# SGS

# **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:

Jani Tuomela **Testing Engineer** 

Date:

Checked by:

15 September 2020

to

Mikko Halonen Development Engineer

These test results are valid for the tested unit only.

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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**

## **PRODUCT DESCRIPTION**

## **Equipment Under Test**

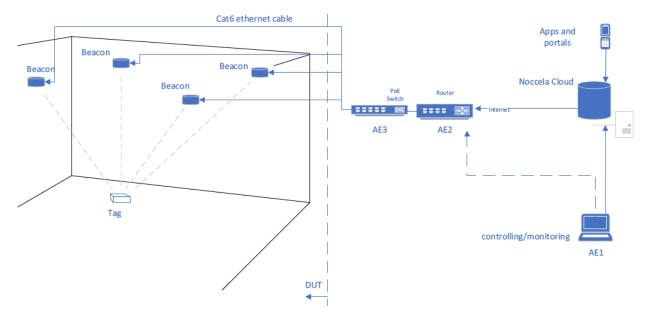
Trade mark:	Noccela
Model:	BEACON-3
Туре:	-
Serial no:	2013000007
FCC ID:	2AVRO-BEACON-3
IC:	-

## **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	$\bowtie$
Mobile Device (Human body distance > 20cm)	
Portable Device (Human body distance < 20cm)	

## **Modifications Incorporated in the EUT**

No modifications.



#### **Product Description**

## **Ratings and declarations**

Operating Frequency Range: Nominal Frequency: UWB Device type:	6 – 9 GHz 6.5 GHz Indoor communication device
Handheld device:	🗆 Yes 🖾 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	PASS
§15.207(a) / RSS-GEN 8.8	Conducted emissions on power supply lines	PASS
§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

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.

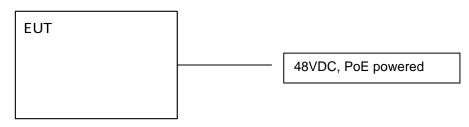


Figure 1: Test setup blocking diagram

Summary of Testing

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# 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:	<ul> <li>K10LAB, ISED Canada registration number: 8708A-1</li> <li>K5LAB, ISED Canada registration number: 8708A-2</li> <li>T10LAB</li> </ul>



#### Antenna requirement

## **TEST RESULTS**

## Antenna requirement

Standard:	FCC Rule §15.203, RSS-220 5.1(b)
Tested by: Date:	JAT 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> <li>Permanently attached antenna</li> <li>Unique coupling to the intentional radiator</li> <li>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>	PASS
Note	Option 2 is used	



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

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

Execution of omission (MU)	Conducted limit (dBµV)				
Frequency of emission (MHz)	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.

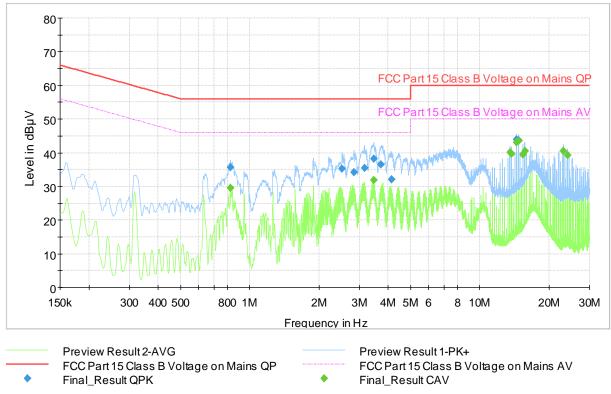


Figure 2: The measured curves with peak- and average detector



## CONDUCTED EMISSIONS IN THE FREQUENCY RANGE 150 KHz - 30 MHz

## Final measurements from the worst frequencies

Table 1: Final	QuasiPeak and Average measurements from the worst frequence	uencies

			0			•				
Frequency	QuasiPeak	CAverage	Limit	Margin	Meas. Time	Bandwidth	Line	Filter	Corr.	Comment
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	(ms)	(kHz)			(dB)	
0.825500		29.51	46.00	16.49	1000.0	9.000	Ν	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.



