

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test: RFID module

Type/ Model: NUR-10W

Manufacturer: Nordic ID Oy
Myllyojakatu 2A
FI-24100 Salo
FINLAND

Customer: Nordic ID Oy
Myllyojakatu 2A
FI-24100 Salo
FINLAND

FCC Rule Part: 15.247: 2014
RSS-247, Issue 1, 2015
RSS-GEN Issue 4, 2014

KDB: Filing and Measurement Guidelines for
Frequency Hopping Spread Spectrum Systems
DA 00-705 (March 30, 2000)

Date: 4.11.2015

Issued by:

A blue ink signature of Pekka Kälviäinen.

Pekka Kälviäinen
Testing Engineer

Date: 4.11.2015

Checked by:

A blue ink signature of Janne Nyman.

Janne Nyman
Compliance Specialist

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Equipment Under Test (EUT)

RFID Module	
Type/ Model:	NUR-10W
Serial Number:	00100789
FCC ID:	SCCNUR10W
IC:	5137A-NUR10W

Cross Dipole antenna with reflector (Ant1):	-
4 Patch antenna-array (Ant2)	-

NUR-10W is an RFID module using 902-928 MHz frequency band.
The EUT has SMA female antenna connector. EUT has two alternative external antennas.

Classification of the device

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

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing

Ratings and declarations

Operating Frequency Range :	902 – 928 MHz
Channels:	52
Channel separation:	500 kHz
Conducted power:	28.26 dBm
	FHSS

Modulation:	ASK, PR-ASK
External antenna Ant1, Cross Dipole antenna with reflector:	5 dBi
External antenna Ant2, 4 Patch antenna-array:	6 dBi

Power Supply

Operating voltage:	3.6 VDC
Operating voltage AC/DC power supply	230V50Hz
type: Thandar TS3021S, s/n: 099609	
:	

Disclaimer

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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	Result
§15.207(a) / RSS-GEN 8.8	Conducted Emissions on Power Supply Lines	PASS
§15.247(b)(2) / RSS-247 5.4	Maximum Peak Conducted Output Power	PASS
§15.247(a)(1)(i) / RSS-247 5.1	Hopping Channel Carrier Frequency Separation	PASS
§15.247(a)(1)(i) / RSS-247 5.1	Number of Hopping Frequencies	PASS
§15.247(a)(1)(i) / RSS-247 5.1	Average Time of Occupancy of Hopping Frequency	PASS
§15.247(a)(1)(i) / RSS-247 5.1	20 dB Bandwidth	PASS
RSS-GEN 6.6	99 % Occupied Bandwidth	PASS
§15.247(d) / RSS-247 5.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	PASS
§15.209(a), §15.247(d) / RSS-247 5.5	Radiated Emissions Within The Restricted Bands	PASS
§15.209 / RSS-GEN 6.13	Unintentional Radiated Emissions	PASS
§15.109 / RSS-GEN 7.1	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.

Following channels were used during the tests:

Channel	Frequency/ MHz
LOW (CH 0)	902.250
MID (CH 25)	914.750
HIGH (CH 51)	927.750

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

Conducted Emissions In The Frequency Range 150 kHz – 30 MHz

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

Standard: ANSI C63.10 (2013)
Tested by: NKO
Date: 5.9..2015
Temperature: 20 °C
Humidity: 30 % RH
Barometric pressure: -
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.

During the test the EUT was powered from the separate power supply through the LISN.

Frequency of emission (MHz)	Conducted limit (dB μ 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.

Conducted Emissions In The Frequency Range 150 kHz – 30 MHz

Conducted Emission Mains FCC Part 15 Class B with ESH3-Z5 8019

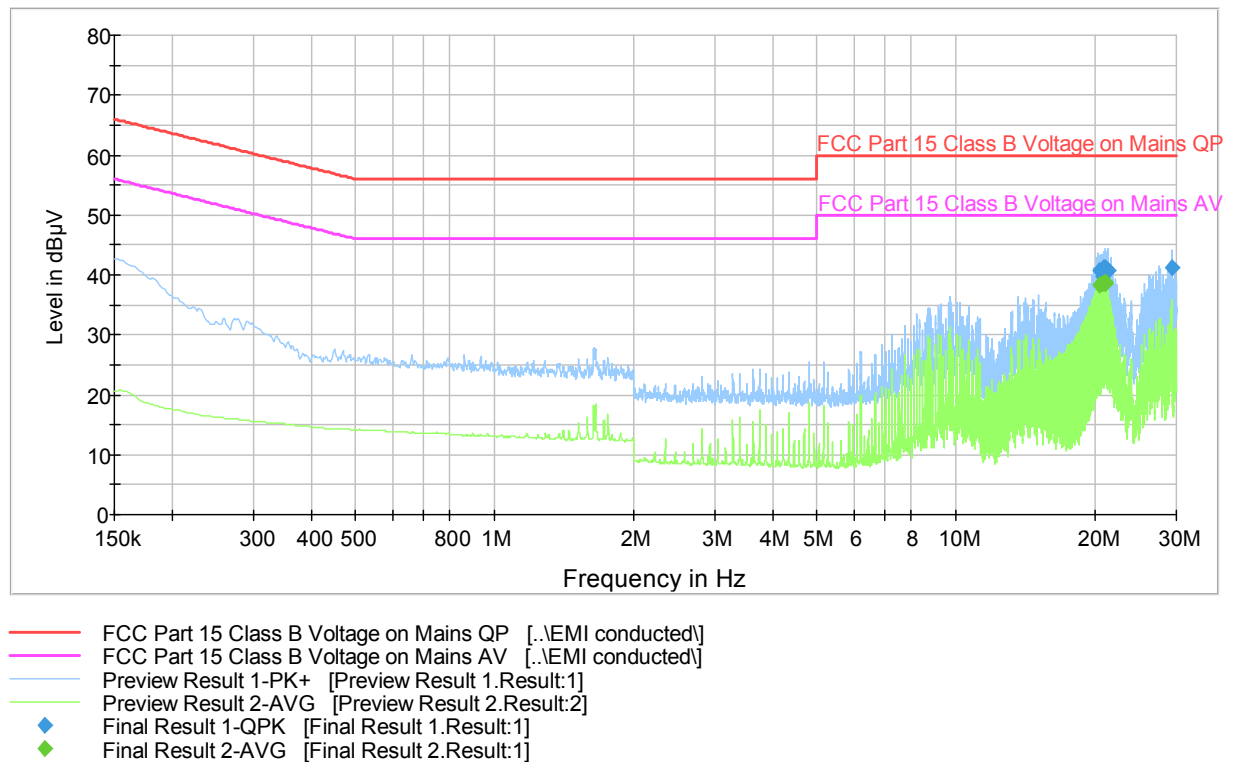


Figure 1. The measured curves with peak- and average detector

Final measurements from the worst frequencies

Table 1. Final results.

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr (dB)	Margin (dB)	Limit (dBμV)	Comment
20.503000	40.8	1000.0	9.000	GND	L1	11.9	19.2	60.0	
20.775250	39.9	1000.0	9.000	GND	L1	11.9	20.1	60.0	
20.849500	41.1	1000.0	9.000	GND	L1	11.9	18.9	60.0	
20.986750	41.1	1000.0	9.000	GND	L1	11.9	18.9	60.0	
21.326500	40.7	1000.0	9.000	GND	L1	11.9	19.3	60.0	
29.296000	41.1	1000.0	9.000	GND	L1	12.1	18.9	60.0	

Table 2. Final results.

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr (dB)	Margin (dB)	Limit (dBμV)	Comment
20.433250	38.2	1000.0	9.000	GND	L1	11.9	11.8	50.0	
20.503000	38.4	1000.0	9.000	GND	L1	11.9	11.6	50.0	
20.779750	38.7	1000.0	9.000	GND	L1	11.9	11.4	50.0	
20.984500	38.7	1000.0	9.000	GND	L1	11.9	11.3	50.0	
21.052000	38.6	1000.0	9.000	GND	L1	11.9	11.4	50.0	

Maximum Peak Conducted Output Power**Maximum Peak Conducted Output Power**

Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 7.10.2015
Humidity: 21 %
Temperature: 23 °C
Measurement uncertainty $\pm 2.87\text{dB}$ Level of confidence 95 % (k = 2)

FCC Rule: 15.247(b) (2)
RSS-247 5.4

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling 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.

Results:

Channel	Conducted Power [dBm]	Limit [dBm]	Result
Low	28.26	30	PASS
Mid	27.05	30	PASS
High	26.54	30	PASS

Maximum Peak Conducted Output Power



Date: 7.OCT.2015 09:48:28

Figure 2. Channel LOW.

Maximum Peak Conducted Output Power



Date: 7.OCT.2015 09:51:03

Figure 3. Channel MID.

Maximum Peak Conducted Output Power



Date: 7.OCT.2015 09:53:06

Figure 4. Channel HIGH.

Transmitter and Receiver Radiated Emissions 30 MHz to 10 GHz

Standard:	ANSI C63.10	(2013)
Tested by:	PKA	
Date:	6. and 12.-14.10.2015	
Temperature:	21 - 22 °C	
Humidity:	30 - 36 % RH	
Measurement uncertainty	± 4.51 dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.247(d), 15.209(a), 15.109
RSS-247 5.5, RSS-GEN 6.13, RSS-GEN 7.1

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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. 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 result value is the measured value corrected with the correction factor.

Measurements were done separately with both alternative antennas. Measurements were done EUT in three orthogonal orientations.

