

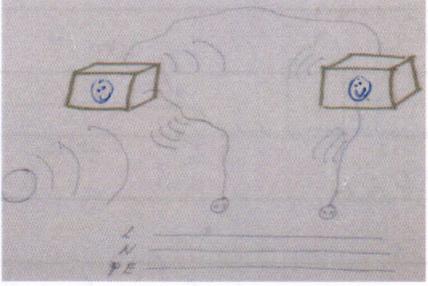
Robust Lec 6

Introduction to EMC

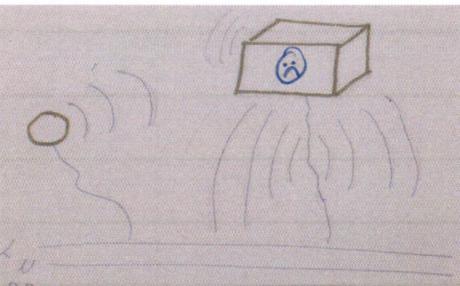
Mikael Hellgren



Electro Magnetic Compatibility EMC

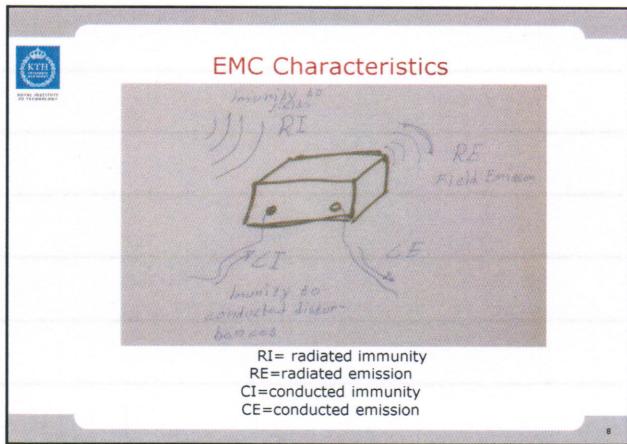
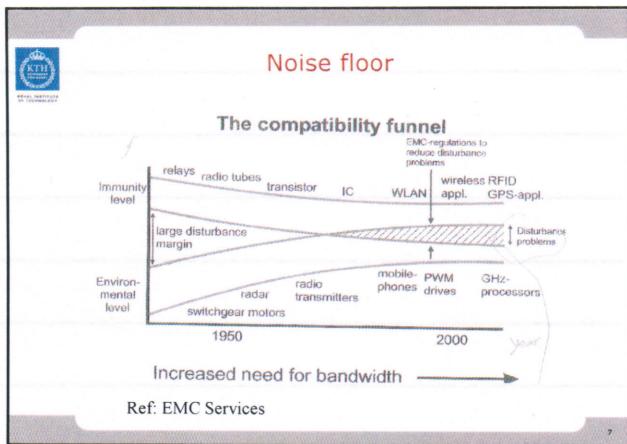


