



# Passing FCC Regulations and RF Design Considerations

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# Agenda



- US Regulatory History
- Requirements for Indoor & Handheld UWB Devices
- Differences Between WLAN and UWB FCC Certification
- What the FCC Looks For
- What you can expect for an FCC Submission
- UWB Test Plan - Summary
- Global Bandplan and Regulation Status

# The U.S. Regulatory History



- FCC Notice of Intent (NOI) 00-163 May 10, 2000
- FCC First Report and Order (R&O) 02-48 Feb. 14, 2002
  - CFR\* 47 15.501 [http://www.access.gpo.gov/nara/cfr/waisidx\\_05/47cfr15\\_05.html](http://www.access.gpo.gov/nara/cfr/waisidx_05/47cfr15_05.html)
- FCC MBOA Waiver 05-58 Mar. 10, 2005
- ANSI C63-4 (document that describes how to test)
  - <http://webstore.ansi.org/ansidocstore/product.asp?sku=ANSI+C63%2E4%2D2003>:

\*CFR = Code of Federal Regulations

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# Requirements for Indoor UWB Devices (47 CFR 15.517c)



- **Scanning Limits**

- May transmit only when sending information to an associated receiver
- Must be designed so that indoor operation is required

- **Operating Band Requirements**

- The UWB bandwidth must be constrained between 3100 MHz and 10600 MHz

- **Antenna Restrictions**

- The use of antennas mounted outdoors is prohibited

- **Usage Constraints**

- UWB Devices may not be employed for the operation of toys

# Requirements for Handheld UWB Devices (47 CFR 15.519c)



- **Scanning Limits**

- May transmit only when sending information to an associated receiver
- Must stop transmission (outdoors) after 10 seconds if no response is received

- **Operating Band Requirements**

- The UWB bandwidth must be constrained between 3100 MHz and 10600 MHz
- More stringent limits apply 1610MHz – 3100 MHz and above 10,600 MHz

- **Antenna Restrictions**

- Outdoor fixed antenna are not allowed

- **Usage Constraints**

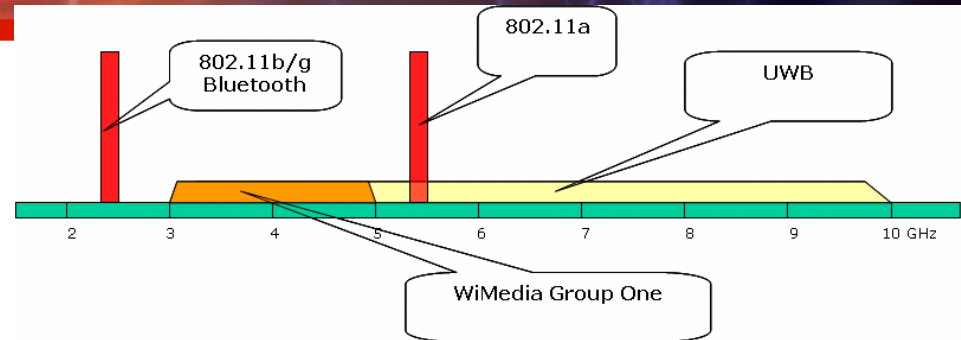
- UWB Devices may not be employed for the operation of toys

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# The Difference Between WLAN and UWB FCC Certification



- Spectrum
  - WLAN is narrow band and operates in license free spectrum
  - UWB is wideband and operates in the same spectrum as licensed and unlicensed services
- Power
  - Transmitted power level is very low
- Interference
  - WLAN co-exists with other unlicensed services but should not cause interference
  - UWB must not cause interference to the licensed services

# WLAN vs. UWB



- Measurement
  - WLAN can be conducted measurements at the antenna port. Test time is fast
  - UWB measurements must be radiated. Test time is very slow.
  - Conducted measurements may be allowed in EU and Japan
- Modularity / Qualification Requirements
  - WLAN can submit as a permissive change and/or modular approval
  - These are not allowed for UWB (today)

