What’s new in EMC?

Current Events: August 2010

Boxborough – 19 August 2010

David Schramm
Assistant Chief Engineer, EMC
It’s a moving target!
FCC - Overview

• FCC – the Regulatory Authority for the USA
  • Section 302 of the Communications Act of 1934 authorizes the FCC to regulate devices capable of harmful interference.
  • Telecom Act of 1996 does not affect this authority
Overview of FCC Rules

Some Code of Federal Regulations (CFR) titles:

Title 6 Homeland Security
Title 7 Agriculture
Title 10 Energy
Title 21 Food and Drugs

**Title 47 Telecommunications**

Title 49 Transportation
General Rules under Title 47 CFR

Part 0 – Organization
0.457, 0.459 confidentiality (short-term, permanent)

Part 1 – Practice and procedures
1.1102 licensing fees
1.1103 approval fees
1.1307-1.1310 RF exposure

Part 2 – General rules; frequency allocations
2.1 definitions
2.106 frequency vs. rule part table
2.801-2.803 marketing RF devices
2.901… authorization procedures
2.1033 certification exhibits
2.1043 changes in certified equip.
2.1046-2.1057 licensed radio tests
2.1501.. tests for EPIRBs

Part 5 – Experimental radio
Specific Rules – 47 CFR:

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Emergency alarm</td>
</tr>
<tr>
<td>15</td>
<td>RF devices</td>
</tr>
<tr>
<td>18</td>
<td>ISM devices</td>
</tr>
<tr>
<td>20</td>
<td>Commercial mobile radio (cellular HAC) rules</td>
</tr>
<tr>
<td>21</td>
<td>Domestic public fixed radio services</td>
</tr>
<tr>
<td>22</td>
<td>Public mobile services (cellular etc.)</td>
</tr>
<tr>
<td>24</td>
<td>Personal communication services (PCS cellular)</td>
</tr>
<tr>
<td>25</td>
<td>Satellite communications</td>
</tr>
<tr>
<td>27</td>
<td>Misc. wireless communication services</td>
</tr>
<tr>
<td>68</td>
<td>Telephone terminal equipment</td>
</tr>
<tr>
<td>74</td>
<td>Broadcast auxiliary services</td>
</tr>
<tr>
<td>80</td>
<td>Maritime services</td>
</tr>
<tr>
<td>87</td>
<td>Aviation services</td>
</tr>
<tr>
<td>90</td>
<td>Private land mobile radio services</td>
</tr>
<tr>
<td>95</td>
<td>Personal radio services (R/C, FRS, MIC, WMTS...)</td>
</tr>
<tr>
<td>97</td>
<td>Amateur radio service</td>
</tr>
<tr>
<td>101</td>
<td>Fixed microwave services</td>
</tr>
</tbody>
</table>
## FCC Authorization Requirements

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Authorization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most Part 15 transmitters</strong></td>
<td>Certification</td>
</tr>
<tr>
<td>Scanning Receiver</td>
<td>Certification</td>
</tr>
<tr>
<td><strong>Unlicensed PCS (Part 15 D)</strong></td>
<td>Certification</td>
</tr>
<tr>
<td>Telephone Terminal Equipment</td>
<td>SDoc or Certification</td>
</tr>
<tr>
<td>Cable System Terminal Device</td>
<td>Declaration of Conformity</td>
</tr>
<tr>
<td><strong>PC’s &amp; peripherals</strong></td>
<td>Cert or Declaration of Conformity</td>
</tr>
<tr>
<td>Most receivers</td>
<td>Cert or Declaration of Conformity</td>
</tr>
<tr>
<td>TV Interface device</td>
<td>Cert or Declaration of Conformity</td>
</tr>
<tr>
<td>Consumer ISM (Part 18)</td>
<td>Cert or Declaration of Conformity</td>
</tr>
<tr>
<td>Other ISM equipment (Part 18)</td>
<td>Verification</td>
</tr>
<tr>
<td>TV &amp; FM receivers</td>
<td>Verification</td>
</tr>
<tr>
<td>All other ITE</td>
<td>Verification</td>
</tr>
<tr>
<td>Point-to-point Microwave</td>
<td>Verification</td>
</tr>
<tr>
<td>Broadcast transmitters</td>
<td>Verification</td>
</tr>
<tr>
<td>Auxiliary BC transmitters</td>
<td>Verification</td>
</tr>
<tr>
<td>INMARSAT equipment</td>
<td>Verification</td>
</tr>
<tr>
<td>406 MHz ELT</td>
<td>Verification</td>
</tr>
<tr>
<td>Cable TV Relay xtmrs</td>
<td>Verification</td>
</tr>
<tr>
<td>Wildlife tracking xtmrs</td>
<td>Verification</td>
</tr>
</tbody>
</table>
FCC Test Procedures

