

# Test Report

<b>Product</b>	Location transmitter for indoors way finding and tracking	
<b>Name and address of the applicant</b>	Sonor Technologies AS Drammensveien 288, 0283 Oslo, Norway	
<b>Name and address of the manufacturer</b>	Sonor Technologies AS Drammensveien 288, 0283 Oslo, Norway	
<b>Model</b>	INF-C322	
<b>Rating</b>	6Vdc (4x1.5V AA battery)	
<b>Trademark</b>	ultraBeacon™	
<b>Serial number</b>	Radiated sample: 660; Conducted sample: 657	
<b>Additional information</b>	This tested device supports both IEEE802.15.4 based and BLE radio technologies. This test report covers only IEEE802.15.4	
<b>Tested according to</b>	<b>FCC Part 15.247</b> Frequency Hopping Transmitters / Digital Transmission Systems <b>Industry Canada RSS-247, Issue 2</b> Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices	
<b>Order number</b>	379748	
<b>Tested in period</b>	2019.10.23 – 2019.10.25	
<b>Issue date</b>	2019.10.30	
<b>Name and address of the testing laboratory</b>	 Institutveien 6 Kjeller, Norway CAB Number: FCC: NO0001 ISED: NO0470 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50	 
<i>An accredited technical test executed under the Norwegian accreditation scheme</i>		
		
Prepared by [G.Suhanthakumar]		
		
Approved by [Frode Sveinsen]		
This report shall not be reproduced except in full without the written approval of Nemko. Opinions and interpretations expressed within this report are not part of the current accreditation. This report was originally distributed electronically with digital signatures. For more information contact Nemko.		

Template version: C

## CONTENTS

<b>1 INFORMATION .....</b>	<b>3</b>
1.1 Test Item.....	3
1.2 Normal test condition.....	4
1.3 Test Engineer(s) .....	4
1.4 Description of modification for Modification Filing .....	4
1.5 Family List Rational .....	4
1.6 Antenna Requirement.....	4
1.7 Worst-Case Configuration and Mode .....	4
1.8 Comments .....	4
<b>2 TEST REPORT SUMMARY .....</b>	<b>5</b>
2.1 General.....	5
2.2 Test Summary .....	6
<b>3 TEST RESULTS.....</b>	<b>7</b>
3.1 Test Frequencies.....	7
3.2 99% Occupied Bandwidth .....	8
3.3 DTS Bandwidth.....	11
3.4 Peak Power Output .....	14
3.5 Conducted Emissions at Antenna Connector.....	20
3.6 Restricted Bands of operation .....	24
3.7 Spurious Emissions (Radiated) .....	25
3.8 Power Spectral Density (PSD).....	46
<b>4 Measurement Uncertainty.....</b>	<b>49</b>
<b>5 LIST OF TEST EQUIPMENT .....</b>	<b>50</b>
<b>6 BLOCK DIAGRAM.....</b>	<b>51</b>
6.1 Power Line Conducted Emission.....	51
6.2 Test Site Radiated Emission .....	51

# 1 INFORMATION

## 1.1 Test Item

<b>Name</b>	ultraBeacon™
<b>FCC ID</b>	2AD7T21118051701
<b>ISED ID</b>	2030-21118051701
<b>Model/version</b>	INF-C322
<b>Serial number</b>	Radiated sample: 660; Conducted sample: 657
<b>Hardware identity and/or version</b>	V2.00
<b>Software identity and/or version</b>	INF-C322-1.1.0-rc 1.52638
<b>Frequency Range</b>	2400 – 2483.5 MHz
<b>Tunable Bands</b>	None
<b>Number of Channels</b>	16
<b>Operating Modes</b>	TX and RX
<b>Measured BW (99%)</b>	2.30 MHz
<b>Emission clasification</b>	F2D
<b>Transmitter spurious, dB<math>\mu</math>V/m@3m</b>	PK: 60.85; AV: 40.85 ((2.4835GHz))
<b>Type of Modulation</b>	O-QPSK modulation
<b>User Frequency Adjustment</b>	None
<b>Conducted Output Power, Max</b>	0.00224 W (3.51dBm)
<b>Type of Power Supply</b>	6Vdc
<b>Antenna Connector</b>	No, integral antenna
<b>Number of Antennas</b>	1
<b>Diversity or Smart Antennas</b>	No
<b>Desktop Charger</b>	N/A

### Description of Test Item

The ultraBeacon is a combined BLE and ultrasound beacon used as a part of Forkbeard platform for indoors positioning.

The Forkbeard platform delivers near 100 times better distance accuracy than Bluetooth signals alone, allowing you to get down to centimeter level location accuracy in indoor environments. Combining the strength of ultrasound and Bluetooth with the formidable array of sensor technologies found in modern device platforms, Forkbeard accurately positions mobile devices such as smartphones, tablets and laptops with a latency of only up to 1 – 2 seconds. Moreover, the ultrasound technology always ensures >99.9% room-level location accuracy, which makes Forkbeard the only indoor positioning technology needed for any workflow, and way-finding applications.

## 1.2 Normal test condition

Temperature: 20 - 24 °C  
Relative humidity: 20 - 50 %  
Normal test voltage: 6Vdc

The values are the limit registered during the test period.

## 1.3 Test Engineer(s)

G.Suhanthakumar

## 1.4 Description of modification for Modification Filing

Not applicable.

## 1.5 Family List Rational

Ultrasonic varriants

Model/type	Comment	Tested
INF-C322	The only test repeated with both PBA variants is FCC 18.305: PBA variant 21314134 with Ultrasonic transducers: 40 kHz: Murata, MA40S4S 20 kHz: APC International, Ltd, 20T-16W	<input checked="" type="checkbox"/>
INF-C322	The only test repeated with both PBA variants is FCC 18.305: PBA variant 21314114 with Ultrasonic transducers: 40 kHz: Seltech, KTC10P070P02-40000 20 kHz: Seltech, KTC16P120P02-20250	<input checked="" type="checkbox"/>

## 1.6 Antenna Requirement

Is the antenna detachable?

Yes  No

If detachable, is the antenna connector non-standard?

Yes  No

Type of antenna connector: RP-SMA

Ref. FCC §15.203

## 1.7 Worst-Case Configuration and Mode

Radiated Emissions were performed with the EUT set to transmit at the channel with the highest output power as worst-case scenario.

## 1.8 Comments

All measurements were done with the EUT powered by a fully charged battery.

All ports were populated during spurious emission measurements.

## 2 TEST REPORT SUMMARY

### 2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and ISED Canada RSS-247 Issue 2 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 1m, 3m and 10m.

A description of the test facility is on file with FCC and ISED.

<input checked="" type="checkbox"/> New Submission	<input checked="" type="checkbox"/> Production Unit
<input type="checkbox"/> Class II Permissive Change	<input type="checkbox"/> Pre-production Unit
<b>DTS</b> Equipment Code	<input type="checkbox"/> Family Listing



#### THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

Nemko Group authorizes the above named entity to reproduce this report provided it is reproduced in its entirety and for use by the entity's employees only. Any reproduction of parts of this report requires approval in writing from Nemko Group.

Any use that a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Group accepts no responsibility for damages suffered by any third party caused by decisions made or actions based on this report.

## 2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2, RSS-GEN Issue 5 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	N/A <sup>1</sup>
Number of frequencies	15.31(m)	6.8 (RSS-GEN)	Complies
Antenna Requirement	15.203	6.8 (RSS-GEN)	N/A <sup>2</sup>
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	N/A <sup>1</sup>
99% Occupied Bandwidth	N/A	6.7 (RSS-GEN)	Complies
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	Complies
Power Spectral Density	15.247(e)	5.2 (2) (RSS-247)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)(d)	5.5 (RSS-247)	Complies
Spurious Emissions (Radiated)	15.247(c)(d) 15.109(a) 15.209(a)	5.5 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	Complies

<sup>1</sup> Battery operated device

<sup>2</sup> Integral antenna only

## Revision history

Version	Date	Comment	Sign
00	2019.10.30	First Version	gns

## 3 TEST RESULTS

### 3.1 Test Frequencies

FCC Part 15.31 (m)

RSS-Gen 6.8

Authorized Band:	2400 - 2483.5 MHz
Frequency band width:	83.5MHz
Low Channel:	2405MHz
Mid channel:	2440MHz
High Channel:	2480MHz

### 3.2 99% Occupied Bandwidth

**RSS-Gen, 6.7**

**ISED Canada RSS-247 Issue 2, Clause 5.1**

**ISED Canada RSS-GEN Issue 5, Clause 6.7**

**Measurement procedure: ANSI C63.10-2013 Clause 6.9.2 / 7.8.3**

**Test Results:** Complies

**Measurement Data:**

Channel Frequency (MHz)	Measured 99% BW (MHz)
2405	2.29
2440	2.29
2480	2.30

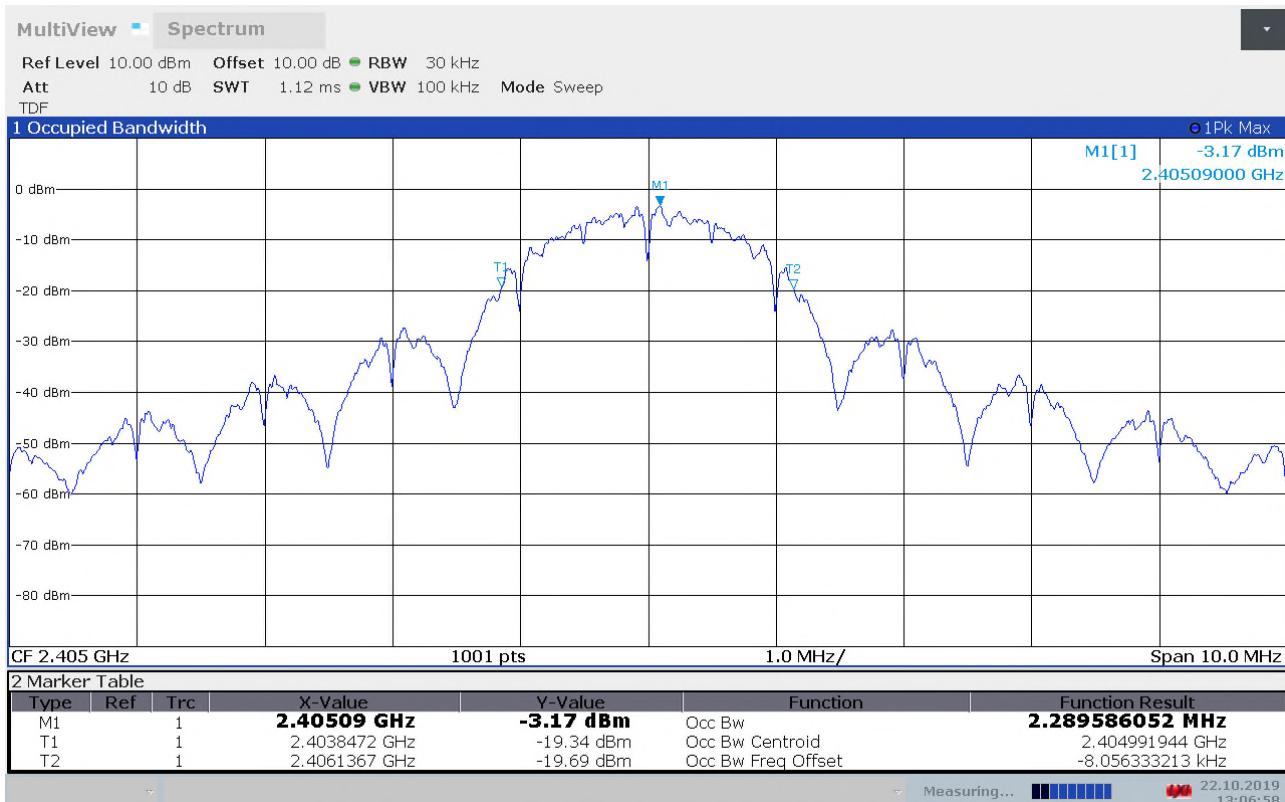
See attached plots.

#### **Requirements:**

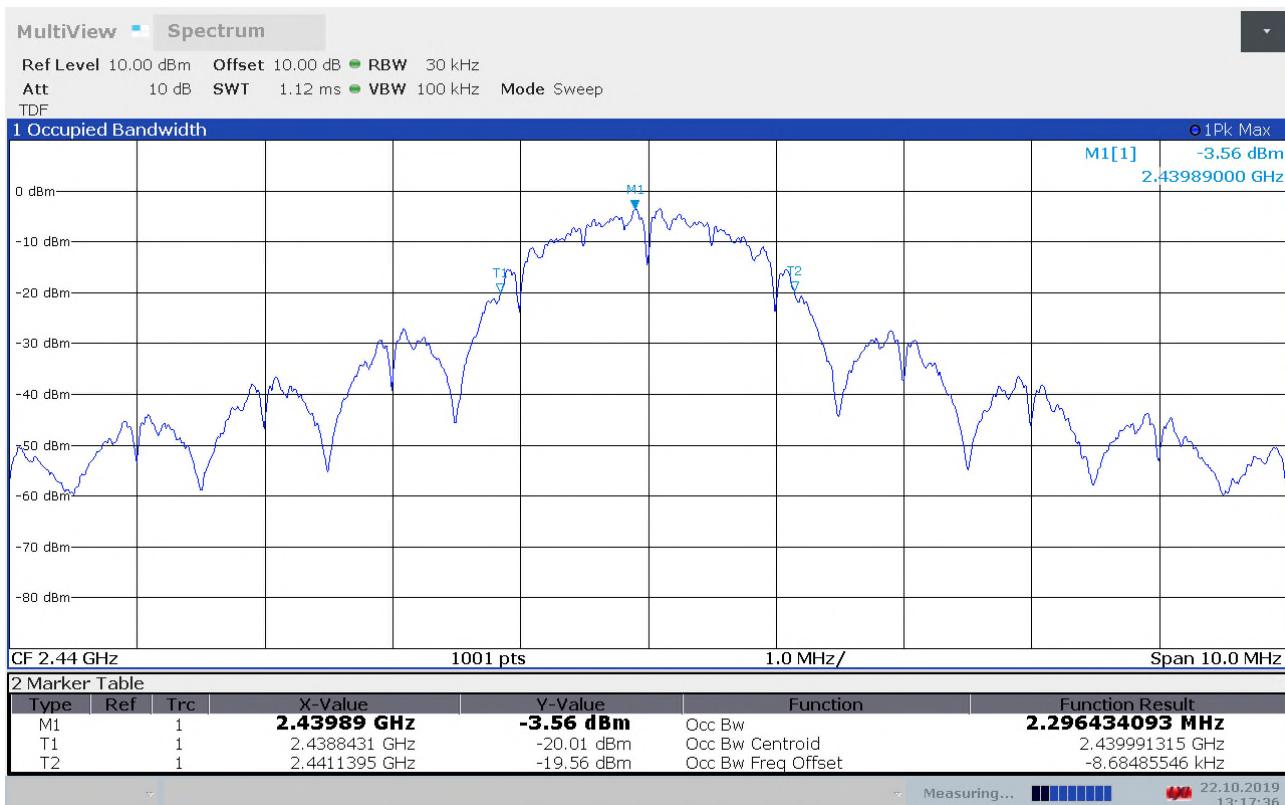
Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

No requirements for Digital Transmission Systems.

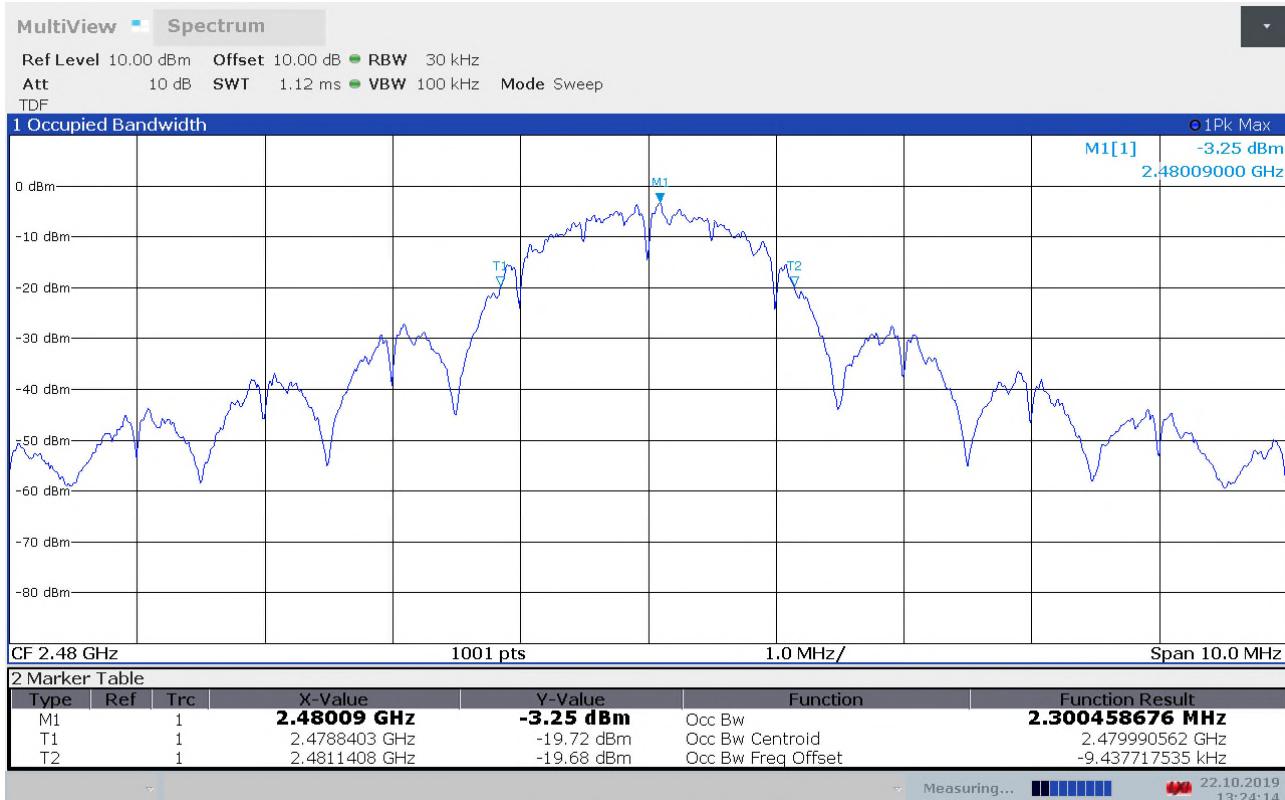
No requirement for 99% BW.



