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Short Range Devices (SRD)
using Ultra Wide Band (UWB);
Part 3: Worldwide UWB regulations between 3,1 and 10,6 GHz

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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document is part 3 of a multi-part deliverable covering UWB signal characteristics and related mitigation techniques, as identified below:

Part 1: "UWB signal characteristics and overview CEPT/ECC and EC regulation";

Part 2: "UWB mitigation techniques";

Part 3: "Worldwide UWB regulations between 3,1 GHz and 10,6 GHz".

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document presents a summary of the worldwide regulatory situation relating to UWB.

NOTE: The present document is a snapshot of the known UWB regulation worldwide in June 2018. The reader is invited to report any changes and additional information on UWB regulations and standards to ETSI.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI EN 302 065-1 (V2.1.1): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Requirements for Generic UWB applications".

[i.2] ETSI EN 302 065-2 (V2.1.1): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 2: Requirements for UWB location tracking".

[i.3] ETSI EN 302 065-3 (V2.1.1): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 3: Requirements for UWB devices for ground based vehicular applications".

[i.4] ETSI EN 302 065-4 (V1.1.1): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 4: Material Sensing devices using UWB technology below 10,6 GHz".

[i.5] ETSI EN 302 065-5 (V1.1.1): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU; Part 5: Devices using UWB technology onboard aircraft".

[i.6] ETSI EN 302 066-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Ground- and Wall- Probing Radar applications (GPR/WPR) imaging systems; Part 1: Technical characteristics and test methods".

[i.7] ETSI EN 302 066 (V2.1.1): "Short Range Devices (SRD); Ground- and Wall- Probing Radar applications (GPR/WPR) imaging systems; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[i.8] Industry Canada: "Devices Using Ultra-Wideband (UWB) Technology", RSS-220, Issue 1, March 2009.

[i.9] FCC Code of Federal Regulations 47.

[i.10] CITC RI085 Issue 1, 10/01/2010.

[i.11] Radio communications (Low Interference Potential Devices) Class Licence 2015 including Variation Notice 2016 (No. 1).

[i.12] MIIT File 354.

[i.13] ARIB: "UWB (Ultra-Wideband) Radio Systems", STD-T91 Version 2.0.

[i.14] Ministry of Science and ICT - Notification No.2018-4, "Technical standards of radio equipment for radio stations that can be used without notification".

[i.15] Communications and Multimedia Commission SKMM SRSP-549 UWB.

[i.16] New Zealand Gazette, Radiocommunications Regulations (General User Radio Licence for Ultra-Wide Band Devices) Notice 2017, 2/2/2017, Notice Number 2017-go406, Issue Number 11.

[i.17] IDA: "Technical Specification - Ultra Wideband (UWB) Devices", Issue 1 Rev1, October 2016.

[i.18] ETSI TR 103 181-1 (V1.1.1): "Short Range Devices (SRD) using Ultra Wide Band (UWB); Technical Report Part 1: UWB signal characteristics and overview CEPT/ECC and EC regulation".

[i.19] ETSI TR 103 181-2 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wide Band (UWB);Transmission characteristics Part 2: UWB mitigation techniques".

[i.20] ETSI EN 302 065 (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wide Band technology (UWB) for communications purposes; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[i.21] Recommendation ITU-R SM 1754: "Measurement techniques of ultra-wideband transmissions".

[i.22] Recommendation ITU-R SM.1757: "Impact of devices using ultra-wideband technology on systems operating within radiocommunication services".

[i.23] ETSI TS 103 060: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Method for a harmonized definition of Duty Cycle Template (DCT) transmission as a passive mitigation technique used by short range devices and related conformance test methods".

[i.24] ECC Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".

[i.25] CEPT ECC/DEC/(06)04 of 24 March 2006 amended 9 December 2011: "The harmonised conditions for devices using Ultra-Wideband (UWB) technology in bands below 10.6 GHz".

[i.26] ETSI EN 302 500-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra WideBand (UWB) technology; Location Tracking equipment operating in the frequency range from 6 GHz to 9 GHz; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

[i.27] ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements".

[i.28] ETSI EN 301 489-32: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 32: Specific conditions for Ground and Wall Probing Radar applications".

[i.29] ETSI EN 301 489-33: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 33: Specific conditions for Ultra Wide Band (UWB) communications devices".

[i.30] Addendum 16 the GRFC decision May 7, 2007, No. 07-20-03-001.

[i.31] Addendum to the GRFC decision from December 15, 2009, No. 5/9/02-05-02.

[i.32] Anatel Act No. 11542 of August 23, 2017.

[i.33] Ministry of Information and Communications, Circular No. 46/2016/TT-BTTTT, 26 December 2016.

[i.34] Communications Regulatory Authority: "Qatar National Frequency Allocation Plan and Specific Assignments", November 2016.

[i.35] Telecommunications Regulatory Authority: "Regulations for Ultra-Wide Band and Short Range Devices", version 2.0, 18 May 2016.

[i.36] ETSI EN 302 500-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra WideBand (UWB) technology; Location Tracking equipment operating in the frequency range from 6 GHz to 9 GHz; Part 1: Technical characteristics and methods of measurement".

[i.37] ETSI EN 302 435-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics for SRD equipment using Ultra WideBand technology (UWB); Building Material Analysis and Classification equipment applications operating in the frequency band from 2,2 GHz to 8,5 GHz; Part 1: Technical characteristics and test methods".

[i.38] Commission Decision 2007/131/EC of 21 February 2007 on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community (notified under document number C(2007) 522).

[i.39] CEPT Report 45: "Report from CEPT to the European Commission in response to the Fifth Mandate to CEPT on ultra-wideband technology to clarify the technical parameters in view of a potential update of Commission Decision 2007/131/EC; Report approved on 21 June 2013 by the ECC".

[i.40] Commission Decision 2014/702/EU of 7 October 2014 amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community (notified under document C(2014) 7083).

[i.41] ECC Recommendation (11)09 on UWB Location Tracking Systems Type 2 (LT2), October 2011.

[i.42] ECC Recommendation (11)10 on Location Tracking Application for Emergency and Disaster Situations, October 2011.

[i.43] ECC/DEC/(07)01: "ECC Decision of 30 March 2007 on specific Material Sensing devices using Ultra-Wideband (UWB) technology (amended 26 June 2009)".

[i.44] Commission Decision 2009/343/EC of 21 April 2009 amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonized manner in the Community (notified under document number C(2009) 2787) (Text with EEA relevance).

[i.45] CEPT ECC/DEC/(12)03 of 2 November 2012: "The harmonised conditions for UWB applications onboard aircraft".

[i.46] ECC Decision of 1 December 2006 on the conditions for use of the radio spectrum by Ground- and Wall- Probing Radar (GPR/WPR) imaging systems, ECC/DEC/(06)08.

[i.47] Recommendation ITU-R SM.1755: "Characteristics of ultra-wideband technology".

[i.48] Recommendation ITU-R SM.1896: "Frequency ranges for global or regional harmonization of short-range devices".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

activity factor: reflects the effective transmission time ratio

maximum mean e.i.r.p. spectral density: highest signal strength measured in any direction at any frequency within the defined range

NOTE: The mean e.i.r.p. spectral density is measured with a 1 MHz resolution bandwidth, an RMS detector and an averaging time of 1 ms or less.

maximum peak e.i.r.p.: highest signal strength measured in any direction at any frequency within the defined range

NOTE: The peak e.i.r.p. is measured within a 50 MHz bandwidth centred on the frequency at which the highest mean radiated power occurs.

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI TS 103 060 [i.23] and the following apply:

f_C	Centre frequency
f_M	frequency at which the highest radiated emission occurs

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
ACMA	Australian Communications and Media Authority
ARIB	Association of Radio Industries and Businesses (Japan)
CEPT	Commission Européenne des Postes et Télécommunications
CFR	Code of Federal Regulations (USA)
CISPR	Comité International Spécial des Perturbations Radioélectriques
CITC	Communications and Information Technology Commission (Saudi Arabia)
DAA	Detect And Avoid
e.i.r.p	equivalent isotropically radiated power
EC	European Commission
ECC	European Communication Comity
EIRP	Effective Isotropic Radiated Power
EMEA	Europe, Middle East and Africa
FCC	Federal Communications Commission (USA)
GPR	Ground Probing Radar
GRFC	General Radio Frequency Centre
IDA	Info-communication Development Authority of Singapore
ILAC	International Laboratory Accreditation Cooperation
LAES	Location tracking Application for Emergency and disaster Situations
LDC	Low Duty Cycle
MIIT	Ministry of Industry & Information Technology (China)
RLM	Robotic Lawn Mower
RMS	Root Mean Square
SKMM	Suruhanjaya Komunikasi dan Multimedia Malaysia (Malaysian Communications and Multimedia Commission)
TBC	To Be Confirmed
UAE	United Arab Emirates
USA	United States of America
WPR	Wall Probing Radar

4 Global Summary

4.1 Introduction

This clause presents a summary of the global regulatory situation relating to UWB in the frequency range from 3,1 GHz to 10,6 GHz. Each jurisdiction in the world is considered and the current situation presented in tabular form. This clause is only concerned with UWB as a communications medium, it does not concern itself with other UWB uses for which there may be additional regulations (e.g. ground penetrating radar, through wall imaging systems or automotive radar applications).

Recommendation ITU-R SM.1755 [i.47] contains recommendations regarding how UWB should be treated in regulations. Attention is specifically drawn to "considering" j) that devices using UWB technology normally operate on a non-protected, non-interference basis; and "recommends" that the following notes will be considered as part of this Recommendation.

NOTE 1: Administrations authorizing or licensing devices using UWB technology should ensure, pursuant to the provisions of the Radio Regulations, that these devices, will not cause interference to and will not claim protection from, or place constraints, on the radiocommunication services of other administrations as defined in the Radio Regulations and operating in accordance with those Regulations.

NOTE 2: Upon receipt of a notice of interference to the radiocommunication services referred to in note 1 above from devices using UWB technology, administrations should take immediate action(s) to eliminate such interference.

The importance of worldwide harmonisation for UWB is reflected in the inclusion of UWB in the draft recommendation Recommendation ITU-R SM.1896 [i.48].

Within CEPT, UWB is regarded as a short-range device and consequently cannot claim protection from any other service operating in the same frequency range as the UWB devices and shall not cause interference to any other service operating in the same frequency band.

Attention is further drawn to the European Commission Decision (2007/131/EC) [i.38] which states in whereas (14):

"The use of radio spectrum by equipment using ultrawideband technology under this Decision is to be allowed on a non-interference and non-protected basis and therefore should be subject to Article 5(1) of Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services".

and in article 2(2):

"Non-interference and non-protected basis' means that no harmful interference may be caused to any radiocommunication service and that no claim may be made for protection of these devices against harmful interference originating from radiocommunication services".

All short-range devices, including UWB, in Europe are subject to the Radio Equipment Directive (RED), and therefore subject to recital 10:

"In order to ensure that radio equipment uses the radio spectrum effectively and supports the efficient use of radio spectrum, radio equipment should be constructed so that: in the case of a transmitter, when the transmitter is properly installed, maintained and used for its intended purpose it generates radio waves emissions that do not create harmful interference, while unwanted radio waves emissions generated by the transmitter (e.g. in adjacent channels) with a potential negative impact on the goals of radio spectrum policy should be limited to such a level that, according to the state of the art, harmful interference is avoided; and, in the case of a receiver, it has a level of performance that allows it to operate as intended and protects it against the risk of harmful interference, in particular from shared or adjacent channels, and, in so doing, supports improvements in the efficient use of shared or adjacent channels".

And recital 11:

"Although receivers do not themselves cause harmful interference, reception capabilities are an increasingly important factor in ensuring the efficient use of radio spectrum by way of an increased resilience of receivers against harmful interference and unwanted signals on the basis of the relevant essential requirements of Union harmonisation legislation".

Colours are used to give a visual indication of the status with the following meanings.

Table 1: Colour legend

Table Colour	What does this mean?
	Specific UWB regulations exist in the named jurisdiction
	Specific UWB regulations do not exist in the named jurisdiction. Either: • the regulatory regime remains to be clarified; or • the technical requirements that most typically apply (usually FCC or ETSI) are listed.

The various headings in the tables that follow have the following meanings.

Table 2: Heading legend

Table Heading	What does this mean?	Potential responses
Country	The name of the jurisdiction	
Do Specific UWB regulations exist?	Has the communications regulatory body in this jurisdiction introduced specific regulations governing the use of UWB in this jurisdiction?	Y = Yes N = No
What is the regulatory regime?	What is the source of the regulations governing the use of UWB in this jurisdiction?	Where the jurisdiction has implemented specific regulations the source reference is listed. Where the jurisdiction has not implemented specific regulations, the usual approach to such matters is described
What frequency range is permitted?	What range of frequencies is permitted to be used for UWB transmission at the mean EIRP under the applicable regulatory regime?	Given in GHz range of frequencies e.g. 6,0 - 8,5 GHz
Do these regulations permit outdoor use?	Does the applicable regulatory regime permit use of UWB outdoors?	Y = Yes, regulations permit use outdoors TBC = To be confirmed N = No, regulations do not permit use outdoors
e.i.r.p. (dBm / MHz)	What is the maximum value of mean power spectral density permitted under the applicable regulatory regime?	Where known this is given in dBm / MHz otherwise it is marked as TBC
Emission profile	What is the spectral emissions profile allowed under the applicable regulatory regime?	This column refers to later clause in the present document

4.2 Europe, Middle East and Africa

4.2.1 Europe

A short overview is given in table 3, for more details please check, clause 5 and ETSI TR 103 181-1 [i.18].