B

## 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 cantered 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	Н	300	-5.40	0	PASS

Ref Level 12. Att	25 dBm Offse 0 dB • SWT	t 21.65 dB 🖷 RI 1 s 🖷 VI	3W 80 MHz N	<b>/lode</b> Auto Sweep	)		Fn	equency 6.50	00000 GH
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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 [µV/m]	Limit [dBµV/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	

#### Radiated Emissions 9 kHz - 960 MHz

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#### **Results:**

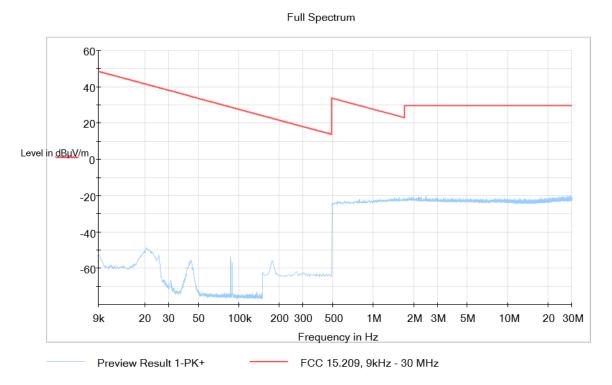
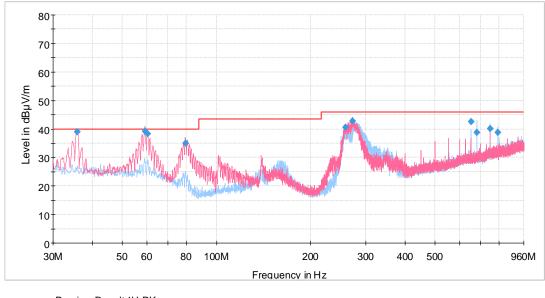


Figure 4: Radiated emissions 9 kHz - 30 MHz



Full Spectrum

Preview Result 1H-PK+

Preview Result 1V-PK+
 FCC Part 15 Class B Electric Field Strength 3 m QP

Final\_Result QPK

Figure 5: Radiated emissions 30 MHz - 960 MHz



## Radiated Emissions 9 kHz - 960 MHz

## Table 3: Quasi-peak results

	•									
Frequency	QuasiPeak	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Corr.	Comment
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(ms)	(kHz)	(cm)		(deg)	(dB/m)	
35.846000	38.95	40.00	1.05	1000.0	120.000	109.0	۷	29.0	16.6	-
59.043000	39.29	40.00	0.71	1000.0	120.000	109.0	٧	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	٧	196.0	13.2	-
258.895000	40.46	46.00	5.54	1000.0	120.000	109.0	٧	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	Н	79.0	27.6	-
678.914000	38.81	46.00	7.19	1000.0	120.000	217.0	Н	90.0	27.8	-
750.059000	40.10	46.00	5.90	1000.0	120.000	109.0	Н	348.0	29.2	-
792.055000	38.82	46.00	7.18	1000.0	120.000	100.0	н	103.0	29.8	-



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 U	WB 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(dBµV/m) = P(dBm EIRP) + 95.2 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

