Appendix A

Design checklist

Many factors must be considered when looking at the EMC aspects of a design, and it is easy to overlook an important point. This checklist is provided for you to assess your design against as it proceeds.

- Design for EMC from the beginning; know what performance you require
- Partition the system into critical and non-critical sections:
  - determine which circuits will be noisy or susceptible and which will not
  - lay them out in separate areas as far as possible
  - select internal and external interface points to allow optimum common mode current control
- Select components and circuits with EMC in mind:
  - use slow and/or high-immunity logic; apply slew rate limiting to data transmission interfaces
  - use good rf decoupling techniques: capacitors adjacent to the ICs they are decoupling, consider also using series R or L in the supply line
  - reduce fan-out on clock circuits by liberal use of buffers
  - minimize signal bandwidths, maximize levels
  - check stability in wideband amplifiers
  - include resistive, ferrite or capacitive filtering at all sensitive analogue inputs
  - incorporate a watchdog circuit on every microprocessor
- PCB layout:
  - ensure proper signal returns; if necessary include isolation to define preferred current paths
  - keep interference paths away from sensitive circuits: incorporate an interface ground plane
  - minimize ground inductance, preferably with one or more ground planes; also incorporate power planes, but do not overlap these
  - minimize enclosed loop areas in high current, high di/dt or sensitive circuits
  - minimize surface areas of nodes with high dv/dt: do not leave any floating conductor areas, make sure flood fills are connected
  - minimize track and component leadout lengths
  - place filters adjacent to their interfaces, critical circuits away from ground plane edges

- Cables:
  - avoid parallel runs of signal and power cables
  - use signal cables and connectors with adequate screening
  - use twisted pair if appropriate, for balanced or high di/dt lines
  - run cables away from apertures in the shielding, close to conductive grounded structures
  - avoid resonant lengths where possible, consider damping cables with ferrite suppressors
  - ensure that cable screens are properly terminated to the connector; avoid pigtails
  - terminate lines carrying high frequency signals with the correct impedance
- Grounding:
  - design and enforce the ground system at the product definition stage
  - consider the ground system as a return current path, not as 0V reference
  - ensure adequate bonding of screens, connectors, filters, cabinets etc.
  - ensure that bonding methods will not deteriorate in adverse environments
  - mask paint from any intended conductive areas
  - keep earth leads short and define their geometry
  - avoid common ground impedances
  - provide a “clean” ground area for decoupling all interfaces
- Filters:
  - optimize the mains filter for the application
  - filter all I/O lines, using either or a combination of capacitors to quiet ground and common mode chokes
  - apply pi filters at the DC power input to each board
  - ensure a good ground return for each filter
  - apply filtering to interference sources, such as switches or motors
  - pay attention to the layout of filter components and associated wiring or tracks
- Shielding:
  - determine the type and extent of shielding required from the frequency range of interest
  - enclose particularly sensitive or noisy areas with extra internal shielding
  - avoid large or resonant apertures in the shield, or take measures to mitigate them
  - ensure that separate panels are well bonded along their seams
- Test and evaluate for EMC continuously as the design progresses