Table 3: Overview Europe

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	Max mean e.i.r.p. (dBm / MHz)	Emission Profile
1	Albania	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
2	Andorra	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
3	Austria	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
4	Belarus	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
5	Belgium	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
6	Bosnia & Herzegovina	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
7	Bulgaria	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
8	Canary Islands	Y	Telecoms matters overseen by government of Spain	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
9	Croatia	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
10	Cyprus	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
11	Czech Republic	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	Max mean e.i.r.p. (dBm / MHz)	Emission Profile
12	Denmark	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
13	Estonia	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
14	Finland	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note 1) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
15	France	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
16	Germany	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
17	Gibraltar	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
18	Greece	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
19	Hungary	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
20	Iceland	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
21	Ireland	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
22	Italy	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
23	Latvia	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
24	Lithuania	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
25	Luxembourg	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
26	Macedonia	N	TBC	TBC			

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	Max mean e.i.r.p. (dBm / MHz)	Emission Profile
27	Malta	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
28	Moldova	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
29	Monaco	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
30	Montenegro	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
31	Netherlands	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
32	Norway	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
33	Poland	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
34	Portugal	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
35	Romania	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
36	Russia	Y	Has implemented ECC Rec 70-03 [i.24] but with local modifications Addendum No. 16 the GRFC decision May 7, 2007 No. 07-20-03-001 [i.30] Addendum to the GRFC decision from December 15, 2009 # 5/9/02-05-02 [i.31]	6,0 - 8,1 8,625 - 9,15 9,15 - 10,6	Y	-47 -45 (in 9,15 to 10,6 freq range)	Clause 5
37	San Marino	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
38	Serbia	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
39	Slovakia	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
40	Slovenia	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5	Y	-41,3	ETSI clause 5

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	Max mean e.i.r.p. (dBm / MHz)	Emission Profile
				8,5 - 9,0 (see note)			
41	Spain	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
42	Sweden	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
43	Switzerland	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
44	Turkey	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
45	United Kingdom	Y	ECC Rec 70-03 [i.24] / ECC Decision 06(04) [i.25]/ ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
46	Ukraine	N	ECC Rec 70-03 [i.24] under consideration but not yet adopted	TBC			
NOTE: Mitigation techniques required.							

4.2.2 Middle East

Table 4: Overview Middle East

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
47	Bahrain	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
49	Iran	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
49	Iraq	N	TBC	TBC			
50	Israel	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan. Confusion exists over the approval status of UWB equipment. There are rumours that the low band is being allocated for UWB trials.				

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
51	Jordan	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
52	Kuwait	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
53	Lebanon	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
54	Oman	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
55	Qatar	Y	National frequency allocation plan refers to ETSI EN 302 065 [i.20]	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
56	Saudi Arabia	Y	CITC RI085 [i.10]	6,0 - 8,5	Y	-41,3	Clause 6
57	Syria	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
58	UAE	Y	TRA Regulations for Ultra-Wide Band and Short Range Devices	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
59	Yemen	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
NOTE: Mitigation techniques required.							

4.2.3 Africa

Table 5: Africa

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
60	Algeria	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
61	Angola	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
62	Benin	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
63	Burkina Faso	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
64	Cameroon	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
65	Cape Verde	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
66	Central African Republic	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
67	Chad	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
68	Democratic Republic of the Congo	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
69	Djibouti	N	TBC	TBC			
70	Egypt	N	TBC	TBC			
71	Ethiopia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
72	Gabon	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
73	Gambia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
74	Ghana	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
75	Guinea-Bissau	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
76	Ivory Coast	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
77	Kenya	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
78	Lesotho	N	Generally will approve equipment approved for use in South Africa				
79	Liberia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
80	Libya	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
81	Madagascar	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
82	Malawi	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
83	Mali	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
84	Mauritius	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
85	Morocco	N	TBC	TBC			

	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
86	Mozambique	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
87	Namibia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
88	Niger	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
89	Nigeria	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
90	Rwanda	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
91	Senegal	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
92	Sierra Leone	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
93	Somalia	N	TBC	TBC			
94	South Africa	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
95	Sudan	N	TBC	TBC			
96	Swaziland	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
97	Tanzania	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
98	Togo	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
99	Tunisia	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
100	Uganda	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
101	Zambia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
102	Zimbabwe	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				

NOTE: Mitigation techniques required.

4.3 Asia Pacific

Table 6: Overview Asia Pacific

#	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
103	Afghanistan	N	TBC	TBC			
104	Armenia	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
105	Australia	Y	Radio Communications (Low Interference Potential Devices) Class Licence 2000 as modified July 2014	3,4 – 4,8 6,0 – 8,4	Y	-41,3	Clause 12
106	Azerbaijan	N	TBC	TBC			
107	Bangladesh	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
108	Brunei	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
109	Cambodia	N	TBC	TBC			
110	China	Y	MIIT Wireless File 354 (2008) [i.12]	6.0 - 9.0	Y	-41	Clause 13
111	Cook Islands	N	TBC	TBC			
112	Fiji	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
113	French Polynesia	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
114	Georgia		TBC	TBC			
115	Guam	Y	Territory of the USA	3,1 - 10,6	Y	-41,3	FCC clause 9
116	Hong Kong	N	Specific regulations do not currently exist. Regulator is currently considering regulations allowing the use of unlicensed UWB in the range 3,4 - 8,5 GHz. Historically, HK has approved equipment compliant to ETSI standards where compatible with national band plan	3,4 - 4,2 (see note) 4,2 - 4,8 6,0 - 8,5 (proposed)		-41,3 (proposed)	
117	India	N	Specific regulations do not currently exist. Regulator is currently considering regulations allowing the use of unlicensed UWB in the range 6,0 - 7,25 GHz. Historically, India has approved equipment compliant to ETSI standards where compatible with national band plan	6,0 - 7,25 (proposed)		-41 (proposed)	
118	Japan	Y	ARIB STD-T91 Ver. 2.0 2015 [i.13]	3,4 - 4,8 (see note) 7,25 - 10,25	N	-41,3	Clause 12
119	Kazakhstan	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
120	Korea, North	N	TBC	TBC			
121	Korea, South	Y	Korean Communications Commission Republic of Korea	3,735 - 4,8 (see note) 7,2 - 10,2	Y	-41,3	Clause 15

#	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
122	Kyrgyzstan	N	TBC	TBC			
123	Laos	N	TBC	TBC			
124	Macau	N	TBC	TBC			
125	Malaysia	Y	SKMM SRSP-549 UWB, 5th December 2013 [i.15]. Refers to ETSI EN 302 065 [i.20], ETSI EN 302 066-1 [i.6] and Recommendation ITU-R SM 1754 [i.21]	6,0 - 8,5	Y	-41,3	Clause 16
126	Myanmar	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
127	Nepal	N	TBC	TBC			
128	New Caledonia	Y	Telecoms matters overseen by government of France	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
129	New Zealand	Y	New Zealand Gazette, 2/2/2017 [i.16]. Refers to ETSI EN 302 065 [i.20]	2.7 – 4.8 (see note) 6.0 - 8.5	Y	-41,3	Clause 17
130	Pakistan	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
131	Papua New Guinea	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
132	Philippines	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
133	Reunion	Y	Telecoms matters overseen by government of France	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
134	Samoa (Independent State of)	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
135	Singapore	Y	IDA TS UWB Issue 1 Rev 1, May 2011 [i.17]. Refers to ETSI EN 302 500-2 [i.26] and ETSI EN 302 065 [i.20]	3,4 - 4,2 (see note) 4,2 - 4,8 6,0 - 8,5	Y	-41,3	Clause 18
136	Sri Lanka	N	TBC	TBC			
137	Thailand	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
138	Turkmenistan	N	TBC	TBC			
139	Uzbekistan	N	TBC	TBC			
140	Vietnam	Y	Circular 46/2016/TT-BTTTT from MIC Vietnam [i.33]	6,0 – 8,5	N	-41,3	Clause 19

NOTE: Mitigation techniques required.

4.4 Americas

4.4.1 North America

Table 7: Overview North America

#	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
141	Antigua & Barbuda	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
142	Aruba	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
143	Bahamas	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
144	Barbados	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
145	Bermuda	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
146	British Virgin Islands	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
147	Canada	Y	Industry Canada RSS-220 specification [i.8]	4,75 - 10,6	Y	-41,3	Clause 10
148	Cayman Islands	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
149	Costa Rica	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
150	Cuba	N	TBC	TBC			
151	Curacao	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
152	Dominica	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
153	Dominican Republic	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
154	El Salvador	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
155	Grenada	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
156	Guadeloupe	Y	Telecoms matters overseen by government of France	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
157	Guatemala	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
158	Haiti	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				

#	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
159	Honduras	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
160	Martinique	Y	Telecoms matters overseen by government of France	3,1 - 4,8 (see note) 6,0 - 8,5 8,5 - 9,0 (see note)	Y	-41,3	ETSI clause 5
161	Jamaica	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
162	Mexico	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
163	Nicaragua	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
164	Panama	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
165	St Kitts & Nevis	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
166	St Lucia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
167	St Vincent & the Grenadines	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
168	Trinidad & Tobago	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
169	USA	Y	FCC CFR 47 Part 15 [i.9]	3,1 - 10,6	Y	-41,3	FCC clause 9
170	US Virgin islands	Y	Telecoms matters overseen by government of USA	3,1 - 10,6	Y	-41,3	FCC clause 9
NOTE: Mitigation techniques required.							

4.4.2 South America

Table 8: Overview South America

#	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
171	Argentina	N	TBC	TBC			
172	Bolivia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
173	Brazil	Y	Anatel Act No. 11542 of August 23, 2017 [i.32]	3,1 – 10,6	Y	-41,3	Clause 11
174	Chile	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				

#	Country	Do specific UWB regs exist?	What is the regulatory regime?	What frequency range is permitted (GHz)?	Do these regs permit outdoor use?	EIRP (dBm / MHz)	Emission Profile
175	Colombia	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
176	Ecuador	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
177	Falkland Islands	N	Generally will approve equipment compliant to ETSI standards where compatible with national band plan				
178	Guyana	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
179	Paraguay	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
180	Peru	N	Generally will approve equipment compliant to ETSI or FCC standards where compatible with national band plan				
181	Uruguay	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
182	Venezuela	N	Generally will approve equipment compliant to FCC standards where compatible with national band plan				
NOTE: Mitigation techniques required.							

5 EMEA: Europe: EC

5.1 UWB Regulatory Authority

Regulatory Authority: European Commission and CEPT/ECC

Standards Authority: ETSI

5.2 Applications

- Communications
- Locations Tracking
- Road and rail vehicles
- Ground probing radar
- On-board aircraft

For more information please see ETSI TR 103 181-1 [i.18].

5.3 Requirements

5.3.1 Communication devices

Regulations are defined in CEPT ECC/DEC/(06)04 [i.25] and EC Decision 2007/131/EC (as amended) [i.38]. The technical requirements that need to be satisfied to be able to claim a presumption of conformity to the essential requirements of article 3.2 of the RED are defined in ETSI EN 302 065-1 [i.1].

Applies to fixed (indoor only), mobile or portable applications.

5.3.2 Location tracking devices

The technical requirements that need to be satisfied to be able to claim a presumption of conformity to the essential requirements of article 3.2 of the RED are defined in ETSI EN 302 065-2 [i.2].

Three different types of location tracking system are defined:

- LT1 systems: These systems, operating in the 6 GHz to 9 GHz region, are intended for general location tracking of people and objects. They operate on an unlicensed basis. The transmitting terminals in these systems are mobile (indoors or outdoors), or fixed (indoors only). Fixed outdoor LT1 transmitters are not permitted. Typically, LT1 transmitters are mobile location tracking tags which are attached to people or objects, and tags are tracked using a fixed receiver infrastructure to only receive the UWB emission emitted by the tags. Regulations are defined in EC Decision 2014/702/EU (as amended) [i.40].
- LT2 systems: These systems, operating in the 3,1 GHz to 4,8 GHz region, are intended for person and object tracking and industrial applications at well-defined locations. The transmitting terminals in these systems may be located indoors or outdoors, and may be fixed or mobile. They operate at fixed sites and may be subject to registration and authorization, provided local coordination with possible interference victims has been performed. Regulations are defined in ECC/REC/(11)09 [i.41].

- LAES systems: These systems, operating in the 3,1 GHz to 4,8 GHz region, are intended for tracking staff belonging to the fire and other emergency services, who need to work in dangerous situations. Being able to track such people, even when deep inside a building, provides an important enhancement to command and control and to their personal safety. Typically, an LAES system is deployed temporarily at the scene of a fire or other emergency in a building. Licences may be required for user organization. Regulations are defined in ECC/REC/(11)10 [i.42].

Table 9: Operating frequency bands per system type under ETSI EN 302 065-2 [i.2] - Europe

System type	Mode	Frequency band [GHz]
LT1	Transmit	6,0 - 9,0
	Receive	6,0 - 9,0
LT2	Transmit	3,1 - 4,8
	Receive	3,1 - 4,8
LAES	Transmit	3,1 - 4,8
	Receive	3,1 - 4,8

5.3.3 Road & Rail mounted devices

Regulations are defined in CEPT ECC/DEC/(06)04 [i.25] and EC Decision 2014/702/EU (as amended) [i.40]. The technical requirements that need to be satisfied to be able to claim a presumption of conformity to the essential requirements of article 3.2 of the RED are defined in ETSI EN 302 065-3 [i.3].

5.3.4 Material Sensing

Regulations are defined in CEPT ECC/DEC/(07)01 [i.43] and EC Decision 2009/343/EC (as amended) [i.44]. The technical requirements that need to be satisfied to be able to claim a presumption of conformity to the essential requirements of article 3.2 of the RED are defined in ETSI EN 302 065-4 [i.4].