- ANSI C63.4:2009 or ANSI C63.4: 2003
  - 2009 Version has
    - added site requirements above 1 GHz
    - Clarified the information and criteria to be used for selecting what must appear on video displays during emission testing
    - Updated the signal levels used in receiver testing in Clause 12
    - Cable losses must be re-characterized when temperature change is greater than 15°C
    - References the latest version of ANSI C63.5 – antenna calibrations
    - Additional precautions for using a spectrum analyzer vs. CISPR 16-1-1 receiver
FCC Test Procedures

- ANSI C63.10:2009
  - Has put into one standard most of the common tests for intentional radiators
    - Previous tests were listed in ANSI C63.4, FCC Part 15 rules, FCC Public Notices, FCC Knowledge Database
    - This made it extremely difficult to find all the test methods for a particular FCC rule part
    - Future versions of ANSI C63.4 will not reference testing of intentional radiators
    - ANSI C63.10:2009 did not include “controversial” test methods like DFS. The newest version will have considerations for testing MIMO devices, EIRP, Band-edge and other transmitter specific tests
FCC Test Procedures

- ANSI C63.26: 201?
  - Similar to ANSI C63.10, except it is specifically for licensed devices
    - Previous tests were listed in TIA 603, FCC Part 22/24/27/90/95 rules (and others), FCC Public Notices, FCC Knowledge Database
    - This made it extremely difficult to find all the test methods for a particular FCC rule part
    - Draft due to committee in September, but…
European Union
EMC is primarily governed in the EU by the EMC Directive

- Original Directive was 89/336/EEC, which was amended several times
- 2004/108/EC is the current EMC directive
- Fundamental protection requirements remained the same, but relaxed the requirements for “Fixed” installations
- EMC Directive is not applicable to devices covered under
  - Medical Device Directive, 93/42/EEC
  - R&TTE Directive, 1999/5/EC
European Union

“New Approach” Directives

• Published in Last ~15 Years.
• Compliance is presumed if equipment meets harmonized standards.
• Compliance is Indicated by CE Marking.
EMC Directive - Standards

There are many!

- Over 140 standards listed in the Official Journal
- Cover many types of products from …

Computers

Elevators

Cable Network Equipment

Trains
EMC Directive - Standards

Common Standards Include:


Appliances: EN 55014-1:2006 (emissions)

           EN 55020:2007

Test and Measurement Equipment:
    EN 61326-1: 2006

EMC Directive - Standards

Information Technology Equipment

  - Amendment A1 adds emissions limits for frequencies above 1 GHz and requirements for the site
  - New equipment requirements for ISN when measuring emissions on telecommunication lines
EN 55022: SVSWR Setup
EN 55022: SVSWR Requirements
EN 55022: SVSWR Requirements

6 Positions

F1  F2  F3  F4  F5  F6

2cm  10cm  18cm  30cm  40cm

3m

2 Polarities
EN 55022: SVSWR Results

Future requirements?
Maybe

6 GHz
18 GHz
Changes are coming under CISPR 35

Other Common Standards Include:

  • No changes in the last five years
  • Changes are coming under CISPR 35
EMC Directive - Standards

Other Common Standards Include:

- ISM:
  - IEC version gives interesting changes
CISPR 11 Amendment 1: 2010

- On a test site, class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m.
- Class B equipment at a nominal distance of 3 m or 10 m.
- CONDITION: A measuring distance less than 10 m is allowed only for equipment which complies with the definition small equipment.
- Small Equipment: equipment, either positioned on a table top or standing on the floor which, including its cables fits in a cylindrical test volume of 1.2 m in diameter and 1.5 m above the ground plane.
- Not yet harmonized in the OJ…
EMC Directive - Standards

Other Common Standards Include:

- Appliances (Household)

- EN 55014-1:2006 (emissions)
  No recent changes

  No recent changes
EMC Directive - Standards

Broadcast and associated equipment:

  No recent changes, but...

