



MALTA COMMUNICATIONS AUTHORITY


## **Twenty-First Schedule to Decision No. MCA/D-22-4662**

*Apparatus General Authorisation for Apparatus using Ultra-Wideband (UWB) Technology*

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## Revision History of the Twenty-First Schedule

### Apparatus using ultra-wideband technology

Date	Comments
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**This Schedule shall be read and construed as one with  
Part I and Part II of Decision No. MCA/D/22-4662**

**Adopted pursuant to Article 30A of the  
Electronic Communications (Regulation) Act (Cap. 399)  
establishing the radiocommunications apparatus  
general authorisation**

## Article 1 – Applicability

This apparatus general authorisation applies to any person installing or using radiocommunications apparatus using ultra-wideband technology or any apparatus intended to be used as a component part of that apparatus.

## Article 2 – Interpretation

In this Schedule unless the context otherwise requires:

- (1) "apparatus using ultra-wideband technology" or "apparatus using UWB technology" means apparatus incorporating, as an integral part or as an accessory, technology for short-range radiocommunication, involving the intentional generation and transmission of radio-frequency energy that spreads over a frequency range wider than 50 MHz, which may overlap several frequency bands allocated to radiocommunication services;
- (2) "Directive 2007/46/EC" means Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles;
- (3) "indoors" means inside buildings or places in which the shielding will typically provide the necessary attenuation to protect radiocommunication services against harmful interference;
- (4) "LT1" means systems intended for general location tracking of people and objects that can be put into service on an unlicensed basis;
- (5) "maximum mean power spectral density" means the average power per unit bandwidth (centred on that frequency) radiated in the direction of the maximum level under the specified conditions of measurement and which is specified as e.i.r.p. of the radio device under test at a particular frequency;
- (6) "motor vehicle" has the same meaning as set out in Article 3(11) of Directive 2007/46/EC;
- (7) "on-board aircraft" means the use of radio links for communications purposes inside an aircraft;
- (8) "peak power" means the power contained within a 50 MHz bandwidth at the frequency at which the highest mean radiated power occurs, radiated in the direction of the maximum level under the specified conditions of measurement and which is specified as e.i.r.p.;
- (9) "railway vehicle" has the same meaning as set out in Article 3(1)(4) of Regulation (EU) 2018/643;

- (10) "Regulation (EU) 2018/643" means Regulation (EU) 2018/643 of the European Parliament and of the Council of 18 April 2018 on rail transport statistics;
- (11) "total radiated power spectral density" or "TRPsd" means the average of the mean radiated power spectral density (e.i.r.p.) values measured with a resolution of 15 degrees over a sphere around the apparatus using UWB technology (generic or vehicular use) or around the use case-related scenario (as indirect emissions from the apparatus using UWB technology determining materials; and
- (12) "UWB" means ultra-wideband.

### **Article 3 – Minimum technical parameters**

Apparatus using UWB technology shall meet the conditions set out in the Annex to this Schedule.

### **Article 4 – Minimum technical parameters**

- (1) Apparatus using UWB technology meeting the conditions specified in this Schedule shall be used indoors or, if it is used outdoors, it is not attached to a fixed installation, a fixed infrastructure or a fixed outdoor antenna.
- (2) Where explicitly permitted in the Annex to this Schedule, apparatus using UWB technology meeting the conditions specified in this Schedule may also be used in motor and railway vehicles or be attached to a fixed installation or fixed infrastructure or be used with a fixed outdoor antenna.

