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# Test Report

Report Number:

**F201553E1**

Equipment under Test (EUT):

**Hino Telematics Control Unit  
Hino TCU**

Applicant:

**Hino Motors Sales U.S.A., Inc**

Manufacturer:

**Bosch Car Multimedia Portugal SA**



Deutsche  
Akkreditierungsstelle  
D-PL-17186-01-01  
D-PL-17186-01-02  
D-PL-17186-01-03

## References

- [1] **ANSI C63.10-2013**, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- [2] **FCC CFR 47 Part 15**, Radio Frequency Devices
- [3] **RSS-247 Issue 2 (March 2017)**, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- [4] **RSS-Gen Issue 5 (March 2019)**, General Requirements for Compliance of Radio Apparatus

## Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.

The complete test results are presented in the following.

Test engineer:	Paul NEUFELD Name	 Signature	25.03.2021 Date
Authorized reviewer:	Bernd STEINER Name	 Signature	25.03.2021 Date

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This test report is valid in hardcopy form as well as in electronic form.

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# 1 Identification

## 1.1 Applicant

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Country:	United States of America
Name for contact purposes:	Rachel Suttle
Phone:	248.699.9358
eMail Address:	suttle@hino.com
Applicant represented during the test by the following person:	None

## 1.2 Manufacturer

Name:	Bosch Car Multimedia Portugal SA
Address:	Rua Max Grundig 35 – Lomar, Braga 4705-820
Country:	Portugal
Name for contact purposes:	Maria Pereira
Phone:	+351 (253) 078761
eMail Address:	Maria.Pereira3@pt.bosch.com
Applicant represented during the test by the following person:	None

## 1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**  
**Königswinkel 10**  
**32825 Blomberg**  
**Germany**

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Accreditation designation number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

## 1.4 EUT (Equipment Under Test)

Type of equipment: *	Telematics Control Unit
Type / PMN: *	HINO TELEMATICS CONTROL UNIT
Product number: *	7620.000.271
FCC ID: *	2AXKD-HINOTCU
IC certification number: *	26600-HINOTCU
Serial number: *	2710003202
EUT marking: *	none
PCB identifier: *	8638.920.344
HVIN (Hardware Version Identification Number): *	HINO TELEMATICS CONTROL UNIT
FVIN (Firmware Version Identification Number): *	NA
Hardware version: *	4246H04
Software version: *	GENERIC.CCU.20.01.D.032.PLATFORM

\* Declared by the applicant

Note: Phoenix Testlab GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

Bluetooth LE frequencies				
Channel 0	RX	2402 MHz	TX	2402 MHz
Channel 19	RX	2440 MHz	TX	2440 MHz
Channel 39	RX	2480 MHz	TX	2480 MHz

Bluetooth classic + EDR frequencies				
Channel 0	RX	2402 MHz	TX	2402 MHz
Channel 39	RX	2441 MHz	TX	2441 MHz
Channel 78	RX	2480 MHz	TX	2480 MHz

IEEE 802.11 b/g/n20				
Channel 0	RX	2412 MHz	TX	2412 MHz
Channel 6	RX	2437 MHz	TX	2437 MHz
Channel 11	RX	2462 MHz	TX	2462 MHz

## 1.5 Technical Data of Equipment

Fulfills specifications: *	Bluetooth 4.2 Low Energy (1 Mbps only) Bluetooth classic + EDR (1 +2 + 3 Mbps) 802.11 b/g/n20					
Antenna type: *	4-in-1 external antenna for use on vehicles					
Antenna name: *	PP407087 by TAOGLAS					
Antenna gain: *	GNSS: 3 dBi (Peak gain) Cellular: 6 dBi (Max. peak gain @ 1710 - 2155 MHz) 0 dBi (Min. peak gain @ 699 - 746 MHz) BT/WIFI: 4 dBi (Peak gain)					
Antenna connector: *	SMB					
Supply voltage EUT: *	U <sub>nom</sub> =	12.0 V DC	U <sub>min</sub> =	8.0 V DC	U <sub>max</sub> =	16.0 V DC
Type of modulation: *	BT LE: GFSK BT Classic + EDR: GFSK, 8DPSK, π/4 DQPSK 802.11 b/g/n20: DSSS, OFDM					
Operating frequency range: *	BT LE: 2402 – 2480 MHz BT Classic + EDR: 2402 – 2480 MHz 802.11 b/g/n20: 2412 – 2462 MHz					
Number of channels: *	BT LE: 40 BT Classic + EDR: 79 802.11 b/g/n20: 11					
Temperature range: *	-40 °C to 70 °C					
Lowest / highest Internal clock frequency: *	32.768 kHz / 16 MHz / 24 MHz / 26 MHz / 2480 MHz					

\* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Antennas	SMB FAKRA plugs	Combined GPS/cellular/WLAN/BT antenna	~ 1.8 m	Yes
Main connector	Customized 24 pin	DC Laboratory plug* <sup>3</sup> used for power supply with back up vehicular battery/ Other wires left open	~ 1.8 m	No
SIM plug	SIM plug	-	-	-
USB	Micro USB port, type B	Test laptop* <sup>4</sup>	~ 3 m	Yes

Equipment used for testing	
Cables (connected to the EUT): *1*3	<ul style="list-style-type: none"> <li>- Main connector - cable only connected to DC supply during the tests*3 (~ 3 m)</li> <li>- USB cable – X7601 @ EUT connected to test Laptop PC*4</li> <li>- X700 – SMB port for WLAN/BT – connected to Analyzer during antenna port conducted tests or PP407087 antenna during radiated tests.</li> <li>- X7201, X7200, X7000 Cellular connectors + GNSS connector – connected to PP407087 antenna during radiated tests, not connected during antenna port conducted tests</li> </ul>
Ancillary Laptop PC:*1	<ul style="list-style-type: none"> <li>- HP 840 G2 (S/N: 5CG546382G)</li> </ul>

\*1 Provided by the applicant

\*2 Provided by the laboratory

\*3 Powered with 13.5 V during the tests. Buffered via car battery inside the anechoic chamber for radiated tests.

\*4 Connected via USB to fiber optic converters to the Laptop PC during the radiated tests in the anechoic chamber.

## 1.6 Dates

Date of receipt of test sample:	29.10.2020
Start of test:	23.11.2020
End of test:	21.12.2020

## 2 Operational States

The product is a telematics control unit integrated into the vehicle. It collects data from the vehicle and the environment via various internal interfaces, processes these and sends them via the mobile network to the customer's backend server.

This test report only contains the test results for the WLAN / Bluetooth module. For the results of the integrated WWAN module and the results of the simultaneous transmissions of both modules see test report 201553E2 by Phoenix Testlab.

The conducted tests at the antenna port were performed using a SMB to SMA converter and a 0.3 m SMA cable.

The radiated tests were performed using a panel antenna labeled "HINO REVISED ANTENNA 21 OCTOBER 2020", which was provided by the applicant.

The radio test modes were set using a terminal application on the laptop PC, that was connected to the EUT via an USB cable.

Maximum power Settings for all measurements:

Modulation	Power level set for the test
802.11 b	14
802.11 g/n20	11
BT classic + EDR / BLE	4

The following operation modes were used for the tests.

Operation mode	Description of the operation mode	mode	channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 2402 MHz	BLE	0	GFSK	1 Mbps
2	Continuous transmitting on 2440 MHz	BLE	19	GFSK	1 Mbps
3	Continuous transmitting on 2480 MHz	BLE	39	GFSK	1 Mbps
4	Continuous transmitting on 2402 MHz	BT BR	0	GFSK	1 Mbps
5	Continuous transmitting on 2441 MHz	BT BR	39	GFSK	1 Mbps
6	Continuous transmitting on 2480 MHz	BT BR	79	GFSK	1 Mbps
7	Continuous transmitting on 2402 MHz	BT EDR	0	8DPSK	2 Mbps
8	Continuous transmitting on 2441 MHz	BT EDR	39	8DPSK	2 Mbps
9	Continuous transmitting on 2480 MHz	BT EDR	79	8DPSK	2 Mbps
10	Continuous transmitting on 2402 MHz	BT EDR	0	$\pi/4$ DQPSK	3 Mbps
11	Continuous transmitting on 2441 MHz	BT EDR	39	$\pi/4$ DQPSK	3 Mbps
12	Continuous transmitting on 2480 MHz	BT EDR	79	$\pi/4$ DQPSK	3 Mbps
13	Continuous transmitting on 2412 MHz	802.11 b	1	DSSS	1 Mbps
14	Continuous transmitting on 2437 MHz	802.11 b	6	DSSS	1 Mbps
15	Continuous transmitting on 2462 MHz	802.11 b	11	DSSS	1 Mbps
16	Continuous transmitting on 2412 MHz	802.11 g	1	OFDM	6 Mbps
17	Continuous transmitting on 2437 MHz	802.11 g	6	OFDM	6 Mbps
18	Continuous transmitting on 2462 MHz	802.11 g	11	OFDM	6 Mbps
19	Continuous transmitting on 2412 MHz	802.11 n20	1	OFDM	6.5 Mbps
20	Continuous transmitting on 2437 MHz	802.11 n20	6	OFDM	6.5 Mbps
21	Continuous transmitting on 2462 MHz	802.11 n20	11	OFDM	6.5 Mbps

### 3 Additional Information

All tests were performed with an unmodified sample.

