Connectors

Lecture 18

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Learning Objectives

By the end of this lecture you will be able to:

- List the most commonly used connectors in embedded systems.
- Select an appropriate connector for a particular application.
- Design a plan for wiring up your final project.

How to Select a Connector

Selection Criteria

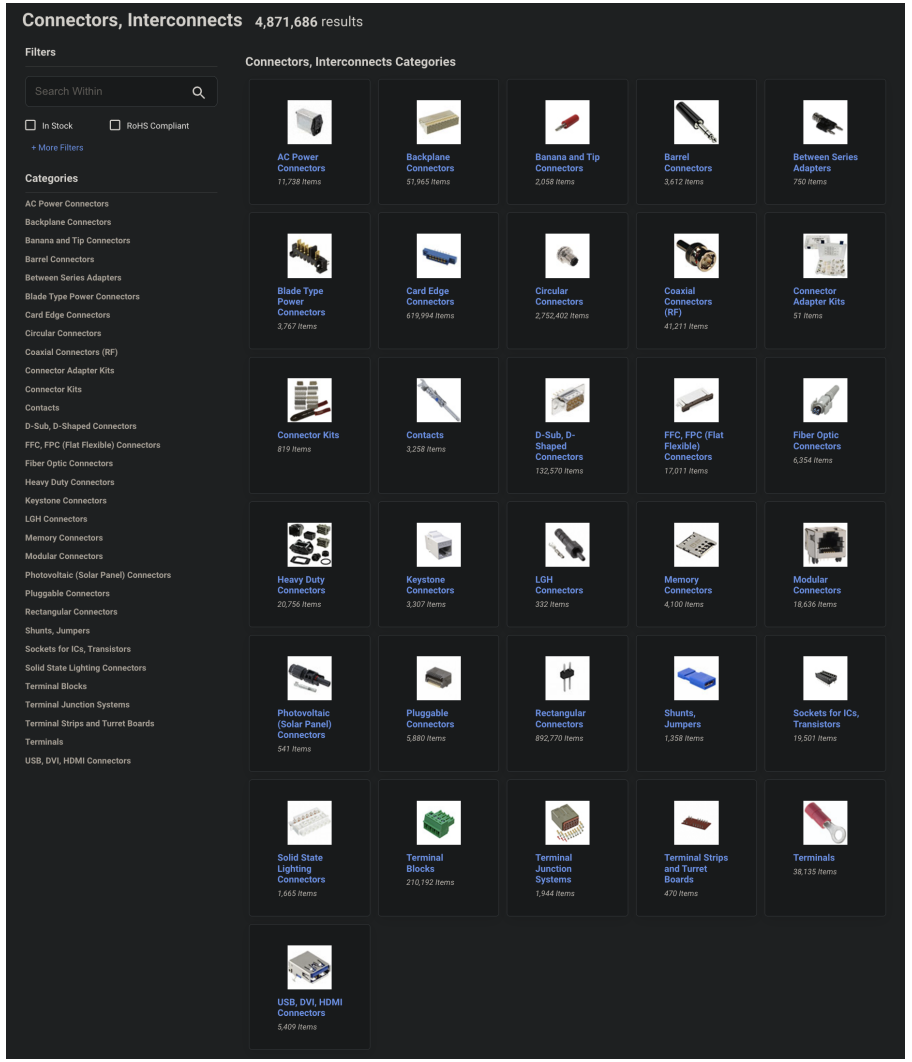
- Environmental Factors
- Current/Voltage Requirements
- Size and Weight
- Ease of Assembly
- Cost

Types of Connectors

- Wire to Wire
- Board to Board
- Wire to Board
- Power
- Modular
- Terminal Blocks

Searching for connectors

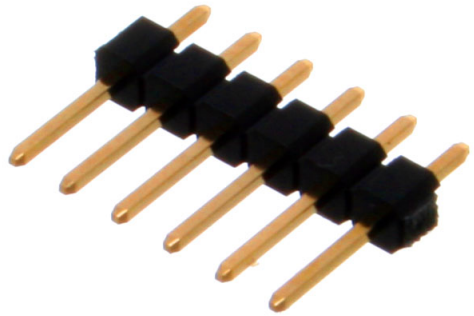
- Often can use an (overwhelming!) parametric search on an electronics distributor website (e.g., Digikey, Mouser).
- Helpful to go in with an idea of what the basic types and parameters are.