5.3.5 On-board aircraft

Regulations are defined in CEPT ECC/DEC/(12)03 [i.45] and EC Decision 2014/702/EU (as amended) [i.40]. The technical requirements are defined in ETSI EN 302 065-5 [i.5]. This standard is currently not listed in the OJEU and hence cannot be used to claim presumption of conformity.

5.3.6 Ground Probing Radar

Regulations are defined in CEPT ECC/DEC/(06)08 [i.46]. The technical requirements are defined in ETSI EN 302 066 [i.7]. This standard is currently not listed in the OJEU and hence cannot be used to claim presumption of conformity.

5.4 Mitigation Techniques

5.4.1 General

Various techniques are described:

- Low Duty Cycle (LDC)
- Detect And Avoid (DAA)

Additional mitigation techniques used and implemented in CEPT/ECC and EC are described in more detail in ETSI TR 103 181-2 [i.19].

5.4.2 Low Duty Cycle (LDC)

Table 10: Low duty cycle baseline limits

Parameter	Symbol	Limit
Max transmitter on time	$T_{on\ max}$	5 ms
Mean transmitter off time	$T_{off\ mean}$	≥ 38 ms (averaged over 1 s)
Sum transmitter off time	ΣT_{off}	> 950 ms per second
Sum transmitter on time	ΣT_{on}	< 18 s per hour

5.4.3 Detect And Avoid (DAA)

Before transmitting, a system should sense the channel within its operative bandwidth in order to detect the possible presence of other systems. If another system is detected, the first system should avoid transmission until the detected system disappears.

6 EMEA: Middle East: Saudi Arabia

6.1 Regulatory Authority

The Communications and Information Technology Commission of Saudi Arabia (CITC).

The rules are as stated in CITC RI085 Issue 1 [i.10].

6.2 UWB Definition

Not stated. Refers to ETSI standards.

6.3 Applications

Not stated. Refers to ETSI standards.

6.4 Requirements

Excerpt of [i.10]:

"It is recommended that test reports are obtained from a laboratory that has been accredited by a body that is a member of the ILAC Mutual Recognition Arrangement".

Specific reference is made to the following ETSI documents:

- ETSI EN 302 065 [i.20] (no revision stated).
- ETSI EN 302 066-1 [i.6] (no revision stated).
- ETSI EN 302 500-2 [i.26] (no revision stated).
- ETSI EN 301 489-1 [i.27] (no revision stated).
- ETSI EN 301 489-32 [i.28] (no revision stated).
- ETSI EN 301 489-33 [i.29] (no revision stated).

Excerpt of [i.10]:

"In addition to meeting the above requirements, all equipment must comply with the requirement of CITC specification GEN001, be safe and must not adversely affect other electrical equipment".

6.5 Limits

Excerpt of [i.10]:

"Emission limits are the same as those specified in the original ETSI EN 302 065 with the exception that only the high band channels (6.0 to 8.5 GHz) are permitted to transmit at the maximum mean level of -41.3 dBm / MHz".

Table 11: e.i.r.p. emission limits Saudi Arabia [i.10]

Frequency	Max. mean e.i.r.p. (dBm/MHz)	Max. Peak e.i.r.p. (dBm / 50MHz)
30 - 1 610 MHz	- 90,0	-50,0
1,60 - 2,70 GHz	- 85,0	- 45,0
2,70 - 3,40 GHz	- 70,0	- 36,0
3,40 - 3,80 GHz	- 80,0	- 40,0
3,80 - 4,20 GHz	-70,0	- 30,0
4,20 - 4,80 GHz	-70,0	- 30,0
4,80 - 6,00 GHz	-70,0	- 30,0
6,00 - 8,50 GHz	- 41,3	0,0
8,50 - 10,60 GHz	- 65,0	- 25,0
> 10,6 GHz	- 85,0	- 45,0

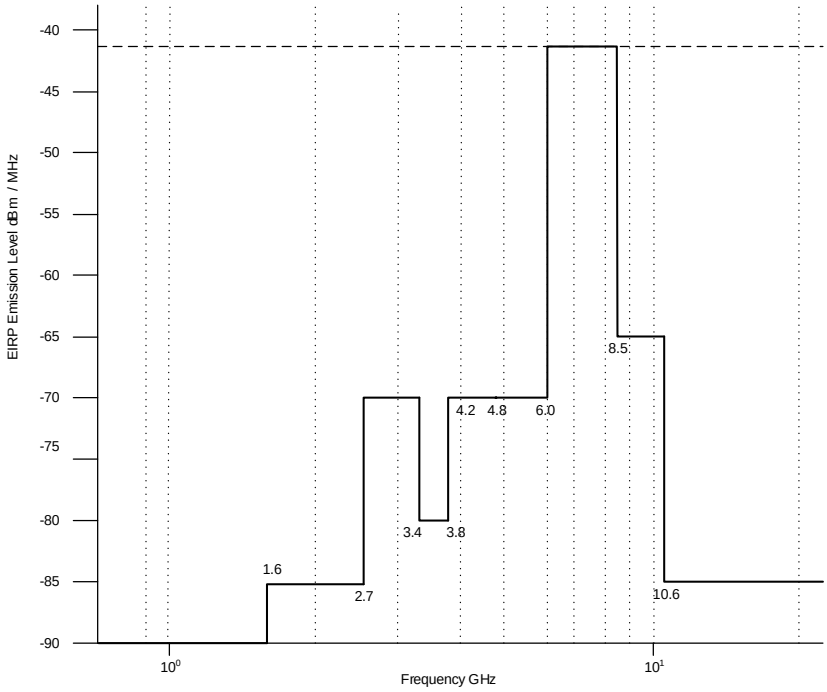

Figure 1: Max mean e.i.r.p. emission limits - Saudi Arabia

6.6 Mitigation Techniques

None stated explicitly. Refers to ETSI standards.

7 EMEA: Qatar

7.1 Regulatory Authority

State of Qatar, Communications Regulatory Authority (www.cra.gov.qa) has Ultra-Wide Band Applications in its Qatar National Frequency Allocation Plan and Specific Assignments [i.34]

The frequency allocation plan has entries for Ultra-Wide Band Applications and refers to ETSI EN 302 065 [i.20].

8 EMEA: United Arab Emirates (UAE)

8.1 Regulatory Authority

The Telecommunications Regulatory Authority (www.tra.gov.ae) has TRA Regulations for Ultra-Wide Band and Short Range Devices [i.35]

8.2 UWB Definition

No definition is given. [i.35] refers to ETSI standards.

8.3 Applications and Requirements

The table for Short Range Devices contains entries for Tank Level Probing Radar.

Generic UWB devices have to comply with ETSI EN 302 065-1 [i.1].

For location tracking devices, [i.35]refers to ETSI EN 302 500-1 [i.36].

UWB devices for Building Material Analysis have to comply with ETSI EN 302 435-1 [i.37].

9 Americas, North: United States

9.1 Regulatory Authority

Federal Communications Commission

UWB rules in the United States of America are defined in part 15, subpart F of the FCC Code of Federal Regulations [i.9]. The following subsections of part 15 are particularly relevant.

Table 12: Relevant sub-parts of part 15 of the CFR

Subsection of the CFR part 15	Description
15.509	GPR and wall imaging systems
15.510	Through wall imaging systems
15.511	Surveillance systems
15.513	Medical imaging systems
15.515	Vehicular radar systems
15.517	Indoor systems
15.519	Hand-held UWB systems
15.521	Technical requirements applicable to all UWB devices

9.2 UWB Definition

Ultra-wideband transmitter defined as an intentional radiator that, at any point in time, has a UWB bandwidth equal to or greater than 500 MHz or a fractional bandwidth > 0,2.

9.3 Applications

- Ground penetrating radar & wall imaging systems
- Through wall imaging systems
- Surveillance systems
- Medical imaging systems
- Vehicular radar systems
- Indoor systems
- Handheld systems

9.4 Requirements

9.4.1 General

From FCC Code of Federal Regulations 47 [i.9]:

a) "UWB devices may not be employed for the operation of toys. Operation on board an aircraft, a ship or a satellite is prohibited.

b) Manufacturers and users are reminded of the provisions of §15.203 (antennas) and §15.204 (external amplifiers).

c) Emissions from digital circuitry used to enable the operation of the UWB transmitter shall comply with the limits in §15.209, rather than the limits specified in this subpart, provided it can be clearly demonstrated that those emissions from the UWB device are due solely to emissions from digital circuitry contained within the transmitter and that the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in §15.3(k), e.g. emissions from digital circuitry used to control additional functions or capabilities other than the UWB transmission, are subject to the limits contained in Subpart B of this part".

9.4.2 Ground penetrating radar (GPR) & wall imaging systems under CFR §15.509

Ground penetrating radar (GPR) is defined as a field disturbance sensor that is designed to operate only when in contact with, or within one meter of, the ground for the purpose of detecting or obtaining the images of buried objects or determining the physical properties within the ground. The energy from the GPR is intentionally directed down into the ground for this purpose.

A Wall imaging system is a field disturbance sensor that is designed to detect the location of objects contained within a "wall" or to determine the physical properties within the "wall." The "wall" is a concrete structure, the side of a bridge, the wall of a mine or another physical structure that is dense enough and thick enough to absorb the majority of the signal transmitted by the imaging system. This category of equipment does not include products such as "stud locators" that are designed to locate objects behind gypsum, plaster or similar walls that are not capable of absorbing the transmitted signal. This definition has arisen to distinguish this application from through wall surveillance uses of ultra-wideband technology.

§15.509 [i.9] lists the technical requirements for the GPRs and wall imaging systems; specifically:

a) "The UWB bandwidth must be below 10.6 GHz.

b) Operation is limited to GPRs and wall imaging systems operated for purposes associated with law enforcement, fire fighting, emergency rescue, scientific research, commercial mining, or construction. This provision and reference to Part 90 eliminate the need for individual operator licensing for such devices.

c) The operation of imaging systems requires coordination according to §15.525. Essentially, the users of UWB imaging devices shall supply operational areas to the FCC Office of Engineering and Technology.

d) A GPR that is designed to be operated while being hand held and a wall imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of a switch located on the imaging system, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator.

e) Emission limits are listed in paragraph 7.5.1".

9.4.3 Through D-wall imaging systems under CFR §15.510

§15.510 applies to Through-Wall imaging systems. They are designed to detect the location or movement of persons or objects that are located on the other side of an opaque structure such as a wall or a ceiling. This category of equipment may include products such as "stud locators" that are designed to locate objects behind gypsum, plaster or similar walls that are not thick enough or dense enough to absorb the transmitted signal.

Relevant technical requirements are listed in FCC Code of Federal Regulations 47 [i.9] as follows:

a) "The UWB bandwidth must be below 960 MHz or the centre frequency, f_C, and the frequency at which the highest radiated emission occurs, f_M, must be contained between 1990 MHz and 10600 MHz.

b) Operation is limited to through-wall imaging systems operated by law enforcement, emergency rescue or firefighting organizations that are under the authority of a local or state government.

c) *For through-wall imaging systems operating with the UWB bandwidth below 960 MHz:*

1) Parties operating this equipment must be eligible for licensing.

2) Operation of these imaging systems requires coordination, as detailed in §15.525.

d) For equipment operating with f_C and f_M between 1,990 MHz and 10,600 MHz:

1) Parties operating this equipment must hold a license issued by the Federal Communications Commission to operate a transmitter in the Public Safety Radio Pool under part 90 of this chapter. The license may be held by the organization for which the UWB operator works on a paid or volunteer basis.

2) This equipment may be operated only for law enforcement applications, the providing of emergency services, and necessary training operations.

e) Through-wall imaging systems operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device: "Operation of this device is restricted to law enforcement, emergency rescue and firefighter personnel. Operation by any other party is a violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties."

f) The imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of a switch located on the imaging system, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator.

g) Emission limits are listed in paragraph 7.5.2".

9.4.4 Surveillance systems under CFR §15.511

Excerpt of [i.9]:

a) "The UWB bandwidth of an imaging system operating under the provisions of this section must be contained between 1,990 MHz and 10,600 MHz.

b) Operation under the provisions of this section is limited to fixed surveillance systems operated by law enforcement, fire or emergency rescue organizations or by manufacturers licensees, petroleum licensees or power licensees as defined in §90.7 of this chapter:

1) Parties operating under the provisions of this section must be eligible for licensing under the provisions of part 90 of this chapter.

2) The operation of imaging systems under this section requires coordination, as detailed in §15.525.

c) Imaging systems operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device: "Operation of this device is restricted to law enforcement, fire and rescue officials, public utilities, and industrial entities. Operation by any other party is a violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties".

9.4.5 Medical imaging systems under CFR §15.513

Excerpt of [i.9]:

a) "The UWB bandwidth of an imaging system operating under the provisions of this section must be contained between 3,100 MHz and 10,600 MHz.

b) Operation under the provisions of this section is limited to medical imaging systems used at the direction of, or under the supervision of, a licensed health care practitioner. The operation of imaging systems under this section requires coordination, as detailed in §15.525.

c) A medical imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of a switch located on the imaging system, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator".

9.4.6 Vehicular radar systems under CFR §15.515

Excerpt of [i.9]:

a) "Operation under the provisions of this section is limited to UWB field disturbance sensors mounted in terrestrial transportation vehicles. These devices shall operate only when the vehicle is operating, e.g. the engine is running. Operation shall occur only upon specific activation, such as upon starting the vehicle, changing gears, or engaging a turn signal.

b) The UWB bandwidth of a vehicular radar system operating under the provisions of this section shall be contained between 22 GHz and 29 GHz. In addition, the centre frequency, f_C, and the frequency at which the highest level emission occurs, f_M, must be greater than 24.075 GHz.

c) Following proper installation, vehicular radar systems shall attenuate any emissions within the 23.6-24.0 GHz band that appear 38 degrees or greater above the horizontal plane by 25 dB below the limit specified in paragraph (d) of this section. For equipment authorized, manufactured or imported on or after January 1, 2005, this level of attenuation shall be 25 dB for any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane. For equipment authorized, manufactured or imported on or after January 1, 2010, this level of attenuation shall be 30 dB for any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane. For equipment authorized, manufactured or imported on or after January 1, 2014, this level of attenuation shall be 35 dB for any emissions within the 23.6-24.0 GHz band that appear 30 degrees or greater above the horizontal plane. This level of attenuation can be achieved through the antenna directivity, through a reduction in output power or any other means".

