PHOENIX TESTLAB
Königswinkel 10
32825 Blomberg, Germany
Phone: +49 (0) 52 35 / 95 00-0
Fax: +49 (0) 52 35 / 95 00-10
office@phoenix-testlab.de
www.phoenix-testlab.de

Test Report

Report Number:

F201874E1

Equipment under Test (EUT):

MAS433

Applicant:

Continental Automotive GmbH (FCC)
Continental Automotive Systems US Inc. (ISED Canada)

Manufacturer:

Continental Automotive GmbH

ilac-MRA
DAkkS 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-210 Issue 10 (December 2019)**
Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

[4] **RSS-Gen Issue 5 (March 2019) Amendment 1**
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:	Wolfgang KASALOWSKY	W. Kasalowsky	21.01.2021
	Name	Signature	Date
Reviewed and approved by:	Manuel BASTERT	L. Bast	21.01.2021
	Name	Signature	Date

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalizations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

Contents: Page

1 Identification

1.1 Applicant

1.1.1 FCC

Name:	Continental Automotive GmbH
Address:	Siemensstrasse 12, 93055 Regensburg
Country:	Germany
Name for contact purposes:	Dagmar KOLAR
Phone:	+49 941 790 6699
eMail address:	dagmar.kolar@continental-corporation.com
Applicant represented during the test by the following person:	-

1.1.2 ISED Canada

Name:	Continental Automotive Systems US Inc.
Address:	4685 Investment Drive Troy 48098, Michigan
Country:	United States
Name for contact purposes:	Mr. Charles MUMA
Phone:	0012487646783
eMail address:	charles.muma@continental-corporation.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Continental Automotive GmbH
Address:	Siemensstrasse 12, 93055 Regensburg
Country:	Germany
Name for contact purposes:	-
Phone:	-
eMail address:	-
Manufacturer represented during the test by the following person:	-

1.3 Test laboratory

The tests were carried out at:

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-17186-01-06 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment Under Test)

Test object: *	FCA_M240 Fobik (Car Key)
Model / HVIN: *	MAS433
PMN: *	MAS433
Serial number: *	N/A
PCB identifier: *	N/A
Hardware version: *	EUT 1 (Application mode): A3C0645390100 EUT 2 (Test mode): A3C0646040100
Software version / FVIN: *	V11.00
FCC ID: *	M3NMAS433
IC: *	7812D-MAS433

*: Declared by the applicant

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

1.5 Technical data of equipment

Vehicle key:			
Power supply: *	Lithium battery CR2032		
Supply voltage: *	U_{nom} = 3.0 V_{DC}	U_{min} = 2.3 V_{DC}	U_{max} = 3.2 V_{DC}
Temperature range: *	-20 °C to +70 °C		
Duty cycle class: *	RKE: Manual triggered device PASE: Trigged by LF command		
Operating Frequency: *	433.92 MHz		
Bandwidth: *	32 kHz for RKE (ASK) and 57 kHz for PASE (FSK)		
Transmitter power (ERP): *	typ. -13 dBm		
Data code: *	Inv. Manchester		
Modulation: *	ASK (RKE), FSK (PASE)		
Frequency deviation: *	+/- 10 kHz, +/- 20 kHz		
Data rate: *	2.4 kbps for RKE and 9.6 kbps for PASE		
Antenna: *	internal PCB antenna		

*: Declared by the applicant

1.6 Dates

Date of receipt of test sample:	23.11.2020
Start of test:	24.11.2020
End of test:	02.12.2020

2 Operational states

MAS433 is a car key designed to provide remote keyless entry, passive entry, passive engine start and immobilization functionality. MAS433 consists of a receiver at 125 kHz and a transmitter at 433.92 MHz. The receiver at 125 kHz of MAS433 is always active. The transmitter at 433.92 MHz is activated by push button at MAS433 (RKE) or by LF command from RFHM (PASE).

The Remote Keyless Entry (RKE) and Start uses a Radio Frequency (RF) link for communication between the end user and the vehicle.
For Passive Entry and Passive Start function, MAS433 receives LF command from RFHM via a Low Frequency (LF) link at 125 kHz and responses back via RF link at 433.92 MHz.

The Immobilization uses a Low Frequency (LF) link for communication/authentication between MAS433 and IMMO.

2 samples were provided by the applicant:

Identification	Operation mode
Sample marked as EUT 1	Application mode
Sample marked as EUT 2	Test mode

The radiated tests were performed with a sample in test mode powered by its battery.

Test modes (Sample marked with EUT 2):

RKE protocol Short button press: (Single Button)	**Test mode**	
LOCK	1	Continuous message group for Lock functionality (without battery information)
UNLOCK	2	Continuous wave ASK
TRUNK	3	Continuous Manchester ASK

PASE protocol Short button press: (Button combinations)	**Test mode**	
LOCK + UNLOCK	4	Continuous wave for FSK lower frequency
TRUNK + LOCK	5	Continuous wave for FSK higher frequency
UNLOCK + TRUNK	6	Continuous Manchester FSK

All continuous emissions are sent for 4 minutes.

The selected test mode can be switched off by pressing any button again.

The test case “Timing of the transmitter” was performed with a sample in application mode (sample marked with EUT 1) powered by its battery.

3 Additional information

The tests were performed with a new battery inserted to the EUT.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 10 [3] or RSS-Gen, Issue 5 [4]	Status	Refer page	EUT *
Timing of the transmitter (Duty cycle correction factor)	433.92	15.35 (c)	8.2 [4]	Performed	9	1
Occupied bandwidth	433.92	15.231 (c)	A1.3 [3]	Passed	12	2
Switch off time	433.92	15.231 (a) (1)	A1.1 (a) [3]	Passed	14	1
Radiated emissions	0.009 – 4500	15.231 (b) 15.205 (a) 15.209 (a)	A1.2 [3] 8.1 [4] 6.13 [4]	Passed	20	2

* EUT 1: Application software
EUT 2: Test software (refer to chapter 2 of this Report)

5 Results

5.1 Timing of the transmitter

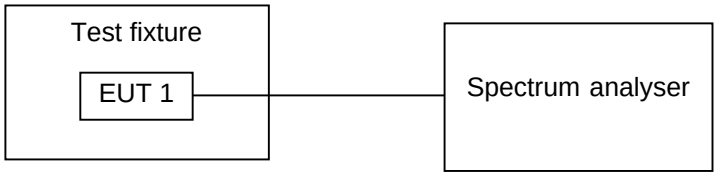
5.1.1 Method of measurement

The EUT has to be connected to the spectrum analyser. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed or a test fixture has to be used. The EUT has to be switched on.

