

# Test Report

Report Number:

**F200776E4**

Equipment under Test (EUT):

**Pac 6500**

Applicant:

**Dräger Safety AG & Co. KGaA**

Manufacturer:

**Dräger Safety AG & Co. KGaA**



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] **558074 D01 15.247 Meas Guidance v05r02 (April 2019)**, GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
- [4] **RSS-247, Issue 2 (2017-02)** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- [4] **RSS-Gen, Issue 5 (2019-03)** 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.

Tested and  
written by:

Paul Neufeld

Name



Signature

16.02.2021

Date

Reviewed  
and approved  
by:

Bernd Steiner

Name



Signature

16.02.2021

Date

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# 1 Identification

## 1.1 Applicant

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Country:	Germany
Name for contact purposes:	Mr. Lutz RÜFFERT
Phone:	+49 451 882 1623
Fax:	-
eMail Address:	Lutz.rueffert@draeger.com
Applicant represented during the test by the following person:	-

## 1.2 Manufacturer

Name:	Dräger Safety AG & Co. KGaA
Address:	Revalstrasse 1, 23560 Lübeck
Country:	Germany
Name for contact purposes:	Mr. Lutz RÜFFERT
Phone:	+49 451 882 1623
Fax:	-
eMail Address:	Lutz.rueffert@draeger.com
Applicant represented during the test by the following person:	-

## 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)

EUT	
Test object: *	Portable single gas monitor
PMN / Model name: *	Pac 6500
FCC ID: *	X6O-BT005
IC: * ISED Certification number: *	5895F-BT005
Serial number: *	Internal antenna with direct test mode: ARNF-0075* <sup>1</sup> Temporary antenna connector with direct test mode: ARND-0294* <sup>1</sup>
PCB identifier: *	8328687_6
Hardware version: * HVIN: *	BT005
Software version: * FVIN: *	-

\* Declared by the applicant

\*<sup>1</sup> Serial number as marked on the PCB (not the housing)

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

## 1.5 Technical Data of Equipment

EUT data						
Power supply EUT: *	DC (by internal battery)					
Supply voltage EUT: *	U <sub>nom</sub> =	3.6 V <sub>DC</sub>	U <sub>min</sub> =	2.6 V <sub>DC</sub>	U <sub>max</sub> =	3.7 V <sub>DC</sub>
Temperature range: *	-40 °C to +55 °C					
Lowest / highest internal clock frequency: *	32.768 kHz / 2480 MHz (in BLE mode)					

Ports / Connectors				
Identification			Length during test	Shielding (Yes / No)
	EUT	Ancillary		
None				

Bluetooth® Low Energy radio mode		
Fulfils radio specification: *	Bluetooth Low Energy™ 5.2 (only 1 Mbit/s PHY supported by EUT)	
Radio chip: *	nRF52832, Nordic Semiconductors	
Antenna type: *	Ceramic Antenna	
Antenna name: *	-	
Antenna gain: *	Peak:	2.0 dBi (Typical)
Antenna connector: *	None (Temporary antenna connector only provided for test purposes)	
Conducted output power:	BLE 1 M PHY	0 dBm
Type of modulation: *	BLE 1 M PHY	GFSK
Operating frequency range: *	BLE 1 M PHY	2402 – 2480 MHz
Number of channels: *	BLE 1 M PHY	40 (2 MHz channel spacing)



Bluetooth® LE frequencies				
Channel 00	RX	2402 MHz	TX	2402 MHz
...	...	...	...	...
Channel 19	RX	2440 MHz	TX	2440 MHz
...	...	...	...	...
Channel 39	RX	2480 MHz	TX	2480 MHz

### 1.5.1 Ancillary Equipment / Equipment used for testing

Equipment used for testing	
Cables (connected to the EUT):	FTDI cable (TTL-232-3V3) * <sup>1</sup>
Fibre optic converter:	Opto USB2.0, MK Messtechnik (PM. No. 482617) * <sup>2</sup>
PC:	Raspberry Pi 3 Model B V1.2* <sup>1</sup>

\*<sup>1</sup> Provided by the applicant

\*<sup>2</sup> Provided by the laboratory

### 1.6 Dates

Date of receipt of test sample:	02.11.2020
Start of test:	05.11.2020
End of test:	15.12.2020

## 2 Operational States

### 2.1 Description of function of the EUT

The EUT is a gas measuring device that can incorporate different sensor types for various gases. The measured gas concentration can be transferred to an ancillary device with the aid of the integrated Bluetooth® Low Energy 5.2 transceiver. As declared by the applicant, the final firmware will only support the tested 1 Mbit/s.

The EUT:



### 2.2 The following states were defined as the operating conditions

During all tests, the EUT was supplied by its internal battery.

#### 2.2.1 Radio test

For the radio tests the following settings were used:

A special EUT with regulatory radio firmware was used for the radio tests.

A connection to the EUT was established via delivered FTDI (UART to USB) cable with the aid of USB to FO converter. All relevant RF-parameter could be set via console at a delivered Raspberry Pi.

Following parameter were set according to the applicant:

Default mode LE 1M PHY, 0 dBm transmit power

a. `hcidtool -i hci1 cmd 0x08 0x31 0x00 0x01 0x01`

Min Channel (2402 MHz) long packet 240 byte payload

a. `hcidtool -i hci1 cmd 0x08 0x1e 0x00 0xF0 0x07`

Mid Channel (2440 MHz) long packet 240 byte payload

a. `hcidtool -i hci1 cmd 0x08 0x1e 0x13 0xF0 0x07`

Max Channel (2480 MHz) long packet 240 byte payload

a. `hcidtool -i hci1 cmd 0x08 0x1e 0x27 0xF0 0x07`

### 2.2.2 Operation modes

Operation mode #	Radio technology	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate	Power setting
1	BLE	2402	0	GFSK	1 Mbit/s	0 dBm
2	BLE	2440	19	GFSK	1 Mbit/s	0 dBm
3	BLE	2480	39	GFSK	1 Mbit/s	0 dBm
4	BLE	2402	0	GFSK	1 Mbit/s	+4 dBm
5	BLE	2440	19	GFSK	1 Mbit/s	+4 dBm
6	BLE	2480	39	GFSK	1 Mbit/s	+4 dBm

The maximum output power of the Radio chip is +4 dBm (typical)



## 4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [4] RSS-Gen [5]	Status	Refer page
Maximum peak conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	Passed	14
Maximum conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	Passed	14
DTS Bandwidth / 99% Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [4]	Passed	19
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	Passed	22
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	Passed	22
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [4]	Passed	23
Maximum unwanted emissions	0.009 – 26,500	15.247 (d) 15.205 (a) 15.209 (a)	8.9 [5]	Passed	27
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Not applicable* <sup>1</sup>	
Antenna Requirement	-	15.203 15.247 (b)	5.4 (f) (ii) [4]	Passed* <sup>2</sup>	-

\*<sup>1</sup> Not applicable because the EUT is powered with an internal battery without the possibility to charge by connecting to the public mains power grid directly or via charger.

\*<sup>2</sup> Fixed Antenna, gain below 6 dBi, no power reduction necessary.

## 5 Results

### 5.1 Duty cycle

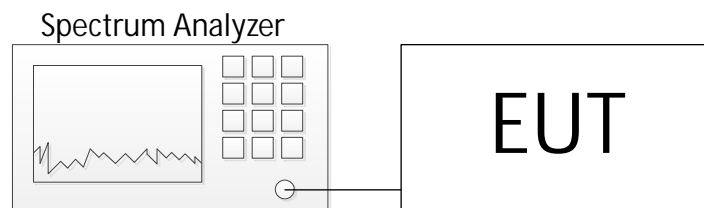
#### 5.1.1 Method of measurement (conducted)

The EUT was measured conducted on a sample with an antenna connector, which was provided by the applicant.

##### Acceptable measurement configurations

According to [3] chapter 6 method b), which is equal to method described in chapter 11.6 b) of document [1] was used to perform the following test.

