

# Test Report



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

Equipment Under Test: Noccela positioning system: Tracking Device  
Beacon Unit

Model: BEACON-3

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 blue ink signature of the name 'Jani Tuomela'.

Jani Tuomela  
Testing Engineer

Date:

15 September 2020

Checked by:

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Mikko Halonen  
Development Engineer

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## **GENERAL REMARKS**

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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**

Version	Changes	Issued
1.0	Initial release	14 September 2020
2.0	Summary of testing updated	15 September 2020

## PRODUCT DESCRIPTION

### Equipment Under Test

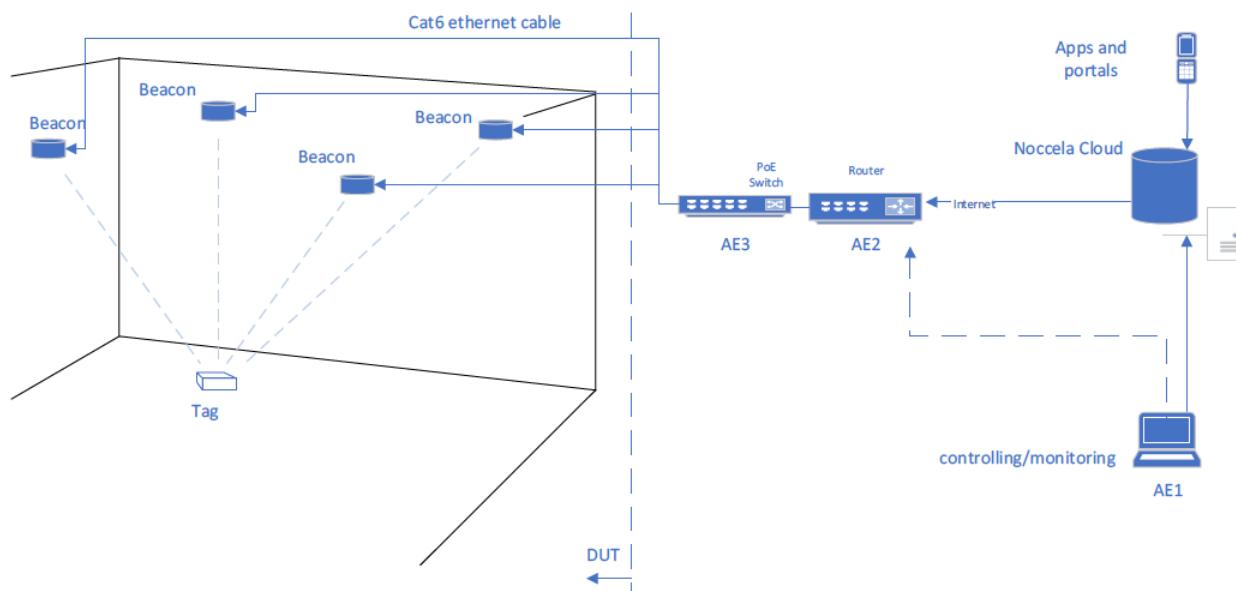
Trade mark: Noccela  
Model: BEACON-3  
Type: -  
Serial no: 2013000007  
FCC ID: 2AVRO-BEACON-3  
IC: -

### General Description

Noccela positioning system: Tracking Device Beacon Unit.

EUT is a beacon unit of indoor locating system. Unit is fixed device and consist of Radio Frequency Transceiver with internal Flex type antenna, Processor card and peripheral parts. Beacons are powered via PoE (Power over Ethernet) ethernet connection from PoE ethernet switch and regulated by internal DC/DC converters. Power supply voltage from PoE switch is 48V DC nominal (37 – 57V). Beacon unit is compatible with 802.3af (PD power class2). Beacon Device is assembled in plastic enclosure.

Installed Beacons are connected to internet via PoE capable ethernet switch and ethernet router.



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

### Classification

Fixed device	<input checked="" type="checkbox"/>
Mobile Device (Human body distance > 20cm)	<input 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:	555 MHz
Channels:	1
Modulation:	BPM/BPSK
Antenna type:	Integral

## Power Supply

Operating voltage range: 37 - 57 VDC (tested with 48VDC, PoE powered)

## Mechanical Size of the EUT

Height: 72 mm

Width: 150 mm

Length: 150 mm

## Ports and Cables

Cable / Port	Description
Ethernet / RJ45	EUT was having only one connector

## 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

All peripherals were supplied by the manufacturer.

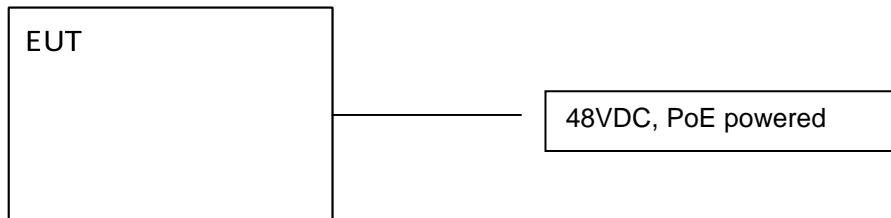
**SUMMARY OF TESTING**

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

*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 a7a0 during the tests.



**Figure 1:** Test setup blocking diagram

**Test Facility**

Testing Laboratory / address: FCC designation number: <b>FI0002</b> ISED CAB identifier: <b>T004</b>	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	<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

**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 2 is used	

## Conducted Emissions In The Frequency Range 150 kHz - 30 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	JAT	
Date:	6 August 2020	
Temperature:	23 ± 3°C	
Humidity:	20 - 60 % RH	
Barometric pressure:	1001 hPa	
Measurement uncertainty:	± 2.9 dB	Level of confidence 95 % (k = 2)

## FCC Rule: 15.207 (a)

## RSS-GEN 8.8

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors.

Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

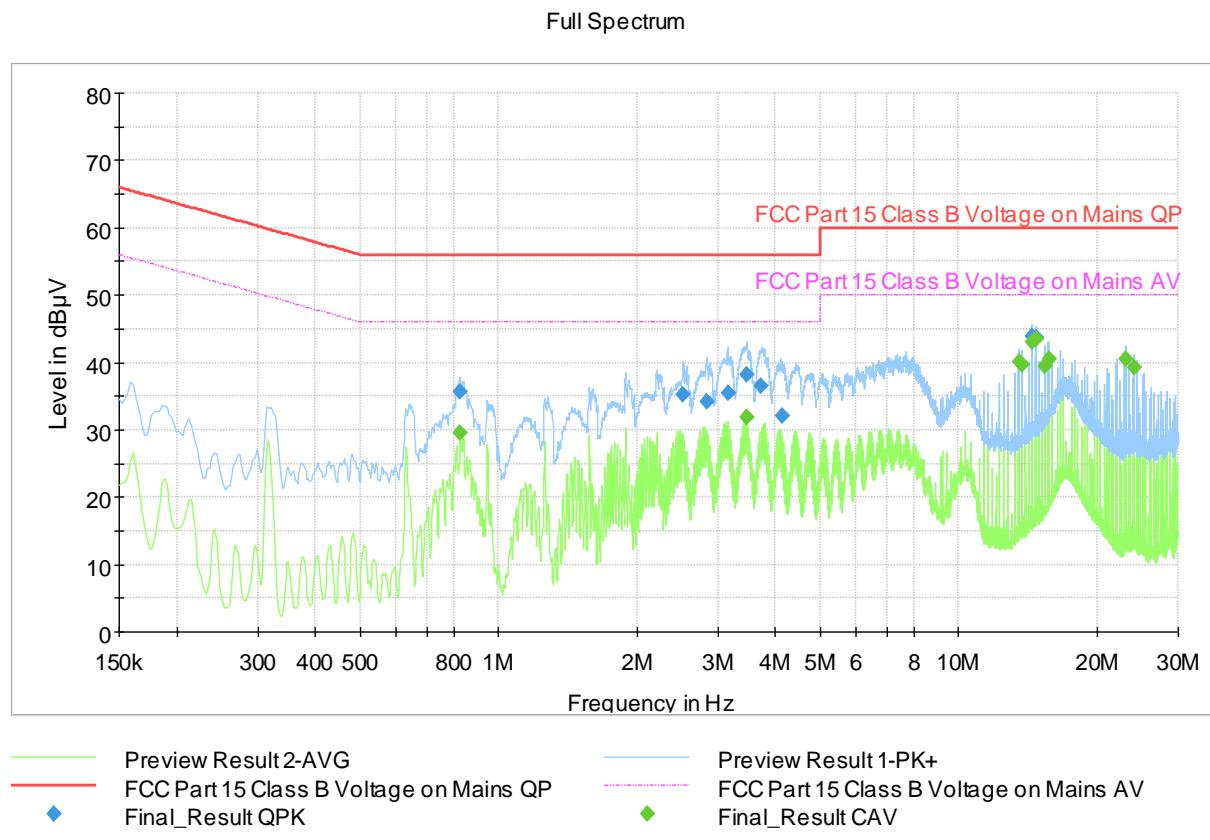


Figure 2: The measured curves with peak- and average detector

**Final measurements from the worst frequencies****Table 1:** Final QuasiPeak and Average measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dB $\mu$ V)	CAverage (dB $\mu$ V)	Limit (dB $\mu$ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.825500	---	29.51	46.00	16.49	1000.0	9.000	N	ON	9.7	-
0.826250	35.63	---	56.00	20.37	1000.0	9.000	L1	ON	9.7	-
2.521750	35.21	---	56.00	20.79	1000.0	9.000	L1	ON	9.9	-
2.844750	34.15	---	56.00	21.85	1000.0	9.000	L1	ON	9.9	-
3.159750	35.53	---	56.00	20.47	1000.0	9.000	L1	ON	9.9	-
3.462750	38.19	---	56.00	17.81	1000.0	9.000	L1	ON	9.9	-
3.465000	---	31.87	46.00	14.13	1000.0	9.000	L1	ON	9.9	-
3.713750	36.53	---	56.00	19.47	1000.0	9.000	L1	ON	10.0	-
4.144500	32.17	---	56.00	23.83	1000.0	9.000	L1	ON	10.0	-
13.497250	---	40.13	50.00	9.87	1000.0	9.000	L1	ON	10.3	-
13.738000	---	39.65	50.00	10.35	1000.0	9.000	L1	ON	10.3	-
14.458500	43.89	---	60.00	16.11	1000.0	9.000	L1	ON	10.3	-
14.462500	---	43.05	50.00	6.95	1000.0	9.000	L1	ON	10.3	-
14.703250	43.68	---	60.00	16.32	1000.0	9.000	L1	ON	10.3	-
14.703250	---	43.44	50.00	6.56	1000.0	9.000	L1	ON	10.3	-
15.425500	---	39.49	50.00	10.51	1000.0	9.000	L1	ON	10.3	-
15.666250	---	40.54	50.00	9.46	1000.0	9.000	L1	ON	10.3	-
23.136250	---	40.61	50.00	9.39	1000.0	9.000	L1	ON	10.5	-
24.101500	---	39.26	50.00	10.74	1000.0	9.000	L1	ON	10.5	-

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

The result value is the measured value corrected with the correction factor.

