CEPT ECC
Electronic Communications Committee

ECC Decision (07)01

The harmonised use, exemption from individual licensing and free circulation of Material Sensing Devices using Ultra-Wideband (UWB) technology[1]

approved 30 March 2007

updated 1 July 2022

[1] Comparable technical specifications to those in this ECC Decision are given in Decision (EU) 2019/785. EU member states and, if so approved by the EEA Joint Committee, Iceland, Liechtenstein and Norway are obliged to implement the EC Decision

EXPLANATORY MEMORANDUM

1 INTRODUCTION

This ECC Decision has been developed in response to market demands for Material Sensing devices using UWB technology. The ECC Decision should ensure that frequency bands are available on a harmonised basis to enable the introduction of UWB devices in a timely manner and ensuring economies of scale while ensuring protection of existing applications or services.

It should be noted that this ECC Decision is designed to be part of a "regulatory package" on UWB, with various regulatory and legal provisions. The generic regulation for UWB devices in Europe consists of Decision ECC Decision (06)04 and was developed to respond primarily to the core market demand for communication applications and cable replacement. It enables also various types of radiodetermination applications using UWB technology in bands below 10.6 GHz e.g. location-tracking, sensor technologies. In addition, Decision ECC Decision(06)08 on the conditions for use of the radio spectrum by Ground- and Wall- Probing Radar (GPR/WPR) imaging systems was developed to respond to a specific UWB requirement that shall be subject to an appropriate licensing regime.

In CEPT Report 10 developed in response to an EC Mandate on UWB Specific Applications, it was emphasised that the generic UWB regulation shall remain the cornerstone of European regulatory package on UWB. Additional ECC Decisions for specific UWB applications, which could result in confusion for the industry, spectrum users and market surveillance authorities, should be avoided.

Requirements from the industry for specific UWB applications ought obviously to be considered for applications with clear benefits from using UWB technology that cannot fit under the generic Decision on UWB. The use of UWB technology in accurate imaging applications is expected to be the main application for which the development of specific UWB regulations can be justified because of physical reasons (e.g. reflections of clutter and penetration depth). The narrow pulses used by UWB imaging systems enable them to make sophisticated signal measurements, allowing material differentiation and analysis in 3-dimensional immediate vicinity on a millimetre-level positioning.

Material sensing devices will have a direct impact in a number of markets, such as workplace, security, and manufacturing. Development of this market will depend on the high accuracy and reliability provided by UWB systems.

Users of material sensing devices include skilled workers, experts, art historians, architects, planners, environmentalists, civil engineers as well as ordinary DIYs ("do-it-yourself"). The markets and applications for this technology are expected to primarily involve professional usage and low density deployments.

2 BACKGROUND

In response to demands brought to the attention of ECC by industry, harmonised frequency bands are required for the introduction of material sensing devices ensuring economies of scale and a harmonised introduction of these devices inside CEPT.

Material sensing Devices can use the generic UWB regulation in ECC Decision (06)04 without any violation of the technical requirements set out in the generic UWB regulation.

It should be noted that the generic UWB regulation excludes fixed outdoor installations. Emissions into the air from a material sensing device shall not exceed the limits of the generic UWB regulation. Material sensing devices have to fulfil the mitigation techniques defined in the generic rules.

This approach supports the over-all harmonisation of the UWB regulatory framework. Furthermore, the deployment of these devices in the core UWB bands 3.1 to 4.8 GHz and 6.0 to 9.0 GHz would be encouraged.

Material sensing devices are split into two classes of sensing and imaging devices. These classes are:

- Contact-based sensors and imaging devices. The UWB transmitter is only switched on when in direct contact with the material under investigation;
- Non-contact-based sensor and imaging devices. The UWB transmitter is only switched on when in close proximity with the investigated material and the UWB transmitter is directed into the direction of the material under investigation (e.g. manually, by using a proximity sensor or by mechanical design).

The detailed compatibility studies performed by CEPT considered the specific deployment scenarios and mitigation factors of material sensing devices and have led to highly specific requirements in different frequency bands, taking into account specificities of the victim services and operational requirements for material sensing devices.