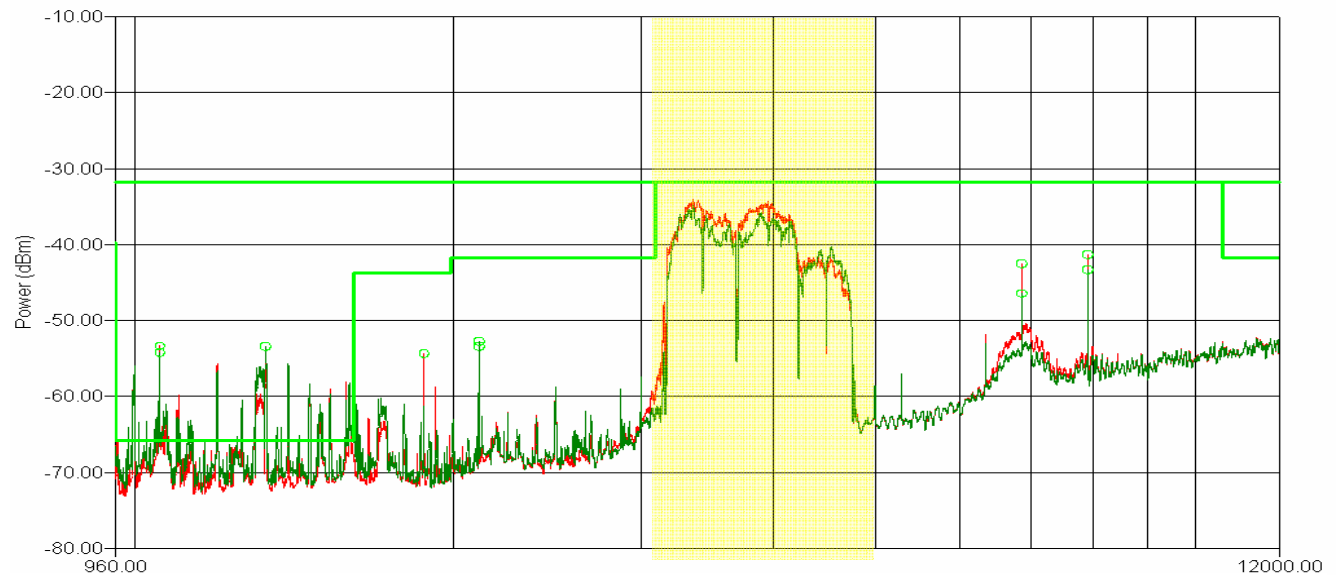
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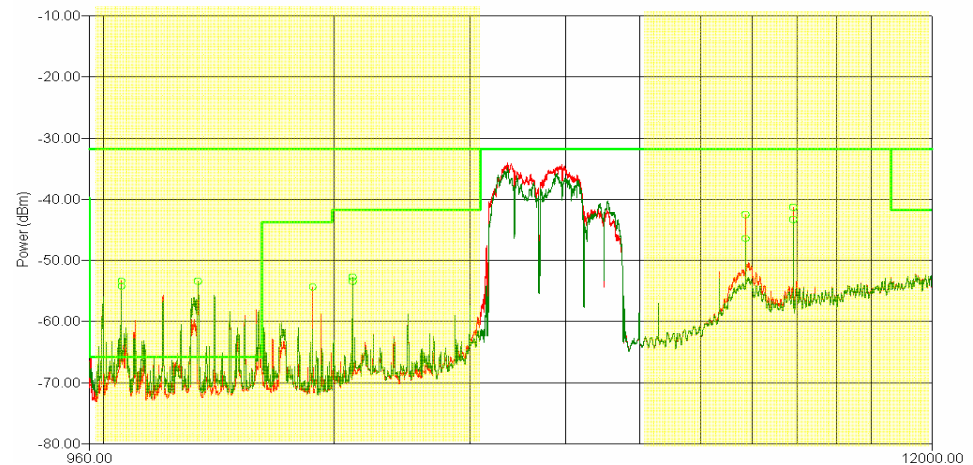
# What the FCC Looks For