- EN 55020:2007
  No recent changes, but...
R&TTE Directive

History:

• Originally enacted in 1991
• R&TTE Directive 99/5/EC came fully into force on April 7, 2000
• Applies to Radio Equipment and to Telecommunications Terminal Equipment
  • TTE is equipment which can be connected either directly or indirectly to the public telecommunications network
  • Radio Equipment must efficiently use radio spectrum and avoid interfering with other communications
• Essential requirements of Low Voltage Directive and EMC Directives are covered under the R&TTE Directive
The R&TTE Directive contains a requirement that equipment which utilizes a non-harmonized frequency band must go through a special notification procedure before it can be legally CE marked and sold.

Such equipment must also be marked with a warning symbol to draw the user's attention to the fact that it might not be legal to use the equipment in every member state.
R&TTE Directive

Standards:

- Over 220 standards listed in the Official Journal
  - Covers basic EMC for transmitters and receiver in EN 301 489-x standards
  - Covers Spectrum Requirements, such as:
    - EN 300 220 – Short range devices (25 – 1000 MHz)
    - EN 300 330 – Short range devices (9k – 30 MHz)
    - EN 300 440 – Short range devices (1 – 40 GHz)
    - EN 300 328 – Spread Spectrum devices
    - Many, many more
Example of radio EMC in USA vs. EU

**USA – 433 MHz remote control**
- spectrum: 15.231
  - fundamental field strength
  - spurious field strength
  - duty cycle
- receiver: 15B
  - spurious field strength
  - AC conducted emissions
- EMC: none

**EU – 433 MHz remote control**
- spectrum: EN 300 220-1/-2
  - fundamental erp
  - spurious erp
  - duty cycle
  - adjacent channel power
  - low battery frequency stability
- receiver: EN 300 220-1/-2
  - spurious eirp
  - Class 1: selectivity etc.
  - Class 1, 2: blocking
- EMC: EN 301 489-1/-3
Medical Device Directive

Covers medical devices …

- any instrument, apparatus, appliance, material or other article, whether used alone or in combination, including the software necessary for its proper application intended by the manufacturer to be used for human beings for the purpose of:
  - diagnosis, prevention, monitoring, treatment or alleviation of disease,
  - diagnosis, monitoring, treatment, or alleviation of or compensation for an injury or handicap,
  - investigation, replacement or modification of the anatomy or of a physiological process,
  - control of conception
  - and which does not achieve its principal intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its function by such means.
Medical Device Directive

For EMC

- The standard is EN 60601-1-2: 2007 (for 3rd Edition)
- There are no changes in the EMC technical requirements in the transition from 2nd Edition to 3rd Edition
- The RISK assessment has been pushed into IEC 60601-1:2005.
Structure of IEC 60601

General standard (Part 1 standard) IEC 60601-1

Collateral standards IEC 60601-1-XX

60601-1-2 60601-1-3 60601-1-XX

Particular standards (Part 2 standards) IEC 60601-2-XX IEC/ISO 80601-2-XX

60601-2-1 60601-2-2 60601-2-3 60601-2-XX 80601-2-XX

Amendments

CTL Decision sheets (CB Scheme)
Reference Standards for EMC:

- CISPR 11 is used for all products under EN 60601-1-2 except for
  - Simple electrical components: CISPR 14-1 applies
  - Lighting equipment: CISPR 15 applies
  - Information Technology Equipment: CISPR 22 applies
- Harmonics and Flicker requirements are also specified
- For immunity (regardless of the type of product) the following basic standards are used:
  - 61000-4-2 (ESD), 61000-4-3 (Radiated RF immunity), 61000-4-4 (EFT), 61000-4-5 (Surge), 61000-4-6 (Conducted RF immunity), 61000-4-8 (Power frequency magnetic fields), and 61000-4-11 (Voltage dips and variations)
EN 60601-1-2: Immunity Compliance Criteria

Under the test conditions of 60601-1-2, the equipment shall be able to provide the BASIC SAFETY and ESSENTIAL PERFORMANCE.

