Practical Advice on Certification Testing when Designing with RF Modules

‘Designing for Success’ Webinar Series
Today’s Presenters

Tom Smith
Director of EMC Compliance

Dave Burleton
Director of Product Marketing
Topics for Today

• Brief Overview of FCC, IC, and CE Certification Requirements
• How to leverage “Full” and Limited Modular Approvals in your product design
• Industry Updates
  – Upcoming changes to ETSI EN 301 893 v1.8.1 and ETSI EN 300 328 v1.9.1
• Live Q&A
WICED Forums, SDKs, Documentation, Help Topics, Partner Portals & Discussion Forums
  - Enabled through a click license
  - No SLA/NDA
  - Automated registration with the use of corporate/Educational institution e-mail account
  - Actively monitored and managed by Broadcom personnel
  - Just under 100K page views / month, over 1M annual
  - Over 4,000 Questions/Answers
  - 15,000+ registered users
Certification is a critical step to bringing wirelessly-enabled products to market.

Your Wireless Product Design

Your Target Markets

License to sell/market in a particular country

Regulatory Certification

License to sell/market in a particular country
Since 1996, LSR has provided EMC testing and radio certification services for companies worldwide.

- Accredited to ISO / IEC 17025
- On-site FCC / IC / CE Certifications
- International Testing Services
- On-site antenna patterning and scans
- Intentional radiator specialists
- Facilities include new 5M Chamber, 3M Chamber, & new automated Antenna Chamber
Overview of FCC/IC/CE Compliance Requirements for Wireless Products
Most common certifications/qualifications

- **FCC** (US)
- **IC** (Canada)
- **ETSI** (EU, Africa, Middle East, and parts of Asia)
- **Giteki / MIC** (Japan (formerly TELEC))
- **Wi-Fi® Alliance**
- **Bluetooth® SIG**
Compliance Requirement Overview

**North American (FCC & IC) Requirements**

- EMC and RF testing is limited to Emissions only
- Performed using one of 2 methods:
  - Radiated where the receive antenna is placed a specified distance from the product
  - Conducted measurements use an LISN (Line Impedance Stabilization Network) on the power mains or I/O signal Lines

**ETSI Requirements**

- Susceptibility or immunity testing in addition to emissions
  - The intent is to cause a phenomena the product may experience in the field
  - Ensure performance of the product is not interrupted or affected beyond a specific performance criteria
- Tests included in susceptibility testing
  - ESD (Electrostatic Discharge)
  - Radiated Immunity
  - Electrical/Fast Transient Burst
  - Surge, Conducted RF Immunity
  - Magnetic Field, Dips and Interruptions
Product Standards – *N. and S. America*

### North American Requirements

- **Unintentional Radiators FCC Subpart B**
  - Conducted Emissions - 15.107
  - Radiated Emissions – 15.109
- **Intentional Radiators FCC Subpart C**
  - Narrow Band Transmitters - 15.209, 15.231 and 15.249
  - Frequency Hoppers and Digitally Modulated Transmitters - 15.247
- **Intentional Radiators FCC Subpart E**
  - Unlicensed National Information Infrastructure Devices - 15.407

**South American Countries typically follow the FCC requirements and will accept FCC testing data.**

**A few, such as Brazil and Argentina require in-country testing but their rules are similar to the FCC.**

**LSR is accredited by A2LA (American Association for Laboratory Accreditation)**
Module has been tested and certified to the following standards

- FCC 15.247
- FCC 15.407
- FCC 15.209

Module has been found to satisfy the requirements for a radio module per FCC DA 00-1407 [8]

FCC rules allow for module to be used in the “mobile” configuration

- Antenna must be >20 cm from the human body
IC certifications are based on FCC certification testing using the same antennas and transmit power, and covering the same frequency bands.

LSR’s modules are certified to the IC RSS-210 & RSS-247 standards:

- RSS-210 Radio Standards Specification
  RSS-210, Issue 8, License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- RSS-247 DTS, FHS, and LE-LAN Devices
- RSS-Gen Issue 2 General Requirements and Information for the Certification of Radio Communication Equipment
Product Standards – *European Union*

Note that only the Directives are listed, however LSR also has numerous product family and basic standards on the scope of Accreditation.

**EMC Directive 2014/30/EU**
- Unintentional Radiators - Interference Causing Equipment Standards

**R&TTE Directive 1999/5/EC**  (Soon to be replaced with new revision)

**Middle Eastern and African countries typically follow the European requirements**
European Telecommunications Standards Institute (ETSI) is the standards body for most of Europe; Africa, Middle East, and parts of Asia use the ETSI Standards as a reference.

CE rules differ from those of the FCC and IC in that there are no provision for a modular approval. All approvals and certifications must exist at the device, rather than the radio module, level.

