

# Test Report



## INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 F AND ISED CANADA REQUIREMENTS

Equipment Under Test: Noccela locating system: Tracking Device TAG Unit

Model: TAG-DUAL-2B

Manufacturer: Noccela Oy  
Kaarinantie 700  
20540 Turku, FINLAND

Customer: Noccela Oy  
Kaarinantie 700  
20540 Turku, FINLAND

FCC Rule Part: 15.517: 2019  
IC Rule Part: RSS-220, Issue 1, Amendment 1, 2018  
RSS-GEN Issue 5 Amendment 1, 2019

Date: 15 September 2020

Issued by:

A handwritten signature in blue ink, appearing to read 'Jani Tuomela'.

Jani Tuomela  
Testing Engineer

Date: 15 September 2020

Checked by:

A handwritten signature in blue ink, appearing to read 'Mikko Halonen'.

Mikko Halonen  
Testing Engineer

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## GENERAL REMARKS

### Disclaimer

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*Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.*

**RELEASE HISTORY**

<b>Version</b>	<b>Changes</b>	<b>Issued</b>
1.0	Initial release	14 September 2020
2.0	Summary of testing updated	15 September 2020

## PRODUCT DESCRIPTION

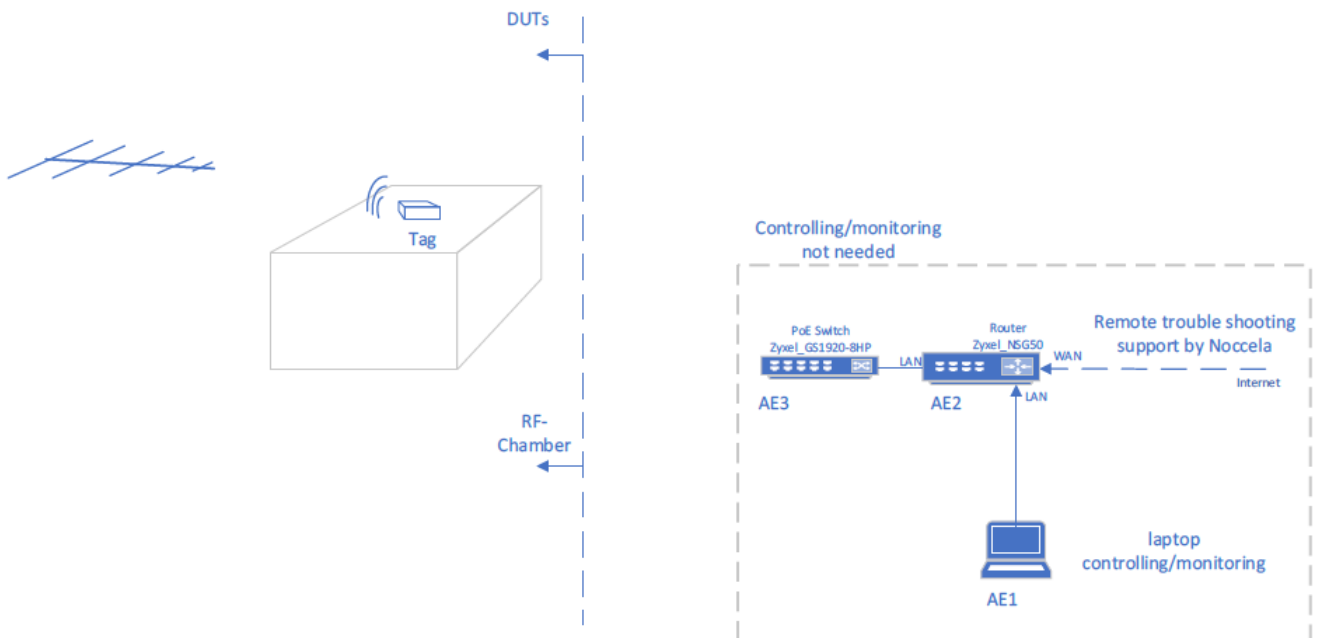
### Equipment Under Test

Trade mark:	Noccela
Model:	TAG-DUAL-2B
Type:	-
Serial no:	2011000272
FCC ID:	2AVRO-TAG-DUAL-2B
IC:	-

### General Description

Noccela locating system: Tracking Device TAG Unit.

Tag unit is portable device and consist of Radio Frequency Transceiver with PCB integrated antenna, Processor and peripheral parts. Power supply of device consist of 2x 1.5V (in series 3V) AAA battery cell and Boost type SMPS. Device is assembled in plastic enclosure.



EUT is Short Range Device (SRD) using Ultra Wide Band technology (UWB). EUT operates in 6-9 GHz frequency band.

### Classification

- |  |                                     |
|--|-------------------------------------|
| Fixed device                                 | <input type="checkbox"/>            |
| Mobile Device (Human body distance > 20cm)   | <input checked="" type="checkbox"/> |
| Portable Device (Human body distance < 20cm) | <input type="checkbox"/>            |

### Modifications Incorporated in the EUT

No modifications.

**Ratings and declarations**

Operating Frequency Range:	6 – 9 GHz
Nominal Frequency:	6.5 GHz
UWB Device type:	Indoor communication device
Handheld device:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Channel bandwidth:	503.5 MHz
Channels:	1
Modulation:	BPM/BPSK
Antenna type:	Integral PCB antenna
Integral Antenna gain:	-

**Power Supply**

Operating voltage range: 3 VDC

**Mechanical Size of the EUT**

Height: 21 mm

Width: 57 mm

Length: 67 mm

**Ports and Cables**

Cable / Port	Description
-	-

**Peripherals**

Peripheral	Description / Usage
AE3, PoE switch	Ethernet connection and powering of the EUT is routed from PoE switch
AE2, Router	Internet connection to PoE switch is routed from ethernet router
AE1, Laptop	Used for EUT monitoring and controlling of EUT
BEACON-3	Serial number: 2013000007

All peripherals were supplied by the manufacturer. Peripherals were used only for transmission time test.

## SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.203 / RSS-220 5.1(b)	Antenna requirement	PASS
§15.207(a) / RSS-GEN 8.8	Conducted emissions on power supply lines	N/T <sup>(1)</sup>
§15.517(e), §15.521 / RSS-220 5.2.1(g)	Peak Power within a 50 MHz bandwidth	PASS
§15.517(b) / RSS-220 2, 5.1 (a)	10 dB Bandwidth	PASS
RSS-GEN 6.7	99% Occupied Bandwidth	PASS
§15.209(a), §15.517(c), §15.521 / RSS-220 5.2.1	Radiated emissions 9 kHz – 960 MHz	PASS
§15.517(c)(d), §15.521 / RSS-220 5.2.1	Radiated emissions 960 MHz – 40 GHz	PASS
§15.517(a)(5)	Transmission time	PASS

1) Not applicable for battery operated device

*The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.3 of ANSI C63.10-2013.*

## EUT Test Conditions during Testing

During the tests the configuration of the EUT was made to correspond to the actual assembling conditions as far as possible. All tests were performed as radiated measurements. During the tests EUT was set into continuous transmit/receive mode by using the special test software. Normal modulation and maximum transmit power was used during the tests. Tx power level setting was a3a8 during the tests.

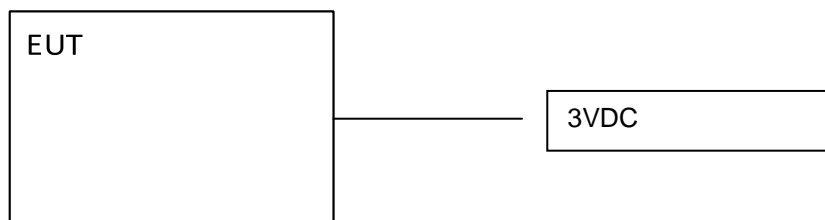


Figure 1: Test setup blocking diagram

**Test Facility**

<p>Testing Laboratory / address:          FCC designation number: <b>FI0002</b>          ISED CAB identifier: <b>T004</b></p>	<p>SGS Fimko Ltd          Takomotie 8          FI-00380, HELSINKI          FINLAND</p>
<p>Test Site:</p>	<p><input type="checkbox"/> K10LAB, ISED Canada registration number: <b>8708A-1</b>  <input checked="" type="checkbox"/> K5LAB, ISED Canada registration number: <b>8708A-2</b>  <input type="checkbox"/> T10LAB</p>



**TEST RESULTS**

**Antenna requirement**

**Standard:** FCC Rule §15.203,  
RSS-220 5.1(b)  
**Tested by:** JAT  
**Date:** 6 August 2020

**FCC Rule: 15.203**  
**RSS-220 5.1(b)**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Specification	Requirement (at least one of the following shall be applied)	Conclusion
§15.203	<ol style="list-style-type: none"> <li>1. Permanently attached antenna</li> <li>2. Unique coupling to the intentional radiator</li> <li>3. Professionally installed radio. The installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.</li> </ol>	<b>PASS</b>
Note	Option 1 is used	

**Peak Power within 50 MHz bandwidth**

**Peak Power within 50 MHz bandwidth**

**Standard:** ANSI C63.10 (2013)  
**Tested by:** JAT  
**Date:** 30 July 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH  
**Measurement uncertainty:** ± 5.44dB Level of confidence 95 % (k = 2)

