



Another EMC resource
from EMC Standards



4. Shielding for EMC

Updated for 2018

Helping you solve your EMC problems

emc12ms v3.4a CCC

Module 4: Shielding for EMC (DC to GHz)

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4.0.1 1 of 125
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Change Record: v2.6 – v3.4a, August 2018

- Change record slide added, 4.0.1a (this one)
- Design checklist slide added: 4.0.1b
- Footnote added to all slides: 'Cherry Clough Consultants confidential training material'
- Slide 4.3.2: Note added: "see Skin Effect, in Module 1"; new slide 4.3.4 added
- Slide 4.4.1: title changed; slide 4.4.2: text improved; new slide 4.4.3 added
- Slide 4.6.5 modified slightly; new 4.6.6 added, old 4.6.6 and 4.6.6a renumbered as 4.6.7 and 4.6.8, additional info added to 4.6.8; new 4.6.9 added; old 4.6.7 – 4.6.9 renumbered as 4.6.10 – 4.6.12, 4.6.11 and 4.6.12 modified slightly
- Slide 4.7.2 added a note about wireless antennas; new slide 4.7.3 added
- Slide 4.8.2 modified slightly
- Slide 4.9.1 section title extended to cover RF-bonding in general; old 4.9.2 renumbered as 4.9.5; new 4.9.2 – 4.9.4 added; new 4.9.6 added; old 4.9.3 renumbered as 4.9.7 with small mod's; old 4.9.4 and 4.9.5 renumbered as 4.9.10 and 4.9.11; old 4.9.6 renumbered as 4.9.9; new 4.9.8 added, new 4.9.12 and 4.9.13 added; old 4.9.7 – 4.9.9 renumbered as 4.9.16 – 4.9.19; old 4.9.10 renumbered as 4.9.15; 4.9.14 added (was 4.11.8); new slides 4.9.20 – 4.9.32 added (on military and similar high-spec. shielding)
- New slide 4.10.5a added; slide 4.10.6 modified
- 4.11.3 now has EM Zone designations added to it; 4.11.8 renumbered as 4.9.14; 4.11.9 deleted
- 4.12.2 has added information; 4.12.3 has added URLs
- 4.13.2 has added URL; new 4.13.4 added, old 4.13.4 – 4.13.11 renumbered as 4.13.5 – 4.13.12; new 4.13.13 added
- Old 4.14.3 renumbered as 4.14.7; new slides 4.14.3 – 4.14.6 added
- Old section 4.15 renumbered as 4.16, also updated and improved with an extra slide
- New section added: 4.15 'D-I-Y testing SE of an assembly before its hardware or software are ready'

4.0.1a 2 of 125
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Good Electromagnetic (EM) Engineering...

- is cost-effective SI, PI and EMC engineering: well-proven to save time & money in all lifecycle stages, helping to increase profits & reduce financial risks...
- for PCBs, modules, sub-assemblies, devices, products, equipment, vehicles, sub-systems, systems, installations, etc., etc.; of any size, in all applications
see Module 1 especially 1.15 (also in Webinar 1c) and 1.16 (also in Webinar 1d)

■ **This Module contains many EM Engineering guidelines that should also be used as an initial design checklist: *any that can't or won't be followed identify a project risk!***
see Module 1, section 1.16 (also in Webinar 1d)

- to adapt any λ -based design guidelines to different EMC standards, see *Module 1, section 1.18* *(also in Webinar 1d)*

Cherry Clough Consultants confidential training material 3 of 125

emc12ms v3.4a CCC

Contents

1. Economic issues for shielding
2. Shielding with metal plates (image planes)
3. How shielded enclosures work
4. DC and low frequency shielding
5. The problems caused by apertures
6. The problems caused by box resonances
7. The problems caused by conductor penetrations
8. Shields in the near field of a source
9. RF-bonding with multiple metal bonds or conductive gaskets
10. Waveguides-below-cutoff
11. Shielding of displays
12. Shielding of ventilation
13. Shielding of plastic enclosures
14. Preventing corrosion at shielding joints
15. D-I-Y testing SE before its hardware or software are ready
16. Some free SE calculators and useful references

