Test report

according to ISO/IEC 17025:2017

FCC
(Federal Communications Commission)
Test Firm Registration Number: 768032
Designation Number DE0022

Electromagnetic compatibility

Intentional Radiators

Deutsche Akkreditierungsstelle
D-PL-17379-01-01
D-PL-17379-01-02
D-PL-17379-01-03

Bundesnetzagentur

BNetzA-CAB-18/21-19

TESTED IN GERMANY

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Test report no.: **20/07-0012**

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Location of test facility:

STC TESTED IN GERMANY

STC Germany GmbH
Ohmstrasse 1
84160 Frontenhausen
Germany

1. Client information

Name:	EKF-diagnostic GmbH
Address:	Ebendorfer Chaussee 3 39179 Barleben Germany
Name of contact:	Kerstin Riemer
Telephone:	+4939203511144
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E-mail:	kerstin.riemer@ekf.diagnostic.de

2. Equipment under test (EUT)

2.1 Identification of the EUT

Equipment:	Meter
Model:	DiaSpect Tm
Brand name:	-/-
Serial no.:	20TB0751, 20TB0750, 15TM4240, 15TM1451, 15TM1453
Manufacturer:	EKF-diagnostic GmbH
Country of origin:	Germany
Power rating:	AC-adaptor (SM15-5-V-138) Input: 100-240 V~ 50/60 Hz 0.2 A, Out: 5 V ⎓ 1 A Li-Ion battery 3,6V – 2,2Ah – 7,92Wh
Highest frequency generated or used in the device or on which the device operates or tunes:	2.48 GHz
Date Sample Received:	02.07.2020
Tests were performed:	02.07.2020 – 26.01.2021

2.2 Additional information about the EUT:

-/-

To duplicate parts of this test report needs the written confirmation of the test laboratory.

The test results relate only to the above mentioned test sample(s).

3. Description of the Equipment under test and test conditions

FCC-ID:	2AWUY704900130264
Cables:	USB cable 95 cm
Approx. Size (l x w x h):	(15.0 x 9.0 x 3.8) cm
Test conditions:	The “Meter – DiaSpect Tm” (= equipment under test – EUT) had been tested, where applicable, in the following modes: (1) Bluetooth Low Energy: Tx mode GFSK 2402.0 MHz (2) Bluetooth Low Energy: Tx mode GFSK 2440.0 MHz (3) Bluetooth Low Energy: Tx mode GFSK 2444.0 MHz (4) Bluetooth Low Energy: Tx mode GFSK 2480.0 MHz controlled by a test software with maximum RF-output power, Duty Cycle ≥ 98% and different data rate in order to find the worst case. As well as in normal operation mode with an active connection Bluetooth connection to Smartphone in following modes. (5) Evaluation of test strips – BT con. to Smartphone – Charge Mode (6) Evaluation of test strips – BT con. to Smartphone – Battery operating Mode (7) Meter active / USB connected to Laptop Data transfer via USB and BLE active In charge mode the EUT was powered with 120 V~ 60Hz. The tested configuration represents (based on the product specification) with the tested operation modes the worst case
Additional information:	Conducted RF Measurements were carried out on a temporary SMA socket
RF Module Model Number:	CC2540
Frequency range:	2.400 GHz – 2.483,5 GHz
Operating frequencies:	2.402 GHz – 2.480 GHz
Module Tranmission Type:	Bluetooth Low Energy
Modulation:	GFSK
Date Rates:	1 MBit/s
Channel separation:	2 MHz
Number of channels:	40
Spurious Emissions: radiated lowest margin to limit	35.52 dBµV/m @ 3 m
Environmental conditions during tests:	Ambient temperature: 21 °C Relative humitity 39 % Atmospheric pressure 963 mbar
Antenna specification:	Model: Printed PCB Antenna Gain: max. -2.8 dBi Type: ☐ External (with accessible antenna socket) ☒ Internal (integrated, PCB antenna)
Test standard:	- e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

Channel List

Bluetooth Low Energy

Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	18	2442
0	2404	19	2444
1	2406	20	2446
2	2408	21	2448
3	2410	22	2450
4	2412	23	2452
5	2414	24	2454
6	2416	25	2456
7	2418	26	2458
8	2420	27	2460
9	2422	28	2462
10	2424	29	2464
38	2426	30	2466
11	2428	31	2468
12	2430	32	2470
13	2432	33	2472
14	2434	34	2474
15	2436	35	2476
16	2438	36	2478
17	2440	39	2480

4. Performed measurements and results

The complete list of measurements required in e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 is given below.

Standard:	**Test Method:**		**Test requirements:**			
			applicable:		**fulfilled:**	
			yes	**no**	**yes**	**no**
§ 15.207	ANSI 63.10 Section 6.2	AC Mains Conducted Emissions	☒	☐	☒	☐
§ 15.209	ANSI 63.10 Section 6.3 - 6.6	Radiated Emissions	☒	☐	☒	☐
§15.247	ANSI 63.10 Section 11.8.1	6 dB DTS Bandwidth	☒	☐	☒	☐
§15.247	ANSI 63.10 Section 11.9.1	Output Power of Fundamental Emissions	☒	☐	☒	☐
§15.247	ANSI 63.10 Section 11.10.2	Maximum Power Spectral Density	☒	☐	☒	☐
§15.247	ANSI 63.10 Section 11.13.2	Band Edges Measurement	☒	☐	☒	☐

All required / applicable tests according to the following standards were performed under Ref-No. 20/07-0012.

- e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 with test Method according to ANSI C63.10-2013

- e-CFR data is current as of July 23, 2020

Remark: -/-

5. AC Mains conducted emissions

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.207 Conducted limits

Test site
Measurements of conducted emission from EUT was made in the shielded chamber (DC - 10GHz) located in the test facility.

Test equipment and test set up
Test equipment used for conducted measurements on Mains as given in clause Test equipment of this report.
Test setup used for conducted measurements on Mains as given in clause Test setups of this report.

Detector function selection and bandwidth
In conducted emissions measurement CISPR quasi-peak- and average-detector were used.
The bandwidth of the detector of instrument is 10 kHz over the frequency range of 150 kHz to 30 MHz.

Frequency range to be scanned
For conducted emission measurements, the spectrum in the range of 150 kHz to 30 MHz was investigated.

Test conditions and configuration of EUT
The EUT was configured and operated with conditions as mentioned under “Test conditions” in clause 3 of this report.

All modes are investigated by operating the EUT in a range of typical modes of operation, with typical cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation and for each ac power current-carrying conductor, cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below. The corresponding configuration is shown in the “Photo(s) of test setup”.
The EUT was placed on a 80 cm high non metallic table.
Measurements were performed on neutral (N)- and live (L1)- wire on the AC terminals of the AC-Adaptor for the operation mode No.5 as well as on neutral (N)- and live (L1)- wire on the AC terminals of the Host AC-Adaptor (Laptop) for the operation modes No. 1 - 4.

Requirements

Frequency Range [MHz]	Quasi-Peak Limits [dBµV]	Average Limits [dBµV]
0.15 - 0.5	66 to 56 Note 1	56 to 46 Note 1
0.5 - 5.0	56	46
5.0 - 30.0	60	50
Note 1: The level decreases linearly with the logarithm of the frequency		

Measurement

Measurement performed on 23.07.2020

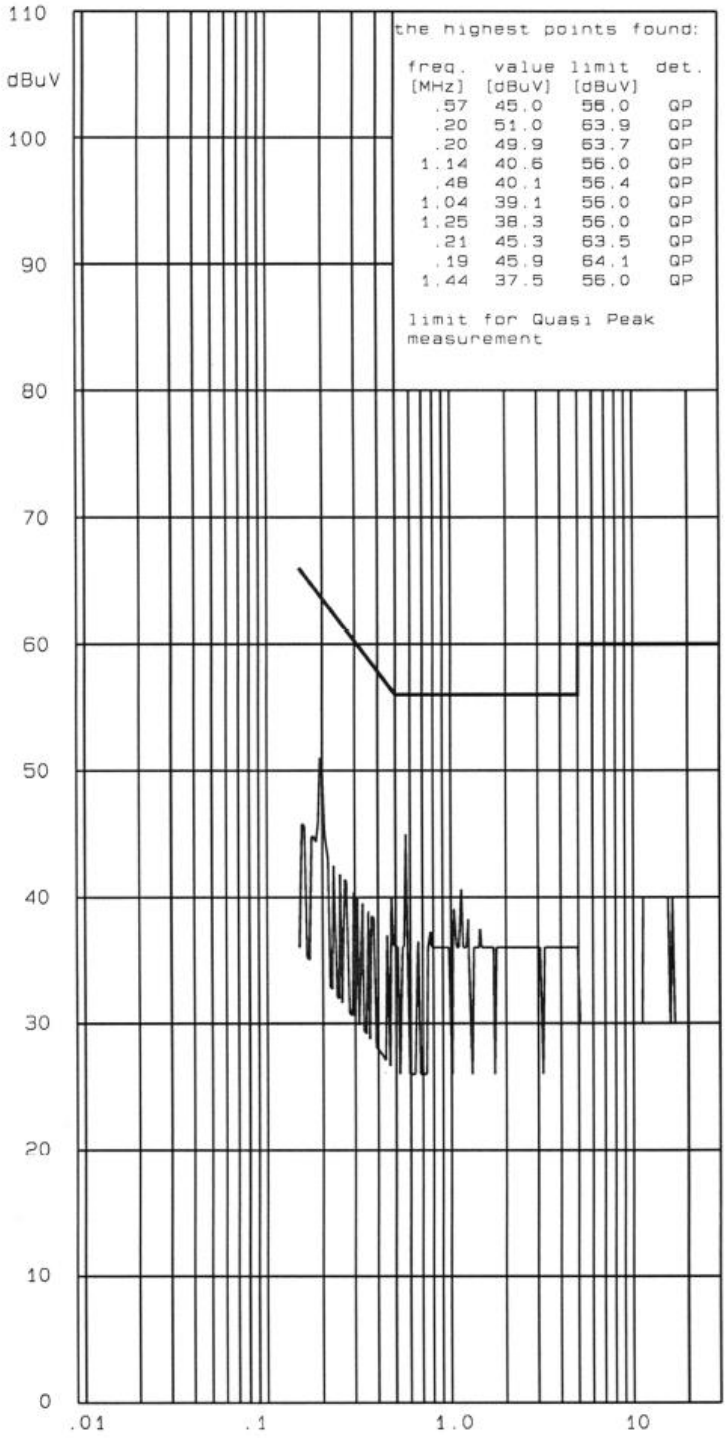
As worst cases the mode No. 3. with Tx BT low energy CH.19 – GFSK – Input Voltage 120 V / 60 Hz was found and documented in this report.

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC Subpart C 15.207

Cabin 1



the highest points found:

freq. [MHz]	value [dBuV]	limit [dBuV]	det.
.57	45.0	56.0	QP
.20	51.0	63.9	QP
.20	49.9	63.7	QP
1.14	40.6	56.0	QP
.48	40.1	56.4	QP
1.04	39.1	56.0	QP
1.25	38.3	56.0	QP
.21	45.3	63.5	QP
.19	45.9	64.1	QP
1.44	37.5	56.0	QP

limit for Quasi Peak measurement

Ref.-No.: 20/07-0012

Product: Meter

Sample: 01

Date: 23 Jul 2020

Operator: Ji/Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
Host Laptop APL 28

Operating mode:

Tx BT low energy CH.19
GFSK
Tested on N

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass ⋈ fail [ ]

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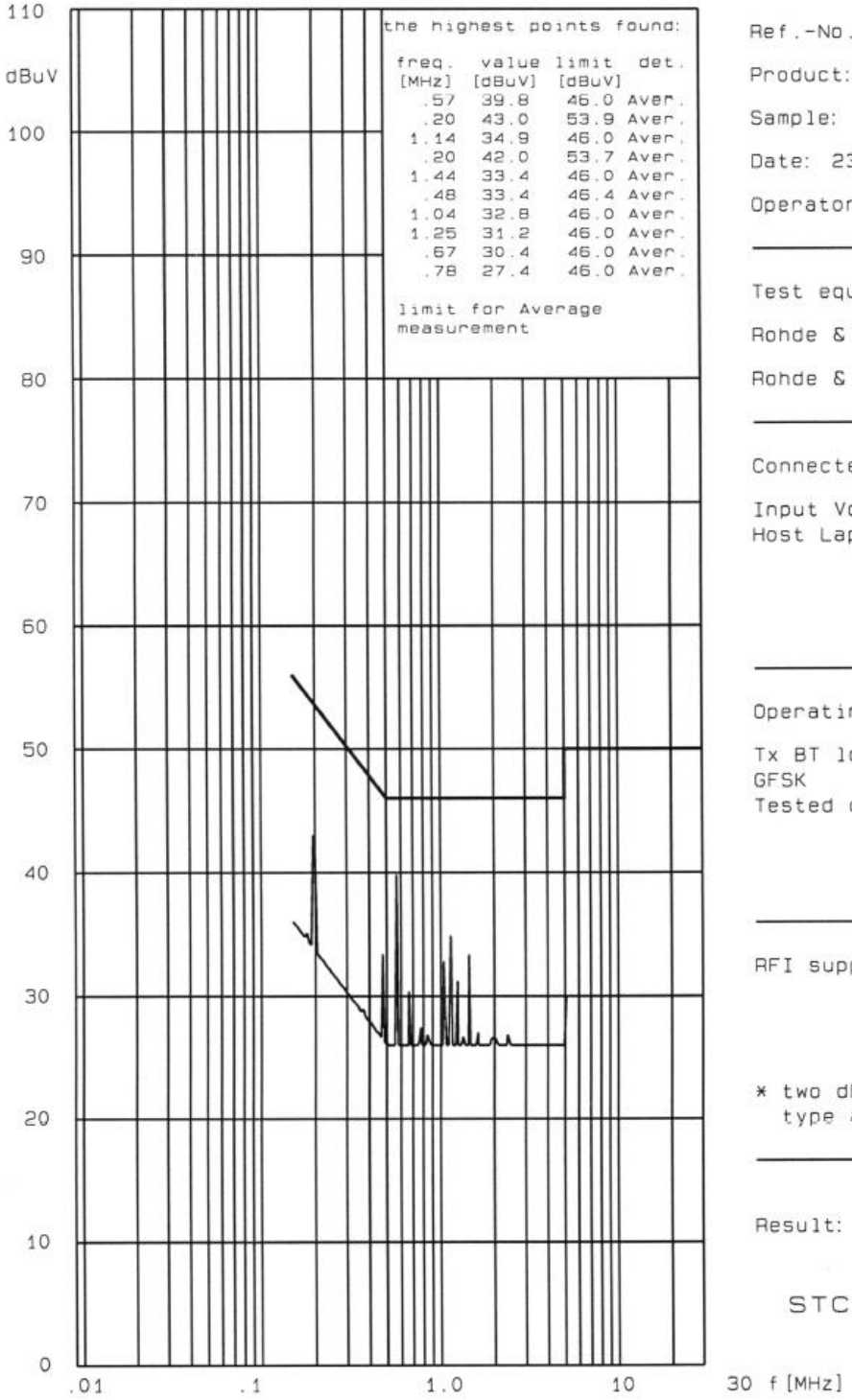
IT 1/2

Interference Voltage 150 KHz - 30 MHz

acc. FCC Subpart C 15.207

Cabin 1



the highest points found:

freq. [MHz]	value [dBuV]	limit [dBuV]	det.
.57	39.8	46.0	Aver.
.20	43.0	53.9	Aver.
1.14	34.9	46.0	Aver.
.20	42.0	53.7	Aver.
1.44	33.4	46.0	Aver.
.48	33.4	46.4	Aver.
1.04	32.8	46.0	Aver.
1.25	31.2	46.0	Aver.
.67	30.4	46.0	Aver.
.78	27.4	46.0	Aver.

limit for Average measurement

Ref.-No.: 20/07-0012

Product: Meter

Sample: 01

Date: 23 Jul 2020

Operator: Ji/Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
Host Laptop APL 28

Operating mode:

Tx BT low energy CH.19
GFSK
Tested on N

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass ⋈ fail [ ]

