Electromagnetic Compatibility and International Regulatory Approvals

Most countries have now implemented strict regulations regarding Electromagnetic Compatibility (EMC) for electronic devices. This paper describes the current regulatory environment and examines the cost of obtaining the necessary approvals.

White Paper by Silex Technology America, Inc.

March 06, 2012

REV. 2.1

ELECTROMAGNETIC COMPATIBILITY AND INTERNATIONAL REGULATORY APPROVALS

Electromagnetic Compatibility (EMC) refers to the ability of a device to operate properly in its intended environment without intolerable interference to other devices. All electronic devices must meet certain international agency regulations regarding EMC. These regulations cover both intentional (for example, radio and TV broadcasts) and non-intentional (electrical noise) radiation.

The need to regulate electromagnetic radiation began with the advent of the radio in the early 20th century. Regulations were required because of the need to assign frequencies to different radio stations and to ensure that these frequencies were properly used and did not conflict with each other. In the U.S., this regulation was originally under the authority of the U.S. Department of Commerce and Labor, but was later transferred to the Federal Radio Commission and its successor, the Federal Communications Commission (FCC). The FCC later extended its authority to cover any type of device that transmitted or received electromagnetic signals over the airwaves, including televisions and wireless computer systems. This transmission of electromagnetic signals is considered to be intentional radiation, since the transmitter is deliberately sending out signals at an assigned frequency with well-defined characteristics.

In 1977, Apple Computer and others popularized the personal computer for home use. Unfortunately, their products had a tendency to severely interfere with television broadcasts. This interference (electrical noise) is known as electromagnetic interference (EMI) or radio frequency interference (RFI), and is considered to be unintentional radiation since the manufacturer obviously didn't intend to interfere with the television broadcasts. EMI sent over the airwaves is a form of radiated emissions, while EMI sent over AC power lines is conducted emissions. Because EMI directly impacted regulated TV/radio transmissions, the FCC established new rules to limit the amount of unintentional radiation from electronic devices. Note that the unintentional radiation rules apply to both wireless and non-wireless products.

In addition to EMI, induced radiation and RF exposure are also potential regulatory issues. Induced radiation refers to how well a device withstands unintentional radiation from an external source. For example, if a high voltage electrical charge is momentarily applied to the device, the device must recover gracefully and resume normal operation.

RF exposure regulations, on the other hand, determine if the device emits radiation that is harmful to human beings. This is normally only a concern for high-power transmission devices, but there have been some concerns (yet to be proven) that long-term exposure to even low-levels of electromagnetic radiation could potentially result in cancer and other health problems. For devices that may be positioned within 20 cm of a human

body, SAR (Specific Absorption Rate) testing is required to ensure radiation levels are below a certain limit.

ındustrial. Scientific and Medical (ISM) Radio Bands

The ITU Radiocommunication Sector (ITU-R) division of the International Telecommunication Union (ITU) is responsible for the international allocation of the radio frequency spectrum and assignment of frequencies to avoid harmful interference between radio stations of different countries. The ITU-R has defined several unlicensed frequency bands, which were originally designed for industrial, scientific, and medical wireless applications (and are therefore known as the ISM bands). 802.11a/b/g wireless devices use the 2.400-2.500GHz and 5.150-5.875GHz unlicensed bands (there are a total of twelve ISM bands; note that certain countries or regions may further restrict the actual frequencies available on these bands). Unlike cellular telephones and television/radio broadcasts, these bands do not require special licensing from the FCC or other agencies. However, devices operating in these bands do need to meet certain standards regarding both intentional and unintentional radiation, as described in the following sections.

International Regulatory Agencies

As mentioned previously, the FCC is the primary U.S. government agency for regulating both intentional and non-intentional radiation. The key EMC standard is FCC Title 47 CFR 15. This standard consists of several parts, such as:

- Intentional radiation (Part 15 Subpart C (802.11b/g) and E (802.11a); 15.207, 15.209; 15.245, 15.247, 15.249, 15.407)
- Unintentional radiation (Part 15 Subpart B, Class A or B -- required for both wired and wireless devices; 15.107, 15.109; note that Class A is for devices used in businesses, while Class B is for devices used in homes and has stricter limits).

