



# Your Soldering is Terrible (probably)

*or*

“How I learned to stop worrying and love flux.”

Pauline Pounds

13 April 2021

University of Queensland

---

But first...

---

**A valuable message about safety...**



---

But secondly...

---

Some house keeping

# Calendar at a glance

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	22/2 – 26/2	Introduction			
2	1/3 – 5/3	Principles of Mechatronic Systems design			Problem analysis
3	8/3 – 12/3	Previous years deconstruction case studies			
4	15/3 – 19/3	Professional Engineering Topics	Progress review 1		
5	22/3 – 26/3	PCB design tips			
6	29/3 – 2/4*	Introduction to firmware design			
Break	5/4* – 9/4				
7	12/4 – 16/4	Your soldering is (probably) terrible	Progress seminar	25% demo	
8	19/4 – 23/4	No lecture!			
9	26/4 – 30/4	Q and A sessions		50% demo	
10	3/5* – 7/5	Q and A sessions	Progress review		
11	10/5 – 14/5	Q and A sessions		75% demo	Preliminary report
12	17/5 – 21/5	Q and A sessions			
13	24/5 – 28/5	Closing lecture		Final testing	Final report and reflection

You are  
here →

---

# FAQ Roundup

---

- **Does the power controller reset functionality have to disconnect power to the fan/ESC, or can it just set the throttle to zero?**
  - The power must be disconnected (ie. input potential across the subsystem = 0V).
- **Does the abort functionality have to disconnect power to the fan/ESC, or can it just set the throttle to zero?**
  - The ESC can simply command zero throttle; no need to disconnect power.
- **When is the spec update coming? When is the payload spec coming?**
  - Actually...

---

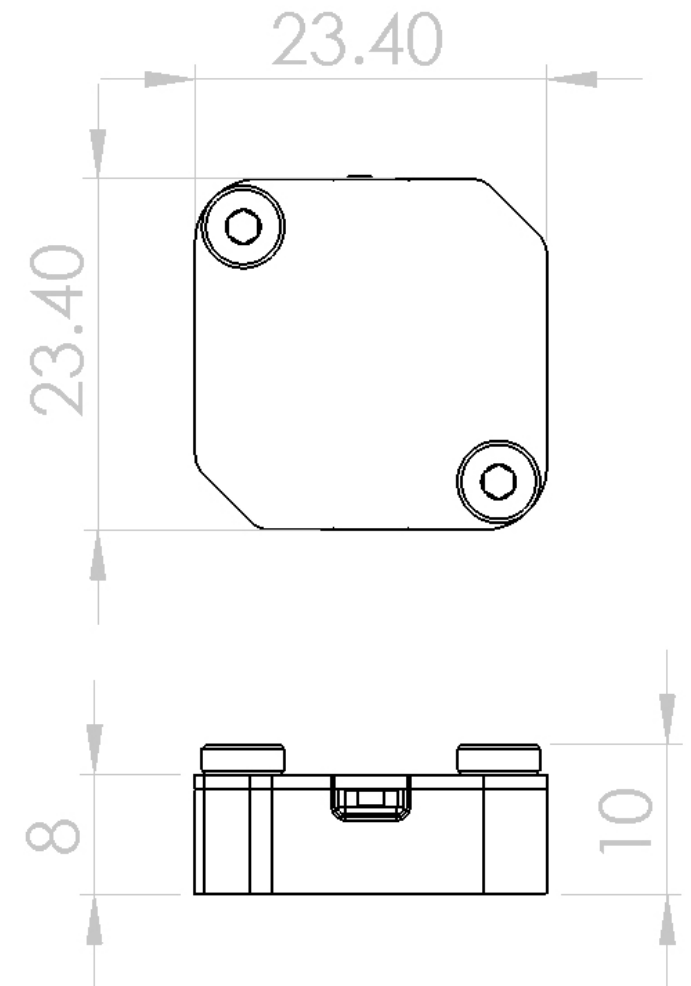
## \*\*\*SPEC UPDATE\*\*\*

---

- Now available on Blackboard!
  - Minor changes – mostly to do with summarising clarifications and eliminating the COG requirement.
  - Changes tracked in colour!
- Most importantly, now includes technical spec for the payload!

# Payload specification

- 23.4 x 23.4 x 8 mm box with two protruding 2mm screw heads on top
- Approximately 10 g weight
- Will have Velcro hooks on the back
  - Nice and easy to attach to!
- Top centre of box will have coloured LED display – do not cover!



---

# Back to business...

---

Soldering ahoy!