##### Test Setup:

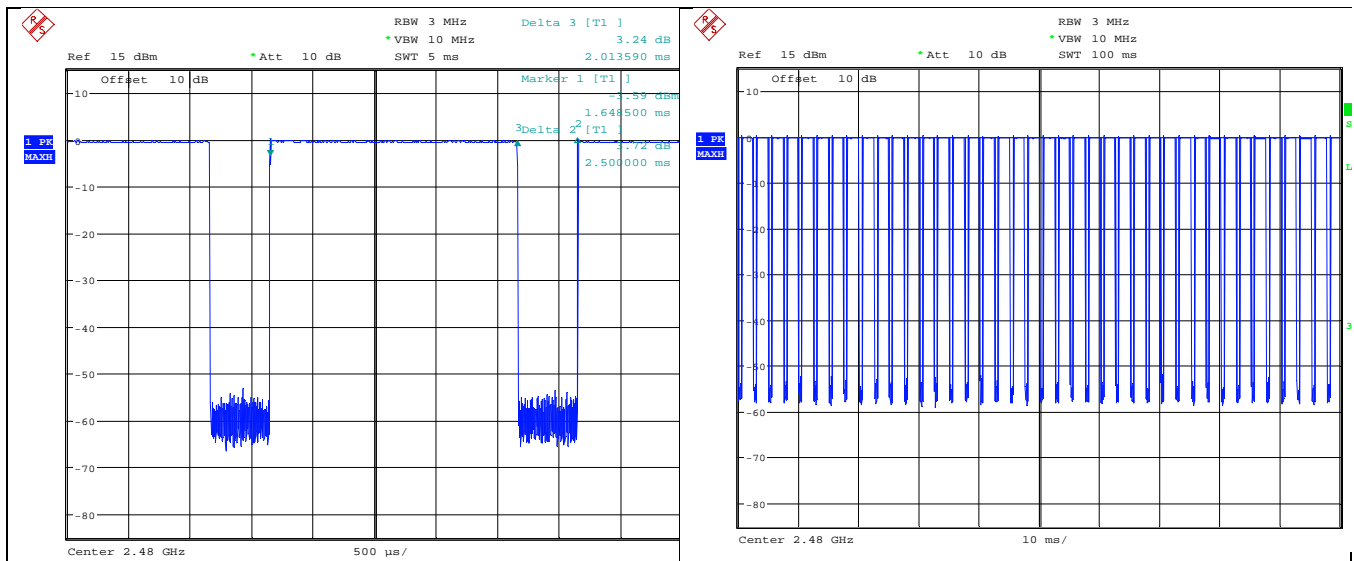


Only one representative plot is provided.

### 5.1.2 Test results

Ambient temperature	22 °C
Relative humidity	53 %

Date	15.12.2020
Tested by	B. ROHDE



Operation mode	TX_on [µs]	TX_ges [µs]	RBW [MHz]	50/T [kHz]	50/T < RBW?
BLE 1 Mbit/s	2014	2500	3	25	Yes

Operation mode	Sweep points	Sweep time [µs]	Meas points	Meas points >100?	Duty cycle %	DCCF [dB]
BLE 1 Mbit/s	10001	3000	8334	Yes	81	0.94

The DCCF (duty cycle correction factor) is calculated by:

$$DCCF = 10 * \log_{10} \left( \frac{1}{Duty\ cycle} \right)$$

Therefore, for average measurements a correction factor of 0.94 dB is used for all tests in test mode 1 -3.

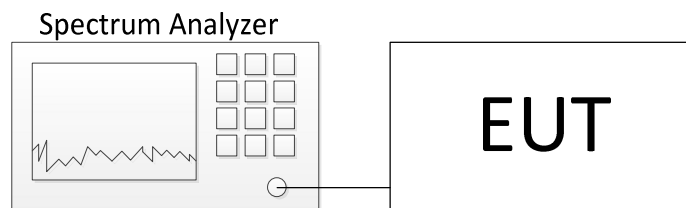
Test equipment (please refer to chapter 6 for details)
1

## 5.1 Maximum conducted output power

### 5.1.1 Method of measurement (conducted)

The measurements were done conducted at the antenna connectors.

#### Test Setup:



#### Acceptable measurement configurations

See 8.3 of document [3] for details.

For the **Maximum *peak* conducted output power** the Procedure **11.9.1.1** in [1] was used.

For the **Maximum conducted *average* output power** the Procedure **11.9.2.2.4** in [1] was used.

Only one representative plot for each measurement configuration is provided.

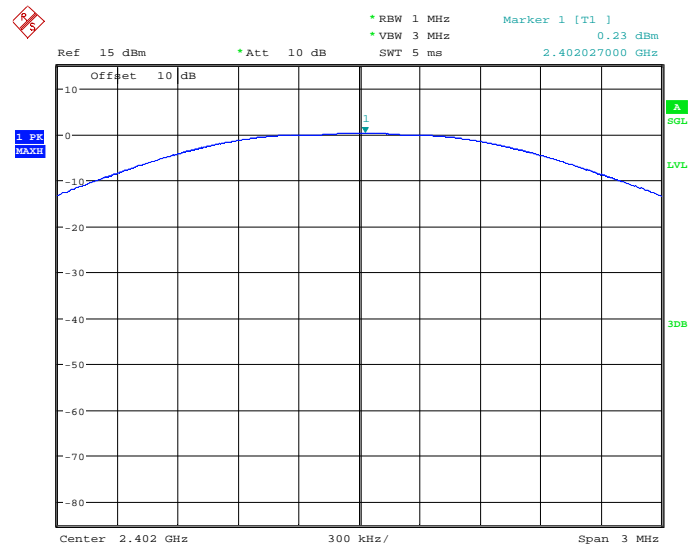


### 5.1.2 Test results

Ambient temperature	22 °C
Relative humidity	53 %

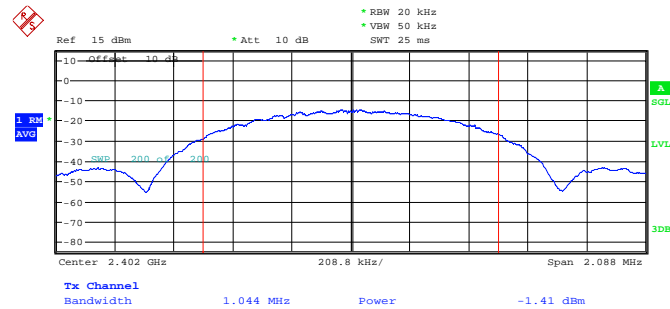
Date	15.12.2020
Tested by	B. ROHDE

Maximum *peak* conducted output power:



Operation mode	Reading [dBm]	Corr. Fact. [dB]	Peak output power [dBm]	Limit [dBm]	Result
1	0.2	0.2	0.4	30	passed
2	0.2	0.2	0.4	30	passed
3	0.1	0.2	0.3	30	passed

**Maximum average conducted output power:**



Operation mode	Reading [dBm]	Corr. Fact. [dB]	Power [dBm]	DCCF [dB]	Power Incl. DCCF [dBm]	Limit [dBm]	Result
1	-1.4	0.2	-1.2	0.9	-0.3	30.0	passed
2	-1.4	0.2	-1.2	0.9	-0.3	30.0	passed
3	-1.5	0.2	-1.3	0.9	-0.4	30.0	passed

Test equipment (please refer to chapter 6 for details)

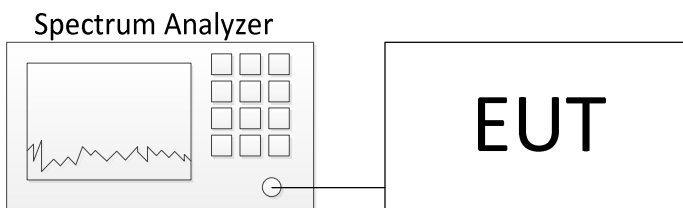
1

## 5.1 DTS Bandwidth / 99% Bandwidth

### 5.1.1 Method of measurement (conducted)

The measurements were done conducted at the antenna connector.

#### Test Setup:



#### Acceptable measurement configurations

See chapter 8.2 of document [3]

For the **DTS bandwidth** the Procedure **11.8.1** in [1] was used.

For the **Occupied bandwidth – 99% Bandwidth** the Procedure **6.9.3** in [1] was used.

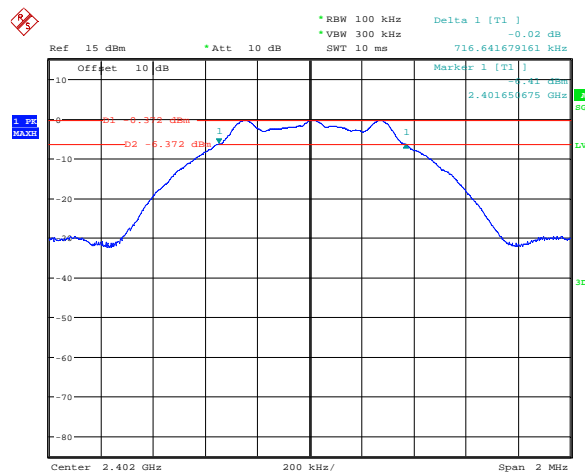
Only one representative plot for each measurement configuration is provided.