## Peak Power within 50 MHz bandwidth

Standard:	ANSI C63.10	(2013)
Tested by:	JAT	
Date:	4 August 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)

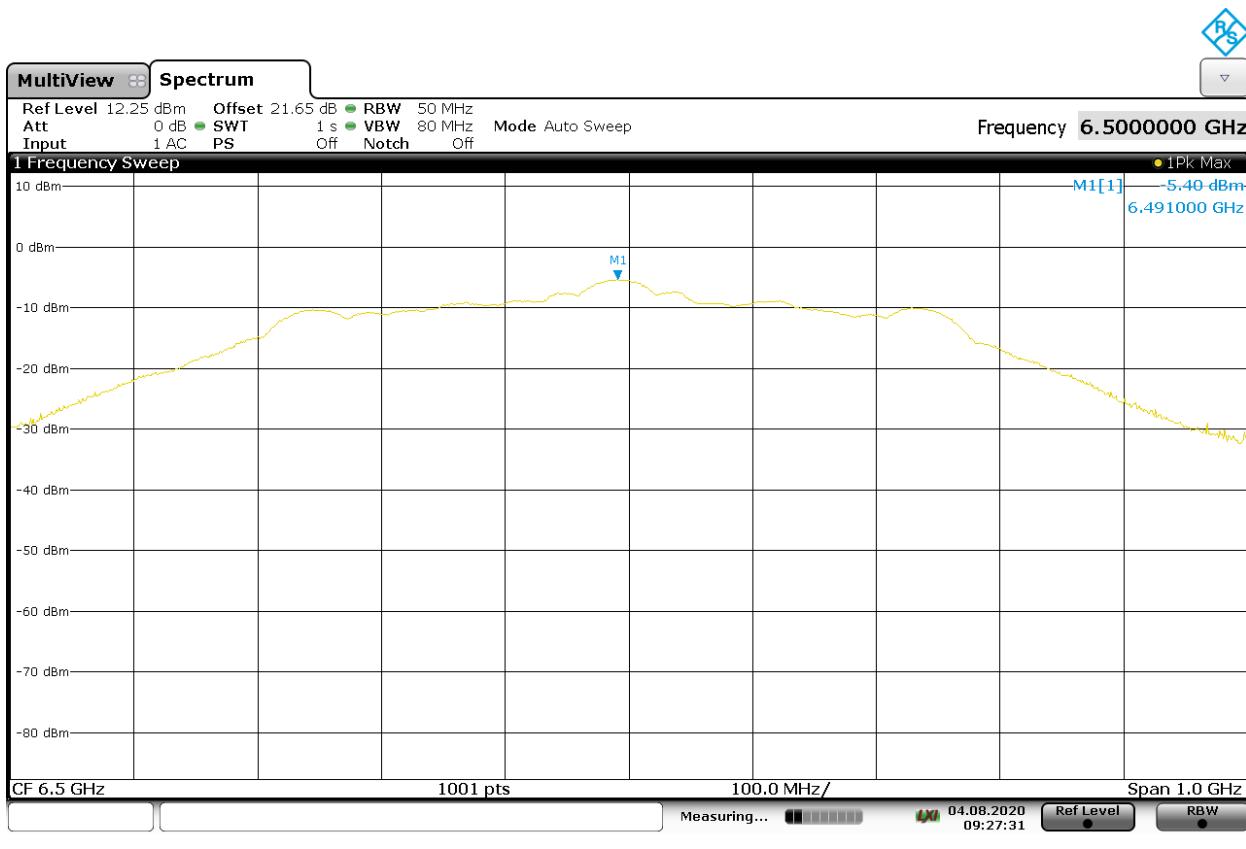
There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest emission occurs. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following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

Measurement distance: 3m

## Results:

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

Freq [MHz]	Height [cm]	Polarization	Azimuth [deg]	Level [dBm/50 MHz]	Limit [dBm/50 MHz]	Result
6491.0	180	H	300	-5.40	0	PASS



**Figure 3:** Peak power within 50 MHz bandwidth

**Radiated Emissions 9 kHz - 960 MHz**

**Standard:** ANSI C63.10 (2013)  
**Tested by:** JAT  
**Date:** 6 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).

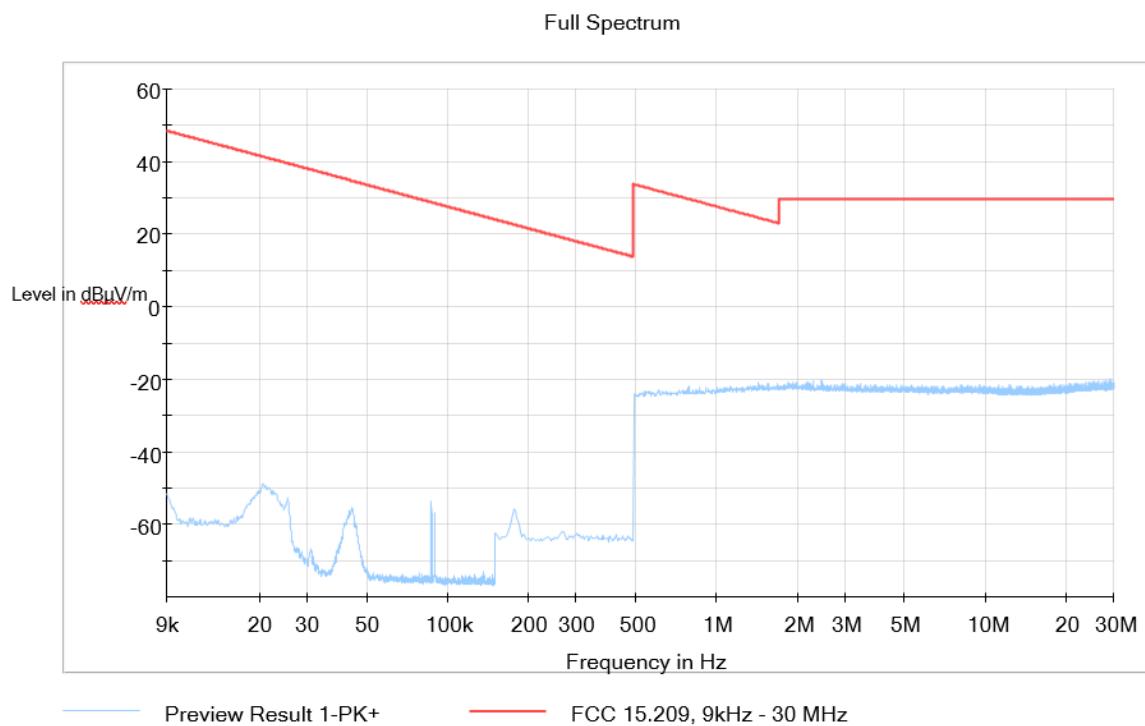
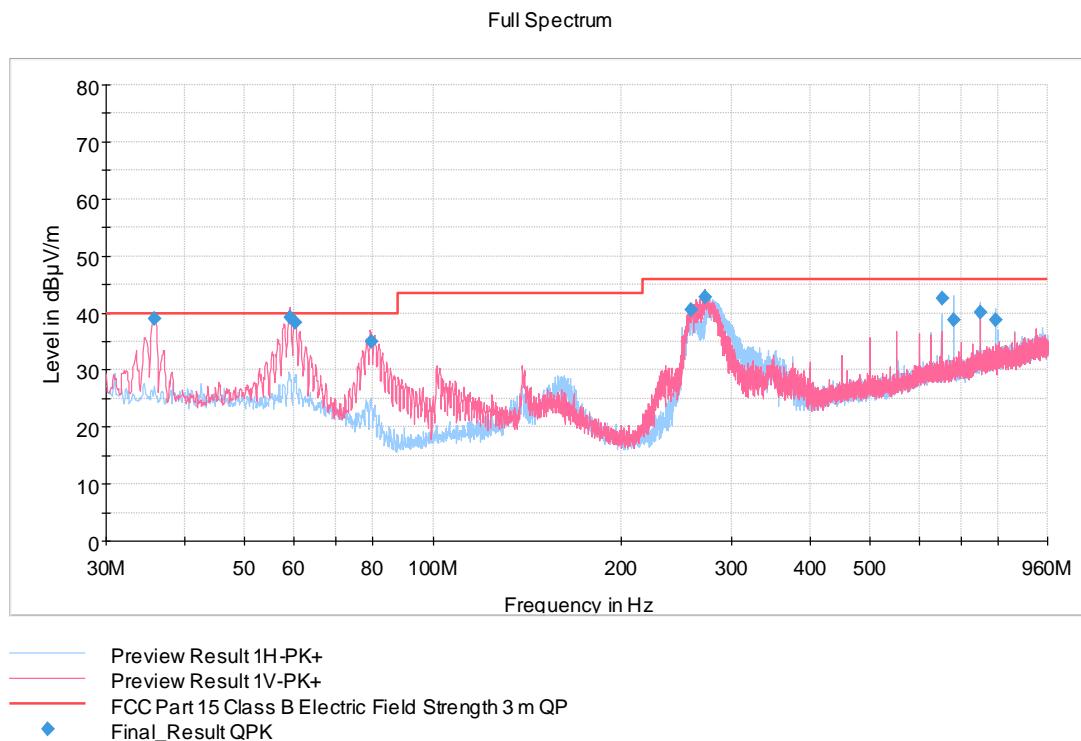
The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables).

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. X orientation was used for final measurements.