Electro Magnetic Interference EMI



EMC => No / low interference

EMI => Bad



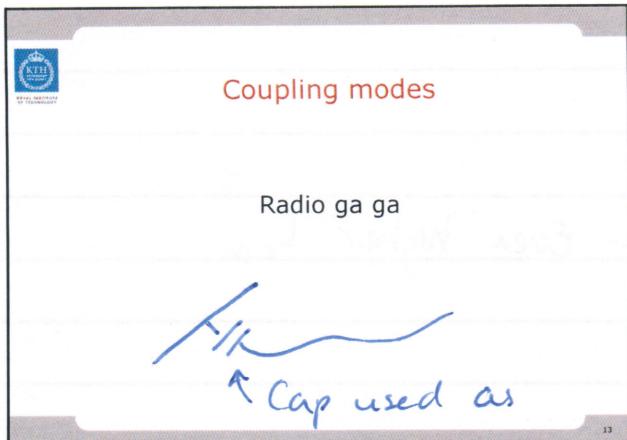
EM waves

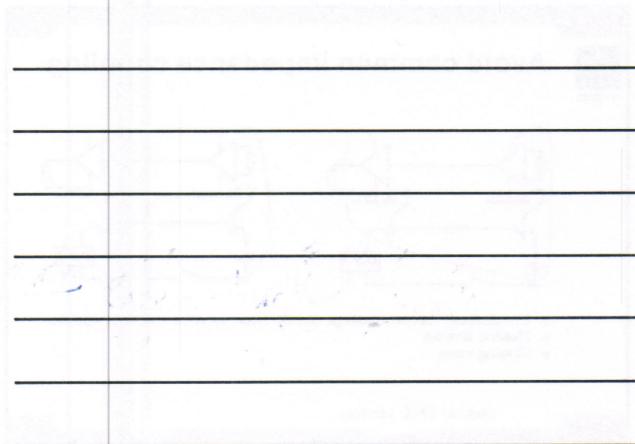
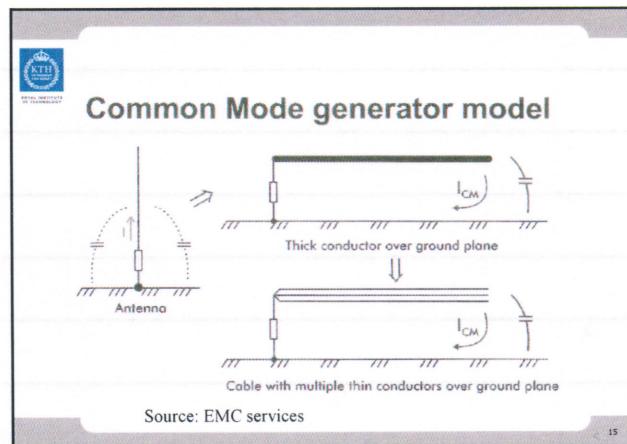
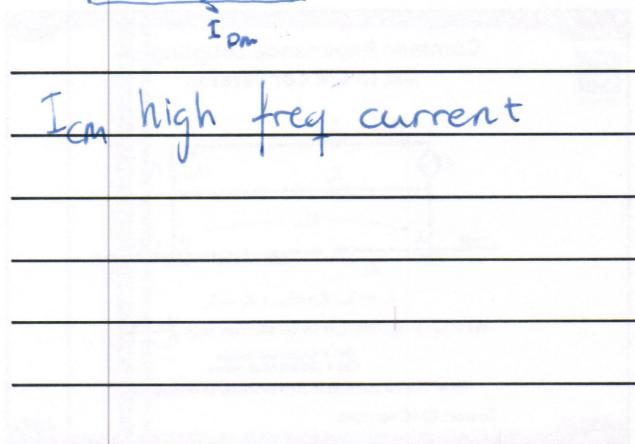
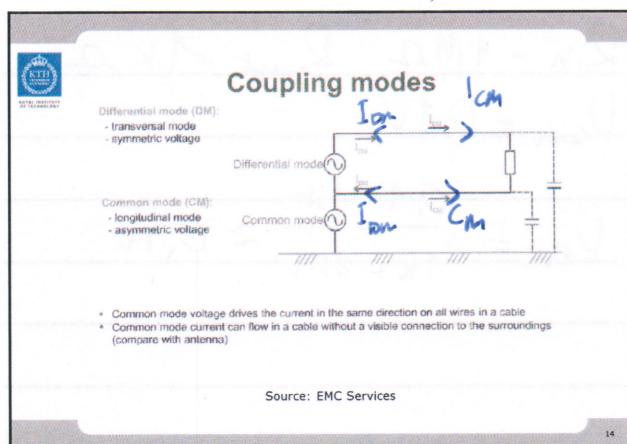
$$C = \lambda \cdot f$$

3 kHz => 100000 m

3 MHz => 100 m

3 GHz => 0,1 m







General measures for EMI

1. Non-emission devices
2. Immune components
3. Isolate
4. Divert
5. Reflect
6. Absorb

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Isolation means

- Isolate 0 V from box
- Isolate box from earth
- Isolation transformer
- Isolation amplifier
- Opto coupler
- Fibre optics
- IR
- Radio

Source: EMC services



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Signal return vs Ground

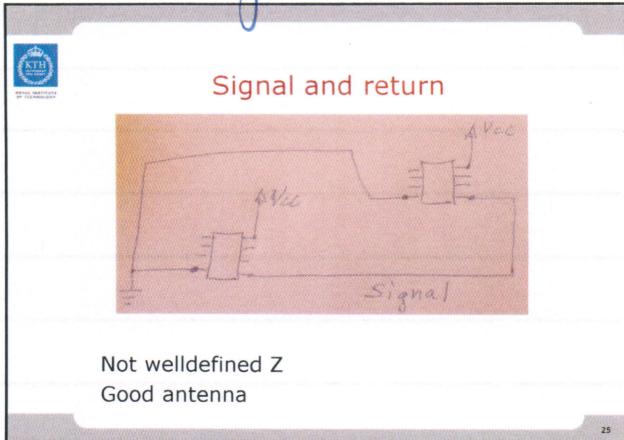
The current will always travel back to the source, called signal return.

