SDP22

Lecture 9

22 Nov 2021

MDR, HW/SW Exemptions, Lithium Batteries & Digi-Key

LinkedIn


UMASS
AMHERST
UMass Amherst Electrical and Computer Engineering Alumni & Friends
Listed group

21	22 Lecture 9	23	24 Thanksgving Recess	25 Thanksgving Recess	26 Thanksgving Recess	27
28	29 MDR	30 MDR	1 MDR	2 MDR	3 MDR HW/SW Exemption Requests due	

December 2021

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6 Lecture 10	7	8 Last day of classes	9	10 Finals begin	11
12	13	14	15	16 Finals end	17	18

7 days to MDR

MDR Scheduling Responsibilities

- Teams schedule MDR (evaluators & advisor)
- Teams reserve conference room

Teams schedule MDRs (evals & advisor)

- Use email (to: evaluators & advisor; cc: team)
- Example email

  Dear Team xy Evaluators,

  I'm reaching out to the Evaluators and Advisor for MDR scheduling. Presently, Team xy is hoping that we can have our MDR presentation on **November 19, Thursday, 18:30.** As of right now, with other classes' final exams taken into consideration, Thursday works the best for Team 29.

  If the time doesn't work, we're also available any time after 17:00 until 20:00. If the date does not work, please let me know and I will speak with the team to figure out a better day.

  Sincerely,

  Team xy

- Team confirms date/time and conference room location with evaluators and advisor
- Day before: Team sends out reminder email to evaluators and advisor.
- Day of: Team emails copy of slide deck to evaluators and advisor. **Team uploads deck and demo video to team slack channel**

Teams reserve conference rooms

- Available conference rooms:
  - KEB 109
  - KEB 211
  - KEB 309
  - Marcus 201
  - Marcus 215
- Reserve conference rooms through staff members (visit or email)
  - Terry Bernard, Marcus 201G, tbernard@ecs.umass.edu
  - Jenn Pease, Marcus 201G, jpease@admin.umass.edu

MDR Presentation

Presentation/evaluation schedule:

- Team presentation and project demo: 30 min (uninterrupted)
- Evaluators Q&A: 20 min (advisor silent)
- Team leaves conference room
- Advisor/Evaluator huddle
- Evaluator feedback sent to advisor
- Advisor shares feedback with team

MDR Rubric (1)

- **10%** Presentation
  - Includes Problem Statement
  - Teamliness
  - The team scheduled the review in a clear and professional manner
  - Evidence that the presentation was rehearsed
- **20%** Goals, Specifications & Testing Plan
  - All items described in detail and refined from PDR
  - Goals are design-agnostic
  - Quantitative, testable system specifications
    - Justifiable benchmarks/thresholds
  - What are you measuring and how will you measure it

MDR Rubric (2)

- **20%** System Design Documentation
  - Documentation of the System Design (Software & Hardware)
    - Block diagrams
    - List all hardware and software components & modules used
    - Justification of key hardware and software components & modules choices
    - Any other documentation needed to describe the system design
  - Commitment to the custom PCB plan.
- **40%** Performance of the Integrated System
  - A convincing demonstration of the critical aspects of the integrated system
  - MDR Deliverables achieved

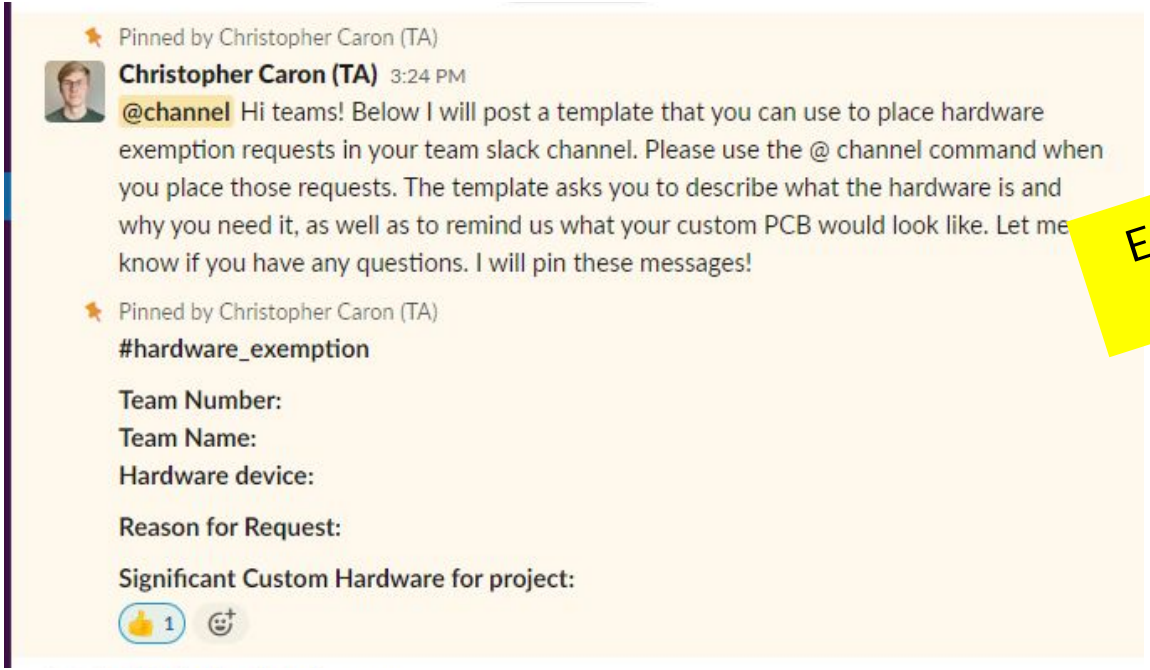
MDR Rubric (3)

