

**IEEE 802.15 WNG**  
**Total Radiated Power spectral density ( $TRP_{sd}$ )**  
**measurements by JRC, Ispra, Italy**

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**Authors:**

Name	Company	Address	Phone	Email
Friedbert Berens	FBConsulting Sarl			Friedbert.berens@me.com

# Summary of $TPR_{sd}$ measurement in 2023 by JRC, ISPRA

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Friedbert Berens, FBConsulting Sarl

# Introduction

- **These slides present a summary of the measurement results contained in the  $TRP_{sd}$  measurement report from the JRC in Ispra**
- **The Joint Research Centre (JRC) is part of the EU commission and supports the regulation activities in Europe**
- **“Report on Measurement Campaigns for Total Radiated Power of UltraWideBand (UWB) device to support EU RF spectrum regulation”**
  - <https://publications.jrc.ec.europa.eu/repository/handle/JRC134860>
- **Results should be used for the future simulation in the band extension WI in SE24**
- **Further measurements are planned in 2024**

## Total Radiate Power spectral density ( $TRP_{sd}$ )

- **Total Radiated Power (TRP) is a Radio Frequency (RF) engineering term used to describe the sum of all power radiated by an antenna connected to a transmitter**
- **$TRP_{sd}$  represent the overall power emitted by a device in the given bandwidth (typically 1MHz)**
- **$TRP_{sd}$  represents an average value for the interference potential of a device in all directions.**
  - In contrast to the e.i.r.p in dBm/MHz value which represents the worst case of the interference potential into one dedicated direction
- **For any kind of aggregated interference investigations, the  $TRP_{sd}$  value is the more appropriate value**

## Definition of $TRP_{sd}$

$$TRP_{sd} = \int_{\Theta=0}^{\pi} \int_{\Phi=0}^{2\pi} \frac{P_{psd,\Theta,\Phi}}{A_r} \times r^2 \times \sin(\Theta) d\Theta d\Phi \quad (\text{A.10})$$

Where:

- Radiated mean power spectral density  $P_{psd,\Theta,\Phi}$  measurement in 1 MHz (recorded) one point of the sphere depending  $\Theta$  and  $\Phi$  and frequency
- $r$  is the radius of the sphere/measurement distance
- $\Theta$  is the elevation angle
- $\Phi$  is the azimuth angle
- $A_r$  is the effective area of the receiving antenna (measurement antenna)

# Basic measurement setup



Figure 1: Over The Air (OTA) measurement set up in the Shielded Anechoic Chamber (SAC) in full anechoic configuration.