- UWB Intentional emissions
  - 10 dB BW >500 MHz
  - RMS power below  $-41.3$  dBm/MHz EIRP
  - Peak power < 0 dBm EIRP in a 50 MHz BW



# What the FCC Looks For

- Unintentional emissions -- 30 MHz to 40 GHz
  - Must meet part 15 subpart B limits
  - Must meet more stringent requirements in the GPS bands
- AC Conducted emissions -- 150 KHz to 30 MHz if not battery operated



# The UWB Test Environment

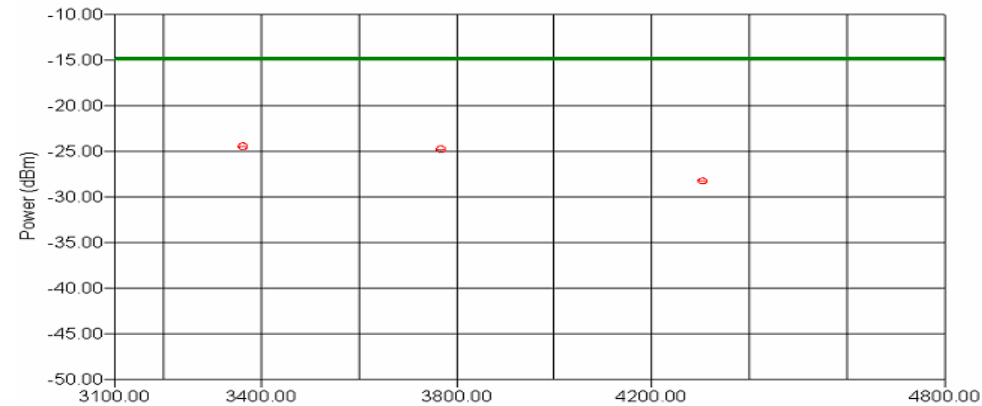
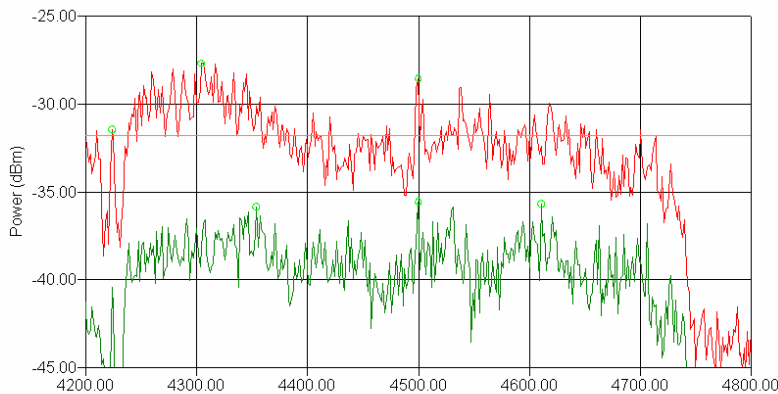


# The Device and Measurement Condition



- The equipment under test physical setup is done as prescribed in ANSI C63.4
- The equipment under test is operating in accordance with its intended usage as per FCC 02-48 First R&O and the FCC 05-58 MBOA Waiver
- The equipment under test is configured to transmit at the worst case configuration
- The EMI Limits are measured in accordance with FCC Part 15, Subpart F adjusted for the appropriate test distances and resolution bandwidth (if applicable)

