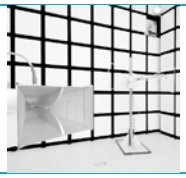
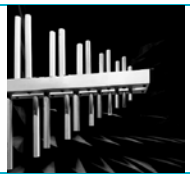
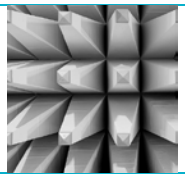

CTC advanced
member of RWTÜV group

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-04

TEST REPORT

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-05

Test Report No.: 1-9102/19-01-07

Testing Laboratory

CTC advanced GmbH
Untertürkheimer Straße 6 – 10
66117 Saarbrücken/Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Test Laboratory:
The testing laboratory (FCC part 15 D) is accredited according to DIN EN ISO/IEC 17025 (2018) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-04 / -05

Applicant

Yamaha Corporation
10-1 Nakazawa-cho Naka-ku
430-8650 Hamamatsu
Japan

Contact: /
e-mail: /
Phone: /

Manufacturer

RTX A/S
Stroemmen 6
9400, Noerresundby
Denmark

Test Standard/s

FCC Part 15, subpart D: 2016	Isochronous UPCS Device 1920 – 1930 MHz
Industry Canada RSS-213, Issue 3: 2015	2 GHz Licence-exempt Personal Communication Service Devices (LE-PCS)

Test Item

Kind of product:	**Wireless microphone system, Microphone unit**
Product name:	**RM-WOM, RM-WDR, RM-WGS, RM-WGL**
HVIN:	**RM-WOM, RM-WDR, RM-WGS, RM-WGL**
PMN:	**RM-WOM, RM-WDR, RM-WGS, RM-WGL**
FVIN:	**-/-**
HMN:	**-/-**
FCC ID:	**A6RRMWMIC**
IC:	**740B-RMWMIC**
S/N serial number:	Radiated: / Conducted: /
HW hardware status:	V2
SW software status:	V0012
Frequency [MHz]:	1920 -1930
Type of Modulation:	π/2-DBPSK, π/4-DQPSK
Number of channels:	5 RF Channels, 5x12 = 60 TDMA Duplex Channels
Antenna:	Two integrated antennas
Power Supply:	Li-Ion battery, 3.6 V DC
Temperature Range:	-20°C to 50°C

Test Report authorised:

cn=Marco Lenjoint, o=CTC advanced GmbH, ou=LEJ-200505, email=marco.lenjoint@ctcadvanced.com, c=DE
2021.01.14 11:42:06 +01'00'

2020-09-17 Lenjoint, Marco
Lab Manager RCE

Test performed:

cn=Joachim Wolf, o=CTC advanced GmbH, ou=WOL-170322, email=Joachim.Wolf@ctcadvanced.com, c=DE
2021.01.14 11:36:27 +01'00'

2020-09-17 Wolf, Joachim
Head of Department EPNS

1 Table of contents

1 Table of contents 2
2 General information 3
2.1 Notes and disclaimer 3
2.2 Application details 3
3 Test standard/s: 3
4 Test Environment 4
5 Summary of Measurement Results 5
6 Test Set-up 6
6.1 Frequency Measurements 6
6.2 Timing Measurements 6
6.3 Conducted Emission Test 6
6.4 Radiated Emission Test 7
6.5 Power Line Conducted Emissions Test 9
6.6 Monitoring Tests 10
6.7 Radiated Output Power Test 10
7 Detailed Test Results 11
7.1 Power Line Conducted Emissions 11
7.2 Digital Modulation Techniques 14
7.3 Labeling Requirements 14
7.4 Antenna Requirements 15
7.5 Channel Frequencies 15
7.6 Automatic Discontinuation of Transmission 16
7.7 Peak Power Output 17
7.8 Emission Bandwidth B 22
7.9 Power Spectral Density 27
7.10 In-Band Unwanted Emissions, Conducted 34
7.11 Out-of-Band Emissions, Conducted 39
7.12 Carrier Frequency Stability 43
7.13 Frame Repetition Stability 47
7.14 Frame Period and Jitter 47
7.15 Monitoring Threshold, Least Interfered Channel 49
7.16 Threshold Monitoring Bandwidth 51
7.17 Reaction Time and Monitoring Interval 52
7.18 Time and Spectrum Window Access Procedure 54
7.19 Acknowledgments and Transmission duration 55
7.20 Dual Access Criteria Check 57
7.21 Alternative monitoring interval 58
7.22 Spurious Emissions (Radiated) 58
7.23 Receiver Spurious Emissions 61
8 Test equipment and ancillaries used for tests 64
9 Observations 65
Annex A: Photographs of the Test Set-up 65
Annex B: External Photographs of the EUT 65
Annex C: Internal Photographs of the EUT 65
Annex D: Document History 66
Annex E: Further Information 67
Annex F: Accreditation Certificate 68

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report is electronically signed and valid without handwriting signature. For verification of the electronical signatures, the public keys can be requested at the testing laboratory.

RM-WOM was used for testing. As declared by the customer, the three variants (RM-WDR, RM-WGS and RM-WGL) use the same PCB, but with minor population differences. The reduced user interface on the RM-WDR, RM-WGS and RM-WGL variants means, that some parts are not mounted, e.g. colour LED's and capacitive touch points.

The gooseneck variants are identical except for the difference in gooseneck length.

These hardware differences have no impact on the radio performance of the different microphones.

2.2 Application details

Date of receipt of order:	2020-07-07
Date of receipt of test item:	2020-08-31
Start of test:	2020-09-03
End of test:	2020-09-17
Person(s) present during the test:	

3 Test standard/s:

Test Standard	Version	Test Standard Description
FCC Part 15, subpart D	2016-06	Isochronous UPCS Device 1920 – 1930 MHz

Industry Canada RSS-213, Issue 3	2015-03	2 GHz Licence-exempt Personal Communication Service Devices (LE-PCS)
ANSI C63.17	2013-08	American National Standard for Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communication Services (UPCS) Devices
ANSI C63.4	2014-06	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

4 Test Environment

Temperature:	+ 22 °C during room temperature tests + 50 °C during high temperature test - 20 °C during low temperature test
Relative humidity content:	38 %
Air pressure:	not relevant for this kind of testing

5 Summary of Measurement Results

☒	**No deviations from the technical specifications were ascertained**
☐	There were deviations from the technical specifications ascertained

CFR 47 Part 15 UPCS

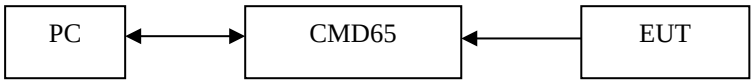
Name of test	FCC CFR 47 Paragraph	IC RSS-213 Paragraph	Verdict
Digital Modulation Techniques	15.319(b)	6.1	Complies
Labeling requirements	15.19(a)(3)	RSS-GEN 5.2	Complies
Antenna requirements	15.317, 15.203	4.1(e)	Complies
Power Line Conducted Emission	15.107(a), 15.207(a)	5.4 RSS_GEN 7.2 RSS_GEN 8.8	Complies
Emission Bandwidth	15.323(a)	6.4	Complies
In-band Emission	15.323(d)	6.7.2	Complies
Out-of-band Emissions	15.323(d)	6.7.1	Complies
Peak Transmit Power	15.319(c)(e), 15.31(e)	6.5	Complies
Power Spectral Density	15.319(d)	4.3.2.1	Complies
Automatic discontinuation of transmission	15.319(f)	4.3.4(a)	Complies
Carrier frequency stability	15.323(f)	6.2	Complies
Frame repetition stability	15.323(e)	4.3.4(c)	Complies
Frame period and jitter	15.323(e)	4.3.4(c)	Complies
Monitoring threshold, Least interfered channel	15.323(c)(2);(5);(9)	4.3.4(b)	Complies
Monitoring of intended transmit window and maximum reaction time	15.323(c)(1)	4.3.4	Complies
Threshold monitoring bandwidth	15.323(c)(7)	4.3.4	N/A
Reaction time and monitoring interval	15.323(c)(1);(5);(7)	4.3.4	Complies
Access criteria test interval	15.323(c)(4);(6)	4.3.4	Complies
Access criteria functional test	15.323(c)(4);(6)	4.3.4	Complies
Acknowledgments	15.323(c)(4)	4.3.4	Complies
Transmission duration	15.323(c)(3)	4.3.4	Complies
Dual access criteria	15.323(c)(10)	4.3.4	Complies
Alternative monitoring interval	15.323(c)(10);(11)	4.3.4	N/A[2]
Spurious Emissions (Antenna Conducted)	15.323(d)	6.7.1	Complies[3]
Spurious Emissions (Radiated)	15.319(g), 15.109(a), 15,209(a)	4.3.3 RSS-GEN 7.2.3	Complies[4]
Receiver Spurious Emissions	N/A	6.8	Complies

[1] Only applicable for EUT that can initiate a communication link
[2] The client declares that the tested equipment does not implement this provision
[3] The tested equipment has integrated antennas only
[4] Only requirement FCC 15.109 for unintentional radiators was tested radiated

6 Test Set-up

6.1 Frequency Measurements

Test Set-up 1:

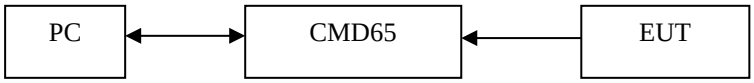


This setup is used for measuring Carrier Frequency Stability at nominal and extreme temperatures.

For long term Frequency Stability, the EUT was in loopback-mode and was controlled with the CMD65, the modulation pattern was set to 01010101….

6.2 Timing Measurements

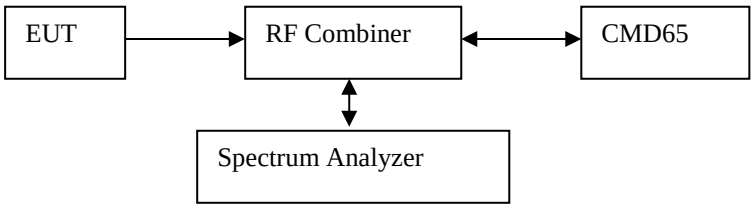
Test Set-up 2:



This setup is used for measuring Frame Repetition Stability, Frame Period and Jitter.

6.3 Conducted Emission Test

Test Set-up 3:



This setup is used for all conducted emission tests.

The EUT was in loopback-mode and was controlled with the CMD65, the modulation pattern was set to Pseudo-Random bit sequence to simulate normal speech.

6.4 Radiated Emission Test

30 MHz – 1GHz:

Test Set-up 4:

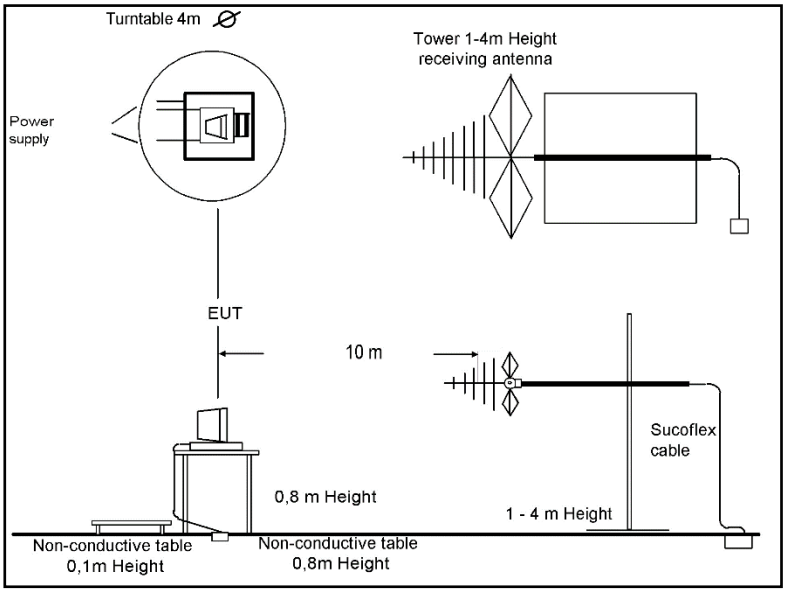
- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a no conducting table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.



1GHz – 10 GHz:

Test Set-up 5:

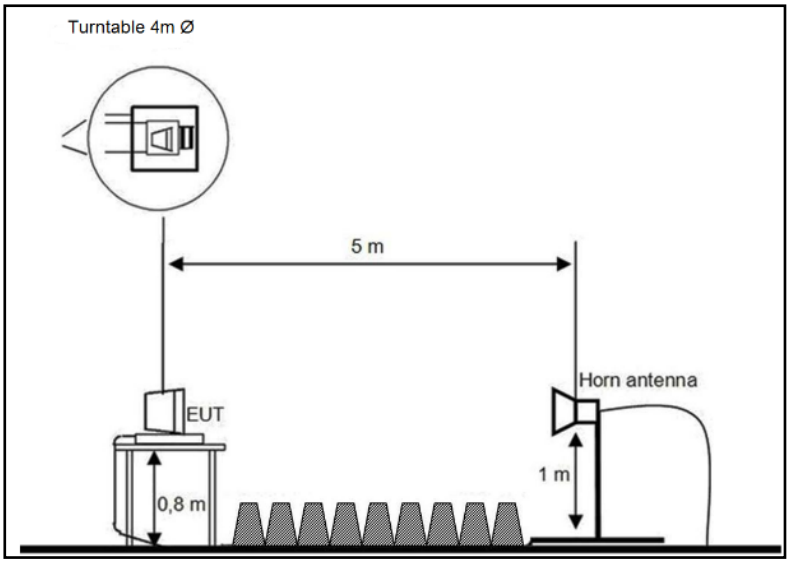
- The Equipment was setup to simulate a typical usage like described in the user manual / or described by manufacturer.
- If the EUT is a tabletop system, a no conducting table with 0,8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is: (see ANSI C 63.4)
  < 18 GHz = 3 m
  18-26 GHz = 1,5 m
  26-40 GHz = 0,75 m
- The EUT was set into operation.

Premeasurement

- The turntable rotates continuous from 0° to 360°
- The antenna is polarized vertical and horizontal.
- In accordance to the antenna beam and the size of the EUT the antenna height changes in 30 cm steps, start at 1 meter. If it is not possible to tilt the emissions will be checked with a manually tilted antenna from top side.
- The analyzer scans quickly to find the maximum emissions of the EUT

Final measurement

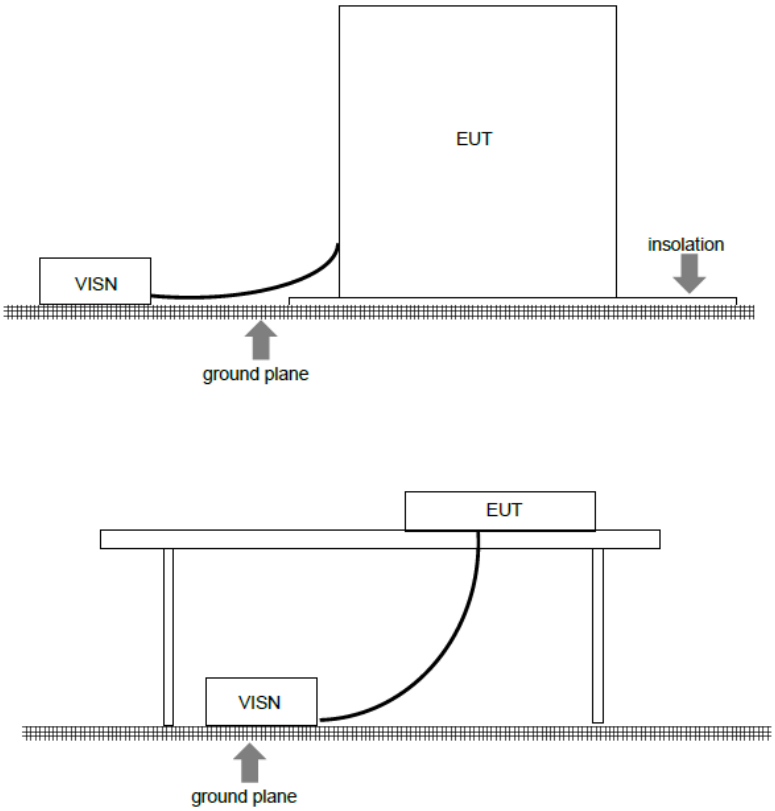
- The final measurement will be performed with minimum the six highest peaks (depends on emissions and number of measured points below 1 GHz)
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.
- The final measurement will be done with AV (Average / see ANSI C 63.4) detector
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit, and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.



6.5 Power Line Conducted Emissions Test

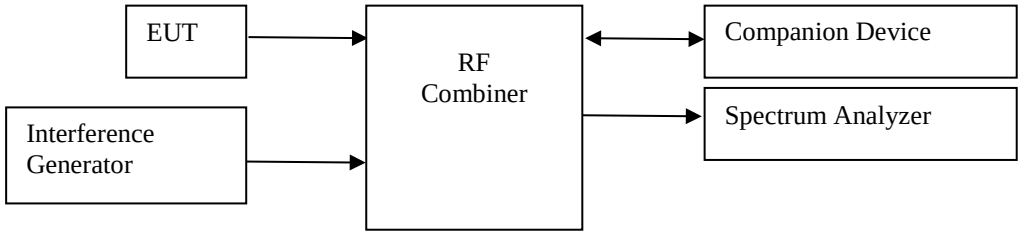
Test Set-up 6:

According to EMC basic standard **ANSI C 63.4**



6.6 Monitoring Tests

Test Set-up 6:

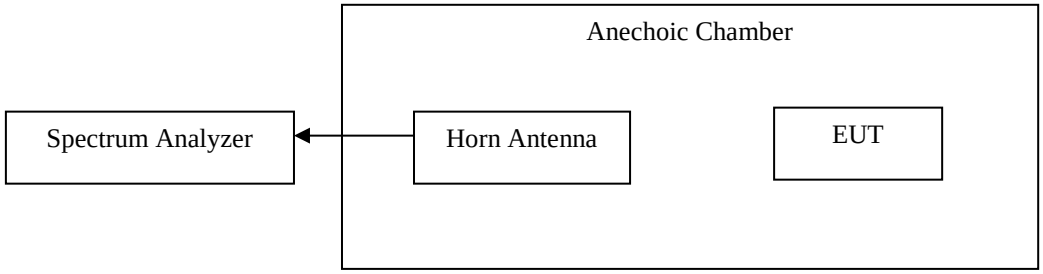


This test setup is used for all Monitoring and Time and Spectrum Access Procedure tests. The path loss from the signal generator to the EUT is measured with a power meter before the testing is started.

A clock signal is used to synchronize the Interference Generator to the start of the DECT frame, this signal always comes from the base station. If the EUT is a DECT Portable Part (i.e. a handset) the clock signal will come from the Companion Device.