The following spectrum analyser settings shall be used:

- Span: = 0 Hz.
- Resolution bandwidth: 100 kHz.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep time: 100 ms.
- Detector function: peak.
- Trace mode: Single sweep.

Test set-up:



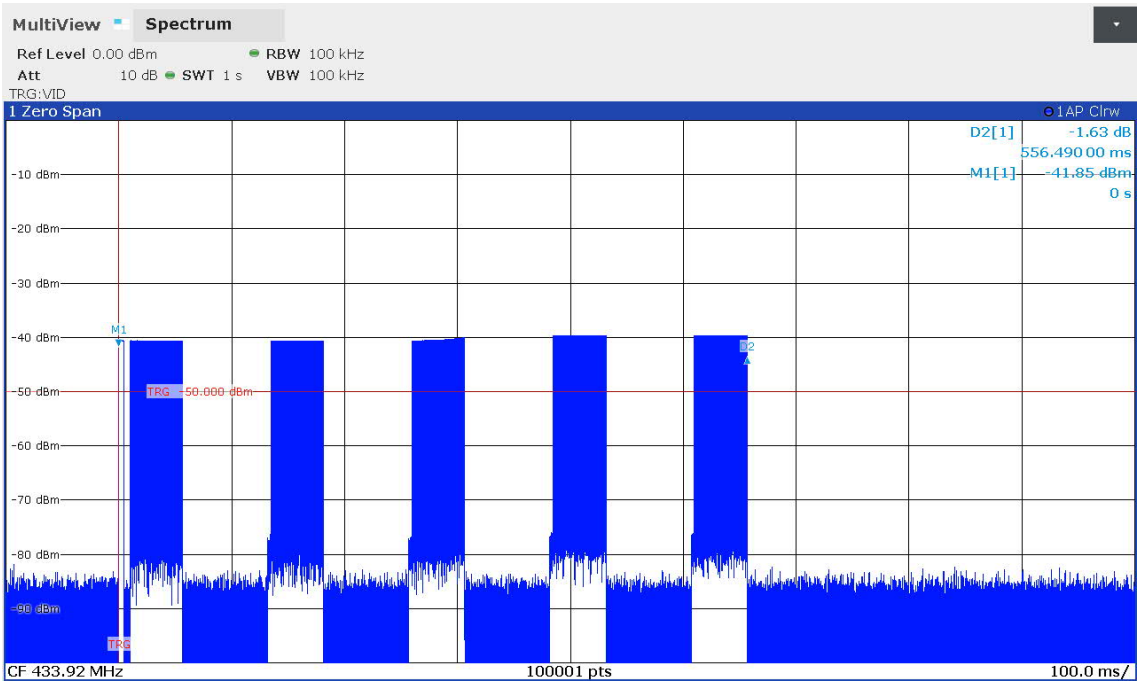
EUT 1: EUT with application SW

In PASE mode the bursts are significant shorter because of higher Baud rate. As stated by the applicant the maximum burst length is 11 ms.

5.1.2 Test result

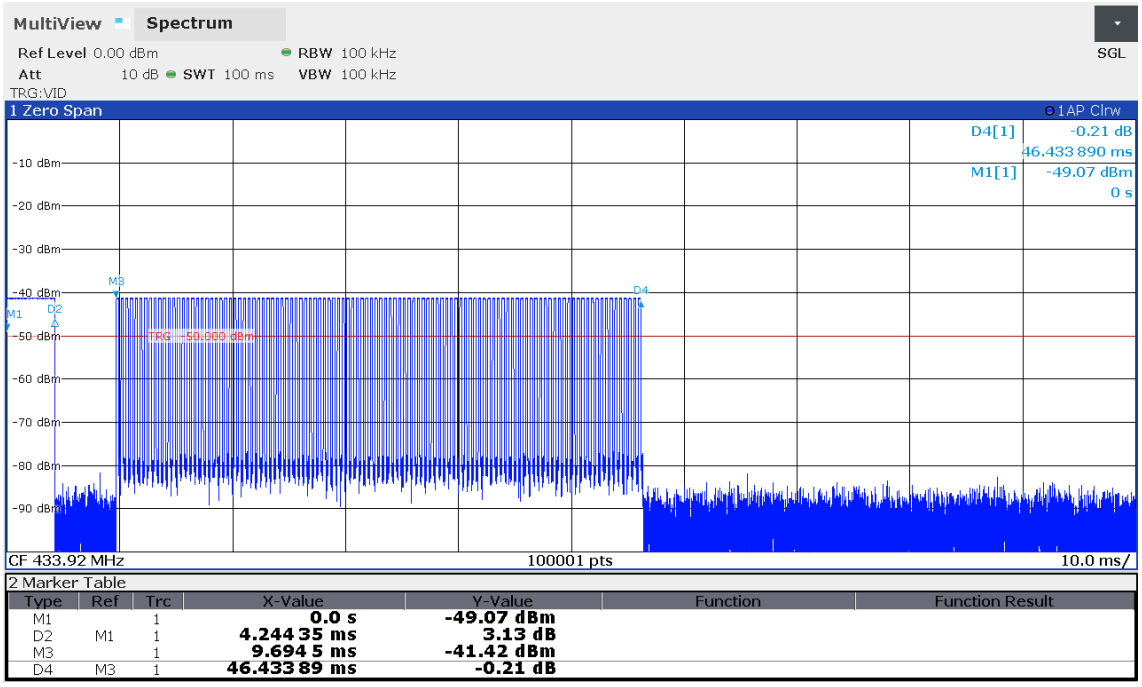
Ambient temperature	22 °C	Relative humidity	26 %

Pulse train:



The pulse train exceeds 0.1 seconds. Therefore, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

Detail for calculation of peak-to-average correction factor:



Worst case in 100 ms:
TX on = 4.24ms (CW signal) + (46.43 / 2) ms (ASK signal, inv. Manchester coded) = 27.46 ms