## 4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen [4]	Status	Refer page
Maximum conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	12 et seq
DTS Bandwidth / 99% Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [3]	Passed	14 et seq
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [3]	Passed	17 et seq
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3]	Passed	19 et seq.
Maximum unwanted emissions	0.009 – 26,500	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	23 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Not applicable*	-

\* Not applicable, because the EUT will only be operated in vehicular environments and not be connected to the AC power grid directly or indirectly.

## 5 Results

### 5.1 Duty cycle

#### 5.1.1 Method of measurement

The test was performed conducted at the SMB antenna connector of the EUT.

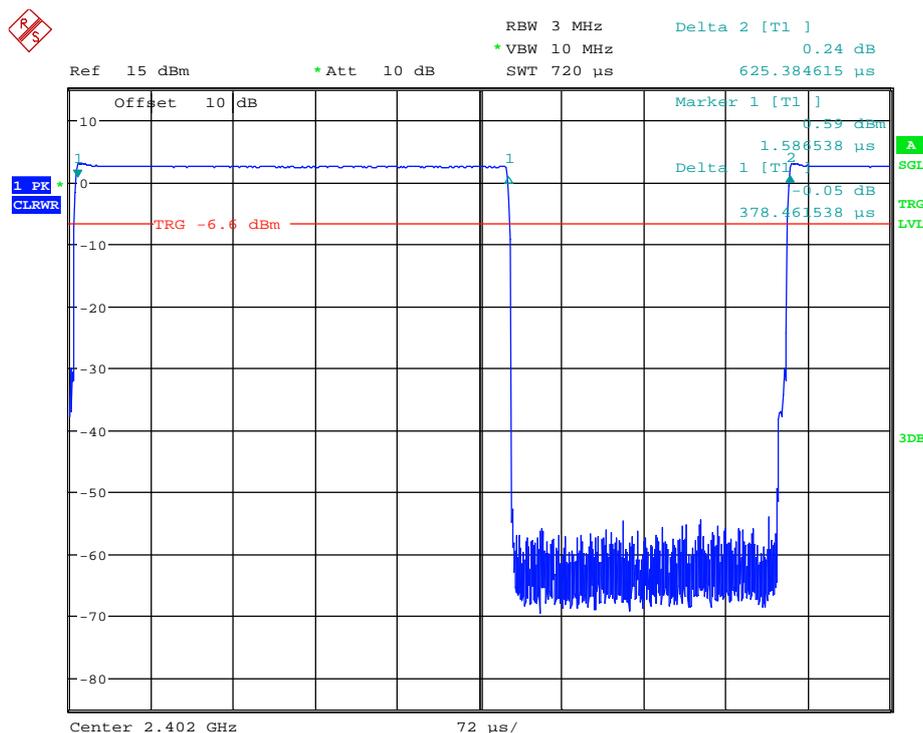
The procedure according to clause 11.6 b) of [1] was used for the following test. Since it does not affect the duty cycle, the measurement was only performed on one channel.

#### 5.1.2 Test results

Ambient temperature	22 °C	Relative humidity	32 %
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Only one plot of the worst case duty cycle is shown below.

201553\_DCCF\_BLE\_2402MHz.wmf: Duty cycle measurement on channel 0 (operation mode 0):



$$\frac{50}{T_{TxOn}} \leq RBW \leq VBW$$

If power averaging (RMS) mode was used in step f), then the applicable correction factor is  $10 \log(1/x)$ , where  $x$  is the duty cycle.

$$x_{DutyCycle} = \frac{T_{TxOn}}{T_{TxCycle}}, \quad \text{correction factor} = F_{DCCF} = 10 \cdot \log\left(\frac{1}{x}\right)$$

Mode	T <sub>XOn</sub> [ms]	T <sub>XCycle</sub> [ms]	X <sub>DutyCycle</sub>	F <sub>DCCF</sub> [dB]	$\frac{50}{T_{TXOn}}$ [kHz]	RBW/VBW [MHz]
BTLE	0.379	0.605	0,6052	2,2	132.113	3 / 10
BT 1 Mbps	2,888	3,78	0,7640	1,2	17.313	3 / 10
BT 2 Mbps	2,894	3,75	0,7717	1,1	17.277	3 / 10
BT 3 Mbps	2,894	3,75	0,7717	1,1	17.277	3 / 10
802.11b 1 Mbps	997,876	1001,214	0.9967	-*	0.050	3 / 10
802.11 g 6 Mbps	992,916	997,877	0.9950	-*	0.050	3 / 10
802.11 n20 6.5 Mbps	994,846	999,800	0.9950	-*	0.050	3 / 10

\* Duty cycle is > 98 %, therefore no duty cycle correction is required.

TEST EQUIPMENT USED FOR THE TEST:

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## 5.2 Maximum conducted output power

### 5.2.1 Method of measurement

The test was performed conducted at the SMB antenna connector of the EUT.

The procedure according clause 11.9.2.2.2 of [1] was used for the following test.

The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

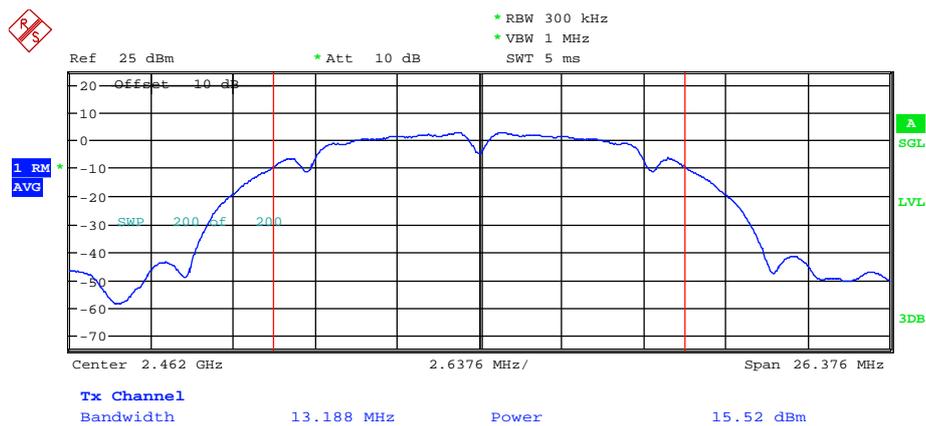
### 5.2.2 Test results

Ambient temperature	22 °C
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Relative humidity	32 %
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The plot below shows the worst-case result. All other results are submitted in the table below

201553\_AvOutPwr\_1M\_2462MHz.wmf: Maximum output power measured on channel 11 (operation mode 15):



The antenna gain is below 6 dBi, therefore no conducted output limit reduction is necessary.

Operation mode		Frequency [MHz]	Reading [dBm]	Corr.* [dB]	Corr. Reading [dBm]	Margin [dB]	Limit [dBm]
1	GFSK	2402	-0.2	2.4	2.2	27.8	30
2	GFSK	2440	0.0	2.4	2.4	27.6	30
3	GFSK	2480	-0.1	2.4	2.3	27.7	30
4	GFSK	2402	0.7	1.4	2.1	27.9	30
5	GFSK	2441	1.0	1.4	2.4	27.7	30
6	GFSK	2480	0.9	1.4	2.3	27.7	30
7	8DPSK	2402	1.3	1.3	2.6	27.4	30
8	8DPSK	2441	1.4	1.3	2.7	27.3	30
9	8DPSK	2480	1.3	1.3	2.6	27.4	30
10	$\pi/4$ DQPSK	2402	1.4	1.3	2.7	27.3	30
11	$\pi/4$ DQPSK	2441	1.4	1.3	2.7	27.3	30
12	$\pi/4$ DQPSK	2480	1.2	1.3	2.5	27.5	30
13	DSSS	2412	14.3	0.2	14.5	15.5	30
14	DSSS	2437	14.7	0.2	14.9	15.1	30
15	DSSS	2462	15.5	0.2	15.7	14.3	30
16	OFDM	2412	9.6	0.2	9.8	20.3	30
17	OFDM	2437	10.0	0.2	10.2	19.9	30
18	OFDM	2462	10.2	0.2	10.4	19.6	30
19	OFDM	2412	9.4	0.2	9.6	20.4	30
20	OFDM	2437	9.7	0.2	9.9	20.1	30
21	OFDM	2462	10.1	0.2	10.3	19.7	30
Measurement uncertainty				+/- 2.71 dB			

\* Correction for duty cycle and antenna cable attenuation of 0.2 dB.

Test: Passed

Test equipment (refer to chapter 6)

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### 5.3 DTS Bandwidth / 99% Bandwidth

#### 5.3.1 Method of measurement

The test was performed conducted at the SMB antenna connector of the EUT.

For the measurement for the DTS bandwidth the procedure according to clause 11.8.1 of [1] was used.

For the measurement for the 99 % bandwidth the procedure according to clause 6.9.3 of [1] was used.