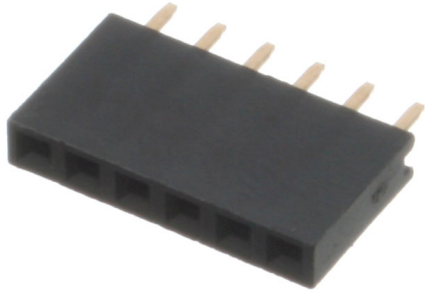
Digikey Connector Library

Pin Headers

- Very common connector
- Typically come in 0.100” (2.54 mm) pitch
- Good for simple board-to-board or wire-to-board connections, but no locking mechanism which makes it mechanically unstable.



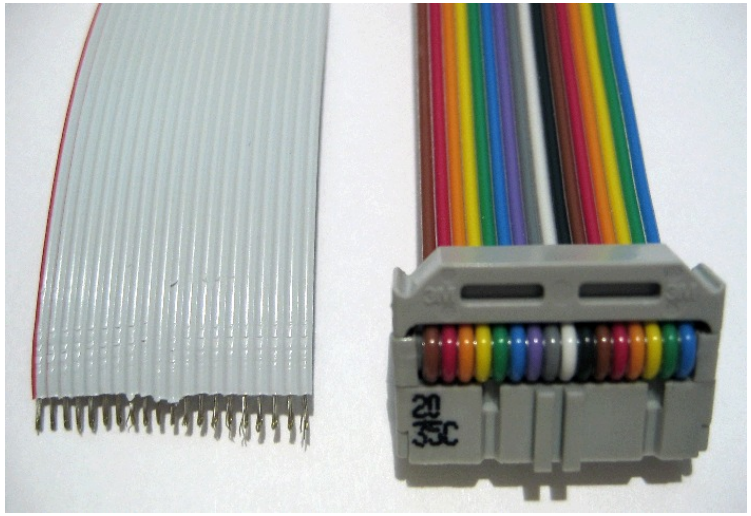
Male header By oomlout - Flickr: 6 Pin Header - HEAD-06, CC BY-SA 2.0



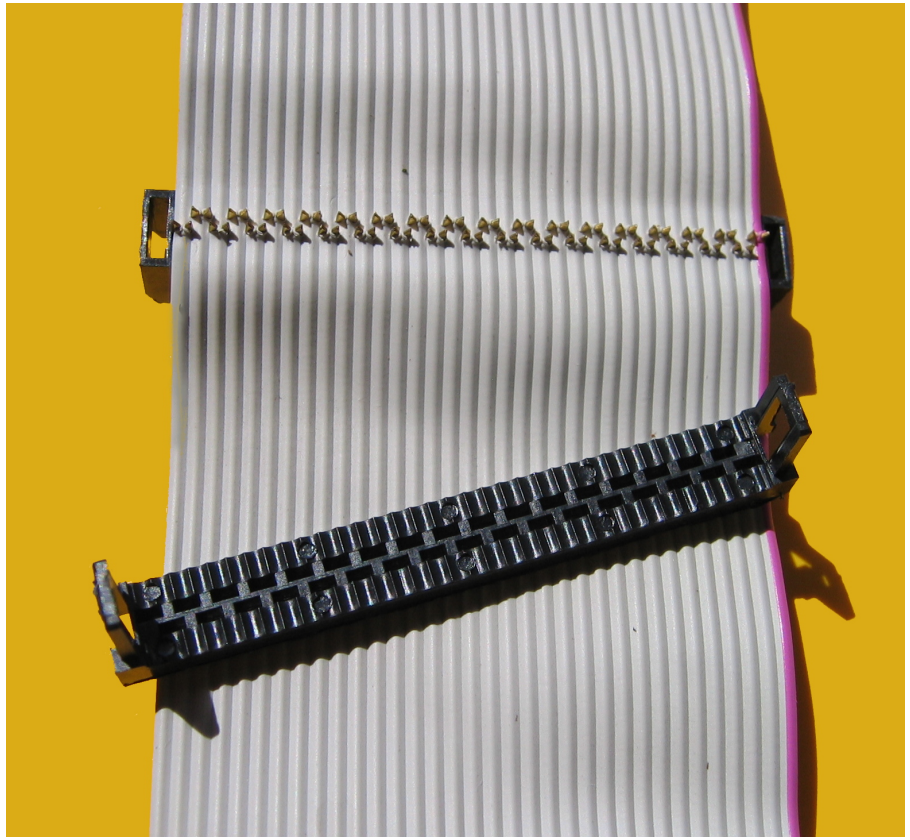
Female header By oomlout - Flickr: 6 Pin Female Header - FHEA-06, CC BY-SA 2.0