Mode	Transmit time (Tx on) [ms]	Tx on + Tx off [ms]	Peak-to-average correction factor 20 log (Tx on/(Tx on + Tx off)) [dB]
RKE	27.46	100	-11.2
PASE	11 *	100	-19.2

* as declared by the applicant

Test equipment (please refer chapter 6 for details)

13, 14

5.2 Switch off time

5.2.1 Method of measurement

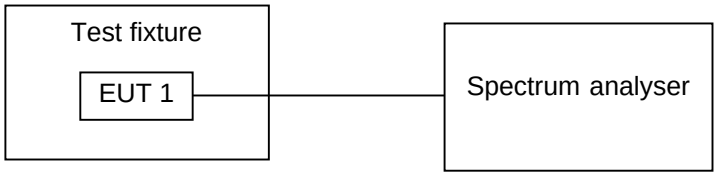
The EUT has to be connected to the spectrum analyser. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed or a test fixture has to be used. The EUT has to be switched on and then switched off.
A manually operated transmitter shall automatically deactivate the transmitter within not more than 5 seconds of being released.
A transmitter activated automatically shall cease transmission within 5 seconds after activation.

Only the timing in RKE mode was taken into account because this is the worst case as stated by the applicant.

The following spectrum analyser settings shall be used:

- Span: = 0 Hz.
- Resolution bandwidth: 100 kHz.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep time: 100 ms.
- Detector function: peak.
- Trace mode: Single sweep.

Test set-up:

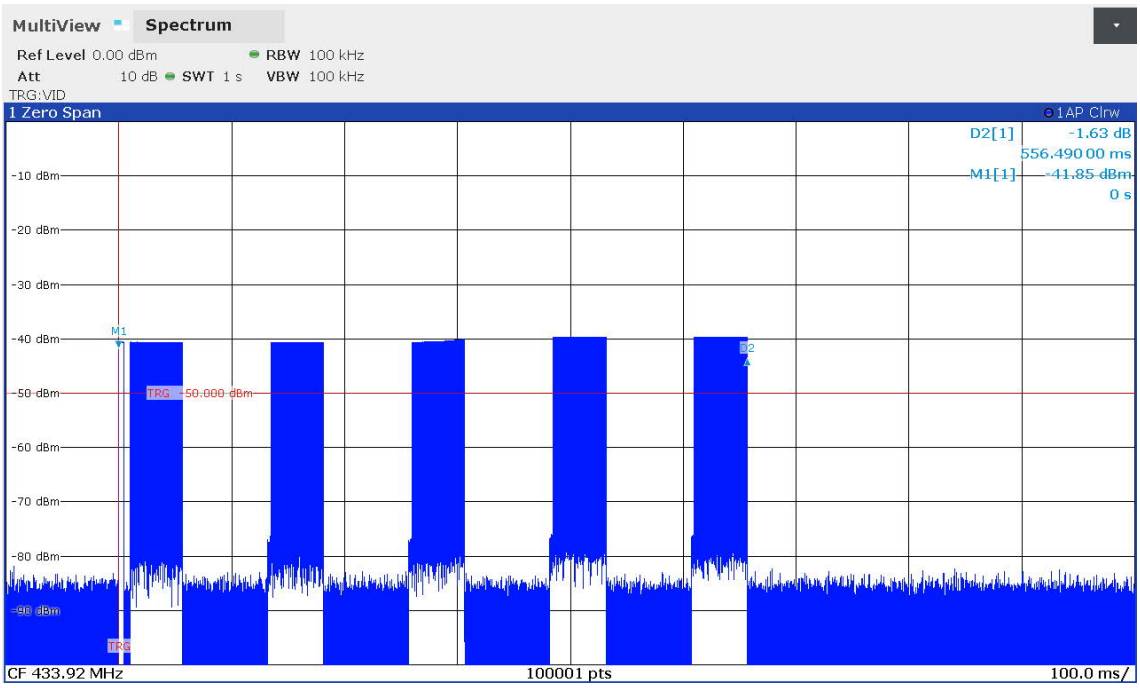


EUT 1: EUT with application SW

5.2.2 Test result

Ambient temperature	22 °C	Relative humidity	26 %

Mode: RKE



The activation of the pulse train is at the same time as the deactivation because no additional action for deactivation is needed.

Switch off time (Tx on) [ms]	Limit [ms]
556.49	5000

Test equipment (please refer chapter 6 for details)

13, 14

5.3 Occupied bandwidth

5.3.1 20 dB bandwidth

5.3.1.1 Method of measurement

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed or a test fixture has to be used. The EUT has to be switched on; the transmitter shall work with its maximum data rate.

The following spectrum analyser settings shall be used:

- Span: App. 2 to 5 times the 20 dB bandwidth, centred on the actual channel.
- Resolution bandwidth: Between 1 % to 5 % of the required bandwidth, if no requirements were made,
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve.

The measurement will be performed at the middle of the assigned frequency band.

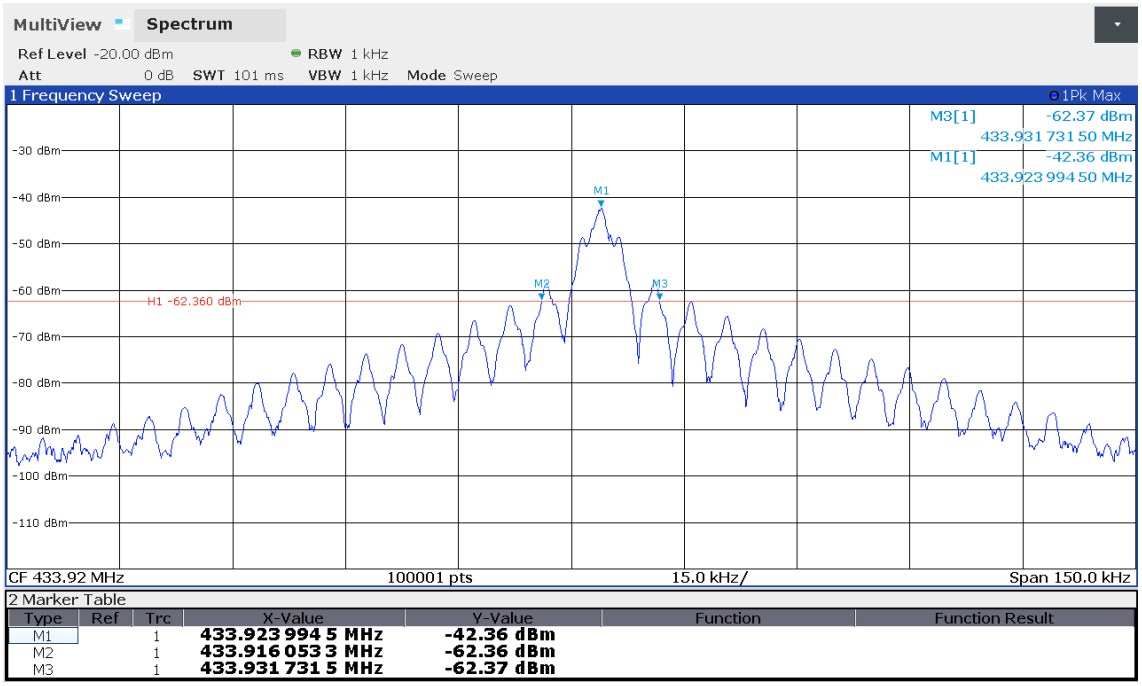
Test set-up: Measurement was performed using a test fixture with EUT 2 with test SW in test mode 3 (RKE) and test mode 6 (PASE).

