



Developers Conference 2007

Amsterdam, The Netherlands



Passing European Regulations and RF Design Considerations

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Agenda



- European Regulatory History
- Highlights of the EC Decision
- Essential Requirements for UWB Devices
- Differences between Declaration of Conformity to the Essential Requirements of the R&TTE Directive and FCC Certification
- UWB Test Plan
- Global Bandplan and Regulatory Status

EU Regulatory History



- EC Mandate to CEPT – March 2004
 - Identify conditions for harmonized UWB introduction to the EU
- ECC Report 64 – February 2005
 - Protection requirements from UWB greater than the FCC
 - 20 – 30 dB more stringent PSD limits
 - Assumption of 5% activity factor, 80% used indoors, 3.1 – 10.6 GHz
- Second EC Mandate M329 to CEPT – June 2005
 - Impact analysis based on -55dBm/MHz
 - Possible mitigation factors
 - Assumption of 1% activity factor, 100% indoor, 6 – 8 GHz
- EC decision – March 2006
- EN302 065 comment period closed – August 2007
- EN302 065 comment resolution – November 2007 (anticipated)
- EN302 065 listed in the OJ – January 2008 (anticipated)

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The ECC Decision Highlights



On allowing the use radio spectrum for equipment using Ultra-Wideband (UWB) technology in a harmonized manner in the community (2007/131/EC)

- Technology for short-range-radio communications
- Bandwidths wider than 50 MHz
- Technology used for communications, measurement, location, imaging, surveillance, and medical
- Harmonized conditions help establish an effective single market
- Harmonized conditions that encourage global convergence
- Operate on a non-interference, non-protected basis
- Primary market is indoor and handheld communication application
- Devices predominantly used outdoors are explicitly excluded
- Higher PSD limits are allowed in the 6 GHz – 8.5 GHz band
- Devices operated on Aircraft or a vessel are the responsibility of the aeronautical or maritime regulatory authorities

The ECC Decision Highlights – cont.



- The use of spectrum is subject to the requirements for public health protection and ensured by the R&TTE Directive
- Transmission will cease within 10 seconds unless it receives an acknowledgement from an associated receiver
- Video signals will be transmitted using predominantly high-efficiency coding
- ETSI is developing Harmonized Standard EN 302 065
- Appropriate mitigation techniques (including DAA or Low Duty Cycle approach) should be included in the Harmonized Standard
- The condition in 4.2 – 4.8 GHz band without appropriate mitigation techniques should be time limited and be replaced by more restrictive conditions beyond December 31, 2010
- The Member States shall no later than six months following the entry in to force of this Decision, allow the use of the use of UWB spectrum



