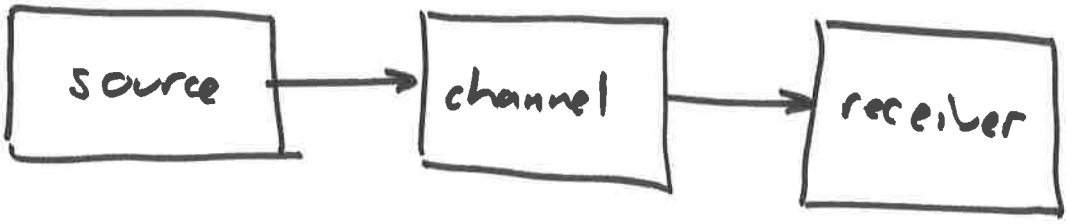
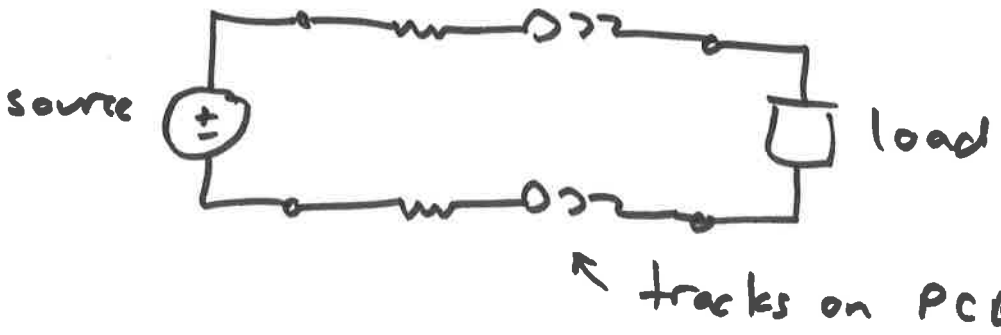
Lecture 7 - EMC

EMC - electromagnetic compatibility
i.e. does not cause "interference"
is not susceptible to "interference"



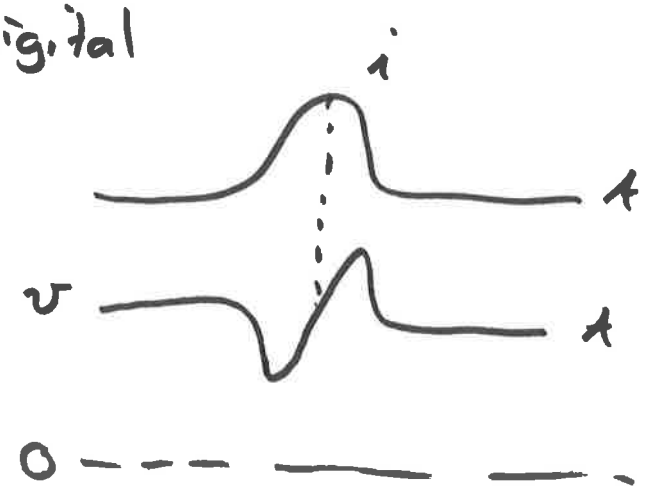
Sources

- supply line transients due to changing load conditions & intervening impedance



- some circuits have large $\frac{di}{dt}$ by their nature ∴ large $v = L\frac{di}{dt}$

e.g. digital



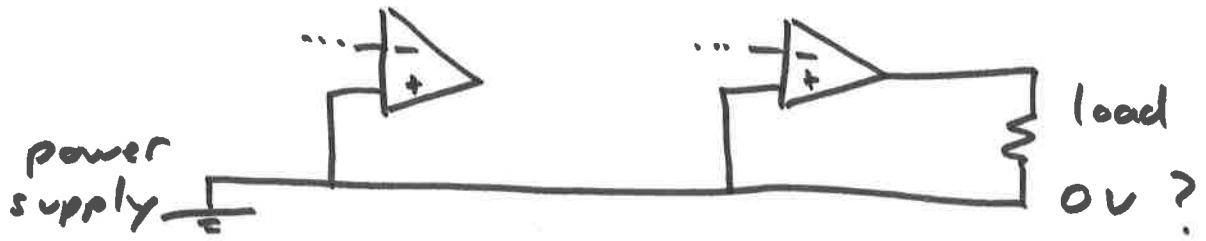
- EMP & RFI caused by arcs & sparks
  i.e. any time we switch an inductive load
  - especially bad in automotive environment
- ESD caused by human contact