Measurement distance: 3m

Frequency range [MHz]	Limit [ $\mu$ V/m]	Limit [dB $\mu$ 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 - 88	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 4:** Radiated emissions 9 kHz – 30 MHz**Figure 5:** Radiated emissions 30 MHz – 960 MHz

**Table 3:** 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
35.846000	38.95	40.00	1.05	1000.0	120.000	109.0	V	29.0	16.6	-
59.043000	39.29	40.00	0.71	1000.0	120.000	109.0	V	273.0	17.8	-
60.239000	38.22	40.00	1.78	1000.0	120.000	109.0	V	264.0	17.8	-
79.770000	35.06	40.00	4.94	1000.0	120.000	109.0	V	196.0	13.2	-
258.895000	40.46	46.00	5.54	1000.0	120.000	109.0	V	101.0	17.9	-
272.252000	42.71	46.00	3.29	1000.0	120.000	100.0	V	126.0	18.6	-
650.071000	42.61	46.00	3.39	1000.0	120.000	127.0	H	79.0	27.6	-
678.914000	38.81	46.00	7.19	1000.0	120.000	217.0	H	90.0	27.8	-
750.059000	40.10	46.00	5.90	1000.0	120.000	109.0	H	348.0	29.2	-
792.055000	38.82	46.00	7.18	1000.0	120.000	100.0	H	103.0	29.8	-

**Radiated Emissions 960 MHz – 40 GHz**

**Standard:** ANSI C63.10 (2013)  
**Tested by:** JAT  
**Date:** 4 – 6 August 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH  
**Measurement uncertainty:** ± 5.44 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. X 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 [dB $\mu$ V/m] 3m	Limit [dB $\mu$ V/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 [dB $\mu$ V/m] 3m	Limit [dB $\mu$ V/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

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

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

$$\text{Distance extrapolation factor} = 20 \log (\text{specific distance [3m]} / \text{test distance [m]}) \text{ (dB)}$$
$$\text{Limit line} = \text{Limit at 3m (dB}\mu\text{V/m)} + \text{distance extrapolation factor (dB)}$$

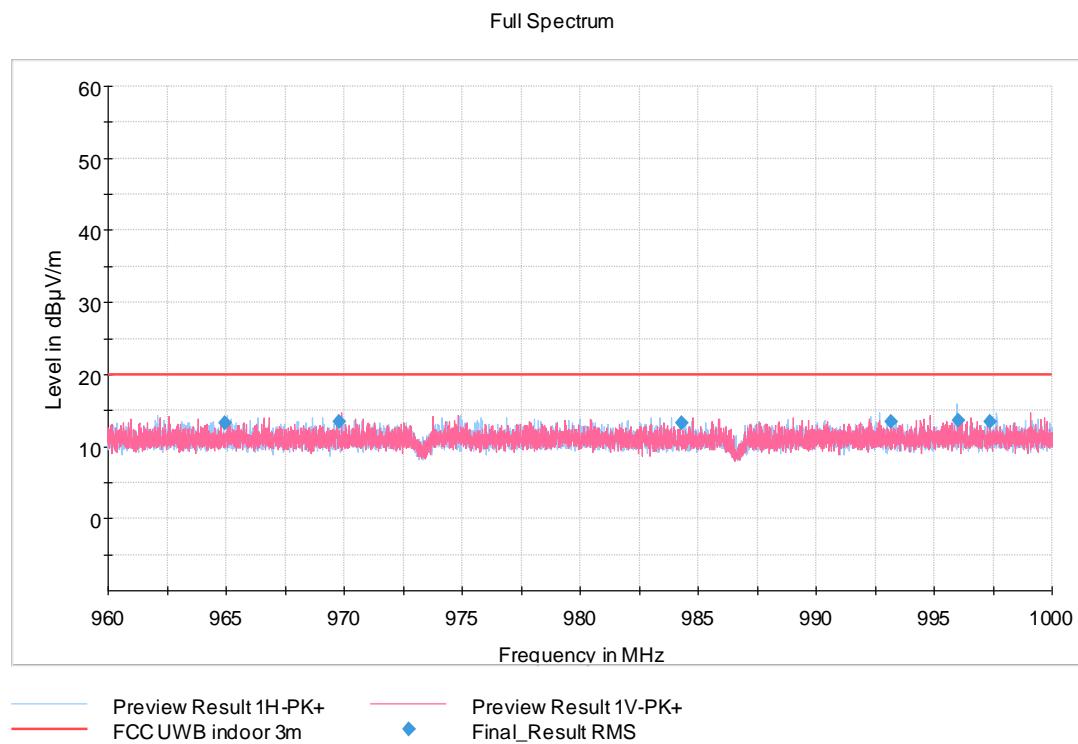
In addition, UWB transmitter shall not exceed following average limits when measured using resolution bandwidth of no less than 1 kHz.

Frequency range [MHz]	Limit EIRP [dBm]	Limit [dB $\mu$ V/m] 3m	Limit [dB $\mu$ V/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 [dB $\mu$ V/m] 3m	Limit [dB $\mu$ V/m] 0.5m	Detector
Above 1000	53.9	69.4	Average
Above 1000	73.9	89.4	Peak

**Results:**

**Figure 6:** Radiated emissions 960 MHz – 1000 MHz

## Radiated Emissions 960 MHz – 40 GHz

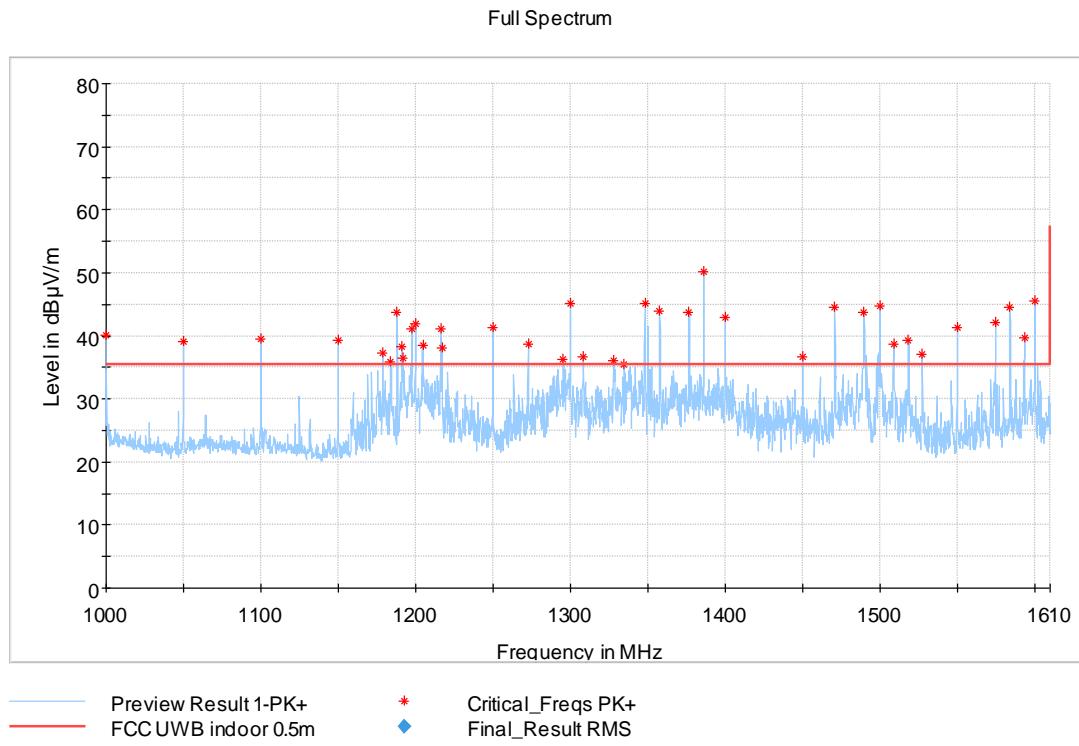


Figure 7: Radiated emissions 1000 MHz – 1610 MHz, Emission are from digital circuitry

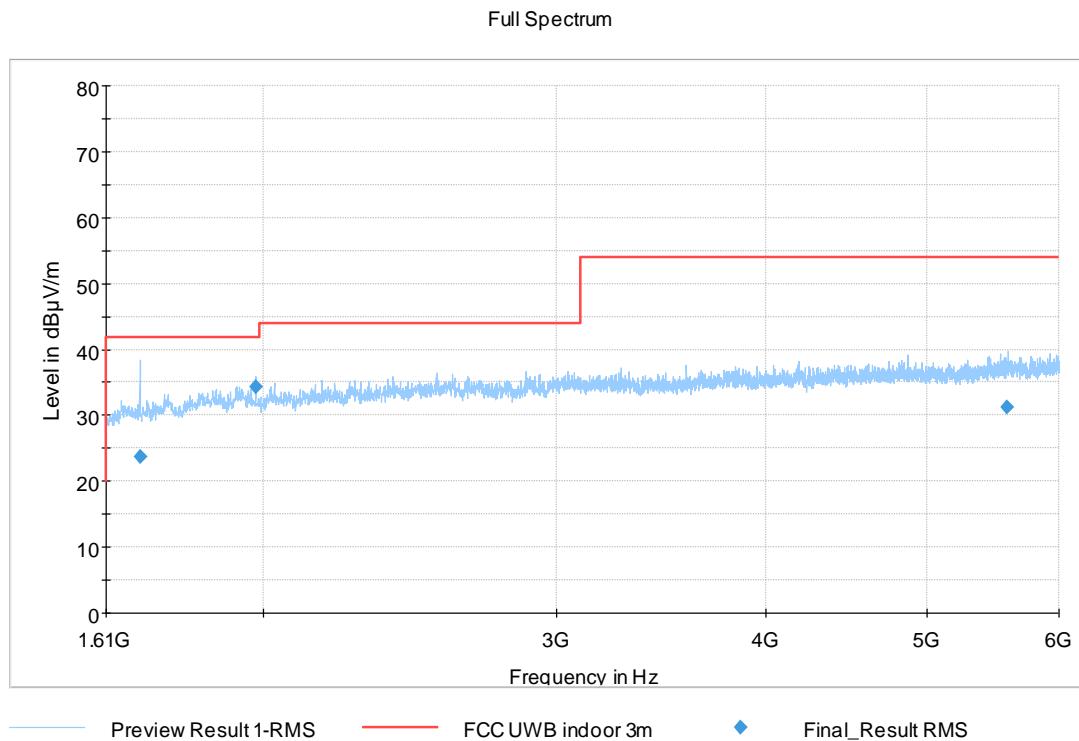
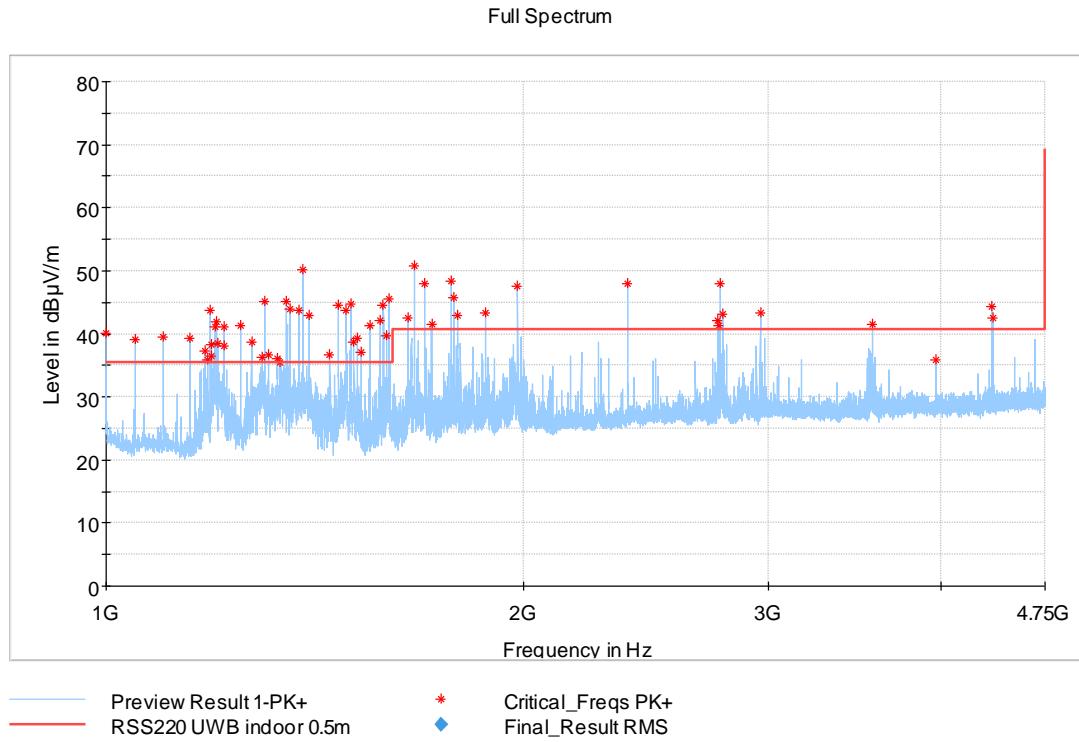
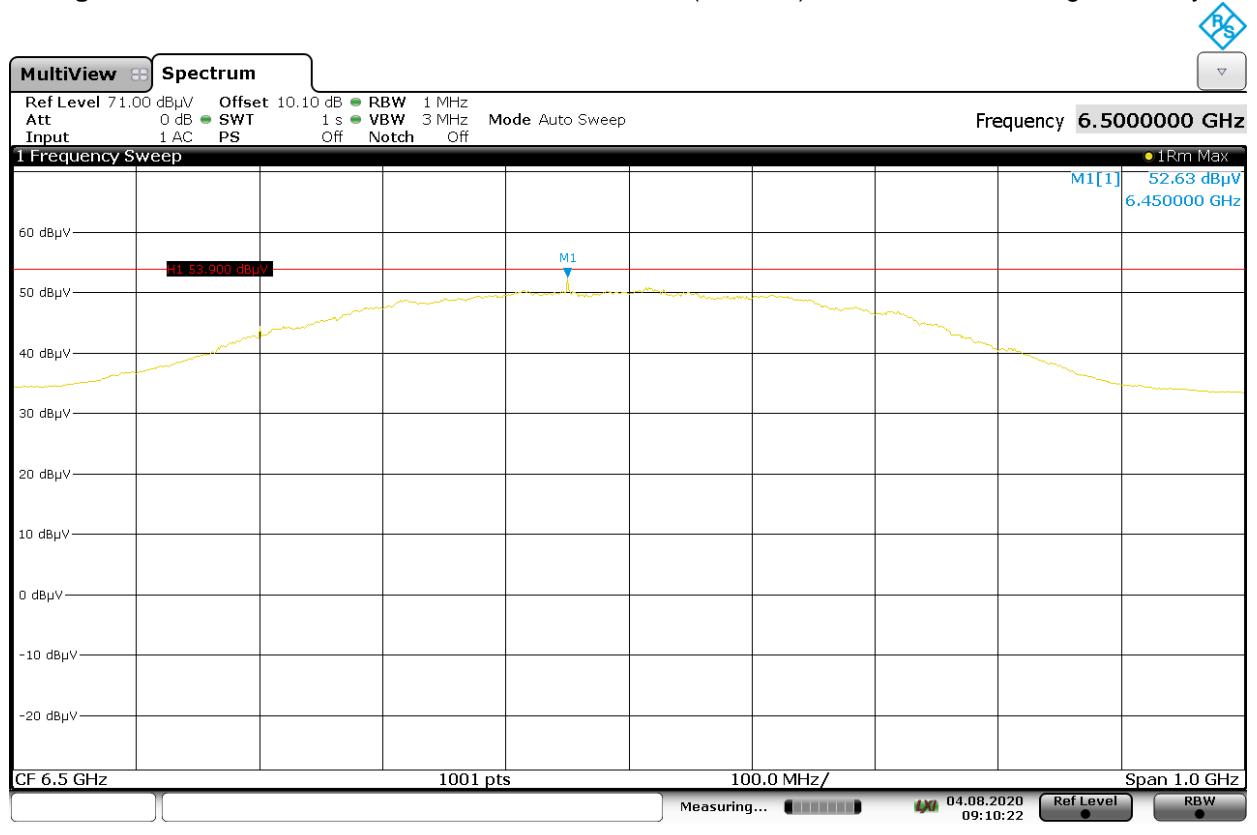


