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| U.S. Radiocommunications Sector  Fact Sheet | |
| **Working Party:** ITU-R WP5B | **Document No:** USWP5B31-06\_FD\_R1\_THz Spec |
| **Ref**  Resolution **731 (Rev. WRC-19)** | **Date:** 8 March 2023 |
| Document Title: Liaison Statement to WP 1A, WP5A, WP 5C, WP 7C and WP 7D. | |
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| **Purpose/Objective:** To begin consideration under the terms of Res. 731 of sharing by Terahertz Spectroscopy, an evolving radio determination service, of passive spectrum above 71 GHz | |
| **Abstract:** Terahertz Spectroscopy, is a very short range, typically less than 1 m, nondestructive testing technology that meets the definition of a radiodetermination service. It needs large contiguous blocks of spectrum above 71 GHz to sense unique spectral information about materials which may fall into bands that are covered by the present terms of **5.340**. Res. **731** provides a mechanism to determine if sharing without harmful interference is possible and a path to enable such sharing. CEPT has recently completed ECC Decision (22)03 which included a detailed emission standard for this spectrum use which it calls “Radiodetermination systems for industry automation in shielded environments (RDI-S)”. The LS statement seeks a dialogue on this sharing issue and whether the levels in the CEPT document are an acceptable basis. | |

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| United States of America | |
| PROPOSED liaison statement to Working Parties 1A, 5A, 5C, 7C and 7D ON | |
| Studies under Resolution 731 (Rev. WRC-19) on sharing and compatibility  between passive and active services above 71 GHz in the case of very short range indoor radiodetermination systems | |

Background

A very wideband, very short range radiodetermination generally indoor transmitter application above 71 GHz, variously called “Terahertz Spectroscopy” or “Radiodetermination systems for industry automation in shielded environments (RDI-S)”, has been developed in several countries for uses in research and in real time non-destructive quality control of various manufacturing processes to improve industrial productivity. Many uses of this technology require uses of spectrum that is forbidden under the present terms of **5.340** but could be usable if ITU-R could find emission limits under the terms of Res. **731** (Rev. WRC-19) that protects passive services from harmful interference. The 20 November 2020 letter from the Chairmen of Study Groups 1, 5 and 7 clarified procedures to be used in ITU-R for such Res. **731** considerations.

Proposal

This contribution is a Liaison Statement to ITU-R groups that have been identified in the above 20 November 2020 letter from the Chairmen of Study Groups 1, 5 and 7. The LS includes a specific proposal for emission limits for this technology and suggests that actions pursuant to Res. **731** commence within ITU-R.

**Attachment:** 1

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| Working Party 5B  PROPOSED liaison statement to  Working Parties 1A, 5A, 5C, 7C and 7D ON  Studies under Resolution 731 (Rev. WRC-19) on sharing and compatibility  between passive and active services above 71 GHz in the case of very short range indoor radiodetermination systems | |
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WRC-2000 adopted Res. **731** on consideration by a future competent world radiocommunication conference of issues dealing with sharing and adjacent-band compatibility between passive and active services above 71 GHz as part of an action that included most of the present allocations in 100-275 GHz. The inclusion of such a resolution in the new allocations was contained in both the European inputs to the conference as well as the USA inputs as was based on the lack of knowledge at the time of future active transmitter needs above 71 GHz as well as unknown technology that would be available. Res. **731** was amended at WRC-19 to address issues above 275 GHz but the original WRC-2000 71-275 GHz sharing text remains unchanged.

On 20 November 2020 the Chairmen of Study Groups 1, 5 and 7 issued a letter on Consideration of sharing and adjacent-band compatibility between passive and active services above 71 GHz that stated “work under Resolution **731 (Rev. WRC-19)** pertaining to the protection of the passive services with respect to *invites the ITU Radiocommunication Sector* 1 will be done within Working Parties (WP) 7C and 7D, which will be the lead groups working in close cooperation with WPs 5A and 5C”. At the time of this letter the chairmen probably understood that the only possible sharing would involve Fixed and Mobile services. However, there is a growing interest and requirement for a very wideband, very short range radiodetermination, generally indoor transmitter application above 71 GHz which is variously called “Terahertz Spectroscopy” or “Radiodetermination systems for industry automation in shielded environments (RDI-S)”. While this spectrum use is different than the much more common radar-like radiodetermination, it appears to meet the **1.9** definition of radiodetermination since it involves “The determination of … characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of radio waves.”