Coupling

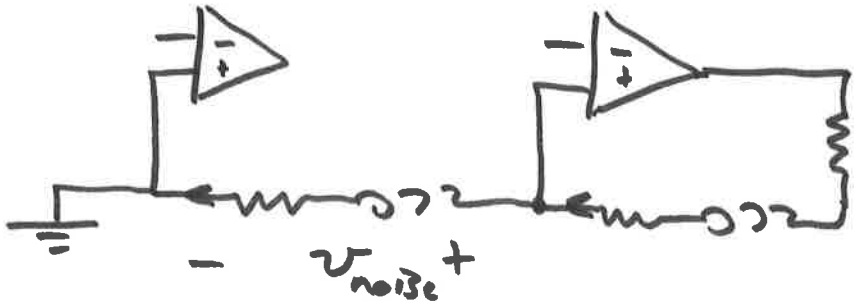
- common impedance coupling "ground coupling" (R)

schematic

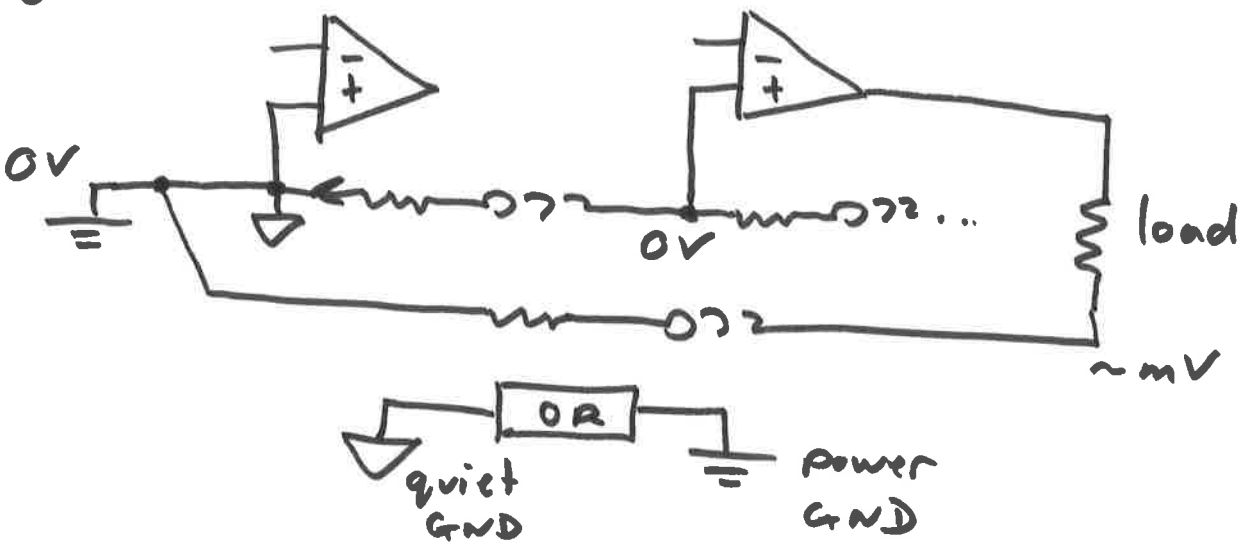
PCB view



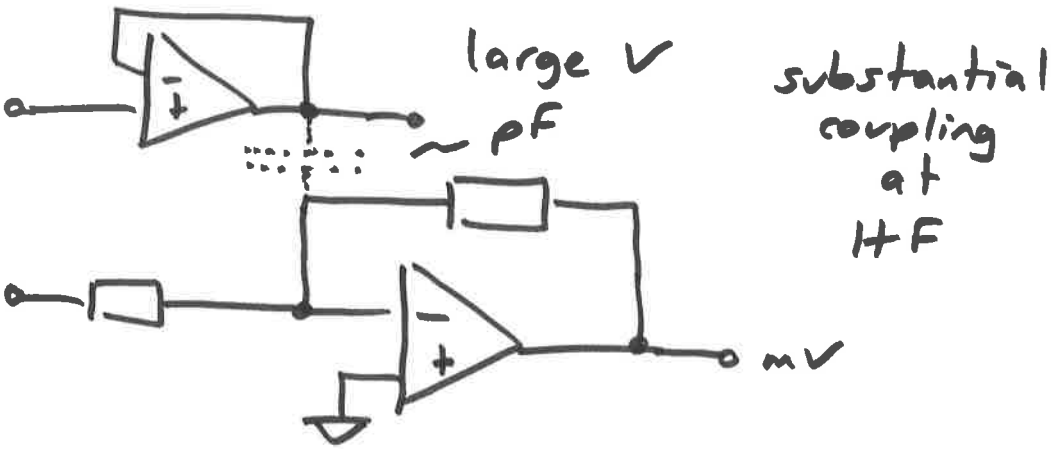
model



