

# Test Report

<b>Product</b>	Transceiver Module		
<b>Name and address of the applicant</b>	Scanreco AB Stensättravägen 13, SE-127 39 Skärholmen Box 90304, SE-120 25 Stockholm, SWEDEN		
<b>Name and address of the manufacturer</b>	Scanreco AB Stensättravägen 13, SE-127 39 Skärholmen Box 90304, SE-120 25 Stockholm, SWEDEN		
<b>Model</b>	TR06-004		
<b>Rating</b>	3.4Vdc and 4.0Vdc, Battery		
<b>Trademark</b>	Scanreco		
<b>Serial number</b>	See page 3		
<b>Additional information</b>	902 – 928 MHz FHSS radio module		
<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>	400635		
<b>Tested in period</b>	2020.06.17 - 2020.09.14		
<b>Issue date</b>	2021.01.18		
<b>Name and address of the testing laboratory</b>	 Instituttveien 6 Kjeller, Norway www.nemko.com	CAB Number: FCC: NO0001 ISED: NO0470  TEL: +47 22 96 03 30 FAX: +47 22 96 05 50	 
An accredited technical test executed under the Norwegian accreditation scheme			
 Prepared by [G.Suhanthakumar]		 Approved by [Frode Sveinsen]	
<p>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.</p>			

## CONTENTS

<b>1</b>	<b>INFORMATION .....</b>	<b>3</b>
1.1	Test Item.....	3
1.2	Normal test condition.....	3
1.3	Test Engineer(s).....	4
1.4	Model Variants.....	4
1.5	Antenna Requirement.....	4
1.6	Worst-Case Configuration and Mode.....	5
1.7	Comments.....	5
<b>2</b>	<b>TEST REPORT SUMMARY .....</b>	<b>6</b>
2.1	General.....	6
2.2	Test Summary.....	7
<b>3</b>	<b>TEST RESULTS.....</b>	<b>8</b>
3.1	Channel Separation and 20dB Bandwidth.....	8
3.2	Pseudorandom Hopping Algorithm.....	13
3.3	Occupancy Time.....	14
3.4	Occupied Bandwidth (99% BW) and Hopping Bandwidth.....	21
3.5	Peak Power Output.....	25
3.6	Conducted Emissions at Antenna Connector.....	33
3.7	Restricted Bands of operation.....	42
3.8	Radiated Emissions, Band Edge.....	43
3.9	Radiated Emissions, 10 kHz – 30 MHz.....	48
3.10	Radiated Emission, 30 – 1000 MHz.....	49
3.11	Radiated Emissions, 1-10 GHz.....	52
3.12	Measurement Uncertainty.....	72
<b>4</b>	<b>LIST OF TEST EQUIPMENT.....</b>	<b>73</b>
<b>5</b>	<b>BLOCK DIAGRAM .....</b>	<b>74</b>
5.1	Power Line Conducted Emission.....	74
5.2	Test Site Radiated Emission.....	74

# 1 INFORMATION

## 1.1 Test Item

<b>Name</b>	Transceiver Module
<b>FCC ID</b>	N5OTR064
<b>ISED ID</b>	6476A-TR064
<b>Model/version</b>	TR06-004
<b>Serial number</b>	Marked as "915"
<b>Hardware identity and/or version</b>	102112
<b>Software identity and/or version</b>	G6COMM_PROD
<b>Frequency Range</b>	903.50 - 926.53 MHz
<b>Tunable Bands</b>	None
<b>Number of Channels</b>	50
<b>Operating Modes</b>	TX/RX
<b>Type of Modulation</b>	FSK
<b>User Frequency Adjustment</b>	None
<b>Rated Output Power</b>	922.57 mW
<b>Type of Power Supply</b>	Battery, 3.4Vdc for RF and 4.0Vdc for Amp
<b>Antenna Connector</b>	RP-SMA for both TX and RX
<b>Number of Antennas</b>	1 for TX, Monopole, Type: FB35T900
<b>Diversity or Smart Antennas</b>	Yes
<b>Desktop Charger</b>	N/A

### Description of Test Item

915MHz FHSS Transceiver module

## 1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	3.4 V dc
	4.0 V dc

The values are the limit registered during the test period.

### 1.3 Test Engineer(s)

G.Suhanthakumar

### 1.4 Model Variants

The same printed circuit board is used for the different radio module models. Different frequencies (f. ex. 915Mhz and 2.4GHz) can not be transmitted simultaneously, only one at a time.

Model/type	Comment	Tested
TR06 004	Components belonging to the 2.4GHz, 915MHz and additional sub-GHz radio parts are assembled on the board.	<input checked="" type="checkbox"/>
TR06 001	Components belonging just to the 2.4GHz radio part are assembled on the board.	<input type="checkbox"/>
TR06 002	Components belonging to the 2.4GHz and 915MHz parts are assembled on the board.	<input type="checkbox"/>

### 1.5 Antenna Requirement

Is the antenna detachable?

Yes  No

If detachable, is the antenna connector non-standard?

Yes  No

Type of antenna connector: RP-SMA

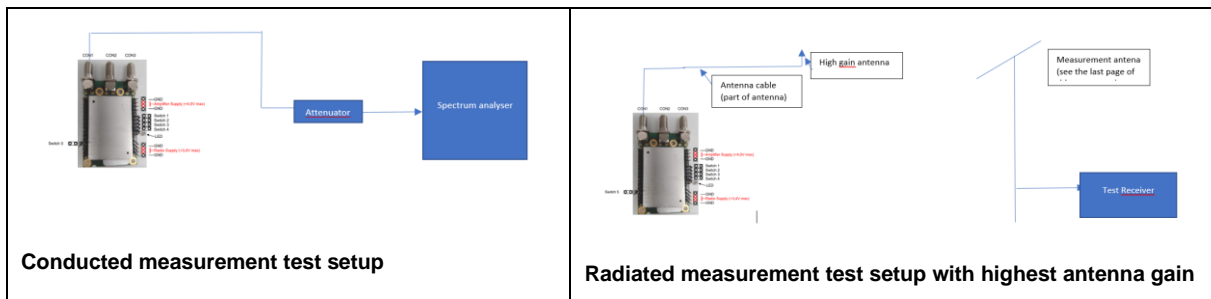
Ref. FCC §15.203

## 1.6 Worst-Case Configuration and Mode

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

Channel no.	Frequency (MHz)	Modulation	SW Name	Power setting (dBm)
1	903.500	FSK	G6COMM_TEST	29.8
25	914.780	FSK	G6COMM_TEST	29.8
50	926.530	FSK	G6COMM_TEST	29.8

Output power was set and pre-determined in the SW and adjusted by moving the jumpers. It is described document "TR06 Output power adjusting."



## 1.7 Comments

All measurements were done with the external dc power supply.

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 Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5.

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

New Submission

Production Unit

Class II Permissive Change

Pre-production Unit

**DSS** Equipment Code

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	ANSI C63.10-2013 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	N/A <sup>1</sup>
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A <sup>1</sup>
Channel Separation and 20 dB BW	15.247(a)(1)	5.1 (4) (RSS-247)	7.8.2 (FHSS)	Complies
Number of Hopping Frequencies	15.31(m)	5.1 (6) (RSS-247)	7.8.3 (FHSS)	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	5.1 (3) (RSS-247)	N/A (FHSS)	Complies
Time of Occupancy (dwell time)	15.247(a)(1)(iii)	5.1 (5) (RSS-247)	7.8.4 (FHSS)	Complies
Occupied Bandwidth (20dB BW)	15.247(a)(1)	5.1 (7) (RSS-247)	6.9.2 FHSS)	Complies
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	
Peak Power Output	15.247(b)	5.4 (RSS-247)	11.9.1.1	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	6.7 7.8.6 (FHSS) 7.8.8 (FHSS)	Complies
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6, 6.10	Complies

<sup>1</sup> The tested equipment operates only with battery.

### 3 TEST RESULTS

#### 3.1 Channel Separation and 20dB Bandwidth

FCC Part 15.247(a)(1)

ISED RSS-247 Issue 2, Clause 5.1 (b)

Measurement procedure: ANSI C63.10-2013 Clause 7.8.2

Test Results: Complies

##### Measurement Data:

Channel Separation:	470 kHz
20 dB Bandwidth of hopping channel:	95.2 - 99.8 kHz
Nominal value for Channel Separation	470 kHz

Channel bandwidth for 4 channels is 1.88MHz,

Channel separation is  $1.88\text{MHz}/4 = 470\text{kHz}$

RF channel has no influence on 20 dB bandwidth.

**See attached plots**

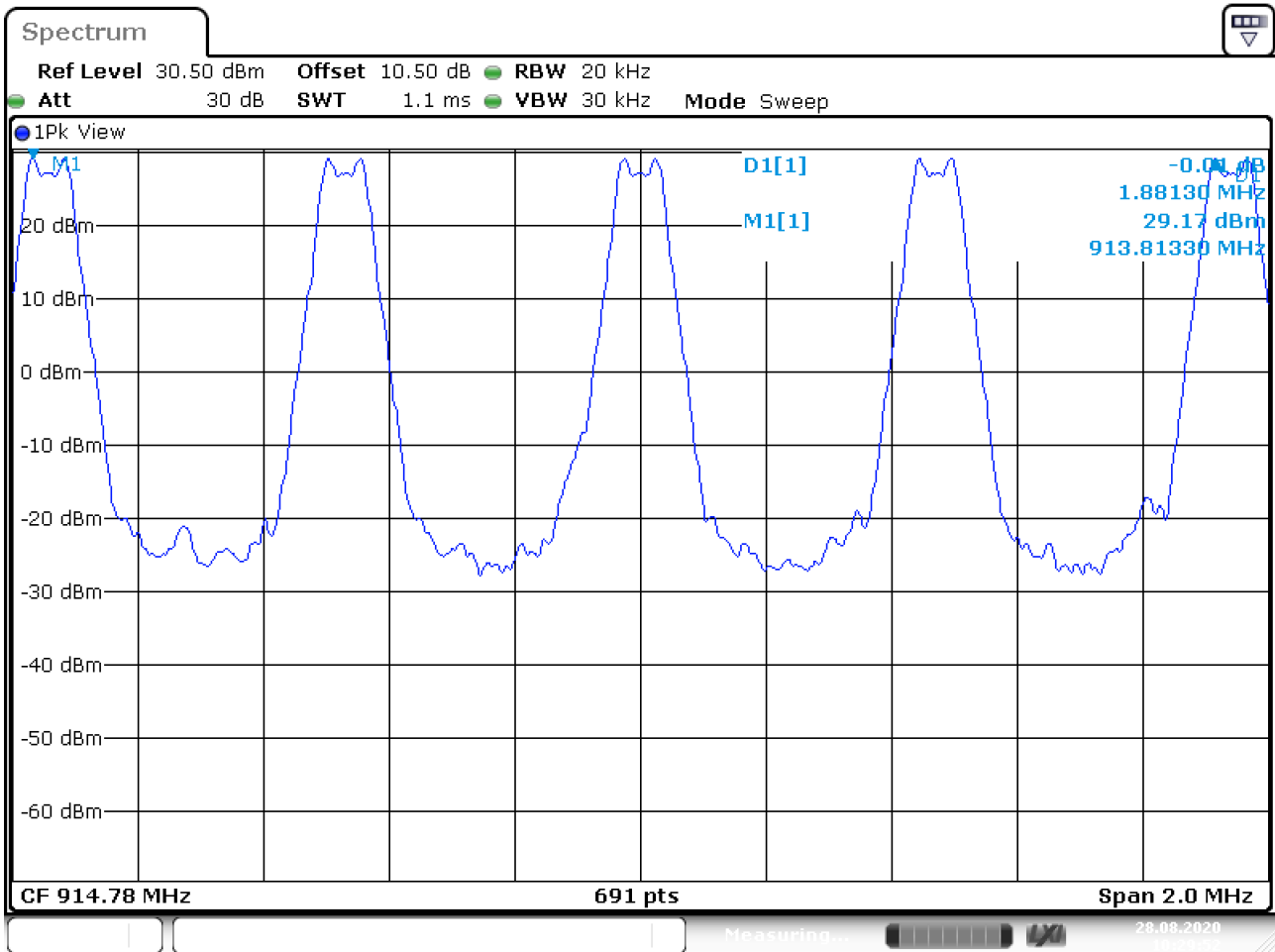
##### Requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

or:

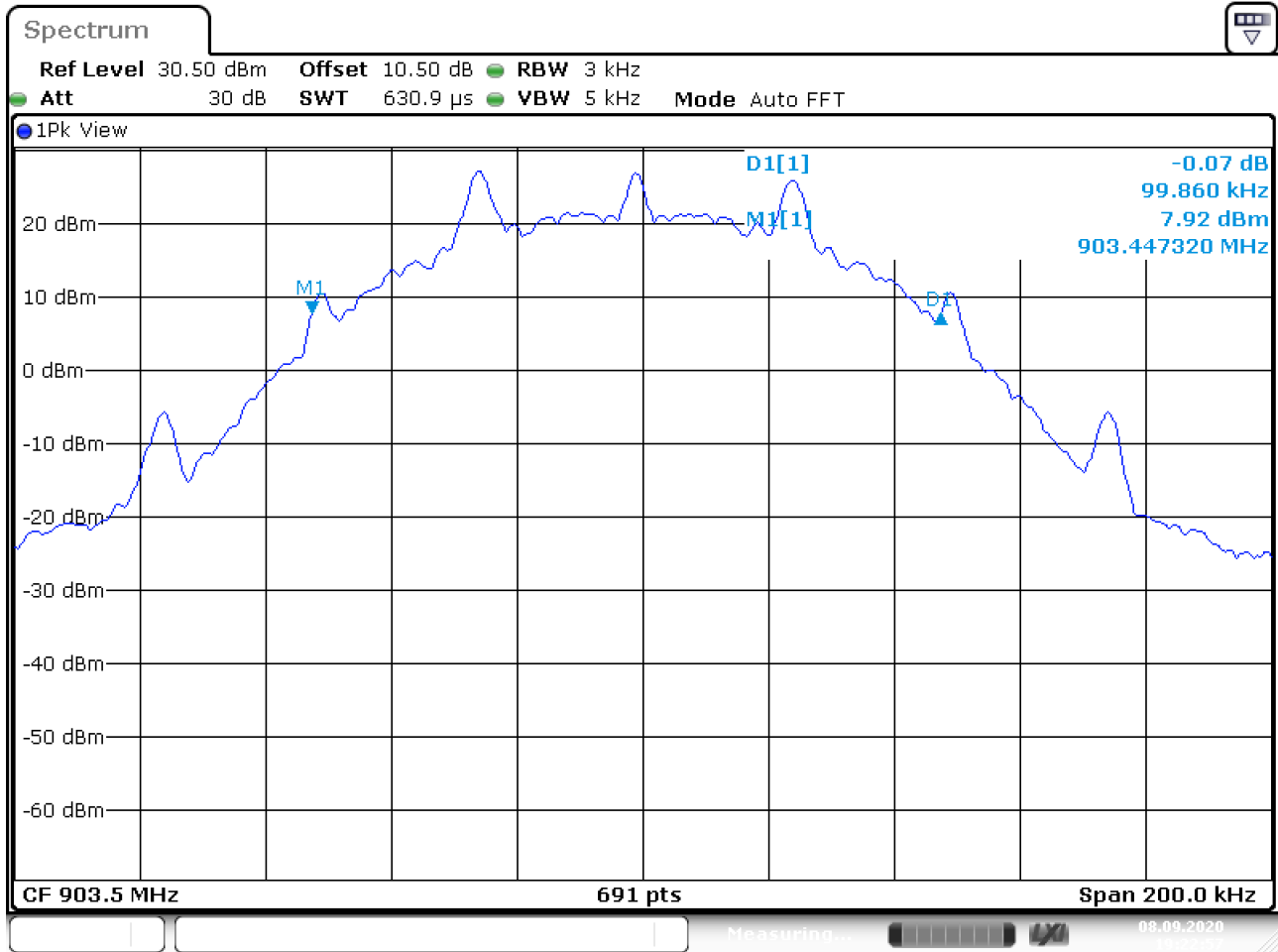
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.





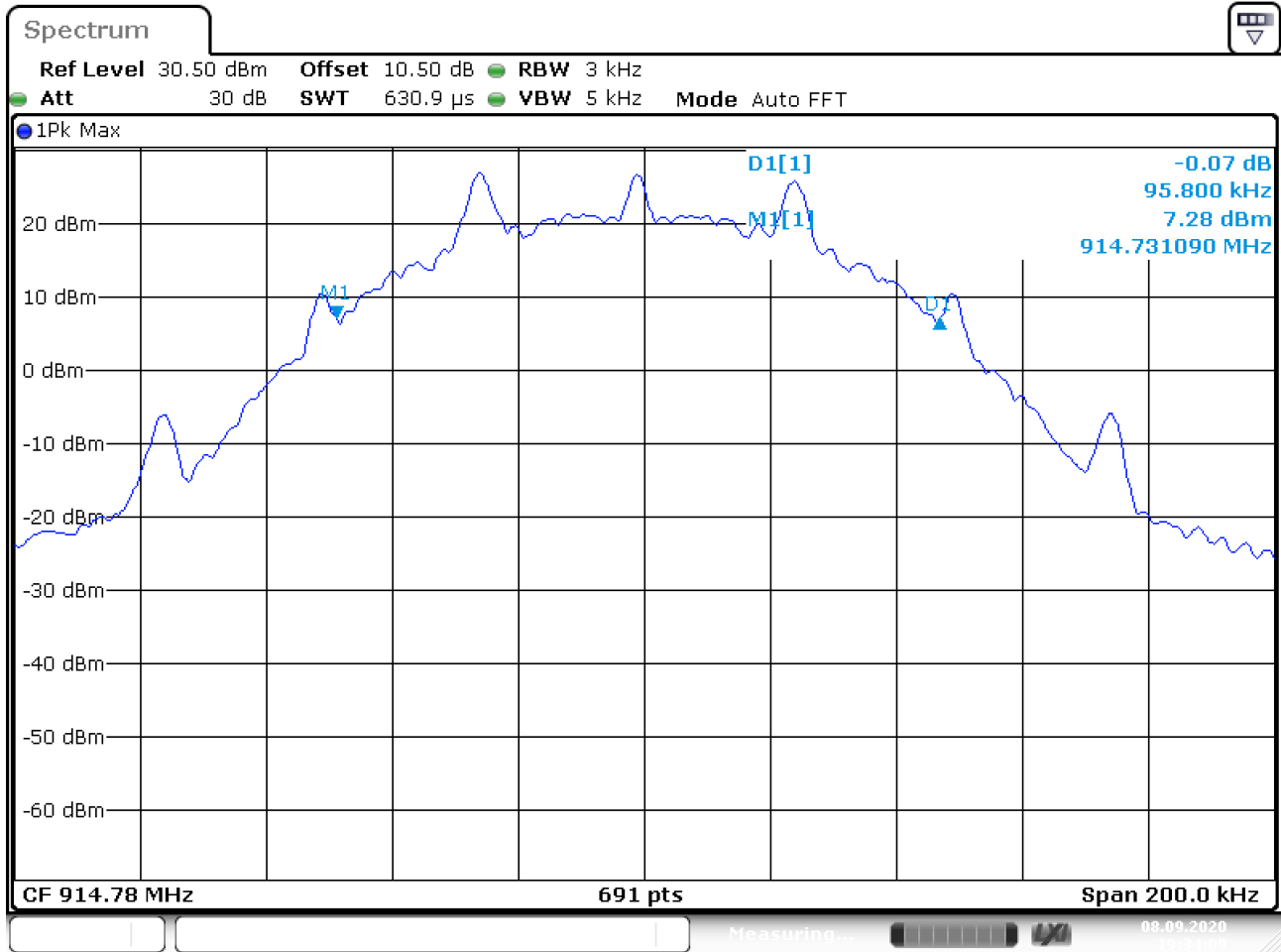
Date: 28.AUG.2020 10:29:52

### Channel Separation



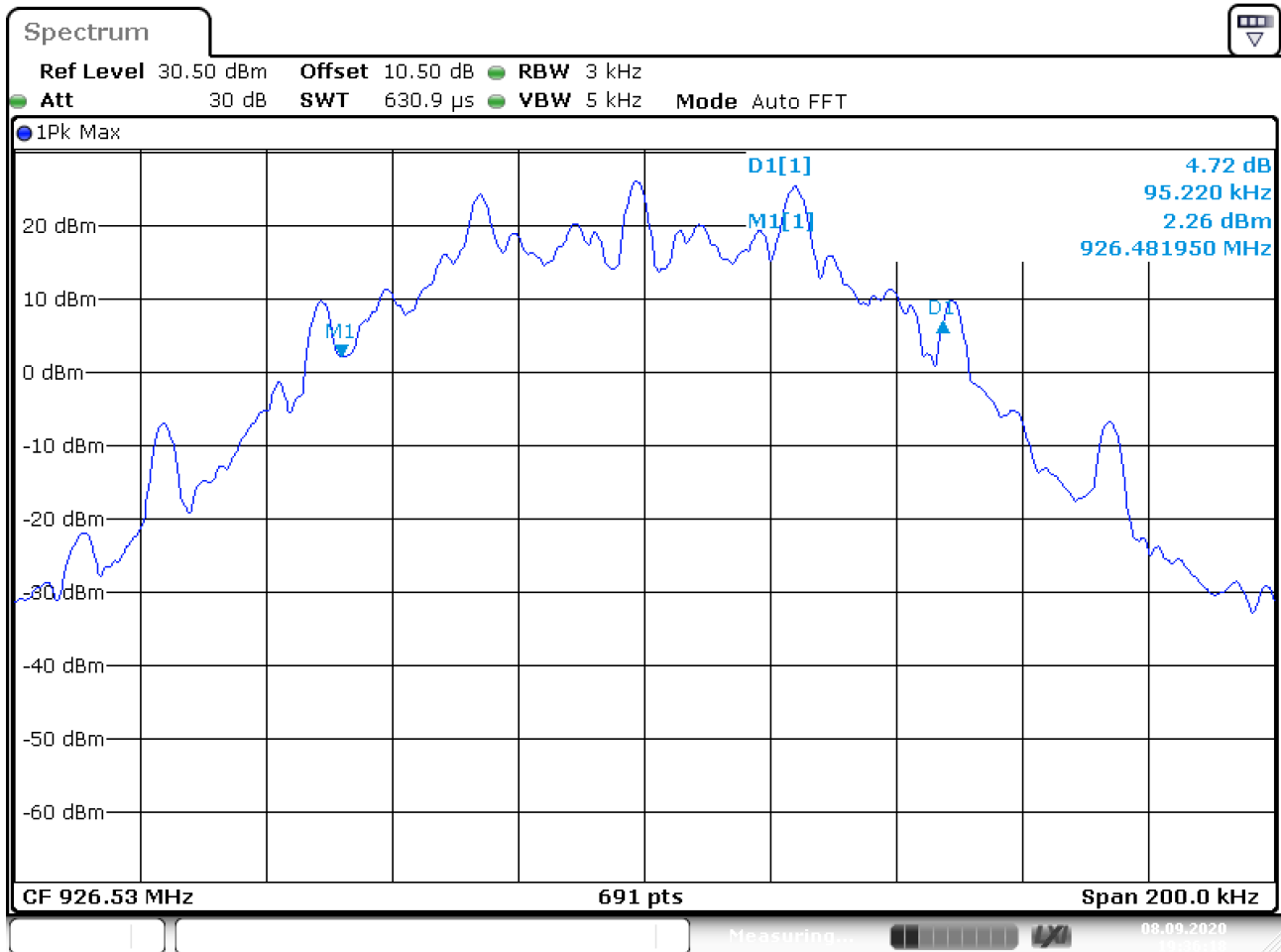
Date: 8.SEP.2020 19:22:57

**20dB Bandwidth, 903.50MHz**



Date: 8.SEP.2020 19:34:10

### 20dB Bandwidth, 914.78 MHz



Date: 8.SEP.2020 19:36:19

**20dB Bandwidth, 926.53 MHz**

## 3.2 Pseudorandom Hopping Algorithm

FCC Part 15.247 (a)(1)

ISED Canada RSS-247 Issue 2, Clause 5.1

Test Results: **Complies**

Measurement Data: /

### Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

No requirements for Digital Transmission Systems.

