

Bluetooth Over The Air Performance Test Report for Audi DDA by Kathrein



Report Reference: MDE_KATHR_1603_BT_RP
Date: 22.11.2016
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1 References and Standards Used

- [1] CTIA: "Test Plan for Wireless Device Over the Air Performance", Revision Number 3.6, 06/2016.

2 Project and Result Summary

DUT	Audi DDA	SN	BN2-BN204.10.1600020017
Test lab	7 layers GmbH Borsigstr. 11 40880 Ratingen Germany	Set up	free space
		Test start	10.11.2016
Customer	KATHREIN Automotive GmbH Römerring 1 31137 Hildesheim	Report date	22.11.2016
		Report by	Dieter Sütthoff
		Approved by	Robert Machulec

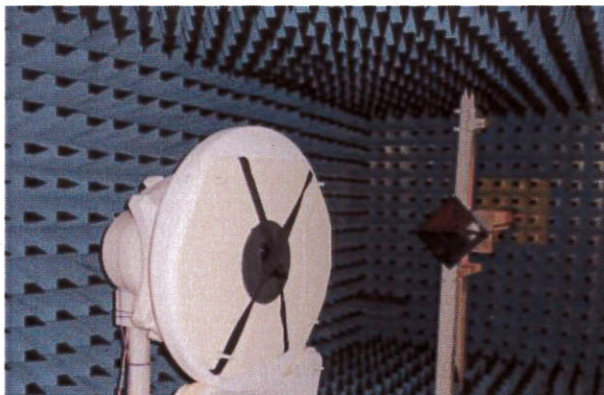


Fig. 1: Photo of DUT.

2.1 Signatures

Responsible for
Accreditation Scope:

Robert Machulec

Robert Machulec

Responsible
for Test Report:

Dieter Sütthoff

Dieter Sütthoff

3 Brief Description of Settings and Test Method

3.1 Test Procedure TRP Bluetooth

The method of measurement for radiated RF power performance are based on the principals of the test standard CTIA: "Test Plan for Mobile Station Over the Air Performance" [1].

In general, the following approach is applied for TRP measurements:

- For TRP measurement put OUT in a mode where it transmitting periodical RF energy.
- Rotate the OUT in all room directions with an angle grid of 15°.
- Gather power data for both, vertical and horizontal polarization.
- Calculate total radiated power by integrating over the whole sphere as outlined in [1].

The test setup was placed at the turning device inside a fully anechoic chamber. The object under test (OUT) was set to transmit permanently signal on specific frequencies

The total radiated power (TRP) of the test setup on low mid and high channel of the Bluetooth band was measured in all angle direction (3D) using a step width of 15° and using two measurement antenna polarizations (vertical and horizontal).

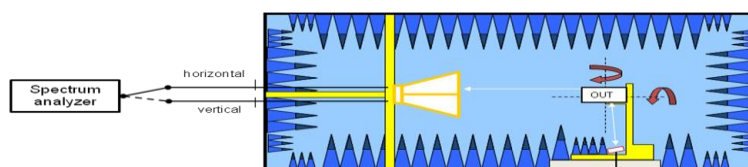
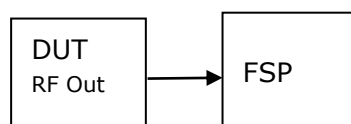


Fig. 1: Block diagram for TRP measurement

3.2 Test conducted power Bluetooth



Resolution band: 1000 kHz
Video band: 10000 kHz
Sweep time: 10 ms
Detector: Positive Peak Detector

Fig. 2: Test set up and block diagram antenna port input peak power

3.3 Definitions:

3GPP	3 rd Generation Partnership Project
CTIA	Cellular Telecommunications & Internet Association
DUT	Device under test
FS	Free space
TRP	Total Radiated Power
EIRP	Effective Isotropic Radiated Power
FSP	FSP3 spectrum analyzer by R&S for 2.4 GHz
NWA	Network Analyzer

3.4 Equipment List

For TRP measurements:

Antenna:	Dual polarized horn ETS3164-03 by ETS	SN 00052619
Receiver:	FSP3 spectrum analyzer by R&S for 2.4 GHz	SN 838164/004