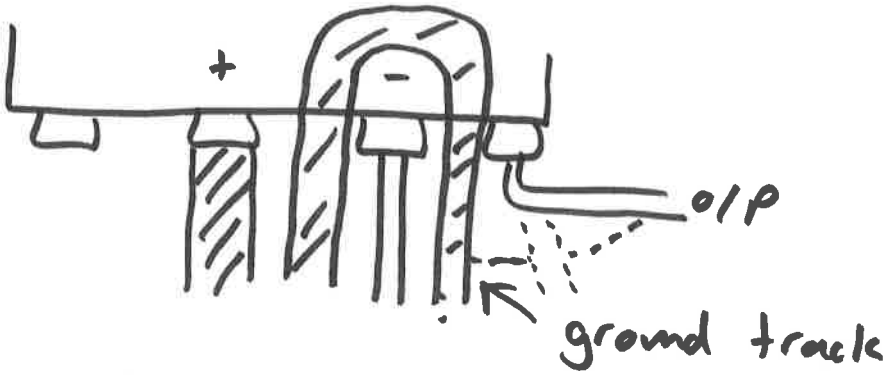
good design



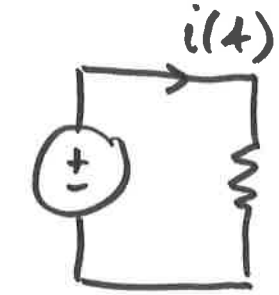
- capacitive coupling (C)
  - never shown on a schematic!



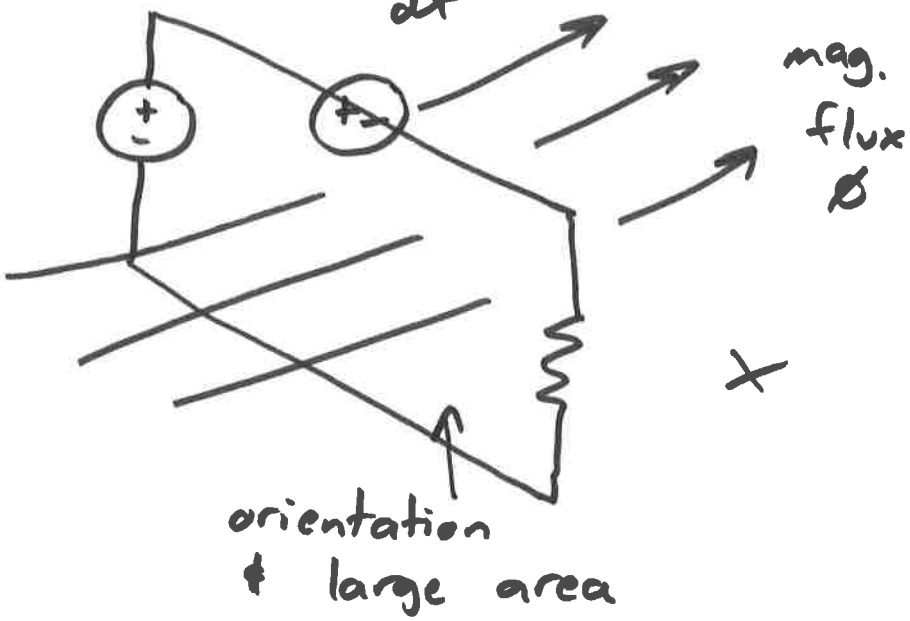
- use a "guard" track around & near summing junctions