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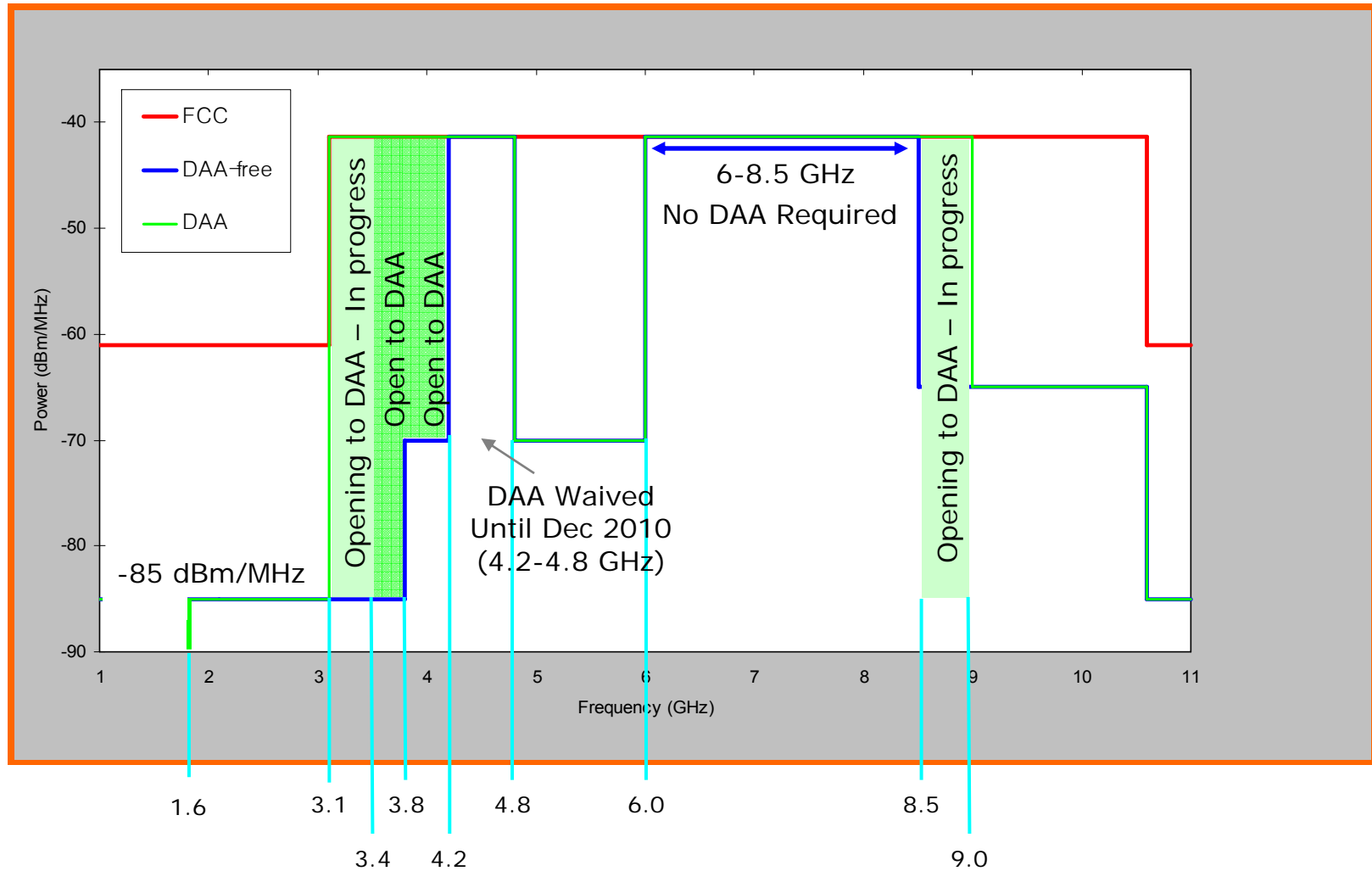
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Essential Requirements for UWB Devices



Frequency range (GHz)	Maximum mean e.i.r.p. density (dBm/MHz)	Maximum peak e.i.r.p. density (dBm/50MHz)
Below 1.6	-90.0	-50.0
1.6 to 3.4	-85.0	-45.0
3.4 to 3.8	-85.0	-45.0
3.8 to 4.2	-70.0	-30.0
4.2 to 4.8	-41.3 (until 31 December 2010)	0.0 (until 31 December 2010)
	-70.0 (beyond 31 December 2010)	-30.0 (beyond 31 December 2010)
4.8 to 6.0	-70.0	-30.0
6.0 to 8.5	-41.3	0.0
8.5 to 10.6	-65.0	-25.0
Above 10.6	-85.0	-45.0

Essential Requirements for UWB Devices – cont.



Essential Requirements for UWB Devices – cont.



- Pulse Repetition Frequency – not less than 1 MHz
- Transmission activity
- Only transmit to an associated receiver
- Cease transmission within 10 seconds unless an acknowledgement is received
- Peak EIRP can be measured in a 3 MHz BW using $20\log(3/50)^*$
- Does not apply to flying models
- Outdoor fixed installations are not allowed

*under technical discussion



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The Difference Between DoC and FCC Certification



- FCC has 3 levels of compliance
 - Self declaration of compliance
 - Verification
 - Certification - Currently all UWB devices fall into this category
 - Classify as outdoor (handheld) or indoor (AC Powered)
 - Test as transmitter
 - In-band RMS and Peak
 - Out-of-Band 30 MHz – 40 GHz
 - UWB Bandwidth >500 MHz
 - GPS bands
 - MBOA waiver*
- All tests are done radiated in Semi Anechoic Chamber

*FCC ET Docket No. 04-352, Petition for Waiver of the part 15 UWB regulations filed by MBOA-SIG, March 10, 2005.