### Base Table Hopping Sequence

The hopping sequence is described in the document "Scanreco Frequency Hopping Algorithm".

### 3.3 Occupancy Time

FCC Part 15.247 (a)(1)(iii)

ISED Canada RSS-247 Issue 2, Clause 5.1 (c)

Measurement procedure: ANSI C63.10-2013 Clause 7.8.4

Test Results: Complies

**Measurement Data:**

	Ch 903.500MHz	Ch 914.780MHz	Ch 926.530MHz
Number of RF Channels:	50	50	50
Maximum Length of RF Burst pr. channel	10.46 ms	10.46 ms	10.48 ms
Time between RF Burst on same RF Channel	2.50 s	2.50 s	2.50 s
Time of Occupancy	0.08368 s	0.08368 s	0.08384 s

Ch903.500MHz; Time of occupancy:  $(0.01046 \times 0.4 \times 50) / 2.5 = 0.08368s$

Ch914.780MHz; Time of occupancy:  $(0.01046 \times 0.4 \times 50) / 2.5 = 0.08368s$

Ch926.530MHz; Time of occupancy:  $(0.01048 \times 0.4 \times 50) / 2.5 = 0.08384s$

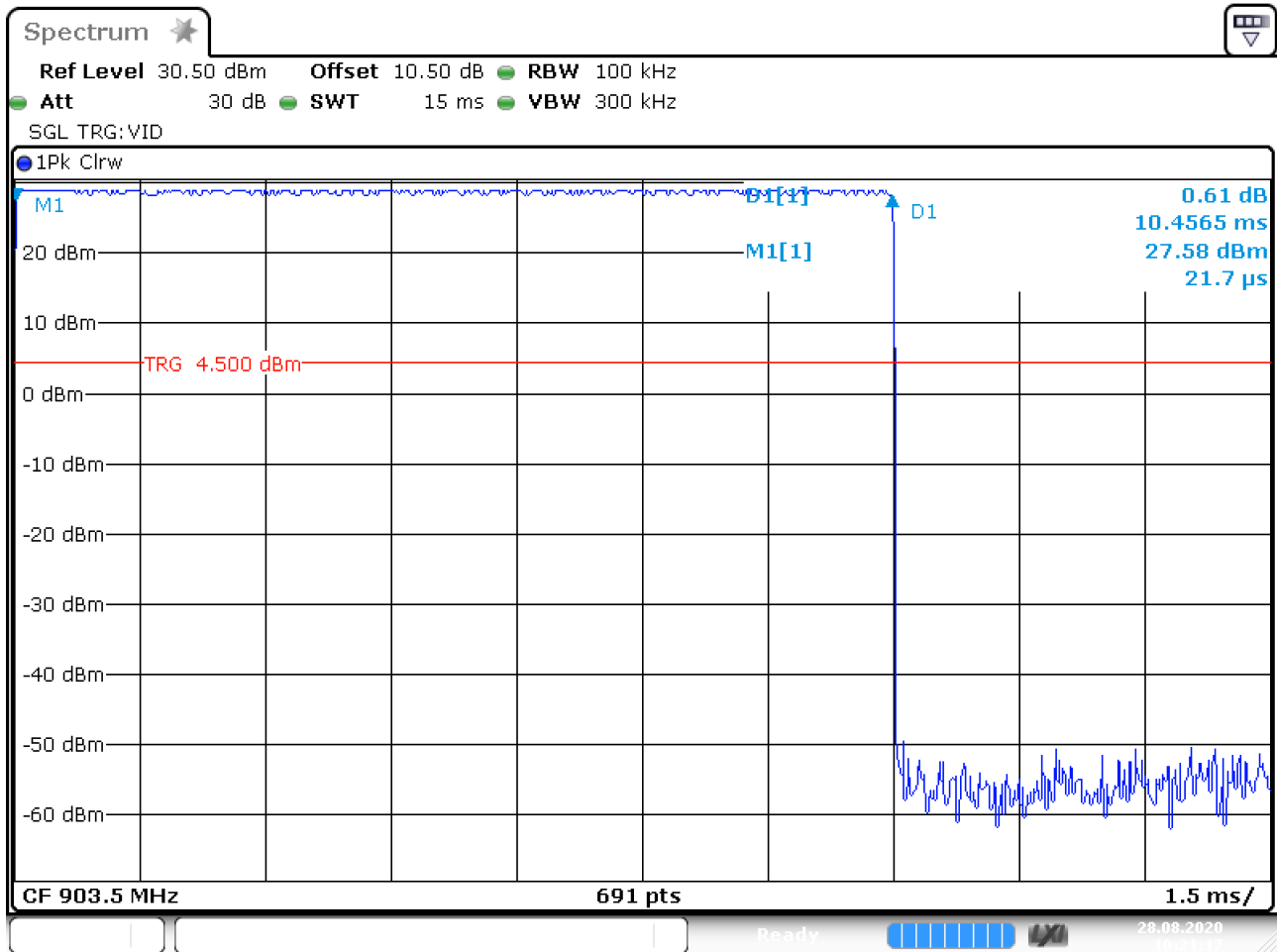
Number of RF channels maximum 50

See attached plots

**Requirements:**

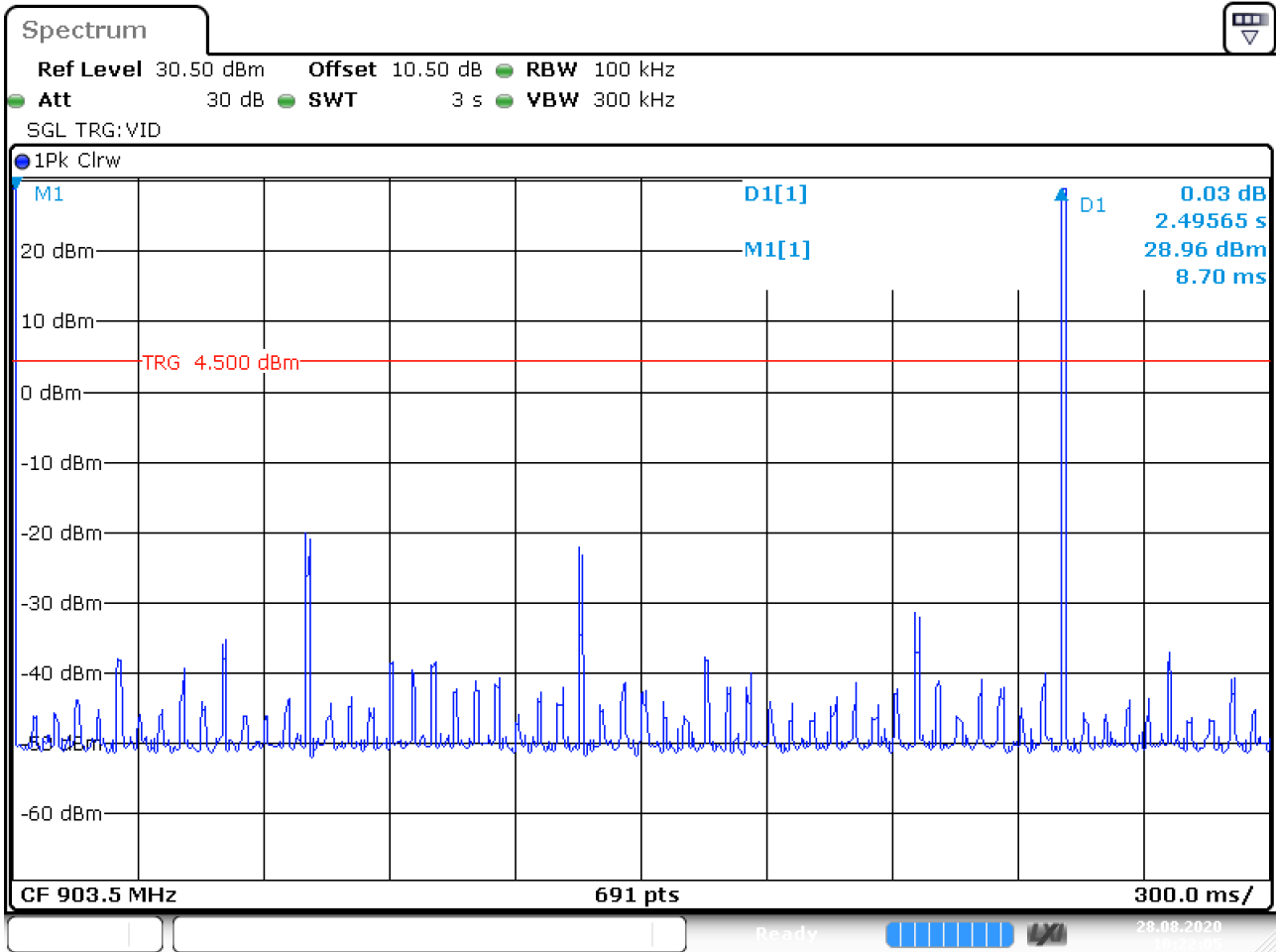
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz



Date: 28.AUG.2020 10:21:18

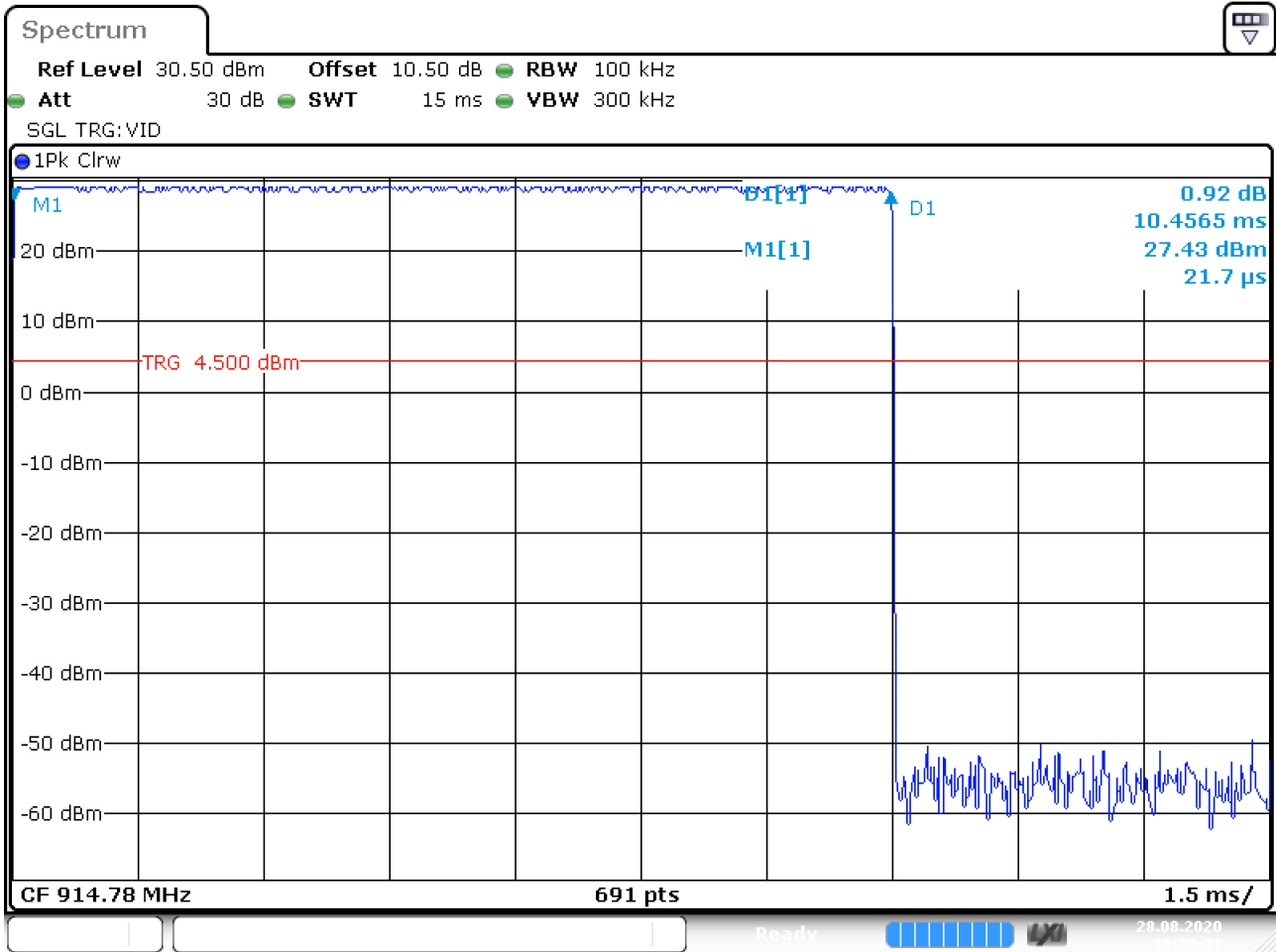
**Burst Length, ch903.50MHz**



Date: 28.AUG.2020 10:22:05

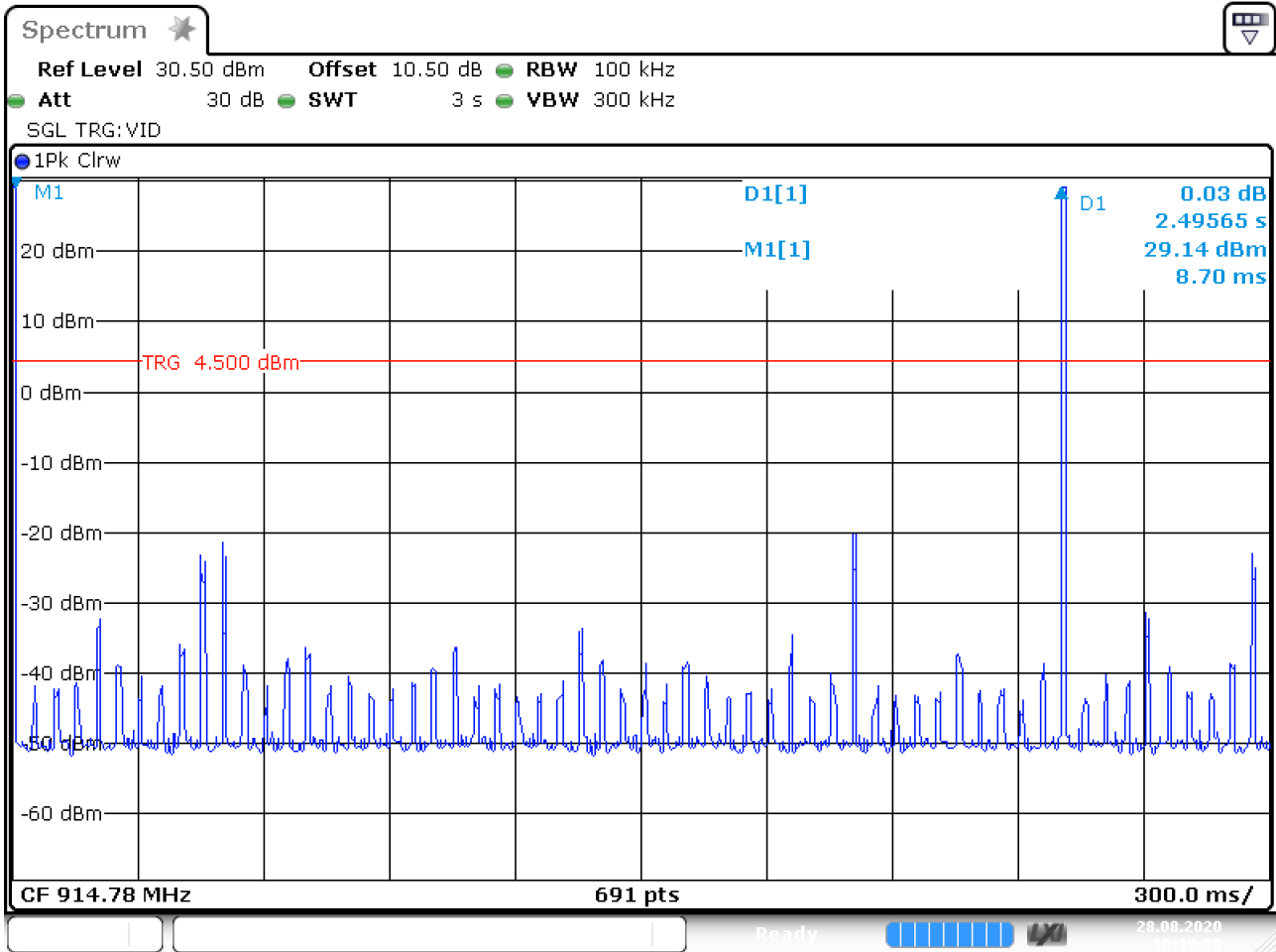
**Time between each burst, ch903.50MHz**





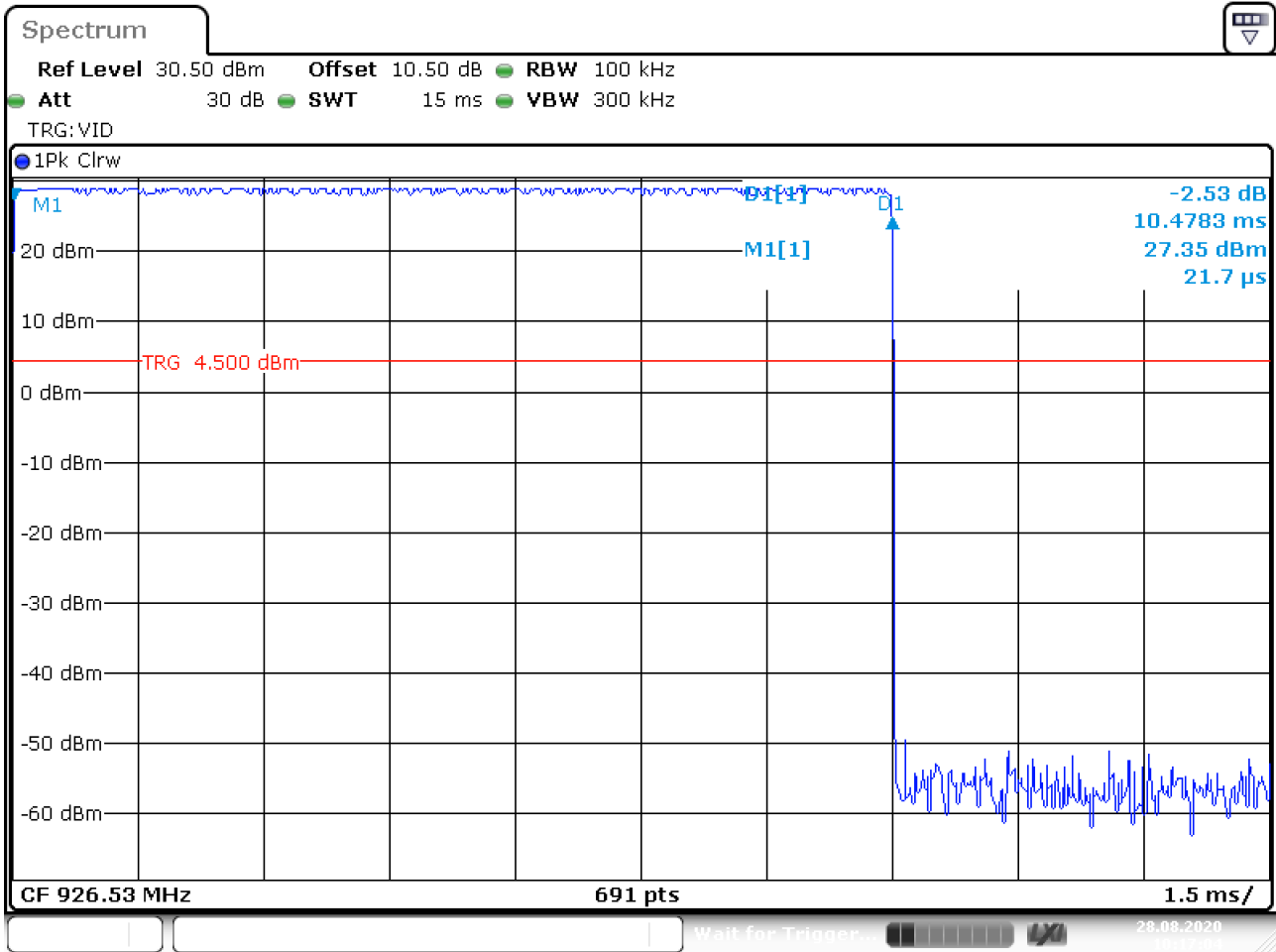
Date: 28.AUG.2020 10:20:31

**Burst Length, ch914.78MHz**



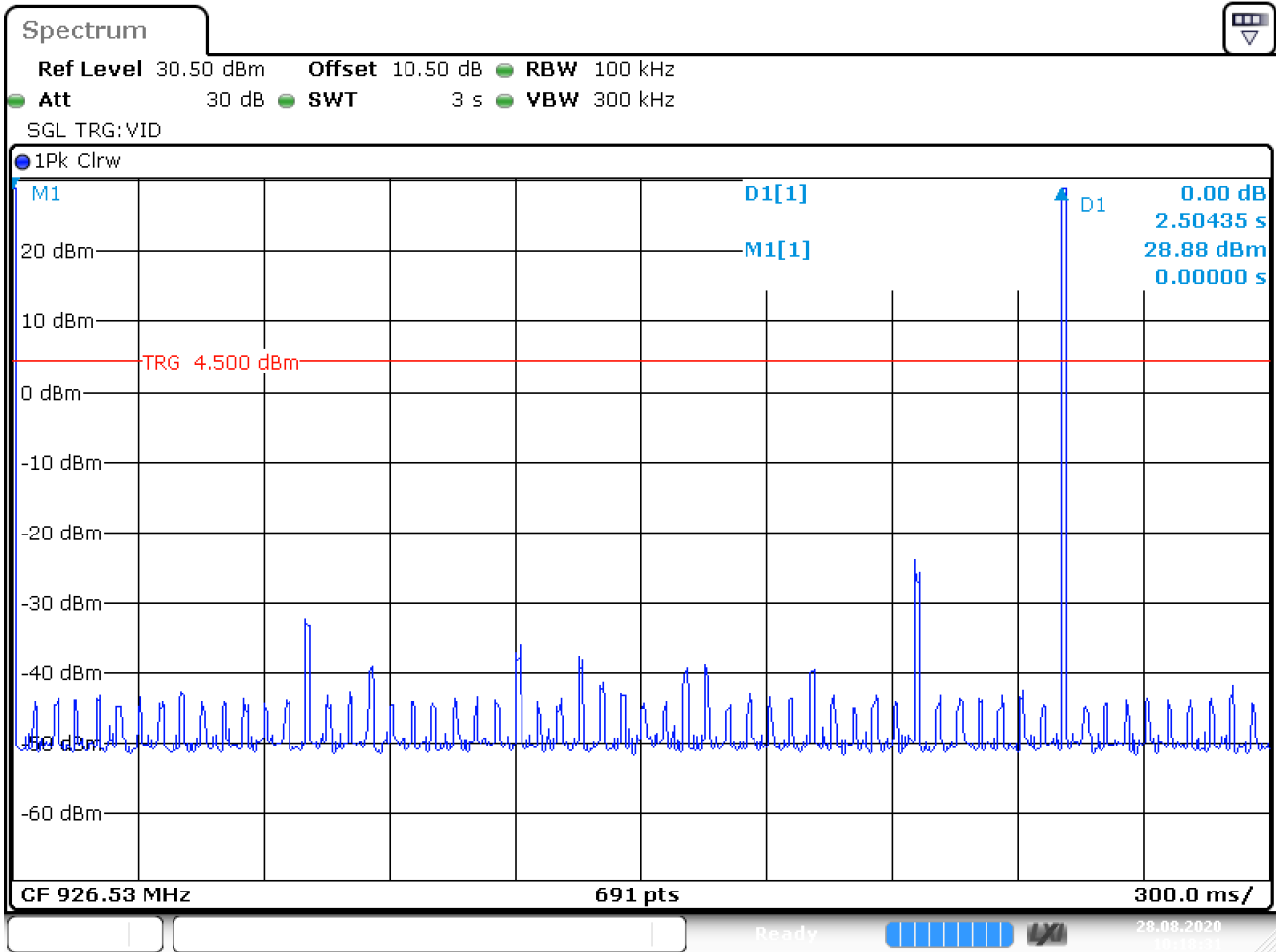
Date: 28.AUG.2020 10:19:50

**Time between each burst, ch914.78MHz**



Date: 28.AUG.2020 10:17:04

**Burst Length, ch926.53MHz**



Date: 28.AUG.2020 10:18:31

**Time between each burst, ch926.53MHz**

### 3.4 Occupied Bandwidth (99% BW) and Hopping Bandwidth

FCC Part 15.247 (a)(1)(iii)