## Annex to the Twenty-First Schedule

### Minimum Technical Parameters for Apparatus using Ultra-Wideband technology

#### 1. Generic UWB usage

Technical requirements		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
$f \leq 1.6$ GHz	-90 dBm/MHz	-50 dBm
$1.6 < f \leq 2.7$ GHz	-85 dBm/MHz	-45 dBm
$2.7 < f \leq 3.1$ GHz	-70 dBm/MHz	-36 dBm
$3.1 < f \leq 3.4$ GHz	-70 dBm/MHz or -41.3 dBm/MHz using LDC <sup>(1)</sup> or DAA <sup>(2)</sup>	-36 dBm or 0 dBm
$3.4 < f \leq 3.8$ GHz	-80 dBm/MHz or -41.3 dBm/MHz using LDC <sup>(1)</sup> or DAA <sup>(2)</sup>	-40 dBm or 0 dBm
$3.8 < f \leq 4.8$ GHz	-70 dBm/MHz or -41.3 dBm/MHz using LDC <sup>(1)</sup> or DAA <sup>(2)</sup>	-30 dBm or 0 dBm
$4.8 < f \leq 6$ GHz	-70 dBm/MHz	-30 dBm
$6 < f \leq 8.5$ GHz	-41.3 dBm/MHz	0 dBm
$8.5 < f \leq 9$ GHz	-65 dBm/MHz or -41.3 dBm/MHz using DAA <sup>(2)</sup>	-25 dBm or 0 dBm
$9 < f \leq 10.6$ GHz	-65 dBm/MHz	-25 dBm
$f > 10.6$ GHz	-85 dBm/MHz	-45 dBm

**Notes:**

(1) Within the 3.1 GHz to 4.8 GHz band.  
The Low Duty Cycle ('LDC') mitigation technique and its limits are set out in clauses 4.5.3.1, 4.5.3.2 and 4.5.3.3 of ETSI Standard EN 302 065-1 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements specified in this Schedule.

(2) Within the 3.1 GHz to 4.8 GHz and 8.5 GHz to 9 GHz bands.  
The Detect and Avoid ('DAA') mitigation technique and its limits are defined in clauses 4.5.1.1, 4.5.1.2 and 4.5.1.3 of ETSI Standard EN 302 065-1 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements specified in this Schedule.

The technical requirements specified in the table above shall not apply to:

- (1) apparatus and infrastructure used at a fixed outdoor location or connected to a fixed-outdoor antenna;
- (2) apparatus installed in flying models, aircraft and other aviation; and
- (3) apparatus installed in road and railway vehicles.

## 2. Location tracking systems type 1 (LT1)

Technical requirements		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
$f \leq 1.6$ GHz	-90 dBm/MHz	-50 dBm
$1.6 < f \leq 2.7$ GHz	-85 dBm/MHz	-45 dBm
$2.7 < f \leq 3.4$ GHz	-70 dBm/MHz	-36 dBm
$3.4 < f \leq 3.8$ GHz	-80 dBm/MHz	-40 dBm
$3.8 < f \leq 6.0$ GHz	-70 dBm/MHz	-30 dBm
$6 < f \leq 8.5$ GHz	-41.3 dBm/MHz	0 dBm
$8.5 < f \leq 9$ GHz	-65 dBm/MHz or -41.3 dBm/MHz using DAA <sup>(1)</sup>	-25 dBm or 0 dBm
$9 < f \leq 10.6$ GHz	-65 dBm/MHz	-25 dBm
$f > 10.6$ GHz	-85 dBm/MHz	-45 dBm

**Notes:**

(1) The DAA mitigation technique and its limits are defined in clauses 4.5.1.1, 4.5.1.2 and 4.5.1.3 of ETSI Standard EN 302 065-2 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements specified in this Schedule.