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



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:**

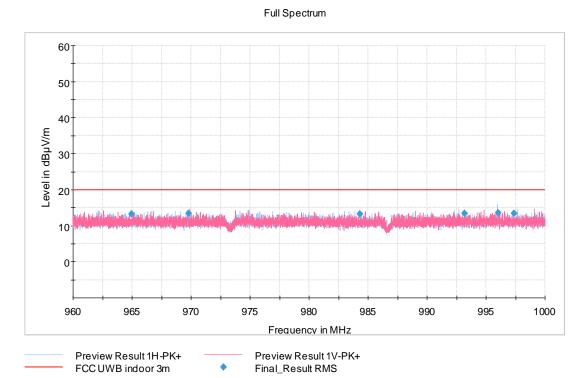


Figure 6: Radiated emissions 960 MHz - 1000 MHz



Full Spectrum

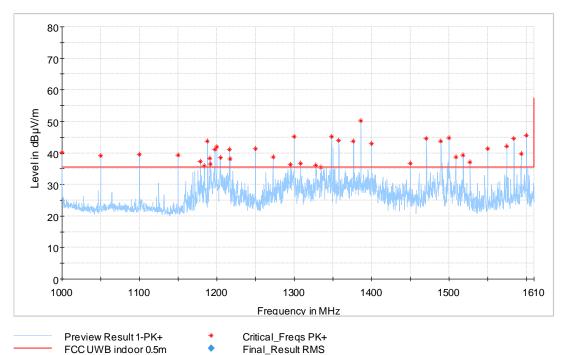


Figure 7: Radiated emissions 1000 MHz - 1610 MHz, Emission are from digital circuity

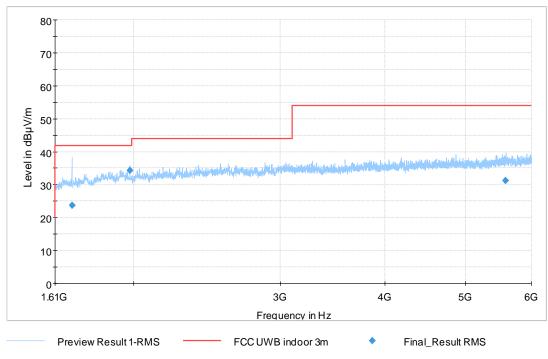


Figure 8: Radiated emissions 1610 - 6000 MHz



Full Spectrum

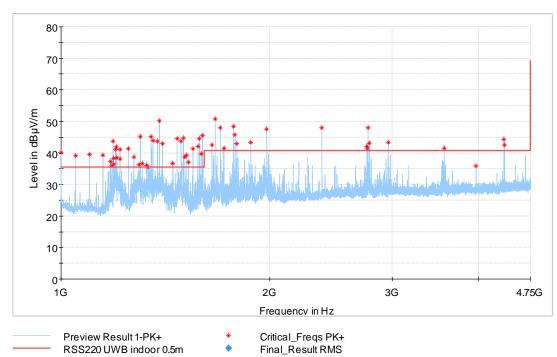


Figure 9: Radiated emissions 1000 MHz - 4750 MHz (RSS220), Emission are from digital circuity

MultiView 8	Spectrum								
Ref Level 71.0 Att Input	0 dBµV Offse 0 dB ● SWT 1 AC PS	1 s 👄	RBW 1 MHz VBW 3 MHz Notch Off	Mode Auto Sweep	)		Fr	equency 6.5	000000 GH
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Figure 10: Radiated emissions 6 GHz - 7 GHz horizontal



MultiView 😁	Spectrum							▼
Ref Level 71.30 d Att Input	dBµV Offset 0 dB ● SWT 1 AC PS	10.40 dB • R 1 s • V Off N	BW 1 MHz BW 3 MHz Mi potch Off	ode Auto Sweep		Fre	equency 6.50	000000 GHz
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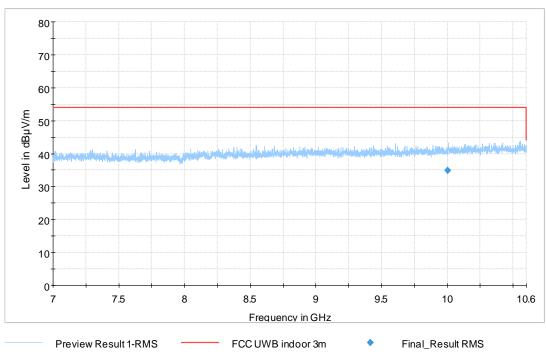