### 5.1.2 Test results

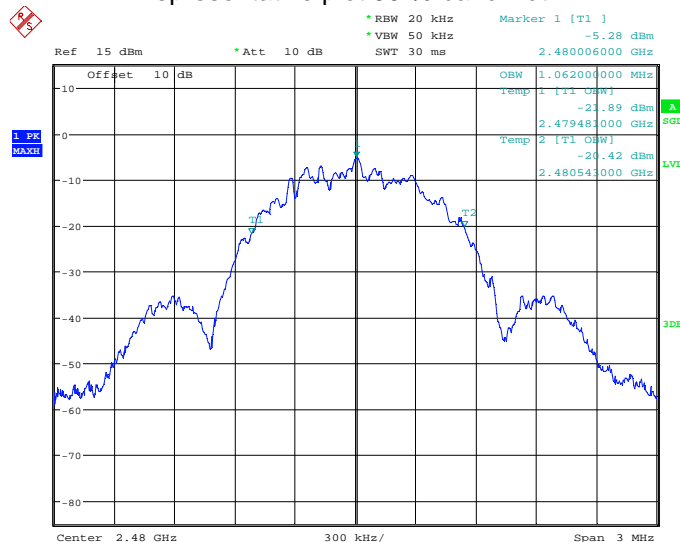
Ambient temperature	22 °C
Relative humidity	53 %

Date	15.12.2020
Tested by	B. ROHDE

Representative plot DTS bandwidth



Representative plot 99 % bandwidth



OP mode	Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [kHz]	6 dB Bandwidth [kHz]	99 % Bandwidth [kHz]	Result
1	2402	500	716.6	1056.0	Passed
2	2440	500	713.6	1059.0	Passed
3	2480	500	707.6	1062.0	Passed

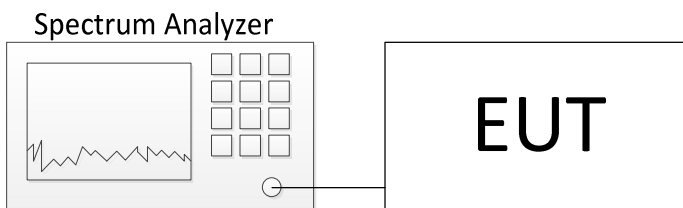
Test equipment (please refer to chapter 6 for details)
1

## 5.2 Power spectral density

### 5.2.1 Method of measurement (conducted)

The measurements were done conducted at the antenna connector.

#### Test Setup:



#### Acceptable measurement configurations

See chapter 8.4 of document [3]

For the **Maximum *peak* power spectral density level in the fundamental emission** the Procedure **11.10.2** in [1] was used.

For the **Maximum *average* power spectral density level in the fundamental emission** the Procedure **11.10.5** in [1] was used.

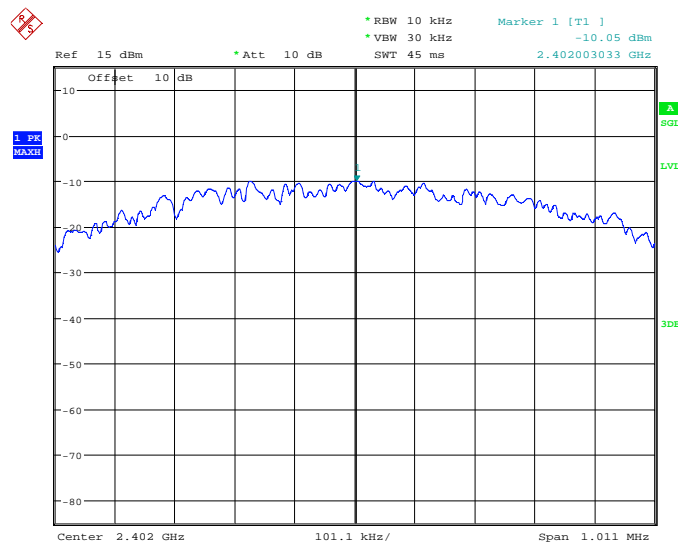
Only one representative plot for each measurement configuration is provided.

### 5.2.2 Test results

Ambient temperature	22 °C
Relative humidity	53 %

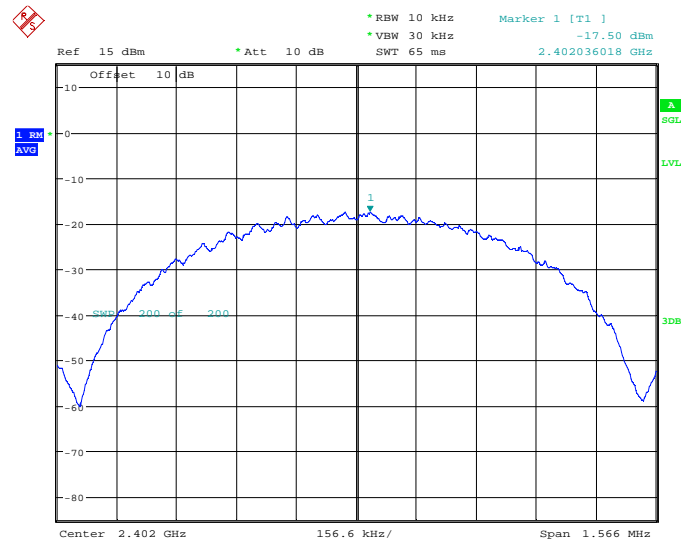
Date	15.12.2020
Tested by	B. ROHDE

Maximum *peak* power spectral density level in the fundamental emission:



OP mode	Peak Frequency [MHz]	Reading dBm / 10kHz	Corr. Fact. [dB]	PPSD [dBm / 10 kHz]	PSD Limit [dBm / 3 kHz]	Result
1	2402.003	-10.1	0.2	-9.9	8	Passed
2	2439.824	-10.1	0.2	-9.9	8	Passed
3	2479.824	-10.2	0.2	-10.0	8	Passed

**Maximum average power spectral density level in the fundamental emission:**



OP mode	Peak Frequency [MHz]	Reading [dBm / 10kHz]	Corr. Fact. [dB]	DCCF [dB]	Result incl. DCCF [dBm / 10 kHz]	PSD Limit [dBm / 3 kHz]	Result
1	2402.036	-17.5	0.2	0.9	-16.4	8	Passed
2	2440.035	-17.5	0.2	0.9	-16.4	8	Passed
3	2479.971	-17.5	0.2	0.9	-16.4	8	Passed

Test equipment (please refer to chapter 6 for details)

1

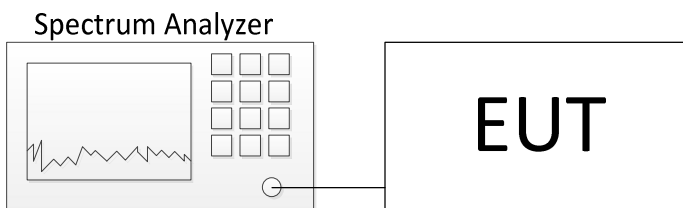


## 5.3 Band edge

### 5.3.1 Method of measurement (conducted)

The measurements were done conducted at the antenna connector.

#### Test Setup:



#### Acceptable measurement configurations

See chapter 8.7 of document [3].

For the **Band-edge testing (unrestricted bands)** the Procedure **6.10.4** in [1] was used, see remarks of #59, table A2 of document [1].

For the **Band-edge testing (restricted bands)** the tests were done radiated.

Only one representative plot is provided.

### 5.3.2 Method of measurement (radiated)

The EUT was measured radiated in an anechoic chamber. For test setup and measurement configuration see 5.4.1

For the **Band-edge testing (restricted bands)** the 15.209 limits apply.

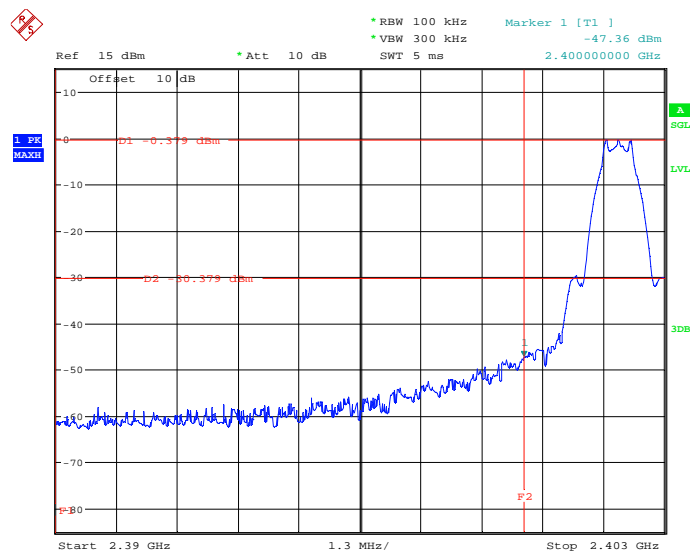
Only one representative plot is provided.