9.4.7 Indoor systems under CFR §15.517

Excerpt of [i.9]:

a) "Operation under the provisions of this section is limited to UWB transmitters employed solely for indoor operation:

1) Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g. a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.

2) The emissions from equipment operated under this section shall not be intentionally directed outside of the building in which the equipment is located, such as through a window or a doorway, to perform an outside function, such as the detection of persons about to enter a building.

3) The use of outdoor mounted antennas, e.g. antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.

4) Field disturbance sensors installed inside of metal or underground storage tanks are considered to operate indoors provided the emissions are directed towards the ground.

5) A communications system shall transmit only when the intentional radiator is sending information to an associated receiver.

b) The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3,100 MHz and 10,600 MHz.

c) UWB systems operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device or in the instruction manual supplied with the device:

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".

9.4.8 Handheld systems under CFR §15.519

Excerpt of [i.9]:

a) "UWB devices operating under the provisions of this section must be hand held, i.e. they are relatively small devices that are primarily hand held while being operated and do not employ a fixed infrastructure.

b) A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

c) UWB devices operating under the provisions of this section may operate indoors or outdoors.

d) The use of antennas mounted on outdoor structures, e.g. antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device".

9.4.9 Wideband systems under CFR section §15.250

Section §15.250 of the CFR [i.9], while not specifically mentioning UWB systems deals with what are referred to as "Wideband Systems":

a) "The -10 dB bandwidth of a device operating under the provisions of this section must be contained within the 5,925-7,250 MHz band under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

b) The -10 dB bandwidth of the fundamental emission shall be at least 50 MHz. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the -10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency following the provisions of CFR §15.31(m).

c) Operation on board an aircraft or a satellite is prohibited. Devices operating under this section may not be employed for the operation of toys. Except for operation on board a ship or a terrestrial transportation vehicle, the use of a fixed outdoor infrastructure is prohibited. A fixed infrastructure includes antennas mounted on outdoor structures, e.g. antennas mounted on the outside of a building or on a telephone pole".

9.5 Limits

9.5.1 Ground penetrating radar & wall imaging systems under §15.509

Excerpt of [i.9]:

a) "The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209".

Table 13: e.i.r.p. emission limits for ground penetrating radar & wall imaging systems under §15.209 - USA

Frequency (MHz)	*Field strength (microvolts/meter)*	*Measurement distance (meters)*
0.009-0.490	*2400/F (kHz)*	*300*
0.490-1.705	*24000/F (kHz)*	*30*
1.705-30.0	*30*	*30*
30-88	*100***	*3*
88-216	*150***	*3*
216-960	*200***	*3*
Above 960	*500*	*3*

b) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 14: e.i.r.p. emission limits for ground penetrating radar & wall imaging systems under §15.509 - USA

Frequency	*Max. mean e.i.r.p. (dBm/MHz)*
960 - 1,610 MHz	*- 75.3*
1.610 - 1,990 GHz	*- 53.3*
1.990 - 3.100 GHz	*- 51.3*
3.100 - 10.60 GHz	*- 41.3*
> 10.6 GHz	*- 51.3*

c) In addition to the radiated emission limits specified in Table 14 above, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Table 15: Specific emission limits for ground penetrating radar & wall imaging systems under §15.509

Frequency	*Max. mean e.i.r.p. (dBm/MHz)*
1,164 - 1,240 MHz	*- 75.3*
1,559 - 1,610 MHz	*- 73.3*

d) For UWB devices where the frequency at which the highest radiated emission occurs, f_M, is above 960 MHz, there is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centred on f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521".

9.5.2 Through-wall imaging systems under CFR §15.510

9.5.2.1 For through-wall imaging systems operating with the UWB bandwidth below 960 MHz

Excerpt of [i.9]:

a) "The radiated emissions at or below 960 MHz shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 16: e.i.r.p. emission limits for ground penetrating radar & wall imaging systems under §15.209 - USA

Frequency (MHz)	*Field strength (microvolts/meter)*	*Measurement distance (meters)*
0.009-0.490	*2400/F (kHz)*	*300*
0.490-1.705	*24000/F (kHz)*	*30*
1.705-30.0	*30*	*30*
30-88	*100***	*3*
88-216	*150***	*3*
216-960	*200***	*3*
Above 960	*500*	*3*

b) The radiated emissions above 960 MHz shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 17: Max mean emission limits for through-wall imaging systems under §15.510 - USA

Frequency	*Max. mean e.i.r.p. (dBm/MHz)*
960 - 1,610 MHz	*- 65.3*
1.610 - 1.990 GHz	*- 53.3*
> 1.990 GHz	*- 51.3*

c) In addition to the radiated emission limits specified in the Table 17, emissions from these imaging systems shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Table 18: Specific emission limits for through-wall imaging systems under §15.510 - USA

Frequency	*Max. mean e.i.r.p. (dBm/MHz)*
1,164 - 1,240 MHz	*- 75.3*
1,559 - 1,610 MHz	*- 73.3*

9.5.2.2 For equipment operating with f_C and f_M between 1 990 MHz and 10 600 MHz

Excerpt of [i.9]:

a) The radiated emissions at or below 960 MHz shall not exceed the emission levels in §15.209 of this chapter. The radiated emissions above 960 MHz shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 19: Max mean emission limits for through-wall imaging systems under §15.510 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
960 - 1 610 MHz	- 46.3
1.610 - 10.600 GHz	- 41.3
> 10.600 GHz	- 51.3

b) In addition to the radiated emission limits specified in Table 19, emissions from these imaging systems shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Table 20: Specific emission limits for through-wall imaging systems under §15.510 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
1,164 - 1,240 MHz	- 56.3
1,559 - 1,610 MHz	- 56.3

c) There is also a limit on the peak level of the emissions contained within a 50 MHz bandwidth centred on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP".

9.5.3 Surveillance systems under CFR §15.511

Excerpt of [i.9]:

a) "The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 21: e.i.r.p. emission limits for surveillance systems §15.511 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
960 - 1,610 MHz	- 55.3
1.610 - 1.990 GHz	- 51.3
1.990 - 10.6 GHz	- 41.3
> 10.6 GHz	- 51.3

b) In addition to the radiated emission limits specified in Table 21, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Table 22: Specific emission limits for surveillance systems under §15.511 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
1164 - 1240 MHz	- 63.3
1559 - 1610 MHz	- 63.3

c) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centred on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521".

9.5.4 Medical imaging systems under CFR §15.513

Excerpt of [i.9]:

a) "The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 23: e.i.r.p. emission limits for medical imaging systems under §15.513 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
960 - 1,610 MHz	- 65.3
1.610 - 1.990 GHz	- 53.3
1.990 - 3.100 GHz	- 51.3
3.100 - 10.60 GHz	- 41.3
> 10.6 GHz	- 51.3

b) In addition to the radiated emission limits specified in Table 23, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Table 24: specific emission limits for medical imaging systems under §15.513 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
1,164 - 1,240 MHz	- 63.3
1,559 - 1,610 MHz	- 63.3

c) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centred on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521".

9.5.5 Vehicular radar systems under CFR §15.515

Excerpt of [i.9]:

a) "The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 25: e.i.r.p. emission limits for vehicular radar systems under §15.515 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
960 - 1,610 MHz	- 75.3
1.610 - 22.0 GHz	- 61.3
22.0 - 29.0 GHz	- 41.3
29.0 - 31.0 GHz	- 51.3
> 31.0 GHz	- 61.3

b) In addition to the radiated emission limits specified in the table in paragraph (d) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Table 26: Specific emission limits for vehicular radar systems under §15.515 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
1,164 - 1,240 MHz	- 85.3
1,559 - 1,610 MHz	- 85.3

c) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centred on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

d) The emission levels from devices operating under the provisions of this section that employ gated transmissions may be measured with the gating active. Measurements made in this manner shall be repeated over multiple sweeps with the analyser set for maximum hold until the amplitude stabilizes".

9.5.6 Indoor systems under CFR §15.517

Excerpt of [i.9]:

a) "The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in CFR 15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the average limits given in Table 27 when measured using a resolution bandwidth of 1 MHz:

Table 27: e.i.r.p. emission limits for indoor systems under §15.517 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)	Max. Peak e.i.r.p. (dBm / 50MHz)
960 - 1,610 MHz	- 75.3	
1.610 - 1.990 GHz	- 53.3	
1.990 - 3.100 GHz	- 51.3	
3.100 - 10.60 GHz	- 41.3	0
> 10.6 GHz	- 51.3	

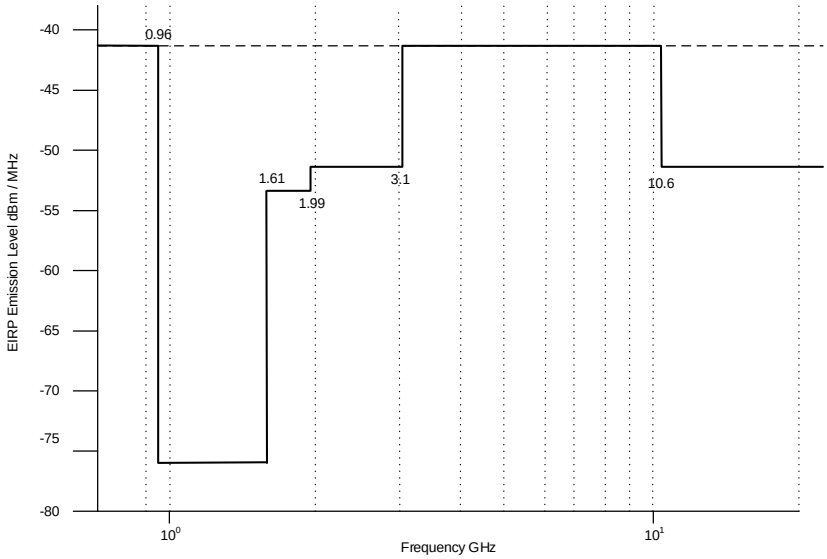

Figure 2: Max mean e.i.r.p emission limits for indoor systems under §15.517 - USA

b) In addition to the radiated emission limits specified in Table 27, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centred on the frequency at which the highest radiated emission occurs, f_M. That limit is 0 dBm e.i.r.p. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in CFR 15.521".

Table 28: Specific emission limits for indoor systems under §15.517 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
1,164 - 1,240 MHz	- 85.3
1,559 - 1,610 MHz	- 85.3

9.5.7 Handheld systems under CFR §15.519

Excerpt of [i.9]:

a) "The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the average limits given in Table 29 when measured using a resolution bandwidth of 1 MHz.

Table 29: e.i.r.p. emission limits for handheld systems under §15.519 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)	Max. Peak e.i.r.p. (dBm / 50MHz)
960 - 1 610 MHz	*- 75.3*	
1.610 - 1.990 GHz	*- 63.3*	
1.990 - 3.100 GHz	*- 61.3*	
3.100 - 10.60 GHz	*- 41.3*	*0*
> 10.6 GHz	*- 61.3*	

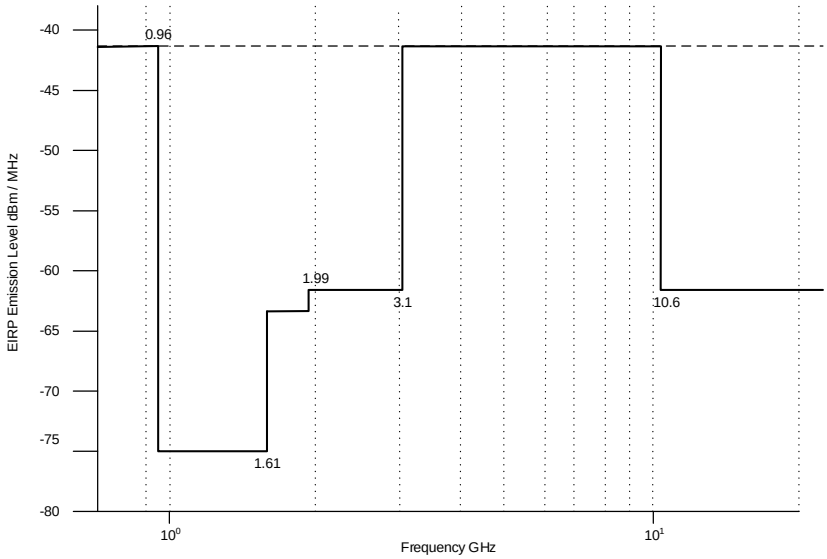

Figure 3: Max mean e.i.r.p for handheld systems under §15.519 - USA

b) In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz":

Table 30: Specific emission limits for handheld systems under §15.519 - USA

Frequency	Max. mean e.i.r.p. (dBm/MHz)
1,164 - 1,240 MHz	*- 85.3*
1,559 - 1,610 MHz	*- 85.3*

9.5.8 Wideband Systems under CFR §15.250

Table 31: e.i.r.p. emission limits for wideband systems under §15.250

Frequency	*Max. mean e.i.r.p. (dBm/MHz)*	*Max. Peak e.i.r.p. (dBm / 50MHz)*
960 - 1 610 MHz	*- 75.3*	
1.610 - 1.990 GHz	*- 63.3*	
1.990 - 3.100 GHz	*- 61.3*	
3.100 - 5.925 GHz	*- 51.3*	*0*
5.925 - 7.250 GHz	*- 41.3*	
7.250 -10.600 GHz	*- 51.3*	
> 10.6 GHz	*- 61.3*	

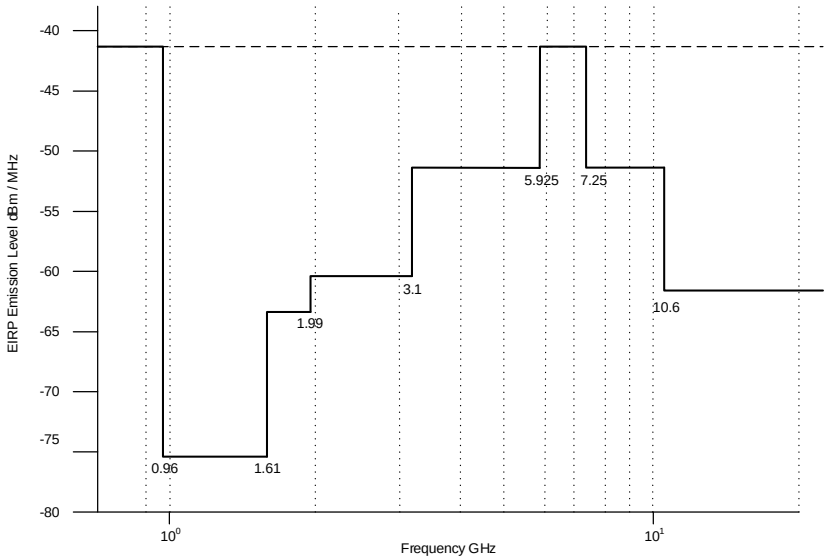

Figure 4: Max mean e.i.r.p. for wideband systems under §15.250 - USA

9.6 Mitigation Techniques

No specific mitigation techniques are mentioned.

