Test Report

FINAS
Finnish Accreditation Service
T004 (EN ISO/IEC 17025)

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

Equipment Under Test:	USB powered controller for drones
Marketing name:	Intel® Drone Link DVT FabA
Type:	IWBS1
Manufacturer:	Intel Behringstraße 10 82152 Planegg GERMANY
Customer:	Intel Corporation 2200 Mission College Blvd Santa Clara, CA 95054 USA
FCC Rule Part:	15.247: 2017
IC Rule Part:	RSS-247, Issue 2, 2017 RSS-GEN Issue 4, 2014
KDB:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (April 5, 2017)

Date:	30 October 2017	Date:	30 October 2017
Issued by:	Pekka Kälviäinen Testing Engineer	Checked by:	Rauno Repo Testing Engineer

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Equipment Under Test (EUT)

EUT:	USB powered controller for drones
Type:	IWBS1
Serial no:	W1DVT1KY7380023
SW:	Main FW: F407_test_171009 Radio card FWs: v3.8 testing editions Bluetooth FW: 9.1.10.0
FCC ID:	CC2500: 2AJ2A-RCM24G Bluetooth: SQGBT900
IC:	CC2500: 1000B-RCM24G Bluetooth: 3147A-BT900

Description of the EUT

The EUT is the radio module of the controller system for drones. It consists two 2.4 GHz radios for remote controlling and a Bluetooth radio for connection to a computer. It is equipped with USB connector.

This test report contains emission test results for all transmitters operating same time.

Classification of the device

Fixed device	☐
Mobile Device (Human body distance > 20cm)	☒
Portable Device (Human body distance < 20cm)	☒

Ratings and declarations

Remote controller radios:

Operating Frequency Range (OFR):	2402.5 – 2471.5 MHz
Channels:	70
Channel separation:	1 MHz
Effective conducted power:	19.93 dBm
Transmission technique:	ADFSS
Modulation:	MSK
Antenna gain:	2.0 dBi

Bluetooth:

Operating Frequency Range (OFR):	2402 – 2480 MHz
Channels:	80
Channel separation:	1 MHz
Effective conducted power:	8 dBm
Transmission technique:	FHSS
Modulation:	GFSK
Antenna gain:	0.5 dBi

Power Supply

Operating voltage range:	5.0 VDC (UBS connection), USB cable 1.0 m length

Mechanical Size of the EUT

Height: 2 cm Width: 11 cm Length: 11 cm

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SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.207(a) / RSS-GEN 8.8	Conducted Emissions on Power Supply Lines	**PASS**
§15.247(b)(3) / RSS-247 5.4(d)	Maximum Peak Conducted Output Power	**not tested**
§15.247(a)(2) / RSS-247 5.2(a)	6 dB Bandwidth	**not tested**
§15.247(e) / RSS-247 5.2(b)	Power Spectral Density	**not tested**
RSS-GEN 6.6	99% Occupied Bandwidth	**not tested**
§15.247(d) / RSS-247 5.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	**not tested**
§15.209(a), §15.247(d) / RSS-247 5.5	Radiated Emissions Within the Restricted Bands	**PASS**

EUT Test Conditions during Testing

The transmitters of the EUT were in continuous transmit mode during all the tests. The hopping was stopped and the EUT was configured into the wanted channel using software provided by the manufacturer. Normal modulation was applied in all the tests. Transmitters 1 and 3 were set to transmit continuously without any duty cycle.

Following channels were used during the tests:
Transmitter 1 (remote controller): 2402.5 MHz
Transmitter 2 (Bluetooth): 2440.0 MHz
Transmitter 3 (remote controller): 2471.5 MHz

Test Facility

☐ Testing Location / address: FCC registration number: **90598**	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
☒ Testing Location / address: FCC registration number: **178986** Industry Canada registration number: **8708A-2**	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

TEST RESULTS

Conducted Emissions In The Frequency Range 150 kHz - 30 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	MIH	
Date:	23 October 2017	
Temperature:	23 °C	
Humidity:	19 % RH	
Barometric pressure:	1019 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 4.5 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors. The USB port of the EUT was connected to a portable computer.

Computer used:
type HP EliteBook 8540w, s/n CND1177MFQ

The input voltage of the computer was 115V 60Hz during the test.

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.

