

Test Report

Electromagnetic Compatibility (EMC)



TESTS ACCORDING TO FCC PART 15 B REQUIREMENTS

Equipment Under Test: UWIS Diver unit

Models: UWIS-DU100

Manufacturer: UWIS Oy
Kaarintie 700
20540 Turku
FINLAND

Customer: UWIS Oy
Kaarintie 700
20540 Turku
FINLAND

FCC Rule Part: FCC CFR 47 Part 15 Subpart B (2017), Class B

Date: 22 May 2019

Issued by:

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

Jani Tuomela
Testing Engineer

Date: 22 May 2019

Checked by:

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Rauno Repo
Testing Engineer

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Equipment Under Test (EUT)

UWIS is an underwater navigation, communications and surveillance system that utilizes the triangulation principle. With UWIS's help the divers' underwater location can be determined with just a few meters accuracy. It also enables communication between the dive participants and the surface via pre-set messages. The dive data is relayed to the surface via a buoy and the dive leaders can use the UWIS-software to track the progress of the divers in real time. Recording of the data helps to analyze and plan the dive missions. The system can track up to 100 divers simultaneously over an area of 800 meters across an in depth of 150 meters.

UWIS system consists of three buoys and a diver unit that is attached on the air tank. The system communicates underwater via ultrasound.

The diver unit is attached on the air tank and it connects to the display wirelessly via Bluetooth, Wi-Fi or inductive data transfer. The communications between a diver unit and the master buoy are carried out via ultrasound.

Diver unit for UWIS system

	Radio Interface	Manufacturer	Model No.	Mode	Operating Freq	Tx power	Distance to User	Simultaneous transmission	FCC ID	Grant	ISED ID	Mobile / Portable	Antenna	Notes
[a]	Wi-Fi module	Gainspan	GS2100MIP	b	2,4 GHz	15 dBm, Average	more than 20cm	Possible with [b], [c]	YOPGS2100MIP	Modular	9154A-GS2100MIP	Mobile (module)	Integrated on PWB, Gain 1 dBi	Integral Antenna (original)
				g		14 dBm, Average								
[b]	Bluetooth 4.2 BLE	Rigado	BMD-300	BLE	2,4 GHz	4 dBm, Average	more than 20cm	Possible with [a], [c]	2AA9B04	Limited	12208A-04	Mobile (module)	Integrated on PWB, Gain 0 dBi	Integral Antenna (original)
[c]	Low Power	UWIS	UWIS-INDS100	-	123 kHz	25 dBm, Peak	more than 20cm	Possible with [a], [b]	-	-	No	-	Integrated, Gain 2.15 dBi	Inductive communication module, UWIS-INDS100
[e]	Wireless Charging	-	-	-	100-200 kHz	-	-	-	-	-	-	-	-	Receiver Unit selfdesigned
[f]	Ultrasonic transmitter	-	-	-	56 kHz	200 W	-	Used for communication with buoy	-	-	-	-	-	Pulses 300ms

This report contains the results for diver unit.

Power Requirements

The EUT is a battery-operated device.

Samples

One Sample was used for testing. No modifications were made during the testing.

Peripherals

- Wireless charger: Model VUSOLOGY-T; Input DC 5V, 1.8A; Output 5W
- Charger: Model Samsung EP-TA12EWE; Input 100-240V 50/60Hz, 0.35A; Output 5.0V, 2.0A

All peripherals were supplied by the manufacturer.

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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 90 days only. This document cannot be reproduced except in full, without prior approval of the Company.

Summary of Testing

Test Specification	Description of Test	Test site	Result
§15.107	Conducted Emissions	5m	PASS
§15.109	Radiated Emissions	5m	PASS

EUT Test Conditions during Testing

Configuration of the EUT was made to correspond to the actual assembling conditions as far as possible. All transmitters were on and the product was charged with a wireless charger during the tests.

Test Facility

<input checked="" type="checkbox"/> Testing Location / address: FCC registration number: 904175	SGS Fimko Ltd Särkinenmentie 3 FI-00210, HELSINKI FINLAND
Test Site:	Kara5m

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

Standard: ANSI C63.4 (2014)
Tested by: JAT
Date: 14 November 2017
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH
Measurement uncertainty: ± 2.9 dB Level of confidence 95 % (k = 2)

FCC Rule: 15.107 (a)

Test plan

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4.5 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors. During the test the EUT was powered from the separate power supply (115 VAC / 60 Hz) through the LISN.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	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.