### 99% Bandwidth , ch2405MHz



### 99% Bandwidth , ch2440MHz



**99% Bandwidth , ch2480MHz**

### 3.3 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 2, Clause 5.2 (a)

Measurement procedure: ANSI C63.10-2013 Clause 11.8

Test Results: Complies

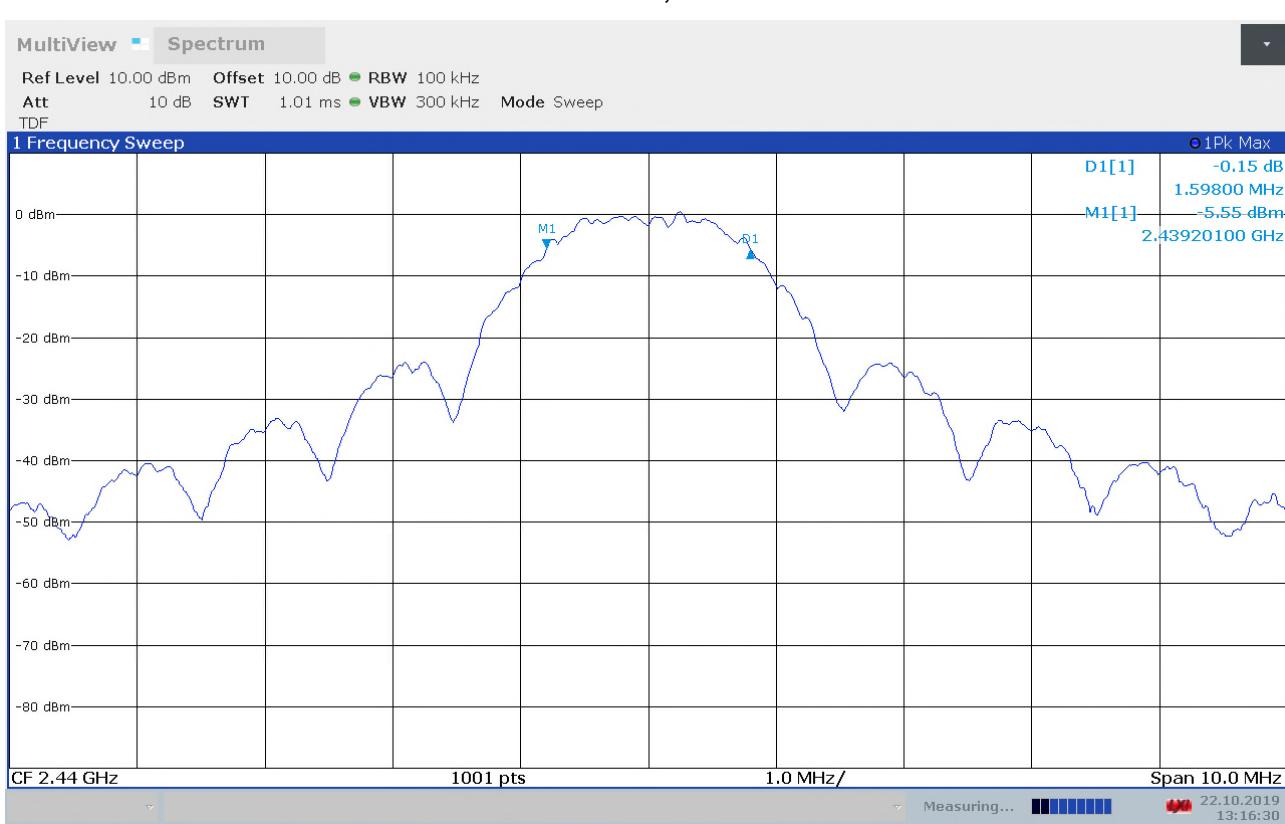
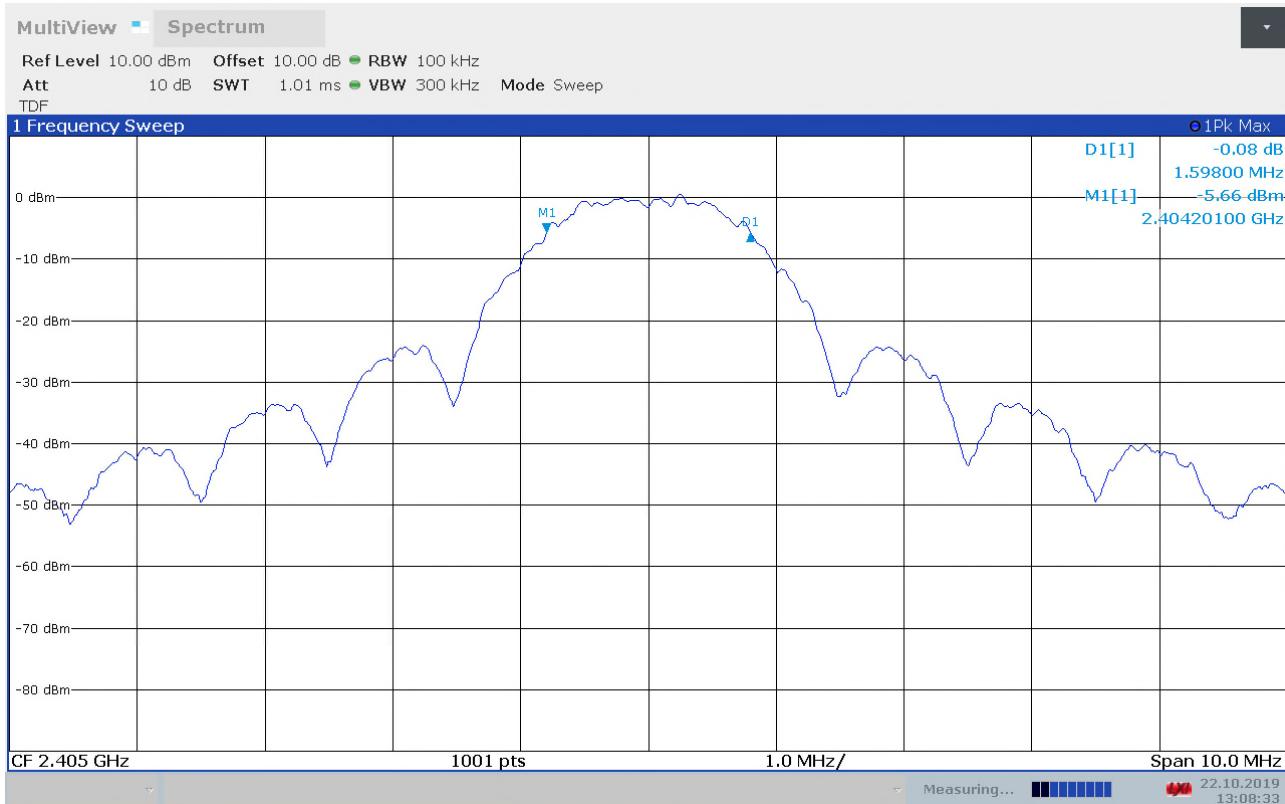
Measurement Data:

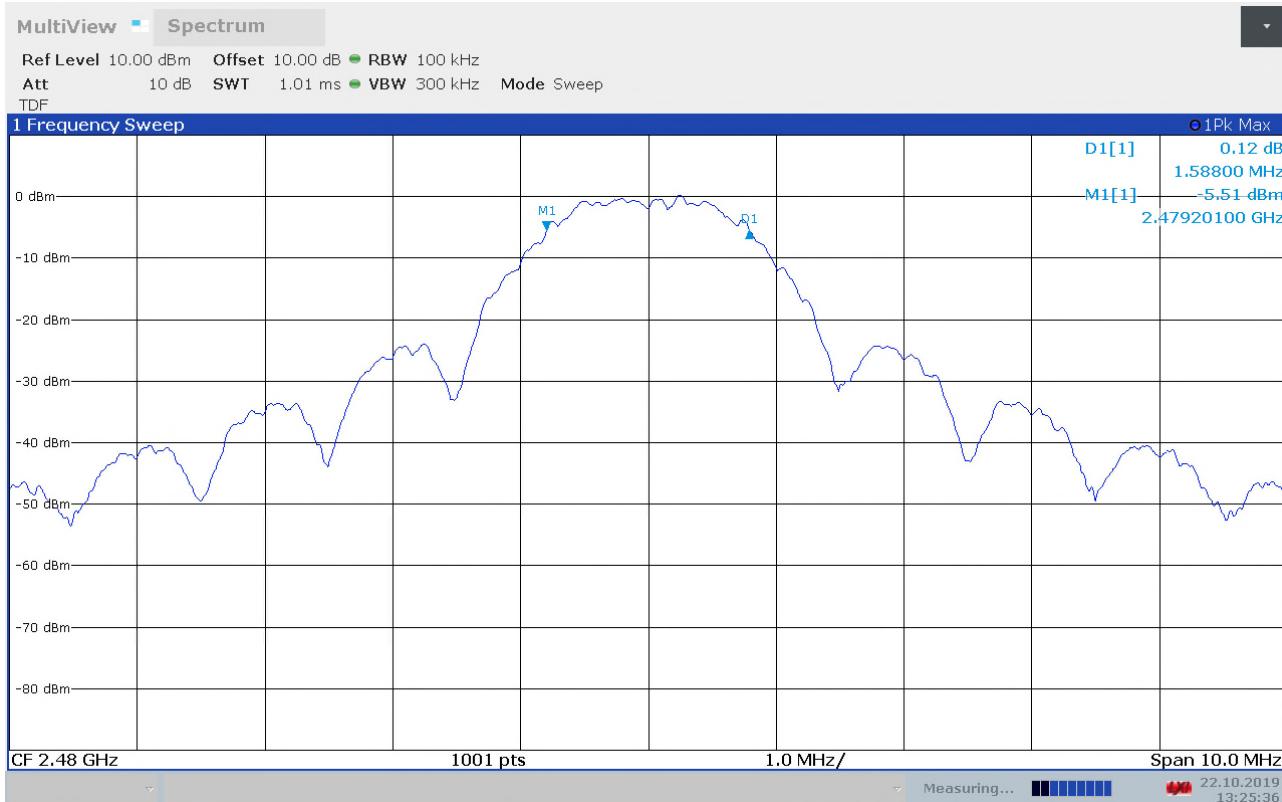
Channel Frequency (MHz)	Measured DTS BW (MHz)
2405	1.59
2440	1.59
2480	1.59

#### Requirements:

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

No requirements for Frequency Hopping Systems.





**DTS Bandwidth, ch2480MHz**

### 3.4 Peak Power Output

FCC part 15.247 (b)

ISED Canada RSS-247 Issue 2, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

Measurement Data:

	2405 MHz	2440 MHz	2480 MHz
<b>Conducted Power (dBm)</b>	3.51	3.40	3.29
<b>Conducted Power (Watts)</b>	0.00224	0.00219	0.00213
<b>Internal antenna:</b> <b>Field Strength (dB<math>\mu</math>V/m), HP</b>	94.97	94.01	97.24
<b>EIRP, Calculated (mWatts)</b>	0.94	0.76	0.50
<b>Antenna gain (dBi)</b>	-3.8	-4.6	-6.3

Antenna gain =  $10 \times \log(EIRP/Conducted\ power)$  dBi

EIRP is calculated from measured field strength by the formulas in KDB 412172 D01 Determining ERP and EIRP v01.

See attached plots.

#### Requirements:

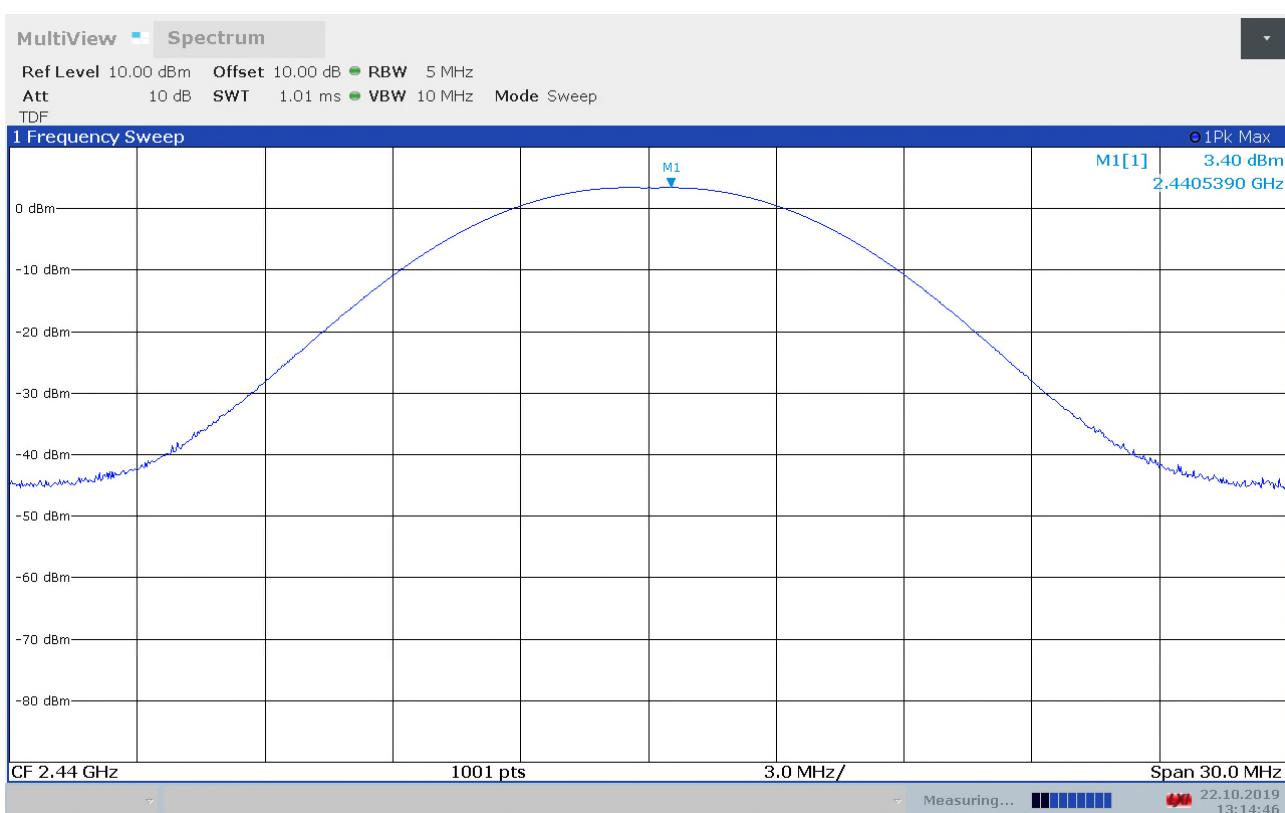
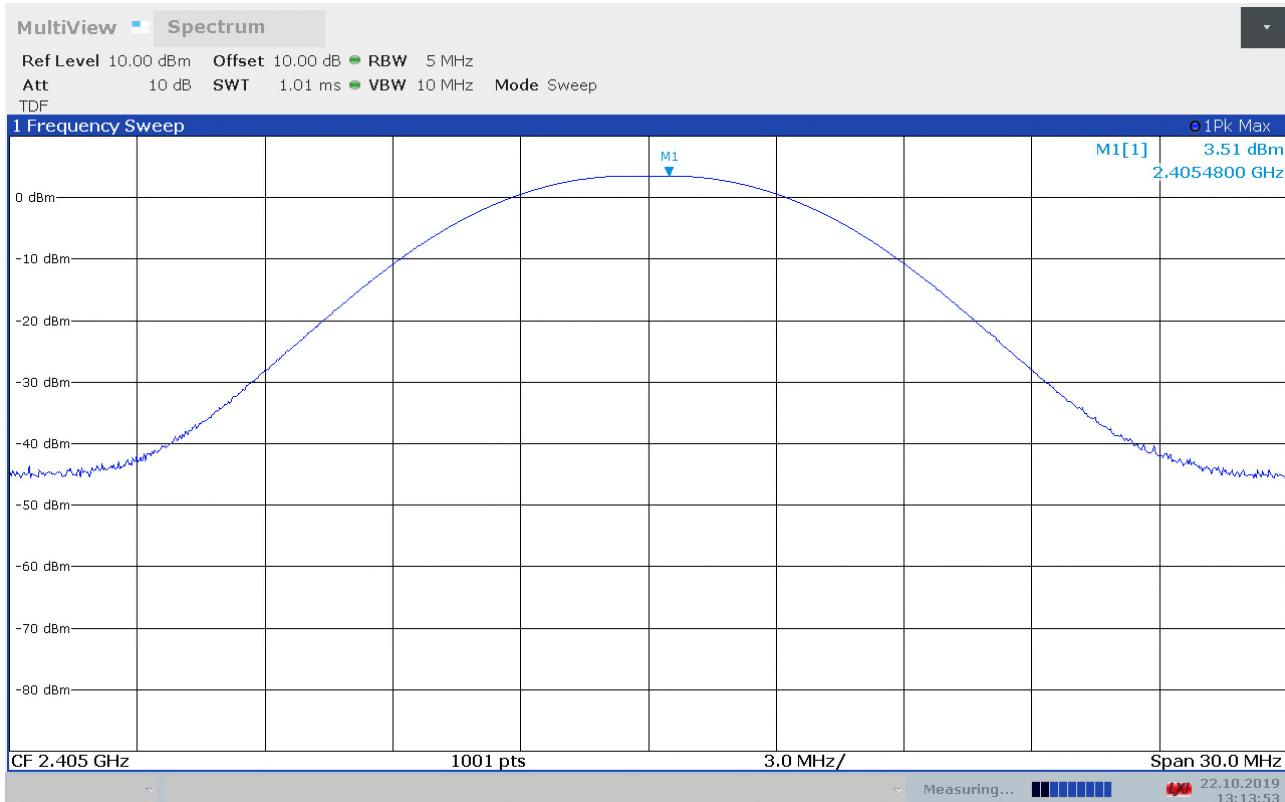
The maximum peak output power shall not exceed the following limits:

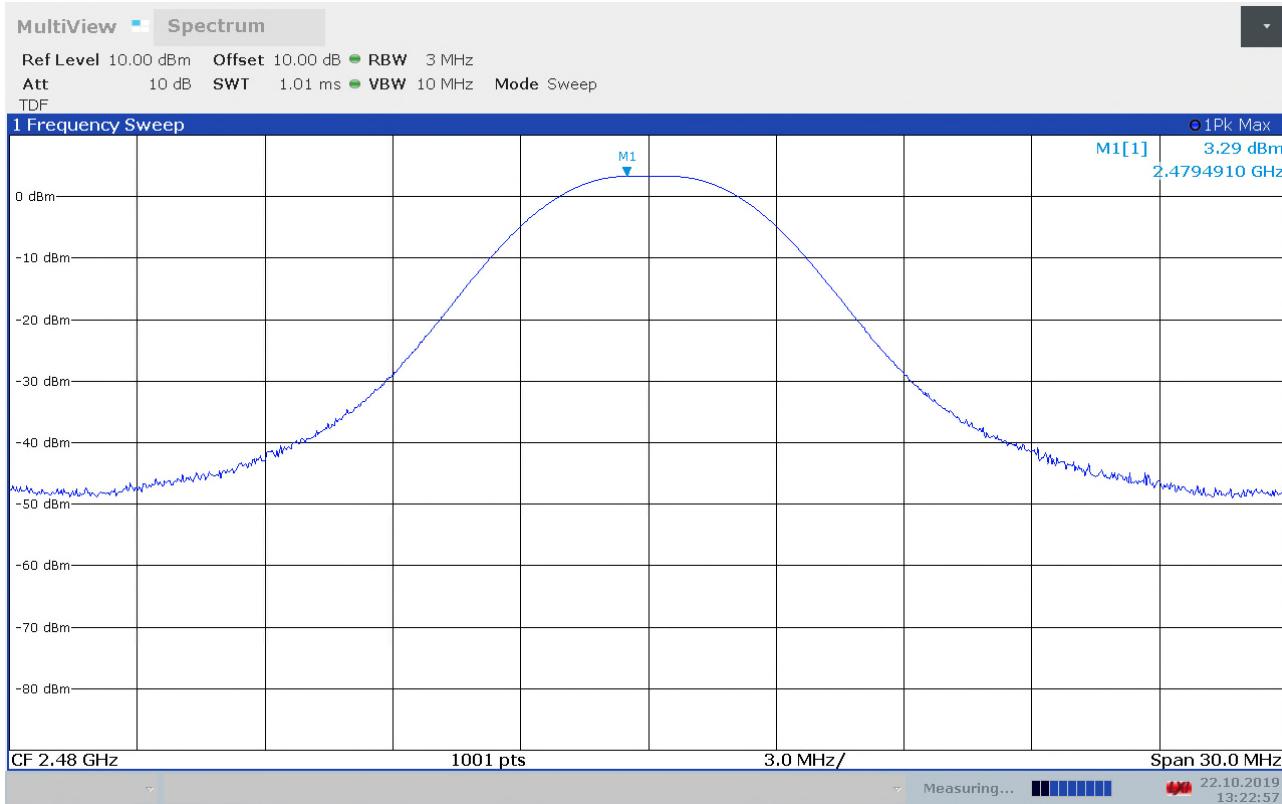
For frequency hopping systems employing at least 75 hopping channels: 1 Watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

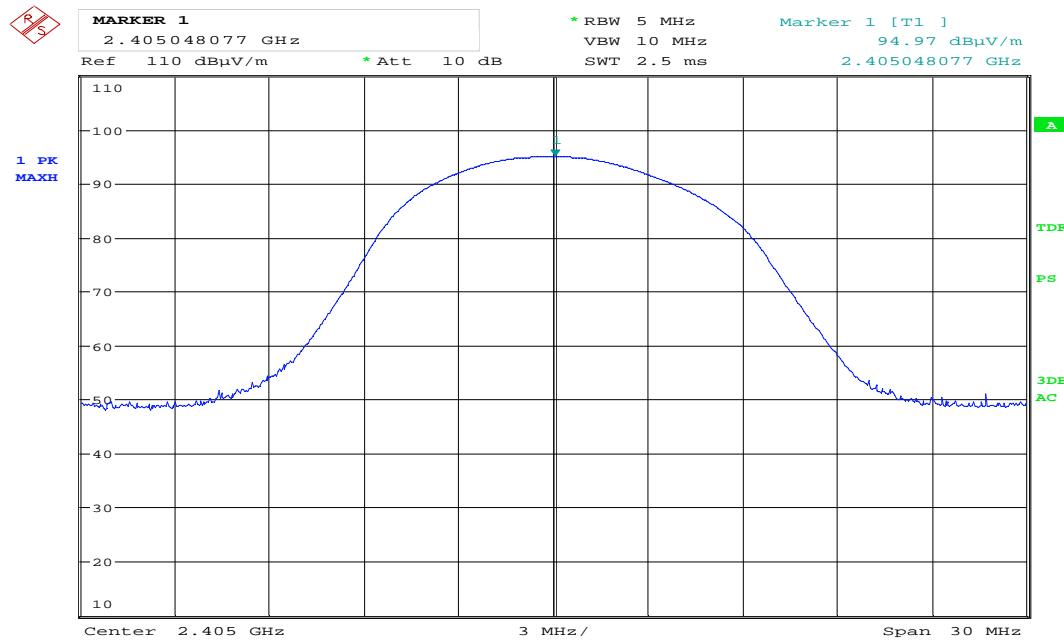
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



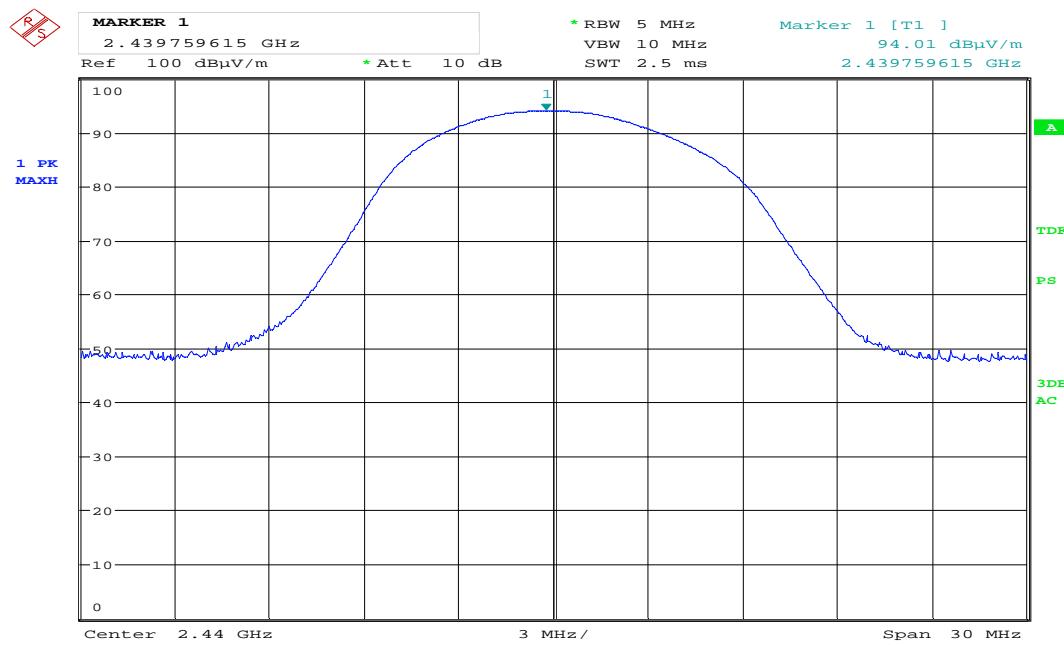


Conducted Power, Ch2480MHz



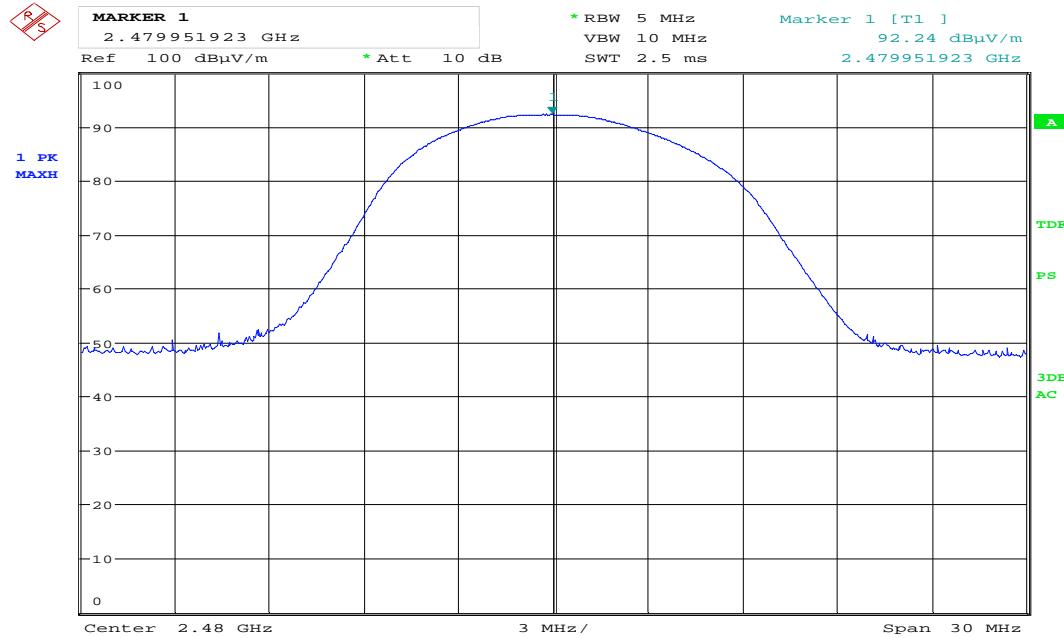
Date: 23.OCT.2019 10:24:53

### Measured Field Strength, HP, ch2405MHz



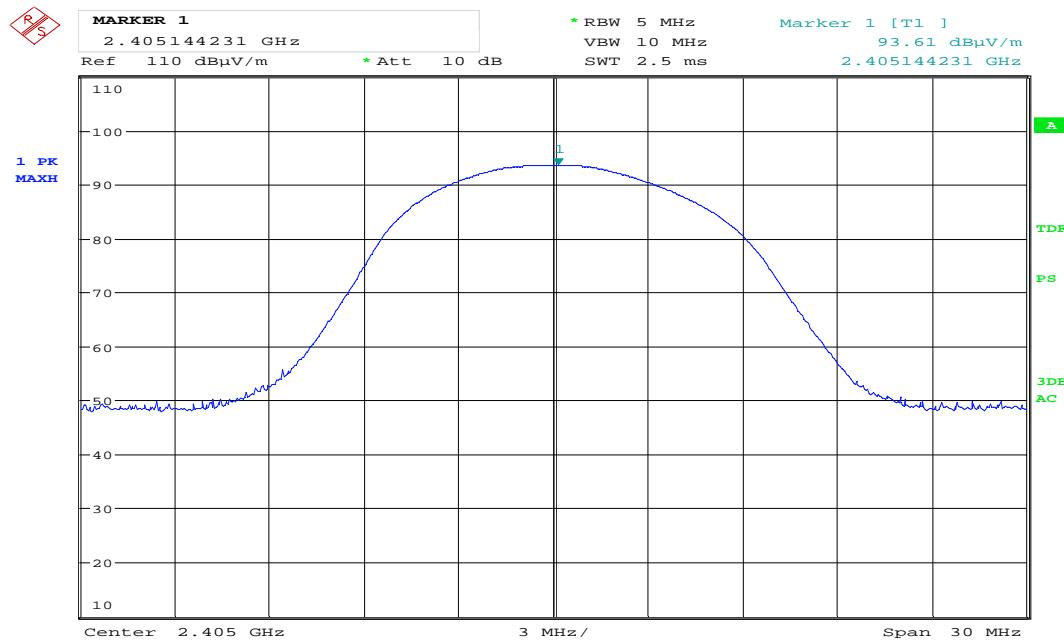
Date: 23.OCT.2019 10:53:22

### Measured Field Strength, HP, ch2440MHz



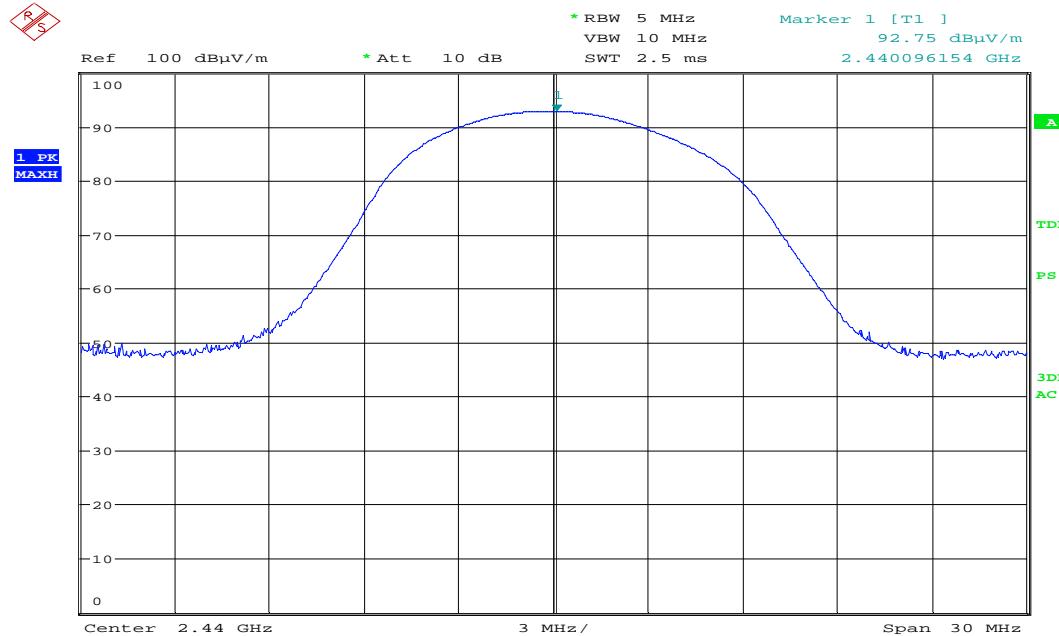
Date: 23.OCT.2019 11:00:10

### Measured Field Strength, HP, ch2480MHz



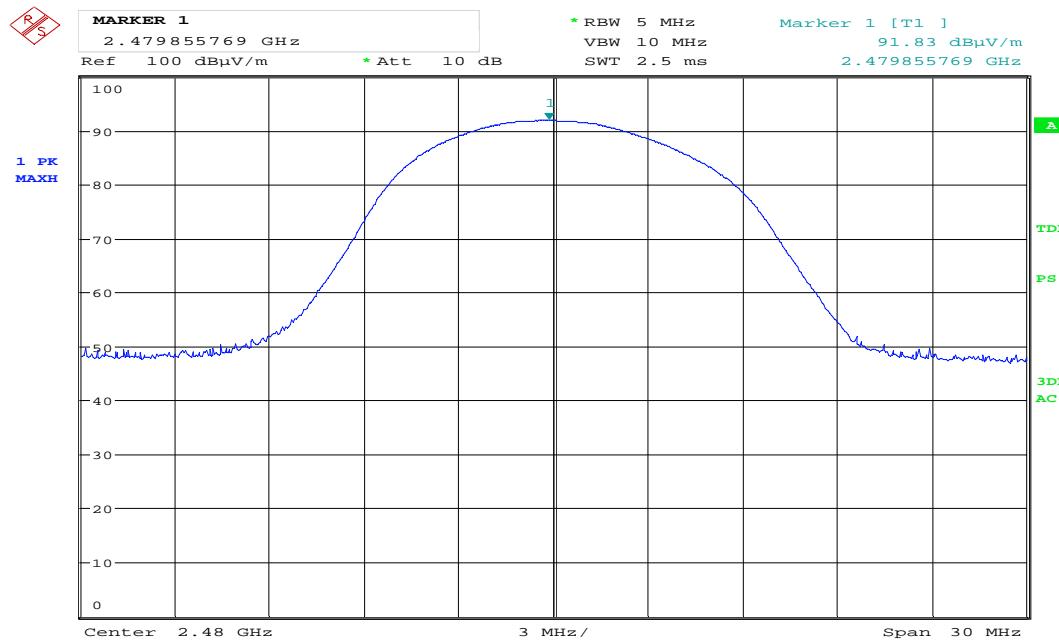
Date: 23.OCT.2019 10:17:56

### Measured Field Strength, VP, ch2405MHz



Date: 23.OCT.2019 10:54:51

### Measured Field Strength, VP, ch2440MHz



Date: 23.OCT.2019 13:51:41

### Measured Field Strength, VP, ch2480MHz

### 3.5 Conducted Emissions at Antenna Connector

Para. No.: 15.247 (d)

ISED Canada RSS-247 Issue 2, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2405 MHz	42.2	>30	Pass
2440 MHz	43.4	>30	Pass
2480 MHz	47.1	>30	Pass

Measured with Peak Detector

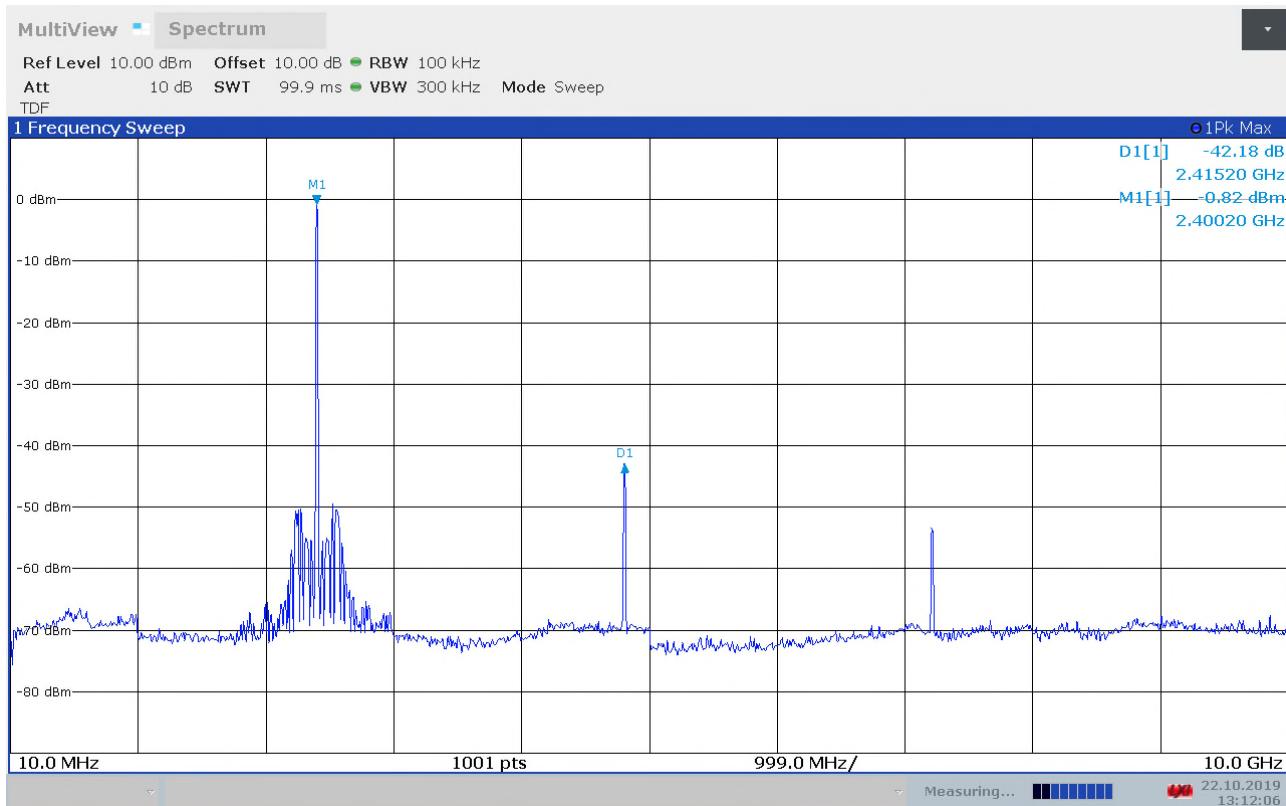
RF conducted power to 25 GHz: see attached plots.