6.7 Radiated Output Power Test

Test Set-up 7:



This setup is used for measuring the radiated output power in a fully anechoic chamber with a measurement distance of 1m.

7 Detailed Test Results

7.1 Power Line Conducted Emissions

Measurement Procedure:

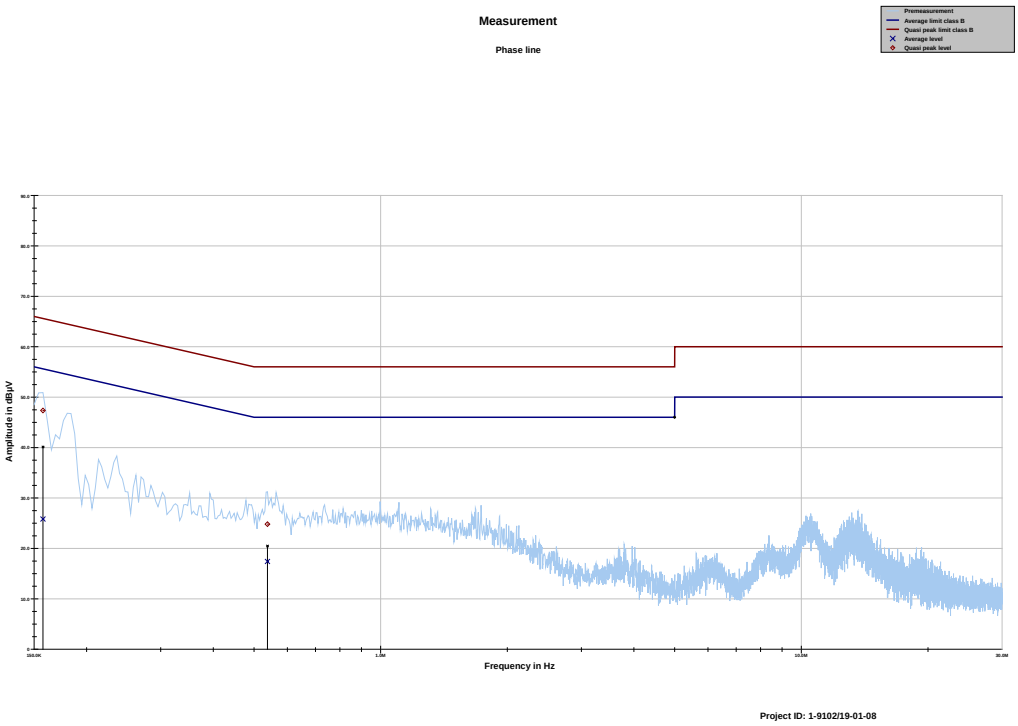
ANSI C63.4-2014 using 50µH/50 ohms LISN.

Test Result: **Pass**

Measurement Data: **See attached plots and tables**

Requirement: FCC 15.107 (a), FCC 15.207 (a)

Phase Line



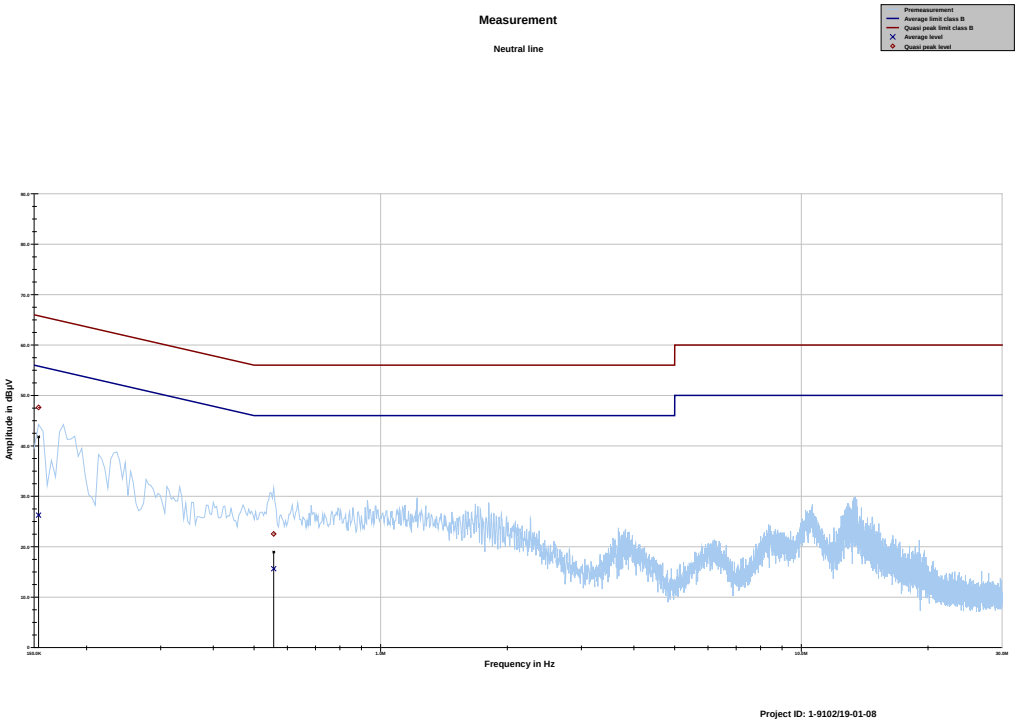
Phase line tbl

Project ID: 1-9102/19-01-08

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.157463	47.35	18.25	65.597	25.82	29.97	55.787
0.538050	24.80	31.20	56.000	17.39	28.61	46.000

Project ID - 1-9102/19-01-08
EUT - RM-WCH-8 + RM-WOM + RM-WDR + RM-WGS + RM-WGL + PA-300C
Serial Number - Z6R000041 + Z6L000132 + Z6M000144 + Z6P000039 + Z6N000069 + JIID03P1SSY
Operating mode - charging 4 microphones

Neutral Line



Neutral line tbl
Project ID: 1-9102/19-01-08

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.153731	47.62	18.18	65.796	26.25	29.64	55.893
0.556706	22.53	33.47	56.000	15.63	30.37	46.000

Project ID - 1-9102/19-01-08
EUT - RM-WCH-8 + RM-WOM + RM-WDR + RM-WGS + RM-WGL + PA-300C
Serial Number - Z6R000041 + Z6L000132 + Z6M000144 + Z6P000039 + Z6N000069 + JIID03P1SSY
Operating mode - charging 4 microphones

7.2 Digital Modulation Techniques

The tested equipment is based on DECT technology, the only difference is that the channel allocation is modified to operate in the 1920-1930 MHz band.

The EUT use Multi Carrier / Time Division Multiple Access / Time division duplex and Digital GFSK modulation.

For further details see the operational description provided by the applicant.

Requirement: FCC 15.319(b)

All transmissions must use only digital modulation techniques.

7.3 Labeling Requirements

See separate documents showing the label design and the placement of the label on the EUT.

Requirement: FCC 15.19

The FCC identifier shall be displayed on the label, and the device(s) shall bear the following statement in a conspicuous location on the device or in the user manual if the device is to small:

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The label itself shall be of a permanent type, not a paper label, and shall last the lifetime of the equipment.

7.4 Antenna Requirements

Does the EUT have detachable antenna(s)? ☐Yes ☒ No

If detachable, is the antenna connector(s) non-standard? ☐Yes ☐ No

The tested equipment has only integral antennas. The conducted tests were performed on a sample with a temporary antenna connector.

Requirements: FCC 15.203, 14.204. 15.317

7.5 Channel Frequencies

UPCS CHANNEL	FREQUENCY (MHz)
Upper Band Edge	1930.000
0 (Highest)	1928.448
1	1926.720
2	1924.992
3	1923.264
4 (Lowest)	1921.536
Lower Band Edge	1920.000

Requirement: FCC 15.301

Within 1920-1930 MHz band for isochronous devices.

7.6 Automatic Discontinuation of Transmission

Does the EUT transmit control and Signaling Information?	☐ **Yes**	☒ **No**
Type of EUT:	☒ **Initiating device**	☐ **Responding device**

The following tests simulate the reaction of the EUT in case of either absence of information to transmit or operational failure after a connection with the companion device is established.

Number	Test	EUT Reaction	Verdict
1	Power removed from EUT	C	**Pass**
2	EUT switched Off	C	**Pass**
3	Hook-On by companion device	N/A	**N/A**
4	Hook-On by EUT	N/A	**N/A**
5	Power removed from companion device	A	**Pass**
6	Companion device switched Off	N/A	**N/A**

A – Connection breakdown, Cease of all transmissions
B – Connection breakdown, EUT transmits control and signaling information
C – Connection breakdown, companion device transmits control and signaling information
N/A – Not applicable (the EUT does not have an on/off switch and can not perform Hook-On)

Requirement: FCC 15.319(f)

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. This provision is not intended to preclude transmission of control and signaling information or use or repetitive code used by certain digital modulation technologies to complete frame or burst intervals.

7.7 Peak Power Output

Measurement Procedure:

ANSI C63.17, clause 6.1.2.

Test Results: Pass

Measurement Data:

Maximum Conducted Output Power

Channel No.	Frequency (MHz)	Maximum Conducted Output Power (dBm) DBPSK	Maximum Radiated Output Power (dBm) DBPSK	Maximum Antenna Gain (dBi) DBPSK
4	1921.536	18.8	19.6	0.8
2	1924.992	18.7	20.1	1.4
0	1928.448	18.6	19.8	1.2

Channel No.	Frequency (MHz)	Maximum Conducted Output Power (dBm) DQPSK
4	1921.536	18.8
2	1924.992	18.7
0	1928.448	18.6

For this test it was also checked that the input voltage variation of 85 and 115% of nominal value did not have any effect on the measured output power, neither radiated nor conducted.

Limit:

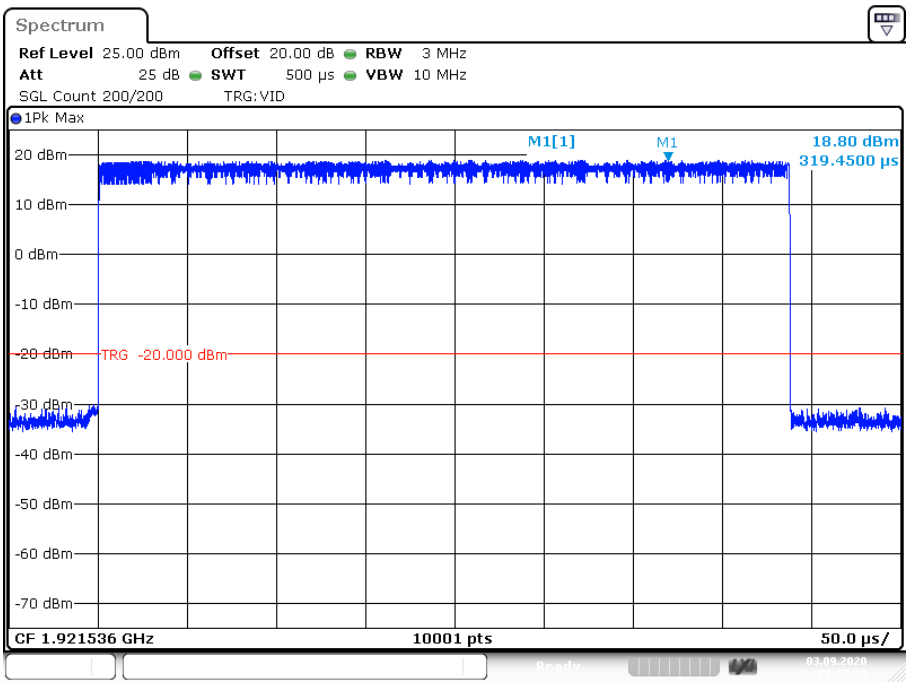
Conducted: 100 µW X SQRT(B) where B is the measured Emission Bandwidth in Hz
FCC 15.319(c)(e): 21.2 dBm (131 mW)
RSS-213, Issue 2: 21.2 dBm (131 mW)
The antenna gain is below 3 dBi.

Requirements: FCC 15.319(c)(e). RSS-213, Issue 2

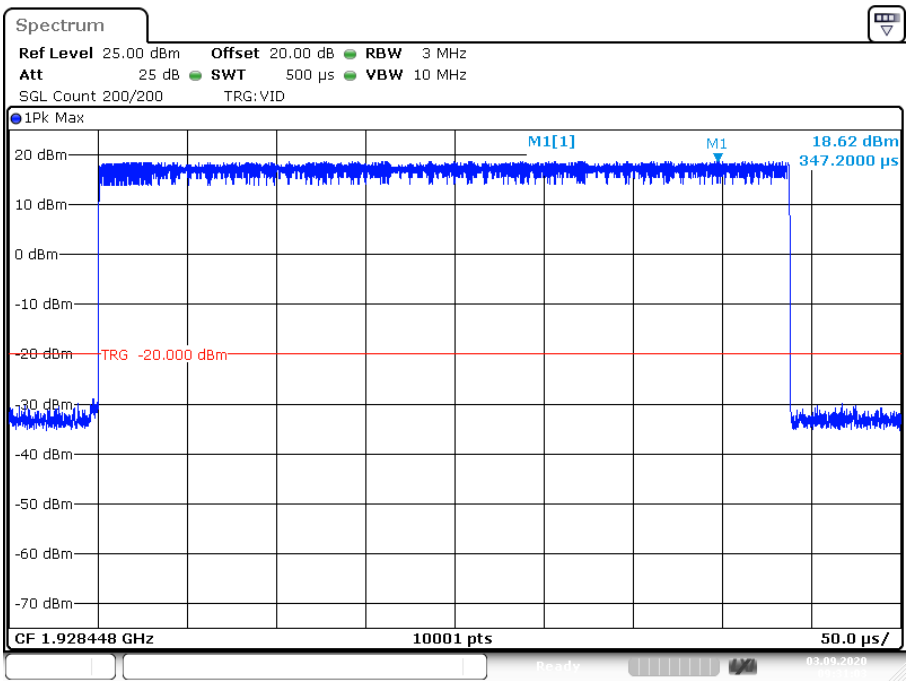
Peak transmit power shall not exceed 100 microwatts multiplied by the square root of the emission bandwidth in Hertz.

The peak transmit power shall be reduced by the amount in decibels that the maximum directional gain of the antenna exceeds 3 dBi.