---

# Notes on safety

---

- Soldering is generally a low-risk activity, with the following exceptions:
  - Minor to moderate to severe burns
  - Cuts, punctures and lacerations
  - Electrocutation
  - Lead poisoning, other chemical poisoning
  - Partial loss of eyesight, total loss of eyesight

**... so nothing to worry about, right?**

---

# Helpful safety tips

---

Zeroth rule of soldering:

- “Mind where you stick the hot pointy end”
  - Take note of people around you when working
  - Return the iron to its cradle when not soldering
  - If you drop it, *don't try to catch it!*
    - This is also why you should be wearing closed-toe footwear in the labs!

---

# Helpful safety tips

---

## First Rule of soldering:

- Always assume a soldering iron is hot!
  - NEVER pick it up by the wrong end
  - A soldering iron will remain hot for a while after use, even when unplugged
- Corollary to the First Rule:
  - Things heated by a soldering iron are also hot

---

# Helpful safety tips

---

- Treat a hot-air gun or hot-air reflow soldering station like a tiny lightsabre
  - Invisible beam of destruction 30 cm from tip
  - Nozzles also get extremely hot! ( $>500^{\circ}\text{C}$ )
- Fumes are less good for you than they smell
  - They cannot get you high (I can confirm this)
  - Work in a well-ventilated area
  - Use the extractor if you have it

---

# Helpful safety tips

---

- Wash hands before eating
  - ... no matter how good the lead tastes
  - Lead is toxic: acceptable exposure level is tiny
  - Use ROHS solder and materials where possible
- Use and dispose of chemicals responsibly
  - Don't just flush PCB washing chemicals
  - Be *extremely* careful of etching chemicals
  - Do not eat the flux (tastes terrible)

---

# Helpful safety tips

---

- Don't solder on flammable surfaces (duh)
  - Ceramic tiles make excellent soldering surfaces!
  - \$0.50 worth of Not-Burning-Your-House-Down
- Keep flammable liquids and heat separated
  - Methylated spirits, kerosene, turpentine etc.
- Turn off circuit power before working on it
  - Pay particular attention to Lipo cells
  - Solder one lead at a time (insulate the other)

---

# Helpful safety tips

---

Wear eye protection. *Always.*

It might only matter once in your career,  
but you'll be grateful you did

---

# Warning

---

“Do not attempt to solder with remaining eye.”

*Always wear eye protection*

---

# Principles of soldering

---

- Soldering is the process of joining two metal surfaces with a fusible metal

Heat both surfaces simultaneously and  
then introduce solder to the joint

*Don't apply solder to iron first and then to joint*

- Clean surfaces, enough heat, enough flux
  - Quick zap and out

---

# Helpful soldering tips

---

- Solder flux is the universe's gift to you

It is highly likely that—

- You need to use less solder
- You need to use less heat
- You need to use more flux