#### Limit

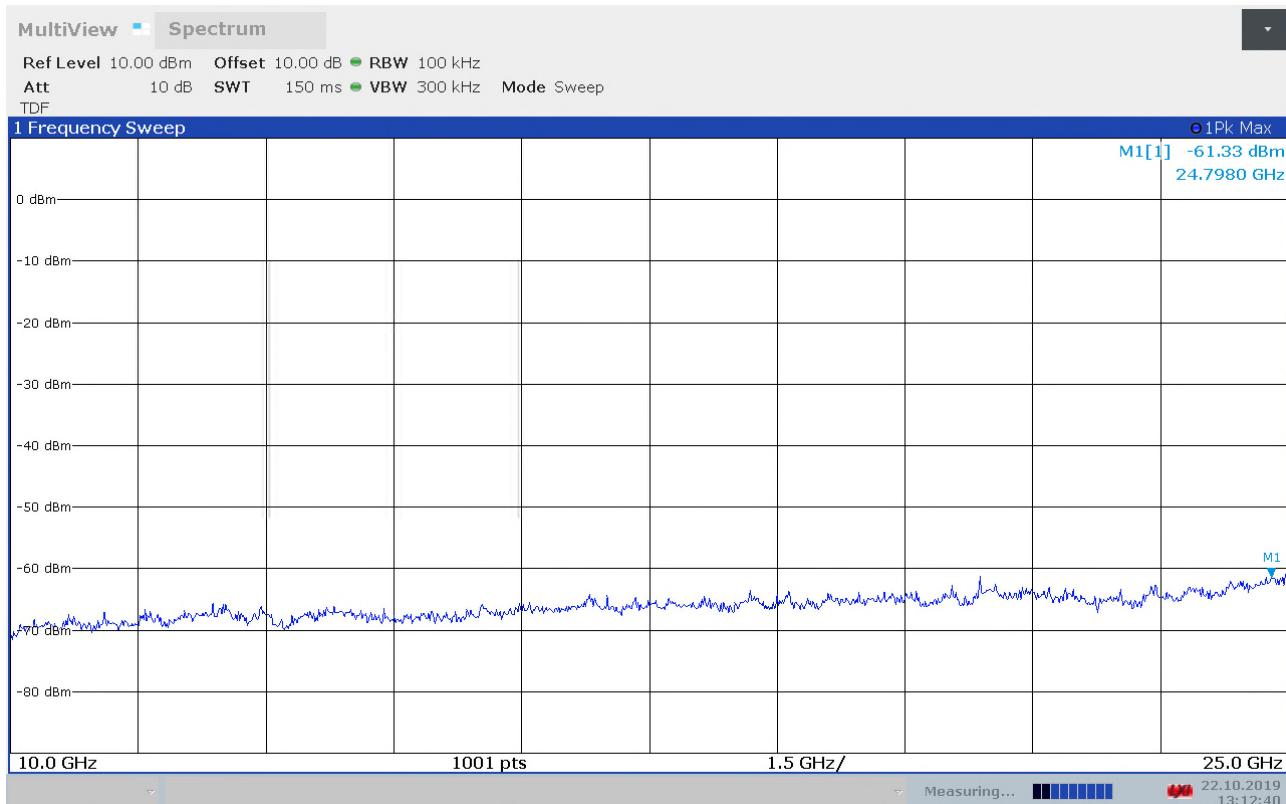
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

Detector type shall be the same as used for measuring Output Power.

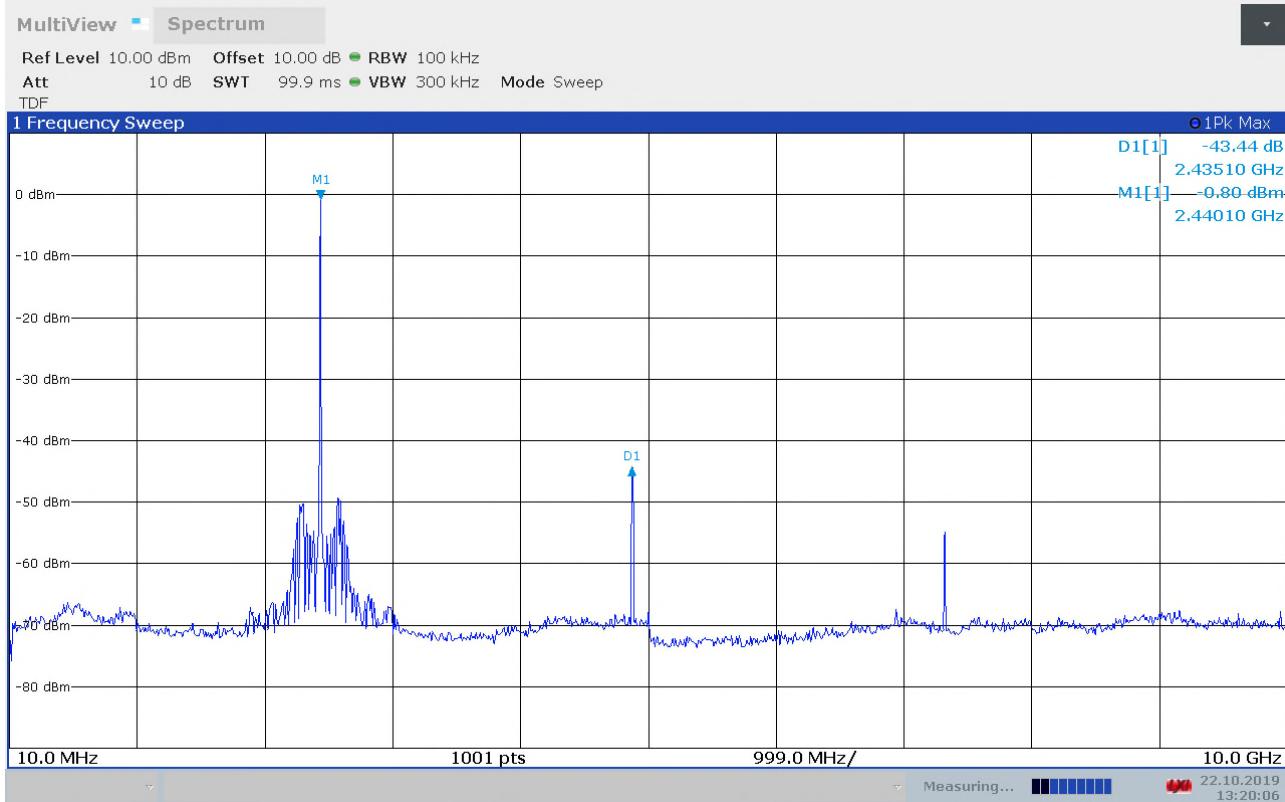
Attenuation below the general limits specified in part 15.209(a) is not required.



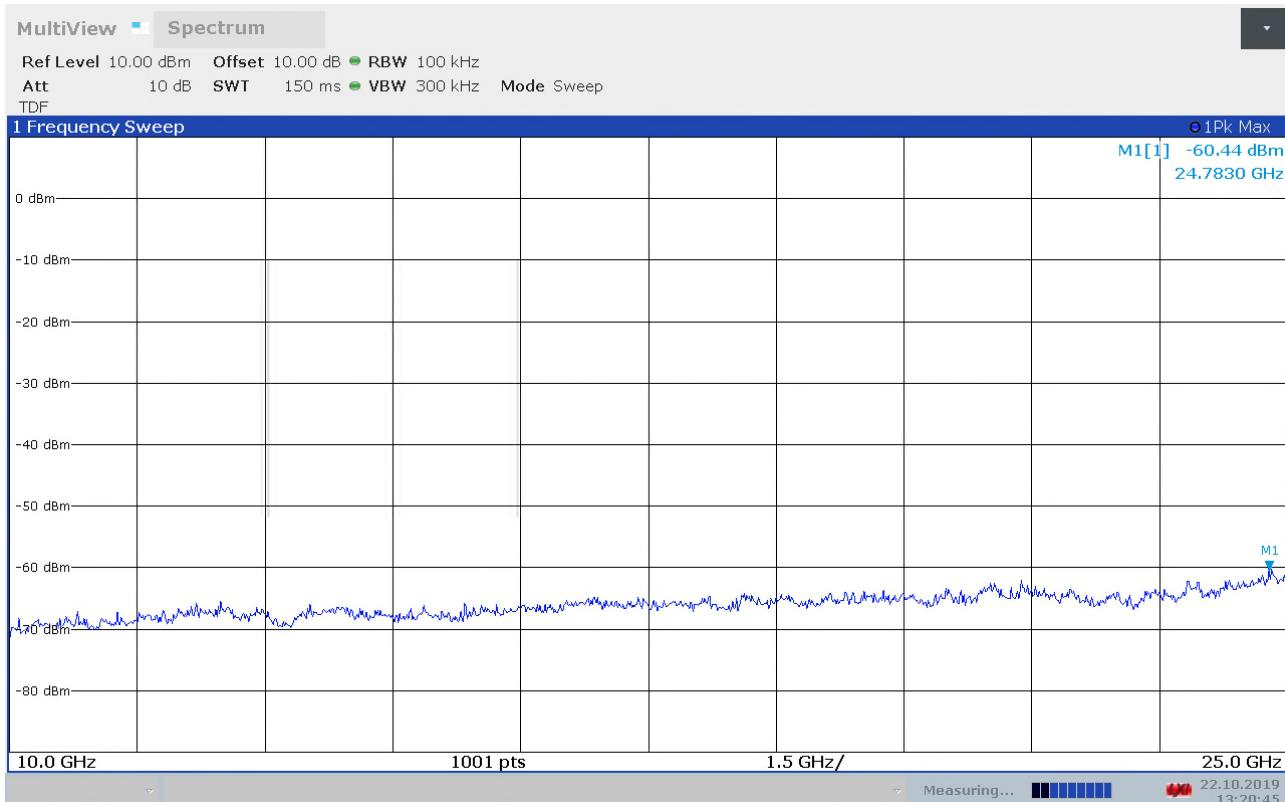
Conducted spurious emissions, 10MHz - 10GHz, ch2405MHz



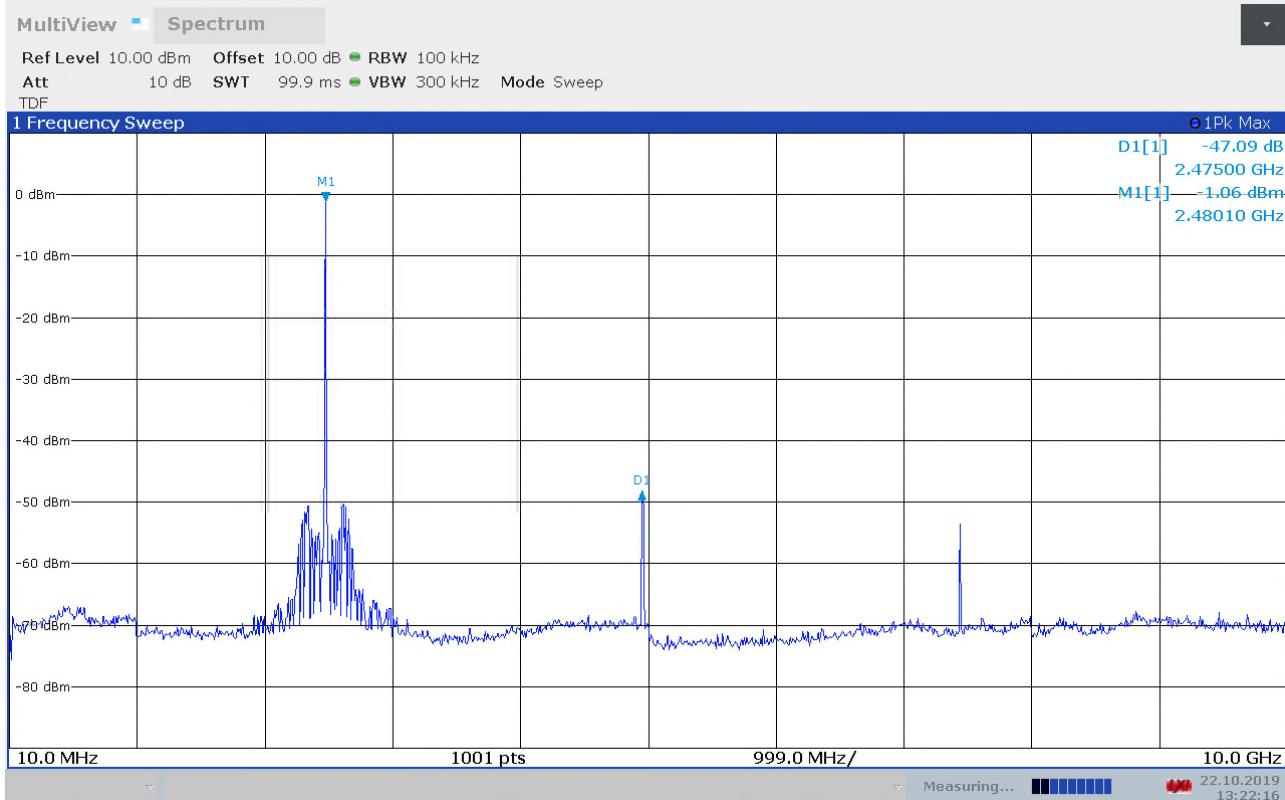
Conducted spurious emissions, 10GHz - 10GHz, ch2405MHz



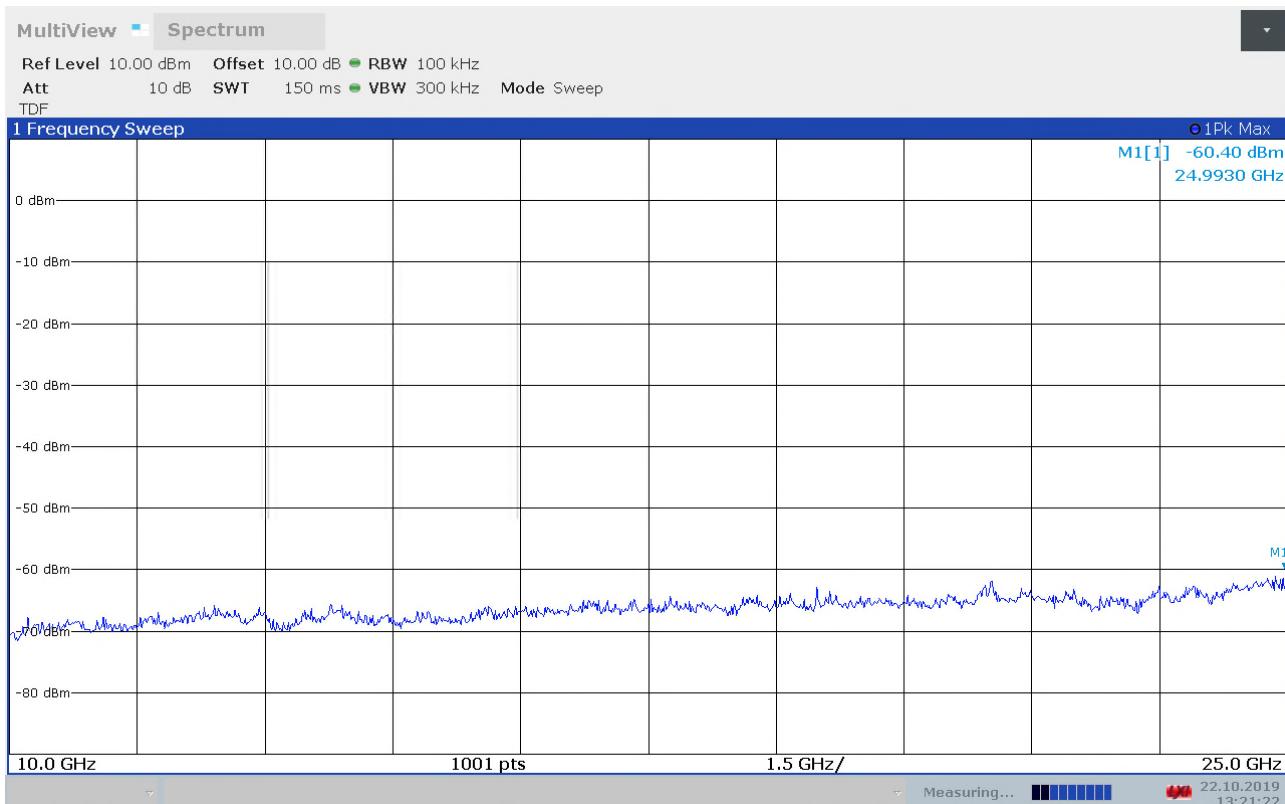
Conducted spurious emissions, 10MHz - 10GHz, ch2440MHz



Conducted spurious emissions, 10GHz - 25GHz, ch2440MHz



Conducted spurious emissions, 10MHz - 10GHz, ch2480MHz



Conducted spurious emissions, 10GHz - 25GHz, ch2480MHz

### 3.6 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED RSS-GEN, Issue 4 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		<b>0.96-1.24</b> 1.3-1.427	<b>0.96-1.427</b>
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	<b>3.020-3.026</b>	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	<b>5.677-5.683</b>	2.4835-2.5	
6.215-6.218		<b>2.69-2.9</b>	<b>2.655-2.9</b>
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		<b>3.6-4.4</b>	<b>3.5-4.4</b>
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
<b>108-121.94</b> <b>123-138</b>	<b>108-138</b>	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISED, all other frequencies are common.

### 3.7 Spurious Emissions (Radiated)

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Band-Edge:

	Measured field strength (dB $\mu$ V/m)		Limit dB $\mu$ V/m	Margin	
	2388 MHz	2483.5 MHz		dB	
Peak Detector	44.94	60.85	74	29.06	13.15
Average Detector	/	/	54	/	/
Average with DC correction	/	40.85	54	/	13.15

See attached plots.

