Practical Advice on Certification Testing when Designing with RF Modules

‘Designing for Success’ Webinar Series

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Today's Presenters

Tom Smith
Director of EMC Compliance

Dave Burleton
Director of Product Marketing

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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

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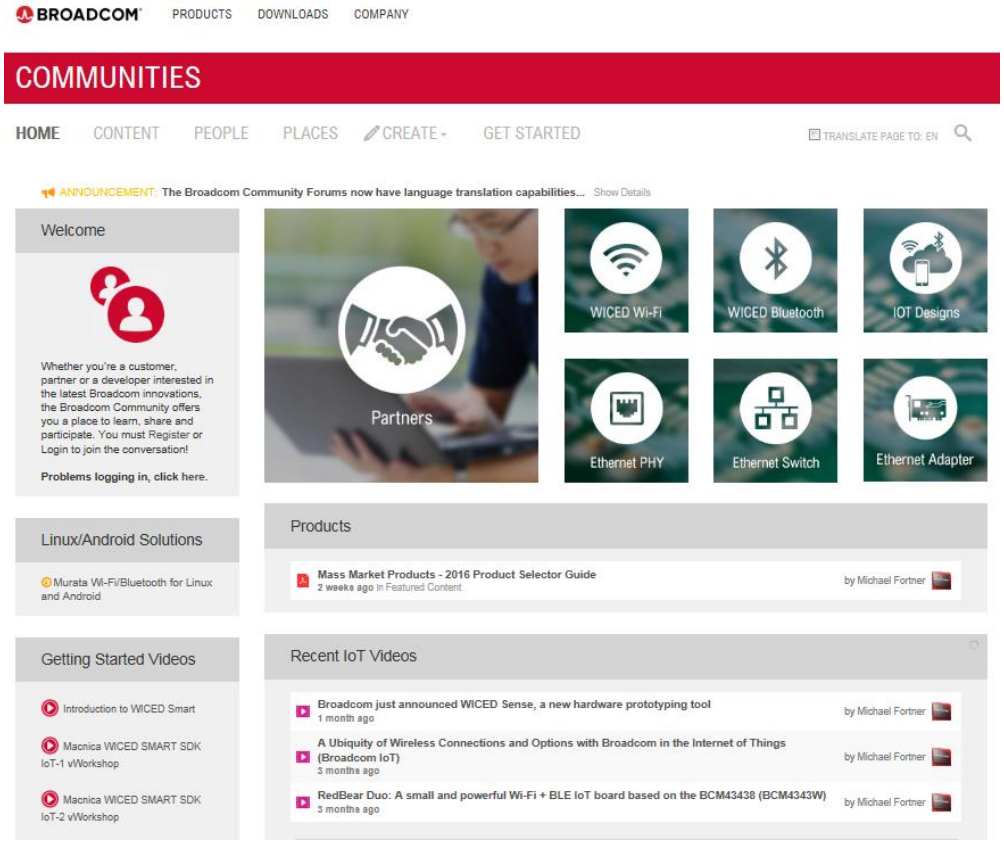
Broadcom Community Website



- 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

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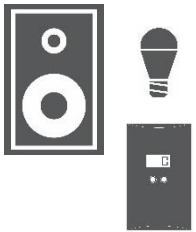
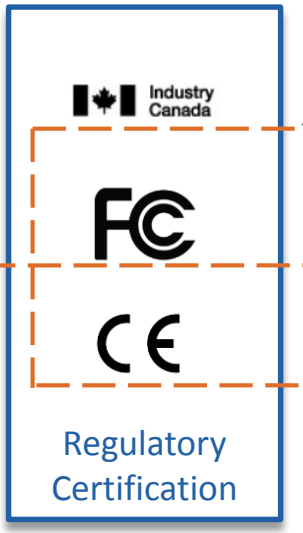
Certification is a critical step to bringing wirelessly-enabled products to market

Your Wireless Product Design



Your Target Markets



License to sell/market in a particular country

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In-house Certification services to *prove* product performance

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

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Overview of FCC/IC/CE Compliance Requirements for Wireless Products