5.3.1.2 Test result

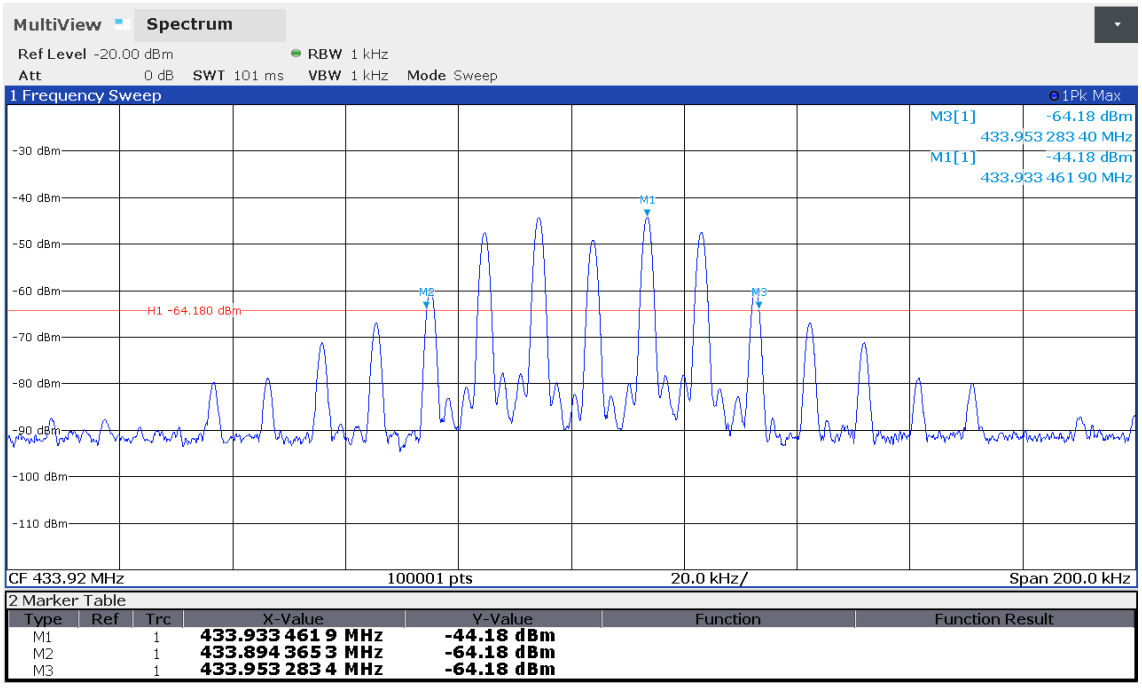
Ambient temperature	22 °C

Relative humidity	26 %

RKE mode



PASE mode



Mode	Lower frequency [MHz]	Upper frequency [MHz]	20 dB bandwidth [kHz]	Limit (0.25 % of the center frequency) [kHz]
RKE	433.916053	433.931732	15.679	1084.800
PASE	433.894365	433.953283	58.918	1084.800
Measurement uncertainty: 8.94×10^{-8}				

Test: Passed

Test equipment (please refer chapter 6 for details)

13, 14

5.3.2 99 % bandwidth

5.3.2.1 Method of measurement

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency).
This frequency is then recorded.

The difference between the two recorded frequencies is the 99 % occupied bandwidth.

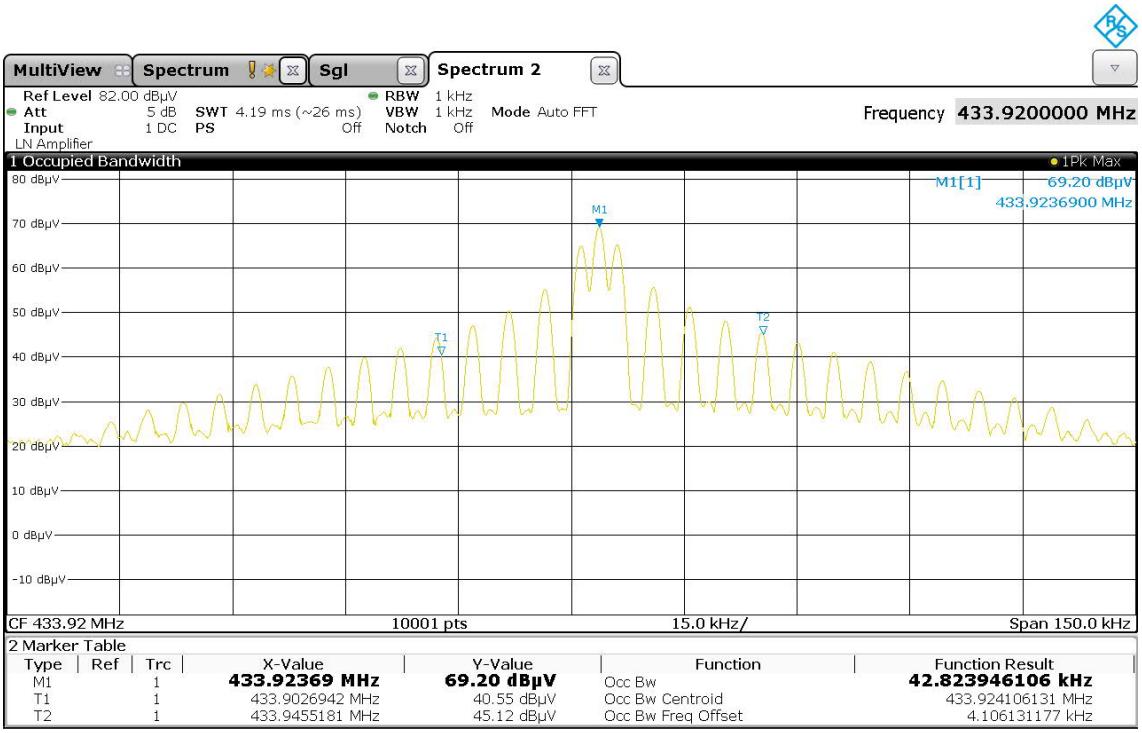
Test set-up: Measurement was performed using a test fixture with EUT 2 with test SW in test mode 3 (RKE) and test mode 6 (PASE).

