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Necessity of EMC Practice in Bangladesh

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Abstract

This paper discusses Electromagnetic Compatibility (EMC) a phenomena which has become important in recent years. Two approaches are taken to EMC in this paper, firstly product design consideration to reduce the Emissions of Electromagnetic Interference (EMI) and secondly on methods available which will ensure compliance with product susceptibility as stated by various international bodies. Benefits from the EMC practice are also described in this paper.

Introduction

Every aspects of electrical and electronic engineering is somehow or other involve with EMC problems. Thus the widespread proliferation of electronic apparatus and instruments (starting from kitchen tools to satellite communication), causes the pollution of electromagnetic environment. Electromagnetic interference both inter and intra-device is the well known pollutant. For example, the common interference phenomena are computer malfunction and memory erasure, malfunction of process control instruments which are very sensitive to undesired emissions, navigational errors in marine and air-craft, etc. In order to control electromagnetic compatibility problems various governmental and international bodies have responded by introducing stringent regulations which cover both emission and susceptibility limits of various types of electrical and electronic equipment.

Electrical and electronic industries are growing up rapidly in Bangladesh. Thus, to export the products and to compete the international market as well as for better electromagnetic environment it is necessary to consider the product EMC before marketing any product in the country and outside the country.

The purpose of this paper is to highlight and gain a better understanding of EMC and EMI problem in electrical and electronic equipment. This paper discusses various aspects of EMC, EMC standards and regulations of different countries like UK, Germany, and USA, reduction and minimisation of EMC problem in the equipment.

What is EMC and EMI

The well-known definition of Electromagnetic Compatibility (EMC) is given in the draft International Electrotechnical Commission (IEC) vocabulary is,

"The ability of a device, equipment or system to function satisfactory in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in the environment".

At the same time, it should be immune to interference from other electronic/electrical equipment. A non EMC compatible situation is shown in fig. 1.

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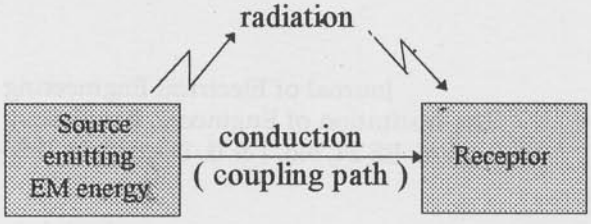

Fig. 1 : Three aspects of EMC[1].

It is clear from fig. 1 that if one of the three aspects in the drawing is missing, there is no interference or, rather, it is not noticed. In practice, the coupling path usually consists of a combination of conduction (cable) and radiation (in free space).

EMC has implications in radiation to safety, product reliability, and protection of the congested radio frequency spectrum. This can be achieved by designing, shielding and suppression at source.

On the otherhand EMI can be defined by the IEC vocabulary as,

"The degradation of the performance of a device, equipment, or system caused by an electromagnetic disturbance".

It is generated by sources at frequency ranges just above DC voltages, through the radio and audio frequency ranges to day light and beyond into the Gamma and X-ray regions of the electromagnetic spectrum as shown in fig.2.

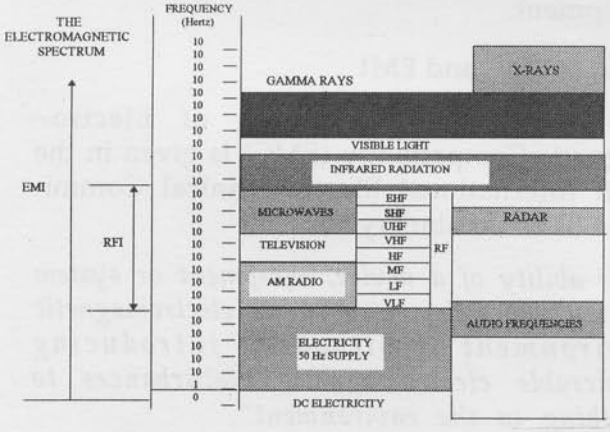

Fig. 2 : Electromagnetic Spectrum[2].

Sources and receptors of EMI

Any device or apparatus that transmits, distributes, processes, or otherwise utilizes any form o electrical energy can be a source of EMI if any aspect of this operation generates conducted and/or radiated electromagnetic signals that can cause a degradation of performance of any other equipment or system that shares the same equipment.