9.7 FCC Waivers

The FCC has granted a number of waivers in relation to the use of UWB in the USA a sample of which are shown below.

Table 32: Sample FCC waivers

Date	*To whom granted*	*In relation to what*
Aug 12, 2015	*iRobot Inc.*	*Section 15.250(c) of the wideband rules. Specifically waiving the prohibition on the use of fixed outdoor infrastructure to allow iRobot to obtain equipment certification for and market a robotic lawn mower ("RLM") that operates in the 6240-6740 MHz frequency range.*
Jan 11, 2012	*Curtiss-Wright Controls Inc.*	*Sections 15.503(d) and 15.521(d) of the ultra-wideband ("UWB") rules for its ground penetrating radar ("GPR") system, known as 3d-Radar.*
May 23, 2011	*Robert Bosch, GmbH*	*Section 15.503(h) for its Wallscanner D-tect 150 Professional ("wallscanner") device and for functionally identical versions of that device.*

10 Americas, North: Canada

10.1 Regulatory Authority

Industry Canada.

The rules are defined in RSS220 - Issue 1, March 2009 [i.8].

10.2 UWB Definition

Excerpt of [i.8]:

a) "The transmit bandwidth (-10 dB) is at least 500 MHz or a fractional bandwidth greater than 0.2.

b) The -10dB bandwidth shall be completely between 3.1 to 10.6 GHz".

10.3 Applications

10.3.1 Indoor Communication Devices

Excerpt of [i.8]:

a) "Indoor communications device: a device designed to transfer voice or data information, to detect the location of tags, or to serve as an underground field disturbance sensor.

b) The -10 dB bandwidth of the device shall be totally contained in the band 3.1-10.6 GHz.

c) The antenna of the UWB device shall be factory-installed and shall not be made modifiable by users.

d) Indoor UWB communications devices, by the nature of their design, shall be capable of operation only indoors or in locations completely enclosed by walls and a ceiling. The necessity to operate within a fixed indoor infrastructure (e.g. a transmitter that must be connected to the AC power lines, an enclosure that is not weatherproof, etc.) may be considered sufficient to meet this requirement".

10.3.2 Handheld Communication Devices

Excerpt of [i.8]:

a) "Hand-held communications device: a device used to transfer voice or data information or designed to detect the location of tags.

b) The -10 dB bandwidth of the device shall be totally contained in the band 3.1-10.6 GHz.

c) The antenna of the UWB device shall be factory-installed and shall not be made modifiable by users.

d) The device shall be designed so as to prevent its connection to antennas mounted on outdoor structures, e.g. antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure.

e) The device is to transmit only when it is sending information to an associated receiver. The device shall cease transmission of information within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB device at least every 10 seconds or the UWB device shall cease transmitting any information other than periodic signals used for the establishment or re-establishment of a communication link with an associated receiver".

10.3.3 Ground penetrating radar

Excerpt of [i.8]:

a) "Ground penetrating radar: a field disturbance sensor that operates when in contact with or within 1 m of the ground for the purpose of detecting or mapping subsurface structures. While primarily used for examining "underground," the term "ground" can be expanded to mean any lossy dielectric material. The energy from the GPR is intentionally directed down into the ground for this purpose.

b) In addition to the labelling requirements of RSS-Gen, the GPR device user manual shall also contain the following statements or equivalent:

- *"This Ground Penetrating Radar Device shall be operated only when in contact with or within 1 m of the ground.*
- *This Ground Penetrating Radar Device shall be operated only by law enforcement agencies, scientific research institutes, commercial mining companies, construction companies, and emergency rescue or firefighting organizations.*

c) UWB radar imaging devices may not be designed to detect tags or transfer data or voice information.

d) The -10 dB UWB bandwidth for a GPR imaging device shall be entirely below 10.6 GHz.

e) A device operating under the provisions of this section shall contain a mechanism that deactivates the equipment when normal use is interrupted. For manually operated hand-held devices, this mechanism shall contain a manual switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of remotely / computer controlled equipment with a switch located on the radar imaging device, it is permissible to operate the device by a remote control unit provided that deactivation takes place within 10 seconds of the remote switch being released by the operator".

10.3.4 In-wall radar imaging

Excerpt of [i.8]:

a) "In-wall radar imaging device: a field disturbance sensor that is designed to examine and map the interior of walls. The walls are usually made of a concrete structure or similar dense, impermeable material that absorbs much of the impinging radio-wave energy. Typical walls include reinforced concrete building walls, retaining walls, tunnel liners, the walls of a mine, the sides of a bridge, or another physical structure that is dense enough and thick enough to dissipate and absorb most of the signal transmitted by the imaging device.

b) In addition to the labelling requirements of RSS-Gen, the in-wall radar imaging device user manual shall also contain the following or equivalent statements:

- *"This In-wall Radar Imaging Device shall be operated where the device is directed at the wall and in contact with or within 20 cm of the wall surface.*
- *This In-wall Radar Imaging Device shall be operated only by law enforcement agencies, scientific research institutes, commercial mining companies, construction companies, and emergency rescue or firefighting organizations.*

c) UWB radar imaging devices may not be designed to detect tags or transfer data or voice information.

d) The -10 dB UWB bandwidth for an in-wall radar imaging device shall be entirely below 10.6 GHz.

e) A device operating under the provisions of this section shall contain a mechanism that deactivates the equipment when normal use is interrupted. For manually operated hand-held devices, this mechanism shall contain a manual switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of remotely / computer controlled equipment with a switch located on the radar imaging device, it is permissible to operate the device by a remote control unit provided that deactivation takes place within 10 seconds of the remote switch being released by the operator".

10.3.5 Through-wall imaging

Excerpt of [i.8]:

a) "Through-wall radar imaging device: a field disturbance sensor used to transmit energy through an opaque structure, such as a wall or a ceiling, to detect the movement or location of persons or objects that are located on the other side.

b) In addition to the labelling requirements of RSS-Gen, the device user manual shall also contain the following statement or equivalent:

- *"This Through-wall Radar Imaging Device shall be operated only by law enforcement agencies or emergency rescue or firefighting organizations that are under a local, provincial or federal authority. The equipment is to be operated only in providing services and for necessary training operations."*

c) UWB radar imaging devices may not be designed to detect tags or transfer data or voice information.

d) The -10 dB UWB bandwidth of a through-wall radar imaging device shall be totally contained either below 960 MHz or the centre frequency, f_C, and the frequency, at which the highest emission level occurs, f_M, shall be contained in the band 1.99-10.6 GHz".

10.3.6 Radar surveillance

Excerpt of [i.8]:

a) "Radar surveillance device: a field disturbance sensor used to establish a stationary radio frequency perimeter field that is used for security purposes to detect the intrusion of persons or objects.

b) In addition to the labelling requirements of RSS-Gen, the device user manual shall also contain the following statement or equivalent:

- *"This Radar Surveillance Device shall be installed in a manner that minimizes radiated emissions beyond the property line of the area under surveillance.*
- *This Radar Surveillance Device shall be operated only by military, law enforcement, emergency rescue or firefighting organizations that are under a local, provincial or federal authority. The equipment is to be operated only in providing services and for necessary training operations."*

c) UWB radar surveillance devices may not be designed to detect tags or transfer data or voice information.

d) The -10 dB UWB bandwidth of a radar surveillance device shall be totally contained in the band 1.99-10.6 GHz".

10.3.7 Medical radar imaging

Excerpt of [i.8]:

a) "Medical radar imaging device: a field disturbance sensor used to detect the location or movement of objects inside the body of a human or an animal.

b) In addition to the labelling requirements of RSS-Gen, the device user manual shall also contain the following statement or equivalent:

- *"This Medical Radar Imaging Device shall be operated only in hospitals and health-care facilities, and only at the direction or under the supervision of a health-care practitioner."*

c) UWB radar imaging devices may not be designed to detect tags or transfer data or voice information.

d) The -10 dB UWB bandwidth of a medical radar imaging device shall be totally contained in the band 3.1-10.6 GHz.

e) A medical radar imaging device shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. It is permissible to operate an imaging device by remote control provided that the imaging device ceases transmission within 10 seconds of the remote switch being released by the operator".

10.4 Limits

10.4.1 Radiated emissions at or below 960 MHz

Excerpt of [i.8]:

"Radiated emissions at or below 960 MHz for all subclasses of UWB device shall not exceed the limits in Table 33 below. A CISPR quasi-peak detector is used with the according bandwidth specifications. All UWB devices need to fulfil these requirements".

Table 33: e.i.r.p. emission limits below 960 MHz - Canada

Frequency (MHz)	Field Strength (Microvolts/m)	Measurement Distance (m)	e.i.r.p. (dBmW)
0.009-0.490	2,400/F (F in kHz)	300	10 log (17.28 / F2) (F in kHz)
0.490-1.705	24,000/F (F in kHz)	30	10 log (17.28 / F2) (F in kHz)
1.705-30	30	30	-45.7
30-88	100	3	-55.2
88-216	150	3	-51.7
216-960	200	3	-49.2

NOTE: "The emission limits for the bands 9-90 kHz and 110 - 490 kHz are based on measurements employing an average emission detector".

10.4.2 Indoor Communication Devices

Excerpt of [i.8]:

a) "AC line-conducted emissions from the device shall comply with the limits for AC line-conducted emissions set out in RSS-Gen.

b) Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 10.4.1.

c) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 34: e.i.r.p. emissions limits for indoor communication devices - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1,610 MHz	- 75.3
1.61 - 4.75 GHz	- 70
4.75 - 10.6 GHz	- 41.3
> 10.6 GHz	- 51.3

d) In addition to the limits specified in Table 34, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 35: Specific emission limits for indoor communication devices - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	-85.3
1,559 - 1,610 MHz	-85.3

e) Within the tables in paragraphs (c) and (d) above, the tighter emission limit applies at the band edges.

f) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex".

10.4.3 Handheld Communication Devices

Excerpt of [i.8]:

a) "Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 10.4.1.

b) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 36: e.i.r.p. emissions limits for handheld devices - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1 610 MHz	- 75.3
1.61 - 4.75 GHz	- 70
4.75 - 10.6 GHz	- 41.3
> 10.6GHz	- 61.3

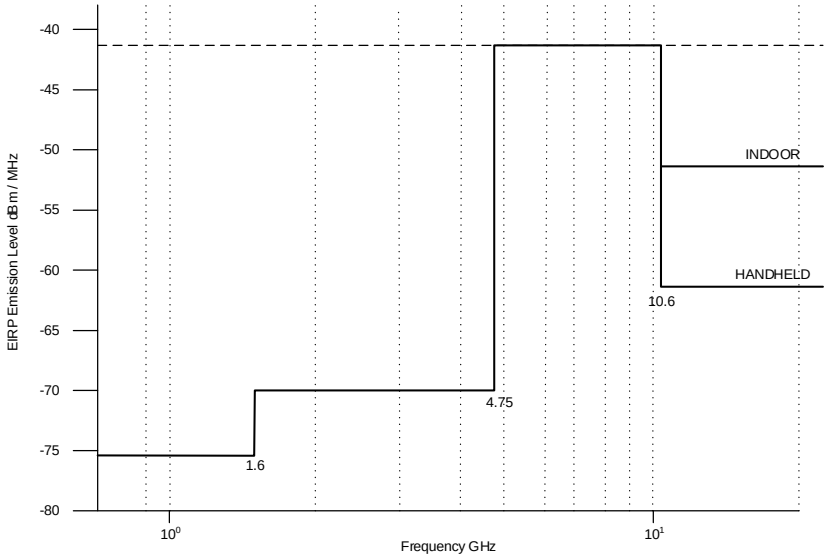

Figure 5: Max mean e.i.r.p. limits for communication devices under RSS220

c) In addition to the limits specified in Table 36, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 37: Specific e.i.r.p. emissions limits for handheld devices - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	- 85.3
1,559 - 1,610 MHz	- 85.3

d) Within the tables in paragraphs (c) and (d) above, the tighter emission limit applies at the band edges.

e) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex".