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1

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

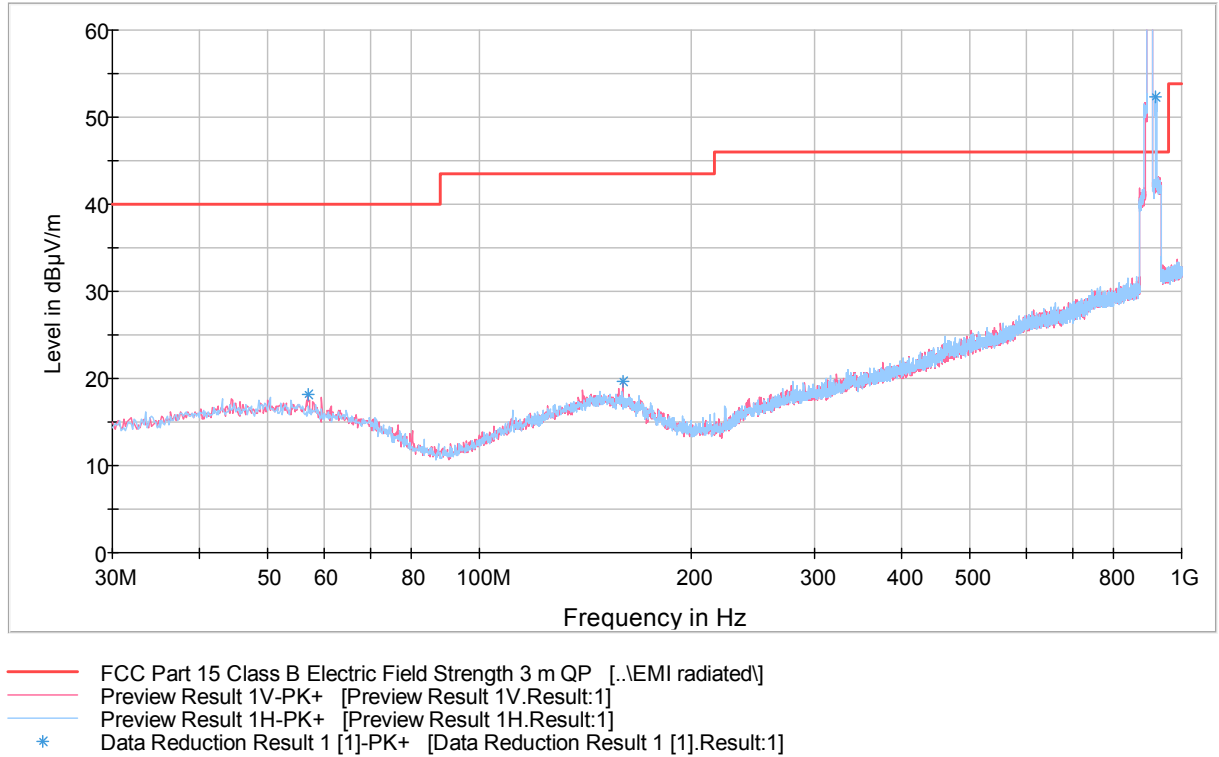


Figure 5. Measured curve with peak-detector. Channel LOW.

Highest Result

Frequency MHz	Max result dBμV/m	Limit dBμV/m	Margin dB
956.475	32.8	45.5	12.7

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1

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

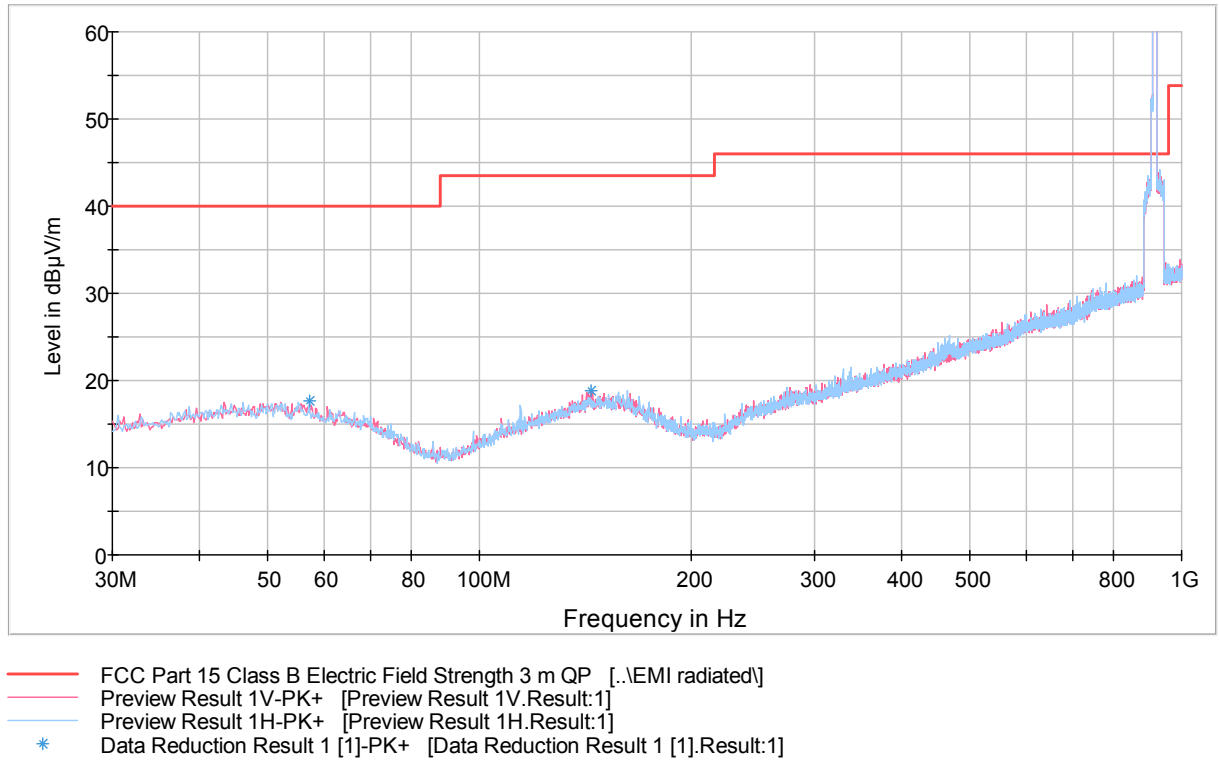


Figure 6. Measured curve with peak-detector. Channel MID.

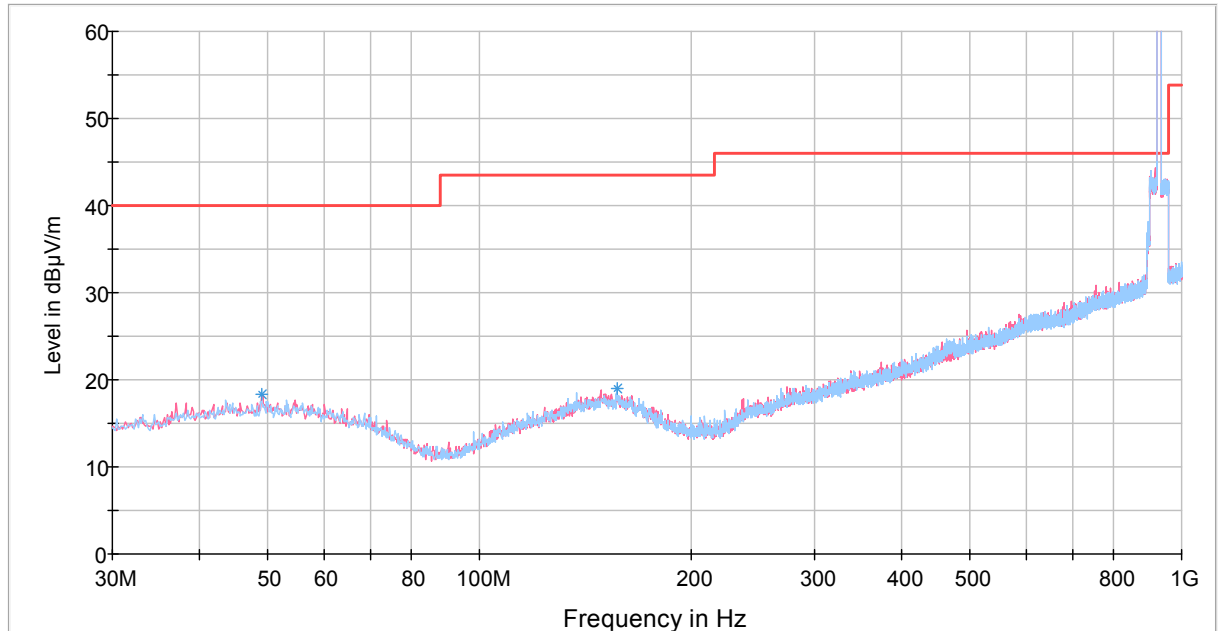
Highest Result

Frequency MHz	Max result dB μ V/m	Limit dB μ V/m	Margin dB
959.625	33.3	45.5	12.2

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1

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



— FCC Part 15 Class B Electric Field Strength 3 m QP [..\EMI radiated]
 — Preview Result 1V-PK+ [Preview Result 1V.Result:1]
 — Preview Result 1H-PK+ [Preview Result 1H.Result:1]
 * Data Reduction Result 1 [1]-PK+ [Data Reduction Result 1 [1].Result:1]

Figure 7. Measured curve with peak-detector. Channel HIGH.

Highest Result

Frequency MHz	Max result dBµV/m	Limit dBµV/m	Margin dB
957.975	32.8	45.5	12.7

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1

FCC Part 15 Class B Spurious Emission 1-10GHz 3m Restricted band limit

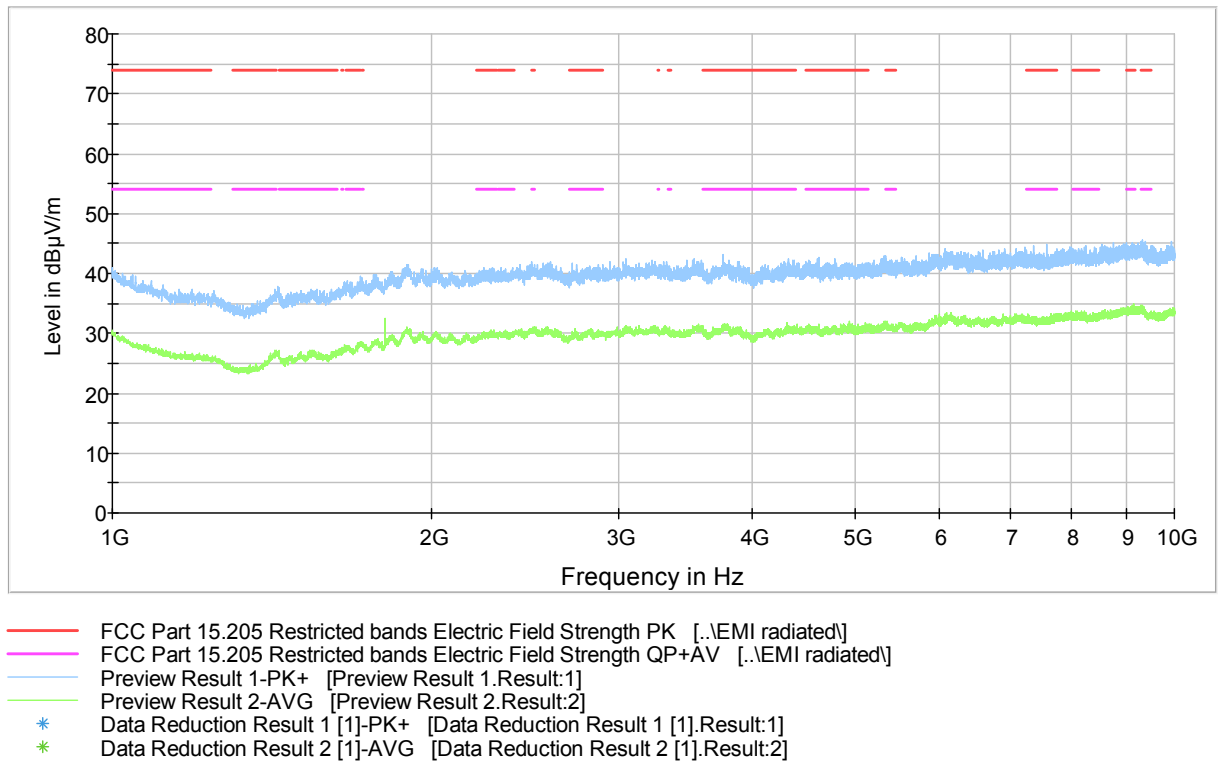


Figure 8. Measured curve with peak- and average detector. Channel LOW.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1