5.3.2.2 Test result

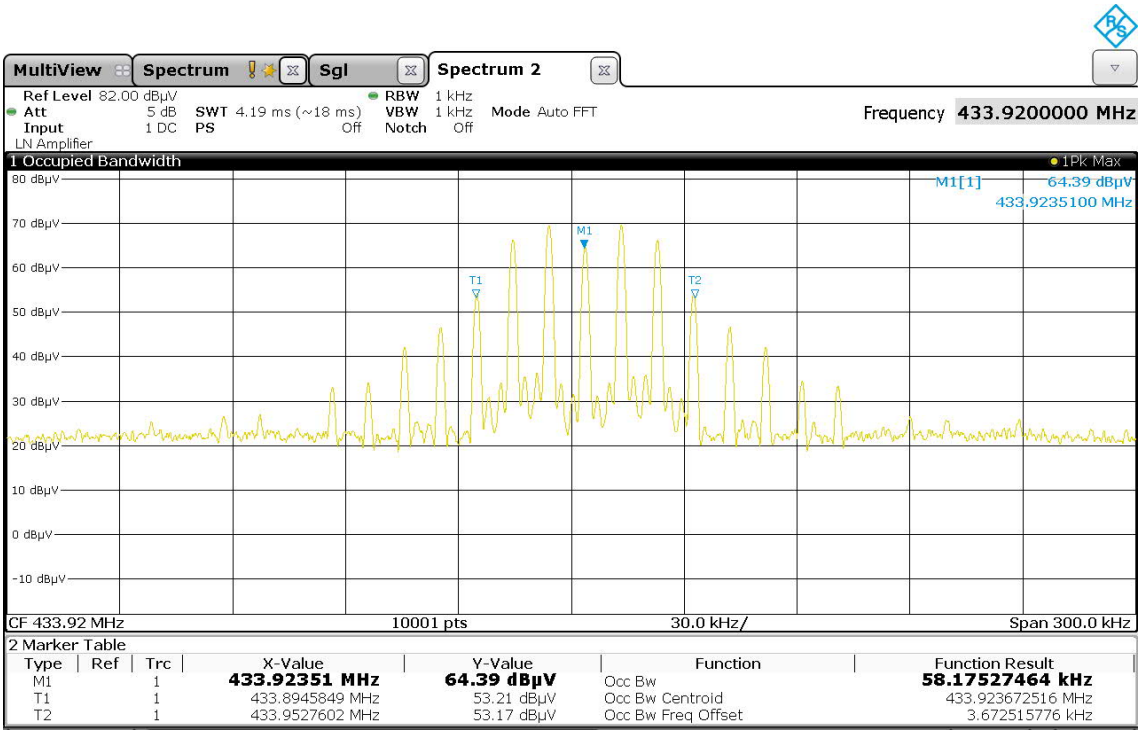
Ambient temperature	22 °C

Relative humidity	26 %

RKE mode



PASE mode



Mode	Lower frequency [MHz]	Upper frequency [MHz]	99 % bandwidth [kHz]	Limit (0.25 % of the center frequency) [kHz]
RKE	433.902694	433.945518	42.824	1084.800
PASE	433.894585	433.952760	58.175	1084.800
Measurement uncertainty: 8.94×10^{-8}				

Test: Passed

Test equipment (please refer chapter 6 for details)

13, 14

5.4 Radiated emissions

5.4.1 General method of measurement

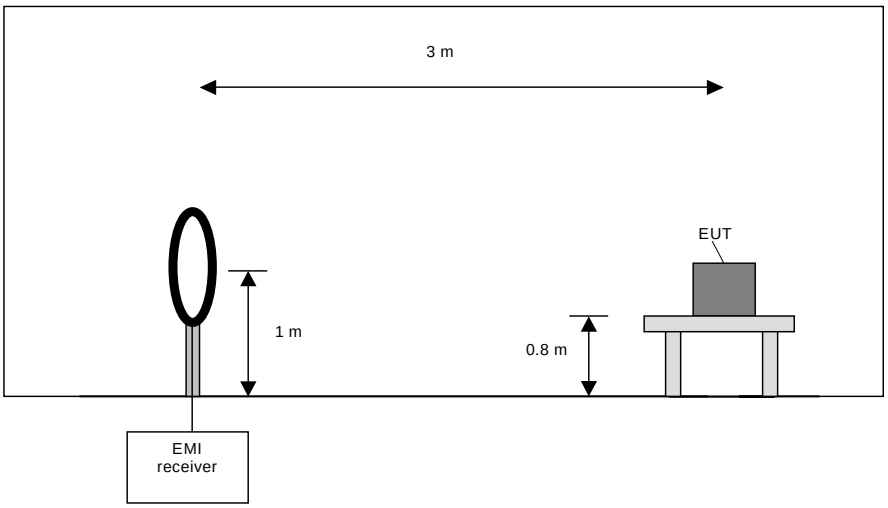
Preliminary measurement (9 kHz to 30 MHz):

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 support with a size of 1 m by 1.5 m and a height of 80 cm. 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 find 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	300 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.