10.4.4 Ground Penetrating Radar (GPR)

Excerpt of [i.8]:

a) "Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 10.4.1.

b) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 38: e.i.r.p. emissions limits for ground penetrating radar devices - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1,610 MHz	- 65.3
1,610 - 1,990 MHz	- 53.3
1.99 - 3.10 GHz	-51.3
3.10 - 10.6 GHz	- 41.3
> 10.6 GHz	- 51.3

c) In addition to the limits specified in paragraph (b) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 39: Specific emission limits for ground penetrating radar devices - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	-75.3
1,559 - 1,610 MHz	-75.3

d) Within the tables in paragraphs (b) and (c) above, the tighter emission limit applies at the band edges.

e) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex".

10.4.5 In-wall Imaging Radar

Excerpt of [i.8]:

a) "Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 10.4.1.

b) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 40: e.i.r.p. emissions limits for ground penetrating radar devices - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1,610 MHz	- 65.3
1,610 - 1,990 MHz	- 53.3
1.99 - 3.10 GHz	-51.3
3.10 - 10.6 GHz	- 41.3
> 10.6 GHz	- 51.3

c) In addition to the limits specified in paragraph (b) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 41: Specific emission limits for ground penetrating radar devices - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	-75.3
1,559 - 1,610 MHz	-75.3

d) Within the tables in paragraphs (c) and (d) above, the tighter emission limit applies at the band edges.

e) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex".

10.4.6 Through-wall Imaging Radar

Excerpt of [i.8]:

a) "Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 10.4.1.

b) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 42: e.i.r.p. emissions limits for through-wall imaging devices with -10 dB bandwidth = 960 MHz - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1 610 MHz	- 65.3
1.61 - 1.99 GHz	- 53.3
> 1.99 GHz	- 51.3

Table 43: e.i.r.p. emissions limits for through-wall imaging devices with fC & fM between 1.99 & 10.6 GHz - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1 610 MHz	- 46.3
1.61 - 10.6 GHz	- 41.3
> 10.6 GHz	- 51.3

c) In addition to the limits specified in paragraph (b) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 44: Specific emission limits for through-wall imaging devices with -10 dB bandwidth = 960 MHz - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	-75.3
1,559 - 1,610 MHz	-75.3

Table 45: Specific emission limits for through-wall imaging devices with fC & fM between 1.99 & 10.6 GHz - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	-56.3
1,559 - 1,610 MHz	-56.3

d) Within the tables in paragraphs (b) and (c) above, the tighter emission limit applies at the band edges.

e) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex".

10.4.7 Radar Surveillance Devices

Excerpt of [i.8]:

a) "Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 10.4.1.

b) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 46: e.i.r.p. emissions limits for radar surveillance devices - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1,610 MHz	- 53.3
1,610 - 1,990 MHz	- 51.3
1.99 - 10.6 GHz	-41.3
> 10.6 GHz	- 51.3

c) In addition to the limits specified in paragraph (b) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 47: Specific emission limits for radar surveillance devices - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	-63.3
1,559 - 1,610 MHz	-63.3

d) Within the tables in paragraphs (b) and (c) above, the tighter emission limit applies at the band edges.

e) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex".

10.4.8 Medical Radar Imaging Devices

Excerpt of [i.8]:

a) "Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 10.4.1.

b) Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

Table 48: e.i.r.p. emissions limits for medical radar imaging devices - Canada

Frequency	Max. mean EIRP (dBm/MHz)
960 - 1,610 MHz	- 65.3
1,610 - 1,990 MHz	- 53.3
1.99 - 3.10 GHz	-51.3
3.10 - 10.6 GHz	- 41.3
> 10.6 GHz	- 51.3

c) In addition to the limits specified in paragraph (b) of this section, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 49: Specific emission limits for medical radar imaging devices - Canada

Frequency	Max. mean EIRP (dBm/MHz) in a resolution of 1 kHz
1,164 - 1,240 MHz	-75.3
1,559 - 1,610 MHz	-75.3

d) Within the tables in paragraphs (b) and (c) above, the tighter emission limit applies at the band edges.

e) The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex".

10.5 Mitigation Techniques

None.

10.6 Measurement Techniques

Measurement techniques are defined in the annex to the regulations.

11 Americas, south: Brazil

11.1 Regulatory Authority

Anatel (Portuguese: Agência Nacional de Telecomunicações, National Telecommunications Agency)Rules are defined in [i.32].

11.2 UWB definition

Intentional emissions with fractional bandwidth greater than or equal to 20%, or a bandwidth measured between the points of 10 dB of the carrier wave peak, greater than or equal to 500 MHz, regardless of the fractional bandwidth.

11.3 Applications

- Portable devices
- Indoor communications
- Medical imaging systems

11.4 Requirements

11.5 Limits

Table 50: UWB Emission limits - Brazil

Radio frequency band	Operational Restrictions	Power or Field Strength Limit in the Operating Band	Power or Field Strength Limit for Out of Band and Spurious Emissions
3 100 MHz to 10 600 MHz	Medical imaging systems	1) 0 dBm (note 1); and 2) -41,3 dBm (note 2)	1) Table 51 (below 960 MHz); 2) -53,3 dBm (note 2) (between 960 MHz and 1 164 MHz); 3) -75,3 dBm (note 2) (between 1 164 MHz and 1 240 MHz); 4) -53,3 dBm (note 2) (between 1 240 MHz and 1 559 MHz); 5) -75,3 dBm (note 2) (between 1 559 MHz and 1 610 MHz); 6) -51,3 dBm (note 2) (Above 1 610 MHz)

Radio frequency band	Operational Restrictions	Power or Field Strength Limit in the Operating Band	Power or Field Strength Limit for Out of Band and Spurious Emissions
3 100 MHz to 10 600 MHz	Restricted to indoor use in buildings	1) 0 dBm (note 1); and 2) -41,3 dBm (note 2)	1) Table 51 (below 960 MHz); 2) -75,3 dBm (note 2) (between 960 MHz and 1 164 MHz); 3) -85,3 dBm (note 2) (between 1 164 MHz and 1 240 MHz); 4) -75,3 dBm (note 2) (between 1 240 MHz and 1 559 MHz); 5) -85,3 dBm (note 2) (between 1 559 MHz and 1 610 MHz); 6) -53,3 dBm (note 2) (1 610 MHz to 1 990 MHz); and 7) -51,3 dBm (note 2) (Above 1 990 MHz)
3 100 MHz to 10,600 MHz	Portable devices (note 3)	1) 0 dBm (note 1); and 2) -41,3 dBm (note 2)	1) Table 51 (below 960 MHz); 2) -75,3 dBm (note 2) (between 960 MHz and 1 164 MHz); 3) -85,3 dBm (note 2) (between 1 164 MHz and 1 240 MHz); 4) -75,3 dBm (note 2) (between 1 240 MHz and 1 559 MHz); 5) -85,3 dBm (note 2) (between 1 559 MHz and 1 610 MHz); 6) -63,3 dBm (note 2) (1 610 MHz to 1 990 MHz); and 7) -61,3 dBm (note 2) (Above 1 990 MHz)
NOTE 1: Peak EIRP limit measured with 50 MHz resolution bandwidth centred on the frequency that has the greatest radiated emission. It is acceptable to use a different resolution bandwidth, in which case the EIRP limit shall be 20 log (RBW/50) dBm where RBW is the used resolution bandwidth in MHz. NOTE 2: Average EIRP limit measured using 1 MHz resolution bandwidth. NOTE 3: A relatively small device that can be handheld whilst being operated and does not use fixed infrastructure. These devices can operate both indoors and outdoors.			

Other emissions shall not exceed the values stated in table 51.

Table 51: Other and spurious emission limits - Brazil

Radio Frequency Band	Field Strength (microvolt per metre)	Measurement Distance (metre)
9 kHz to 490 kHz	2 400/*f*(kHz)	300
490 kHz to 1 705 kHz	24 000/*f*(kHz)	30
1,705 MHz to 30 MHz	30	30
30 MHz to 88 MHz	100	3
88 MHz to 216 MHz	150	3
216 MHz to 960 MHz	200	3
Above 960 MHz	500	3
NOTE 1: The field strength of any spurious emissions or harmonics shall not exceed the value of the fundamental frequency emission. NOTE 2: At the transition frequencies in this table, the most restrictive field strength limit shall apply.		

11.6 Mitigation techniques

None mentioned.

12 Asia: Australia

12.1 Regulatory Authority

Australian Communications and Media Authority (ACMA).

Rules are defined in [i.11].

12.2 UWB Definition

Refers to ETSI standards.

12.3 Applications

- Communications.
- Short range vehicle radar.
- In-ground UWB sensors.
- Building material analysis devices.

12.4 Requirements

Excerpt of [i.11]:

For generic UWB transmitters:

(a) "The transmitter must comply with either:

(i) ETSI Standard ETSI EN 302 500-2; or

(ii) ETSI Standard ETSI EN 302 065.

(b) The transmitter must not be operated on board any aircraft or from any fixed outdoor location.

(c) The transmitter must not be operated in the 3425-3575 MHz band before 14 December 2015.

(d) The transmitter must not be operated within a nominated distance of a specified Australian radio-astronomy site.

(e) The transmitter must not be operated in the 8400–8500 MHz band within the nominated distance of a specified SRS earth station".

For in-ground UWB transmitters:

(a) "The transmitter must comply with Part 2 of ETSI Standard ETSI EN 302 065.

(b) The transmitter must not be operated within a nominated distance of a specified Australian radio-astronomy site

For building material analysis transmitters:

(a) The transmitter must comply with ETSI Standard ETSI EN 302 435-1.

(b) The transmitter must be operated in a position such that emissions are directed into building material.

(c) The transmitter must not be operated within a nominated distance of a specified Australian radio-astronomy site.

(d) *The transmitter must not be operated in the 8400–8500 MHz band within the nominated distance of a specified SRS earth station".*

Restricted site are listed at https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Class-licences/lipd-class-licence-spectrum-acma.

12.5 Limits

Generic UWB transmitters can operate between 3,4 GHz to 4,8 GHz and 6,0 GHz to 8,5 GHz and must comply with ETSI EN 302 065 [i.20] or ETSI EN 302 500-2 [i.26].

In-ground UWB transmitters are restricted to -62 dBm/MHz between 4,2 GHz to 4,8 GHz and 6,0 GHz to 6,8 GHz.

Building material analysis transmitters can operate in the 2,2 GHz to 8,5 GHz range and must comply with ETSI EN 302 435-1 [i.37].

12.6 Mitigation Techniques

Refers to ETSI standards.

13 Asia: China

13.1 Regulatory Authority

Ministry of Industry and Information Technology (MIIT).

Regulations are defined in [i.12].

13.2 UWB Definition

Excerpt of [i.12]:

"The device's transmit signal bandwidth (-10dB) should be at least 500 MHz".

13.3 Applications

Not stated.

13.4 Requirements

Excerpt of [i.12]:

- *"UWB devices should follow the regulations of micro-power (short range) wireless transmit devices and a certificate from MIIT is compulsory.*
- *UWB radio transmitting devices shall not cause radio interference to other radio stations, and shall not request interference protection from other radio stations.*
- *The transmission of UWB radio devices is prohibited to be used 1 kilometre around the Radio Astronomy Stations, listed by "the wireless frequency regulations in P.R. China" note "CHN12".*
- *UWB is prohibited on board of aircraft".*

13.5 Limits

Table 52: Max mean e.i.r.p. emission limits - China [i.10]

Frequency	Max. e.i.r.p. (dBm/MHz), Effective value RMS
< 1.6 GHz	*- 90*
1.6 - 3.6GHz	*- 85*
3.6 - 6 GHz (Note 1)	*- 70*
6.0 - 9.0 GHz	*- 41*
- 10.6 GHz	*- 70*
> 10.6 GHz	*- 90*

Note 1: *"In the 4.2 to 4.8 GHz band, if mitigation techniques are implemented, then a max. EIRP limit of -41 dBm/MHz applies".*

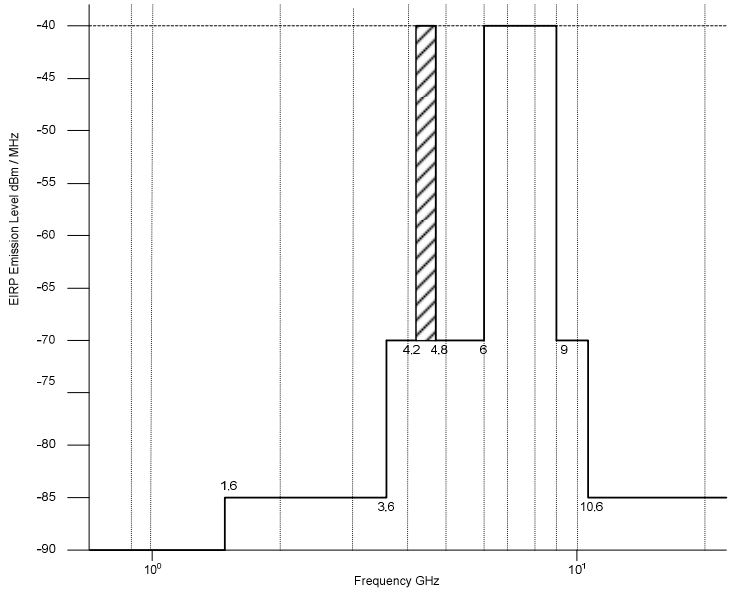

Figure 6: Max mean e.i.r.p limits - China

Table 53: Narrowband spurious emissions of UWB radio transmitting devices - China [i.10]

Frequency	Resolution Bandwidth	Operating (dBm)	Stand-By (dBm)
48.5 - 72.5 MHz, 76 - 108 MHz, 167 - 223 MHz, 470 - 798 MHz	*100 kHz*	*- 54*	*- 57*
30 MHz - 1 GHz	*100 kHz*	*- 36*	*- 47*
1 GHz - 40 GHz	*1 MHz*	*- 30*	*- 47*

13.6 Mitigation Techniques

Any mitigation technologies employed require approval by the Agency of Radio Management of the Peoples' Republic of China.