**FCC Rule: 15.517(e), 15.521**  
**RSS-220 5.2.1(g)**

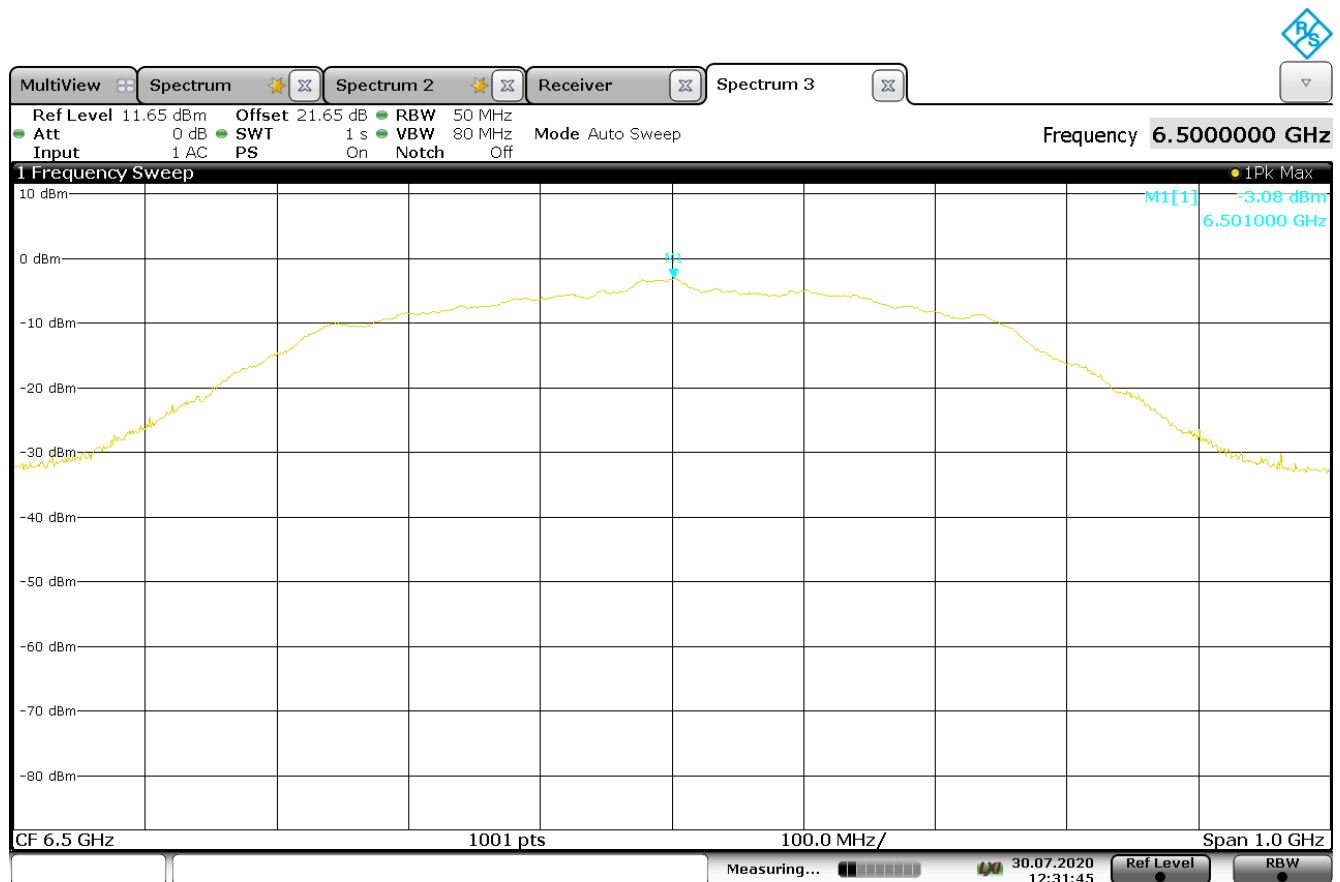
There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centred on the frequency at which the highest emission occurs. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

Measurement distance: 3m

**Results:**

**Table 1: Peak power within 50 MHz bandwidth**

Freq [MHz]	Height [cm]	Polarization	Azimuth [deg]	Level [dBm/50 MHz]	Limit [dBm/50 MHz]	Result
6501.0	100	H	140	-3.08	0	PASS



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**Figure 2: Peak power within 50 MHz bandwidth**

**Radiated Emissions 9 kHz - 960 MHz**

**Standard:** ANSI C63.10 (2013)  
**Tested by:** JAT  
**Date:** 3 August 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH  
**Measurement uncertainty:** ± 4.51 dB Level of confidence 95 % (k = 2)

**FCC Rule: 15.517(c), 15.209(a), 15.521**

**RSS-220 5.2.1**

Emissions shall not exceed the field strength levels specified in the following table. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables).

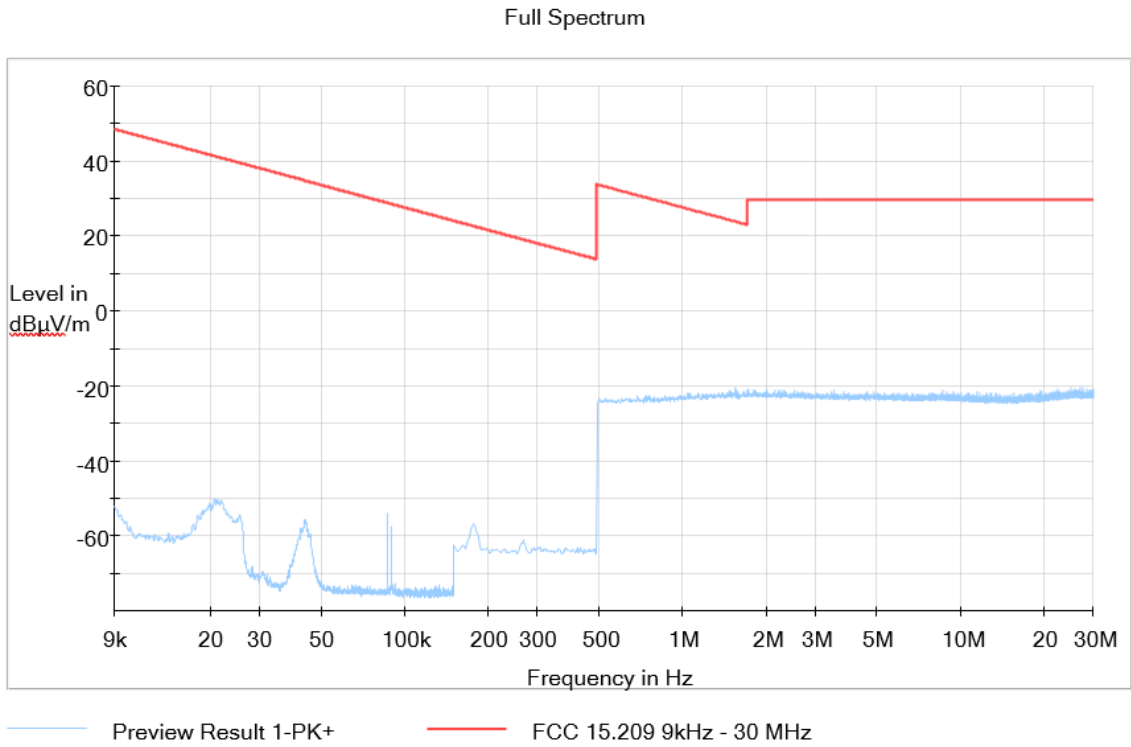
Peak values of emissions below measured for reference as well as transmitter fundamental.

The pre-measurements were performed with the EUT being in three orthogonal positions (X, Y, Z). Final measurements were done in worst position. Z orientation was used for final measurements.

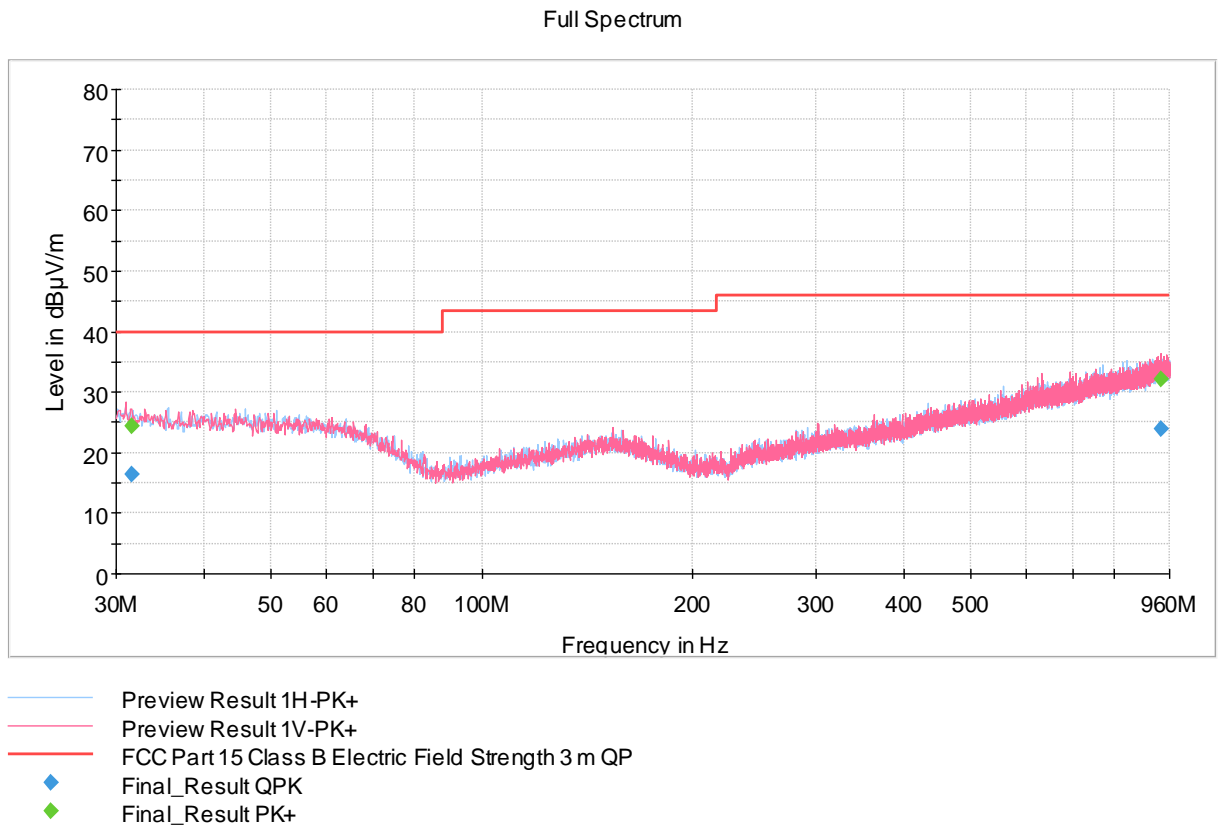
Measurement distance: 3m

Frequency range [MHz]	Limit [ $\mu\text{V/m}$ ]	Limit [ $\text{dB}\mu\text{V/m}$ ]	Detector
0.009-0.490	2400/F(kHz)	48.5-13.8	Quasi-peak
0.490-1.705	24000/F(kHz)	33.8-22.97	Quasi-peak
1.705-30.0	30	29.54	Quasi-peak
30 - 80	100	40.0	Quasi-peak
88 - 216	150	43.5	Quasi-peak
216 - 960	200	46.0	Quasi-peak
960 - 1000	500	53.9	Quasi-peak
Above 1000	500	53.9	Average
Above 1000	5000	73.9	Peak

**Results:**



**Figure 3:** Radiated emissions 9 kHz – 30 MHz



**Figure 4:** Radiated emissions 30 MHz – 960 MHz

**Table 2:** Quasi-peak results

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
31.530000	16.45	40.00	23.55	1000.0	120.000	325.0	V	31.0	16.7	-
932.597000	23.97	46.00	22.03	1000.0	120.000	336.0	V	306.0	31.8	-

**Radiated Emissions 960 MHz – 40 GHz**

<b>Standard:</b>	ANSI C63.10	(2013)
<b>Tested by:</b>	JAT	
<b>Date:</b>	31 July - 6 August 2020	
<b>Temperature:</b>	23 ± 3 °C	
<b>Humidity:</b>	20 - 60 % RH	
<b>Measurement uncertainty:</b>	± 4.51 dB	Level of confidence 95 % (k = 2)

**FCC Rule: 15.517(c)(d), 15.521**
**RSS-220 5.2.1**

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables). Peak values of emissions below measured for reference as well as transmitter fundamental.

