

Your Soldering is Terrible (probably)

or

“How I learned to stop worrying and love flux”

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But first...

A valuable message about safety...

But secondly...

Some house keeping

Calendar at a glance

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	25/2 – 1/3	Introduction			
2	4/3 – 8/3	Principles of Mechatronic Systems design			Problem analysis
3	11/3 – 15/3	Previous years deconstruction case studies			
4	18/3 – 22/3	Professional Engineering Topics	Progress review 1		
5	25/3 – 29/3	PCB design tips			
6	1/4 – 5/4	Your soldering is (probably) terrible			
7	8/4 – 12/4	Introduction to firmware design	Progress seminar	25% demo	
8	15/4 – 19/4	<i>Q and A sessions</i>			
Break	22/4 – 26/4				
9	29/4 – 3/5	<i>Q and A sessions</i>		50% demo	
10	6/5 – 10/5	No lecture	Progress review		
11	13/5 – 17/5	<i>Q and A sessions</i>		75% demo	Preliminary report
12	20/5 – 24/5	<i>Monday lecture!!</i>			
13	27/5 – 31/5	Closing lecture		Final testing	Final report and reflection

You are here →

Progress seminars

- Progress seminars are next week!
 - First group-based assessment
 - Gives you presenting experience and brings us up to date with your team's progress
- Sign up for session slots via Doodle poll
 - Link to poll will be sent out via Blackboard announcement after the lecture (closes Friday)

Progress seminars

- Group presentation – 10 minutes per team
 - Stand up and talk about your progress
 - Each person talks for roughly equal time
- Focus on progress, *not* the requirements!
 - We know what the project goal is (really!)
 - We know what your proposed solution is.
 - Don't waste valuable time repeating them.
 - Just show us your *progress*.

Progress seminars

- You will be ranked 50% on individual and 50% on group presentation, plus PAFs
 - Yep, more PAFs.
- Recall the presentation tips and tricks from lecture 3 – expectations are high!

Progress seminars

- How to sign up:
 - Have **one and only one** member of your team nominate a time for your team on the poll
 - When they sign up, they must include their **full name and team number**. If they don't have both, the slot will be cleared.
- If you absolutely can't get a slot that works for all of your group, email me ASAP
 - *But this should never happen*

Incremental demos coming up

- Lots of people are super keen to be testing!
 - Great! 😊
- Foam is in!
 - I'll bring it over to the labs once I unpack the ~~box crate~~ pallet (!) it came in
 - A small supply will be issued to each team; use it wisely, and sparingly
- Start thinking about whether you want to demo or not in week 7

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 lightsaber
 - 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

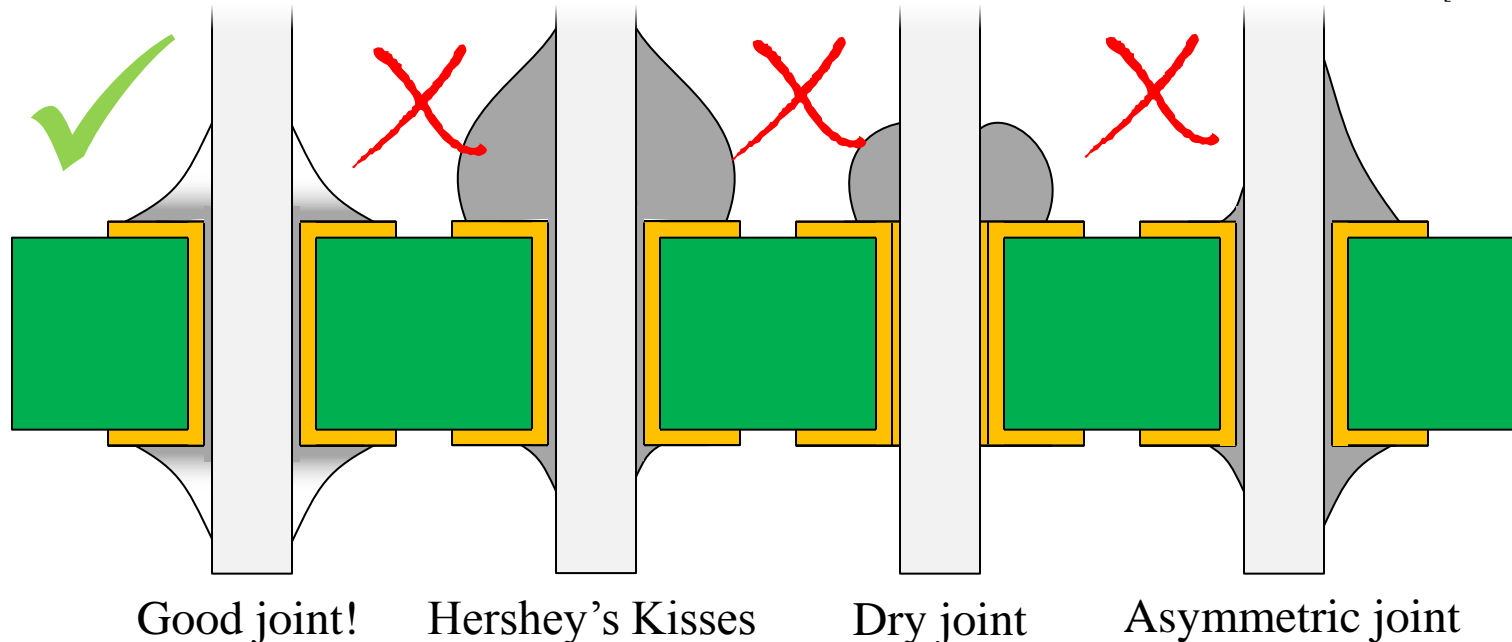


Helpful soldering tips

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



Hershey's Kiss
[Hershey's]

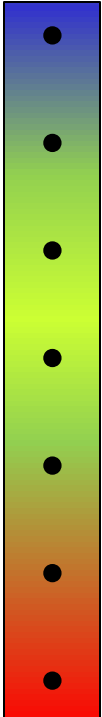


How to fix dodgy a joint

- 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 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

- Actuators != transmissions.
 - Don't reject a good motor just because it seems harder to integrate...
 - Don't pick stuff just because it's "easy to use"
 - Beware false economy. A lot of pre-made transmissions are complete rubbish.
- What sort of transmission do you need, anyway?
 - What is the tradeoff between speed/precision/repeatability/cost?

Gratuitous project tips

- Nobody is thinking about position control nearly enough
 - **Nobody** has gone deep enough on this yet
 - Controlling your tool trajectory is of paramount importance – ***disregard it at your peril!***
- How are you going to sequence your motors, anyway?
 - Seems hard... hmmm

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.