The Institution of Engineering and Technology

Introductory Manager's Guide to **EMC for Functional Safety**

Functional safety

is part of the overall safety of a system that depends upon the correct functioning of electrical and/or electronic equipment.

The basic publication that covers Functional Safety is IEC 61508.

Electromagnetic Interference (EMI)

Some natural phenomena (lightning, static discharges, etc.) and **all** electrical and electronic equipment emit EM disturbances.

All electronic equipment (hardware and/or software) is vulnerable to certain EM disturbances. When they are so affected, we say they are suffering from EMI.

Functional Safety Risks due to EMI

Where EMI causes errors, malfunctions or failures in the correct functioning of electronics (hardware or software), which can in turn increase functional safety risks.

The basic IEC publication covering this issue is IEC TS 61000-1-2~:2008.

Note: this is **not** concerned with compliance with the EMC Directive or other EMC regulations; **only** with functional safety risks.

Risk reduction

Requires design measures from concept to completion.

Help available!

The IET's 2013 Guidance on EMC for Functional Safety.

Liability

Functional Safety risks due to EMI may cause breaches of Health and Safety legislation.

Note: The medical devices, equipment and systems industries use ISO 14971 instead of IEC61508, and its terminology "EMC for Functional Safety" is instead called "Risk Management of EMC".

The IET has published **guidance** on electromagnetic compatibility (EMC) for engineers involved with the design and installation of electronic safety-related systems (e.g. fly-by-wire in aircraft; railway signalling systems; shutdown systems in the petrochemical industry and offshore; safeguarding arrangements for machinery and industrial automation, etc.). Of particular concern are those systems employing programmable electronic technology.

Most European Managers will be familiar with the requirements of EMC Directive 2004/108/EC. Compliance with the Directive is normally demonstrated by documents that provide evidence of compliance with applicable harmonised standards.

However, the EMC Directive is not concerned with safety of any kind, and traditional EMC testing does not address failure modes. EMC testing, even at higher levels, is not adequate for functional safety.

For functional safety a different approach is needed for EMC and this is described below.

Electromagnetic Interference (EMI)
EMI is the term used to describe the degradation in performance of equipment caused by sources of electromagnetic disturbance which can be categorised as:

- Natural sources e.g. lightning and electro-static discharge (ESD)
- Man-made, all electrical and electronic equipment sub-divided further as:
  - Intentional radiators e.g. radio communication devices
  - Unintentional radiators e.g. all non-radio electrical and electronic equipment

The sources of electromagnetic disturbance listed above contribute to the overall electromagnetic environment within which electrical/electronic safety-related systems must operate safely.

Functional Safety
Is defined as the part of the overall safety of a system that depends upon the correct functioning of electrical and/or electronic equipment in response to its inputs.

Functional safety is safety achieved by ‘active ‘systems e.g. smoke detection by sensors and intelligent activation of evacuation and fire suppression systems.

The basic standard that covers Functional Safety is IEC 61508.

Functional Safety Risks due to EMI
Electronic safety-related systems must remain safe over their entire lifecycle despite foreseeable electromagnetic disturbances. Designers must take into account reasonably foreseeable issues such as:

- A wide range of electromagnetic disturbances that may occur simultaneously e.g. a transient plus a continuous RF field
- Electromagnetic disturbances combined with faults, misuse, wear, corrosion, aging, etc.

NB Traditional EMC testing is based on applying a single disturbance at a time to a perfect item of equipment and so does not address these issues.

The issues listed above may result in incorrect functioning of the electronic safety-related system leading to an increase in functional safety risks and an unsafe condition.

The basic IEC publication covering EMC for functional safety is IEC TS 61000-1-2:2008. This publication establishes a methodology for the achievement of functional safety with regard to electromagnetic phenomena of electrical and electronic systems and installations.

IEC TS 61000-1-2:2008 uses the terminology of IEC 61508 and can be used to support this standard for EMC.

EMC Risk Reduction
The methodology set out in IEC TS 61000-1-2:2008 is based on risk management principles and focusses on reducing risks throughout the design stage.

Help is available
The IET has produced a **Guidance document** on EMC for Functional Safety that describes practical and cost-effective procedures for management and engineering: http://www.theiet.org/factfiles/emc/emc-factfile.cfm. It is intended to be read by both EMC specialists and engineers from other disciplines.

The main body of the **Guide** consists of 10 steps (0-9) where steps 1-9 describe the process which includes key stages, identifying the electromagnetic environment, equipment design and verification and validation.

Checklists are provided for each of the steps (0-9) to provide an easy way to focus on the key issues. When completed, the checklists can be used to record and document the entire process.