The pre-measurements were performed with the EUT being in three orthogonal positions (X, Y, Z). Final measurements were done in worst position. Z orientation was used for final measurements.

The radiated emissions above 960 MHz shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

FCC Indoor UWB system:

Frequency range [MHz]	Limit EIRP [dBm]	Limit [dBµV/m] 3m	Limit [dBµV/m] 0.5m	Test distance [m]
960-1610	-75.3	19.9	35.4	0.5
1610-1990	-53.3	41.9	57.4	3
1990-3100	-51.3	43.9	59.4	3
3100-10600	-41.3	53.9	69.4	3
above 10600	-51.3	43.9	59.4	0.5

RSS-220 Indoor communication device:

Frequency range [MHz]	Limit EIRP [dBm]	Limit [dBµV/m] 3m	Limit [dBµV/m] 0.5m	Test distance [m]
960-1610	-75.3	19.9	35.4	0.5
1610-4750	-70.0	25.2	40.7	0.5
4750-10600	-41.3	53.9	69.4	3
above 10600	-51.3	43.9	59.4	0.5

Note 1: EIRP dBm limit is converted to field strength limit at 3 meters using

$$E(\text{dB}\mu\text{V/m}) = P(\text{dBm EIRP}) + 95.2 \text{ dB (ANSI C63.10 (10.3.9), RSS-220 Annex clause 4(c))}$$

Note 2: Field strength limit in 3m is converted to different measurements distances using distance extrapolation factor

$$\text{Distance extrapolation factor} = 20 \log (\text{specific distance [3m]} / \text{test distance [m]}) \text{ (dB)}$$

$$\text{Limit line} = \text{Limit at 3m (dB}\mu\text{V/m)} + \text{distance extrapolation factor (dB)}$$

In addition, UWB transmitter shall not exceed following average limits when measured using resolution bandwidth of no less than 1 kHz.

Frequency range [MHz]	Limit EIRP [dBm]	Limit [dBµV/m] 3m	Limit [dBµV/m] 1m	Test distance [m]
1164-1240	-85.3	9.9	19.4	3
1559-1610	-85.3	9.9	19.4	3

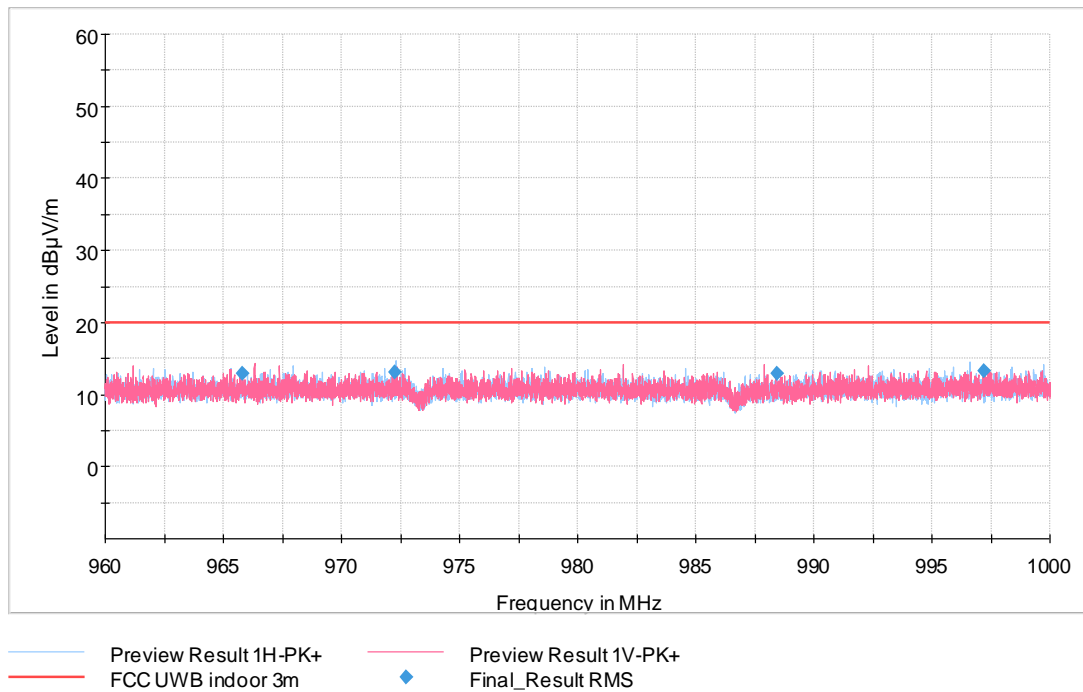
**Radiated Emissions 960 MHz – 40 GHz**

Emissions from digital circuitry used to enable the operation of the UWB transmitter shall comply with the limits in §15.209, rather than these limits, provided it can be clearly demonstrated that those emissions from the UWB device are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter’s antenna.

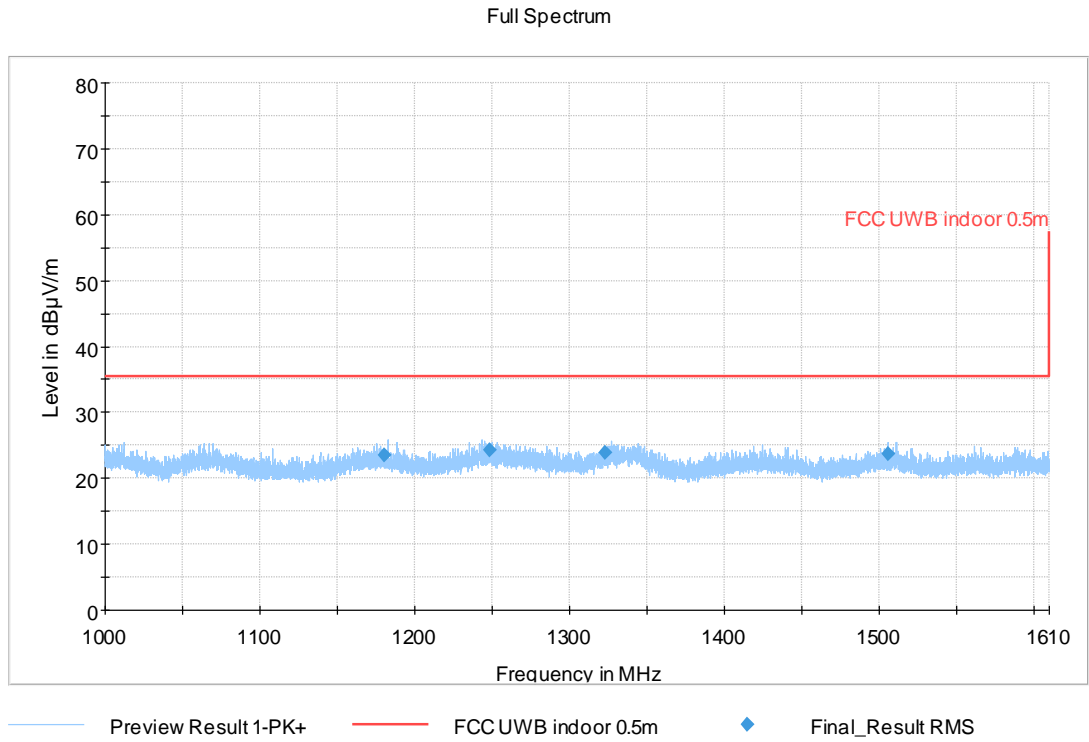
Frequency range [MHz]	Limit [dBµV/m] 3m	Limit [dBµV/m] 0.5m	Detector
Above 1000	53.9	69.4	Average
Above 1000	73.9	89.4	Peak