# Peak Emissions in a 50 MHz Bandwidth



Each sub-band has many peaks

High resolution BW averages out these peaks

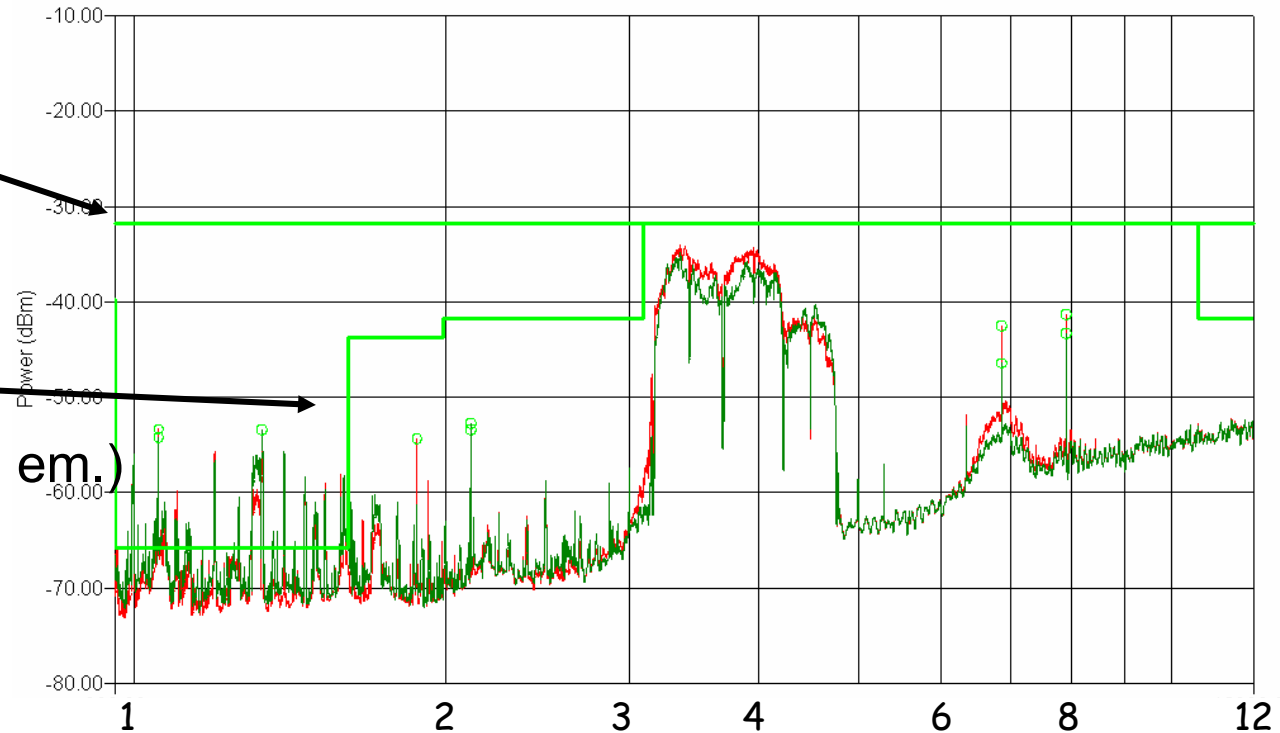
3 MHz RBW compensation  
as per FCC requirements:  
 $20\text{LOG}(3/50)$