- **5%** Project Expenditures (Current and Projected)
- **5%** Project Management
  - Gantt Chart (to CDR)
  - Team Responsibilities
    - Specify the team coordinator
    - Describe the technical responsibilities for each team member

Demo Video

- MDR: Live demo of integrated system required
- Produce demo video (including audio) as backup
- Upload video (and slide deck) to team slack channel on day of MDR

HW Exemption Template



Exemptions due:
Friday, 3 Dec'21

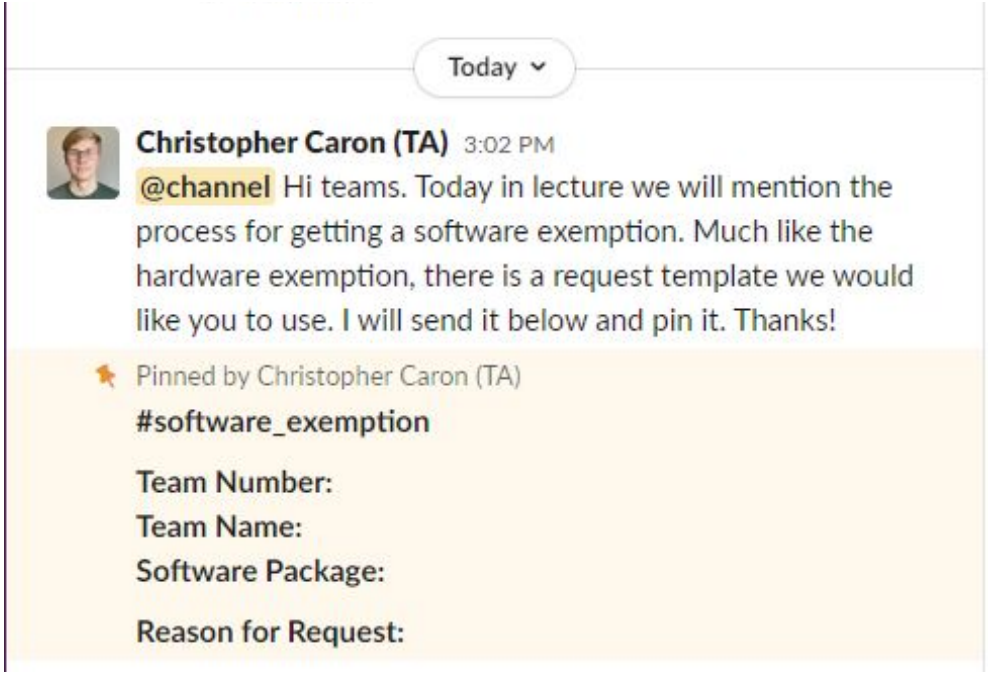
SW Requirement

Software requirement which must be satisfied by FPR, showing evidence that the migration process major steps are complete by CDR:

Exemptions due: Friday, 3 Dec'21

- Use professional IDE (examples: Atmel Studio, MPLabX)
  - (counterexamples: Arduino IDE, Notepad)
- **Must use C/C++ in programming a microcontroller**; e.g., Atmega328P, ESP8266
  - Exemptions; e.g, CircuitPython, submit SW exemption by Friday, 3 Dec'21
  - Arduino libraries not allowed
    - Exception: Can use a library that uses an Arduino library (example: Adafruit's RTClib library).

SW Exemption Template



Exemptions due:
Friday, 3 Dec'21

Rechargeable Lithium Batteries

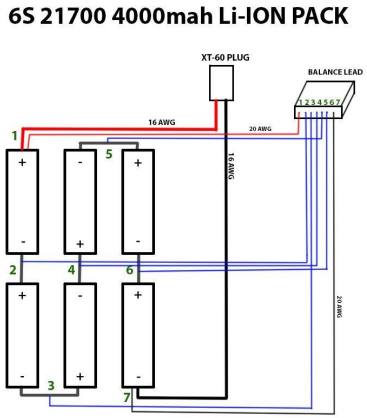
General Info and Safety

The Seriousness of the Situation

- Lithium-ion (Li-ion) batteries are by far the most dangerous object you will be working with in SDP lab
- Li-ion battery safety is not taken seriously by most users of lithium batteries, the TSA, and plenty of other usually safety centered facilities.
- When used correctly they are innocuous but incorrect usage can be truly catastrophic.
- Li-ion battery fires cannot be extinguished with water, or smothered