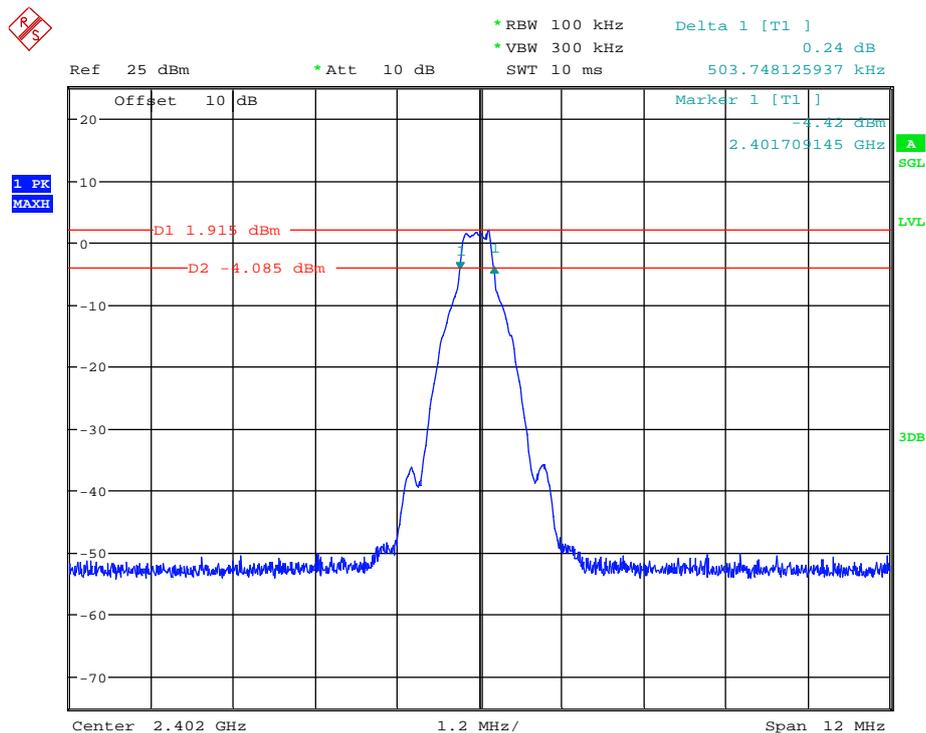
#### 5.3.2 Test result

Ambient temperature	22 °C
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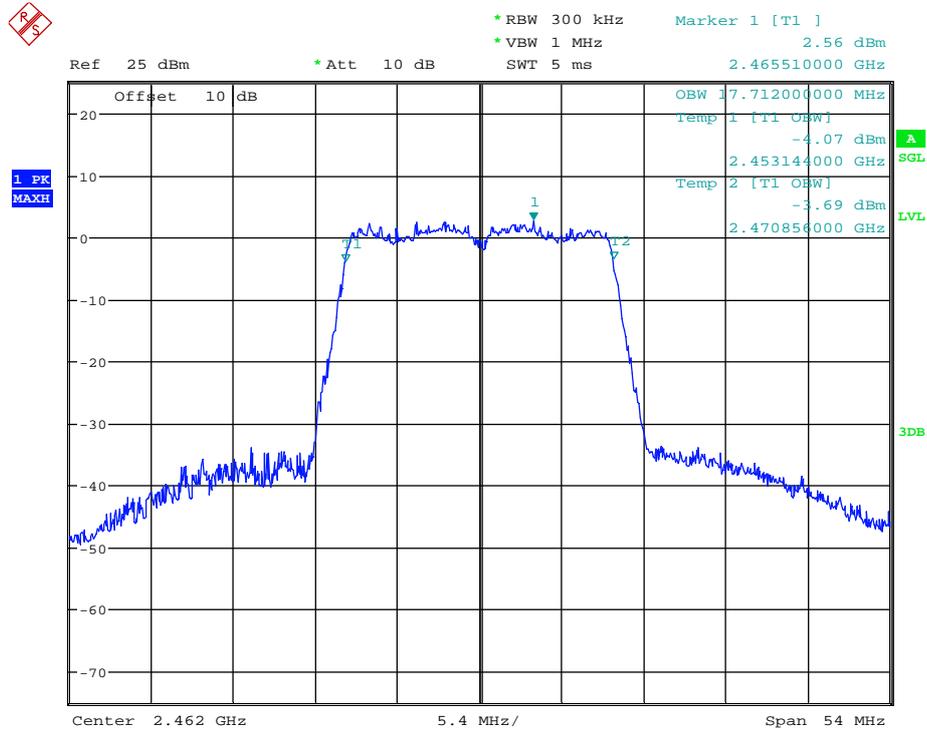
Relative humidity	32 %
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The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

201553\_6dB-BW\_1M\_2402MHz.wmf: 6-dB Bandwidth (operation mode 4):



201553 99%BW MCS0 2462MHz.wmf: 99% Bandwidth (operation mode 19):



Operation Mode		Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Result
1	GFSK	2402	0.5	0.695652	1.026000	Passed
2	GFSK	2440	0.5	0.702849	1.029600	Passed
3	GFSK	2480	0.5	0.705247	1.026000	Passed
4	GFSK	2402	0.5	0.503748	0.864000	Passed
5	GFSK	2441	0.5	0.503748	0.877500	Passed
6	GFSK	2480	0.5	0.503748	0.866700	Passed
7	8DPSK	2402	0.5	1.057871	1.173600	Passed
8	8DPSK	2441	0.5	1.057871	1.173600	Passed
9	8DPSK	2480	0.5	1.056672	1.173600	Passed
10	$\pi/4$ DQPSK	2402	0.5	1.050675	1.177200	Passed
11	$\pi/4$ DQPSK	2441	0.5	1.048276	1.173600	Passed
12	$\pi/4$ DQPSK	2480	0.5	1.049475	1.173600	Passed
13	DSSS	2412	0.5	10.102949	13.188000	Passed
14	DSSS	2437	0.5	10.102949	13.230000	Passed
15	DSSS	2462	0.5	10.102949	13.188000	Passed
16	OFDM	2412	0.5	16.600700	16.881000	Passed
17	OFDM	2437	0.5	16.600700	16.881000	Passed
18	OFDM	2462	0.5	16.583708	16.830000	Passed
19	OFDM	2412	0.5	17.685157	17.766000	Passed
20	OFDM	2437	0.5	17.721139	17.712000	Passed
21	OFDM	2462	0.5	17.703148	17.712000	Passed
Measurement uncertainty				+/- 1.789 kHz		

Test: Passed

Test equipment (refer to chapter 6)

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## 5.4 Average Power Spectral Density

### 5.4.1 Method of measurement

The test was performed conducted at the SMB antenna connector of the EUT.

The procedure according to clause 11.10.5 of [1] was used.

Method AVGPSD-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.

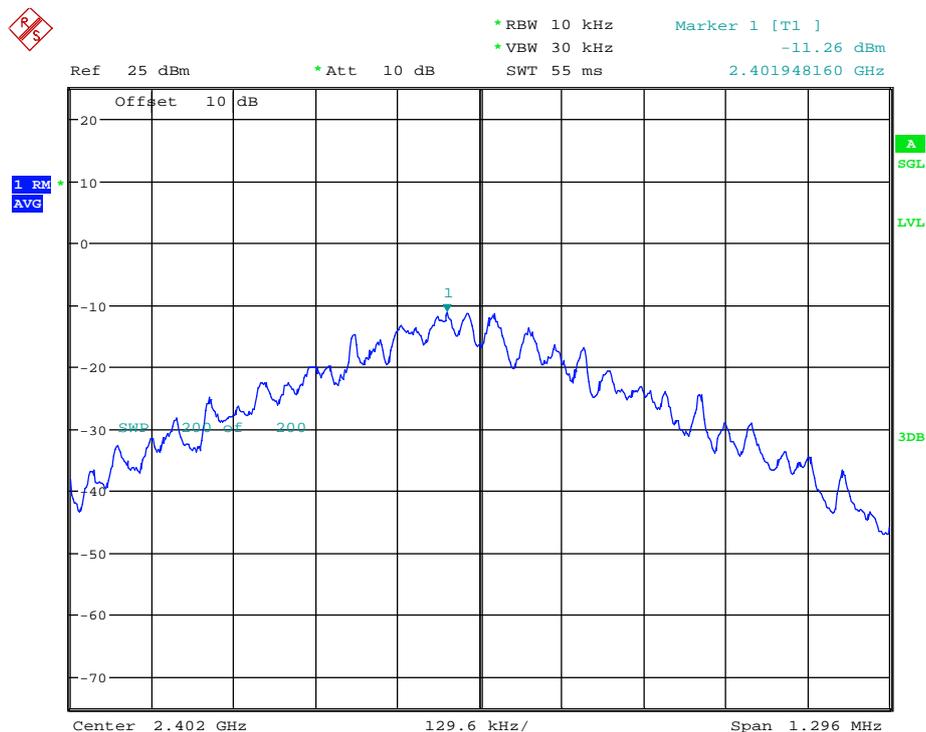
The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

### 5.4.2 Test result

Ambient temperature	22 °C	Relative humidity	32 %
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The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

201553\_AvPSD\_1M\_2402MHz.wmf: Average Power Spectral Density (operation mode 4):