The Difference Between DoC and FCC Certification – cont.



- ECC is Declaration of Conformity
 - Classification as Pulsed or RF Carrier based technology
 - Tests in both Tx and Rx mode
 - UWB Tx power - Peak & Mean
 - UWB Bandwidth >50 MHz
 - Out-of-Band 30 MHz – 40 GHz
- Tests are both conducted antenna port and Radiated
- Radiated tests use both Anechoic and Semi Anechoic chambers

salient points only, many small details are different

Semi Anechoic Chamber



Test in Semi Anechoic Chamber below 1GHz

Fully Anechoic Chamber



Test in Fully Anechoic Chamber above 1GHz



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The Device and the Measurement Condition



- The equipment under test physical setup is done as prescribed in CISPR 16-1
- The equipment under test is operating in accordance with its intended usage as per R&TTE Directive 1999/5/EC
- The equipment under test is configured to transmit at the worst case configuration
- The UWB specific measurements in accordance with EN302 065 distances and resolution bandwidth

What Measurements are Required



- In-band measurements
 - Maximum value of mean power spectral density (e.i.r.p) including 20 MHz outside Band Edge
 - Maximum value of peak power (e.i.r.p)
 - Operational bandwidth – impulse and modified impulse transmitters
 - Occupied Bandwidth – RF Carrier based transmitters
- Out of band measurements (e.r.p.)
 - Transmitter unwanted emissions in the spurious domain
 - Receiver spurious emissions
- Pulse Repetition Frequency – impulse and modified impulse transmitters

What Measurements are Required – cont.



- Electromagnetic Compatibility
 - Susceptibility (continuous and transient)
 - Generic Radiated and Conducted EMI
- Product Safety (Low Voltage Directive)
- Safety requirements
 - AC adapter with CE mark
 - Flame resistant PCB and case
- EMC measurements are potentially destructive
- Need to supply at least 3 test samples

What Measurements are Required – cont.



- Low Duty Cycle
 - Is declared not tested
 - 3.4 GHz to 4.8 GHz
 - Max Tx on ≤ 5 ms
 - Minimum Tx off ≥ 38 ms
 - Accumulated minimum Tx off ≥ 950 ms within 1 sec
 - Maximum accumulated Tx 18 sec in 1 hour
- Transmitter 10 second timer
 - is declared not tested
 - Does not include management beacons*

