

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C and INDUSTRY CANADA REQUIREMENTS

Equipment Under Test: WiFi Location Tag Transmitter

Type/ Model: W4

Manufacturer: Ekahau Oy
Hiilikatu 3
FI-00180 HELSINKI
FINLAND

Customer: Ekahau Oy
Hiilikatu 3
FI-00180 HELSINKI
FINLAND

FCC Rule Part: 15.247: 2012
IC Rule Part: RSS-210, Issue 8, 2010
RSS-GEN Issue 3, 2010

KDB: Guidance for Performing Compliance
Measurements on Digital Transmission Systems
(DTS) Operating Under §15.247 (April 9, 2013)

Customer has made modifications for the certified unit. The RF shield of the RF chip is removed compared to the certified original product (T301-W1, FCC ID: TA7-T301-W1). Only partial tests have been performed for C2PC.

Date: November 11, 2013

Issued by:



Rauno Repo
Testing Engineer

Date: November 11, 2013

Checked by:



Jari Merikari
Technical Manager

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Equipment Under Test (EUT)

WiFi Location Tag Transmitter
 Type/ Model: W4
 Serial Number: N/A

The EUT is a wrist watch-sized, battery powered, location tag device, which utilizes 802.11b radio technology using GainSpan GS1011 chip.

Classification of the device

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

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing

Ratings and declarations

Operating Frequency Range (OFR): 2412 – 2462 MHz
 Channels: 11
 Channel separation: 5 MHz
 Channel bandwidth: 20 MHz (802.11b-mode)
 Conducted power: +6.81 dBm
 Transmission technique: DSSS
 Modulation: CCK
 Transmission rate: 1, 2, 5.5 and 11 Mbps
 Antenna gain (Antenova Mica chip ant): 1.8 dBi (PK)/ -1.9 dBi (AV)

Power Supply

Internal battery.

Disclaimer

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SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.247(b)(3) / RSS-210 8.4	Maximum Conducted Output Power	PASS
§15.209 / RSS-GEN 7.2.3.2	Unintentional Radiated Emissions	PASS

EUT Test Conditions during Testing

The EUT was configured into the wanted channel and was in continuous transmit mode during all the tests

The power of all modes and data rates were measured with a power meter (low, mid and high channel) and the signal giving the highest power was selected for the measurements (802.11 b-mode with 1 Mbps data rate).

Following channels were used during the tests:

Channel	Frequency/ MHz
LOW	2412
MID	2437
HIGH	2462

Test Facility

<input type="checkbox"/>	Testing Location / address: FCC registration number: 90598	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
<input checked="" type="checkbox"/>	Testing Location / address: FCC registration number: 178986 Industry Canada registration number: 8708A-2	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

Maximum Conducted Output Power Measurement

Standard: ANSI C63.10 (2009)
Tested by: NKO
Date: 8.1.2014
Temperature: 20.9 °C
Humidity: 22 % RH

FCC Rule: 15.247 (b) (3)

For systems using digital modulation in the 2400-2483.5 MHz band: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

Output power was measured with using the same method as in the test report (LS Research, LLC: Report #: 310207)

Data rate [Mbps]	Channel	Measured Power [dBm]	BW Correction Factor [dB]	Corrected Output Power [dBm]	Limit [dBm]	Result
11	Low	6.75	5.32	12.07	30	PASS
11	Mid	7.07	5.28	12.35	30	PASS
11	High	7.10	5.25	12.35	30	PASS

The output power in the original test report (LS Research, LLC: Report #: 310207) was 6.85 dBm. The deviation with measured maximum value is 0.25 dBm.

Transmitter Radiated Emissions 30 – 26 500 MHz and Band Edge

Standard: ANSI C63.10 (2009)
Tested by: RRE
Date: 4.11 – 5.11.2013
Temperature: 21 – 22 °C
Humidity: 31 – 33 % RH
Measurement uncertainty: ± 4.51 dB Level of confidence 95 % (k = 2)

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

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 QuasiPeak value is the measured value corrected with the correction factor.

Measurements are done with 1 Mbps data rate.