2016-10-29 06:35:44
Rue vue gauche

General Battery Info and Terminology



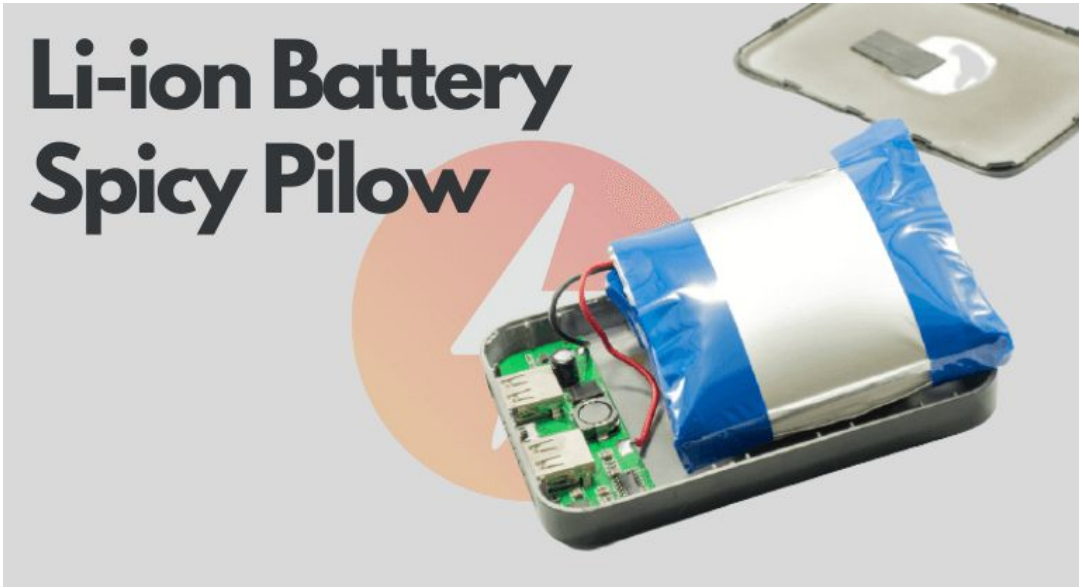
- Alkaline, Lithium, NiMh, Lithium-ion, Lead Acid.
  - What are these chemistries good for?
  - Learn about the differences between the chemistries for safety and to choose a battery that fits your project
  - When I say Li-ion I am referring to most rechargeable batteries with lithium in its chemistry.
- Battery cells, and packs.
  - Cells are individual batteries generally with a single + and -
  - Packs are cells wired in series or parallel usually with more than two electrodes.
- Battery Protection and a BMS
  - Fuses, overcharging, overheating and overdischarging protection
  - BMS- Battery management system for making sure that all cells in a battery pack are being charged/discharged equally
- C-Rate
  - rate at which a battery can discharge or recharge.
  - C-rate * total Ah of the battery = maximum amps the battery can discharge or recharge depending on if the c-rate is for charging or discharging
  - A 4Ah battery with a discharge c-rate of 10C was designed to discharge up to 40 amps.
- Thermal Runaway
  - When heat generated from the battery is more than the amount of heat absorbed by the surroundings.


Time for Smores!

General Safety

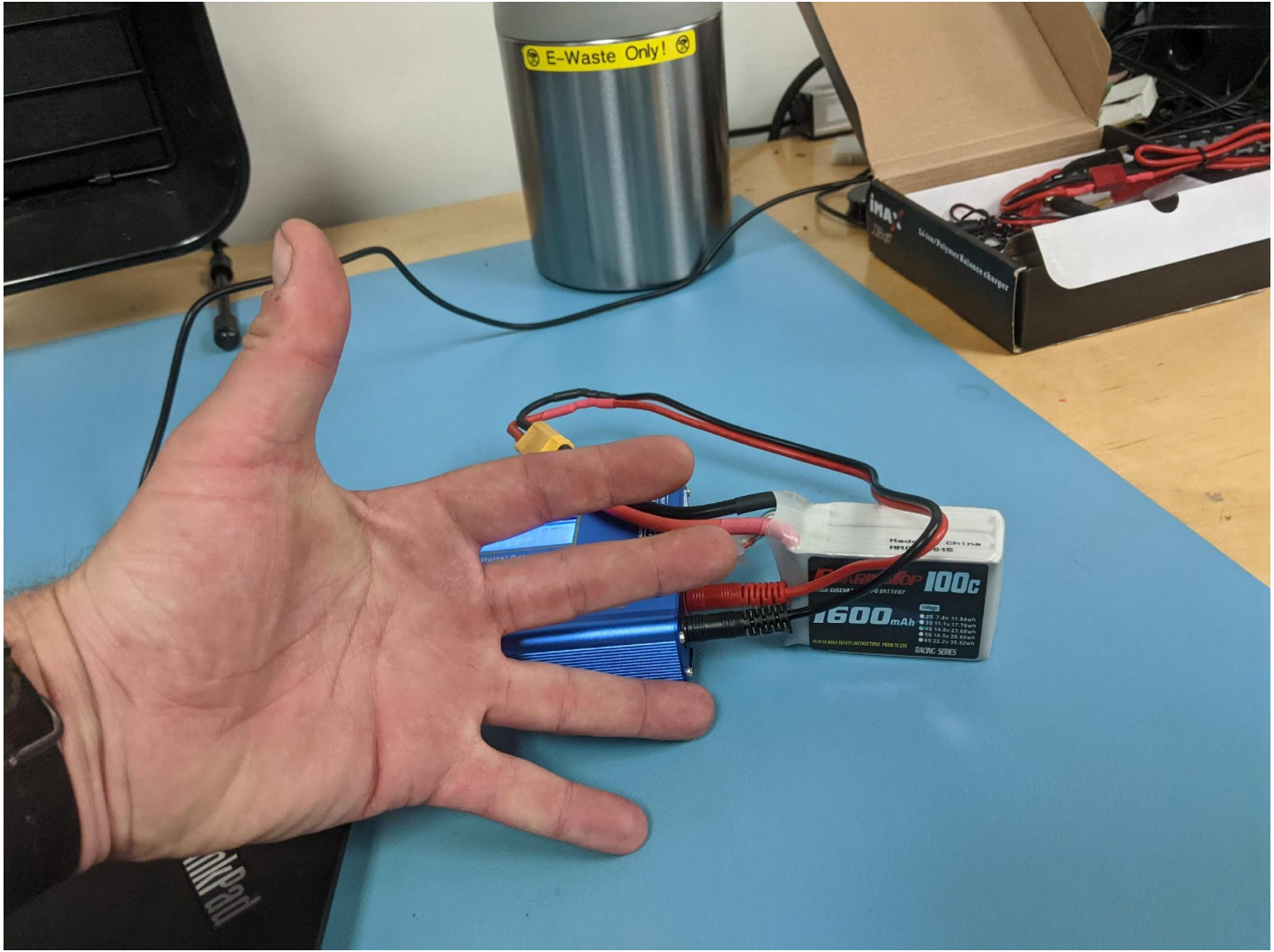
- Read the SOP from EH&S: https://ehs.umass.edu/batteries
- Do not cut positive and negative wires together, cut wires one at a time.
- Keep your batteries away from any metals, circuit boards or tools that could inadvertently cause a short. Have the terminals covered when not actively in use.
- Keep the batteries away from materials that could puncture the cells.
- Store batteries in metal container with vent holes (The metal lab bench drawers should be sufficient for the time being).
- Puffed batteries should go to the safe collection area. Tape up terminals.
- Puffed and hot batteries should be treated like an emergency, put in a metal container and put outside until thermal runaway is over.
- Do not throw any batteries away in a normal trash can.