Figure 12: Radiated emissions 7 GHz - 10.6 GHz



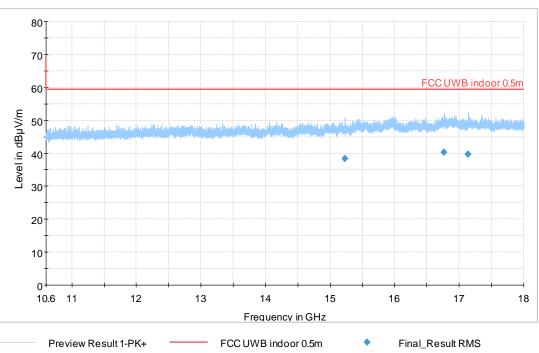


Figure 13: Radiated emissions 10.6 GHz – 18 GHz

Full Spectrum

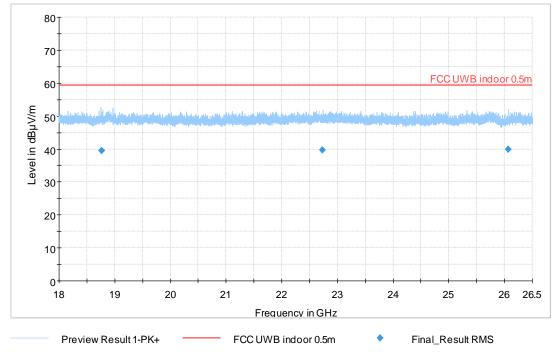


Figure 14: Radiated emissions 18 GHz - 26.5 GHz



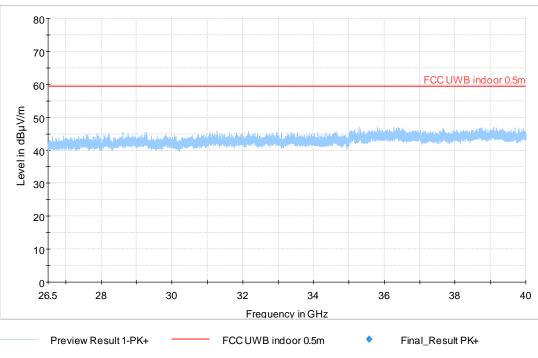


Figure 15: Radiated emissions 26.5 GHz - 40 GHz

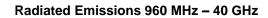
Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
964.972000	13.30	19.90	6.60	1000.0	120.000	109.0	Н	27.0	6.0	-
969.784000	13.39	19.90	6.51	1000.0	120.000	199.0	v	45.0	6.1	-
984.288000	13.21	19.90	6.69	1000.0	120.000	144.0	Н	58.0	6.1	-
993.164000	13.43	19.90	6.47	1000.0	120.000	226.0	Н	130.0	6.1	-
996.040000	13.59	19.90	6.31	1000.0	120.000	163.0	Н	45.0	6.3	-
997.380000	13.51	19.90	6.39	1000.0	120.000	388.0	Н	199.0	6.2	-
1687.850000	23.80	41.90	18.10	1000.0	1000.000	157.0	н	315.0	0.8	-
1980.050000	34.33	41.90	7.57	1000.0	1000.000	146.0	н	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	н	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	н	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	Н	195.0	9.7	-