This technology uses bandwidth in spectrum above 71 GHz generally greater than 35 GHz (in the case of MMIC-based RDI-S technology) and greater than 100 GHz (in the case of “traditional” laser-based Terahertz spectroscopy technology). Most uses of this technology are indoor and involves either scientific measurements or real time non-destructive testing during manufacturing processes to improve the quality, safety and yield of items being manufactured. Use of this technology has positive benefits for national economies. The use of this technology appears to be forbidden under the provisions of **5.340** that states “All emissions are prohibited” in 11 bands in 71-275 GHz. Determining acceptable emission limits for such devices will allow this valuable spectrum use while also protecting the vital spectrum uses that **5.340** is intended to protect.

Some administrations may determine use of this technology within their jurisdiction to be either Short Range Device (SRD) or industrial, scientific and medical (ISM) applications (as USA has done) and authorize them and authorize them under the provisions of **4.4** or **15.3**. But the restrictions of **5.340** apparently still apply to such emissions unless actions is taken pursuant to Res. **731** to enable authorized sharing of spectrum. We note that Part A1/AR4 of the Rules of Procedure approved by the Radio Regulations Board, 2021 edition (+ rev.2), states “The Board considers that, in view of this (**5.340**) prohibition, a notification concerning any other use than those authorized in the band or on the frequencies concerned cannot be accepted even with a reference to No. 4.4; furthermore, the administration submitting such a notice is urged to abstain from such usage.”

It appears that the only possible approach to achieve the benefits of this new technology without violating **5.340** is to use the procedures in *invites the ITU Radiocommunication Sector* 1 of **Res.731** “to determine if and under what conditions sharing is possible between active and passive services in the frequency bands above 71 GHz”. The 20 November 2020 letter cited above states that “WP 7C and 7D, which will be the lead groups”. While WP 5B is not mentioned, we believe that that was an oversight and that 5B should have a parallel role for this radiodetermination service since it “is responsible for studies related to the maritime mobile service, including the Global Maritime Distress and Safety System (GMDSS), the aeronautical mobile service and the **radiodetermination service**, including both radiolocation and radionavigation services.”

On 18 November 2022 CEPT’s Electronics Communications Committee (ECC) approved ECC Decision (22)03, Technical characteristics, exemption from individual licensing and free circulation and use of specific radiodetermination applications in the frequency range 116-260 GHz. Annex 2.6 of this document, “A2.6 TECHNICAL REQUIREMENTS FOR RADIODETERMINATION SYSTEMS FOR INDUSTRY AUTOMATION IN SHIELDED ENVIRONMENTS (RDI-S)” contains limits for this type of system addressing both mean and peak e.i.r.p. and use conditions. These limits are attached as the ANNEX.

In considering the adoption of limits in the ANNEX, ECC issued a report with “compatibility studies, which are based on the assumption that a wide contiguous bandwidth was available and also provides the technical justification why the large bandwidths are needed and why no technical solutions, such as notching out some frequencies, exist to avoid emitting in the RR 5.340 bands.” (ECC Report 334, UWB radiodetermination applications in the frequency

range 116-260 GHz, approved 28 January 2022, amended 3 February 2023; <https://docdb.cept.org/download/4289>). WP7C and 7D may be able to use this ECC analysis to begin their deliberations on this issue of whether this technology under either the ECC emission standards or other standards meets the protection goals of **Res. 731** and proceed in implementing the goals of *invites 5* and *6:*

5 to complete the necessary studies when the technical characteristics of the active services  
in these frequency bands are known;  
6 to develop Recommendations specifying sharing criteria for those frequency bands where sharing is feasible,

This will then enable the *resolves* goal of **Res. 731**

to invite a future competent world radiocommunication conference to consider the results of ITU-R studies referred to in *invites the ITU Radiocommunications Sector* below with a view to taking the necessary action, as appropriate, in order to accommodate the emerging requirements of active services, taking into account the requirements of the passive services, in frequency bands above 71 GHz

WP5B therefore will appreciate feedback from WP1A, 5A, 5C, 7C AND 7D on whether the approach in the ANNEX is a good starting point for a determination under the provisions of *invites the ITU Radiocommunication Sector* 1 of **Res.731.**

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| **Status:** For information and action |  |
| **Deadline:** [Next WP 5B meeting] |  |
| **Contact:** | **E-mail:** |

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**ANNEX**

**EXCERPT OF ECC Decision (22)03**

A2.6 Technical requirements for radiodetermination systems for industry automation in shielded environments (RDI-S)

Radiodetermination systems for industry automation in shielded environments (RDI-S) are used for sensing unique frequency dependent material properties and/or wideband frequency responses (e.g. S-parameters to extract other physical properties) of target objects inside buildings (indoors) or in similarly shielded environments. Examples of RDI-S systems are radar sensors for plastic extrusion thickness measurement or for non-destructive testing. The RDI-S application is intended for industrial and professional use only.