### 3. Apparatus using UWB technology installed in motor and railway vehicles

#### 3.1 General technical requirements

Technical requirements		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
$f \leq 1.6$ GHz	-90 dBm/MHz	-50 dBm
$1.6 < f \leq 2.7$ GHz	-85 dBm/MHz	-45 dBm
$2.7 < f \leq 3.1$ GHz	-70 dBm/MHz	-36 dBm
$3.1 < f \leq 3.4$ GHz	-70 dBm/MHz or -41.3 dBm/MHz using LDC <sup>(1)</sup> + e.i. <sup>(4)</sup> or -41.3 dBm/MHz using TPC <sup>(3)</sup> + DAA <sup>(2)</sup> + e.i. <sup>(4)</sup>	-36 dBm or $\leq 0$ dBm or $\leq 0$ dBm
$3.4 < f \leq 3.8$ GHz	-80 dBm/MHz or -41.3 dBm/MHz using LDC <sup>(1)</sup> + e.i. <sup>(4)</sup> or -41.3 dBm/MHz using TPC <sup>(3)</sup> + DAA <sup>(2)</sup> + e.i. <sup>(4)</sup>	-40 dBm or $\leq 0$ dBm or $\leq 0$ dBm
$3.8 < f \leq 4.8$ GHz	-70 dBm/MHz or -41.3 dBm/MHz using LDC <sup>(1)</sup> + e.i. <sup>(4)</sup> or -41.3 dBm/MHz using TPC <sup>(3)</sup> + DAA <sup>(2)</sup> + e.i. <sup>(4)</sup>	-30 dBm or $\leq 0$ dBm or $\leq 0$ dBm
$4.8 < f \leq 6$ GHz	-70 dBm/MHz	-30 dBm
$6 < f \leq 8.5$ GHz	-53.3 dBm/MHz or -41.3 dBm/MHz using LDC <sup>(1)</sup> + e.i. <sup>(4)</sup> or -41.3 dBm/MHz using TPC <sup>(3)</sup> + e.i. <sup>(4)</sup>	-13.3 dBm or $\leq 0$ dBm or $\leq 0$ dBm
$8.5 < f \leq 9$ GHz	-65 dBm/MHz or -41.3 dBm/MHz using TPC <sup>(3)</sup> + DAA <sup>(2)</sup> + e.i. <sup>(4)</sup>	-25 dBm or $\leq 0$ dBm
$9 < f \leq 10.6$ GHz	-65 dBm/MHz	-25 dBm
$f > 10.6$ GHz	-85 dBm/MHz	-45 dBm

**Notes:**

- <sup>(1)</sup> The LDC mitigation technique and its limits are defined in clauses 4.5.3.1, 4.5.3.2 and 4.5.3.3 of ETSI Standard EN 302 065-3 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements specified in this Schedule.



**Notes:**

- (2) The DAA mitigation technique and its limits are defined in clauses 4.5.1.1, 4.5.1.2 and 4.5.1.3 of ETSI Standard EN 302 065-3 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements specified in this Schedule.
- (3) The Transmit Power Control ('TPC') mitigation technique and its limits are defined in clauses 4.7.1.1, 4.7.1.2 and 4.7.1.3 of ETSI Standard EN 302 065-3 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the conditions specified in this Schedule.
- (4) The exterior limit (e.l.)  $\leq -53.3$  dBm/MHz is required. The exterior limit is defined in clauses 4.3.4.1, 4.3.4.2 and 4.3.4.3 of ETSI Standard EN 302 065-3 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the conditions specified in this Schedule.

**3.2 Specific technical requirements for vehicular access systems using trigger-before-transmit**

Technical requirements to be used within the bands 3.8-4.2 GHz and 6-8.5 GHz for vehicular access systems using trigger-before-transmit are set out in the following table.

Technical requirements		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
$3.8 < f \leq 4.2$ GHz	-41.3 dBm/MHz with trigger-before-transmit operation and LDC $\leq 0.5\%$ (in 1hour)	0 dBm
$6 < f \leq 8.5$ GHz	-41.3 dBm/MHz with trigger-before-transmit operation and LDC $\leq 0.5\%$ (in 1hour) or TPC	0 dBm

'Trigger-before-transmit' mitigation is defined as a UWB transmission that is only initiated when necessary, specifically where the system indicates that apparatus using UWB technology are nearby. The communication is either triggered by a user or by the vehicle. The subsequent communication can be considered as 'triggered communication'. The existing LDC mitigation applies (or alternatively TPC in the 6 GHz to 8.5 GHz range). An exterior limit requirement must not be applied when using the trigger-before-transmit mitigation technique for vehicular access systems.