4.0.2 Cherry Clough Consultants confidential training material 4 of 125

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4. Shielding for EMC

4.1

Economic issues for shielding

4.1.1 5 of 125
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Economic issues for shielding (example costs – for comparison only)

– Shielding an IC on its own	£	0.25
– Shielding an area on a PCB	£	1
– Shielding a whole PCB	£	10
– Sub-assemblies and modules	£	15
– Shielding a complete product	£	100
– Shielding a system (e.g. a rack cabinet)	£	1000
– Shielding a room	£	10,000 +
– Shielding a building	£	100,000 ++

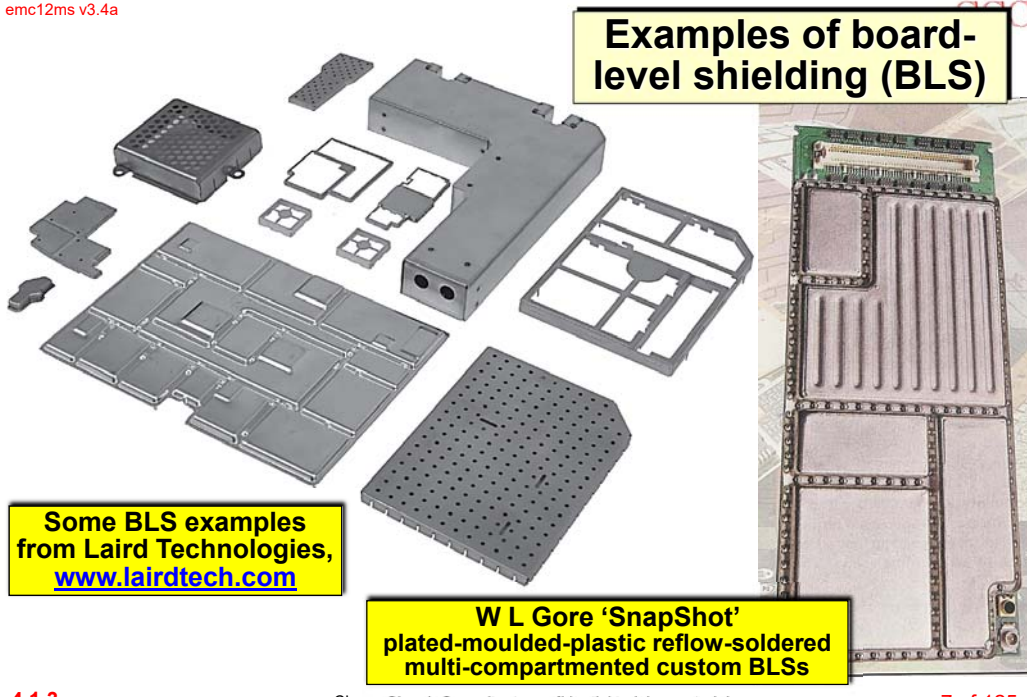
■ **To save cost, it is best to design products to be able to use shielding at lower levels of assembly (if it turns out to be necessary)**

4.1.2 6 of 125
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Examples of board-level shielding (BLS)




Some BLS examples from Laird Technologies, www.lairdtech.com

W L Gore 'SnapShot' plated-moulded-plastic reflow-soldered multi-compartmented custom BLSs

4.1.3 Cherry Clough Consultants confidential training material 7 of 125

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Example: using BLS to avoid more expensive shielding on a moulded plastic enclosure



4.1.4 Cherry Clough Consultants confidential training material 8 of 125

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4. Shielding for EMC

4.2

Shielding with metal plates (image planes)

4.2.1 Cherry Clough Consultants confidential training material 9 of 125

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Metal plates can give useful shielding

- **Ensuring that all components and conductors are close to large metal surfaces can provide some degree of shielding**
 - e.g. keeping close to PCB planes, metal chassis, metal enclosures and metal shields (the image plane effect)
 - this might provide enough Shielding Effectiveness (SE) to eliminate the need for a shielded enclosure
 - or at least reduce its SE specifications and its cost
- **RF-bonding to the metal surface helps to return stray CM currents locally, helping to improve SE**

4.2.2 Cherry Clough Consultants confidential training material 10 of 125