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 6.9.3 / 7.8.3

Test Results: Complies

#### Measurement Data:

Number of RF Channels in use:	50
Channel Centre Frequencies:	903.500 - 926.530 MHz
99% BW Measured on Centre Channel (914.78 MHz)	94.12kHz

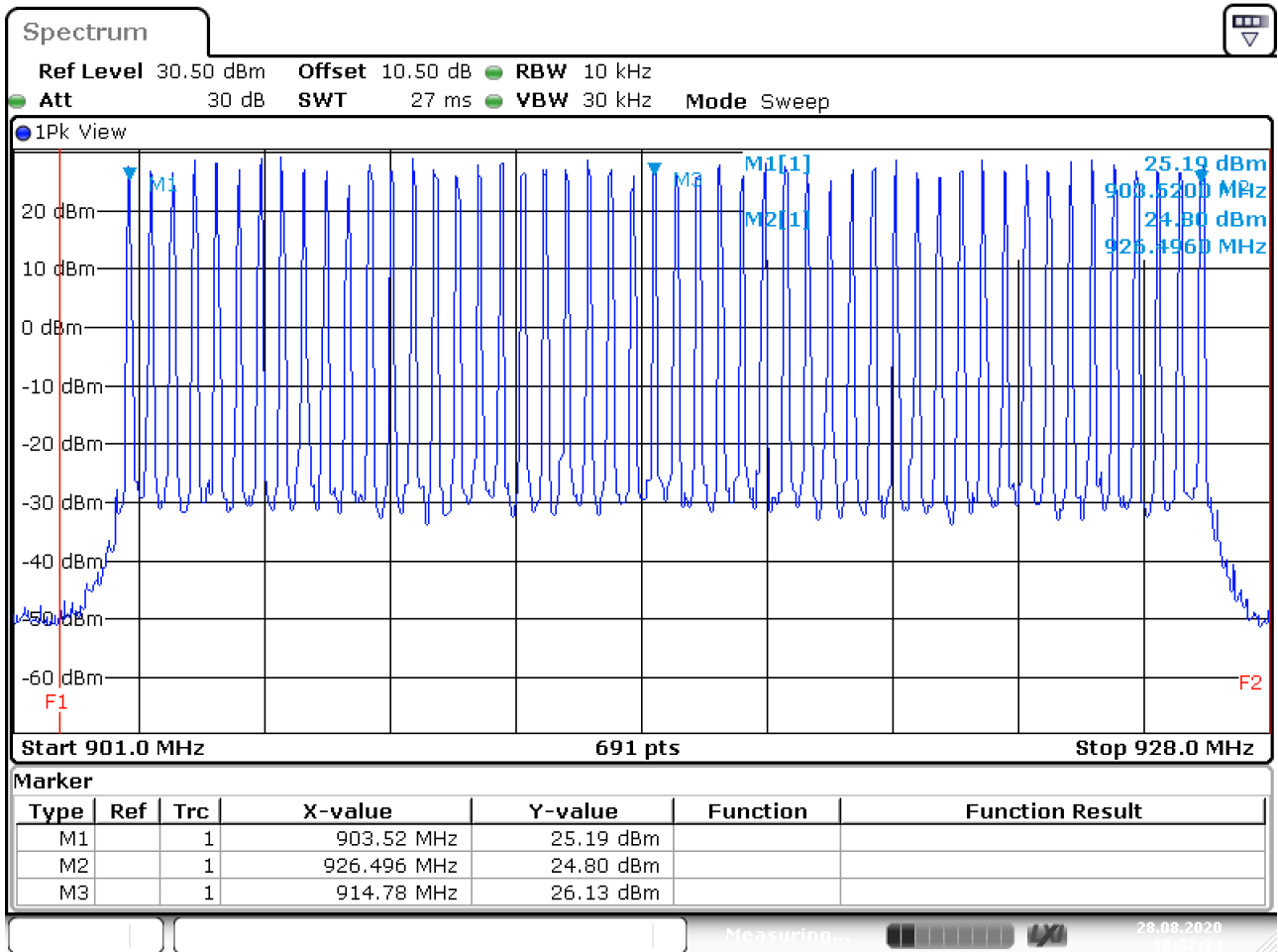
See attached plots.

#### Requirements:

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

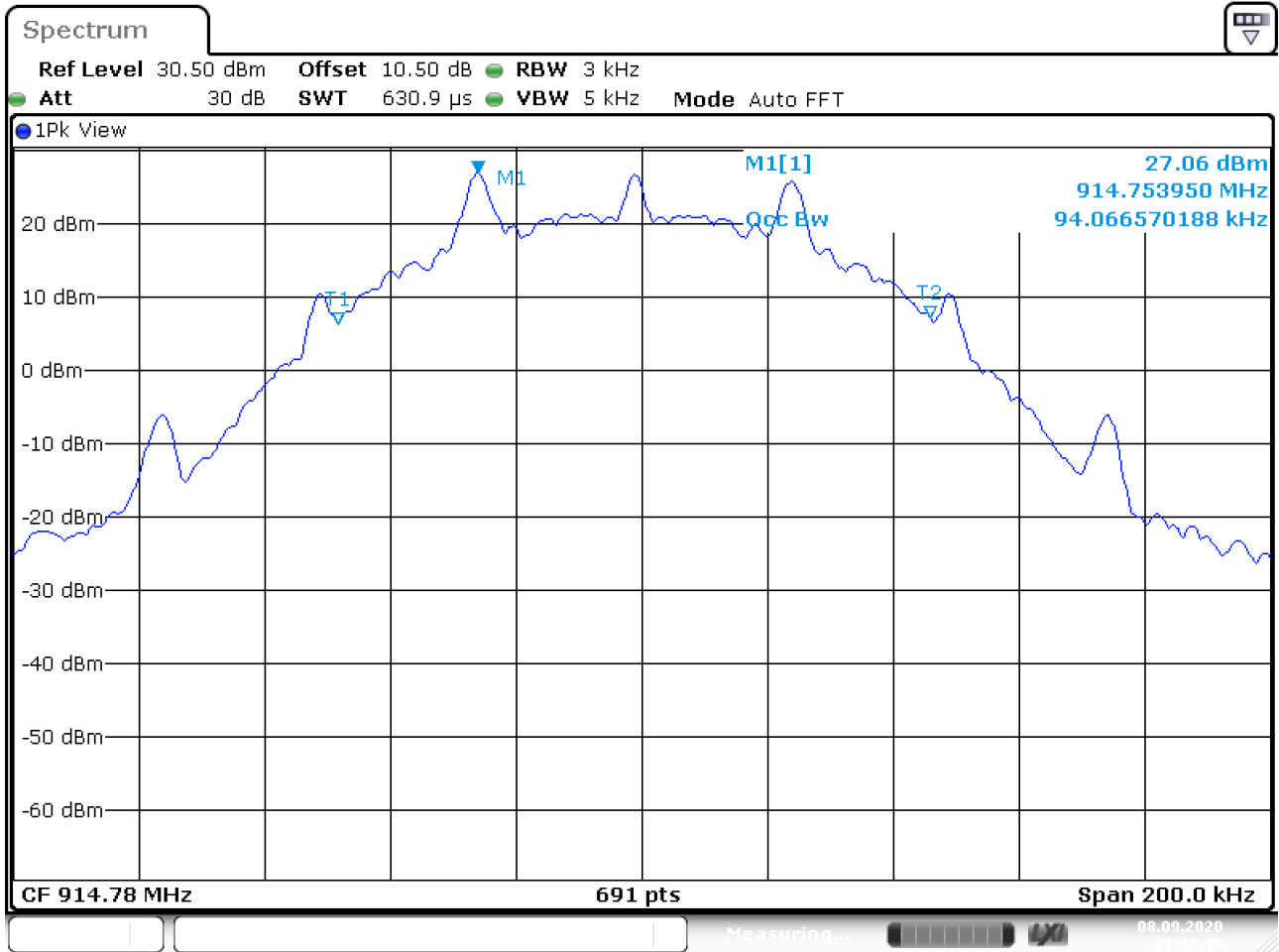
No requirements for Digital Transmission Systems..

No requirement for 99% BW, reported for information only.



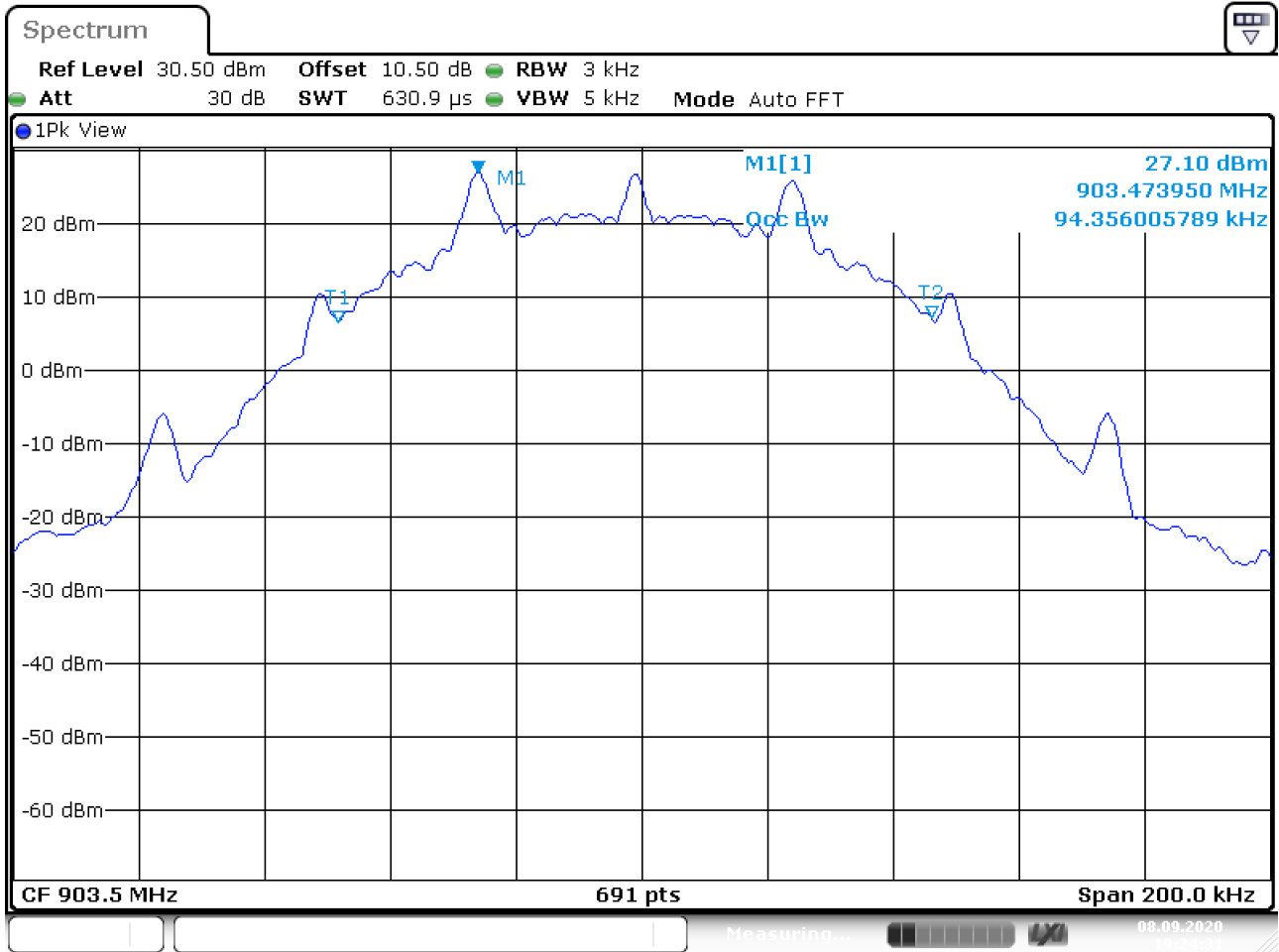
Date: 28.AUG.2020 10:32:34

**RF Channels in Use**



Date: 8.SEP.2020 19:32:11

**99% Bandwidth – ch914.78MHz**



Date: 8.SEP.2020 19:24:31

**99% Bandwidth – ch903.50MHz**



### 3.5 Peak Power Output

FCC Part 15.247 (b)(2)

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:**

	903.50 MHz	914.78 MHz	926.53 MHz
Conducted Power (dBm)	29.54	29.65	29.36
Conducted Power (mWatts)	899.50	922.57	862.98
Field Strength (dB $\mu$ V/m), VP	124.77	124.92	125.01
ERP, Calculated (mWatts)	552.08	571.48	583.45
Antenna gain (dBd)	-2.1	-2.1	-1.7

Output Power reported is Maximum Peak Power.

Radiated Power was calculated from measured Field Strength using the method described in ANSI C63.10-2013 Eq. 39.

Antenna Gain is less than 6 dBi.

See attached plots.

**Requirements:**

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

For frequency hopping systems operating in the 902-928 MHz band:

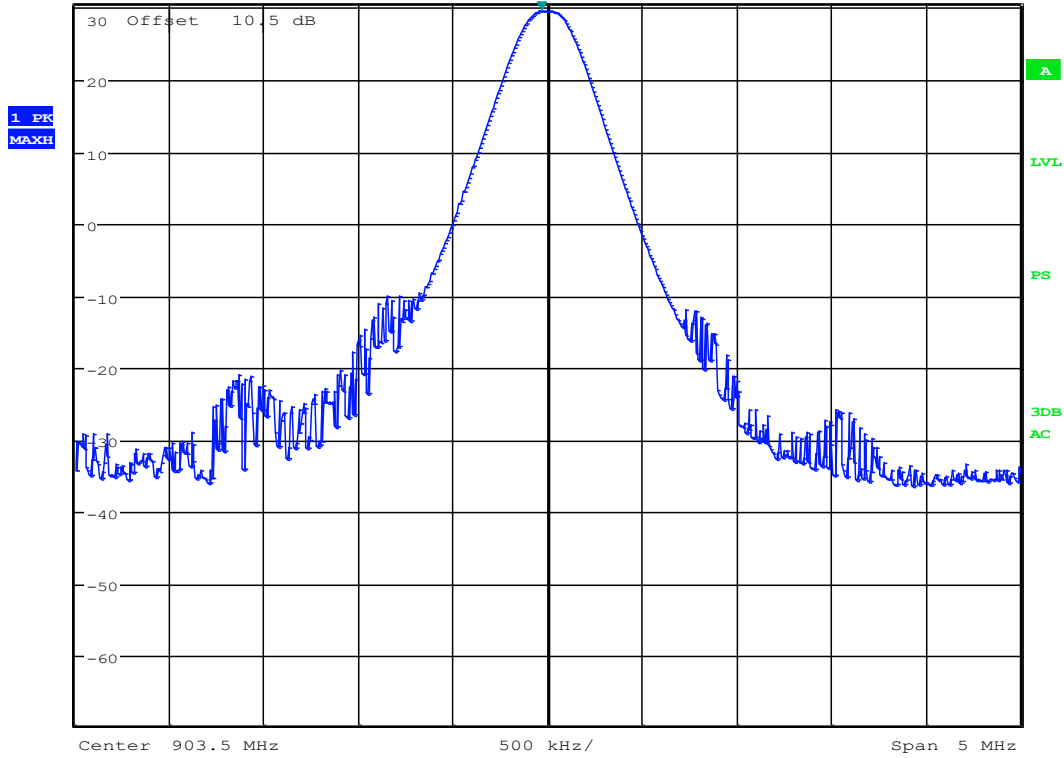
1 watt for systems employing at least 50 hopping channels; and,

0.25 watts for systems employing less than 50 hopping channels,

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.



**MARKER 1**  
 903.4679487 MHz  
 Ref 30.5 dBm \*Att 20 dB 1 \*RBW 200 kHz \*SWT 10 ms  
 Marker 1 [T1 ] 29.54 dBm  
 903.467948718 MHz

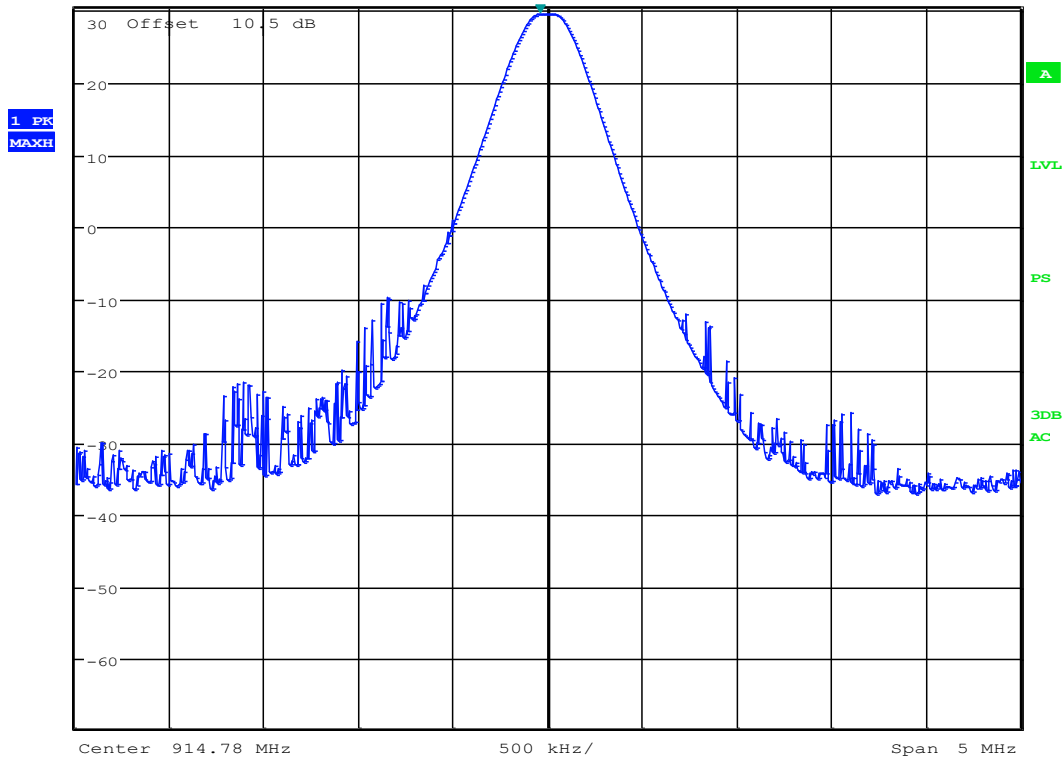


Date: 14.SEP.2020 08:47:34

**Conducted Power 903.50MHz**



**MARKER 1**  
914.7399359 MHz  
Ref 30.5 dBm \*Att 20 dB \*RBW 200 kHz \*VBW 500 kHz \*SWT 10 ms  
Marker 1 [T1 ] 29.65 dBm  
914.739935897 MHz

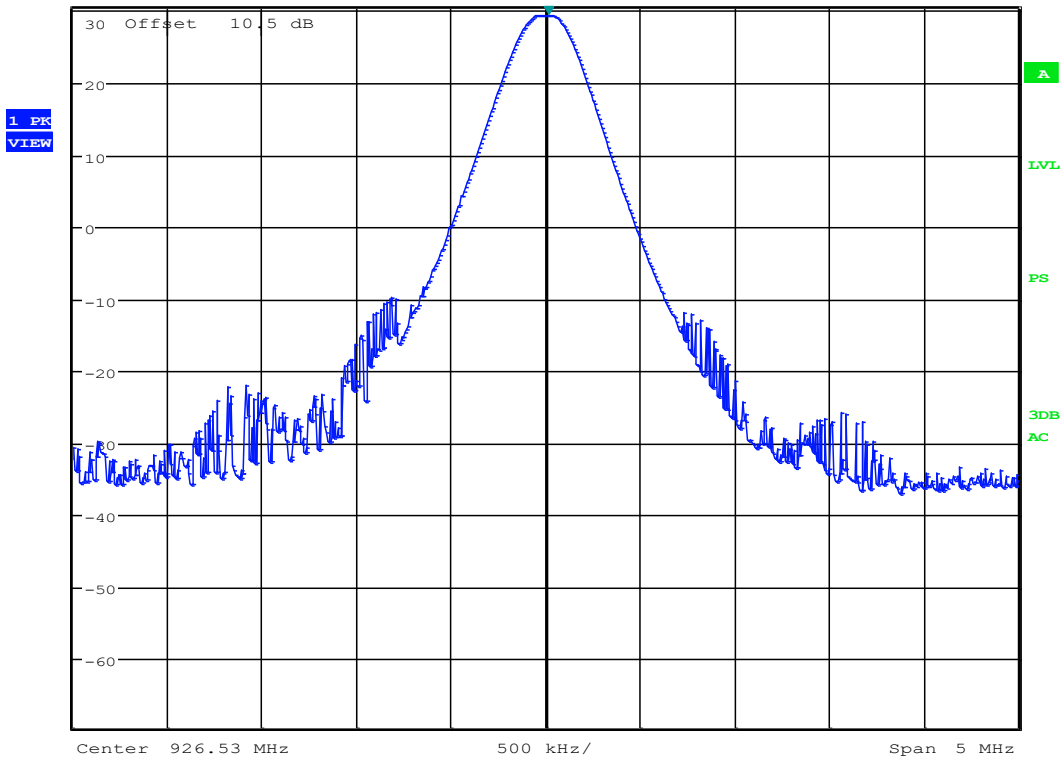


Date: 14.SEP.2020 08:49:25

**Conducted Power 914.78MHz**



\*RBW 200 kHz      Marker 1 [T1 ]  
VBW 500 kHz      29.36 dBm  
Ref 30.5 dBm      \*Att 20 dB      1 \*SWT 10 ms      926.546025641 MHz