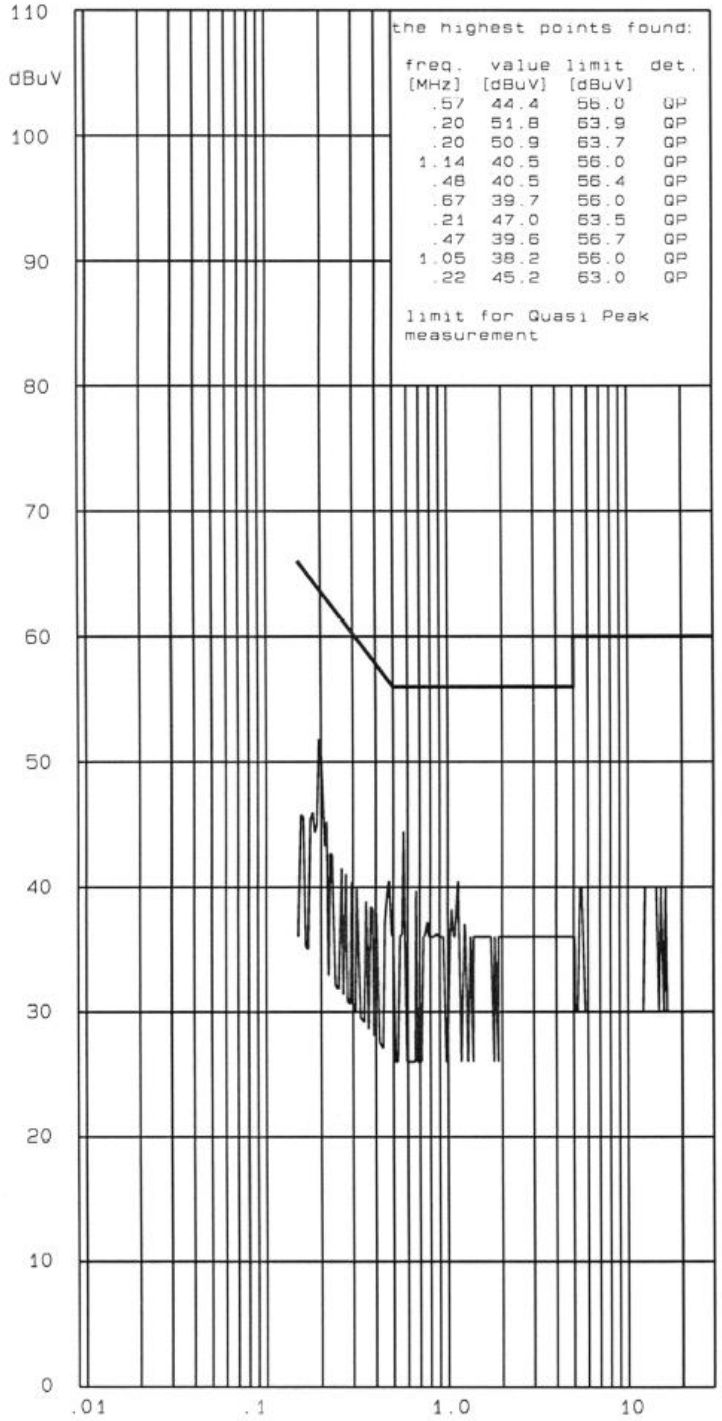
STC Germany GmbH

IT 1/2

Interference Voltage 150 KHz - 30 MHz

acc. FCC Subpart C 15.207

Cabin 1



the highest points found:

freq. [MHz]	value [dBuV]	limit [dBuV]	det.
.57	44.4	56.0	QP
.20	51.8	63.9	QP
.20	50.9	63.7	QP
1.14	40.5	56.0	QP
.48	40.5	56.4	QP
.67	39.7	56.0	QP
.21	47.0	63.5	QP
.47	39.6	56.7	QP
1.05	38.2	56.0	QP
.22	45.2	63.0	QP

limit for Quasi Peak measurement

Ref.-No.: 20/07-0012

Product: Meter

Sample: 01

Date: 23 Jul 2020

Operator: Ji/Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
Host Laptop APL 28

Operating mode:

Tx BT low energy CH.19
GFSK
Tested on L1

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass ☒ fail [ ]

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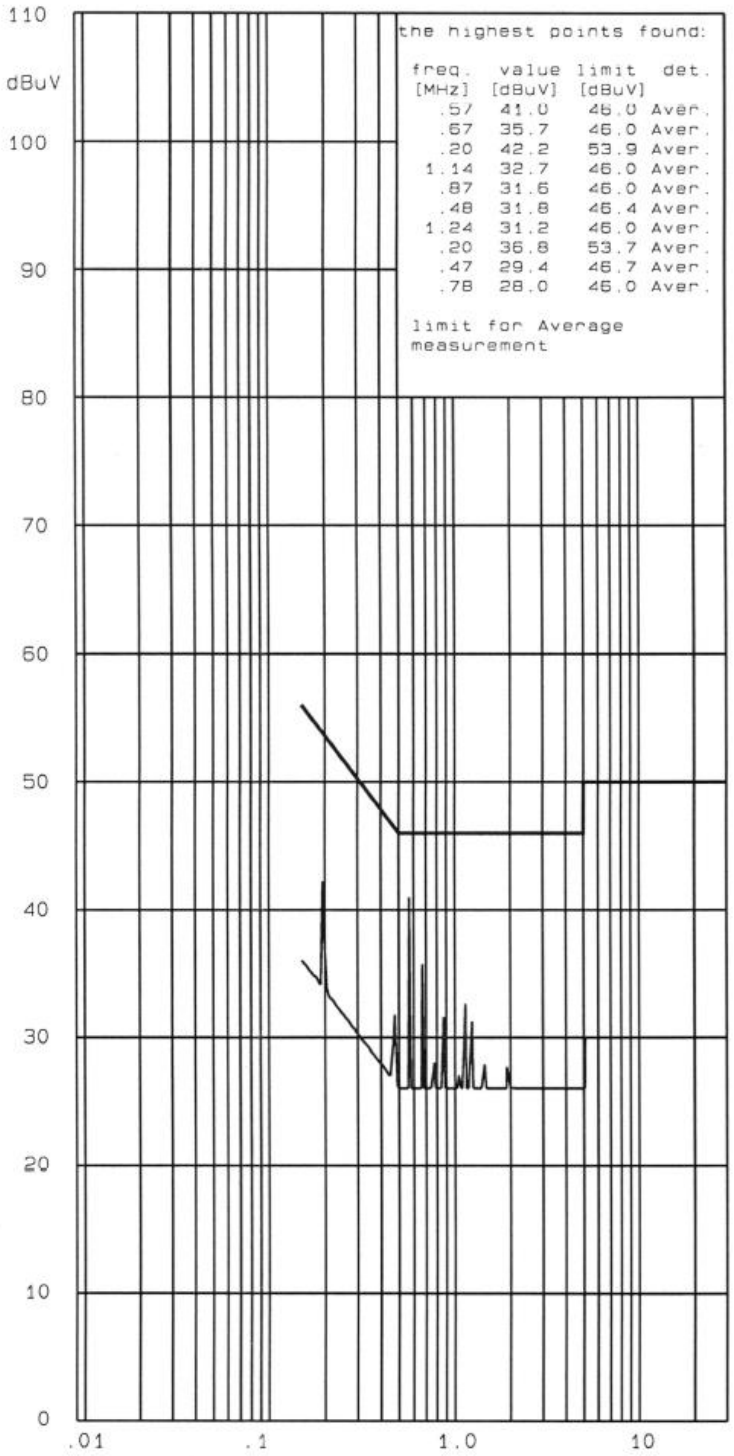
IT 1/2

Interference Voltage 150 KHz - 30 MHz

acc. FCC Subpart C 15.207

Cabin 1



the highest points found:

freq. [MHz]	value [dBuV]	limit [dBuV]	det.
.57	41.0	46.0	Aver.
.67	35.7	46.0	Aver.
.20	42.2	53.9	Aver.
1.14	32.7	46.0	Aver.
.87	31.6	46.0	Aver.
.48	31.8	46.4	Aver.
1.24	31.2	46.0	Aver.
.20	36.8	53.7	Aver.
.47	29.4	46.7	Aver.
.78	28.0	46.0	Aver.

limit for Average measurement

Ref.-No.: 20/07-0012

Product: Meter

Sample: 01

Date: 23 Jul 2020

Operator: Ji/Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
Host Laptop APL 28

Operating mode:

Tx BT low energy CH.19
GFSK
Tested on L1

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass [X] fail [ ]

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The six highest emissions for each port (L/N)/detector are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Detector (3)	Port (4)	loss of cable between LISN and test receiver [dB] (5)	LISN correction [dB] (6)	AC power line conducted emission [dBµV] (7)	Limit [dBµV] (8)	Result (9)
0.57	45.00	QP	N	0.10	0.10	45.20	56.00	Pass
0.20	51.00	QP	N	0.10	0.10	51.20	63.90	Pass
0.20	49.90	QP	N	0.10	0.10	45.10	63.70	Pass
1.14	40.60	QP	N	0.10	0.10	40.80	56.00	Pass
0.48	40.10	QP	N	0.10	0.10	40.30	56.40	Pass
1.04	39.10	QP	N	0.10	0.10	39.30	56.00	Pass
0.57	39.80	AV	N	0.10	0.10	40.00	46.00	Pass
0.20	43.00	AV	N	0.10	0.10	43.20	53.90	Pass
1.14	34.90	AV	N	0.10	0.10	35.10	46.00	Pass
0.20	42.00	AV	N	0.10	0.10	42.20	53.70	Pass
1.44	33.40	AV	N	0.10	0.10	33.60	46.00	Pass
0.48	33.40	AV	N	0.10	0.10	33.60	46.40	Pass
0.57	44.40	QP	L1	0.10	0.10	44.60	56.00	Pass
0.20	51.80	QP	L1	0.10	0.10	52.00	63.90	Pass
0.20	50.90	QP	L1	0.10	0.10	51.10	63.70	Pass
1.14	40.50	QP	L1	0.10	0.10	40.70	56.00	Pass
0.48	40.50	QP	L1	0.10	0.10	40.70	54.40	Pass
0.67	39.70	QP	L1	0.10	0.10	39.90	56.00	Pass
0.57	41.00	AV	L1	0.10	0.10	41.20	46.00	Pass
0.67	35.70	AV	L1	0.10	0.10	35.90	46.00	Pass
0.20	42.20	AV	L1	0.10	0.10	42.40	53.90	Pass
1.14	32.70	AV	L1	0.10	0.10	32.90	46.00	Pass
0.87	31.60	AV	L1	0.10	0.10	32.00	46.00	Pass
0.48	31.80	AV	L1	0.10	0.10	32.00	46.40	Pass

(1) = test frequency
(2) = Reading of test receiver in dBµV without correction factors
(3) = used detector
(4) = tested port Phase (live, L1) or Neutral (N)
(5) = loss of cable between LISN and test receiver in dB
(6) = correction factor of LISN in dB
(7) = Reading of test receiver [dBµV] (2) + loss of cable between Line impedance stabilisation network (LISN) and test receiver (dB) (5) + LISN correction [dB] (6)
(8) = relevant limit in dBµV
(9) = comparison between Limit [dBµV] (7) / (8) and AC power line conducted emission [dBµV]

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Conducted Emission**.

6. Radiated emission measurements

Test site
Measurement of radiated emissions from EUT was made in the semi-anechoic chamber SAC3 (DC to 40 GHz) located in the test facility.

Test equipment and test set up
Test equipment used for radiated measurements as given in clause Test equipment of this report.
Test setup used for radiated measurements as given in clause Test setups of this report.

Detector function selection and bandwidth
In radiated emissions measurement, an EMI test receiver that have CISPR detectors was used.

Frequency range	Resolution Bandwidth
9KHz – 150kHz (Quasi Peak & Average* Detector)	200Hz
150KHz – 30MHz (Quasi Peak & Average* Detector)	9kHz
30MHz – 1GHz (Quasi Peak Detector)	120kHz
Above 1GHz (Peak & Average Detector)	1MHz

*Average Detector only in specify frequency range.

Antennas
Measurements were made using a calibrated loop antenna in the range 9 kHz – 30 MHz, as well as a calibrated bilog antenna in the range of 30 to 1000 MHz to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization.
The horizontal distance between the receiving antenna and the EUT was 3 meters.
In the range of 1 GHz to 26 GHz measurements were made using a calibrated horn antenna to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization. The horizontal distance between the receiving antenna and the EUT was 3 meters.

Frequency range to be scanned
For radiated emissions measurements, the spectrum in the range of 9kHz MHz to 26 GHz was investigated as the highest frequency generated/used in the EUT is 2.480 GHz.

Test conditions and configuration of EUT

The EUT was configured and operated with conditions as mentioned under “Test conditions” in clause 3 of this report.

During test the EUT was operated as specified in the user manual of the EUT. For frequencies below 1000 MHz the EUT was placed on a 80 cm and for frequencies above 1000 MHz the RF Transmitter modul was placed on a 150 cm high non metallic table placed on the turntable. The EUT was rotated and the antenna height was varied between 1 m to 4 m to find the maximum RF energy generated from EUT. The procedure according to ANSI C63.10:2013 is used and all modes are investigated by operating the EUT in a range of typical modes of operation, with typical cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation, cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below.

Remarks:
-Correction factor included antenna factor and cable attenuation.

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits
-RSS-Gen issue 05 section 8.9

Requirements:

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits

Frequency MHz	Limits [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/m] Average	Test distance [m]
0.009 – 0.090	-/-	-/-	2400/F (kHz)	48.5 – 28.5	300
0.090 - 0.110	2400/F (kHz)	28.5 – 26.8	-/-	-/-	300
0.110 – 0.490	-/-	-/-	2400/F (kHz)	26.8 – 13.8	300
0.490 - 1.705	24000/F (kHz)	33.8 – 23.0	-/-	-/-	30
1.705 - 30.0	30	29.5	-/-	-/-	30

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits

Frequency MHz	Limits [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/m] Average	Test distance [m]
30 - 88	100	40	-/-	-/-	3
88 - 216	150	43.5	-/-	-/-	3
216 - 960	200	46	-/-	-/-	3
960 - 1000	500	54	-/-	-/-	3
Above 1000	-/-	-/-	500	54	3

Measurements

The Measurement was performed on: 09.07.2020, 10.07.2020 and 26.01.2021

Result 9 kHz – 30 MHz

In the frequency range 9 kHz – 30 MHz the EUT had been scanned in a distance of 3 m and
the Limit were corrected to the test distance of 3 m using a factor with 40 dB/decade acc. to § 15.31 (f)(2).

All emissions in the frequency range 9 kHz – 30 MHz are at least 20 dB below the relevant limit.

Result 30 MHz – 1000 MHz

As worst cases the mode No. 5 with Evaluation of test strips – BT con. to Smartphone – Charge Mode – with an Input Voltage 120 V / 60 Hz was found and documented in this report.

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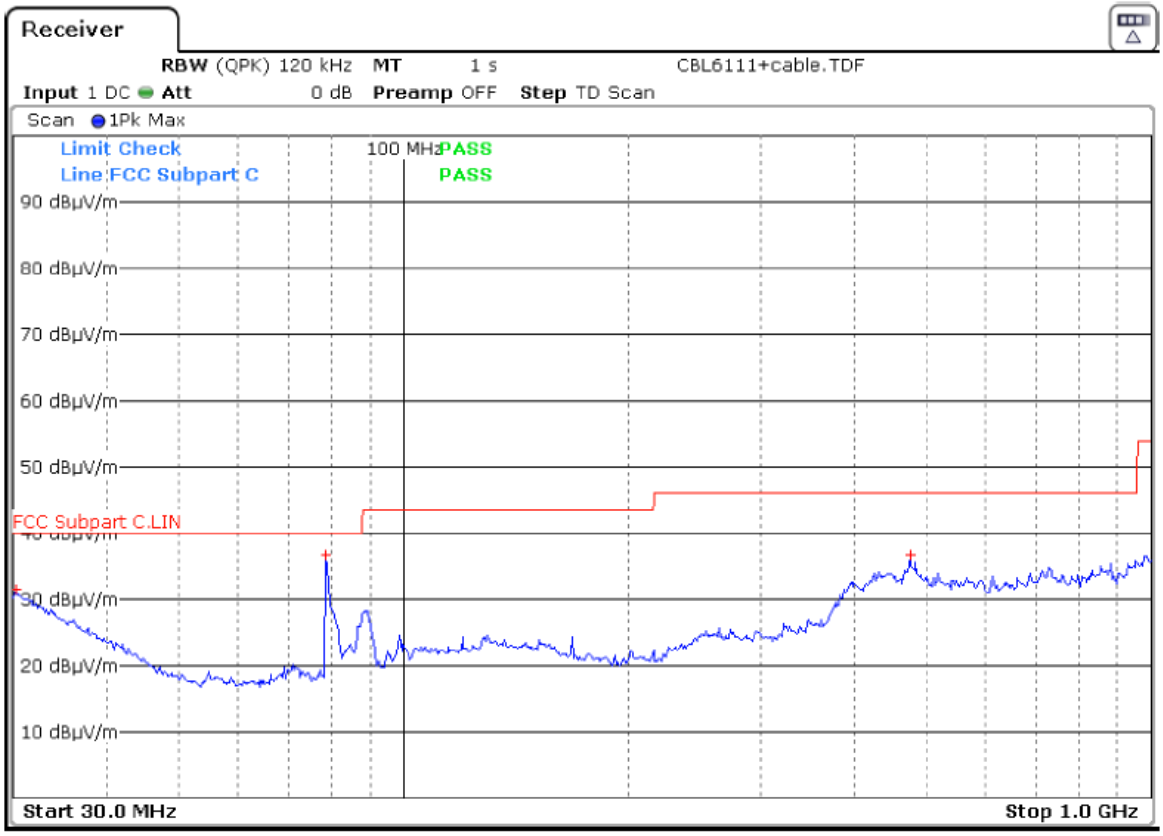
IT 5/6
Interference radiation
acc.FCC Subpart C § 15.209/RSS-Gen

STC

			pass	fail
Ref.-No.:	20/07-0012			
Product:	Meter			
Sample:	01			
Date:	26.01.2021			
Operator:	BI			
Remarks:	All cables connected; Input Voltage: 120V/60Hz	Result:	☒	☐

Final Measurement

Operation mode: Meter active; USB connected to PC-Datatransfer; Bluetooth (LE) active



Polarisation: V									
Scan Detector Peak					Final Detector Quasi Peak				
Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
78,72	36,65	-3,35	40,00	pass					
30,27	31,60	-8,40	40,00	pass					
475,98	36,64	-9,36	46,00	pass					
*Retest with Quasi Peak					Retest with Quasi Peak Detector not required				