4 Test Results and Pattern

4.1 Results Bluetooth TRP and Conducted antenna port input peak power

Kathrein Audi DDA			
Tested Frequency (MHz)	2402	2440	2480
Ant. Port Input Pwr. (dBm)	-0.9	-1.5	-2.1
Tot. Rad. Pwr. (dBm)	-1.3	-1.8	-2.4
Peak EIRP (dBm)	4.6	3.8	3.0
Directivity (dBi)	5.9	5.5	5.4
Efficiency (dB)	-0.4	-0.3	-0.3
Efficiency (%)	91.2	93.9	93.2
Max. Gain (dBi)	5.5	5.3	5.1
Theta 90° plain max. Gain (dB)	-12.7	-15.5	-13.2

Tab. 1: Test result summary Bluetooth

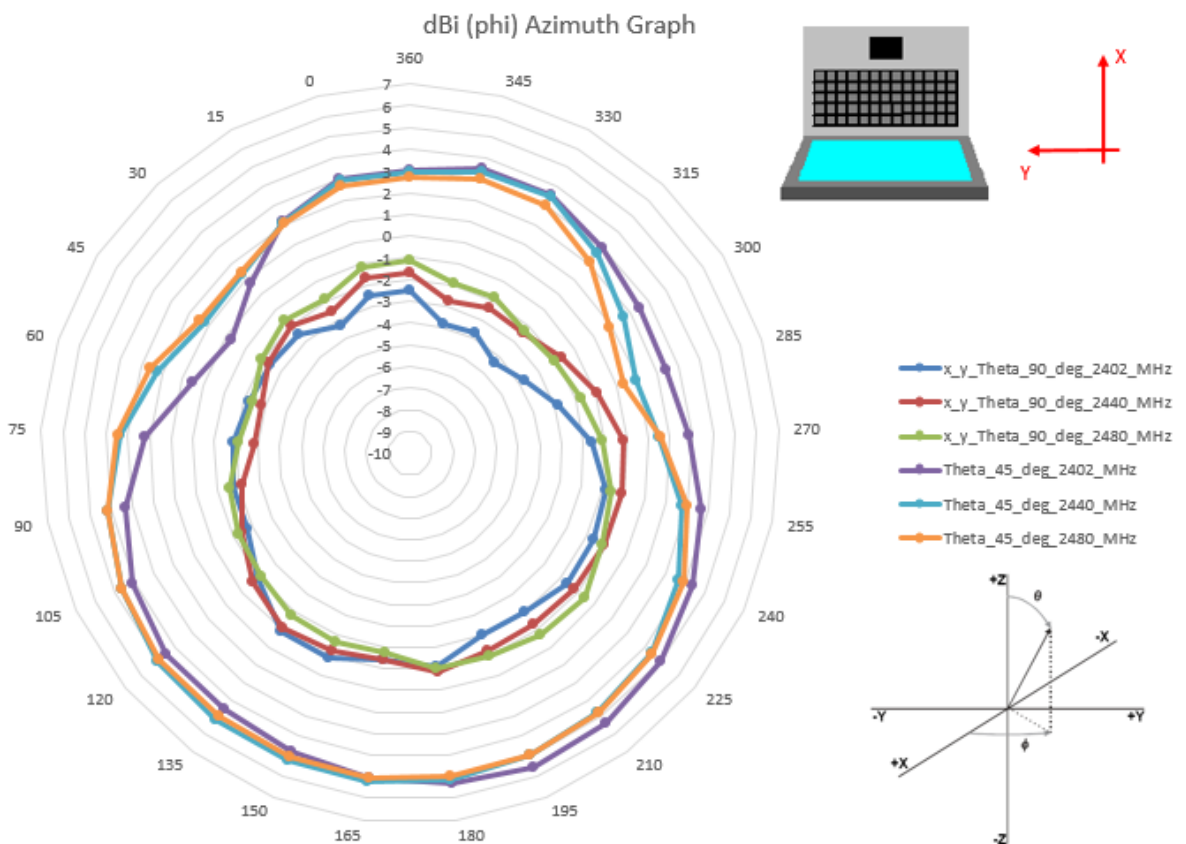


Fig. 2: Two dimensional Gain diagram Theta =90, Theta =45 dBi (Phi).

Orientation of DUT compared to a standard device

For orientation of the DUT in the result pictures the following photos illustrate the used orientation compared to a standard device:

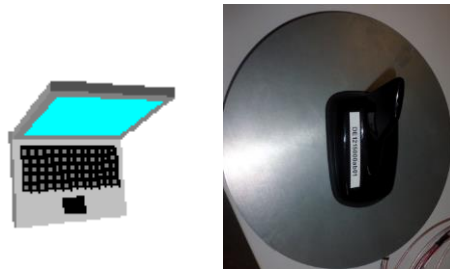


Fig. 3: Photo orientation of DUT compared to a Laptop.