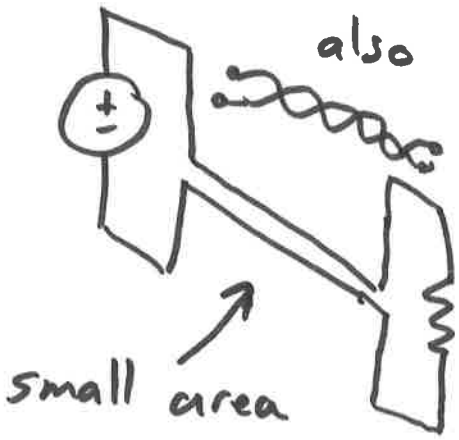
- inductive coupling (L)
  - produced when current changes
  - depends on "loop area" i.e. circuit size



$$e = -\frac{d\lambda}{dt}$$

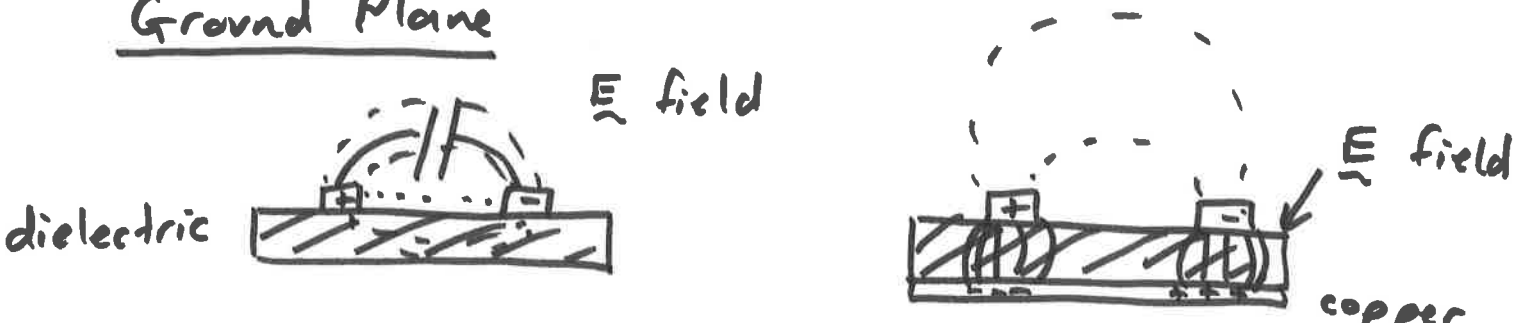


run return tracks adjacent to source tracks

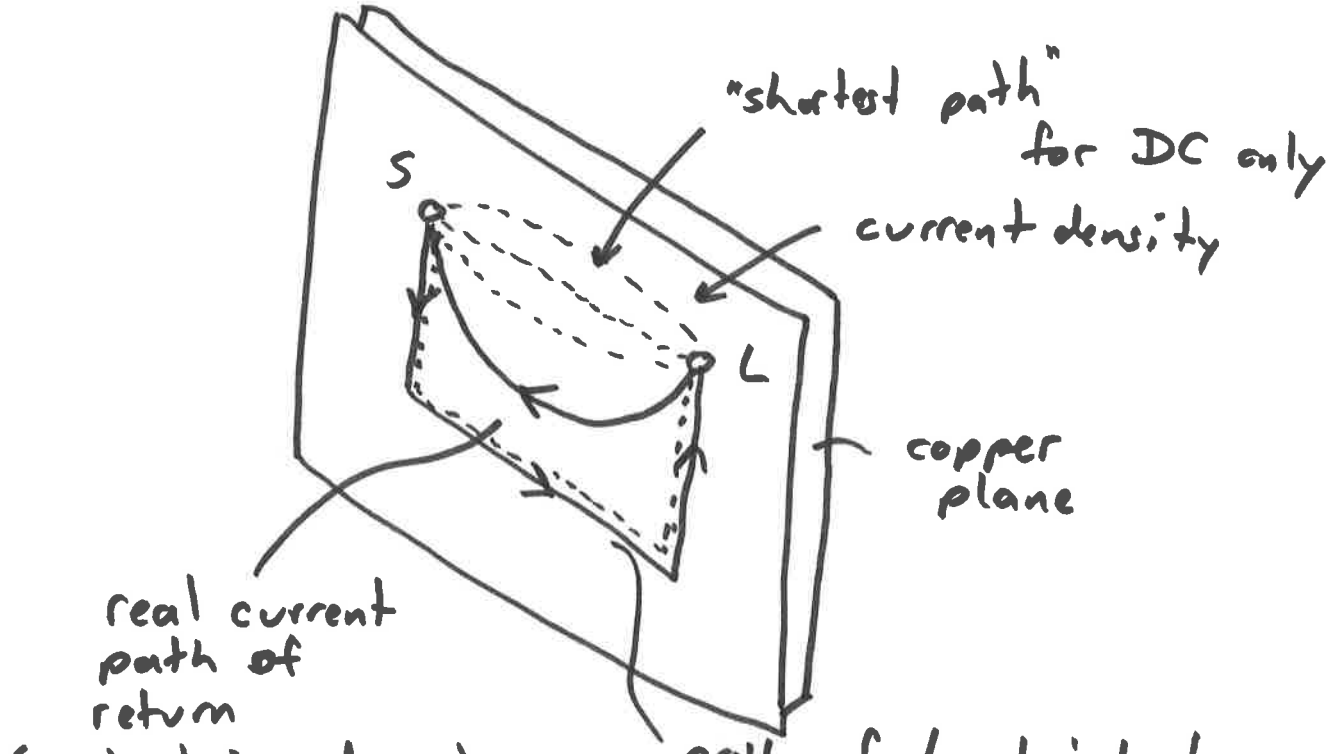


✓

Ground Plane