Figure 8: Radiated emissions 1610 – 6000 MHz



**Figure 9:** Radiated emissions 1000 MHz – 4750 MHz (RSS220), Emission are from digital circuitry



**Figure 10:** Radiated emissions 6 GHz – 7 GHz horizontal

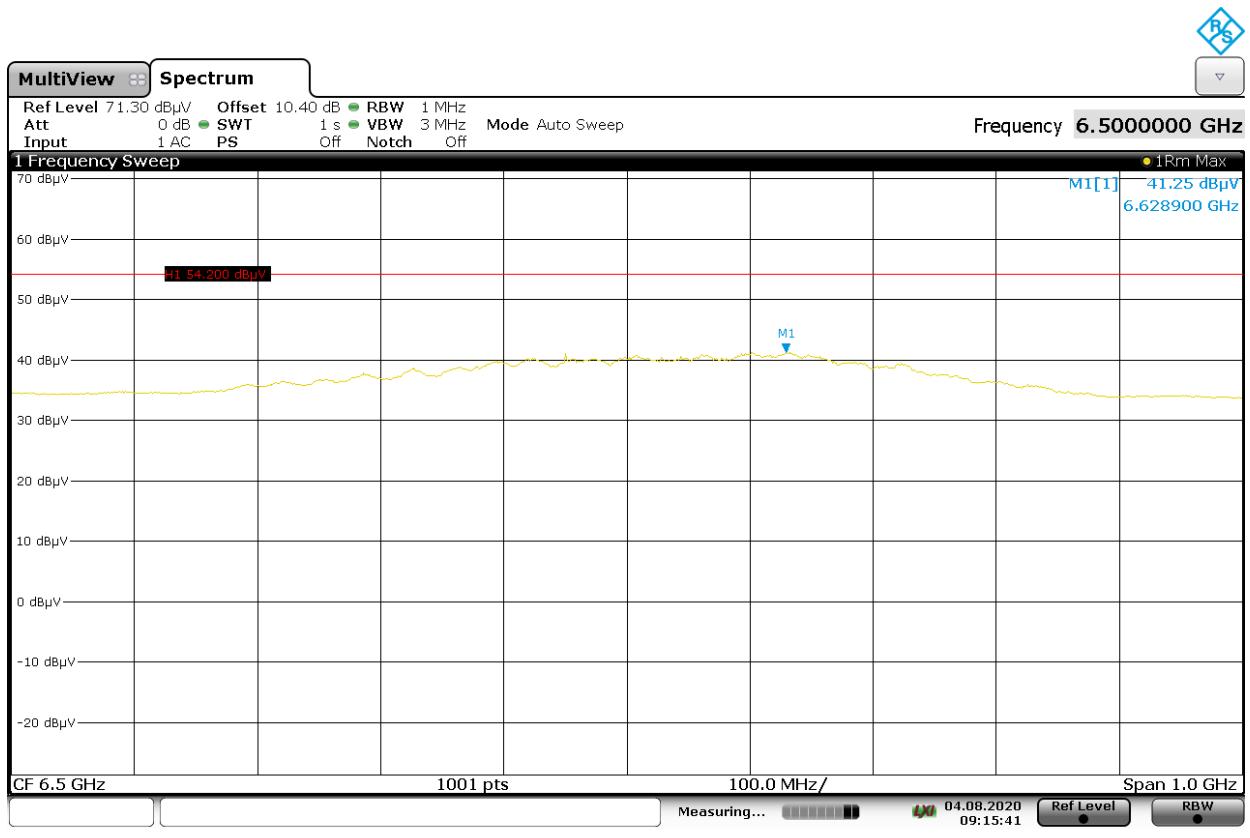


Figure 11: Radiated emissions 6 GHz – 7 GHz vertical

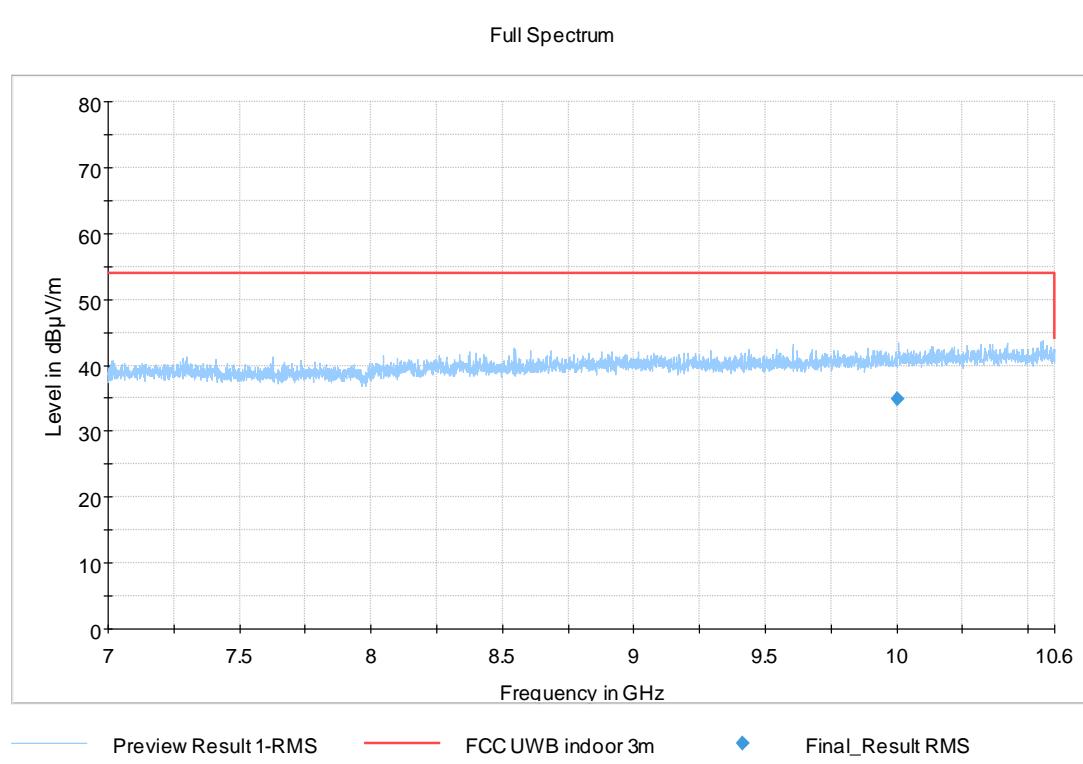
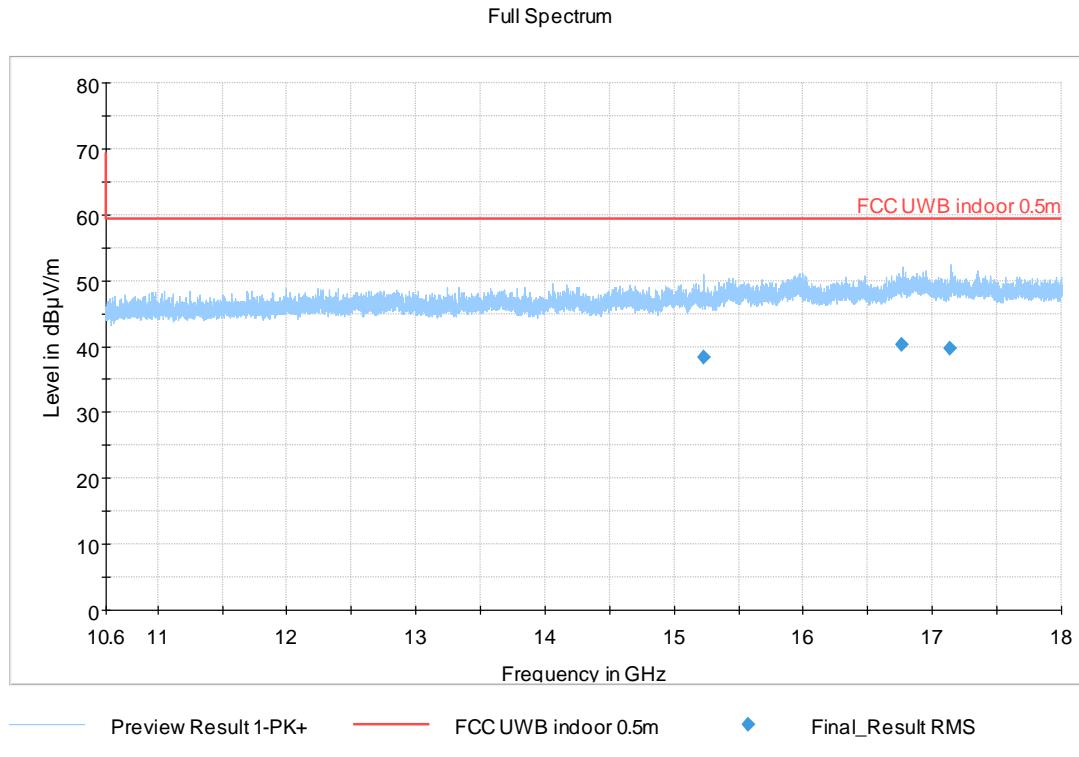
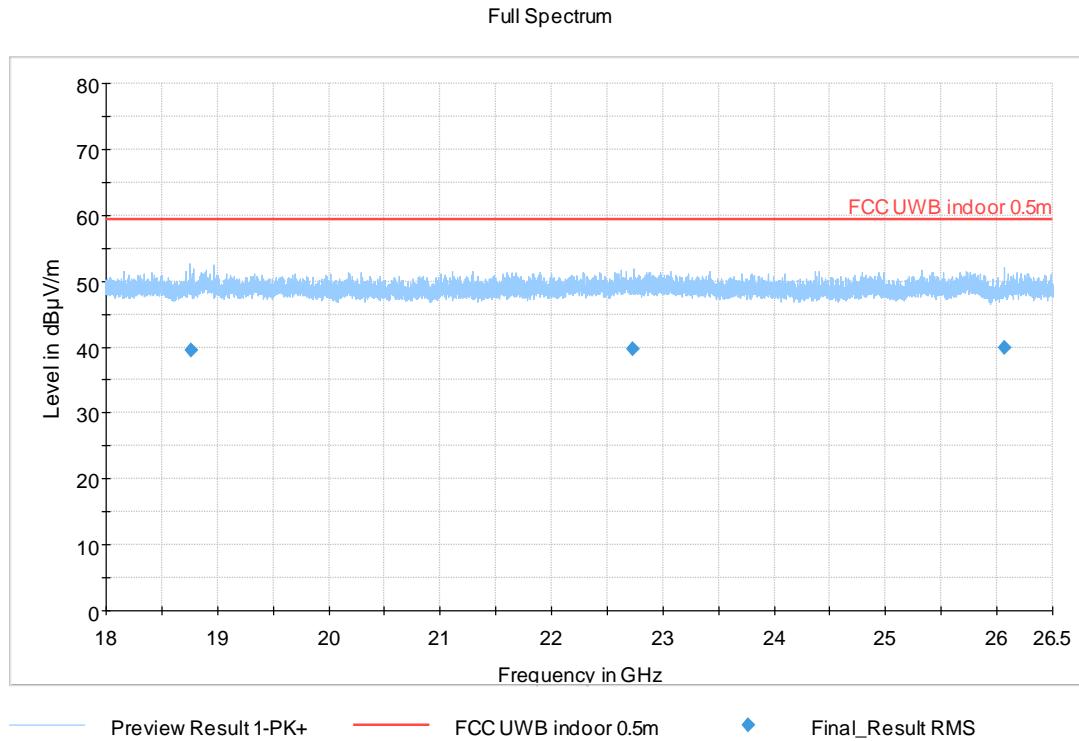


Figure 12: Radiated emissions 7 GHz – 10.6 GHz

## Radiated Emissions 960 MHz – 40 GHz



**Figure 13:** Radiated emissions 10.6 GHz – 18 GHz



**Figure 14:** Radiated emissions 18 GHz – 26.5 GHz

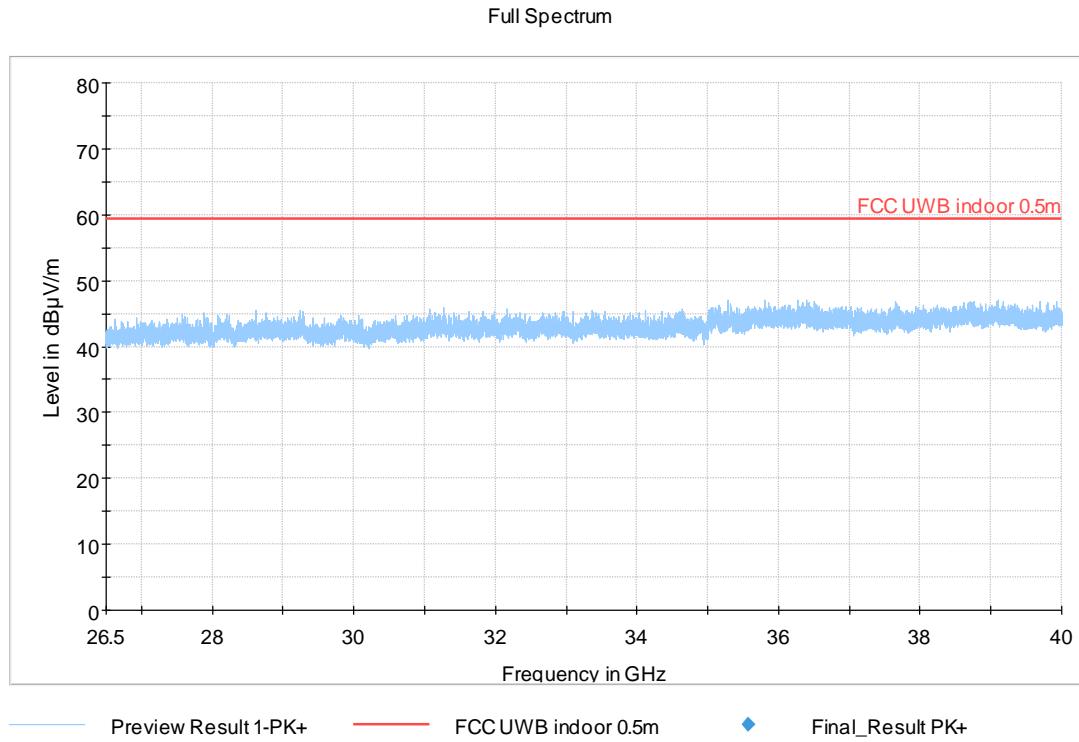


Figure 15: Radiated emissions 26.5 GHz – 40 GHz

Table 4: RMS results from 960 MHz – 40 GHz

Frequency (MHz)	RMS (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
964.972000	13.30	19.90	6.60	1000.0	120.000	109.0	H	27.0	6.0	-
969.784000	13.39	19.90	6.51	1000.0	120.000	199.0	V	45.0	6.1	-