FCC Part 15 Class B Spurious Emission 1-10GHz 3m Restricted band limit

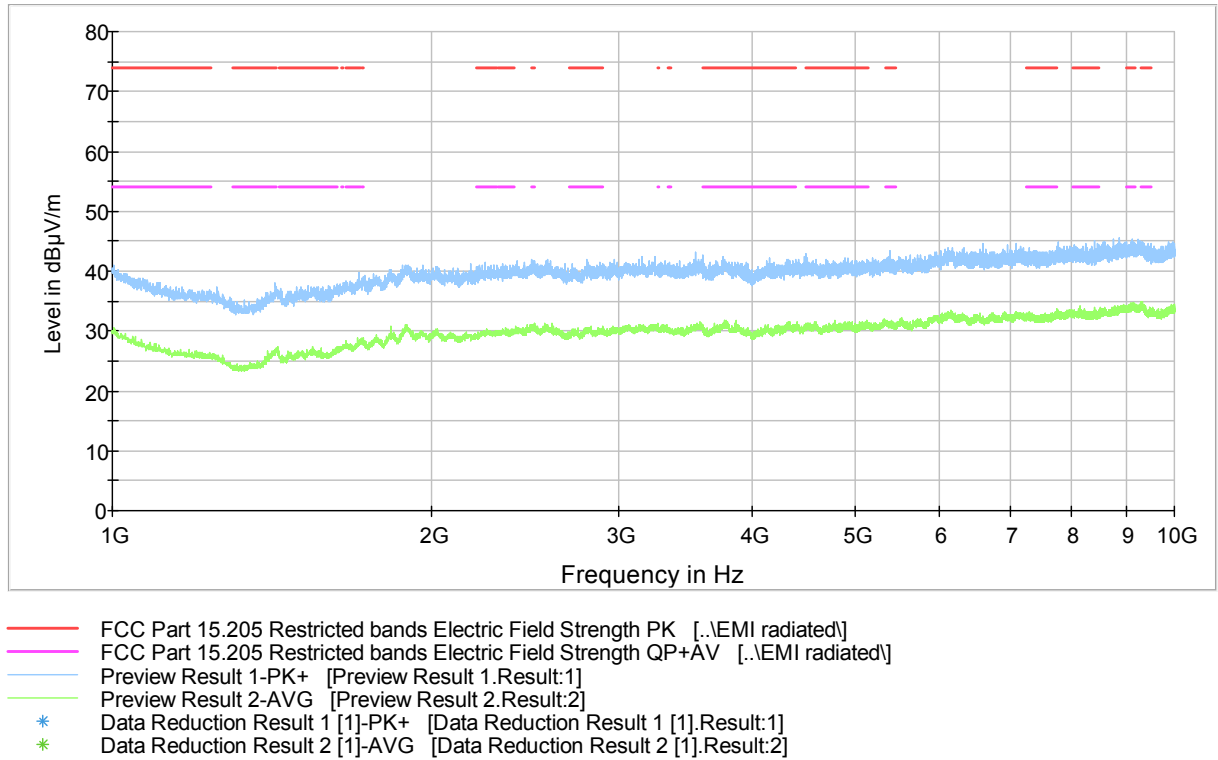


Figure 9. Measured curve with peak- and average detector. Channel MID.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1

FCC Part 15 Class B Spurious Emission 1-10GHz 3m Restricted band limit

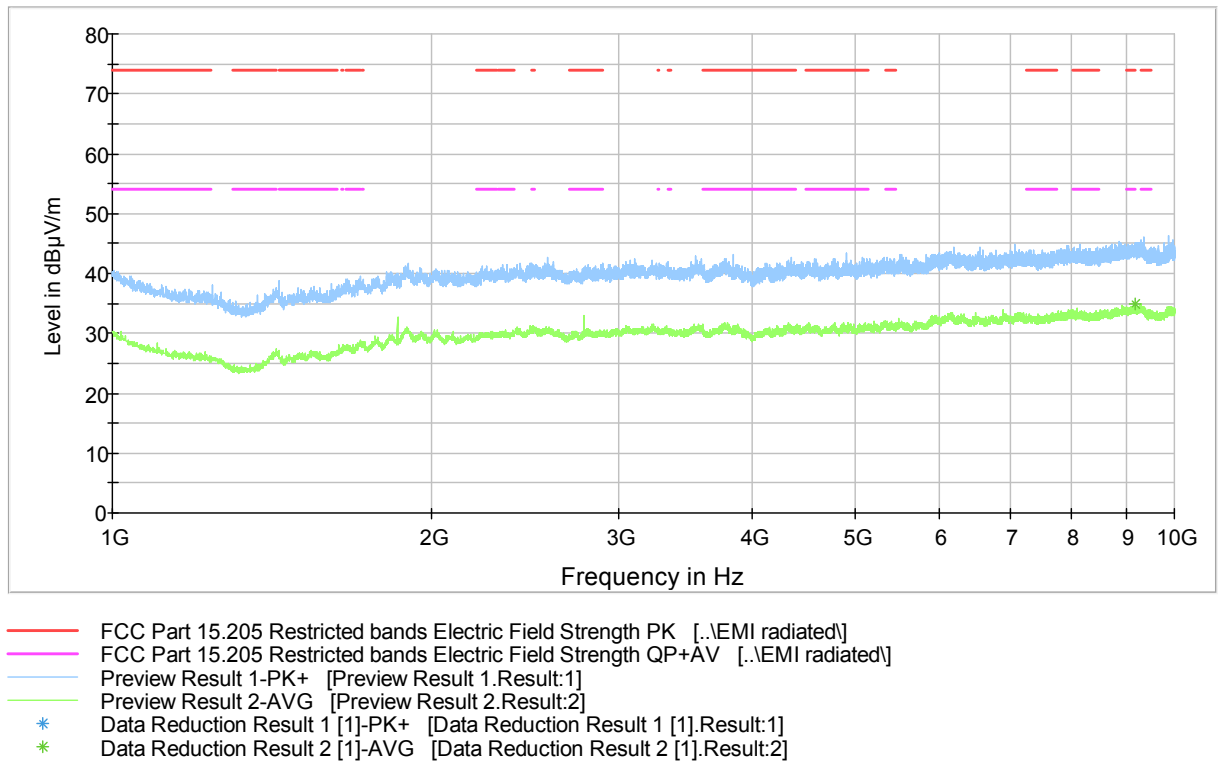


Figure 10. Measured curve with peak- and average detector. Channel HIGH.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1, Receiver

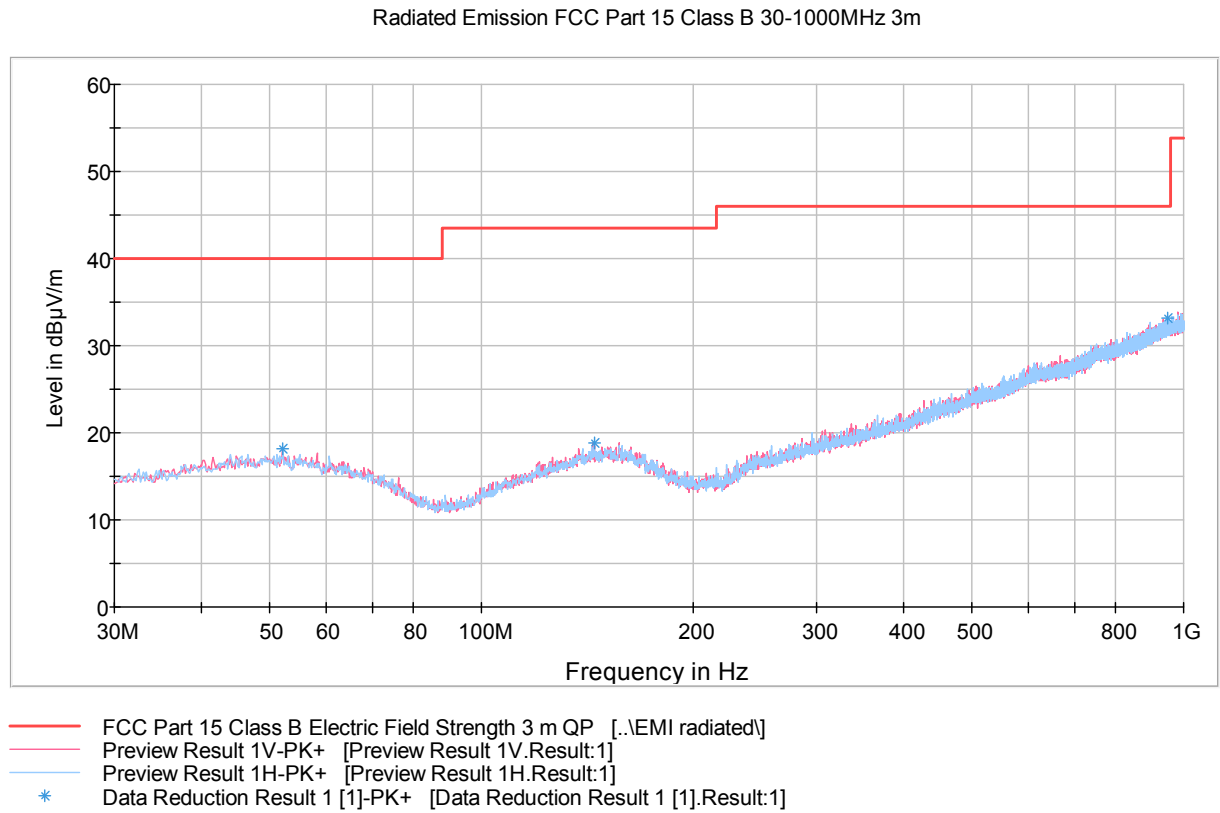


Figure 11. Measured curve with peak-detector. Receiver.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant1, Receiver