Date: 14.SEP.2020 08:46:00

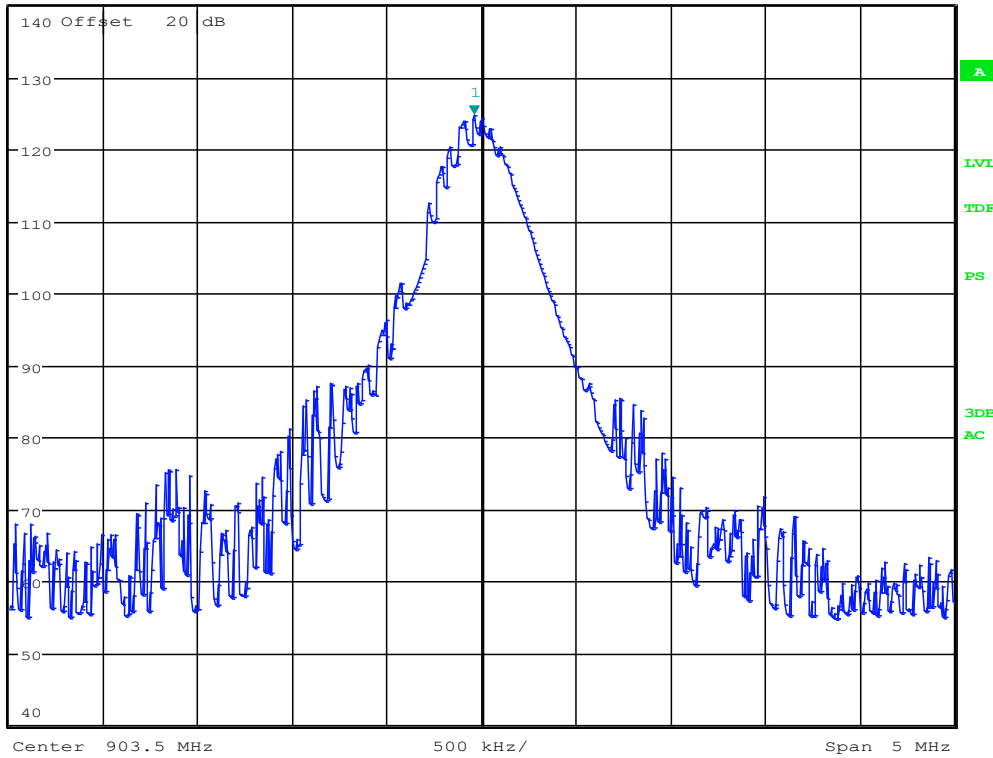
**Conducted Power 926.53MHz**



\*RBW 200 kHz      Marker 1 [T1 ]  
 VBW 500 kHz      124.77 dBµV/m  
 \*SWT 10 ms      903.459935897 MHz

Ref 140 dBµV/m      \*Att 15 dB

1 PK  
 VIEW



Date: 14.SEP.2020 08:10:32

**Radiated Field strength ,VP, ch903.50MHz**

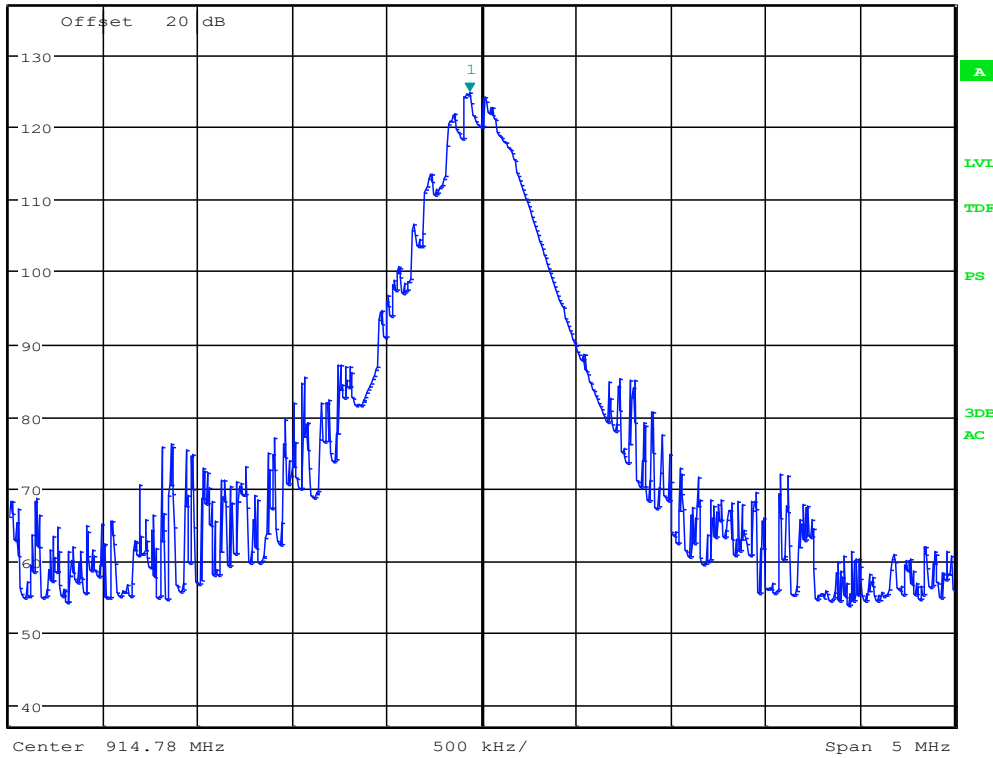


**MARKER 1**  
 914.7158974 MHz

\*RBW 200 kHz      Marker 1 [T1 ]  
 \*VBW 500 kHz      124.92 dBuV/m  
 \*SWT 10 ms      914.715897436 MHz

Ref 137 dBuV/m      \*Att 10 dB

1 PK  
 VIEW

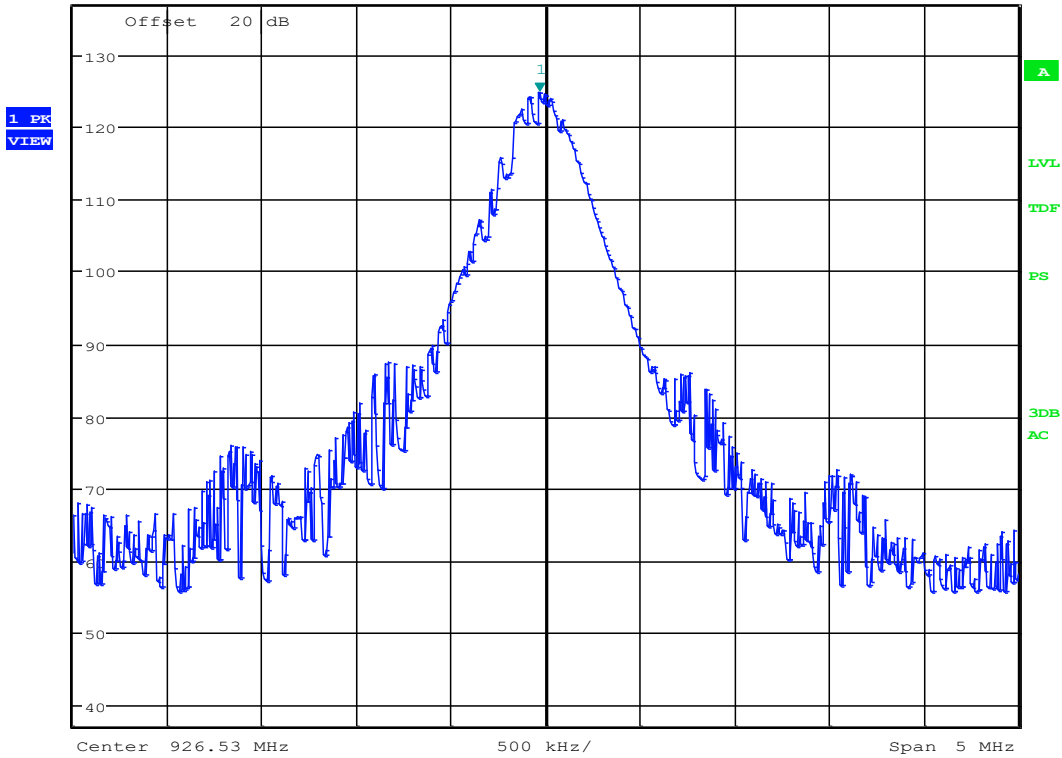


Date: 14.SEP.2020 08:17:50

**Radiated Field strength,VP, ch914.78MHz**



\*RBW 200 kHz      Marker 1 [T1 ]  
VBW 500 kHz      125.01 dBµV/m  
\*Att 10 dB      \*SWT 10 ms      926.497948718 MHz  
Ref 137 dBµV/m

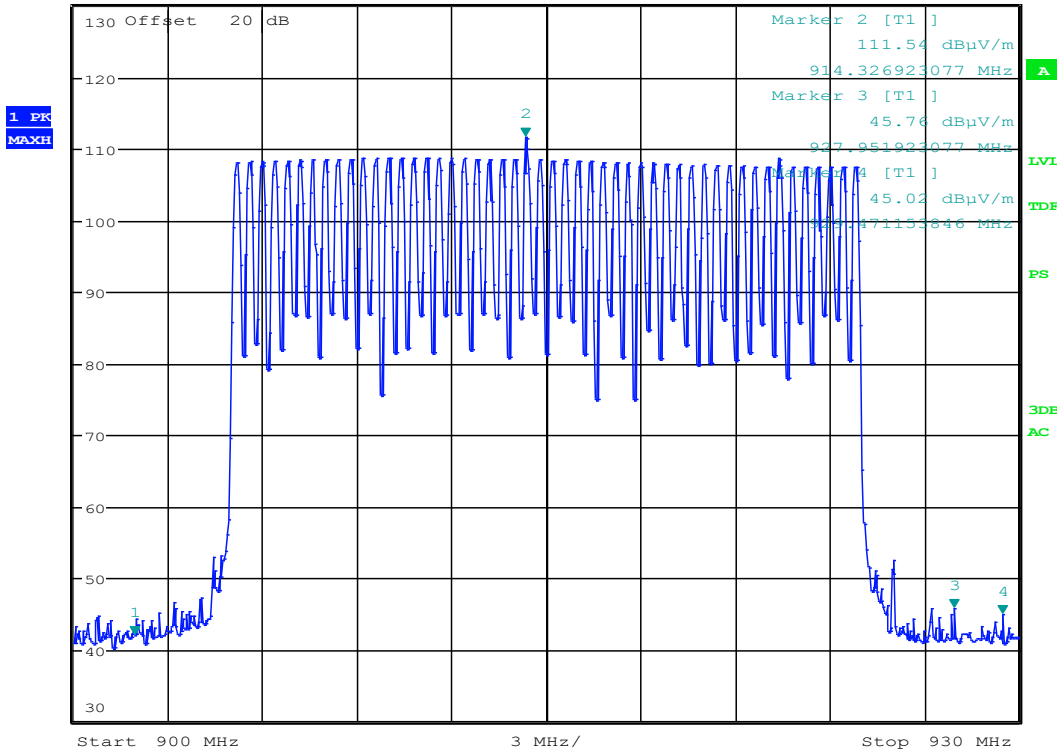


Date: 14.SEP.2020 08:31:05

**Radiated Field strength,VP, ch926.53MHz**



**MARKER 1**  
 901.9038462 MHz  
 Ref 130 dBuV/m \*Att 15 dB \*RBW 100 kHz \*SWT 20 ms  
 Marker 1 [T1 ] 42.15 dBuV/m  
 901.903846154 MHz



Date: 18.JUN.2020 09:20:00

**Radiated field strength during hopping, VP**



### 3.6 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 2, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

**Measurement Data:**

Carrier Frequency	Highest value fundamental (dBm)	Highest value Harmonic (dBm)	Highest Value (dBc)	Margin (dB)	Verdict
903.500 MHz	29.61	-51.99	81.60	>40	Pass
914.780 MHz	29.71	-54.07	83.78	>40	Pass
926.530 MHz	29.68	-55.01	84.69	>40	Pass
In hopping mode	29.70	-61.25	90.95	>40	Pass

Measured with Peak Detector

RF conducted power to 10 GHz: see attached plots.

**Limit**

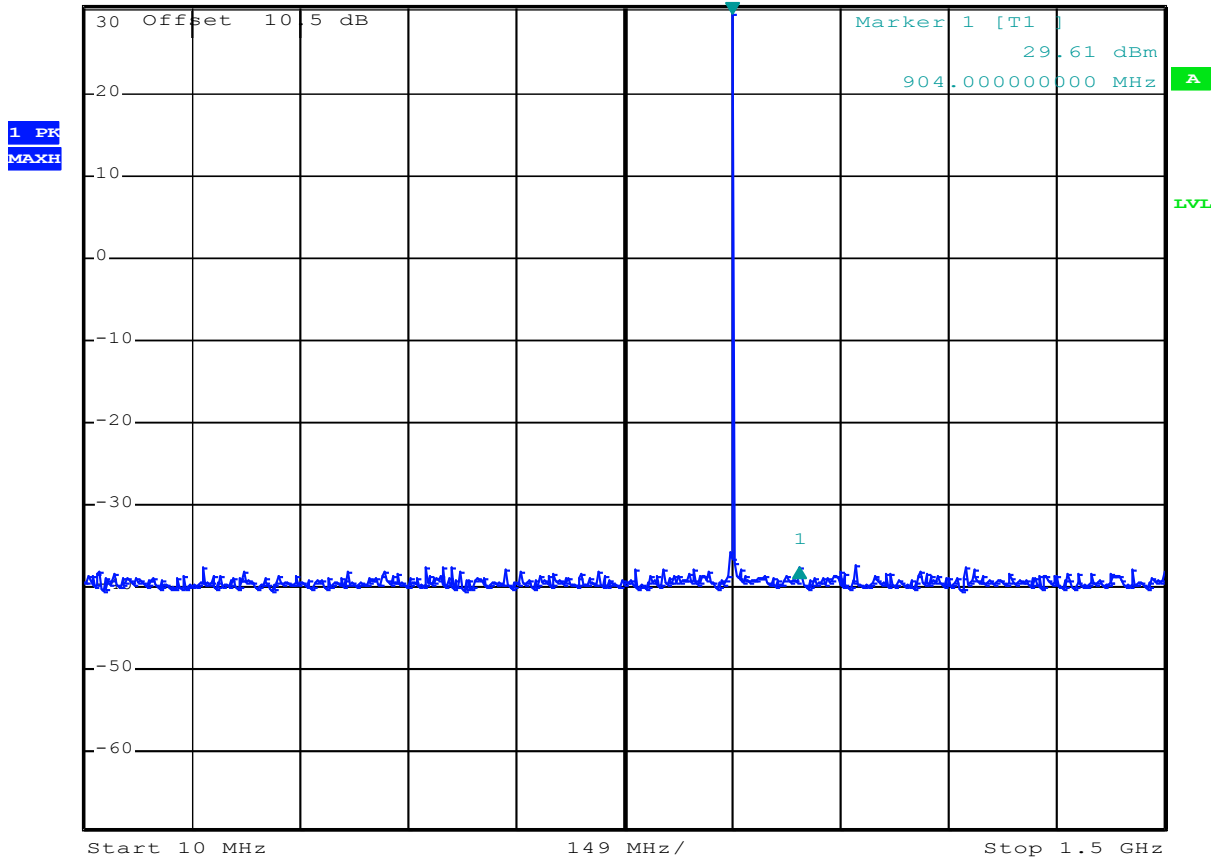
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

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.



Ref 30.5 dBm      \*Att 30 dB      SWT 150 ms      92.380000000 MHz  
 \*RBW 100 kHz      Delta 1 [T1 ]  
 \*VBW 300 kHz      -67.31 dB



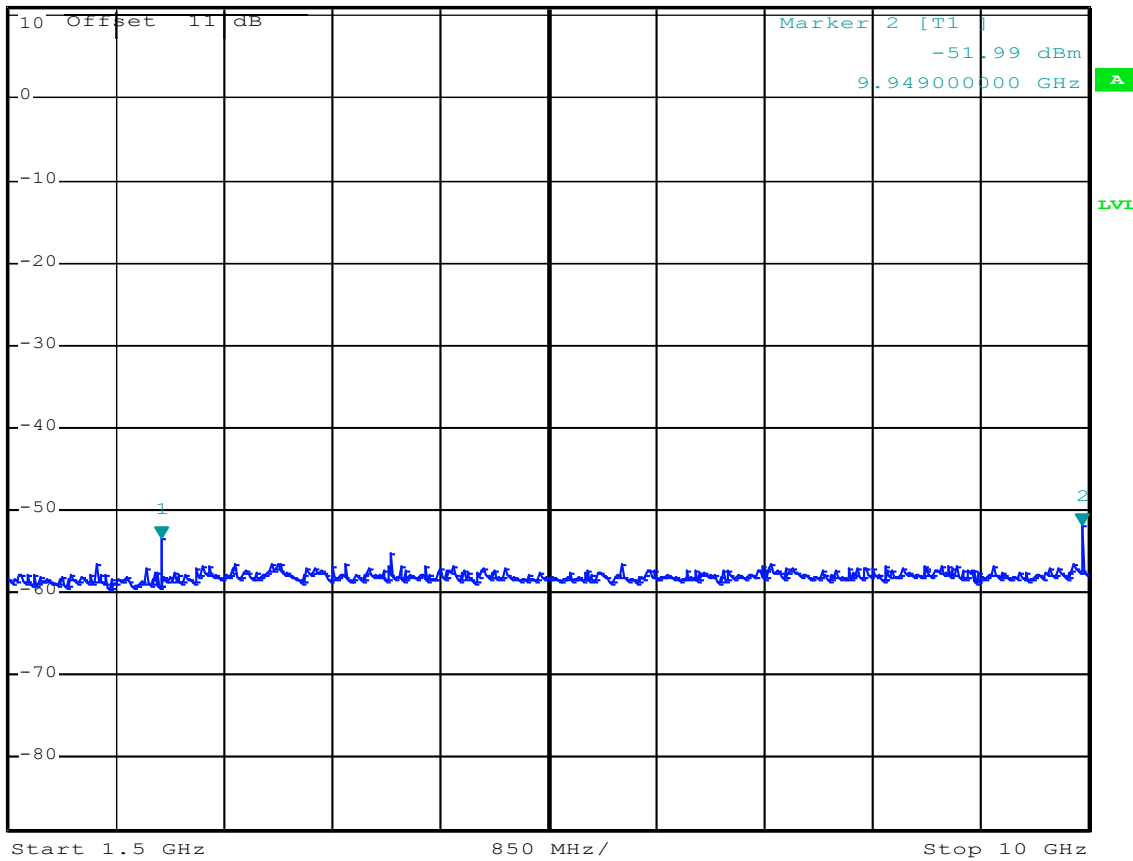
Date: 30.AUG.2020 13:17:51

**Conducted spurious emissions ch903.50MHz, 10MHz - 1.5GHz**



\*RBW 100 kHz Marker 1 [T1 ]  
 \*VBW 300 kHz -53.32 dBm  
 Ref 11 dBm \*Att 10 dB SWT 860 ms 2.707000000 GHz

1 PK  
 VIEW

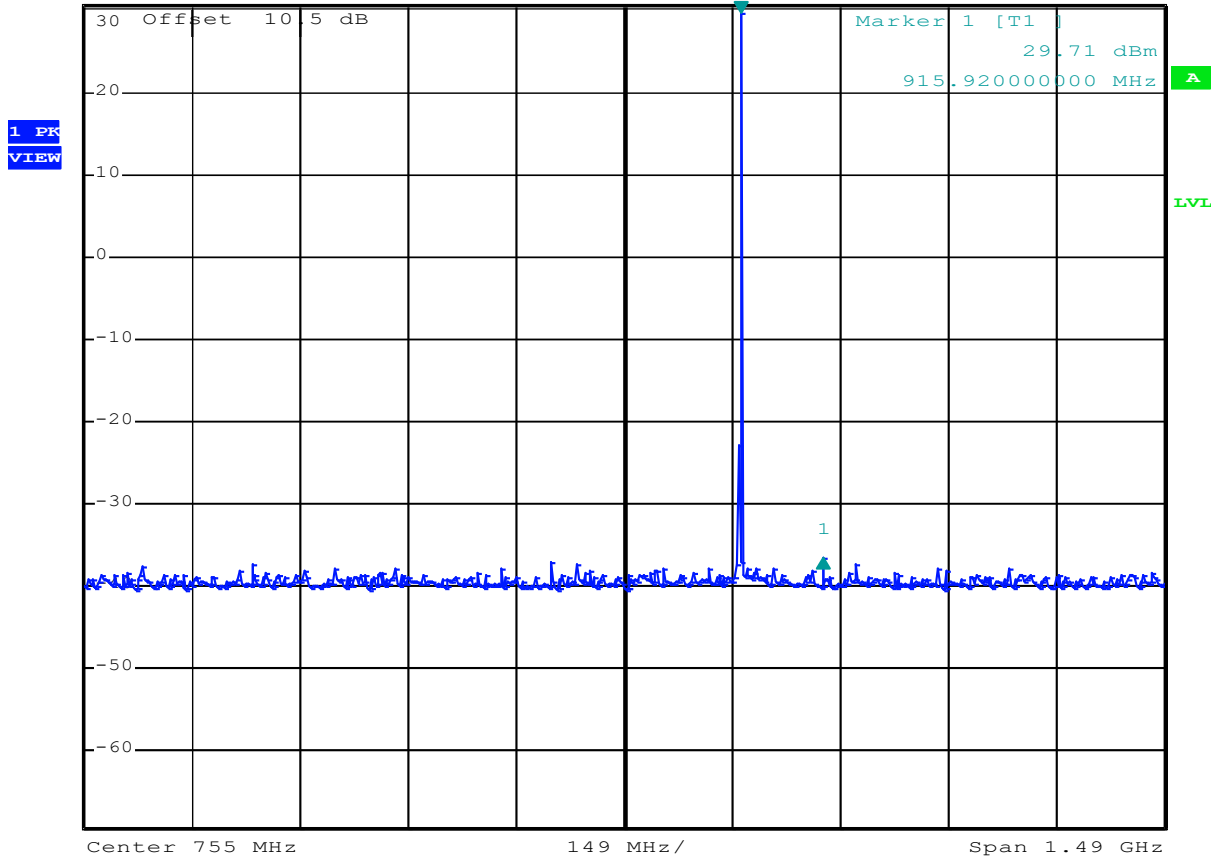


Date: 30.AUG.2020 13:35:20

**Conducted spurious emissions ch903.50MHz, 1.5GHz - 10GHz**



\*RBW 100 kHz    Delta 1 [T1 ]  
 \*VBW 300 kHz                       -66.28 dB  
 Ref 30.5 dBm    \*Att 30 dB    SWT 150 ms    113.240000000 MHz