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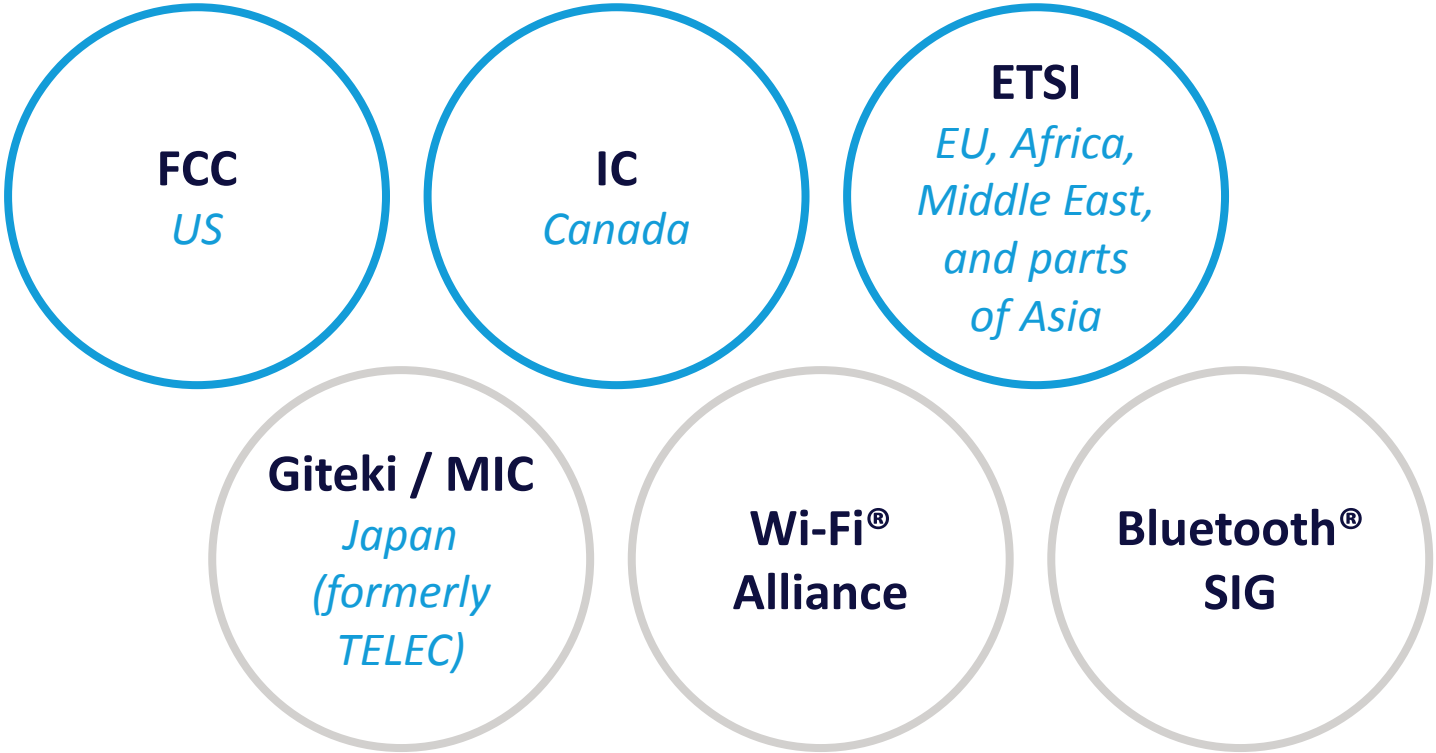
Most common certifications/qualifications



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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

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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)

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FCC Modular Certification

What does it mean?

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

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Industry Canada (IC) Certification

What does it mean?

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

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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

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ETSI Certification for CE

What does it mean?