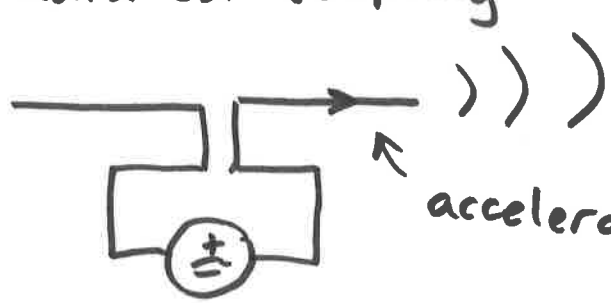


minimises capacitive coupling

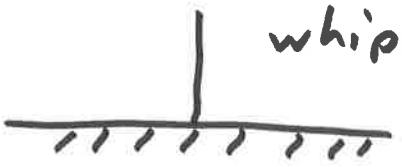


minimises inductive coupling

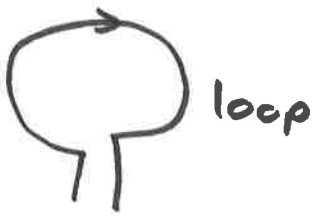
- radiated coupling



two types



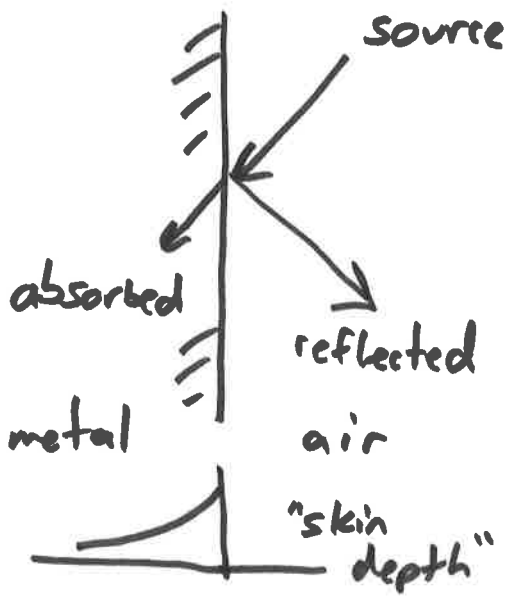
E - field
dominates
"close-up"
"near-field"
λ/6
"capacitive coupling"