FCC Part 15 Class B Spurious Emission 1-18GHz 3m Rx

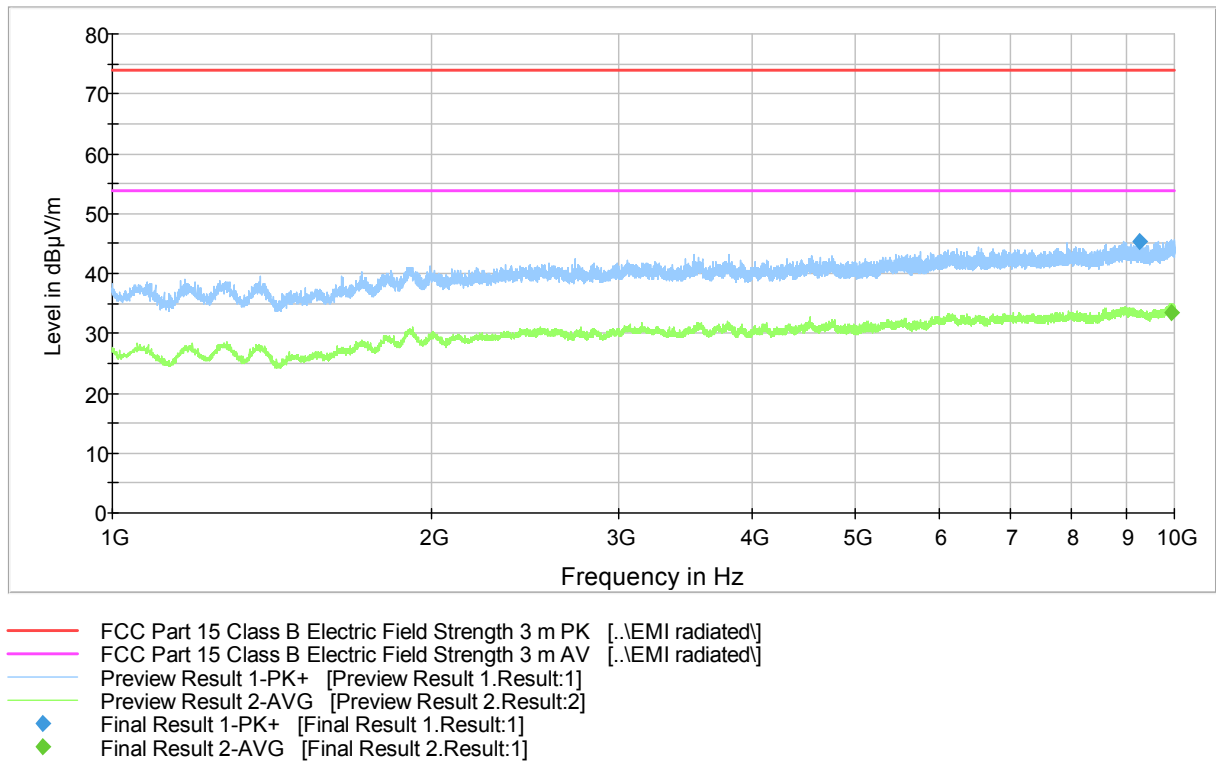


Figure 12. Measured curve with peak- and average detector. Receiver

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m (optimized 900 MHz TX)

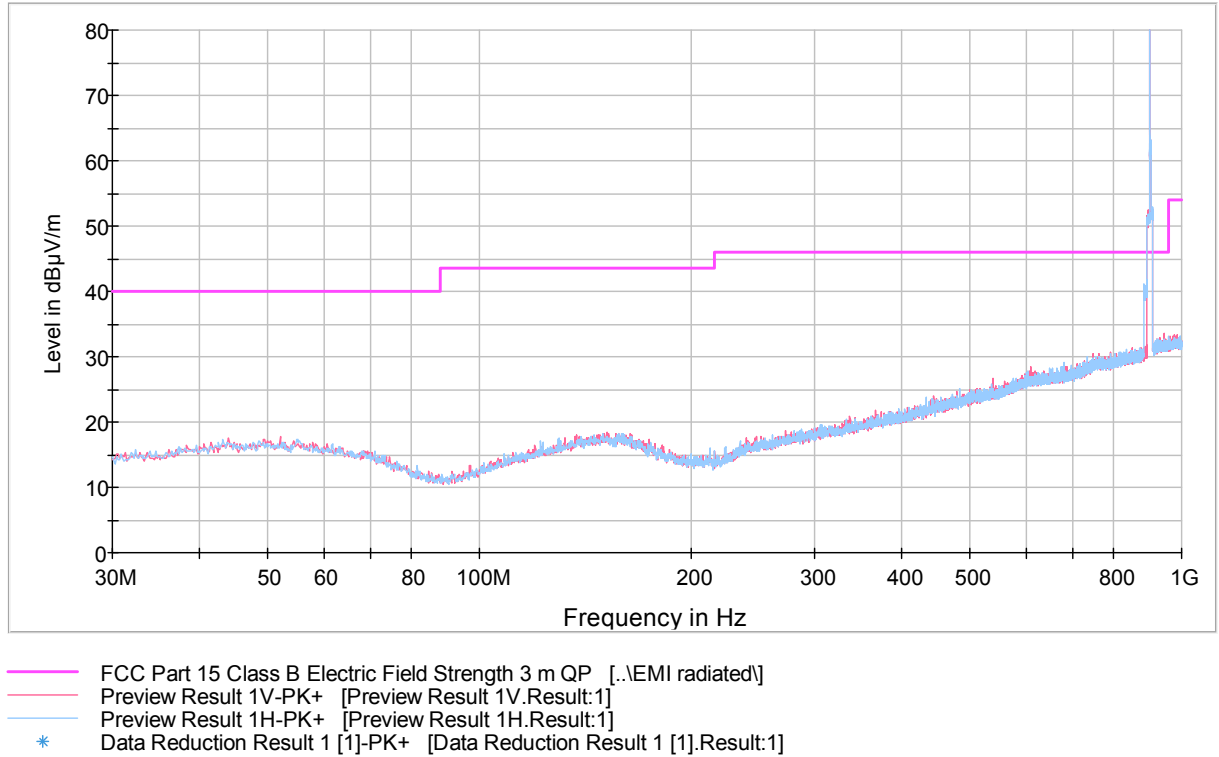


Figure 13. Measured curve with peak- and average detector. Channel LOW.

Highest Result

Frequency MHz	Max result dB μ V/m	Limit dB μ V/m	Margin dB
958.875	33.0	45.5	12.5

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m (optimized 900 MHz TX)

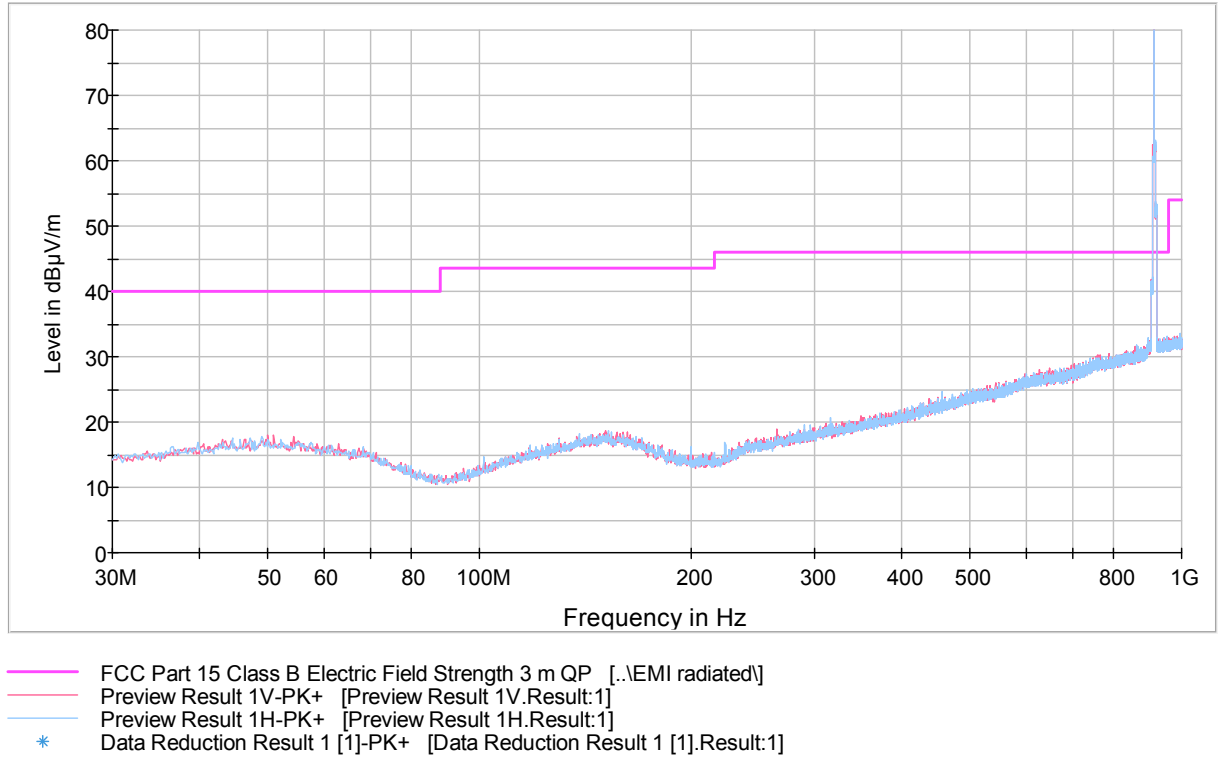


Figure 14. Measured curve with peak- and average detector. Channel MID.