3 REQUIREMENT FOR AN ECC DECISION

The allocation or designation of frequency bands under specified conditions in CEPT member countries is laid down by law, regulation or administrative action. ECC Decisions are required to deal with the carriage and use of equipment throughout Europe. The ECC also recognises that for UWB devices to be introduced successfully throughout Europe, confidence must be given on the one hand to manufacturers to make the necessary investment in the new pan European Radiocommunications systems and services and on the other hand to users of existing services that their protection will be ensured.

The harmonisation on a European basis would support the aims of Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment.

A commitment by CEPT member countries to implement an ECC Decision will provide a clear indication that the required frequency range will be made available on time and on a Europe-wide basis and that the means to ensure protection of existing services will be applied.

ECC DECISION OF 30 MARCH 2007 ON MATERIAL SENSING DEVICES USING ULTRA-WIDEBAND (UWB) TECHNOLOGY (ECC DECISION(07)01), AMENDED ON 8 MARCH 2019 AND LATEST UPDATED ON 1 JULY 2022

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that Decision (EU) 2019/785 on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community defines conditions of use of the spectrum for material sensing devices;

b) that Ultra-Wideband (UWB) technology shall mean technology for short-range radiocommunication, involving the intentional generation and transmission of radio-frequency energy that spreads over a very large frequency range, which may overlap several frequency bands allocated to radiocommunication services;

c) that the generic UWB regulation consisting of Decision ECC Decision(06)04 should primarily be used for applications using UWB technology in bands below 10.6 GHz;

d) that, in order to allow the introduction of material sensing devices using UWB technology within the CEPT, the use of the frequency range 2.2 to 8.5 GHz has been requested by the industry because:

- there is a need for higher emission limits than those contained in ECC Decision(06)04 in certain frequency ranges;
- a larger bandwidth is required for spatial resolution;
- lower frequency bands are required for material penetration and clutter suppression;
- the technology is available;

e) that the radiated emissions of material sensing devices are intended to be transmitted into a structure or material for the purpose of detecting the location of objects within the structure or to determine the physical properties of the material;

f) that a regulatory framework for specific licence-exempt material sensing devices using UWB technology will enable the operation of such devices as well as other types of radiodetermination applications with similar characteristics;

g) that CEPT Report 69 in response to the Permanent Mandate to CEPT on Ultra-wideband technology includes a review of the regulatory approach for material sensing devices and concluded that an approach in a more neutral fashion is needed in order to allow for innovative material sensing solutions;

h) that CEPT Report 69 also clarified the possibility to use the generic UWB regulation in ECC Decision (06)04 for material sensing applications without any violation of the technical requirements set out in the generic UWB regulation;

i) that these material sensing devices are not intended for communications purposes;

j) that the consideration of the specific deployment scenarios and mitigation factors of material sensing devices has led to specific requirements in different frequency bands, taking into account also specificities of the victim services and operational requirements for material sensing devices compared to the generic regulation for UWB;

k) that technical requirements for LBT mechanisms given in this ECC Decision need to be supplemented by adequate guidance on LBT measurement procedures and test patterns as defined in the relevant Harmonised European Standard EN 302 065-4-1 adopted under Directive 2014/53/EU.

l) that the LBT mechanism for material sensing devices may not be fully efficient to detect meteorological radars in some of their specific operational modes but that, recognising the low activity factor of material

sensing devices, potential corresponding interference situations are assumed as relating to very low interference probability;

m) that the efficiency of LBT may need to be further investigated for the protection of mobile terminals in idle mode;

n) that the aggregate power in radio astronomy receivers that would result from the operation of licence-exempt material sensing devices in bands allocated to the Radio Astronomy Service may exceed the threshold levels of interference detrimental to radio astronomy observations given in ITU-R Recommendation RA.769;

o) that administrations are encouraged to monitor the impact of material sensing devices on radiocommunication services, especially on RAS;

p) that in EU/EFTA countries the radio equipment that is under the scope of this Decision shall comply with the RE Directive. Conformity with the essential requirements of the RE Directive may be demonstrated by compliance with the applicable relevant versions of the Harmonised European Standard EN 302 065 or by using the other conformity assessment procedures set out in the RE Directive.