Trigger-before-transmit mitigation techniques that provide an appropriate level of performance in order to comply with the essential requirements of Directive 2014/53/EU shall be used for vehicular access systems. If relevant techniques are described in harmonised standards or parts thereof the references of which have been published in the *Official Journal of the European Union* under Directive 2014/53/EU, performance at least equivalent to these techniques shall be ensured. These techniques shall respect the technical requirements specified in this Schedule.

### 3.3 Technical requirements for other vehicular applications in the 6-8.5 GHz band including applications that involve infrastructure-to-vehicle and vehicle-to-vehicle communications

The technical requirements in the table below are applicable to vehicular applications operating in the 6-8.5 GHz band, including applications that involve infrastructure-to-vehicle and vehicle-to-vehicle communications. The technical requirements applicable to emissions below 6 GHz and above 8.5 GHz are those set out in the table in section 3.1 of the Annex to this Schedule.

Technical requirements		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
6.0 < f ≤ 8.5 GHz <sup>(1), (2)</sup>	-41.3 dBm/MHz	0 dBm
<b>Notes:</b> (1) Within the 6-8.5 GHz band. The following additional requirements apply to fixed outdoor installations supporting communication with apparatus using UWB technology installed in road and railway vehicles: Antennas are directive, down tilted and installed at a maximum height of 10 m. The duty cycle is limited to maximum 5% per second. (2) Within the 6-8.5 GHz band. The following additional requirements apply to apparatus using UWB technology installed in road and railway vehicles: Antennas are installed at a maximum height of 4 m. The duty cycle is limited to maximum 1% per second.		

## 4. Specific radiodetermination, location tracking, tracing and data acquisition applications in the 6-8.5 GHz band

### 4.1 Specific applications that involve fixed outdoor installations

The technical requirements in the table below are applicable to apparatus and infrastructure used at a fixed outdoor location or connected to a fixed outdoor antenna and supporting radiodetermination, location tracking, tracing or data acquisition applications operating in the 6-8.5 GHz band.

Technical requirements		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
$f \leq 1.6$ GHz	-90 dBm/MHz	-50 dBm
$1.6 < f \leq 2.7$ GHz	-85 dBm/MHz	-45 dBm
$2.7 < f \leq 3.1$ GHz	-70 dBm/MHz	-36 dBm
$3.1 < f \leq 3.4$ GHz	-70 dBm/MHz	-36 dBm
$3.4 < f \leq 3.8$ GHz	-80 dBm/MHz	-40 dBm
$3.8 < f \leq 4.2$ GHz	-70 dBm/MHz	-30 dBm
$4.2 < f \leq 4.8$ GHz	-70 dBm/MHz	-30 dBm
$4.8 < f \leq 6$ GHz	-70 dBm/MHz	-30 dBm
$6 < f \leq 8.5$ GHz <sup>(1),(2),(3)</sup>	-41.3 dBm/MHz	0 dBm
$8.5 < f \leq 10,6$ GHz	-65 dBm/MHz	-25 dBm
$f > 10.6$ GHz	-85 dBm/MHz	-45 dBm
<p><b>Notes:</b></p> <p>(1) Within the 6-8.5 GHz band, the duty cycle is limited to maximum 5% per second and antennas are installed at a maximum height of 10 m.</p> <p>(2) For antenna heights above 2.5 m the maximum total radiated power spectral density (TRPsd) is limited to -46.3 dBm/MHz and the antennas must be directive and down tilted.</p> <p>(3) Antennas for data acquisition for authentication/access control (PACS) are excluded from the antenna directivity requirements given under note 2.</p>		

#### 4.2 Specific applications that involve enhanced indoor apparatus

The technical requirements in the table below are applicable to enhanced power apparatus operating indoor and supporting radiodetermination, location tracking, tracing or data acquisition applications operating in the 6-8.5 GHz band. The technical requirements applicable to emissions below 6 GHz and above 8.5 GHz are set out in the table in section 2 of the Annex to this Schedule.