Insulation-Displacement Contact (IDC) Connectors

- Connector pierces cable to make connections
- Often keyed to ensure alignment
- Used to route large numbers of wires with ribbon cables



By Heron 21:16, 22 Nov 2004 (UTC) - Self-photographed, CC BY-SA 3.0



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Japan Solderless Terminal (JST) Connectors

- Design standard created by Japan Solderless Terminal (J.S.T.) Manufacturing Company
- Wire-to-board and wire-to-wire
- A variety of different families with different parameters
  - Pin-to-pin pitch
  - Number of rows
  - Current/Voltage ratings and wire size
  - Shroud
  - Lock

See more on the Wikipedia page.

Wire-to-board connectors

JST series	Pin-to-pin pitch	Pin rows	Current (Amp)	Voltage (Volt)	Wire size (AWG)	Shroud	Lock	Notes	Datasheet
VH [5]	3.96 mm (0.156 in)	1	10	250	22 to 16	Yes/No	Yes	Unshrouded seems to be more popular than shrouded.	JST VH
RE [6]	2.54 mm (0.100 in)	1	2	250	30 to 24	No	No	Similar to female "DuPont" connectors and male pin headers. RF series is double row.[7]	JST RE
EH [8]	2.50 mm (0.098 in)	1	3	250	32 to 22	Yes	No	Not 0.1-inch pitch.	JST EH
XA [9]	2.50 mm (0.098 in)	1	3	250	30 to 20	Yes	Yes	Not 0.1-inch pitch.	JST XA
XH [10]	2.50 mm (0.098 in)	1	3	250	30 to 22	Yes	No	Not 0.1-inch pitch. Used by many radio control (R/C) batteries.	JST XH
PA [11]	2.00 mm (0.079 in)	1	3	250	28 to 22	Yes	Yes	Used by FMA Cellpro R/C battery chargers.	JST PA
PH [12]	2.00 mm (0.079 in)	1	2	100	32 to 24	Yes	No	Many stepper motors. Compatible with KR (IDC), KRD (IDC), CR (IDC) series.[13][14][15]	JST PH
ZH [16]	1.50 mm (0.059 in)	1	1	50	32 to 26	Yes	No	Compatible with ZR (IDC) and ZM (crimp) series.[17][18]	JST ZH
GH [19]	1.25 mm (0.049 in)	1	1	50	30 to 26	Yes	Yes	Not 0.05-inch pitch. Sometimes confused with Molex PicoBlade.[20]	JST GH
SH [21]	1.00 mm (0.039 in)	1	1	50	32 to 28	Yes	No	Compatible with SR (IDC) and SZ (IDC) series.[22]	JST SH

Wire-to-wire connectors

JST series	Pin-to-pin pitch	Pin rows	Current (Amp)	Voltage (Volt)	Wire size (AWG)	Features	Notes	Datasheet
RCY [23]	2.50 mm (0.098 in)	1	3	250	28 to 22	Locking	Used in radio control (R/C), also known as BEC or P connector. Commonly found on small models, toys, and small LiPo packs.	JST RCY
SM [24]	2.50 mm (0.098 in)	1	3	250	28 to 22	Locking, High force	Used in some RGB LED decorative light strips.	JST SM