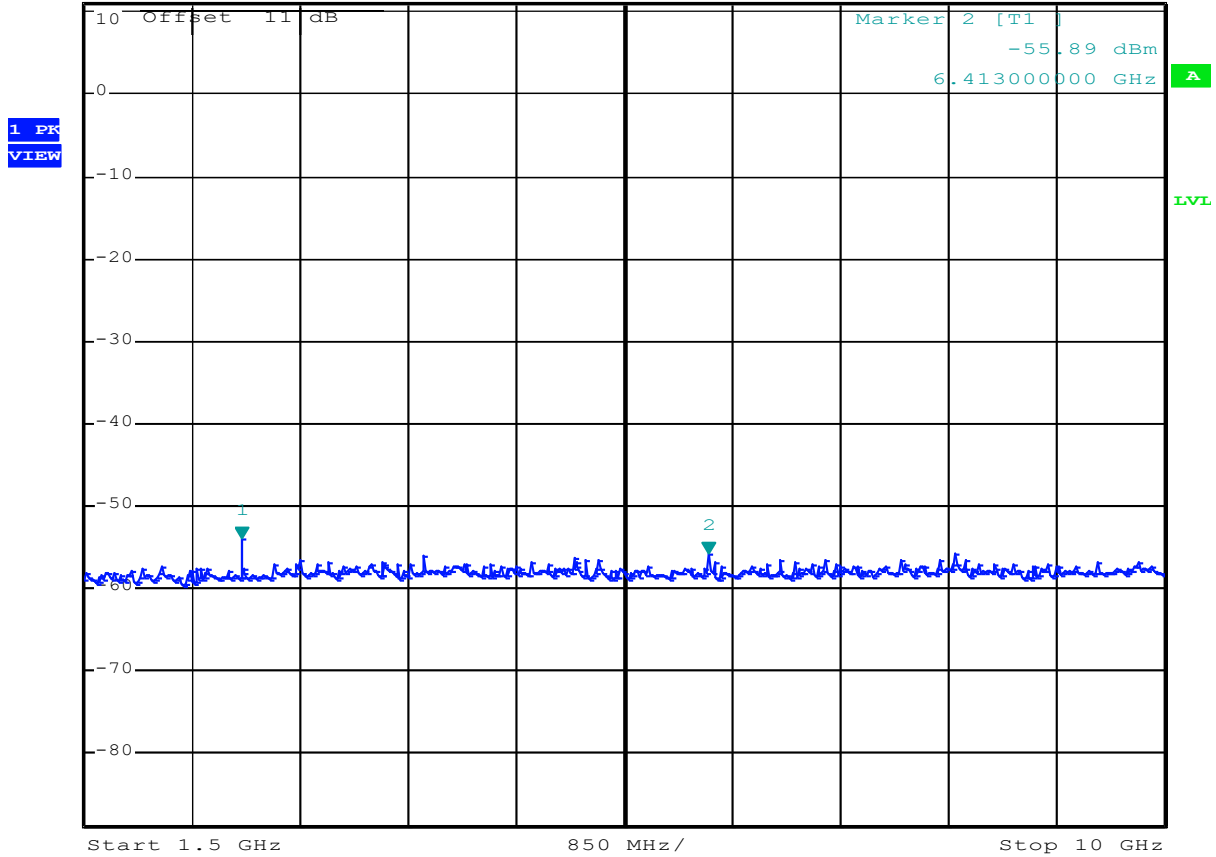


Date: 30.AUG.2020 13:20:14

**Conducted spurious emissions ch914.78MHz, 10MHz - 1.5GHz**



\*RBW 100 kHz    Marker 1 [T1 ]  
 \*VBW 300 kHz                    -54.07 dBm  
 Ref 11 dBm                    \*Att 10 dB                    SWT 860 ms                    2.741000000 GHz



Date: 30.AUG.2020 13:33:03

**Conducted spurious emissions ch914.78MHz, 1.5GHz - 10GHz**

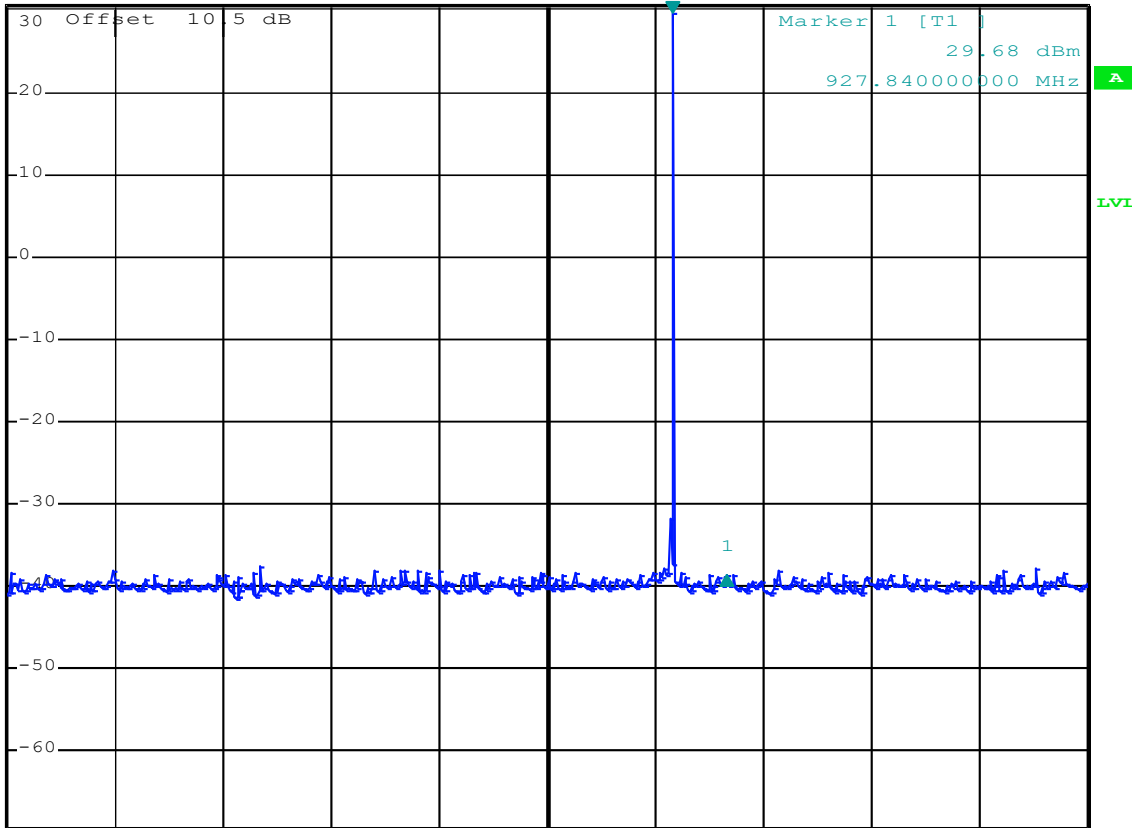


\*RBW 100 kHz Delta 1 [T1 ]  
\*VBW 300 kHz -68.23 dB  
SWT 150 ms 74.500000000 MHz

Ref 30.5 dBm

\*Att 30 dB

1 PK  
VIEW



Start 10 MHz 149 MHz/ Stop 1.5 GHz

Date: 30.AUG.2020 13:21:19

Conducted spurious emissions ch926.53MHz, 10MHz – 1.5GHz

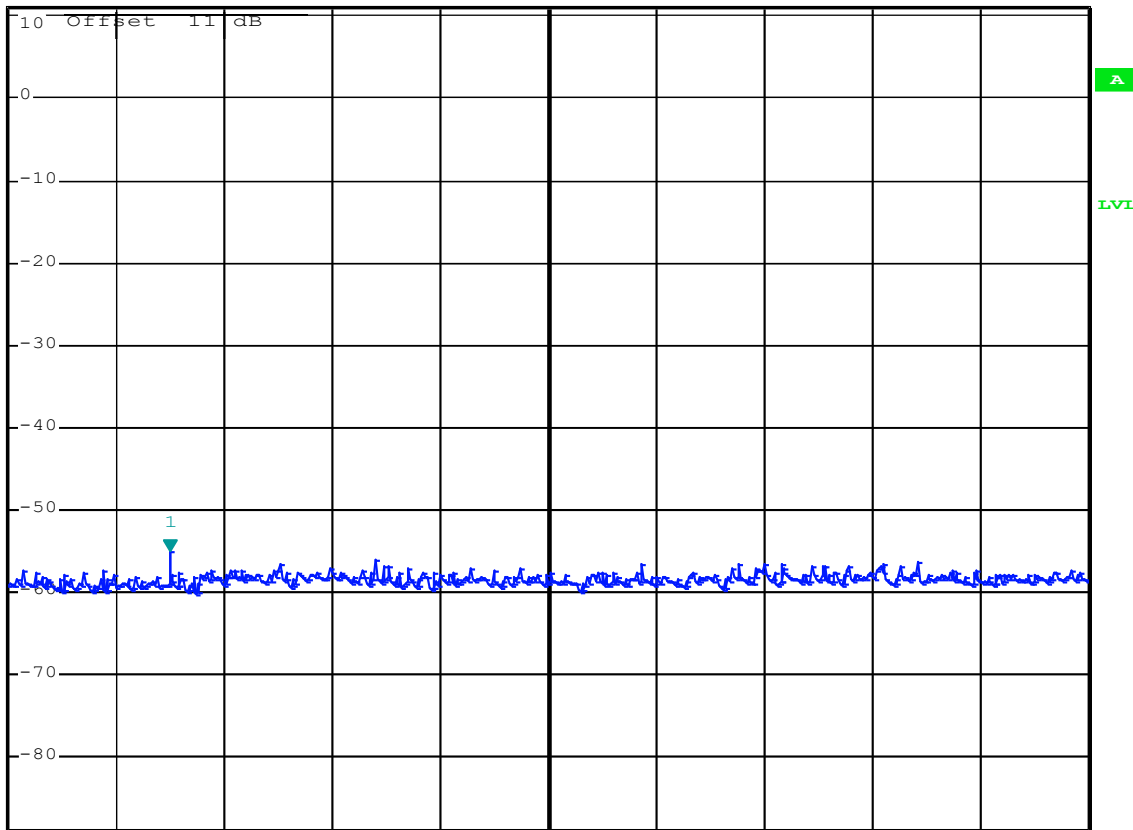


\*RBW 100 kHz Marker 1 [T1 ]  
\*VBW 300 kHz -55.01 dBm  
SWT 860 ms 2.775000000 GHz

Ref 11 dBm

\*Att 10 dB

1 PK  
VIEW



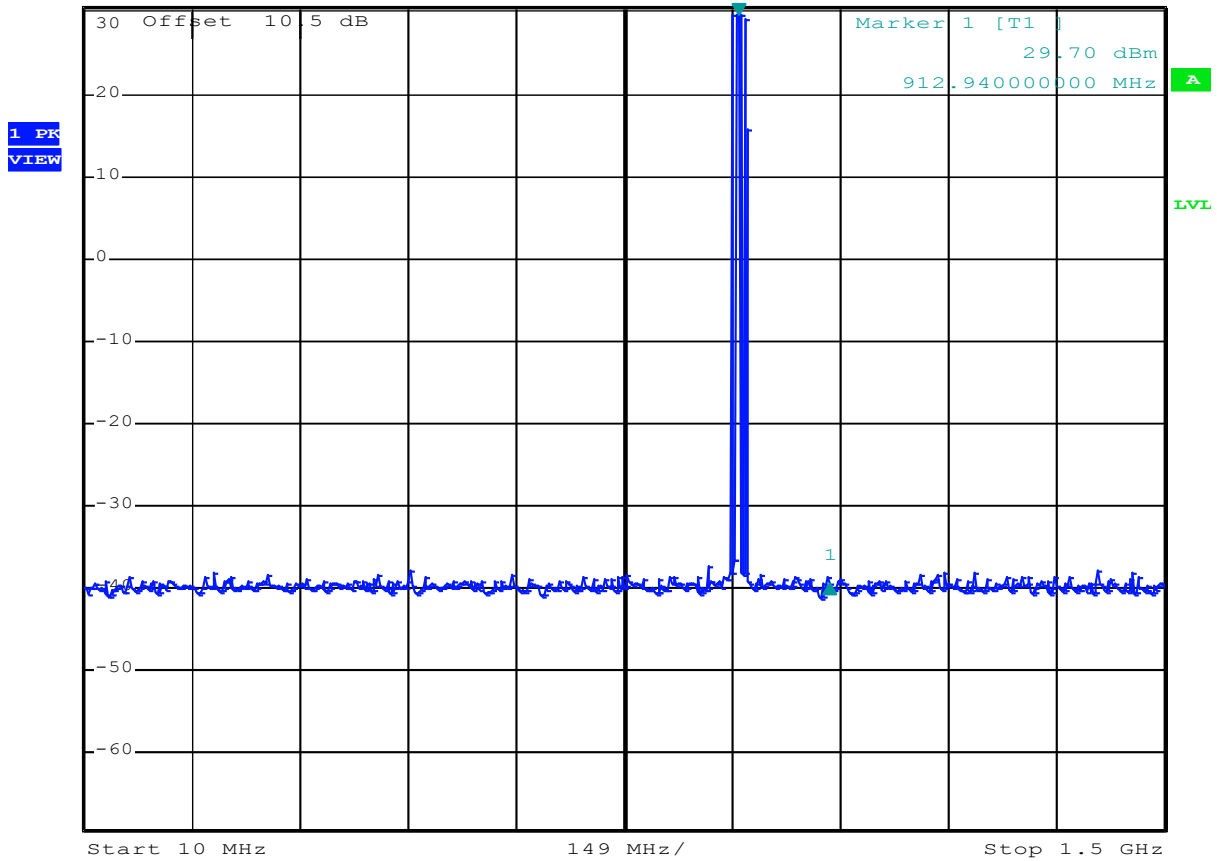
Start 1.5 GHz 850 MHz/ Stop 10 GHz

Date: 30.AUG.2020 13:38:15

Conducted spurious emissions ch926.53MHz, 1.5GHz - 10GHz



\*RBW 100 kHz Delta 1 [T1 ]  
 \*VBW 300 kHz -69.20 dB  
 Ref 30.5 dBm \*Att 30 dB SWT 150 ms 125.160000000 MHz



Date: 30.AUG.2020 13:42:41

Conducted spurious emissions in hopping mode, 10MHz - 1.5GHz



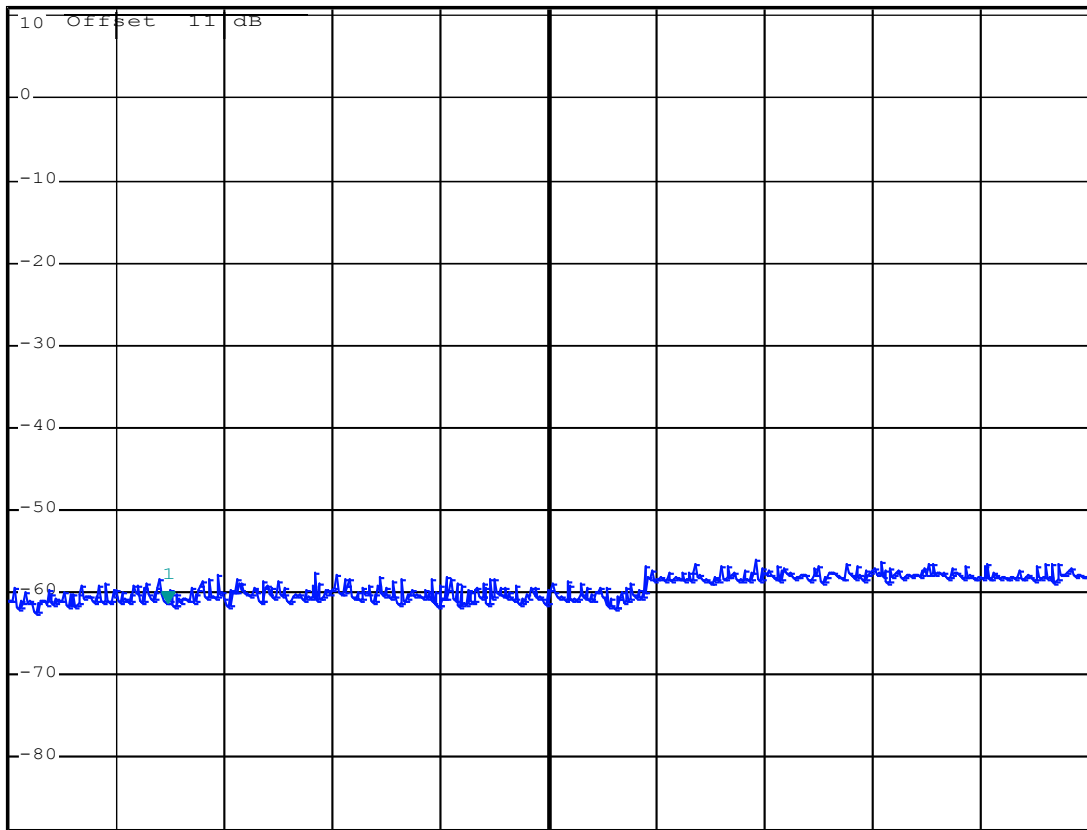


\*RBW 100 kHz Marker 1 [T1 ]  
\*VBW 300 kHz -61.35 dBm  
SWT 860 ms 2.758000000 GHz

Ref 11 dBm

\*Att 10 dB

1 PK  
MAXH



Start 1.5 GHz 850 MHz/ Stop 10 GHz

Date: 30.AUG.2020 13:40:25

**Conducted spurious emissions in hopping mode, 1.5 GHz - 10 GHz**

### 3.7 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED RSS-GEN, Issue 5 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> <b>1.3-1.427</b>	<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.

### 3.8 Radiated Emissions, Band Edge

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 radiated field strength

	Measured field strength (dB $\mu$ V/m)		Limit	Margin	
	Lower band edge 902MHz	Upper band edge 928MHz	dBc	dB	
Peak Detector	65.42	57.21	20	58.48	68.08

Lower Band:

PK field strength at fundamental frequency ch903.50MHz: 123.9 dBuV/m, dbc=123.9 – 65.42=58.48 dB

Upper band:

PK field strength at fundamental frequency ch926.53MHz: 125.2 dBuV/m, dbc=125.2 – 57.41=68.08 dB

See attached plots.

**Duty Cycle Correction Factor Calculation:**

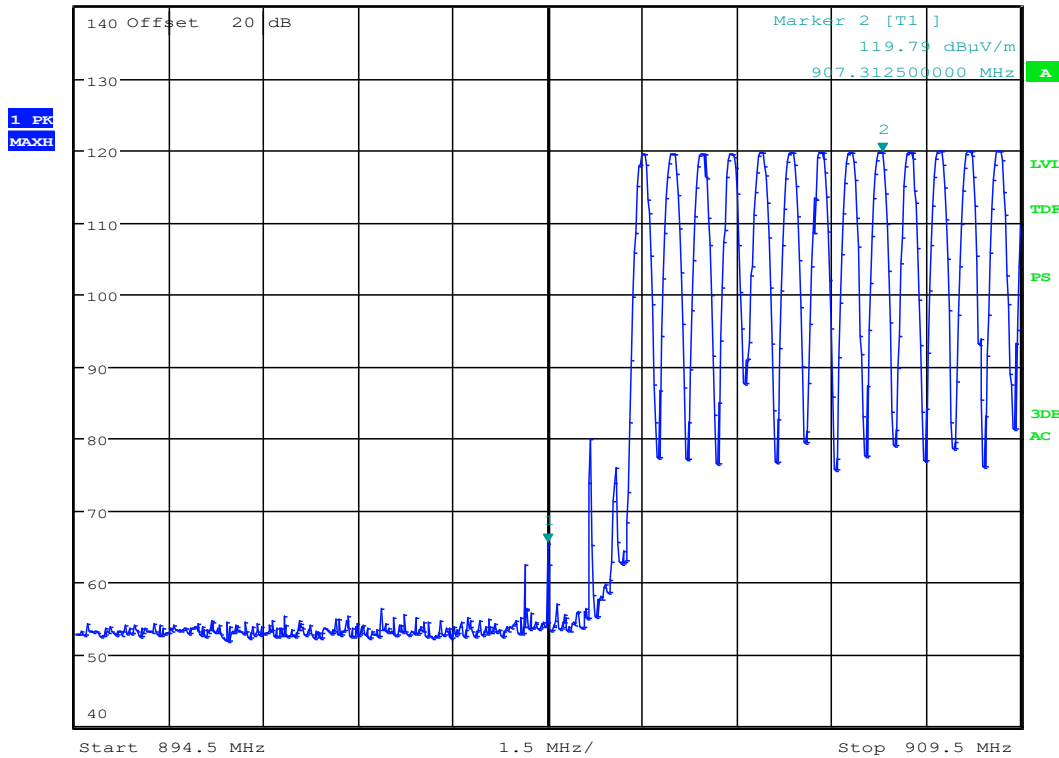
Duty Cycle Correction factor =  $-20 \times \log(0.21) = -13.6$  dB

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



**MARKER 1**  
 902 MHz  
 Ref 140 dBuV/m \*Att 30 dB

\*RBW 100 kHz Marker 1 [T1 ]  
 VBW 300 kHz 65.42 dBuV/m  
 \*SWT 15 ms 902.00000000 MHz



Date: 25.AUG.2020 15:10:34

**Lower band edge**

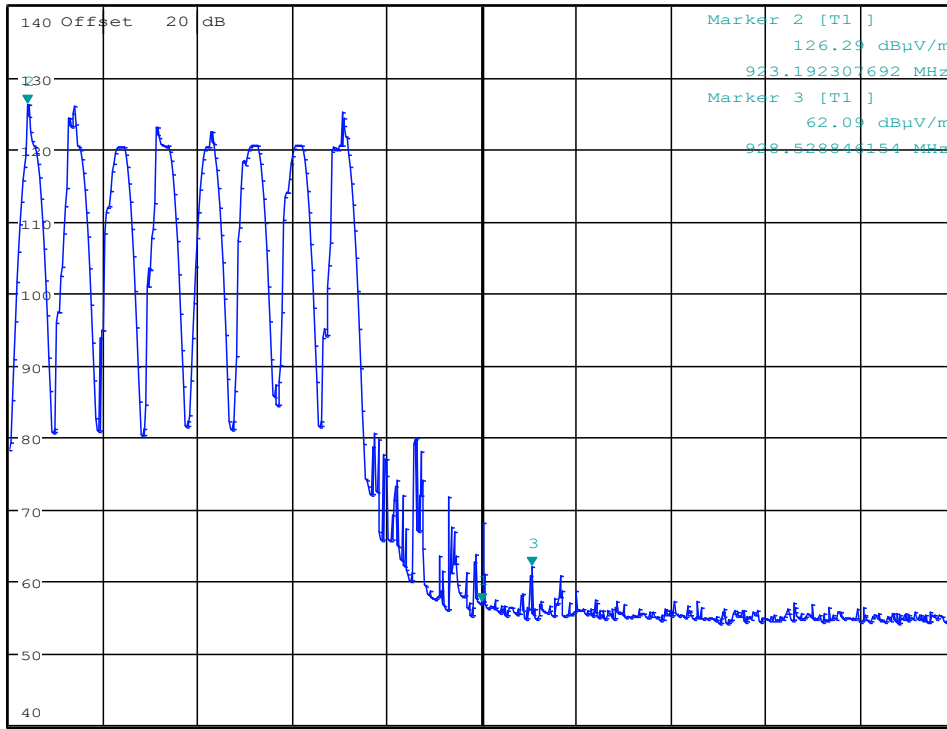


**MARKER 1**  
 928 MHz

\*RBW 100 kHz      Marker 1 [T1 ]  
 VBW 300 kHz      57.21 dBuV/m  
 \*SWT 15 ms      928.000000000 MHz