984.288000	13.21	19.90	6.69	1000.0	120.000	144.0	H	58.0	6.1	-
993.164000	13.43	19.90	6.47	1000.0	120.000	226.0	H	130.0	6.1	-
996.040000	13.59	19.90	6.31	1000.0	120.000	163.0	H	45.0	6.3	-
997.380000	13.51	19.90	6.39	1000.0	120.000	388.0	H	199.0	6.2	-
1687.850000	23.80	41.90	18.10	1000.0	1000.000	157.0	H	315.0	0.8	-
1980.050000	34.33	41.90	7.57	1000.0	1000.000	146.0	H	13.0	3.1	-
5588.850000	31.31	53.90	22.59	1000.0	1000.000	175.0	V	318.0	8.9	-
6450.000000	52.36	53.90	1.54	1000.0	1000.000	180.0	H	300.0	10.1	Fundamental
10002.20000	34.97	53.90	18.93	1000.0	1000.000	125.0	V	202.0	15.7	-
15230.07000	38.36	59.40	21.04	1000.0	1000.000	129.0	V	218.0	21.2	-
16765.73000	40.37	59.40	19.03	1000.0	1000.000	179.0	V	134.0	24.7	-
17137.12000	39.77	59.40	19.63	1000.0	1000.000	178.0	V	183.0	24.8	-
18758.30000	39.56	59.40	19.84	1000.0	1000.000	141.0	H	177.0	7.3	-
22731.37500	39.68	59.40	19.72	1000.0	1000.000	110.0	V	303.0	7.8	-
26067.77500	39.95	59.40	19.45	1000.0	1000.000	129.0	H	195.0	9.7	-