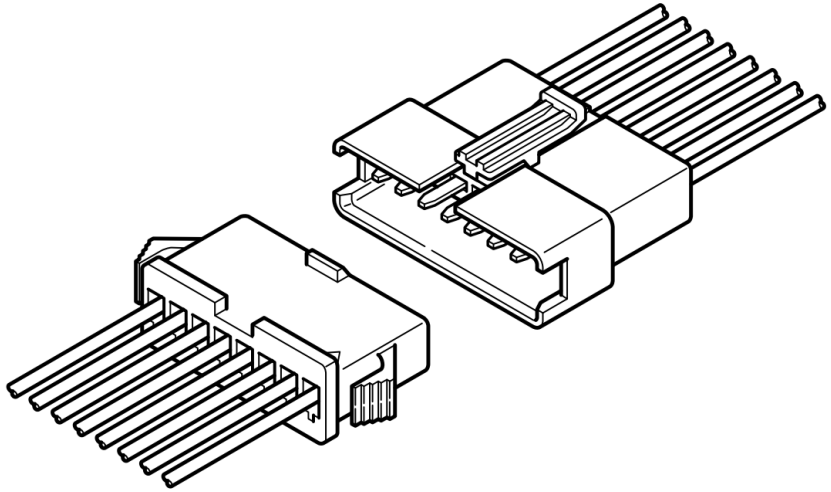
Table of connectors from the Wikipedia page.

Example JST Connectors

JST-XH vertical wire-to-board

By Laurenz Wagner - Own work, CC BY 3.0

JST-SM Connector wire-to-wire



JST-SM Connector from Datasheet

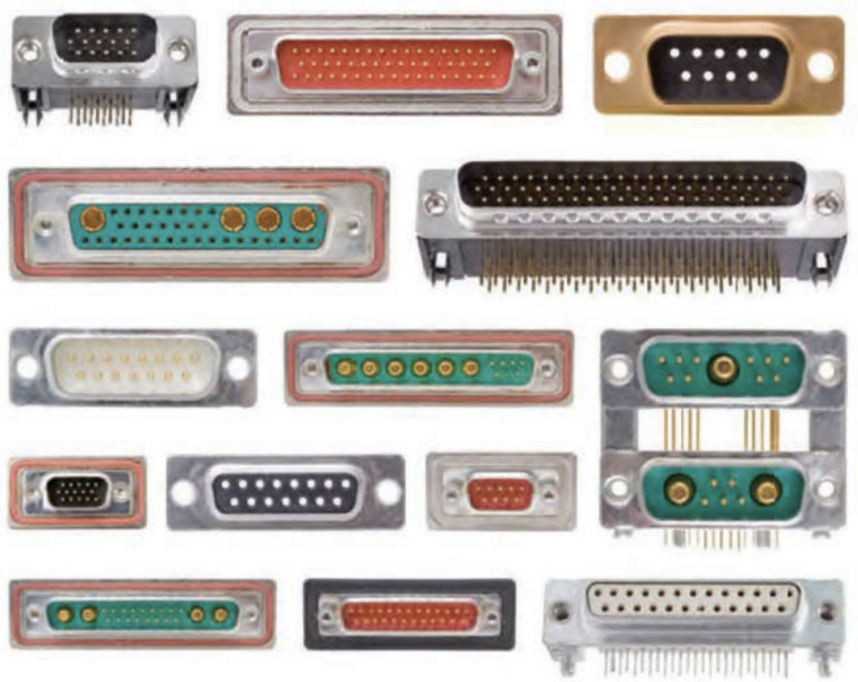
DIN Connectors

- Standardized by Deutsches Institut für Normung (DIN), the German Institute for Standards.
- Some common examples include the DIN 41524 circular connector for audio (e.g., MIDI)
- Includes not just the most common circular connectors, but some others as well under the DIN umbrella.