14 Asia: Japan

14.1 Regulatory Authority

The UWB rules are defined in ARIB STD-T91 [i.13].

14.2 UWB Definition

Excerpt of [i.13]:

"Device transmit bandwidth (-10 dB) is at least 450 MHz".

14.3 Applications

- ARIB focus on systems with an antenna input power of < 0,001 W.
- Restricted to indoor use.

14.4 Requirements

Excerpt of [i.13]:

- *"Tolerance of antenna power shall be less than allowed maximum + 20%.*
- *For operation in the 3.4 to 4.8 GHz band, the data rate used must be higher than 50 Mbps. No such restriction is placed on the 7.25 to 10.6 GHz band".*

14.5 Limits

Table 54: Wanted e.i.r.p emission limits - Japan [i.11]

Frequency	Max. mean EIRP (dBm/MHz)	Max. Peak e.i.r.p. (dBm / 50MHz)
3.4 - 4.8 GHz (Note1)	*- 41.3*	*0*
7.25 - 10.25 GHz	*- 41.3*	*0*

Note 1: with Mitigation Techniques

Table 55: Unwanted e.i.r.p emission limits - Japan [i.11]

Frequency	Max. mean EIRP (dBm/MHz)	Max. Peak e.i.r.p. (dBm / 50MHz)
< 1 600 MHz	*- 90*	*- 84*
1.6 - 2.7 GHz	*- 85*	*- 79*
2.7 - 10.6 GHz	*- 70*	*- 64*
10.6 - 10.7 GHz	*- 85*	*- 79*
10.7 - 11.7 GHz	*- 70*	*- 64*
11.7 - 12.75 GHz	*- 85*	*- 79*
> 12.75 GHz	*- 70*	*- 64*

Table 56: Receiver Emissions - Japan [i.11]

Frequency	*Mean power limit (dBm/MHz) if 3.4 to 4.8 GHz band used*	*Mean power limit (dBm/MHz) if 7.25 to 10.25 GHz band used*
< 1 600 MHz	*- 90*	*- 90*
1.6 - 2.7 GHz	*- 85*	*- 85*
2.7 - 3.4 GHz	*- 70*	*- 70*
3.4 - 4.8 GHz	*- 54*	*- 70*
4.8 - 7.25 GHz	*- 70*	*- 70*
7.25 - 10.25 GHz	*- 70*	*- 54*
10.25 - 10.6 GHz	*- 70*	*- 70*
10.6 - 10.7 GHz	*- 85*	*- 85*
10.7 - 11.7 GHz	*- 70*	*- 70*
11.7 - 12.75 GHz	*- 85*	*- 85*
> 12.75 GHz	*- 70*	*- 70*

14.6 Mitigation Techniques

Only Detect and Avoid (DAA) is permitted as a mitigation technique. LDC is not permitted.

15 Asia: Korea

15.1 Regulatory Authority

The regulatory body is called "RAPA - Korea Radio Promotion Association" (www.rapa.or.kr) and the regulation can be checked at www.spectrum.or.kr. The Korean rules are defined in [i.14].

15.2 UWB Definition

Excerpt of [i.14]:

"Device transmit bandwidth (-10 dB) is at least 450 MHz".

15.3 Applications

- Use in model airplanes, aircraft, ships and satellites is prohibited.

15.4 Requirements

- Point to point communication needs to be implemented.
- Fixed devices are not permitted.

15.5 Limits

Table 57: e.i.r.p. emission limits - Korea [i.12]

Frequency	*Max. mean EIRP (dBm/MHz)*	*Max. Peak e.i.r.p. (dBm / 50MHz)*
< 1.6 GHz	*- 90*	
1.6 - 2.7 GHz	*- 85*	
2.7 - 3.1 GHz	*- 70*	
3.1 - 3.735 GHz	*- 51.3*	
3.735 - 4.8 GHz (Note 1)	*- 41.3*	*0*
4.8 - 7.2 GHz	*- 70*	
7.2 - 10.2 GHz	*- 41.3*	*0*
> 10.2 GHz	*- 70*	
Note 1: Wireless equipment used in 3.735 – 4.8 GHz shall use one of the mitigation techniques below		

15.6 Mitigation Techniques

Excerpt of [i.14]:

"Wireless equipment used in 3.735Ghz – 4.8Ghz shall conform the following one of DAA or LDC condition(A – D)

A. Average Power density including Antenna gain should be below -70dBm/MHz

B. Continuous transmission time and idle time (sleep time) should follow the conditions in Table 57a below for indoor application. In case of outdoor application, the continuous transmission time should be below 5 ms with more than 1 sec idle time.

Table 57a: Activity factor limits for indoor applications

Classification	*Shall be*	*Out of*
Continuous transmission time		
Sum of transmission time	*Under 18 s*	*1 hour*
Idle time	*Over 950 ms*	*1 sec*
Idle time of 1 time transmission(average)	*Over 38 ms*	*1 sec*

C. When detecting any other wireless signal stronger than -61dBm while in operation, should reduce the power below -70dBm/Mhz in 2 sec.

D. When detecting stronger signal than -61dBm from other wireless equipment, should avoid in 2 sec".

16 Asia: Malaysia

16.1 Regulatory authority

Regulatory authority: Communications and Multimedia Commission.

Rules are defined in SKMM SRSP-549 UWB [i.15].

16.2 UWB Definition

Not specified.

16.3 Applications

Excerpt of [i.15]:

2A UWB communications device is a short range communication device using UWB technology to transmit and/or receive information between devices.

An automotive radar device is a radar device using UWB technology mounted on land transportation vehicles to detect the location and/or movement of persons or objects near the vehicle.

A Radar imaging device is a device using UWB technology used to obtain images of obstructed objects. This includes in-wall and through-wall detection, ground penetrating radar, medical imaging and surveillance devices".

16.4 Requirements

16.4.1 General

Excerpt out of [i.15]:

"*Devices using UWB technology shall be tested for compliance with the technical requirements, following the appropriate techniques for measuring UWB transmissions given in ETSI EN 302 065, ETSI EN 302 066-1 or Recommendation ITU-R SM 1754".*

The operation of devices using UWB technology on aircraft, ship or satellite is not permissible.

Devices using UWB technology shall not cause harmful interference to primary radio communication services operating in the said bands, operate on a non-interference basis and cannot claim protection from these radio communication services".

16.4.2 Communication Devices

Excerpt of [i.15]:

- *"UWB communication device which operates in the frequency band of 3.1 GHz to 10.6 GHz shall only be utilized for communication purposes and shall only be used in confined areas of buildings or localized on-site operations. The use of outdoor mounted antennae is not permissible.*
- *The emission of UWB communication device shall not be intentionally directed outside of the building in which the device is being used.*
- *The transmission of UWB communication devices shall only be permitted when it is in communication with an intended receiver. The device shall cease transmission unless it receives acknowledgment from the intended receiver.*
- *The operation of UWB communication device is not permissible to:*
- *Devices and/or antenna used or connected at outdoor location.*
- *Devices installed in flying models, aircraft or other aviation.*
- *Devices installed in road and rail vehicles".*

16.4.3 Automotive radar devices

Excerpt of [i.15]:

"UWB automotive radar device which operates in the frequency bands of 21.65 GHz to 29.5 GHz and/or 77 GHz to 81 GHz shall be permitted for land transportation only.

The operation of UWB automotive radar device shall only be activated when the land transportation or vehicle is operating.

16.4.4 Imaging Devices

Excerpt of [i.15]:

- *The use of UWB radar imaging device shall be contained within the frequency bands of 30 MHz to 960 MHz and/or 2.17 GHz to 10.6 GHz.*
- *The UWB radar imaging device shall not be used for communication purposes where the radiation into free space is not permissible.*
- *The UWB radar imaging device shall have a deactivation mechanism to deactivate the device when it is interrupted in normal use. This mechanism shall fulfil the following requirements.*
- *Contain a manually operated non-locking switch which ensures that the UWB radar imaging device deactivates (i.e. the transmitter switches off) within 10 seconds of the control system being switched off; and*
- *In the case of remotely/computer controlled imaging equipment, the UWB radar imaging device is deactivated via the control system provided that deactivation takes place within 10 seconds of the control system being switched off.*
- *The UWB ground probing radar device, in-wall probing radar device and through-wall probing radar device shall operate only when in contact with, or within close proximity of the ground or the wall and the emission from these devices shall intentionally be directed towards ground or wall for the purpose of detecting or obtaining the images of objects".*

16.5 Limits

16.5.1 Communication devices

Excerpt of [i.15]:

"UWB communication devices shall operate in the frequency band of 3.1 GHz to 10.6 GHz. The permitted maximum mean and maximum peak e.i.r.p. emission limits for such devices are given in Table 58 below".

Table 58: e.i.r.p. emission limits for communications devices - Malaysia [i.13]

Frequency	***Max. mean e.i.r.p. (dBm/MHz), Effective value RMS***	***Max. peak e.i.r.p. (dBm/MHz), Effective value RMS***
3.1 - 3.4 GHz	*- 70*	*- 36*
3.4 - 3.8 GHz (Note 1)	*- 80*	*- 40*
3.8 - 6.0 GHz	*- 70*	*- 36*
6.0 - 8.5 GHz	*-41.3*	*0*
8.5 - 10.6 GHz	*- 65*	*- 25*

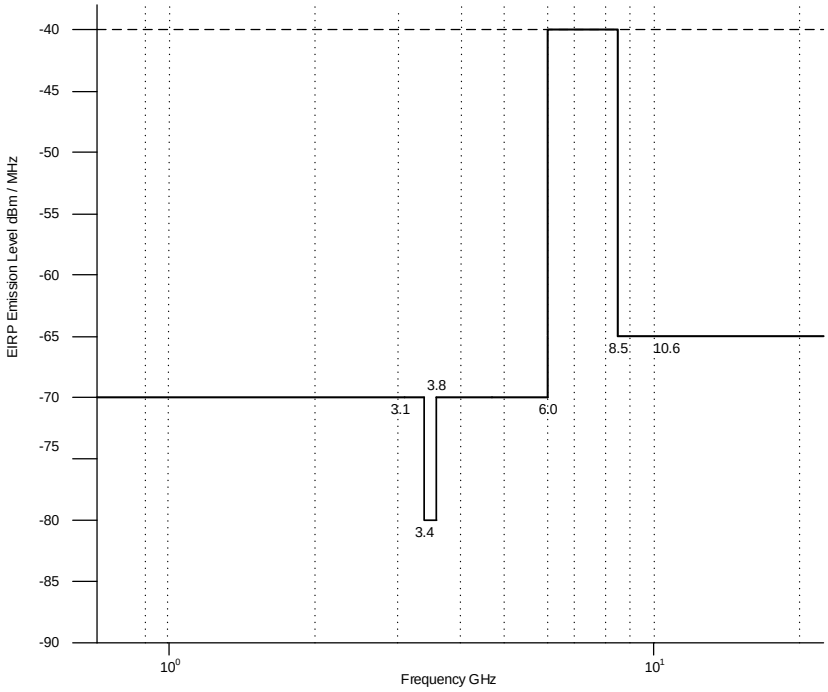

Figure 7: Max mean e.i.r.p. emission limits - communication devices - Malaysia

16.5.2 Automotive radar devices

Excerpt of [i.15]:

"UWB automotive radar devices shall operate in the frequency bands of 21.65 GHz to 29.5 GHz and/or 77 GHz to 81 GHz. The permitted maximum mean and maximum peak e.i.r.p. emission limits for such devices are given in table 59 below:

Table 59: e.i.r.p. emission limits for automotive radar devices - Malaysia [i.13]

Frequency	***Max. mean e.i.r.p. (dBm/MHz), Effective value RMS***	***Max. peak e.i.r.p. (dBm/MHz), Effective value RMS***
21.65 - 22 GHz	*- 61.3*	*- 0*
22 - 29.5 GHz	*- 41.3*	*- 0*
77 - 81 GHz	*- 3*	*- 55*

The emissions within the 23.6 GHz to 24 GHz frequency band that appear 30° or greater above the horizontal plane shall be attenuated by at least 35 dB. The level of attenuation can be achieved through antenna directivity, reduction of output power or any other means.

For the frequency band of 24.00 GHz to 24.25 GHz, narrow band emission with a maximum peak EIRP of 30 dBm is allowed".

16.5.3 Ground, in-wall & through-wall probing devices

Excerpt of [i.15]:

"The permitted maximum mean and maximum peak e.i.r.p emission limits for ground probing radar devices, in-wall probing radar devices, and through-wall probing radar devices is given in Table 60 below:

Table 60: e.i.r.p. emission limits for ground, in-wall & through-wall devices - Malaysia [i.13]

Frequency	Max. mean e.i.r.p. (dBm/MHz), Effective value RMS	Max. peak e.i.r.p. (dBm/MHz), Effective value RMS
3.1 - 3.4 GHz	- 70	- 36
3.4 - 3.8 GHz (Note 1)	- 80	- 40
3.8 - 6.0 GHz	- 70	- 36
6.0 - 8.5 GHz	-41.3	0
8.5 - 10.6 GHz	- 65	- 25

The permitted maximum mean e.i.r.p emission limits for the use of medical imaging device and surveillance device are given in Table 61".