### 5.3.3 Test results

#### 5.3.3.1 Band-edge testing (unrestricted bands; conducted):

Ambient temperature	22 °C
Relative humidity	53 %

Date	15.12.2020
Tested by	B. ROHDE



Operation mode	Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emission Level [dBm]	Margin [dB]	Result
1	2400.000	-0.4	-30.4	-47.4	17.0	Passed

Test equipment (please refer to chapter 6 for details)

1

### 5.3.3.2 Band-edge testing (restricted bands; radiated):

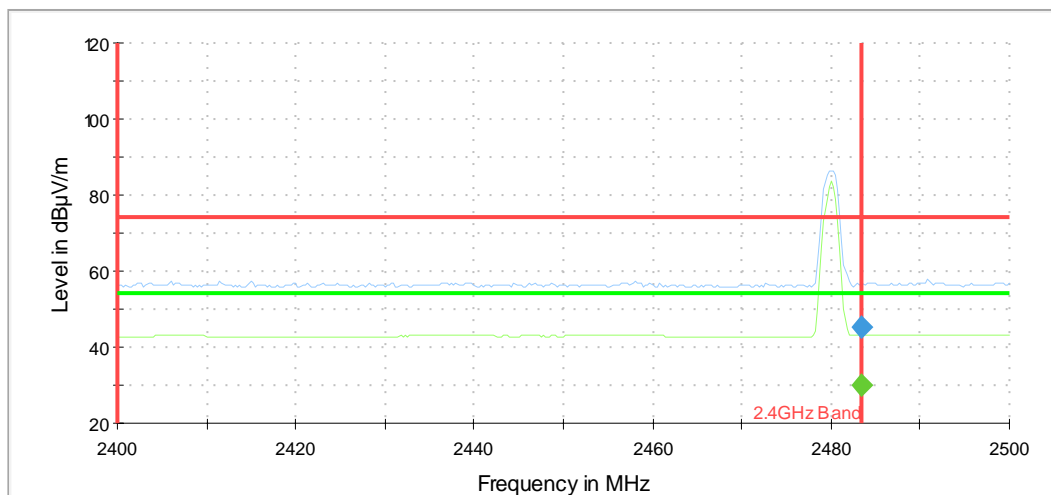
Ambient temperature	22 °C
Relative humidity	31 %

Date	05.11.2020
Tested by	B. ROHDE

Operation mode 1:

Not tested, no emissions in the restricted band

Operation mode 3:



Frequency [MHz]	Result (Pk) [dBµV/m]	Result (Av) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Pol.	Result
2483.500	---	30.7	54	23.3	34.0	120	277	H	Passed
2483.500	45.0	---	74	29.0	33.1	120	277	H	Passed
Measurement uncertainty					+/- 4.79 dB				

Test equipment (please refer to chapter 6 for details)

2 - 9

## 5.4 Maximum unwanted emissions Maximum unwanted emissions

### 5.4.1 Method of measurement (radiated)

The radiated emission measurement is subdivided into six stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out on an outdoor test site without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A preliminary and final measurement carried out in a semi anechoic chamber with a varying antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary and final measurement carried out in a semi anechoic chamber with ground absorbers with a varying antenna height in the frequency range above 1 GHz.

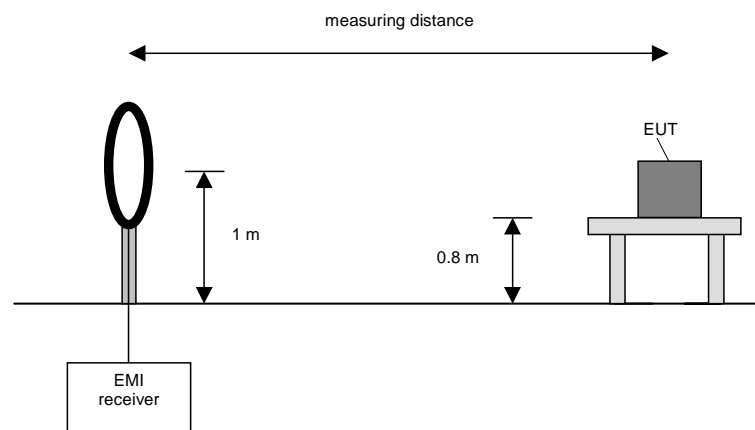
#### Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Tabletop devices will be set up on a non-conducting turn device on the height of 0.8 m. 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 analyzer 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 find the maximum emissions.

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

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



#### Preliminary measurement procedure:

Pre-scans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

Pre-scans were performed in the frequency range 30 MHz to 1 GHz.

The following procedure will be used:

1. Monitor the frequency range at horizontal polarization 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 polarization of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
7. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

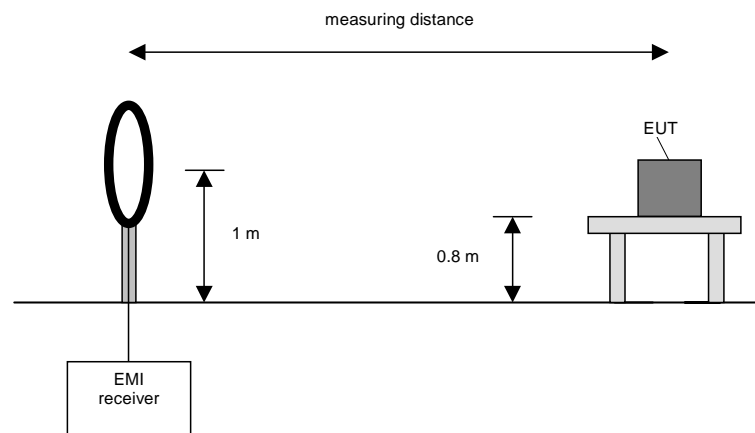
#### Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the frequencies, which were detected during the preliminary measurements, the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

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

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

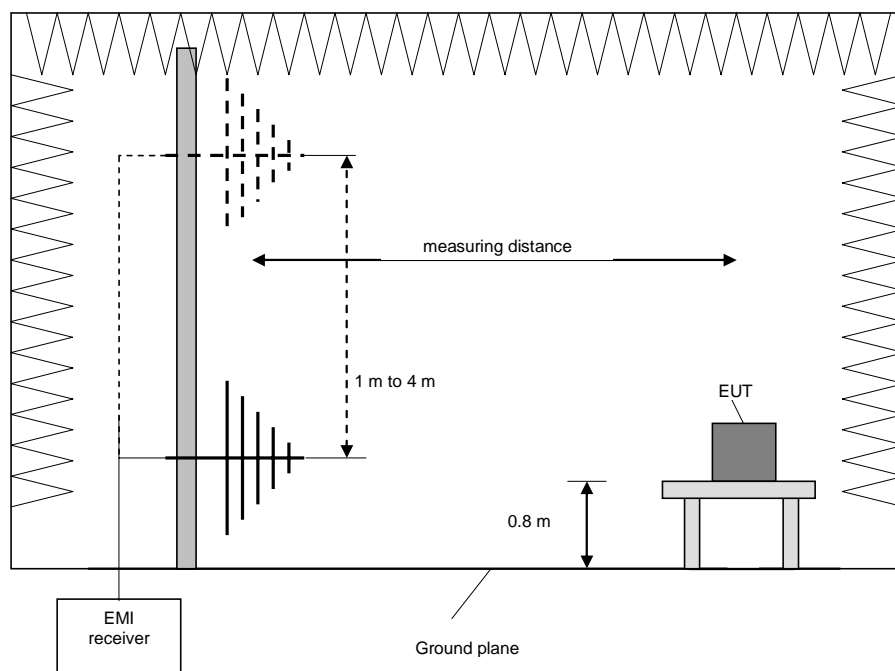


### Preliminary and final measurement (30 MHz to 1 GHz)

The preliminary and final measurements were conducted in a semi-anechoic chamber with a metal ground plane. During the test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarization 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:

Test	Frequency range	Resolution bandwidth	Step size	Measurement time
Preliminary measurement	30 MHz to 1 GHz	120 kHz	40 kHz	100 ms
Frequency peak search	3 x RBW	120 kHz	10 kHz	1000 ms
Final measurement	30 MHz to 1 GHz	120 kHz	-	5 x 1000 ms



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarization and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 2) with the vertical polarization of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached.
6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for the highest value.