Conducted Emissions In The Frequency Range 150 kHz – 30 MHz

Results

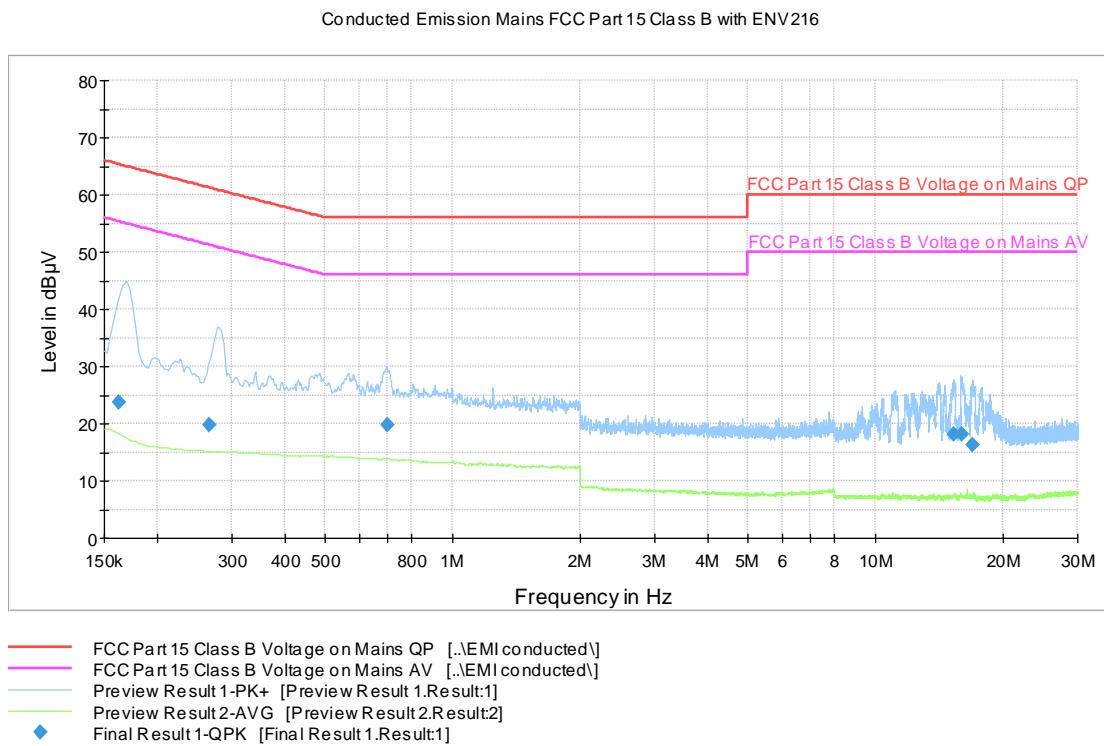


Figure 1. The measured curves with peak- and average detector.

Table 1. Final Quasipeak results

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.162000	23.7	1000.0	9.000	On	N	10.1	41.7	65.4
0.266000	19.9	1000.0	9.000	On	N	10.2	41.4	61.2
0.702500	19.8	1000.0	9.000	On	L1	10.1	36.2	56.0
15.260750	18.3	1000.0	9.000	On	L1	10.4	41.8	60.0
15.953750	18.1	1000.0	9.000	On	L1	10.4	41.9	60.0
16.947250	16.3	1000.0	9.000	On	L1	10.5	43.7	60.0

The presented final values contain the correction factors and can be directly compare with the limits.

Radiated Emissions In The Frequency Range 9 kHz to 26500 MHz

Standard:	ANSI C63.4	(2014)
Tested by:	JAT	
Date:	13 – 14 November 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	
Barometric pressure:	1000 hPa	
Measurement uncertainty:	± 4.9 dB (30 - 200 MHz) ± 4.1 dB (0.2 - 1 GHz)	Level of confidence 95 % (k = 2).

FCC Rule: 15.107 (a)**Test plan**

Radiated electric field strength was measured from 9 kHz to 26.5 GHz in a semi-anechoic chamber. The EUT was placed on a table 0.8 meters above the ground plane.

Testing was performed at a 3 meters distance and the field strength reading below 30MHz extrapolated to 30 or 300 meters for comparison to the 30 or 300 meters limits.

The field strength reading was extrapolated using the extrapolation (distance) factor of 40dB/decade as specified in 15.31 (f) (2) for frequencies below 30MHz.