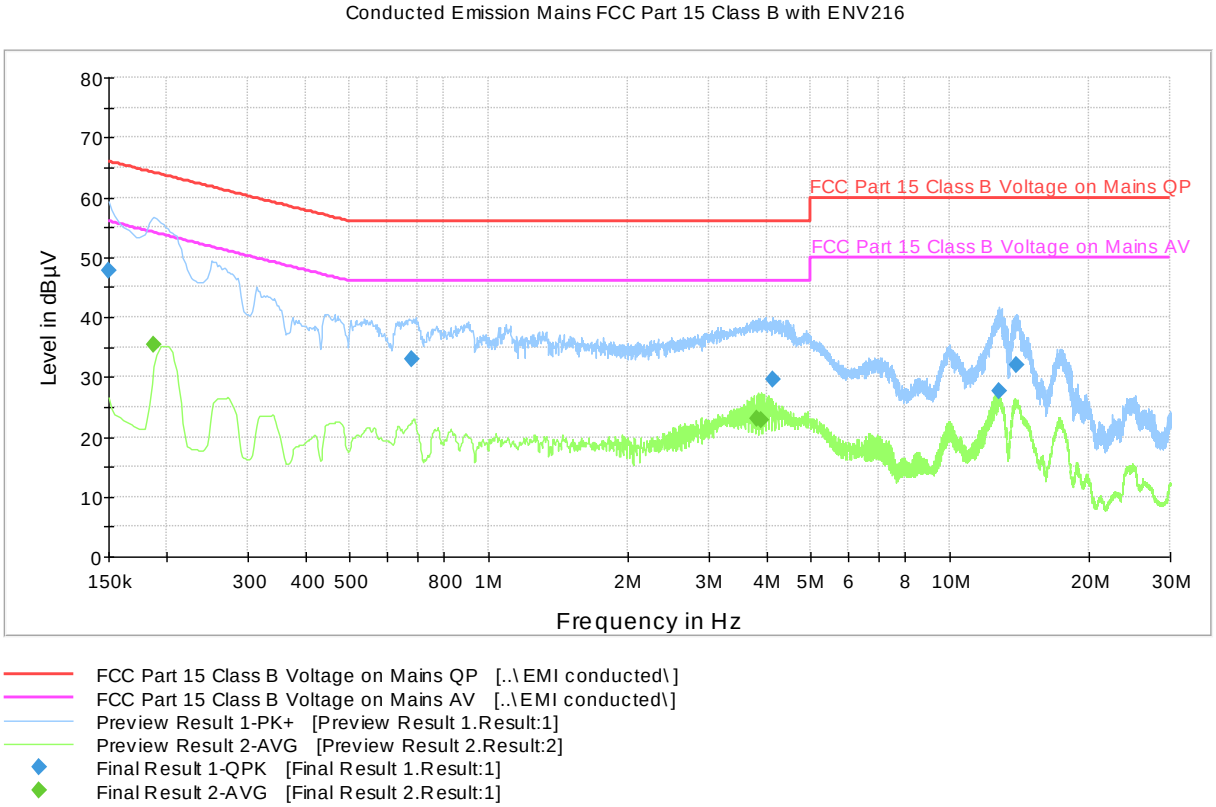


Figure 1: The measured curves with peak- and average detector.

Table 1: Final QuasiPeak measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	47.8	1000.0	9.000	On	L1	9.9	18.2	66.0
0.680000	33.0	1000.0	9.000	On	N	10.3	23.0	56.0
4.137750	29.7	1000.0	9.000	On	N	10.4	26.3	56.0
12.762000	27.5	1000.0	9.000	On	L1	10.4	32.5	60.0
13.935000	32.1	1000.0	9.000	On	N	10.6	27.9	60.0

Table 2: Final Average measurements from the worst frequencies

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.188250	35.5	1000.0	9.000	On	N	10.1	18.6	54.1
3.811750	23.0	1000.0	9.000	On	N	10.4	23.0	46.0
3.884000	22.7	1000.0	9.000	On	N	10.4	23.3	46.0

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.

Transmitter Radiated Spurious Emissions 0.009 - 26500 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	PKA and MIH	
Date:	23 - 24 October 2017 -	
Temperature:	19 °C	
Barometric pressure:	1019 – 1024 hPa	
Humidity:	20 - 60 % RH	
Measurement uncertainty:	± 4.51 dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.247(d), 15.209(a)

RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. 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).

