These days, in-vehicle electronic equipment have been rapidly enhancing their higher function, higher performance and higher integration, and their progress has been continuing. In addition, the utilization of electromagnetic waves such as with mobile telephones and wireless LAN has been exploding, thereby increasing the risk that they and the automotive electronics equipment will exert a harmful influence on each other.

Meanwhile, EMC (Electro Magnetic Compatibility) regulations in each country and EMC specifications required from customers have become more demanding, and the compatibility of equipment performance and EMC performance is required.

Consequently, a review of product design technique has become necessary and Fujitsu Ten has worked on the following improvement activities for EMC design quality:

1. EMC front-loading design,
2. EMC-DR (Design Review) and consulting activity,
3. EMC design elemental technology development,
4. EMC design education,
5. EMC rule checker introduction.

We introduce these improvement activities for EMC design quality in twice.

Abstract

These days, in-vehicle electronic equipment have been rapidly enhancing their higher function, higher performance and higher integration, and their progress has been continuing. In addition, the utilization of electromagnetic waves such as with mobile telephones and wireless LAN has been exploding, thereby increasing the risk that they and the automotive electronics equipment will exert a harmful influence on each other.

Meanwhile, EMC (Electro Magnetic Compatibility) regulations in each country and EMC specifications required from customers have become more demanding, and the compatibility of equipment performance and EMC performance is required.

Consequently, a review of product design technique has become necessary and Fujitsu Ten has worked on the following improvement activities for EMC design quality:

1. EMC front-loading design,
2. EMC-DR (Design Review) and consulting activity,
3. EMC design elemental technology development,
4. EMC design education,
5. EMC rule checker introduction.

We introduce these improvement activities for EMC design quality in twice.
**Introduction**

In the automotive industry, the rapid advancement in electronics technology has significantly increased the demand for high-quality, reliable electronic systems. Despite this progress, it has become evident that there is a need to improve the reliability of electrified systems to ensure safe operations. Electromagnetic Compatibility (EMC) refers to the ability of electronic and electrical systems to function properly in their environment, without causing and being susceptible to electromagnetic disturbances.

**What EMC Is**

EMC is the ability of electrical and electronic systems to function properly in their environment without causing and being susceptible to electromagnetic disturbances. EMC demands improvement in the reliability of electrified systems to ensure safe operation. EMC is the combination of Electromagnetic Susceptibility (EMS) and Electromagnetic Interference (EMI).

Electromagnetic wave  
Electromagnetic wave

EMS performance  (Immunity)
No malfunction even if interfering electromagnetic is given.

EMI performance  (Emission)
Not emit interfering electromagnetic

**EMC Environment Surrounding Fujitsu Ten**

**3.1 Progress of Automotive Electronics Equipment**

The automotive electronics equipment has been progressing rapidly. This development is due to the rapid progress in automotive electronics technology in countries such as the U.S., which has boosted the electronics industry in Japan. As a result, the quality and function of automotive electronics equipment are increasingly advanced. The market demand is increasing, and there is also a consistent increase in the number of passenger cars equipped with this equipment in Japan, indicating a broad market. Further, the development of EVs and other electrified vehicles is increasing. In this environment, there is an increasing awareness of the importance of improving the reliability of electrified systems to ensure safe operations.

**3.2 Strengthening of EMC Regulations**

The ever-increasing number of electrified vehicles has been the cause of the strengthening of EMC regulations. These regulations have been putting pressure on the automotive industry. The mounting pressure from the government's promotion of EVs increased the market for automotive electronics equipment, which in turn pressured manufacturers to meet the high requirements of the EMC regulations. In recent years, the Japanese government has been promoting the development of EVs, which has increased the market for automotive electronics equipment. The strengthening of EMC regulations is a result of this increasing pressure and demand for automotive electronics equipment.
Current Situation of EMC Design

4.1 Trend around the World

The current situation of EMC design is evolving due to changes occurring in the global environment. This is further complicated by the increased use of information and communication technologies. As a result, systems are becoming more complex, and the importance of EMC design is becoming more apparent. There have been numerous regulations and standards set forth to deal with this problem, and companies are paying close attention to improving their EMC design processes.