# UWB Radiated Emissions (Indoor Limits)



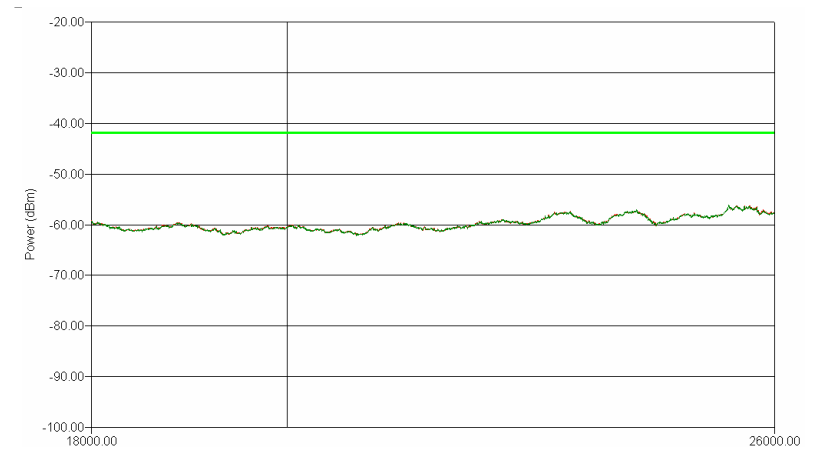
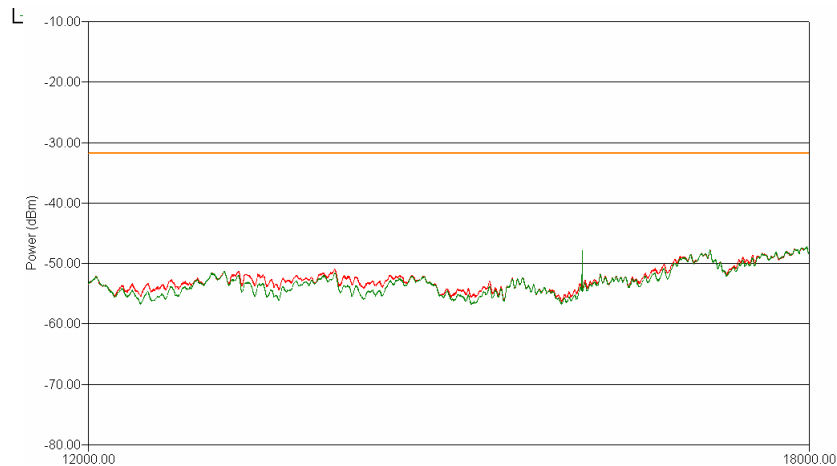
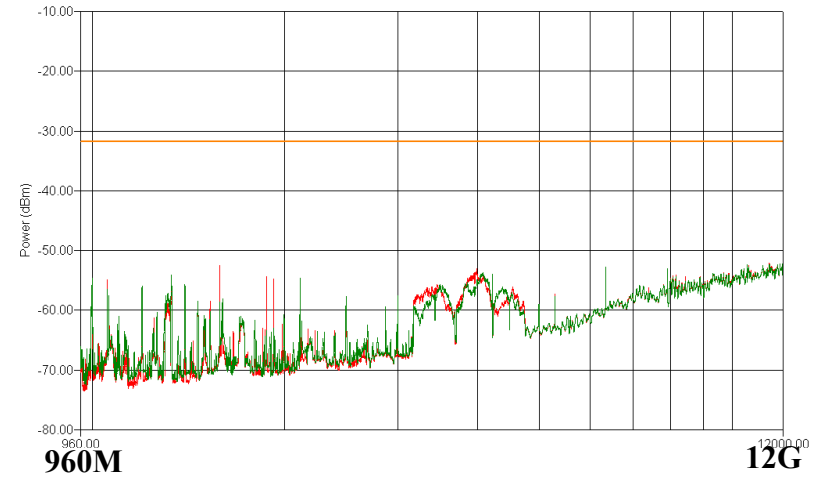
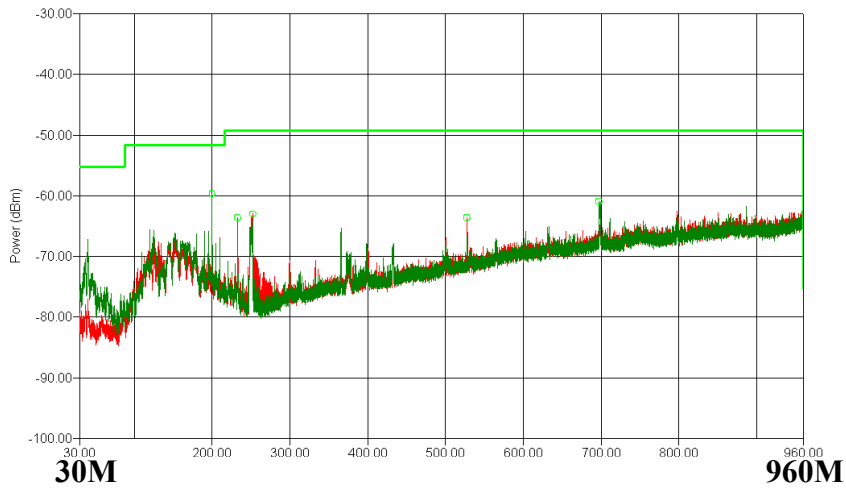
Subpart B limits  
(unintentional em)