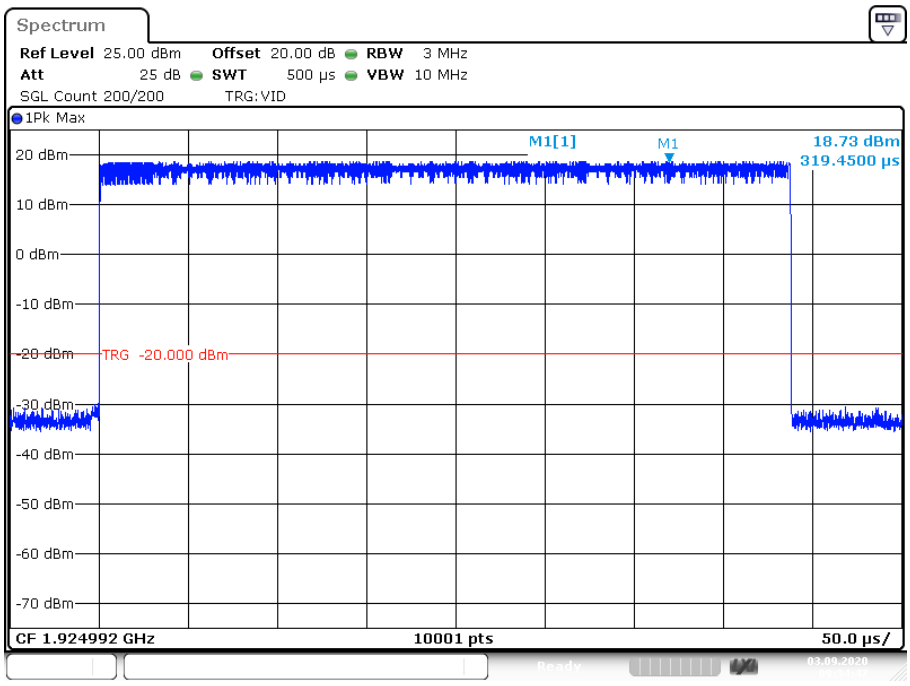
Conducted Peak Output Power, DBPSK



Lower Channel

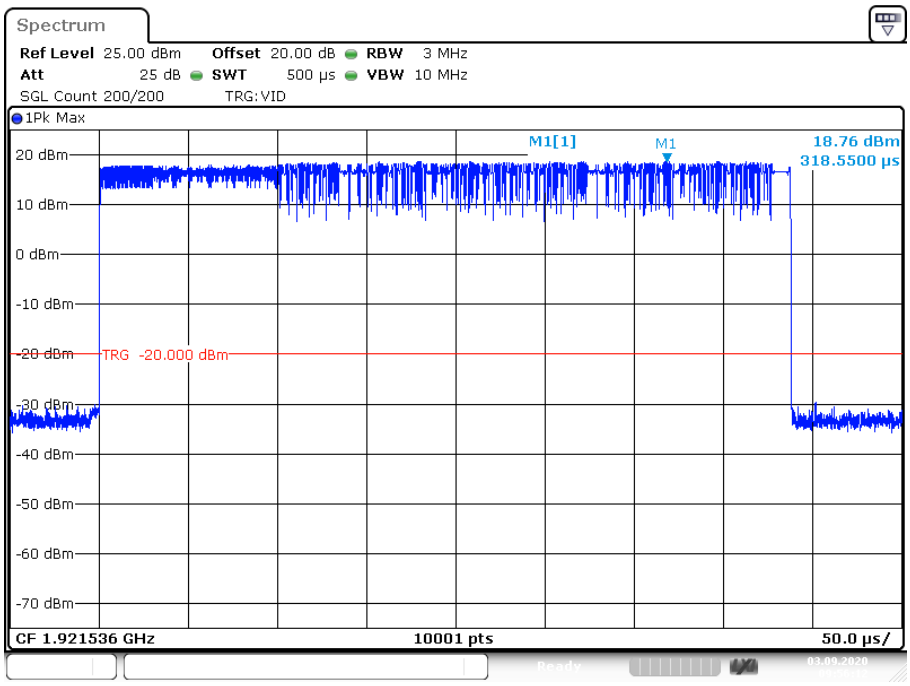


Upper Channel

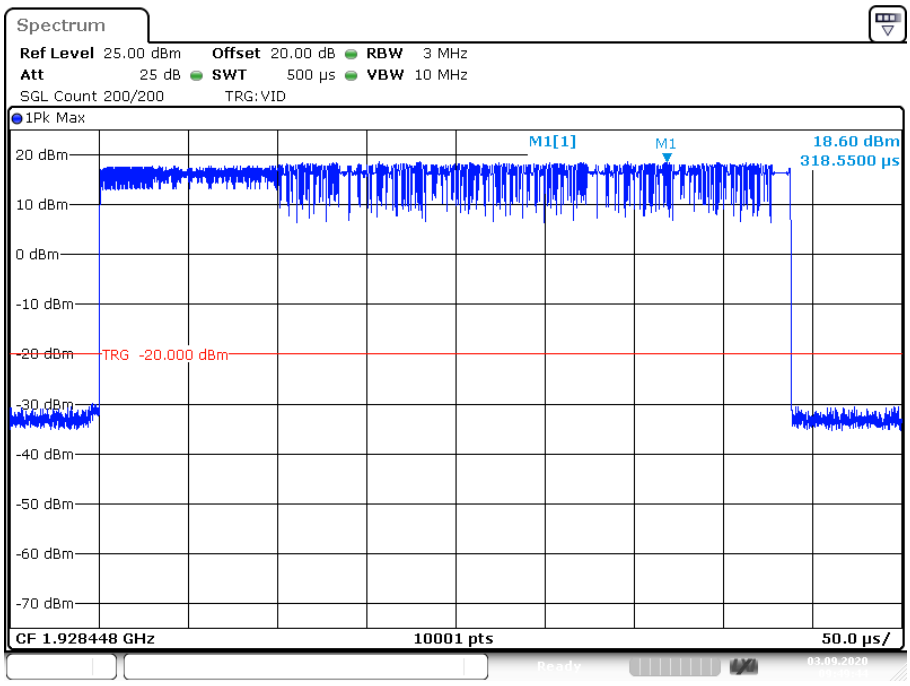


Middle Channel

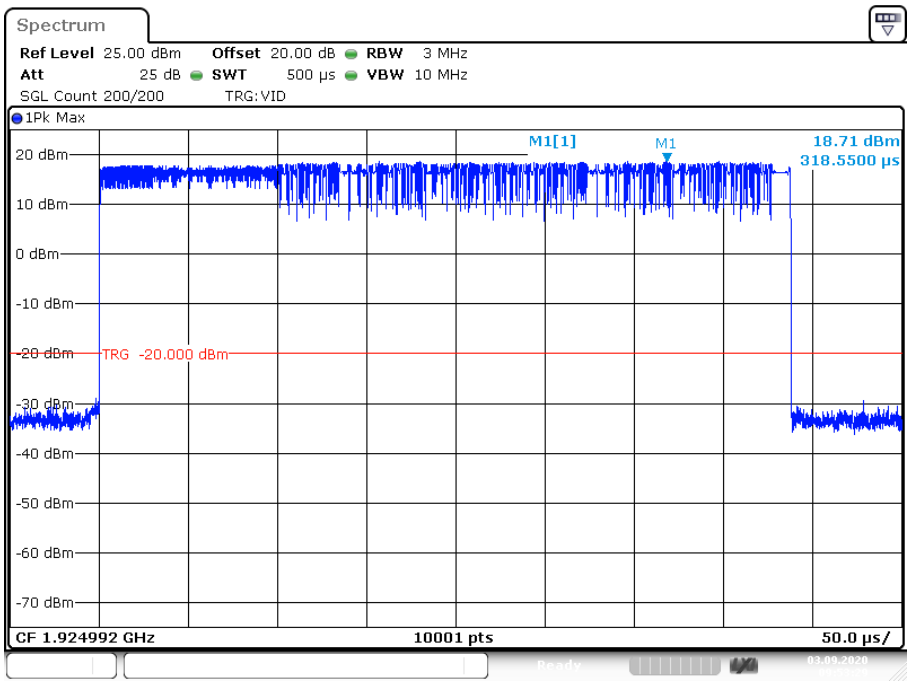
Conducted Peak Output Power, DQPSK



Lower Channel

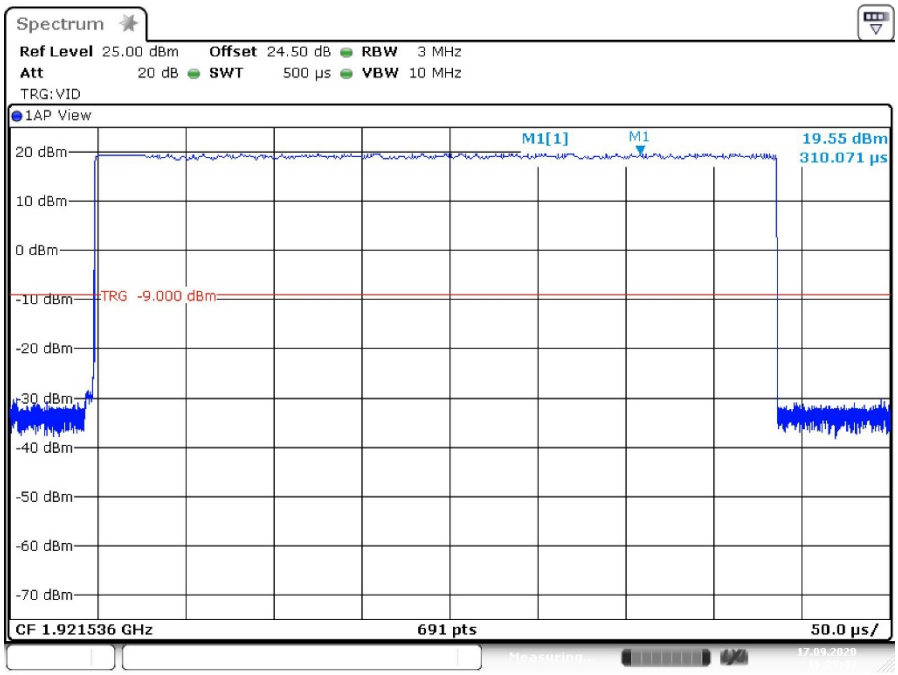


Upper Channel

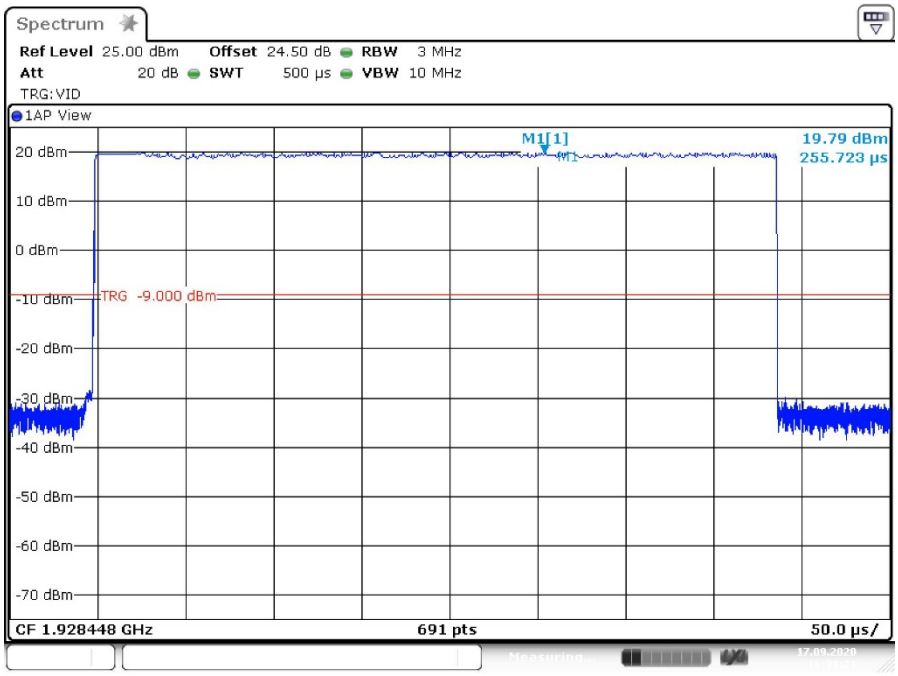


Middle Channel

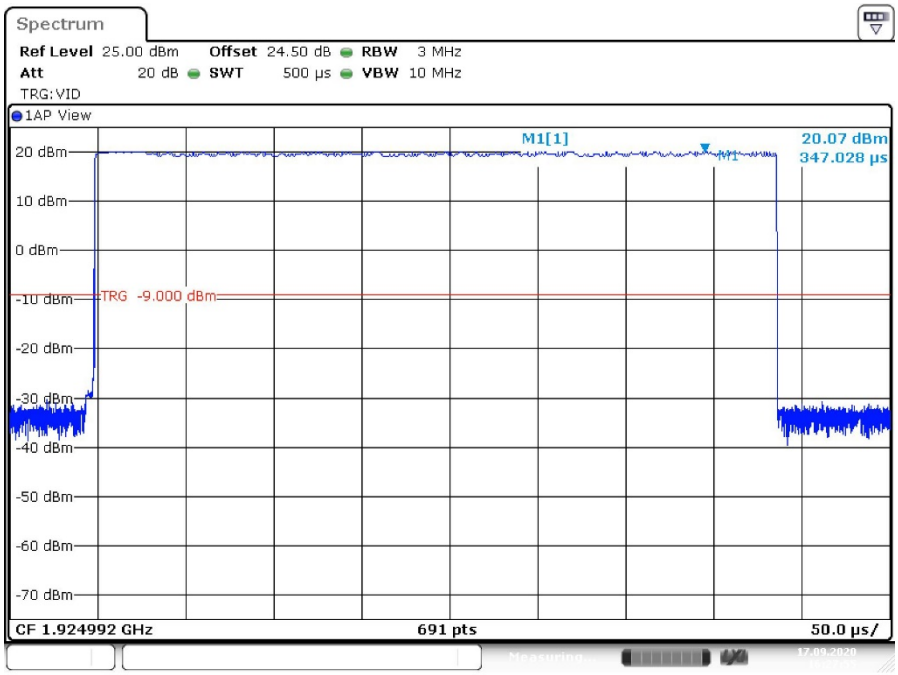
Radiated Peak Output Power DBPSK



Lower Channel



Upper Channel



Middle Channel

7.8 Emission Bandwidth B

Measurement Procedure:

ANSI C63.17, clause 6.1.3.

Test Results: Pass

Measurement Data:

Channel No. DBPSK	Frequency (MHz)	26 dB Bandwidth B (kHz)
4	1921.536	1686
0	1928.448	1689

Channel No. DQPSK	Frequency (MHz)	26 dB Bandwidth B (kHz)
4	1921.536	1722
0	1928.448	1724

Channel No. DBPSK	Frequency (MHz)	99% Bandwidth B (kHz)
2	1924.992	1686

Channel No. DQPSK	Frequency (MHz)	99% Bandwidth B (kHz)
2	1924.992	1722

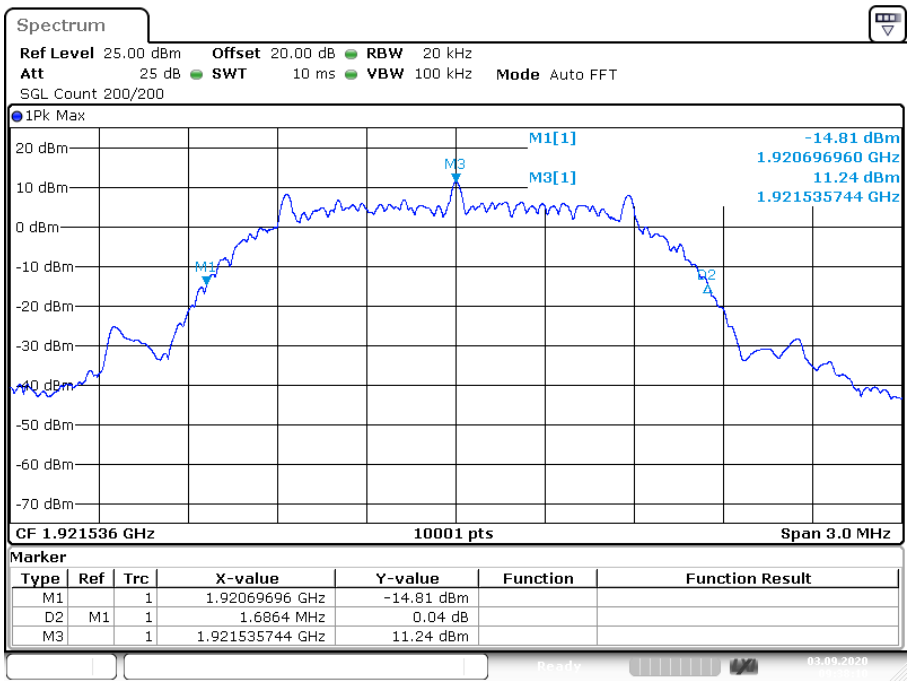
Channel No.	Frequency (MHz)	6 dB Bandwidth B (kHz)
4	1921.536	N/A
0	1928.448	N/A
Channel No.	**Frequency (MHz)**	**12 dB Bandwidth B (kHz)**
4	1921.536	N/A
0	1928.448	N/A

Requirement: FCC 15.323(a)
The 26 dB Bandwidth B shall be larger than 50 kHz and less than 2.5 MHz.

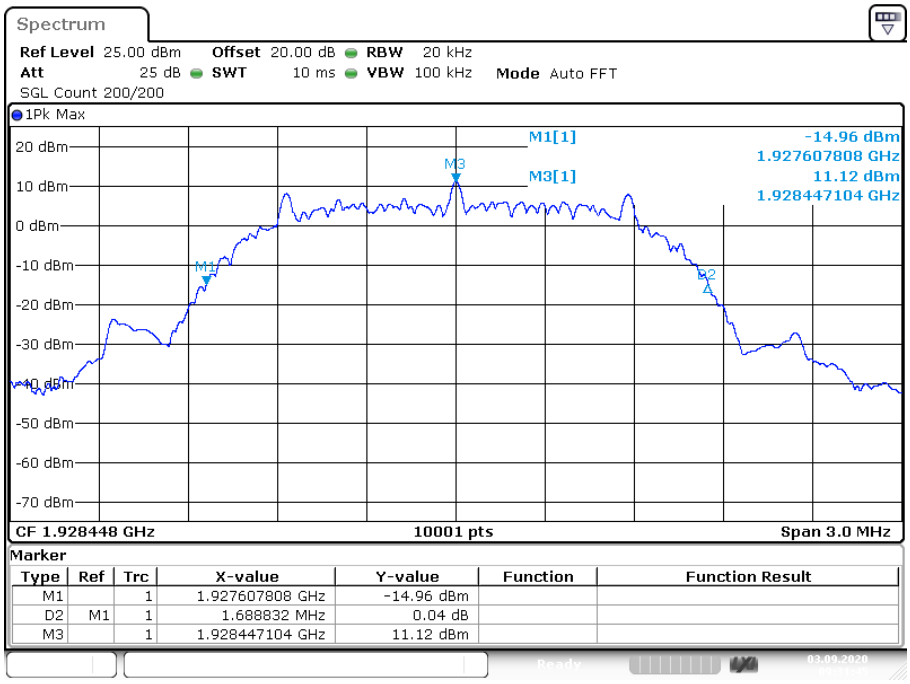
Requirement: RSS-213 Issue 2, clause 6.4
The 20 dB Bandwidth B shall be larger than 50 kHz and less than 2.5 MHz.

No requirement for 6 dB and 12 dB Bandwidth. These values are only used for testing Monitoring Bandwidth if the Simple Compliance test fails (ANSI C63.17, clause 7.4).