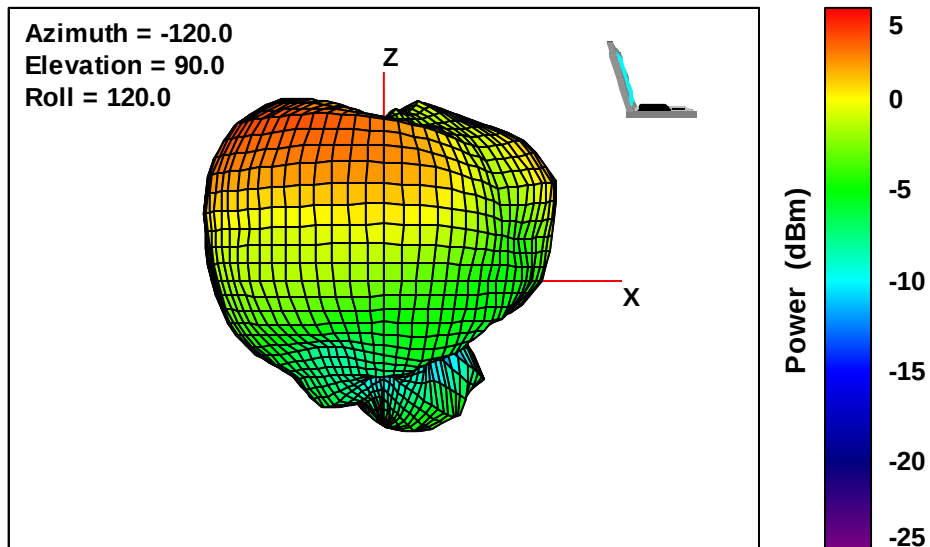
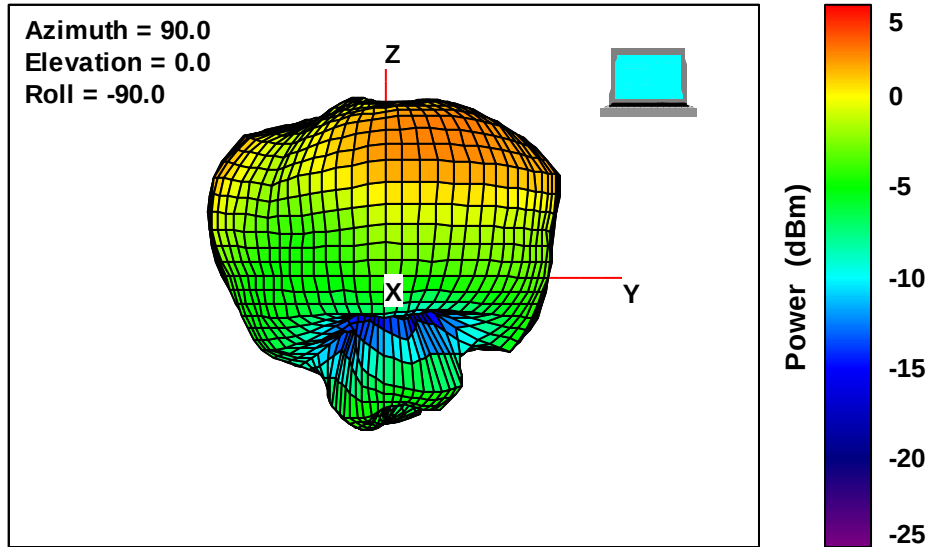
4.2 TRP Antenna Pattern EIRP (dBm) BLUETOOTH 2402 MHz