**Table 5:** Peak results for FCC 1 – 1.61 GHz and RSS-220 1 – 4.75 GHz, Emission are from digital circuitry

Frequency (MHz)	MaxPeak (dB $\mu$ V/m)	AVG Limit (dB $\mu$ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1000.000000	40.10	69.4	29.3	150.0	H	312.0	-0.4	FCC 15.209 limit
1050.000000	39.02	69.4	30.38	150.0	H	339.0	-0.5	FCC 15.209 limit
1100.000000	39.47	69.4	29.93	150.0	H	320.0	-1.7	FCC 15.209 limit
1150.000000	39.24	69.4	30.16	150.0	H	337.0	-1.2	FCC 15.209 limit
1178.600000	37.32	69.4	32.08	150.0	H	138.0	-0.5	FCC 15.209 limit
1184.000000	35.86	69.4	33.54	150.0	H	248.0	-0.4	FCC 15.209 limit
1188.000000	43.64	69.4	25.76	150.0	H	75.0	-0.3	FCC 15.209 limit
1191.200000	38.36	69.4	31.04	150.0	H	75.0	-0.3	FCC 15.209 limit
1191.800000	36.42	69.4	32.98	150.0	H	75.0	-0.3	FCC 15.209 limit
1197.400000	41.19	69.4	28.21	150.0	H	266.0	-0.2	FCC 15.209 limit
1200.000000	41.96	69.4	27.44	150.0	H	0.0	-0.2	FCC 15.209 limit
1204.600000	38.55	69.4	30.85	150.0	H	30.0	-0.1	FCC 15.209 limit
1216.400000	41.20	69.4	28.2	150.0	H	243.0	0.1	FCC 15.209 limit
1217.200000	38.10	69.4	31.3	150.0	H	75.0	0.2	FCC 15.209 limit
1250.000000	41.32	69.4	28.08	150.0	H	13.0	0.0	FCC 15.209 limit
1272.800000	38.63	69.4	30.77	150.0	H	53.0	0.6	FCC 15.209 limit
1295.400000	36.21	69.4	33.19	150.0	H	53.0	0.9	FCC 15.209 limit
1300.000000	45.04	69.4	24.36	150.0	H	327.0	0.8	FCC 15.209 limit
1308.400000	36.71	69.4	32.69	150.0	H	53.0	0.5	FCC 15.209 limit
1327.600000	36.05	69.4	33.35	150.0	H	53.0	0.6	FCC 15.209 limit
1334.800000	35.48	69.4	33.92	150.0	H	30.0	0.7	FCC 15.209 limit
1348.400000	45.16	69.4	24.24	150.0	H	26.0	0.5	FCC 15.209 limit
1357.800000	43.95	69.4	25.45	150.0	H	222.0	0.0	FCC 15.209 limit
1376.600000	43.75	69.4	25.65	150.0	H	243.0	0.0	FCC 15.209 limit
1386.000000	50.26	69.4	19.14	150.0	H	53.0	0.1	FCC 15.209 limit
1400.000000	42.87	69.4	26.53	150.0	H	314.0	0.0	FCC 15.209 limit
1450.000000	36.61	69.4	32.79	150.0	H	326.0	0.0	FCC 15.209 limit
1471.000000	44.47	69.4	24.93	150.0	H	53.0	-0.5	FCC 15.209 limit
1489.800000	43.68	69.4	25.72	150.0	H	26.0	-0.2	FCC 15.209 limit
1500.000000	44.73	69.4	24.67	150.0	H	350.0	-0.1	FCC 15.209 limit
1508.800000	38.72	69.4	30.68	150.0	H	276.0	0.1	FCC 15.209 limit
1518.400000	39.21	69.4	30.19	150.0	H	325.0	-0.2	FCC 15.209 limit
1527.400000	37.14	69.4	32.26	150.0	H	30.0	-0.7	FCC 15.209 limit
1550.000000	41.31	69.4	28.09	150.0	H	66.0	-0.4	FCC 15.209 limit
1574.600000	42.14	69.4	27.26	150.0	H	276.0	-0.5	FCC 15.209 limit
1584.000000	44.45	69.4	24.95	150.0	V	3.0	-0.5	FCC 15.209 limit
1593.600000	39.63	69.4	29.77	150.0	H	276.0	-0.3	FCC 15.209 limit
1600.000000	45.58	69.4	23.82	150.0	H	281.0	-0.2	FCC 15.209 limit
1650.000000	42.48	69.4	26.92	150.0	H	53.0	1.0	FCC 15.209 limit
1669.000000	50.69	69.4	18.71	150.0	H	75.0	1.0	FCC 15.209 limit
1697.200000	48.02	69.4	21.38	150.0	H	292.0	1.0	FCC 15.209 limit
1716.200000	41.50	69.4	27.9	150.0	H	276.0	1.1	FCC 15.209 limit
1772.800000	48.31	69.4	21.09	150.0	H	12.0	1.3	FCC 15.209 limit
1782.200000	45.73	69.4	23.67	150.0	H	276.0	1.6	FCC 15.209 limit
1791.800000	42.94	69.4	26.46	150.0	H	70.0	2.0	FCC 15.209 limit
1876.400000	43.35	69.4	26.05	150.0	H	12.0	3.6	FCC 15.209 limit
1980.200000	47.46	69.4	21.94	150.0	H	28.0	3.1	FCC 15.209 limit
2376.200000	47.92	69.4	21.48	150.0	H	43.0	3.9	FCC 15.209 limit
2757.600000	42.21	69.4	27.19	150.0	V	324.0	4.4	FCC 15.209 limit
2764.000000	41.29	69.4	28.11	150.0	H	13.0	4.3	FCC 15.209 limit
2772.200000	47.87	69.4	21.53	150.0	H	13.0	4.2	FCC 15.209 limit
2781.600000	43.14	69.4	26.26	150.0	V	324.0	4.3	FCC 15.209 limit
2960.800000	43.37	69.4	26.03	150.0	V	177.0	5.0	FCC 15.209 limit
3564.400000	41.57	69.4	27.83	150.0	H	49.0	5.5	FCC 15.209 limit
3960.400000	35.81	69.4	33.59	150.0	H	44.0	5.9	FCC 15.209 limit
4347.000000	44.41	69.4	24.99	150.0	H	339.0	6.6	FCC 15.209 limit
4356.400000	42.44	69.4	26.96	150.0	H	339.0	6.6	FCC 15.209 limit

Results in GPS bands with 1 kHz bandwidth:

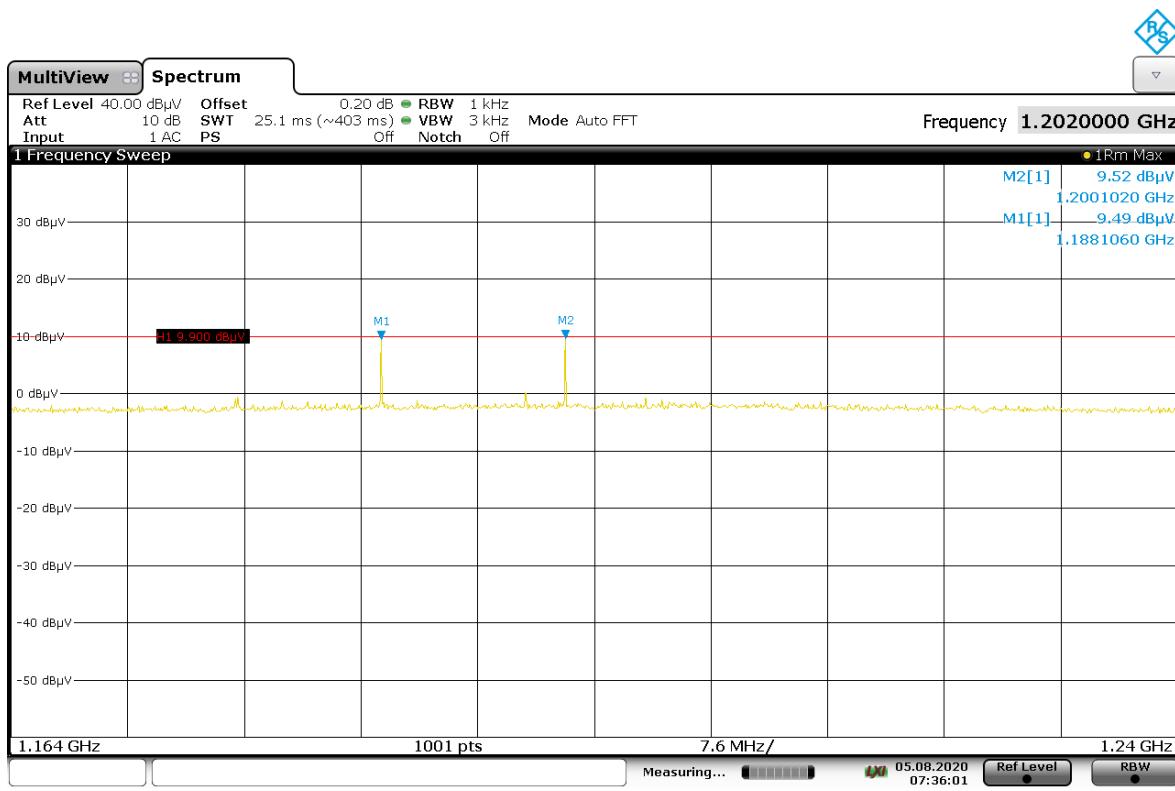


Figure 16: Radiated emissions 1164 MHz – 1240 MHz, Horizontal. Emission are from digital circuitry