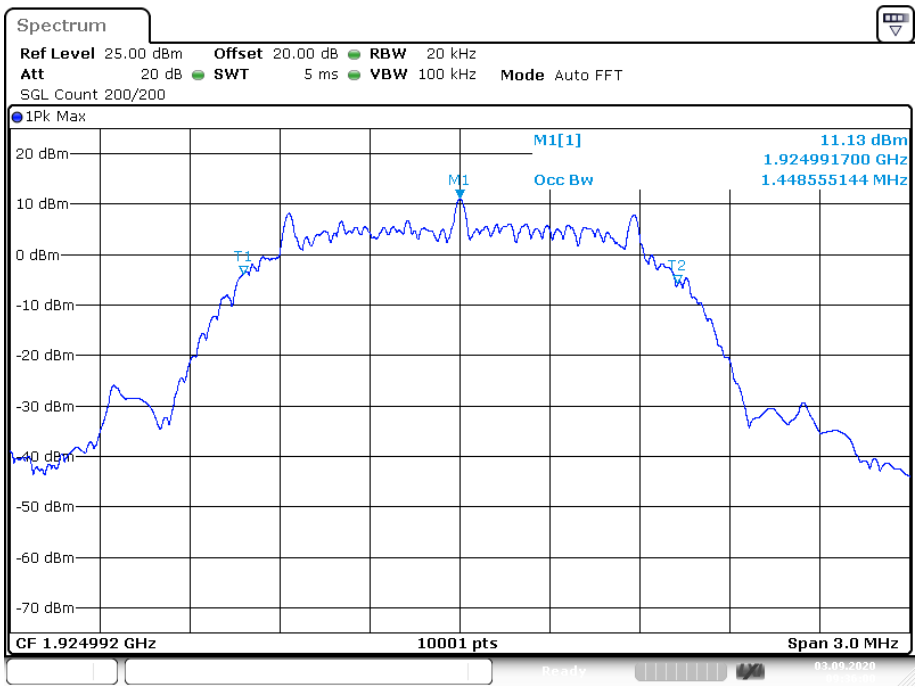
Modulation: DBPSK



26 dB Emission Bandwidth B, Lower Channel

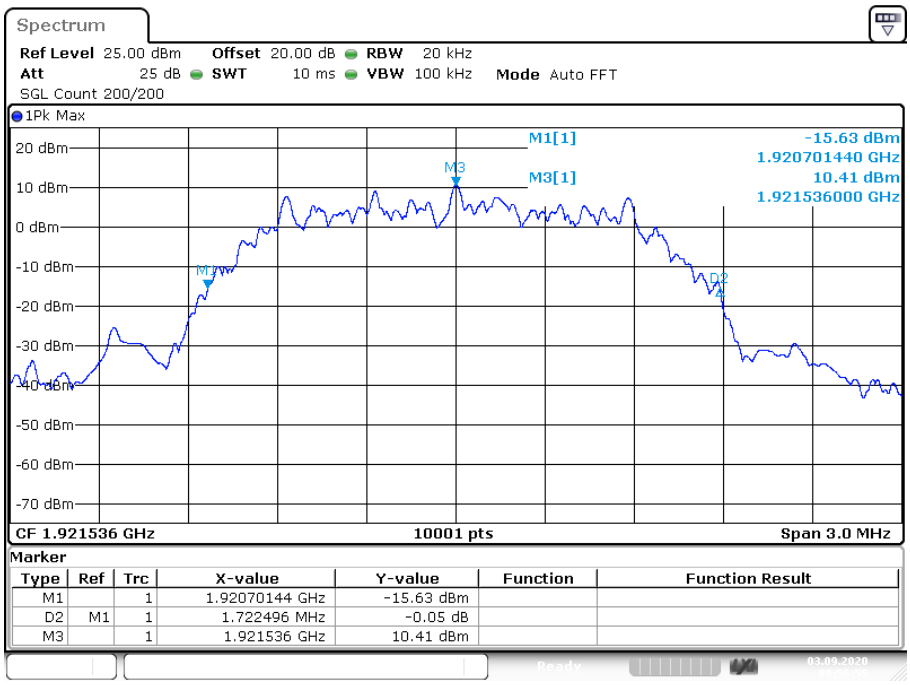


26 dB Emission Bandwidth B, Upper Channel

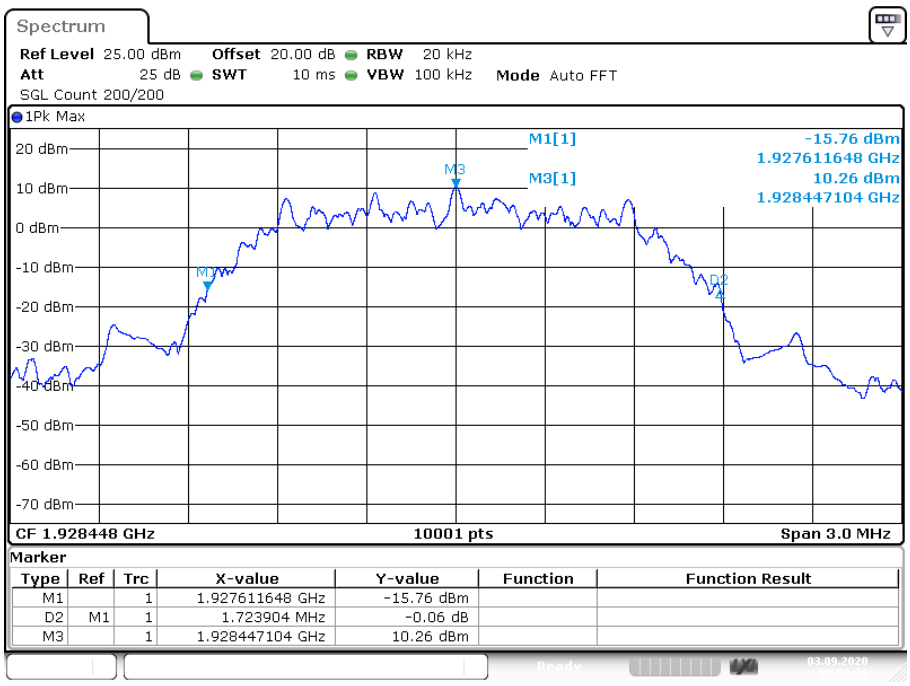


99% Emission Bandwidth B, Middle Channel

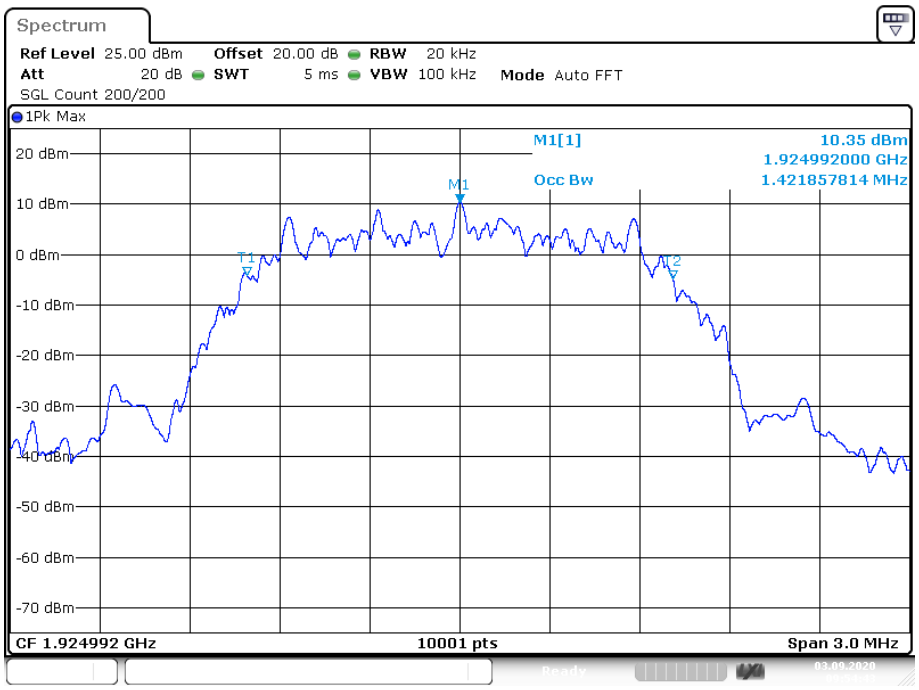
Modulation: DQPSK



26 dB Emission Bandwidth B, Lower Channel



26 dB Emission Bandwidth B, Upper Channel



99% Emission Bandwidth B, Middle Channel

7.9 Power Spectral Density

Measurement Procedure:

ANSI C63.17, clause 6.1.5.

Test Results: Pass

Measurement Data:

Channel No. DBPSK	Frequency (MHz)	Power Spectral Density (dBm/3kHz)
4	1921.535744	-3.40
0	1928.447104	-3.26

Channel No. DQPSK	Frequency (MHz)	Power Spectral Density (dBm/3kHz)
4	1921.536000	-1.99
0	1928.447104	-2.32

Averaged over 100 sweeps.

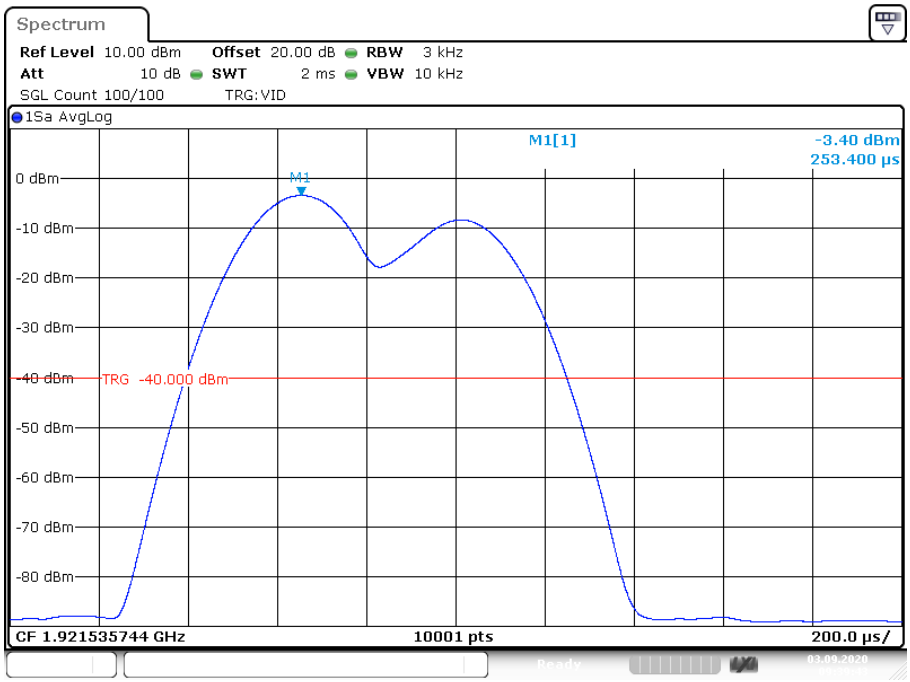
Requirement: FCC 15.319(d)

The Power Spectral Density shall be less than 3 mW/3kHz (4.77 dBm) when averaged over at least 100 sweeps.

Power Spectral Density, DBPSK

Lower Channel:

Frequency of the maximum level was recorded under chapter 5.9.

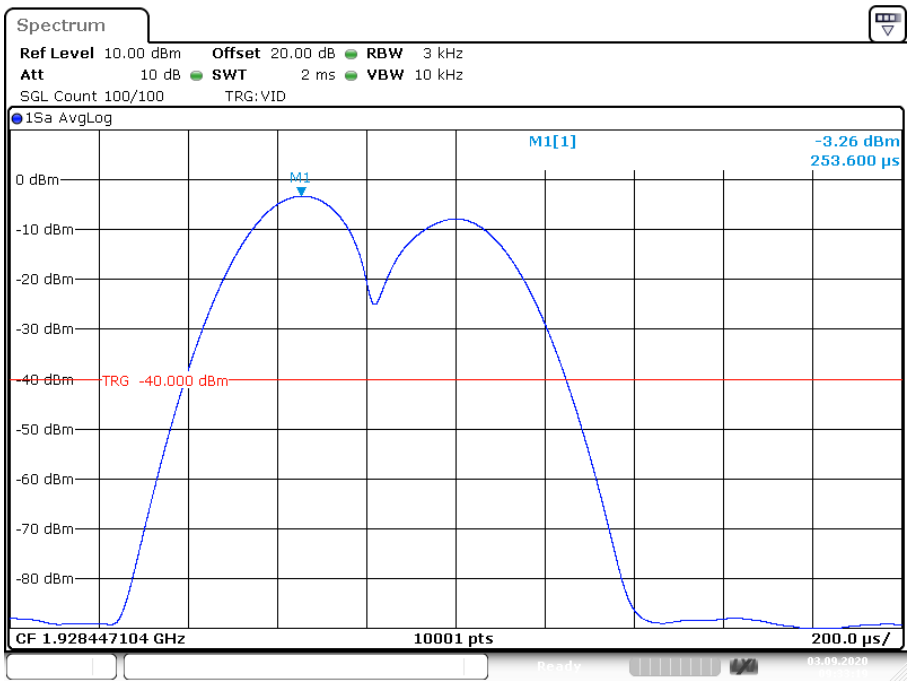


Averaged, 100 Sweeps

Pulse power [dBm]	-3.40
Pulse power [mW]	0.46

Upper Channel:

Frequency of the maximum level was recorded under chapter 5.9.



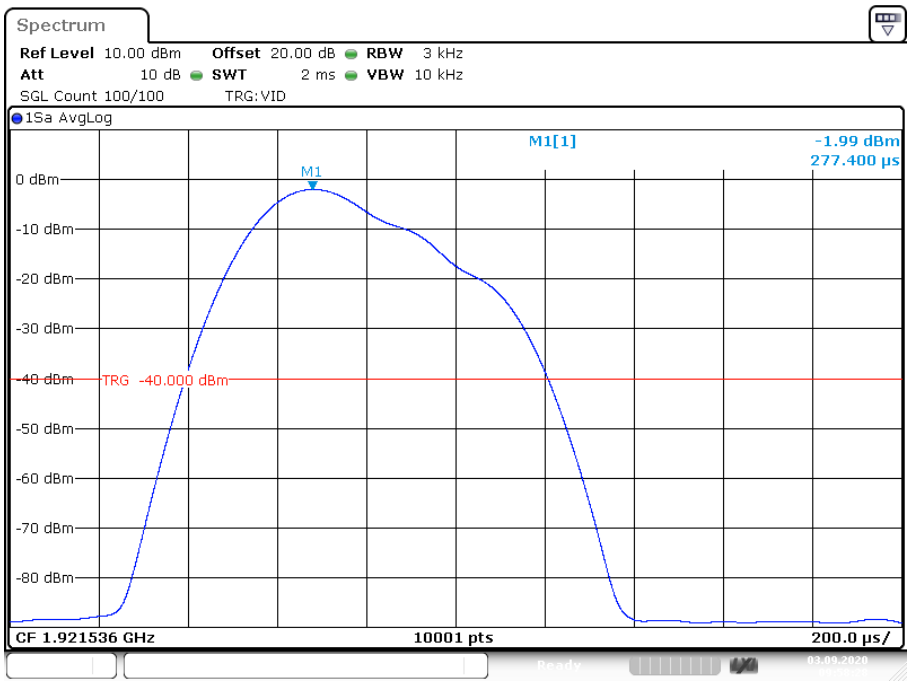
Averaged, 100 Sweeps

Pulse power [dBm]	-3.26
Pulse power [mW]	0.47

Power Spectral Density, DQPSK

Lower Channel:

Frequency of the maximum level was recorded under chapter 5.9.

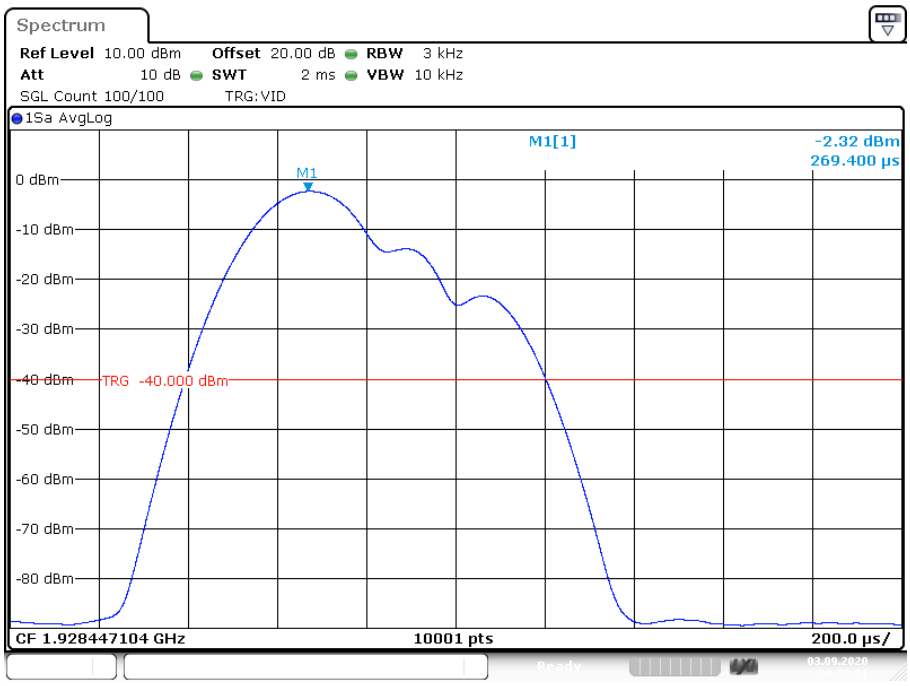


Averaged, 100 Sweeps

Pulse power [dBm]	-1.99
Pulse power [mW]	0.63

Upper Channel:

Frequency of the maximum level was recorded under chapter 5.9.



Averaged, 100 Sweeps

Pulse power [dBm]	-2.32
Pulse power [mW]	0.59

7.10 In-Band Unwanted Emissions, Conducted

Measurement Procedure:

ANSI C63.17, clause 6.1.6.1.

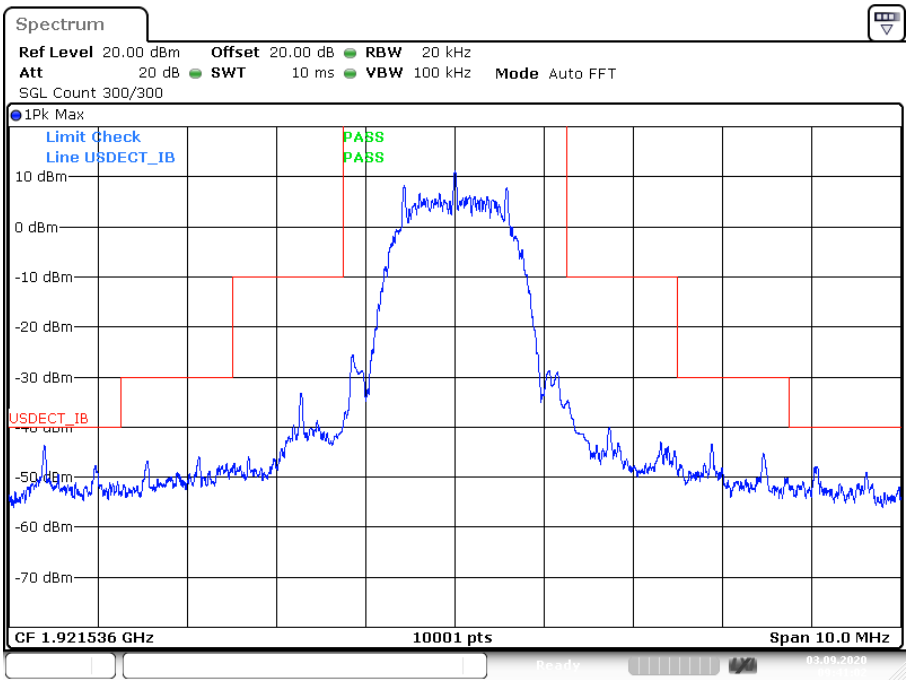
Test Results: Pass

Measurement Data:
See plots.