**What customers need to do:**

- For ETSI, LSR certifications can be leveraged by device vendors as part of their self-declaration to obtain the CE mark required by members of the European Union.
- LSR customers can download information on our ETSI testing form our website or ask our sales team for more information.
Defining Modular Approvals
FCC/IC Modular Approval

• For FCC/IC, 8 requirements can be found in CFR Title 47 Section 15.212
  – ETSI does not have a defined Modular Approval approach, however companies can still leverage modular test data for their CE mark

• 4 Types of Modular Approvals granted by FCC & IC
  – Single-Modular transmitter (“Full”)
  – Limited Single-Modular transmitter
  – Split-Modular Transmitter
  – Limited Split-Modular Transmitter
8 Requirements for “Full” Modular Approval

1. RF circuitry must be shielded
2. Buffered modulation/data inputs. Module must inherently ensure compliance under host fault (watch dog) conditions
3. Power supply regulation on the module.
4. Permanently attached antenna or unique antenna connector.
5. The module must demonstrate compliance in a stand-alone configuration
6. The module must be labeled with its permanently affixed FCC ID label or use an electronic display
7. User manual needs to provide comprehensive instructions to explain compliance requirements.
8. Module must comply with RF exposure requirements

If any of these 8 points are not met, must file for Limited Modular Approval

These requirements are defined in FCC §15.212, “Modular Transmitters”
Leveraging a Modular Approval vs Discrete Design

Benefits
- Amount of testing
- Risk of Re-Design
- Time to Market
  - Both Design and Certification time
- NRE Cost

Caveats to Leveraging Modular Approval
- Antenna Choice
- Co-Location of multiple radios
- End-Product
  - e.g. Mobile vs. Portable
How to leverage “Full” Modular Approvals in your design
Scenario #1: Designing in a Module with “Full” Single Modular Approval

How can I determine if it has Full Modular Approval?

- Shield
- Permanently Attached Antennas OR Certified Reference Layout w/ Antenna
- Stand-Alone Configuration
- Permanently affixed label
- Documented in FCC Grant

LSR’s Sterling-LWB™ Module featuring Broadcom 4343W
Option 1: Full Product Certification

End Product Testing:
General Emissions + Intentional Radiation (per product in line)

RF Module Testing:
General Emissions + Intentional Radiation (per module)

Does not include $$$ cost for radio design efforts

Option 2: Custom (“from scratch”) Modular Development

End Product Testing:
General Emissions only (per product in line)

RF Module Testing:
General Emissions + Intentional Radiation (per module)

Option 3: Pre-Certified Module Purchase

End Product Testing:
General Emissions only (per product in line)

RF Module Testing:
NONE, if used within Certification approval
**Scenario #1: Designing In Module with “Full” Single Modular Approval**

Steps to leverage the “Full” Single Modular Filing

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>1.</strong></td>
<td>Perform Unintentional Emissions testing in end-product</td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td>Evaluate for SAR</td>
</tr>
<tr>
<td><strong>3.</strong></td>
<td>If SAR requirements are met, everything is complete.</td>
</tr>
</tbody>
</table>
How to leverage *Limited* Modular Approvals in your design
Scenario #2: Designing In Module with Limited Single Modular Approval

Key Items

- Grant of Authorization
  - Module Type
  - Grant Notes
- Review 8 pt modular Letter
- Review User Manual

**TCB**

**TCB**

**Broadcom 2073XS SiP**

Includes:
- BCM2073X SoC
- 512K EEPROM
- Crystal
- Passives
- Integrated Antenna
Scenario #2: Designing In Module with Limited Single Modular Approval

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# Scenario #2: Designing In Module with Limited Single Modular Approval

## Key Items

- **Grant of Authorization**
  - Module Type
  - Grant Notes
- **Review 8 pt modular Letter**
- **Review User Manual**

### Table: Single Modular Approval Requirements

<table>
<thead>
<tr>
<th>Requirements</th>
<th>EUT Conditions</th>
<th>Comply (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The radio elements of the modular transmitter must have their own shielding. The physical crystal and tuning capacitors may be located external to the shielded radio elements.</td>
<td>There is no RF shielding on the BCM20732S. Request for Limited Modular Approval.</td>
<td>N</td>
</tr>
<tr>
<td>The modular transmitter must have buffered modulation/data inputs (if such inputs are provided) to ensure that the module will comply with Part 15 requirements under conditions of excessive data rates or over-modulation.</td>
<td>All inputs to the modules are buffered through logic or microprocessor inputs. Refer to Schematics.</td>
<td>Y</td>
</tr>
<tr>
<td>The modular transmitter must have its own power supply regulation.</td>
<td>The BCM20732S uses the built-in LDO (low drop-out regulator) on the chip. It converts external voltage to 1.2V for use in the chip core.</td>
<td>Y</td>
</tr>
<tr>
<td>The modular transmitter must comply with the antenna and transmission system requirements of Sections 15.203, 15.204(b) and 15.204(c). The antenna must either be permanently attached or employ a “unique” antenna coupler (at all connections between the module and the antenna, including the cable). The embedded antenna is considered permanently attached.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Scenario #2: Designing In Module with Limited Single Modular Approval

Limited Approval is still available if all 8 requirements can not be met

Benefits

• Many of the same benefits as “Full” Single Modular approval without meeting all the requirements
• Less Testing than starting from scratch (i.e. discrete design)
• Provides unique FCC ID and separates filing from Original Certification
• Potentially can be converted to Full Modular approval