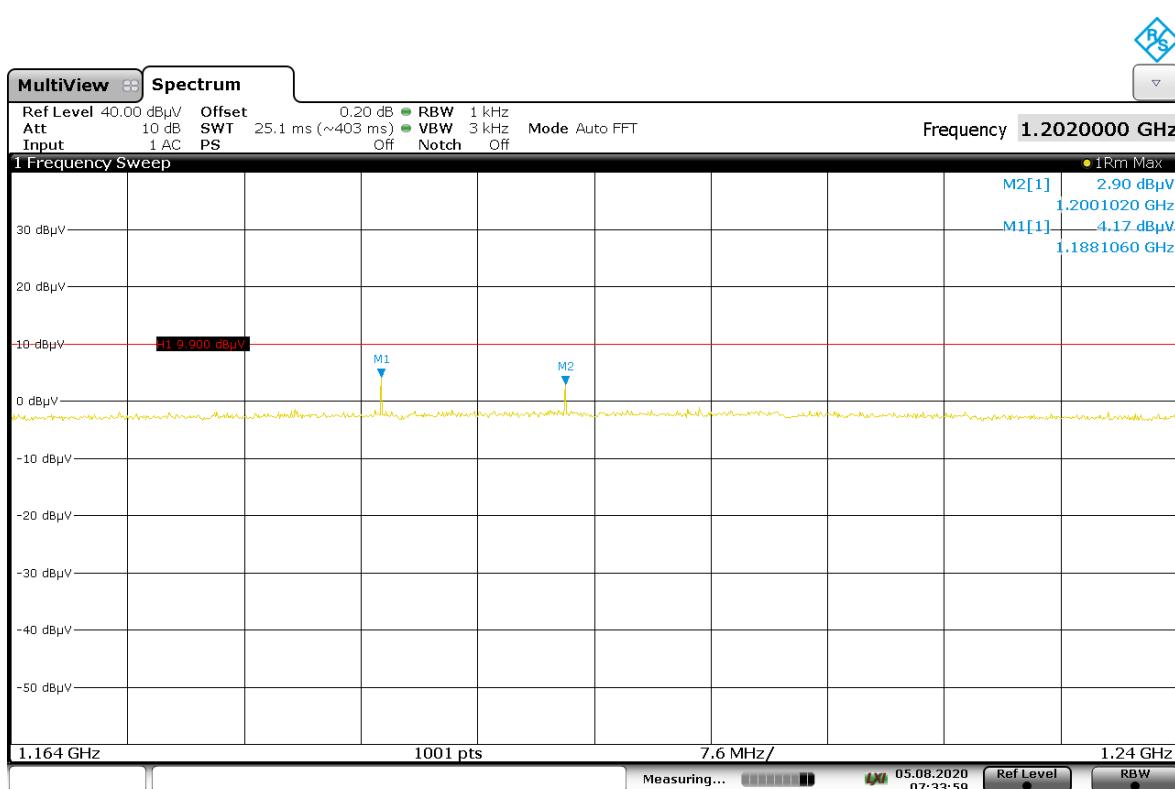
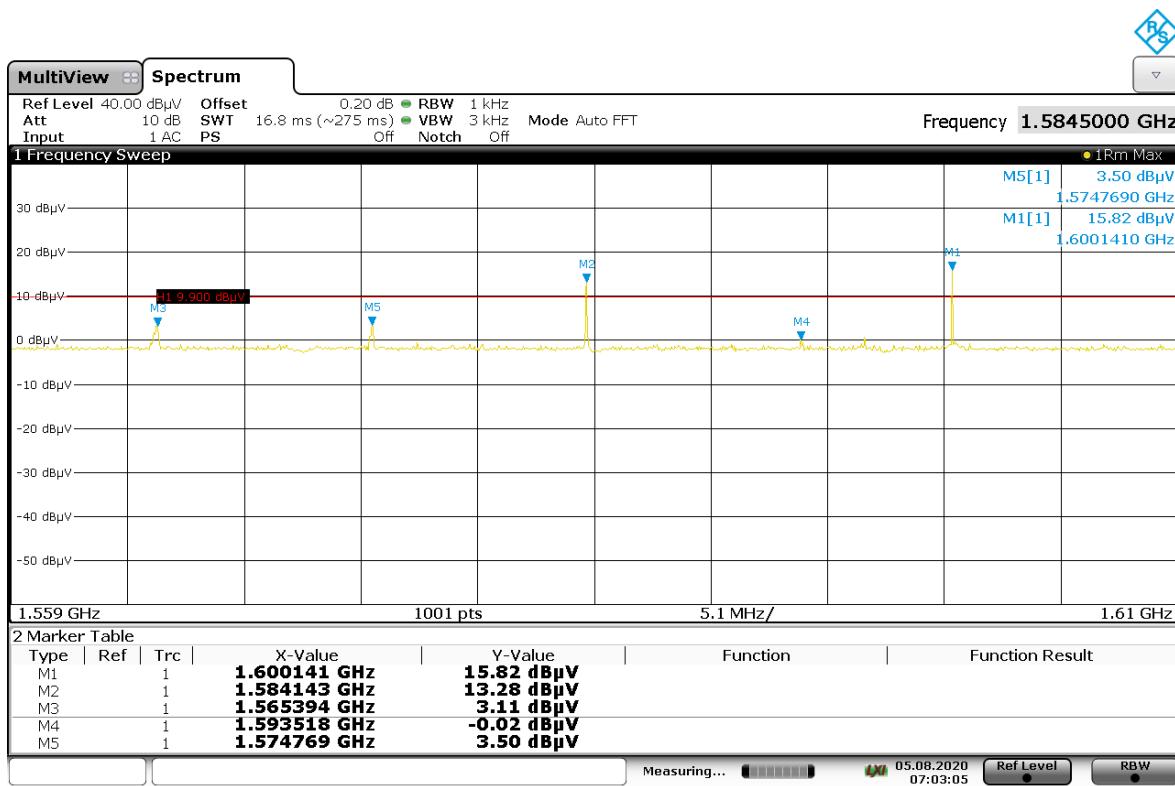
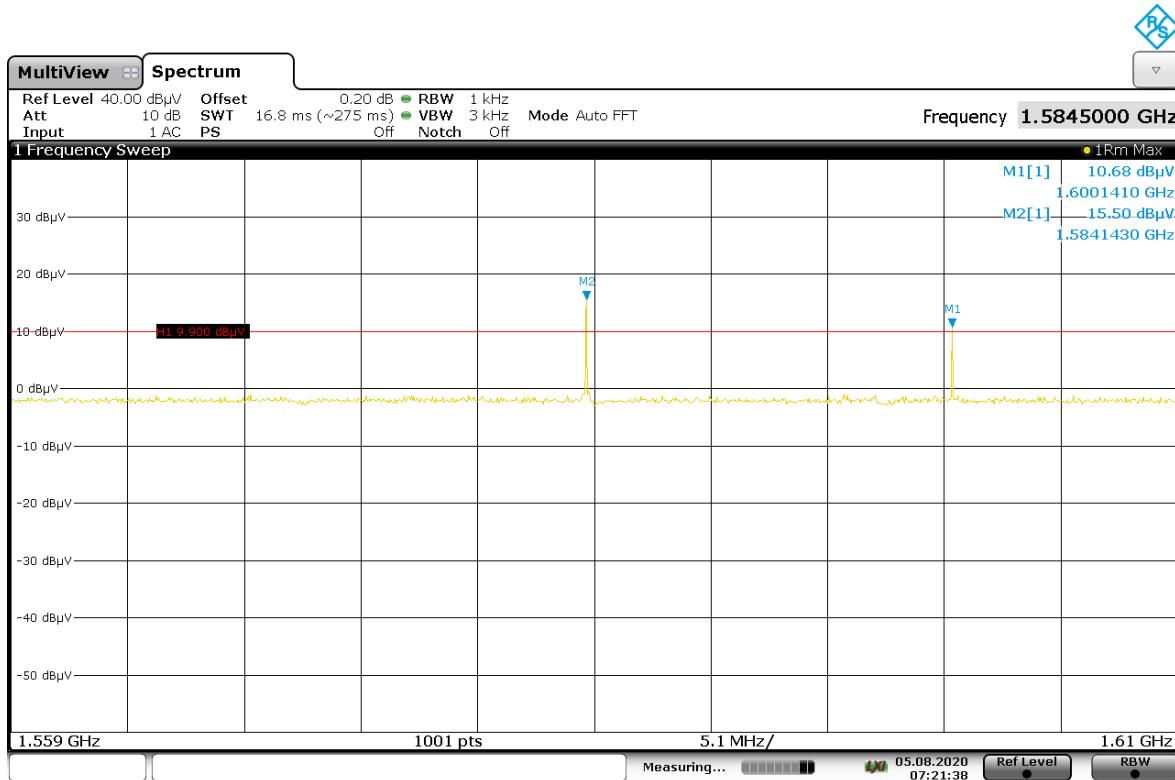


Figure 17: Radiated emissions 1164 MHz – 1240 MHz, Vertical. Emission are from digital circuitry



07:03:06 05.08.2020

Figure 18: Radiated emissions 1559 MHz – 1610 MHz, Horizontal. Emission are from digital circuitry



07:21:39 05.08.2020

Figure 19: Radiated emissions 1559 MHz – 1610 MHz, Vertical. Emission are from digital circuitry

**10 dB Bandwidth**

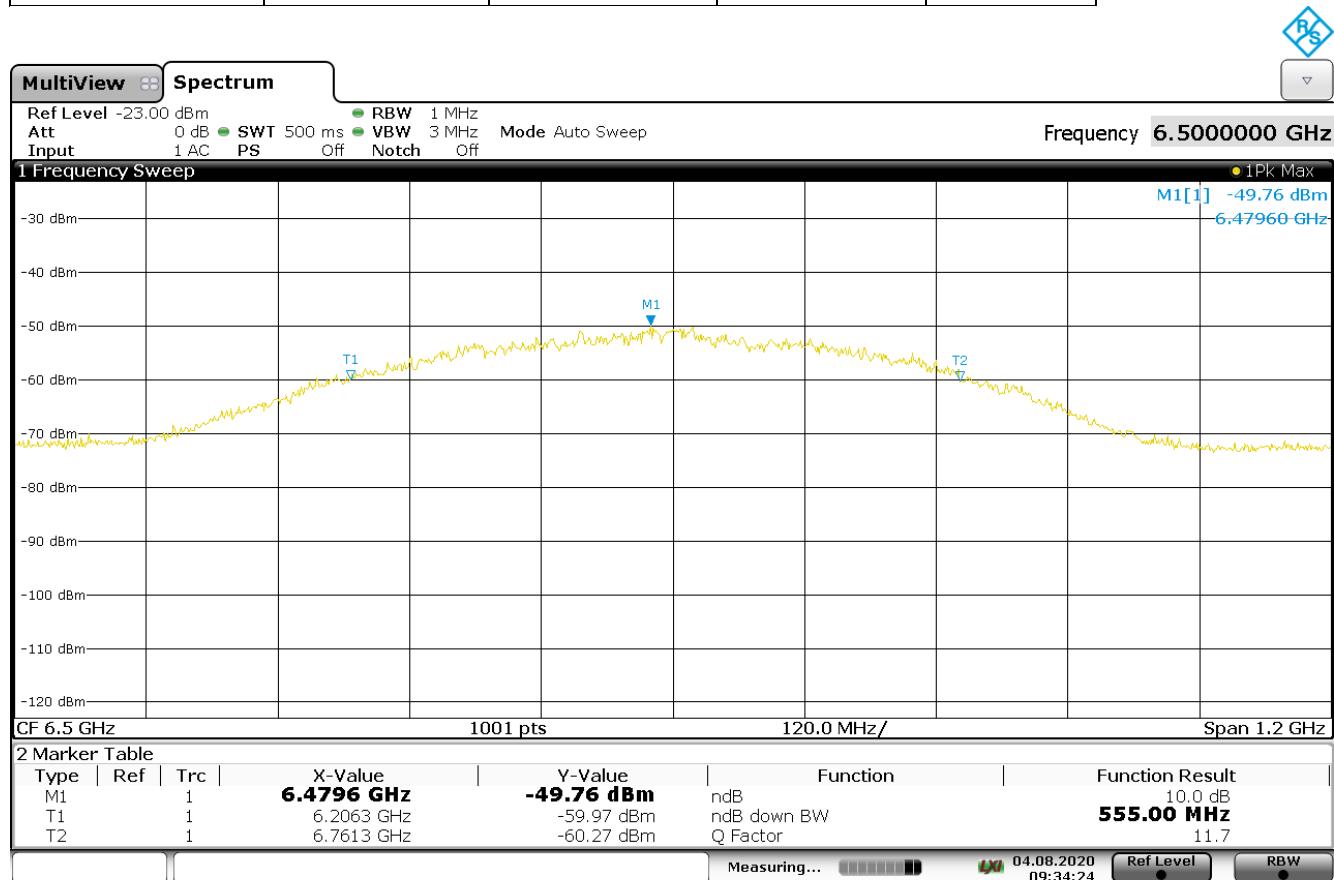
**Standard:** ANSI C63.10 (2013)  
**Tested by:** JAT  
**Date:** 4 August 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH

**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 was 3m.

**Results:****Table 6:** 10 dB bandwidth test results

Frequency low [MHz]	Frequency High [MHz]	Frequency Center [MHz]	-10 dB BW [MHz]	Result
6206.3	6761.3	6479.6	555.00	<b>PASS</b>



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**Figure 20:** 10 dB Bandwidth