Subpart F limits  
(un- and intentional em.)



960 MHz – 12 GHz

# Unintentional Radiated Emissions (Indoor Limits)

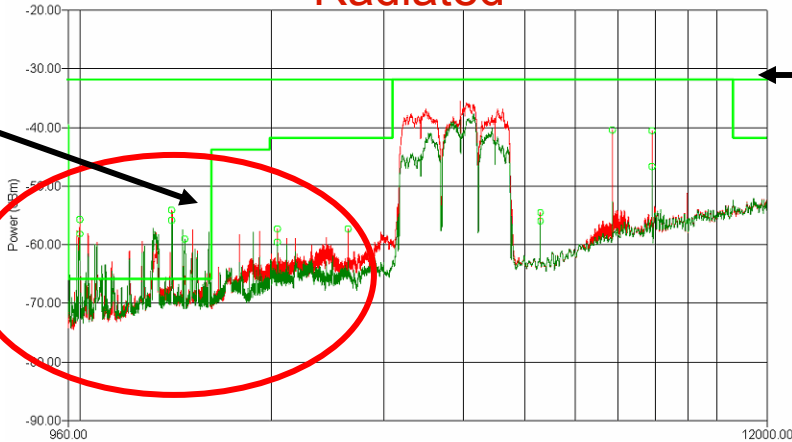


30 MHz – 40 GHz

# The Need for Conducted and Terminated Measurements

- Must be able to prove that the EMC is from the digital circuit and not intended to be emitted