The main sources of EMI is natural sources and man-made sources. It is very difficult to separate the sources of EMI from its receptors. Probably most of the sources (except the natural sources of EMI) are also victims of EMI generated by other sources. In some cases the same system is defined both as a source and as a receptor of EMI. Examples of sources and victims of EMI are depicted in fig. 3 and fig. 4 respectively[3].

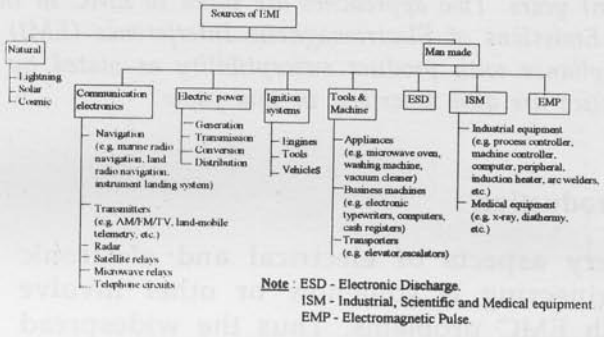

Fig. 3 : Sources of EMI.

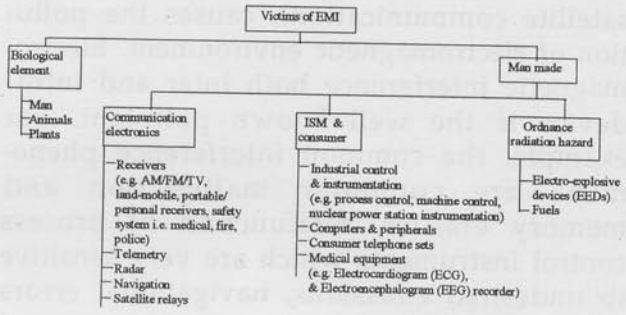

Fig. 4 : Receptors (victims) of EMI.

EMC Standards / Regulations

EMI has been recognised as a problem ever since the advent of radio communication and regulation were introduced to monitor and restrict the use of radio frequencies. Increased levels of sophistication of electronic equipment using microprocessors with high clock speeds has also increased the problem.

In responding EMC problems, in Europe a directive (89/336/EEC) was issued by the European Electromechanical Standardization Committee, CENELEC (Comité Européen Normalisation Electrotechnique), in May

1989, based on the recommendation of CISPR (International Special Committee on Radio Interference). From, 1st January 1996, all manufacturers must be able to prove that their product complies with the guide lines given by CENELEC. At the same time, all relevant electrical/electronic equipment may be marketed in the community only if they are CE certified[2.1].

There are four types of standard :

a) Basic Standards
b) General Standards
c) Product Family Standards and
d) Dedicated Product Standards

The general standard provide EMC specification for those instances where no product group standard is available. For example, [standard EN50081-1 lays down

limits of emission for equipment intended for domestic use. The] standard requires, for instance, that all apparatuses provide with a process or control circuit operating at a clock frequency higher than 9 KHz must be tested for interfering radiation. Legal limits have been set for the electric field: 30dB μV/m [in the frequency range of 30-230 MHz and 37dB μV/m] for the range 230-1000 MHz. The specified distance from the apparatus is 10m. These limits will provide a high probability of non-interference with radio and TV reception 10m away which is shown in fig. 5.

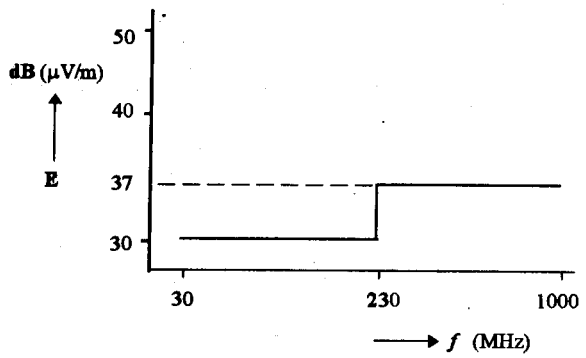

Fig. 5 : Characteristic of the permissible electric field at a distance of 10m (33 ft)[1].

The Federal Communications Commissions (FCC) and the Department of Defense (DoD) in USA, and the Verband Deutscher Elektrotechniker (VDE) in Germany specify the EMC requirements for various types of electronic equipment. In Bangladesh there is no such available standard.