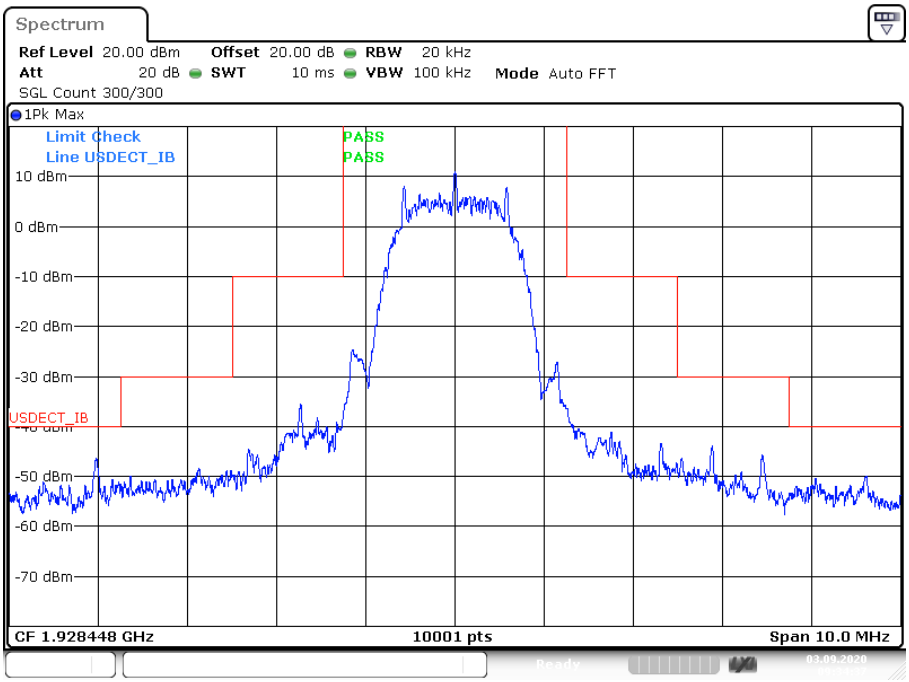
Requirement: FCC 15.323(d)

B < f2 ≤2B:	less than or equal to 30 dB below max. permitted peak power level
2B < f2 ≤3B:	less than or equal to 50 dB below max. permitted peak power level
3B < f2 ≤UPCS Band Edge:	less than or equal to 60 dB below max. permitted peak power level

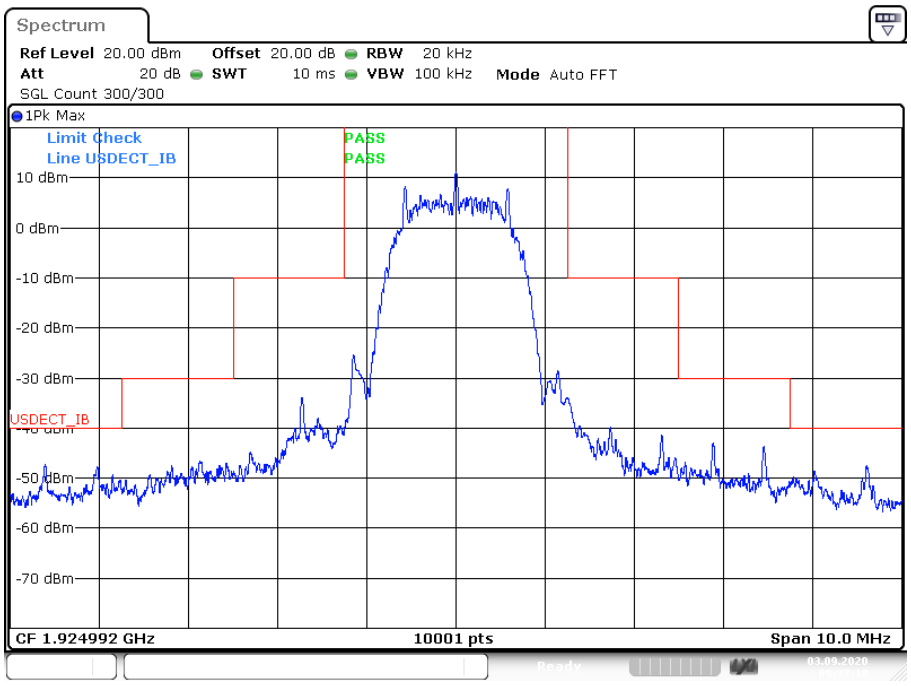
In-Band Unwanted Emissions, Conducted, DBPSK



Lower Channel

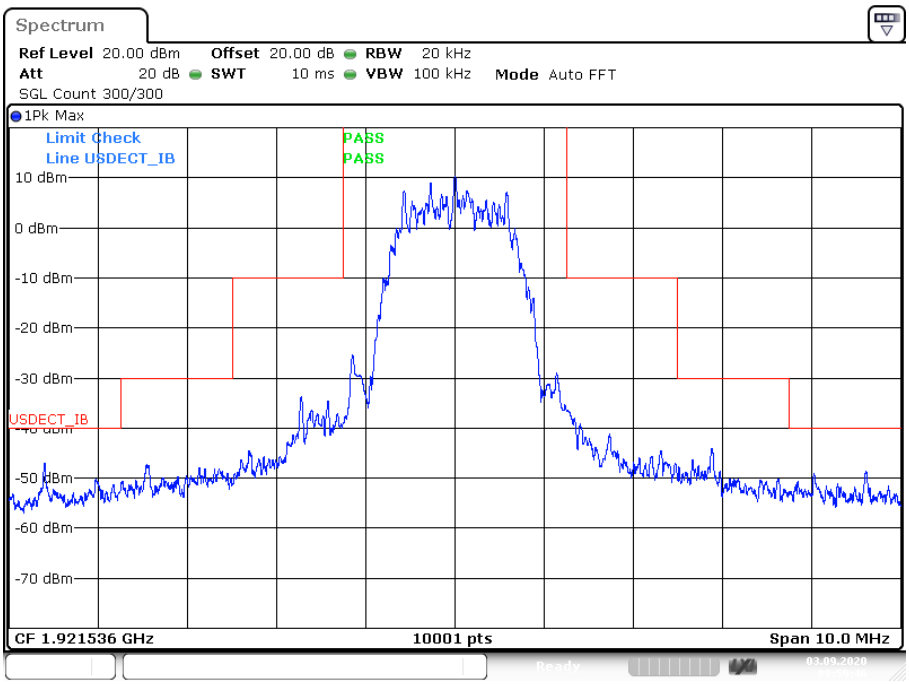


Upper Channel

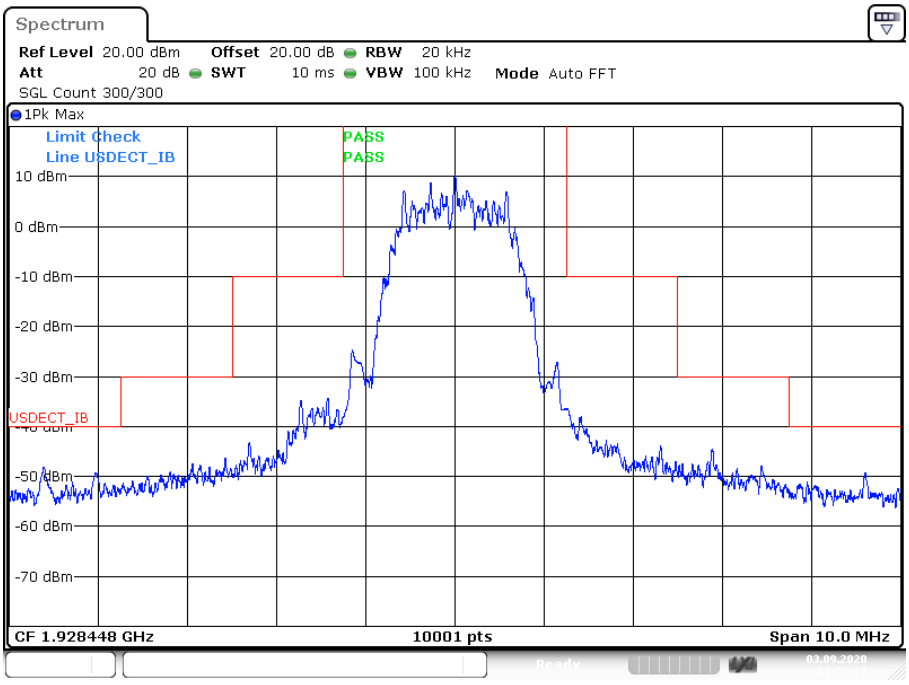


Middle Channel

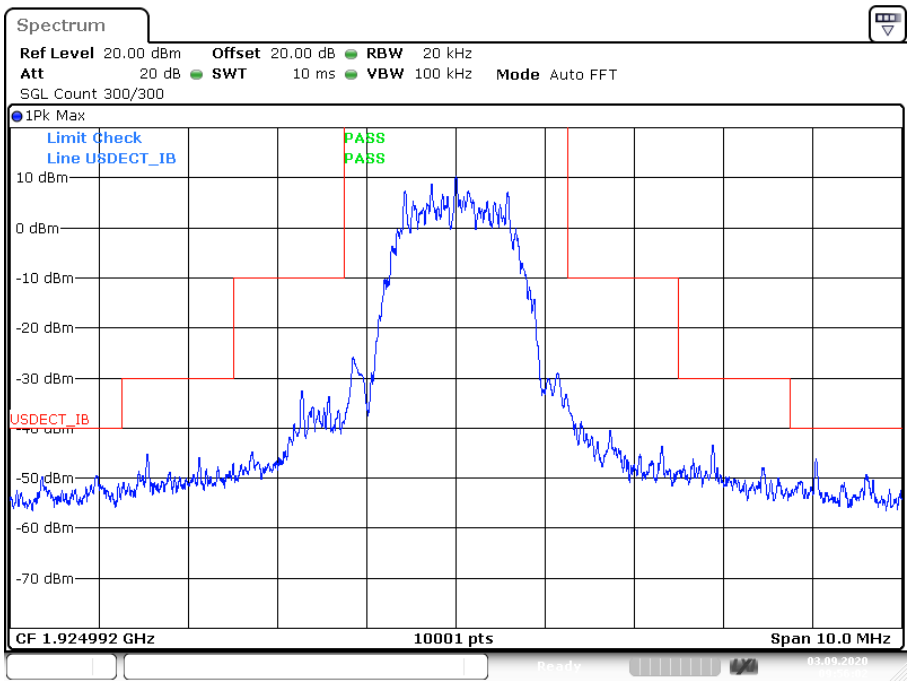
In-Band Unwanted Emissions, Conducted, DQPSK



Lower Channel



Upper Channel



Middle Channel

The BS spurious in-band transmission level is below the indicated limit.

7.11 Out-of-Band Emissions, Conducted

Measurement Procedure:

ANSI C63.17, clause 6.1.6.2.

Test Results: Pass

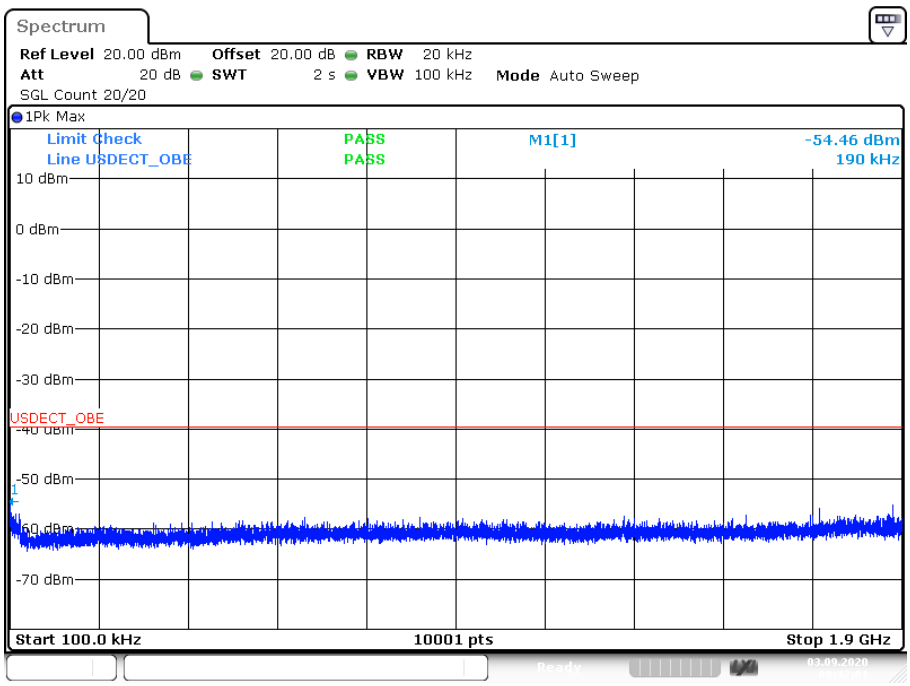
Measurement Data:
See plots.

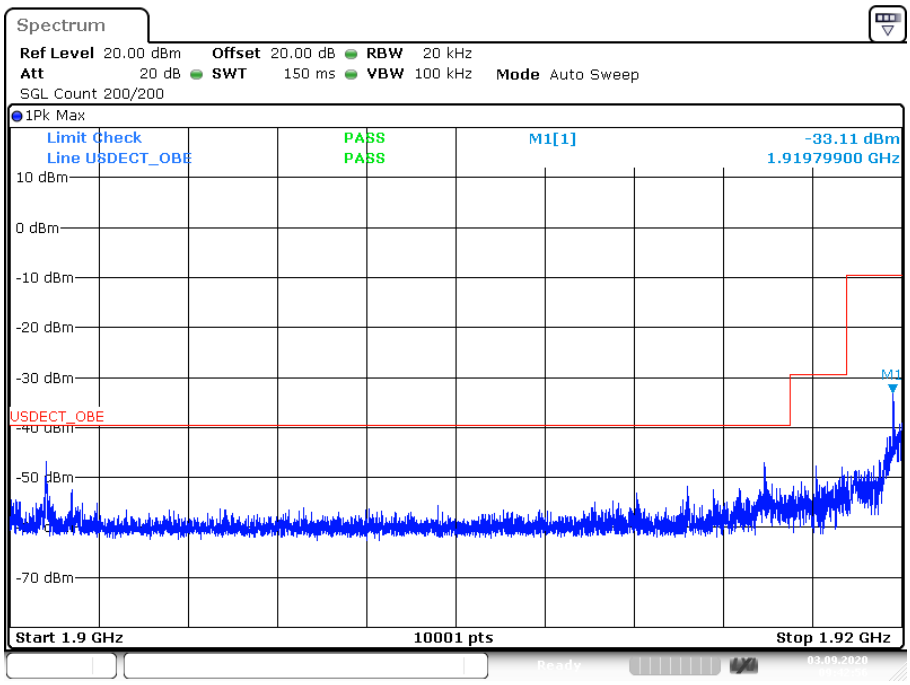
Requirement: FCC 15.323(d)

f ≤ 1.25 MHz outside UPCS band:	≤ -9.5 dBm
1.25 MHz ≤ f ≤ 2.5 MHz outside UPCS band:	≤ -29.5 dBm
f ≥ 2.5 MHz outside UPCS band:	≤ -39.5 dBm

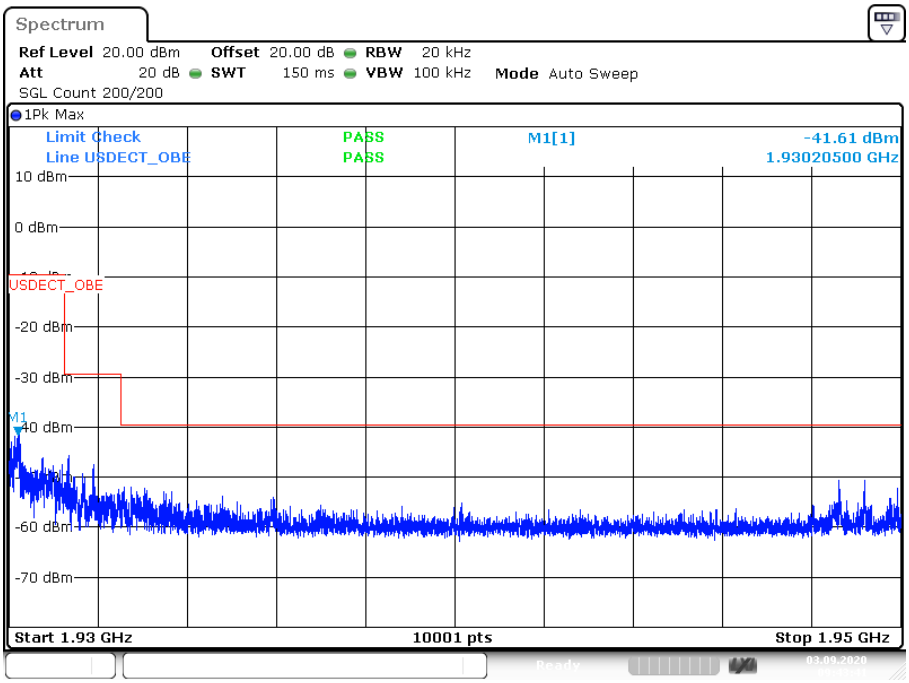
Out-of-Band Unwanted Emissions, Conducted, DBPSK

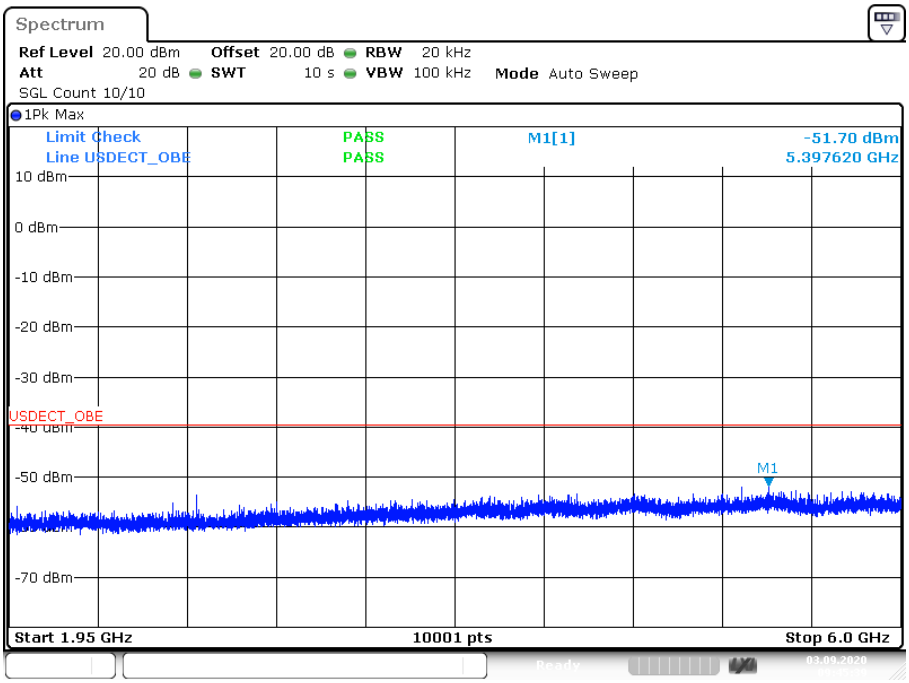
Upper and Lower Channel:



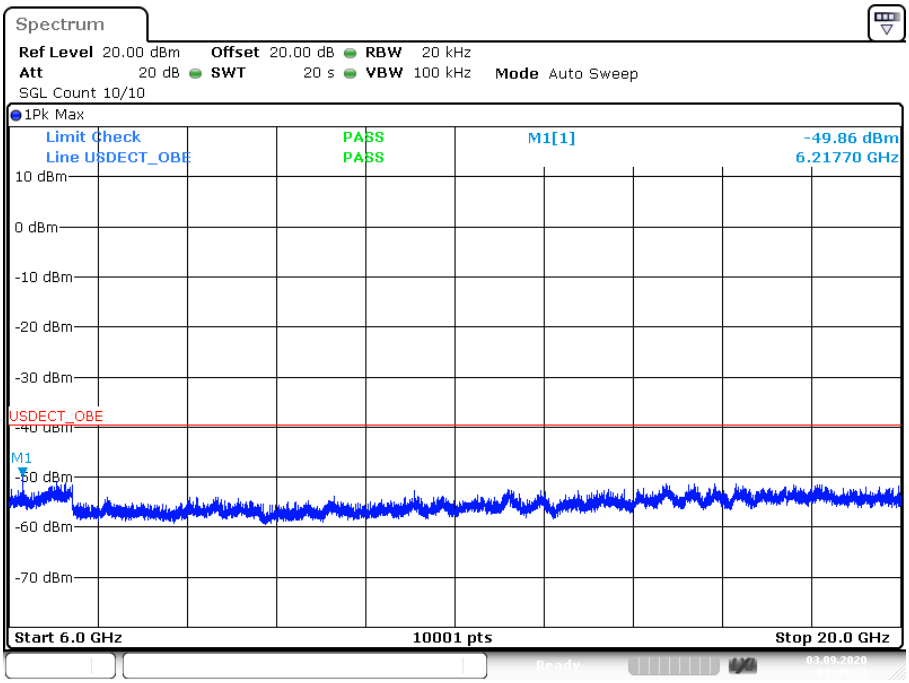


Out-of-Band Unwanted Emissions, Conducted, DBPSK





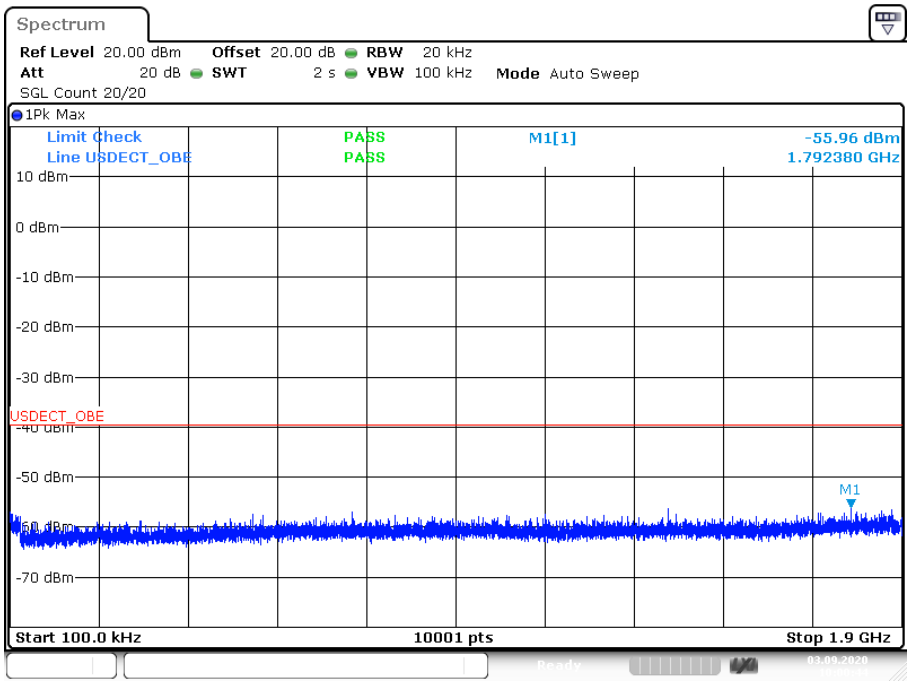
Out-of-Band Unwanted Emissions, Conducted, DBPSK

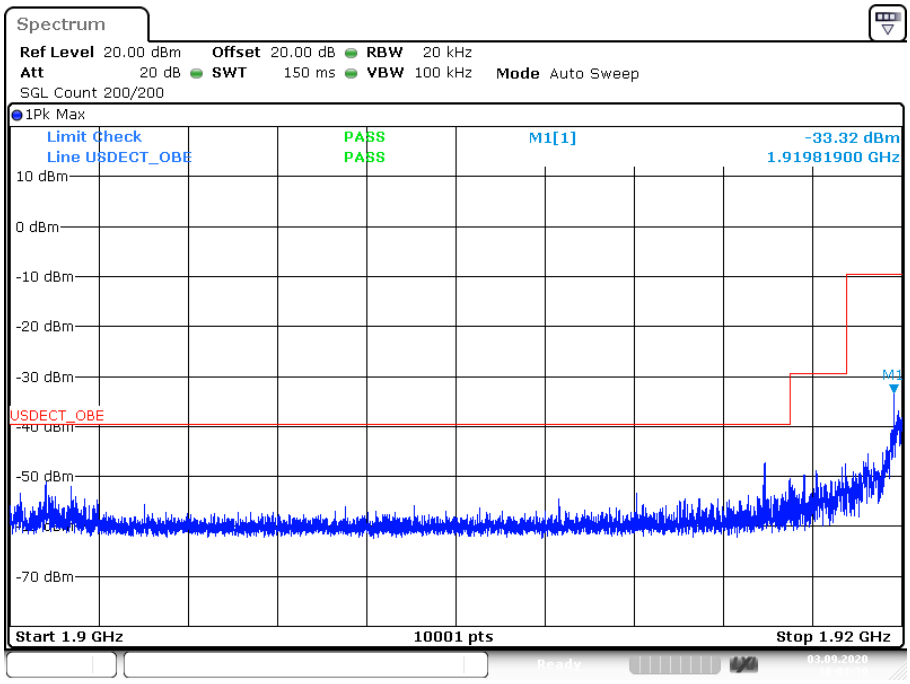


The BS spurious out-of-band transmission level is below the indicated limit.

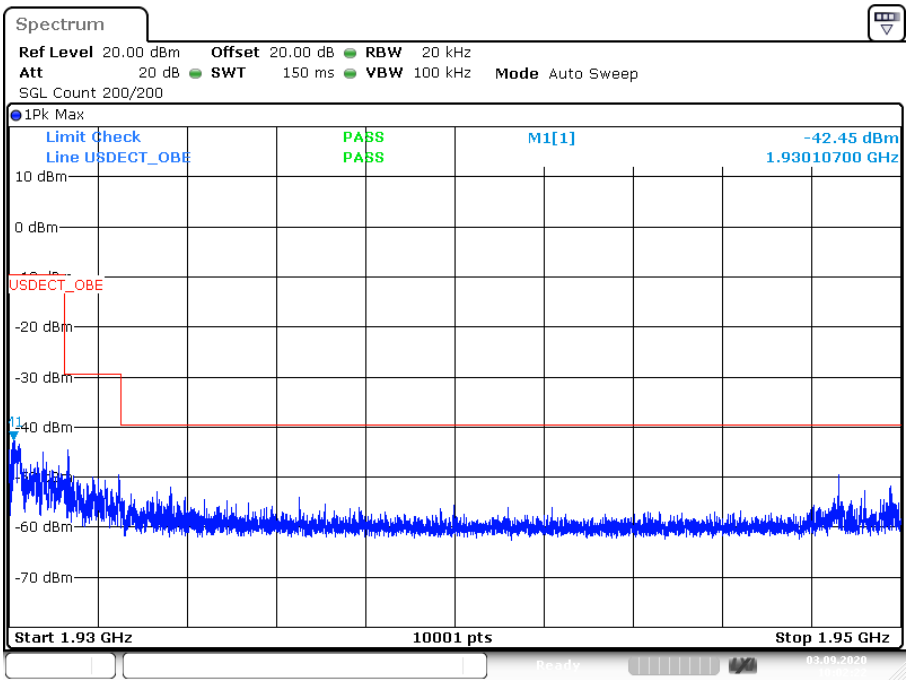
Out-of-Band Unwanted Emissions, Conducted, DQPSK

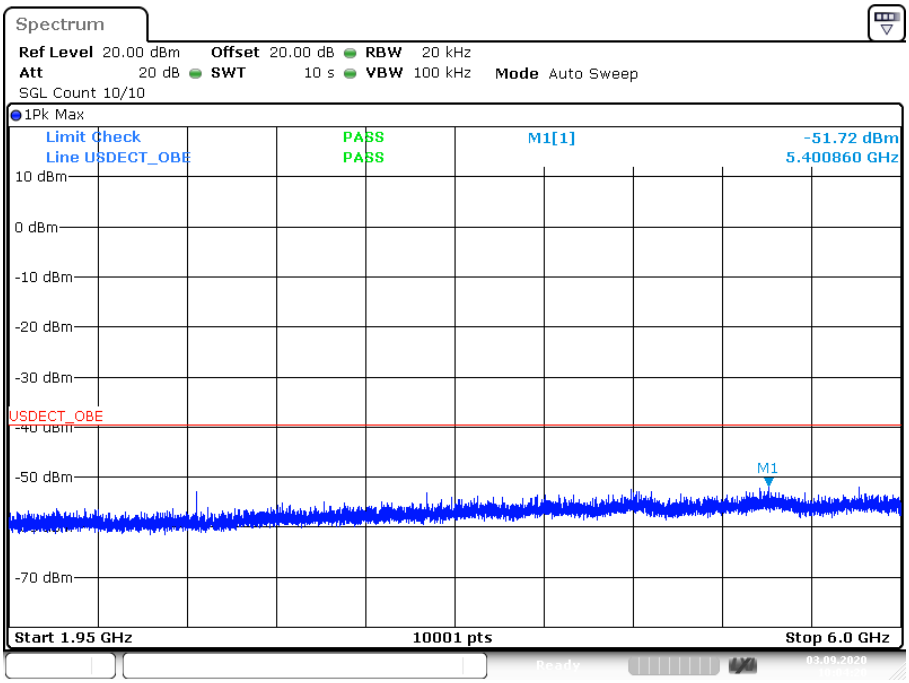
Upper and Lower Channel:



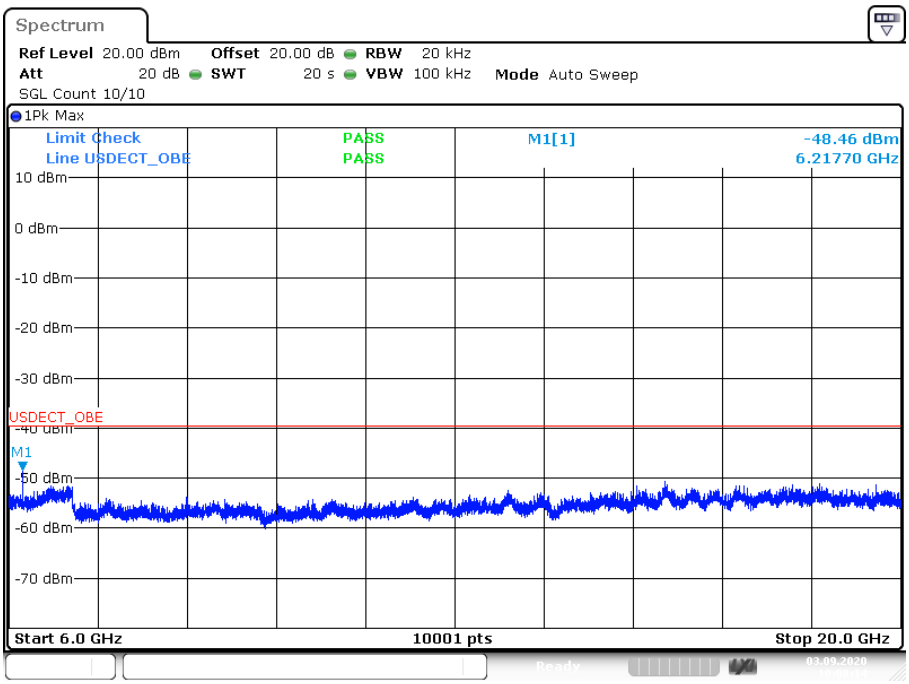


Out-of-Band Unwanted Emissions, Conducted, DQPSK





Out-of-Band Unwanted Emissions, Conducted, DQPSK



The BS spurious out-of-band transmission level is below the indicated limit.

7.12 Carrier Frequency Stability

Measurement Procedure:

ANSI C63.17, clause 6.2.1.

Requirement: FCC 15.323(f)

Test Results: Pass

Measurement Data:

The Frequency Stability is measured with the CMD65. The CMD65 was logged by a computer programmed to get the new readings as fast as possible (about 3 readings per second) over the noted time period or number of readings. The peak-to-peak difference was recorded and the mean value and deviation in ppm was calculated.

The Carrier Frequency Stability over power Supply Voltage and over Temperature is measured also with the CMD65.

Carrier Frequency Stability over Time at Nominal Temperature

Average Mean Carrier Frequency (MHz)	Max. Diff. (kHz)	Min. Diff. (kHz)	Max Dev. (ppm)	Limit (ppm)
1924.987882	-1.59	-4.59	1.312	±10

Deviation ppm = ((Max.Diff. – Mean.Diff.) / Mean Carrier Freq.) x 10^6
Deviation (ppm) is calculated from 3000 readings with the CMD65.

Carrier Frequency Stability over Power Supply at Nominal Temperature

Voltage	Measured Carrier Frequency (MHz)	Difference (kHz)	Deviation (ppm)	Limit (ppm)
3.6 V DC	1924.990	Ref.	Ref.	±10
4.2 V DC	1924.990	0.0	0.0	
3.3 V DC	1924.990	0.0	0.0	

Deviation ppm = ((Mean – Measured frequency) / Mean) x 10^6

Carrier Frequency Stability over Temperature

Temperature	Measured Carrier Frequency (MHz)	Difference (kHz)	Deviation (ppm)	Limit (ppm)
T = +20°C	1924.990	Ref.	Ref.	±10
T = -20°C	1924.990	0.0	0.0	
T = +50°C	1924.990	0.0	0.0	

Deviation ppm = ((Mean – Measured frequency) / Mean) x 10^6

7.13 Frame Repetition Stability

Measurement Procedure:

ANSI C63.17, clause 6.2.2.

Test Results: Pass

Measurement Data:

The Frame Repetition Stability is measured with the CMD65. The Frame Repetition Stability is 3 times the standard deviation.

Carrier Frequency (MHz)	Mean (Hz)	Standard Deviation (ppm)	Frame Repetition Stability (ppm)
1924.992	100.0000000000	0.055	0.165

Limit:

Frame Repetition Stability	±10 ppm (TDMA)

Ref. FCC 15.323(e). ANSI C63.17, clause 6.2.2.

7.14 Frame Period and Jitter

Measurement Procedure:

ANSI C63.17, clause 6.2.3.

Test Results: Pass

Measurement Data:

The Frame Repetition Stability is measured with the CMD65

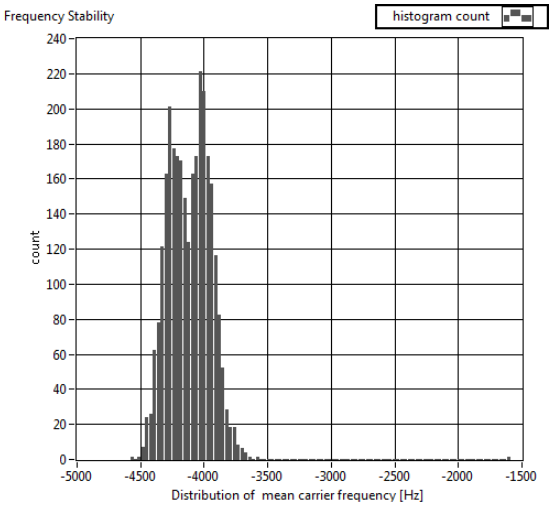
Carrier Frequency (MHz)	Frame Period (ms)	Max Jitter (µs)	3xStandard Deviation of Jitter (µs)
1924.992	10.000	0.003	0.002

Max Jitter = (1/(Frame Period + Pk-Pk)/2) – (1/Frame Period), when Pk-Pk and Frame Period are in Hz.
3xSt.Dev.Jitter 3x(1/(Frame Period + St.Dev)) – (1/St.Dev)) x 10^6

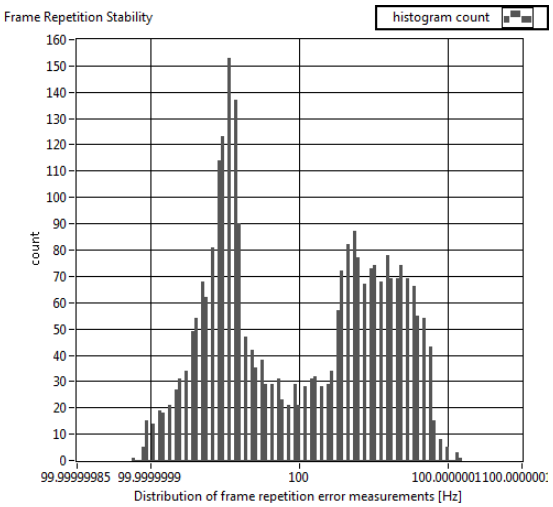
Limit:

Frame Period	20 or 10 ms
Max Jitter	25 µs
3 times St.Dev. of Jitter	12.5 µs

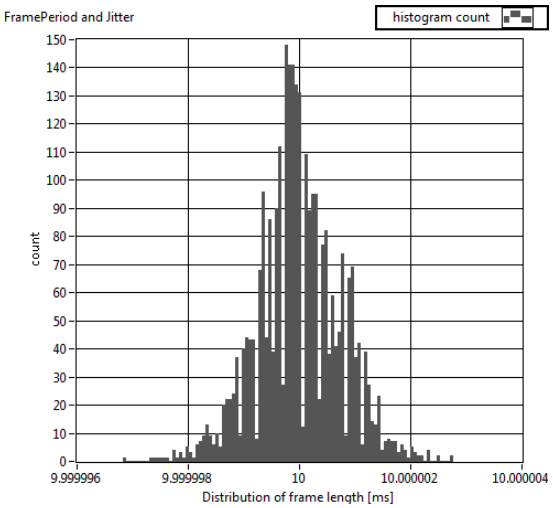
Ref. FCC 15.323(e). ANSI C63.17, clause 6.2.3.