Operation Mode	Peak Frequency [MHz]	AvPSD Reading [dBm/10 kHz]	Corr.* [dB]	Corr. Reading [dBm /10 kHz]	Margin [dB]	AvPSD Limit [dBm/3kHz]	
1	GFSK	2401.977	-14.3	2.4	-11.9	19.9	8
2	GFSK	2439.977	-14.1	2.4	-11.7	19.7	8
3	GFSK	2479.977	-14.2	2.4	-11.8	19.8	8
4	GFSK	2401.948	-11.3	1.4	-9.9	17.9	8
5	GFSK	2440.983	-11.3	1.4	-9.9	17.9	8
6	GFSK	2479.948	-11.0	1.4	-9.6	17.6	8
7	8DPSK	2401.616	-14.7	1.3	-13.4	21.4	8
8	8DPSK	2440.975	-14.8	1.3	-13.5	21.5	8
9	8DPSK	2479.653	-14.8	1.3	-13.5	21.5	8
10	$\pi/4$ DQPSK	2401.940	-15.3	1.3	-14.0	22.0	8
11	$\pi/4$ DQPSK	2440.940	-15.0	1.3	-13.7	21.7	8
12	$\pi/4$ DQPSK	2479.938	-15.4	1.3	-14.1	22.1	8
13	DSSS	2412.678	-12.7	0.2	-12.5	20.5	8
14	DSSS	2437.660	-12.1	0.2	-11.9	19.9	8
15	DSSS	2461.179	-11.5	0.2	-11.3	19.3	8
16	OFDM	2415.083	-19.1	0.2	-18.9	26.9	8
17	OFDM	2434.165	-18.4	0.2	-18.2	26.2	8
18	OFDM	2459.162	-18.7	0.2	-18.5	26.5	8
19	OFDM	2419.462	-19.0	0.2	-18.8	26.8	8
20	OFDM	2444.459	-18.8	0.2	-18.6	26.6	8
21	OFDM	2459.453	-18.3	0.2	-18.1	26.1	8
Measurement uncertainty				+/- 2.71 dB			

\* Correction for duty cycle and antenna cable attenuation of 0.2 dB.

Test: Passed

Test equipment (refer to chapter 6)

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## 5.5 Band-edge compliance

### 5.5.1 Method of measurement (band edges next to unrestricted bands (conducted))

The test was performed conducted at the SMB antenna connector of the EUT.

The procedure according to clause 11.11.2 and 11.11.3 of [1] was used.

The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission, were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20 dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

The measurements were performed at the lower end of the 2.4 GHz band.

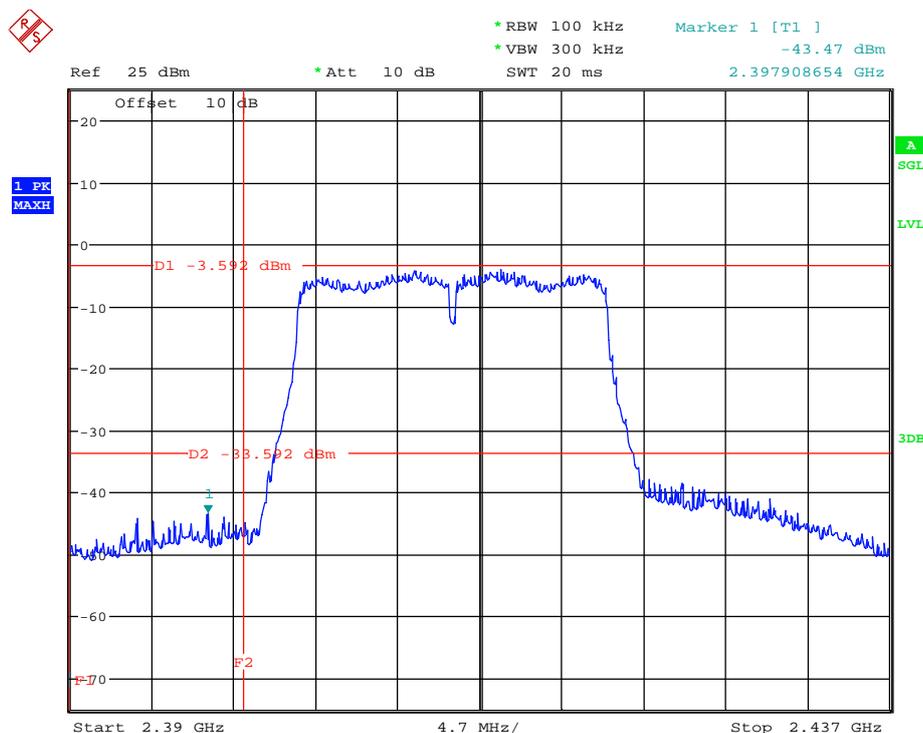
### 5.5.2 Test result (band edges next to unrestricted bands (conducted))

Ambient temperature	22 °C
---------------------	-------

Relative humidity	32 %
-------------------	------

The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

201553 BandEdgeUnrestr\_MCS0\_2412MHz.wmf: Antenna port conducted band-edge compliance at an unrestricted band-edge (operation mode 19):



Operation Mode		Tx Frequency [MHz]	Emission Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emission Level [dBm]	Margin [dB]	Result
1	GFSK	2402	2399.943	2.2	-27.8	-48.9	21.1	Passed
4	GFSK	2402	2390.021	2.5	-27.5	-50.8	23.3	Passed
7	8DPSK	2402	2399.148	3.0	-27.0	-49.9	22.9	Passed
10	$\pi/4$ DQPSK	2402	2399.814	3.3	-26.7	-48.5	21.8	Passed
13	DSSS	2412	2396.935	5.8	-24.2	-40.6	16.4	Passed
16	OFDM	2412	2399.736	-2.0	-32.0	-42.9	10.9	Passed
19	OFDM	2412	2397.909	-3.6	-33.6	-43.5	9.9	Passed
Measurement uncertainty					+/- 2.71 dB			

Test: Passed

Test equipment (refer to chapter 6)

18 - 20

### 5.5.3 Method of measurement (band edges next to restricted bands (radiated))

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1.

The same measurement procedures as described in 5.6.1. were used for the preview and final measurement.

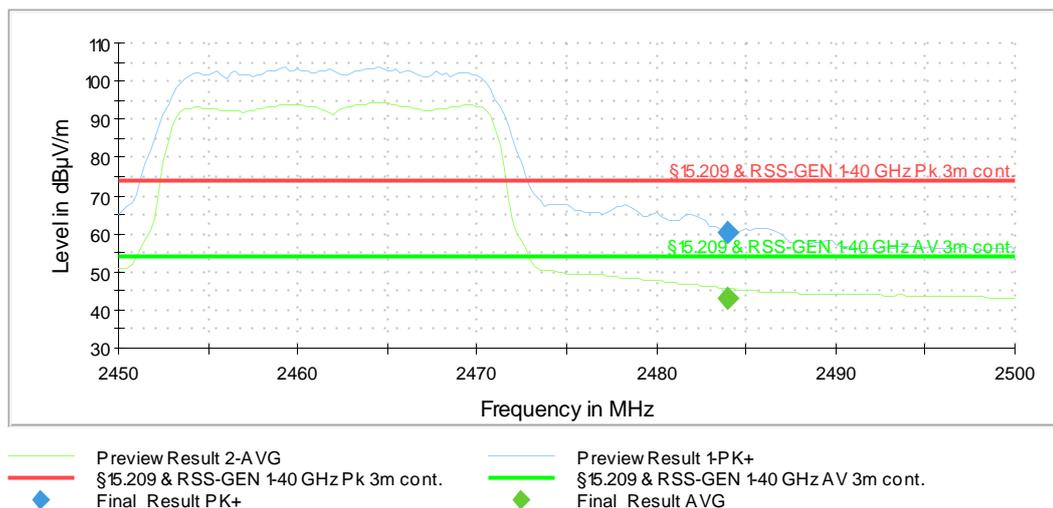
### 5.5.4 Test result (band edges next to restricted bands (radiated))

Ambient temperature	22 °C
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Relative humidity	30 %
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The modulations tested, were the worst-case emissions during the antenna port conducted pre-tests. The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

201553\_n20\_ch1\_UpBE: radiated band-edge compliance at a restricted band-edge (operation mode 21):



### Transmitter operates at the lower end of the assigned frequency band (operation mode 1 GFSK)

Frequency [MHz]	MaxPeak [dBµV/m]	Coverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2389.250000	---	29.99	54.00	24.01	H	241.0	90.0	33.3
2389.250000	48.69	---	74.00	25.31	H	241.0	90.0	33.3
Measurement uncertainty				+2.2 dB / -3.6 dB				

### Transmitter operates at the upper end of the assigned frequency band (operation mode 3 GFSK)

Frequency [MHz]	MaxPeak [dBµV/m]	Coverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2483.750000	---	32.15	54.00	21.85	H	238.0	90.0	33.5
2483.750000	60.24	---	74.00	13.76	H	238.0	90.0	33.5
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the lower end of the assigned frequency band (operation mode 10  $\pi/4$  DQPSK)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2387.500000	49.31	---	74.00	24.69	H	304.0	60.0	33.3
2387.500000	---	30.70	54.00	23.31	H	304.0	60.0	33.3
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the upper end of the assigned frequency band (operation mode 12  $\pi/4$  DQPSK)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2483.500000	---	34.86	54.00	19.14	H	240.0	90.0	33.5
2483.500000	50.99	---	74.00	23.01	H	240.0	90.0	33.5
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the lower end of the assigned frequency band (operation mode 13 DSSS)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2390.000000	59.94	---	74.00	14.06	H	329.0	60.0	33.3
2390.000000	---	41.93	54.00	12.07	H	329.0	60.0	33.3
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the upper end of the assigned frequency band (operation mode 21 OFDM)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2484.000000	---	43.02	54.00	10.98	H	235.0	90.0	33.5
2484.000000	60.20	---	74.00	13.80	H	235.0	90.0	33.5
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test: Passed

Test equipment (refer to chapter 6)

1 – 7, 10, 11,

## 5.6 Maximum unwanted emissions

### 5.6.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

- A preliminary measurement carried out in a semi-anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
- A preliminary and final measurement was carried out in semi-anechoic chamber with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a semi-anechoic chamber with a variable antenna distance and height in the frequency range above 1 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range above 1 GHz.