Distance Factor from 30 meters to 3 meters (1 decade) = -40dB

Distance Factor from 300 meters to 3 meters (2 decades) = -80dB

The EUT was working as described in the section “EUT Test Conditions During Testing”.

Radiated measurement settings:**Preliminary/Final testing (9kHz to 30 MHz):**

Turtable movement:	Continuous
Turtable position:	0 - 360 °
Antenna height:	1 m
Antenna angle:	45° step

Preliminary testing (30 to 26500 MHz):

Turtable movement:	Continuous
Turtable position:	0 - 360 °
Antenna height:	1.5 m
Antenna polarization:	Vertical and horizontal

Final testing (30 to 26500 MHz):

Turtable movement:	Continuous
Turtable position:	0 - 360 °
Antenna movement:	Continuous
Antenna height:	1 m to 4 m
Antenna polarization:	Vertical and horizontal

Radiated Emissions In The Frequency Range 9 kHz – 26500 MHz

Test results

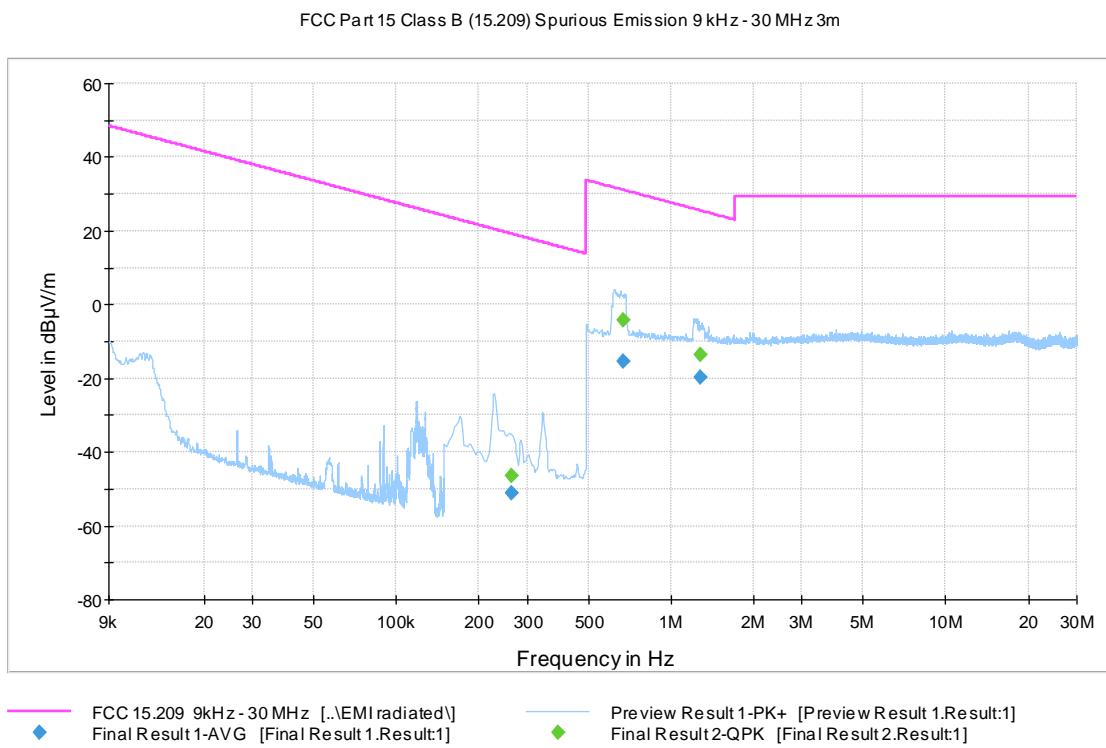


Figure 2. Radiated emission results 9 kHz to 30 MHz. The field strength reading extrapolated to the measuring distance of 300 / 30 m.