*under technical discussion

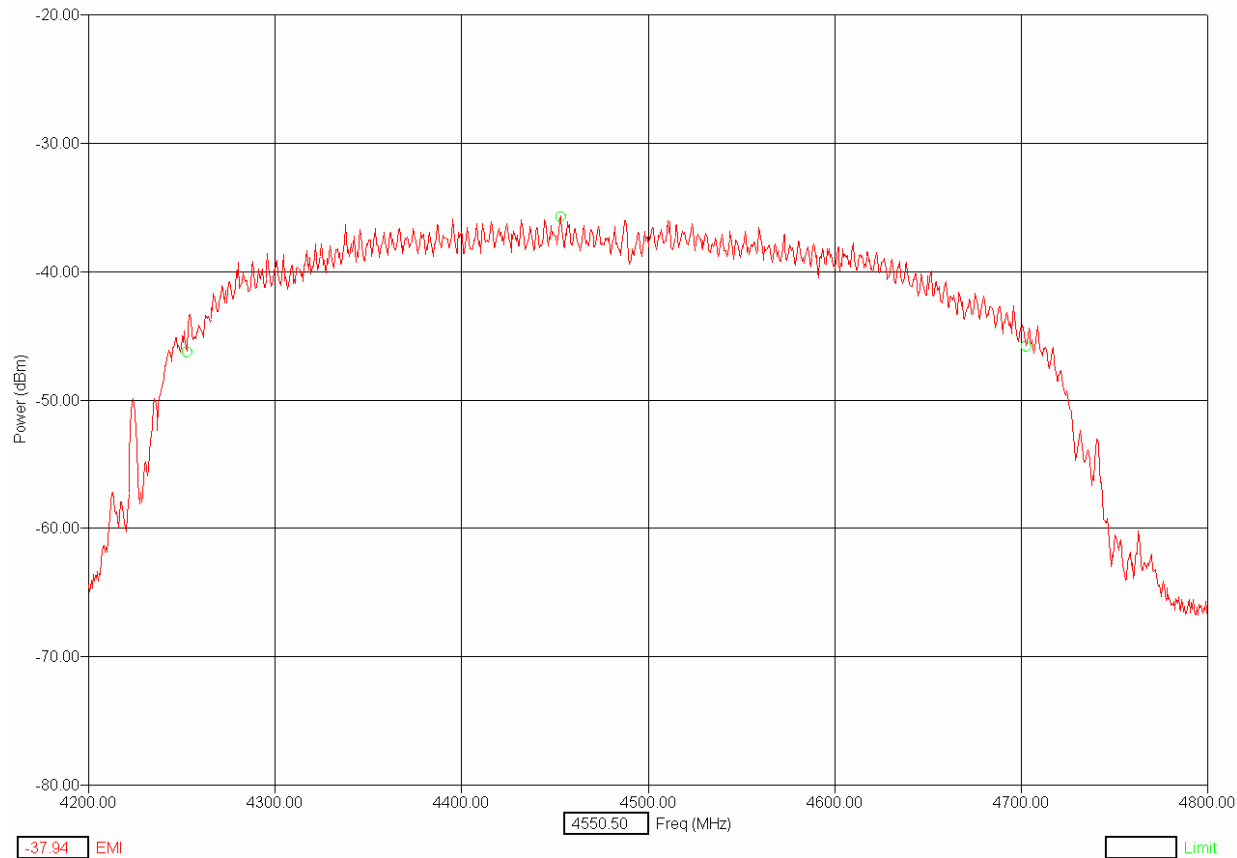
Reference Documents



Directive 1999/5/EC	Radio and Telecommunications Terminal Equipment Article 3.2
EN 302 065	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Ultra Wide Band technologies for communications purposes
Directive 98/34/EC	Procedures
ITU-R SM329-10	Unwanted emissions in the spurious domain
ETSI TR 102 273	Electromagnetic Compatibility and Radio Spectrum Matters
ITU-R SG1,1/83	Measurement techniques of ultra wide band transmissions
CISPR 16-1	C.I.S.P.R. Specification for Radio Interference Measuring Apparatus and Measurement Methods