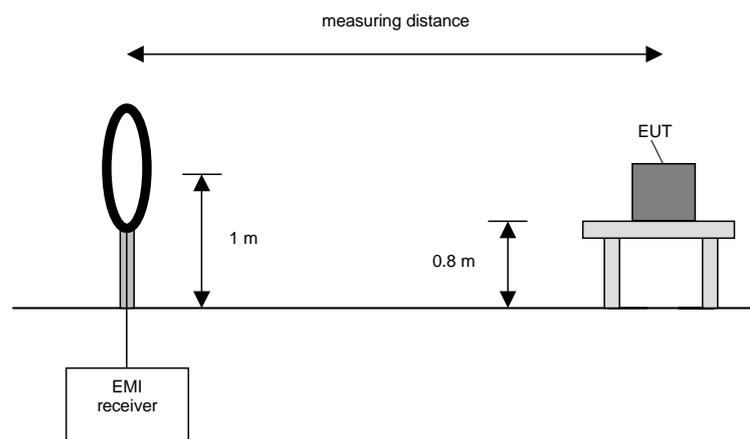
#### **Preliminary measurement (9 kHz to 30 MHz):**

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Table top devices will set up on a non-conducting turn device on the height of 1.5m. Floor-standing devices will be placed directly on the turntable/ground plane. The set-up of the Equipment under test will be in accordance to [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

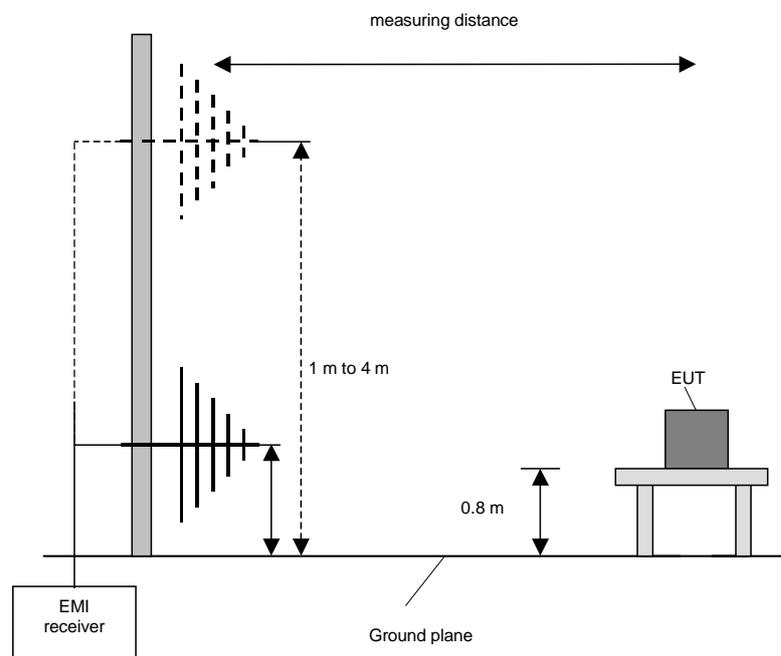
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical and the ground-parallel polarisation of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. The steps before are performed using a test software, which saves the worst-case positions and values for each Antenna and azimuth of the turntable.

**Preliminary and final measurement (30 MHz to 1 GHz)**

A preliminary and final measurement in a semi-anechoic chamber with reflective ground plane will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

- 1) Measure the frequency range 30 MHz to 1 GHz at an antenna height of 1 m and a EUT azimuth of 6 °.
- 2) Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
- 3) Rotate the Turntable by 30 ° and repeat 2) until an azimuth of 366 ° is reached.
- 4) Repeat 1) to 3) for the other orthogonal antenna polarization.
- 5) Move the antenna and the turntable to the position where the maximum values are detected.
- 6) Measure while moving the antenna slowly +/- 1 m.
- 7) Set the antenna to the position where the maximum value is found.
- 8) Measure while moving the turntable +/- 45 °.
- 9) Set the turntable to the azimuth where the maximum value is found.
- 10) Measure with Final detector (QP and AV) and note the value.
- 11) Repeat 5) to 10) for each final frequency.
- 12) Repeat 1) to 11) for each orthogonal axes of the EUT (if the EUT is a module and might be used in a handheld equipment application).
- 13) The steps before are performed using a test software, which saves the worst-case positions and values for each Antenna and azimuth of the turntable.

**Preliminary and final measurement (1 GHz to 40 GHz)**

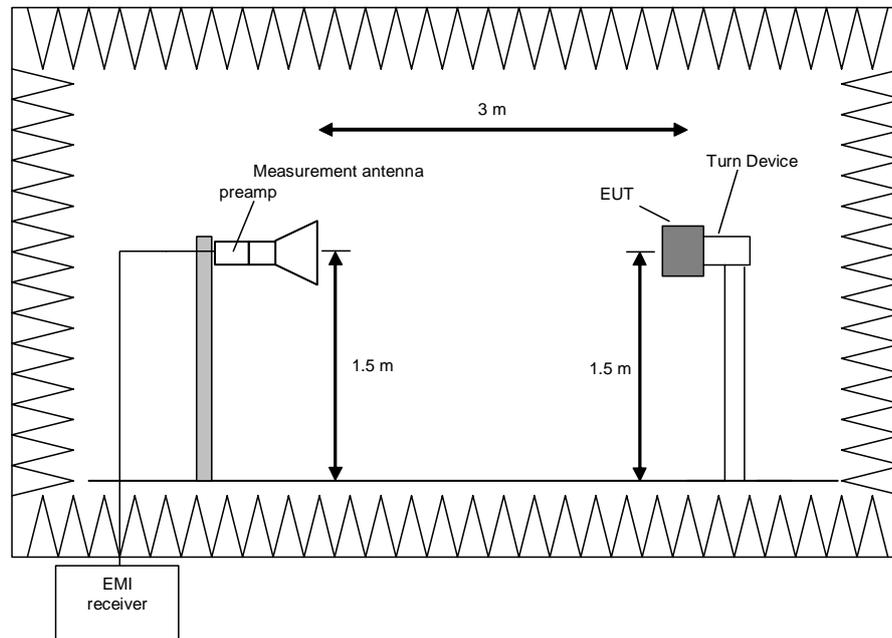
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

**Preliminary measurement (1 GHz to 40 GHz)**

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 25 / 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.

The following procedure will be used:

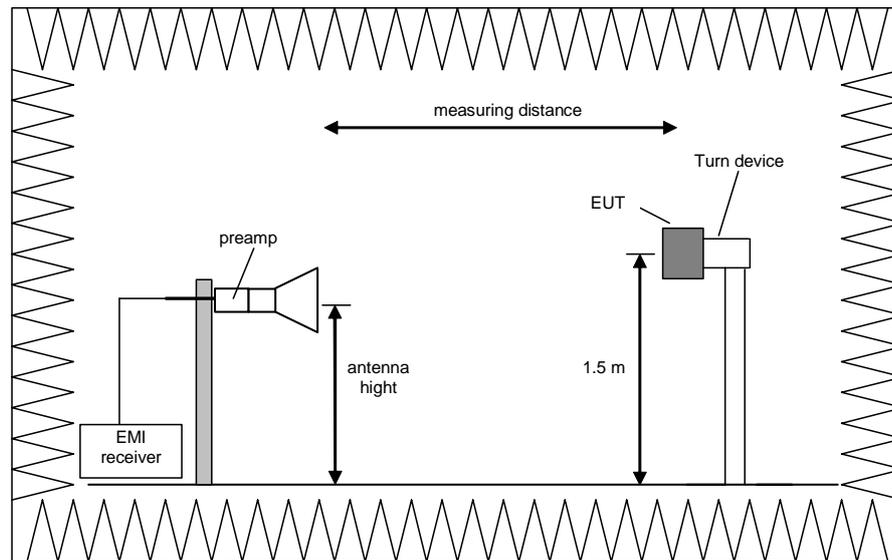
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

**Final measurement (1 GHz to 40 GHz)**

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.