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) Make a hardcopy of the spectrum.
5) Measure the frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6) Repeat steps 1) to 5) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
7) Rotate the measuring antenna and repeat steps 1) to 5).

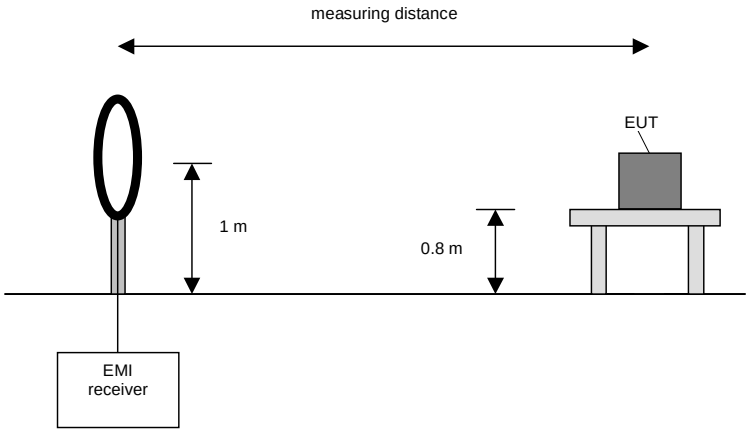
Final measurement (9 kHz to 30 MHz):

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 an 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



Final measurement procedure:

The following procedure will be used:

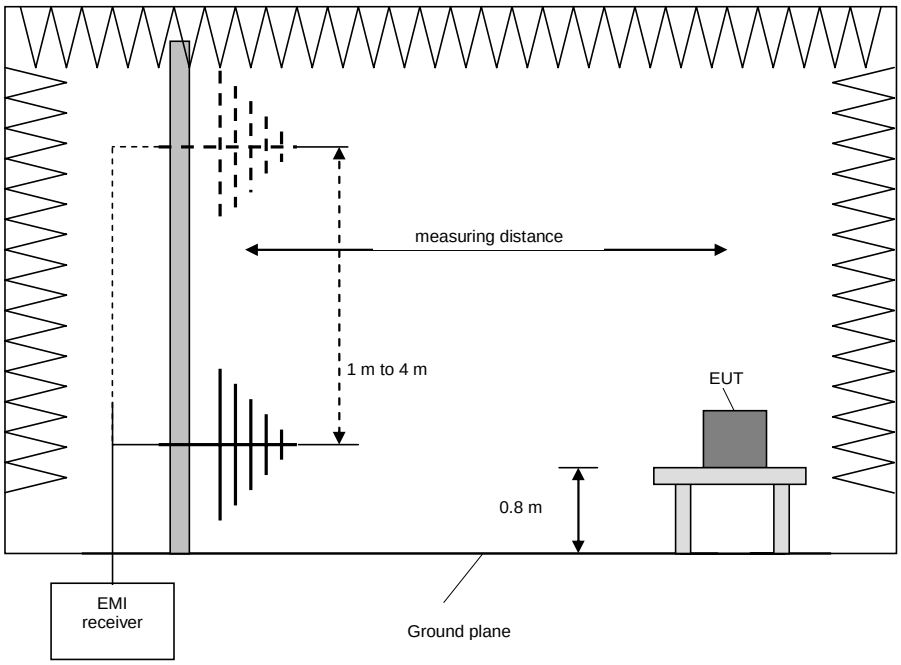
1) Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
3) Rotate the measuring antenna to find the maximum and note the value.
4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT (if the EUT is a module and might be used in a handheld equipment application).

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 in a 3 m distance.
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
Preliminary measurement	30 MHz to 1 GHz	100 kHz
Frequency peak search	+ / - 1 MHz	10 kHz
Final measurement	30 MHz to 1 GHz	120 kHz



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation 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 polarisation 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 that value.

Procedure final measurement:

The following procedure is used:

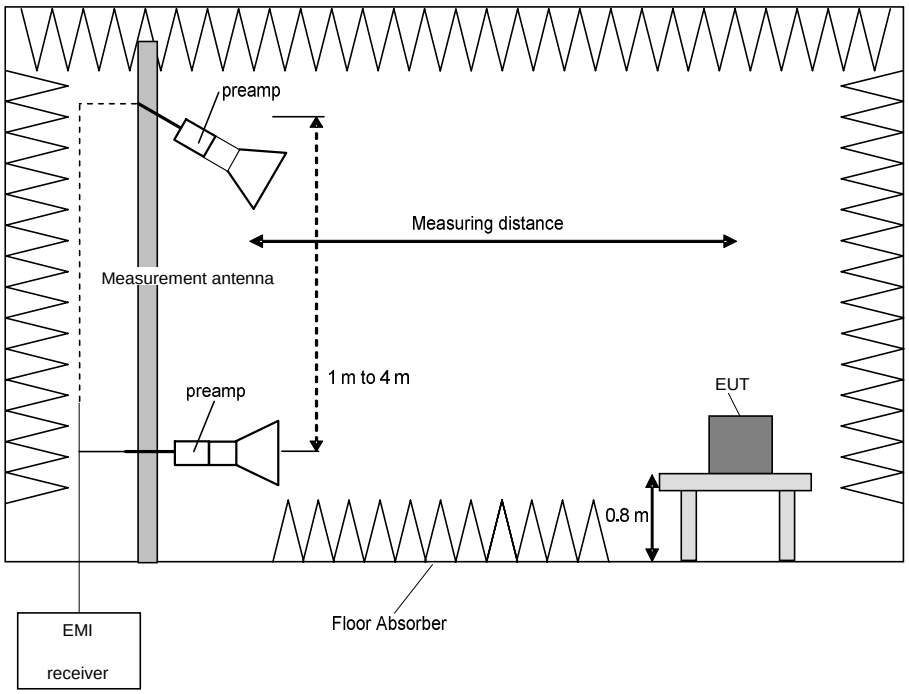
1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT position (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 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 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 – 40 GHz)

The preliminary and final measurements were conducted in a semi-anechoic chamber with floor absorbers between EUT and measurement antenna in a 3 m distance.
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. For each height the angle of the antenna will be tilted so that the measurement antenna is always aiming at the EUT.

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

Test	Frequency range	Resolution bandwidth
Preliminary measurement	1 - 40 GHz	1 MHz
Frequency peak search	+ / - 10 MHz	100 kHz
Final measurement	1 - 40 GHz	1 MHz



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation 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 polarisation 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 RBW with +/- 10 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.