TESTED IN GERMANY

IT 5/6

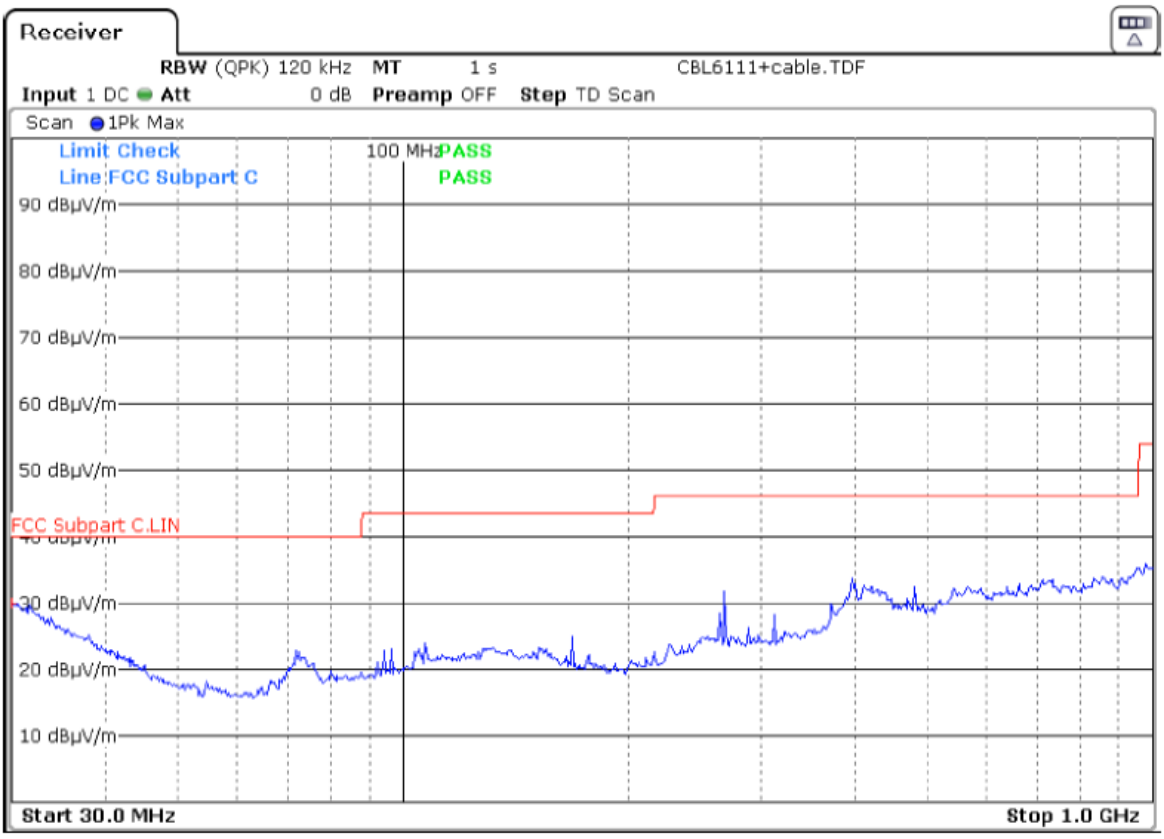
Interference radiation

acc.FCC Subpart C § 15.209/RSS-Gen

STC

Ref.-No.: 20/07-0012

Operation mode: Meter active; USB connected to PC-Datatransfer; Bluetooth (LE) active



Polarisation: H									
Scan Detector Peak					Final Detector Quasi Peak				
Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
30,00	30,05	-9,95	40,00	pass					
*Retest with Quasi Peak					Retest with Quasi Peak Detector not required				

Testdistance Antenna/EUT: 3m

Result 1 GHz – 7 GHz

As worst cases the mode No. 3. Tx BT low energy CH.19 - GFSK with an Input Voltage 120 V / 60 Hz was found and documented in this report.

TESTED IN GERMANY

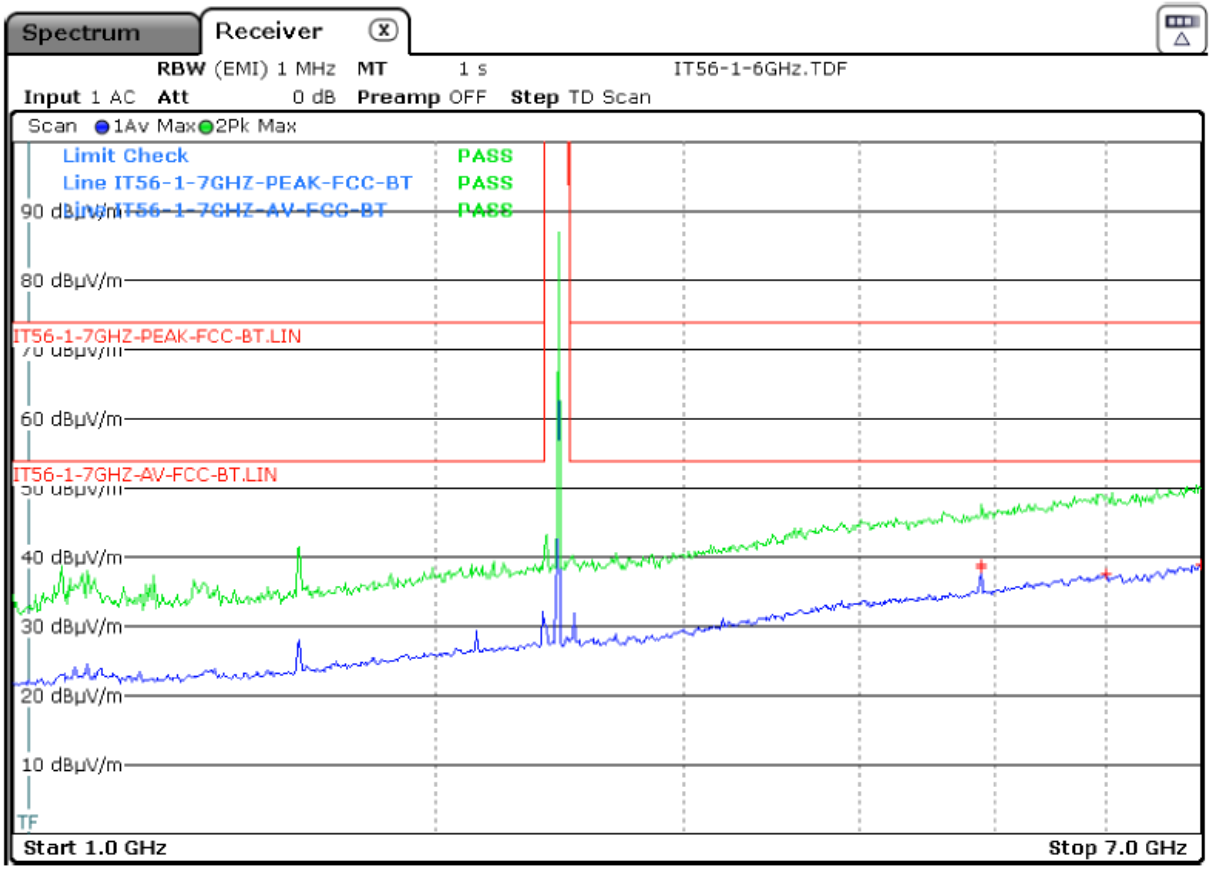
IT 5/6
Interference radiation
acc.FCC Subpart C § 15.209

STC

Ref.-No.:	20/07-0012
Product:	Meter
Sample:	03
Date:	09.07.2020
Operator:	BI
Remarks:	

Result: pass ☒ fail ☐

Operation mode: Tx BT Low Energy; CH.19; GFSK



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
4,8860	38,99	-15,01	54,00	pass	1 - 7	-/-	>20	74	pass
6,9948	38,91	-15,09	54,00	pass					
4,8883	38,53	-15,47	54,00	pass					
5,9878	37,59	-16,41	54,00	pass					

TESTED IN GERMANY

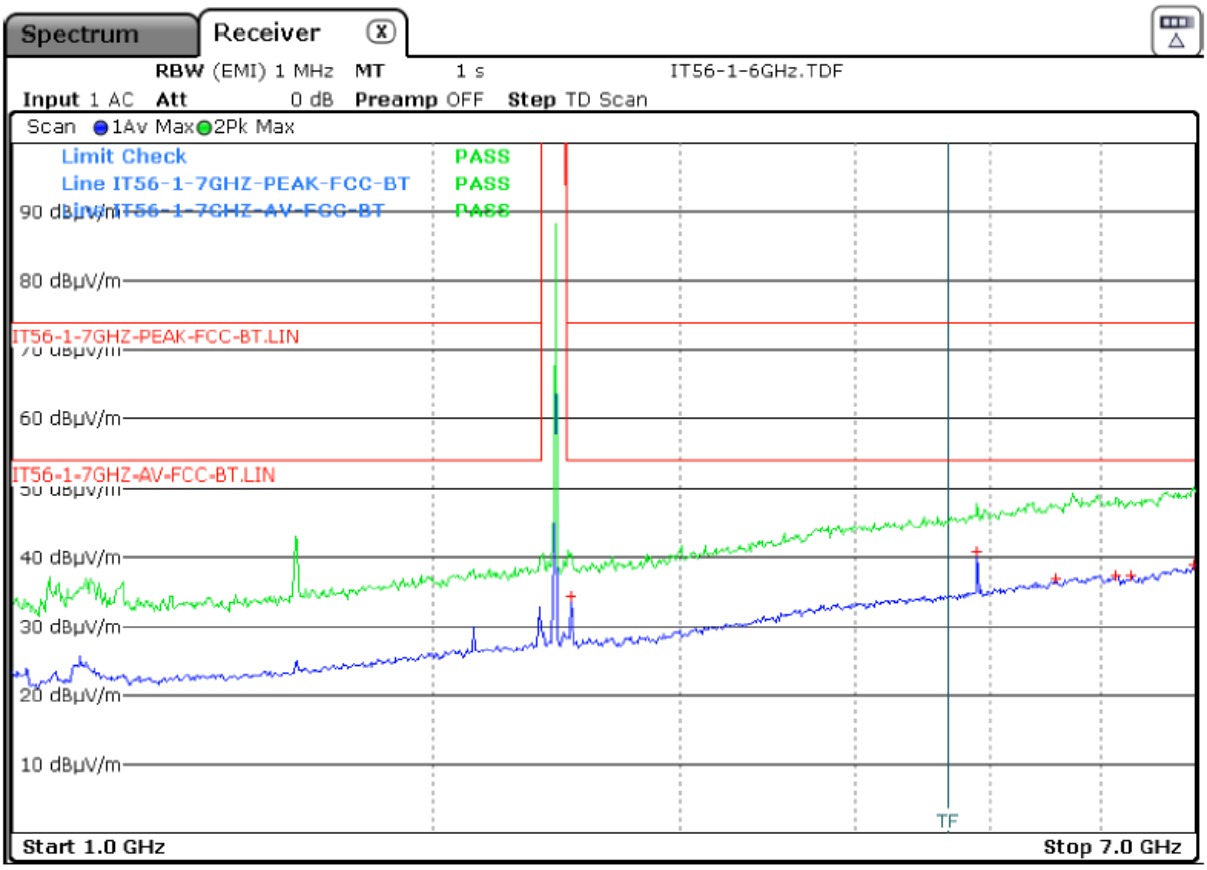
IT 5/6

Interference radiation

acc.FCC Subpart C § 15.209

Ref.-No.: 20/07-0012

Operation mode: Tx BT Low Energy; CH.19; GFSK



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
4,8878	40,96	-13,04	54,00	pass	1 - 7	-/-	>20	74	pass
6,9743	38,83	-15,17	54,00	pass					
6,2990	37,41	-16,59	54,00	pass					
6,1438	37,40	-16,60	54,00	pass					
5,5733	36,91	-17,09	54,00	pass					
2,5080	34,41	-19,59	54,00	pass					

Result 7GHz – 26GHz

All emissions in the frequency range 7 GHz – 26 GHz are at least 20 dB below the relevant limit

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Radiated Emissions**.

7. Operation within the band 902-928 MHz, 2400-2483,5 MHz and 5725-5850 MHz

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247

7.1. 6 dB DTS Bandwidth Measurement

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 (a) (2)

Limit
The minimum 6 dB bandwidth shall be at least 500 kHz.

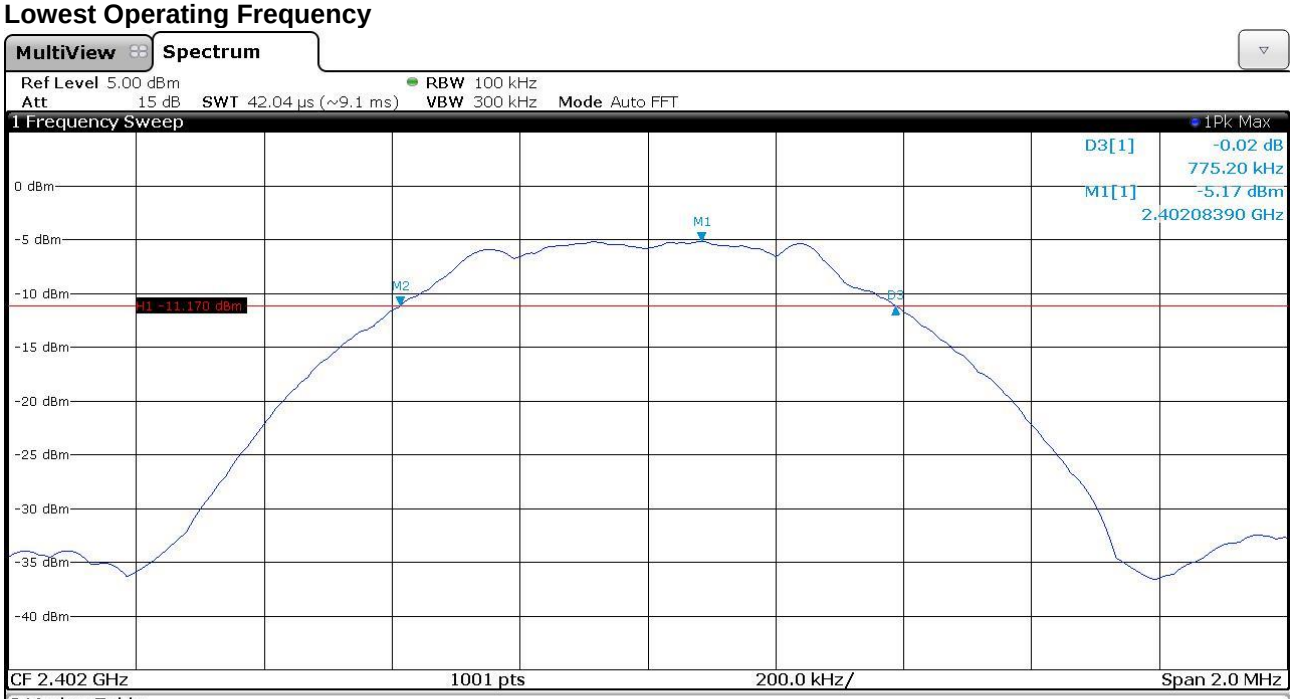
Test equipment and test set up
Test equipment used for conducted measurements as given in clause Test equipment of this report.
Test setup used for conducted measurements as given in clause Test setups of this report.