The following procedure will be used:

- 1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with peak and average detector activated.
- 4) Rotate the turntable from 0° to 360° to find the TT Pos. that produces the highest emissions.
- 5) Note the highest displayed peak and average values
- 6) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

## 5.6.2 Test results (radiated emissions) – Emissions from 9 kHz – 26.5 GHz (external antenna)

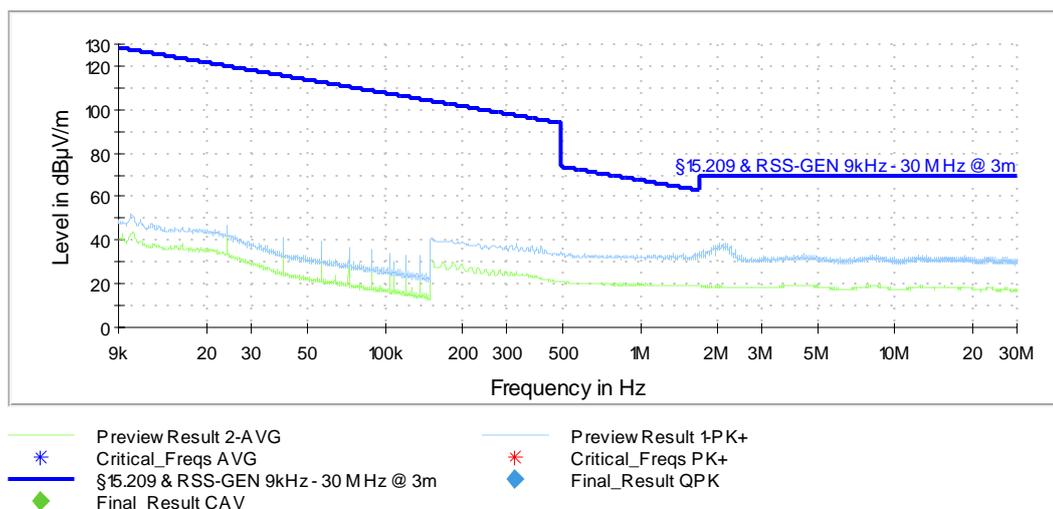
### 5.6.2.1 Preliminary radiated emission measurement 9 kHz – 26.5 GHz

Ambient temperature	22 °C	Relative humidity	27 %
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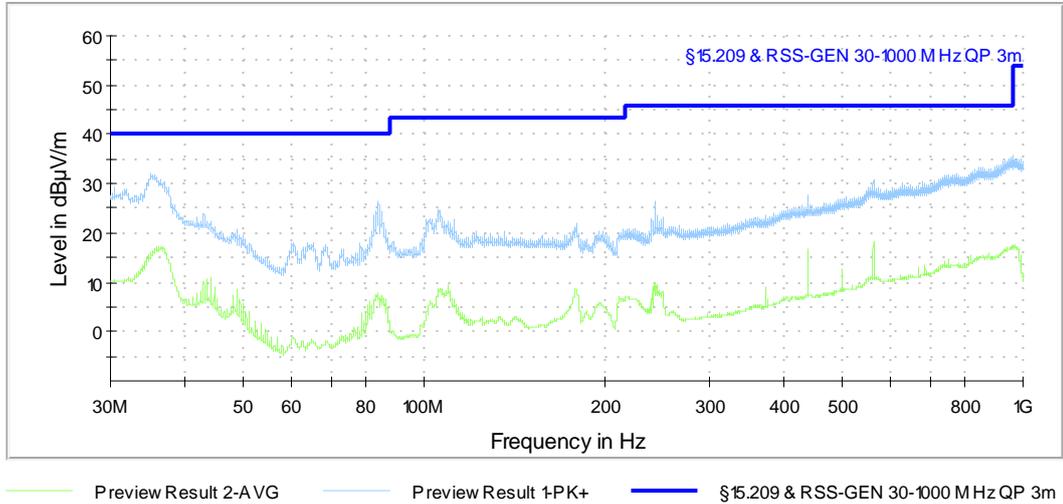
- Position of EUT:** The EUT was set-up on an EUT turn device of a height of 1.5 m for  $f > 1$  GHz. For the test for  $f < 1$  GHz on the open area test site the EUT was placed on a table with the height of 0.8 m. The distance between EUT and antenna was 3 m for all tests.
- Cable guide:** For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.
- Test record:** Only one plot of the worst-case emission of every frequency range is submitted below.
- Remark:** Since there were no differences in the spectrum for  $30 \text{ MHz} < f < 1 \text{ GHz}$ , only one representative plot is submitted below.
- Since no emissions or noise level closer than 20 dB to the limit were found for  $f < 30 \text{ MHz}$  during the preliminary measurements, no final measurement was performed.
- Antenna port conducted pre-tests have shown that the fundamental and spurious emissions for BT classic was basic rate with 1 Mbps and GFSK modulation. Similarly, 802.11b with 1 Mbps data rate produced the worst-case emissions during the antenna port conducted pre-tests. Since BLE only supported one modulation, no reduction of radiated test cases was possible.

### Plots of the worst-case transmitter spurious emissions

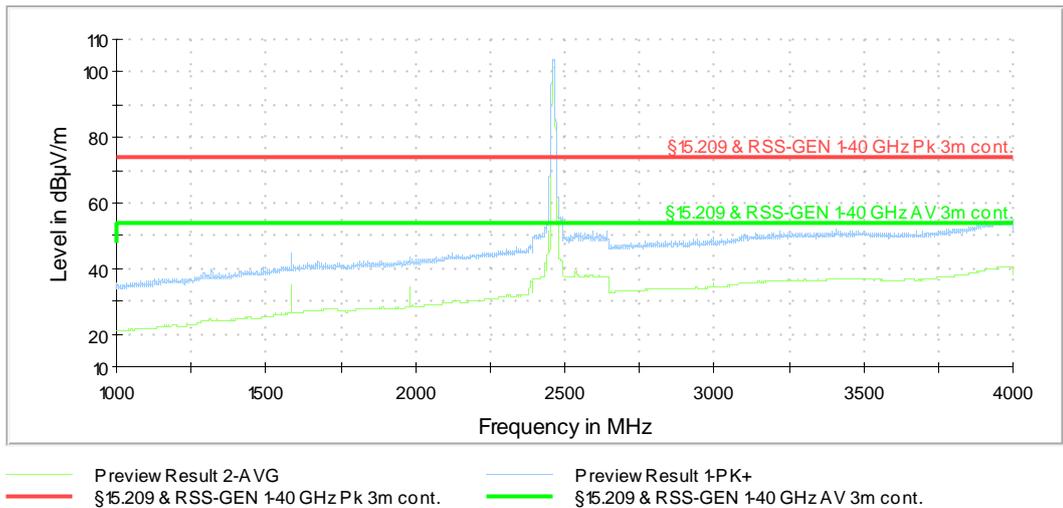
201553 WLAN b CH1 9K-30M: Spurious emissions from 9 kHz to 30 MHz (operation mode 13):



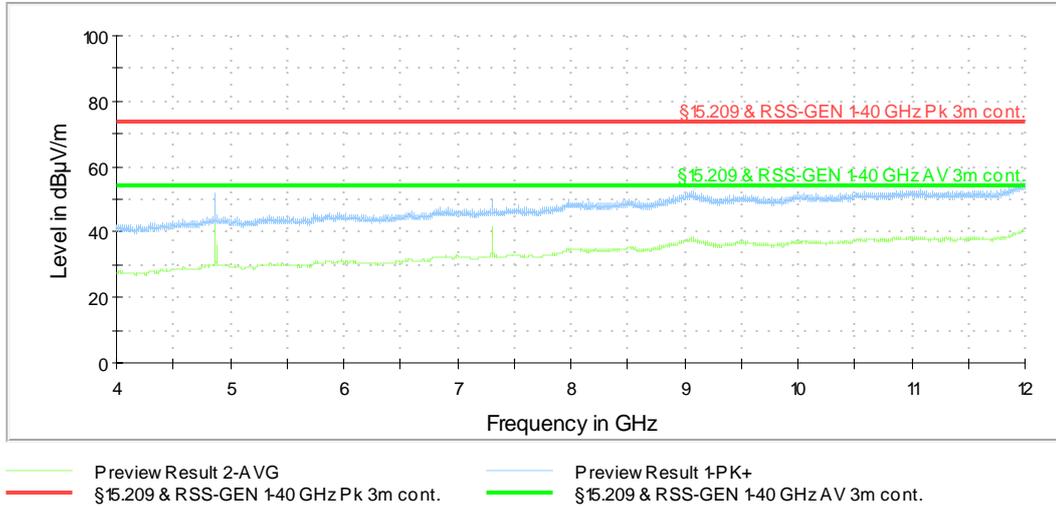
201553 BLE\_CH0\_90°\_30M-1G: Spurious emissions from 30 MHz to 1 GHz (operation mode 1):



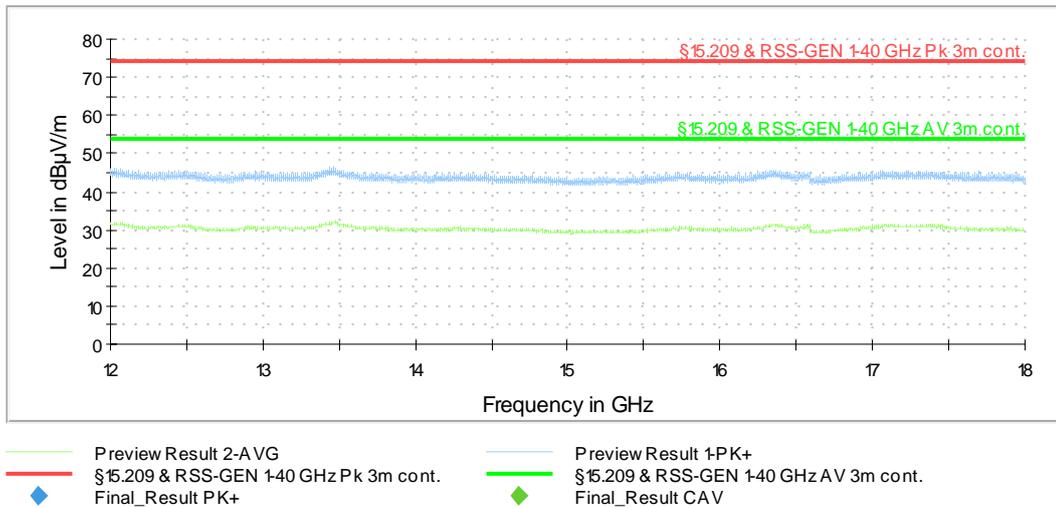
201553\_1M\_ch11\_1-4G: Spurious emissions from 1 GHz to 4 GHz (operation mode 15):