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

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Defining Modular Approvals

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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

Focus of Today's Webinar Topic

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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

These requirements are defined in FCC §15.212, “Modular Transmitters”

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

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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

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How to leverage "Full" Modular Approvals in your design

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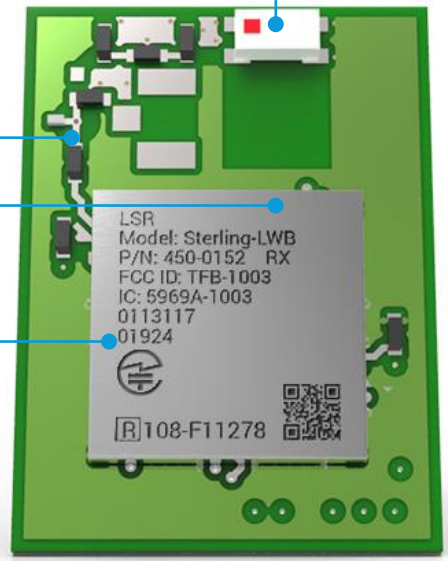
Scenario #1: Designing in a Module with "Full" Single Modular Approval

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

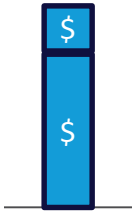


LSR's Sterling-LWB™ Module featuring Broadcom 4343W

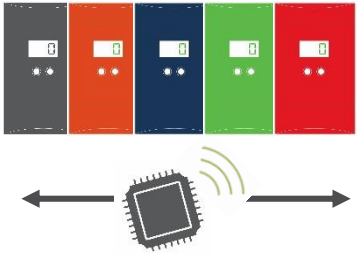
Option 1: Full Product Certification

End Product Testing:

General Emissions + Intentional Radiation (per product in line)



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

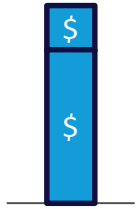


End Product Testing:

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)

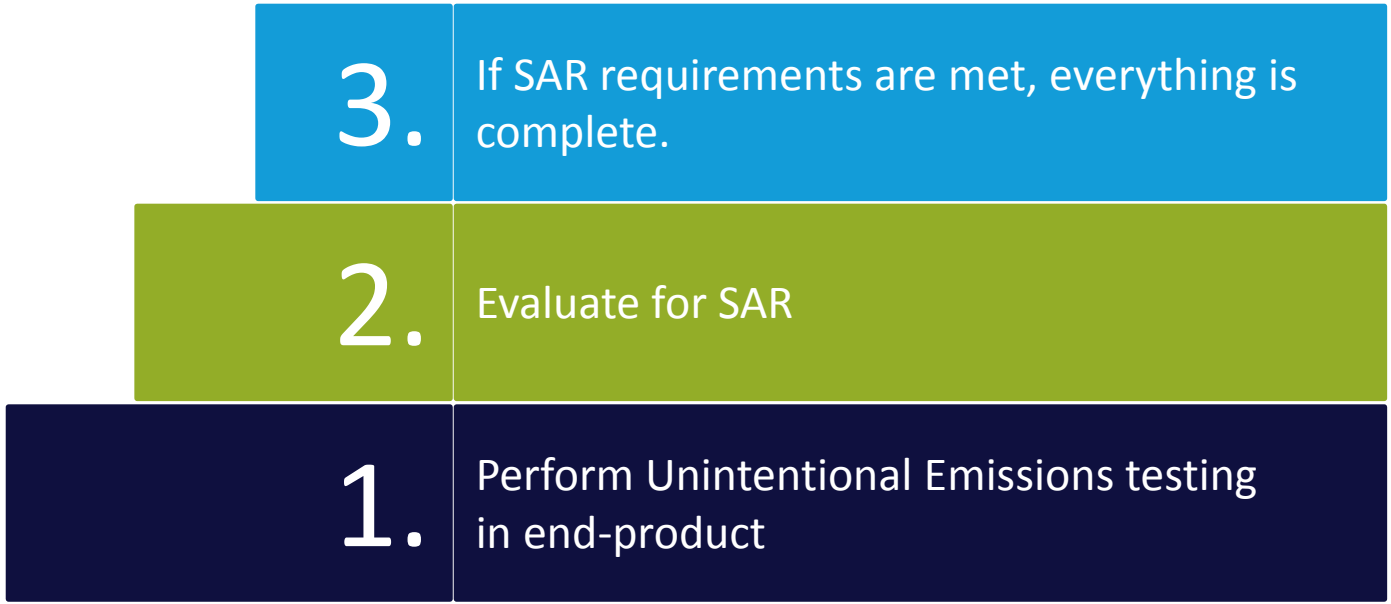
RF Module Testing:

NONE, if used within Certification approval

Does not include $$$ cost for radio design efforts

Scenario #1: Designing In Module with "Full" Single Modular Approval

Steps to leverage the "Full" Single Modular Filing



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How to leverage *Limited* Modular Approvals in your design

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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

TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

TCB

UL Verification Services Inc. (formerly UL CCS)
47173 Benicia Street
Fremont, CA 94538

Date of Grant: 11/06/2013

Application Dated: 11/06/2013

Broadcom Corporation
190 Mathilda Place
Sunnyvale, CA 94086

Attention: Daniel Lawless , Director of Engineering, System Operations

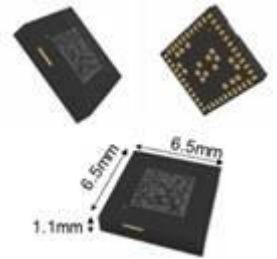
NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: QDS-BRCM1078
Name of Grantee: Broadcom Corporation
Equipment Class: **Digital Transmission System**
Notes: **Broadcom Bluetooth Module**
Modular Type: **Limited Single Modular**

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	2402.0 - 2480.0	0.0018		

Output power listed is Conducted. Compliance of this device in all final host configurations is the responsibility of the Grantee. OEM integrators and end-users must be provided with specific operating instructions for satisfying RF exposure compliance. OEM integrators are instructed to ensure that the end user has no manual instructions to remove or install the device. Installation is limited to the host



Broadcom 2073XS SiP
Includes:
BCM2073X SoC
512K EEPROM
Crystal
Passives
Integrated Antenna

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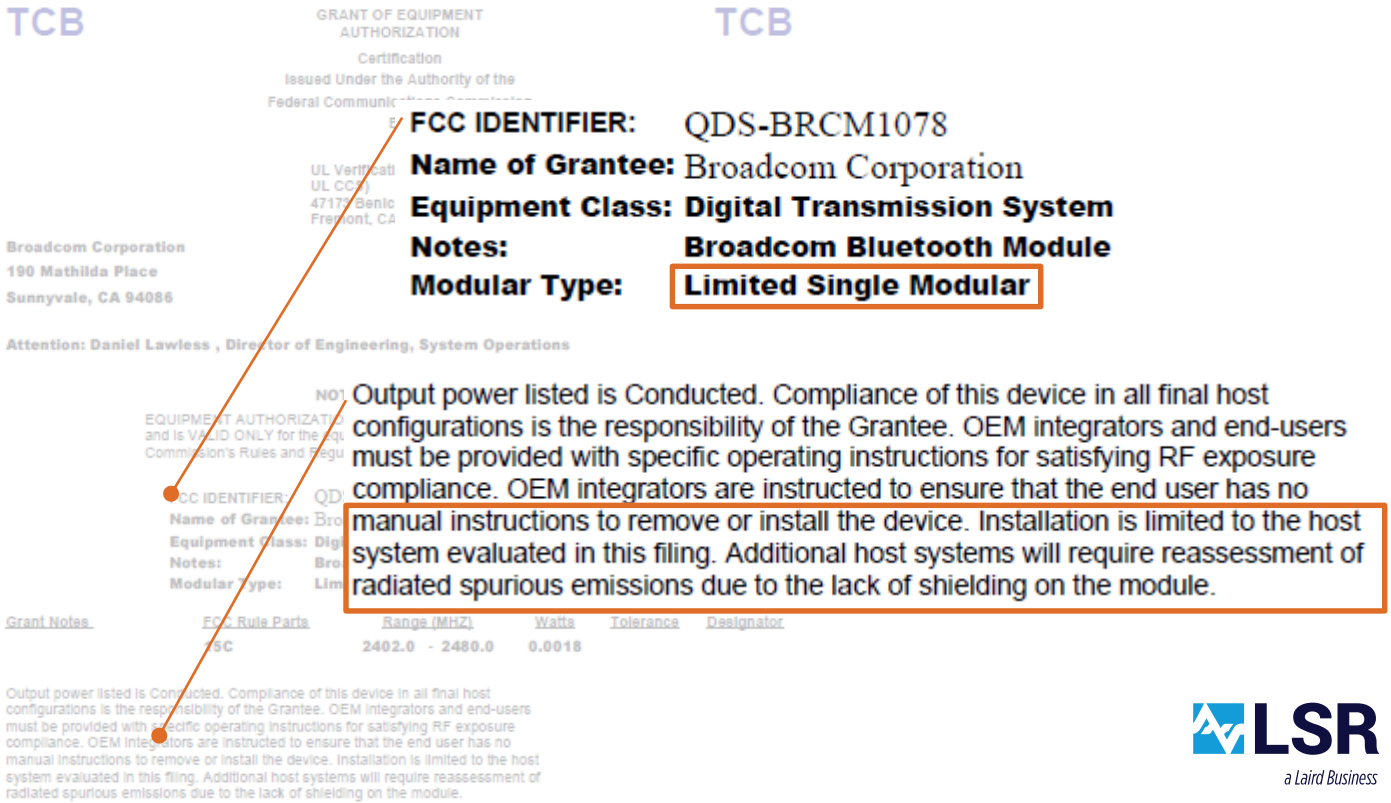
Scenario #2: Designing In Module with Limited Single Modular Approval