Description
The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

Measurement

The Measurement was performed on: 10.07.2020

Lowest Operating Frequency

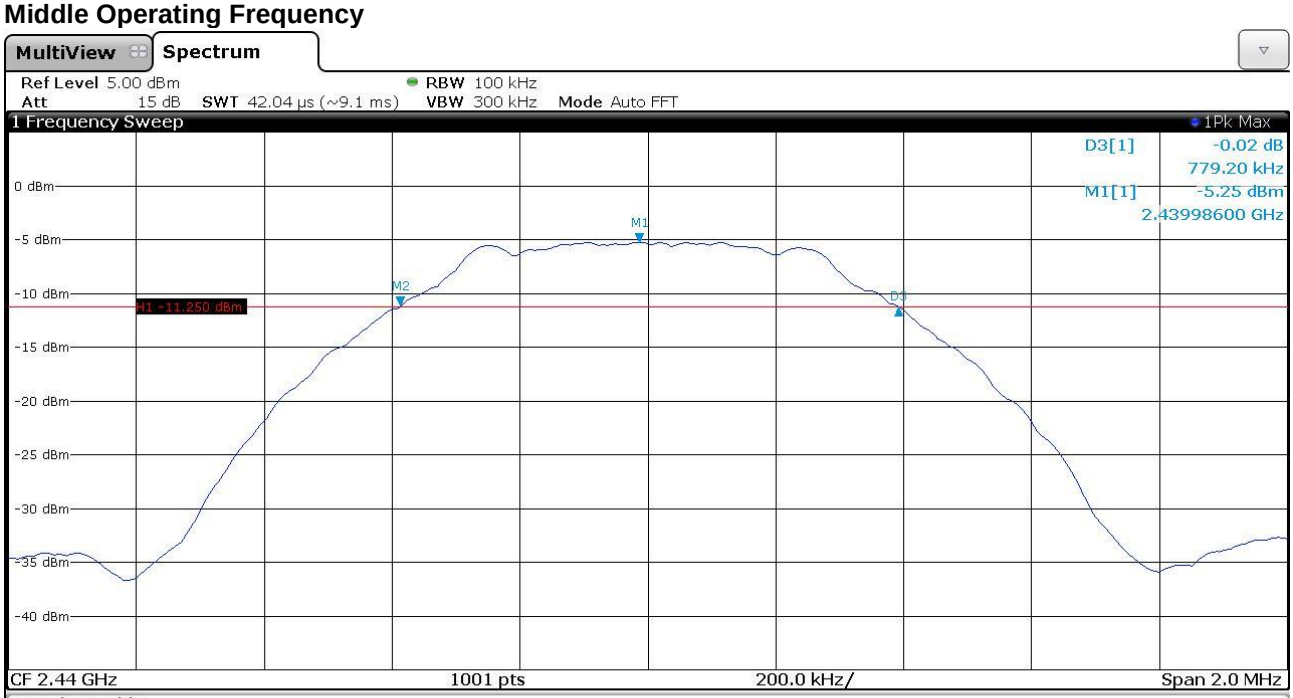


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.4020839 GHz**	**-5.17 dBm**		
M2		1	**2.4016124 GHz**	**-11.15 dBm**		
D3	M2	1	**775.2 kHz**	**-0.02 dB**		

Channel	Frequency [MHz]	6 dB Bandwidth [kHz]	Limit [kHz]	Result
37	2402	775.2	500	Pass

Middle Operating Frequency

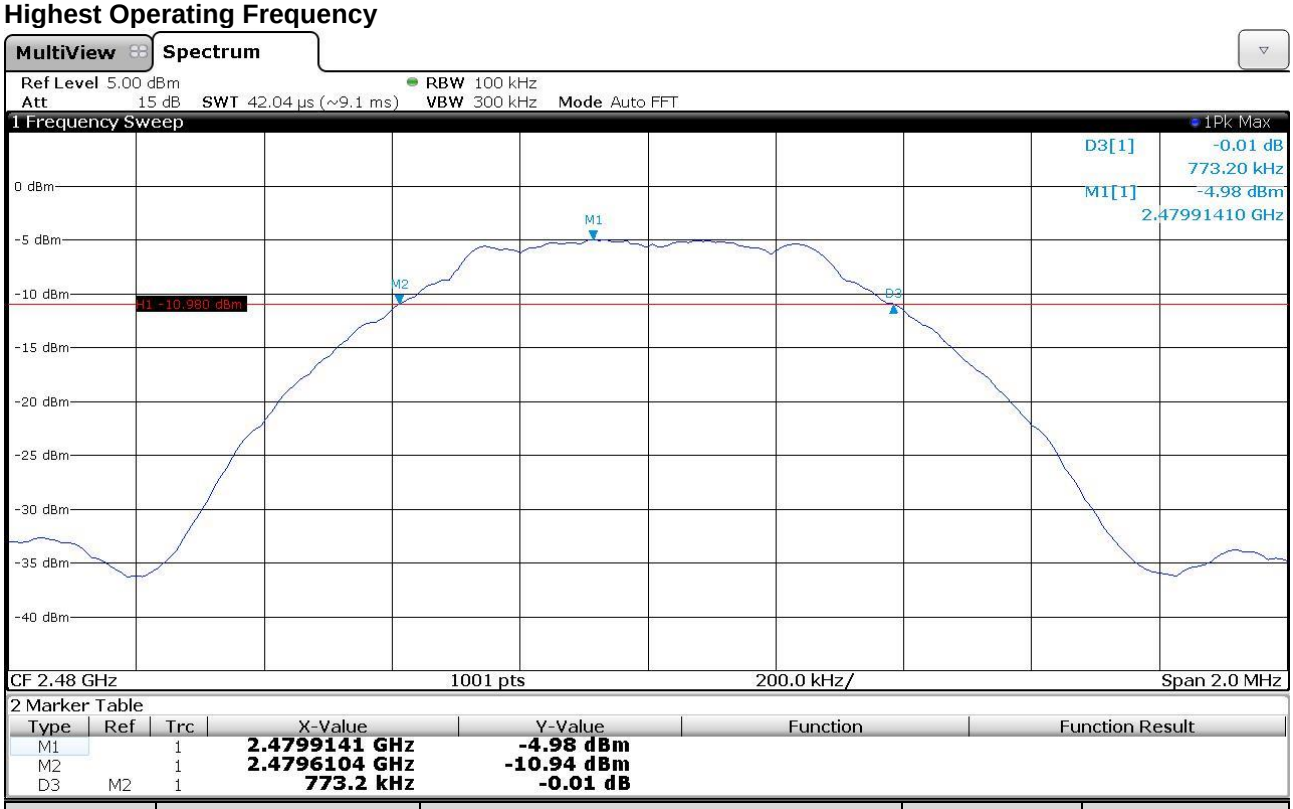


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.439986 GHz**	**-5.25 dBm**		
M2		1	**2.4396124 GHz**	**-11.20 dBm**		
D3	M2	1	**779.2 kHz**	**-0.02 dB**		

Channel	Frequency [MHz]	6 dB Bandwidth [kHz]	Limit [kHz]	Result
17	2440	779.2	500	Pass

Highest Operating Frequency



Channel	Frequency [MHz]	6 dB Bandwidth [kHz]	Limit [kHz]	Result
39	2480	773.2	500	Pass

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **6 dB Bandwidth**.

7.2. Output Power of Fundamental Emissions
Maximum Peak Output Power

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 (b) (3)

Limits for Peak Output Power of Fundamental (EIRP)

The maximum peak conducted output power of the intentional radiator shall not exceeded: 1 Watt
As an alternative to the maximum peak conducted output power the (average) output power is measured to show compliance to the limit

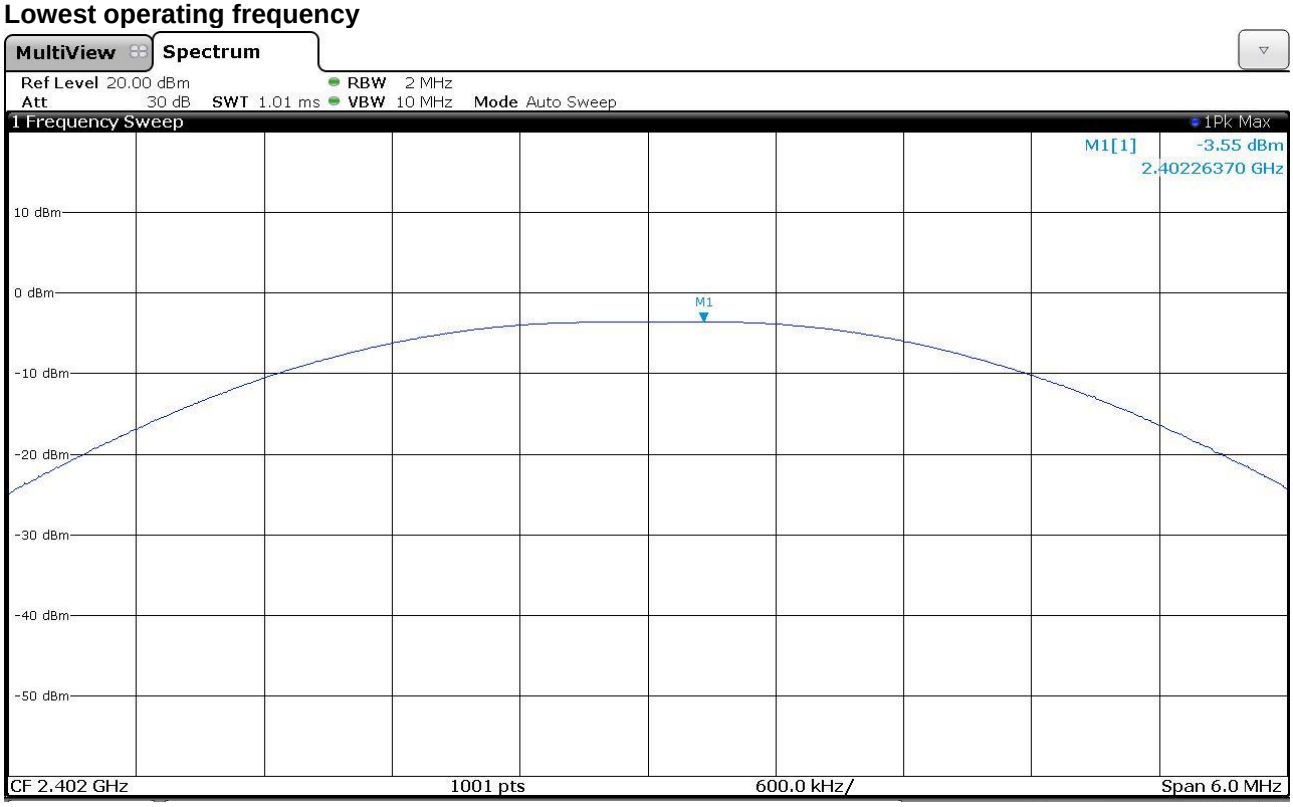
Test equipment and test set up
Test equipment used for conducted measurements as given in clause Test equipment of this report.
Test setup used for conducted measurements as given in clause Test setups of this report.

Description
For the conducted measurement, the RF output of the EUT was connected to the Analyzer.
All the attenuation or cable loss will be added to the measured maximum output power.
The results are recorded in Watt.

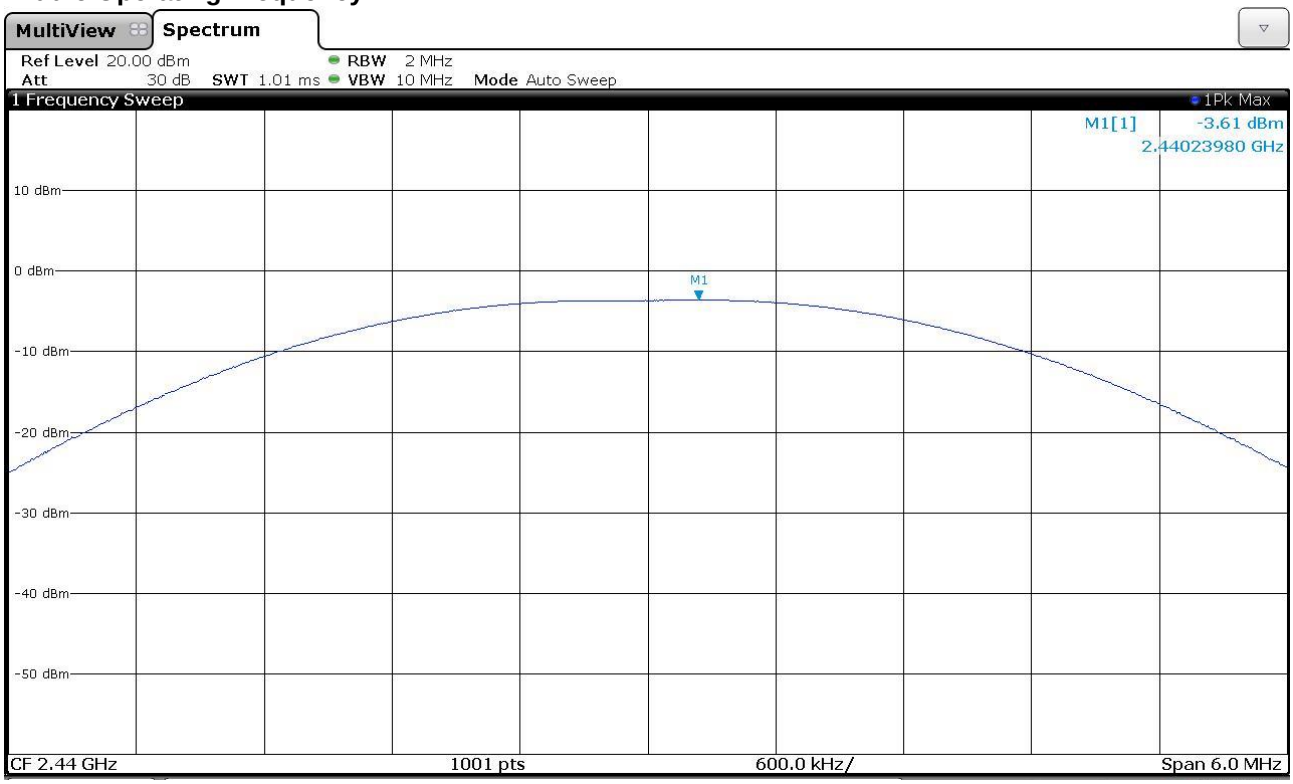
Measurement

The Measurement was performed on: 10.07.2020

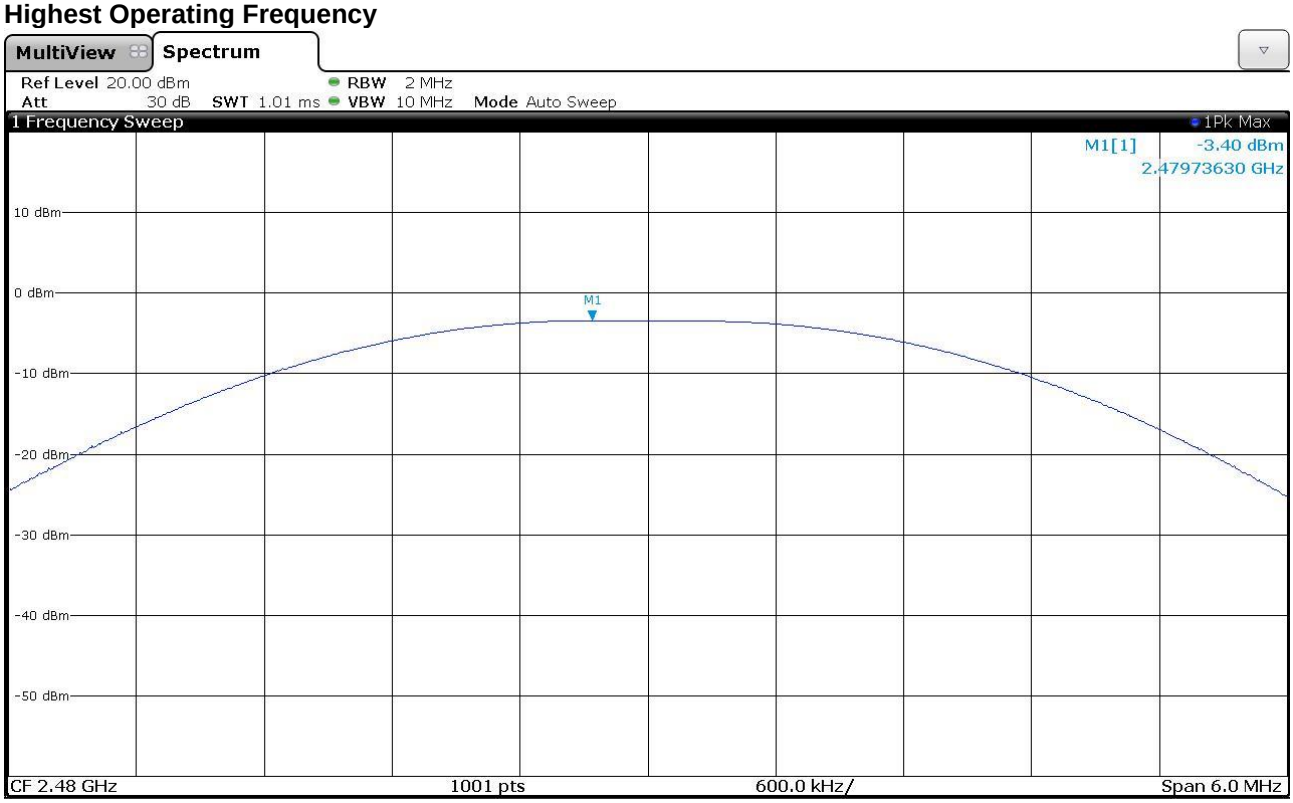
Lowest operating frequency



Middle Operating Frequency



Highest Operating Frequency



Maximum output power conducted measurement - GFSK								
Channel	Frequency [MHz]	Reading of Analyzer [dBm]	Cable Loss [dB]	Output Power		Limit		Result
				[dBm]	[mW]	[dBm]	[mW]	
37	2402	-3.55	1.3	-2.25	0.60	30	1000	Pass
17	2440	-3.61	1.3	-2.31	0.59	30	1000	Pass
39	2480	-3.40	1.3	-2.10	0.62	30	1000	Pass

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements of **Output Power of Fundamental Emissions**.