# Setup: technical details

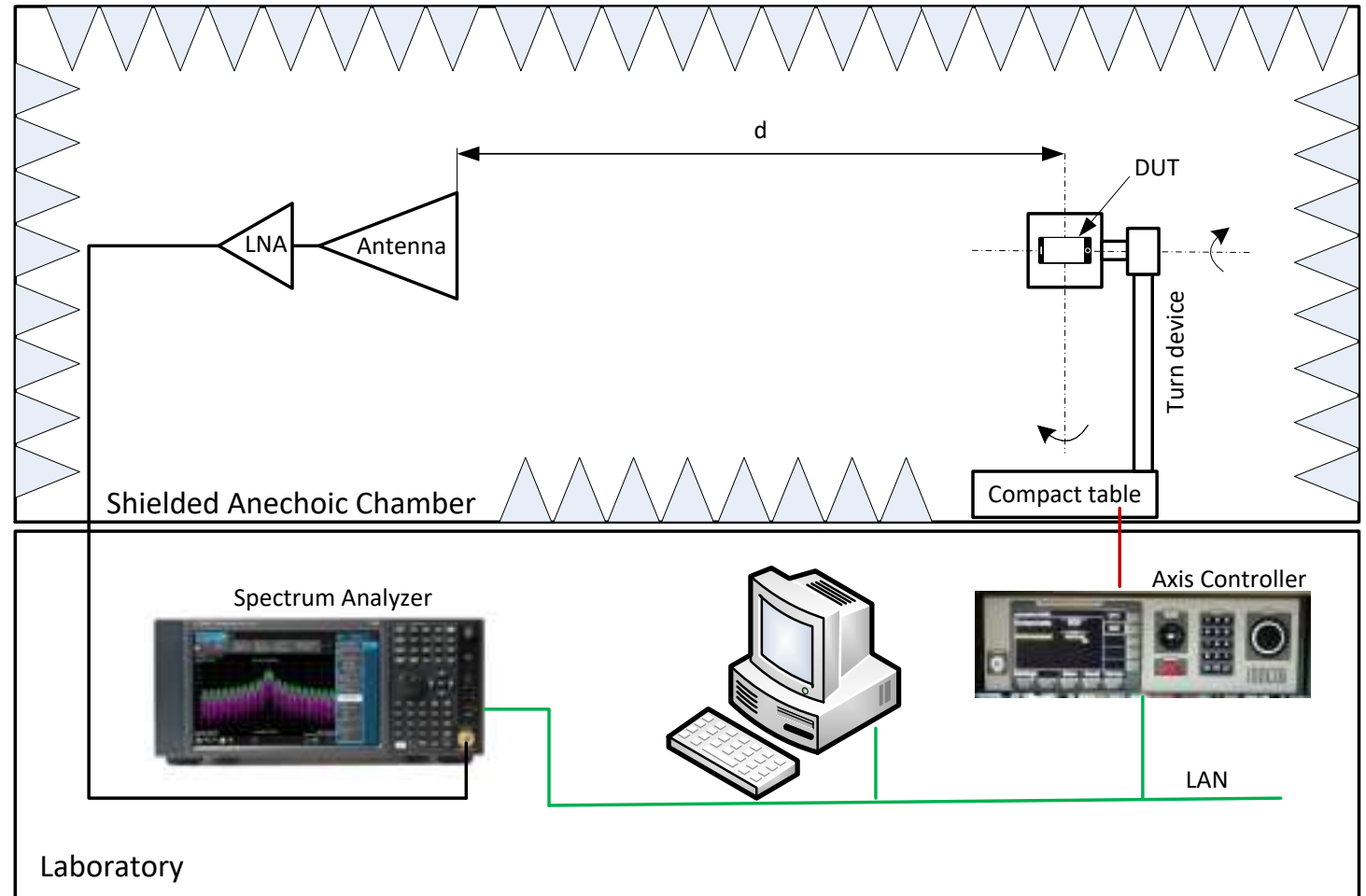


Figure 2: Measurement setup

# Device under test

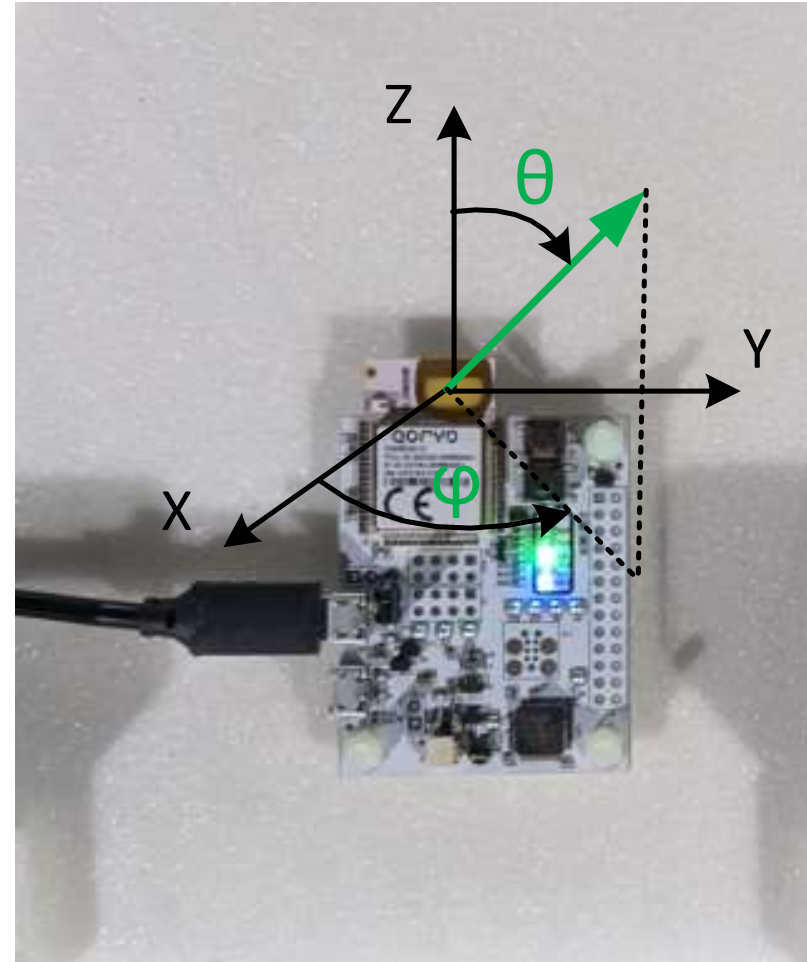


Figure 3: Coordinate system associated with the DUT