Key Items

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



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

Applicant/Grantee	Broadcom Corporation		
FCC ID:	QDS-BRCM1078		
Section 15.212 Modular Transmitters			
Request for Modular Approval	☒	Request for Limited Modular Approval	☐
	Requirements	EUT Conditions	Comply (Y/N)
Single Modular Approval Requirements			
1	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.	There is no RF shielding on the BCM20732S. Request for Limited Modular Approval.	N
2	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.	All inputs to the modules are buffered through logic or microprocessor inputs. Refer to Schematics.	Y
3	The modular transmitter must have its own power supply regulation.	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.	Y
4	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	The embedded antenna is considered permanently attached.	Y

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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

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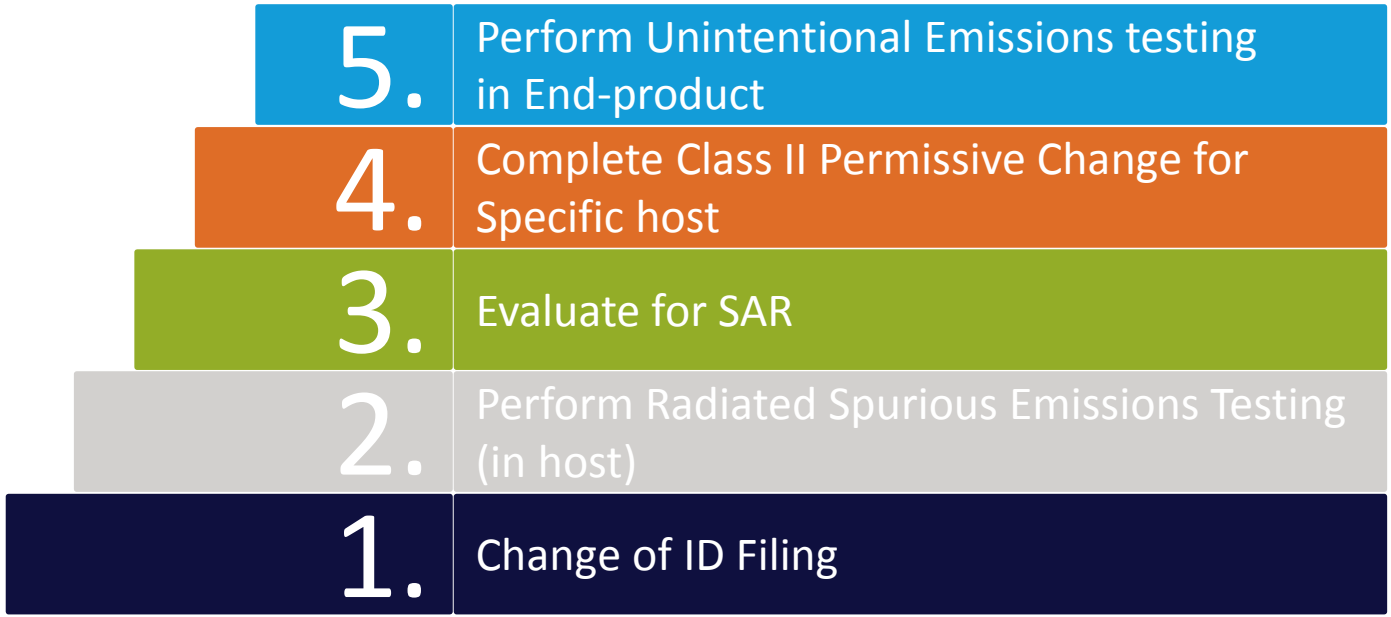
Scenario #2: Designing In Module with Limited Single Modular Approval