**Results:**

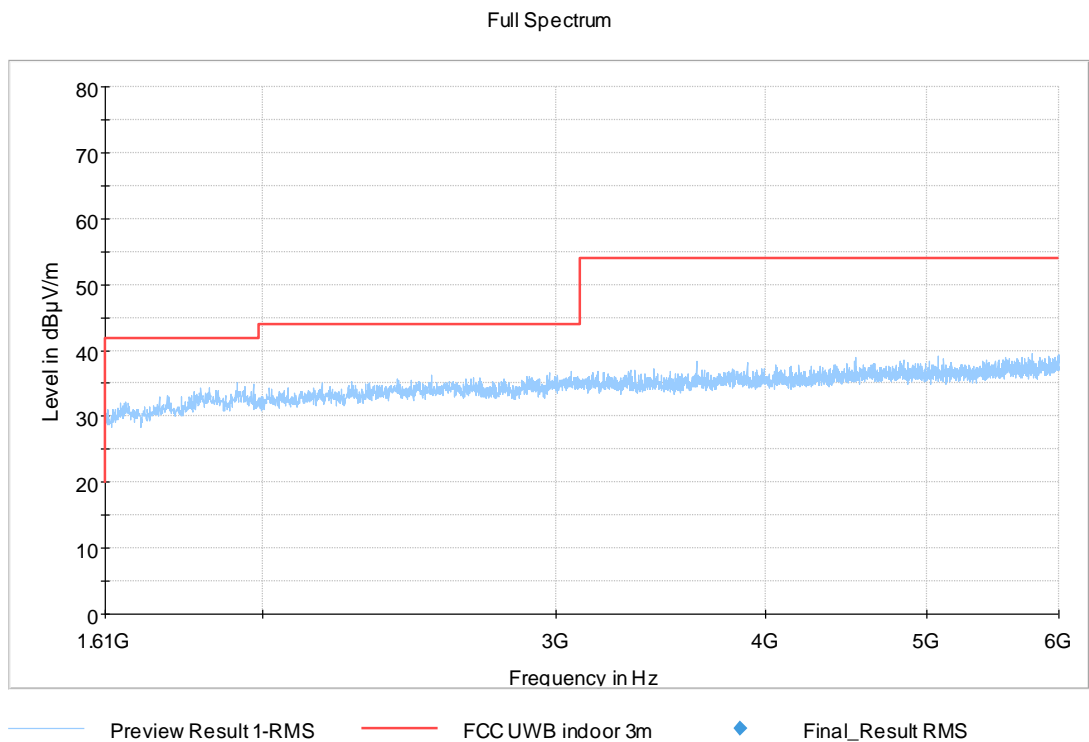
Full Spectrum



**Figure 5:** Radiated emissions 960 MHz – 1000 MHz

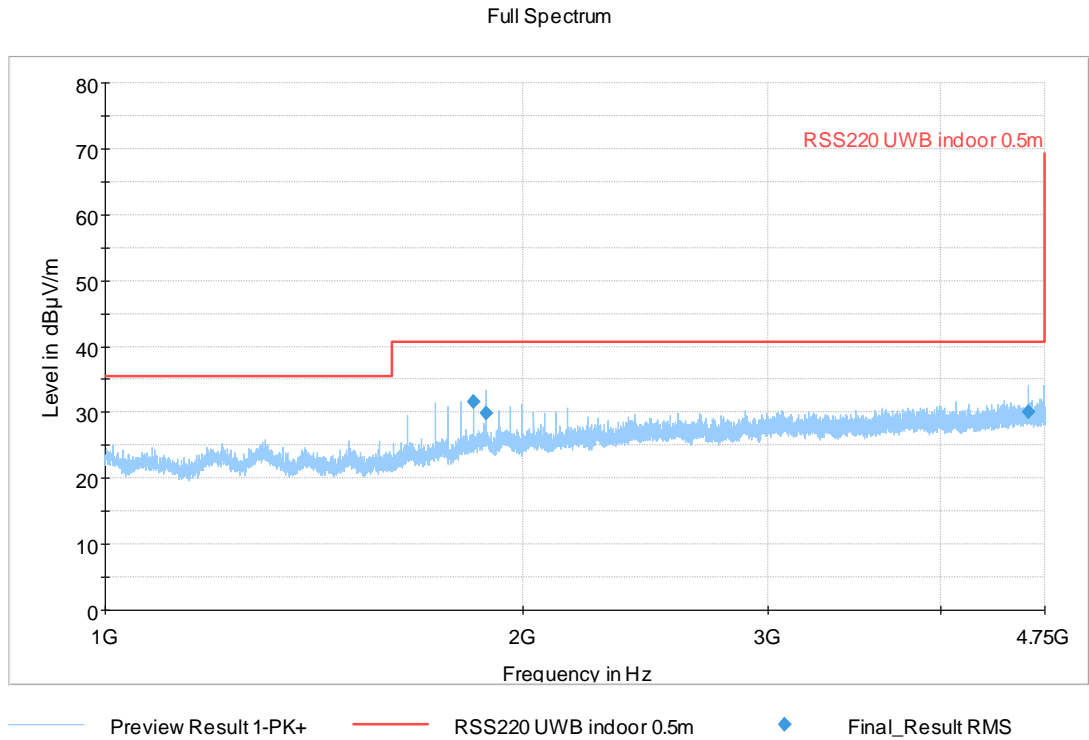


**Figure 6: Radiated emissions 1000 MHz – 1610 MHz**

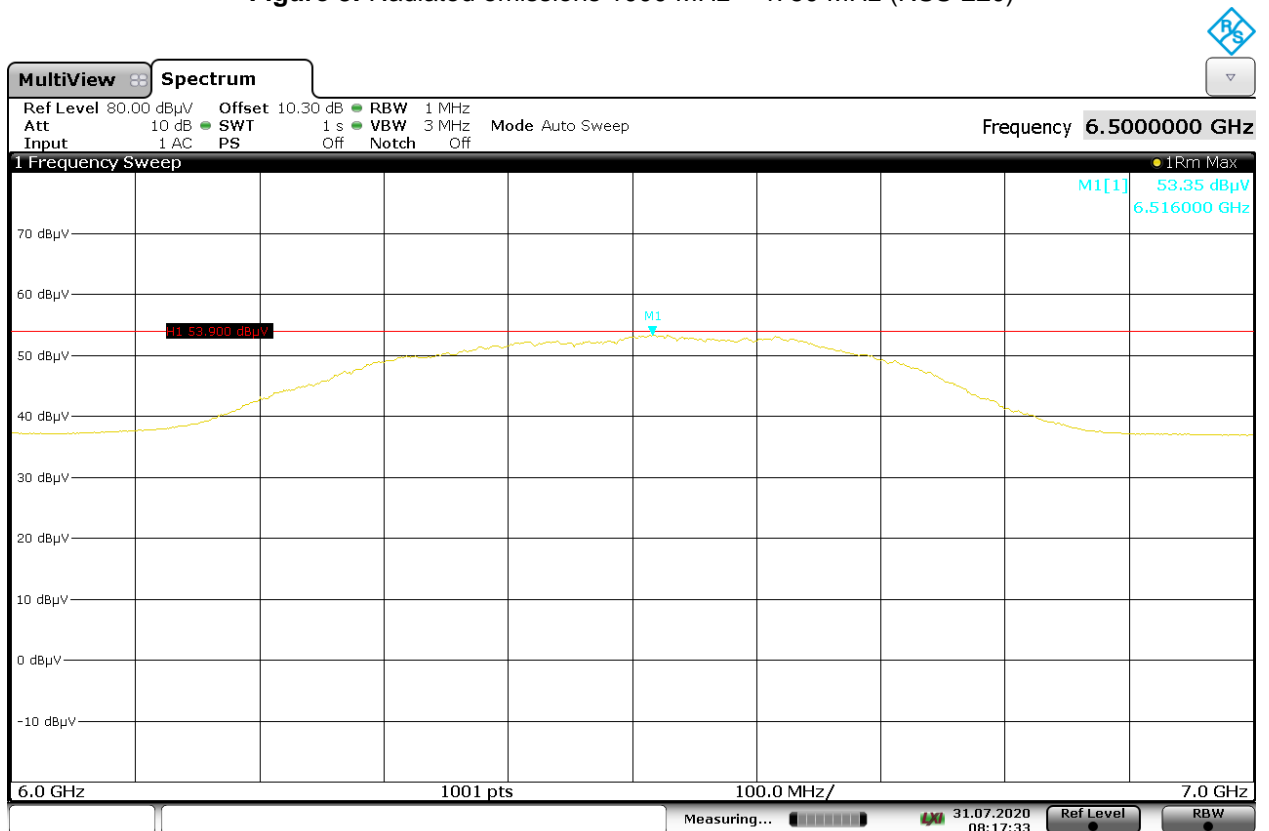


**Figure 7: Radiated emissions 1610 – 6000 MHz**





**Figure 8: Radiated emissions 1000 MHz – 4750 MHz (RSS-220)**



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**Figure 9: Radiated emissions 6 GHz – 7 GHz horizontal**