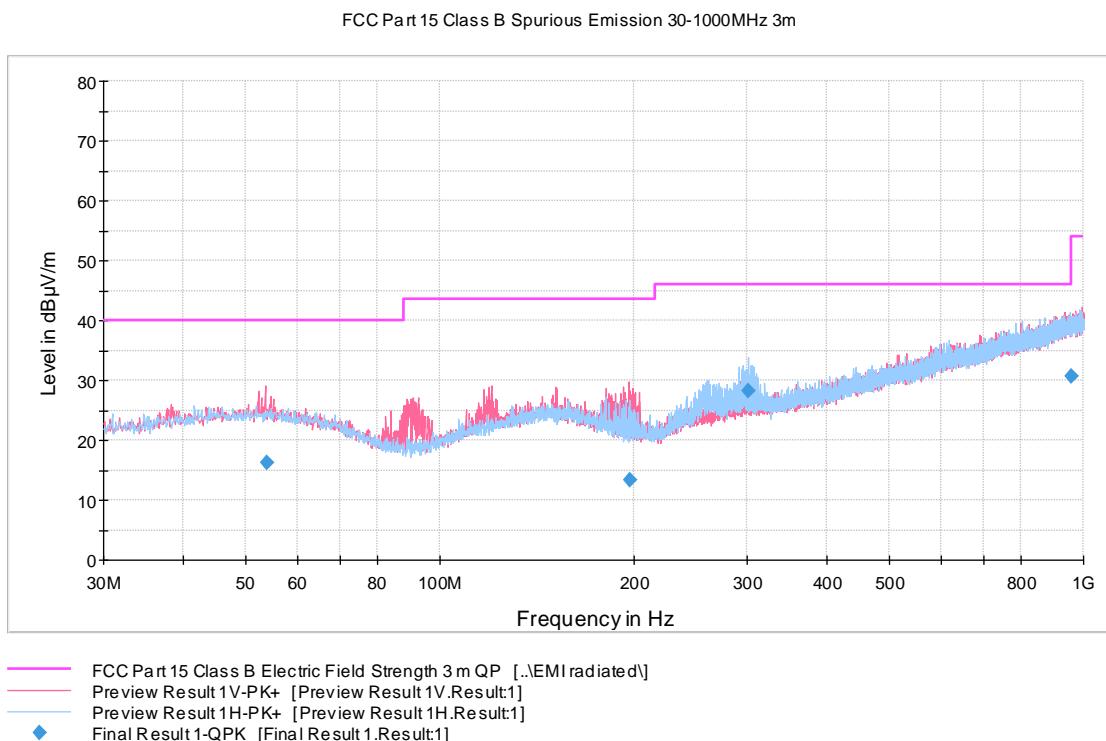
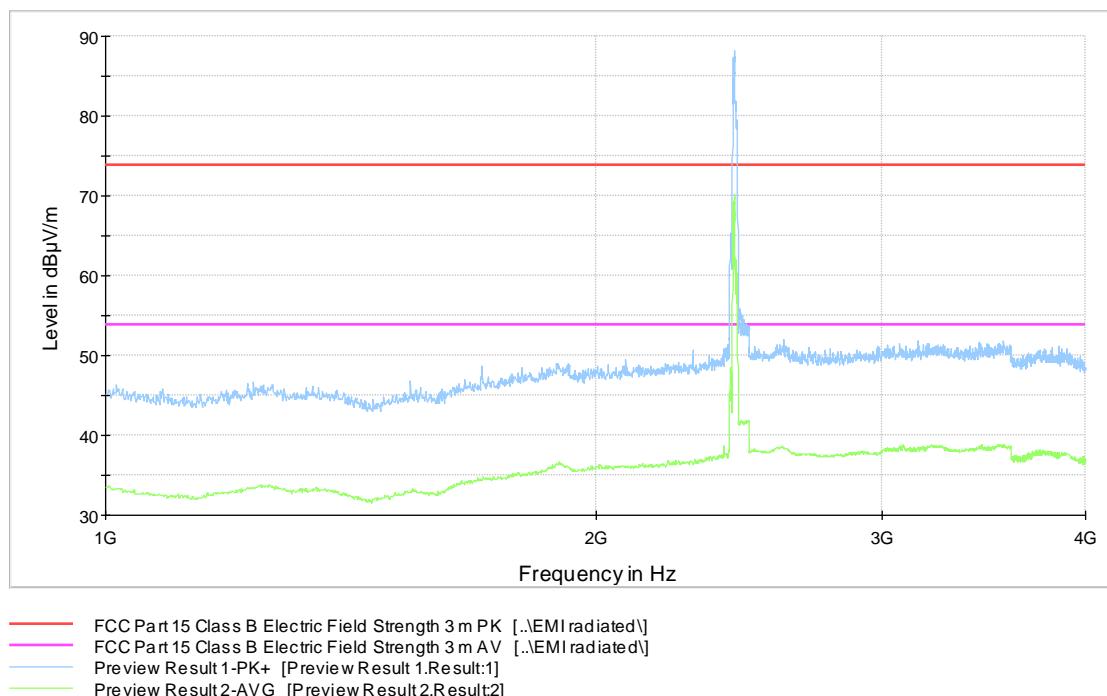