Highest Result

Frequency MHz	Max result dBµV/m	Limit dBµV/m	Margin dB
958.425	32.8	45.5	12.7

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m (optimized 900 MHz TX)

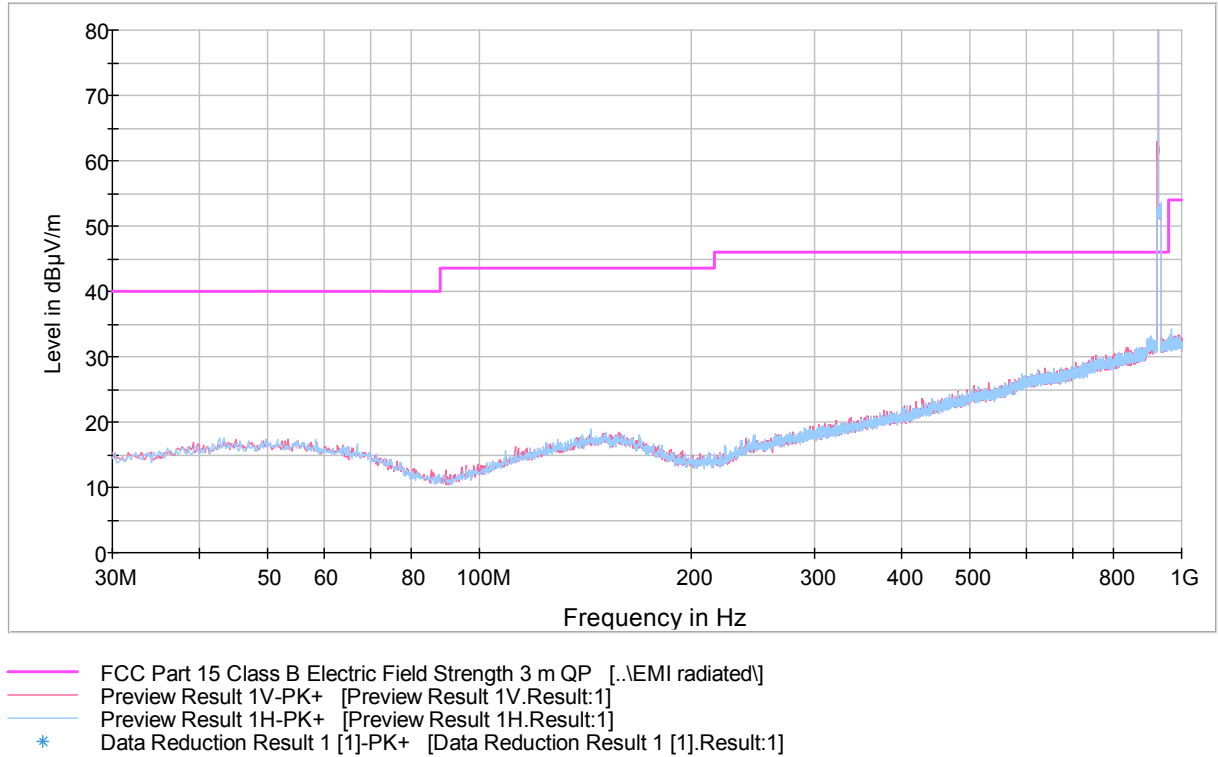


Figure 15. Measured curve with peak- and average detector. Channel HIGH.

Highest Result

Frequency MHz	Max result dBμV/m	Limit dBμV/m	Margin dB
958.875	33.0	45.5	12.5

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2

FCC Part 15 Class B Spurious Emission 1-10GHz 3m Restricted band limit

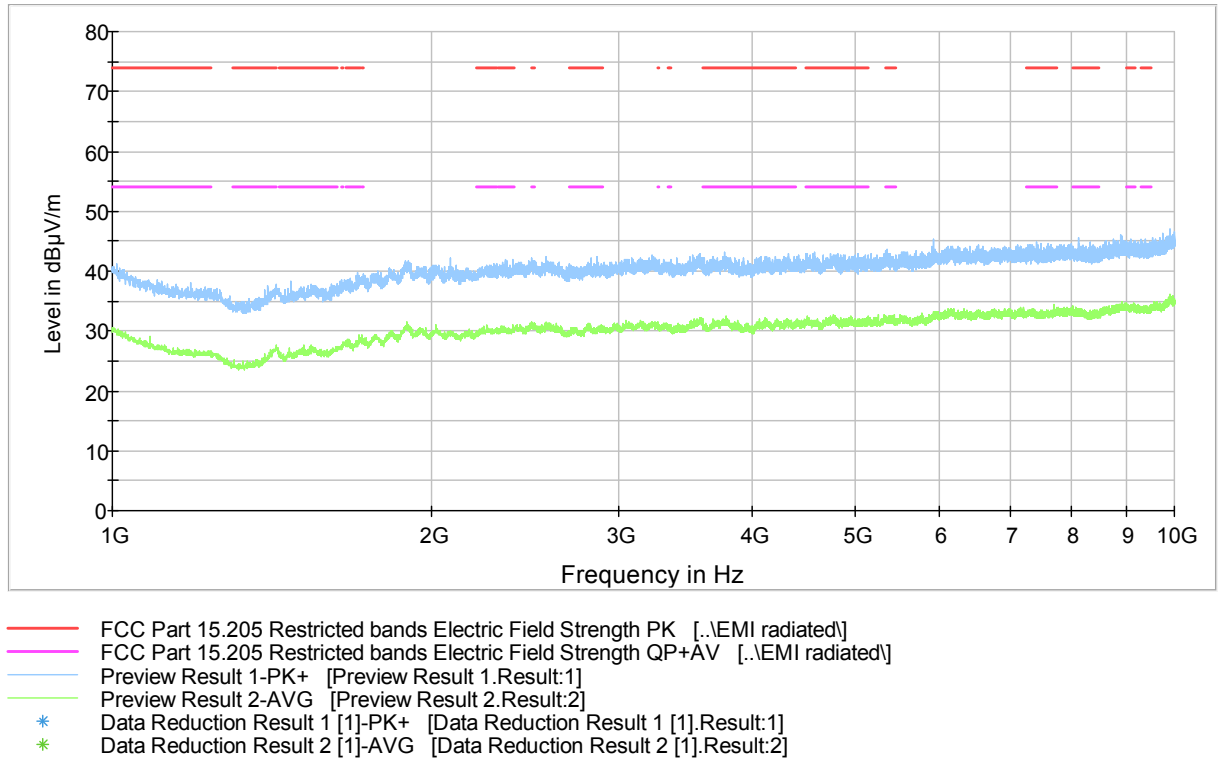


Figure 16. Measured curve with peak- and average detector. Channel LOW.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2

FCC Part 15 Class B Spurious Emission 1-10GHz 3m Restricted band limit

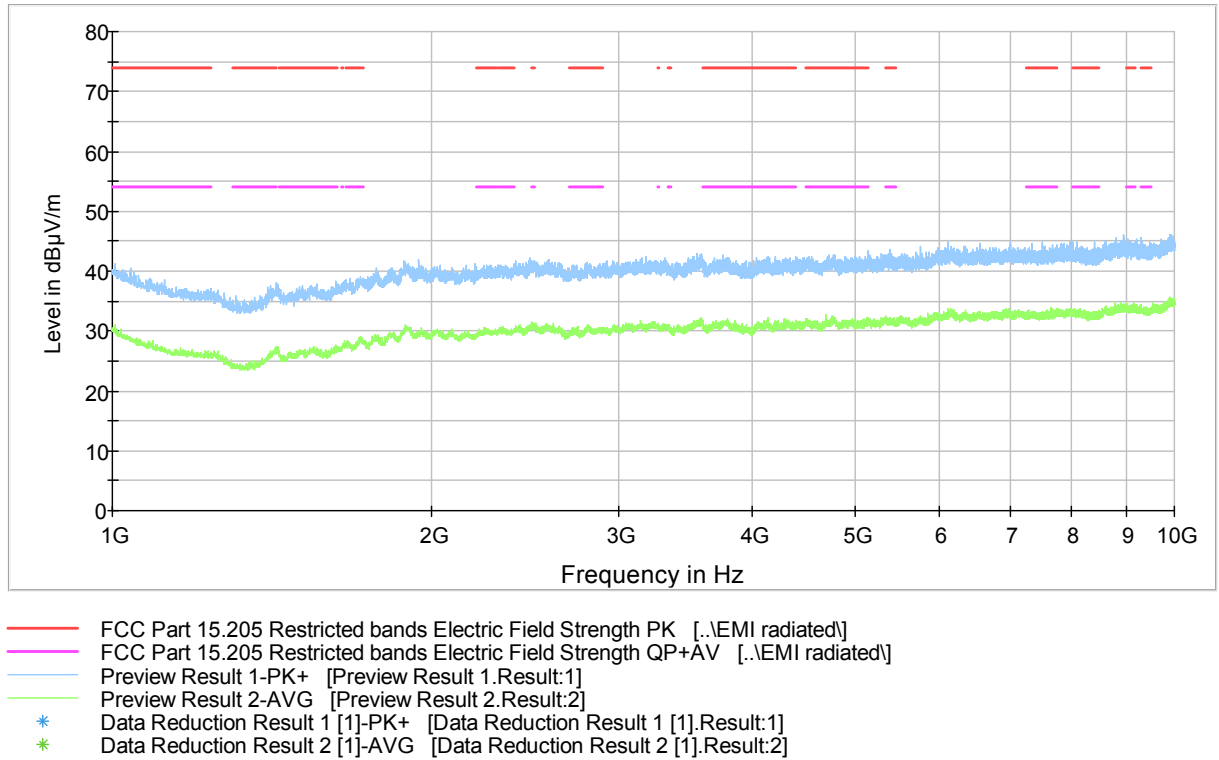


Figure 17. Measured curve with peak- and average detector. Channel MID.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2