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

Test results

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

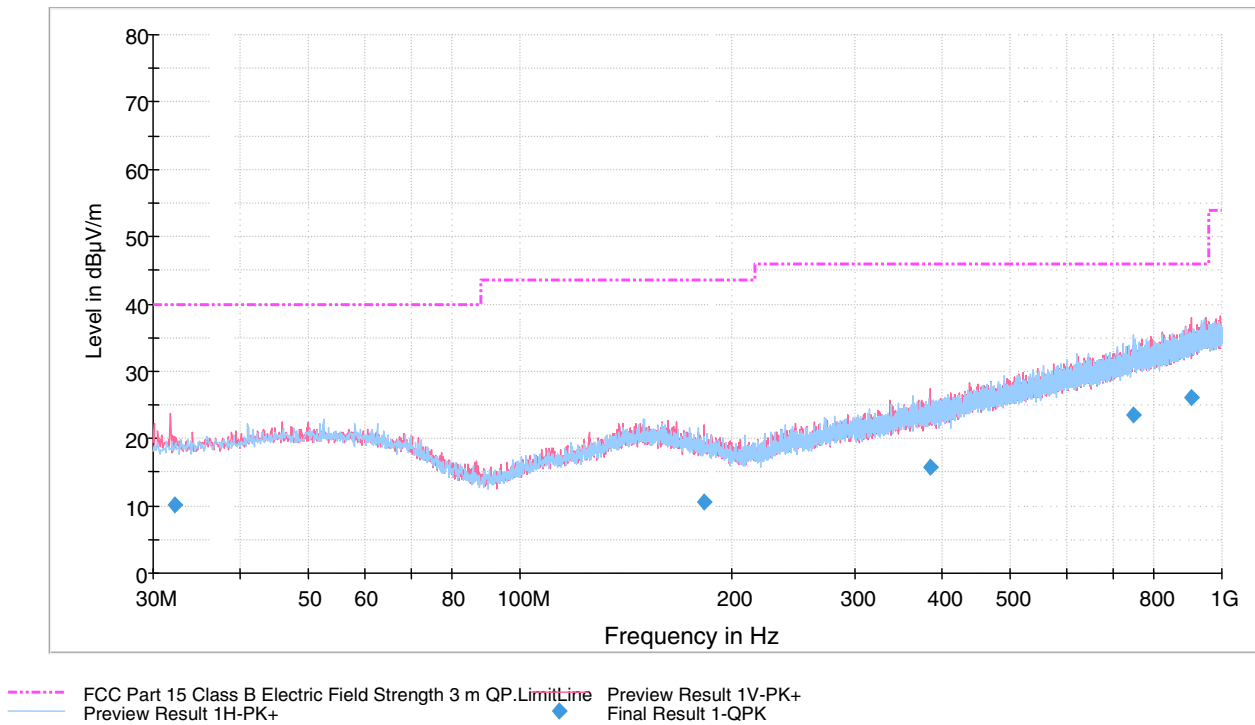


Figure 1. Measured curves with peak-detector (low channel).

Table 1. Final measurements from the worst frequencies.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
32.266000	10.2	1000.0	120.000	235.0	V	42.0	14.1	29.8	40.0	
183.003000	10.6	1000.0	120.000	226.0	V	140.0	13.8	32.9	43.5	
383.576000	15.7	1000.0	120.000	350.0	V	25.0	18.2	30.3	46.0	
748.146000	23.5	1000.0	120.000	132.0	H	237.0	25.4	22.5	46.0	
905.912000	26.0	1000.0	120.000	294.0	V	224.0	27.5	20.0	46.0	

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

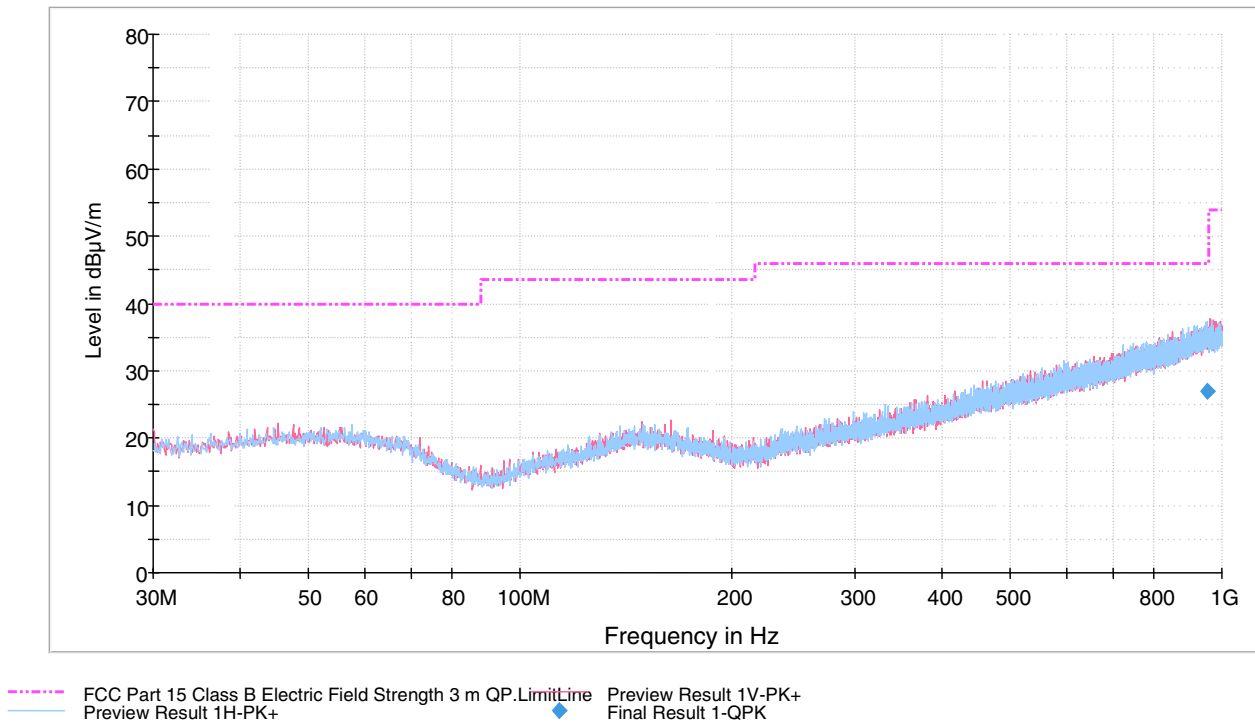


Figure 2. Measured curve with peak-detector (middle channel).