Technical requirements		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
6.0 < f ≤ 8.5 GHz <sup>(1)</sup>	-31.3 dBm/MHz	10 dBm
<b>Notes:</b> (1) Within the 6-8.5 GHz band, the duty cycle is limited to maximum 5% per second. Portable apparatus can operate with a maximum mean e.i.r.p. spectral density higher than -41.3 dBm/MHz and a maximum peak e.i.r.p. higher than 0 dBm defined in 50 MHz only within an identifiable network and subject to control by an indoor infrastructure.		

## 5. UWB onboard aircraft

The values for maximum mean power spectral density (e.i.r.p.) and maximum peak power (e.i.r.p.) for short-range devices using UWB technology, with or without use of mitigation techniques are listed in the table below.

Technical requirements			
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)	Requirements for mitigation techniques
f ≤ 1.6 GHz	-90 dBm/MHz	-50 dBm	
1.6 < f ≤ 2.7 GHz	-85 dBm/MHz	-45 dBm	
2.7 < f ≤ 3.4 GHz	-70 dBm/MHz	-36 dBm	
3.4 < f ≤ 3.8 GHz	-80 dBm/MHz	-40 dBm	
3.8 < f ≤ 6.0 GHz	-70 dBm/MHz	-30 dBm	
6.0 < f ≤ 6.650 GHz	-41.3 dBm/MHz	0 dBm	
6.650 < f ≤ 6.6752 GHz	-62.3 dBm/MHz	-21 dBm	notch of 21 dB should be implemented to meet the -62.3 dBm/MHz <sup>(1)</sup> level
6.6752 < f ≤ 8.5 GHz	-41.3 dBm/MHz	0 dBm	7.25 to 7.75 GHz (FSS and MetSat (7.45 to 7.55 GHz) protection) <sup>(1),(2)</sup> 7.75 to 7.9 GHz (MetSat protection) <sup>(1),(3)</sup>
8.5 < f ≤ 10.6 GHz	-65 dBm/MHz	-25 dBm	
f > 10.6 GHz	-85 dBm/MHz	-45 dBm	

**Notes:**

- (1) Alternative mitigation techniques, such as the use of shielded portholes, may be used if they ensure at least an equivalent performance.
- (2) 7.25 to 7.75 GHz (Fixed Satellite Service) and 7.45 to 7.55 GHz (Meteorological Satellite) protection:  
 $-51.3 - 20 \cdot \log_{10}(10[\text{km}]/x[\text{km}])(\text{dBm}/\text{MHz})$  for heights above ground of over 1000 m, where x is the aircraft height above ground in kilometres,  $-71.3 \text{ dBm}/\text{MHz}$  for heights above ground of 1000 m and below.
- (3) 7.75 to 7.9 GHz (Meteorological Satellite) protection:  
 $-44.3 - 20 \cdot \log_{10}(10 [\text{km}]/x [\text{km}]) (\text{dBm}/\text{MHz})$  for heights above ground of over 1000 m, where x is the aircraft height above ground in kilometres, and  $-64.3 \text{ dBm}/\text{MHz}$  for heights above ground of 1000 m and below.

## 6. Material sensing apparatus using UWB technology

### 6.1 Introduction

Material sensing apparatus using UWB technology is split into two classes:

- Contact based UWB material sensing apparatus, for which the UWB transmitter is only switched on when in direct contact with the material under investigation; and
- Non-contact based UWB material sensing apparatus, for which the UWB transmitter is only switched on when it is near the investigated material and the UWB transmitter is directed towards the material under investigation (for example manually by using a proximity sensor or by mechanical design).