FCC Part 15 Class B Spurious Emission 1-10GHz 3m Restricted band limit

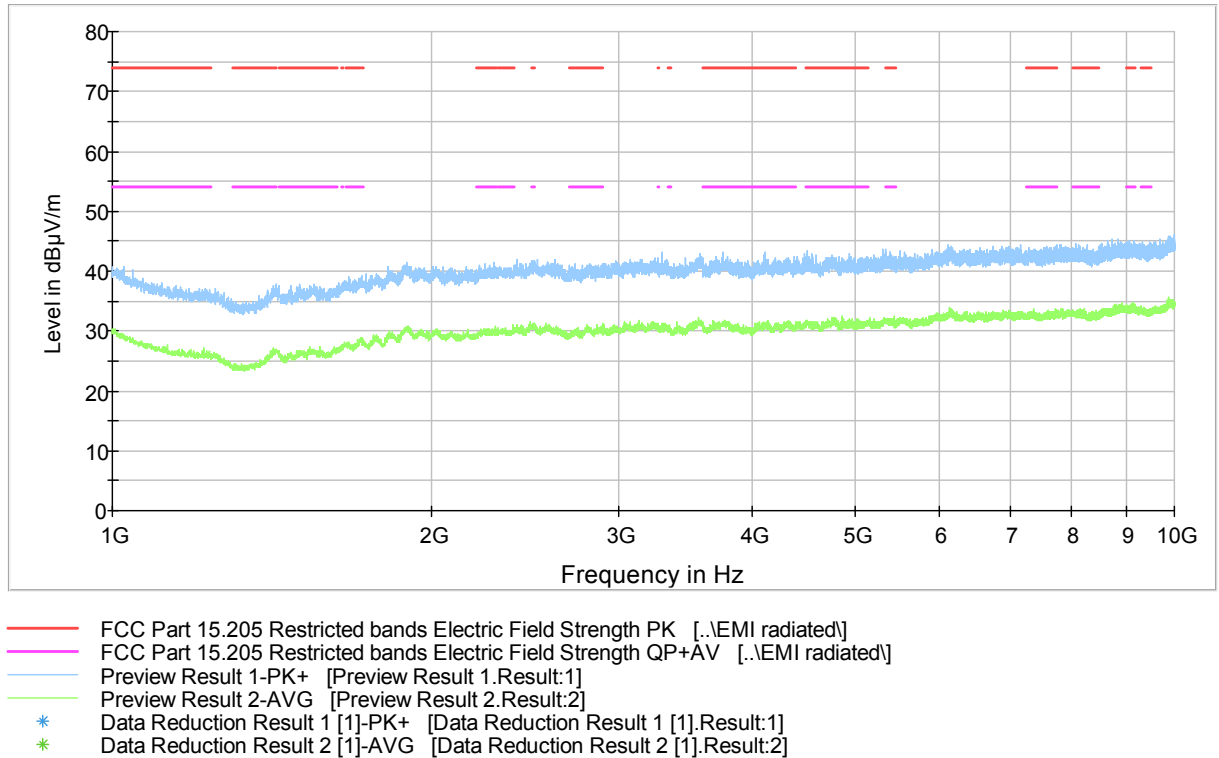


Figure 18. Measured curve with peak- and average detector.

Channel HIGH.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2, Receiver state

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m (optimized 900 MHz TX)

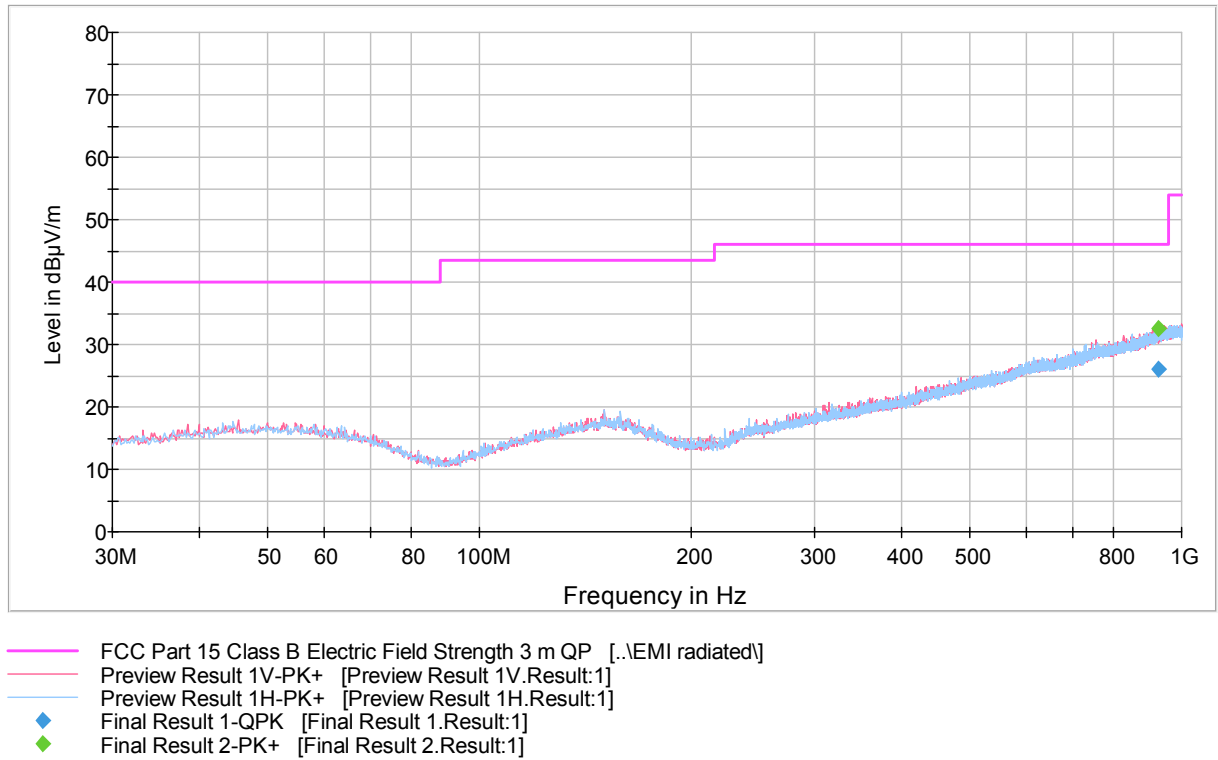


Figure 19. Measured curve with peak- and average detector. Receiver.