By MarcoTangerino - Own work, Public Domain

D-Sub Connectors

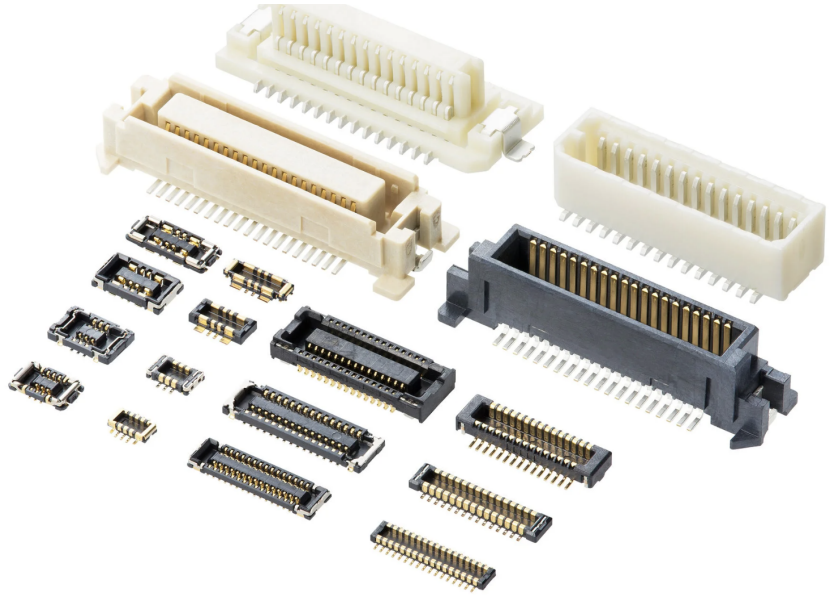
- “D” because of physical shape (ensures orientation)
- More durable and mechanically stable than IDC connectors. (e.g., often come in sturdy housings, include screws to secure)
- Available with shielding to protect signals when traveling longer distances.
- Used in a variety of applications like video (VGA) or serial communication (RS-232, RS-485)



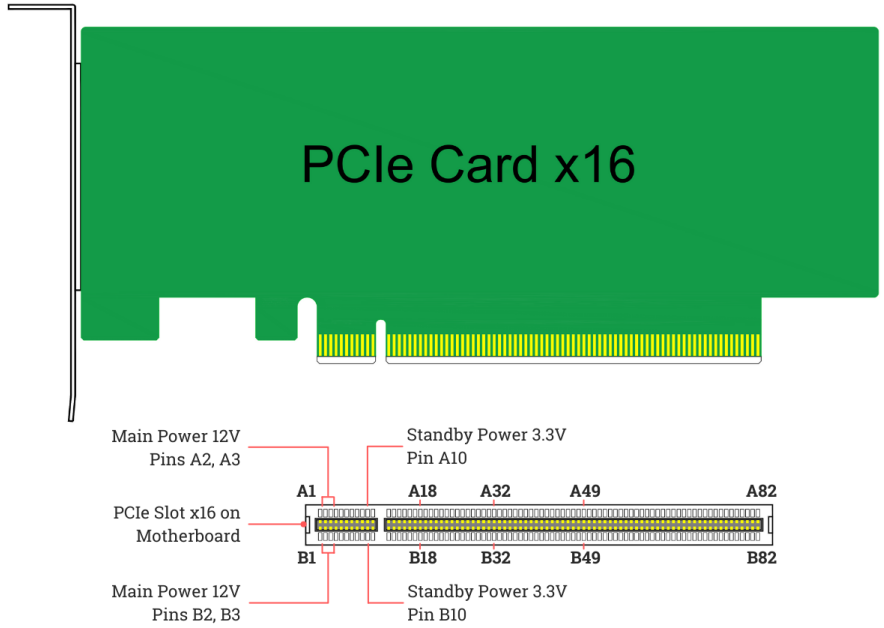
D-Sub connectors from Molex Catalog

Board-to-Board Connectors

- Edge connectors (e.g., PCIe cards, m2 SSDs)
- Sockets/interconnects to stack boards on top of each other