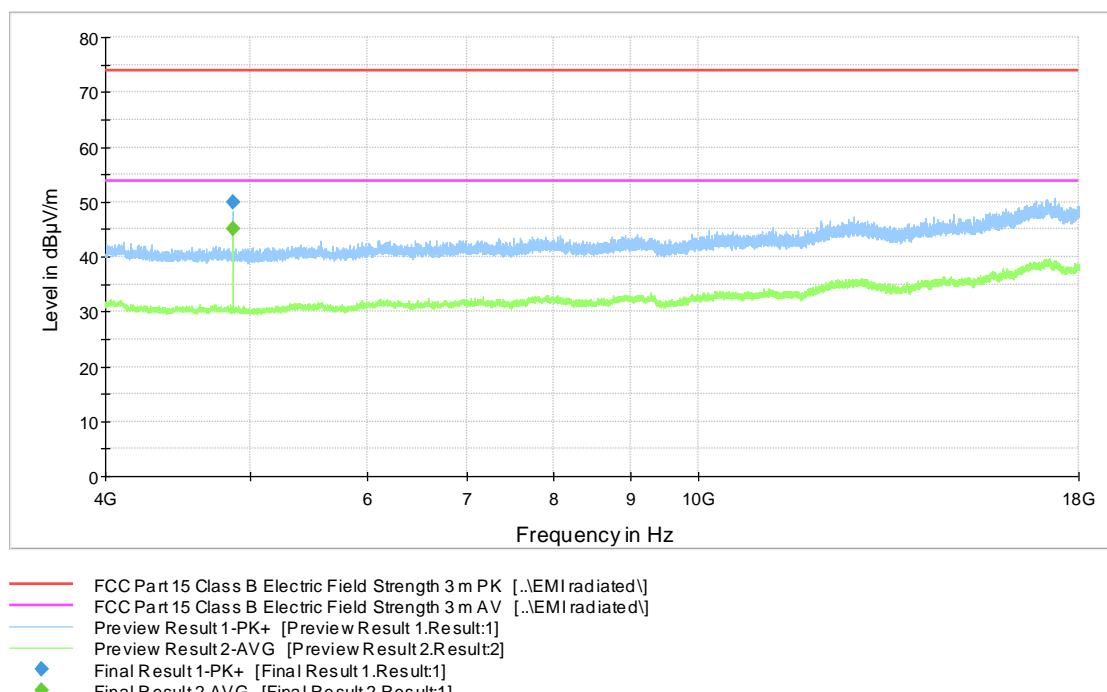
Figure 3. Radiated emission results 30 to 1000 MHz