The following DEGRADATIONS, if associated with BASIC SAFETY and ESSENTIAL PERFORMANCE, shall not be allowed:

- failure of automatic diagnosis or treatment equipment to diagnose or treat, even if accompanied by an alarm
- error of a displayed value sufficiently large to affect diagnosis or treatment
- noise on a waveform in which the noise would interfere with diagnosis, treatment or monitoring
Medical Device Directive

Special testing considerations for immunity:

- Some tests are repeated at maximum and minimum rated input voltages:
  - EFT (61000-4-4)
  - Surge (61000-4-5)
  - Voltage Dips (61000-4-11)
- For immunity to power frequency magnetic fields, testing must be repeated at both 50 and 60 Hz
- For ESD, testing is applied to all “accessible” parts including connectors
  - Accessibility is determined by a test finger (from IEC 60950-1)
  - Exempt if specially marked
Test finger
Particular Standards

60601-2-x: These standards specify operating conditions and sometimes modify test setup and test levels for EMC testing;

- Examples:
  - 60601-2-2 (RF Surgical Equipment) allows emissions testing while RF is not energized
  - 60601-2-24 (Infusion Pumps) requires 400 A/m for power frequency magnetic field immunity
  - 60601-2-19 (Infant Incubators) requires RF Immunity testing at both 3 V/m (no degradation) and at 10 V/m (degradation allowed if no HARM caused)
Clause 5 specifies product labeling and user manual requirements

• Hints for success
  • Assume compliance at normal test levels and complete the tables
  • The standard gives tables, text and flowcharts as a guide
  • The standard gives examples of completed tables
  • So… purchase the standard if you manufacture medical products
Australia

Regulated by ACMA

- Australian Communications and Media Authority
- Regulated by the *Radiocommunications Act of 1992*
- Similar to US in that only emissions from electronic products are regulated (no immunity requirements)
- Similar to EU in that many emissions standards are used as a basis for testing
- Medical devices are regulated by the Therapeutic Goods Administration and are exempt from ACMA’s EMC requirements
Australia

Standards:

- **ITE: AS/NZS CISPR 22**
  - Using CISPR 22:2008 (Ed 6.0)

- Broadcast receivers: AS/NZS CISPR 13

- Electrical Lighting: AS/NZS CISPR 15
Japan – ITE

Voluntary regulation for ITE under VCCI

• VCCI: Voluntary Control Council for Interference
• Test standard similar to CISPR 22, including measurements above 1 GHz
• Testing done at 100 Vac at both 50 and 60 Hz
Japan – Medical

JIS T0601-1-2 is the standard used:

- Identical to IEC 60601-1-2: 2004, but
  - Particular attention must be paid to input voltage
  - Radiated emissions: 100 Vac
  - Conducted emissions: 100 Vac (50 and 60 Hz)
  - ESD: 100 Vac
  - Radiated Immunity: 100 Vac
  - Surge: 100 Vac (50 and 60 Hz)
  - Conducted Immunity: 100 Vac (50 and 60 Hz)
  - Voltage Dips: 100 Vac (50 and 60 Hz)
  - Power Frequency Mag Fields: 100 Vac (50 and 60 Hz)
Japan – CAB

Conformity Assessment Body

• Through Phase II MRA Agreement between USA and Japan governments

• Will allow for certification in the USA for sell in Japan

• Applies to all radio devices…
  • Remote control
  • 802.11b/g/n
  • Low power communications
  • Cellular Phones
Taiwan
Taiwan

CNS 13438:

- As of October 1, 2010:
  - Equipment must be tested to above 1 GHz for radiated emissions
  - Equipment must be tested for conducted disturbances at telecommunications port
Korea

For ITE

- KN 22: Similar to CISPR 22
  - RRA Announce 2009-9, Dec 21, 2009
- KN 24: Similar to CISPR 24
  - RRA Announce 2009-10, Dec 21, 2009
    - KN 61000-4-2
    - KN 61000-4-3
    - KN 61000-4-4
    - KN 61000-4-5
    - KN 61000-4-6
    - KN 61000-4-8
    - KN 61000-4-11
EMC Trends?

• Higher frequencies for testing
  • Both emissions and immunity

• More countries formalizing regulatory requirements
  • Mostly conforming with European Standards with modifications

• Functional Safety is a bit of a buzz word
Questions?