Material sensing apparatus based on UWB technology shall comply either with the generic UWB regulation based on technical conditions specified in section 1 of this Annex or with the specific limits for material sensing devices as set out in sections 6.2 and 6.3.

The generic UWB regulation set out in section 1 excludes fixed outdoor installations. Emissions radiated by a material sensing apparatus must not exceed the limits of the regulation for generic UWB usage specified in section 1. Material sensing apparatus must fulfil the requirements of mitigation techniques specified for the generic use of UWB in section 1.

The specific limits for material sensing apparatus including the mitigation techniques are listed in the following tables. Emissions radiating from material sensing apparatus permitted under this Schedule must be kept to a minimum and in any case not exceeding the emission limits within the following tables. Compliance with the specific limits must be ensured by the apparatus placed on a representative structure of the investigated material. The specific limits listed in the following tables are applicable in all environments for material sensing apparatus, except those to which note 5 of these tables, which excludes fixed outdoor installation in certain applicable frequency ranges, applies.

## 6.2 Contact based material sensing apparatus

The specific limits for maximum mean power spectral density (e.i.r.p.) and maximum peak power (e.i.r.p.) for contact based material sensing apparatus using UWB technology are set out in the table below.

Technical requirements for contact based UWB material sensing devices		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
$f \leq 1.73$ GHz	-85 dBm/MHz <sup>(1)</sup>	-45 dBm
$1.73 < f \leq 2.2$ GHz	-65 dBm/MHz	-25 dBm
$2.2 < f \leq 2.5$ GHz	-50 dBm/MHz	-10 dBm
$2.5 < f \leq 2.69$ GHz	-65 dBm/MHz <sup>(1),(2)</sup>	-25 dBm
$2.69 < f \leq 2.7$ GHz <sup>(4)</sup>	-55 dBm/MHz <sup>(3)</sup>	-15 dBm
$2.7 < f \leq 2.9$ GHz	-70 dBm/MHz <sup>(1)</sup>	-30 dBm
$2.9 < f \leq 3.4$ GHz	-70 dBm/MHz <sup>(1),(6),(7)</sup>	-30 dBm
$3.4 < f \leq 3.8$ GHz <sup>(4)</sup>	-50 dBm/MHz <sup>(2),(6),(7)</sup>	-10 dBm
$3.8 < f \leq 4.8$ GHz	-50 dBm/MHz <sup>(6),(7)</sup>	-10 dBm
$4.8 < f \leq 5.0$ GHz <sup>(4)</sup>	-55 dBm/MHz <sup>(2),(3)</sup>	-15 dBm
$5.0 < f \leq 5.25$ GHz	-50 dBm/MHz	-10 dBm
$5.25 < f \leq 5.35$ GHz	-50 dBm/MHz	-10 dBm
$5.35 < f \leq 5.6$ GHz	-50 dBm/MHz	-10 dBm
$5.6 < f \leq 5.65$ GHz	-50 dBm/MHz	-10 dBm
$5.65 < f \leq 5.725$ GHz	-50 dBm/MHz	-10 dBm
$5.725 < f \leq 6.0$ GHz	-50 dBm/MHz	-10 dBm
$6.0 < f \leq 8.5$ GHz	-41.3 dBm/MHz <sup>(5)</sup>	0 dBm
$8.5 < f \leq 9.0$ GHz	-65 dBm/MHz <sup>(7)</sup>	-25 dBm
$9.0 < f \leq 10.6$ GHz	-65 dBm/MHz	-25 dBm
$f > 10.6$ GHz	-85 dBm/MHz	-45 dBm

