

Your Soldering is Terrible (probably)

or

“How I learned to stop worrying and love flux”

P Pounds

19 March 2018

University of Queensland

But first...

Some house keeping

Calendar at a glance

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	19/2 – 24/2	Introduction			
2	26/2 – 2/3	Principles of Mechatronic Systems design			Problem analysis
3	5/3 – 9/3	Professional Engineering Topics			
4	20/3 – 24/3	Introduction to Practical PCB Design	Progress review 1		
5	19/3 – 23/3	Your soldering is (probably) terrible			
6	26/3 – 29/3	Introduction to firmware design			
Break	30/4 – 13/4				
7	16/4 – 20/4		Progress seminar	25% demo	
8	23/4 – 27/4				
9	30/4 – 4/5			50% demo	
10	8/5 – 11/5	No lecture	Progress review		
11	14/5 – 18/5			75% demo	Preliminary report
12	21/5 – 25/5				
13	28/5 – 1/6	Closing lecture		Final testing	Final report and reflection

You are here ↪

Meditations on progress reviews

- Most people got the message loud and clear
 - But not everyone...
 - If you missed it: GET STARTED OMG!
- PAFs
 - Mostly people were pretty balanced
 - Some of you were caustic – yikes!
 - No need to be crazy fine-grained – eg. 10.75...

Meditations on progress reviews

That said...

- DO NOT JUST DIVE IN MINDLESSLY
 - You MUST do analysis before you start building
 - You SHOULD get your design checked by a tutor before you start getting parts machined
- If you show up without adequate analysis in your final report, you *will* fail this course.
 - I have chewed out teams about this, and I am not kidding.

Getting parts machined

- After consulting with the workshop, they have asked me to be the “conduit” for parts
- Plz send your parts to me, not the workshop
 - Include all drawings *and* native 3D CAD files
 - Specify if you are after productions or quotes
 - I will dispatch them every Monday to be made in the workshop that week (depending on load)
- Machining is expensive! I’ll cost at 20%

Incremental demos coming up

- Lots of people are super keen to be testing!
 - Great! 😊
- Gimbal parts are done
 - I'll bring it over to the labs once I assemble it
- Start thinking about whether you want to demo or not in week 7

Hey, about those placards...

- The brief now specifies text sizes
 - I had some time on the weekend, so yeah...
- Large text: Arial 80 pt font
- Medium text: Arial 70 pt font
- Small text: Arial 60 pt font
- Very small text: Arial 20 pt font
- Bonus text might be smaller still...

(You might still find my test placard up on level 4)

FAQ Roundup

- **None as yet**
 - Hooray!

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
 - Electrocution
 - 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

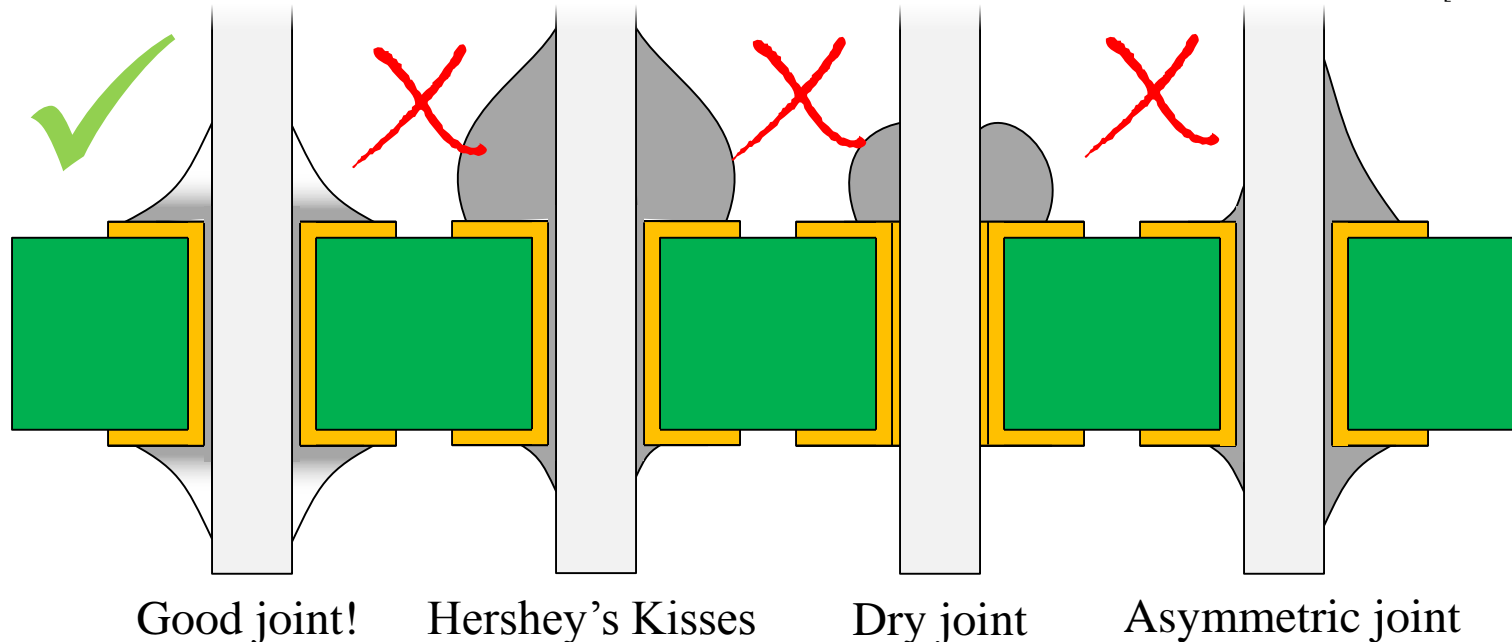


Helpful soldering tips

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



Hershey's Kiss
[Hershey's]

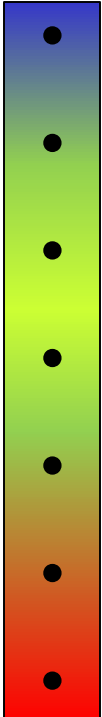


How to fix dodgy a joint

- 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!
 - 275°C can be ok for fragile parts
 - 300°C is pretty comfortable
 - 325°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

Questions

?



‘Hotflash’ aka “Princess Solderflux” [Firepixie]

And now...



Gratuitous 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

- You almost certainly don't need silky smooth video.
 - Why waste all your processor cycles just passing data around? Don't pipe data through a micro unless it's completely unavoidable.
- There is more to wireless communications than Wifi and Bluetooth... seriously
 - FM? Xbee? Zigbee? Smoke signals?

Gratuitous project tips

- Nobody is thinking about angular control nearly enough
 - **Nobody** has gone deep enough on this yet
 - Keeping the image steady is of paramount importance – **disregard it at your peril!**
- How are you going to line up on the targets, anyway?
 - Seems hard... hm

Gratuitous project tips

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

Tune-in next time for...

Introduction to Firmware Design

or

“Firmware: harder than software”

Fun fact: Biocompatible solder is 98% gold.
It is frighteningly expensive.