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GROUNDS AND POWER RAILS

Why ground is the shared reference, what a power rail is, and why a ground plane beats a thin trace for a quiet board.

ONE THOUSAND DRONES ENGINEERING TEAM · VERIFIED 2026-07

Ground is the shared zero that every voltage on the board is measured against, and the power rails are the fixed voltages that feed the parts. Getting both right is what makes a board quiet and reliable.

GROUND IS THE REFERENCE

Voltage is always measured between two points, so a board agrees on one point as zero, called ground. A `3.3 V` rail means 3.3 volts above ground. Every current that flows out to a part also flows back through ground, so ground carries all the return current.

POWER RAILS

A rail is a net held at a fixed voltage that feeds many parts at once, such as `5 V` from USB or `3.3 V` from the regulator. Parts tap the rail they need, and decoupling capacitors keep each rail steady where it is used.

WHY A PLANE BEATS A THIN TRACE

Return current follows the path of lowest impedance, not the shortest line. A wide ground plane gives that current a low-inductance path right under the signal it returns, which a thin ground trace cannot, so a plane keeps noise and interference down (All About Circuits).

- All About Circuits. How to use return paths for better PCB design (ground plane impedance). allaboutcircuits.com

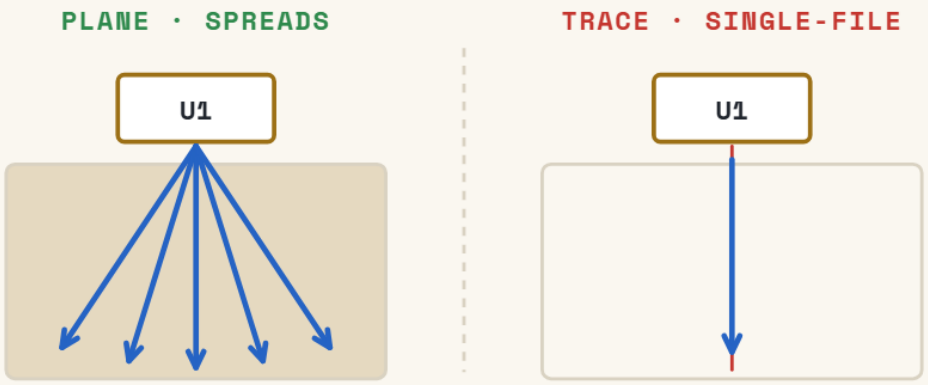
DEEP DIVE · GOING FURTHER: MULTI-LAYER BOARDS

A two-layer board puts the ground plane on the opposite side of the signals. A professional quiet board goes further and uses four or more layers: the fabricator sandwiches the signal layers tightly against dedicated internal power and ground planes, separated by thin insulating cores called prepreg. That tight spacing gives every signal a return plane a fraction of a millimeter away, which drops the loop inductance further still. It is the same principle as the ground plane, taken to the structure of the board itself, and it is a stack-up you set in an EDA tool like KiCad. (Altium)

- Altium. The Right Way to Use Power Planes in a 4-Layer PCB Stackup (signal, power, ground, prepreg). resources.altium.com

▸ FUNDAMENTALS · GROUNDS & RAILS

GROUNDS AND POWER RAILS



Ground is the shared return. A plane lets it spread over many short paths; a thin trace squeezes it single-file down one.

RAILS FEED THE PARTS; RETURN CURRENT FLOWS BACK THROUGH THE GROUND PLANE.

On a One Thousand Drones L1.01 board the ground is a filled copper plane and the rails are wide, so return current has a quiet, low-impedance path back to the source.

CHECKPOINT

1. What is ground on a board?

a. The most negative battery terminal only

b. A part that stores charge

c. The shared zero every voltage is measured against

ANSWER · C

Ground is the agreed reference; a 3.3 V rail is 3.3 V above it, and return current flows through it.

2. A power rail is what?

a. A net held at a fixed voltage that feeds many parts

b. A single wire to one part

c. The edge of the board

ANSWER · A

A rail is a fixed-voltage net (5 V, 3.3 V) that many parts tap.

3. Why does a ground plane beat a thin ground trace?

a. It uses less copper

b. It gives return current a low-impedance path and keeps noise down

c. It makes the board lighter

ANSWER · B

The wide plane offers a low-inductance return right under the signal, cutting noise.

- Prerequisite: voltage, current, and resistance
- See it on a real board: the L1.01 build
- Next: reading a schematic