Existing FCC EMI radiation limits for industrial and commercial class equipment and VDE EMC radiation limit for domestic and residential class equipment is shown in fig. 6 and fig. 7 respectively[2].

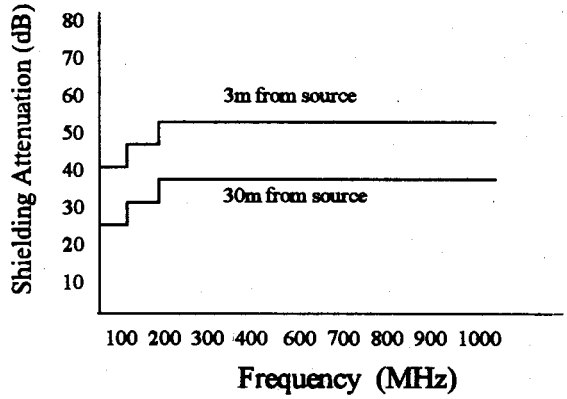

Fig. 6 : FCC EMI radiation limits (Industrial and Commercial class)

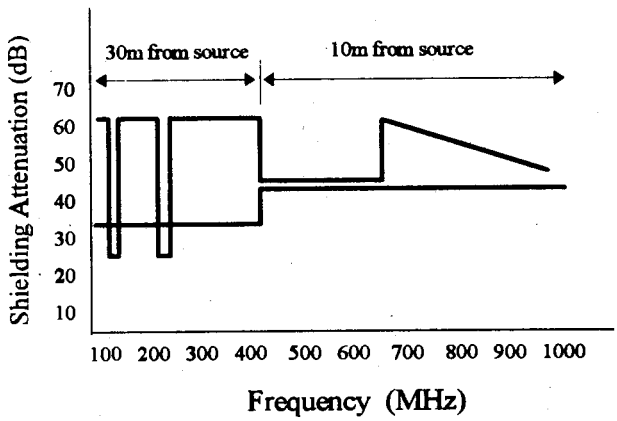

Fig. 7 : VDE EMI radiation limits (Domestic and Residential class).

Equipment EMC

Various sources of EMC problems[3] in a piece of electronic equipment are for examples :

- cables
- PCB
- connectors
- components
- power supplies
- enclosure
- relays, switches, and motors.

Eliminating or minimising EMC problems associated with these sources can help reduce EMC problems n the equipment

Reduction and Minimisation

Once the emission and susceptibility standard of electronic equipment are specified, manufacturers can achieve the required level of EM compliance of their product by reducing or controlling EMI problems at the source level, For example.

- the use of shielded cable could reduce radiated emission from the equipment;

- filtering could attenuate the conducted EMI problems through a cable (e.g. power line cable, DC power cords);

- the common impedance coupling between two subsystems in the equipment can be avoided by the use of a common mode choke, an isolation transformer or a optical coupler[4];

- the use of twisted-pair wire could decrease the crosstalk problem in a cable[5];

- suppression of EMI problems in the design process of components such as ICs, transistors, op-amplifier[6];

- in case of a PCB, proper design of the signal flow path (i.e. track routing), the PCB layout (component placement), the grounding as well as the application of multilayer techniques could improve EMC performance of the equipment[4,5,7,8];

- proper choices of logic families could minimise emission from the equipment;

- EMI problems due to Switch Mode Power Supply (SMPS) can be controlled by the use of a filter at the main inlet of the circuit. Enclosing the SMPS within a shielded box is also advisable[4];

- the use of a solid-state switch or a solid-state relay could eliminate the arc effect in a switch or a relay and hence decrease EMI problems in the equipment[7];

- the low resistivity brush material, the provision of shielding in brushes and brush lead and the frequent replacement of brush could reduce EMI problems in a motor[8];

- the proper choice of enclosure material, and aperture planning (i.e. size, shape and relative position of the aperture) improves the shielding performance of an enclosure and consequently reduces EMI problems in the equipment[9]. At the enclosure resonance the radiation could be reduced by the use of lossy material (electric or magnetic field absorber) within the enclosure to dampen the enclosure resonance[10].

Obviously, many EMC problems can be effectively tackled during the design process.