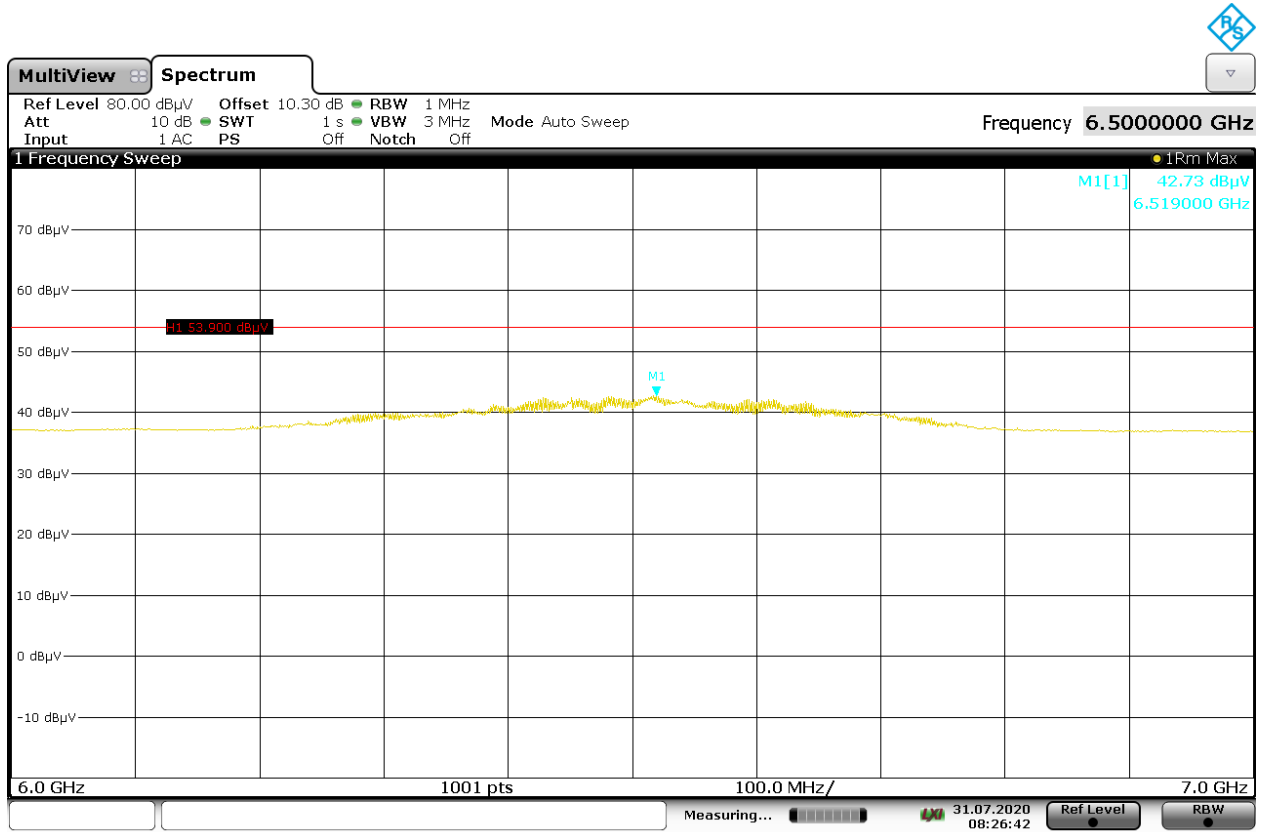


Figure 10: Radiated emissions 6 GHz – 7 GHz vertical

Full Spectrum

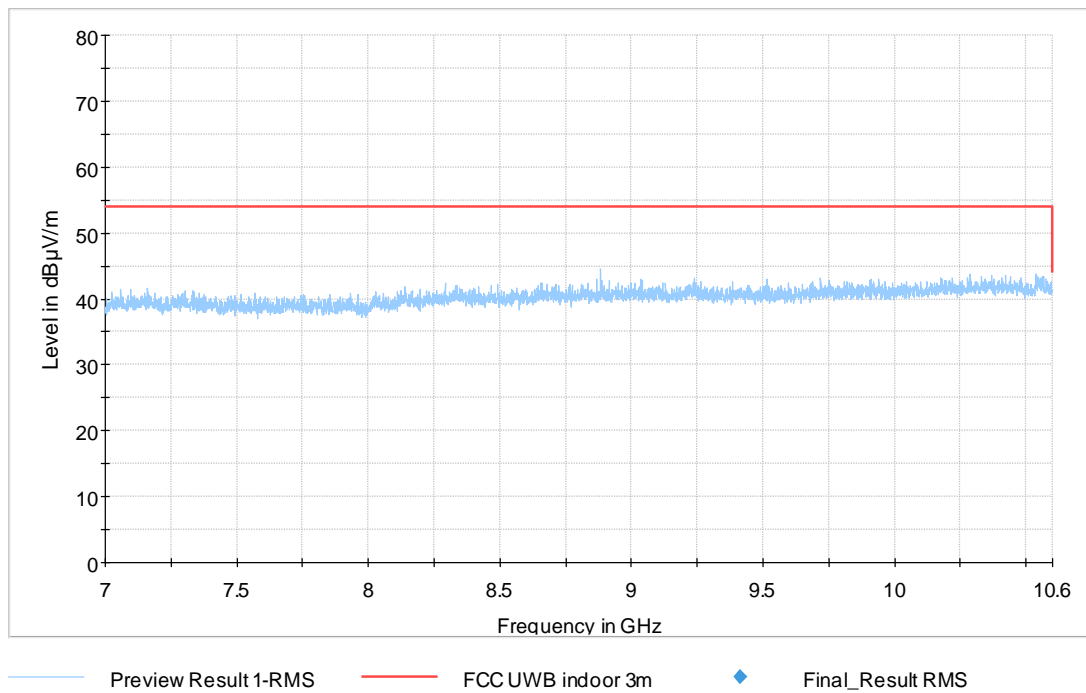
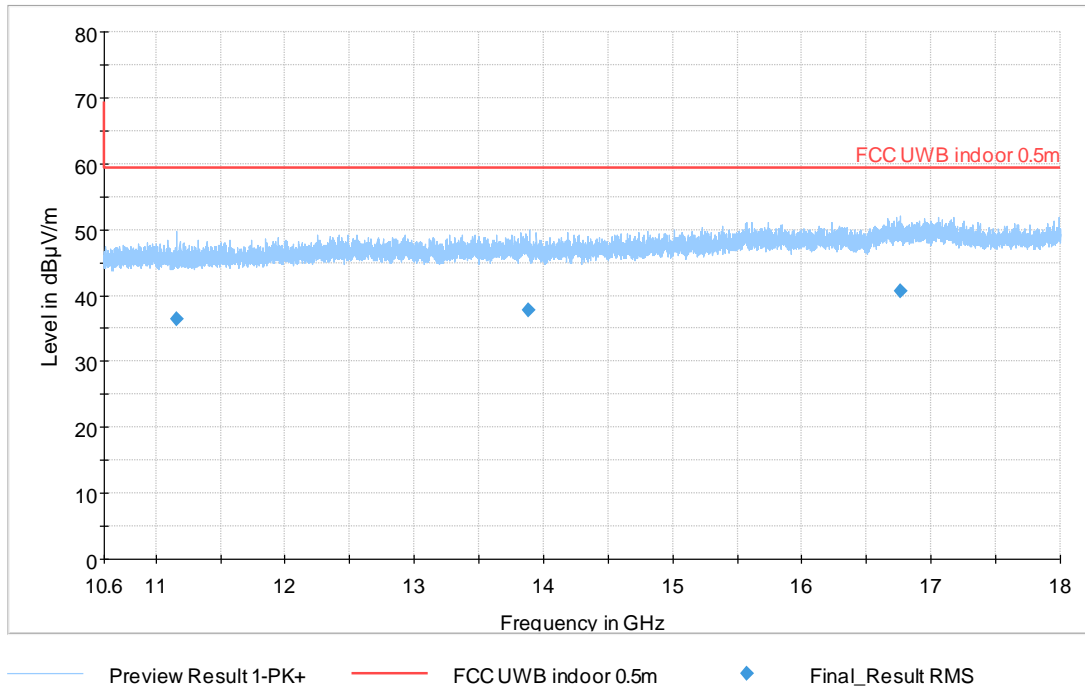