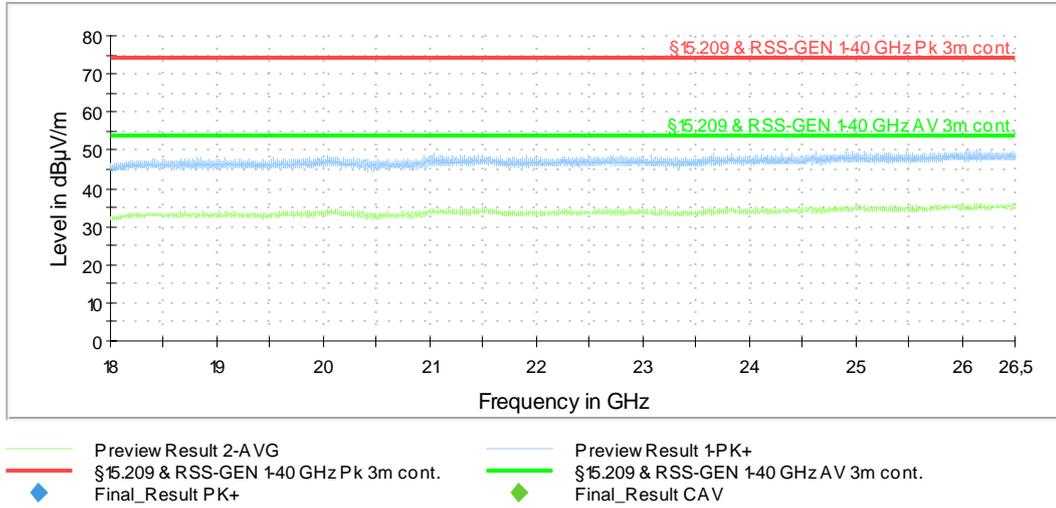
201553 1M\_ch6\_4-12G: Spurious emissions from 4 GHz to 12 GHz (operation mode 14):



201553 WLAN\_1M\_ch6\_12-18G: Spurious emissions from 12 GHz to 18 GHz (operation mode 14):



201553 WLAN 1M ch6 18-26.5G: Spurious emissions from 18 GHz to 26.5 GHz (operation mode 14):



### 5.6.2.2 Final radiated measurements

#### **BLE ch0 30M-1G operation mode 0 (no difference detected when comparing channel / modulation)**

201553\_BLE\_CH0\_90°\_30M-1G

Frequency [MHz]	QuasiPeak [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB]
30.400000	18.62	40.00	21.38	1000.0	120.000	102.0	V	36.0	28.3
35.090000	24.80	40.00	15.20	1000.0	120.000	104.0	V	106.0	26.2
84.190000	14.83	40.00	25.17	1000.0	120.000	116.0	V	204.0	16.0
106.020000	17.23	43.52	26.29	1000.0	120.000	125.0	V	195.0	16.9
562.510000	26.46	46.02	19.56	1000.0	120.000	100.0	V	122.0	28.4
959.370000	24.35	46.02	21.67	1000.0	120.000	181.0	V	151.0	34.1
Measurement uncertainty					+2.2 dB / -3.6 dB				

#### **Transmitter operates at the lower end of the assigned frequency band (operation mode 1, GFSK)**

Frequency [MHz]	MaxPeak [dBμV/m]	Coverage [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.050000	43.94	---	74.00	30.06	H	193.0	150.0	29.0
1584.050000	---	29.08	54.00	24.92	H	193.0	150.0	29.0
1980.050000	43.10	---	74.00	30.90	H	155.0	90.0	31.1
1980.050000	---	27.44	54.00	26.56	H	155.0	90.0	31.1
2402.000000	97.44	---	Fund.	-	H	242.0	90.0	33.4
2402.000000	---	92.10	Fund.	-	H	242.0	90.0	33.4
2485.600000	47.39	---	74.00	26.61	H	241.0	90.0	33.5
2485.600000	---	32.29	54.00	21.71	H	241.0	90.0	33.5
2998.675000	46.93	---	74.00	27.07	V	36.0	60.0	35.6
2998.675000	---	32.20	54.00	21.80	V	36.0	60.0	35.6
3999.400000	52.79	---	74.00	21.21	V	56.0	0.0	38.8
3999.400000	---	39.10	54.00	14.90	V	56.0	0.0	38.8
4803.750000	---	29.34	54.00	24.66	H	335.0	60.0	7.0
4803.750000	41.63	---	74.00	32.37	H	335.0	60.0	7.0
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the middle of the assigned frequency band (operation mode 2, GFSK)**

Frequency [MHz]	MaxPeak [dBμV/m]	Coverage [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.050000	---	25.56	54.00	28.44	H	150.0	90.0	29.0
1584.050000	41.11	---	74.00	32.89	H	150.0	90.0	29.0
1980.050000	---	26.79	54.00	27.21	H	156.0	90.0	31.1
1980.050000	43.39	---	74.00	30.61	H	156.0	90.0	31.1
2440.000000	---	92.94	Fund.	-	H	240.0	90.0	33.5
2440.000000	98.21	---	Fund.	-	H	240.0	90.0	33.5
2516.575000	---	31.73	54.00	22.27	H	244.0	90.0	33.6
2516.575000	47.39	---	74.00	26.61	H	244.0	90.0	33.6
2997.275000	46.03	---	74.00	27.97	V	133.0	90.0	35.6
2997.275000	---	32.25	54.00	21.75	V	133.0	90.0	35.6
3999.600000	52.97	---	74.00	21.03	V	31.0	30.0	38.8
3999.600000	---	39.15	54.00	14.85	V	31.0	30.0	38.8
4879.750000	---	30.51	54.00	23.49	V	246.0	150.0	7.4
4879.750000	43.63	---	74.00	30.37	V	246.0	150.0	7.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the upper end of the assigned frequency band (operation mode 3, GFSK)**