Li-ion Battery Spicy Pilow

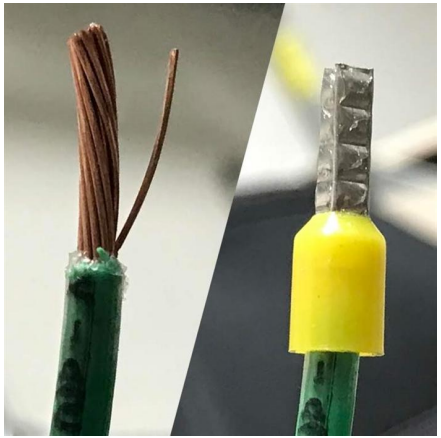


Engineering Safety

- Make sure the battery is not overpowered or underpowered for your project. Read the datasheet and specs to see if it has the correct C rating. If you do not specifically need the qualities of a li-ion battery (high energy density, fast charge rate and fast discharge rate) consider using the cheaper, safer, and more environmentally friendly nickel-metal hydride rechargeable batteries
- Make sure your projects function without shorts using bench top power supply before you attach a battery to your circuit.
- Make sure your battery has battery protection and a BMS if you are using a battery pack
  - Some batteries have built in battery protection circuitry, some do not, and you will have to add your own.
  - Best to pay extra for a battery that will keep you and your project safe.
  - Add fuses to your circuit
- Do not solder directly to battery terminal, if you absolutely need to, ask staff at the makerspace for assistance.
- Terminate wires that go into screw terminals with wire ferrules.


E-Waste Only!
100c
1600mAh
RACING SERIES

Wire Ferrules



www.pololu.com

Questions?

Sources and Reference

- Laptop battery fire: https://youtu.be/NqlMvJi5BOo
- Li-ion battery + Water: https://www.youtube.com/watch?v=bNMfe20I_IE
- Vape explosion due to Li-ion Battery: https://www.youtube.com/watch?v=ImSbVwqbJRM&t=70s
- Li-polymer battery explosion: https://www.youtube.com/watch?v=NQH3mXJ1dmw
- Lithium-ion Battery Pack Explosion: https://www.youtube.com/watch?v=EDhE0pk3FeQ
- Lithium ion safe transport, use and disposal: https://iosh.com/media/9495/lithium-batteries-and-their-safe-storage-transport-use-and-disposal-including-re-use-and-re-cycling.pdf
- Puffy Li-ion Batteries Explained (aka the spicy pillow) https://www.powerbankexpert.com/lithium-battery-spicy-pillow/
- Facial burn from li-ion battery in headphones: https://english.newstracklive.com/news/lithium-ion-battery-21232-1.html

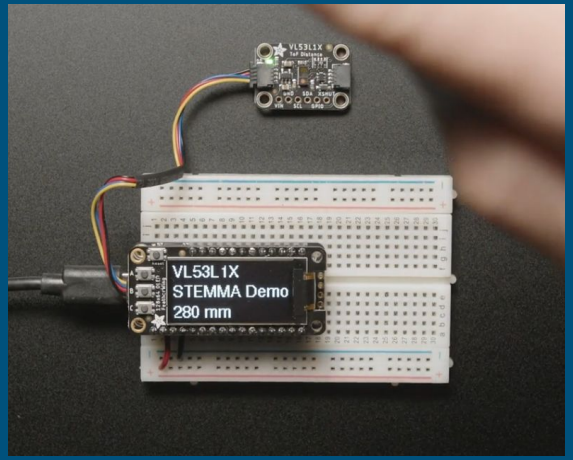
Component Sourcing and Intro to Digi-Key

Christopher Caron
MSECE Candidate
SDP22

Breakout Boards

Prior to MDR, most part sourcing should be done on sites like Adafruit or Sparkfun, where components are sold as part of a:

- **Breakout Board (BOB)**
- **Arduino Shield or FeatherWing**
- **Development Board**
- **Single Board Computer (SBC)**

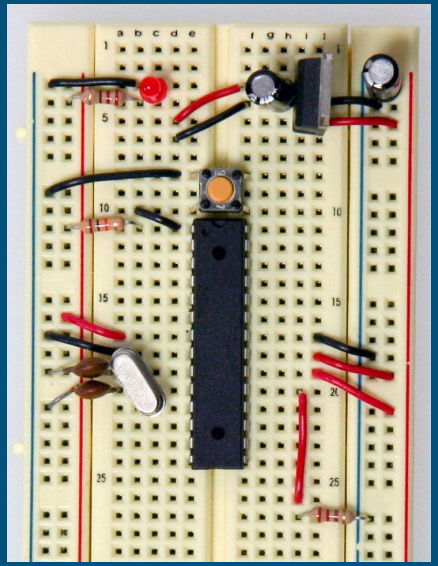


The goal is to source *proven systems* that are *breadboard compatible* and *modular* for easy/quick prototyping