Steps to leverage the Limited Single Modular Filing



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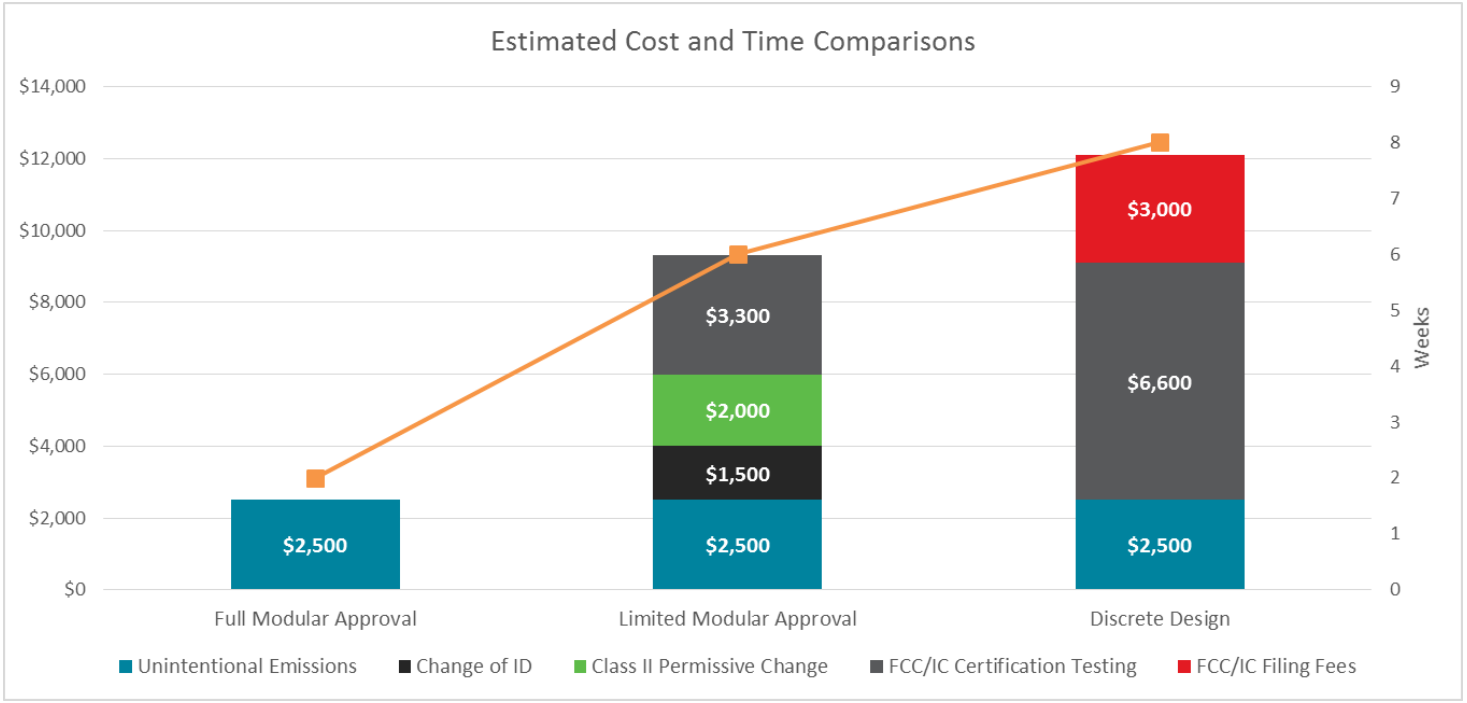
Bringing It All Together: Comparing the 3 Options



Cost Benefits of Modular approach multiplies with multiple products in product line.