Frequency [MHz]	MaxPeak [dBμV/m]	Coverage [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.025000	43.21	---	74.00	30.79	H	159.0	120.0	29.0
1584.025000	---	28.73	54.00	25.27	H	159.0	120.0	29.0
1980.050000	43.04	---	74.00	30.96	H	306.0	90.0	31.1
1980.050000	---	29.82	54.00	24.18	H	306.0	90.0	31.1
2480.000000	---	93.65	Fund.	-	H	240.0	90.0	33.5
2480.000000	99.02	---	Fund.	-	H	240.0	90.0	33.5
2569.425000	47.05	---	74.00	26.95	H	233.0	60.0	33.9
2569.425000	---	32.17	54.00	21.83	H	233.0	60.0	33.9
2996.250000	46.01	---	74.00	27.99	V	68.0	150.0	35.6
2996.250000	---	32.23	54.00	21.77	V	68.0	150.0	35.6
3998.700000	---	39.00	54.00	15.00	H	11.0	30.0	38.8
3998.700000	52.55	---	74.00	21.45	H	11.0	30.0	38.8
4959.750000	---	29.68	54.00	24.32	V	314.0	0.0	7.2
4959.750000	42.39	---	74.00	31.61	V	314.0	0.0	7.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the lower end of the assigned frequency band (operation mode 4, GFSK)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.025000	42.72	---	74.00	31.28	H	192.0	120.0	29.0
1584.025000	---	27.76	54.00	26.24	H	192.0	120.0	29.0
1980.050000	---	32.41	54.00	21.59	H	151.0	90.0	31.1
1980.050000	43.13	---	74.00	30.87	H	151.0	90.0	31.1
2376.675000	47.85	---	74.00	26.15	H	330.0	60.0	33.3
2376.675000	---	32.59	54.00	21.41	H	330.0	60.0	33.3
2402.125000	97.62	---	Fund.	-	H	326.0	60.0	33.4
2402.125000	---	94.37	Fund.	-	H	326.0	60.0	33.4
2998.125000	46.20	---	74.00	27.80	V	-4.0	90.0	35.6
2998.125000	---	32.25	54.00	21.75	V	-4.0	90.0	35.6
3999.400000	---	39.07	54.00	14.93	H	61.0	60.0	38.8
3999.400000	52.36	---	74.00	21.64	H	61.0	60.0	38.8
4804.000000	---	30.70	54.00	23.30	V	333.0	0.0	7.0
4804.000000	42.90	---	74.00	31.10	V	333.0	0.0	7.0
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the middle of the assigned frequency band (operation mode 5, GFSK)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.025000	---	26.36	54.00	27.64	V	187.0	120.0	29.0
1584.025000	41.12	---	74.00	32.88	V	187.0	120.0	29.0
1980.050000	---	27.07	54.00	26.93	H	150.0	90.0	31.1
1980.050000	42.84	---	74.00	31.16	H	150.0	90.0	31.1
2420.075000	---	33.43	54.00	20.57	H	240.0	90.0	33.4
2420.075000	48.14	---	74.00	25.86	H	240.0	90.0	33.4
2441.125000	---	94.75	Fund.	-	H	240.0	90.0	33.5
2441.125000	98.09	---	Fund.	-	H	240.0	90.0	33.5
2998.150000	47.13	---	74.00	26.87	V	93.0	120.0	35.6
2998.150000	---	32.26	54.00	21.74	V	93.0	120.0	35.6
3998.800000	---	39.14	54.00	14.86	V	11.0	120.0	38.8
3998.800000	52.59	---	74.00	21.41	V	11.0	120.0	38.8
4882.000000	---	30.09	54.00	23.91	V	294.0	150.0	7.4
4882.000000	42.53	---	74.00	31.47	V	294.0	150.0	7.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the upper end of the assigned frequency band (operation mode 6, GFSK)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.050000	45.19	---	74.00	28.81	H	187.0	150.0	29.0
1584.050000	---	36.18	54.00	17.82	H	187.0	150.0	29.0
1980.050000	---	31.10	54.00	22.90	V	165.0	0.0	31.1
1980.050000	42.69	---	74.00	31.31	V	165.0	0.0	31.1
2480.125000	99.07	---	Fund.	-	H	238.0	90.0	33.5
2480.125000	---	95.74	Fund.	-	H	238.0	90.0	33.5
2518.075000	---	33.60	54.00	20.40	H	237.0	90.0	33.6
2518.075000	48.79	---	74.00	25.21	H	237.0	90.0	33.6
2997.150000	46.03	---	74.00	27.97	H	140.0	150.0	35.6
2997.150000	---	32.32	54.00	21.68	H	140.0	150.0	35.6
3998.250000	53.11	---	74.00	20.89	H	81.0	120.0	38.8
3998.250000	---	39.07	54.00	14.93	H	81.0	120.0	38.8
4960.000000	---	30.39	54.00	23.61	V	269.0	150.0	7.2
4960.000000	42.86	---	74.00	31.14	V	269.0	150.0	7.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the lower end of the assigned frequency band (operation mode 13, DSSS)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.025000	---	27.24	54.00	26.76	V	201.0	120.0	29.0
1584.025000	42.90	---	74.00	31.10	V	201.0	120.0	29.0
1980.050000	---	31.22	54.00	22.78	H	149.0	90.0	31.1
1980.050000	43.33	---	74.00	30.67	H	149.0	90.0	31.1
2386.050000	48.83	---	74.00	25.17	H	310.0	60.0	33.3
2386.050000	---	37.73	54.00	16.27	H	310.0	60.0	33.3
2411.450000	101.06	---	Fund.	-	H	324.0	60.0	33.4
2411.450000	---	98.13	Fund.	-	H	324.0	60.0	33.4
2487.400000	---	34.33	54.00	19.67	H	217.0	90.0	33.5
2487.400000	46.28	---	74.00	27.72	H	217.0	90.0	33.5
2997.725000	46.21	---	74.00	27.79	V	39.0	30.0	35.6
2997.725000	---	32.30	54.00	21.70	V	39.0	30.0	35.6
3999.850000	---	39.09	54.00	14.91	V	76.0	150.0	38.8
3999.850000	53.33	---	74.00	20.67	V	76.0	150.0	38.8
4824.000000	---	48.95	54.00	5.05	H	255.0	90.0	7.1
4824.000000	51.95	---	74.00	22.05	H	255.0	90.0	7.1
7236.750000	---	37.90	54.00	16.10	V	281.0	30.0	10.9
7236.750000	47.55	---	74.00	26.45	V	281.0	30.0	10.9
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the middle of the assigned frequency band (operation mode 14, DSSS)**

Frequency [MHz]	MaxPeak [dBμV/m]	Coverage [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.025000	42.83	---	74.00	31.17	V	133.0	150.0	29.0
1584.025000	---	26.97	54.00	27.03	V	133.0	150.0	29.0
1980.050000	41.64	---	74.00	32.36	H	9.0	120.0	31.1
1980.050000	---	28.11	54.00	25.89	H	9.0	120.0	31.1
2437.475000	101.77	---	Fund.	-	H	241.0	90.0	33.5
2437.475000	---	98.78	Fund.	-	H	241.0	90.0	33.5
3168.050000	---	34.17	54.00	19.83	H	342.0	90.0	36.7
3168.050000	47.54	---	74.00	26.46	H	342.0	90.0	36.7
3249.050000	---	34.49	54.00	19.51	H	189.0	120.0	36.8
3249.050000	48.67	---	74.00	25.33	H	189.0	120.0	36.8
3993.425000	53.33	---	74.00	20.67	V	202.0	60.0	38.8
3993.425000	---	38.72	54.00	15.28	V	202.0	60.0	38.8
4874.000000	---	49.80	54.00	4.20	H	253.0	90.0	7.4
4874.000000	52.82	---	74.00	21.18	H	253.0	90.0	7.4
7311.750000	---	42.43	54.00	11.57	V	276.0	30.0	11.2
7311.750000	49.79	---	74.00	24.21	V	276.0	30.0	11.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

**Transmitter operates at the upper end of the assigned frequency band (operation mode 15, DSSS)**

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Coverage [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1584.025000	---	26.55	54.00	27.45	V	188.0	90.0	29.0
1584.025000	41.60	---	74.00	32.40	V	188.0	90.0	29.0
1980.050000	---	31.66	54.00	22.34	H	146.0	90.0	31.1
1980.050000	42.60	---	74.00	31.40	H	146.0	90.0	31.1
2462.475000	103.82	---	Fund.	-	H	242.0	90.0	33.6
2462.475000	---	100.85	Fund.	-	H	242.0	90.0	33.6
2537.550000	47.29	---	74.00	26.71	H	245.0	90.0	33.7
2537.550000	---	35.69	54.00	18.31	H	245.0	90.0	33.7
2997.875000	46.93	---	74.00	27.07	H	187.0	90.0	35.6
2997.875000	---	32.36	54.00	21.64	H	187.0	90.0	35.6
3999.275000	---	39.23	54.00	14.77	V	274.0	90.0	38.8
3999.275000	52.23	---	74.00	21.77	V	274.0	90.0	38.8
4924.000000	---	48.93	54.00	5.07	H	253.0	90.0	7.4
4924.000000	51.93	---	74.00	22.07	H	253.0	90.0	7.4
7386.750000	---	41.16	54.00	12.84	V	282.0	30.0	11.3
7386.750000	49.07	---	74.00	24.93	V	282.0	30.0	11.3
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test equipment (refer to chapter 6)

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## 6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Software	EMC32	Rohde & Schwarz	-	483261	Calibration not necessary	
2	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Calibration not necessary	
3	Signal & Spectrum Analyzer	ESW44	Rohde & Schwarz	101635	482467	18.02.2020	02.2022
4	Controller	MCU	Maturo	MCU/043/971107	480832	Calibration not necessary	
5	Turntable	DS420HE	Deisel	420/620/80	480315	Calibration not necessary	
6	Antenna support	AS615P	Deisel	615/310	480187	Calibration not necessary	
7	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100908	482977	13.08.2019	08.2022
8	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Calibration not necessary	
9	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Calibration not necessary	
10	RF-cable 3	Sucoflex 106B	Huber&Suhner	500234/6B	482644	Calibration not necessary	
11	RF-cable 40	Sucoflex106B	Huber&Suhner	SF106B/11N/11N/1500MM	482125	Calibration not necessary	
12	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	14.02.2020	02.2022
13	RF-cable 2 m	KPS-1533-800-KPS	Insulated Wire	-	480302	Calibration not necessary	
14	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	13.02.2020	07.2022
15	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	13.02.2020	02.2022
16	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	13.02.2020	02.2022
17	4 GHz High Pass Filter	WHKX4.0/18G-8SS	Wainwright Instruments	1	480587	Calibration not necessary	
18	Spectrum Analyser	FSU46	Rohde & Schwarz	200125	480956	13.02.2020	03.2021
19	Power Supply	TOE8752-32 (DC)	Toellner Electronic Inst.	31566	480010	Calibration not necessary	
20	Multimeter	971A	Hewlett Packard	JP39009358	480721	16.01.2020	01.2021
21	Semi anechoic chamber	M276	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
22	Antenna mast	BAM4.5-P-10kg	maturo	222/2612.01	483225	Calibration not necessary	
23	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
24	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
25	Software	EMC32	Rohde & Schwarz	ID: 1300.7010.12-100970-Be	482972	Calibration not necessary	
26	Antenne (Bilog)	CBL6111D	Schaffner	22921	480674	27.03.2018	03.2021
27	EMI Testreceiver	ESW	Rohde & Schwarz	101828	482979	12.04.2019	04.2021

## 7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA	ANSI C63.4-2017	19.09.2019	09.2021
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR*1	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	19.09.2019	09.2021
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	13.08.2020	08.2022
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	06.11.2018	11.2020

## 8 Report History

Report Number	Date	Comment
F201553E1	25.03.2021	Initial Test Report

## 9 List of Annexes

ANNEX A	TEST SETUP PHOTOS	10 pages
ANNEX B	EXTERNAL PHOTOS	7 pages
ANNEX C	INTERNAL PHOTOS	6 pages