Keep in mind…

• Requires Change of ID and Module relabeling
• Additional Testing for Radiated Spurious Emissions
• Needs additional testing for each new host configuration
• Costs for additional testing and certification
Scenario #2: Designing In Module with Limited Single Modular Approval

Steps to leverage the Limited Single Modular Filing

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<tr>
<td>1.</td>
<td>Change of ID Filing</td>
</tr>
<tr>
<td>2.</td>
<td>Perform Radiated Spurious Emissions Testing (in host)</td>
</tr>
<tr>
<td>3.</td>
<td>Evaluate for SAR</td>
</tr>
<tr>
<td>4.</td>
<td>Complete Class II Permissive Change for Specific host</td>
</tr>
<tr>
<td>5.</td>
<td>Perform Unintentional Emissions testing in End-product</td>
</tr>
</tbody>
</table>
Bringing It All Together: Comparing the 3 Options

Cost Benefits of Modular approach multiplies with multiple products in product line.
Final Thoughts: Caveats to Leveraging Modular Approvals

• Certified Antennas
  – Changing from the certified antennas can result in a need to perform certification testing again. The gain and type of the antenna, along with the in-band and out of band characteristics determine options.
  – For DTS radios, if the module was tested using a terminated method you may be able to leverage more antenna

• SAR
  – In the past year both FCC and Industry Canada have modified the rules and calculations for SAR exemption.
    • FCC & IC no longer have the same calculations to determine the SAR exemptions
    • Less focus on Mobile and Portable → Focus is now on minimum separation distance
    • The actual SAR limits have not changed, just the criteria for exemption to testing!

• Co-location/Multi-transmitters
  – Having multiple certified radios or even combining multiple radios result in the need for evaluating simultaneous transmissions. Host configurations and SAR requirements need to be reviewed.

Partnering with a lab like LSR can help you navigate these factors efficiently
Industry Update:
Upcoming changes to
ETSI EN 301 893 v1.8.1 and
ETSI EN 300 328 v1.9.1
Industry Update: Upcoming European (ETSI) Standard Changes

• **ETSI EN 300 328 v1.9.1**  
  Standard Wideband devices in the 2.4 GHz band  
  – Latest edition goes into effect **December 1st, 2016**  
  – Many of the changes are not as significant as v1.8.1, however additional testing may be required

• **ETSI EN 301 893 v1.8.1**  
  Standard for 5 GHz RLAN devices  
  – Latest edition goes into effect **January 1st, 2017**  
  – Similar changes to ETSI EN 300 328 v1.9.1

**TO DO:**  
Review existing products’ test reports with ETSI certifications ASAP.
## Breaking down the ETSI EN 300 328 changes

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<tbody>
<tr>
<td>Adaptivity</td>
<td>Yes</td>
<td>No</td>
<td>YES</td>
<td>HIGH</td>
</tr>
<tr>
<td>Rx Blocking</td>
<td>Yes</td>
<td>Yes</td>
<td>YES</td>
<td>HIGH</td>
</tr>
<tr>
<td>Tx out-of-band Emissions</td>
<td>Yes</td>
<td>No</td>
<td>YES</td>
<td>HIGH</td>
</tr>
<tr>
<td>Spectral Density</td>
<td>Yes</td>
<td>No</td>
<td>YES</td>
<td>HIGH</td>
</tr>
<tr>
<td>Tx and Rx Spurious Emissions</td>
<td>Yes</td>
<td>Yes</td>
<td>LIKELY</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Hopping Parameters</td>
<td>Yes</td>
<td>No</td>
<td>POTENTIALLY</td>
<td>LOW</td>
</tr>
<tr>
<td>Occupied Bandwidth</td>
<td>Yes</td>
<td>No</td>
<td>POTENTIALLY</td>
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### Breaking down the ETSI EN 301 893 changes

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<td>Occupied Bandwidth</td>
<td>Yes</td>
<td>Yes</td>
<td>YES</td>
<td>HIGH</td>
</tr>
<tr>
<td>Output Power ($P_{out}$)</td>
<td>Yes</td>
<td>No</td>
<td>LIKELY</td>
<td>MEDIUM</td>
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Other changes that do not impact Testing: Geo Location added, and DFS
Industry Update: New Label Requirements from IC

• COMING SOON!
  Updated FCC & IC Handbooks from LSR

• All Webinar registrants will receive email notification when the updated handbooks become available!
Q&A and Wrap-Up
LSR’s **on-site** compliance testing for your products

<table>
<thead>
<tr>
<th>Wireless Testing</th>
<th>EMC Testing</th>
<th>Support Services</th>
<th>Qualifications</th>
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| • Test personnel with significant experience testing for Product and Modular Certification based on certification requirements for the FCC, Industry Canada, European Union, Australia, Japan, South America and other international countries. | • Strong background in testing non-wireless product to the various EMC requirements worldwide. | • Assists customers in the investigation of appropriate test standards, test plan development, troubleshooting/failure analysis, documentation review and certification services | • Accredited to ISO / IEC 17025 test laboratory  
• FCC accredited test site  
• Industry Canada recognized test site |
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