Table 10: Technical requirements for RDI-S devices in the designated band 116-260 GHz

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| --- | --- | --- | --- | --- |
| Frequency range | Maximum duty cycle | Maximum mean e.i.r.p. spectral density (Note 2) | Maximum peak e.i.r.p. (Note 4) | Unwanted emission limits (Note 1) |
|  | **A** | **B** | **C** | **D** |
| 116 to 122.5 GHz | 100% | -5 dBm/MHz | 45 dBm | -15 dBm/MHz max. mean e.i.r.p. spectral density (Note 2)  and  35 dBm max. peak e.i.r.p. (Note 4) |
| 122.5 to 123 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 123 to 130 GHz | 100% | +10 dBm/MHz | 60 dBm |
| 130 to 134 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 134 to 141 GHz | 100% | +10 dBm/MHz | 60 dBm |
| 141 to 148.5 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 148.5 to 151.5 GHz (Note 3) | 100% | -15 dBm/MHz | 35 dBm |
| 151.5 to 158.5 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 158.5 to 164 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 164 to 167 GHz (Note 3) | 100% | -15 dBm/MHz | 35 dBm |
| 167 to 174.5 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 174.5 to 174.8 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 174.8 to 182 GHz | 100% | +10 dBm/MHz | 60 dBm |
| 182 to 185 GHz (Note 3) | 100% | -15 dBm/MHz | 35 dBm |
| 185 to 190 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 190 to 191.8 GHz (Note 3) | 100% | -15 dBm/MHz | 35 dBm |
| 191.8 to 200 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 200 to 209 GHz (Note 3) | 100% | -15 dBm/MHz | 35 dBm |
| 209 to 226 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 226 to 231.5 GHz (Note 3) | 100% | -15 dBm/MHz | 35 dBm |
| 231.5 to 235 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 235 to 238 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 238 to 241 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 241 to 244 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 244 to 246 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 246 to 250 GHz | 100% | -5 dBm/MHz | 45 dBm |
| 250 to 252 GHz (Note 3) | 100% | -15 dBm/MHz | 35 dBm |
| 252 to 260 GHz | 100% | -5 dBm/MHz | 45 dBm |
| Note 1: The operating frequency range (OFR) is defined over the 10 dB reduction of the intentional transmission (“10 dB bandwidth”) radiated by the equipment into the air. The unwanted emission limits apply to the frequencies outside the OFR. The measurement bandwidth for the unwanted emissions domain is 1 MHz.  Note 2: The given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle Tmeas\_cycle of the device including any Toff times in 1 MHz resolution bandwidth of the measuring receiver.  Note 3: Sub-band protected by the provision RR No. 5.340 [6].  Note 4: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth. | | | | |

Additional requirements for radiodetermination systems for industry automation in shielded environments (RDI-S) to allow licence-exempt use:

1. For RDI-S, the 10 dB contiguous bandwidth shall be equal to or higher than 35 GHz;
2. The operation of RDI-S sensors is envisaged for industrial purposes only;
3. Installation and maintenance of RDI-S equipment shall be performed by professionally trained individuals only;
4. RDI-S equipment shall not be marketed to private end customers;
5. RDI-S equipment shall only be operated indoors (i.e. inside a building) or inside similarly shielded environments;
6. Installers have to ensure that the device main beam is not pointing towards windows or other weak shielded parts of the shielded environment. The direction of main radiation shall be indicated on the specific radiodetermination device;
7. Installers have to ensure that there are no unwanted obstacles in the main beam of the antenna in order to minimise unintentional reflections and scattering;
8. Slow sweeping RDI-S devices with sweep slopes smaller than 2.5 GHz/ms shall notch-out the frequency bands subject to the provision RR No. 5.340 [6] by at least additional 10 dB reduction in mean and peak power (i.e. limits in Table 10 columns B and C reduced by 10 dB);
9. The provider is required to inform the users and installers of RDI-S equipment about the installation requirements and additional special mounting instructions;
10. For RDI-S devices using an antenna gain smaller than 20 dBi, the maximum conducted peak output power shall be limited to 15 dBm.