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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

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Industry Update:

Upcoming changes to ETSI EN 301 893 v1.8.1 and ETSI EN 300 328 v1.9.1

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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.

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Breaking down the ETSI EN 300 328 changes

Characteristic	Change to Testing Procedure?	Change to Test Limits?	Re-Test Required?	Risk
Adaptivity	Yes	No	YES	HIGH
Rx Blocking	Yes	Yes	YES	HIGH
Tx out-of-band Emissions	Yes	No	YES	HIGH
Spectral Density	Yes	No	YES	HIGH
Tx and Rx Spurious Emissions	Yes	Yes	LIKELY	MEDIUM
Hopping Parameters	Yes	No	POTENTIALLY	LOW
Occupied Bandwidth	Yes	No	POTENTIALLY	LOW

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Breaking down the ETSI EN 301 893 changes

Characteristic	Change to Testing Procedure?	Change to Test Limits?	Re-Test Required?	Risk
Adaptivity	Yes	No	YES	HIGH
Occupied Bandwidth	Yes	Yes	YES	HIGH
Output Power (P_{OUT})	Yes	No	LIKELY	MEDIUM
Spectral Density	Yes	No	LIKELY	MEDIUM
Tx and Rx Spurious Emissions	Yes	Yes	LIKELY	MEDIUM

Other changes that do not impact Testing: Geo Location added, and DFS

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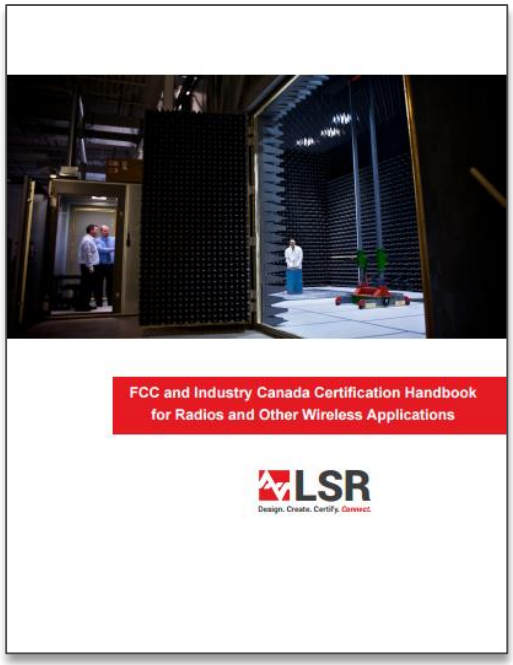
Industry Update: New Label Requirements from IC

- **COMING SOON!**
  Updated FCC & IC Handbooks from LSR

- All Webinar registrants will receive email notification when the updated handbooks become available!



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Q&A and Wrap-Up

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LSR's **on-site** compliance testing for your products

Wireless Testing

- 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.

EMC Testing

- Strong background in testing non-wireless product to the various EMC requirements worldwide.

Support Services

- Assists customers in the investigation of appropriate test standards, test plan development, troubleshooting/ failure analysis, documentation review and certification services

Qualifications

- Accredited to ISO / IEC 17025 test laboratory
- FCC accredited test site
- Industry Canada recognized test site