Table 4: RMS results from 960 MHz - 40 GHz



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

Frequency (MHz)	MaxPeak (dBµV/m)	AVG Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1000.000000	40.10	69.4	29.3	150.0	Н	312.0	-0.4	FCC 15.209 limit
1050.000000	39.02	69.4	30.38	150.0	Н	339.0	-0.5	FCC 15.209 limit
1100.000000	39.47	69.4	29.93	150.0	Н	320.0	-1.7	FCC 15.209 limit
1150.000000	39.24	69.4	30.16	150.0	Н	337.0	-1.2	FCC 15.209 limit
1178.600000	37.32	69.4	32.08	150.0	Н	138.0	-0.5	FCC 15.209 limit
1184.000000	35.86	69.4	33.54	150.0	Н	248.0	-0.4	FCC 15.209 limit
1188.000000	43.64	69.4	25.76	150.0	Н	75.0	-0.3	FCC 15.209 limit
1191.200000	38.36	69.4	31.04	150.0	Н	75.0	-0.3	FCC 15.209 limit
1191.800000	36.42	69.4	32.98	150.0	Н	75.0	-0.3	FCC 15.209 limit
1197.400000	41.19	69.4	28.21	150.0	Н	266.0	-0.2	FCC 15.209 limit
1200.000000	41.96	69.4	27.44	150.0	Н	0.0	-0.2	FCC 15.209 limit
1204.600000	38.55	69.4	30.85	150.0	Н	30.0	-0.1	FCC 15.209 limit
1216.400000	41.20	69.4	28.2	150.0	Н	243.0	0.1	FCC 15.209 limit
1217.200000	38.10	69.4	31.3	150.0	Н	75.0	0.2	FCC 15.209 limit
1250.000000	41.32	69.4	28.08	150.0	Н	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	Η	53.0	0.5	FCC 15.209 limit
1327.600000	36.05	69.4	33.35	150.0	Н	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	Н	26.0	0.5	FCC 15.209 limit
1357.800000	43.95	69.4	25.45	150.0	Н	222.0	0.0	FCC 15.209 limit
1376.600000	43.75	69.4	25.65	150.0	Н	243.0	0.0	FCC 15.209 limit
1386.000000	50.26	69.4	19.14	150.0	Н	53.0	0.1	FCC 15.209 limit
1400.000000	42.87	69.4	26.53	150.0	Н	314.0	0.0	FCC 15.209 limit
1450.000000	36.61	69.4	32.79	150.0	Н	326.0	0.0	FCC 15.209 limit
1471.000000	44.47	69.4	24.93	150.0	Н	53.0	-0.5	FCC 15.209 limit
1489.800000	43.68	69.4	25.72	150.0	Н	26.0	-0.2	FCC 15.209 limit
1500.000000	44.73	69.4	24.67	150.0	Н	350.0	-0.1	FCC 15.209 limit
1508.800000	38.72	69.4	30.68	150.0	Η	276.0	0.1	FCC 15.209 limit
1518.400000	39.21	69.4	30.19	150.0	Н	325.0	-0.2	FCC 15.209 limit
1527.400000	37.14	69.4	32.26	150.0	Н	30.0	-0.7	FCC 15.209 limit
1550.000000	41.31	69.4	28.09	150.0	Н	66.0	-0.4	FCC 15.209 limit
1574.600000	42.14	69.4	27.26	150.0	Н	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	Н	276.0	-0.3	FCC 15.209 limit
1600.000000	45.58	69.4	23.82	150.0	Н	281.0	-0.2	FCC 15.209 limit
1650.000000	42.48	69.4	26.92	150.0	Н	53.0	1.0	FCC 15.209 limit
1669.000000	50.69	69.4	18.71	150.0	Н	75.0	1.0	FCC 15.209 limit
1697.200000	48.02	69.4	21.38	150.0	Н	292.0	1.0	FCC 15.209 limit
1716.200000	41.50	69.4	27.9	150.0	Н	276.0	1.1	FCC 15.209 limit
1772.800000	48.31	69.4	21.09	150.0	Н	12.0	1.3	FCC 15.209 limit
1782.200000	45.73	69.4	23.67	150.0	Н	276.0	1.6	FCC 15.209 limit
1791.800000	42.94	69.4	26.46	150.0	Н	70.0	2.0	FCC 15.209 limit
1876.400000	43.35	69.4	26.05	150.0	Н	12.0	3.6	FCC 15.209 limit
1980.200000	47.46	69.4	21.94	150.0	Н	28.0	3.1	FCC 15.209 limit
2376.200000	47.92	69.4	21.48	150.0	Н	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	Н	13.0	4.3	FCC 15.209 limit
2772.200000	47.87	69.4	21.53	150.0	Н	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	Н	49.0	5.5	FCC 15.209 limit
3960.400000	35.81	69.4	33.59	150.0	Н	44.0	5.9	FCC 15.209 limit
4347.000000	44.41	69.4	24.99	150.0	Н	339.0	6.6	FCC 15.209 limit
4356.400000	42.44	69.4	26.96	150.0	Н	339.0	6.6	FCC 15.209 limit