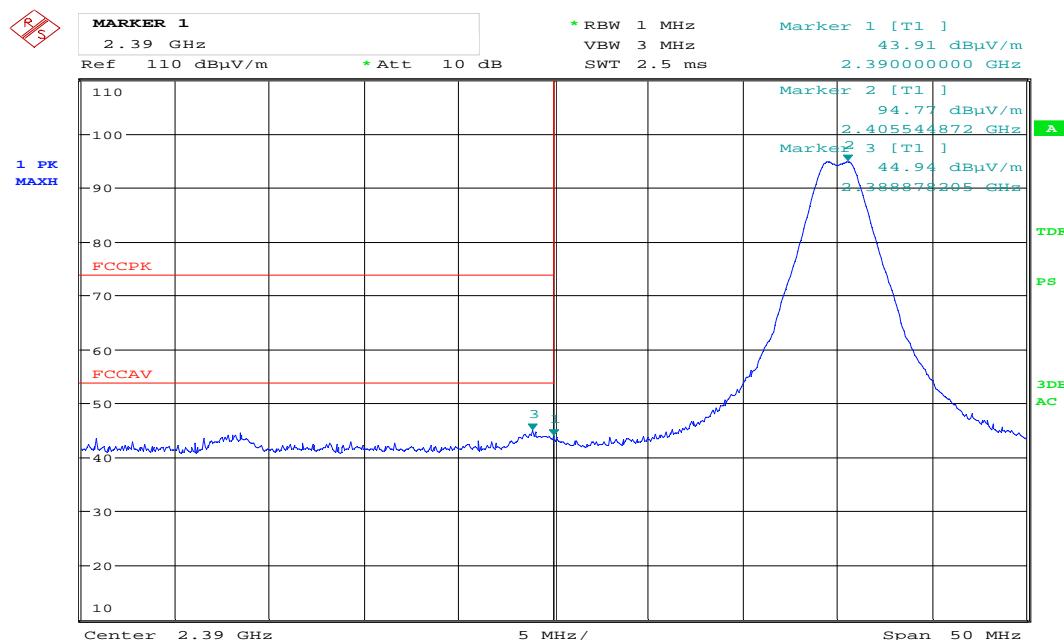
#### Duty Cycle Correction Factor Calculation:

The maximum duty cycle calculation is given by the manufacturer in the operational description is 0.0064%

Duty Cycle Correction factor =  $-20 \times \log(\text{Duty Cycle})$  = -20 dB

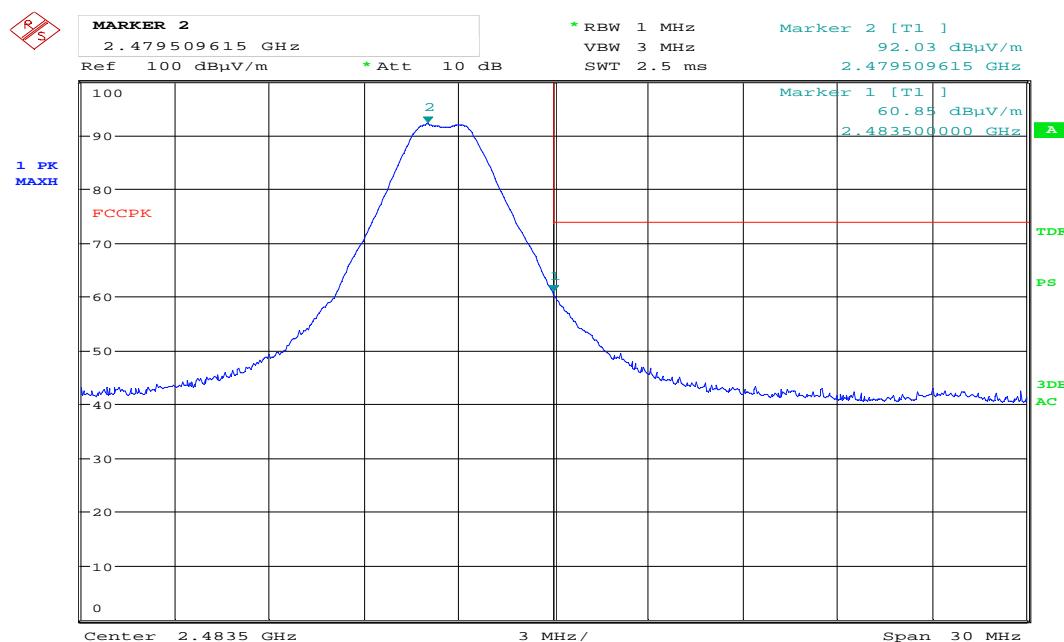
Maximum allowed Duty Cycle Correction: 20 dB

***Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB***



Date: 23.OCT.2019 10:31:08

### Internal antenna: Lower band Edge, PK , ch2405MHz



Date: 23.OCT.2019 11:01:51

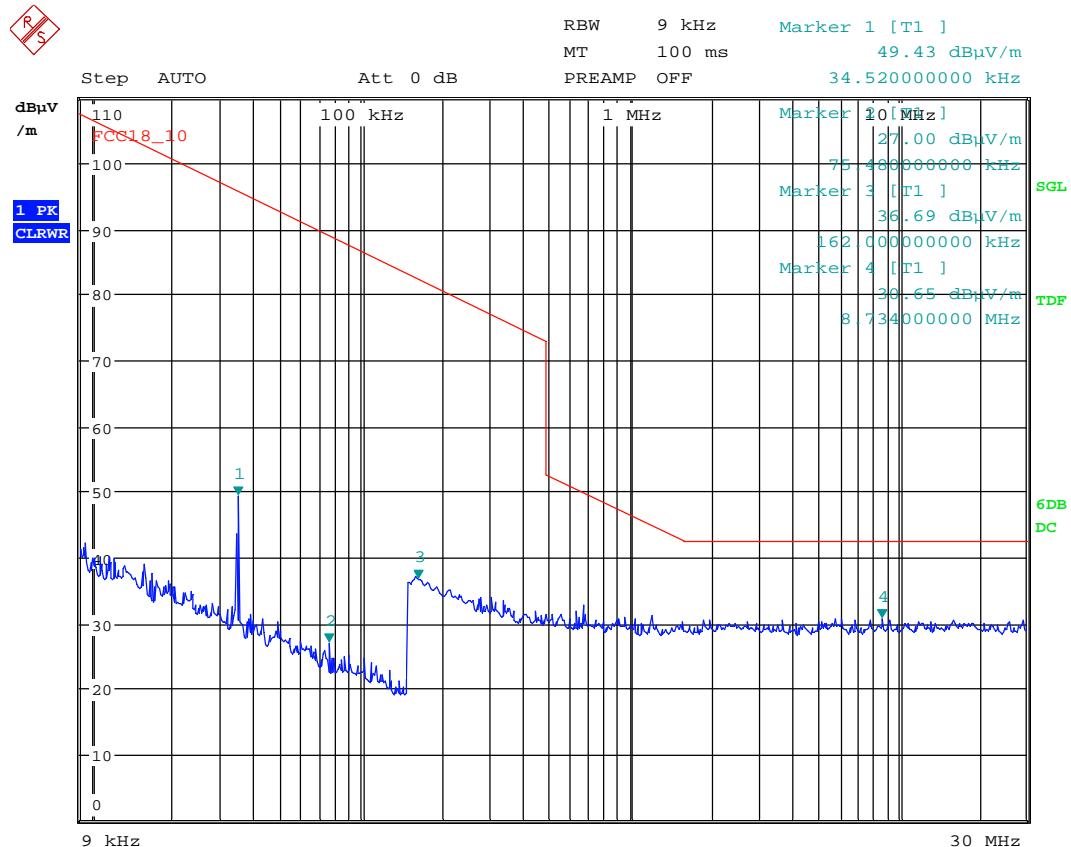
### Internal antenna: Upper band Edge, PK, ch2480MHz

**Radiated emission 9kHz – 30 MHz.**
**FCC Part 18.305 (b)**

Measuring distance 10 m, measured with Peak detector.

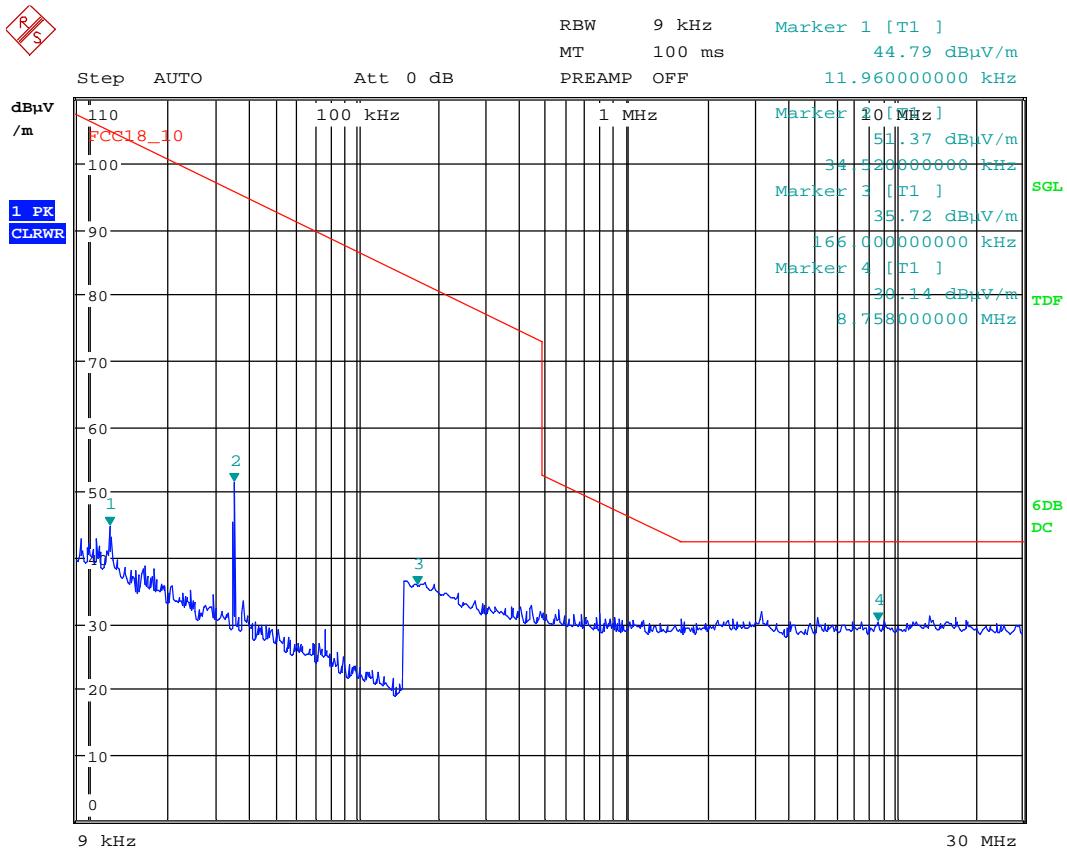
No component detected, see attached graph.

Limit is converted to 10 m using 40 dB/decade according to 15.31 (f) (2).



Date: 23.OCT.2019 08:24:20

Ultrasonic type: UBE14 (the emission at 34.52kHz is part of test setup noise, not from the EUT)



Date: 23.OCT.2019 08:39:01

Ultrasonic type : UBE 34 (the emission at 34.52kHz is part of test setup noise, not from the EUT)

**Radiated emission 30 – 1000 MHz.**

**FCC Part 15.209 (a)**

**ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9**

**Measurement procedure: ANSI C63.10-2013 Clause 11.12**

**Test Results: Complies**

Detector: Quasi-Peak

Measuring distance 3 m

Tested in TX mode

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
101.145150	2.28	43.50	41.22	1000.0	120.000	332.0	V	45.0

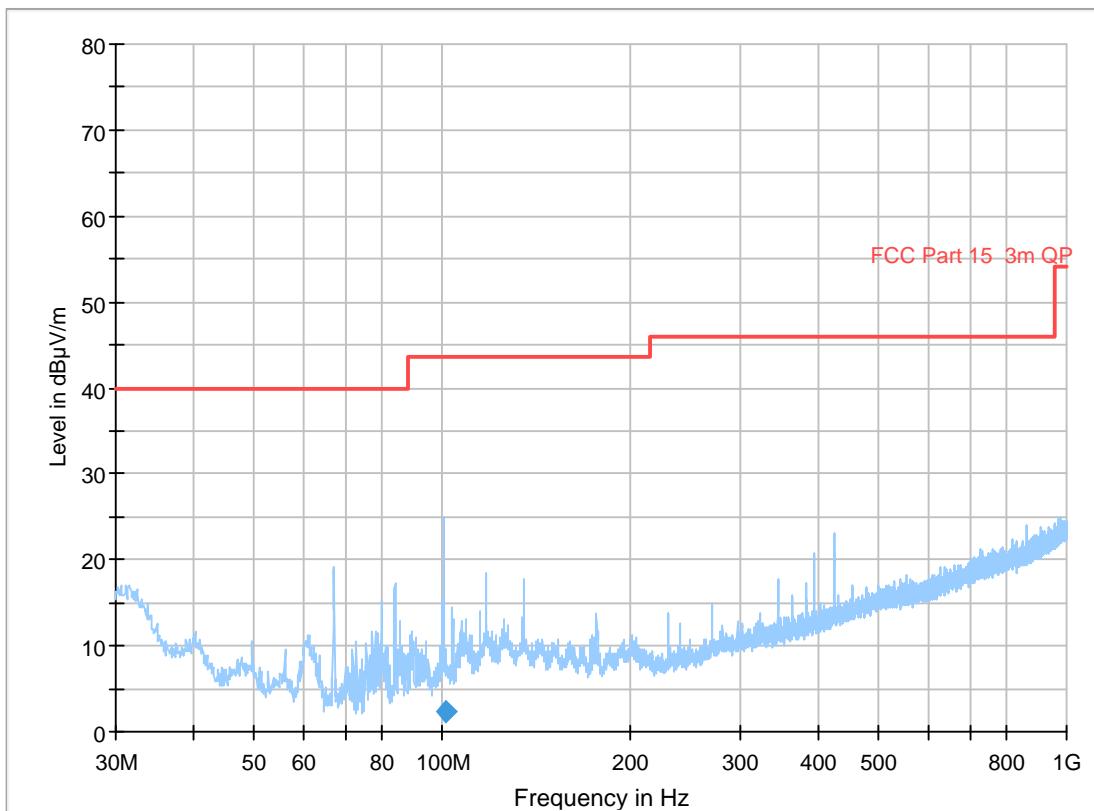
See attached plots

**Requirements/Limit**

<b>FCC</b>	Part 15.209 @ frequencies defined in §15.205	
<b>ISED</b>	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
<b>Radiated emission limit @3 meters</b>		
<b>Frequency (MHz)</b>	<b>Quasi Peak (<math>\mu</math>V/m)</b>	<b>Quasi Peak (dB<math>\mu</math>V/m)</b>
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
<b>Above 960</b>	<b>500</b>	<b>54.0</b>

The limit above 1000 MHz is specified for Average Detector, when the measurement is performed with a Peak Detector a Duty-Cycle Correction Factor has to be calculated to find the corresponding Average Detector value.

Full Spectrum



## Radiated Emissions, 1-25 GHz

FCC Part 15.209 (a), ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Measuring distance: 3m (1 – 18 GHz), 1m (18 – 25 GHz)

### Peak Detector: (Restricted band frequencies)

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Limit	Margin
GHz	L,M,H	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB
4.81	M	0	/	74	/
4.88	H	0	46.19	74	27.81
4.96	L	0	49.56	74	24.44
Other freqs	L,M,H	0	None detected	74	>20

### Average Detector: (Restricted band frequencies)

Frequency	RF channel	Dist. corr. factor	Field strength, Average Detector, 3m	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	dB	dB $\mu$ V/m	dB	dB $\mu$ V/m	dB
4.81	M	0	/	20	54	/
4.88	H	0	/	20	54	/
4.96	L	0	/	20	54	/
Other freqs	L,M,H	/	None detected	/	54	>20

Maximum is obtained in HP

The maximum duty cycle calculation is given by the manufacturer in the operational description is 0.0064%

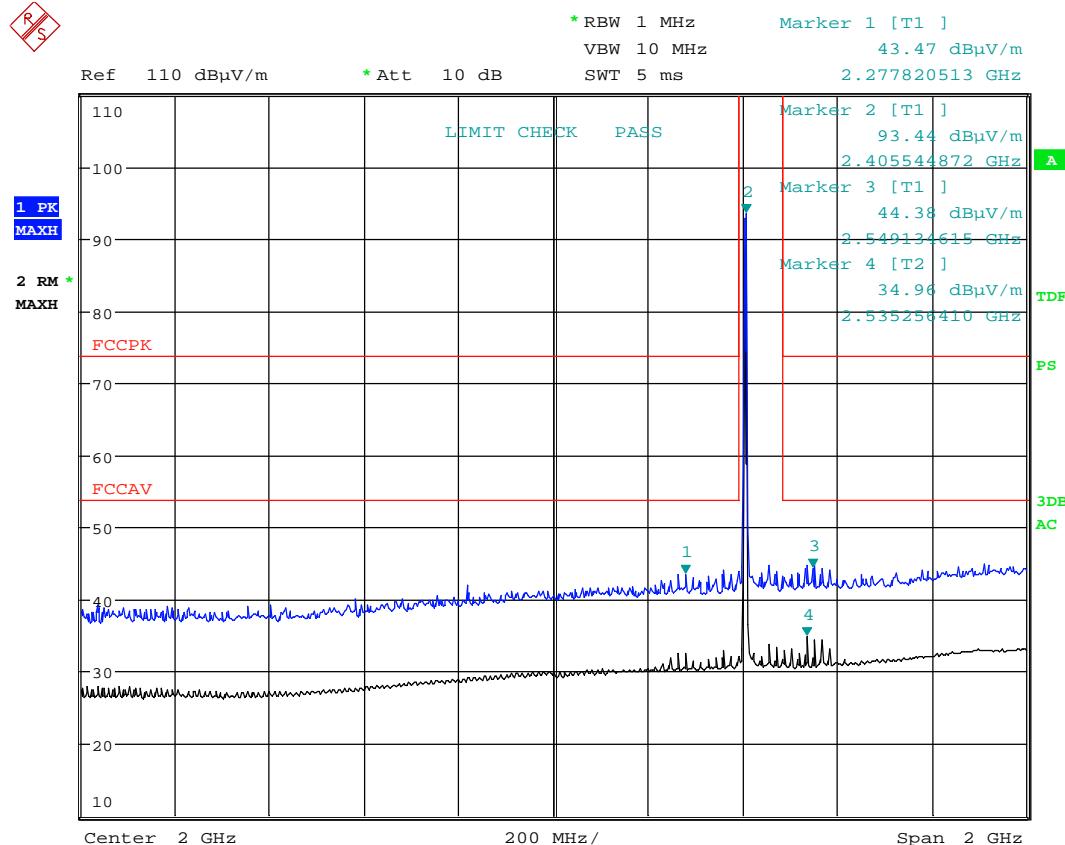
Duty Cycle Correction factor =  $-20 \times \log(0.11) = -20$  dB (Duty cycle: 0.0064%)

Maximum allowed Duty Cycle Correction: 20 dB

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor"., See plots.