Procedure final measurement:

The following procedure is used:

1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced step size with +/- 3 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT orientation (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by +/- 0.5 m from the worst-case value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by +/- 30° from the worst-case value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst-case antenna height and the worst-case turntable azimuth.
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.

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

This measurement will be performed in a fully anechoic chamber. Table top 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].

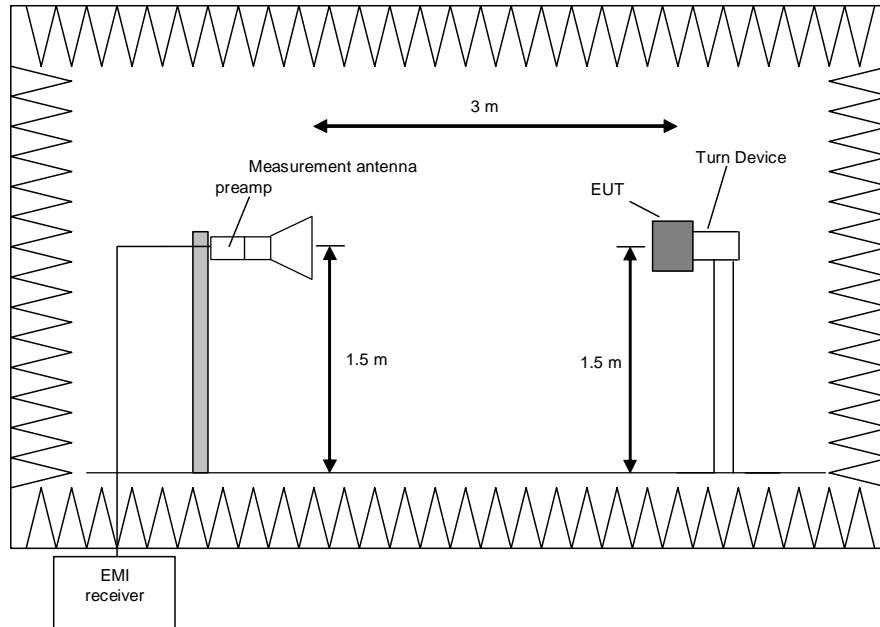
### **Preliminary measurement (1 GHz to 40 GHz)**

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 1 MHz. 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	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 preliminary measurement:

Pre-scans were performed in the frequency range 1 to 40 GHz.

The following procedure will be used:

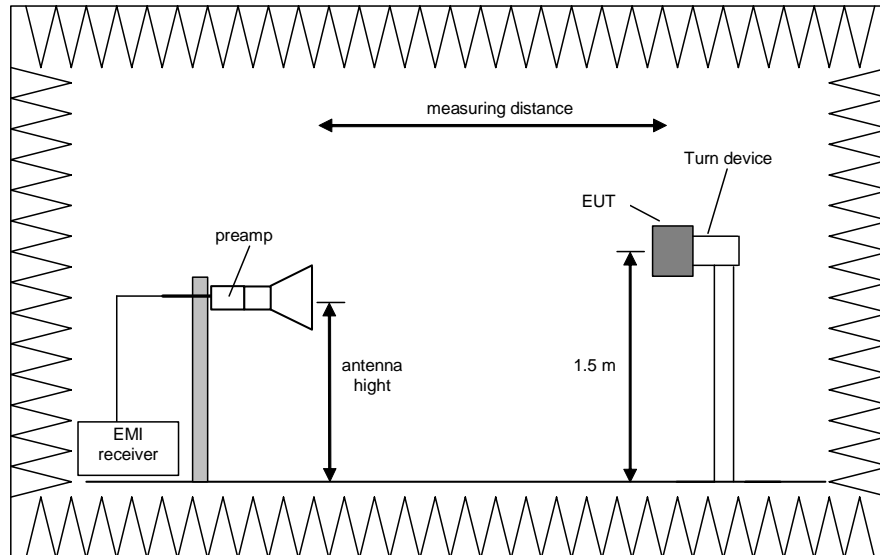
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an 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 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.

## 5.4.2 Test results (radiated)

### 5.4.2.1 Test results (9 kHz – 30 MHz)

Ambient temperature	23 °C
Relative humidity	70 %

Date	13.11.2020
Tested by	B. ROHDE

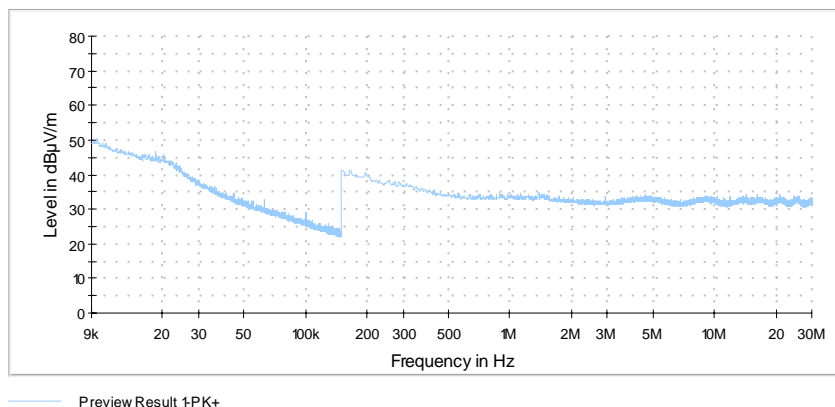
Position of EUT: For tests for f between 9 kHz and 30 MHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

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: As shown below

#### 5.4.2.1.1 Plots

9k-30M: Spurious emissions from 9 kHz to 30 MHz (Operation mode 4)



#### 5.4.2.1.2 Result table

All emissions are more the 20 dB from the limit, so no final measurement was conducted.

Test equipment (please refer to chapter 6 for details)
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#### 5.4.2.2 Test results (30 MHz – 1 GHz)

Ambient temperature	22 °C
Relative humidity	34 %

Date	09.11.2020
Tested by	B. ROHDE / Y. KHALEK

Position of EUT: The EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

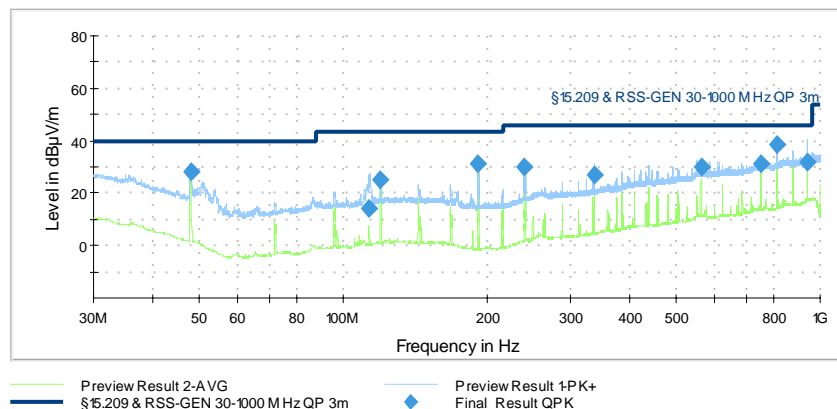
Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Only the worst-case plot is submitted below.

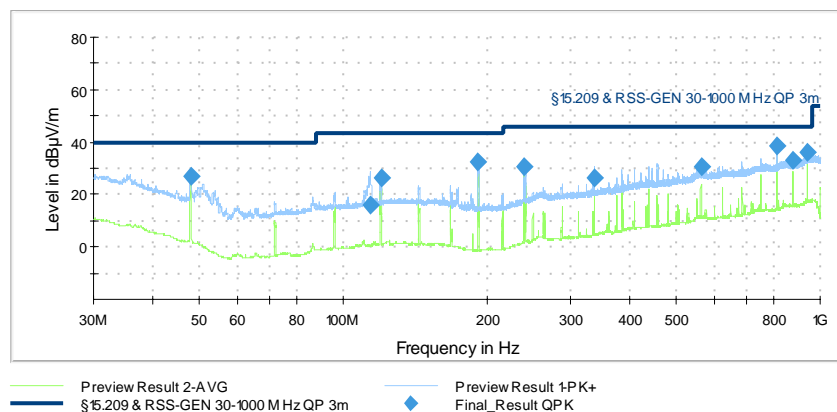
Remark: -

#### 5.4.2.2.1 Plots

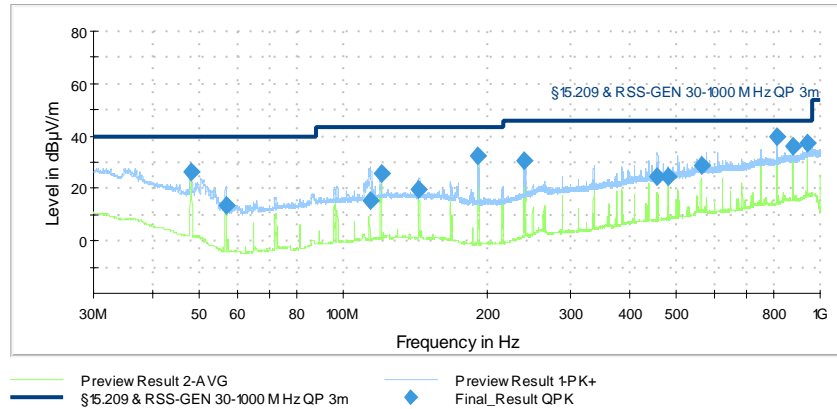
Spurious emissions from 30 MHz to 1 GHz (operation mode 4):