**Radiated**

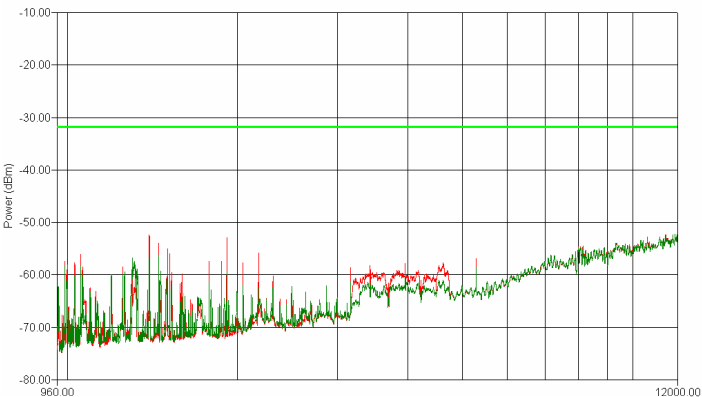


Subpart F limits

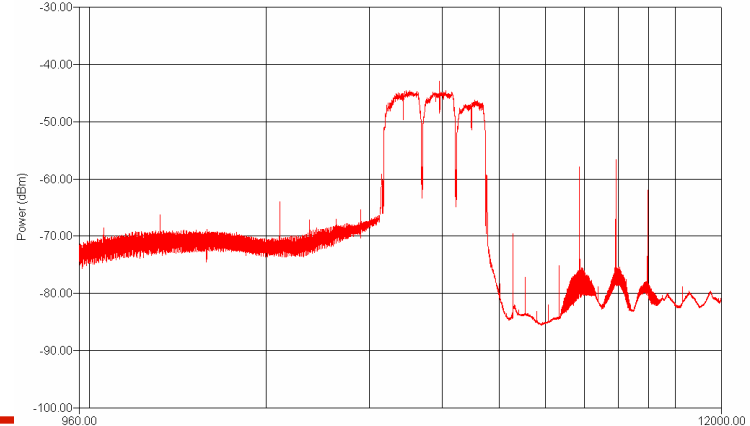
Subpart B limits

Exceeds part F limits  
But under part B

**Radiated with antenna port terminated**



**Conducted Antenna port**



# Emissions in the GPS Bands



1164 MHz -> 1240 MHz

1559 MHz -> 1610 MHz

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# Time and Cost for an FCC Submission



- Test time = 40 hours assuming no EMC band-aids and no re-testing
- Office of Engineering Technology (OET) review time = Approximately 60 days if the submission is complete and no problems
- Most of the silicon providers are submitting their reference designs to:
  - Shorten test time
  - Shorten OET review time
- FCC Fixed costs
  - Grantee Code Registration = \$55
  - Application = \$1200

# OET Required Collateral Materials



- Internal and External photos of all PCB's
- Theory of Operation
- Schematic
- Bill of Materials
- Block Diagram
- Users Manual
- Confidentiality letter
- And of course the TEST REPORT

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# UWB Test Plan - Summary



FCC CFR 47, Part 15, Subpart F	Code of Federal Regulations, Part 15 Subpart F: Ultra-Wideband Operation
FCC ET Docket 98-153, FCC 02-48 First R&O	Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmissions Systems: First Report & Order
ANSI C63.4: 2004	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC CFR 47, Part 15, Subpart C	Code of Federal Regulations, Part 15 Subpart C: Intentional Radiators
FCC CFR 47, Part 15, Subpart B	Code of Federal Regulations, Part 15 Subpart B: Unintentional Radiators
FCC CFR 47, Part 15, Subpart A	Code of Federal Regulations, Part 15 Subpart A: General
CISPR 16-1	C.I.S.P.R. Specification for Radio Interference Measuring Apparatus and Measurement Methods