DECIDES

1. that this ECC Decision defines harmonised conditions for the use in CEPT countries of material sensing devices using UWB technology;
2. that, for the purpose of this Decision, material sensing devices using UWB technology are split into two classes of sensing and imaging devices. These classes are::

   a) Contact-based sensors and imaging devices. The UWB transmitter is only switched on when in direct contact with the material under investigation;
   b) Non-contact-based sensor and imaging devices. The UWB transmitter is only switched on when in close proximity with the investigated material and the UWB transmitter is directed into the direction of the material under investigation (e.g. manually, by using a proximity sensor or by mechanical design).

3. that the devices permitted under this ECC Decision are exempt from individual licensing and shall operate on a non-interference, non-protected basis;
4. that CEPT administrations shall exempt from individual licensing and allow free circulation and use of material sensing devices using UWB technology;
5. that the technical requirements detailed in Annex 1 apply to material sensing device devices permitted under this ECC Decision;
6. that this Decision **enters into force** on 8 March 2019;
7. that the preferred **date for implementation** of this Decision shall be 8 September 2019;
8. that CEPT **administrations shall** communicate the **national measures** implementing this Decision to the ECC Chairman and the Office when this ECC Decision is nationally implemented."

Note:

Please check the Office documentation database https://docdb.cept.org/ for the up to date position on the implementation of this and other ECC Decisions.

ANNEX 1: TECHNICAL REQUIREMENTS FOR MATERIAL SENSING DEVICES USING UWB TECHNOLOGY

In the following Tables 1 to 3, the harmonised limits including the mitigation techniques are depicted.

Emissions radiating from material sensing devices permitted under this Decision shall be kept to a minimum and in any case not exceed the emission limits within the following Tables. The compliance with the limits has to be ensured with the device on a representative structure of the investigated material. The limits defined in Tables 1 and 2 are applicable in all environments for material sensing devices, only note 4 in Tables 1 and 2 excludes fixed outdoor application in some applicable frequency ranges.

Table 1: Limits for contact based UWB material sensing devices

Frequency range	Maximum mean e.i.r.p. spectral density	Maximum peak e.i.r.p. (defined in 50 MHz)
Below 1.73 GHz	-85 dBm/MHz (see note 1)	-45 dBm
1.73 to 2.2 GHz	-65 dBm/MHz	-25 dBm
2.2 to 2.5 GHz	-50 dBm/MHz	-10 dBm
2.5 to 2.69 GHz	-65 dBm/MHz (see notes 1 and 2)	-25 dBm
2.69 to 2.7 GHz (see note 3)	-55 dBm/MHz (see note 2*)	-15 dBm
2.7 to 2.9 GHz	-70 dBm/MHz (see note 1)	-30 dBm
2.9 to 3.4 GHz	-70 dBm/MHz (see notes 1, 5 and 5*)	-30 dBm
3.4 to 3.8 GHz (see note 3)	- 50 dBm/MHz (see notes 2, 5 and 5*)	-10 dBm
3.8 to 4.8 GHz	- 50 dBm/MHz (see notes 5 and 5*)	-10 dBm
4.8 to 5.0 GHz (see note 3)	-55 dBm/MHz (see notes 2 and 2*)	-15 dBm
5.0 to 5.25 GHz	-50 dBm/MHz	-10 dBm
5.25 to 5.35 GHz	-50 dBm/MHz	-10 dBm
5.35 to 5.6 GHz	-50 dBm/MHz	-10 dBm
5.6 to 5.65 GHz	-50 dBm/MHz	-10 dBm
5.65 to 5.725 GHz	-50 dBm/MHz	-10 dBm
5.725 to 6.0 GHz	-50 dBm/MHz	-10 dBm
6.0 to 8.5 GHz	-41.3 dBm/MHz (see note 4)	-0 dBm
8.5 to 9.0 GHz	-65 dBm/MHz (see note 5*)	-25 dBm
9.0 to 10.6 GHz	-65 dBm/MHz	-25 dBm