Table 2. Final measurements from the worst frequencies.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
952.730000	26.9	1000.0	120.000	143.0	H	136.0	28.3	19.1	46.0	

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

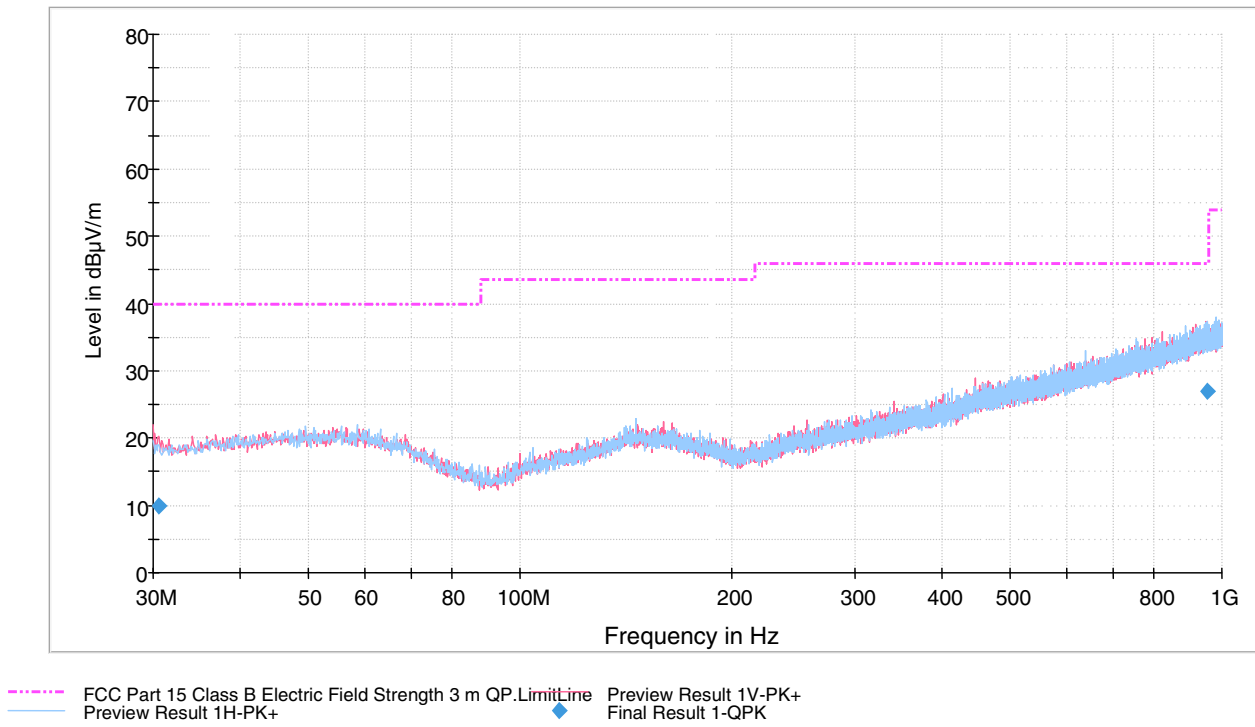


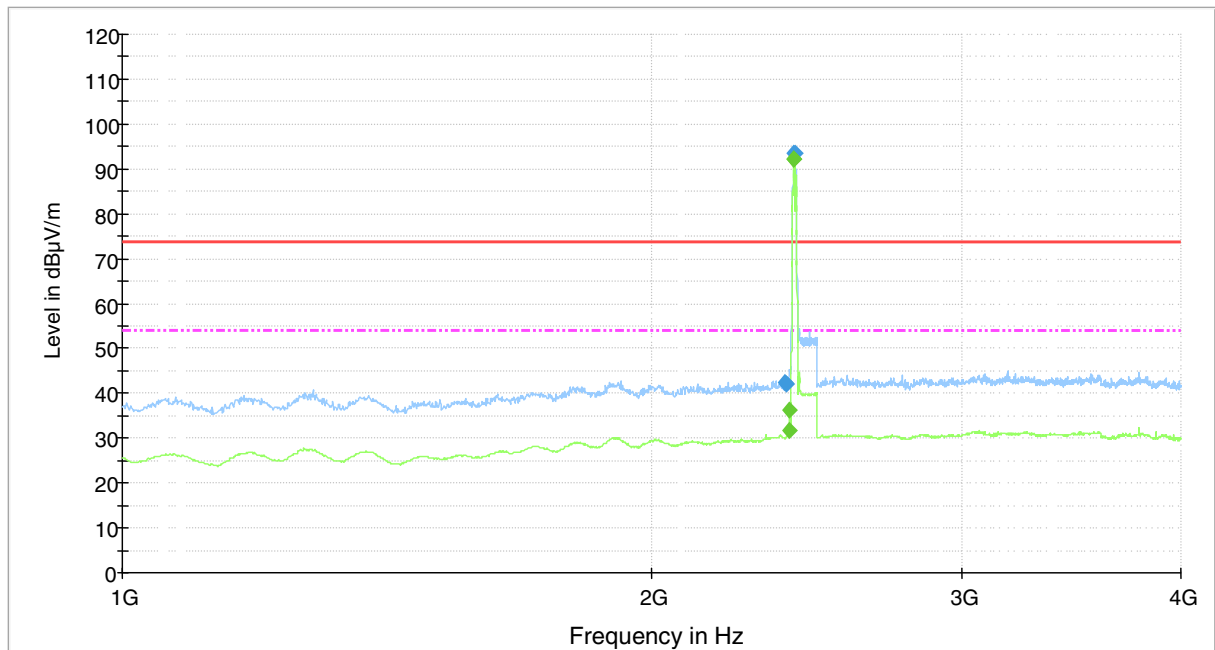
Figure 3. Measured curve with peak-detector (high channel).

