

# Connector selection

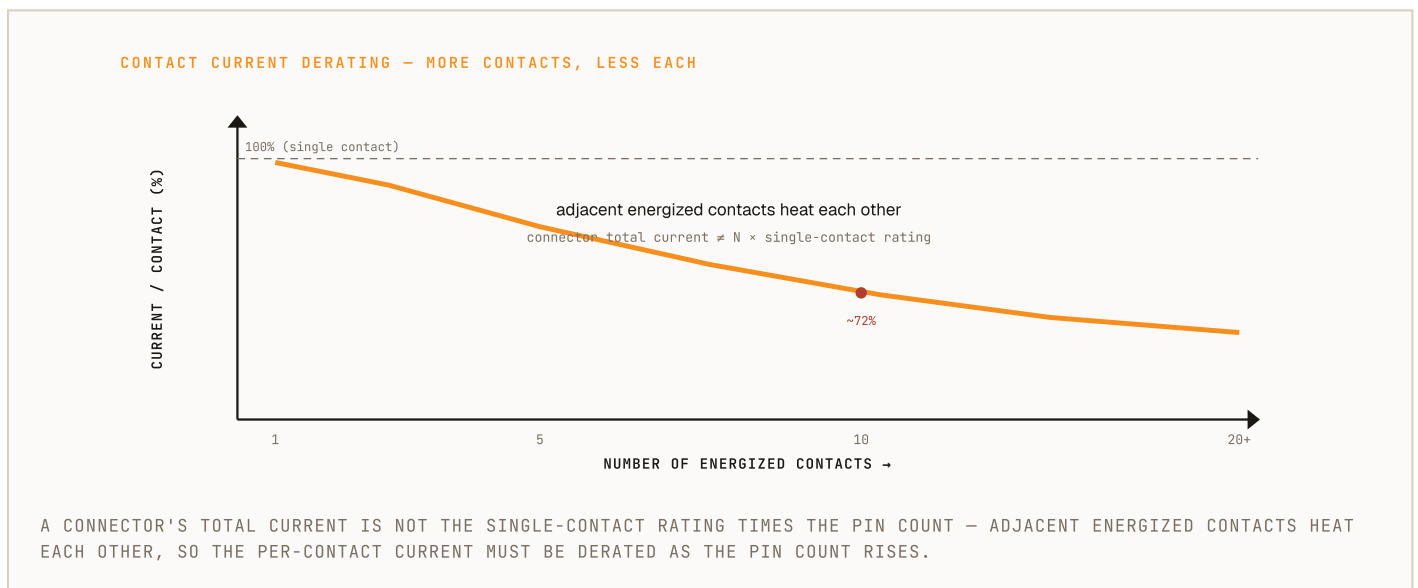
Choosing connectors — the families and where they fit, per-contact current and the derating that bites with pin count, plating and mating cycles, and environment.

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## ABSTRACT

Connectors are chosen on a handful of axes — current, voltage, contact count and pitch, wire gauge, mating cycles and environment — and then narrowed to a family. The two things engineers most often get wrong are current derating (with pin count and temperature) and plating (gold vs tin for the duty).

Section 1 is the selection axes. Section 2 is connector families. Section 3 is current rating and derating. Section 4 is contact resistance and plating. Section 5 is mechanical and environmental. Section 6 is a checklist.



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## 1. Selection axes

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Pin down these before picking a part:

<b>Current / voltage</b>	Per-contact current and working voltage (with creepage/clearance for high V)
<b>Contacts &amp; pitch</b>	Number of positions and centre spacing (2.54 / 2.0 / 1.25 / 1.0 mm...)
<b>Wire-to-board / -wire / board-to-board</b>	Where each end terminates
<b>Mating cycles</b>	How many connect/disconnect cycles over life — drives plating
<b>Environment</b>	Temperature, vibration, sealing (IP), contamination

## 2. Connector families

FAMILY	TYPICAL USE	NOTE
2.54 mm pin header	prototyping, jumpers, ribbon	~3 A/pin; not for vibration
JST SH/ZH/PH (1.0/1.5/2.0)	wire-to-board signal / low power	1–2 A; PH is the LiPo standard
JST XH / VH (2.5/3.96)	wire-to-board power	3–10 A
Molex Micro-Fit / Mini-Fit (3.0/4.2)	board power	5–13 A
Terminal block (3.5/5.0/5.08)	field wiring	8–15 A+, screw/spring
FFC / FPC	flex cables, displays, cameras	low current; ZIF actuators
Barrel / XT60 / Anderson	DC power input	5–60 A
USB / RJ45 / SMA / U.FL	data / RF	controlled impedance (see <i>PCB</i> ref)

### 3. Current rating and derating

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A connector's datasheet current is usually **per contact with a defined temperature rise** (often 30 °C) — and it assumes few contacts energized. Derate for reality:

- **Pin-count derating: energized contacts heat each other, so the per-contact current drops as more are loaded**  
a 12-way connector might allow only ~70% of the single-contact rating on each. Use the maker's derating curve.
- **Temperature derating: the allowable current falls as ambient rises toward the connector's max temp.**
- **Don't parallel a tiny connector for big current expecting  $N\times$ ; parallel contacts share unevenly.**

Total connector current is **not**  $N \times$  single-contact rating — size from the derated value.

## 4. Contact resistance and plating

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- Contact resistance ( $m\Omega$ ) causes voltage drop and self-heating; it rises as plating wears and with fretting.
- Plating choice:
  - **Gold** — low, stable contact resistance; **many mating cycles**; required for **low-level signal** (it doesn't build insulating oxide). Costlier.
  - **Tin** — cheap; fine for **power** and **few mating cycles**; prone to **fretting corrosion** under micro-vibration on signal lines — avoid for low-level signals that move.
- **Don't mate gold to tin**  
the dissimilar pair accelerates wear; match platings.

## 5. Mechanical and environment

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- Mating cycles are plating- and design-limited (tin ~10–50, gold hundreds+). Pick for the service profile.
- Retention / locking (latches, screws, friction) for vibration; add strain relief to the cable.
- Polarization / keying to prevent reversed or offset mating; first-mate/last-break pins for hot-plug power/ground sequencing.
- Sealing (IP) for outdoor/wash-down; vibration wants positive locks and gold contacts.

## 6. Checklist

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- **Electrical:** per-contact current (derated for pin count + temperature), working voltage, creepage/clearance.
- **Mechanical:** position count and pitch, wire gauge/termination (crimp/IDC/solder), mating cycles, locking, strain relief.
- **Plating:** gold for signal/high-cycle, tin for power/low-cycle; match both halves.
- **Environment:** temperature, vibration, IP sealing, contamination.
- **Then pick the family from the table and confirm the derated current against your load (use the Wire gauge & V-drop tool for the conductor).**