7.3. Power Spectral Density

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 (e)

Limit
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

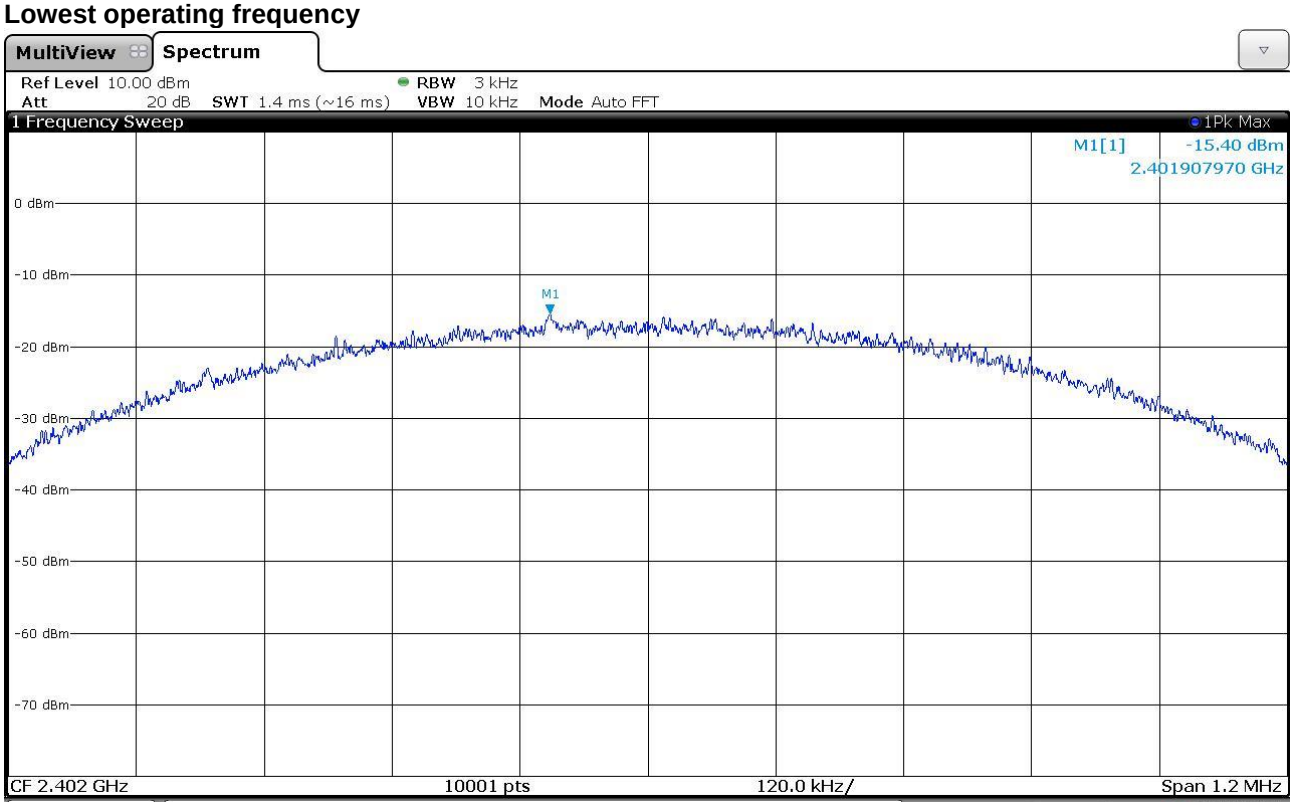
Test equipment and test set up
Test equipment used for conducted measurements as given in clause Test equipment of this report.
Test setup used for conducted measurements as given in clause Test setups of this report.

Description
The maximum peak conducted output power was used to determine compliance to the fundamental output power limit. So the maximum peak conducted PSD level is measured with a peak detector.

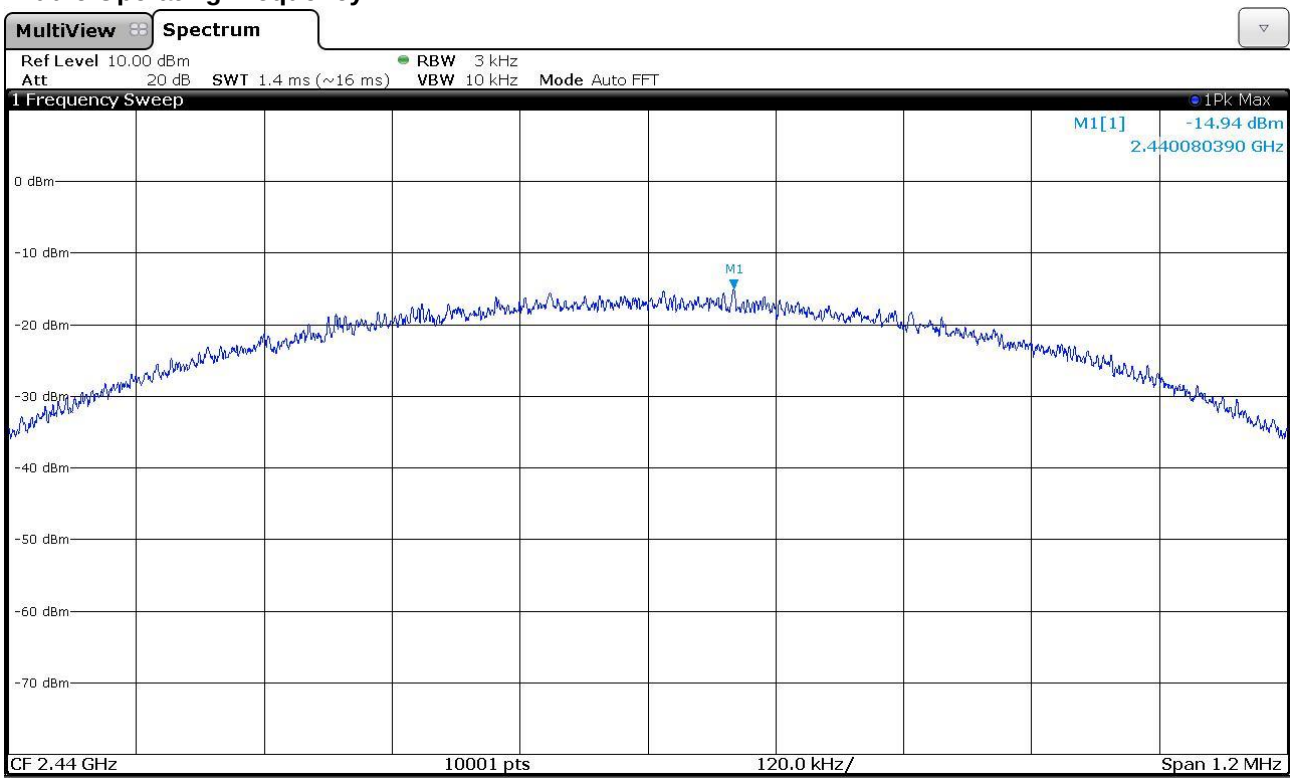
Measurement

The Measurement was performed on: 10.07.2020

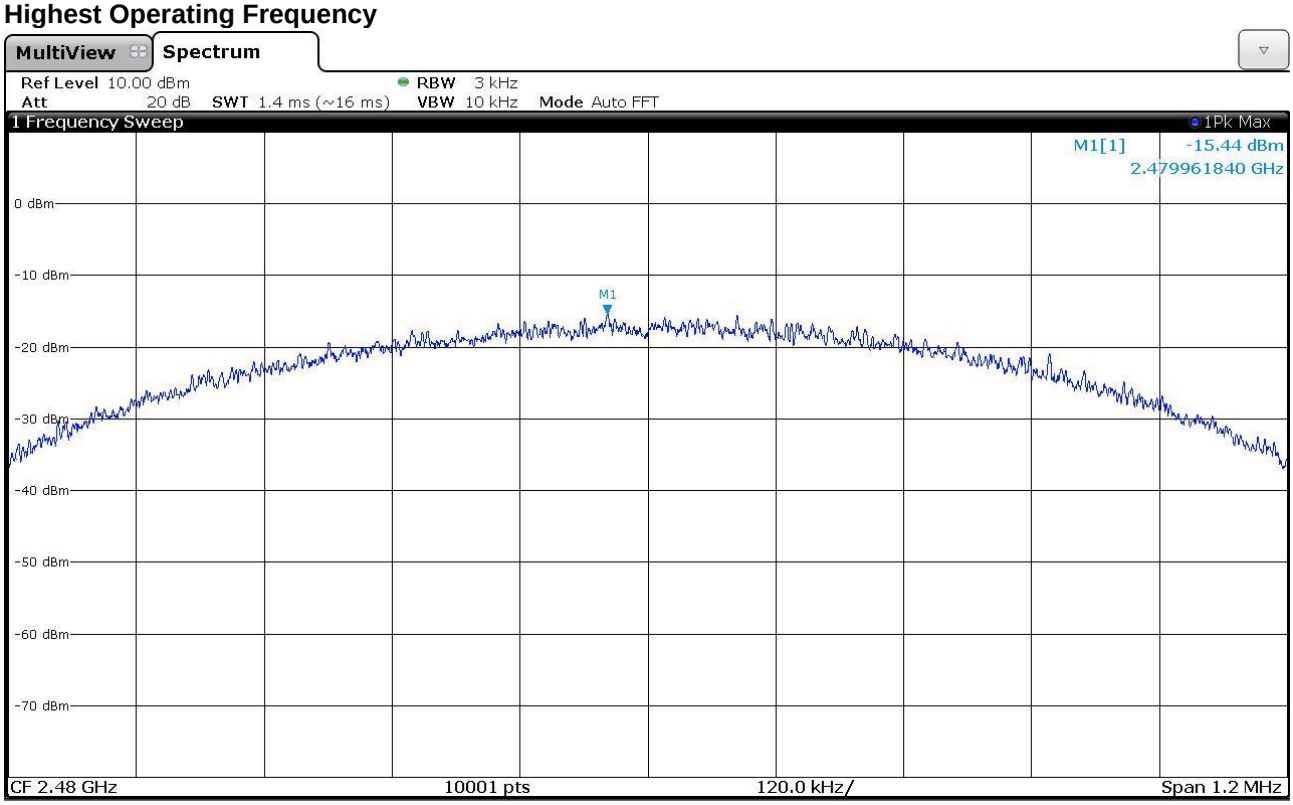
Lowest operating frequency



Middle Operating Frequency



Highest Operating Frequency



Maximum power spectral density						
Channel	**Frequency [MHz]**	**Reading of Analyzer [dBm / 3 kHz]**	**Cable Loss [dB]**	**Power Spectral Density [dBm / 3 kHz]**	**Limit [dBm / 3 kHz]**	**Result**
37	**2402**	**-15.40**	**1.3**	**-14.10**	**8**	**Pass**
17	**2440**	**-14.94**	**1.3**	**-13.64**	**8**	**Pass**
39	**2480**	**-15.44**	**1.3**	**-14.14**	**8**	**Pass**

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Power Spectral Density** measurements.

7.4. Band-Edges Measurement

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 (d)

Limit
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Attenuation below the general limits specified in § 15.209 and RSS-Gen Table 5 is not required. Emissions which fall in the restricted bands, as defined in §15.205 Restricted Bands of operation as well as in restricted bands of the RSS-Gen Issue 5 (see Section 8.10 Restricted Frequency Bands) and must also comply with the radiated emission limits specified in §15.209 Radiated emission limits as well as the limits specified in RSS-Gen Table 5.

Test equipment and test set up
Test equipment used for Band Edge measurements as given in clause Test equipment of this report.
Test setup used for Band Edge measurements as given in clause Test setups of this report.

Description
For restricted Bands:
The Emission must comply with the radiated emission limits. Measured with Average and Peak detector.

For non restricted Bands:
The band edge is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The measurements are initially carried out according to the requirements for restricted bands, as these requirements are more stringent. If the limit value is exceeded in a non-restricted band according to the restricted band specifications, the measurement is repeated again with requirments for non restricted bands in order to prove the conformity.

Note: It was not necessary to carry out a re-test for non restricted band requirments for the tested EUT.

Detector function selection and bandwidth
For the measurement, an EMI test receiver that have CISPR peak detector as well as average detector were used.

Band Edge for restriced Band

Frequency range:	**Bandwidth**	
See measurement graph	RBW:	1 MHz
	VBW:	3 MHz

Band Edge for non resticted Band

Frequency range:	**Bandwidth**	
See measurement graph	RBW:	100 kHz
	VBW:	300 kHz

Measurement

The Measurement was performed on: 09.07.2020

Lower Band Edge – radiated

TESTED IN GERMANY

FCC 3

Band edge emission

according to

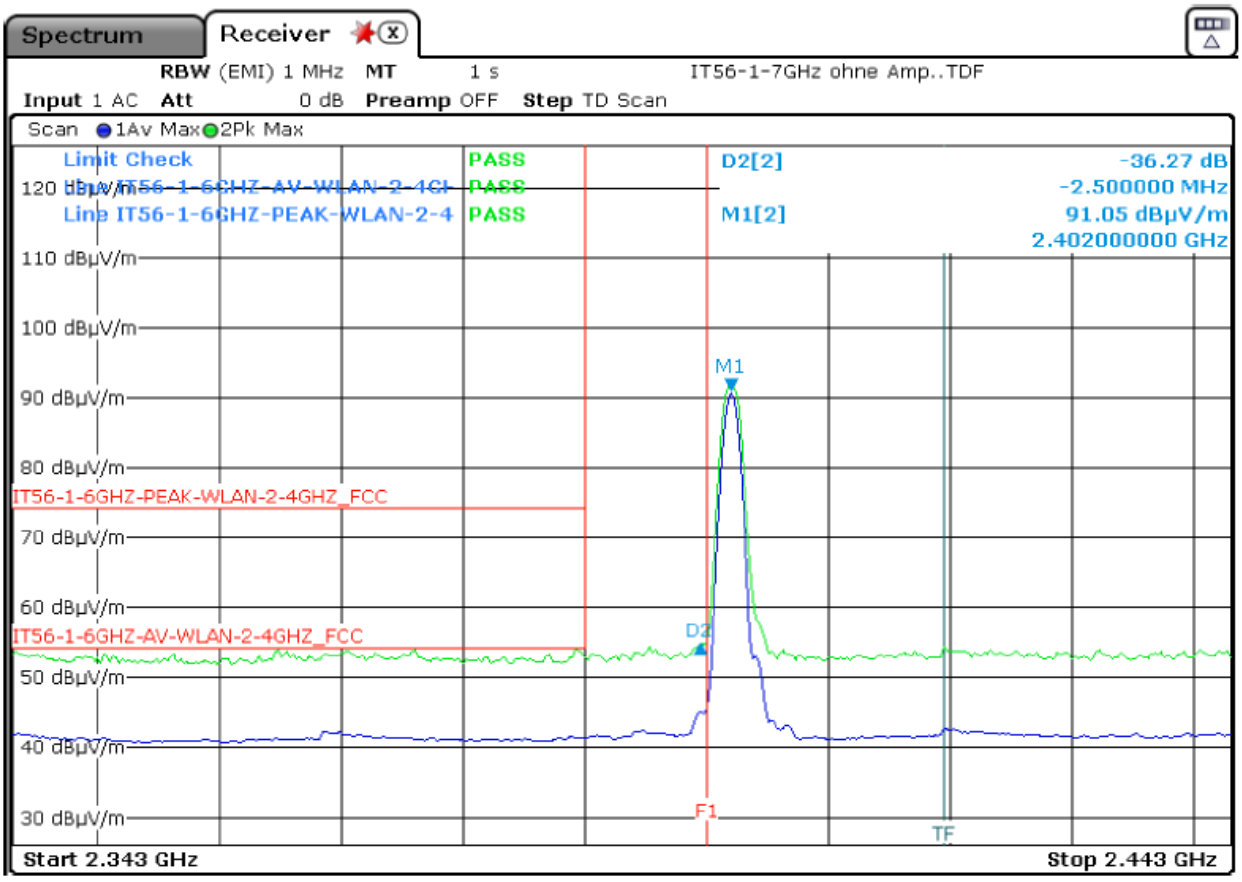
FCC §15.247, FCC §15.209

STC

Ref.-No.:	20/07-0012
Product:	Meter
Sample:	03
Date:	09.07.2020
Operator:	BI
Remarks:	Sample position: Z

Result: pass ☒ fail ☐

Operation mode: BT; GFSK; CH.0; Low edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
all emissions are 10dB below limit				pass	all emissions are 10dB below limit				pass