# Measurement procedure

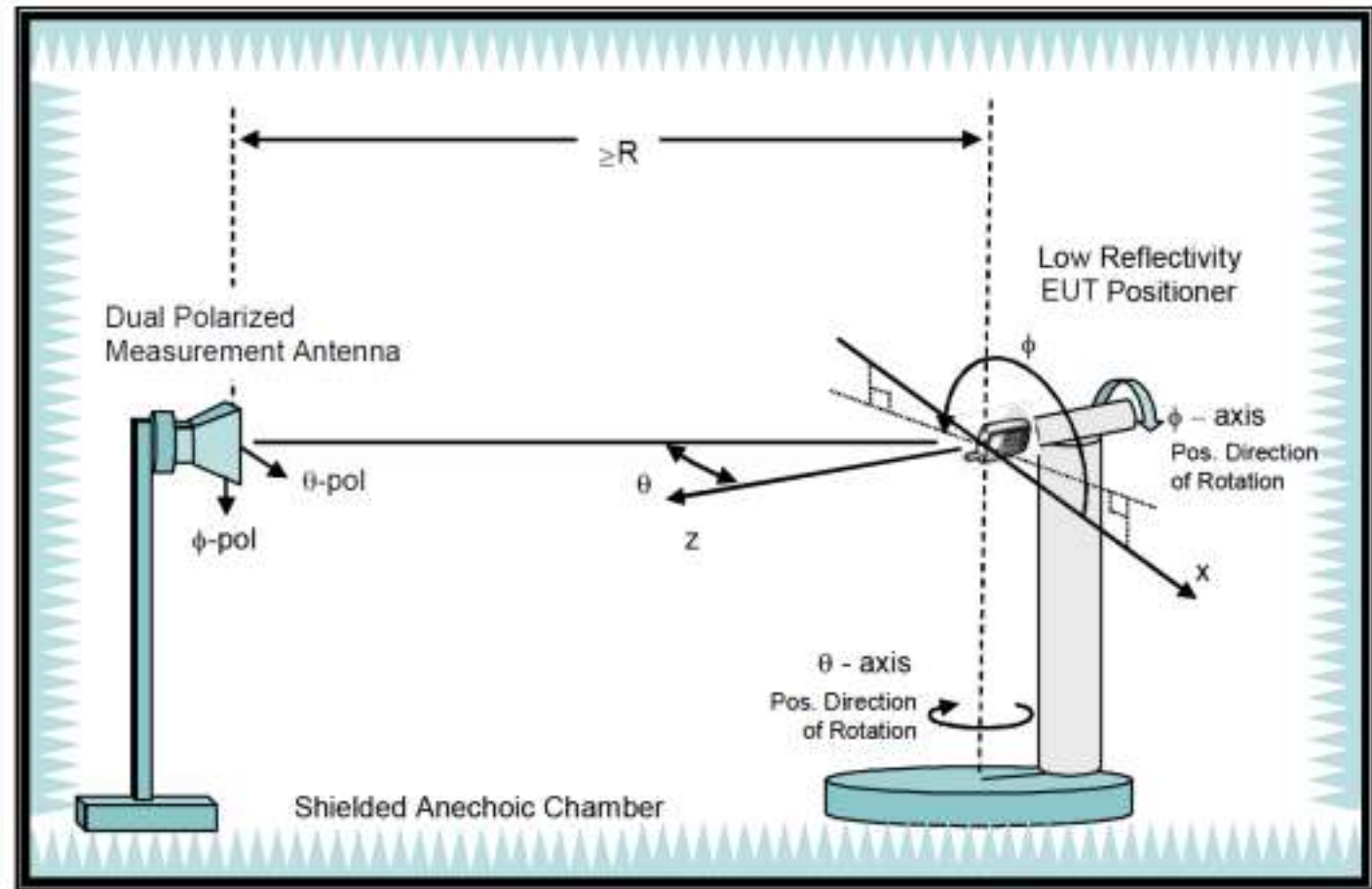


Figure 4: Typical setup for a combined-axes system as shown in Appendix A of the CTIA test plan [4].