Single-Component Sourcing

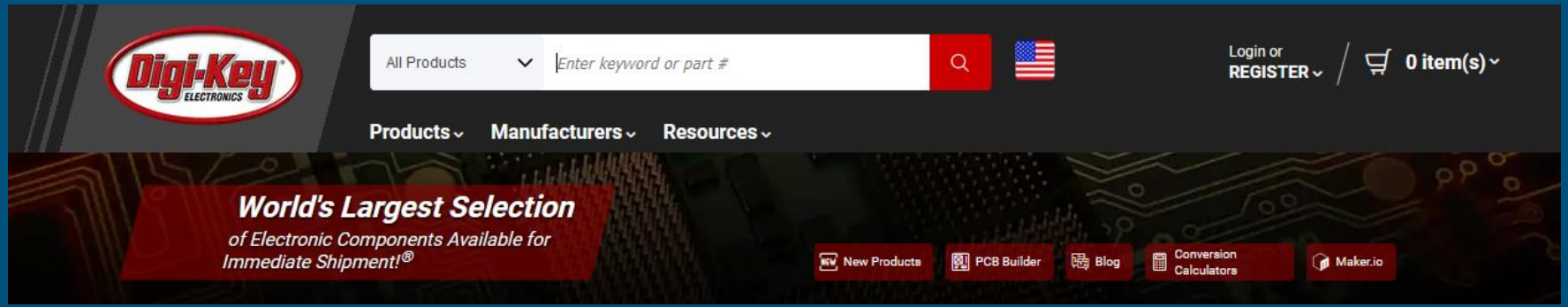
As the semester goes on, you may need to source single parts for various reasons:

- M5 does not have the component or values you need
- A datasheet or application notes recommends a specific component
- You need a very special IC
- You wish to demonstrate low level control over a key device for MDR



Digi-Key

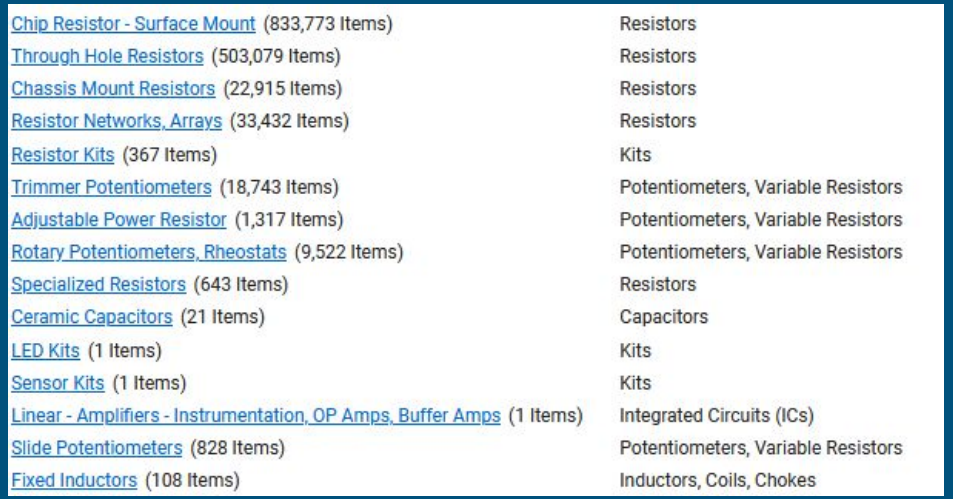
- Digi-Key is the recommended supplier for sourcing components for SDP
- ~11.5 million items, and over 2.6 million items ready for immediate shipment
  - ((Chances are that if it exists, it is on Digi-Key))
- So large and complicated that we try to teach students how to navigate



How to Navigate the site

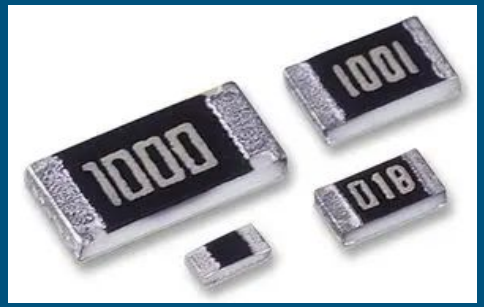
Searching the word “resistor” brings up about 1,500,000 items for sale… yikes

The first thing to know is the component *category*



Chip Resistor - Surface Mount (833,773 Items)	Resistors
Through Hole Resistors (503,079 Items)	Resistors
Chassis Mount Resistors (22,915 Items)	Resistors
Resistor Networks, Arrays (33,432 Items)	Resistors
Resistor Kits (367 Items)	Kits
Trimmer Potentiometers (18,743 Items)	Potentiometers, Variable Resistors
Adjustable Power Resistor (1,317 Items)	Potentiometers, Variable Resistors
Rotary Potentiometers, Rheostats (9,522 Items)	Potentiometers, Variable Resistors
Specialized Resistors (643 Items)	Resistors
Ceramic Capacitors (21 Items)	Capacitors
LED Kits (1 Items)	Kits
Sensor Kits (1 Items)	Kits
Linear - Amplifiers - Instrumentation, OP Amps, Buffer Amps (1 Items)	Integrated Circuits (ICs)
Slide Potentiometers (828 Items)	Potentiometers, Variable Resistors
Fixed Inductors (108 Items)	Inductors, Coils, Chokes

Categories Example



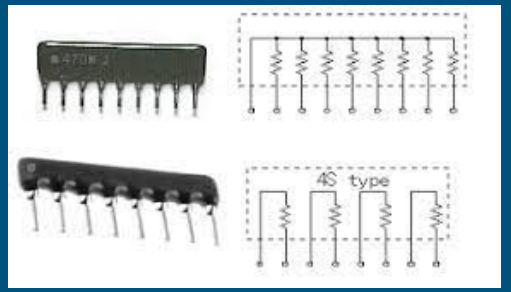
Chip Resistors (SMD)