Histogram of Carrier Frequency Stability



Histogram of Frame Repetition Stability



Histogram of Frame Period and Jitter

7.15 Monitoring Threshold, Least Interfered Channel

Measurement Procedure:

ANSI C63.17, clause 7.3.2

Monitoring Threshold limits:

Lower Threshold:

$T_L = 15 \log B - 184 + 30 - P_{EUT}$ (dBm)

B is measured Emission Bandwidth in Hz
P_{EUT} is measured Transmitter Power in dBm

Calculated value:

Lower Threshold	-79.7 dBm

Least Interfered Channel (LIC) Procedure Test, FCC 15.323(c)(2) and (c)(5)

ANSI C63.17 clause 7.3.2 ref.	Observation	Verdict
b) f_1 T_L + 13 dB, f_2 T_L + 6 dB	Transmission always on f_2	**Pass**
c) f_1 T_L + 6 dB, f_2 T_L + 13 dB	Transmission always on f_1	**Pass**
d) f_1 T_L + 7 dB, f_2 T_L	Transmission always on f_2	**Pass**
e) f_1 T_L, f_2 at T_L+ 7 dB	Transmission always on f_1	**Pass**

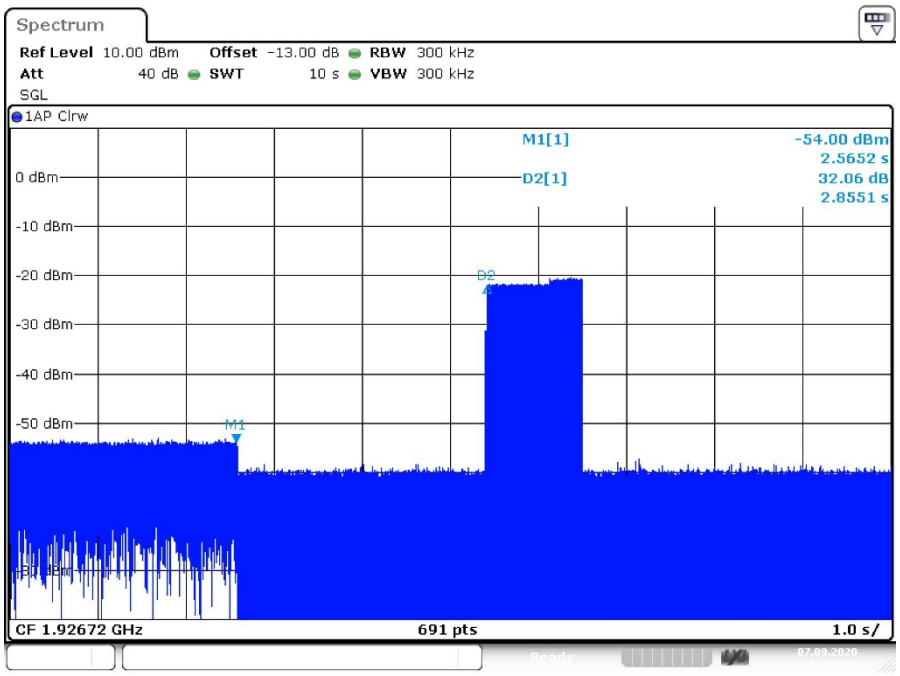
Measurement Procedure:

ANSI C63.17, clause 7.3.3

Selected Channel Confirmation, FCC 15.323(c)(1) and (5)

ANSI C63.17 clause 7.3.3	Observation	Verdict
b) Shall **not** transmit on f_1	EUT transmits on f_2	**Pass**
d) Shall **not** transmit on f_2	EUT transmits on f_1	**Pass**

Comment: This test is only applicable for EUTs that can be an initiating device.



7.3.3 Selected Channel Confirmation, connection 2.9 s after interferer removed

7.16 Threshold Monitoring Bandwidth

This test is only required if a dedicated monitoring receiver is used. If the test is not carried out the manufacturer shall declare and provide evidence that the monitoring is made through the radio receiver used for communication.

Measurement Procedure:

Simple Compliance Test, ANSI C63.17, clause 7.4.1

More Detailed Test, ANSI C63.17, clause 7.4.2

The test is passed if **either** the Simple Compliance Test or the More Detailed Test is passed.

During this test the spectrum analyzer is observed visually to see if the EUT transmits or not.

Test Results:

Test performed	Observation	Verdict
Simple Compliance Test, at ±30% of B	N/A	**N/A**
More Detailed Test, at -6 dB points	N/A	**N/A**
More Detailed Test, at -12 dB points	N/A	**N/A**

The More Detailed Test must be pass at both the -6dB and -12 dB points if the Simple Compliance Test fails.

Comment: The tested EUT uses the same receiver for monitoring and communication, this test is therefore not required.

Limits: FCC 15.323(c)(7):

The monitoring system bandwidth must be equal to or greater than the emission bandwidth of the intended transmission.

7.17 Reaction Time and Monitoring Interval

Measurement Procedure:

ANSI C63.17, clause 7.5

Test Results:

By administrative commands and out-of-operating region interference, the EUT is restricted to operate on carrier frequencies f_1 and f_2.

Time-synchronized pulsed interference was then applied on f_1 at pulsed levels TL + UM to check that the EUT does not transmit. The level was raised 6 dB for part d) with 35 µs pulses. Additionally a CW signal was applied on f_2 with a level of TL.

The pulses are synchronized with the EUT timeslots and applied cantered within all timeslots.

Pulse Width, ref. to ANSI C63.17 clause 7.5	Observation	Verdict
c) > largest of 50 µs and 50*SQRT(1.25/B)	Transmission on f_2	**Pass**
d) > largest of 35 µs and 35*SQRT(1.25/B) and with interference level raised 6 dB	Transmission on f_2	**Pass**

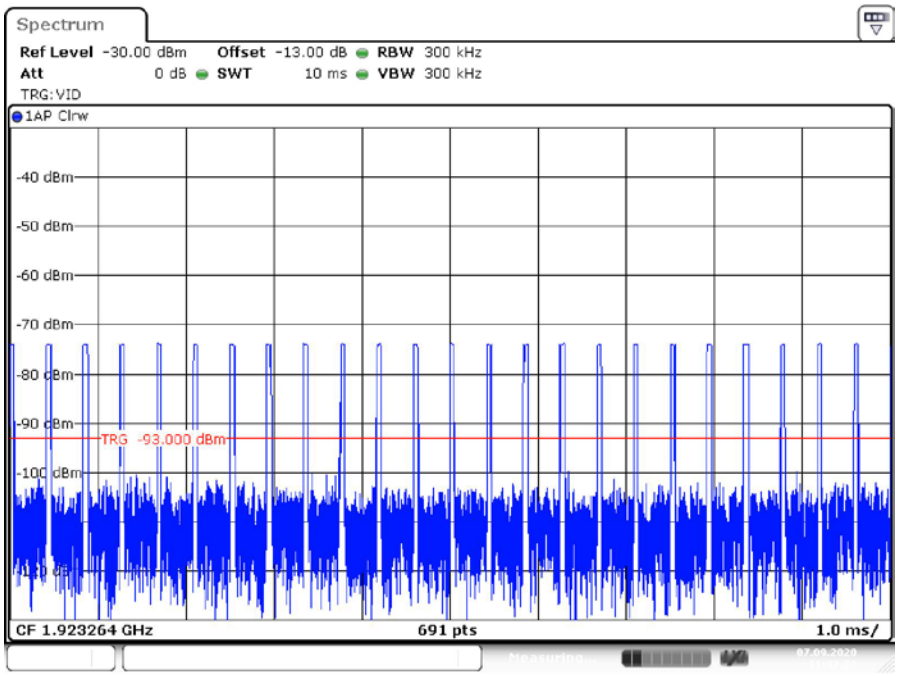
Comment: Since B is larger than 1.25 MHz, the test was performed with pulse lengths of 50 µs and 35 µs.

Limits: FCC 15.323(c)(1), (5) and (7)

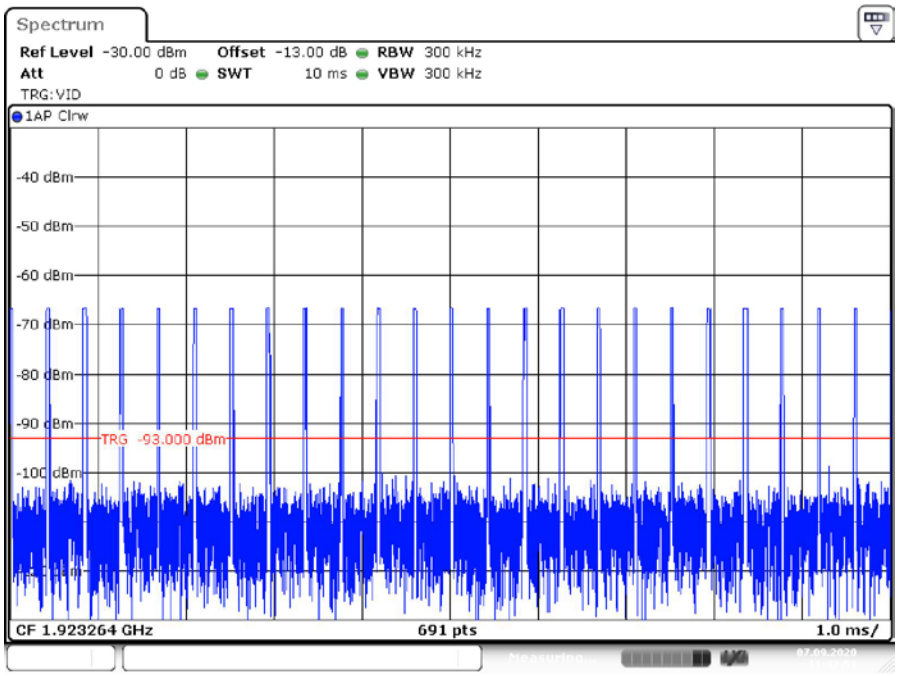
The maximum reaction time must be less than 50xSQRT (1.25/emission bandwidth in MHz) microseconds for signals at the applicable threshold level but shall not be required to be less than 50 microseconds.

If a signal is detected that is 6 dB or more above the applicable threshold level, the maximum reaction time shall be 35xSQRT (1.25/emission bandwidth in MHz) microseconds but shall not be required to be less than 35 microseconds.

Comment: This test is only applicable for EUTs that can be an initiating device.



50 µs Pulses



35 µs Pulses

7.18 Time and Spectrum Window Access Procedure

This requirement is only for EUTs which transmit unacknowledged control and signaling information

Measurement Procedure:

Timing for EUTs using control and signaling channel type transmissions: ANSI C63.17, clause 8.1

Test results:

Access Criteria, ref. to ANSI C63.17 clause 8.1.1	Observation	Verdict
b) Check that the EUT transmits on the interference free time slot	N/A	**N/A**
b) The EUT must terminate or pause in its repetitive transmission of the control and signaling channel on the open channel to repeat the access criteria not less frequently than every 30 s	N/A	**N/A**

If FCC 15.323(c)(6) option Random Waiting Interval is NOT implemented

Access Criteria, ref. to ANSI C63.17 clause 8.1.2	Observation	Verdict
b) Check that the EUT changes to interference free time slot when interference is introduced on the time slot in use	N/A	**N/A**

If FCC 15.323(c)(6) option Random Waiting Interval is implemented

Access Criteria, ref. to ANSI C63.17 clause 8.1.3	Observation	Verdict
b-d) Check that the EUT uses random waiting interval before continuing transmission on an interfered time slot	N/A	**N/A**

Comment: The tested EUT does not support the Random Waiting Interval option.

Limits:

FCC 15.323(c)(4):

Once access to specific combined time and spectrum windows is obtained an acknowledgement from a system participant must be received by the initiating transmitter within one second or transmission must cease. Periodic acknowledgments must be received at least every 30 seconds or transmission must cease. Channels used exclusively for control and signaling information may transmit continuously for 30 seconds without receiving an acknowledgement, at which the time access criteria must be repeated.

FCC 15.323(c)(6):

If the selected combined time and spectrum windows are unavailable, the device may either monitor and select different windows or seek to use the same windows after waiting an amount of time, randomly chosen from a uniform random distribution between 10 and 150 milliseconds, commencing when the channel becomes available.

7.19 Acknowledgments and Transmission duration

Measurement Procedure:

Acknowledgments: ANSI C63.17, clause 8.2.1

Transmission Duration: ANSI C63.17, clause 8.2.2

During the test **Initial transmission without acknowledgments** the signal from the EUT to the companion device is blocked by circulators in addition to the tunable attenuator.

The test **Transmission time after loss of acknowledgments** is performed by cutting-off the signal from the companion device by a RF switch the time until the EUT stops transmitting.

The **Transmission Duration** test is performed by monitoring the slot in use and measuring the time until the EUT changes to a different slot.

Test Results:

Acknowledgments

Test ref. to ANSI C63.17 clause 8.2.1	Observation	Verdict
a) Initial transmission without acknowledgments	0.4 ms	**Pass**
c) Transmission time after loss of acknowledgments	6.1 s	**Pass**

Transmission Duration

Test ref. to ANSI C63.17 clause 8.2.2	Observation	Verdict
b) Transmission duration on same time and frequency window	5 s	**Pass**

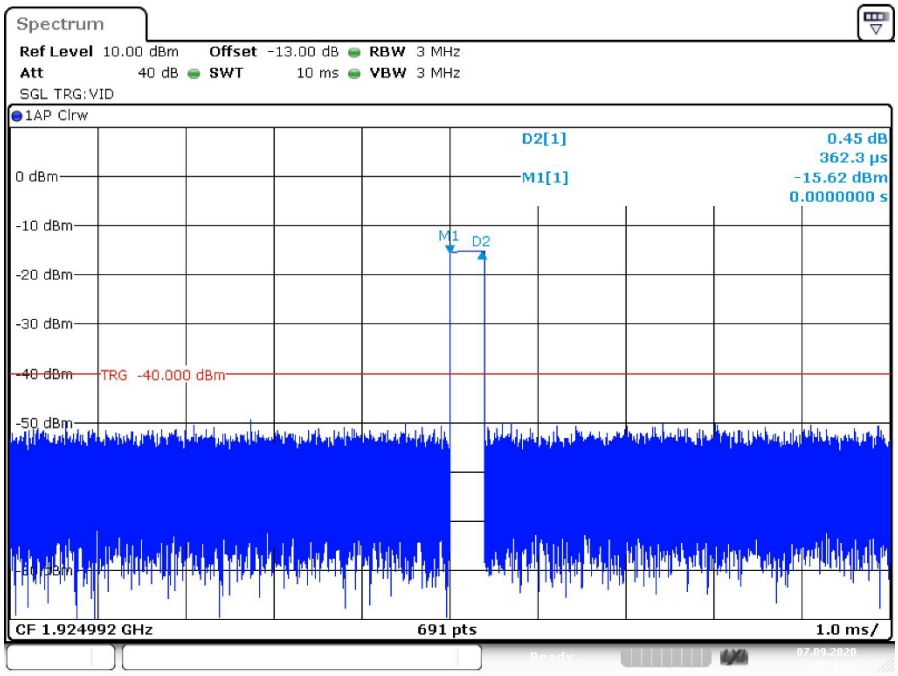
Comment: /

Limits: FCC 15.323(c)(3) and (4)

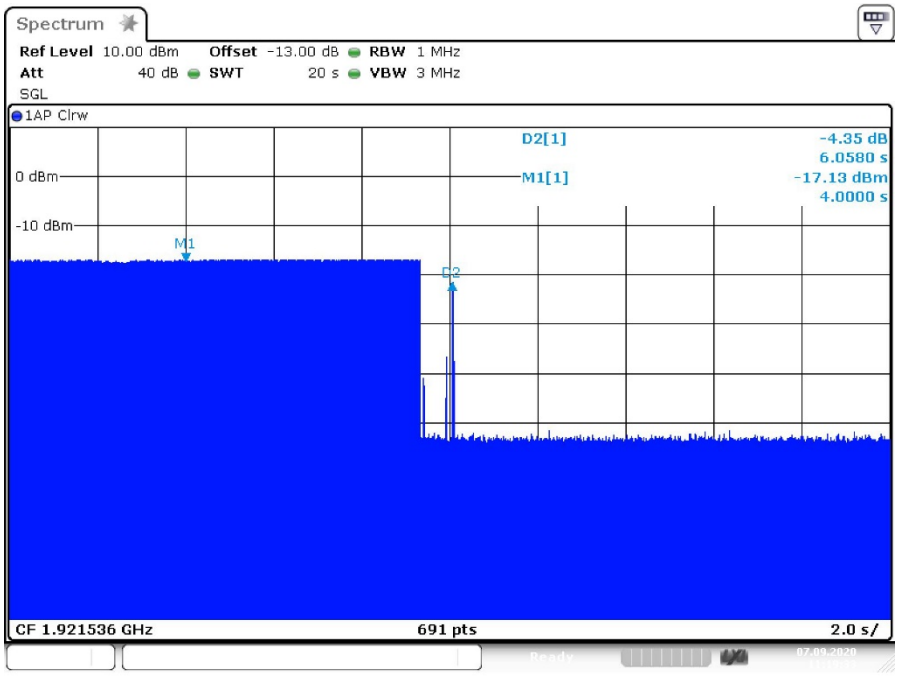
Occupation of the same combined time and spectrum windows by a device or group of cooperating devices continuously over a period of time longer than 8 hours is not permitted without repeating the access criteria.

Once access to specific combined time and spectrum windows is obtained an acknowledgment from a system participant must be received by the initiating transmitter within one second or transmission must cease.

Periodic acknowledgments must be received at least every 30 seconds or transmission must cease. Channels used exclusively for control and signaling information may transmit continuously for 30 seconds without receiving an acknowledgement, at which the time access criteria must be repeated.



8.2.1a) Initial Transmission Time without Acknowledgments



8.2.1c) Transmission Time after Loss of Acknowledgments

7.20 Dual Access Criteria Check

Measurement Procedure:

EUTs that do not implement the Upper Threshold: ANSI C62.17, clause 8.3.1
EUTs that implement the Upper Threshold: ANSI C62.17, clause 8.3.2
This test is required for equipment that uses the access criteria in FCC 15.323(c)(10).

Test Results:

EUTs that do NOT implement the LIC algorithm:

Test ref. to ANSI C63.17 clause 8.3.1	Observation	Verdict
b) EUT is restricted to a single carrier f_1 for TDMA systems. The test is pass if the EUT can set up a communication link.	N/A	**N/A**
c) d) No transmission on interference-free **receive** time/spectrum window. All transmit slots blocked	N/A	**N/A**
e) f) No transmission on interference-free **transmit** time/spectrum window. All transmit slots blocked	N/A	**N/A**

EUTs that implement the LIC algorithm:

Test ref. to ANSI C63.17 clause 8.3.2	Observation	Verdict
b) EUT is restricted to a single carrier f_1 for TDMA systems. The test is pass if the EUT can set up a communication link.	N/A	**N/A**
c) d) Transmission on interference-free **receive** time/spectrum window.	N/A	**N/A**
e) f) Transmission on interference-free **transmit** time/spectrum window.	N/A	**N/A**

Comment: This test is only applicable for EUTs that can be an initiating device of a duplex connection.

Limits: FCC 15.323(c)(10)

An initiating device may attempt to establish a duplex connection by monitoring both, its intended transmit and receive time and spectrum windows. If both the intended transmit and receive time and spectrum windows meet the access criteria, then the initiating device can initiate a transmission in the intended transmit time and spectrum window. if the power detected by the responding device can be decoded as a duplex connection signal from the initiating device, then the responding device may immediately begin transmitting on the receive time and spectrum window monitored by the initiating device.

7.21 Alternative monitoring interval

Test procedure described in ANSI C63.17, clause 8.4.

This test is required if the EUT implements the provision of FCC 15.323(c)(11).

Test Result:

Not tested. The tested EUT does not implement this provision. See manufacturer's declaration.