# Example 3D radiation pattern

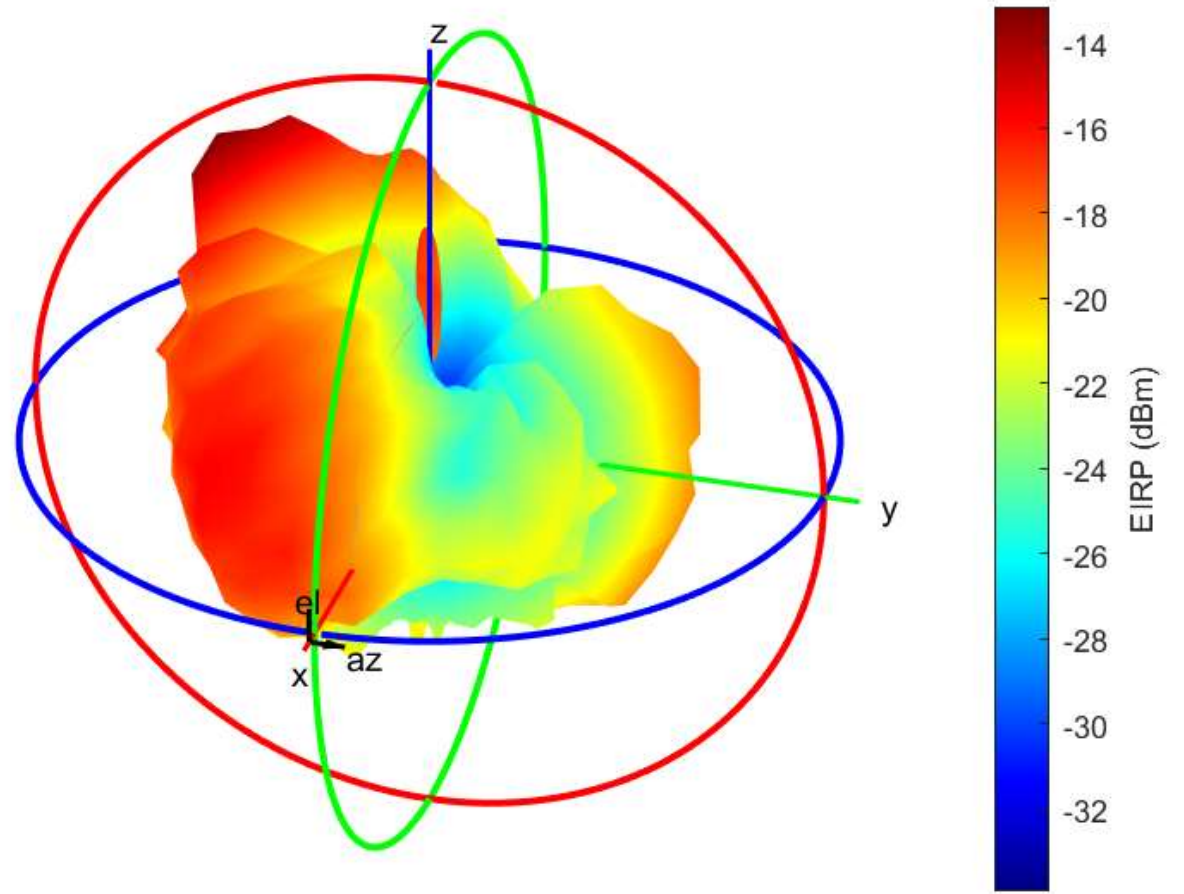


Figure 13: Example of 3D radiation pattern

# Measurement results

*Table 9: Measurement results*

UWB channel	Distance (m)	EIRP (dBm)	EIRP <sub>SD</sub> (dBm/MHz)	TRP (dBm)	TRP <sub>SD</sub> (dBm/MHz)
5	1	-13.15	-38.25	-20.16	-45.57
9	1	-13.3	-38.11	-19.72	-45.28
5	3	-12.93	-37.95	-19.9	-45.2

## Some comments to measurements

- **Duty Cycle of the device has been set to the maximum possible**
- **In all channels the  $TRP_{sd}$  levels are significantly below the maximum mean e.i.r.p. value**
- **More directive antennas or absorbing material will increase the difference between maximum mean e.i.r.p. and  $TRP_{sd}$**
- **Assumption of fully omnidirectional emissions is very worst case and not realistic**

## Summary and outlook

- **Slides presented a summary of the JRC  $TRP_{sd}$  measurements**
- **An isolated UWB device reaches an  $TRP_{sd}$  level which is 7dB below the maximum mean e.i.r.p. value**
  - -48.3dBm/MHz ( $TRP_{sd}$ ) versus -41.3dBm/MHz (maximum e.i.r.p.), mitigating factor of 7dB
- **Additional gains can be assumed in real deployment scenarios for**
  - Body worn devices
  - Fixed installed access point with directive antennas
  - Wall mounted device
- **Based on the results an area/directional probability of the the maximum mean e.i.r.p. value could be extracted**
- **Additional measurements to confirm this assumptions are planned**
- **Future regulation should include maximum mean e.i.r.p. value and  $TRP_{sd}$**
- **More details: <https://publications.jrc.ec.europa.eu/repository/handle/JRC134860>**

# Acknowledgment

- **This presentation is based on the work of the Joint research Centre of the EU commission in Ispra**
- **The author of the reports are**
  - Gianmarco Baldini
  - Jean-Marc Chareau
  - Fausto Bonavitacola