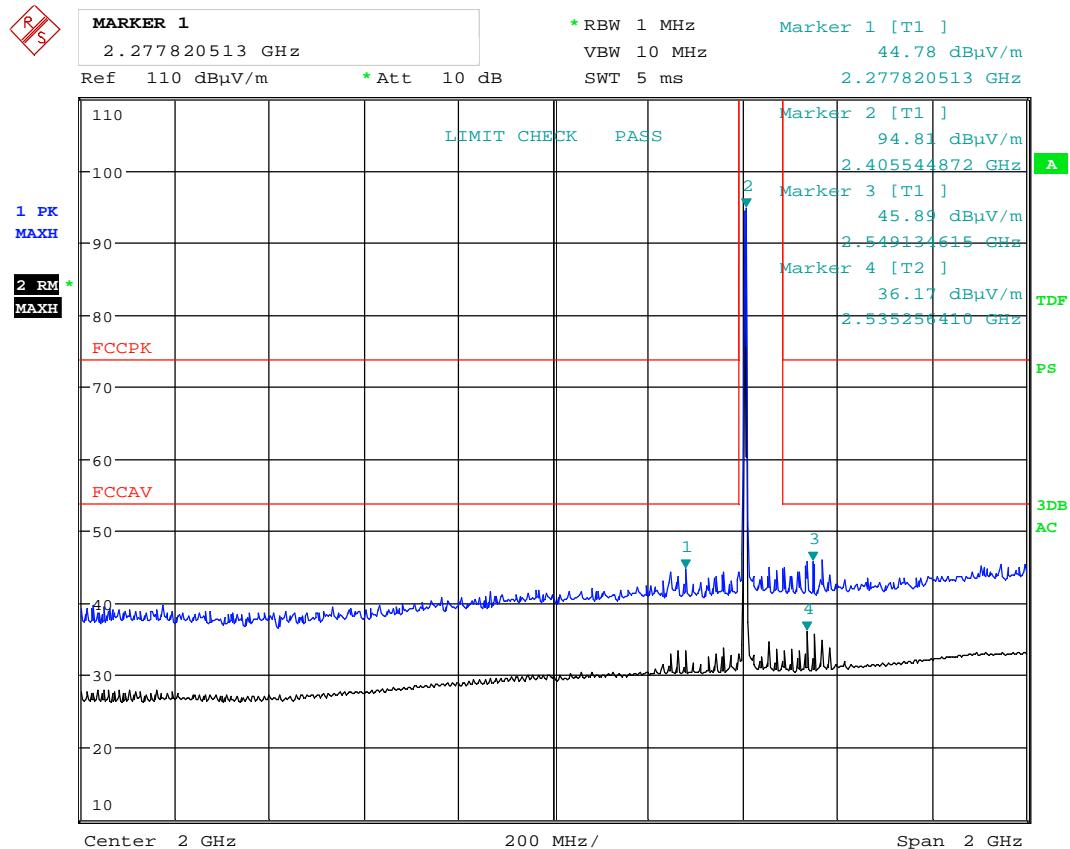
### Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Radiated emission limit @3 meters		
Frequency (MHz)	AV (dB $\mu$ V/m)	Peak (dB $\mu$ V/m)
Above 1 GHz	54.0	74.0