TESTED IN GERMANY

FCC 3

Band edge emission

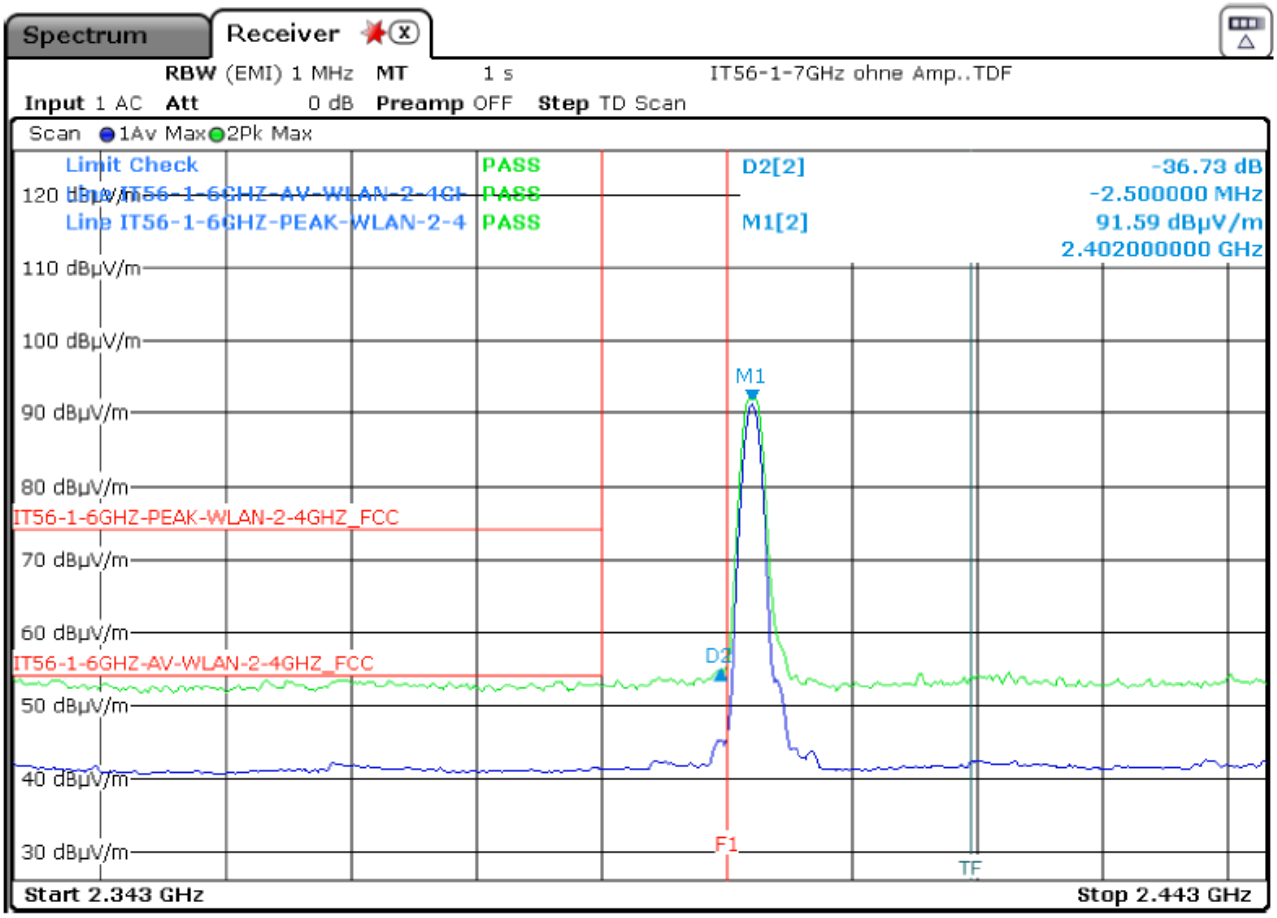
according to

FCC §15.247, FCC §15.209

STC

Ref.-No.: 20/07-0012

Operation mode: BT; GFSK; CH.0; Low edge



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
all emissions are 10dB below limit				pass	all emissions are 10dB below limit				pass

TESTED IN GERMANY

FCC 3

Band edge emission

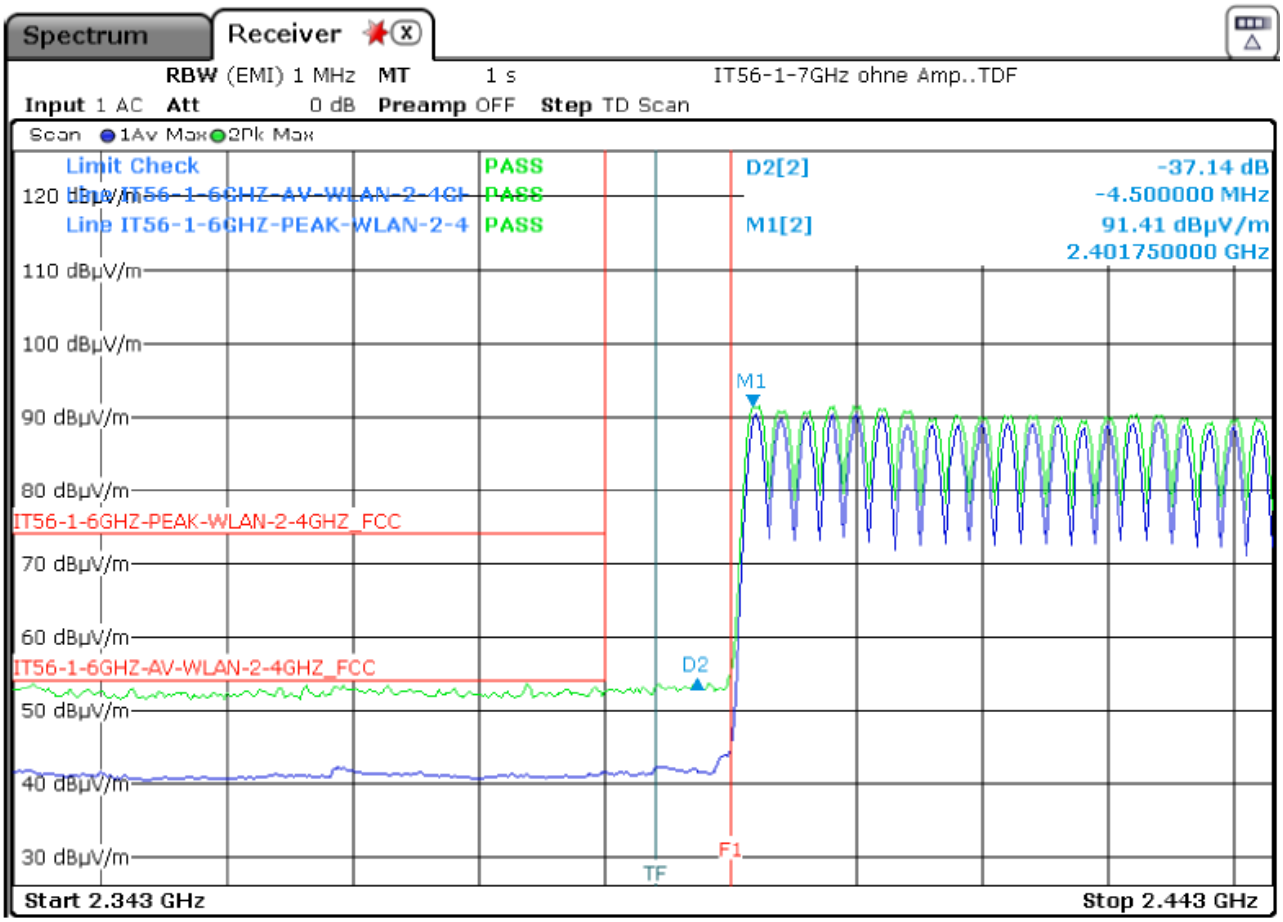
according to

FCC §15.247, FCC §15.209

STC

Ref.-No.: 20/07-0012

Operation mode: BT; GFSK; Hopping; Low edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
all emissions are 10dB below limit				pass	all emissions are 10dB below limit				pass

TESTED IN GERMANY

FCC 3

Band edge emission

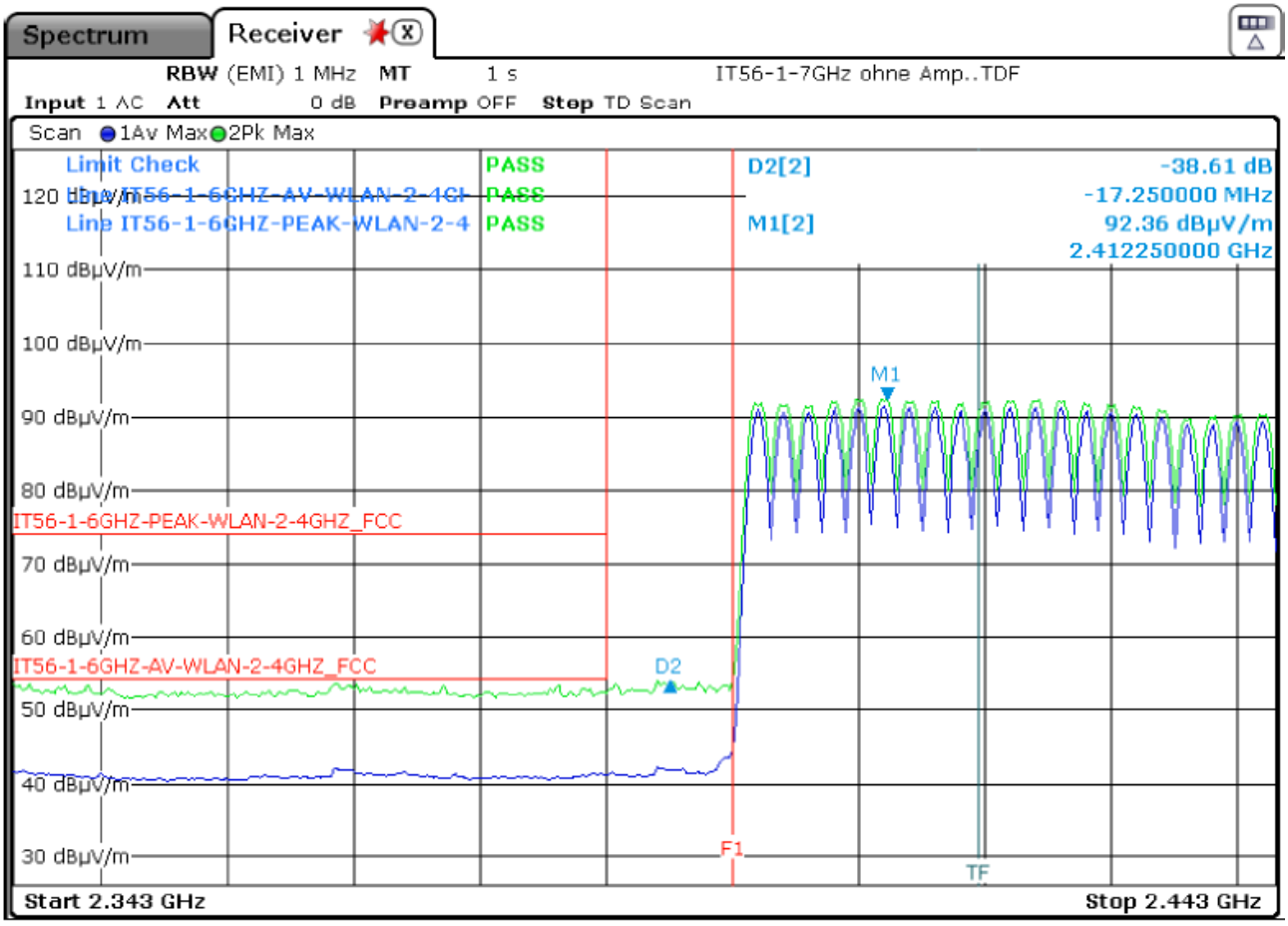
according to

FCC §15.247, FCC §15.209

STC

Ref.-No.: 20/07-0012

Operation mode: BT; GFSK; Hopping; Low edge



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
all emissions are 10dB below limit				pass	all emissions are 10dB below limit				pass

Higher Band Edge – radiated

TESTED IN GERMANY

FCC 3

Band edge emission

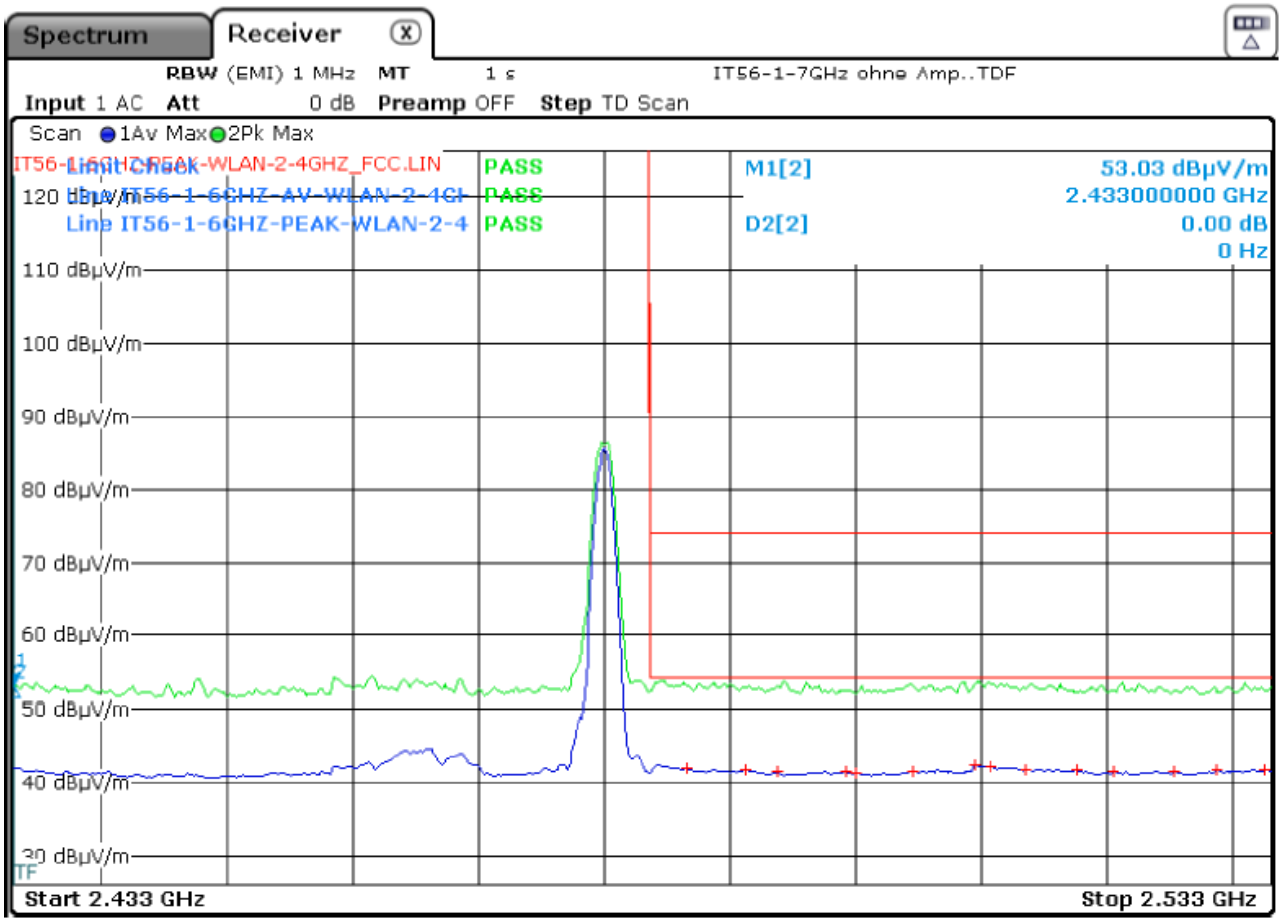
according to

FCC §15.247, FCC §15.209

STC

Ref.-No.: 20/07-0012

Operation mode: BT; GFSK; CH.39; High edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,5095	42,29	-11,71	54,00	pass	all emissions are 10dB below limit				pass
2,5108	42,14	-11,86	54,00	pass					
2,4865	41,82	-12,18	54,00	pass					
2,4913	41,74	-12,26	54,00	pass					
2,5135	41,73	-12,27	54,00	pass					
2,5325	41,70	-12,30	54,00	pass					

FCC 3

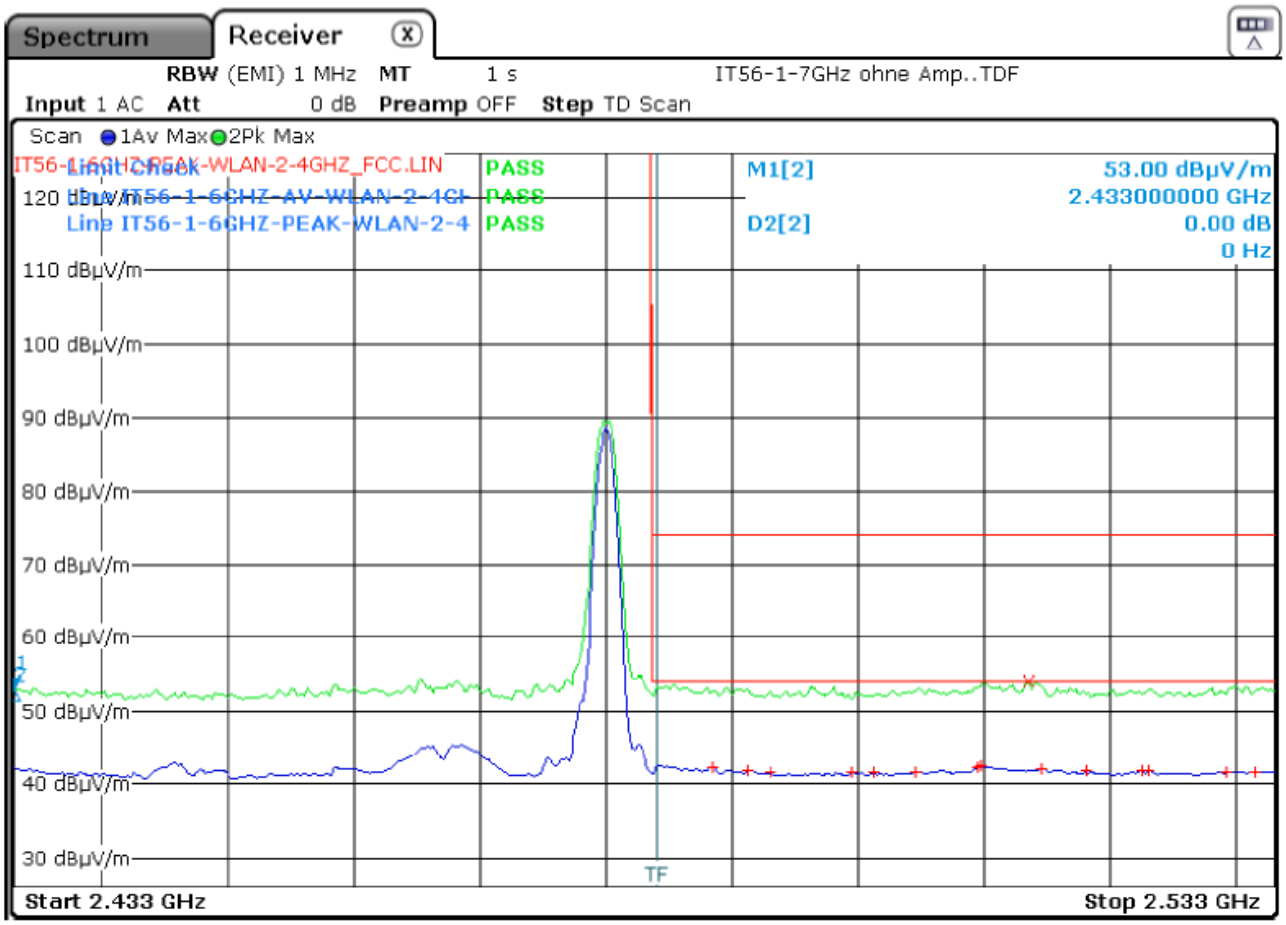
Band edge emission

according to

FCC §15.247, FCC §15.209

Ref.-No.: 20/07-0012

Operation mode: BT; GFSK; CH.39; High edge



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,5098	42,21	-11,79	54,00	pass	2,5135	54,12	-19,88	74,00	pass
2,4885	42,15	-11,85	54,00	pass					
2,5095	42,15	-11,85	54,00	pass					
2,5145	41,94	-12,06	54,00	pass					
2,4913	41,69	-12,31	54,00	pass					
2,5230	41,65	-12,35	54,00	pass					