Table 3. Final measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
30.560000	9.9	1000.0	120.000	124.0	V	196.0	14.1	30.1	40.0	
952.726000	26.9	1000.0	120.000	315.0	H	95.0	28.3	19.1	46.0	

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

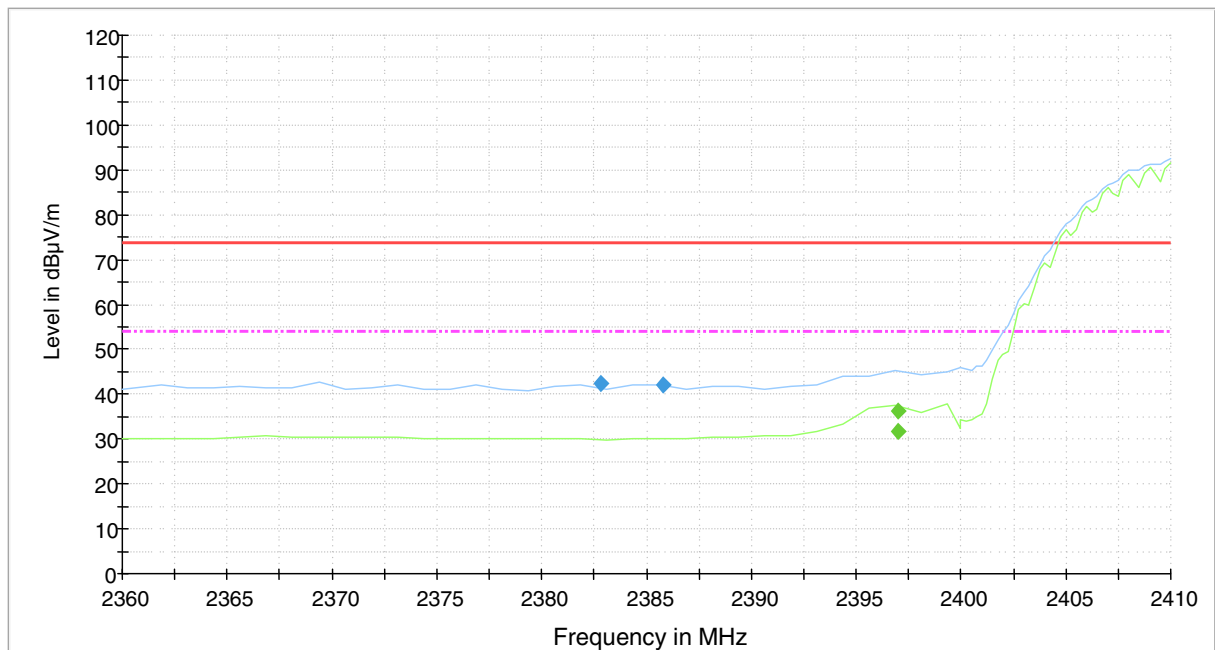
FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
— Preview Result 2-AVG
◆ Final Result 1-PK+
◆ Final Result 2-AVG

Figure 4. Measured curve with peak- and average detector (low channel).

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



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
— Preview Result 2-AVG
◆ Final Result 1-PK+
◆ Final Result 2-AVG

Figure 5. Low channel band edge

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge
Final measurements from the worst frequencies
Table 4. Final Max Peak results.

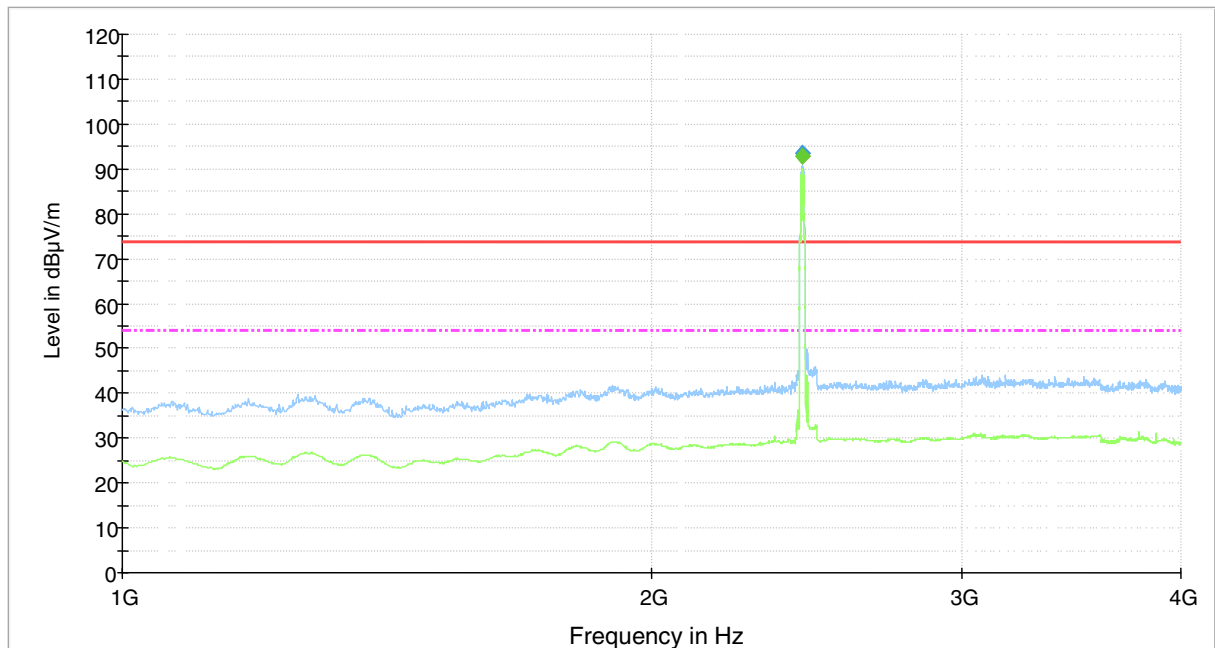
Frequency (MHz)	MaxPeak (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2382.800000	42.4	1000.0	1000.000	295.0	H	30.0	4.3	31.5	73.9	
2385.800000	42.1	1000.0	1000.000	100.0	V	355.0	4.3	31.8	73.9	
2410.800000	93.4	1000.0	1000.000	196.0	V	3.0	4.5	-	-	carrier
2414.000000	93.5	1000.0	1000.000	370.0	V	3.0	4.5	-	-	carrier

Table 5. Final Average results.