#### Results in GPS bands with 1 kHz bandwidth:

	Υ <u></u>	٦					<u></u>
MultiView 85 Ref Level 40.00 Att Input	J dBµV Offset	0.20 dB ● RBW . ms (~403 ms) ● VBW Off Notch	3 kHz Mode Auto	FFT		Freq	uency 1.2020000 GHz
1 Frequency Sw	veep						⊙1Rm Max
							M2[1] 9.52 dBµV
00 d0 d1							1.2001020 GHz 
30 dBµ∨							1.1881060 GHz
20 dBµV							
		M1	M2				
10-dBµV	H1 9.900 dBµV						
0 dBµV							
minhorm	server and aread	understand hundress with	menshand	muluman	montender	- marganet -	and a sub- and a second and a second se
-10 dBµV							
-10 dBh4							
-20 dBµ∨							
-30 dBµ∨							
-40 dBµV							
FO HOUL							
-50 dBµ∨							
1.164 GHz		1001 p	ts	7	.6 MHz/		1.24 GHz
				Measuring		05.08.202 07:36:0	0 Ref Level RBW

07:36:01 05.08.2020

Figure 16: Radiated emissions 1164 MHz - 1240 MHz, Horizontal. Emission are from digital circuity

30 dBµv     M2[1]     2.90       30 dBµv     M1[1]     4.17       10 dBµv     M1     M2       10 dBµv     M1     M2       -10 dBµv     M1     M2       -20 dBµv     M1     M2       -10 dBµv     M1     M2       -20 dBµv     M1     M2       -40 dBµv     M1     M2								<b></b>
Att         10 dB         SWT         25.1 ms (~403 ms)         VBW         3 kHz         Mode Auto FFT         Frequency         1.2020000           Input         1AC         PS         Off         Notch         Off         Imput         1.2020000         Imput         Imput	ultiView 😁 S	Spectrum	)					
I Frequency Sweep         • 1 Rm           30 dвµv         M2[1]         2.000           30 dвµv	.tt 10	)dB <b>SWT</b> 25.1 m	ms (~403 ms) • VBW 3	kHz Mode Auto	FFT		Frequer	ncy 1.2020000 GHz
30 dBµV       1.200102         30 dBµV       1.188106         20 dBµV       1.188106         10 dBµV       1.18000         10 dBµV       1.18000         -10 dBµV       1.18000         -20 dBµV       1.18000         -40 dBµV       1.18000								
30 dBµV								
20 dBµv       11.188106         10 dBµv       11.188106         0 dBµv       11.188106         -10 dBµv       11.188106         -20 dBµv       11.188106         -30 dBµv       11.188106								1.2001020 GHz
20 dBµV	dBµ∨							1.1881060 GHz
10 dBμV								1.1001000 012
M1     M2     M2       0 dBμV     -10 dBμV     -10 dBμV       -20 dBμV     -10 dBμV       -30 dBμV     -10 dBμV	dBµV							
M1     M2     M2       0 dBμV     -10 dBμV     -10 dBμV       -20 dBμV     -10 dBμV       -30 dBμV     -10 dBμV								
M1     M2     M2       0 dBμV     -10 dBμV     -10 dBμV       -20 dBμV     -10 dBμV       -30 dBμV     -10 dBμV	dBuV	H1 9.900 dBuV						
-10 dBµV			M1	M2				
-10 dBµV				T I				
-20 dBμV -30 dBμV -40 dBμV	1BµV	man and marked	Moorman Mary ran manage	man	manaph	man	monument	monorman marken when
-20 dBµV								
-30 dBμV	) dBµV							
-30 dBμV								
-30 dBμV	) dBµV							
-40 dBµV								
-40 dBµV								
	1 gBhA							
	) dBµV							
-50 dBµV	) dBµV							
	164 GHz		1001 pts	;	7.	6 MHz/		1.24 GHz
Measuring 11111 5.08.2020 Ref Level R					Measuring		05.08.2020 07:33:59	Ref Level RBW