No final measurements needed, marginal > 20dB

Transmitter Radiated Emissions 30 MHz to 10 GHz

Ant2, Receiver state

FCC Part 15 Class B Spurious Emission 1-18GHz 3m Rx

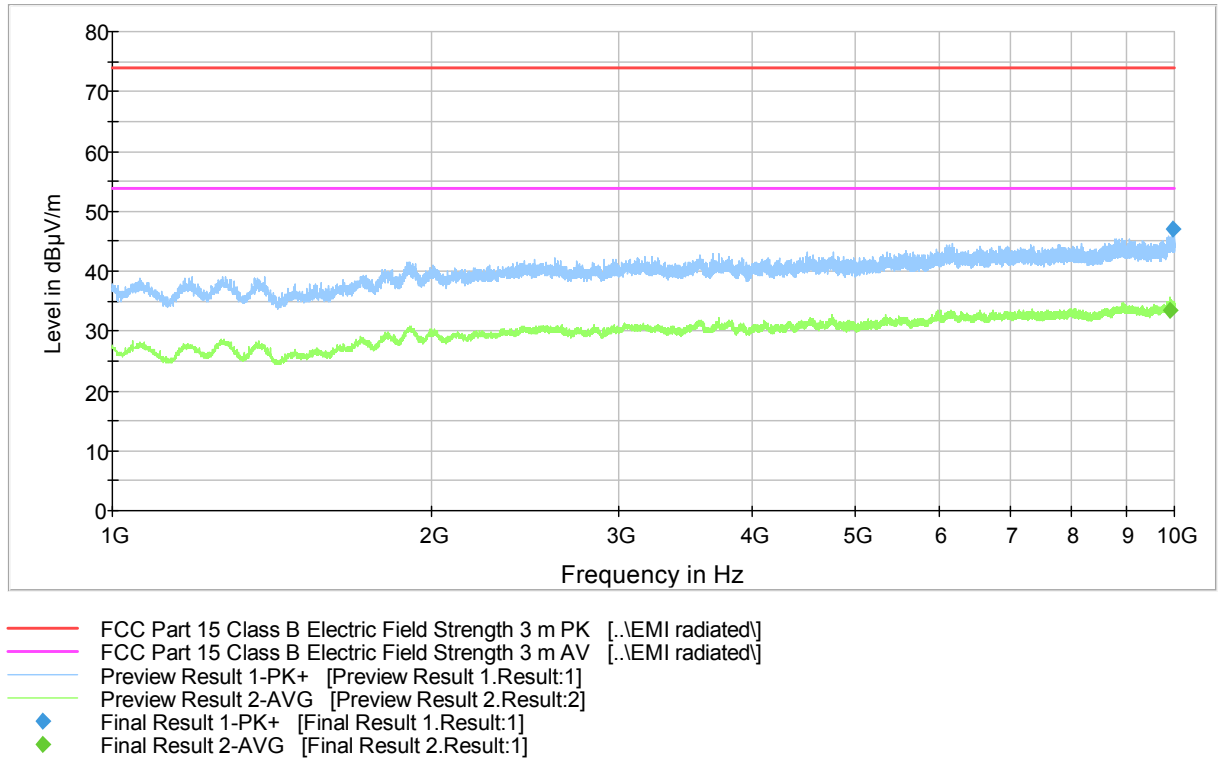


Figure 20. Measured curve with peak- and average detector. Receiver

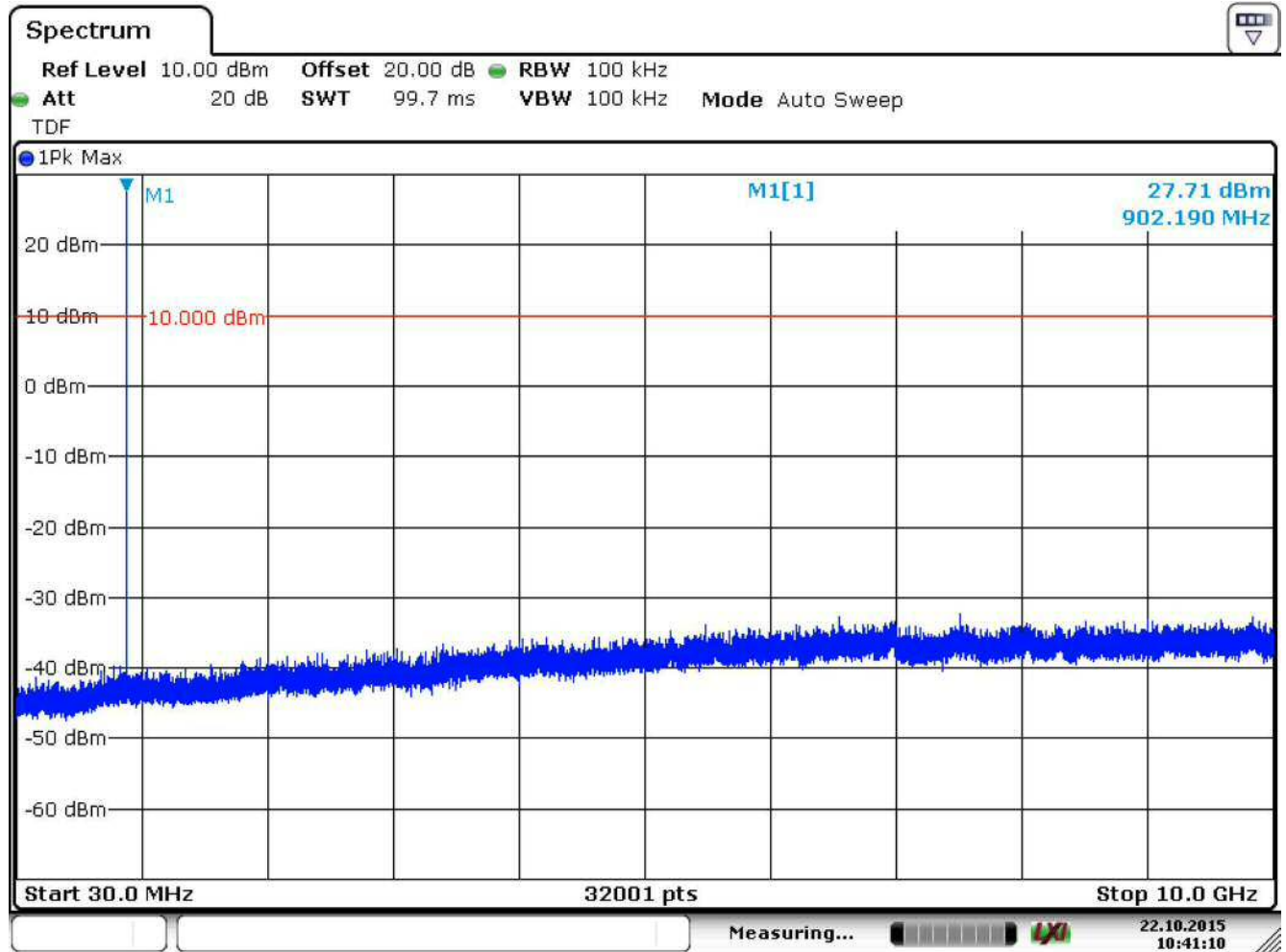
No final measurements needed, marginal > 20dB

Conducted Spurious Emission 30 MHz to 10 GHz and Band Edge

Conducted Spurious Emissions 30 MHz to 10 GHz and Band Edge

Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 22.10.2015
Temperature: 21 °C
Humidity: 36 % RH

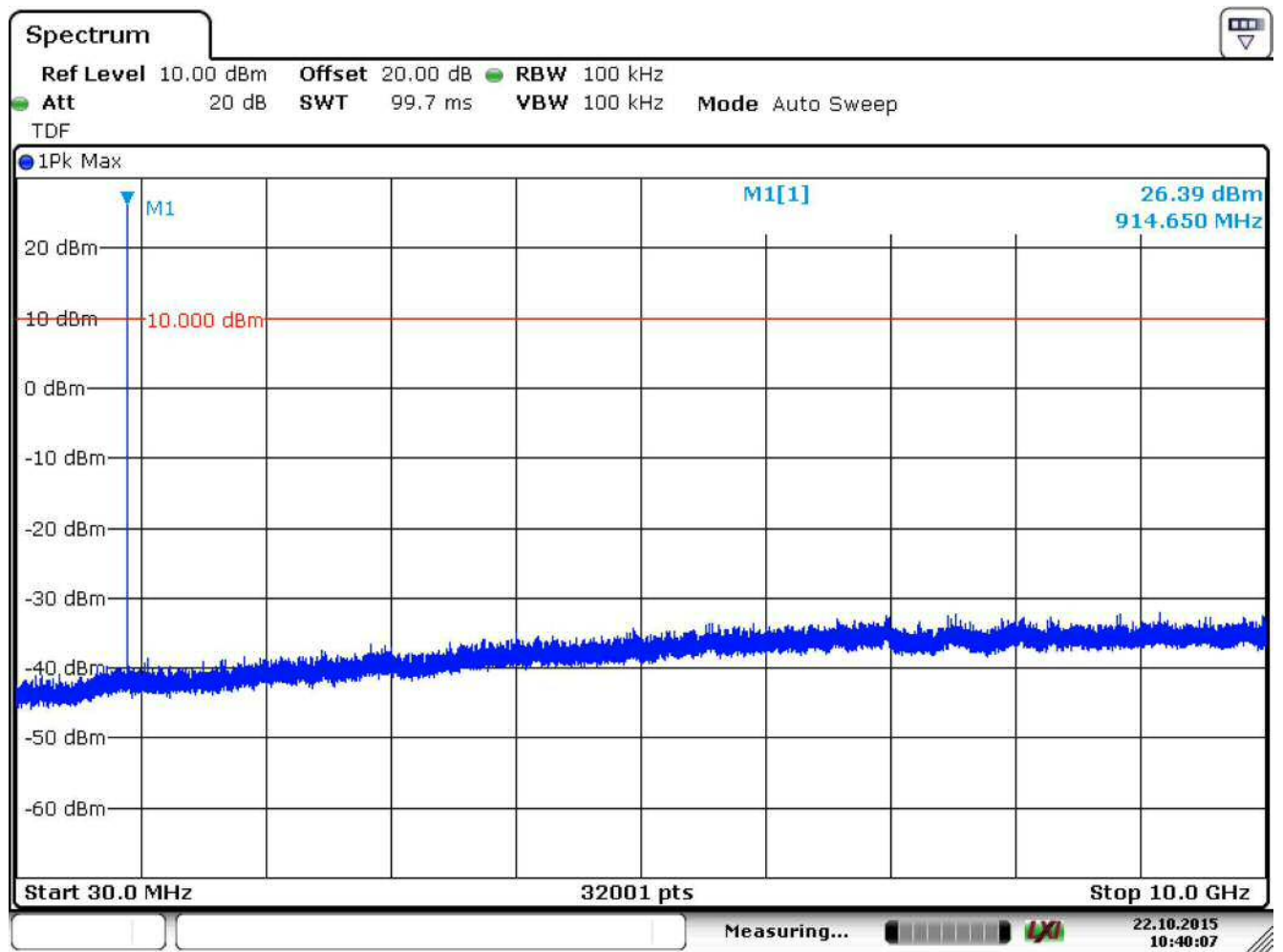
FCC Rule: 15.247 (d)
RSS-247 5.5



Date: 22.OCT.2015 10:41:10

Figure 21. Low channel conducted emission 30 MHz to 10000 MHz.

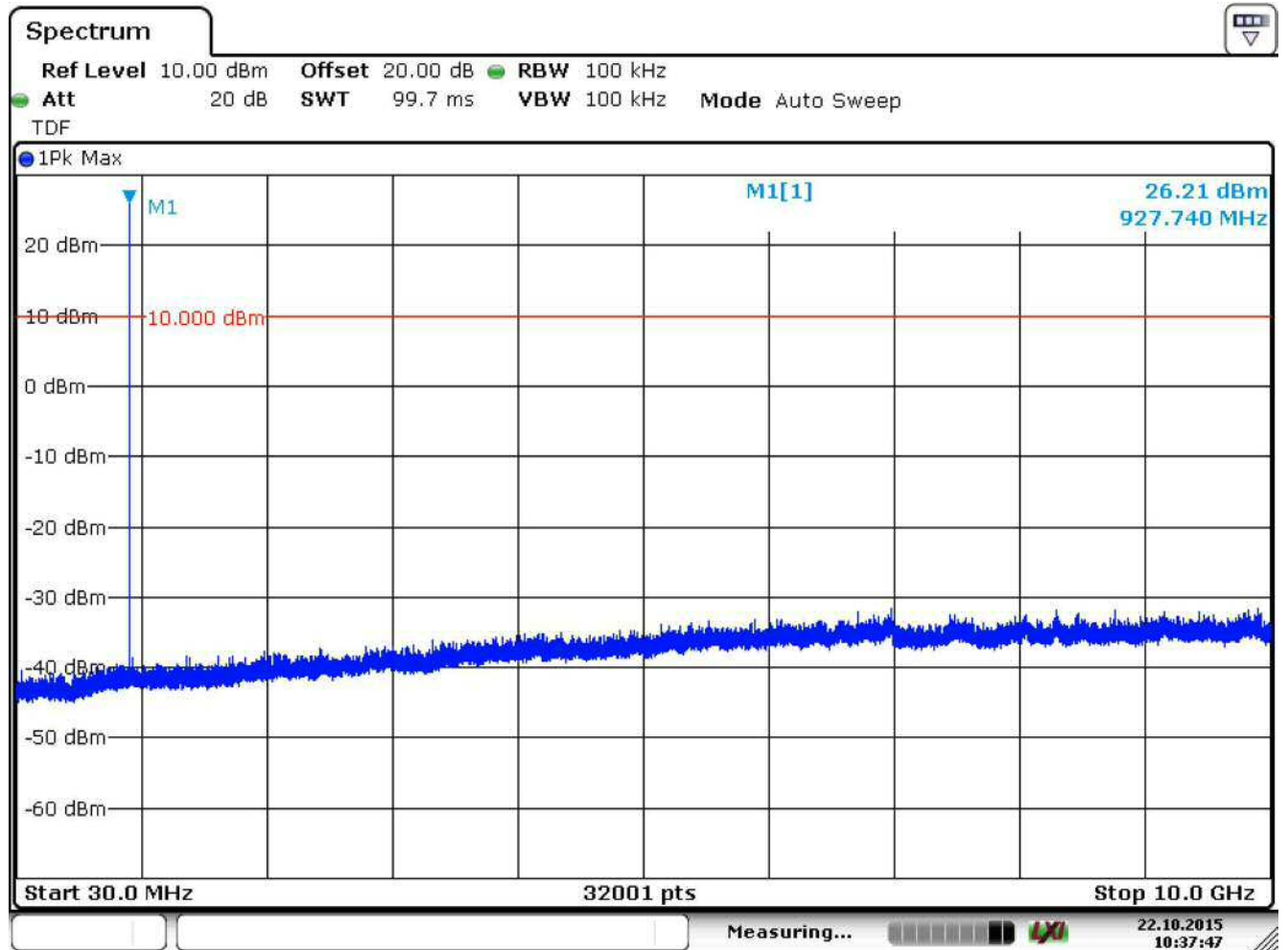
Conducted Spurious Emission 30 MHz to 10 GHz and Band Edge



Date: 22.OCT.2015 10:40:08

Figure 22. Mid channel conducted emission 30 MHz to 10000 MHz.