Frequency (MHz)	Average (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2397.000000	31.7	1000.0	1000.000	205.0	H	175.0	4.5	22.2	53.9	
2397.000000	36.3	1000.0	1000.000	122.0	V	18.0	4.5	17.6	53.9	
2411.000000	92.3	1000.0	1000.000	195.0	V	3.0	4.5	-	-	carrier

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

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



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
— Preview Result 1-PK+ - - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
◆ Final Result 1-PK+ — Preview Result 2-AVG
◆ Final Result 2-AVG

Figure 6. Measured curve with peak- and average detector (middle channel).

Final measurements from the worst frequencies

Table 6. Final Max Peak results.

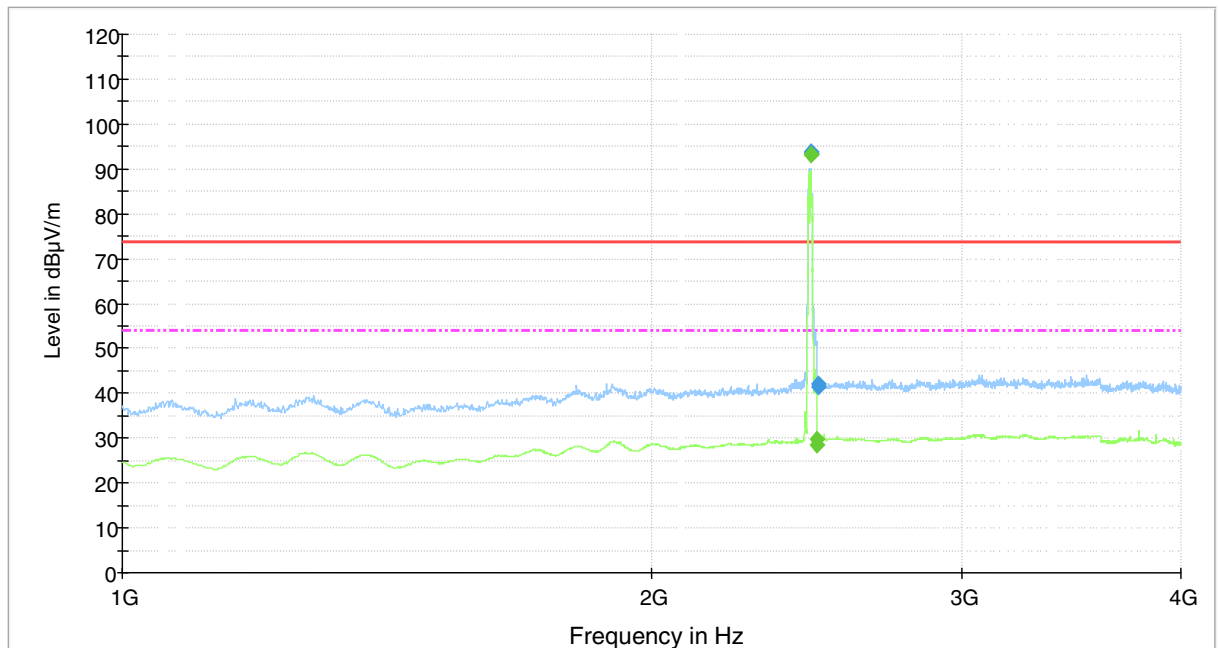
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2435.800000	93.4	1000.0	1000.000	195.0	V	332.0	4.4	-	-	carrier
2438.000000	93.6	1000.0	1000.000	195.0	V	339.0	4.4	-	-	carrier

Table 7. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2438.000000	92.9	1000.0	1000.000	191.0	V	332.0	4.4	-	-	carrier
2438.000000	92.9	1000.0	1000.000	194.0	V	332.0	4.4	-	-	carrier

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

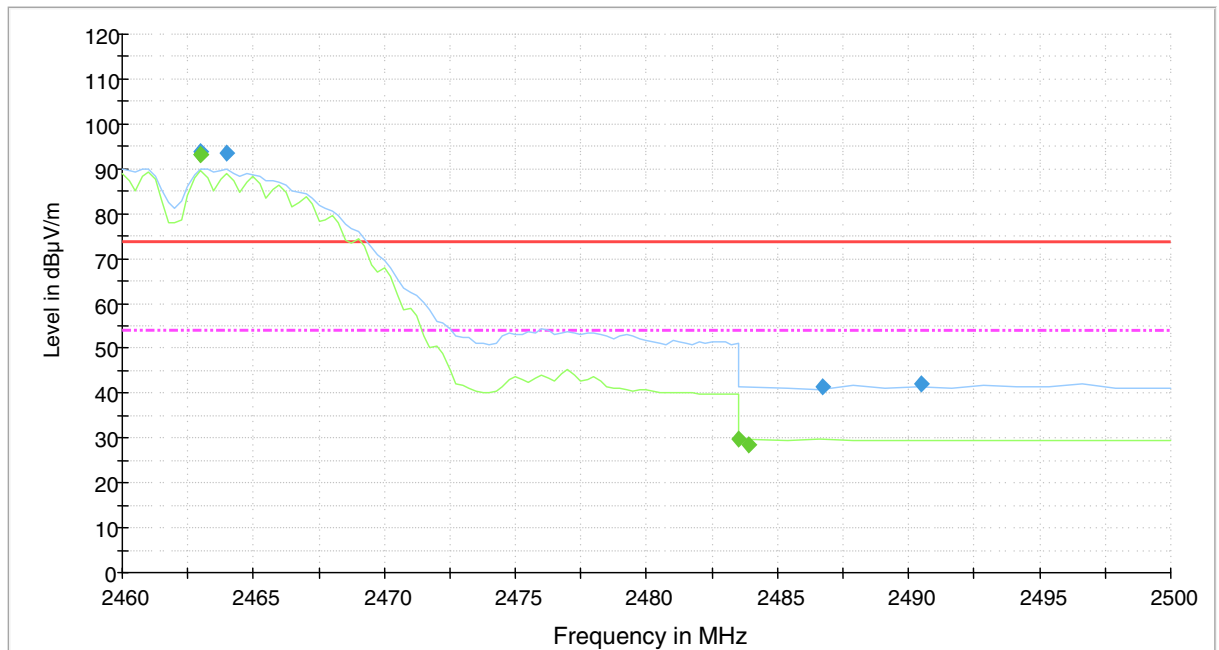
FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
— Preview Result 2-AVG
◆ Final Result 1-PK+
◆ Final Result 2-AVG