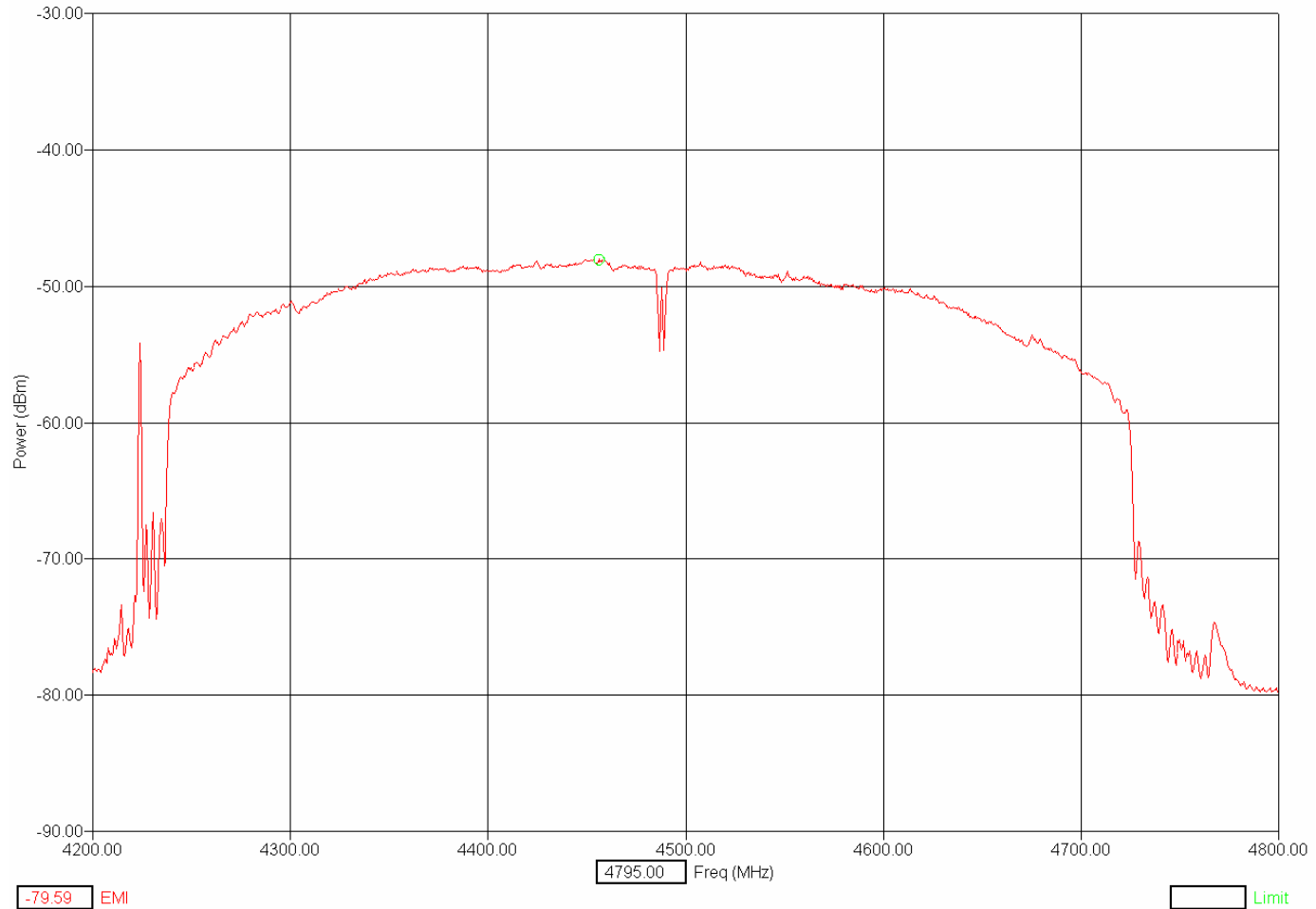
*not an all inclusive list

Peak Emissions in a 50 MHz Bandwidth

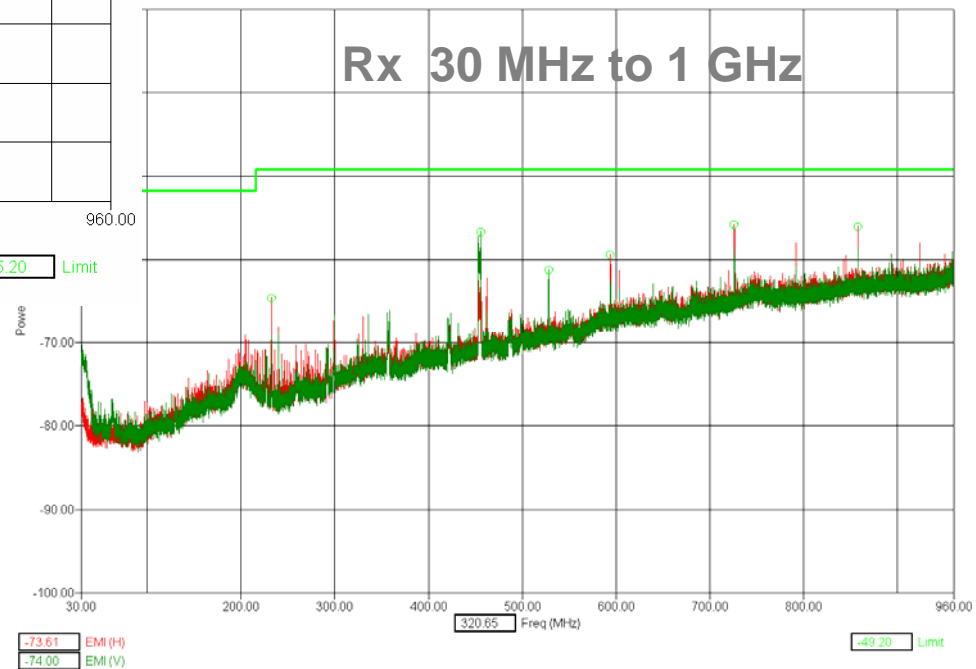
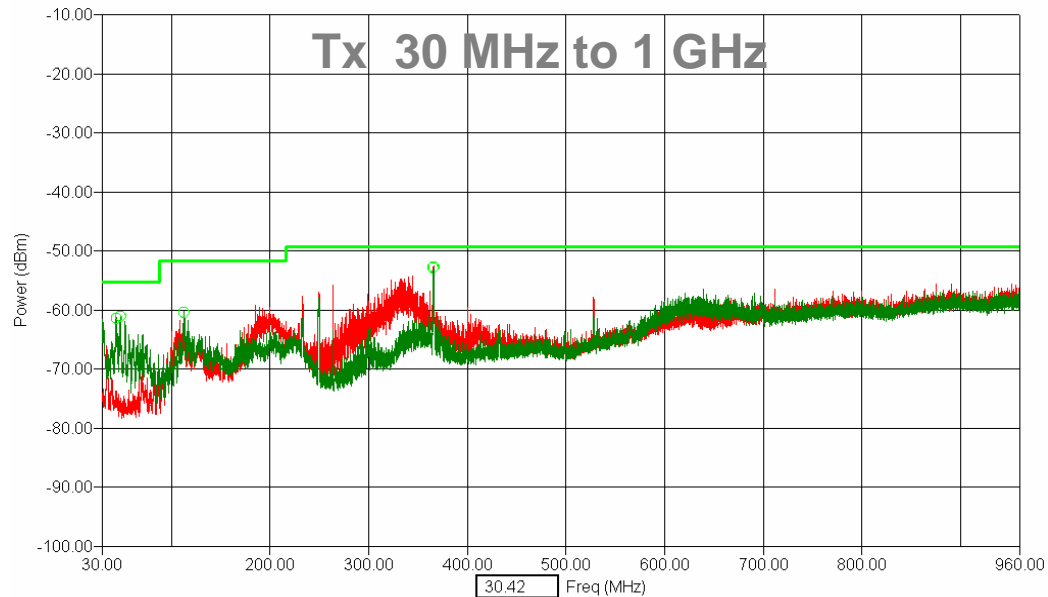


3 MHz RBW compensation as per: $20\text{LOG}(3/50)$

In Band Mean Power



Unintentional Radiated Emissions





Required Product Information

- The type of UWB technology being employed
- The modulation scheme
- Operating frequency range
- Type of equipment
- The intended combination of radio and antenna
- Nominal voltages
- Test setup



Technical Construction File

- Internal and External photos of all PCB's
- Theory of Operation
- Schematic
- Bill of Materials
- Block Diagram
- Users Manual
- Compliance Report (Spectrum, EMC, and Safety)

*not a complete list, additional items as needed

Process for Shipment



- Process for shipment of products into EU member states
 - Spectrum (UWB) test
 - EMC test
 - Safety test
 - Technical Construction File (TCF) preparation
 - NB review of TCF
 - NB issues opinion letter within four weeks
 - Declaration of Conformity
 - Manufacturer notifies EU country's regulators of intention to ship product
- Self Declare and place the CE mark on the device