Through Hole Resistors

Chassis Mount

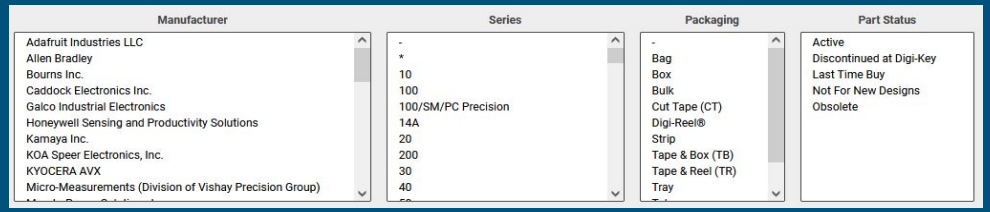
Rotary Potentiometer

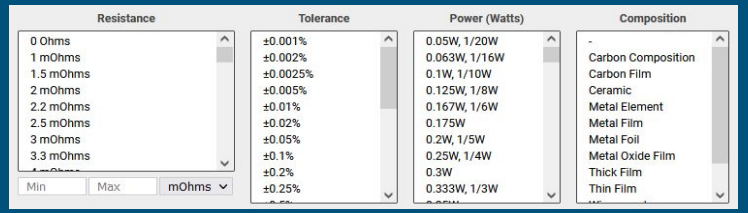
Trimmer (THT)

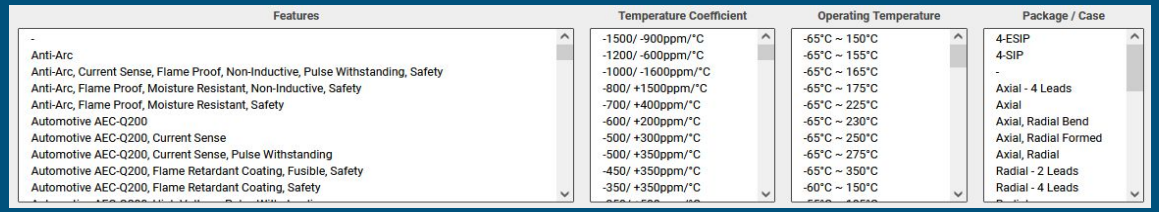


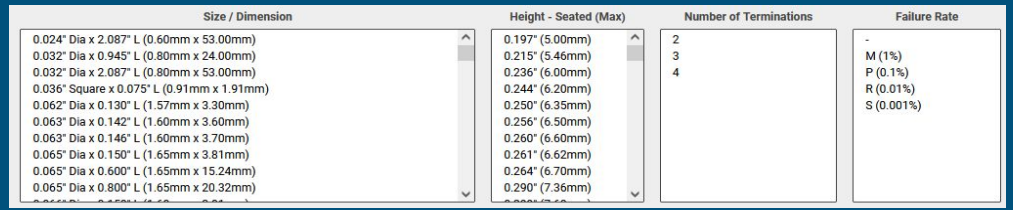
Resistor Array (THT)

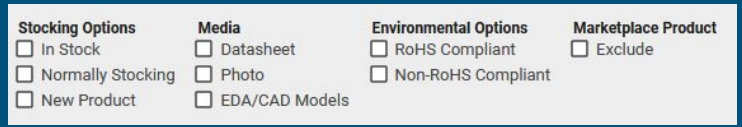
Filtering Example











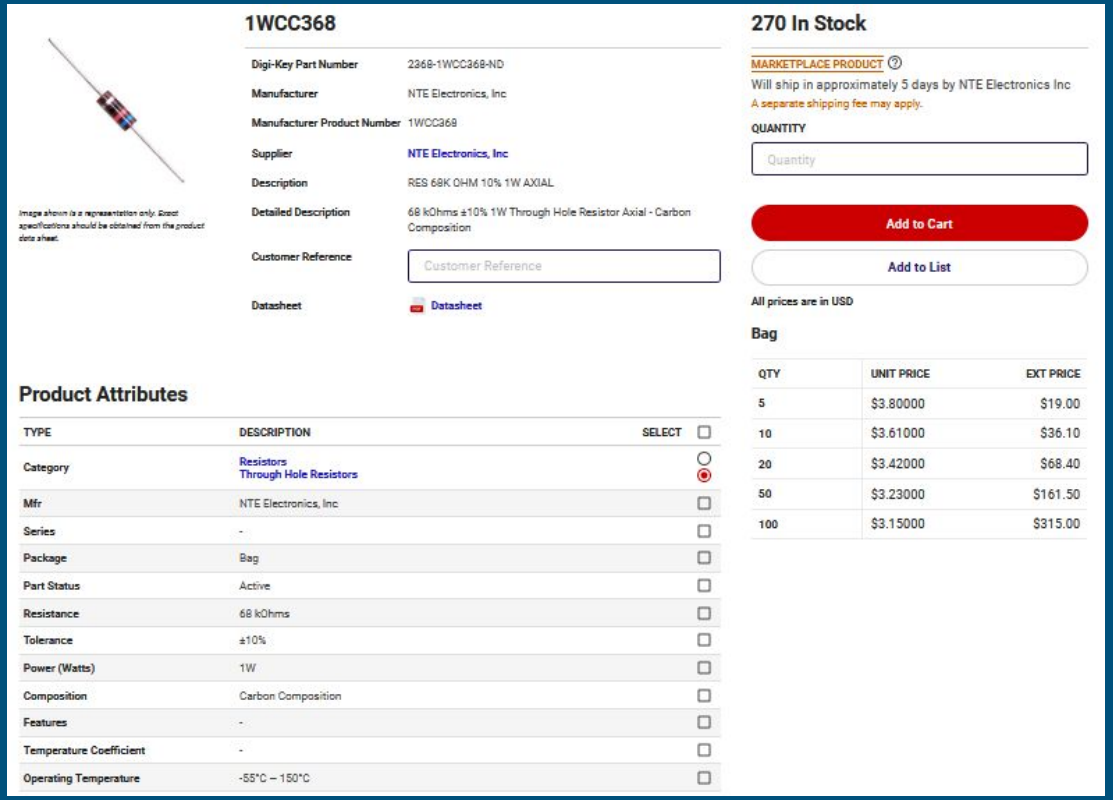
Chris's Filter Priority Example: Resistors