Radiated Emissions In The Frequency Range 9 kHz – 26500 MHz

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

**Figure 4.** Radiated emission results 1000 to 4000 MHz

FCC Part 15 Class B Spurious Emission 4-18GHz 3m

**Figure 5.** Radiated emission results 4000 to 18000 MHz

Radiated Emissions In The Frequency Range 9 kHz – 26500 MHz

FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m

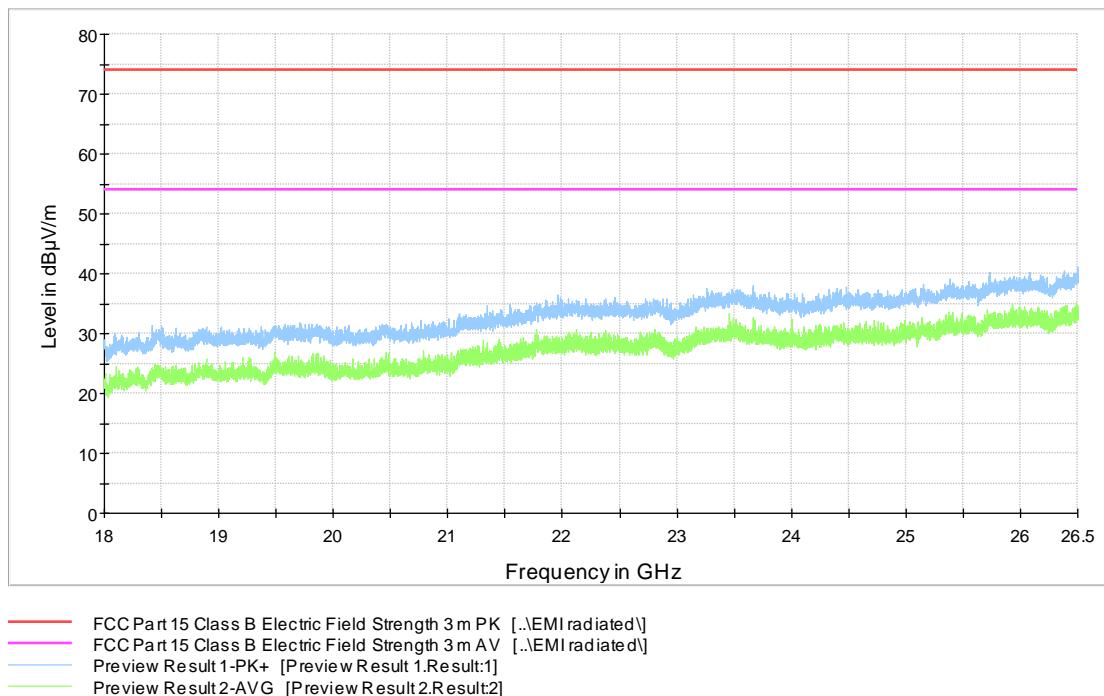


Figure 6. Radiated emission results 18000 to 26500 MHz

Table 2. Final Quasi-Peak results

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
0.262000	-46.3	1000.0	9.000	100.0	V	40.0	-59.9	65.5	19.2
0.669750	-4.3	1000.0	9.000	100.0	V	25.0	-20.1	35.4	31.1
1.279500	-13.6	1000.0	9.000	100.0	V	61.0	-20.2	39.1	25.5
53.751000	16.1	1000.0	120.000	100.0	V	159.0	18.4	23.9	40.0
197.457000	13.3	1000.0	120.000	100.0	V	51.0	15.5	30.2	43.5
301.854000	28.2	1000.0	120.000	111.0	H	98.0	19.3	17.8	46.0
956.011000	30.7	1000.0	120.000	154.0	H	3.0	31.8	15.3	46.0

Table 3. Final Average results

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
0.262000	-51.0	1000.0	9.000	100.0	V	40.0	-59.9	70.3	19.2
0.669750	-15.5	1000.0	9.000	100.0	V	25.0	-20.1	46.6	31.1
1.279500	-19.9	1000.0	9.000	100.0	V	61.0	-20.2	45.4	25.5
4874.00000	45.0	1000.0	1000.000	150.0	H	83.0	8.4	8.9	53.9

Table 4. Final Peak results

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
53.751000	27.2	1000.0	120.000	100.0	V	159.0	18.4	12.8	40.0
197.457000	19.8	1000.0	120.000	100.0	V	51.0	15.5	23.7	43.5
301.854000	34.9	1000.0	120.000	111.0	H	98.0	19.3	11.1	46.0
956.011000	37.4	1000.0	120.000	154.0	H	3.0	31.8	8.6	46.0
4874.00000	49.9	1000.0	1000.000	150.0	H	86.0	8.4	24.0	73.9

The presented final values contain the correction factors and can be directly compare with the limits.

Conducted Emissions

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
LISN	ROHDE & SCHWARZ	ENV216	inv:9611	2017-02-23	2018-02-23
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	inv:8453	2017-07-10	2018-07-10
ATTENUATOR	PASTERNACK	PE 7004-4	inv:10126	2017-03-24	2018-03-24
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv:7826	-	-

Radiated Emissions

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	-	-
SPECTRUM ANALYZER	AGILENT	E7405A	inv:9746	2016-01-07	2018-01-07
PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2016-11-28	2017-11-28
PREAMPLIFIER	AMC microwave	ALS1826-41-12	sn: 11	2017-11-16	2018-11-16
ANTENNA	EMCO	3117	inv:7293	2016-03-16	2018-03-06
ANTENNA	EMCO	3160-09	inv:7294	2017-03-16	2018-03-16
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv:8013	2016-08-29	2018-08-29
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	-	-
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	-	-
ATTENUATOR	PASTERNACK	10dB DC-40GHz	-	-	-
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	inv:8453	2017-07-10	2018-07-10
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2016-10-25	2018-10-25
TEMPERATURE/ HUMIDITY METER	VAISALA	HMT 333	inv:8638	2017-02-21	2018-02-21
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	inv:10403	2017-03-01	2019-03-01