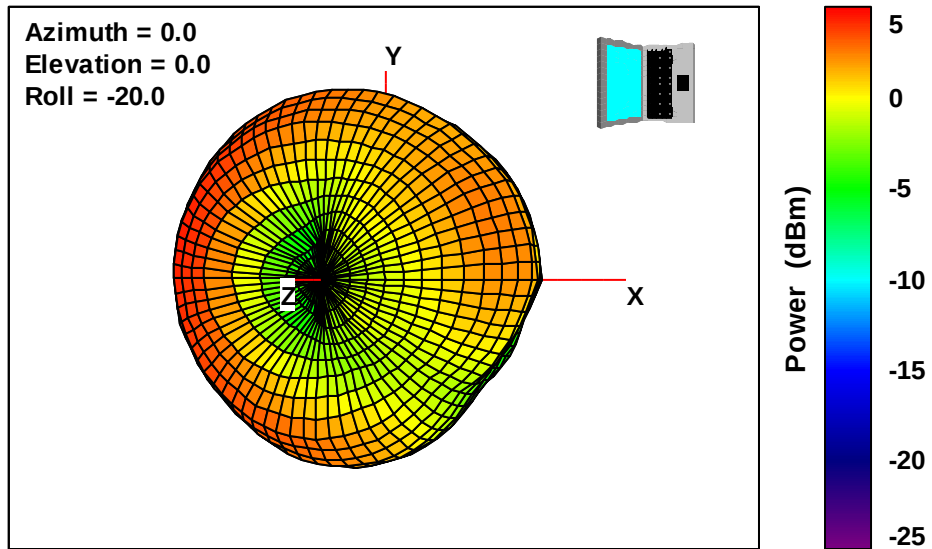
```
-----
Site:                7 layers, Ratingen, Germany
Set up:              free space
-----
Mode:                Bluetooth Transmitter Test Freq. 2402 MHz_
-----
Distance:            2.05 m
Chamber antenna:     ETS 3164-03
Antenna cal.:        c:\afar\cal\ETS.cal
Cable att.:          c:\afar\cal\FSP.cal
Polarization:        both
Table speed:         3
Turn table:          from 0° to 345°, step 15° ("0"=0°)
Tilt device:         from 0° to 165°, step 15° ("0"=0°)
DUT height:          1.44 m
-----
```

```
Resolution band:    1000 kHz
Video band:         10000 kHz
Sweep time:         10 ms
Detector:           Positive Peak Detector
-----
```

```
Equipment:
Receiver:           GPIB=30: FSP
Turn table:         GPIB= 7: CO 2000
Tilt device:         GPIB= 7: CO 2000
RSU:                GPIB= 4: KRE-3078
-----
```

Pattern EIRP (dBm) (Positiv Peak Power):





4.3 TRP Antenna Pattern EIRP (dBm) BLUETOOTH 2440 MHz

Site: 7 layers, Ratingen, Germany
Set up: free space

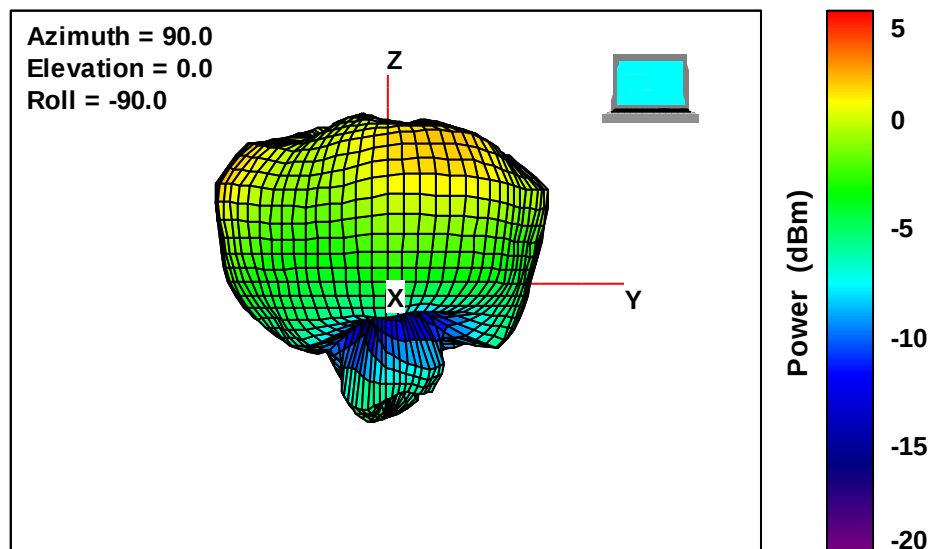
Mode: Bluetooth Transmitter Test Freq. 2440 MHz_