Ref 140 dBuV/m      \*Att 30 dB

1 PK  
 MAXH



Start 923 MHz      1 MHz/      Stop 933 MHz

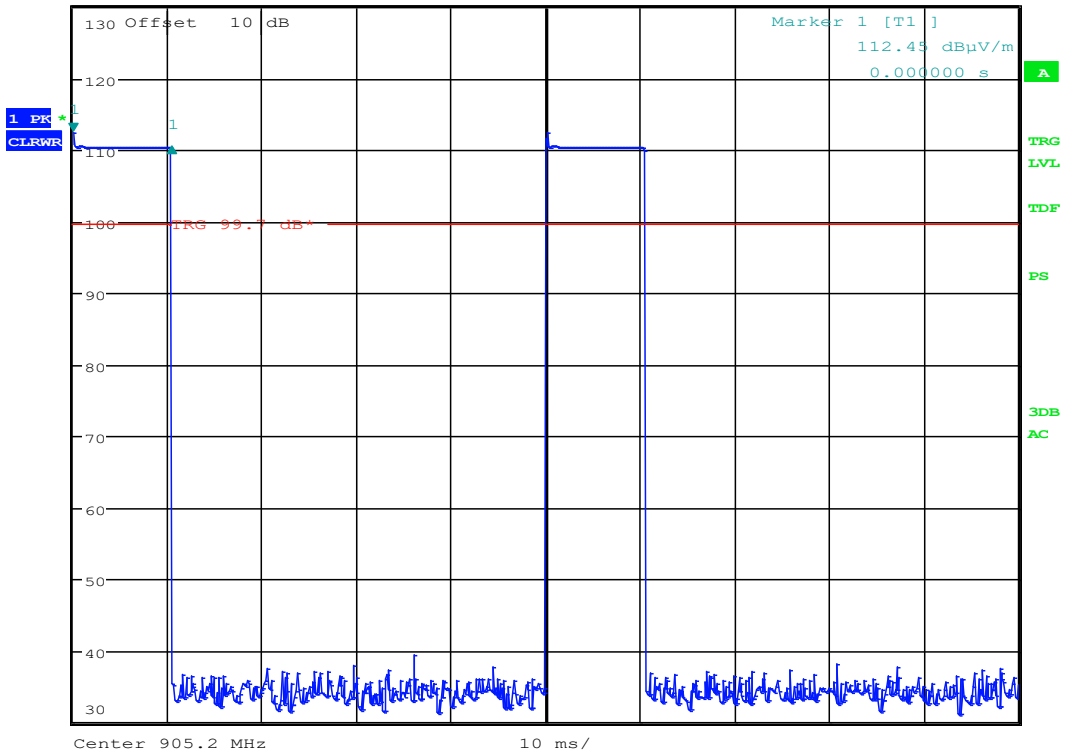
A  
 LVL  
 TDF  
 PS  
 3DB  
 AC

Date: 25.AUG.2020 15:07:28

**Upper band edge**



RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -2.03 dB  
 Ref 130 dBµV/m    \*Att 15 dB      SWT 100 ms      10.416667 ms

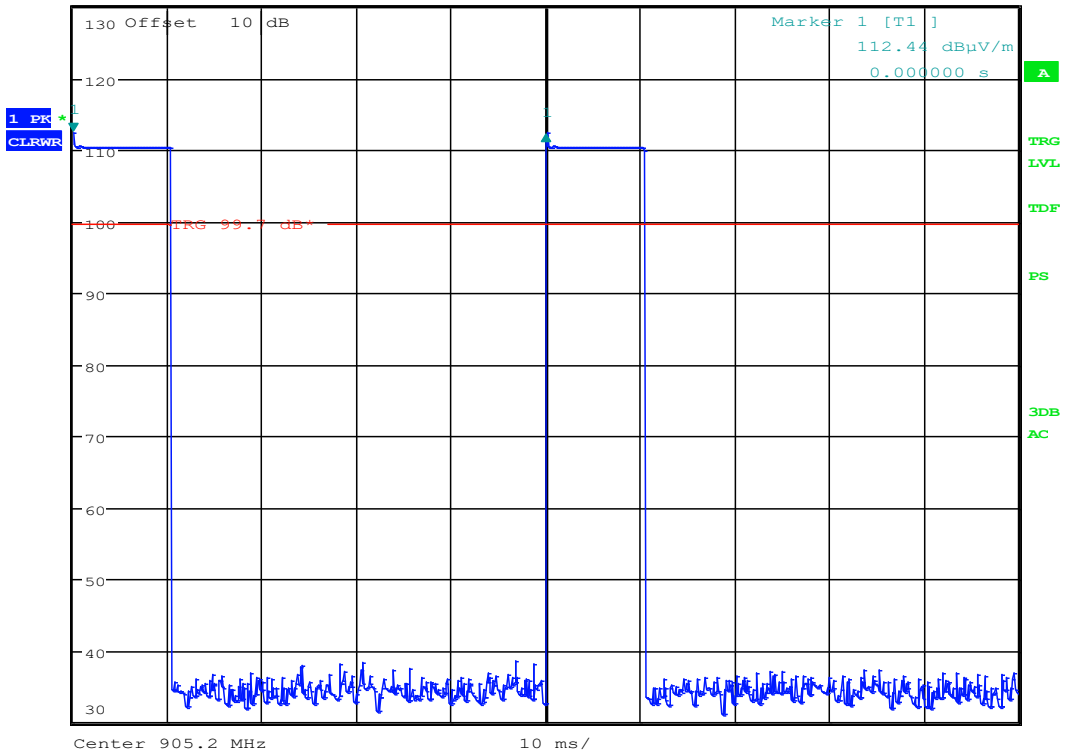


Date: 18.JUN.2020 08:13:03

Duty cycle ON time



RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -0.39 dB  
 Ref 130 dBµV/m    \*Att 15 dB      SWT 100 ms      50.000000 ms



Date: 18.JUN.2020 08:13:28

Duty cycle ON+ OFF time

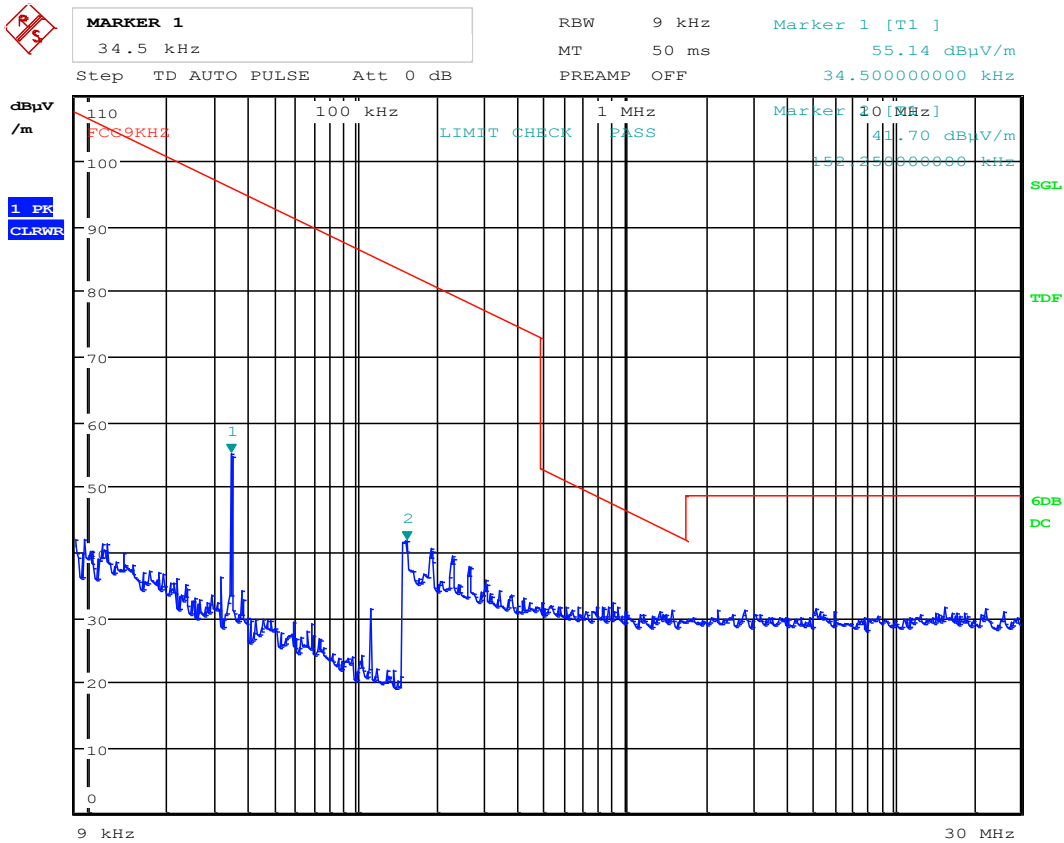
### 3.9 Radiated Emissions, 10 kHz – 30 MHz.

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



Date: 20.JUN.2020 08:58:09

The frequency component 34.5kHz is part of the test setup and not from the EUT.

Measuring distance 10 m, Peak detector.

No component detected, see attached graph.

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



### 3.10 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

#### Measurement Data:

Detector: Peak (found frequencies were measured with Quasi-Peak Detector)

Measuring distance 3 m

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
842.829750	28.77	46.00	17.23	1000.0	120.000	344.0	V	157.0
896.696250	34.31	46.00	11.69	1000.0	120.000	154.0	V	287.0
902.000000	46.00	46.00	0.00	1000.0	120.000	129.0	V	106.0

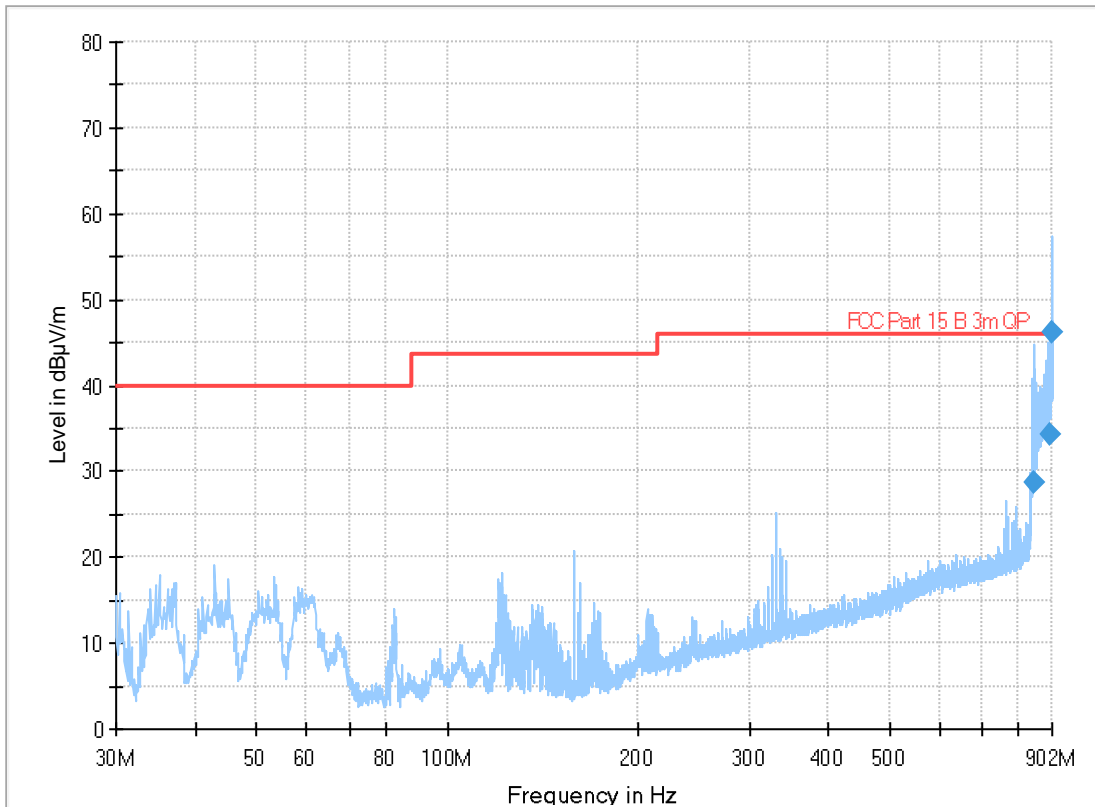
Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
928.000000	45.80	46.00	0.02	1000.0	120.000	165.0	V	136.0
928.131500	45.68	46.00	0.32	1000.0	120.000	107.0	V	256.0
928.516350	39.05	46.00	6.95	1000.0	120.000	152.0	V	63.0
928.929300	39.49	46.00	6.51	1000.0	120.000	161.0	V	280.0
934.860650	34.45	46.00	11.55	1000.0	120.000	103.0	V	131.0
935.728550	34.88	46.00	11.12	1000.0	120.000	118.0	V	160.0

See attached plots

#### Requirements/Limit

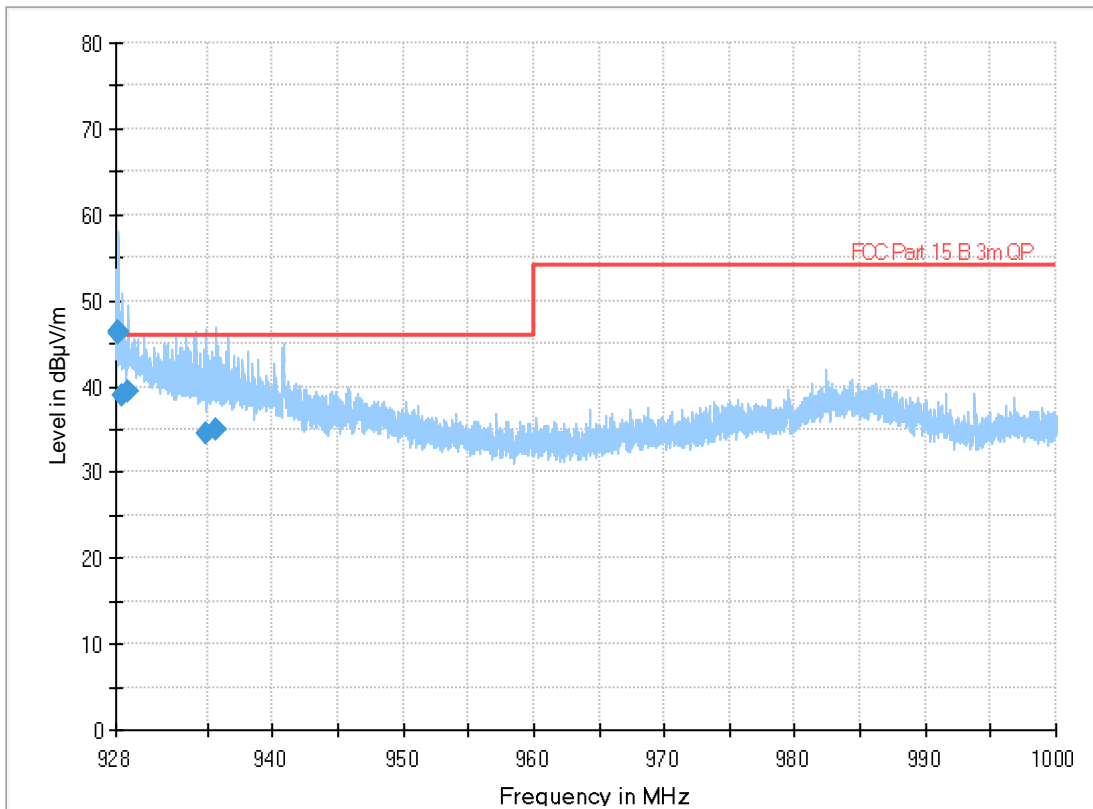
FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 $\mu$ V/m	40.0 dB $\mu$ V/m
88 – 216 MHz	150 $\mu$ V/m	43.5 dB $\mu$ V/m
216 – 960 MHz	200 $\mu$ V/m	46.0 dB $\mu$ V/m
960 – 1000 MHz	500 $\mu$ V/m	54.0 dB $\mu$ V/m
	Limits above are with Quasi Peak Detector	

Full Spectrum



Radiated emissions with antenna, 30 – 902MHz

Full Spectrum



Radiated emissions with antenna, 928 – 1000MHz

### 3.11 Radiated Emissions, 1-10 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

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 10 GHz)

All detected spurious emissions are outside the restricted band.

Restricted band:

Peak Detector:

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Duty cycle corr. factor	Limit	Margin
GHz	MHz	dB	dB $\mu$ V/m	dB	dB $\mu$ V/m	dB
/	903.500	0	/	/	74	/
/	914.780	0	/	/	74	/
/	926.530	0	/	/	74	/

Non- Restricted band:

Peak Detector:

Frequency	RF channel	Dist. corr. factor	Field strength of emission Peak Detector, 3m	Field strength of Fundamental frequency Peak Detector, 3m	Limit	Margin
MHz	MHz	dB	dB $\mu$ V/m	dB $\mu$ V/m	dBc	dB
1810.4	903.500	0	43.98	123.9	20	
1829.6	914.780	0	42.40	124.8	20	
1849.6	926.530	0	48.21	125.2	20	
/	Hopping	0	58.24	125.2	20	66.96
6324.50	903.500	0	59.12	123.9	20	64.78
6403.46	914.780	0	59.83	124.8	20	64.97
6485.71	926.530	0	59.56	125.2	20	65.64

Maximum is obtained in vertical polarization.

Average Detector values are calculated from Peak values by Duty Cycle Correction Factor.

A High Pass Filter was used from 1.5 GHz to 10 GHz.

Maximum is obtained in VP.

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

See plots.

**Requirements/Limit**

<b>FCC</b>	<b>Part 15.209 @ frequencies defined in §15.205</b>	
<b>ISED</b>	<b>RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10</b>	
	<b>Radiated emission limit @3 meters</b>	
<b>Frequency</b>	<b>Average Detector</b>	<b>Peak Detector</b>
<b>1 – 26 GHz</b>	<b>54.0 dBµV/m</b>	<b>74.0 dBµV/m</b>

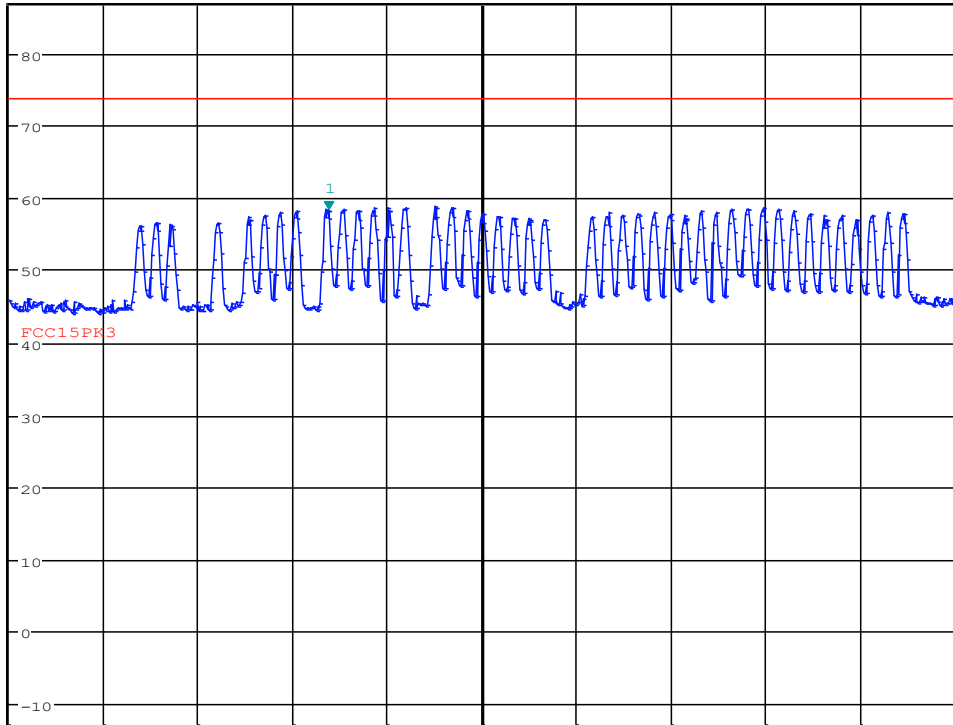


\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      58.24 dBµV/m  
 SWT 20 ms      6.364342949 GHz

Ref 87 dBµV/m

\*Att 15 dB

1 PK  
 MAXH



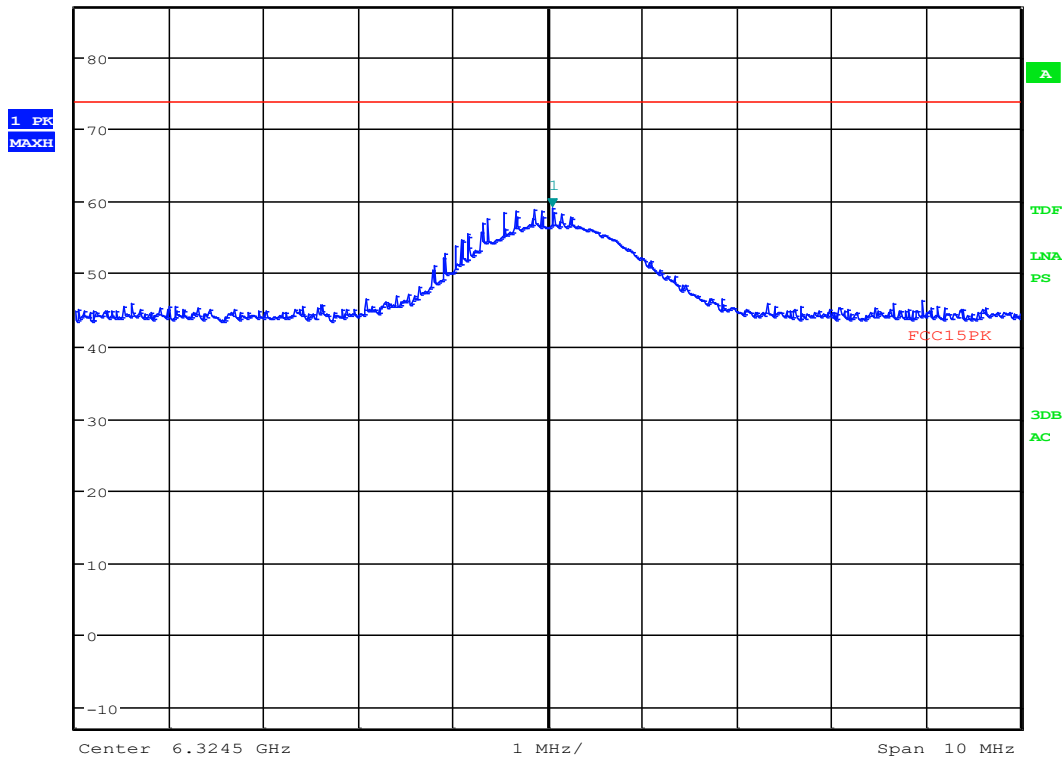
Center 6.396714744 GHz      20 MHz/      Span 200 MHz

Date: 25.AUG.2020 13:35:27

**Radiated spurious emissions,VP, 7<sup>th</sup> Harmonic, In hopping mode**



\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      59.12 dBµV/m  
 \*SWT 20 ms      6.324548077 GHz  
 Ref 87 dBµV/m    \*Att 15 dB