Figure 11: Radiated emissions 7 GHz – 10.6 GHz

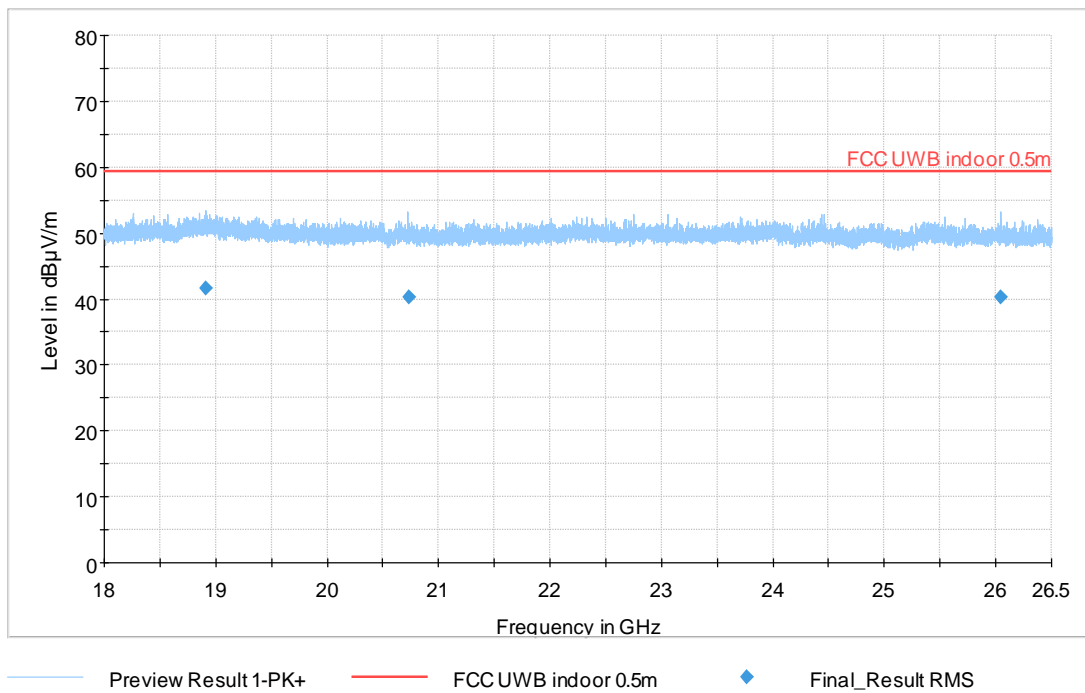
**Radiated Emissions 960 MHz – 40 GHz**

Full Spectrum



**Figure 12: Radiated emissions 10.6 GHz – 18 GHz**

Full Spectrum



**Figure 13: Radiated emissions 18 GHz – 26.5 GHz**

Radiated Emissions 960 MHz – 40 GHz

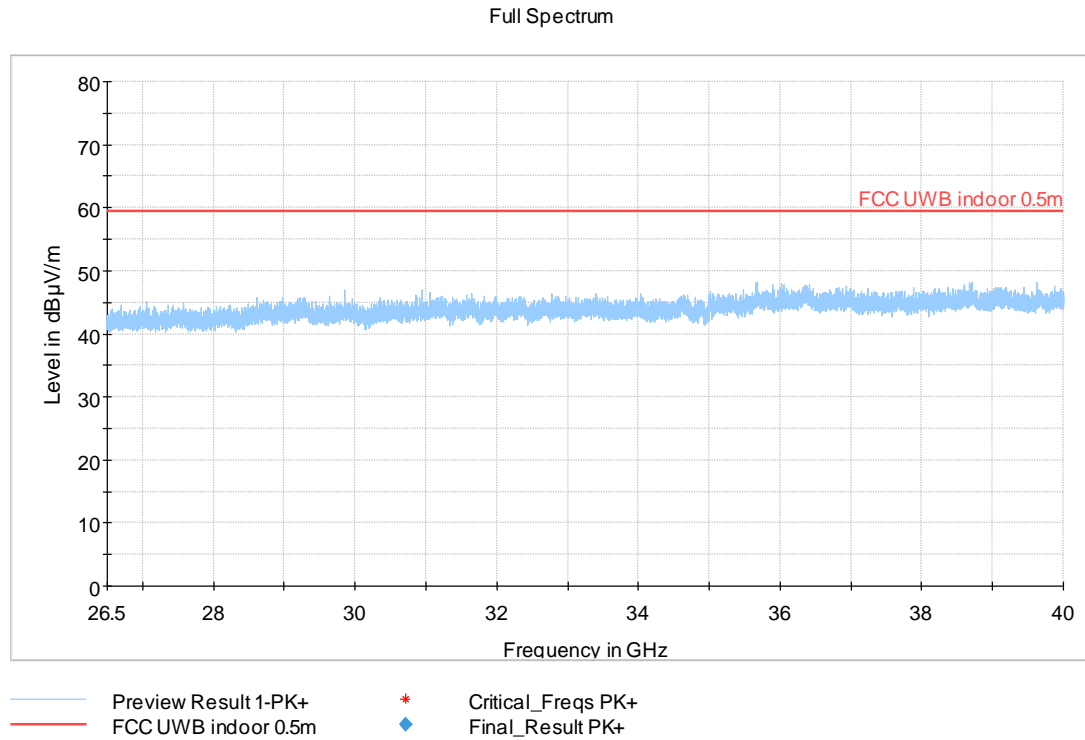


Figure 14: Radiated emissions 26.5 GHz – 40 GHz

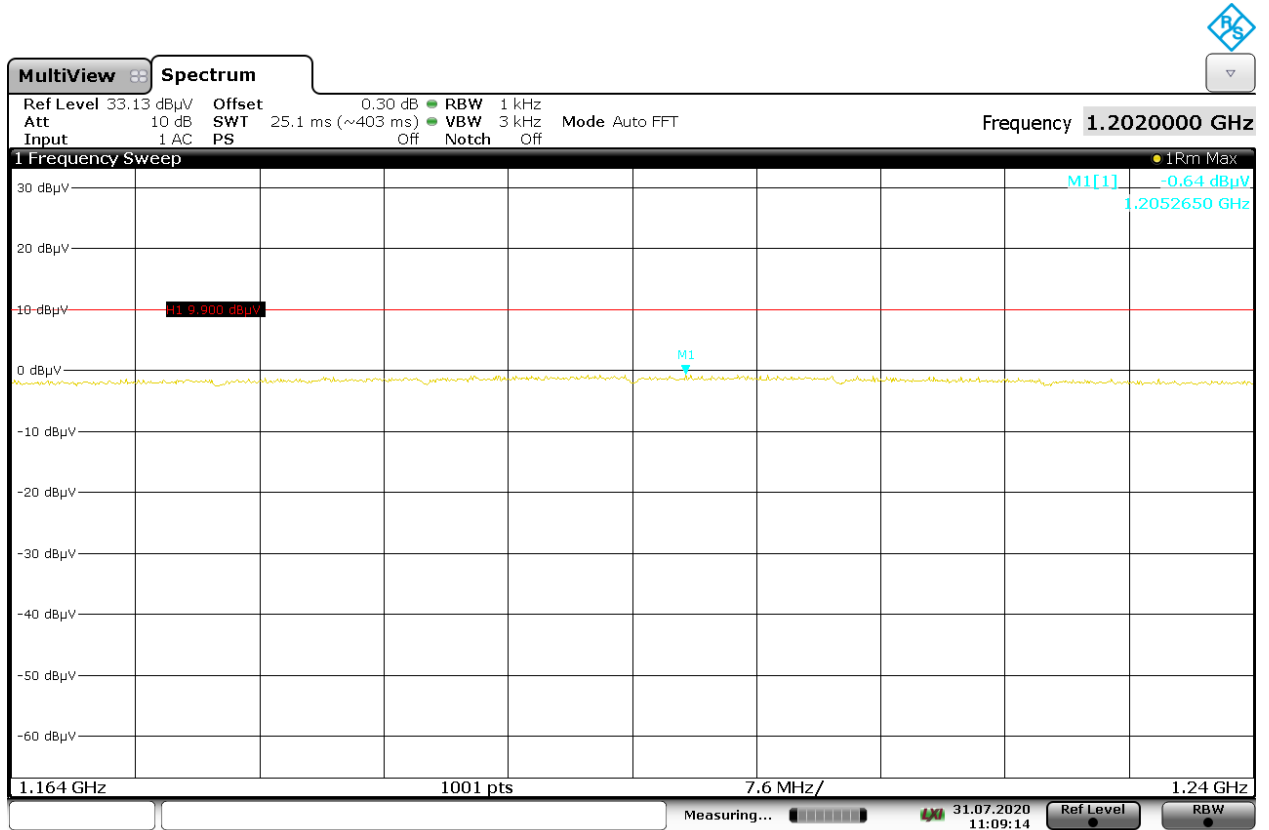
Table 3: RMS results from 960 MHz – 40 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
965.800000	12.91	19.90	6.99	1000.0	120.000	308.0	V	291.0	6.0	-
972.248000	13.15	19.90	6.75	1000.0	120.000	345.0	H	212.0	6.1	-
988.460000	12.98	19.90	6.92	1000.0	120.000	372.0	V	278.0	6.0	-
997.192000	13.20	19.90	6.70	1000.0	120.000	200.0	H	343.0	6.2	-
1180.600000	23.52	35.40	11.88	1000.0	1000.000	132.0	H	0.0	-0.4	-
1248.573000	24.21	35.40	11.19	1000.0	1000.000	169.0	V	109.0	0.2	-
1323.068500	23.99	35.40	11.41	1000.0	1000.000	125.0	V	137.0	0.7	-
1505.686500	23.64	35.40	11.76	1000.0	1000.000	168.0	H	24.0	0.2	-
6516.000000	53.35	53.90	0.55	1000.0	1000.000	100.0	H	140.0	10.3	Fundamental
11163.87000	36.36	59.40	23.04	1000.0	1000.000	144.0	H	297.0	17.6	-
13886.78000	37.75	59.40	21.65	1000.0	1000.000	175.0	H	255.0	19.5	-
16761.35000	40.76	59.40	18.64	1000.0	1000.000	125.0	V	215.0	24.6	-
18913.20000	41.67	59.40	17.73	1000.0	1000.000	168.0	V	188.0	8.7	-
20729.35000	40.33	59.40	19.07	1000.0	1000.000	125.0	V	170.0	8.1	-
26047.50000	40.33	59.40	19.07	1000.0	1000.000	132.0	V	166.0	10.1	-

Table 4: RMS results from RSS-220 1 – 4.75 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1843.18750	31.67	40.70	9.03	1000.0	1000.000	167.0	H	179.0	2.5	-
1881.83750	29.80	40.70	10.90	1000.0	1000.000	190.0	H	316.0	3.7	-
4618.42500	30.07	40.70	10.63	1000.0	1000.000	117.0	H	200.0	7.3	-

Results in GPS bands with 1 kHz bandwidth:



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Figure 15: Radiated emissions 1164 MHz – 1240 MHz, Horizontal