**Notes:**

- (1) Apparatus using the Listen Before Talk ('LBT') mechanism are permitted to operate in the 1.215 GHz to 1.73 GHz frequency range with a maximum mean e.i.r.p. spectral density of -70 dBm/MHz and in the 2.5 GHz to 2.69 GHz and 2.7 GHz to 3.4 GHz frequency ranges with a maximum mean e.i.r.p. spectral density of -50 dBm/MHz and a maximum peak e.i.r.p. of -10 dBm/50 MHz. The LBT mechanism is defined in clauses 4.5.2.1, 4.5.2.2 and 4.5.2.3 of ETSI Standard EN 302 065-4 V1.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the conditions specified of this Schedule.
- (2) To protect the radio services, non-fixed installations must fulfil the following requirement for total radiated power spectral density:
  - (a) In the 2.5 GHz to 2.69 GHz and 4.8 GHz to 5 GHz frequency ranges, the total radiated power spectral density must be 10 dB below the maximum e.i.r.p. spectral density.
  - (b) In the 3.4 GHz to 3.8 GHz frequency range, the total radiated power spectral density must be 5 dB below the maximum e.i.r.p. spectral density.
- (3) To protect the Radio Astronomy Service (RAS) in the 2.69 GHz to 2.7 GHz and 4.8 GHz to 5 GHz bands, the total radiated power spectral density must be below -65 dBm/MHz.
- (4) Limitation of the Duty Cycle to 10% per second.
- (5) No fixed outdoor installation is permitted.
- (6) Within the 3.1 GHz - 4.8 GHz band, apparatus implementing 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 are set out in clauses 4.5.3.1, 4.5.3.2 and 4.5.3.3 of ETSI Standard EN 302 065-1 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements of this Schedule. When LDC is implemented, note 5 applies.
- (7) Within the 3.1 GHz - 4.8 GHz and 8.5 GHz - 9 GHz bands, apparatus implementing 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 are set out in clauses 4.5.1.1, 4.5.1.2 and 4.5.1.3 of ETSI Standard EN 302 065-1 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements of this Schedule. When DAA is implemented, note 5 applies.

### 6.3 Non-contact based material sensing apparatus

The specific limits for maximum mean power spectral density (e.i.r.p.) and maximum peak power (e.i.r.p.) for non-contact based material sensing devices using UWB technology are defined in the table below.

Technical requirements for non-contact based UWB material sensing devices		
Frequency range	Maximum mean power spectral density (e.i.r.p.)	Maximum peak power (e.i.r.p.) (defined in 50 MHz)
$f \leq 1.73$ GHz	-85 dBm/MHz <sup>(1)</sup>	-60 dBm
$1.73 < f \leq 2.2$ GHz	-70 dBm/MHz	-45 dBm
$2.2 < f \leq 2.5$ GHz	-50 dBm/MHz	-25 dBm
$2.5 < f \leq 2.69$ GHz	-65 dBm/MHz <sup>(1),(2)</sup>	-40 dBm
$2.69 < f \leq 2.7$ GHz <sup>(4)</sup>	-70 dBm/MHz <sup>(3)</sup>	-45 dBm
$2.7 < f \leq 2.9$ GHz	-70 dBm/MHz <sup>(1)</sup>	-45 dBm
$2.9 < f \leq 3.4$ GHz	-70 dBm/MHz <sup>(1),(6),(7)</sup>	-45 dBm
$3.4 < f \leq 3.8$ GHz <sup>(4)</sup>	-70 dBm/MHz <sup>(2),(6),(7)</sup>	-45 dBm
$3.8 < f \leq 4.8$ GHz	-50 dBm/MHz <sup>(6),(7)</sup>	-25 dBm
$4.8 < f \leq 5.0$ GHz <sup>(4)</sup>	-55 dBm/MHz <sup>(2),(3)</sup>	-30 dBm
$5.0 < f \leq 5.25$ GHz	-55 dBm/MHz	-30 dBm
$5.25 < f \leq 5.35$ GHz	-50 dBm/MHz	-25 dBm
$5.35 < f \leq 5.6$ GHz	-50 dBm/MHz	-25 dBm
$5.6 < f \leq 5.65$ GHz	-50 dBm/MHz	-25 dBm
$5.65 < f \leq 5.725$ GHz	-65 dBm/MHz	-40 dBm
$5.725 < f \leq 6.0$ GHz	-60 dBm/MHz	-35 dBm
$6.0 < f \leq 8.5$ GHz	-41.3 dBm/MHz <sup>(5)</sup>	0 dBm
$8.5 < f \leq 9.0$ GHz	-65 dBm/MHz <sup>(7)</sup>	-25 dBm
$9.0 < f \leq 10.6$ GHz	-65 dBm/MHz	-25 dBm
$f > 10.6$ GHz	-85 dBm/MHz	-45 dBm