Molex SlimStack Connectors

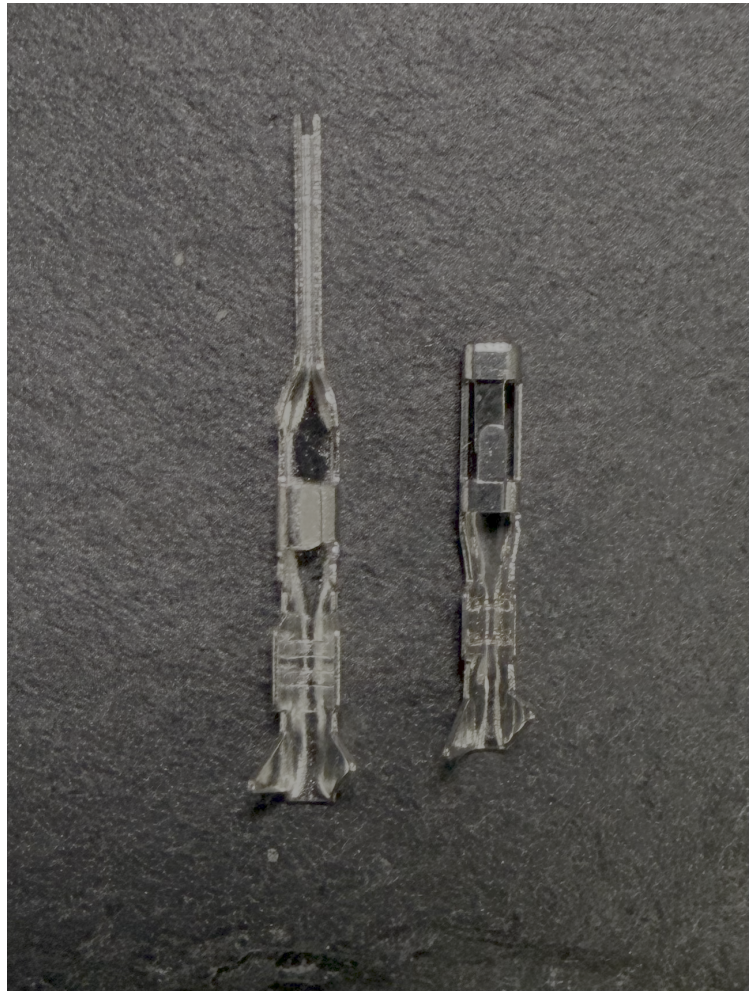


PCIe Card - Own Work by Lam Tung Lee

“DuPont” Connectors

- Not an actual connector term but colloquially used to refer to these
- Likely seen these before in servos
- 0.100” (2.54 mm) pitch

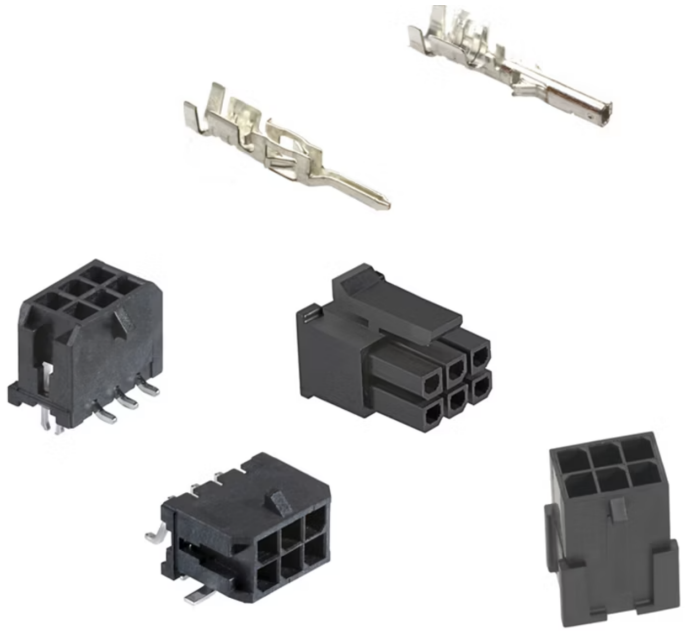
DuPont Connector Shroud



DuPont Connectors

“Molex” Connectors

- Another example of a colloquial term. Molex is a manufacturer and “Molex Connector” doesn’t refer to one specific connector or connector type.
- Often people are referring to Micro/Mini Fit line, commonly used in desktop PC power supplies.



