Electromagnetic Interference and Compatibility

Bill Davis
AEI Cables Ltd

What is EMI ?

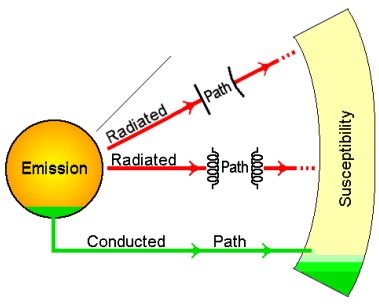
EMI is a type of environmental pollution but unlike the pollution that most of us understand involving water, air, noise, and other contaminants, EMI cannot be directly detected by sight, taste, smell, or touch yet it is pollution just the same. More appropriately it is radio frequency "spectrum pollution".

We have all experienced some form of spectrum pollution. The radiated electrical noise from electric razors and from automobile ignition systems creates interference on our televisions and radios. In these circumstances it is no more than a nuisance but there can be more serious side effects to EMI in certain circumstances. Consider the person with a heart pace maker. If in an environment where RF emitting sources are not properly shielded the effects could be disastrous.

In fact, EMI can be far more damaging and can affect more than just a single individual. It can negatively impact whole societies. Aircraft navigation systems, railway signalling systems, communications systems, computer networks, medical monitoring systems, fire detection systems, traffic control systems, are only a few of the critical systems that can be adversely affected by spectrum pollution. If EMI were left unchecked our lives would be seriously disrupted and the economic consequences would be enormous.

EMI is not just the domain of equipment and device manufacturers. Even the best designed device will fail to satisfy EMC (Electromagnetic Compatibility) compliance if the installation itself is not compliant. To understand the significance of this it's important to recognise the contributing elements to EMI in any installation.

EMI and it's Components



The components or elements that contribute to EMI fall into three categories…..

- Electrical noise emitters
- Propagation media
- Receptors.

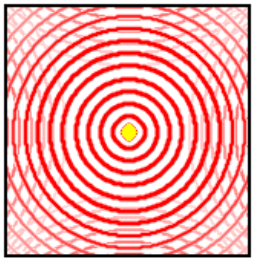
Equipment and electrical devices fall into the emitter category, receptor category, or both. Good equipment/device manufacturers include features in their designs to minimise or eliminate self radiated RF energy into the environment. They also include features to reduce their equipment's susceptibility to existing RF energy. However, most equipment must be powered by some electrical supply source (e.g. mains power) and often it must be interfaced with other equipment and/or systems. This is where electrical cable plays a role in EMC compliance. Electrical cable falls into the propagation media category and as such it features significantly in the EMC equation. As a power supply link or

signalling link in a system, electrical cable can effectively act as an antenna and can emit or receive radiated electrical noise if not designed or installed in a way that provides adequate electrical shielding.

EMI Environments

EMI issues have been understood for many years in the industrial/manufacturing sectors. Factories can be highly charged EMI environments due to the operation of motorised machinery, inductive loads, welding equipment, etc. In recent years as factories have become more automated, EMC has taken on greater prominence in order to protect sensitive computerised equipment, electronic controls, robotics, etc.

However, unlike the industrial sector the residential and commercial building sectors have been slow to consider how they can minimise the adverse effects of EMI in a building complex. Buildings new and old can no longer be considered just structures. Instead, they have become complex containers for a variety of wired and wireless systems that provide data and communication services to resident individuals and organisations. The average building today would have qualified as a "Smart building" just a few decades ago given the degree of installed automation. Furthermore, in spite of efforts to reduce co_2 emissions by developing low energy devices, the average building today requires far more available power than in years past. The use of electrical labour saving devices has increased with each generation and with it more potential sources of EMI.



Today's buildings represent a maze of electrical wiring that's routed through walls, ceilings, floors, and voids. This wiring can act as an extremely large antenna for transmitting electrical noise that's generated from within the building and/or picking up electrical noise generated from outside the building. It's not uncommon for a small building to have over 1,000 unintentional emitters and receptors contributing to EMI. Buildings have become major frequency spectrum polluters as well as victims to EMI. With this said, proper planning and cable selection is an absolute must.

To ignore EMC requirements, especially in a commercial building, a specifier or installer may incur re-work costs that could greatly exceed the cost of a properly designed and installed system in the first instance.

Sources of EMI

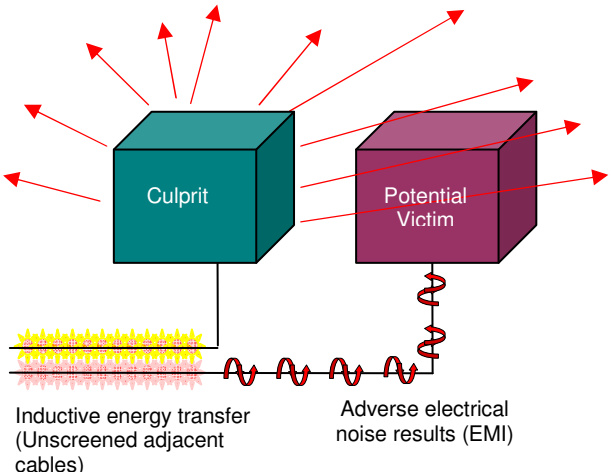
EMI is generated by both natural and man-made means. Natural sources include terrestrial atmospheric noise, precipitation static, lightning discharge and extraterrestrial emissions.

Man-made EMI sources are more plentiful. Some sources are intentional as is the case with equipment generating tele-communications, radar, and navigation transmissions.

Other man-made sources are un-intentional and include emissions from automotive ignition systems, power lines, electric tools, machines, industrial devices, fluorescent lamps, and other consumer products to name just a few. The list is extensive and growing exponentially each year.

What about cable?

Wire and cable, while not a direct source of EMI, provides an inductive medium that can couple unwanted energy through ingress or egress with other wire, cable, or equipment. Cable can also act as an antenna where equipment might produce RF electrical noise that can propagates down the associated cable to its terminating point.



Where EMI is a concern a screened cable should be considered. Whilst the unit cost may be more expensive than an unscreened cable, the installed cost can be significantly less. If unscreened cable is used, careful placement of the cable would be required for EMI immunity and this would increase planning requirements, installation time, and their associated costs.

More importantly, where sensitive equipment might be affected by EMI, as found in hospitals, airports, and other public buildings, a strong case can be made for using screened cable such as AEI's Protec for superior EMI immunity. As building management systems become more intelligent and integrated, EMI immunity will certainly become a key driver for selecting cable that will perform in not only a physically challenging environment but an electrically challenging one as well.

EMC explained

Electro Magnetic Compatibility (EMC) is defined as the gainful operation of electrical and electronic devices, equipment, and systems in a common environment such that no degradation of performance exists due to radiated electromagnetic emissions.

In other words, the system and installation should:

- Tolerate a specified degree of interference,
- Not generate more than a specified amount of interference,
- Be self-compatible

EC Directive 89/336/EEC forms the basis by which all member states implement EMC regulations. As a member state the UK has adopted the EC Directive and established its own statutory compliance directive entitled Electromagnetic Compatibility Directive 2005. The UK requires that all relevant electrical and electronic devices marketed within the UK comply with the EMC directive. All devices must carry the CE mark to indicate compliance.