5.4.2 Test results

5.4.2.1 Preliminary radiated emission measurement (9 kHz to 30 MHz)

Ambient temperature	22 °C	Relative humidity	25 %

Position of EUT: The EUT was set-up on a non-conducting support of a height of 0.8 m.
The distance between EUT and antenna was 3 m.

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

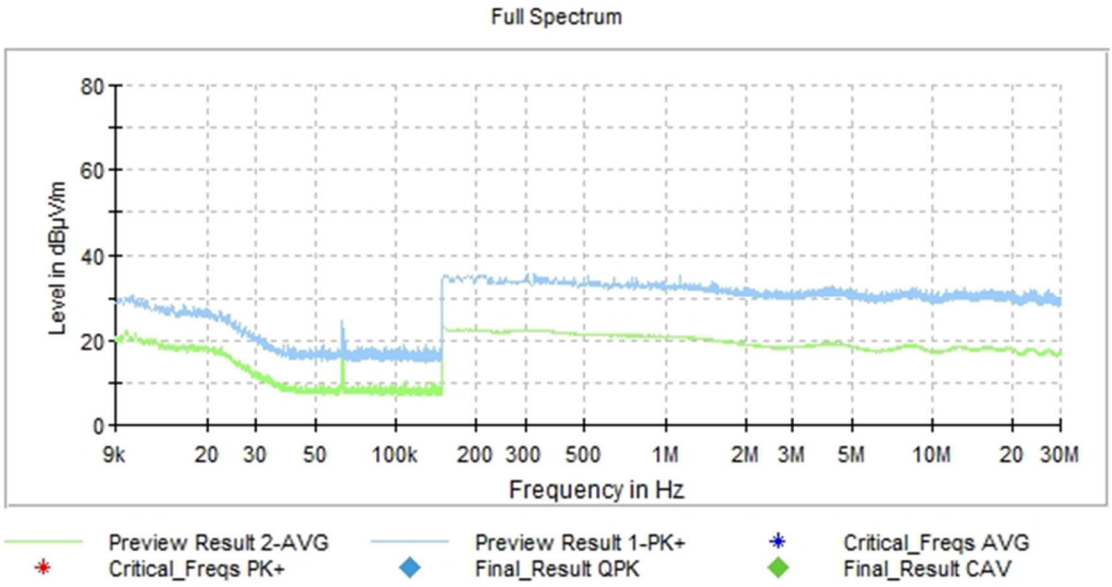
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3 V_{DC} by battery.

Frequency range: The preliminary measurement was carried out in the frequency range 9 kHz to 30 MHz according to [2].

Mode of EUT: EUT 2 in test mode 2 transmits continuously a CW signal.

Spurious emissions from 9 kHz to 30 MHz:



No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test.
Therefore no measurements were carried out at the outdoor test site.

Test equipment used (see chapter 6):

3 – 5, 7 -10

5.4.2.2 Final radiated emission measurement (9 kHz to 30 MHz)

No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test. Therefore no final measurements were carried out at the outdoor test site.

5.4.2.3 Final radiated emission measurement (30 MHz to 1 GHz)

Ambient temperature	22 °C	Relative humidity	25 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m. The test was performed in three orthogonal positions of the EUT (Refer to the photos in annex A of this test report.).

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

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3 V_{DC} by battery.

Mode of EUT: EUT 2
Preliminary Measurement: Test mode 2: Continuous CW signal.
Final measurement RKE: Test mode 3: Continuous Manchester coded ASK signal.
Final measurement PASE: Test mode 6: Continuous Manchester coded FSK signal.

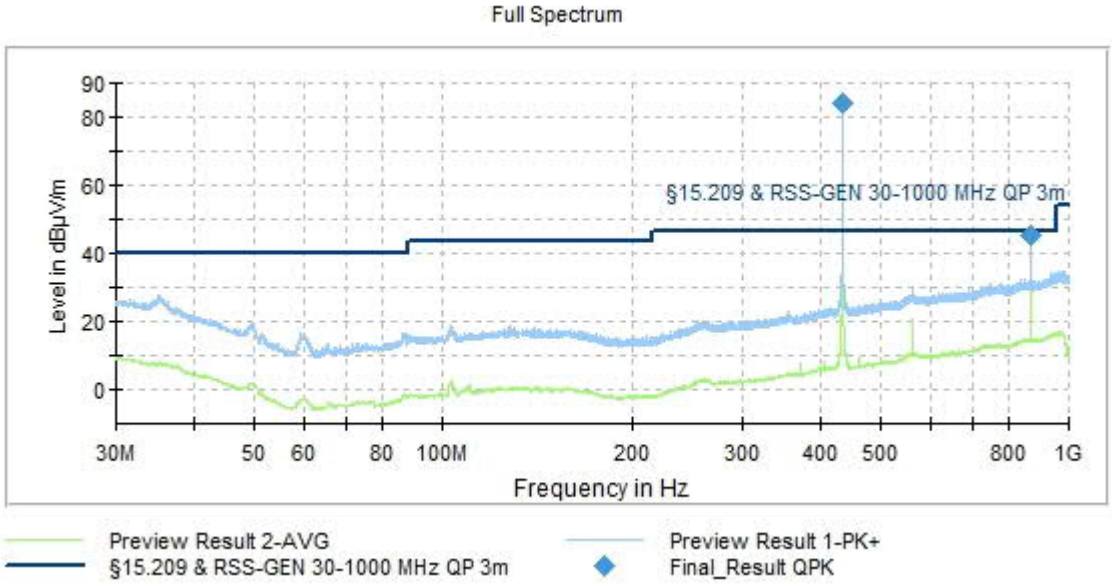
Test results: The test results were calculated with the following formula:

Corr. [dB] = cable loss [dB] + antenna factor [dB/m] + 6 dB (used attenuator) for peak measurements

Corr. [dB] = cable loss [dB] + antenna factor [dB/m] + 6 dB (used attenuator)
+ peak-to-average correction factor [dB] for duty cycle average measurements

Therefore the reading can be calculated as follows:

Reading (dBµV/m) = result Peak/Average (dBµV/m) - Corr. (dB)