07:33:59 05.08.2020

Figure 17: Radiated emissions 1164 MHz - 1240 MHz, Vertical. Emission are from digital circuity



MultiView 88	Spectrum						
Ref Level 40.00	) dBµV Offset	0.20 dB • RBW 1					
Att Input	10 dB SWT 16.3 1 AC PS	8 ms (~275 ms) ● VBW 3 Off Notch	3 kHz Mode Auto Off	FFT	Fn	equency 1.58	845000 GHz
1 Frequency Sw	eep						o1Rm Max
						M5[1]	3.50 dBµV
						1	.5747690 GHz
30 dBµV						M1[1]	15.82 dBµV
						1	.6001410 GHz
20 dBµV			M2			M1	
			V V			ľ	
-10-dBµV	H1 9.900 dBµV	M5					
	M3	VID VID		M4			
O dBµV	A	10			mandinguession		a marate alternation and the
					and the second		
-10 dBµV							
-20 dBµV							
-20 ubµv							
-30 dBµV							
-40 dBµ∨							
-50 dBµV							
		1001					1.61.011-
1.559 GHz		1001 pt	s	5.1 MHz/			1.61 GHz
2 Marker Table							
Type Ref		X-Value   0141 GHz 1	Y-Value 5.82 dBµV	Function		Function Re	sult
M1 M2		4143 GHz 1	3.28 dBµV				
M3		5394 GHz	3.11 dBµV				
M4		3518 GHz -	0.02 dBuV				
M5	1 <b>1.57</b>	4769 GHz	3.50 dBµV				
	Υ			Measuring	100 05.08.2	020 Ref Level	RBW
L					07:0	3:05	

07:03:06 05.08.2020

Figure 18: Radiated emissions 1559 MHz - 1610 MHz, Horizontal. Emission are from digital circuity

MultiView 88		<u> </u>							
	dBμV <b>Offset</b> 0 dB <b>SWT</b> 16.8 1 AC <b>PS</b>	ms (~275 ms) (	<ul> <li>RBW 1 kHz</li> <li>VBW 3 kHz</li> <li>Notch Off</li> </ul>	Mode Auto	FFT		Fre	equency 1.5	845000 GH
Frequency Swe	ep							M1[1]	●1Rm Max 10.68 dBµ
30 dвµV									1.6001410 G⊢ 15.50 dBµ
									1.5841430 G⊦
0 dBµV				M2					
l0-dBµ∨	H1 9.900 dBµV							M1 ▼	
) dBµV	demonstration of the second	- warmen alemand	maren man	mont	mon	home was	when we we want	therewant	ulzumner
10 dBµV									
-20 dBµV									
-30 dBµV									
-40 dBµV									
-50 dBµV									
1.559 GHz			1001 pts		5.	1 MHz/			1.61 GH

07:21:39 05.08.2020

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



10 dB Bandwidth

## 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	Frequency High	Frequency	-10 dB BW	Result
[MHz]	[MHz]	Center [MHz]	[MHz]	
6206.3	6761.3	6479.6	555.00	PASS

MultiView 😁	Spectrum								
Ref Level -23.00 Att Input		500 ms • VBW		<b>de</b> Auto Sweep			F	requency	6.5000000 GHz
1 Frequency Swe									⊙1Pk Max
									M1[1] -49.76 dBm
-30 dBm									6.47960 GHz
-40 dBm									
				M1					
-50 dBm					MA.				
		-	a March	When we want	" more more	Manna 1			
-60 dBm		an monthe	Carla .				12 WV		
-00 ubm		and the second					mary		
	Multing						~~~~	Maryan	
-70 dBm	phene							- mart	while warmen and the man warmen
-80 dBm									
oo abiii									
-90 dBm									
-100 dBm									
-110 dBm									
-120 dBm									
CF 6.5 GHz			1001 p	ts	12	0.0 MHz/			Span 1.2 GHz
2 Marker Table									-p=
Type Ref	Trc	X-Value		Y-Value		Function		Funct	tion Result
M1		6.4796 GHz		-49.76 dBm	ndB	ancion		i unc	10.0 dB
T1	ī	6.2063 GHz		-59.97 dBm	ndB down i	ЗW		555	.00 MHz
T2	1	6.7613 GHz		-60.27 dBm	Q Factor				11.7
					Measuring		🔰 04.08	.2020 Re	f Level RBW