Figure 7. Measured curve with peak- and average detector (high channel).

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



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
— Preview Result 2-AVG
◆ Final Result 1-PK+
◆ Final Result 2-AVG

Figure 8. High channel band edge

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge
Final measurements from the worst frequencies
Table 8. Final Max Peak results.

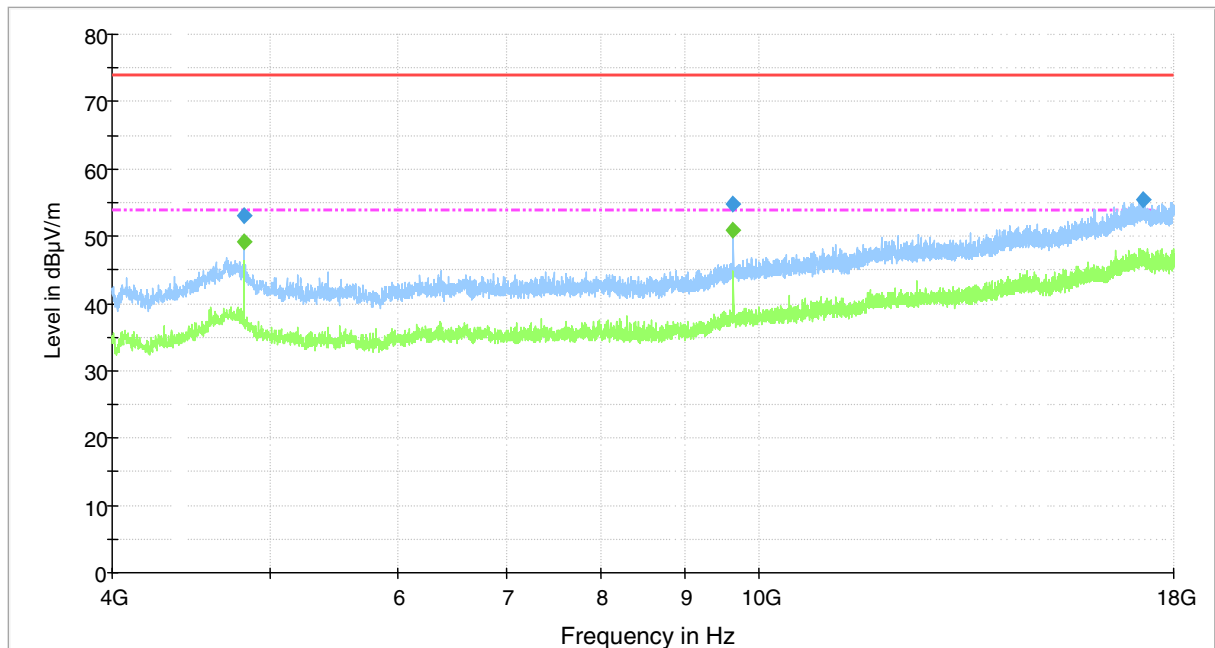
Frequency (MHz)	MaxPeak (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2463.000000	93.8	1000.0	1000.000	195.0	V	0.0	4.5	-	-	carrier
2464.000000	93.6	1000.0	1000.000	192.0	V	3.0	4.5	-	-	carrier
2486.700000	41.4	1000.0	1000.000	260.0	V	21.0	4.8	32.5	73.9	
2490.500000	42.1	1000.0	1000.000	377.0	H	356.0	4.8	31.8	73.9	

Table 9. Final Average results.

Frequency (MHz)	Average (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2463.000000	93.2	1000.0	1000.000	194.0	V	1.0	4.5	-	-	carrier
2463.000000	93.3	1000.0	1000.000	194.0	V	357,9	4.5	-	-	carrier
2483.500000	29.8	1000.0	1000.000	194.0	V	361.0	4.8	24.1	53.9	
2483.900000	28.3	1000.0	1000.000	195.0	H	25.0	4.8	25.6	53.9	

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

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



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
— Preview Result 1-PK+ — FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
◆ Final Result 1-PK+ ◆ Preview Result 2-AVG
◆ Final Result 2-AVG

Figure 9. Measured curve with peak- and average detector (low channel).

Final measurements from the worst frequencies

Table 10. Final Max Peak results.