*The solder must flow*

---

# How to identify a good joint

---

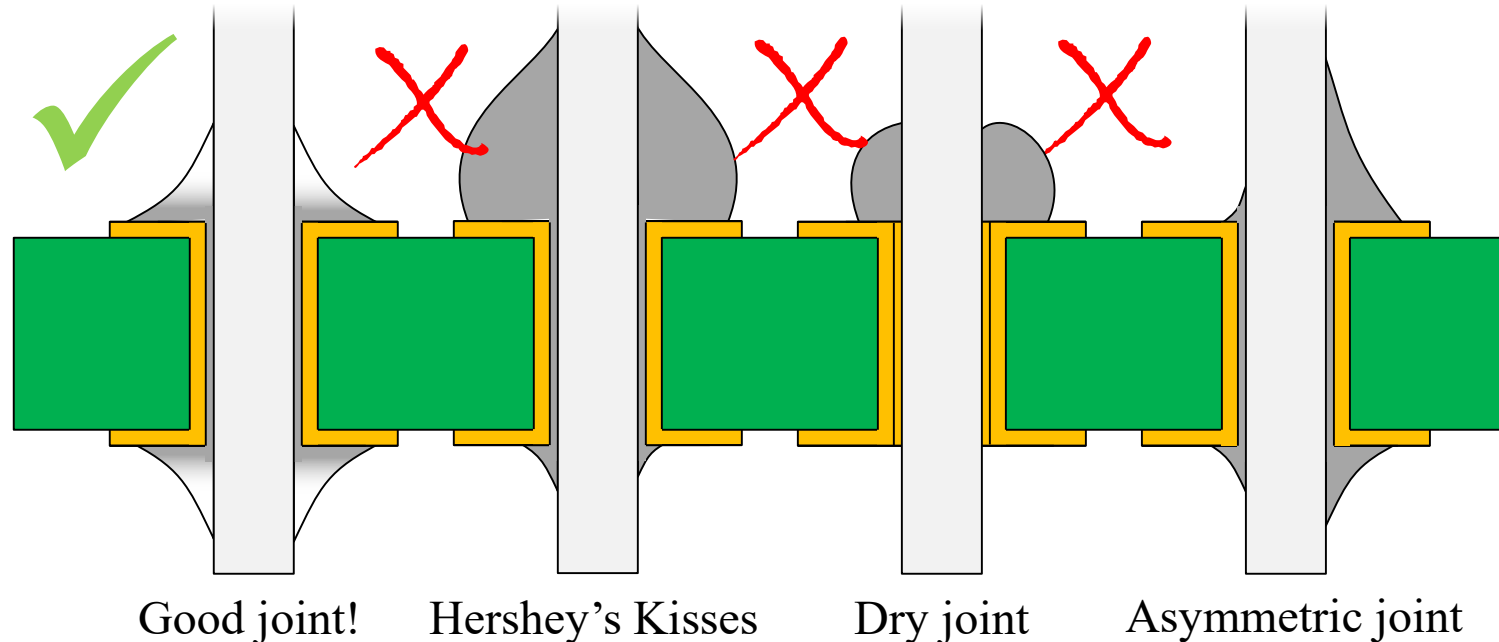


# Helpful soldering tips

- How to identify a good joint
  - Even, shiny symmetric meniscus
  - No “Hershey’s Kisses”, no dull blobs



Hershey's Kiss  
[Hershey's]



---

# How to fix a dodgy joint

---

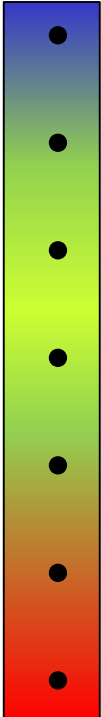
- General method:
  1. Add a little flux
  2. Apply heat to the joint and hold
  3. Wait until the solder wicks into the joint
  4. Remove heat and let cool
  5. If more solder is needed, add more

---

# Helpful soldering tips

---

On temperature:

- 
- 250°C is probably too cold – bump it up!
  - 280°C can be ok for fragile parts
  - 300°C is pretty comfortable
  - 330°C is Just Right™
  - 350°C is more than enough
  - 375°C – what are you *doing*?
  - >400°C What the I don't even??

Different solders need different temperatures – know thine solder!

---

# Practical demonstration

---

- Working with wire
  - Stripping, tinning, joining to PCB
  - Joining and splicing
  - Heat shrink and insulation
  - Thick, multi-core wires
- Through-hole parts
  - Journey to the Lost World

---

# Topics to cover today

---

- SMD passives
  - Point to point, Pre-tin, Reflow
- SMD ICs: SOT-23/SOIC/TSSOP
  - Point to point, Tack and Drag, Pre-tin, Reflow
- Leadless SMD: LGA/QFN/BGA
  - Descent into the winding madness from which there is *no* escape, *only* the gnawing twisting Spiralling Frenzied DeSoLaTiOn ThAt ChEwS uPoN tHe Ur-SoUl In ThE gRiP oF iTs EnDlEsS tOrMeNt iklkjipoleaffffffff it sucks

---

# Questions

---

?



‘Hotflash’ aka “Princess Solderflux” [Firepixie]

---

And now...

---



*Gratis project tips*

---

# Gratuitous project tips!

---

Simple simple simple

Robust robust robust

Test test test

(and test again)

---

# Gratuitous project tips!

---

- Some things engineers *never* try to build if they can buy, copy or otherwise avoid it:
  - Power supplies
  - Motor drivers
  - Analog amplifiers
  - Inertial Measurement Units
  - Sensor fusion and estimation algorithms
  - Vision processing libraries

---

# Gratuitous project tips

---

- Do you know how much force your control vanes produce?
  - Do you have some sort of aerodynamic model?
  - Have you done any experiments?
  - Be mindful of just randomly guessing a size and assuming it'll work because it happens to fit in the duct diameter...
- Don't smother your ducted fan!
  - The rotor needs airflow to produce thrust and the motor needs airflow to stay cool!

---

# Gratuitous project tips

---

- Nobody is thinking about control nearly enough
  - **Nobody** has gone deep enough on this yet
  - Controlling your trajectory/height is of paramount importance – **disregard it at your peril!**
- How are you going to account for variable lighting/shadow conditions?
  - Seems hard... hmmm

---

# Gratuitous project tips

---

That's all for now!  
But maybe more later...

---

# Tune-in next time for...

---

Nothing!

*or*

“I’m attending a junket next week – woooo!”

(I’ll see you back on the 27<sup>th</sup>)

Fun fact: Biocompatible solder is 98% gold.

It is *frighteningly* expensive.