4.2 Current Situation of Fujitsu Ten

At Fujitsu Ten, we have been working on EMC design for many years. However, we have recently encountered a new situation where the demands for EMC have increased due to the introduction of new technologies. This has led to the need for a new approach to EMC design that is focused on prevention rather than just correction. We have been working on this approach for the past few years, and we believe that it is an effective way to deal with the current situation.

Necessity of Incorporation of EMC Design

5.1 Responding to Change of Times

As the world becomes more complex, the need for EMC design becomes more critical. This is especially true in the current environment where new technologies are being introduced at an unprecedented rate. Companies must be prepared to deal with these changes and incorporate EMC design into their processes.

5.2 Specific Example of Design Reformation

We have undertaken a specific example of design reformation at Fujitsu Ten. This involved the incorporation of new techniques into our EMC design process. We were able to improve the performance of our products by incorporating these techniques.

5.3 Importance of Front Loading Design

In addition to the need for EMC design, there is also the importance of front loading design. This involves the incorporation of EMC design into the early stages of product development. We believe that this is the key to successful EMC design, and we have been working on this at Fujitsu Ten for many years.
5.4 EMC-DR

- EMC concept DR (EMC-DR at concept scheme step)
- EMC design DR (EMC-DR at design prototype step)
- EMC countermeasure DR (EMC-DR when countermeasure is needed after prototype)

5.5 Effective Consulting Activity
6.1 Necessity of Elemental Technology

The necessity of elemental technology stems from the requirement to enhance the EMC performance of electronic systems. A comprehensive approach is needed to address electromagnetic compatibility issues, considering design from the ground up.

The development of elemental technology is crucial for achieving high EMC performance. It necessitates a detailed examination of system components and their interactions to ensure effective EMC design.

6.2 Example of Elemental Technology Development

The development of elemental technology is exemplified through various applications, such as printed board pattern technology, circuit elemental technology, and EMC part utilization technology.

- **Printed board pattern elemental technology**: This technology focuses on optimizing the layout of printed circuit boards to minimize electromagnetic interference. It involves detailed analysis and modification of board patterns to reduce EMI.

- **Circuit elemental technology**: This technology aims to integrate circuit design and layout in a manner that reduces electromagnetic interference. It involves the careful placement of components and the use of shielding techniques.

- **EMC part utilization technology**: This technology involves the strategic use of components that are specifically designed to enhance EMC performance, such as shielding and grounding techniques.

These technologies, when implemented effectively, can significantly improve the overall EMC performance of electronic systems.
Mechanical design technology

Effects of EMC Design

7.1 Practice / Successful Example

Layer structure of printed board
Effective utilization of solid GND
Effective part placement for EMC
Basic rules for pattern wiring
7.2 Factor of Success

Factors that contribute to the success of an EMC design project include:

- Designing with the intention of avoiding EMC issues from the start.
- Implementing comprehensive design reviews and assessments.
- Utilizing advanced simulation tools for accurate predictions.
- Incorporating feedback from field testing into the design process.

Conclusion

In conclusion, the success of an EMC design project is significantly influenced by the factors described above. By focusing on comprehensive planning, collaborative design reviews, and adaptive design strategies, companies can significantly improve their chances of achieving EM compatibility in a cost-effective manner.

Profiles of Writers

Katsuji Hirabayashi
Entered the company in 1986. Since then, has engaged in EMC elemental technology development and EMC design education by way of development of automotive wireless applications. Currently in the EMC Engineering Department, Research & Development Group.

Hideo Hanamoto
Entered the company in 1978. Since then, has engaged in business planning by way of automotive electronics equipment development, quality control and prototype. Currently the Department General Manager of the EMC Engineering Department, Research & Development Group and Nakatsugawa Technical Center.