The USB port of the EUT was connected to a DC power supply.

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector
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

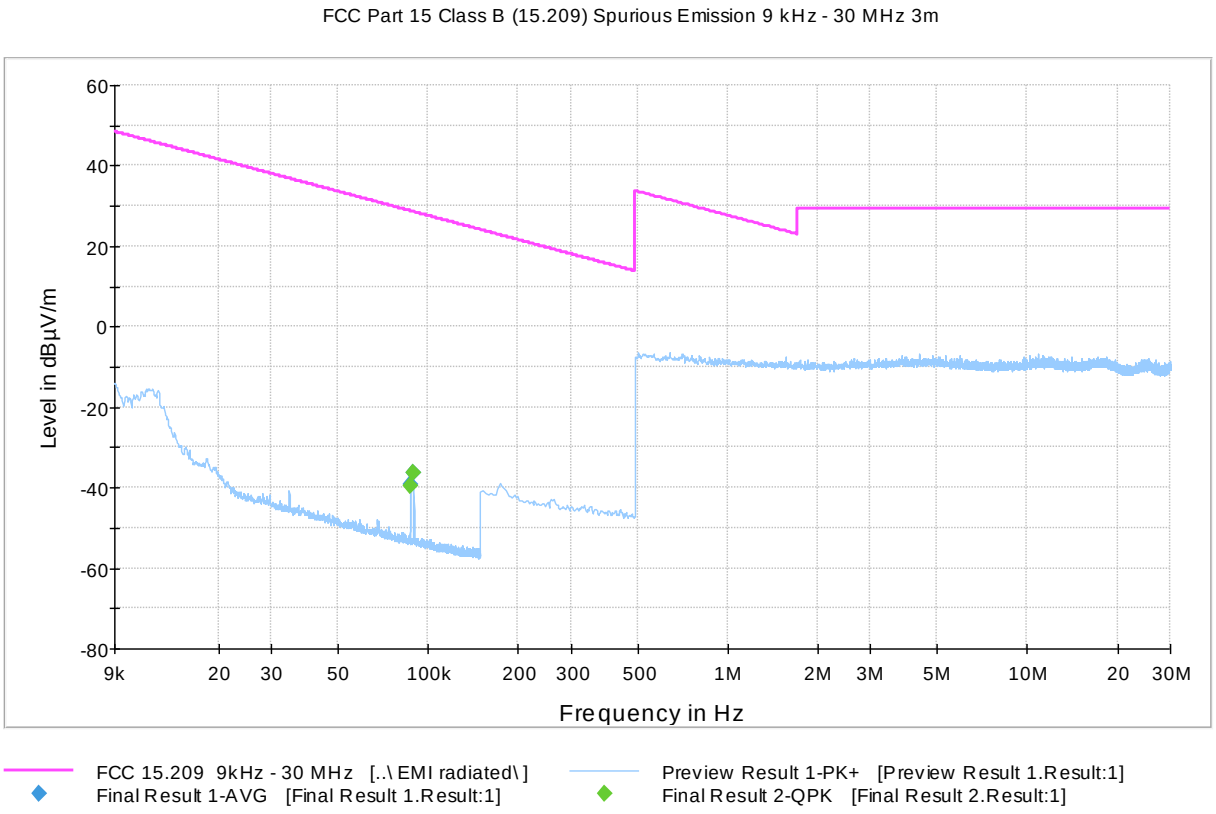


Figure 2: 0.009 MHz – 30 MHz

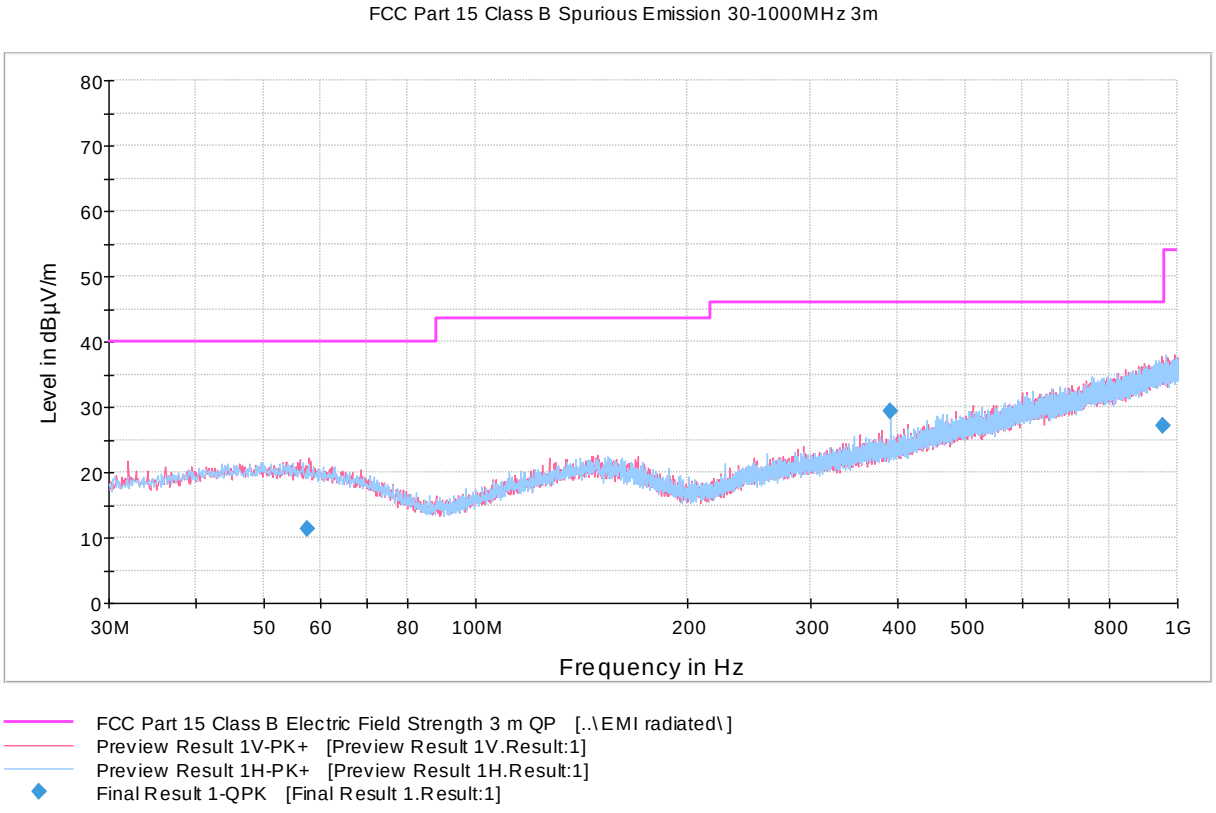
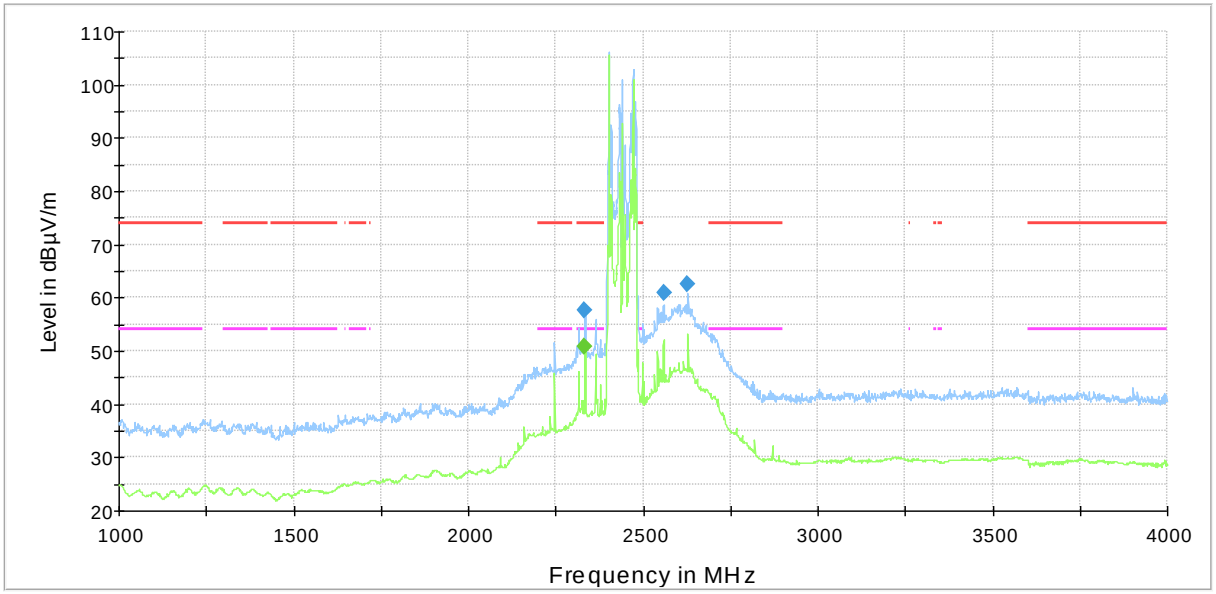