TESTED IN GERMANY

FCC 3

Band edge emission

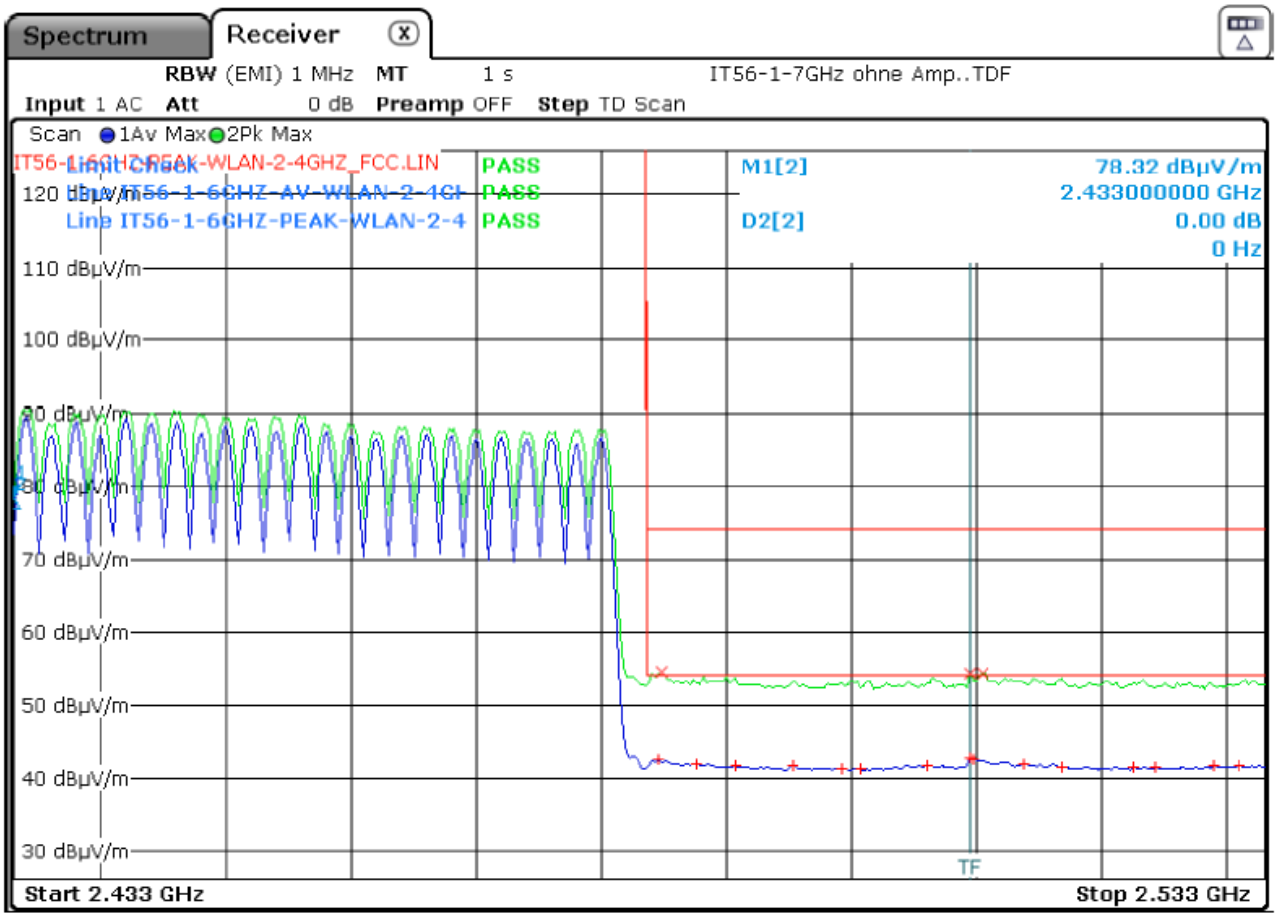
according to

FCC §15.247, FCC §15.209

STC

Ref.-No.: 20/07-0012

Operation mode: BT; GFSK; Hopping; High edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,5095	42,70	-11,30	54,00	pass	2,4848	54,38	-19,62	74,00	pass
2,5098	42,49	-11,51	54,00	pass	2,5105	54,27	-19,73	74,00	pass
2,4845	42,47	-11,53	54,00	pass	2,5095	54,18	-19,82	74,00	pass
2,4875	41,96	-12,04	54,00	pass					
2,5138	41,94	-12,06	54,00	pass					
2,5060	41,70	-12,30	54,00	pass					

TESTED IN GERMANY

FCC 3

Band edge emission

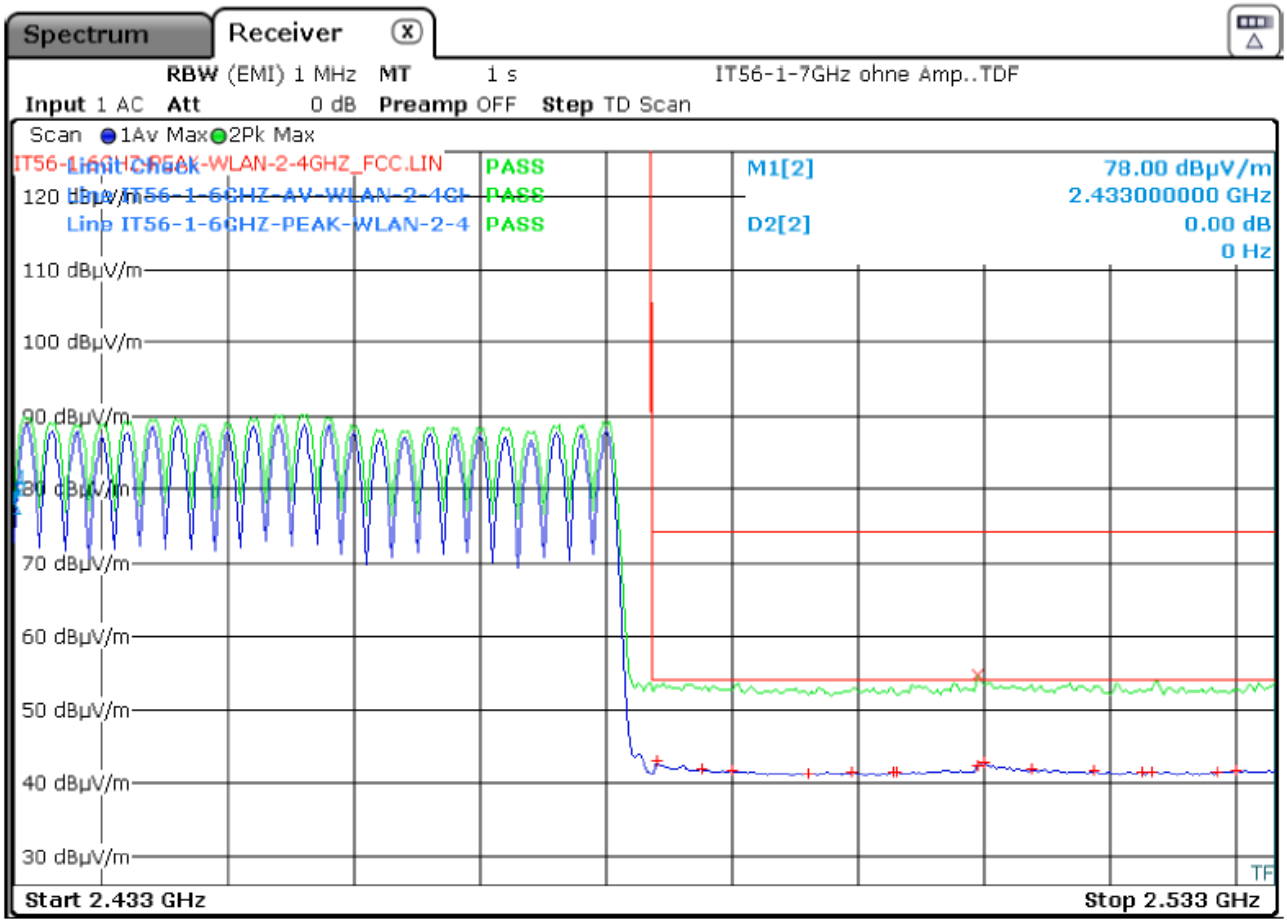
according to

FCC §15.247, FCC §15.209

STC

Ref.-No.: 20/07-0012

Operation mode: BT; GFSK; Hopping; High edge



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4840	42,86	-11,14	54,00	pass	2,5095	54,68	-19,32	74,00	pass
2,5100	42,68	-11,32	54,00	pass					
2,5095	42,23	-11,77	54,00	pass					
2,4875	41,83	-12,17	54,00	pass					
2,5138	41,81	-12,19	54,00	pass					
2,5300	41,71	-12,29	54,00	pass					

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Band Edges Emission**.

8. Test equipment

Test equipment used for Conducted Mains emissions:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
Test-Receiver	Rohde & Schwarz	ESHS30	10571	842053/008	2019 – Mar.	3 years
Software	PKM	PKM U5/6	-/-	V1.01.03	-/-	-/-
Line impedance stabilisation network (LISN)	Rohde & Schwarz	ESH2-Z5	10139	879675/028	2019 – Jan.	3 years
Shielded room	Siemens	(6,2 x 4,7 x 3,3) m (l x w x h) DC – 10 GHz	10113	1	-/-	-/-

Test equipment used for radiated Measurements:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
Signal Spectrum Analyzer 2Hz – 26.5 GHz	Rohde & Schwarz	FSW 26 Instrument FW 2.60	11571	102047	2019-Jan.	3 years
ESR7 EMI Testreceiver 7GHz	Rohde & Schwarz	ESR7	11676	101694	2018-March	3 years
Test-Receiver	Rohde & Schwarz	ESVS30	10572	833825/010	2020-April	3 years
Antenna 9 kHz – 30 MHz	EMCO	6502	10546	2018	2017-Nov.	3 years
Antenna 30 MHz – 1 GHz	Chase	CBL6111C	10022	1064	2019-Dec.	3 years
Antenna 1GHz – 18 GHz	Electro Metric	RGA50/60	10273	2753	2017-Nov.	3 years
Broadband-Hornantenne 15 - 26,5 (40) GHz	Schwarzbeck	BBHA 9170	11580	BBHA9170621	2019-Dec.	3 years
Broadband-Preamplifier 1 - 18 GHz	Schwarzbeck	BBV9718	11231	9718-002	2017-Okt.	3 years
Preamplifier 18 - 40 GHz	CERNEX	CBM18403523	11679	29711	2019 - July	3 years
Cable	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2017-Dec.	3 years
Shielded room/Chamber	Frankonia	SAC3 "SEMI-ANECHOIC-CHAMBER"	11609	004/16	2019-March	3 years

Test equipment used for Band Edge Measurements:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
ESR7 EMI Testreceiver 7GHz	Rohde & Schwarz	ESR7	11676	101694	2018-March	3 years
Antenna 1GHz – 18 GHz	Electro Metric	RGA50/60	10273	2753	2017-Nov.	3 years
Cable	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2017-Dec.	3 years
Shielded room/Chamber	Frankonia	SAC3 "SEMI-ANECHOIC-CHAMBER"	11609	004/16	2019-March	3 years

Test equipment used for conducted measurements:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
Signal Spectrum Analyzer 2Hz – 26.5 GHz	Rohde & Schwarz	FSW 26 Instrument FW 2.60	11571	102047	2019 - Jan.	3 years
EMI-Test-Receiver	Rohde & Schwarz	ESR7 Instrument FW 3.36	11505	101103	2017 - Nov.	3 years
Automatisation unit RF switch and power meter	Rohde & Schwarz	OSP120 and OSP B157	11573	101282	2017 - Dec.	3 years
Cable	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2017 - Dec.	3 years

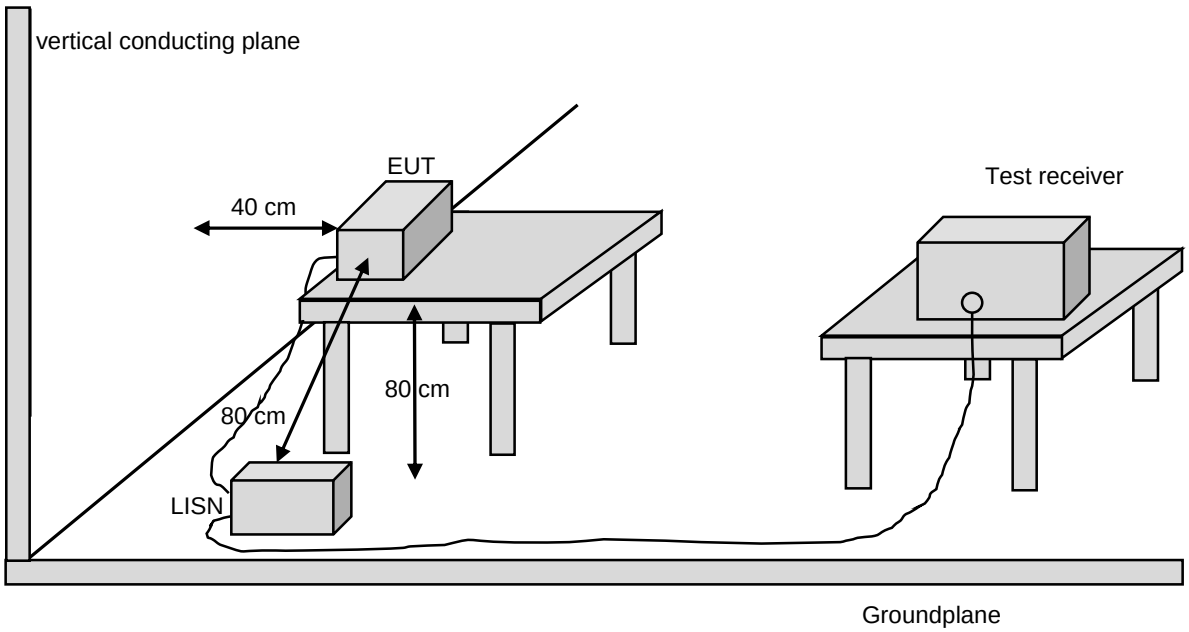
All measurements were made with measuring instruments, including any accessories that may affect test results, calibrated according to the requests of ISO/IEC 17025 according to which the test site is accredited from DAkkS. Measurement of conducted mains emissions was made with instruments conforming to American National Standard Specification, ANSI C63.4-2014.