In 1992, the European Council (CE) unified most of Europe under a single set of EMC standards (a process known as “harmonisation”), which included the regulation of intentional and non-intentional radiation. While the European Council oversees the standards process, there are a number of individual standards organizations that actually create the standards, including:

- CENELEC (European Committee for Electrotechnical Standardization) - European EN 5xxxx standards for safety and EMC
- European Telecommunications Standards Institute (ETSI) - European EN 3xx telecom standards

- CISPR (Comite International Special des Perturbations Radioelectriques) – EMC 55xxx standards (for example, CISPR 22 is the basis for EN 55022 and CISPR 11 is the basis for EN 55011)
- CEN (Comite Europeen de Normalisation)

The key CE EMC standards include:

- EMC directive 2004/108/EC (replaces 89/336/EEC; includes EN 55011, EN 55022:1994, 50082-1:1992, 61000-4-x) – EMC unintentional radiation regulations regarding Industrial, Scientific, Medical RF equipment (EN55011; includes 802.11a/b/g devices) and computing equipment (EN55022), plus induced radiation immunity (EN 61000)
- Radio equipment and telecommunications terminal equipment directive (R&TTE) 1999/5/EC (EN 55022, EN 300 328 (802.11b/g intentional radiation), EN 60950, EN 301 893 (802.11a intentional radiation), EN 301 489 17 (EMC for 802.11a/b/g))

Other countries have their own regulatory agencies and standards. For example:

Canada

- Industry Canada
    - ICES-003 EMC (virtually identical to FCC Part 15 Subpart B)
    - RSS-210 intentional radiation (equivalent to FCC Part 15 Subpart C & E)

Japan

- Association of Radio industries and Businesses (ARIB) – Intentional radiation standards
    - ARIB STD-T71, T72, T73 (= 802.11a)
    - ARIB STD-T66 (= 802.11b/g)
    - RC33 (= 802.11b)
- Voluntary Control Council for Interference (VCCI) – EMC (Class A or B unintentional radiation and immunity)

Australia/New Zealand

- C-Tick Australia/New Zealand (based on CE standards)
    - AS/NZS 3548 = CISPR 22 = EN 55022
    - AS/NZS 2064 = CISPR 11 = EN 55011.
    - AS/NZ 4251.1 = EN50081.1

Taiwan

- BSMI
    - EMC standards based on CISPR standards (CNS 13438, based on CISPR 22, CNS 13803, based on CISPR 11)

China

- China Compulsory Certification (CCC Mark) – EMC (and safety)
- Radio Type approval (SRRC) - Intentional radiation

In addition to the individual countries, the International Electrotechnical Council (IEC) is an international umbrella standards organization that has significant influence in the definition and establishment of international standards. Although IEC standards are generally not applicable to any specific country, they are often modified to meet specific regional requirements; for example:

- IEC 22 is similar to EN 55022 and CISPR 22
- IEC 60950 is the basis for UL 60950-1 2nd Edition, EN 60950-1 2nd Edition, and CN 14336

Note that in many cases, the OEM device manufacturer can self-certify that his device meets the requirements of the regulatory agency. This is done in the form of a Declaration of Conformity (DoC), a document that shows the applicable standards and is signed by the appropriate company representative. The manufacturer must also maintain accurate records of the testing process in the event that a regulatory agency needs to verify the compliance of the device.

If the OEM device manufacturer is using a third-party add-on product in his devices, he must certify that every one of his devices that use this add-on product meets all regulatory requirements when that add-on product is installed in the device. Technically, this means that he must test each one of the relevant devices with the add-on product in every possible hardware configuration. In practice, however, only a representative sample is tested due to the large number of possible configurations.

Modular Approvals

In order to simplify the approval process for 802.11a/b/g wireless devices, the FCC and Industry Canada have established modular approval standards. These standards allow a module vendor to certify that his wireless module meets FCC Part 15 Subpart C and RSS-210 intentional radiation standards. Such a module therefore has FCC or IC modular approval. Any OEM device manufacturer that incorporates a wireless module that has modular approval in their device does not need to go through the FCC Part 15 Subpart C or RSS-210 testing process. Instead, the OEM device manufacturer only needs to reference the wireless vendor's FCC number. Modular approval therefore greatly simplifies the approval process and substantially reduces the cost of testing.