**R  
S**


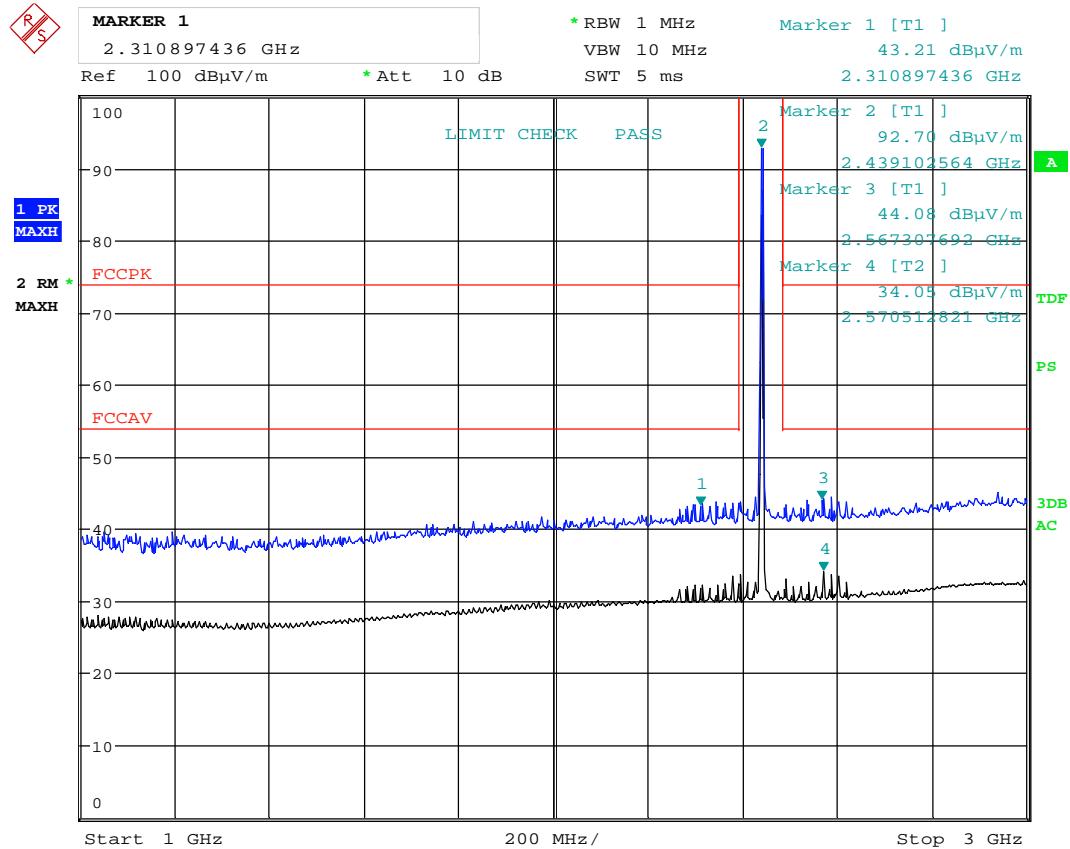
Date: 23.OCT.2019 10:35:06

Radiated spurious emissions, VP, 1 - 3GHz, ch2405MHz, PK scan



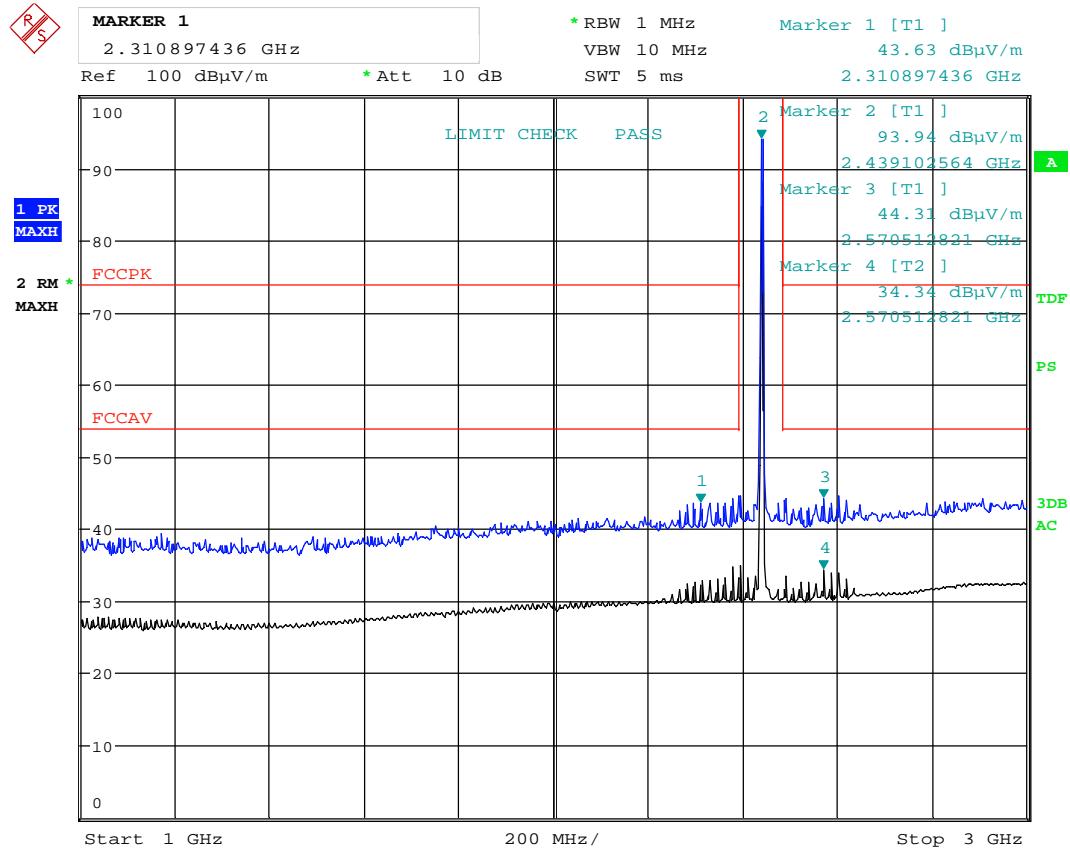
Date: 23.OCT.2019 10:33:09

Radiated spurious emissions, HP, 1 - 3GHz, ch2405MHz, PK scan



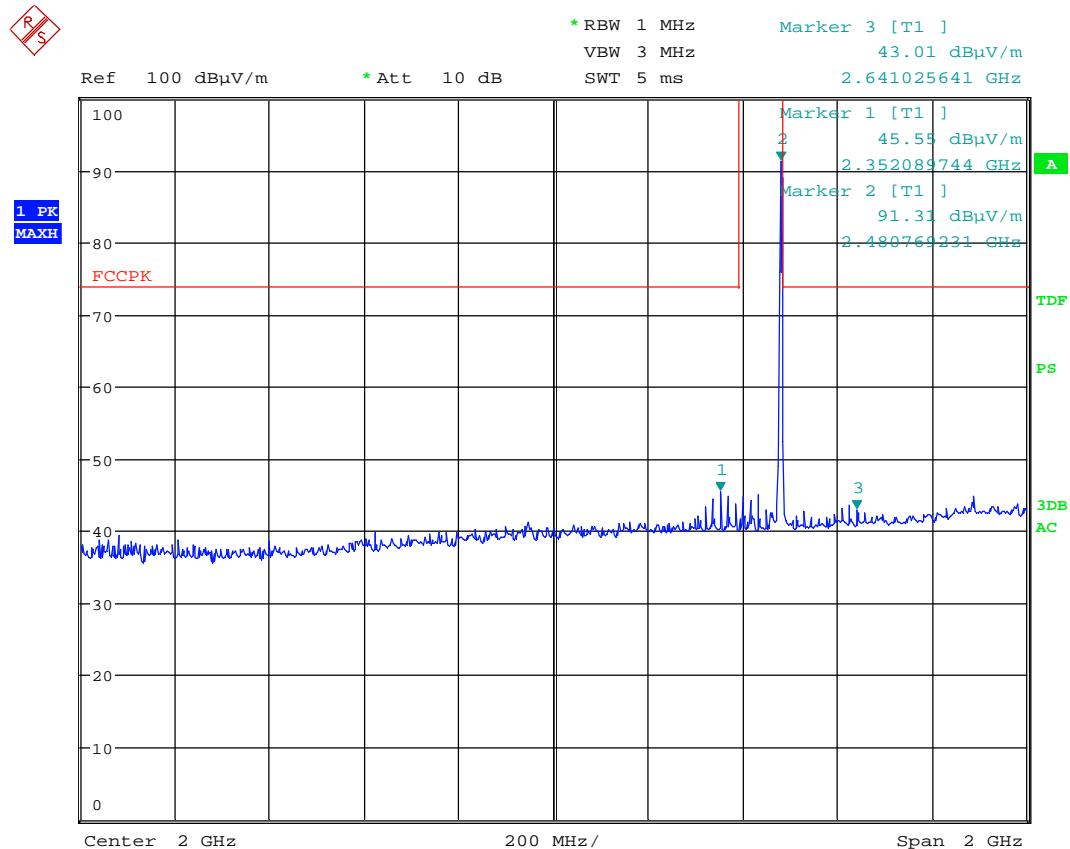
Date: 23.OCT.2019 10:50:37

Radiated spurious emissions, VP, 1 - 3GHz, ch2440MHz, PK scan



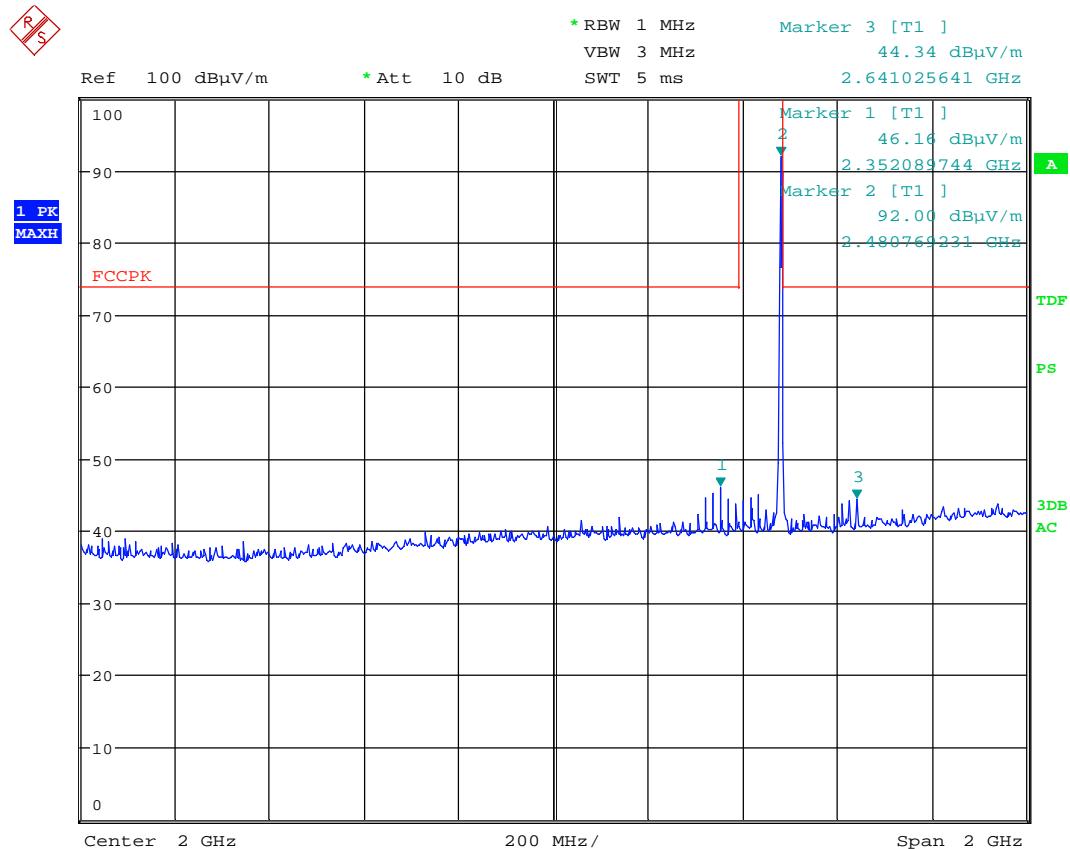
Date: 23.OCT.2019 10:51:39

Radiated spurious emissions, HP, 1 - 3GHz, ch2440MHz, PK scan



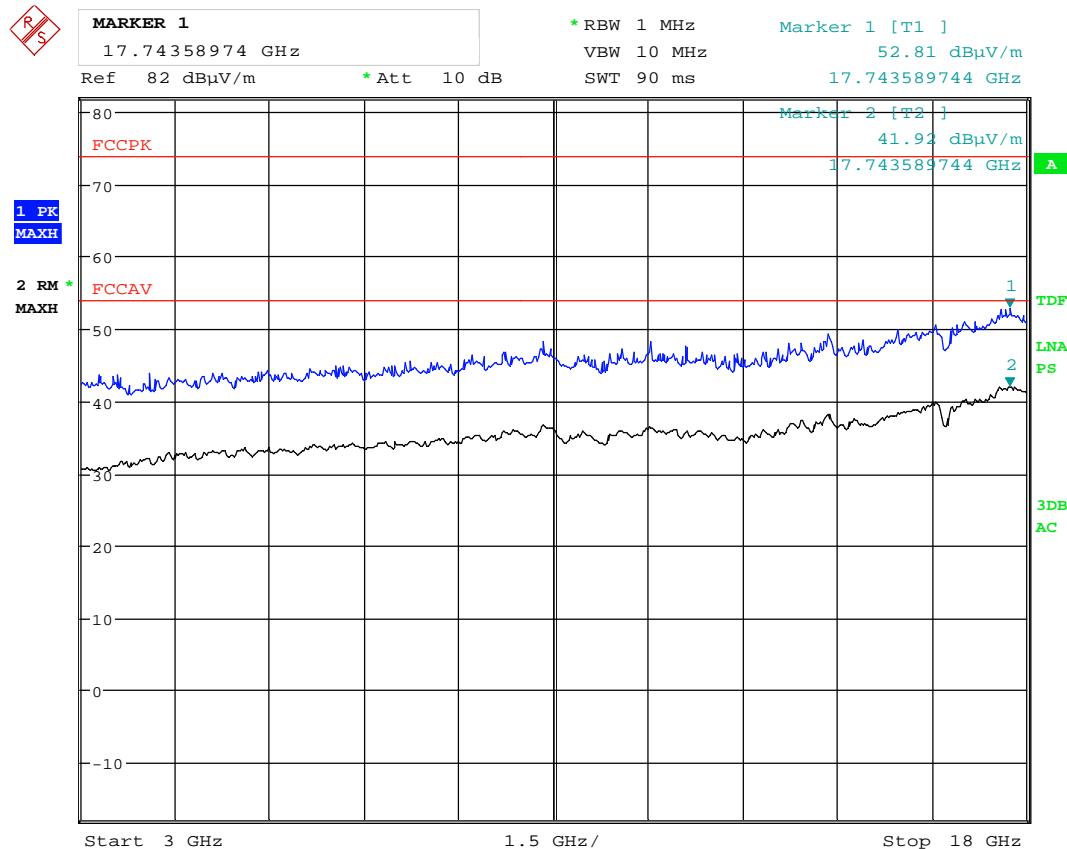
Date: 23.OCT.2019 11:06:44

Radiated spurious emissions, VP, 1 - 3GHz, ch2480MHz, PK scan



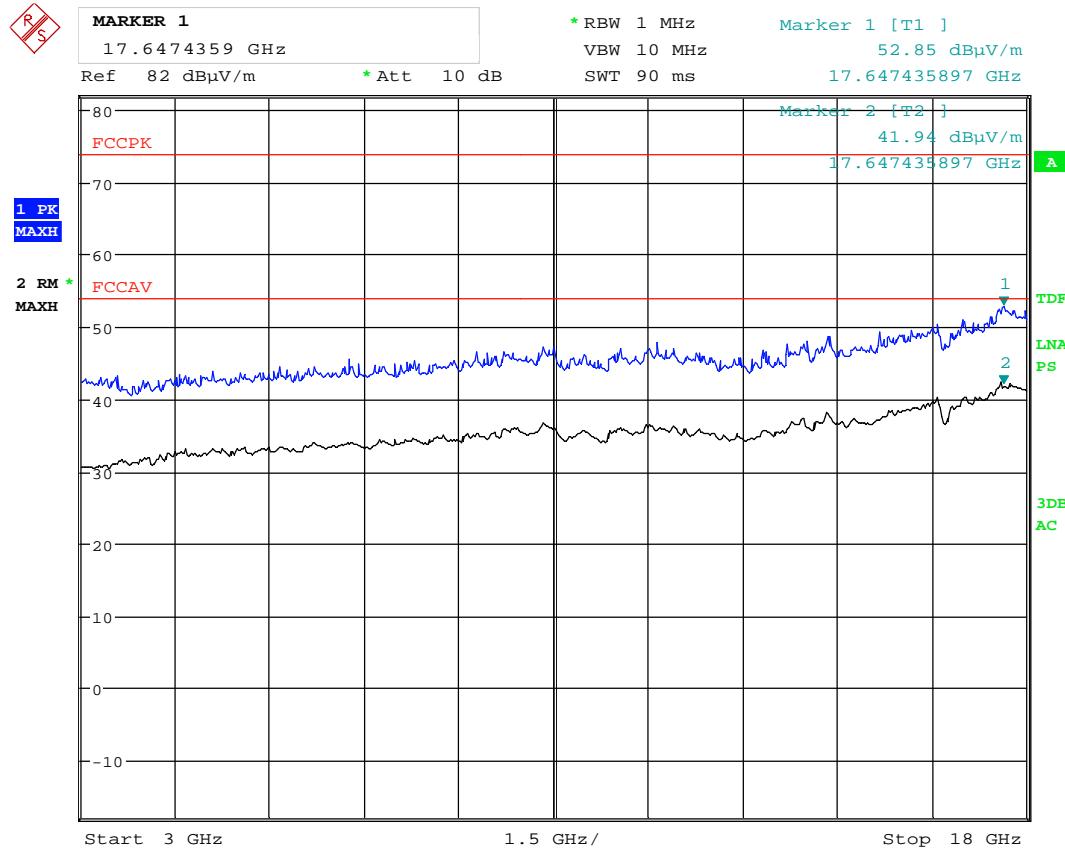
Date: 23.OCT.2019 11:05:56

Radiated spurious emissions, HP, 1 - 3GHz, ch2480MHz, PK scan



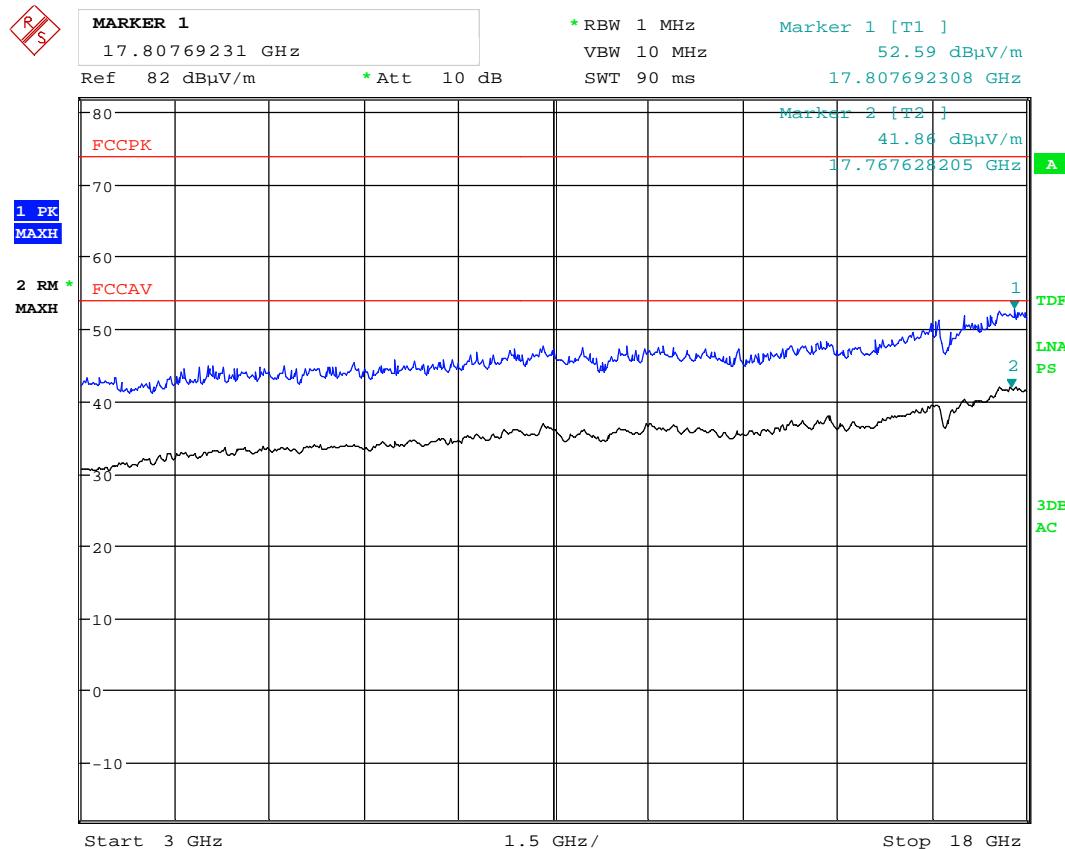
Date: 23.OCT.2019 12:06:10

Radiated spurious emissions, VP, 3 - 18GHz, ch2405MHz, PK scan



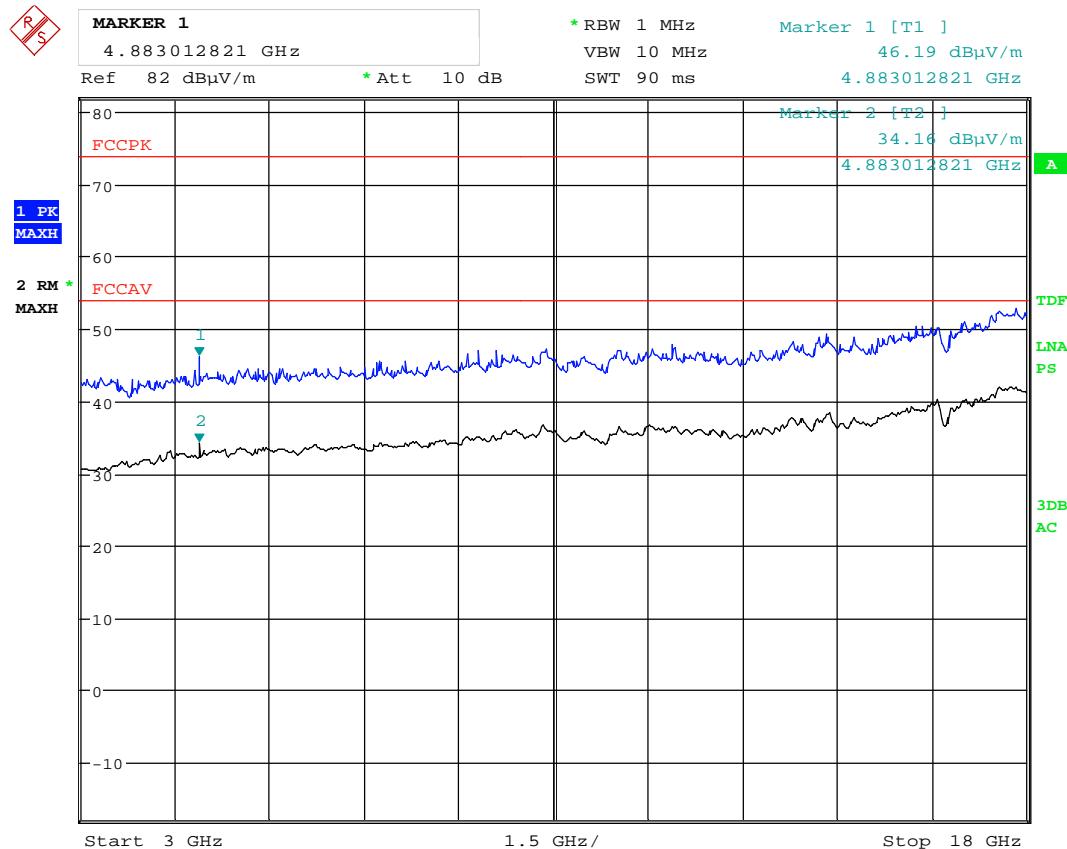
Date: 23.OCT.2019 12:07:20

Radiated spurious emissions, HP, 3 - 18GHz, ch2405MHz, PK scan



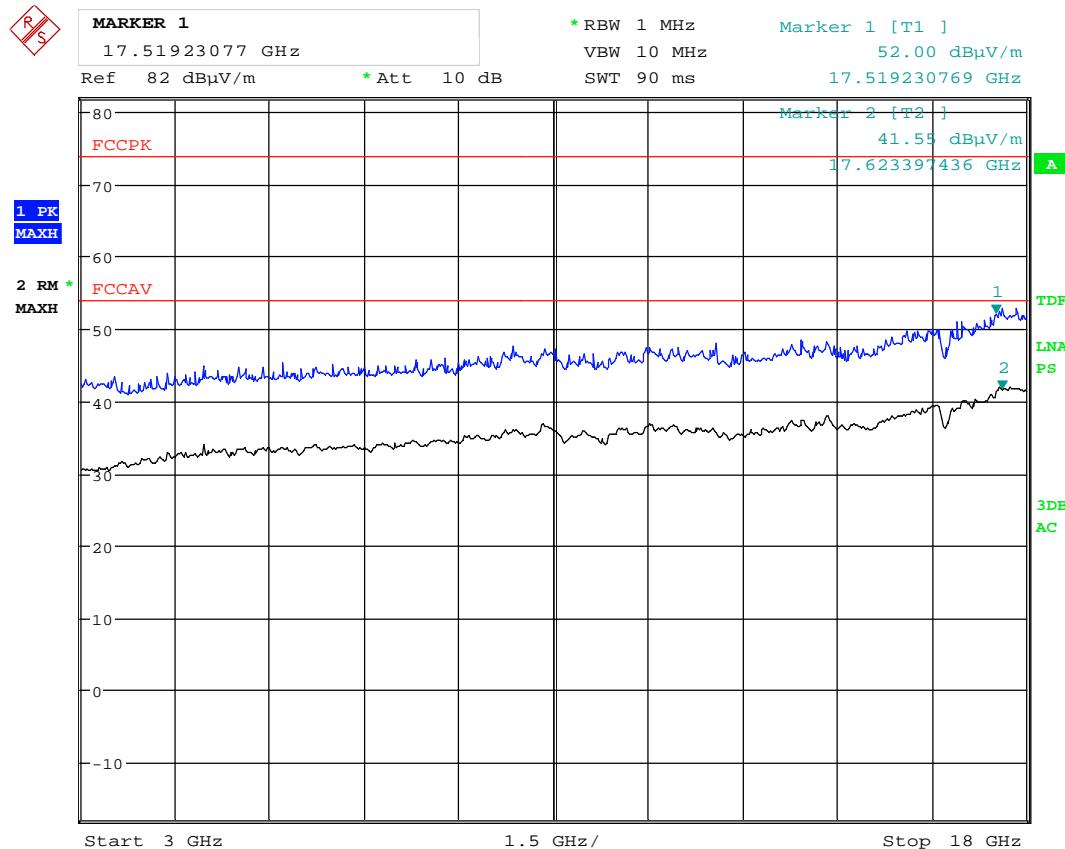
Date: 23.OCT.2019 12:14:38

Radiated spurious emissions, VP, 3 - 18GHz, ch2440MHz, PK scan



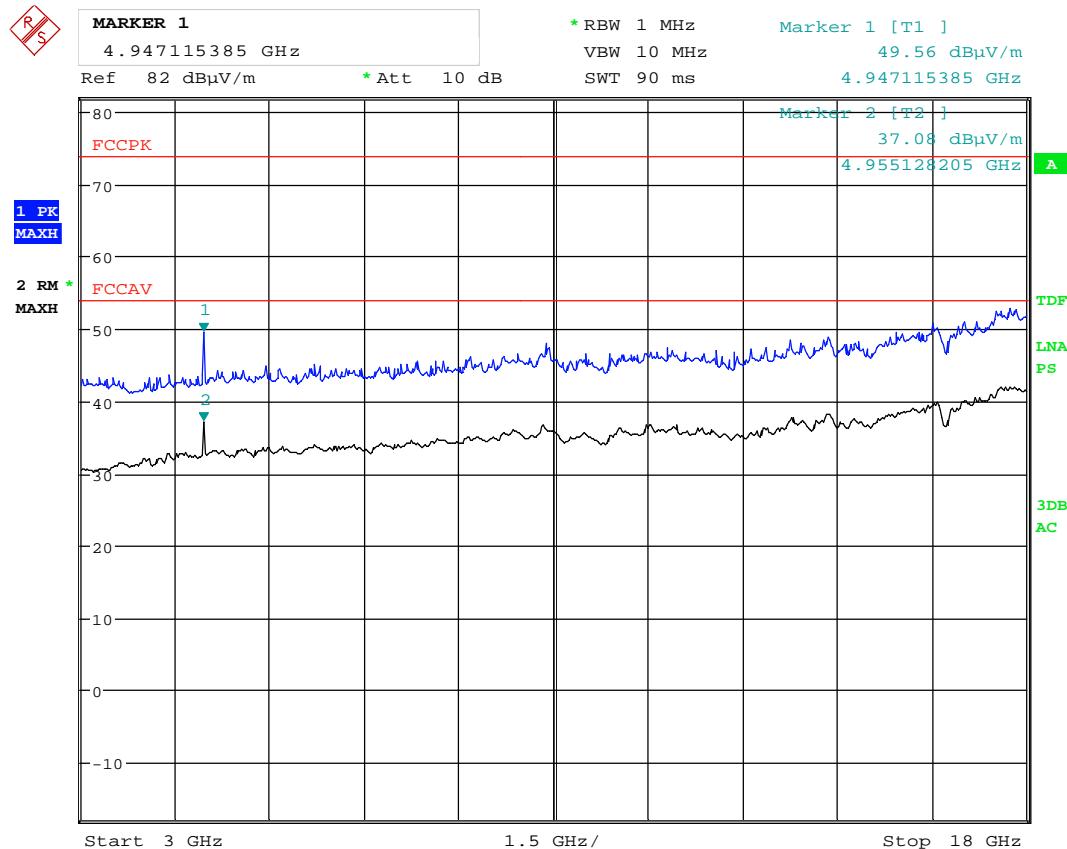
Date: 23.OCT.2019 12:12:34

Radiated spurious emissions, HP, 3 - 18GHz, ch2440MHz, PK scan



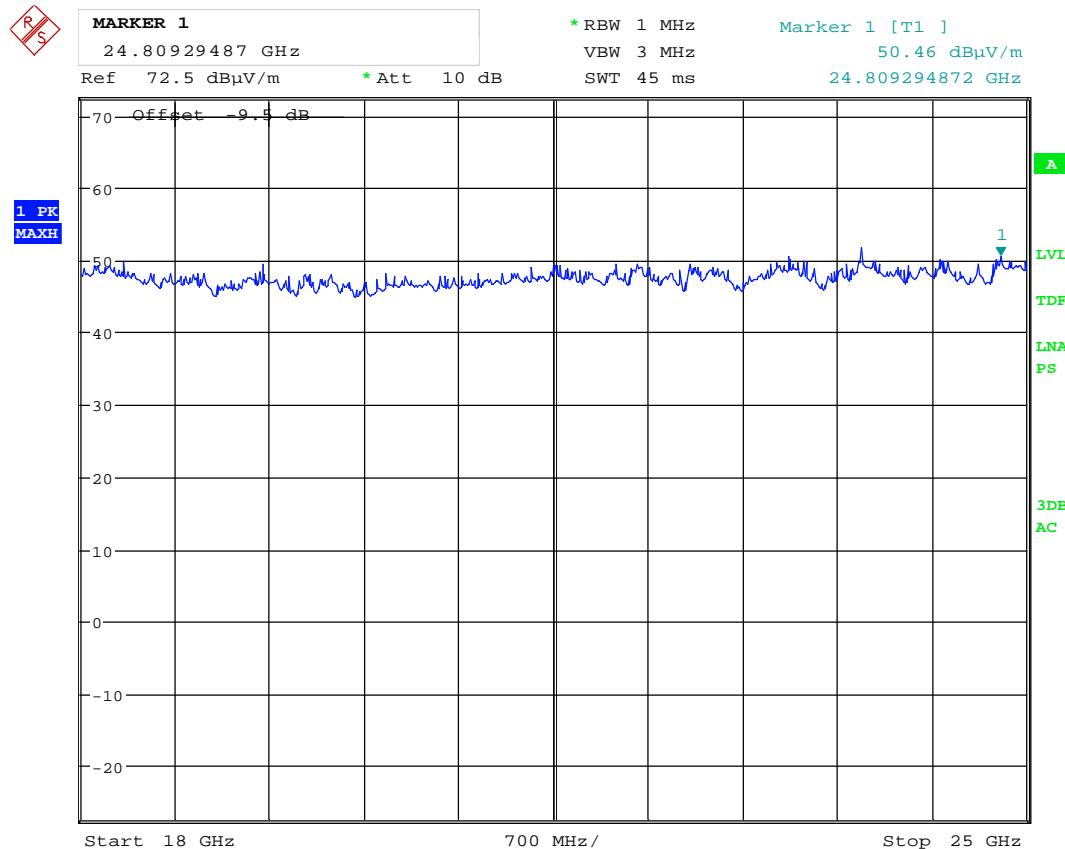
Date: 23.OCT.2019 12:18:01

Radiated spurious emissions, VP, 3 - 18GHz, ch2480MHz, PK scan



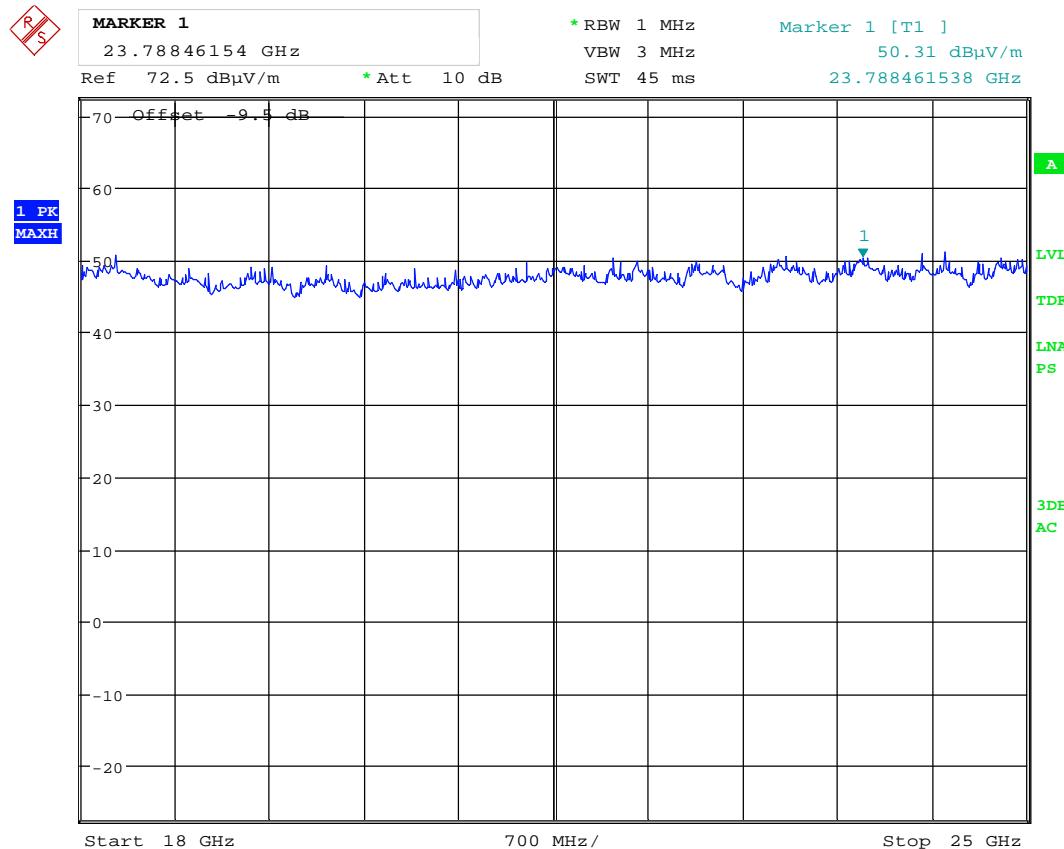
Date: 23.OCT.2019 12:19:24

Radiated spurious emissions, HP, 3 - 18GHz, ch2480MHz, PK scan



Date: 23.OCT.2019 14:57:25

Pre-Scan, Radiated spurious emissions, VP, 18 - 25GHz



Date: 23.OCT.2019 14:56:56

Pre-scan, Radiated spurious emissions, HP, 18 - 25GHz

### 3.8 Power Spectral Density (PSD)

FCC part 15.247(e)