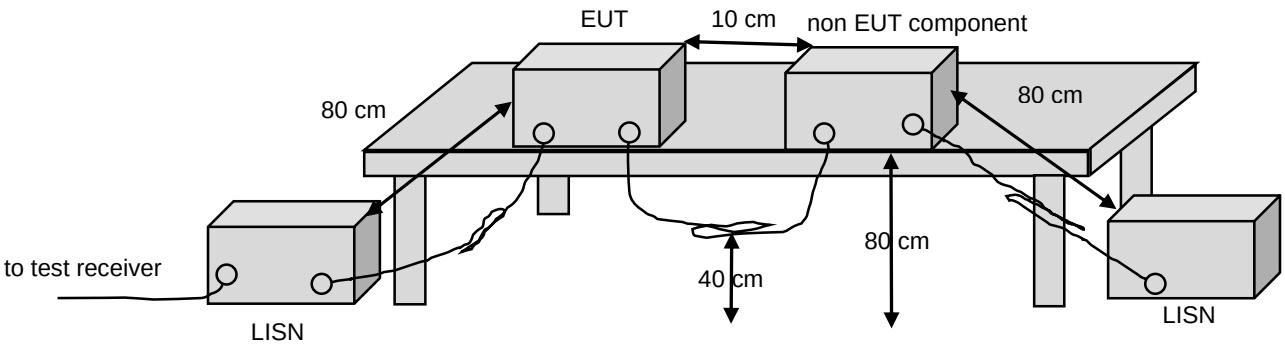
Test equipment to support EUT functions:

Kind of equipment	Manufacturer	Type	Ident no.
Laptop	FUJITSU	Inspiron	11702
AC-Adaptor [Laptop]	FUJITSU	ADP-80NB A	Part of 11702
Software	Provided by EKF (Client)	Btool	-/-
Smartphone	HTC	HTC One_M8	-/-

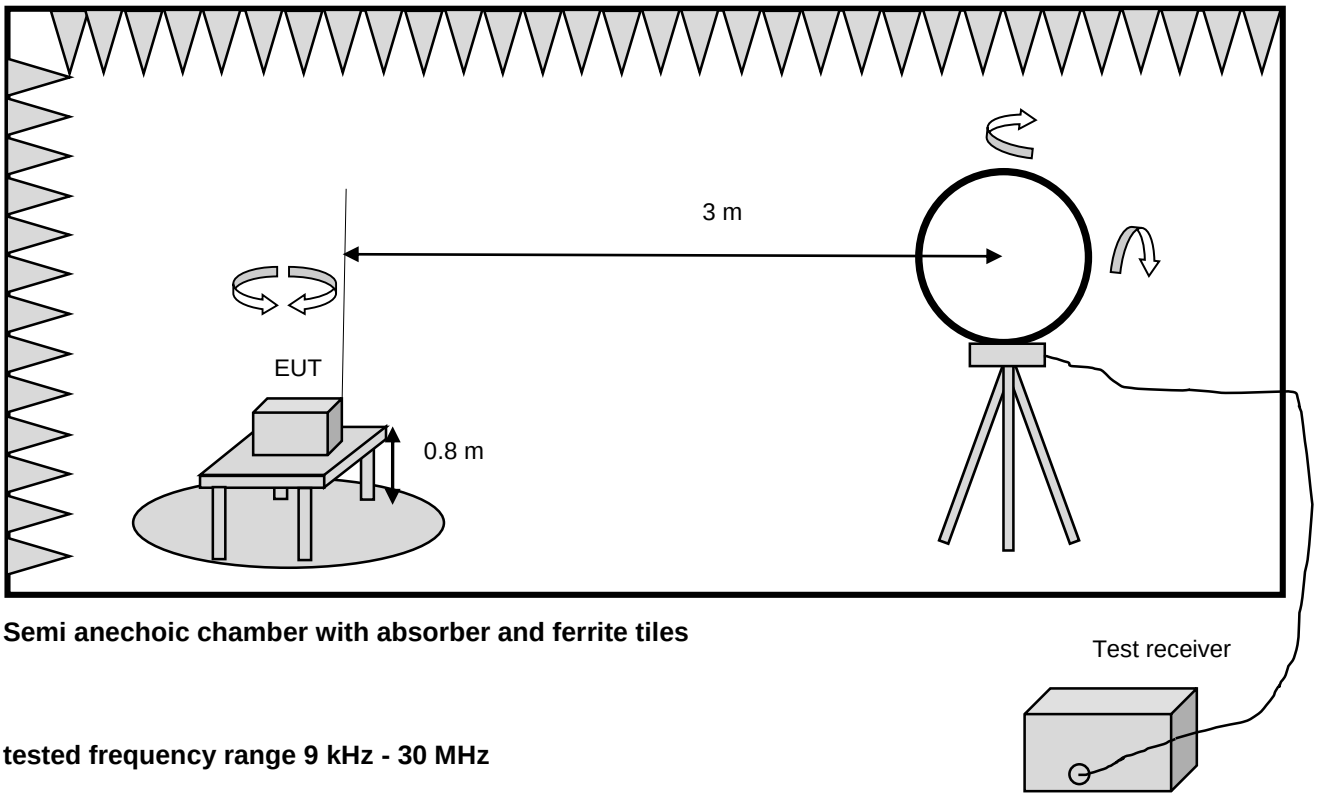
9. Test Setups

Block diagram Conducted Mains emissions



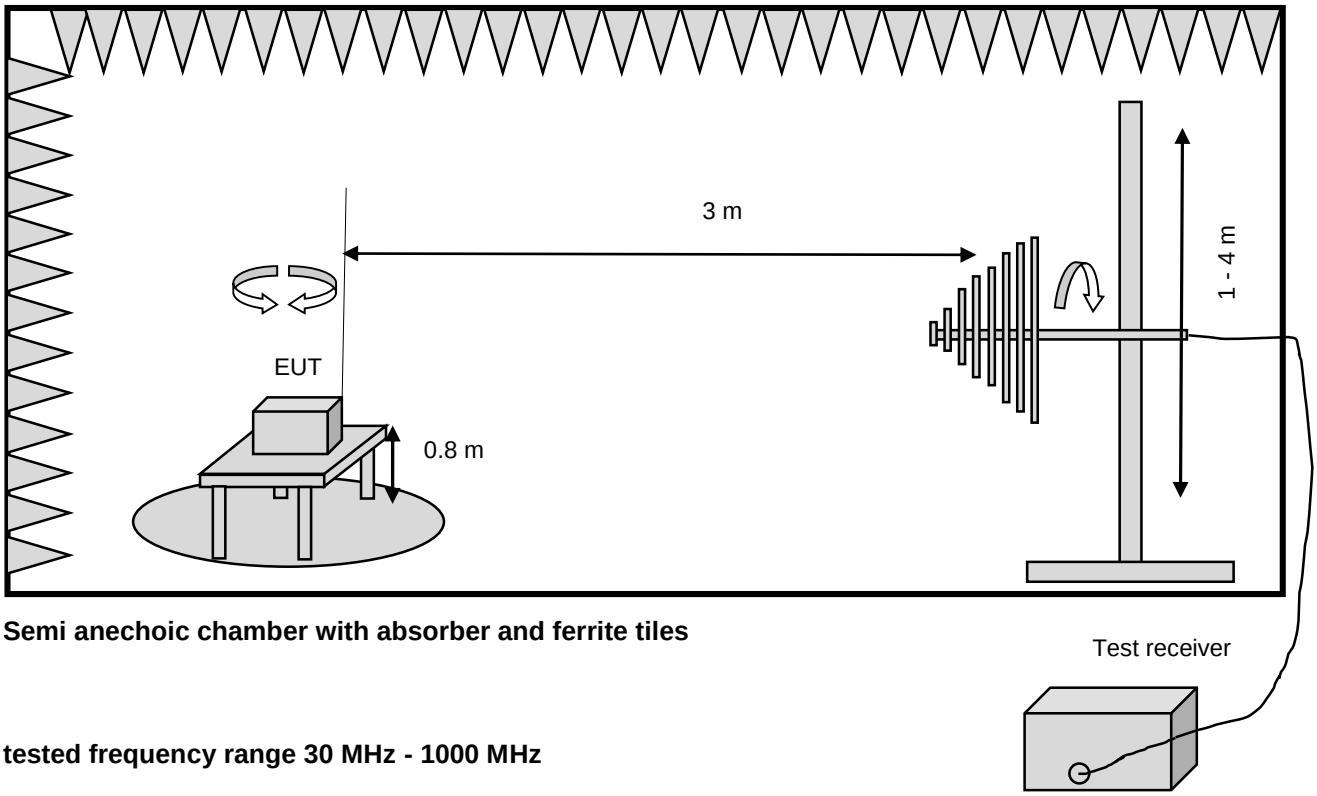


Block diagram Radiated emissions



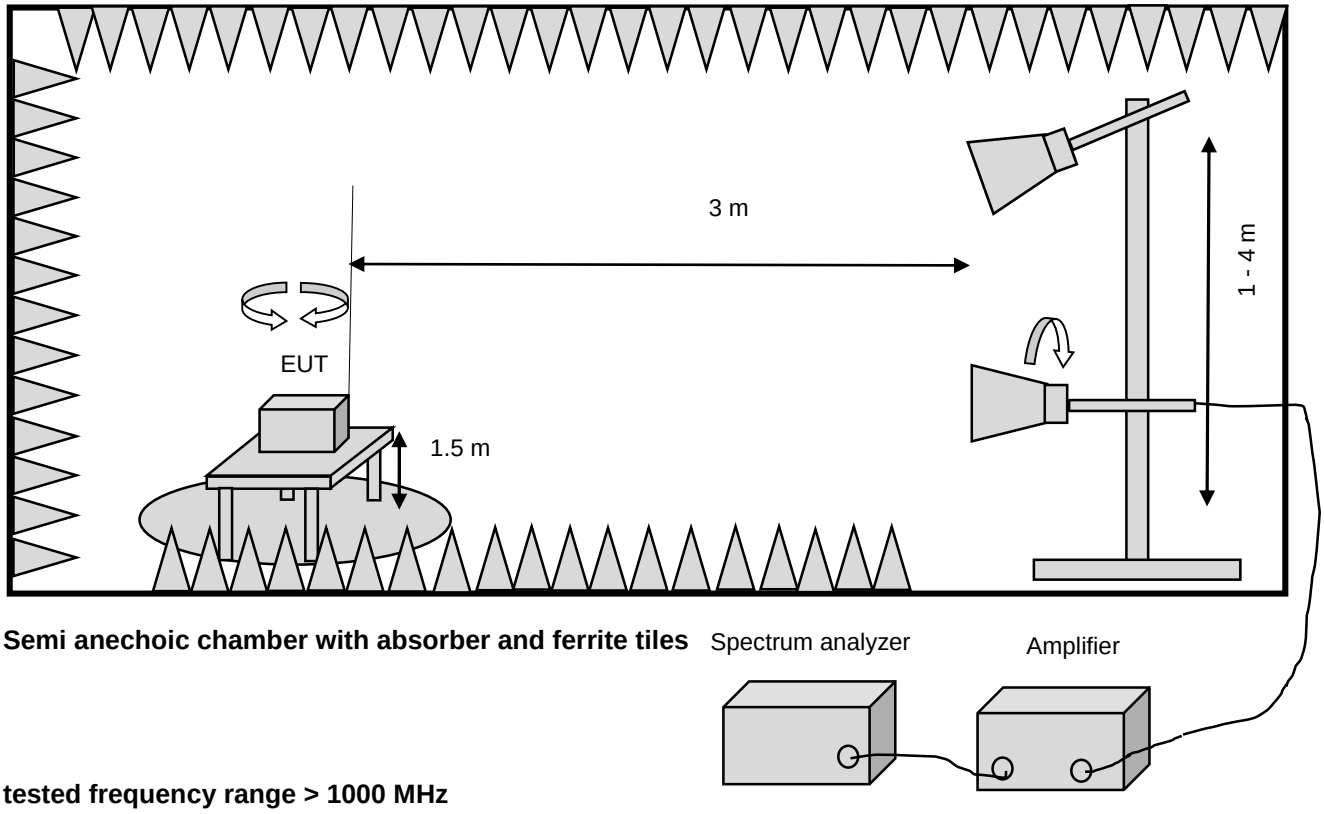
Semi anechoic chamber with absorber and ferrite tiles

tested frequency range 9 kHz - 30 MHz



Semi anechoic chamber with absorber and ferrite tiles

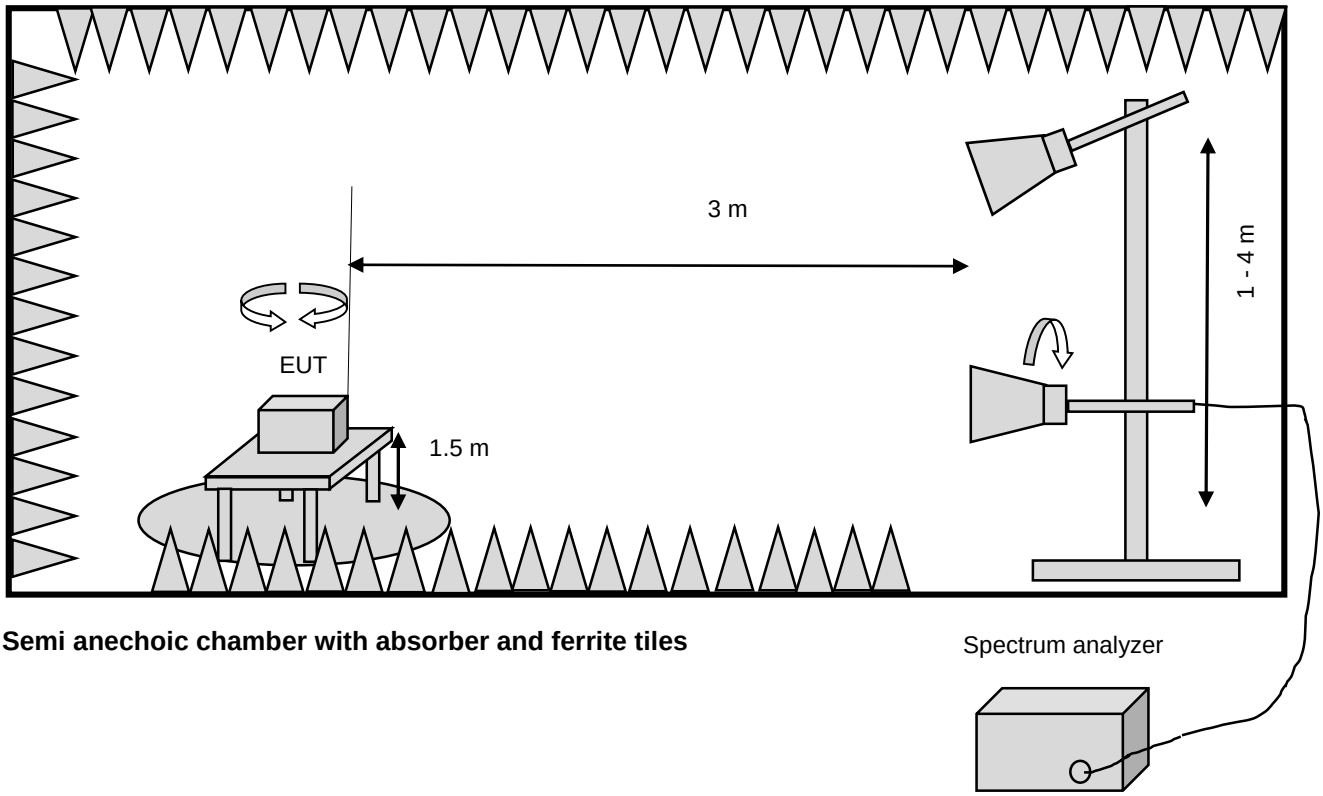
tested frequency range 30 MHz - 1000 MHz



Semi anechoic chamber with absorber and ferrite tiles

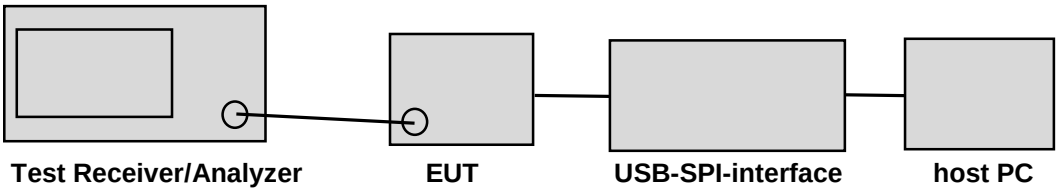
tested frequency range > 1000 MHz

Block diagram Band Edge emissions



Semi anechoic chamber with absorber and ferrite tiles

Block diagram for conducted measurements



10. Measurement uncertainty

according to *CISPR 16-4-2 Edition 2.0 2011-06*

Measurement	**calculated uncertainty U_{lab}**	**Specified CISPR uncertainty according CISPR 16-4-2 Edition 2.0 2011-06, table 1 U_{CISPR}**
Conducted disturbance at mains port using AMN 9 kHz – 150 kHz	3.6 dB	3.8 dB
Conducted disturbance at mains port using AMN 150 kHz – 30 MHz	3.2 dB	3.4 dB
Magn. fieldstrength 9kHz - 30MHz	3.4 dB	-/-
Radiated disturbance (electric field strength in the SAC) 30 MHz to 1 000 MHz	4.7 dB	6.3 dB
Radiated disturbance (electric field strength in the SAC) 1 GHz to 26.5 GHz	4.1 dB	-/-

Measurement	**calculated uncertainty U_{lab}**	**Maximum measurement uncertainty**
Channel Bandwidth	±1.17 %	±5 %
RF output power, conducted	±1.36 dB	±1.5 dB
Power Spectral Density, conducted	±1.99 dB	±3 dB
Unwanted Emissions, conducted	±1.71 dB	±3 dB
All emissions, radiated	±4.8 dB	±6 dB
Temperature	±0.72 °C	±3 °C
Supply voltages	±0.76 % (DC up to 40V) ±1.74 % (AC 50Hz up to 400V)	±3 %
Time	±0.012 %	±5 %

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT in the above mentioned way.

The measurements uncertainty was calculated in accordance with CISPR 16-4-2 Edition 2.0 2011-06.

The measurement uncertainty was given with a confidence of 95 % (k = 2).

11. Photos setup

Refer to “0012-fcc-photos test setup.pdf” file

12. Conclusions

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the relevant §15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

Following specific modifications and/or special attributes are necessary to pass the above mentioned requirements:

none

28.01.2021	M. Beindl, Laboratory Engineer	
Erstellt am/*prepared on*	**(Name/***name* / **Stellung/***position***)**	**(Unterschrift/***signature***)**
28.01.2021	K. Simon, Deputy Head of Laboratory	
Freigabe am/released *on*	**(Name/***name* / **Stellung/***position***)**	**(Unterschrift/***signature***)**

13. Photos of tested sample

Refer to “0012-fcc-ext-photos.pdf” file

End of test report