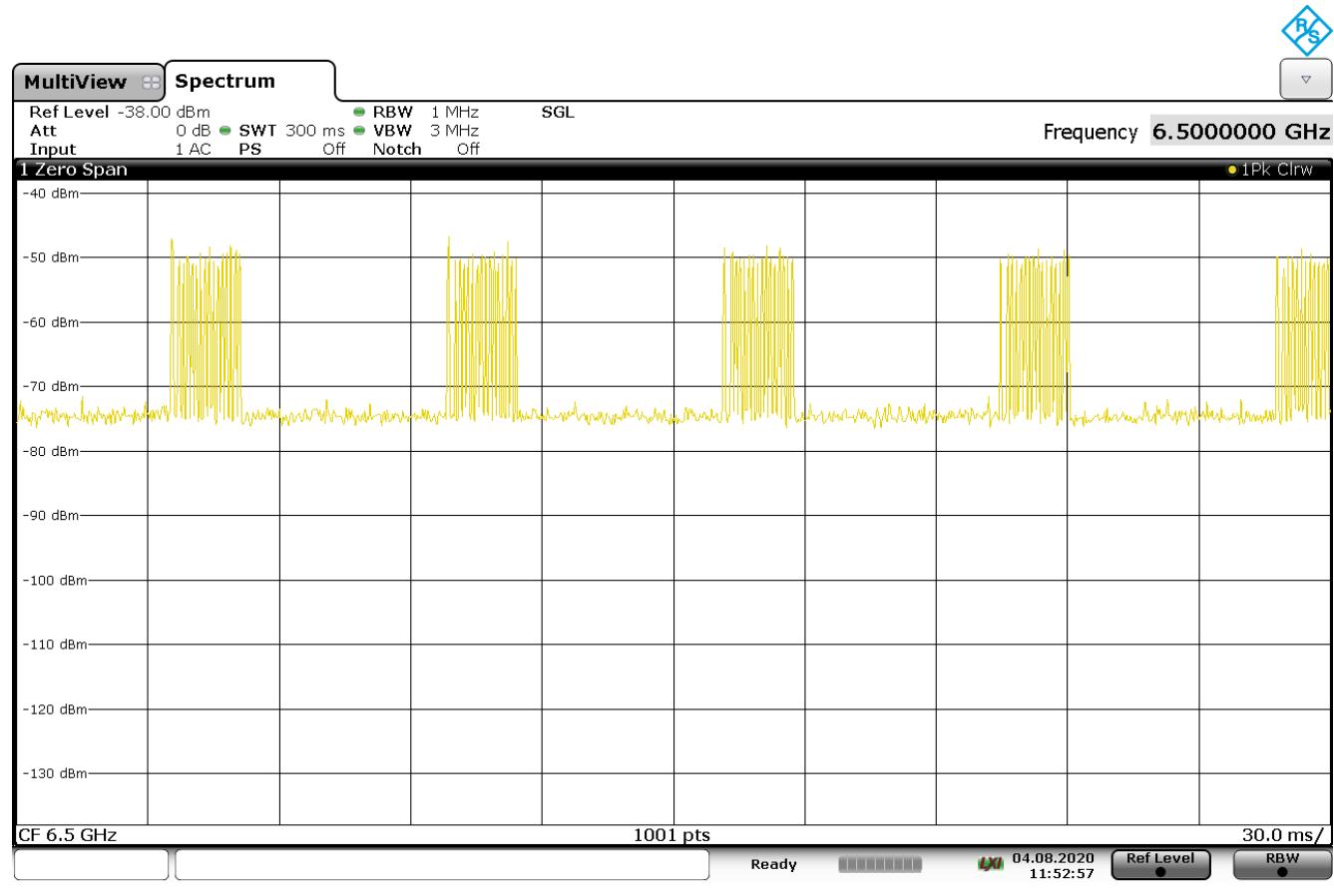
## Transmission Time

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

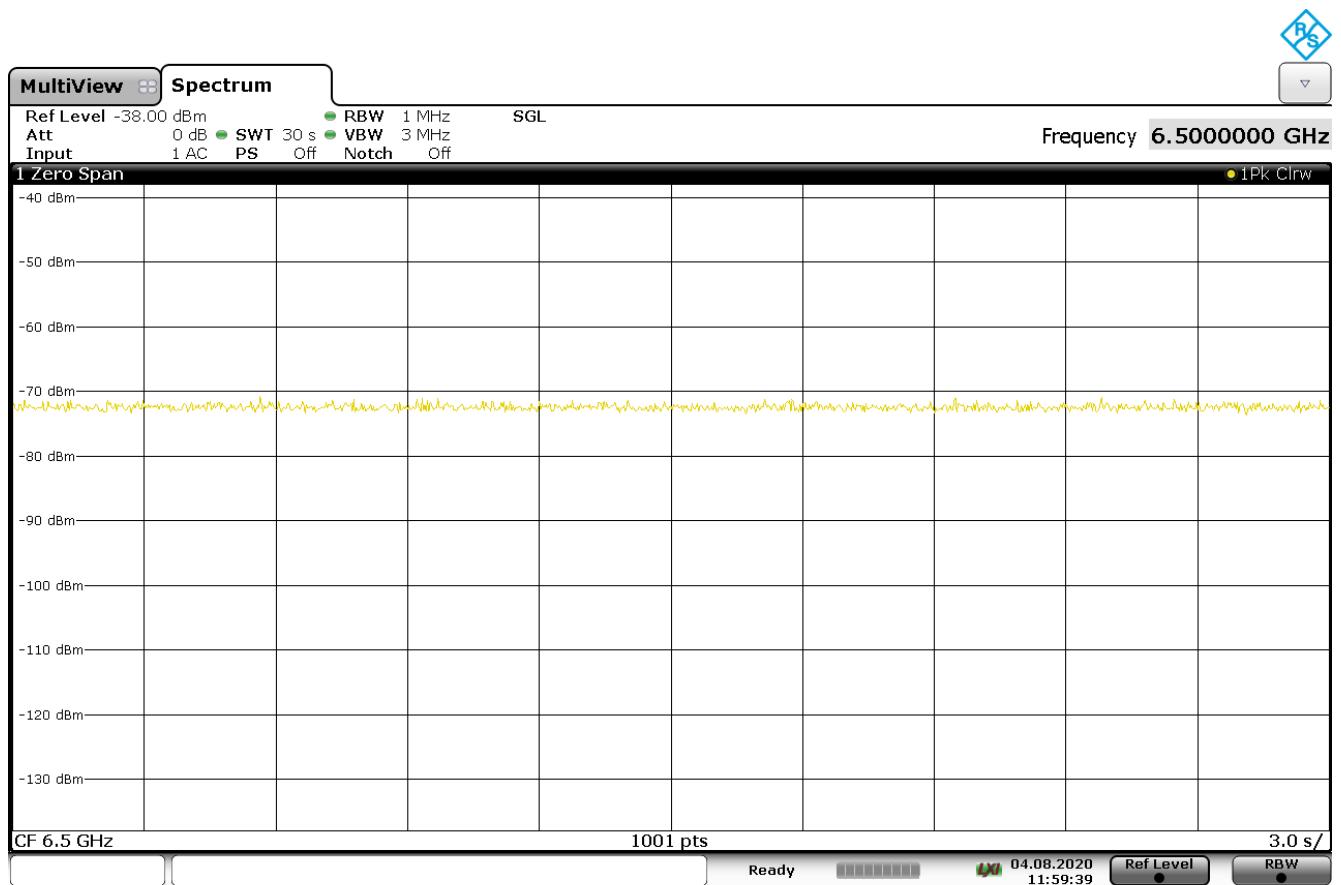
### FCC Rule: 15.517(a)(5)

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

### Results:



**Figure 21:** Transmission time, Beacon in normal operation mode



**Figure 22:** Transmission time, Tx OFF

## 99% Occupied Bandwidth

**Standard:** RSS-GEN (2019)  
**Tested by:** JAT  
**Date:** 4 August 2020  
**Temperature:** 23 ± 3 °C  
**Humidity:** 20 - 60 % RH

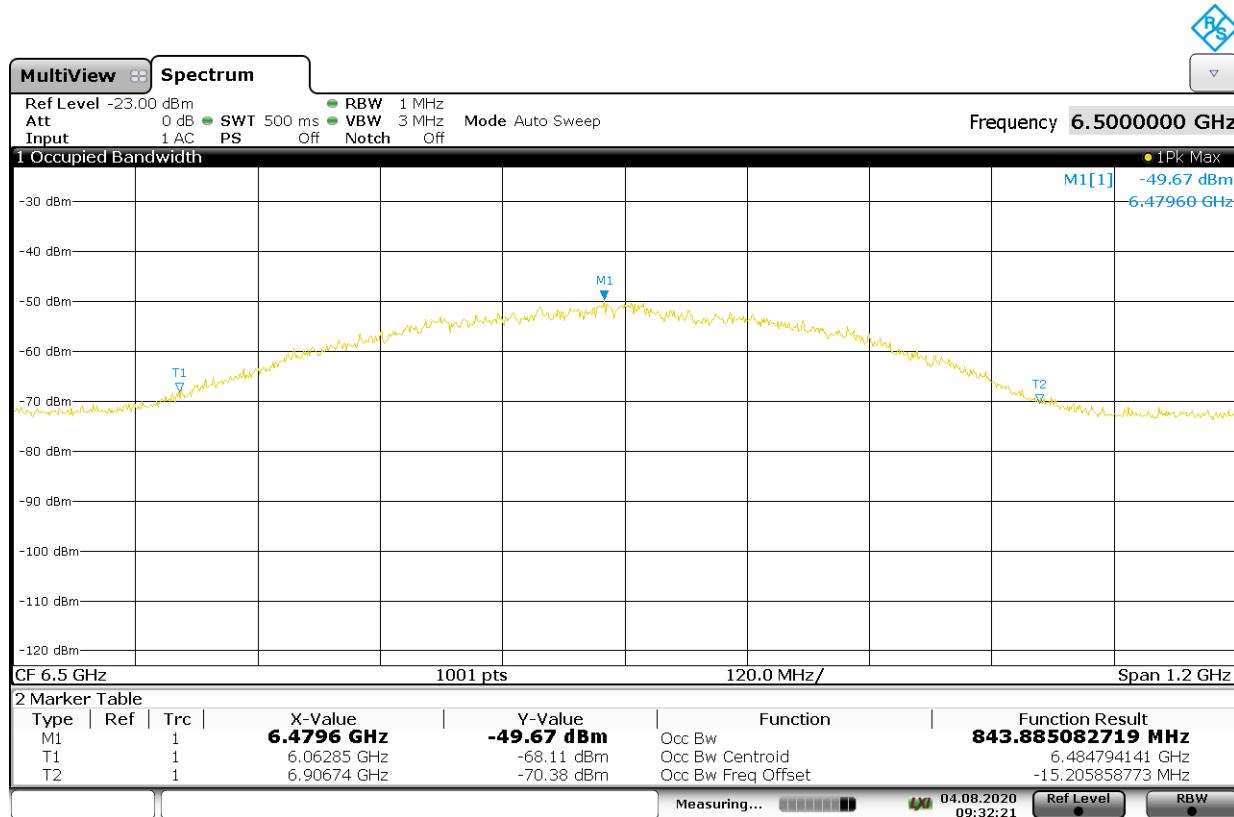
## RSS-GEN 6.6

Measurement distance: 3m

## Results

Table 7: 99% occupied bandwidth test results

Frequency [MHz]	Limit	99 % BW [MHz]	Result
6479.6	-	843.885	PASS



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Figure 23: 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	ROHDE & 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	inv:8638	2020-06-11	2021-06-11
FILTER	WAINWRIGHT	HP, WHNX6-6030-9000-26500-80CD	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 PACKARD	Module: ZFL-1000LN (20 dB)	inv: 8364	2020-03-20	2021-03-20
MULTIMETER		975A	INV:5126	2019-10-30	2020-10-30

NCR = No calibration required