09:34:25 04.08.2020

Figure 20: 10 dB Bandwidth



**Transmission Time** 

**B** 

## **Transmission Time**

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

	dBm			SGL			_		
	0 dB • SWT 300 1 AC PS	ms  VBW Off Notcl					Fre	equency 6.5	000000 G
Zero Span								1	●1Pk Cln
0 dBm									
) dBm	the set of				- Harrida Ana		. h. ml. i.d.		1.00
) dBm									
D dBm	MIN MILWAY	يريد الرور بالو		and an also be		والمعالية مدير ما			المراجعة والمراجع
	an in the transformed worker.	an have house	ent/leader of a chardelees	en an alla Allan a Aud	Prevent duringer	nother reading the second s	Manadorskanta u tada	ht month and	terminiterer of Annalytic II. II.
) dBm									
) dBm									
10 dBm									
00 dBm									
LO dBm									
00 dBm									
0 dBm									

11:52:58 04.08.2020

Figure 21: Transmission time, Beacon in normal operation mode



 $\otimes$ 



MultiView 8									$\bigtriangledown$
Ref Level -38. Att	0 dB 🖷 SWT	• RBW 30 s • VBW	3 MHz	L			Fre	equency 6.5	5000000 GHz
Input	1 AC PS	Off Notch	Off						o 1 Dk. Clau
1 Zero Span									●1Pk Clrw
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm		a a a a an an an a a	dista connecca		u u b - ub all		. An atom of the second	mbarra harabi	and a second and a second and a
and a server a server of a server a	and the strength of the streng	an contraction of a structure of the	an difficult of a constraint of a distributed	- Crowner - Construction of	u der de anter de la faction	an and Ode Browton of Con	es foit. Explored des enfortes des a	And the Alanda and read	And rate of Assessment Assess
-80 dBm									
-90 dBm									
-100 dBm									
-110 dBm									
-120 dBm									
-130 dBm									
				1001					2.0.5/
CF 6.5 GHz				1001	· _		04.00.2		3.0 s/
l					Ready		04.08.2 04.11:59	020 Ref Leve	

11:59:40 04.08.2020





#### 99 % Occupied Bandwidth

## 99% Occupied Bandwidth

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

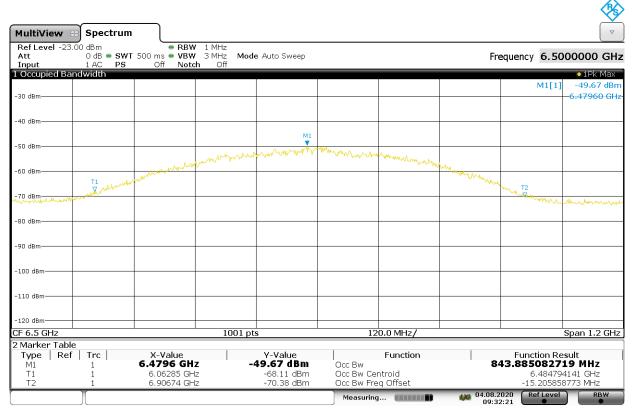
#### **RSS-GEN 6.6**

Measurement distance: 3m

#### Results

Table 7: 99% occupied bandwidth test results

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



09:32:21 04.08.2020

Figure 23: 99% OBW

## **TEST EQUIPMENT**

## **Test Equipment**

## **Conducted Emissions**

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

## **RF-Test Equipment**

Equipment	Manufacturer	Туре	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 ROHDE &	EMC-32	-	NCR	NCR
EMI TEST RECEIVER	SCHWARZ	ESW26	inv:10679	2020-07-20	2021-07-20
SIGNAL ANALYZER	ROHDE & SCHWARZ ROHDE &	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

## **END OF REPORT**