EMC Testing

EMC problems can cause delay's in a product development schedule if one does not pay attention to these problems during the design process. There are two routes to verify the product EMC as shown in fig. 8[3].

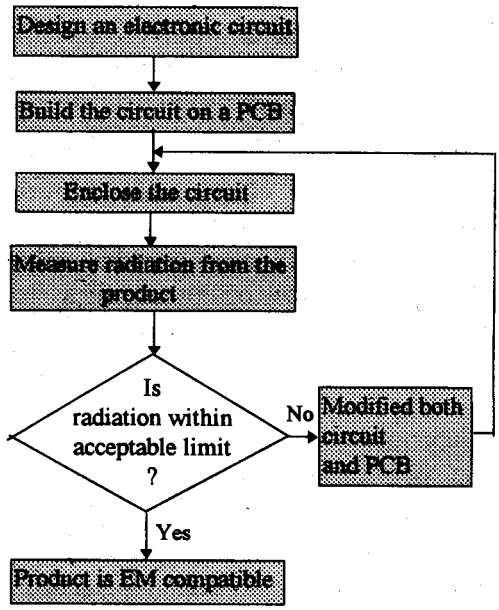

Fig. : 8(a) Test route with hardware.

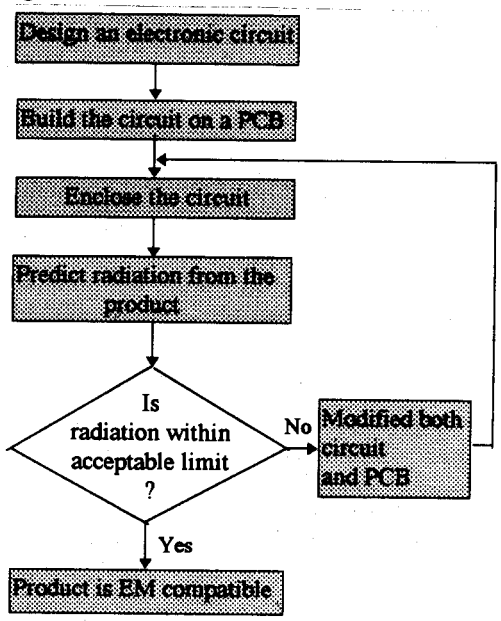

Fig. 8(b) Test route with software.

Benefits from EMC Practice

Recent studies[11] shows that the effective use of EMC can bring benefits for electronic industries in the area of design and development, production, marketing and sales, service and financial aspects. Benefits which can be obtained form various areas are summarized below.

In Design and Development

- More reliable prototype.
- Lower risks, fewer iterations.
- More predictable progress.
-Reduced development cost.
-Improved time-to-market.
- Easier EMC compliance.
- Less support required by early production.

In Production

- Fewer problems with first batches.
- Fewer design changes.
- Reduced production times and costs.
- Improved pass-first-time yields.
- Less rework, less scrap
- Reduced WIP
- Less paper work.

In Marketing and Sales

- Earlier market introduction.
- More competitive products.
- Improved market penetration.
- Highly reliability.
- Lower warranty costs.
- Higher level of repeat orders.
- Higher turnover, higher margins.

In Service and Financial

- Reduced investment per product.
- More predictable expenditure.
- More predictable income.
- Reduced financial risks.
- Break-even point reached earlier.
- Improved profitability.
- Improved return on investment.

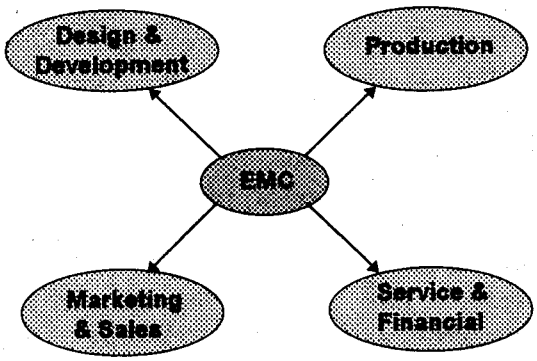

Fig. 9 Benefits from the EMC practice.

Conclusion

The adverse effect of EMI through its main sources had been described in this paper. It may be clear that the necessity of EMC practice at product design level is essential. As electrical and electronic industries are growing rapidly in Bangladesh, there is an opportunity to export our electronic products. But to compete the international market, all product has to be EM compatible.

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