## Radiated Emissions 960 MHz – 40 GHz

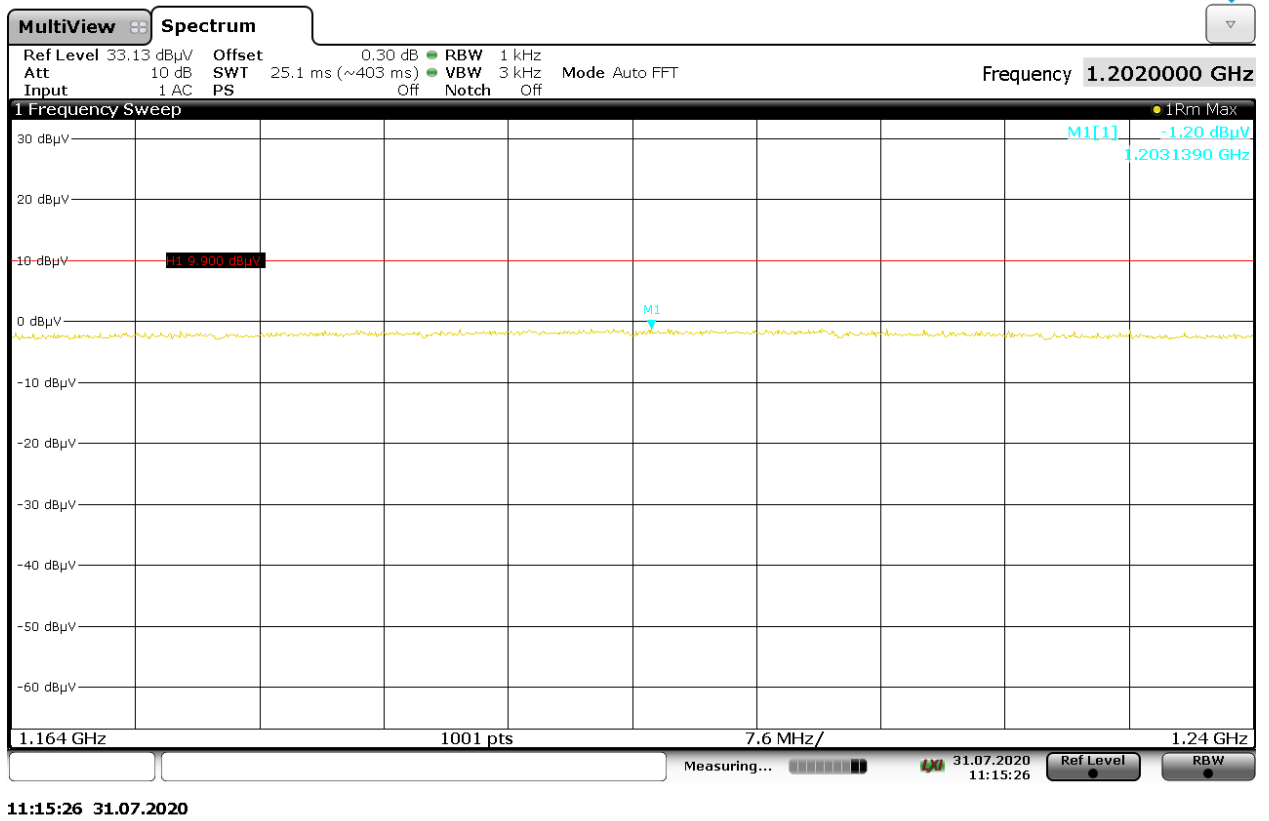


Figure 16: Radiated emissions 1164 MHz – 1240 MHz, Vertical

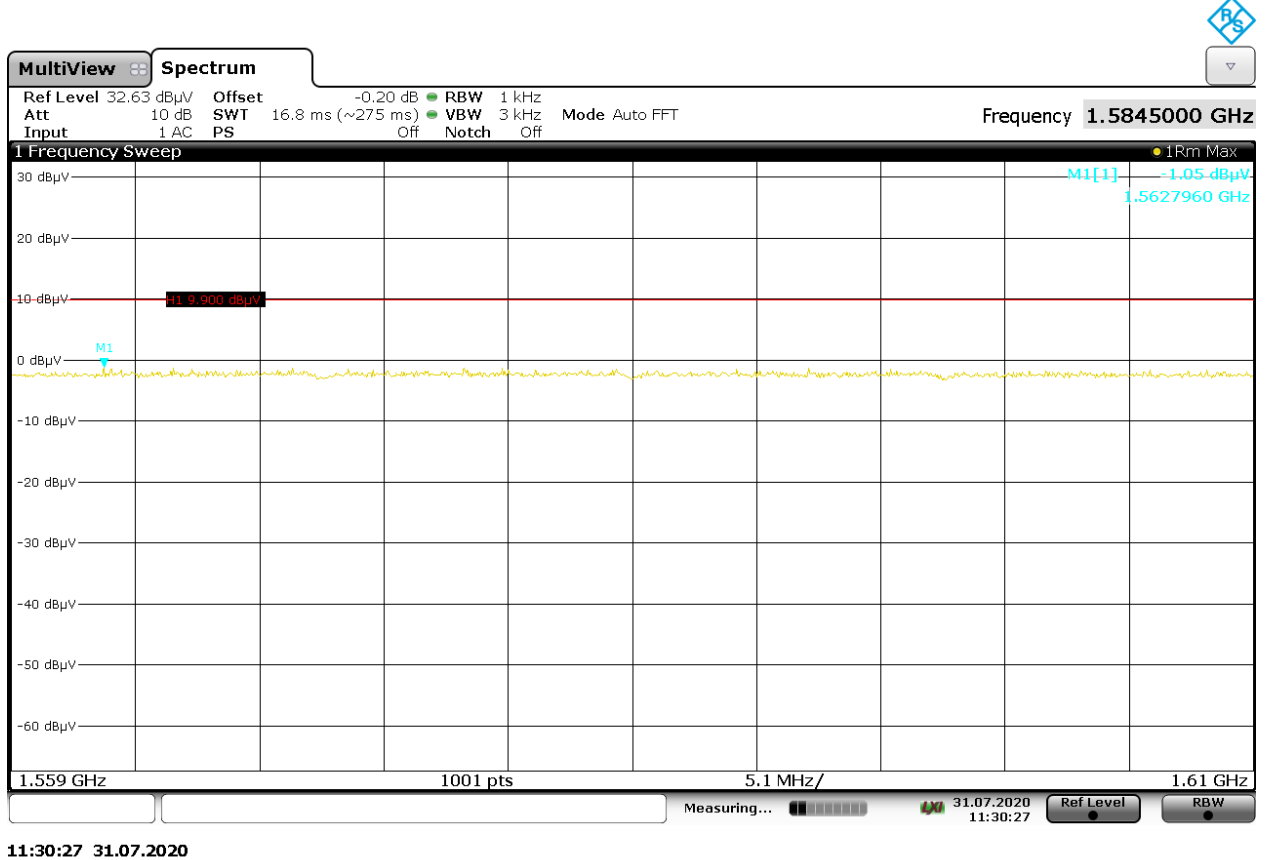
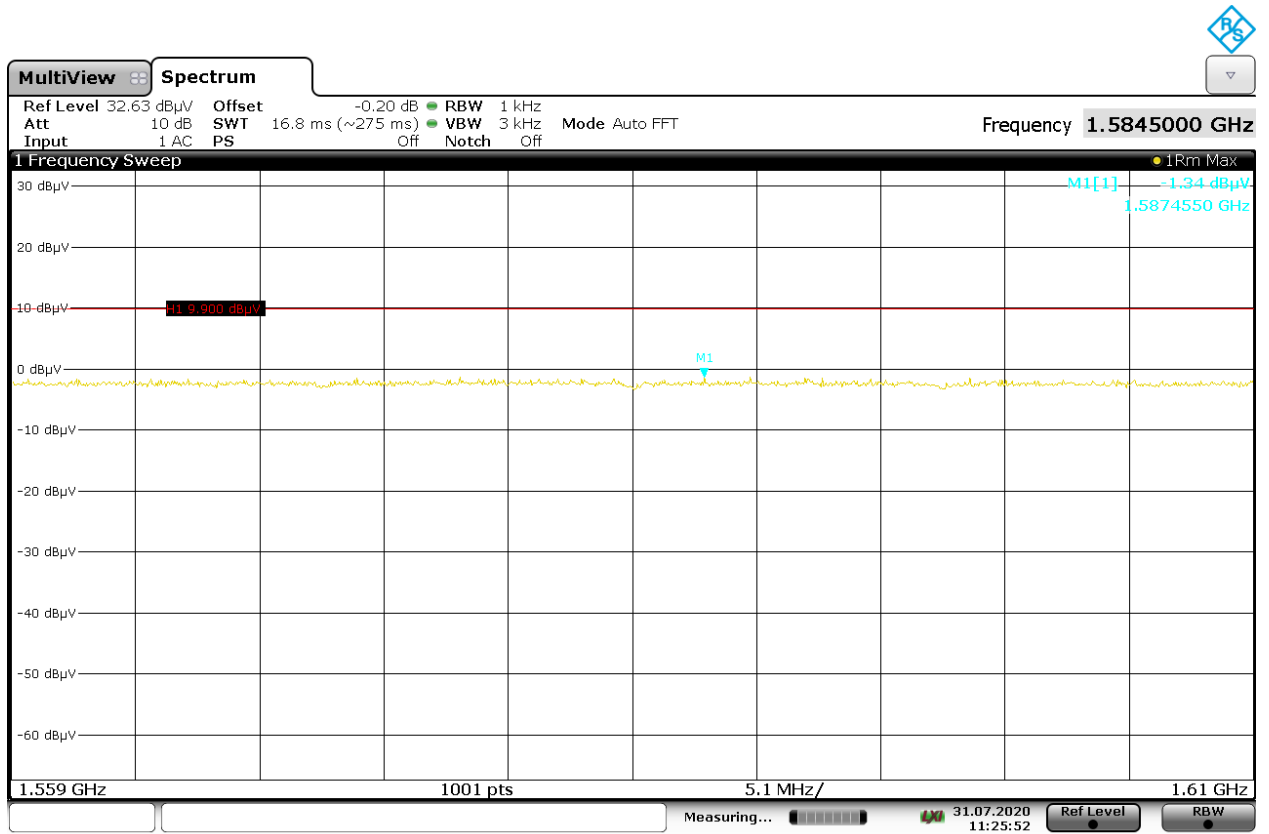


Figure 17: Radiated emissions 1559 MHz – 1610 MHz, Horizontal

## Radiated Emissions 960 MHz – 40 GHz



11:25:53 31.07.2020

Figure 18: Radiated emissions 1559 MHz – 1610 MHz, Vertical

## 10 dB Bandwidth

**Standard:** ANSI C63.10 (2013)  
**Tested by:** JAT  
**Date:** 30 July 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH

**FCC Rule: §15.503(d), §15.517(b)**  
**RSS-220 2, 5.1**

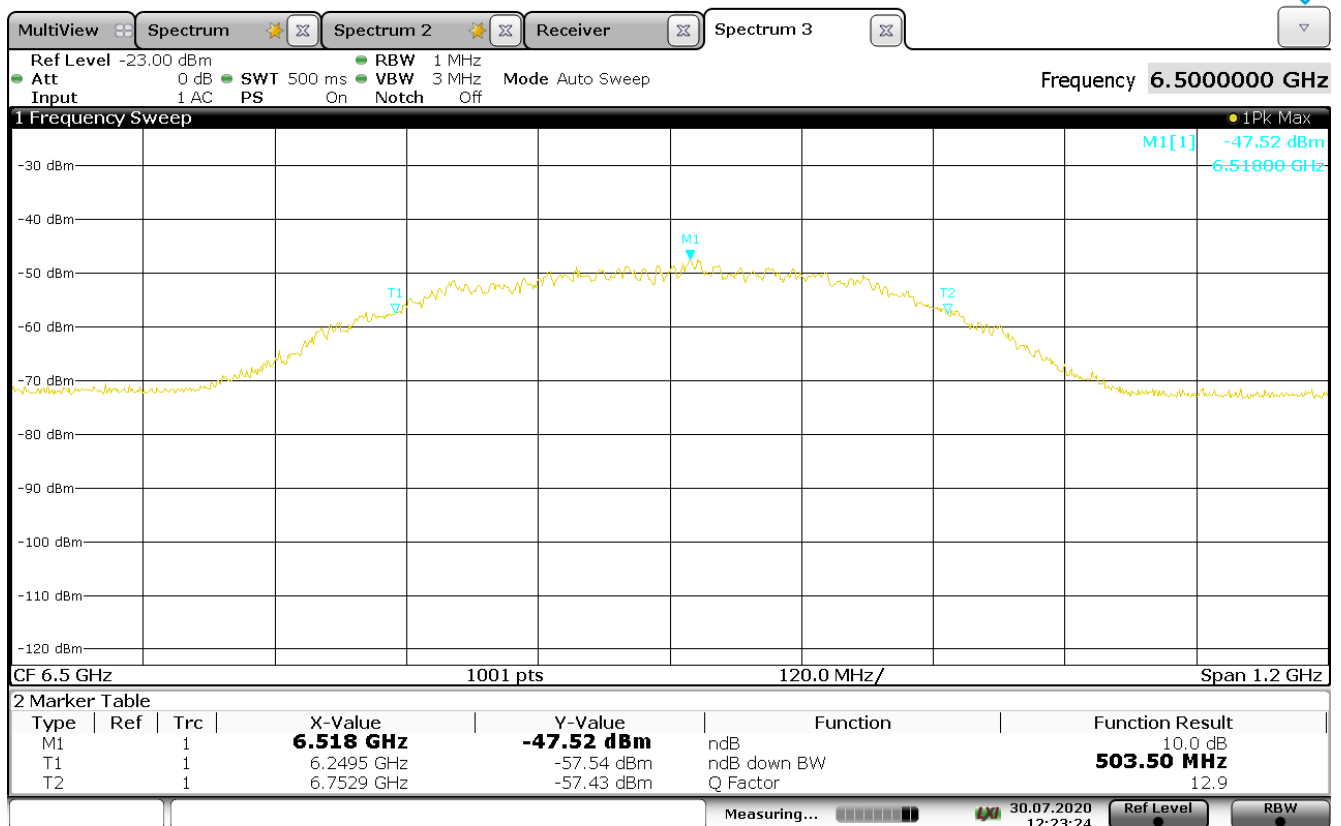
A UWB device is an intentional radiator that has either a -10 dB bandwidth of at least 500 MHz or a -10 dB fractional bandwidth greater than 0.2. The -10 dB bandwidth of the device shall be totally contained in the band 3.1 – 10.6 GHz.