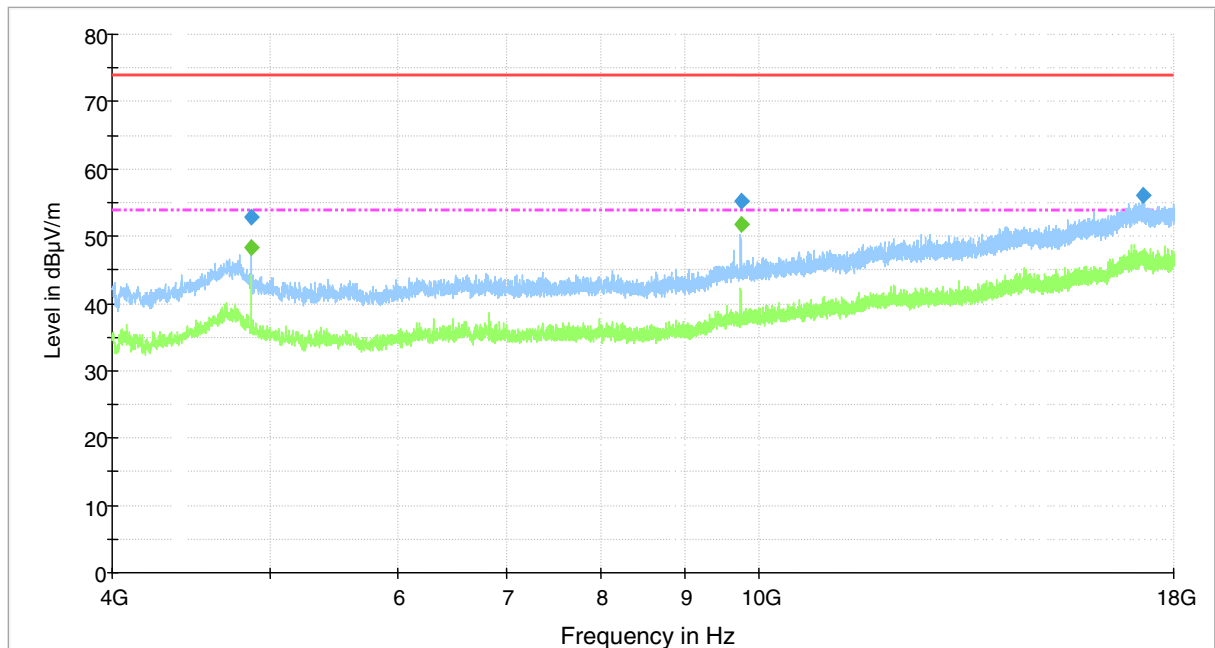
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4824.000000	53.1	1000.0	1000.000	187.0	H	20.0	13.5	20.8	73.9	
9648.000000	54.9	1000.0	1000.000	122.0	H	307.0	16.5	19.0	73.9	
17224.400000	55.5	1000.0	1000.000	100.0	H	101.0	28.3	18.4	73.9	

Table 11. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4824.000000	49.2	1000.0	1000.000	190.0	H	14.0	13.5	4.7	53.9	
9648.000000	50.8	1000.0	1000.000	130.0	H	315.0	16.5	3.1	53.9	

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

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



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
— Preview Result 1-PK+ — FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
◆ Final Result 1-PK+ ◆ Preview Result 2-AVG
◆ Final Result 2-AVG

Figure 10. Measured curve with peak- and average detector (middle channel).

Final measurements from the worst frequencies

Table 12. Final Max Peak results.

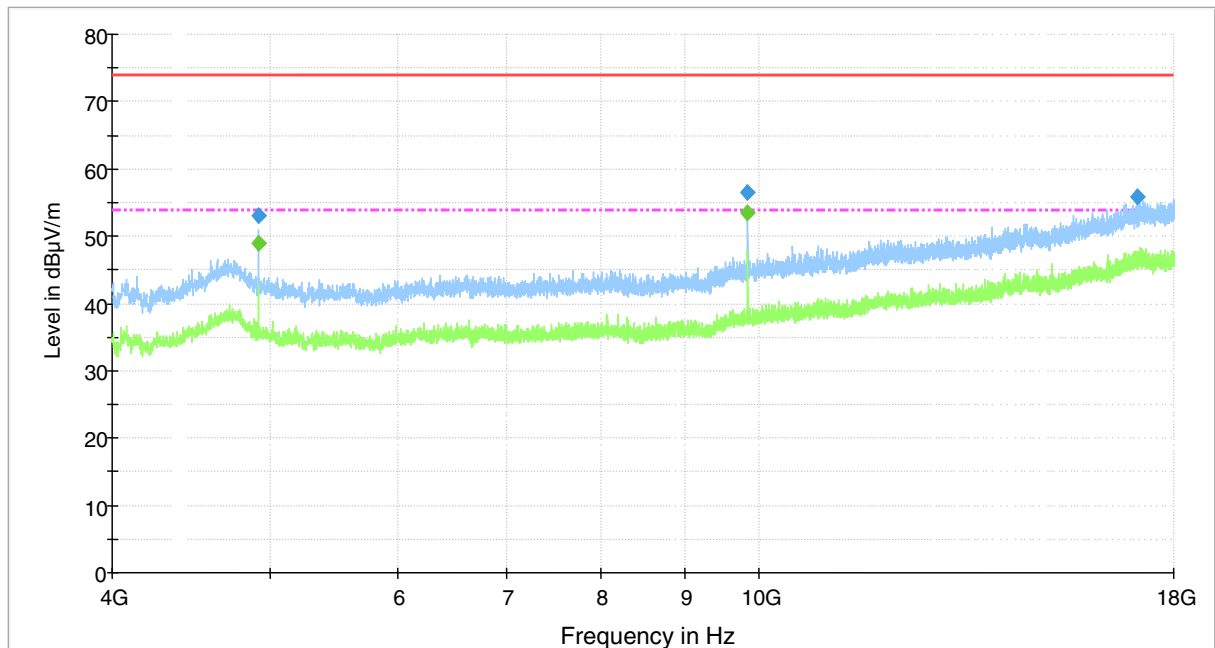
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4874.000000	52.8	1000.0	1000.000	187.0	H	15.0	12.9	21.1	73.9	
9748.000000	55.1	1000.0	1000.000	122.0	H	304.0	16.7	18.8	73.9	
17232.200000	56.0	1000.0	1000.000	100.0	V	122.0	28.3	17.9	73.9	