7.22 Spurious Emissions (Radiated)

Measurement Procedure:

FCC 15.209, FCC 15.109

Test Result: Pass

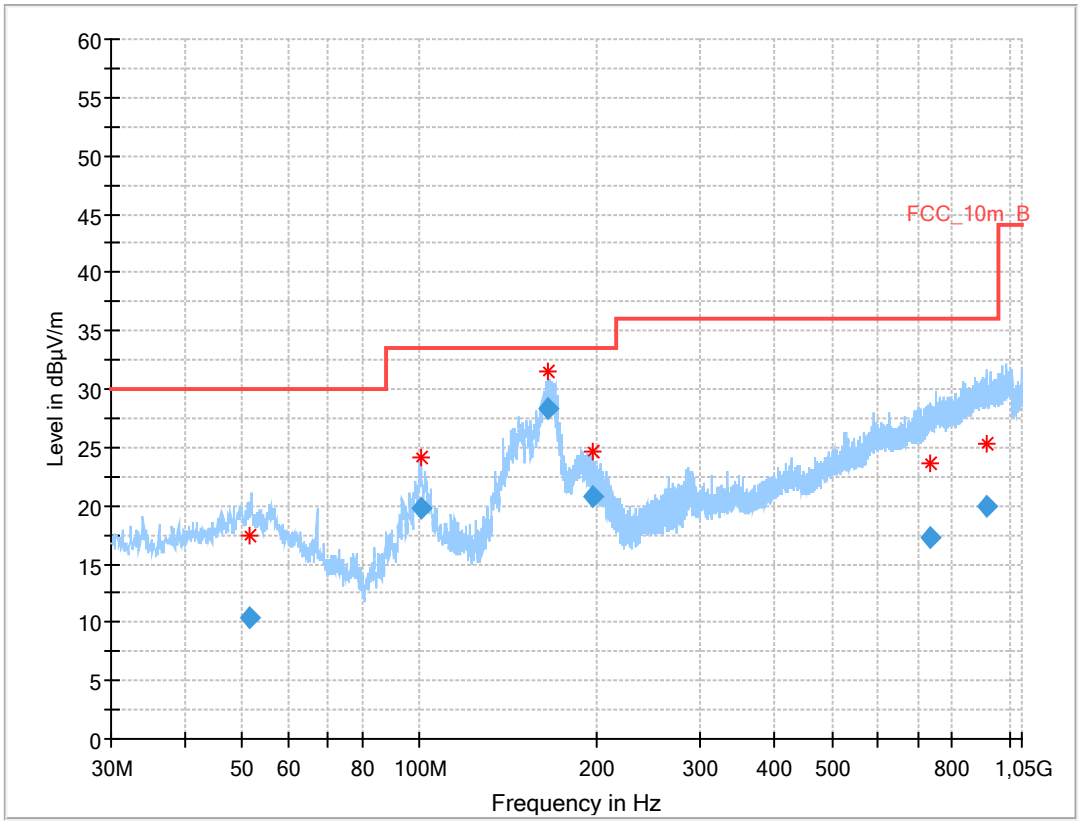
Measurement Data: See plots.

Requirement: FCC 15.109(b)

30 – 88 MHz:	90 µV/m
88 – 216 MHz:	150 µV/m
216 – 960 MHz:	210 µV/m
960 – 1000 MHz:	300 µV/m

Common Information

EUT:	RM-WCH-8 + RM-WOM + RM-WDR + RM-WGS + RM-WGL + PA-300C
Serial number:	Z6R000041 + Z6L000132 + Z6M000144 + Z6P000039 + Z6N000069 + JIID03P1SSY
Test description:	FCC part 15 class B @ 10 m
Operating condition:	charging four microphones
Operator name:	Hennemann
Comment:	AC: 115 V / 60 Hz

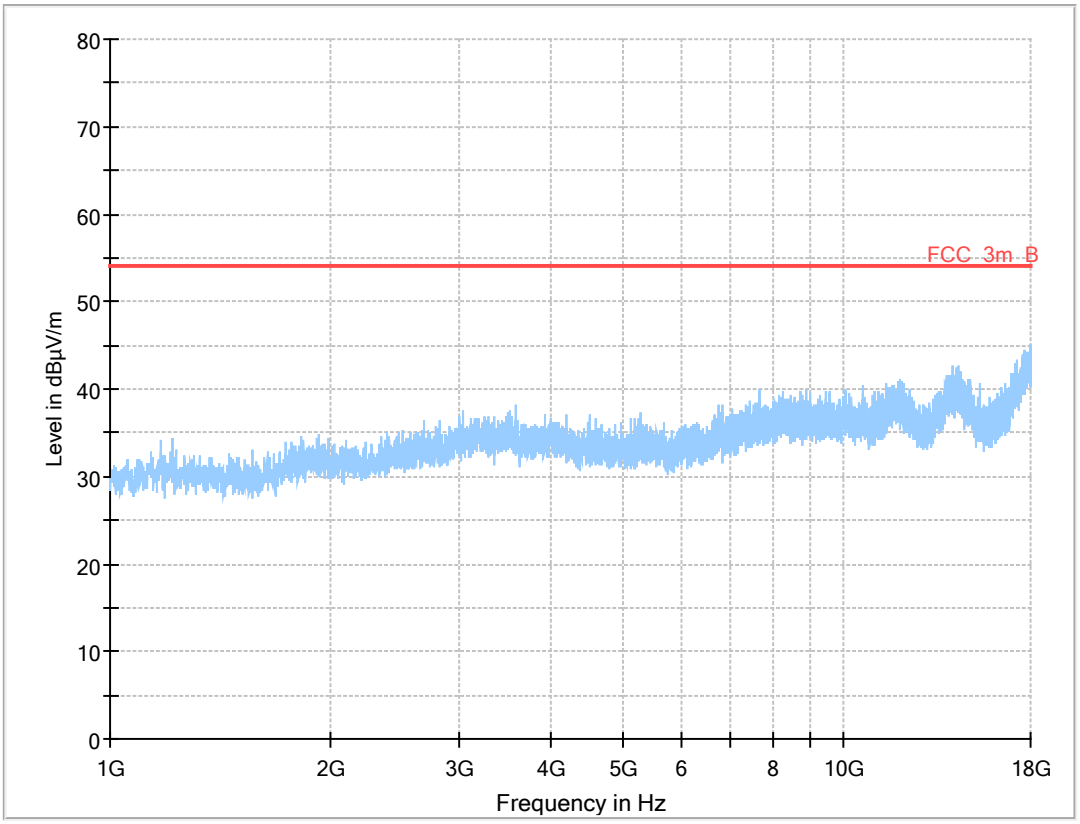


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.647	10.40	30.0	19.6	1000	120.0	127.0	V	180	14
100.577	19.86	33.5	13.6	1000	120.0	100.0	V	90	13
165.588	28.33	33.5	5.2	1000	120.0	100.0	V	354	10
196.667	20.77	33.5	12.7	1000	120.0	392.0	H	9	12
734.175	17.34	36.0	18.7	1000	120.0	209.0	V	15	22
912.805	19.94	36.0	16.1	1000	120.0	200.0	H	126	24

Common Information

EUT:	RM-WCH-8 + RM-WOM + RM-WDR + RM-WGS + RM-WGL + PA-300C
Serial number:	Z6R000041 + Z6L000132 + Z6M000144 + Z6P000039 + Z6N000069 + JIID03P1SSY
Test description:	FCC part 15 class B
Operating condition:	charging four microphones
Operator name:	Hennemann
Comment:	AC: 115 V / 60 Hz



The radiated spurious emission of the unintentional radiator is below the indicated limit.

7.23 Receiver Spurious Emissions

Measurement Procedure:

Industry Canada RSS-213 paragraph 6.8 and RSS-GEN paragraphs 4.8 and 6.

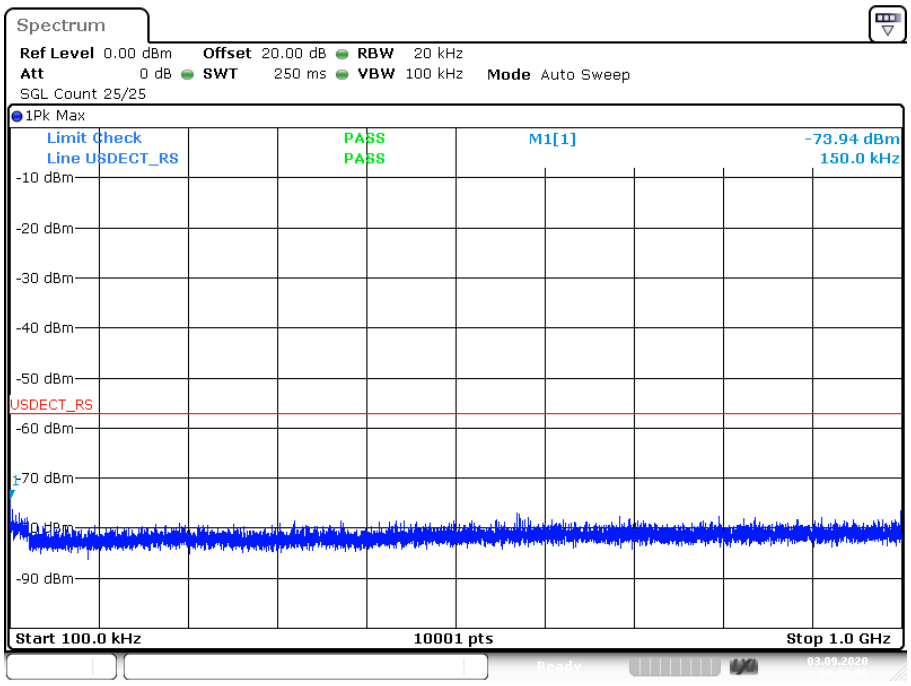
Test results:

Frequency MHz	Carrier No.	Measured Value Conducted dBm	Conducted Limit dBm	Margin dB
30 - 1000	all	-73.9	-57	16.9
> 1000	all	-70.7	-53	17.7

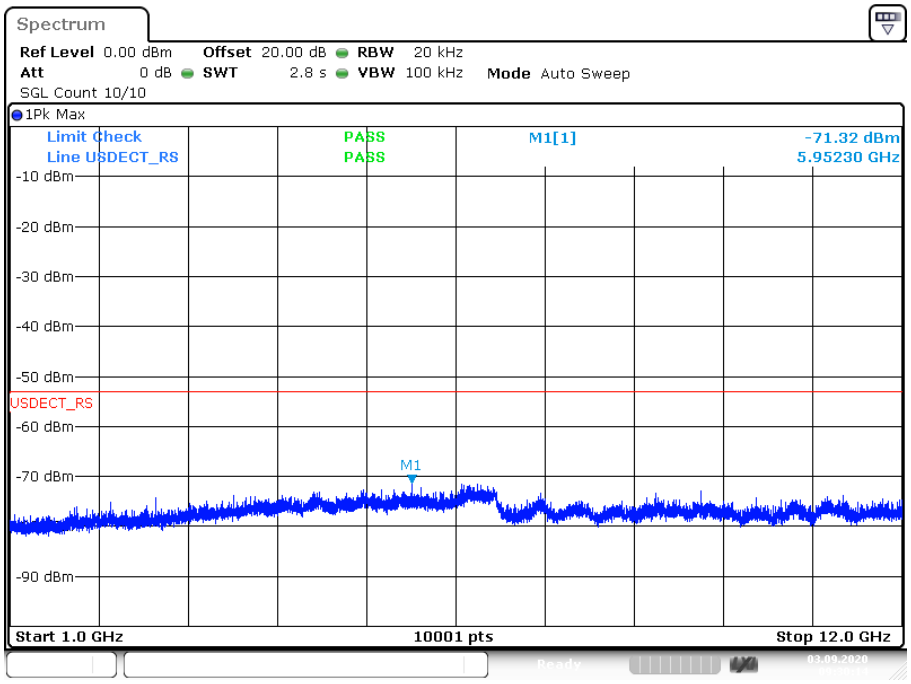
Requirements: RSS-GEN Issue 2, clause 6

The measurement can be performed either radiated or conducted.
When measured conducted: No spurious signals appearing at the antenna terminals shall exceed 2 nW per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nW above 1 GHz.

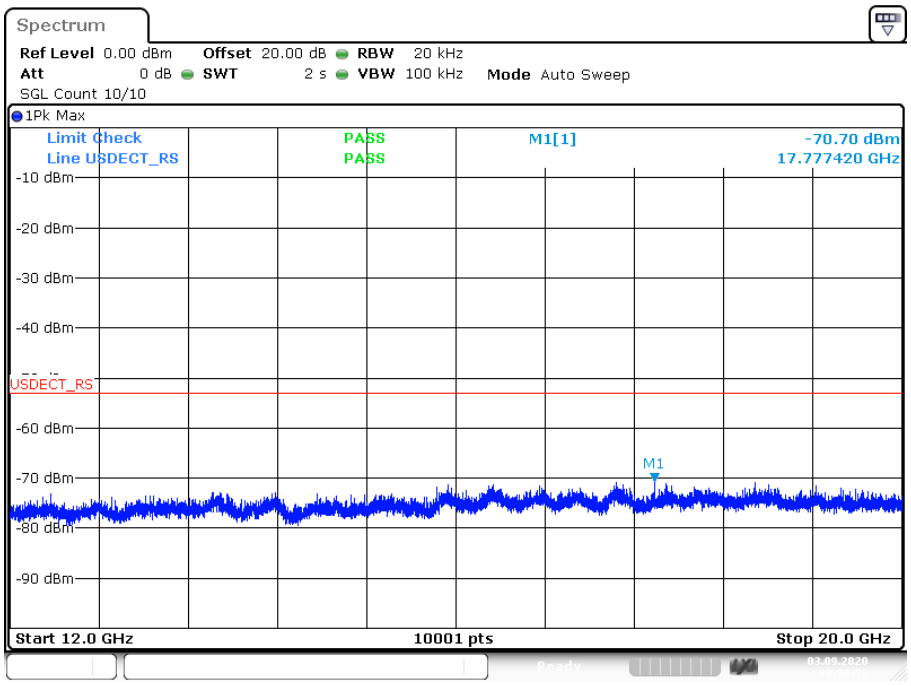
When measured radiated: See table 1 in RSS-GEN Issue2, clause 6.



Receiver Spurious Emissions, Conducted, 100 kHz – 1 GHz



Receiver Spurious Emissions, Conducted, 1 GHz – 12 GHz



Receiver Spurious Emissions, Conducted, 12 GHz – 20 GHz

8 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

No.	Equipment	Manufacturer	Type	Serial No.	Inv. No.	Kind of Calib.	Last Calib.	Next Calib.
	Conducted							
L-1	Spectrum Analyzer	R&S	FSV30	100763	300003950	k	12/2019	12/2020
L-2	Signal Generator	R&S	SMBV100A	257858	300004529	vlkI!	12/2017	12/2020
L-3	Signaling Unit	R&S	CMD 65	825486	300003611	vlkI!	03/2019	03/2021
L-4	Power Meter	R&S	NRP	100212	300003780	vlkI!	12/2018	12/2020
L-5	Power Sensor	R&S	NRP-Z22	100031	400000188	vlkI!	12/2019	12/2021

No.	Equipment	Manufacturer	Type	Serial No.	Inv. No.	Kind of Calib.	Last Calib.	Next Calib.
	Power Line Conducted Emission							
G-1	EMI Receiver	R&S	ESCI 3	100083	3000003312	k	12/2019	12/2020
G-2	VISN	R&S	ESH 3-Z5	893045/004	300000584	vlkI!	12/2018	12/2020

No.	Equipment	Manufacturer	Type	Serial No.	Inv. No.	Kind of Calib.	Last Calib.	Next Calib.
	Radiated Emission							
F-1	EMI Receiver	R&S	ESR3	102587	300005771	k	12/2019	12/2020
F-2	Spectrum Analyzer	R&S	FSU26	200809	300003874	k	12/2019	12/2020
F-3	Trilog Antenna	Schwarzbeck	VULB9163	371	300003854	vlkI!	11/2017	11/2020
F-4	Horn antenna	Schwarzbeck	BBHA9120B	188	300003896	vlkI!	04/2020	04/2022

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkI!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

9 Observations

No observations exceeding those reported with the single test cases have been made.

Annex A: Photographs of the Test Set-up

See additional PDF document Annex A-C.

Annex B: External Photographs of the EUT

See additional PDF document Annex A-C.

Annex C: Internal Photographs of the EUT

See additional PDF document Annex A-C.

Annex D: Document History

Version	Applied Changes	Date of Release

Annex E: Further Information

Glossary

DUT	-	Device under Test
EMC	-	Electromagnetic Compatibility
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	not applicable
S/N	-	Serial Number
SW	-	Software

Annex F: Accreditation Certificate

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	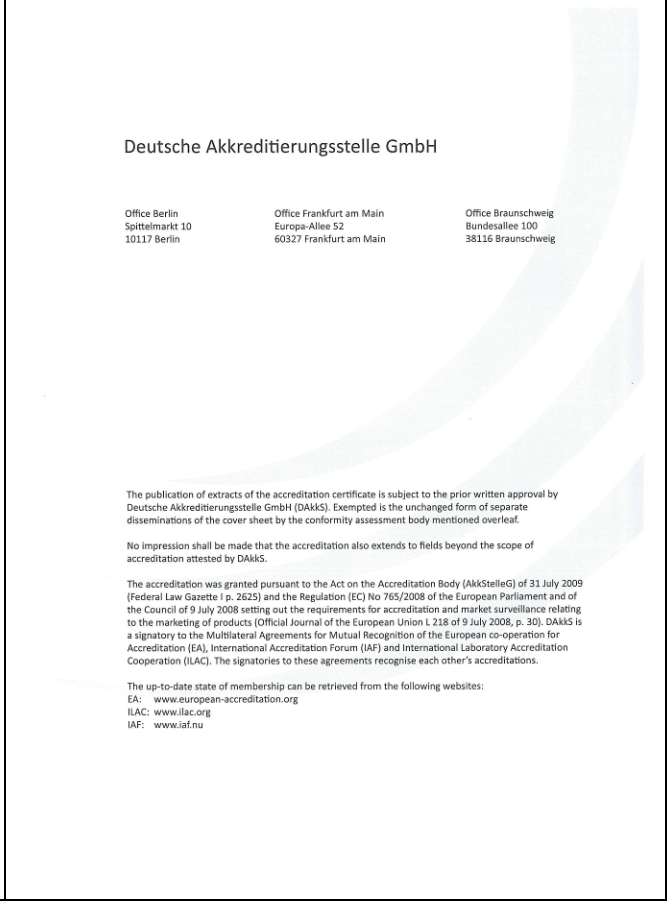

first page	last page

DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory

CTC advanced GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields:

Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards

The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 07 pages.

Registration number of the certificate: **D-PL-12076-01-04**

Frankfurt am Main, 09.06.2020

by order Dipl.-Ing. (FH) Ralf Egner
Head of Division

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.
https://www.dakks.de/en/content/accredited-bodies-dakks

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

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10117 Berlin

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Office Braunschweig
Bundesallee 100
38116 Braunschweig

The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Note:
The current certificate including annex can be received on request.