use of NB optional if harmonized standard published in the OJ



Time and Cost

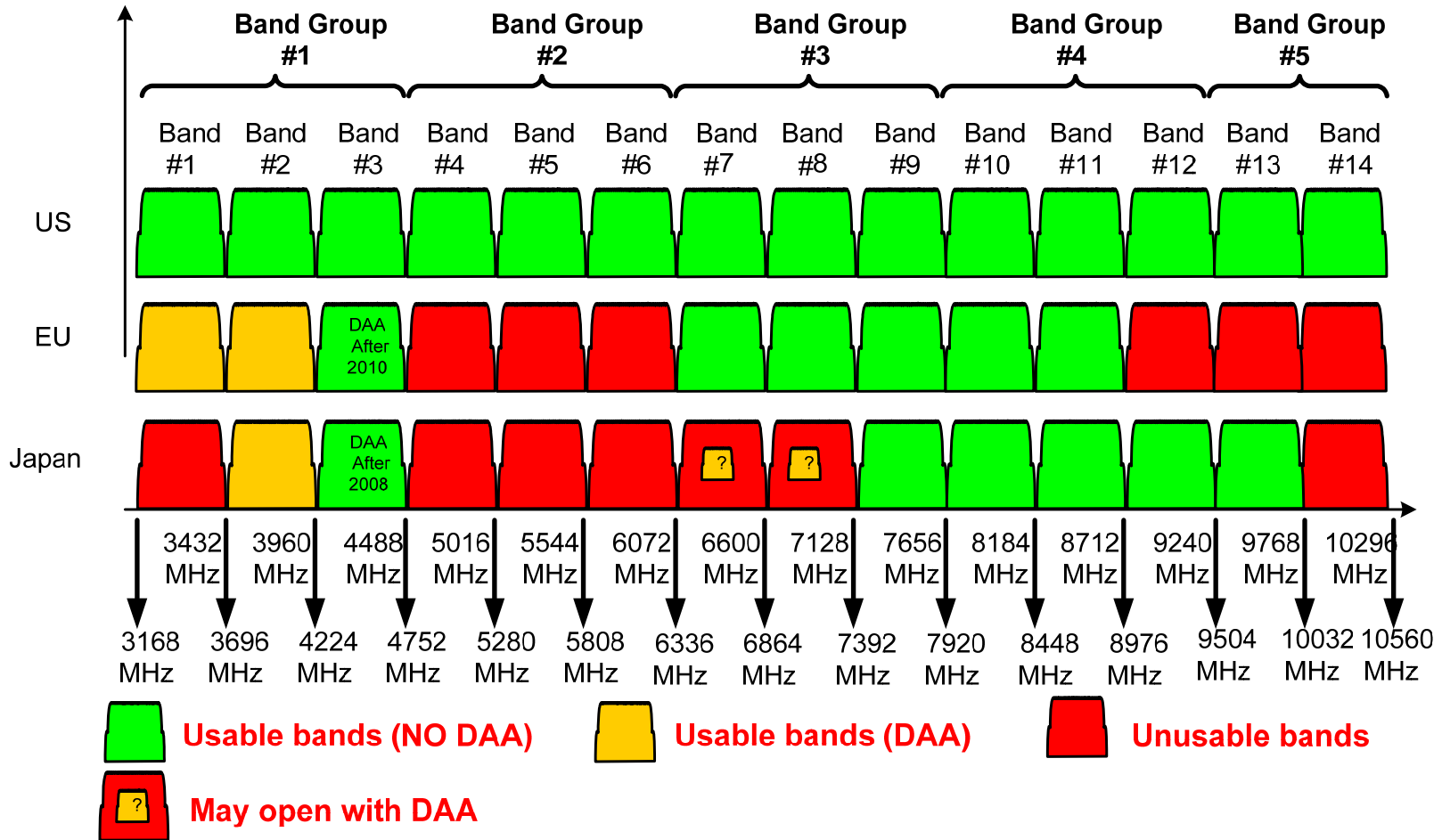
- Spectrum UWB test time – 40 hours assuming no EMC mitigation work
- Product safety test time – approximately 8 hours
- EMI/EMS test time – approximately 20 hours
- NB response time (if applicable) – 2 weeks
- Spectrum authority response time – 4 weeks



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Global Bandplan



Global UWB Regulations



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**

Canada

- *Working towards regulations in 2H2007*
- Similar mask as FCC

Europe

- *Ruling expected in Jan '08*
 - 3.1-4.2GHz (DAA required)
 - 4.2-4.8GHz (no DAA until Jan'11)
 - 6-9GHz (no restrictions)
 - Emission level similar to FCC
- **ECMA adopts WiMedia specs (Dec '05)**
 - ECMA to liaise with ETSI for UWB specs

Regulatory Approval

Intermediary Stance



Japan

- **MIC ruling in Dec '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 July '07
as 3.1Ghz to 4.95Ghz and 7.1Ghz - 10.6Ghz.

Hong Kong/Singapore

- UWB trials allowed
- Emission levels higher than FCC

China

- *Working towards regulations in 2H'07*
- WiMedia China chapter to open shortly



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