Another EMC resource
from EMC Standards

3 - Filtering for EMC - Updated July 2022

emc11ms v3.5

Helping you solve your EMC problems

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By Keith Armstrong

Module 3: Filtering for EMC

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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 Webinar 1c) and 1.16 (also Webinar 1d)

- **This Module contains many EM Engineering guidelines that should *also* be used as an initial design checklist to De-Risk a project's EMC: *any guideline that can't or won't be followed identifies a project EMC risk!***

see Module 1, section 1.16 (also Webinar 1d)

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

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Contents

For safety, see: www.emcstandards.co.uk/the-safe-design-of-electrical-equipment-lvd-com

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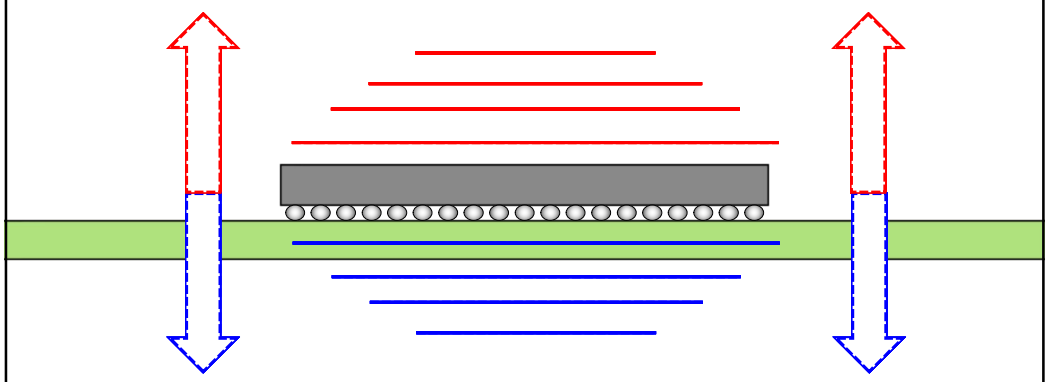
It is important to understand that *all* clocked digital devices suffer from 'ground/power bounce' that puts noises up to GHz *on all their pins* (even inputs) *and therefore on all of the traces, test points, and planes connected to them*



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3. Filtering for EMC

3.1

Filtering is not 'black magic'

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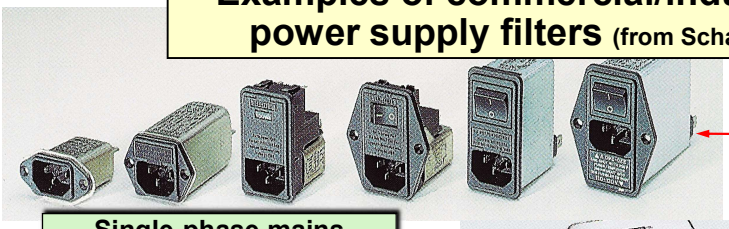
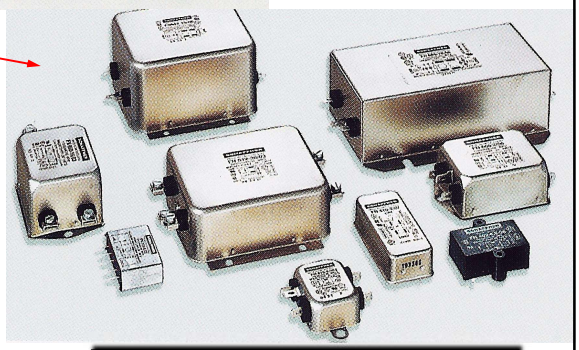
Examples of commercial/industrial power supply filters (from Schaffner)



Low-cost filtered IEC 60320 mains connectors

Single-phase mains chassis-mounting filters



High-cost, very high performance feedthrough filters

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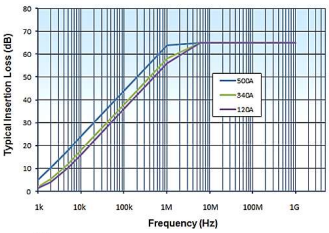
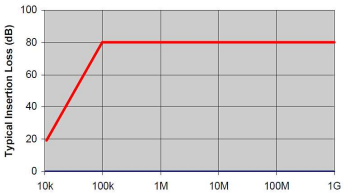
Amphenol

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





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3. Filtering for EMC

3.2

How filters work

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**