Molex Micro-Fit Connectors

Connectors in Practice

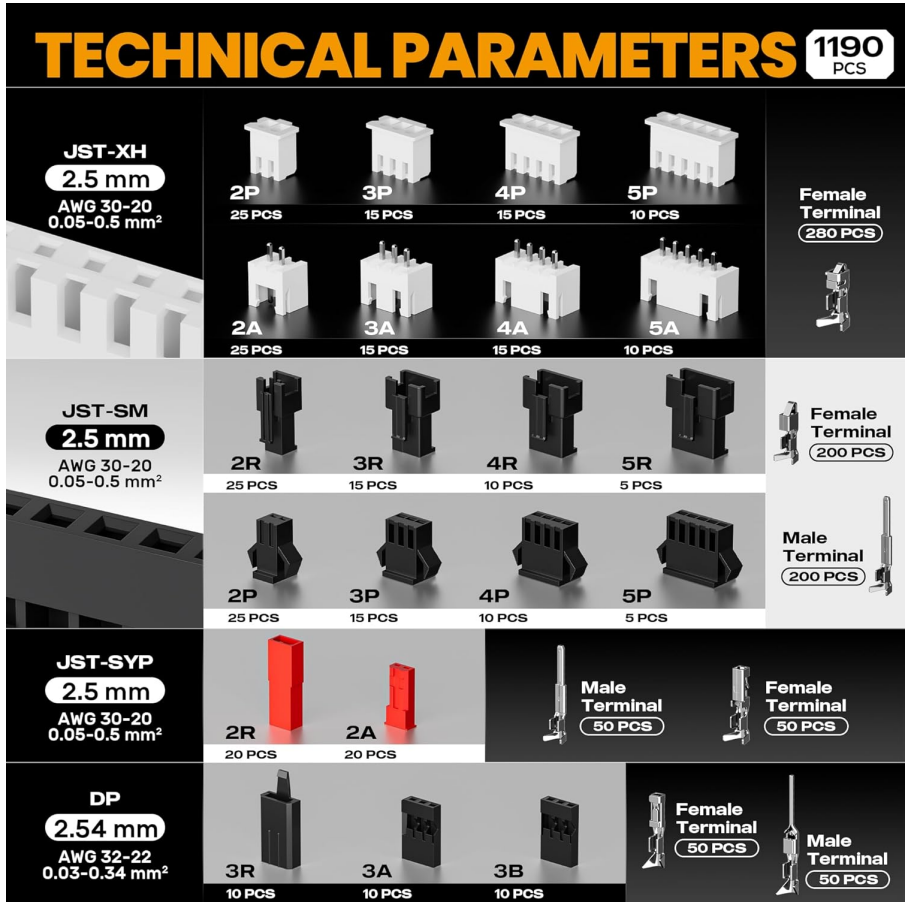
How to make a connector

1. Select the appropriate connector
2. Select the appropriate wire (correct gauge)
3. Use crimping tool to attach the connector
4. Insert connectors into the plastic shroud

What we have in the lab

- JST-XH wire-to-board, locking
- JST-SM wire-to-wire, locking
- JST-SYP wire-to-wire
- Dupont (DP)

Crimp tool



Connector Kit Contents

Activity

In your team, identify the various physical components in your system that will need to be electrically connected with cables. For each connection identify:

1. The number of circuits/wires
2. The type of connection (e.g., wire to wire, wire to board, board to board)
3. The top candidates for connector type
4. A bill of materials for connectors and cabling