



Another EMC resource
from EMC Standards

7 - Circuit design for EMC - Updated Jan 2021



emc8ms v3.7

Helping you solve your EMC problems

Keith Armstrong

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

Module 5: EMC techniques for heatsinks



Keith Armstrong CEng, FIEE/IET, Senior MIEEE, ACGI, Eurling (Gp1)
phone/fax: +44 (0)1785 660 247
keith.armstrong@cherryclough.com, www.cherryclough.com, www.emcstandards.co.uk
More training courses and textbooks on-line: <https://www.emcstandards.co.uk/online-training>
Keith's Blog: <https://www.emcstandards.co.uk/blog>
Linked In: <https://www.linkedin.com/in/keith-armstrong-449801172/>

5.0.1 Cherry Clough Consultants confidential training material 1 of 78

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

Change Record: v2.6 – v2.8, Jan 2021

- **Safety note applied to all slides, with some reformatting**
- Slide 5.4.2 – text improved a little
- Slide 5.10.2 – text improved
- Slide 5.10.8 – new supplier added
- **New slide 5.11.9 added**
'A different proprietary method of combining BLS with cooling'

5.0.1a Cherry Clough Consultants confidential training material 2 of 78

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

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*

5.0.1b Cherry Clough Consultants confidential training material 3 of 78

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

Contents

- 5.1 Importance of controlling stray heatsink currents
- 5.2 Ceramic and plastic heatsinks have *no* stray currents
- 5.3 Returning stray heatsink currents to their sources
- 5.4 Using the PCB's Reference Plane as a heatsink
- 5.5 Practical RF-bonding issues
- 5.6 Heat sink RF resonances
- 5.7 Resonance effects of heat sink shapes, fins, pins, and the locations of the semiconductors
- 5.8 Heat pipes
- 5.9 Some techniques that could be useful
- 5.10 Low-inductance bonding to control resonances to GHz
- 5.11 Combining shielding with heatsinking
- 5.12 Some useful references

For safety requirements, see our training courses on design for safety compliance

5.0.2 Cherry Clough Consultants confidential training material 4 of 78

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

5. EMC techniques for heatsinks

5.1

Importance of controlling stray heatsink currents

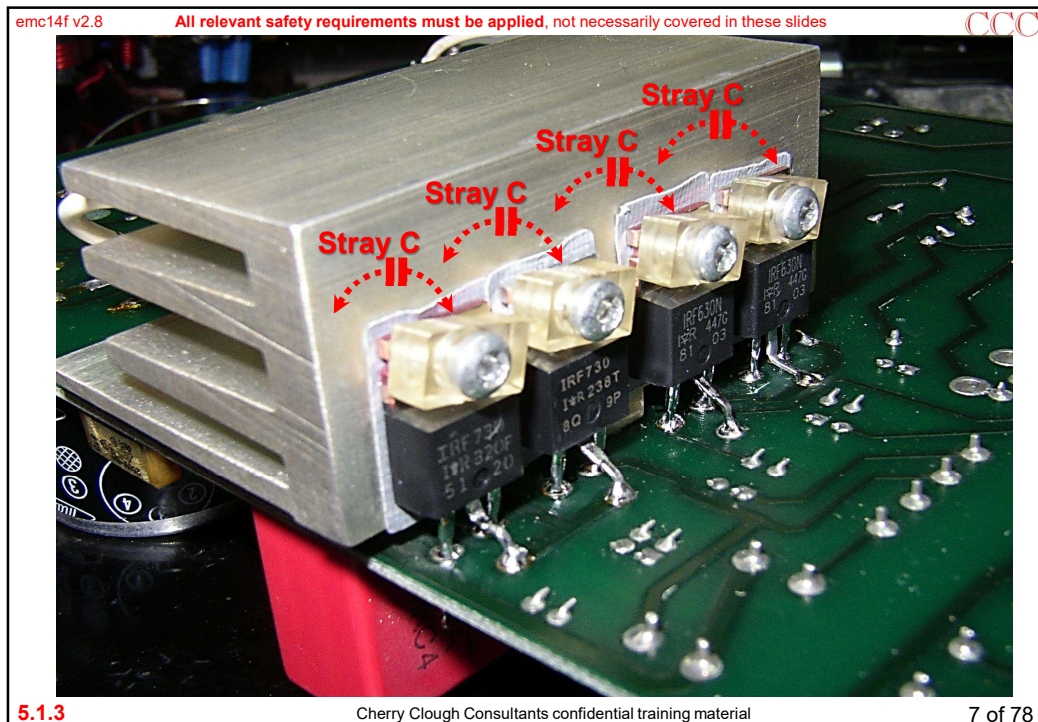
5.1.1 Cherry Clough Consultants confidential training material 5 of 78

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

Controlling stray heatsink currents

- An IC or transistor fitted with a heatsink has a significant stray capacitance to that heatsink...
 - because its thermal interface washer is thin, and has a high value of dielectric constant (ϵ_r)...
 - and sometimes devices are bonded directly to a heatsink
 - when the voltages of the IC or power transistor fluctuate, this stray capacitance injects stray currents into *conductive* heatsinks...
 - returning these stray currents to their sources,
 - the power supply for the IC or transistor,
 - is *very important indeed* for controlling EMC emissions

5.1.2 Cherry Clough Consultants confidential training material 6 of 78



emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

5. EMC techniques for heatsinks

5.2

Ceramic and plastic heatsinks have no stray currents

5.2.1 Cherry Clough Consultants confidential training material 8 of 78

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

Ceramic or plastic heatsinks

-have no stray currents, because they are not conductive (e.g. “CeramCool”, “CoolPoly”)...
 - and they do not need thermal insulating washers so can sometimes have better heat dissipation than metal...
 - as well as having no EMC emissions...
 - and some can have metallised/etched surfaces, like a single-layer PCB, allowing direct bonding of devices...
 - especially good for power LED arrays
- But device heatsink ‘tabs’ will still emit...
 - so some of the following techniques may still be required


5.2.2 Cherry Clough Consultants confidential training material 9 of 78

emc14f v2.8 All relevant safety requirements must be applied, not necessarily covered in these slides CCC

Examples of thermally-conductive plastic heatsinks

For ICs
(glued in place with
thermally-conductive epoxy)

For LED lamp
 housings



Laird TECHNOLOGIES
Innovative Technology for a Connected World
Conductive Plastics

5.2.3 Cherry Clough Consultants confidential training material 10 of 78