Low-EMI and Electrically Robust Product Solutions from Microchip

- 8-bit PIC® Microcontrollers
- Analog Peripherals
- Interface Products
- 16-bit PIC® Microcontrollers and dsPIC® Digital Signal Controllers
- Serial EEPROMs

EMC
Electromagnetic Compatibility

www.microchip.com/emc
**Electromagnetic Compatibility**

**PIC® Microcontrollers Designed for EMC**

**Strength Through Design**

In an effort to meet the needs of embedded system designers, silicon manufacturers continue to increase functionality and performance while decreasing the physical size and cost. This provides a significant benefit to both the embedded system designer and end consumer, but as the demand for sophisticated consumer and embedded products continues to expand, so does the challenge of properly designing such applications. Not only must the embedded system designer contend with meeting the product specifications, but as electronics continue to evolve into “smaller, faster and cheaper”, so does the challenge to achieve Electromagnetic Compatibility (EMC). Whether integrating electronic intelligence into products such as an electric toothbrush or meeting the high standards required of medical equipment, creating the most electromagnetically compatible designs continues to be a necessary, but sometimes challenging endeavor. As an embedded system systems designer, priority must be given to not only meeting the product specifications but to also creating the most reliable end product by limiting the negative influence of Electromagnetic Interference (EMI), both emitted and received. Furthermore, most EMC related issues are typically not discovered until the latter stages of the development cycle and are consequently expensive to fix. They can also seriously impact Time To Market (TTM) goals. It has therefore become increasingly critical to design for EMC from the outset. Selecting system components designed with your EMC goals in mind is a good starting point.

**What is EMC?**

EMC or Electromagnetic Compatibility is the ability of an electrical system or device to operate properly in an electromagnetic environment without being affected by EMI, or affecting other devices with self-generated EMI. Most embedded systems must attain EMC from both an emissions and an immunity (or susceptibility) point of view.

All clocked digital devices generate electromagnetic emissions to some degree or another in the form of radiated or conducted RF energy. The trend towards increasing system operating frequencies often aggravates the problem by generating higher energy, broader bandwidth RF noise. The system designer’s job is to ensure that this energy does not escape from the final product to the extent that it becomes EMI. EMI occurs when the electromagnetic field of one device (or system) has an adverse affect on the operation of another device (or system). Obviously, selecting the quietest EMI source will result in an easier task controlling overall system emissions. This is especially true for EMI issues within the application itself, for example, in mixed signal or radio designs.

As system operating frequencies and the need for lower current consumption increases, physics dictates that end applications will also tend to become increasingly susceptible to externally generated EMI sources. These electrical influences can be generated by either radiated or conducted EMI noise sources. Radiated EMI noise sources include anything electrical or electromechanical, including motors, power lines interference, antennas, traces on a Printed Circuit Board (PCB), and even the silicon components on the PCB.

Conducted EMI noise sources primarily manifest themselves as electrical “noise” on the power supply lines of an application and can be caused by induced voltage spikes from external devices like those mentioned above, or by RF coupling within the system itself.

An important sub-classification of conducted EMI is the Electrical Fast Transient or EFT. This is usually associated with AC power lines and can enter a system through capacitive or inductive coupling. Applications most typically prone to EFTs use capacitive or transformerless power supplies. EMI can wreak havoc on an embedded application with results ranging from simple nuisances (recoverable minor changes in a product’s operation) to catastrophic failures causing a product to fail permanently due to Electrical Over Stress (EOS) of one or more devices within the system.

Ultimately, prevention of EMI related issues within a particular application remains the responsibility of the embedded systems designer. This begins with the implementation of good board and system design practices including proper PCB layout and grounding, limiting trace lengths, placement of electrical components, and enclosure design. Again, selecting components at the outset which offer low RF emissions and electrically robust characteristics, can only make the task easier and first pass success more likely. Of course, not all systems operate in electrically noisy or sensitive environments, so the EMC challenge can vary significantly between applications.

**Microchip’s EMI Defense**

A direct result of Microchip’s commitment to continuous improvement, Microchip’s EMI protection is a compilation of years of EMI/EMC engineering experience and direct feedback from embedded systems designers. Microchip realizes the challenges of the embedded system engineers and has implemented a multifaceted approach to creating PIC microcontrollers that are less sensitive to EMI and limit EMI emissions. Defense against EMI also incorporates methods to deal with EFT bursts, as well as ESD (Electrostatic Discharge). Microchip provides the quietest and most electrically robust products available in the industry.

**EMC Advantages of Microchip Products**

- Ease in EMI/EMC qualification and testing to the latest regulatory laws
- Reduction in radiated and conducted EMI emissions
- Enhanced electrical barrier of protection from ESD and EFT
- Lower system cost by reducing PCB filtering and isolation
- Electrically robust solution for long life reliability
- Higher immunity to injected noise and harsh electrical environments
- EMI/EMC equivalence with legacy Microchip products

Microchip performs extensive EMI/EMC testing to validate the electromagnetic resilience of PIC microcontrollers, dsPIC® digital signal controllers, analog and memory products. EMI/EMC characterization is comprised of a suite of device level tests that determine both radiated and conducted emissions, and the relative degree of immunity to EFT interference a correctly designed application can expect to experience.
The Results

The engineers at Microchip understand the numerous challenges facing the modern embedded system design engineer – schedules, meeting product definition, limiting project costs and creating the most electrically reliable products. Utilizing Microchip products in your application minimizes all of these design challenges by providing flexible solutions that are easy to design-in while providing world-class EMC. Any application can realize the benefits of Microchip’s electrically robust products, particularly applications residing in electrically harsh environments such as appliances, automotive and industrial. And developers creating applications operating in electrically sensitive environments such as radio or sensor based designs, will find Microchip’s low noise products easier and quicker to integrate successfully. Microchip’s contribution to limiting design challenges and the adverse affects of EMI within any application is demonstrated by real-world customer acceptance with a seemingly infinite number of applications powered by Microchip products.

Typical EMI Test Results

The data speaks for itself!

Microchip implements industry standard device-level testing methodologies which are generally regarded to be representative and repeatable. The data shown demonstrates the conducted and radiated RF noise emissions from a typical 8-bit Flash Mid-Range PIC microcontroller.

Go to www.microchip.com/EMC for up-to-date information on various EMI related topics including: technical training, design tips and a listing of the lowest noise and most electrically robust PIC microcontrollers and Microchip products available.

NOTE: The conducted/radiated noise data shown is a typical representation of 8-bit Flash Mid-Range PIC microcontrollers. Note that this will vary based upon process technology, product architecture, etc. Contact your local Microchip representative for specific Microchip product data.
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