There are two types of modular approval:

1. Modular Approval (full)
    - Provides full FCC Part 15 certification (intentional, non-intentional, induced) and sometimes UL/IC safety standards
    - Eliminates need for the OEM device manufacturer to do any wireless agency testing (subject to installation restrictions)
    - Must meet all of the following requirements:
        1) Module must have its own RF shielding (the module must be a self-contained shielded unit)
        2) Module must have its own power supply regulation and must meet FCC 15.207 AC line conducted requirements
        3) Module must meet specific antenna requirements. This originally meant a permanently attached antenna or a unique antenna connector, but FCC Order FCC-04-165 modified the requirement to allow the replacement of antennas with antennas of a similar type that do not exceed the antenna gain of tested antennas without retesting (for example, an OEM device manufacturer could replace a 2dB omnidirectional pole antenna with a different manufacturer's 2dB omnidirectional pole antenna). Manufacturers are expected to supply a list of acceptable antenna types with applications for equipment authorization.
        4) Module must be tested in a standalone configuration
        5) Module must be labeled with its own FCC ID label and meet Industry Canada's certification labeling requirements
        6) Manufacturer must provide adequate instructions to ensure operational compliance with any FCC or IC regulations pertaining to the transmitter
        7) Module must have buffered data inputs
        8) Module must comply with applicable FCC RF exposure and IC RF safety requirements

2. Limited Modular Approval
    - If all eight requirements above cannot be met, limited modular approval can be granted
    - Guarantees conformity with FCC intentional radiation (Part 15 Subpart C & E)
    - Eliminates need for OEM to do separate FCC intentional radiation testing
    - May not guarantee conformity to other FCC requirements, such as unintentional and induced radiation standards (e.g., EN301 489 17)
    - Antenna may be replaced as per FCC Order FCC-04-165 (see above)
    - Does not guarantee conformity to safety standards
    - The OEM device manufacturer must retain control over the final installation of the device to ensure compliance. In general, this means that the module is only approved for use in specific devices that are specified by the OEM device manufacturer.

For both full and limited modular approvals, the module and the OEM device must be labeled with the FCC ID number of the module. Note that modular approvals (full or limited) do not apply to CE or most other international regulatory approvals. However, they may help expedite the approval process in some cases.

Sllex products with limited modular approval include:

- SX-SDCAG 802.11a/b/g SDIO module
- SX-SDWAG 802.11a/b/g SDIO module
- SX-10WG 802.11b/g Mini PCI module
- SX-10WAG 802.11a/b/g Mini PCI module

In addition to the above, the Silex SX-560 has limited modular approval through its use of the SX-SDWAG & SX-SDCAG module (it uses the SX-SDWAG/SX-SDCAG FCC ID number).

Regulatory Approval Costs

Because regulatory approvals are labor intensive, they tend to be quite expensive. For example, Silex charges the following example estimated rates for a typical external serial device server:
The following costs are for unintentional emission testing/approvals.

- Unintentional emission testing/approval (these costs apply to both wireless or wired electronic devices):
    - FCC Part 15 Subpart B and IC ICES-003 unintentional conducted/radiated emissions: $3000
    - CE unintentional conducted/radiated emissions & immunity: $3000
- Intentional radiation testing/approval (these costs apply to wireless devices only):
    - FCC Part 15 Subpart C & E and IC RSS210 intentional radiation testing (includes agency filing fees) $15,000
    - CE intentional radiation: $15,000 (includes test reports)
    - Japan VCCI: $2900 (includes both unintentional and intentional radiation; includes test report; assumes FCC testing has been completed)
    - Australia/New Zealand: $2,150 plus $1,350 per year annual local agent service fees (includes both unintentional and intentional radiation; requires CE approvals)
    - Singapore: $6,000 plus $2,000 per year annual local agent service fees

Note that these rates are examples only. The actual rates depend on the type of device being tested, and will increase if there are any problems found during the test process.

Need Additional Information?

For additional information, please contact Silex Technology at (801) 748-1199, or go to our website at www.silexamerica.com.