Mode: RKE											
Frequency [MHz]	**Peak [dBµV/m]**	**Duty cycle average [dBµV/m]**	**Limit [dBµV/m]**	**Margin [dB]**	**Meas. Time [ms]**	**Bandwidth (kHz)**	**Height [cm]**	**Pol**	**Azimuth [deg]**	**EUT Pos**	**Corr. [dB]**
433.920	84.2	-	-	-	1000	120	130	V	271	2	24.6
	-	73.0	80.8 [1]	7.8	1000	120	130	V	271	2	13.4
867.840	45.9	-	-	-	1000	120	157	H	188	2	31.8
	-	34.7	60.8 [1]	26.1	1000	120	157	H	188	2	20.6
Measurement uncertainty:			±4.8 dB								

[1] according to 15.231 (b) [2] and A1.2 [3]

Mode: PASE											
Frequency [MHz]	**Peak [dBµV/m]**	**Duty cycle average [dBµV/m]**	**Limit [dBµV/m]**	**Margin [dB]**	**Meas. Time [ms]**	**Bandwidth (kHz)**	**Height [cm]**	**Pol**	**Azimuth [deg]**	**EUT Pos**	**Corr. [dB]**
433.920	84.2	-	-	-	1000	120	130	V	271	2	24.6
	-	65.0	80.8 [1]	15.8	1000	120	130	V	271	2	5.4
867.840	45.9	-	-	-	1000	120	157	H	188	2	31.8
	-	26.7	60.8 [1]	34.1	1000	120	157	H	188	2	12-.2
Measurement uncertainty:			±4.8 dB								

[1] according to 15.231 (b) [2] and A1.2 [3]

Test equipment used (see chapter 6):

4 - 12

5.4.2.4 Final radiated emission measurement (1 GHz to 6 GHz)

Ambient temperature	22 °C	Relative humidity	26 %

Position of EUT: The EUT was set-up on a non-conducting turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m. The test was performed in three orthogonal positions of the EUT (Refer to the photos in annex A of this test report.).

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

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3 V_{DC} by battery.

Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

Mode of EUT: EUT 2

Preliminary Measurement:	Test mode 2:	Continuous CW signal.
Final measurement RKE:	Test mode 3:	Continuous Manchester coded ASK signal.
Final measurement PASE:	Test mode 6:	Continuous Manchester coded FSK signal.

Test results: The test results were calculated with the following formula:

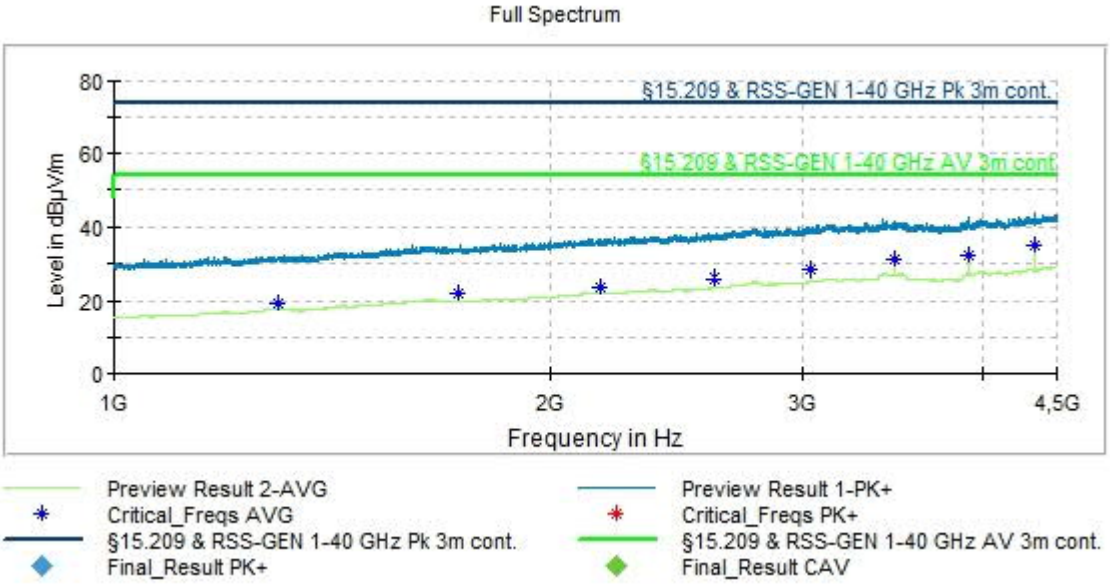
The correction factor was calculated as follows:

Corr. [dB] = cable loss [dB] + antenna factor [dB/m] - amplifier gain[dB] for peak measurements

Corr. [dB] = cable loss [dB] + antenna factor [dB/m] - amplifier gain[dB] + peak-to-average correction factor [dB] for duty cycle average measurements

Therefore the reading can be calculated as follows:

Reading (dBµV/m) = result Peak/Average (dBµV/m) - Corr. (dB)



Frequency [MHz]	Peak [dBµV/m]	Duty cycle average [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Height [cm]	Pol	Azimuth [deg]	EUT Pos	Corr. [dB]
Measurement uncertainty:			±5.1 dB								

Margin of the spurious emissions to the limit is at least 20dB

Test: Passed

Test equipment used (see chapter 6):

1, 2, 4 – 10

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	18.02.2020	02.2022
2	Log Per Antenna	HL050	Rohde & Schwarz	4062.4063.02-100908	482977	13.08.2019	08.2022
3	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	14.02.2020	02.2022
4	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
5	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
6	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
7	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
8	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
9	Software EMC32 M276	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
10	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	14.11.2019	11.2021
11	Antenna (Bilog)	CBL6111D	Schaffner Elektrotest GmbH / Teseq GmbH	25761	480894	09.10.2020	10.2023
12	Attenuator 6 dB	WA2-6	Weinschel		482793	Calibration not necessary	
13	Signal & Spectrum Analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	04.03.2020	03.2022
14	Test fixture	Für Funk 50 Ohm-System	PHOENIX TESTLAB GmbH	Eigenbau	410160	Calibration not necessary	

7 Report History

Report Number	Date	Comment
F201874E1	21.01.2021	Initial test report
-	-	-
-	-	-

8 List of Annexes

Annex A	Test Setup Photos	5 Pages
Annex B	External Photos	3 Pages
Annex C	Internal Photos	4 Pages