



Another EMC resource
from EMC Standards



0 - Introduction to EM Phenomena, EMI and EMC

Version 2.0

Helping you solve your EMC problems

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Module 0: Introduction to EM Phenomena, EMI, and EMC



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Contents

- 1 **What are EMI and EMC?**
- 2 **Four types of EM energy coupling**
- 3 **The EM environment and EM phenomena**
(conducted, radiated, continuous, transient, ESD, power quality, etc.)
- 4 **How devices can be interfered with**
- 5 **EMC and the law**
- 6 **EMC standards**
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- 10 **Financial benefits of designing EMC in, from the start**
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For safety requirements, see our courses on designing for safety compliance

Keep up to date with new versions of this course module!

Visit: www.emcstandards.co.uk/engineering2

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EMC = Electromagnetic Compatibility

- **All fluctuating electrical voltages and currents in conductors, whether signals, data, power or unwanted electrical noise...**
 - **are really electromagnetic (EM) waves**
guided by the physical arrangements of conductors (e.g. copper) and insulating dielectrics (e.g. PVC, fibreglass, air)...
 - **giving rise to EM fields (Volts/metre: V/m, Amps/metre: A/m) in the dielectrics around the conductors...**
 - **their ‘field strength’ diminishing, as the distance from the conductors increases**

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EMC = Electromagnetic *Compatibility*

- The operation / performance of anything that uses electricity or electronics can be affected by EM phenomena in their conductors or in the air...
 - and we call this ElectroMagnetic Interference (EMI)
- Radio and TV receivers are very sensitive...
 - and often suffer from EMI
- But *all* electronic devices can cause EMI and/or suffer from EMI...
 - whether analogue, digital, power, switch-mode, etc.

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EMC = Electromagnetic *Compatibility*

- *Compatibility* means the ability of equipment to function as intended in its 'operational EM environment'...
 - the total set of EM phenomena in its operational location
- Firstly – without the EM environment degrading its functionality by too much...
 - i.e. suffering unacceptable interference (hence EMI)
so, immunity should be high enough
- Secondly – without causing unacceptable interference to other equipment...
 - so, its emissions should be low enough

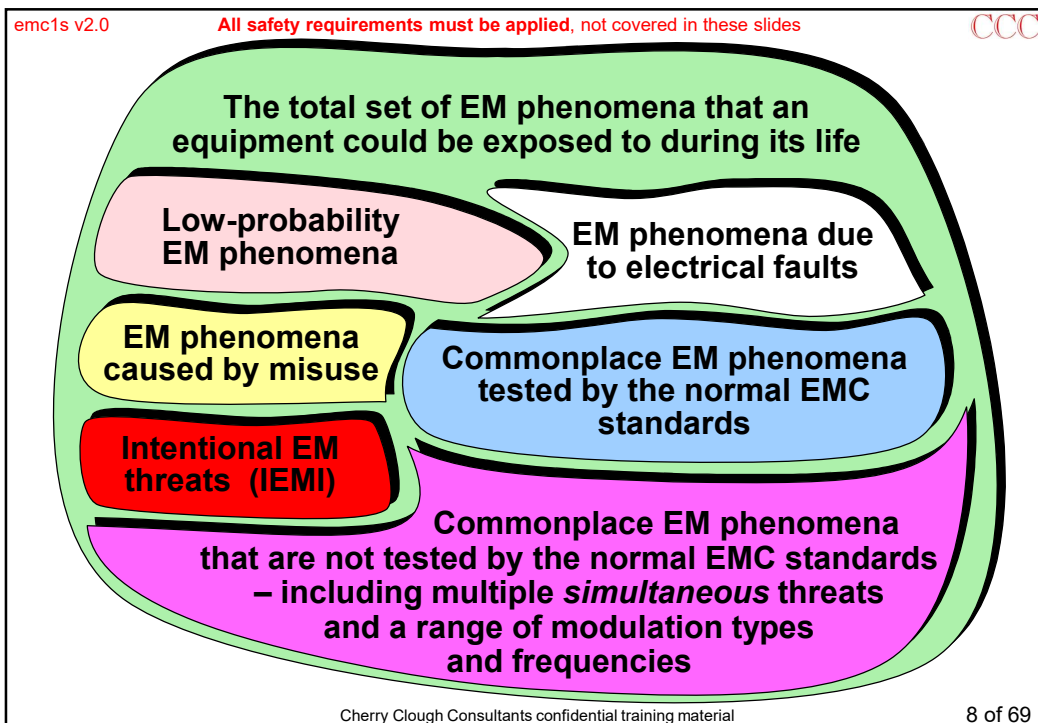
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EMC = Electromagnetic Compatibility

- So, we can now understand the IEC’s definition:
 - EMC is achieved when equipment:**
 - functions satisfactorily in its EM environment(s)
 - without causing intolerable EMI to anything else
- Why would we ever want to design / manufacture products that do not achieve EMC?
 - it would be no good for reputation or profits!
 - **but there’s a lot more to EMC than passing EMC tests!**

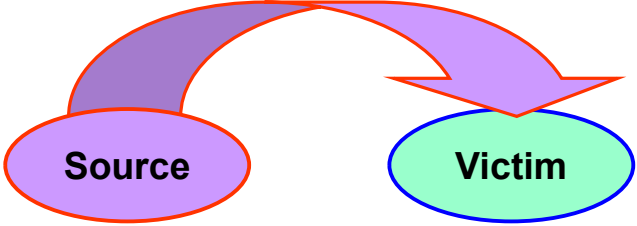
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The three parts to every EMI event

- A source of EM phenomena (a possible EMI threat)
- A possible EMI victim (any electrical/electronic equipment)
- And at least one EM coupling path between them



- The control of source EM emissions, coupling paths, and victim EM susceptibility (immunity) is called: **electromagnetic compatibility (EMC)**

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There are four types of EM coupling, and they can occur singly, or in any combination

- **1 Common impedances...**
 - all metalwork and conductors have impedance (e.g. metal structures, chassis, cables, PCB tracks, etc.)...
 - so when carrying a current due to one electrical or electronic circuit they develop a voltage ('noise')...
 - that can interfere with *other* circuits that are connected to the same metalwork or conductors
 - one consequence is that there can never be a perfect 'earth' or 'ground': so *'safety earths' are ineffective for preventing EMI*

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Four types of EM coupling continued...

- **2 Electric (E) fields**
- **3 Magnetic (H) fields**
- **4 Electromagnetic (EM) fields...**
 - these all radiate through the air
(and through insulators such as plastic, wood, glass, etc.)...
 - and couple into *all* metalwork and conductors
(e.g. metal structures, chassis, cables, PCB tracks, etc.)...
 - by inducing 'noise' currents and voltages into them...
 - which can then interfere with the electrical or electronic circuits connected to them

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Four types of EM coupling continued...

- **The victim experiences the result as noise voltages and currents...**
 - which can be either continuous or transient in nature...
 - and will occur as differential-mode (DM) noise and/or common-mode (CM) noise....
 - DM occurs between a signal or power conductor and its reference or return conductor
 - CM occurs on all conductors simultaneously

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