1. **In Stock**
2. Part Status: Active
3. *MCAD/ECAD model* *...if designing PCB*
4. Composition (Carbon, Metal, Metal-Oxide Film, etc)
5. Resistance
6. Power Rating (¼, ⅛, etc… may be connected to size)
7. Tolerance
8. Package / Case + Size (Axial, Surface Mount, Radial, etc…)
9. Packaging (Cut Tape, Strip, Tray, Tube)

Component Pages

Take note of:

1. Minimum Quantity
2. Stock
3. Unit Prices
4. Shipping Notices
5. Datasheet
6. Part number
7. Datasheet?
8. Other Specs



1WCC368

Digi-Key Part Number	2368-1WCC368-ND
Manufacturer	NTE Electronics, Inc
Manufacturer Product Number	1WCC368
Supplier	NTE Electronics, Inc
Description	RES 68K OHM 10% 1W AXIAL
Detailed Description	68 kOhms ±10% 1W Through Hole Resistor Axial - Carbon Composition
Customer Reference	Customer Reference
Datasheet	Datasheet

270 In Stock

MARKETPLACE PRODUCT

Will ship in approximately 5 days by NTE Electronics Inc

A separate shipping fee may apply.

QUANTITY

Quantity

Add to Cart

Add to List

All prices are in USD

Bag

QTY	UNIT PRICE	EXT PRICE
5	$3.80000	$19.00
10	$3.61000	$36.10
20	$3.42000	$68.40
50	$3.23000	$161.50
100	$3.15000	$315.00

Product Attributes

TYPE	DESCRIPTION	SELECT
Category	Resistors Through Hole Resistors	
Mfr	NTE Electronics, Inc	
Series	-	
Package	Bag	
Part Status	Active	
Resistance	68 kOhms	
Tolerance	±10%	
Power (Watts)	1W	
Composition	Carbon Composition	
Features	-	
Temperature Coefficient	-	
Operating Temperature	-55°C – 150°C	

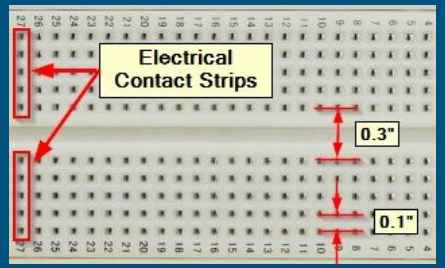
Intro to IC Footprints

- As time goes on, you will hear us talking about ***footprints*** more and more often
- This will be a concern during PCB design, but it is still something to consider
- “Package” and “footprint” are often used interchangeably, they have slightly different meanings
- Lots to learn here, so let’s focus on the basics again

Measurements

- **mm** (Metric) - Millimeter
- **mils** (Imperial) - 1/1000th of an inch, also called thou's