Date: 25.AUG.2020 12:58:03

**Radiated spurious emissions,VP, 7<sup>th</sup> harmonic, ch903.50MHz**



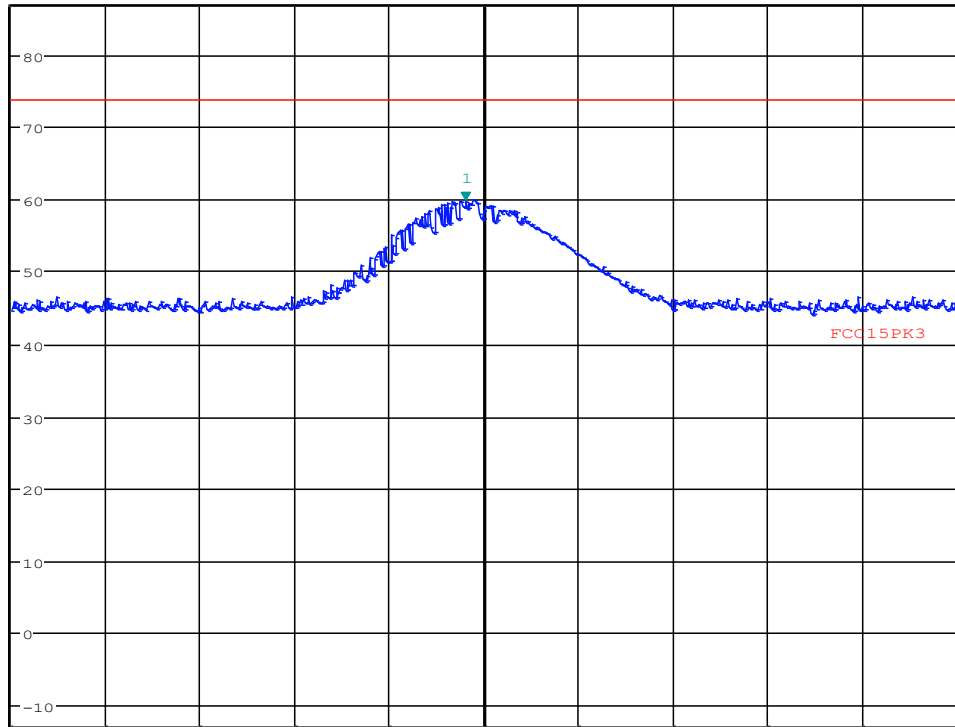
**MARKER 1**  
 6.403267692 GHz

\*RBW 1 MHz  
 VBW 3 MHz  
 SWT 20 ms

Marker 1 [T1 ]  
 59.83 dBµV/m  
 6.403267692 GHz

Ref 87 dBµV/m \*Att 15 dB

1 PK  
 MAXH



Center 6.40346 GHz 1 MHz/ Span 10 MHz

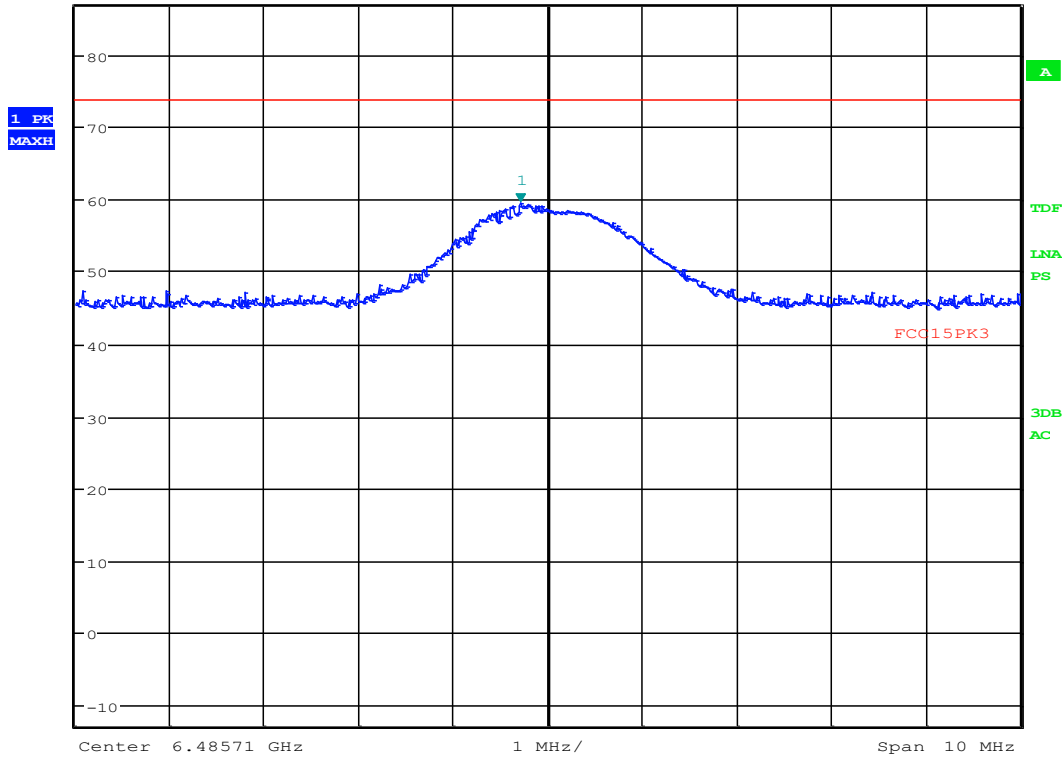
Date: 25.AUG.2020 13:12:23

**Radiated spurious emissions,VP, 7<sup>th</sup> harmonic, ch914.78MHz**



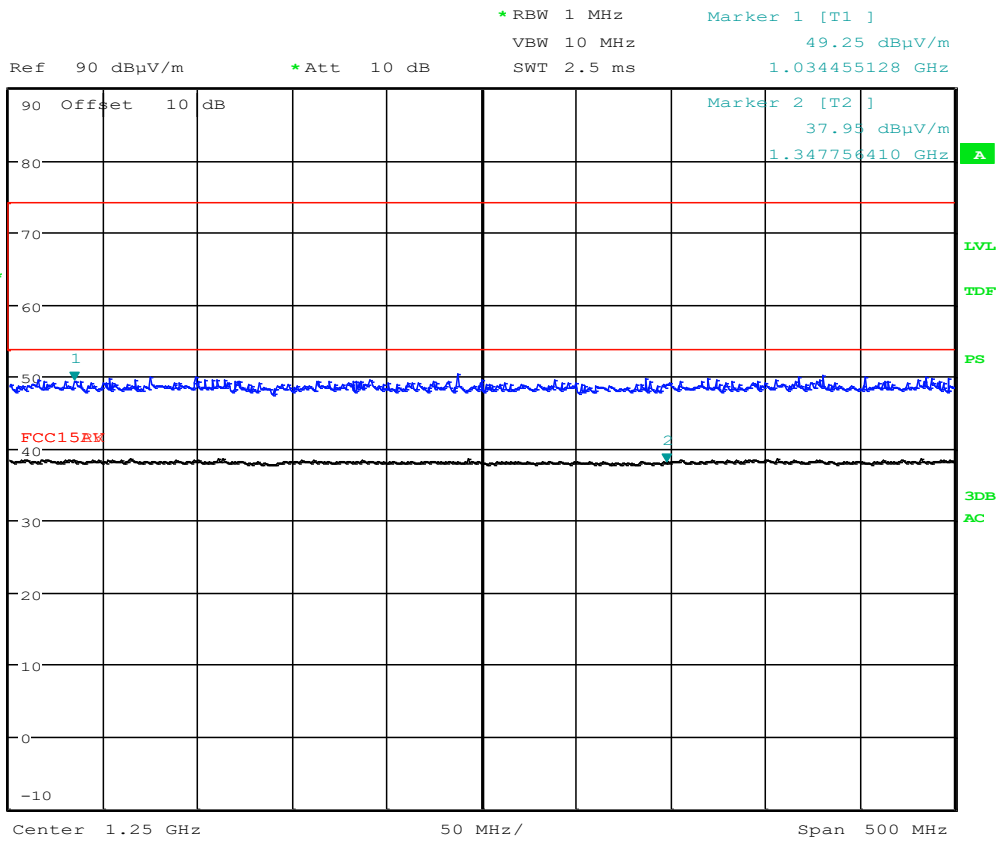


<b>MARKER 1</b>	*RBW 1 MHz	Marker 1 [T1 ]
6.485421538 GHz	VBW 3 MHz	59.56 dBµV/m
Ref 87 dBµV/m	*Att 15 dB	6.485421538 GHz
	SWT 20 ms	



Date: 25.AUG.2020 13:17:40

**Radiated spurious emissions,VP, 7<sup>th</sup> harmonic, ch926.53MHz**

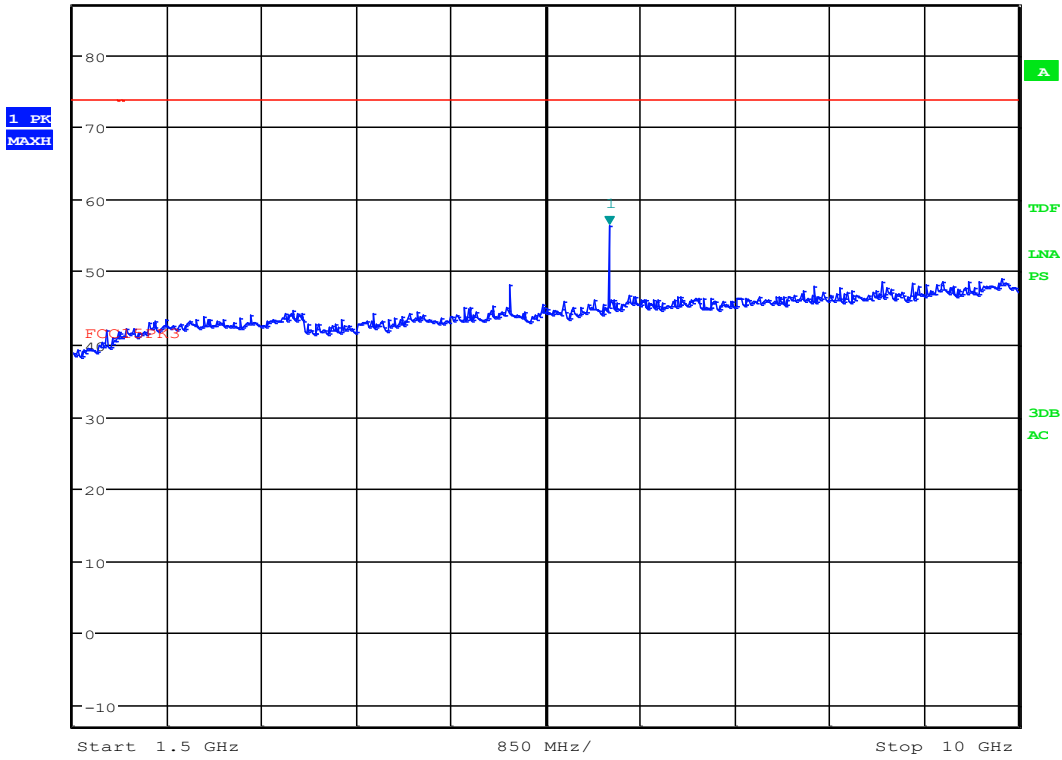


Date: 25.AUG.2020 09:47:06

**Radiated spurious emissions,VP, 1 – 1.5, ch903.50MHz**



\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      56.49 dBµV/m  
 Ref 87 dBµV/m    \*Att 15 dB      SWT 50 ms      6.324548077 GHz

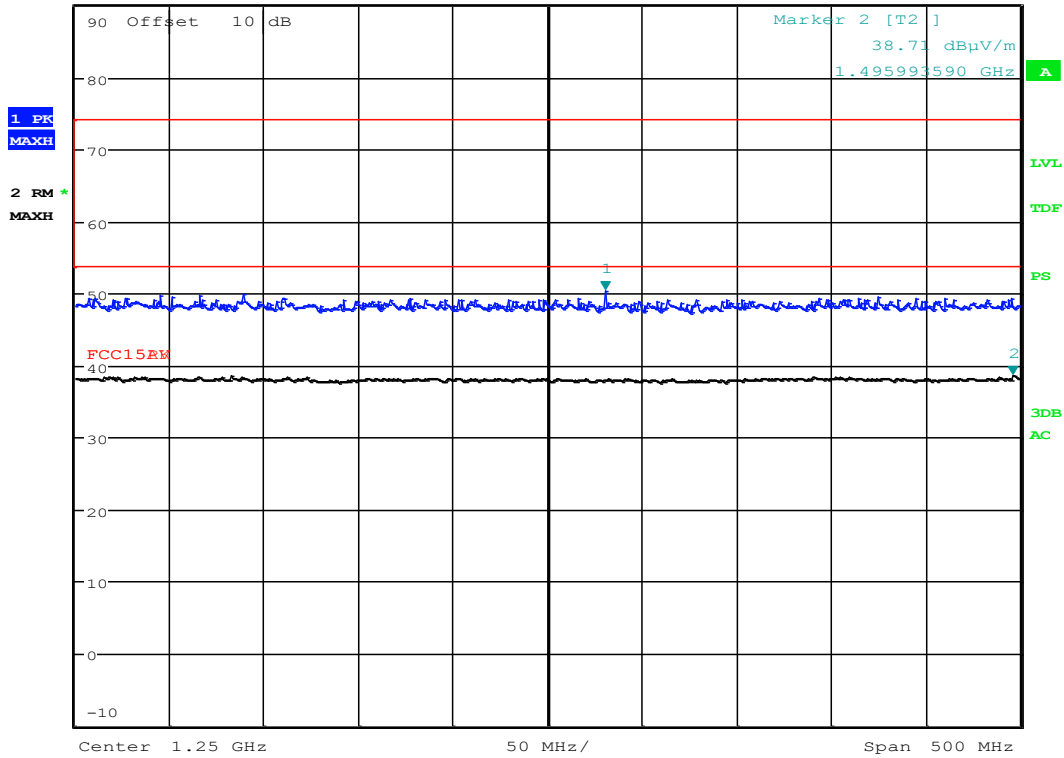


Date: 25.AUG.2020 13:01:01

**Radiated spurious emissions,VP, 1.5 – 10GHz, ch903.50MHz**



**MARKER 1**  
 1.280448718 GHz  
 Ref 90 dB $\mu$ V/m \*Att 10 dB \*RBW 1 MHz VBW 10 MHz SWT 2.5 ms  
 Marker 1 [T1 ]  
 50.42 dB $\mu$ V/m  
 1.280448718 GHz



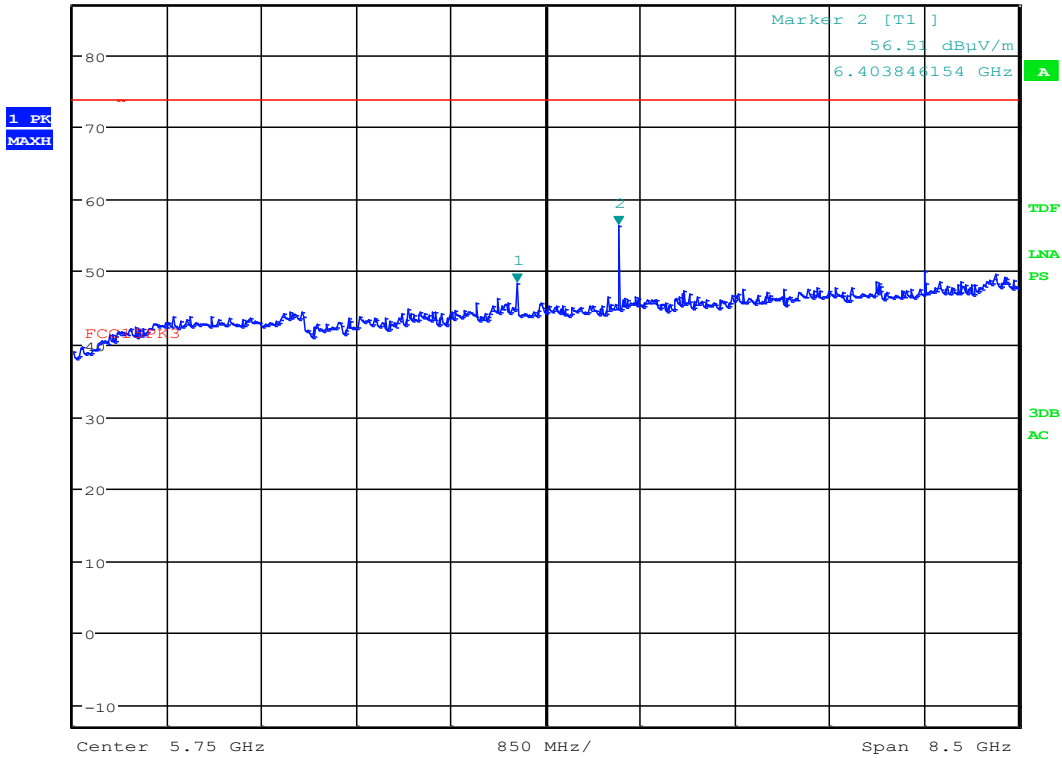
Date: 25.AUG.2020 09:48:09

**Radiated spurious emissions,HP, 1 – 1.5GHz ch903.50MHz**



\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      48.36 dBµV/m  
 SWT 50 ms      5.493618590 GHz

Ref 87 dBµV/m      \*Att 15 dB

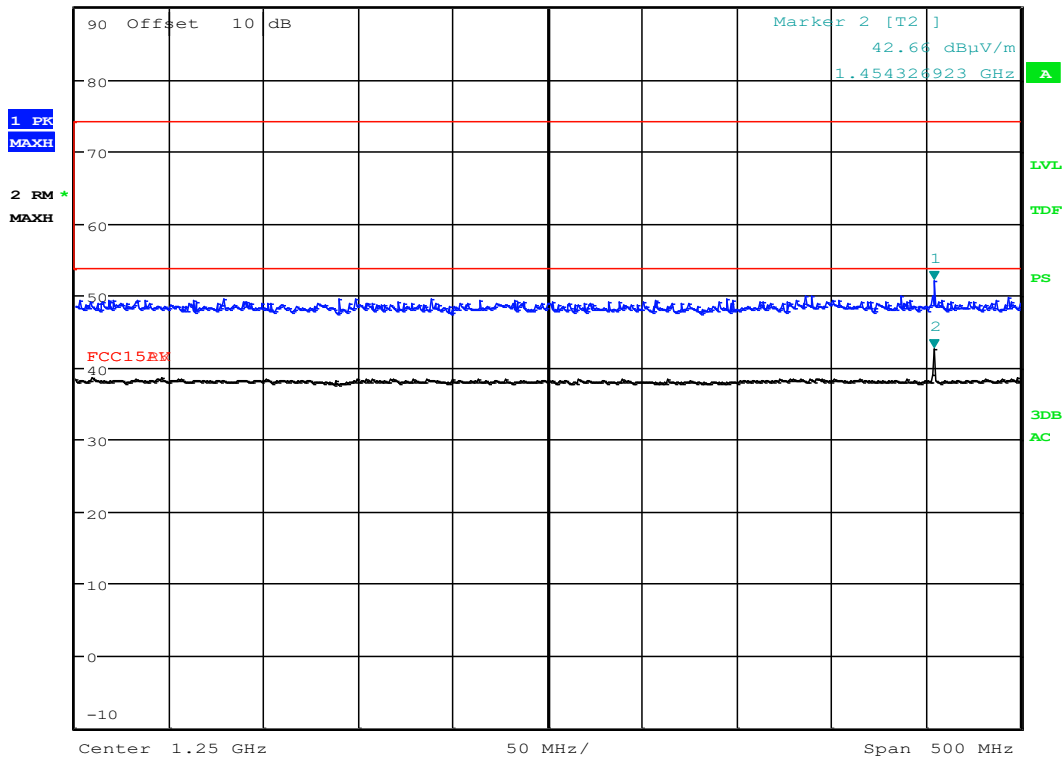


Date: 25.AUG.2020 13:08:04

**Radiated spurious emissions,HP, 1.5 - 10GHz, ch903.50MHz**



**MARKER 1**  
 1.454326923 GHz  
 Ref 90 dBµV/m \*Att 10 dB  
 \*RBW 1 MHz  
 VBW 10 MHz  
 SWT 2.5 ms  
 Marker 1 [T1 ]  
 52.06 dBµV/m  
 1.454326923 GHz



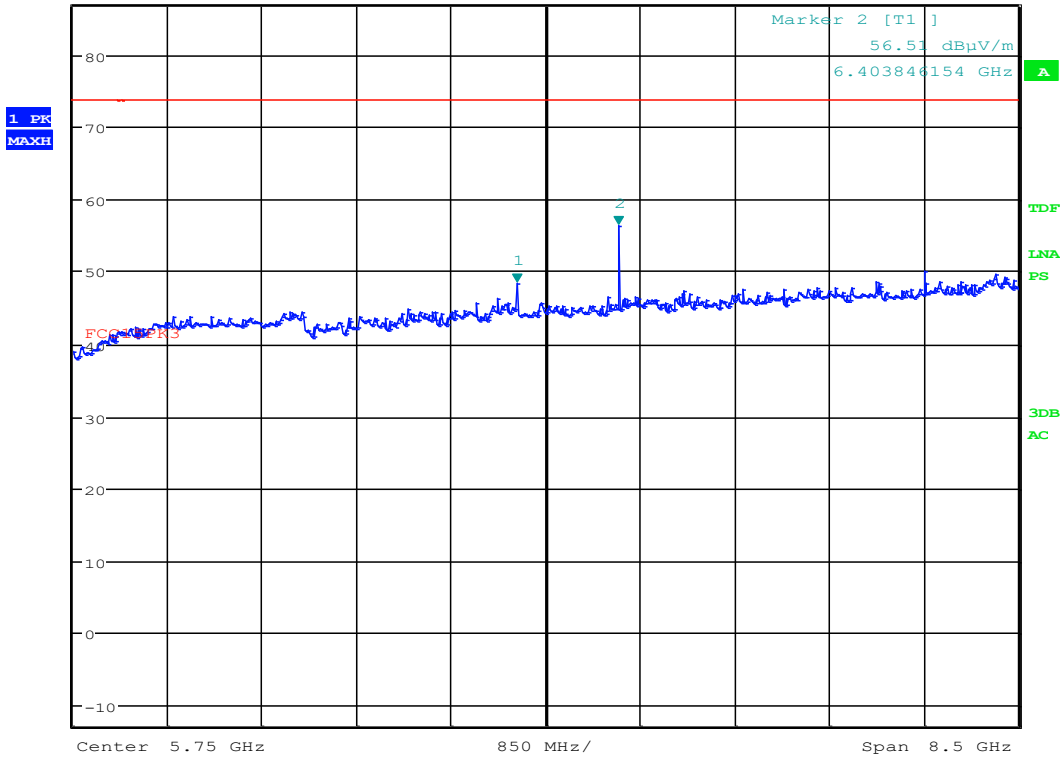
Date: 25.AUG.2020 09:51:36

**Radiated spurious emissions,VP, 1 - 1.5GHz, ch914.78MHz**



\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      48.36 dBµV/m  
 SWT 50 ms      5.493618590 GHz