Spurious emissions from 30 MHz to 1 GHz (operation mode 5):



Spurious emissions from 30 MHz to 1 GHz (operation mode 6):



#### 5.4.2.2.2 Result tables

Result table (operation mode 4):

Frequency [MHz]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Readings [dBμV]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol.	Result
48.010000	27.9	40	12.1	9.0	18.9	100	197	V	Passed
113.690000	14.4	43.52	29.1	-3.2	17.6	102	197	V	Passed
119.970000	25.1	43.52	18.4	6.8	18.3	102	193	V	Passed
192.150000	31.4	43.52	12.1	15.4	15.9	100	240	H	Passed
240.400000	30.1	46.02	15.9	11.4	18.6	138	91	H	Passed
335.710000	27.0	46.02	19.0	5.3	21.7	104	169	V	Passed
562.510000	30.1	46.02	15.9	1.7	28.4	315	133	H	Passed
750.000000	31.0	46.02	15.0	0.3	30.7	124	176	V	Passed
812.500000	38.5	46.02	7.5	7.6	30.8	100	140	V	Passed
937.490000	32.1	46.02	13.9	-1.3	33.4	100	33	H	Passed
Measurement uncertainty				±5.5 dB					

Result table (operation mode 5):

Frequency [MHz]	Result [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Readings [dB $\mu$ V]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol.	Result
48.060000	26.8	40	13.2	8.0	18.9	102	197	V	Passed
114.030000	15.7	43.52	27.8	-2.0	17.7	150	180	V	Passed
120.050000	26.2	43.52	17.3	7.9	18.3	102	179	V	Passed
192.130000	32.2	43.52	11.3	16.3	15.9	159	242	H	Passed
239.770000	30.4	46.02	15.6	11.8	18.6	137	254	H	Passed
335.900000	26.4	46.02	19.6	4.7	21.7	102	192	V	Passed
562.510000	30.3	46.02	15.7	1.9	28.4	315	152	H	Passed
812.500000	38.4	46.02	7.6	7.6	30.8	102	135	V	Passed
875.000000	33.2	46.02	12.8	1.5	31.8	172	50	H	Passed
937.500000	36.2	46.02	9.8	2.8	33.4	143	212	H	Passed
Measurement uncertainty				$\pm 5.5$ dB					

Result table (operation mode 6):

Frequency [MHz]	Result [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Readings [dB $\mu$ V]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol.	Result
48.120000	26.6	40	13.4	7.8	18.8	100	210	V	Passed
56.790000	13.8	40	26.2	0.3	13.4	230	287	V	Passed
113.950000	15.5	43.52	28.0	-2.1	17.7	115	185	V	Passed
120.040000	25.7	43.52	17.8	7.4	18.3	102	180	V	Passed
143.920000	19.5	43.52	24.0	1.0	18.5	207	94	H	Passed
191.900000	32.2	43.52	11.3	16.2	15.9	184	242	H	Passed
239.940000	30.6	46.02	15.4	12.0	18.6	130	274	H	Passed
456.550000	24.6	46.02	21.4	-0.5	25.1	102	185	V	Passed
480.020000	24.7	46.02	21.3	-1.0	25.6	104	188	V	Passed
562.510000	29.0	46.02	17.0	0.5	28.4	100	103	V	Passed
812.500000	39.6	46.02	6.4	8.8	30.8	129	123	V	Passed
875.000000	36.1	46.02	9.9	4.4	31.8	170	311	H	Passed
937.500000	37.4	46.02	8.6	4.0	33.4	143	229	H	Passed
Measurement uncertainty				$\pm 5.5$ dB					

Test equipment (please refer to chapter 6 for details)

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### 5.4.2.3 Test results (above 1 GHz)

Ambient temperature	22 °C
Relative humidity	31 %

Date	05.11.2020
Tested by	B. ROHDE

Position of EUT: For tests for f between 1 GHz and the 10<sup>th</sup> harmonic, the EUT was set-up on a table with a height of 150 cm. The distance between EUT and antenna was 3 m.

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.

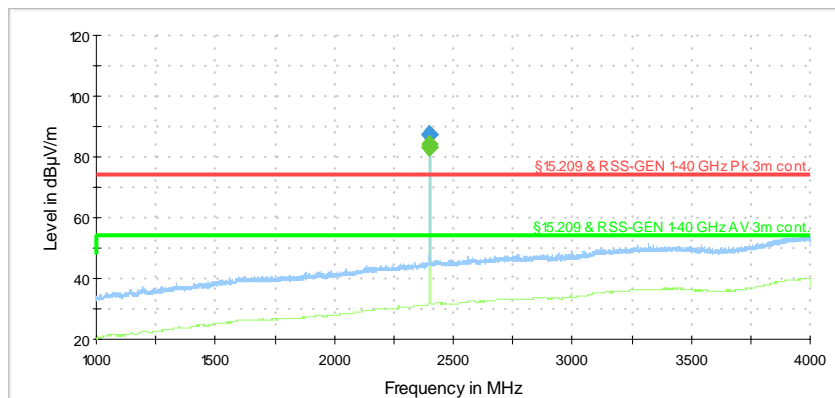
Test record: As submitted below.