H - field
dominates
"close-up"
"near-field"
λ/6
"inductive coupling"

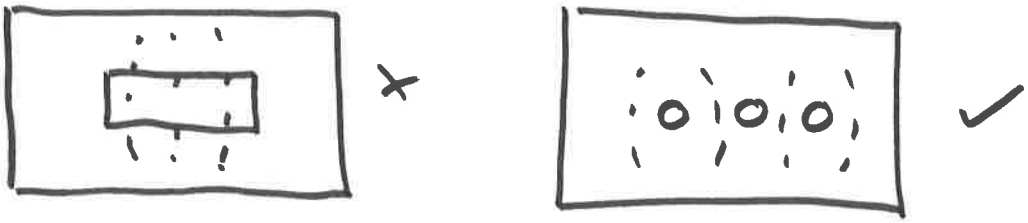
In the "far field" E/H ratio → 377 Ω in free space (air)

We have a "wave".
Metal is special!
When an EM wave hits it - what happens?



induced currents reflect the wave
"some absorption"
- depends on μ & thickness
"skin effect"

Use a metal box to contain our electronics!
Prevents RFI escaping & RFI entering.
Minimise cut-out areas



Reflection depends on σ
Absorption depends on μ.
∴ Use steel!! (not aluminium or copper)
& conductive gaskets.

Regulatory Standards

- ACMA is the Australian authority
- based on IEC standards from Europe
- you need to get your product compliant to be able to enter the market ↑ test report
- label with a "tick"

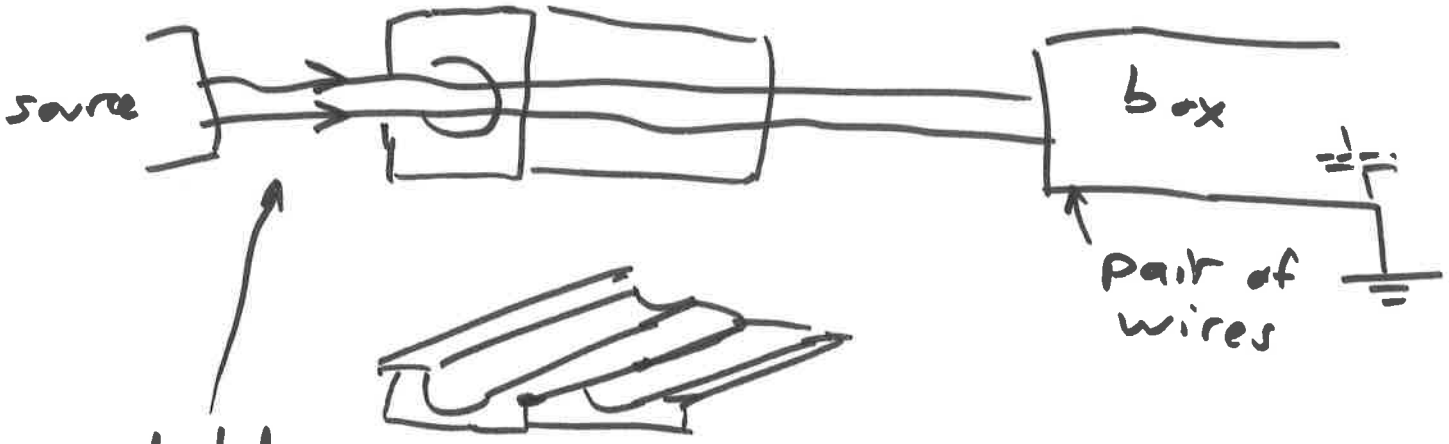
Australian

CE mark

FCC (USA)

ERAC - Electrical Regulatory Authorities Council
E ESS - Electrical Equipment Safety System

Ferrite bead



conducted radiation "common-mode"

common-mode equiv ckt

differential-mode