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# USB BASICS

*USB is a negotiated bus. A host and a device enumerate over a differential pair (D+/D-) before any data flows. What enumeration is and why it matters.*

ONE THOUSAND DRONES ENGINEERING TEAM · VERIFIED 2026-07

USB is a negotiated bus. Before any of your data crosses the cable, a host and a device introduce themselves and agree on terms, a step called enumeration. That handshake is why a board pops up on your computer a second after you plug it in, and why USB carries more machinery than a plain serial link.

## HOST AND DEVICE

One end is the host, usually your computer, and the other is the device, the board. The host runs the bus: it powers it, starts every transfer, and manages who talks. A device stays quiet until the host asks it something.

## ONE DIFFERENTIAL PAIR

Full-speed and low-speed USB carry data on a single differential pair, `D+` and `D-`. The two wires swing in opposite directions and the receiver reads the difference between them, which cancels out noise that hits both wires alike. Power, on `VBUS` and ground, shares the same cable, so one connector both feeds the board and talks to it.

## ENUMERATION, THE HANDSHAKE

On plug-in the host detects the device, resets it, and asks it to describe itself. The device answers with descriptors: who it is, what it does, and how much current it needs. The host loads a matching driver, and only then does your application data start to flow.

- Beyond Logic. USB in a NutShell (host/device, descriptors, enumeration). beyondlogic.org

**DEEP DIVE · WHY USB IS MORE THAN A FAST UART**

A UART link is two chips preset to the same speed, and they just send bytes. USB does more before any payload moves: it detects the device on plug-in, resets it, assigns it an address, and reads its capabilities. That negotiation is what lets one port accept a keyboard, a flash drive, and your board with no manual setup, and it is why a USB stack is a real piece of firmware. On a small board you usually get it for free from the microcontroller's built-in USB, but the handshake is still happening under the hood.

HOST AND DEVICE OVER D+/D-, AND THE ENUMERATION HANDSHAKE THAT RUNS BEFORE ANY DATA.

Plug a One Thousand Drones board into your computer and enumeration is the short pause before it appears as a serial port. The board describes itself, the host loads a driver, and your terminal opens.

## CHECKPOINT

**1. What happens before USB application data can flow?**

a. Enumeration: the device describes itself to the host

b. The device picks a baud rate

c. Both ends agree on a chip-select

ANSWER · A

*The host resets the device and reads its descriptors first; only then does a driver load and data move.*

**2. On a USB link, which end starts every transfer?**

a. The device

b. The host

c. Whichever powers on first

ANSWER · B

*USB is host-directed: the device never speaks until the host asks.*

**3. Full-speed USB carries its data on what?**

a. A single-ended TX and RX pair

b. Eight parallel data lines

c. A differential pair, D+ and D-

ANSWER · C

*The receiver reads the difference between D+ and D-, which cancels noise common to both wires.*

- Prerequisite: what is a bus?
- See it on a real board: the USB-C breakout
- Next: USB-C, the connector