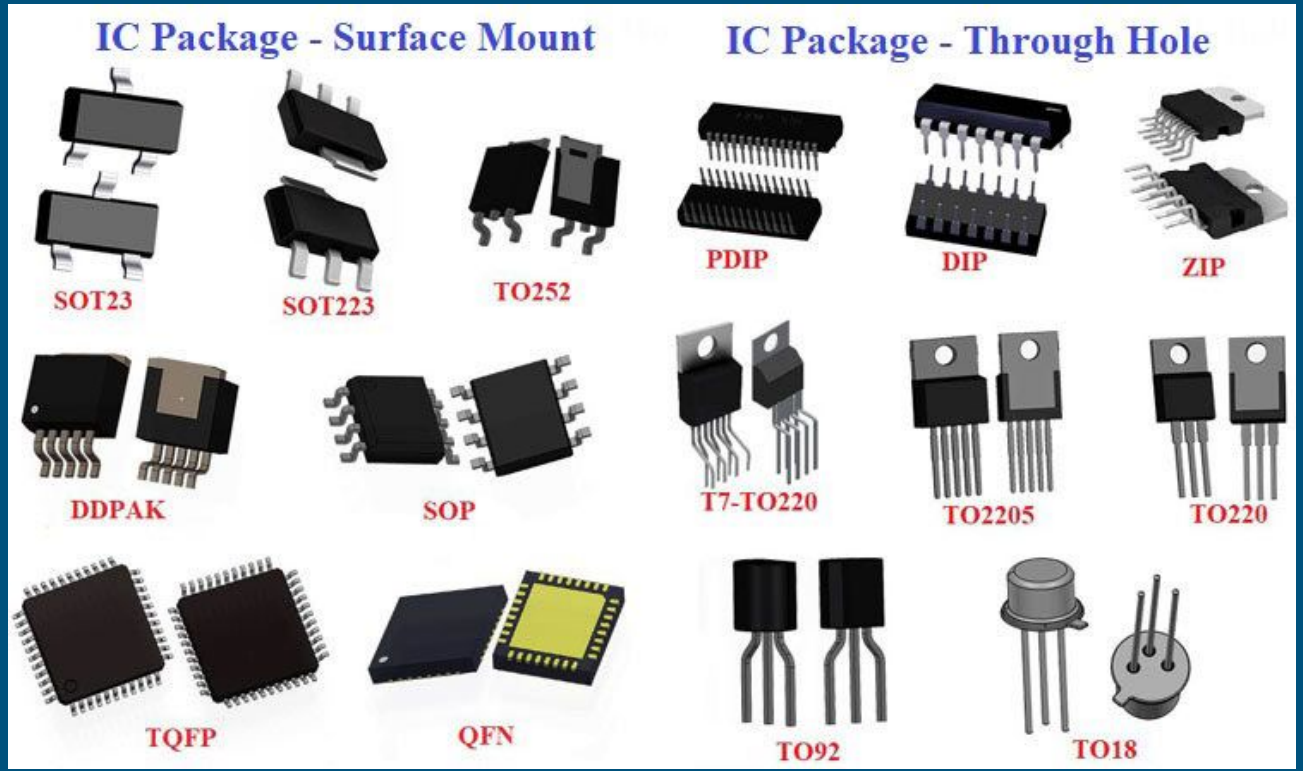
1 mil = 2.54 mm || 1 mm = ~39.3701mils



Breadboard = 100 mil (0.100 in) pitch, 1 mm holes

Typical Perf board pad: 1.5 mm annular ring, 1 mm hole

Common Footprints



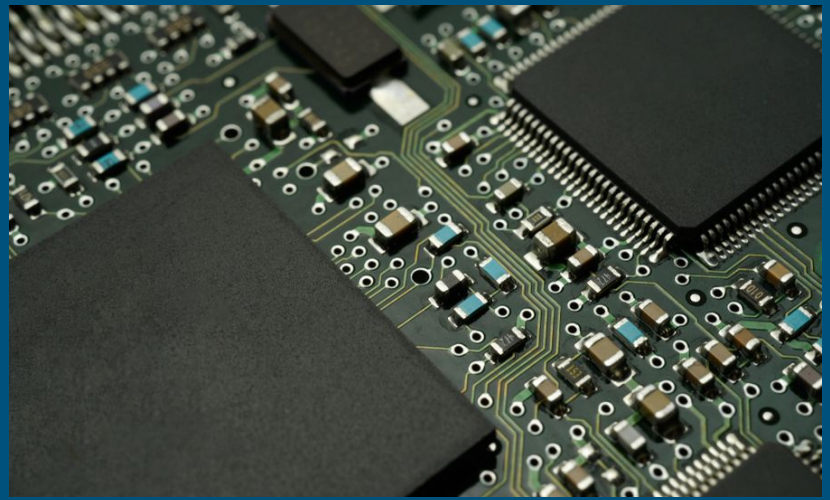
Should I Order this Package?

Example: 1450-1017-ND

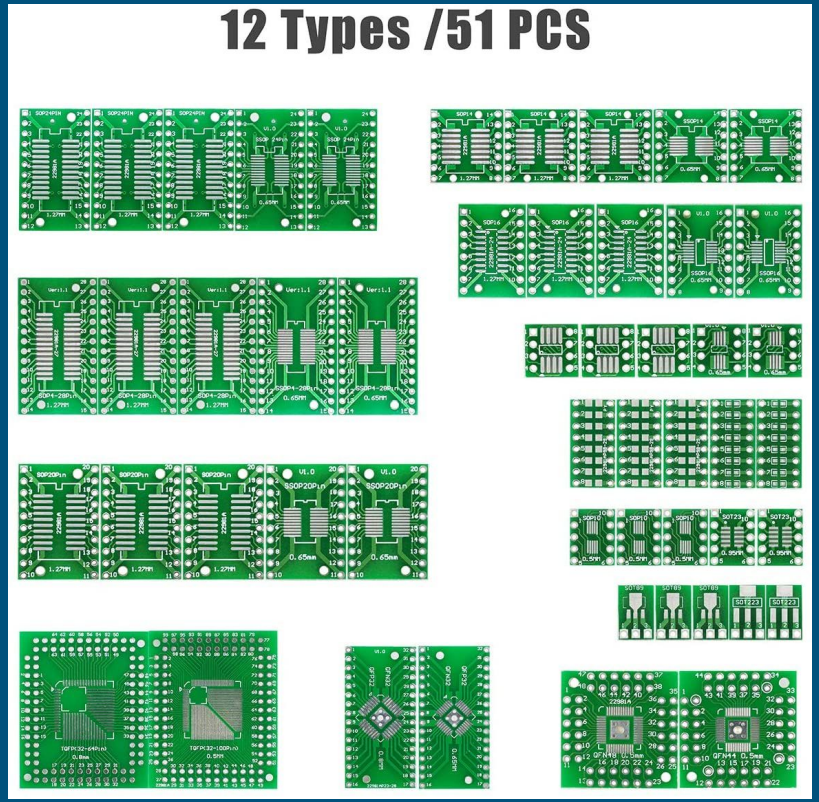
Example: 568-11903-1-ND

Why use SMT?

- Smaller size
- More modern standards
  - Some newer chips are ONLY offered as SMD
- Can have better electrical performance
- Better thermal dissipation
- Can be more cost effective
- Actually makes PCB design easier
  - And even soldering in many cases!



A Note About Adapters



Digi-Key BOM Management

- Can import CSV files directly into Digi-Key and Save as BOM
- When ready to order parts or boards, input number of assemblies, apply quantity savings, and checkout
- Altium even generates these CSVs automatically!!

Example: https://docs.google.com/spreadsheets/d/13QVVRw7uZ9rnPni03JKcmv87sZIuv122-orO0Bd0DLI/edit?usp=sharing