Figure 3: 30 MHz – 1000 MHz

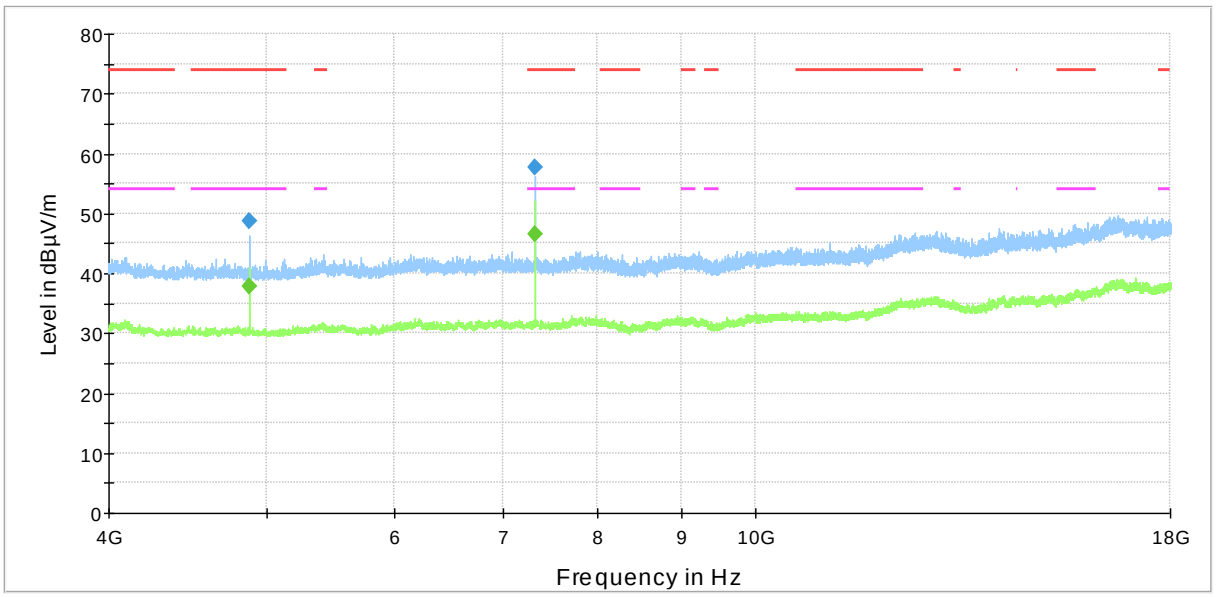
FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



FCC Part 15.205 Restricted bands Electric Field Strength PK [..\EMI radiated\]
FCC Part 15.205 Restricted bands Electric Field Strength QP+AV [..\EMI radiated\]
Preview Result 1-PK+ [Preview Result 1.Result:1]
Preview Result 2-AVG [Preview Result 2.Result:2]
Final Result 1-PK+ [Final Result 1.Result:1]
Final Result 2-AVG [Final Result 2.Result:1]

Figure 4: 1 GHz – 4 GHz

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



Preview Result 1-PK+ [Preview Result 1.Result:1]
Preview Result 2-AVG [Preview Result 2.Result:2]
Final Result 1-PK+ [Final Result 1.Result:1]
Final Result 2-AVG [Final Result 2.Result:1]
FCC Part 15.205 Restricted bands Electric Field Strength PK [..\EMI radiated\]
FCC Part 15.205 Restricted bands Electric Field Strength QP+AV [..\EMI radiated\]

