



Another EMC resource
from EMC Standards



Filtering for EMC

Updated for 2018

Helping you solve your EMC problems

emc11ms v3.1 CCC

Module 3: Filtering for EMC



Keith Armstrong CEng, FIET, Senior MIEEE, ACGI, Eurling (Gp1)
phone/fax: +44 (0)1785 660 247
keith.armstrong@cherryclough.com
www.cherryclough.com www.emcstandards.co.uk

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Change Record: v2.2 – v3.1, July 2018

- Change record slide added, 3.0.1a (this one)
- Design checklist slide added, 3.0.1b
- Footnote added to all slides: 'Cherry Clough Consultants confidential training material'
- New slide 3.1.4 added
- Slides 3.4.6 – 3.4.8 improved
- New slide 3.4.9 added
- Slides 3.5.2 and 3.8.2 modified
- New slides 3.8.3 and 3.8.5 added, old slide 3.8.3 renumbered as 3.8.4 and improved, old slide 3.8.4 renumbered as 3.8.6 and improved
- Old slides 3.8.5 – 3.8.7 renumbered as 3.8.7 – 3.8.9
- New slide 3.8.10 added
- Slides 3.9.2 and 3.9.4 – 3.9.6 modified
- New slides 3.9.8 – 3.9.21 added, old slide 3.9.8 renumbered as 3.9.22
- Slides 3.10.2 updated and improved, new slide 3.10.3 added

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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)*

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3. Filtering for EMC

3.1

Filtering is not 'black magic'

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Filtering is not 'black magic'


- **But in practice it is often necessary to try different options to find the most cost-effective filters**
- **Many textbooks on filter design available**
 - so instead these slides describe issues that should be taken into account so filters will work properly
- **The filters described here assumed to go at the boundary between inside / outside of a product**
 - similar considerations apply to filters inside a product

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Examples of commercial/industrial power supply filters (from Schaffner)



Low-cost filtered IEC 60320 mains connectors

Single-phase mains chassis-mounting filters



High-cost, very high performance feedthrough filters


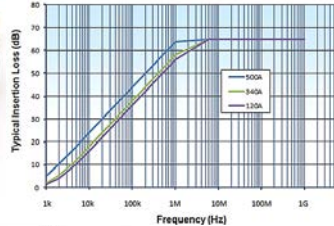
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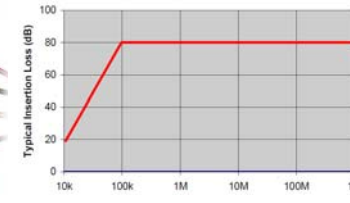

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Examples of military power supply filters (from MPE and Amphenol)

Amphenol

Examples of military power supply filters (from MPE and Amphenol)

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3. Filtering for EMC

3.2

How filters work

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How filters work

- **Filters create a discontinuity in the characteristic impedance...**
 - reflecting RF energy away from the protected circuit...
 - or absorbing it (converting it to heat)
- **R, L, or C can be used as filters on their own...**
 - but combining them gives better rejection
 - LC types can give better rejection than RC (providing they are matched to the source/load impedances)
- **Always use passive filters above 1MHz**

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