Frequency range	Maximum mean e.i.r.p. spectral density	Maximum peak e.i.r.p. (defined in 50 MHz)
Above 10.6 GHz	-85 dBm/MHz	-45 dBm

NOTE 1: Devices using a Listen Before Talk (LBT) mechanism or other equivalent mechanisms, as described in the Harmonised European Standard ETSI EN 302 065-4-1 are permitted to operate in frequency range 1.215 GHz to 1.73 GHz with a maximum mean e.i.r.p. spectral density of -70 dBm/MHz and in the frequency ranges 2.5 GHz to 2.69 GHz and 2.7 GHz to 3.4 GHz with a maximum mean e.i.r.p. spectral density of -50 dBm/MHz. and a maximum peak e.i.r.p of -10dBm/50MHz.

NOTE 2: To protect the radio services as defined by the ITU Radio Regulations, non-fixed installations must fulfil the following requirement for total radiated power spectral density:
a) In the frequency ranges 2.5 GHz to 2.69 GHz and 4.8 GHz to 5 GHz, the total radiated power spectral density has to be 10 dB below the max e.i.r.p. spectral density.
b) In the frequency ranges 3.4 GHz to 3.8 GHz, the total radiated power spectral density has to be 5 dB below the max e.i.r.p. spectral density.

NOTE 2*: To protect the frequency bands 2.69 GHz to 2.7 GHz and 4.8 GHz to 5 GHz used by the radio astronomy service, the total radiated power spectral density has to be below -65 dBm/MHz.

NOTE 3: Limitation of the Duty Cycle to 10 % per second.

NOTE 4: No fixed outdoor permitted.

NOTE 5: Within the band 3.1 GHz – 4.8 GHz, devices implementing Low Duty Cycle (LDC) mitigation technique are permitted to operate with a maximum mean e.i.r.p. spectral density of -41.3 dBm/MHz and a maximum peak e.i.r.p. of 0 dBm defined in 50 MHz. The LDC mitigation technique and its limits is defined in the relevant version of the Harmonised European Standard ETSI EN 302 065-1. When LDC is implemented, Note 4 applies.

NOTE 5*: Within the bands 3.1 GHz – 4.8 GHz and 8.5 GHz - 9 GHz, devices implementing Detect And Avoid (DAA) mitigation technique are permitted to operate with a maximum mean e.i.r.p. spectral density of -41.3 dBm/MHz and a maximum peak e.i.r.p. of 0 dBm defined in 50 MHz. The DAA mitigation technique and its limits is defined in the relevant version of the Harmonised European Standard EN 302 065-1. When DAA is implemented, Note 4 applies.

Table 2: Limits for non-contact based UWB material sensing devices

Frequency range	Maximum mean e.i.r.p. spectral density	Maximum peak e.i.r.p. (defined in 50 MHz)
Below 1.73 GHz	-85 dBm/MHz (see note 1)	-60 dBm
1.73 to 2.2 GHz	- 70 dBm/MHz	-45 dBm
2.2 to 2.5 GHz	-50 dBm/MHz	-25 dBm
2.5 to 2.69 GHz	-65 dBm/MHz (see notes 1 and 2)	-40 dBm
2.69 to 2.7 GHz (see note 3)	-70 dBm/MHz (see note 2*)	-45 dBm
2.7 to 2.9 GHz	- 70 dBm/MHz (see note 1)	-45 dBm
2.9 to 3.4 GHz	-70 dBm/MHz (see note 1, 5 and 5*)	-45 dBm
3.4 to 3.8 GHz (see note 3)	- 70 dBm/MHz (see notes 2, 5 and 5*)	-45 dBm
3.8 to 4.8 GHz	-50 dBm/MHz (see notes 5 and 5*)	-25 dBm
4.8 to 5.0 GHz (see note 3)	-55 dBm/MHz (see notes 2 and 2*)	-30 dBm
5.0 to 5.25 GHz	-55 dBm/MHz	-30 dBm