Measurement distance: 3m

### Results:

**Table 5: 10 dB bandwidth test results**

Frequency low [MHz]	Frequency High [MHz]	Frequency Center [MHz]	-10 dB BW [MHz]	Result
6249.5	6752.9	6518.0	503.50	<b>PASS</b>



12:23:24 30.07.2020

**Figure 19: 10 dB Bandwidth**



## Transmission Time

**Standard:** ANSI C63.10 (2013)  
**Tested by:** JAT  
**Date:** 4 August 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH

### FCC Rule: 15.517(a)(5)

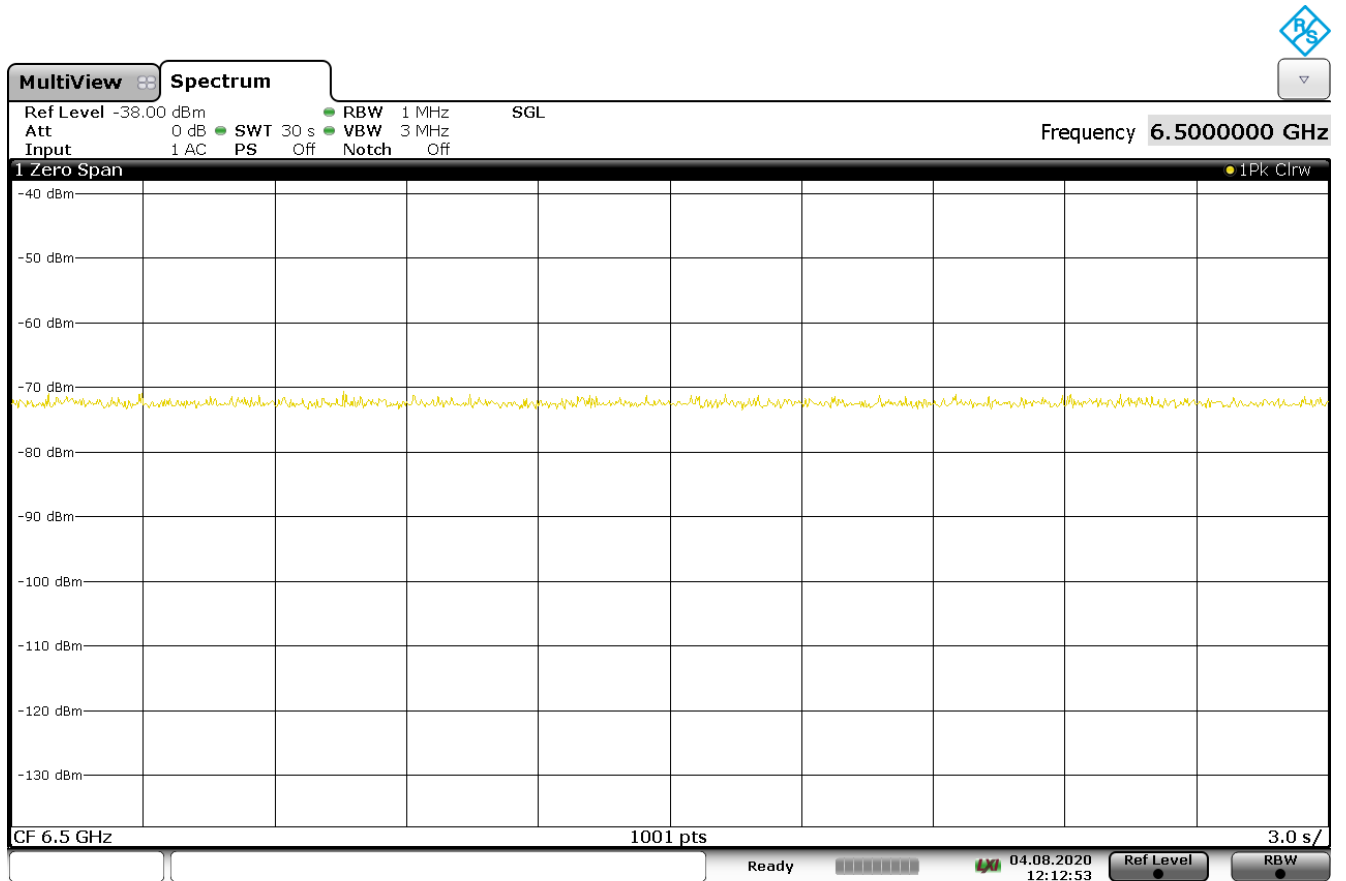
A communication system shall transmit only when the intentional radiator is sending information to an associated receiver.

### Results:



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**Figure 20:** Transmission time, TAG ON - Beacon was turned OFF after 6 transmit



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**Figure 21:** Transmission time, TAG ON - Beacon OFF

### 99% Occupied Bandwidth

**Standard:** RSS-GEN (2019)  
**Tested by:** JAT  
**Date:** 30 July 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH

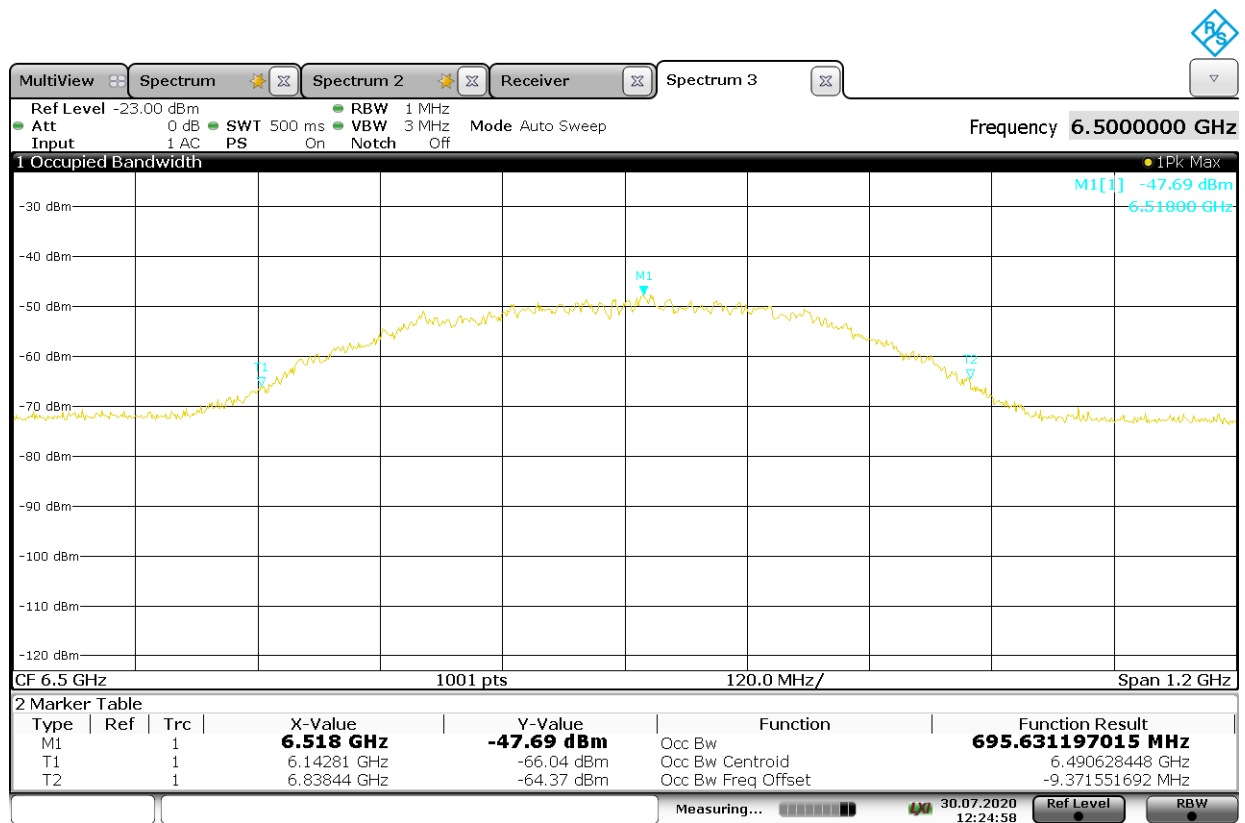
#### RSS-GEN 6.6

Measurement distance: 3m

#### Results

Table 6: 99% occupied bandwidth test results

Frequency [MHz]	Limit	99 % BW [MHz]	Result
6510.0	-	695.631	PASS



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Figure 22: 99% OBW

**TEST EQUIPMENT**
**Conducted Emissions**

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	NCR	NCR
LISN	ROHDE & SCHWARZ	ENV216	inv:9611	2020-03-03	2021-03-03
LISN	ROHDE & SCHWARZ	ESH3-Z5	inv:8019	2020-05-19	2021-05-19
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv:10679	2020-07-20	2021-07-20
ISN	TESEQ CALIFORNIA INSTR.	ISN T8-Cat6	inv:10492	2020-06-09	2021-06-09
POWER SUPPLY		5001 iX Series II	inv:7826	NCR	NCR

**RF-Test Equipment**

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	NCR	NCR
SPECTRUM ANALYZER	AGILENT	E7405A, monitoring	inv:9746	2018-01-08	NCR
RF PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2019-10-09	2020-10-09
RF PREAMPLIFIER	CIAO	CA1840-5019	inv:10593	2019-10-08	2020-10-08
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 EMC	inv:10516	2019-11-07	2020-11-07
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv:10517	2019-11-07	2020-11-07
ANTENNA	EMCO	3117, emi 1-18GHz	inv:7293	2020-03-11	2022-03-11
ANTENNA	EMCO	3160-09, emi 18-26.5GHz	inv:7294	2020-02-20	2021-02-20
ANTENNA	ETS LINDGREN	3160-10, emi 26.5-40GHz	inv:9151	2019-08-07	2020-08-07
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	NCR	NCR
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	NCR	NCR
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	NCR	NCR
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	NCR	NCR
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv:10679	2020-07-20	2021-07-20
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2019-11-18	2020-11-18
ANTENNA	SCHWARZ	HFH2-Z2 , 335.4711.52	inv:8013	2018-10-30	2020-10-30
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2018-10-25	2020-10-25
TEMPERATURE/ HUMIDITY METER	VAISALA	HMT 333 HP, WHNX6-6030-9000-26500-	inv:8638	2020-06-11	2021-06-11
FILTER	WAINWRIGHT	80CD	inv:10522	2019-04-01	2021-04-01
FILTER	WAINWRIGHT	LP, WLJS4500-10EE	inv:10404	2019-04-01	2021-04-01
RF PREAMPLIFIER	SGS Fimko HEWLETT	Module: ZFL-1000LN (20 dB)	inv: 8364	2020-03-20	2021-03-20
MULTIMETER	PACKARD	975A	INV:5126	2019-10-30	2020-10-30

NCR = No calibration required