ISED Canada RSS-247 Issue 2, Clause 5.2 (2)

Measurement procedure: ANSI C63.10-2013 Clause 11.10

Test Results: Complies

**Measured and Calculated Data:**

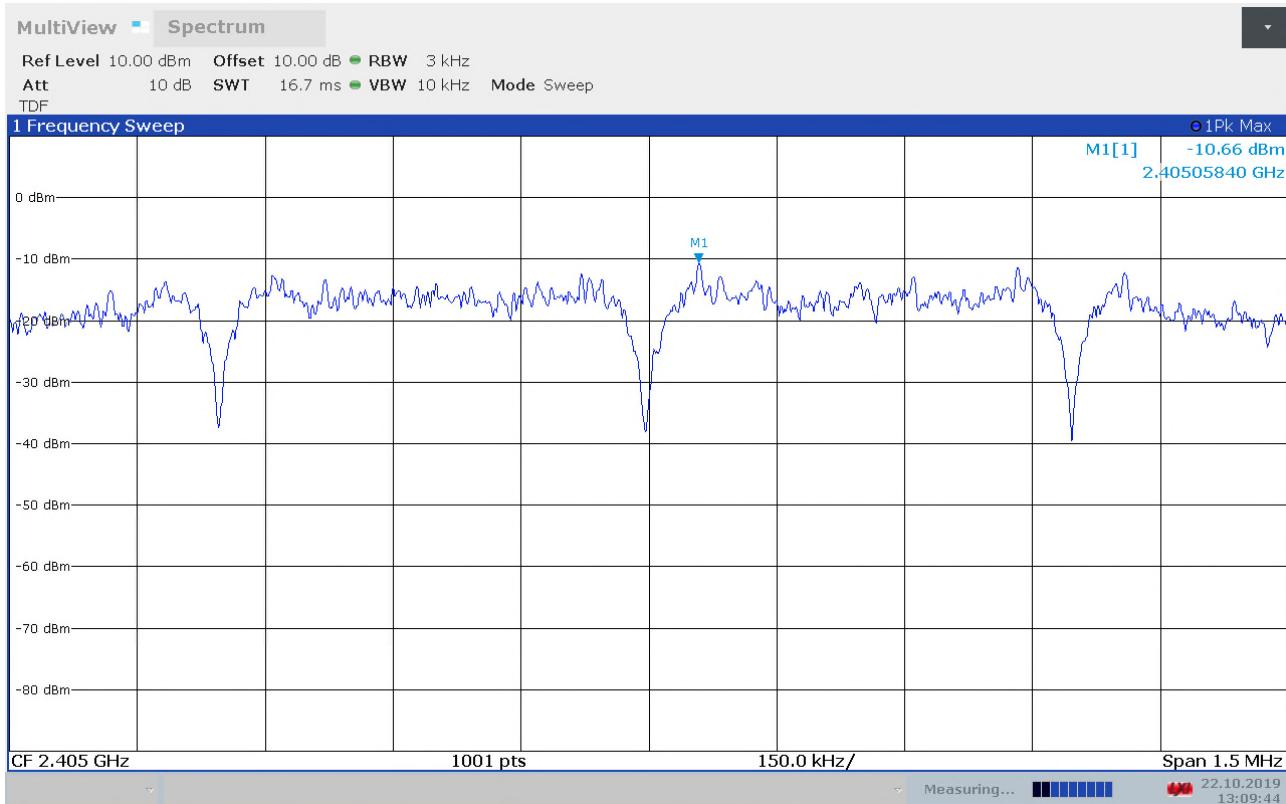
The measurement procedures PKPSD described in ANSI C63.10-2013 was used.

	2405 MHz	2440 MHz	2480 MHz
Measured value (dBm/3kHz)	-10.66	-11.22	-11.22

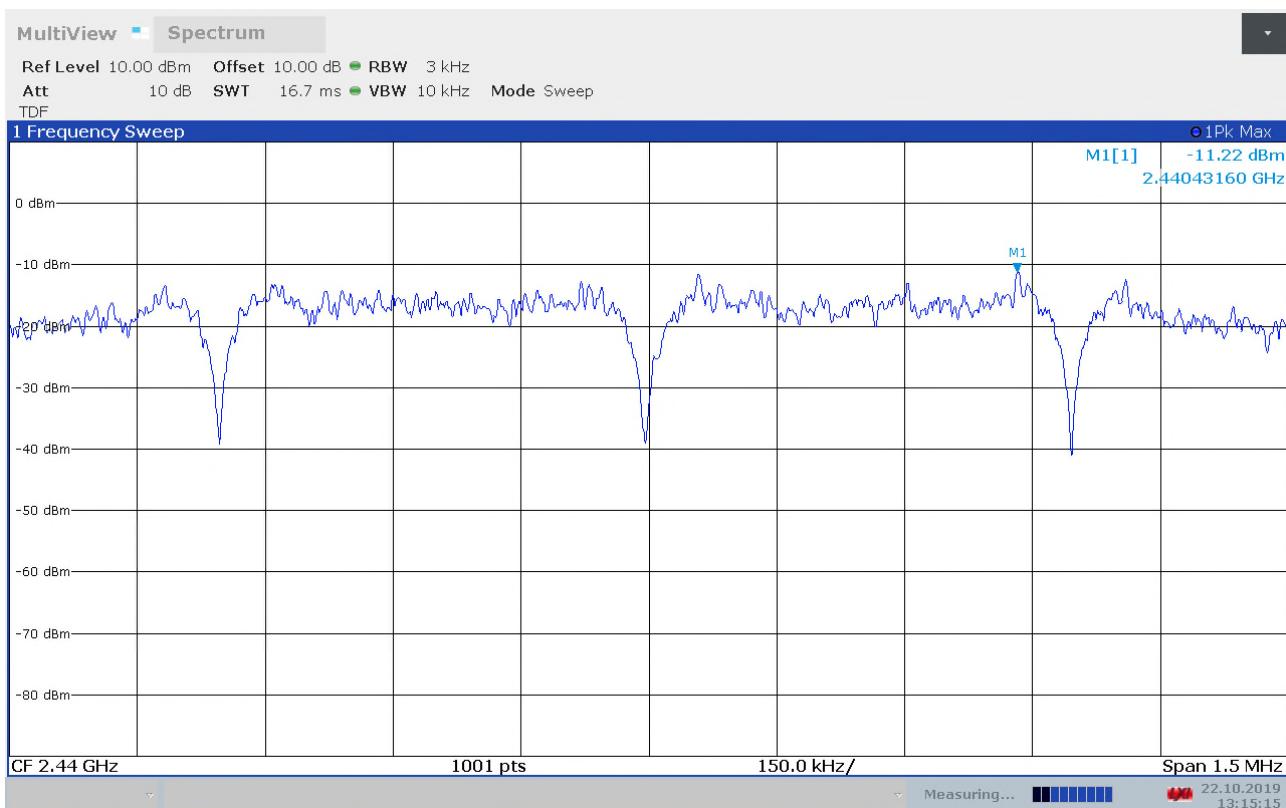
**Requirements:**

The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band

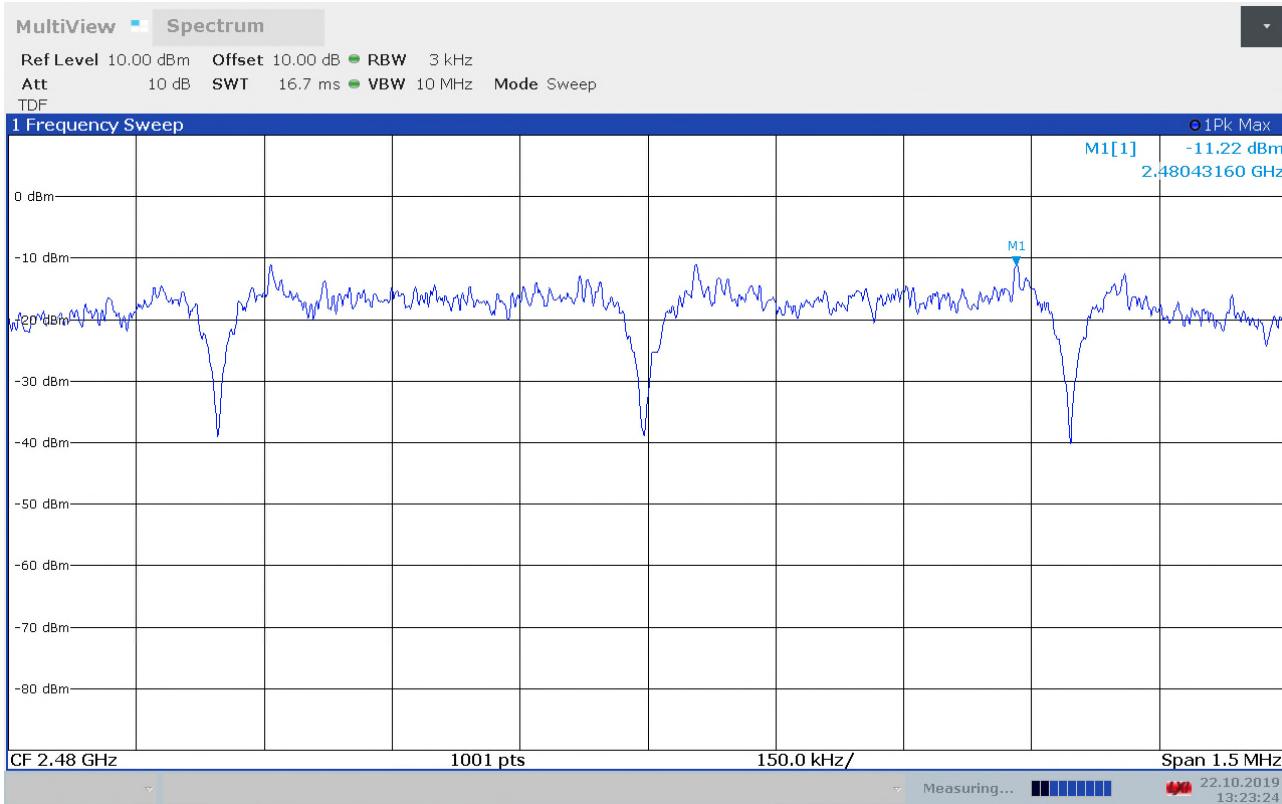
No requirements for Frequency Hopping Systems.



Conducted PSD, ch2405MHz



Conducted PSD, ch2440MHz



Conducted PSD, ch2480MHz

## 4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

## 5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

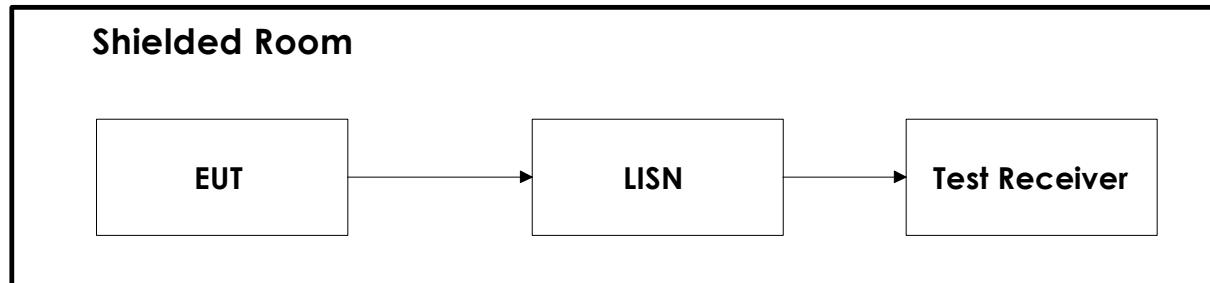
No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1.	ESU40	EMI Receiver	Rohde & Schwarz	LR1639	2019.01	2020.01
2.	FSW43	Spectrum analyser	Rohde & Schwarz	LR1690	2019.01	2020.01
3.	HFH2-Z2	Active Loop antenna	Rohde & Schwarz	LR1660	2019.09	2021.09
4.	3117-PA	Antenna horn	EMCO	LR 1717	2017.05	2020.05
5.	3115	Antenna horn	EMCO	LR 1330	2016.10	2020.10
6.	PM 320K	Antenna Horn	Sivers	LR 102	N/A	
7.	DBF-520-20	Antenna Horn	Systron-Donner corp	LR 101	N/A	
8.	638	Antenna Horn	NARDA	LR 1480	N/A	
9.	637	Antenna Horn	NARDA	LR 099	N/A	
10.	ARJB1	Bi-log Hybrid Antenna	Sunol	LR 1734	2018.05	2020.05
11.	4768-10	Attenuator	Narda	LR 1356	Cal b4 use	
12.	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	Cal b4 use	
13.	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2019.07	2020.07
14.	310N	Pre-amplifier	Sonoma	LR 1686	2019.07	2020.07
15.	Model 45	Multimeter	Fluke	LT 5218	2018.11	2020.11
16.	6812B	AC Power source	Agilent	LR 1515	2019.03	2021.03
17.	CPX400S	Power supply	TTi	LR 1713	Cal b4 use	

The software listed below has been used for one or more tests.

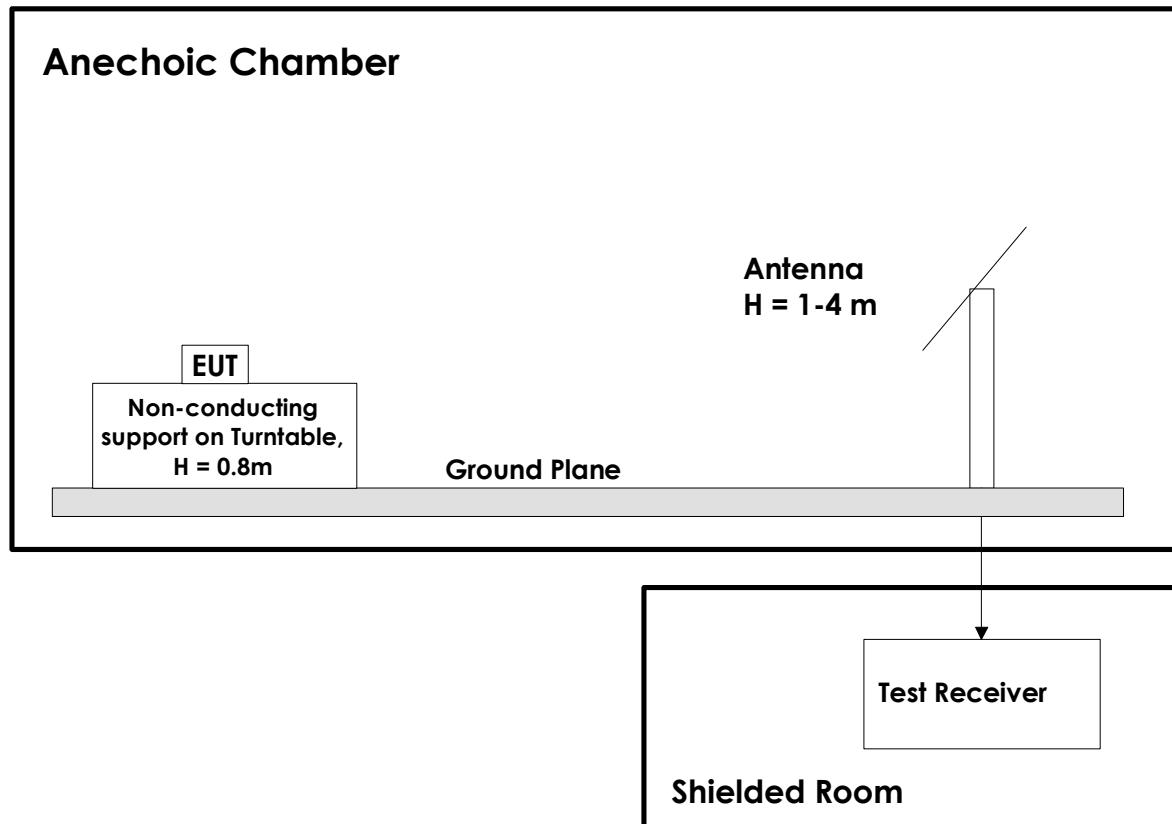
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	GPIBShot	2.7	Screenshots from R&S Spectrum Analyzers
2	Rohde & Schwarz	RSCommander	1.9.2 64bit	Software Tool for R&S Instruments
3	Rohde & Schwarz	EMC 32	10.40.10	Radiated Emission test software

## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.