Ref 87 dBµV/m      \*Att 15 dB



Date: 25.AUG.2020 13:08:04

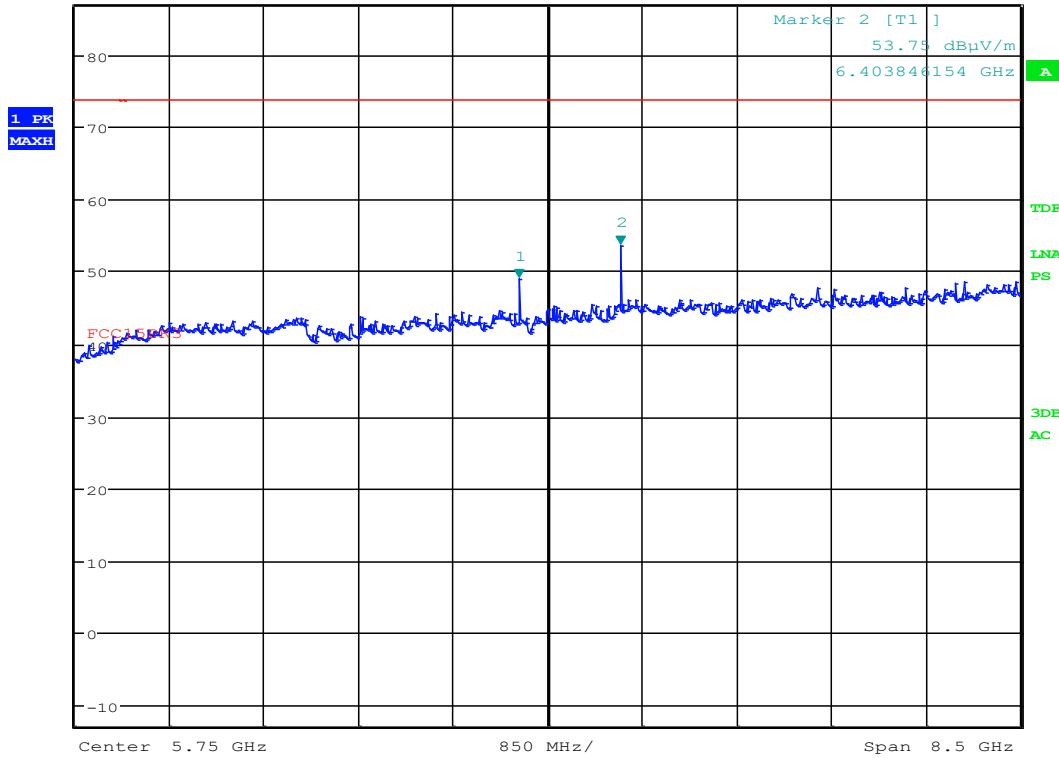
**Radiated spurious emissions,VP, 1.5 - 10GHz, ch914.78MHz**







<b>MARKER 1</b>	*RBW 1 MHz	Marker 1 [T1]
5.49361859 GHz	VBW 3 MHz	49.05 dBuV/m
Ref 87 dBuV/m	*Att 15 dB	5.493618590 GHz
	SWT 50 ms	

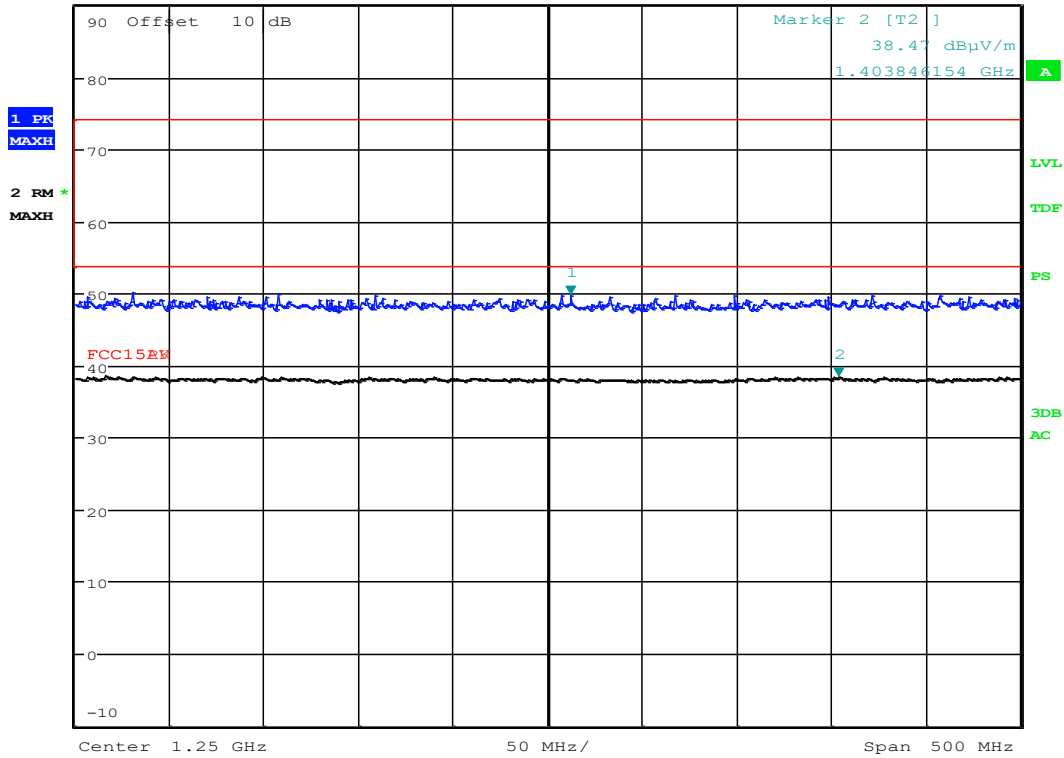


Date: 25.AUG.2020 13:04:46

**Radiated spurious emissions,VP, 1.5 - 10GHz, ch914.78MHz**



**MARKER 1**  
 1.262019231 GHz  
 Ref 90 dBµV/m \*Att 10 dB  
 \*RBW 1 MHz  
 VBW 10 MHz  
 SWT 2.5 ms  
 Marker 1 [T1 ]  
 49.76 dBµV/m  
 1.262019231 GHz



Date: 25.AUG.2020 10:00:17

**Radiated spurious emissions,VP, 1 - 1.5GHz, ch926.53MHz**

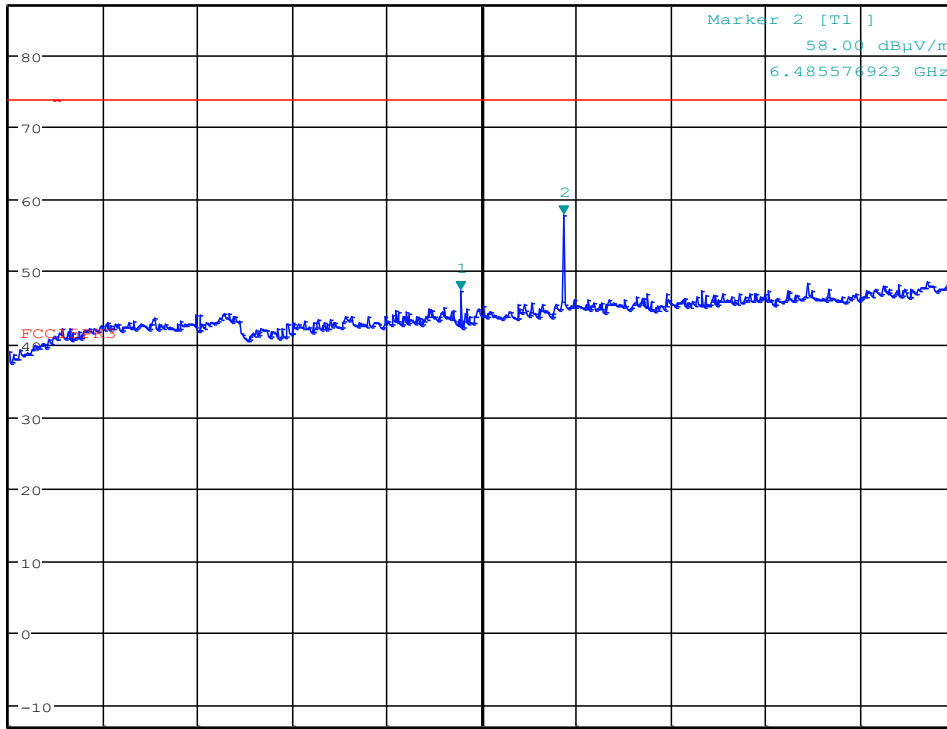


**MARKER 1**  
 5.559139487 GHz  
 Ref 87 dB $\mu$ V/m \*Att 15 dB

\*RBW 1 MHz  
 VBW 3 MHz  
 SWT 50 ms

Marker 1 [T1 ]  
 47.48 dB $\mu$ V/m  
 5.559139487 GHz

1 PK  
 MAXH



Start 1.5 GHz 850 MHz/ Stop 10 GHz

A  
 TDF  
 LNA  
 PS  
 3DB  
 AC

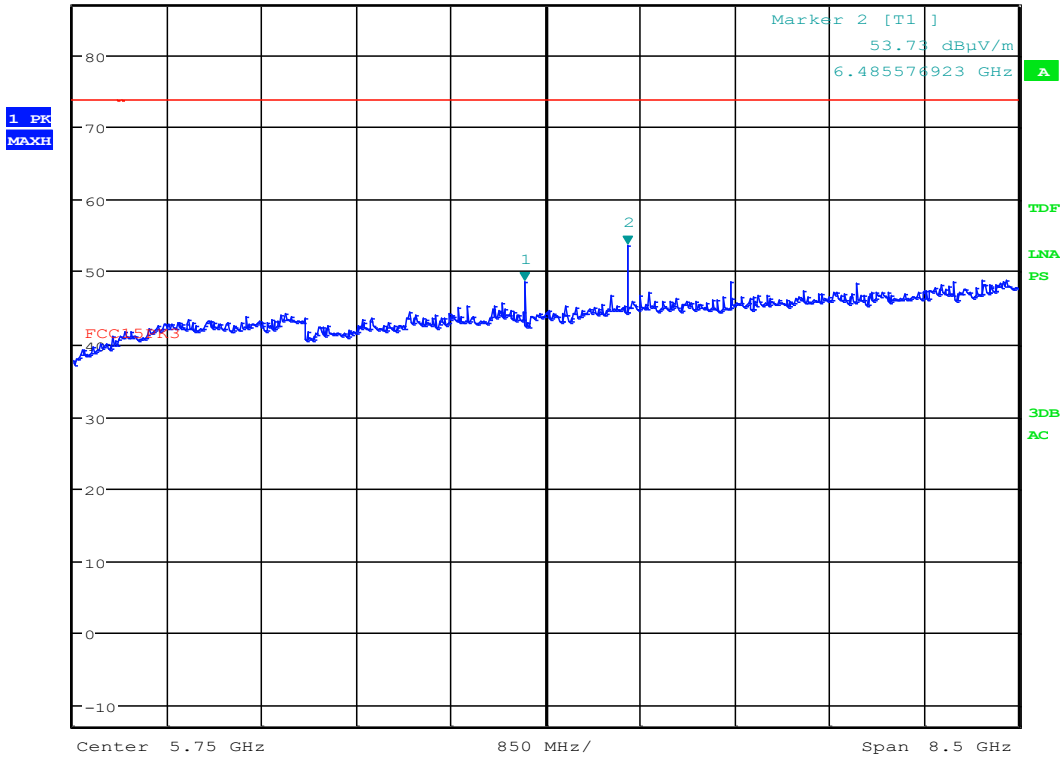
Date: 25.AUG.2020 13:18:30

**Radiated spurious emissions,VP, 1.5 - 10GHz, ch926.53MHz**





\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      48.75 dBμV/m  
 Ref 87 dBμV/m    \*Att 15 dB      SWT 50 ms      5.559139487 GHz

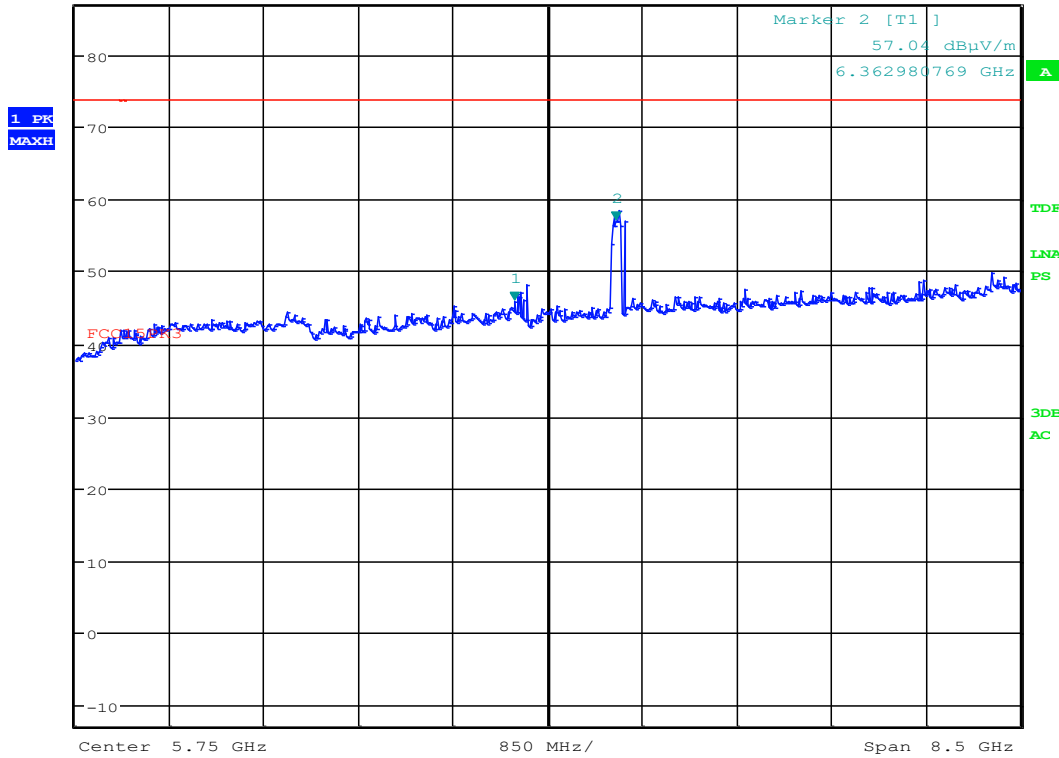


Date: 25.AUG.2020 13:19:26

**Radiated spurious emissions,HP, 1.5 - 10GHz, ch926.53MHz**



**MARKER 1**  
 5.450165128 GHz  
 Ref 87 dB $\mu$ V/m \*Att 15 dB \*RBW 1 MHz VBW 3 MHz SWT 50 ms  
 Marker 1 [T1 ]  
 45.83 dB $\mu$ V/m  
 5.450165128 GHz

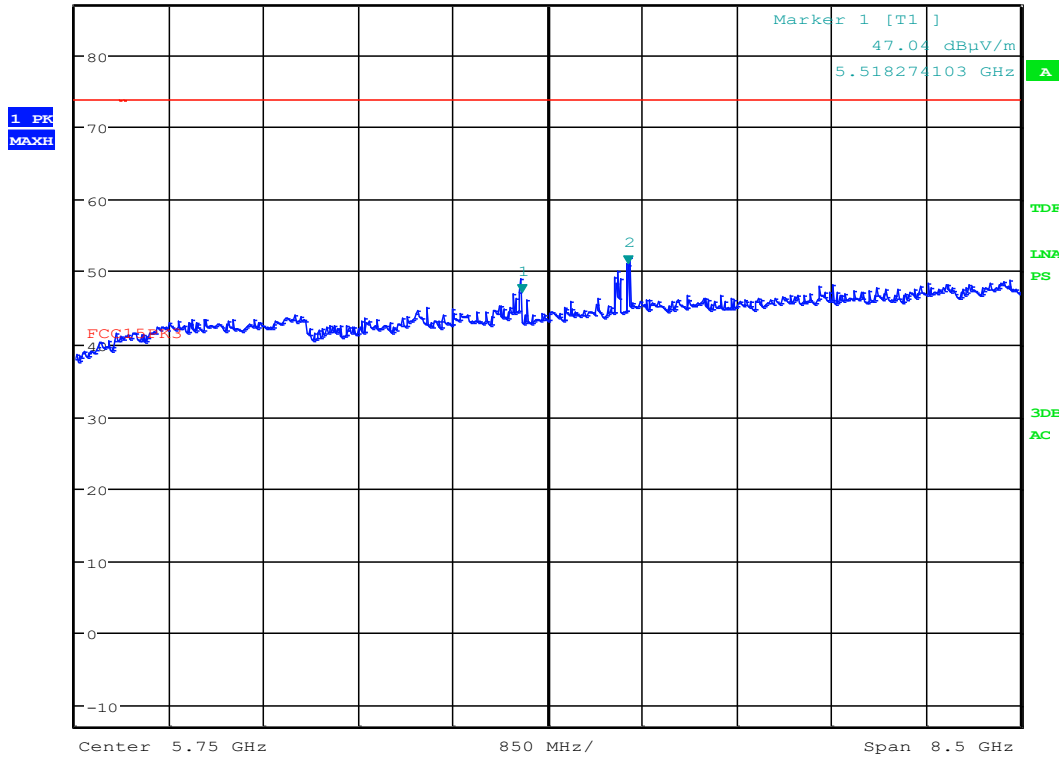


Date: 25.AUG.2020 13:31:16

**Radiated spurious emissions, VP, 1.5 - 10GHz, In hopping mode**



<b>MARKER 2</b>	*RBW 1 MHz	Marker 2 [T1 ]
6.471955128 GHz	VBW 3 MHz	50.94 dBµV/m
Ref 87 dBµV/m	*Att 15 dB	6.471955128 GHz
	SWT 50 ms	



Date: 25.AUG.2020 13:30:19

**Radiated spurious emissions, HP, 1.5 - 10GHz, In hopping mode**

### 3.12 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



## 4 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	2020.01	2021.01
2.	FSW43	Spectrum analyser	Rohde & Schwarz	LR1690	2020.01	2021.01
3.	HFH2-Z2	Active Loop antenna	Rohde & Schwarz	LR1660	2019.06	2021.06
4.	3115	Antenna horn	EMCO	LR 1330	2016.10	2020.10
5.	3117-PA	Horn antenna with PreA	EMCO	LR 1717	2017.12	2020.12
6.	PM 320K	Antenna Horn	Sivers	LR 1717	N/A	
7.	DBF-520-20	Antenna Horn	Systron-Donner corp	LR 102	N/A	
8.	638	Antenna Horn	NARDA	LR 1480	N/A	
9.	637	Antenna Horn	NARDA	LR 099	N/A	
10.	VULB9163	Bi-log Hybrid Antenna	Schwarzbeck	LR 1616	2020.01	2022.01
11.	4768-10	Attenuator	Narda	LR 1670	Cal b4 use	
12.	6HC1500/18000	Highpass Filter	Trilithic	LR 1612	Cal b4 use	
13.	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2020.08	2021.08
14.	310N	Pre-amplifier	Sonoma	LR 1686	2020.08	2021.08
15.	Model 87	Multimeter	Fluke	N4672	2018.11	2020.11
16.	CPX400D	Power supply	TTi	LR 1744	Cal b4 use	
17.	6812B	AC Power source	Agilent	LR 1515	2019.03	2021.03

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

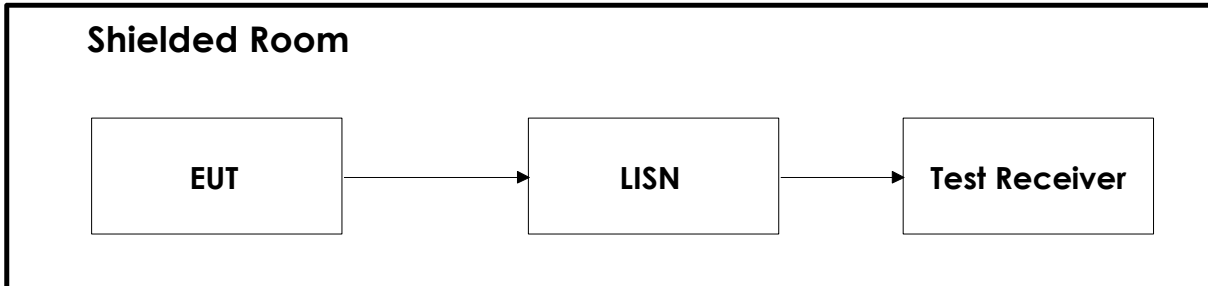
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	GPIBShot	2.7	Screenshots from R&S Spectrum Analyzers
2	Rohde & Schwarz	RSc commander	1.9.2 64bit	Versatile Software Tool for R&S Instruments
3	Rohde & Schwarz	EMC 32	10.50.40	Radiated Emission test software

### Revision history

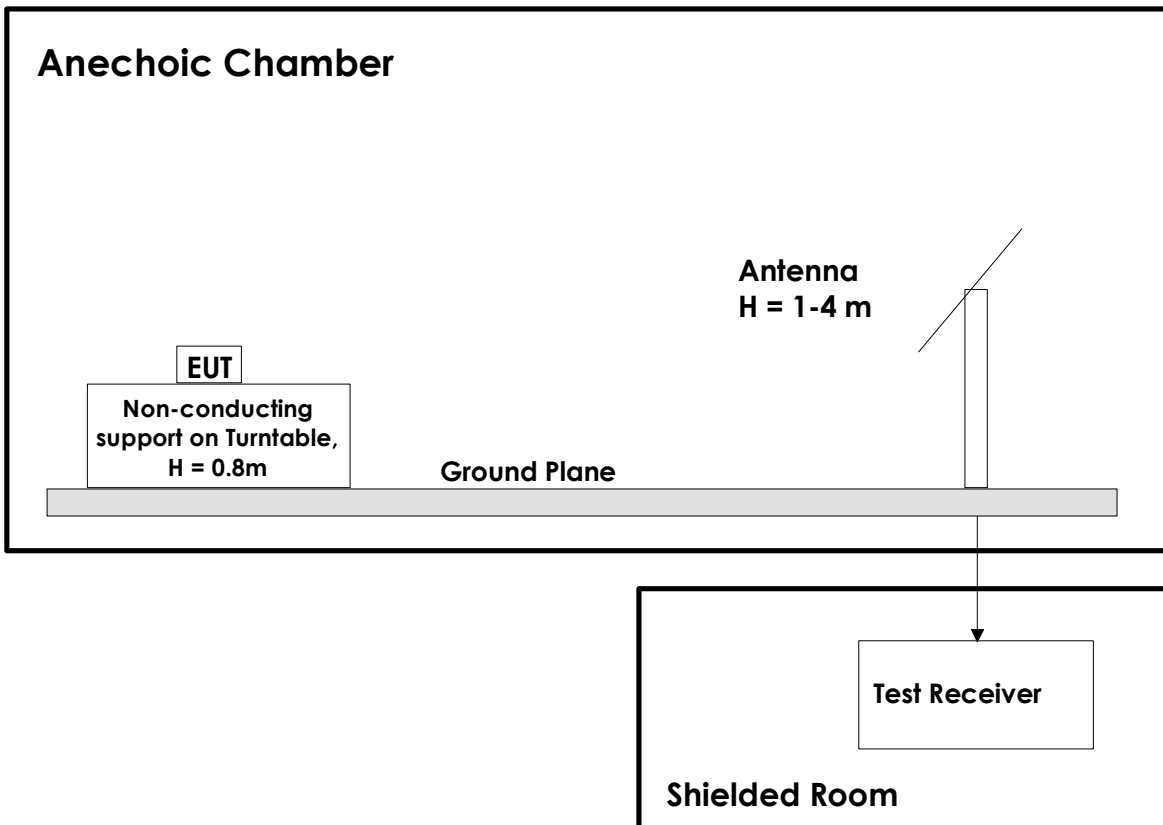
Version	Date	Comment	Sign
00	2020.09.14	First Version	gns
01	2020.12.14	In cl.1.6 detailed test information is given and power table in page 25 is corrected	gns
02	2021.01.18	FCC/ISED updated for each module and SW name is provided	gns

## 5 BLOCK DIAGRAM

### 5.1 Power Line Conducted Emission



### 5.2 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.