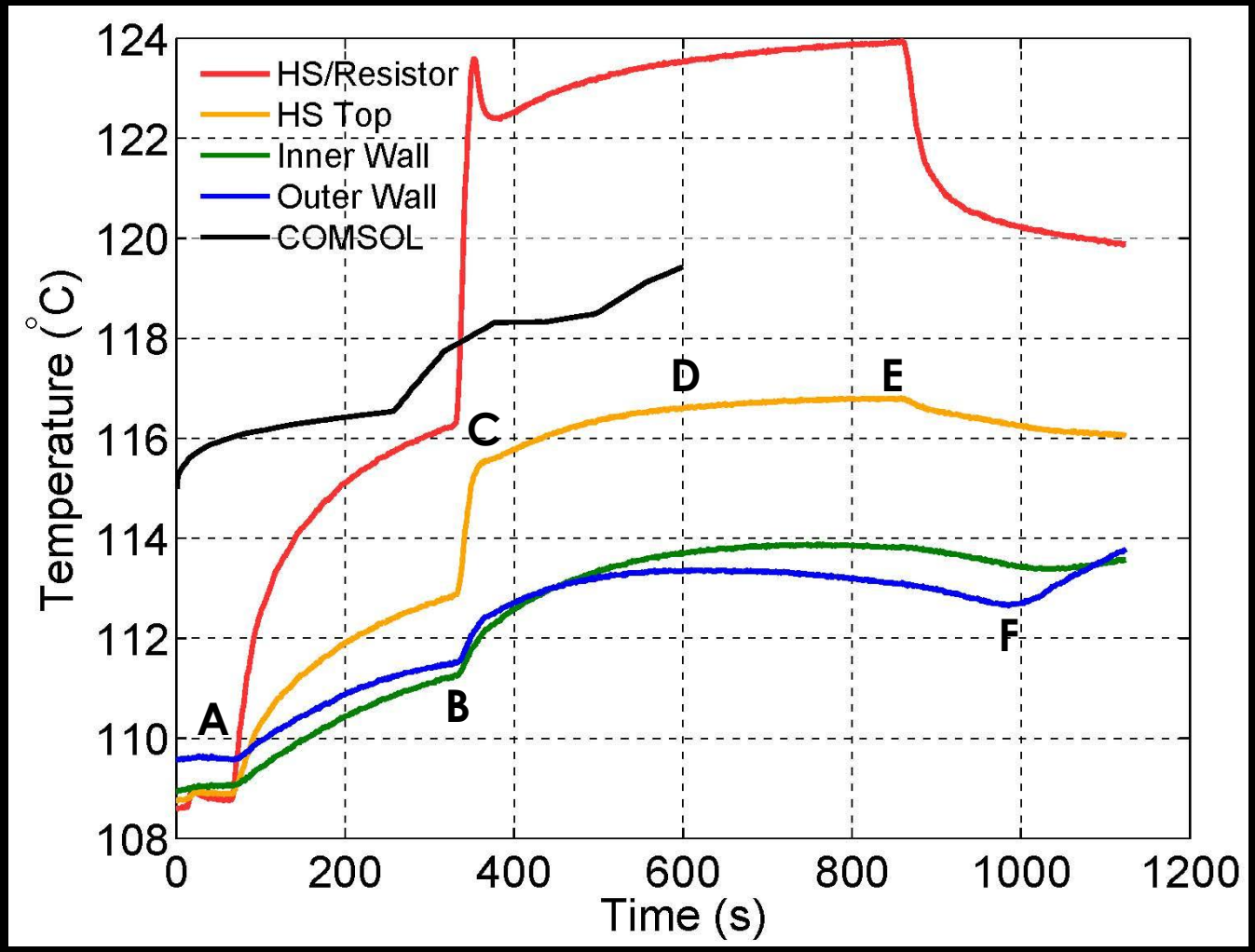


ISSUES/RESOLUTIONS

Issues	Resolution
• Thermocouple calibration	• Calibrated using type E
• Thermal Interface Material	• Created a bracket
• Oven Temperature	• Trial and error
• Oven Time	• Preheat ahead of time

DATA ANALYSIS

- **Experiment shows that prototype exceeds performance specifications:**



A: Resistor set to 1 W, oven turned off
B: Resistor accidentally set to 4 W
C: Resistor set to 2 W
D: Phase change occurring
E: Resistor set back to 1 W
F: Oven turned back on

FUTURE PLANS

- Run more tests
  - Set resistor voltage correctly
  - Insert thermocouple into heatsink
- Improve COMSOL model
  - Change boundary/initial conditions
- Develop draft of manufacturing plan

QUESTIONS?