Table 13. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4874.000000	48.2	1000.0	1000.000	187.0	H	12.0	12.9	5.7	53.9	
9748.000000	51.7	1000.0	1000.000	129.0	H	308.0	16.7	2.2	53.9	

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

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



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
— Preview Result 1-PK+ - - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
◆ Final Result 1-PK+ ◆ Preview Result 2-AVG
◆ Final Result 2-AVG

Figure 11. Measured curve with peak- and average detector (high channel).

Final measurements from the worst frequencies

Table 14. Final Max Peak results.

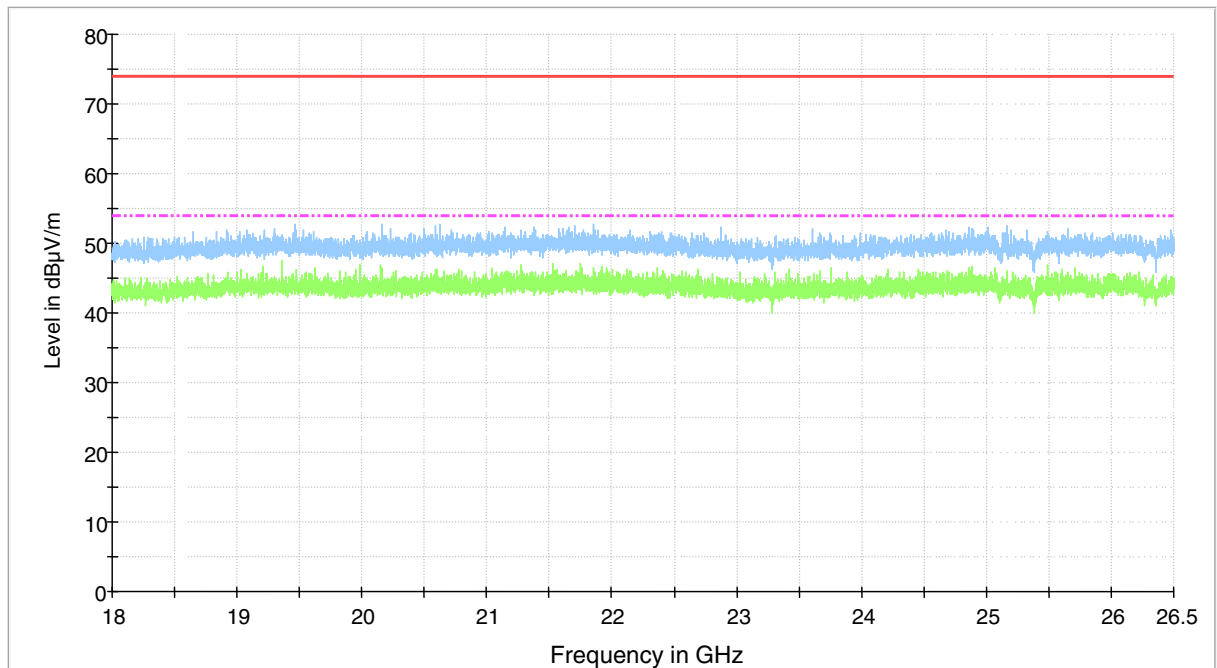
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4924.000000	53.0	1000.0	1000.000	187.0	H	14.0	12.3	20.9	73.9	
9848.000000	56.6	1000.0	1000.000	127.0	H	301.0	16.8	17.3	73.9	
17092.000000	55.8	1000.0	1000.000	100.0	V	312.0	28.2	18.1	73.9	

Table 15. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4924.000000	48.9	1000.0	1000.000	170.0	H	15.0	12.3	5.0	53.9	
9848.000000	53.6	1000.0	1000.000	130.0	H	305.0	16.8	0.3	53.9	

Radiated Spurious emissions 30 to 26 500 MHz and Band Edge

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



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
 - - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
 — Preview Result 2-AVG

Figure 13. Measured curve with peak- and average detector (middle channel).

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

LIST OF TEST EQUIPMENT

Manufacturer	Type	Serial no	Inv. no
ROHDE & SCHWARZ			
Signal Analyzer	FSV40	101068	9093
EMI Test receiver	ESU 26	100185	8453
Test software	EMC32	-	-
BOONTON			
RF power meter	4300	87105ED	5029
Power sensor	51075	34999	8266
DAVIS			
Weather station	Vantage Pro	-	5297
EMCO			
Antenna (1 - 18 GHz)	3117	29617	7293
ETS-LINDGREN			
Antenna (18 GHz – 26 GHz)	3160-09	28535	7294
SCHWARZBECK			
Antenna (30 MHz - 1 GHz)	VULB 9168	9168-503	8911
HEWLETT- PACKARD			
Microwave amplifier	83017A	-	5226
HUBER-SUHNER			
Attenuator 10dB	6810.17B	-	-
DEISEL			
Antenna mast	MA 240	240/455	7896
Turntable	DS 430	-	-
WAINWRIGHT			
High Pass Filter	WHKX	10	8267

All used measurement equipment was calibrated (if required).