Frequency range	Maximum mean e.i.r.p. spectral density	Maximum peak e.i.r.p. (defined in 50 MHz)
5.25 to 5.35 GHz	-50 dBm/MHz	-25 dBm
5.35 to 5.6 GHz	-50 dBm/MHz	-25 dBm
5.6 to 5.65 GHz	-50 dBm/MHz	-25 dBm
5.65 to 5.725 GHz	-65 dBm/MHz	-40 dBm
5.725 to 6.0 GHz	-60 dBm/MHz	-35 dBm
6.0 to 8.5 GHz	-41.3 dBm/MHz (see note 4)	0 dBm
8.5 to 9.0 GHz	-65 dBm/MHz (see note 5*)	-25 dBm
9.0 to 10.6 GHz	-65 dBm/MHz	-25 dBm
Above 10.6 GHz	-85 dBm/MHz	-45 dBm

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a) In the frequency ranges 2.5 GHz to 2.69 GHz and 4.8 GHz to 5 GHz, the total radiated power spectral density has to be 10 dB below the max e.i.r.p. spectral density.

b) In the frequency ranges 3.4 GHz to 3.8 GHz, the total radiated power spectral density has to be 5 dB below the max e.i.r.p. spectral density.

NOTE 2*: To protect the frequency bands 2.69 GHz to 2.7 GHz and 4.8 GHz to 5 GHz used by the radio astronomy service, the total radiated power spectral density has to be below -65 dBm/MHz.

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Peak power threshold values for the “Listen Before Talk” (LBT) mechanism to ensure the protection of the listed radio services are defined within Table 3 below.

Table 3: Technical Requirements of the “Listen Before Talk” Mechanism for Material Sensing Devices

Frequency range	Radio service to be detected	Peak power threshold value
1.215-1.4 GHz	Radiodetermination Service	+8 dBm/MHz
1.61-1.66 GHz	Mobile Satellite service	-43 dBm/MHz
2.5-2.69 GHz	Land mobile service	-50 dBm/MHz
2.9-3.4 GHz	Radiodetermination service	-7 dBm/MHz

Additional requirements for Radar detection: Continuously listening and automatic switch-off within 10ms for the related frequency range if the threshold value is exceeded (Table 3). A silent time of at least 12s while

listening continuously is necessary before the transmitter can be switched on again. This silent time during which only the LBT receiver is active has to be ensured even after the device is switched off.

OTHER REQUIREMENTS

- **Pulse Repetition Frequency (PRF)**

  The pulse repetition frequency (PRF) for pulsed UWB devices shall not be less than 5MHz. This restriction does not apply to burst repetition frequency.

- **Maximum Peak Power**

  The peak e.i.r.p. (in dBm) measured in a bandwidth of 50MHz shall be less than a limit that is obtained by adding a conversion factor (in dB) to the 'maximum mean e.i.r.p. spectral density' (in dBm/MHz) limit. The default conversion factors are in Tables 1 and 2 of this Annex for contact-based and non-contact based material sensing devices.

DEFINITIONS

- **Maximum mean e.i.r.p. spectral density**

  The highest signal strength measured in any direction at any frequency within the defined range. The mean e.i.r.p. spectral density is measured with a 1MHz resolution bandwidth, an RMS detector and an averaging time of 1ms or less.

- **Maximum peak e.i.r.p.**

  The highest signal strength measured in any direction at any frequency within the defined range. 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.

- **Total radiated power spectral density**

  The average of the mean e.i.r.p. spectral density values measured over a sphere around the measurement scenario with a resolution of at least 15 degree. The detailed measuring setup is contained within ETSI EN 302 065-4-1.

- **Representative wall**

  The radiations into the air as a result of the operation of material sensing devices are highly dependent on the operational conditions and are only meaningful if coupled with the material being investigated; therefore a measurement scenario with a representative structure is necessary and is defined within ETSI EN 302 065-4-1. For material sensing devices investigating wall structures; the representative wall has to meet the wall attenuation values within Table 4 of this Decision:

Table 4: Representative wall

Frequency GHz	Wall attenuation values for the representative wall dB		
	Min.	Average	Max.
1	5	7	9
2	8	10	12
3	10	12	14
4	12	14	16
5	14	16	18
6	16	18	20
7	18	20	22
8	20	22	24