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USB-C, THE CONNECTOR

USB-C is reversible because of its CC pins, and a device declares its role with a resistor on CC. Why a simple board needs two 5.1 kohm pull-downs to get 5 V.

ONE THOUSAND DRONES ENGINEERING TEAM · VERIFIED 2026-07

USB-C is reversible because of two extra pins called CC, the configuration channel. A device tells the host what it is by putting a resistor on CC, and for a simple board that resistor is the whole story: two `5.1 kΩ` pull-downs to ground, one on each CC pin, say I am a device, please give me `5 V`.

THE REVERSIBLE CONNECTOR

A USB-C plug goes in either way up. The host uses the CC pins to work out which way it went in and which CC pin is actually connected through the cable, then routes the signals to match. The CC pins are what make the reversibility work.

THE 5.1 KILOHM RESISTORS

On the device end, a `5.1 kΩ` resistor from each CC pin down to ground marks the port as a sink, a device that draws power. The host sees those pull-downs, recognizes a device, and turns on `5 V` on `VBUS`. Leave them off and a proper USB-C host never enables power, so the board stays dead even though the cable is fine. Two resistors, one on `CC1` and one on `CC2`, cover both plug orientations.

- Texas Instruments. A Primer on USB Type-C and USB Power Delivery Applications and Requirements (SLYY109): CC roles, sink Rd pull-downs. ti.com
- Texas Instruments. TUSB320 datasheet: a sink presents 5.1 kohm +/-20% (Rd) on CC. ti.com

> **NO CC RESISTORS, NO POWER**
>
> This is the number-one dead-USB-C-board bug. A compliant USB-C host will not switch on `VBUS` until it sees the `5.1 kΩ` pull-down that marks a sink. Forget the two resistors and the board looks fully wired and stays completely dead, with no `5 V` anywhere. Check for them first when a fresh USB-C board shows no power.

DEEP DIVE · WHY TWO RESISTORS, AND WHY NOT JUST TIE CC TO GROUND

Each CC pin gets its own `5.1 kΩ` because only one of the two is connected through any given cable, and the resistor has to be present whichever way the plug went in. The specific value matters: the host reads the size of the pull-down to decide the role, so a dead short to ground or a wrong value reads as a different kind of port. A plain `5 V` board needs nothing more than these two resistors. USB Power Delivery, which negotiates higher voltages like `9 V` or `20 V`, adds an active chip that actually talks on the CC line, which a simple board does not need.

A USB-C RECEPTACLE WITH A 5.1 KOHM RESISTOR ON EACH CC PIN, SETTING THE DEVICE ROLE.

This is exactly the One Thousand Drones L1.01 board's USB-C input: two 5.1 kΩ resistors from CC1 and CC2 to ground, and nothing more, because the board only needs the default 5 V. It is the smallest circuit that makes a USB-C port come alive.

CHECKPOINT

1. What do the two 5.1 kΩ resistors on the CC pins do?

a. Set the port's device/sink role so the host provides 5 V

b. Speed up the USB data lines

c. Protect against reverse polarity

ANSWER · A

The host reads the pull-downs as a sink asking for power, and only then enables 5 V on VBUS.

2. Why are there two CC resistors instead of one?

a. One is a spare

b. To cover both plug orientations

c. To double the current

ANSWER · B

Only one CC pin connects through any given cable, so each needs its own resistor to work either way up.

3. Does a simple 5 V USB-C board need USB Power Delivery to get power?

a. Yes, PD is always required

b. No, the CC resistors alone get the default 5 V

c. Only if the cable is reversible

ANSWER · B

PD is for negotiating higher voltages; the plain 5 V default just needs the two CC pull-downs.

- See it on a real board: the L1.01 USB-C breakout
- Prerequisite: resistors
- Next: level shifting