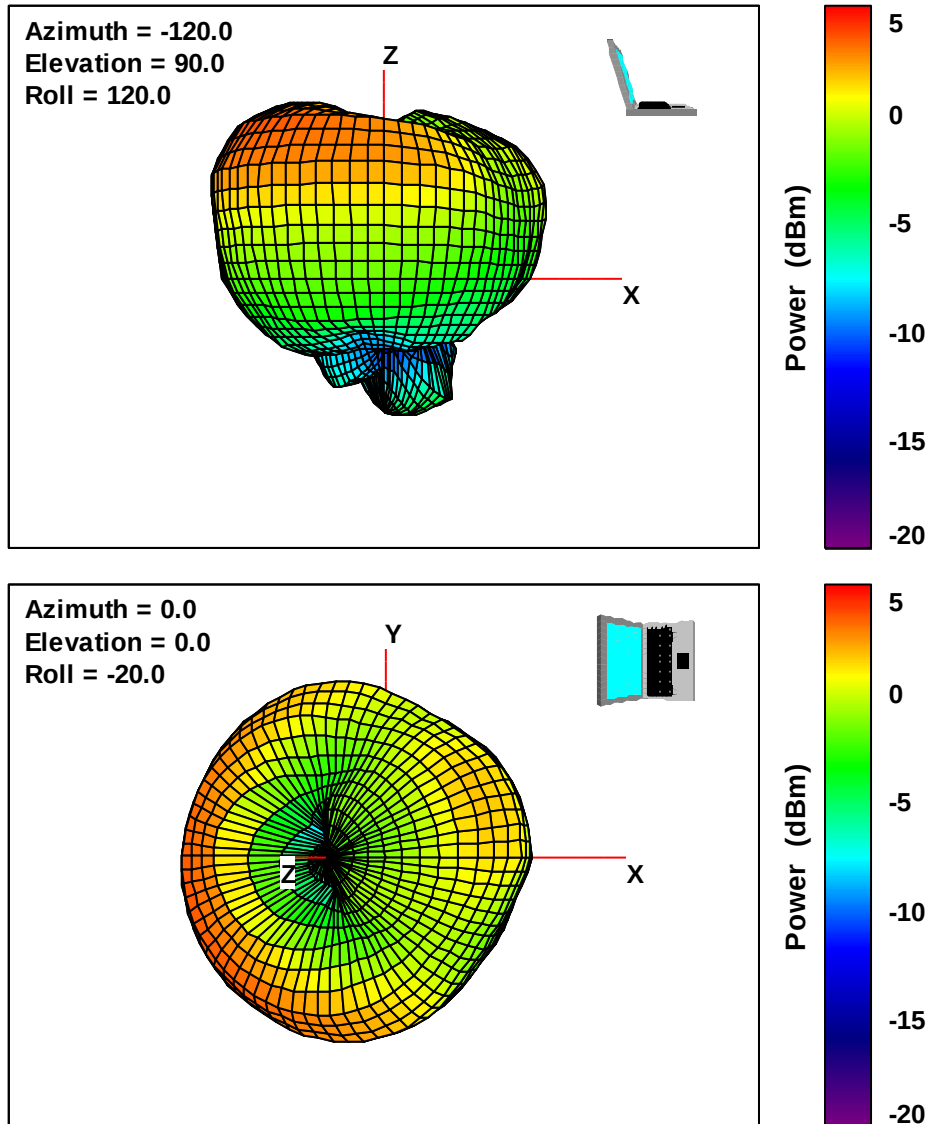
Distance: 2.05 m
Chamber antenna: ETS 3164-03
Antenna cal.: c:\afar\cal\ETS.cal
Cable att.: c:\afar\cal\FSP.cal
Polarization: both
Table speed: 3
Turn table: from 0° to 345°, step 15° ("0"=0°)
Tilt device: from 0° to 165°, step 15° ("0"=0°)
DUT height: 1.44 m

Resolution band: 1000 kHz
Video band: 10000 kHz
Sweep time: 10 ms
Detector: Positive Peak Detector

Equipment:
Receiver: GPIB=30: FSP
Turn table: GPIB= 7: CO 2000
Tilt device: GPIB= 7: CO 2000
RSU: GPIB= 4: KRE-3078

Pattern EIRP (dBm) (Positiv Peak Power):





4.4 TRP Antenna Pattern EIRP (dBm) BLUETOOTH 2480 MHz

Site: 7 layers, Ratingen, Germany
Set up: free space

Mode: Bluetooth Transmitter Test Freq. 2480 MHz_

Distance: 2.05 m
Chamber antenna: ETS 3164-03
Antenna cal.: c:\afar\cal\ETS.cal
Cable att.: c:\afar\cal\FSP.cal
Polarization: both
Table speed: 3
Turn table: from 0° to 345°, step 15° ("0"=0°)
Tilt device: from 0° to 165°, step 15° ("0"=0°)
DUT height: 1.44 m

Resolution band: 1000 kHz
Video band: 10000 kHz
Sweep time: 10 ms
Detector: Positive Peak Detector

Equipment:
Receiver: GPIB=30: FSP
Turn table: GPIB= 7: CO 2000
Tilt device: GPIB= 7: CO 2000
RSU: GPIB= 4: KRE-3078

Pattern EIRP (dBm) (Positiv Peak Power):