Figure 5: 4 GHz – 18 GHz

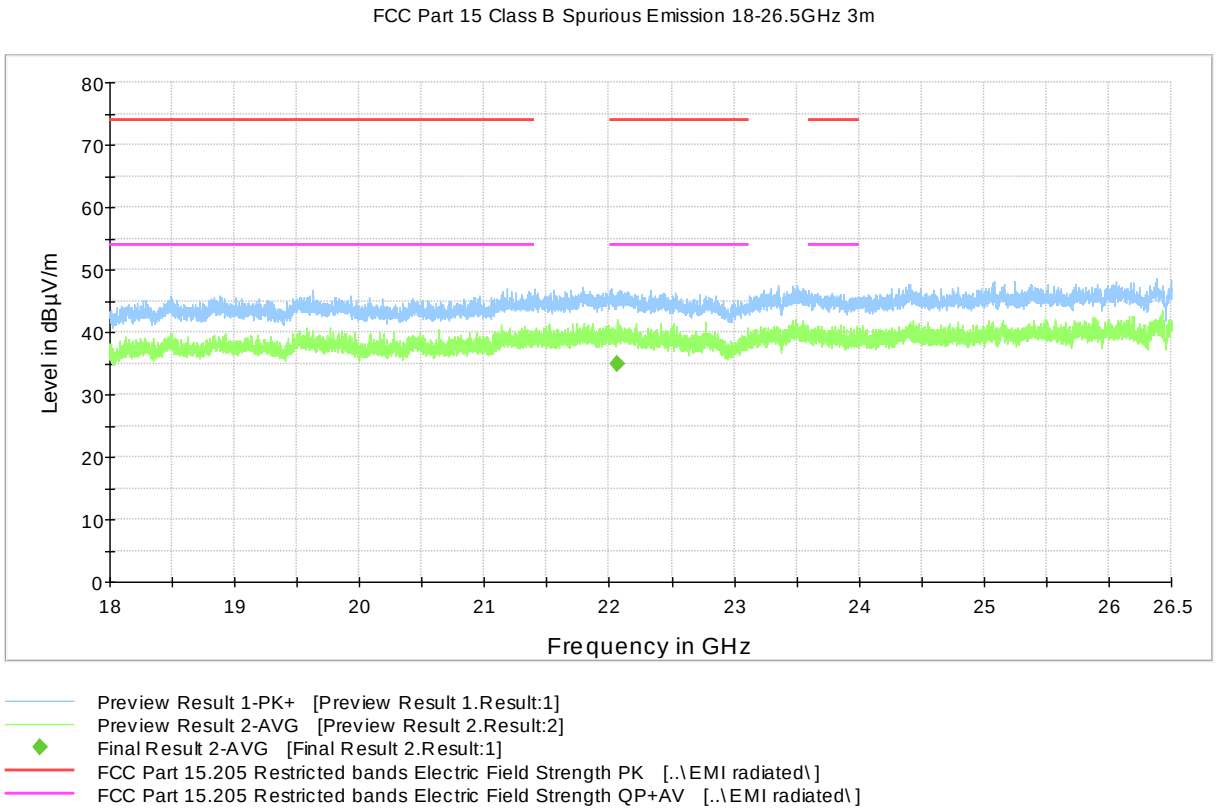


Figure 6: 18 GHz – 26.5 GHz

Table 3: 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)
0.087090	-39.3	1000.0	0.200	135.0	-	67.0	-59.9	68.1	28.8
0.089660	-36.3	1000.0	0.200	135.0	-	280.0	-59.9	64.9	28.5
57.679000	11.3	1000.0	120.000	364.0	V	279.0	14.1	28.7	40.0
389.984000	29.4	1000.0	120.000	100.0	H	177.0	17.6	16.6	46.0
951.692000	27.0	1000.0	120.000	211.0	V	232.0	27.8	19.0	46.0

Table 4: Peak results

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2333.925000	57.6	1000.0	1000.000	150.0	V	109.0	5.2	16.3	73.9
2558.675000	45.2 dBc	1000.0	1000.000	150.0	V	4.0	5.7	25.2	20 dBc
2627.475000	43.5 dBc	1000.0	1000.000	204.0	V	212.0	5.8	23.5	20 dBc
4882.200000	48.6	1000.0	1000.000	150.0	V	273.0	8.3	25.3	73.9
7322.400000	57.6	1000.0	1000.000	150.0	V	64.0	12.1	16.3	73.9