Remark: -

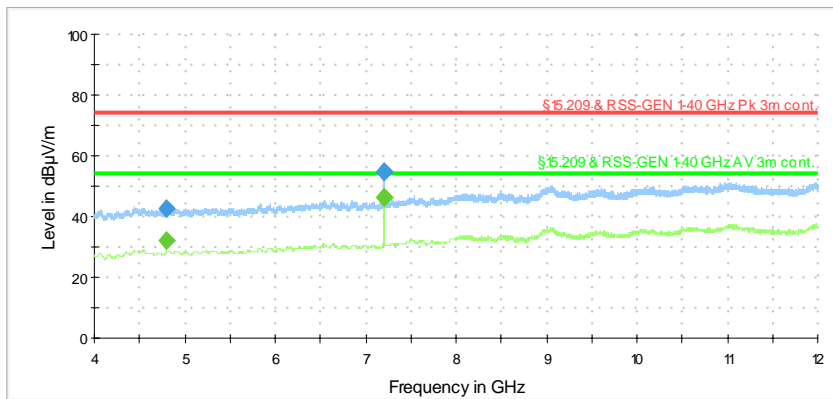
#### 5.4.2.3.1 Plots

##### 5.4.2.3.1.1 Operation mode 4

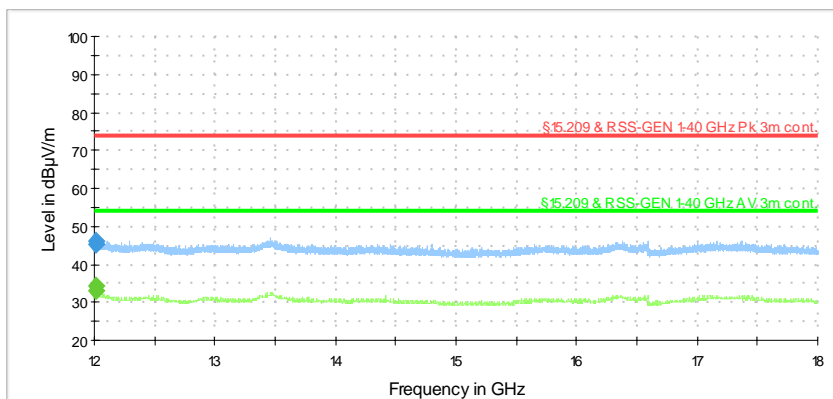
Spurious emissions from 1 GHz to 4 GHz



### Spurious emissions from 4 GHz to 12 GHz

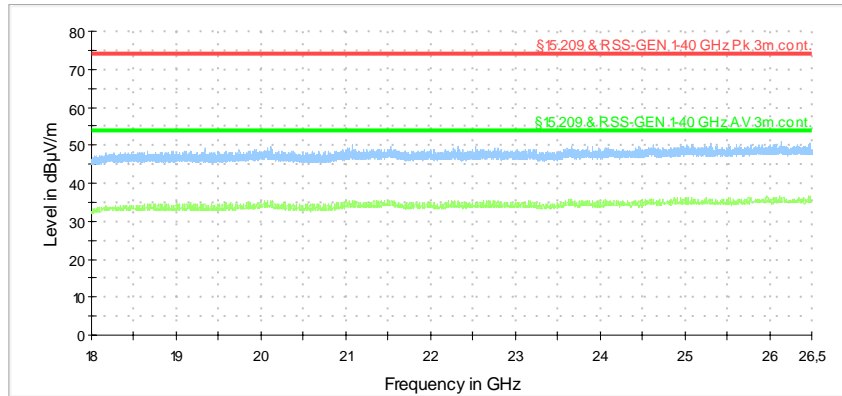


### Spurious emissions from 12 GHz to 18 GHz



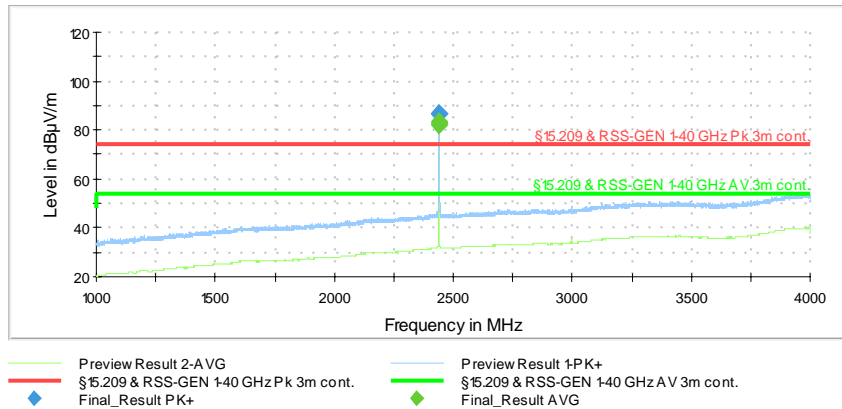


#### Spurious emissions from 18 GHz to 26.5 GHz

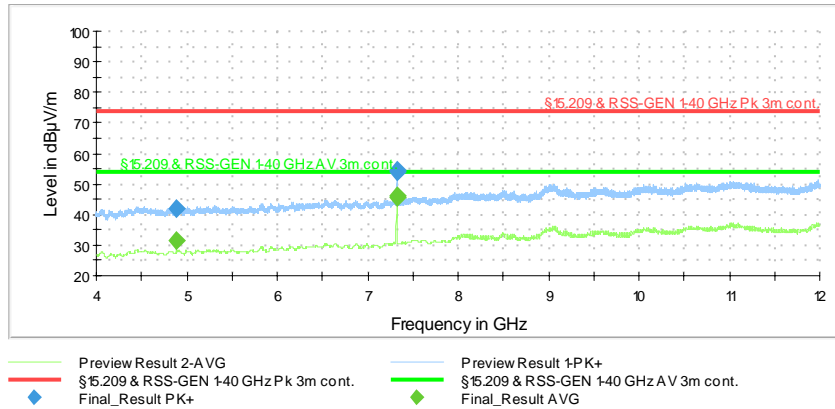


#### 5.4.2.3.1.2 Operation mode 5

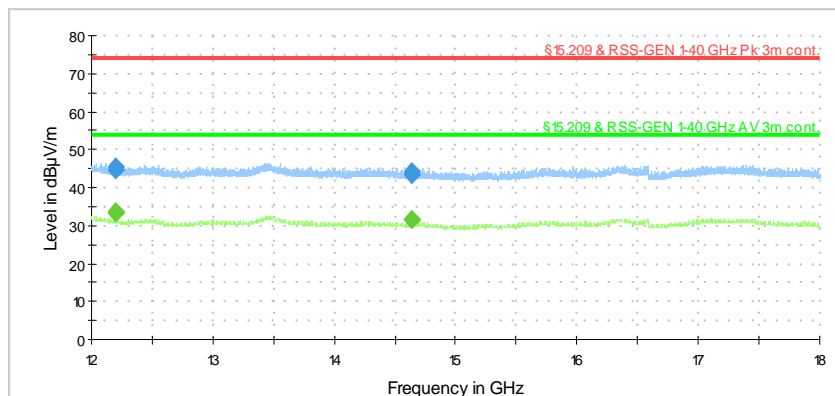
#### Spurious emissions from 1 GHz to 4 GHz



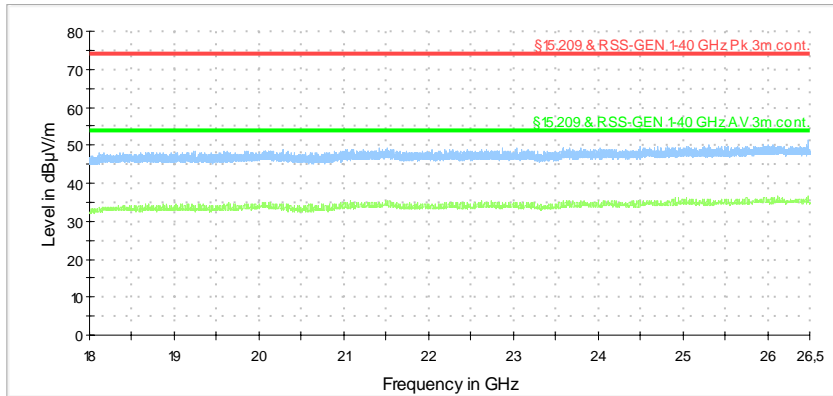
### Spurious emissions from 4 GHz to 12 GHz