**Notes:**

(1) Apparatus using the LBT mechanism are permitted to operate in the 1.215 GHz to 1.73 GHz frequency range with a maximum mean e.i.r.p. spectral density of -70 dBm/MHz and in the 2.5 GHz to 2.69 GHz and 2.7 GHz to 3.4 GHz frequency ranges with a maximum mean e.i.r.p. spectral density of -50 dBm/MHz and a maximum peak e.i.r.p. of -10 dBm/50 MHz. The LBT mechanism is set out in clauses 4.5.2.1, 4.5.2.2 and 4.5.2.3 of ETSI Standard EN 302 065-4 V1.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements of this Schedule.



**Notes:**

- (2) To protect the radio services, non-fixed installations must fulfil the following requirement for total radiated power spectral density:
  - (a) In the 2.5 GHz to 2.69 GHz and 4.8 GHz to 5 GHz frequency ranges, the total radiated power spectral density must be 10 dB below the maximum e.i.r.p. spectral density.
  - (b) In the 3.4 GHz to 3.8 GHz frequency range, the total radiated power spectral density must be 5 dB below the maximum e.i.r.p. spectral density.
- (3) To protect the Radio Astronomy Service (RAS) in the 2.69 GHz to 2.7 GHz and 4.8 GHz to 5 GHz bands, the total radiated power spectral density must be below -65 dBm/MHz.
- (4) Limitation of the Duty Cycle to 10% per second.
- (5) No fixed outdoor installation is permitted.
- (6) Within the 3.1 GHz to 4.8 GHz band, apparatus implementing 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 are set out in clauses 4.5.3.1, 4.5.3.2 and 4.5.3.3 of ETSI Standard EN 302 065-1 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements of this Schedule. When LDC is implemented, note 5 applies.
- (7) Within the 3.1 GHz to 4.8 GHz and 8.5 GHz to 9 GHz bands, apparatus implementing 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 are set out in clauses 4.5.1.1, 4.5.1.2 and 4.5.1.3 of ETSI Standard EN 302 065-1 V2.1.1. Alternative mitigation techniques may be used if they ensure at least an equivalent performance and level of spectrum protection in order to comply with the corresponding essential requirements of Directive 2014/53/EU and respect the technical requirements of this Schedule. When DAA is implemented, note 5 applies.

Peak power threshold values for the LBT mechanism to ensure the protection of radio services listed below are defined in the following table.

Technical requirements of the LBT mechanism for material sensing apparatus		
Frequency range	Radio service to be detected	Peak power threshold value
1.215 < f ≤ 1.4 GHz	Radiodetermination service	+8 dBm/MHz
1.61 < f ≤ 1.66 GHz	Mobile satellite service	-43 dBm/MHz
2.5 < f ≤ 2.69 GHz	Land mobile service	-50 dBm/MHz
2.9 < f ≤ 3.4 GHz	Radiodetermination service	-7dBm/MHz

Additional requirements for radar detection: continuously listening and automatic switch-off within 10 ms for the related frequency range if the threshold value is exceeded (table with LBT mechanism). A silent time of at least 12 s while listening continuously is necessary before the transmitter can be switched on again. This silent time during which only the LBT receiver is active must be ensured even after the apparatus is switched off.