Industry Canada

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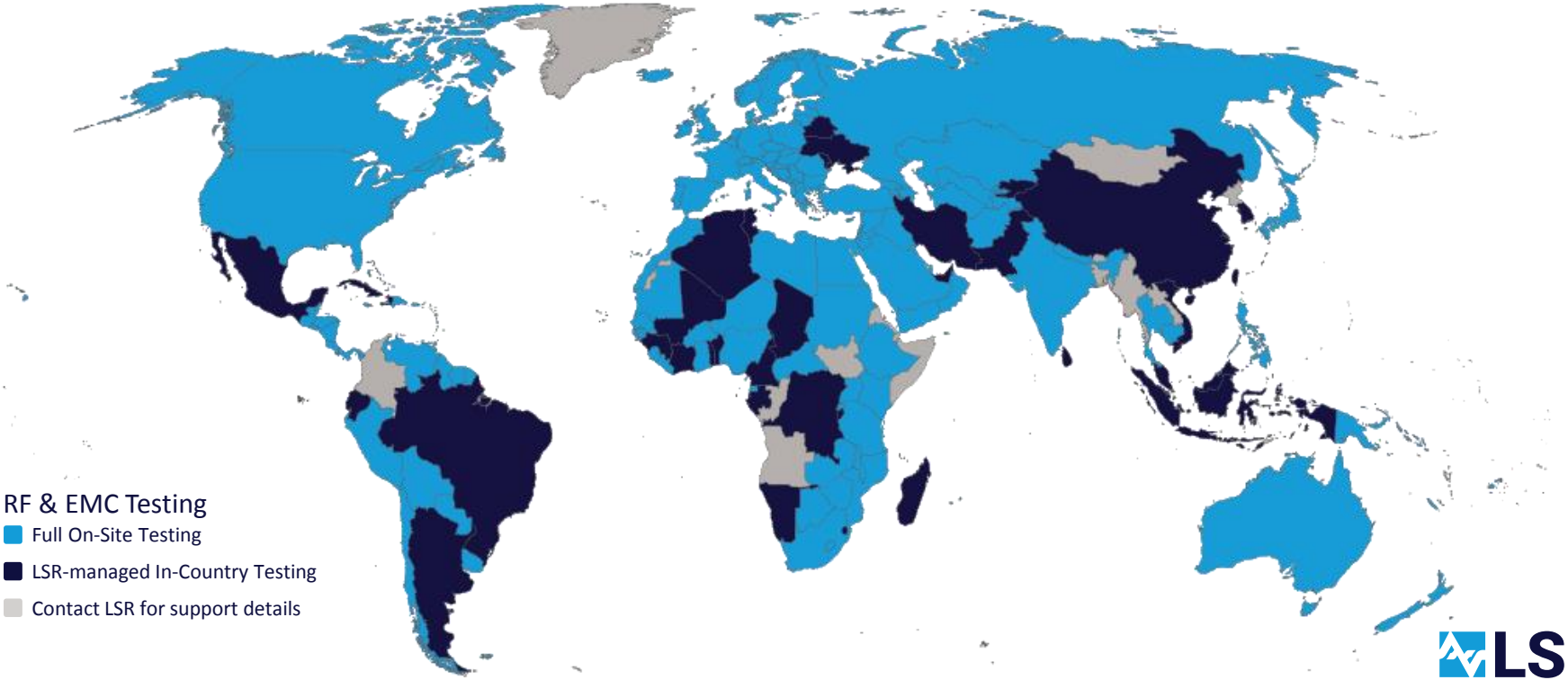
LSR has the services & expertise to ***champion*** your certification needs around the globe



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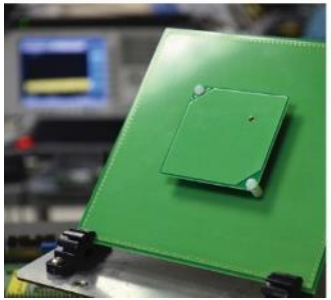
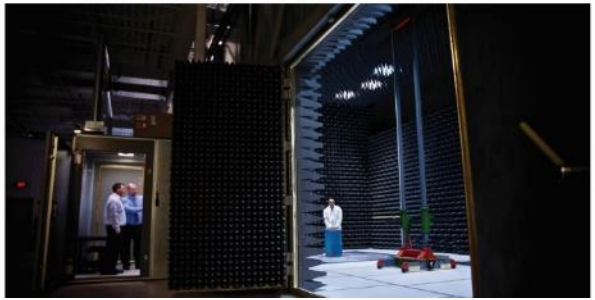

Design. Create. Certify. ***Connect.***

Visit **www.lsr.com/testing** to request an EMC consultation or quote

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