# Labeling Requirements



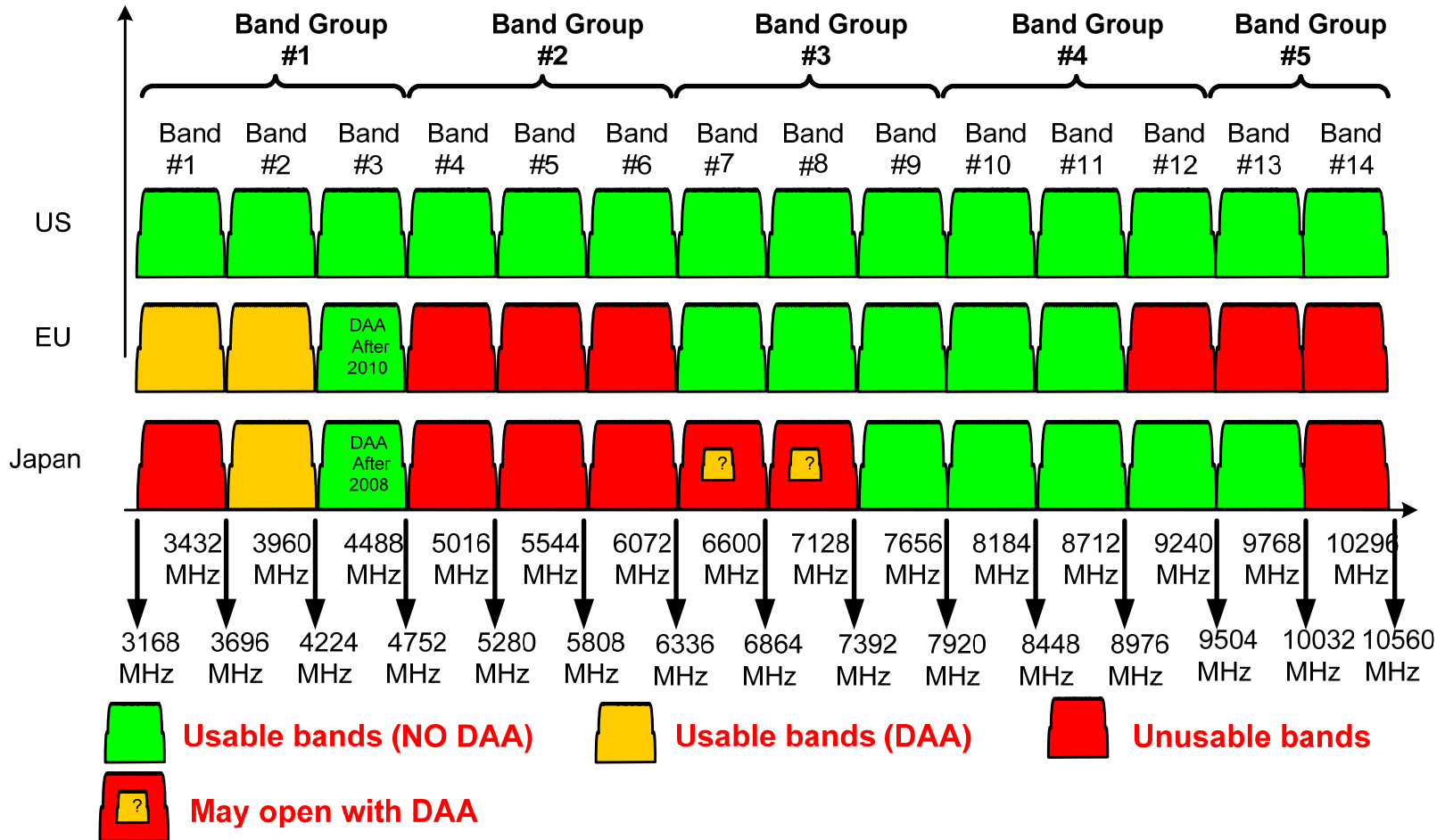
- FCC Requirement from 47 CFR 15.501 (Indoor)
  - “This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties.”
- FCC Requirement from 47 CFR 15.501
  - “This device complies with 47 CFR Part 15 of the FCC rules. Operation is subject to 1) this device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.”

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# Global Bandplan



# Global UWB Regulations Vary From the US



## USA

- **Issued ruling in 2002**
  - Unlicensed allocation
  - 3.1 - 10.6 GHz
  - Emission level: -41.3dBm/MHz
- **Waiver granted in Mar '05 for power measurement procedures**

## Europe

- **Ruling expected in Mar '06**
  - 3.1-4.2GHz (DAA required)
  - 4.2-4.8GHz (no DAA until Jan'11)
  - 6-9GHz (no restrictions)
  - Emission level: same as FCC
- **ECMA adopts WiMedia specs (Dec '05)**
  - ECMA to liaise with ETSI for UWB specs

Regulatory Approval  
Intermediary Stance



## Japan

- **MIC ruling expected in Mar '06**
  - 3.4GHz-4.8GHz (DAA)
  - 4.2-4.8GHz (no DAA until Jan'09)
  - 7.25-10.25GHz (no restrictions)
  - Emission level: same as FCC

## Australia/New Zealand

- UWB trial allowed on interim licenses

## Korea

MIC announced 4/3 allocation as 3.1Ghz to 4.95Ghz and 7.1Ghz - 10.6Ghz.  
MIC public hearing on April 26

## Hong Kong/Singapore

- UWB trials allowed
- Emission levels higher than FCC

## China

- Working towards regulations in 1H'06
- WiMedia China chapter to open shortly



# Developers Conference 2006

Taipei, Taiwan