Current will always travel the easiest way => lowest impedance

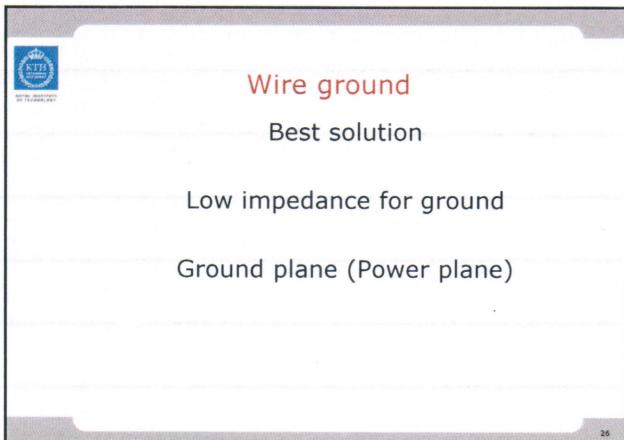
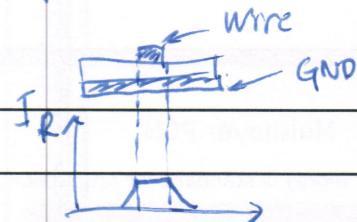
Signal return does not need to be a ground.
But often called so...

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"Star ground"



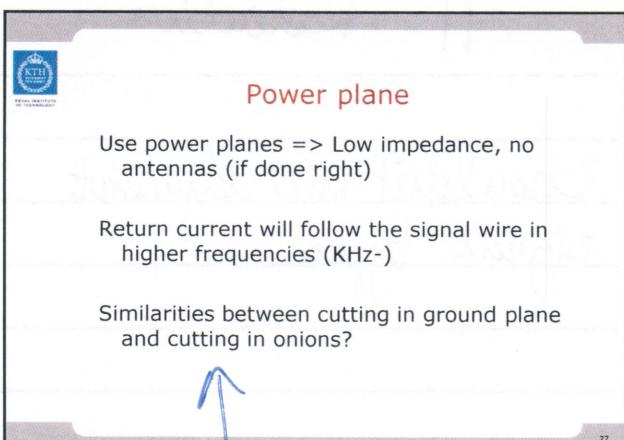
Multiple layer board



Board



Return path under
wire



Not for DC, this is to
reduce inductance

There are higher freq.
signals in for example

 (fowler)

Never cut in ground plane!



Different ground for dig/analog?

Split ground planes are not good

= Broadband transmitting and receiving antenna

+ -

External field

= Concentrated current creates ΔU
= "bent current" creates H-field

Source: EMC services

Example
An  Inductance
Di 

Partitioning

restricted area = no signal traces here

signal trace not allowed

- Continuous ground plane!
- Different zones!

Ref: EMC Services



Decoupling capacitors

All digital circuits will produce noise at Vcc and Gnd.

Reduce this by using 0,047-0,1 μF over the powerlines near the pins.

In mobile phones they use the layers as one decoupling capacitor.

Real capacitors have problems in high frequencies.

Op amp should also have decoupling cap from power to ground.



Zoning

Zone	= Electromagnetic volume
Zone boundary	= surface between different EM environments.
	= surfaces where all coupling reduction measures are placed

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Zoning

Zoning is a design aid

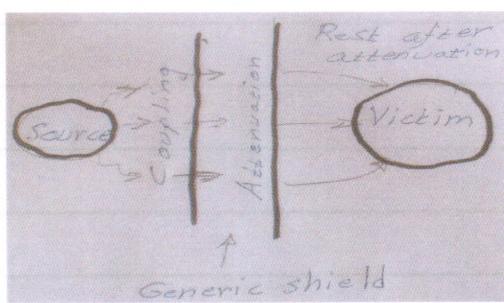
Zones are drawn as areas while designing

All coupling mechanism can be identified since all coupling takes place through the zone boundary

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Zone boundary



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