### Spurious emissions from 12 GHz to 18 GHz

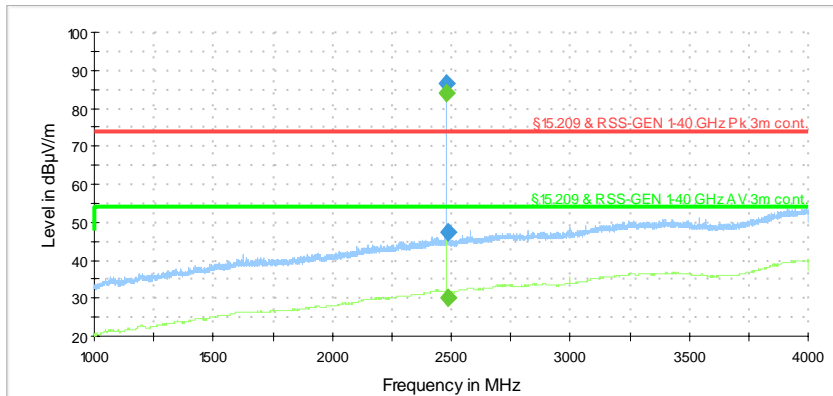


Spurious emissions from 18 GHz to 26.5 GHz

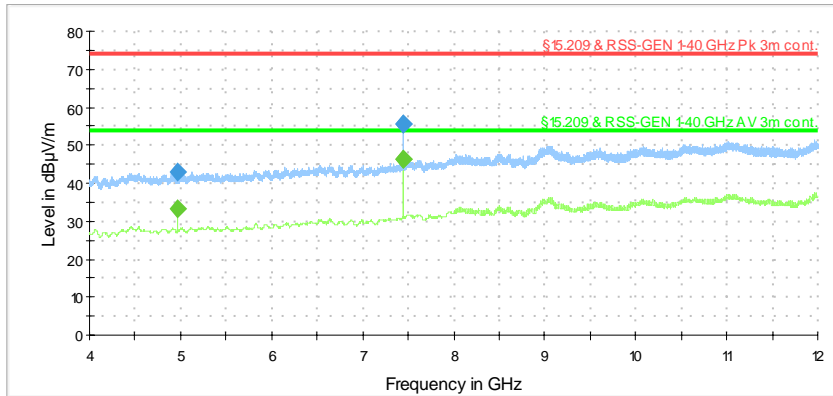


5.4.2.3.1.3 Operation mode 6

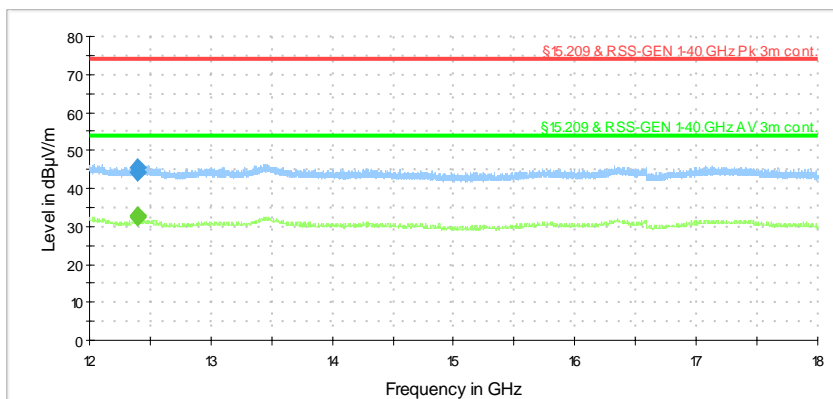
Spurious emissions from 1 GHz to 4 GHz



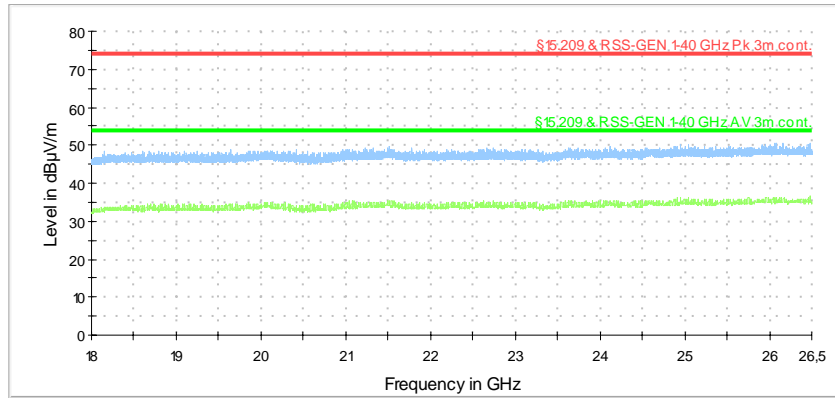
### Spurious emissions from 4 GHz to 12 GHz



### Spurious emissions from 12 GHz to 18 GHz



## Spurious emissions from 18 GHz to 26.5 GHz



#### 5.4.2.3.2 Result tables

Result table operation mode 4:

Frequency [MHz]	MaxPeak [dBμV/m]	Average [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Result
2401.750000	87.2	---	Fund.	-	33.1	0	56	H	Fund.
2401.750000	---	84.0	Fund.	-	34.0	0	56	H	Fund.
2402.000000	---	85.3	Fund.	-	34.0	0	56	H	Fund.
2402.000000	87.2	---	Fund.	-	33.1	0	56	H	Fund.
2402.250000	---	84.1	Fund.	-	34.0	0	57	H	Fund.
2402.250000	87.3	---	Fund.	-	33.1	0	57	H	Fund.
4804.000000	---	33.0	54	21.0	-1.5	150	206	H	Passed
4804.000000	42.6	---	74	31.4	-2.4	150	206	H	Passed
7205.500000	---	47.5	54	6.5	4.5	60	127	H	Passed
7205.500000	54.7	---	74	19.3	3.6	60	127	H	Passed
7206.500000	---	47.4	54	6.6	4.5	60	128	H	Passed
7206.500000	54.8	---	74	19.2	3.6	60	128	H	Passed
12008.750000	45.3	---	74	28.7	12.1	120	287	V	Passed
12008.750000	---	33.9	54	20.1	13.0	120	287	V	Passed
12011.250000	45.9	---	74	28.1	12.1	0	105	H	Passed
12011.250000	---	35.2	54	18.8	13.0	0	105	H	Passed
Measurement uncertainty			+/- 4.79 dB						

Result table operation mode 5:

Frequency [MHz]	MaxPeak [dBμV/m]	Average [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Result
2439.750000	86.6	---	Fund.	-	33.4	0	55	H	Fund.
2439.750000	---	83.4	Fund.	-	34.3	0	55	H	Fund.
2440.000000	---	84.6	Fund.	-	34.4	0	56	H	Fund.
2440.000000	86.6	---	Fund.	-	33.5	0	56	H	Fund.
2440.250000	---	83.4	Fund.	-	34.4	0	56	H	Fund.
2440.250000	86.6	---	Fund.	-	33.5	0	56	H	Fund.
4880.000000	---	32.3	54	21.7	-1.1	30	137	H	Passed
4880.000000	42.0	---	74	32.0	-2.0	30	137	H	Passed
7319.500000	---	46.8	54	7.2	4.9	0	108	H	Passed
7319.500000	54.2	---	74	19.8	4.0	0	108	H	Passed
7320.500000	---	47.0	54	7.0	4.9	0	104	H	Passed
7320.500000	54.3	---	74	19.7	4.0	0	104	H	Passed
12199.000000	44.6	---	74	29.4	11.9	150	232	V	Passed
12199.000000	---	34.0	54	20.0	12.8	150	232	V	Passed
12201.250000	45.4	---	74	28.6	11.9	150	228	V	Passed
12201.250000	---	34.6	54	19.4	12.8	150	228	V	Passed
14638.500000	44.2	---	74	29.8	11.4	0	134	V	Passed
14638.500000	---	32.6	54	21.4	12.3	0	134	V	Passed
14641.500000	43.5	---	74	30.5	11.4	0	140	V	Passed
14641.500000	---	32.5	54	21.5	12.3	0	140	V	Passed
Measurement uncertainty			+/- 4.79 dB						

Result table operation mode 6:

Frequency [MHz]	MaxPeak [dBμV/m]	Average [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Result
2480.000000	---	84.7	Fund.	-	34.0	30	67	H	Fund.
2480.000000	86.7	---	Fund.	-	33.1	30	67	H	Fund.
2483.500000	47.6	---	74	26.4	33.1	30	68	H	Passed
2483.500000	---	30.9	54	23.1	34.0	30	68	H	Passed
4960.000000	43.0	---	74	31.0	-2.1	0	198	H	Passed
4960.000000	---	34.1	54	19.9	-1.2	0	198	H	Passed
7439.250000	55.5	---	74	18.5	4.3	120	131	V	Passed
7439.250000	---	47.3	54	6.7	5.2	120	131	V	Passed
7440.750000	55.4	---	74	18.6	4.3	120	131	V	Passed
7440.750000	---	47.2	54	6.8	5.2	120	131	V	Passed
12398.750000	---	33.6	54	20.4	13.0	120	201	V	Passed
12398.750000	44.4	---	74	29.6	12.1	120	201	V	Passed
12401.250000	---	33.9	54	20.1	13.0	120	202	V	Passed
12401.250000	45.5	---	74	28.5	12.1	120	202	V	Passed
Measurement uncertainty			+/- 4.79 dB						

Test equipment (please refer to chapter 6 for details)

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## 6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Spectrum Analyser	FSU46	Rohde & Schwarz	200125	480956	13.02.2020	02.2021
2	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
3	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
4	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
5	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
6	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
7	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	18.02.2020	02.2022
8	RF cable	SF106B/11N/11 N/4500.0	Huber & Suhner	500218/6B	482415	Calibration not necessary	
9	Log.-Per. antenna	HL050	Rohde & Schwarz	100908	482977	13.08.2019	08.2022
10	Testsoftware M20	EMC32	Rohde & Schwarz		483261	Calibration not necessary	
11	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	05.02.2020	02.2021
12	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
13	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
14	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
15	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
16	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
17	Testsoftware 276	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
18	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	14.11.2019	11.2021
19	Antenne (Bilog)	CBL6111D	Schaffner Elektrotech GmbH / Teseq GmbH	22921	480674	27.03.2018	03.2021
20	Standard gain horn antenna	18240-20	Flann Microwave	483	480294	Calibration not necessary	
21	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	13.02.2020	02.2022
22	Standard gain horn antenna	20240-20	Flann Microwave	411	480297	Calibration not necessary	
23	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	13.02.2020	02.2022
24	Highpass Filter	WHK2.8/18G-10SS	Wainwright Instruments GmbH	1	480867	Calibration not necessary	
25	Microwave cable 2m	Insulated Wire Inc.	Insulated Wire	KPS-1533-800-KPS	480302	Calibration not necessary	
26	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	13.02.2020	02.2022

## 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	18.09.2021
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	24.08.2020	23.08.2022

## 8 Report History

Report Number	Date	Comment
F200776E4	16.02.2021	Initial Test Report
-	-	-
-	-	-

## 9 List of Annexes

Annex A	Test Setup Photos	13 pages
Annex B	External Photos	5 pages
Annex C	Internal Photos	8 pages