Table 61: e.i.r.p. emission limits for medical imaging devices - Malaysia [i.13]

Frequency	Max. mean e.i.r.p. (dBm/MHz), Effective value RMS	Max. peak e.i.r.p. (dBm/ 50 MHz), Effective value RMS
2.17 - 10.6 GHz	- 41.3	- 30

16.6 Mitigation Techniques

Excerpt of [i.15]:

"The following mitigation techniques are listed:

- *Detect and avoid (DAA) technology: the device detects the presence of signals from other radio systems and reduces its transmitted power down to a level where it does not cause interference to these systems;*
- *Low Duty Cycle (LDC) technique: the device operates by lowering the pulse repetition interval or pulse occupation time; and/or*
- *Any other mitigation techniques as stipulated in the Recommendation ITU-R SM.1757 [i.22] document".*

17 Asia: New Zealand

17.1 Regulatory Authority

Commerce Commission of New Zealand (ComCom).

The rules can be found in New Zealand Gazette, 2/2/2017 [i.16].

17.2 UWB Definition

Excerpt of [i.16]:

"Device transmit bandwidth (-10 dB) is at least 500 MHz or a fractional bandwidth of greater than 0.2".

17.3 Applications

- UWB is prohibited on board of aircrafts.
- Fixed outdoor transmitter or antenna is prohibited.

17.4 Requirements

- A general user radio licence is granted for transmitting devices conforming to the rules.

17.5 Limits

Table 62: e.i.r.p. emission limits - New Zealand [i.14]

Frequency	***Max. e.i.r.p. (dBm/MHz)***	***Max. Peak e.i.r.p. (dBm / 50MHz)***
< 1.6 GHz	*- 90*	*- 50*
1.6 - 2.7 GHz	*- 85*	*- 45*
2.7 - 3.4 GHz(Note 1)	*- 70*	*- 36*
3.4 - 3.8 GHz (Note 1)	*- 80*	*- 40*
3.8 - 4.2 GHz (Note 1)	*- 70*	*- 30*
4.2 - 4.8 GHz (Note 1, 2, 3)	*- 70*	*- 30*
4.8 - 6 GHz	*- 70*	*- 30*
6 - 8.5 GHz (Note 2, 3)	*- 41.3*	*0*
8.5 - 10.6 GHz	*- 65*	*- 25*
> 10.6 GHz	*- 85*	*- 45*

Excerpt of [i.16]:

*"**Note 1:** If Low Duty Cycle (LDC) is implemented a maximum mean e.i.r.p. spectral density of -41.3dBm / MHz and a maximum peak e.i.r.p. of 0 dBm applies.*

***Note 2:** If the devices are **installed in road and rail vehicles**, where transmit power control is implemented a maximum mean e.i.r.p. spectral density is -41.3 dBm / MHz and a maximum peak e.i.r.p. of 0 dBm applies and a transmit power control must operate with a range of 12 dB below the maximum mean e.i.r.p. spectral density.*

***Note 3:** If the devices are **installed in road and rail vehicles**, where transmit power control is not implemented a maximum mean e.i.r.p. of -53.3dBm / MHz and the maximum peak e.i.r.p. of -12 dBm is defined.*

***Note 4:** Within the bands 4.2 – 4.8 GHz and 6.0 – 6.8 GHz, fixed outdoor transmitters installed in-ground are permitted for operation below the horizontal plane with a maximum permitted mean power spectral density of -62 dBm/MHz e.i.r.p.; and a maximum power of -52 dBW e.i.r.p".*

18 Asia: Singapore

18.1 Regulatory authority

Info-Communications Development Authority of Singapore (IDA).

The Singaporean UWB rules are defined in [i.17].

18.2 UWB Definition

Excerpt of [i.17]:

"Devices using UWB technology have intentional radiation from the antenna with either a -10 dB bandwidth of at least 500 MHz or a -10 dB fractional bandwidth greater than 0.2".

18.3 Applications

Excerpt of [i.17]:

"A wide variety of new short-range devices may employ the UWB technology. This includes the use of UWB devices in communications, measurement, location, imaging, surveillance and medical systems".

18.4 Requirements

Outdoor operation from a fixed antenna or a fixed location is not allowed.

Excerpt of [i.17]:

"If the UWB device is operating as a communication system, it shall transmit only when it is sending information to an associated receiver. The UWB device shall cease transmission within 10 seconds unless it receives acknowledgment from the associated receiver. The UWB device must continue to receive an acknowledgement of transmission at least every 10 seconds else it must cease transmitting.

If the UWB device is operating as a non-communication system such as an imaging system, it shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. It is also permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator".

18.5 Limits

18.5.1 Communications Systems

The references for these regulations are ETSI EN 302 065 [i.20] and ECC Decision (06)04 amended 6 July 2007 [i.25].

Table 63: e.i.r.p. emission limits for communication devices - Singapore [i.15]

Frequency	Max e.i.r.p. (dBm/MHz)	Max. Peak e.i.r.p. (dBm / 50MHz)
< 1.6 GHz	*- 90*	*- 50*
1.6 - 2.7 GHz	*- 85*	*- 45*
2.7 - 3.4 GHz	*- 70*	*- 36*
3.4 - 4.2 GHz (Note 1)	*- 70*	*- 30*
4.2 - 4.8 GHz ´(Note 2)	*- 41.3*	*0*
4.8 - 6 GHz	*- 70*	*- 30*
6 - 8.5 GHz (Note 3)	*- 41.3*	*0*
8.5 - 10.6 GHz	*- 65*	*- 25*
> 10.6 GHz	*- 85*	*- 45*

Excerpt of [i.17]:

*"**Note 1:** If appropriate mitigation techniques are implemented, then a mean spectral density of -41.3dBm/MHz and a peak spectral density of 0 dBm /50MHz applies.*

***Note 2:** Conditions in the 4.2 to 4.8 GHz band for equipment using UWB technology without appropriate mitigation techniques are said to be time-limited and to be replaced by more restrictive conditions beyond 31 December 2010.*

***Note 3:** The extension of this band from 6 to 9 GHz is also acceptable in the light of new applications".*

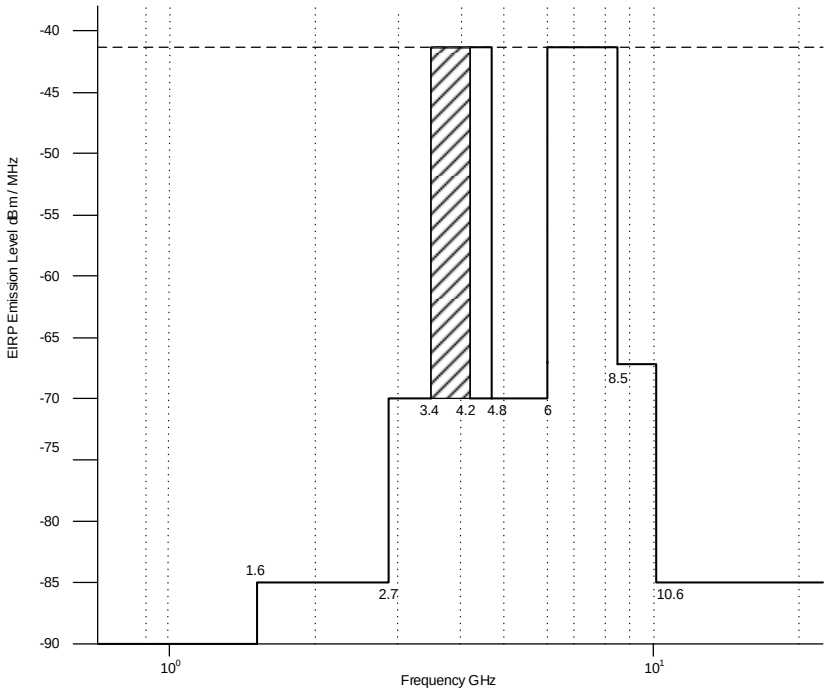

Figure 8: Max mean e.i.r.p. limits for communication devices - Singapore

18.5.2 Radar/Imaging systems

Table 64: e.i.r.p. emission limits for radar devices & imaging systems - Singapore [i.15]

Technical Requirements for Ultra-Wideband (UWB) Imaging Systems based on FCC Part 15 Subpart F (In this Table, unless otherwise stated, the unit of frequency is MHz and the unit of e.i.r.p. is dBm/MHz.)						
Systems / Applications	**GPR and wall imaging**		**Through-wall imaging**		**Surveillance imaging**	**Medical imaging**
Operating bands	Below 960 MHz	Between 3400 and 10600 MHz	Below 960 MHz	Between 3400 MHz and 10600 MHz	Between 3400 MHz and 10600 MHz.	Between 3400 MHz and 10600 MHz.
Radiated emission limits of resolution bandwidth of 1 MHz	See FCC Part 15 § 15.209 for emission limits	*Frequency e.i.r.p.* 960-1610 –65.3 1610-1990 –53.3 1990-3100 –51.3 3100-10600 –41.3 Above 10600 –51.3	*Frequency e.i.r.p.* 960-1610 –65.3 1610-1990 –53.3 Above 1990 –51.3	*Frequency e.i.r.p.* 960-1610 –46.3 1610-1990 –41.3 Above 1990 –51.3	*Frequency e.i.r.p.* 960-1610 –53.3 1610-1990 –51.3 1990-10600 –41.3 Above 10600 –51.3	*Frequency e.i.r.p.* 960-1610 –65.3 1610-1990 –53.3 1990-3100 –51.3 3100-10600 –41.3 Above 10600 –51.3
Limits for resolution bandwidth of no less than 1 kHz		*Frequency e.i.r.p.* 1164-1240 –75.3 1559-1610 –75.3	*Frequency e.i.r.p.* 1164-1240 –75.3 1559-1610 –75.3	*Frequency e.i.r.p.* 1164-1240 –56.3 1559-1610 –56.3	*Frequency e.i.r.p.* 1164-1240 –63.3 1559-1610 –63.3	*Frequency e.i.r.p.* 1164-1240 –75.3 1559-1610 –75.3
Peak level emissions in 50 MHz bandwidth		0 dBm e.i.r.p.	0 dBm e.i.r.p.	0 dBm e.i.r.p.	0 dBm e.i.r.p.	0 dBm e.i.r.p.
Remarks	**The use of UWB imaging system with peak emission below the 960 MHz or in the 3400 to 10600 MHz band shall be approved on an exceptional basis.**					

19 Vietnam

19.1 Regulatory authority

Regulatory is the Ministry of Information and Communications (MIC).

UWB rules are part of the Circular No. 46/2016/TT-BTTTT dated 26 December 2016 [i.33].

19.2 UWB definition

From [i.33]:

An Ultra-Wide Band (UWB) Communication Device is a short-range radio device that is used to transmit data at gigahertz frequencies with a bandwidth of more than 500 MHz.

19.3 Applications

None specifically mentioned.

19.4 Requirements

Device must be used indoors or in an environment that provides equivalent shielding.

Use on airplanes is forbidden.

19.5 Limits

Table 65: e.i.r.p. emission limits Vietnam [i.33]

Frequency (f)	*Mean power (EIRP) spectral density limits*	*Peak power (EIRP) spectral density limits, defined at 50 MHz bandwidth*
f ≤ 1,6 GHz	*-90 dBm/MHz*	*-50 dBm*
1,6 GHz < f ≤ 2,7 GHz	*-85 dBm/MHz*	*-45 dBm*
2,7 GHz < f ≤ 3,1 GHz	*-70 dBm/MHz*	*-36 dBm*
3,1 GHz < f ≤ 3,4 GHz	*-70 dBm/MHz*	*-36 dBm*
3,4 GHz < f ≤ 3,8 GHz	*-80 dBm/MHz*	*-40 dBm*
3,8 GHz < f ≤ 4,2 GHz	*-70 dBm/MHz*	*-30 dBm*
4,8 GHz < f ≤ 6 GHz	*-70 dBm/MHz*	*-30 dBm*
6 GHz < f ≤ 8,5 GHz	*-41,3 dBm/MHz*	*0 dBm*
8,5 GHz < f ≤ 9 GHz	*-65 dBm/MHz*	*-25 dBm*
9 GHz < f ≤ 10,6 GHz	*-65 dBm/MHz*	*-25 dBm*
f > 10,6 GHz	*-85 dBm/MHz*	*-45 dBm*

20 Summary Application Support

Table 66: Overview of defined applications

Region	Country	Indoor	Fixed Outdoor	Automotive	Radar
Americas, North	**Canada**	Yes RSS-220	No	?	Ground probing: RSS-220 [i.8] In-wall: RSS-220 [i.8] Through-wall: RSS-220 [i.8] Surveillance: RSS-220 [i.8] Medical Imaging: RSS-220 [i.8]
	US	Yes §15.517 [i.9] §15.519 [i.9]	With Waiver only	Yes §15.250 [i.9]	Ground probing: §15.509 [i.9] Through-wall, Surveillance, Medical Imaging, Vehicular.
Americas, South	**Brazil**	Yes	No	?	Medical imaging
EMEA	**EC**	Yes ETSI EN 302 065-1 [i.1]	Partly ETSI EN 302 065-2 [i.2]	Yes ETSI EN 302 065-3 [i.3]	Ground probing: ETSI ETSI EN 302 066 [i.6] and [i.7]
	Qatar	Yes	?	?	
	Saudi Arabia	Yes	Partly	Yes	
	Switzerland	Yes	Partly	Yes	
	UAE	Yes	?	?	BMA, TLPR
Asia	**Australia**	Yes	Partly	Yes	
	China	Yes	Yes	Yes	
	Japan	Yes	No	?	
	Korea	Yes	No	Yes	
	Malaysia	Yes	Partly	Yes	
	New Zealand	Yes	No	Yes	
	Singapore	Yes	No	Yes	GPR
	Vietnam	Yes	No	?	

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