Table 5: Average results

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2333.525000	50.9	1000.0	1000.000	150.0	V	310.0	5.2	3.0	53.9
4882.000000	37.8	1000.0	1000.000	150.0	V	273.0	8.3	16.1	53.9
7322.900000	46.5	1000.0	1000.000	150.0	V	64.0	12.1	7.4	53.9

Radiated Band Edge results

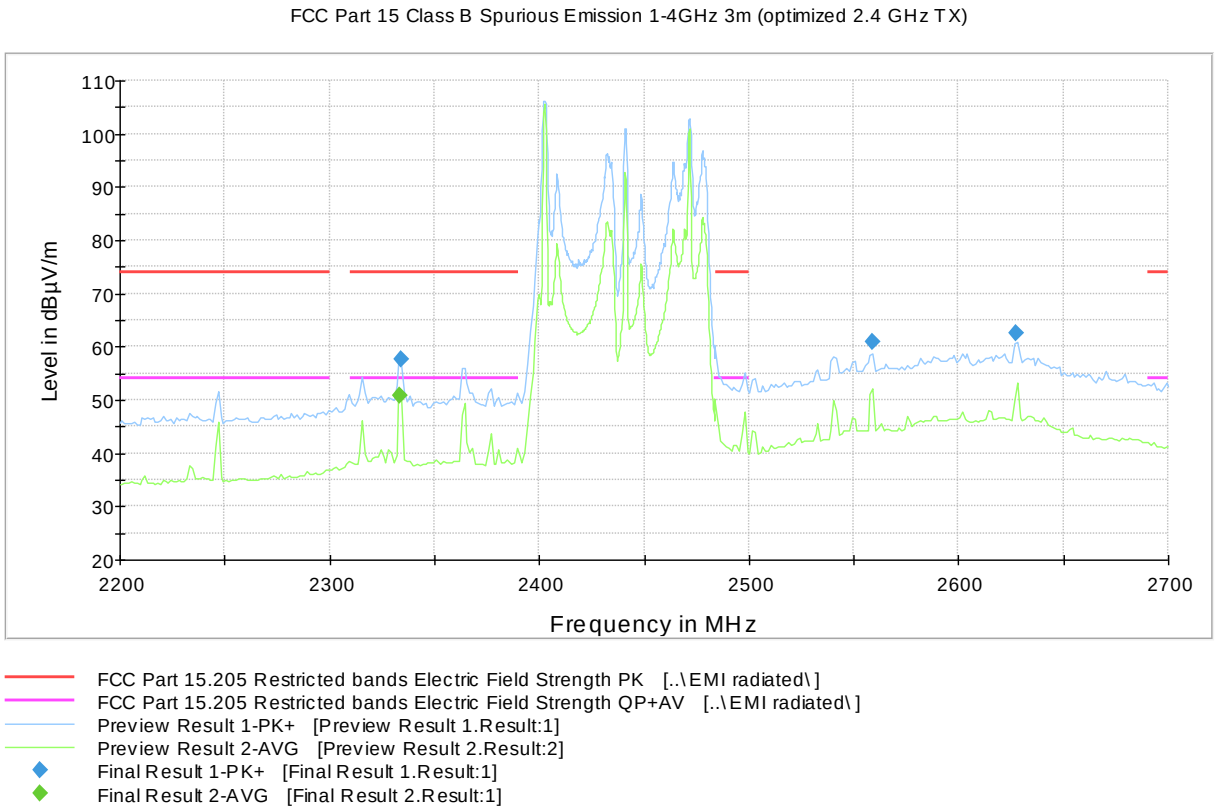


Figure 7: Radiated Band Edge measurement graph

TEST EQUIPMENT

RF-Test Equipment

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv:8013	2016-08-29	2018-08-29
PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2016-11-28	2017-11-28
POWER SUPPLY	DELTA	SM 130-25D	inv:10406	-	-
ANTENNA	EMCO	3117	inv:7293	2016-03-16	2018-03-06
ANTENNA	EMCO	3160-09	inv:7294	2017-03-16	2018-03-16
ANTENNA	ETS LINDGREN	3160-10	inv:9151	2013-08-06	2018-08-06
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	-	-
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	-	-
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
BAND REJECT FILTER	WAINWRIGHT	WRCG2400/2483-2490/2493-35/10SS	inv:8027	2017-03-01	2019-03-01
LISN	ROHDE & SCHWARZ	ENV216	inv:9611	2017-02-23	2018-02-23