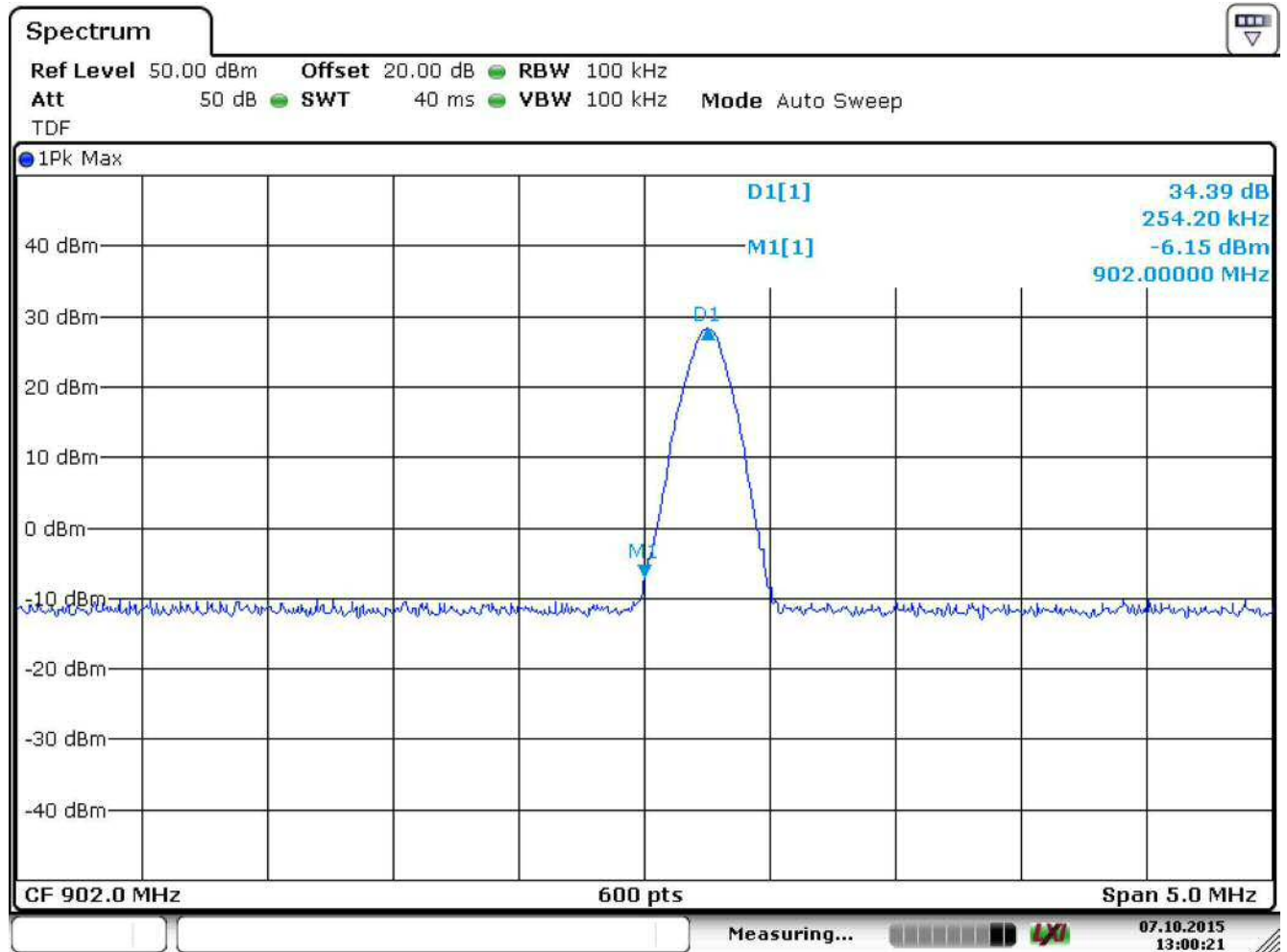
Conducted Spurious Emission 30 MHz to 10 GHz and Band Edge



Date: 22.OCT.2015 10:37:48

Figure 23. High channel conducted emission 30 MHz to 10000 MHz.

Conducted Spurious Emission 30 MHz to 10 GHz and Band Edge

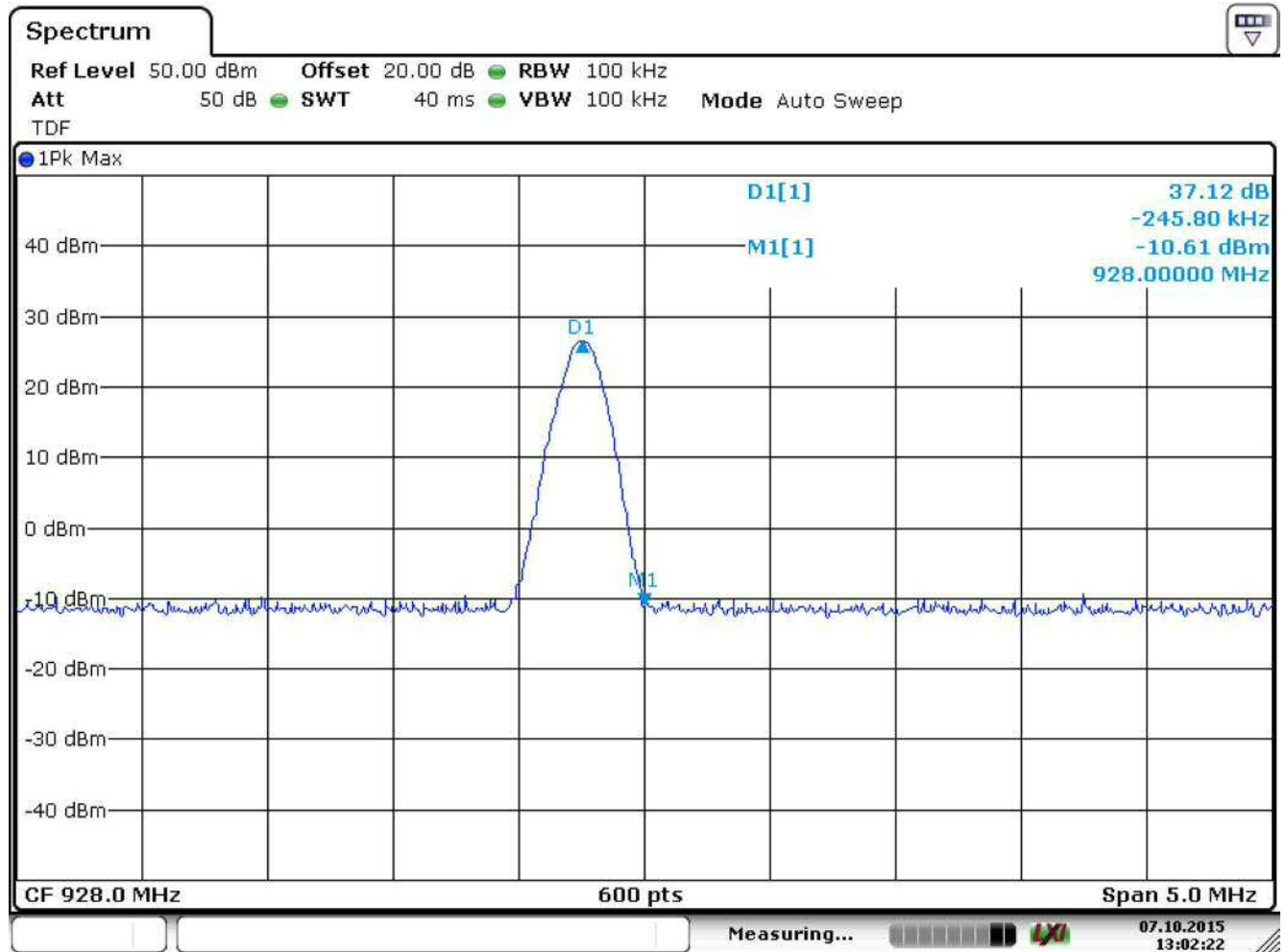


Date: 7.OCT.2015 13:00:21

Figure 24. Conducted emission at low band edge non-hopping mode.

Band edge measurement was done also in hopping mode. The result was equal with non-hopping mode

Conducted Spurious Emission 30 MHz to 10 GHz and Band Edge



Date: 7.OCT.2015 13:02:22

Figure 25. Conducted emission at high band edge non-hopping mode.

Band edge measurement was done also in hopping mode. The result was equal with non-hopping mode

20 dB Bandwidth of the Hopping Channel

Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 22.10.2015
Temperature: 21 °C
Humidity: 36 % RH

FCC Rule: §15.247(a)(1)(i)
RSS-247 5.1

Results:

Table 3. 20 dB bandwidth test results

Channel	20 dB BW [kHz]
Low	115.92
Mid	115.48
High	115.48



Date: 22.OCT.2015 09:27:38

Figure 26. 20 dB channel BW. Channel LOW.

20 dB Bandwidth of the Hopping Channel



Date: 22.OCT.2015 09:28:44

Figure 27. 20 dB channel BW. Channel MID.

20 dB Bandwidth of the Hopping Channel



Date: 22.OCT.2015 09:29:40

Figure 28. 20 dB channel BW. Channel HIGH.

Hopping Channel Carrier Frequencies Separation

Hopping Channel Carrier Frequencies Separation

Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 7.10.2015
Temperature: 21 °C
Humidity: 23 % RH

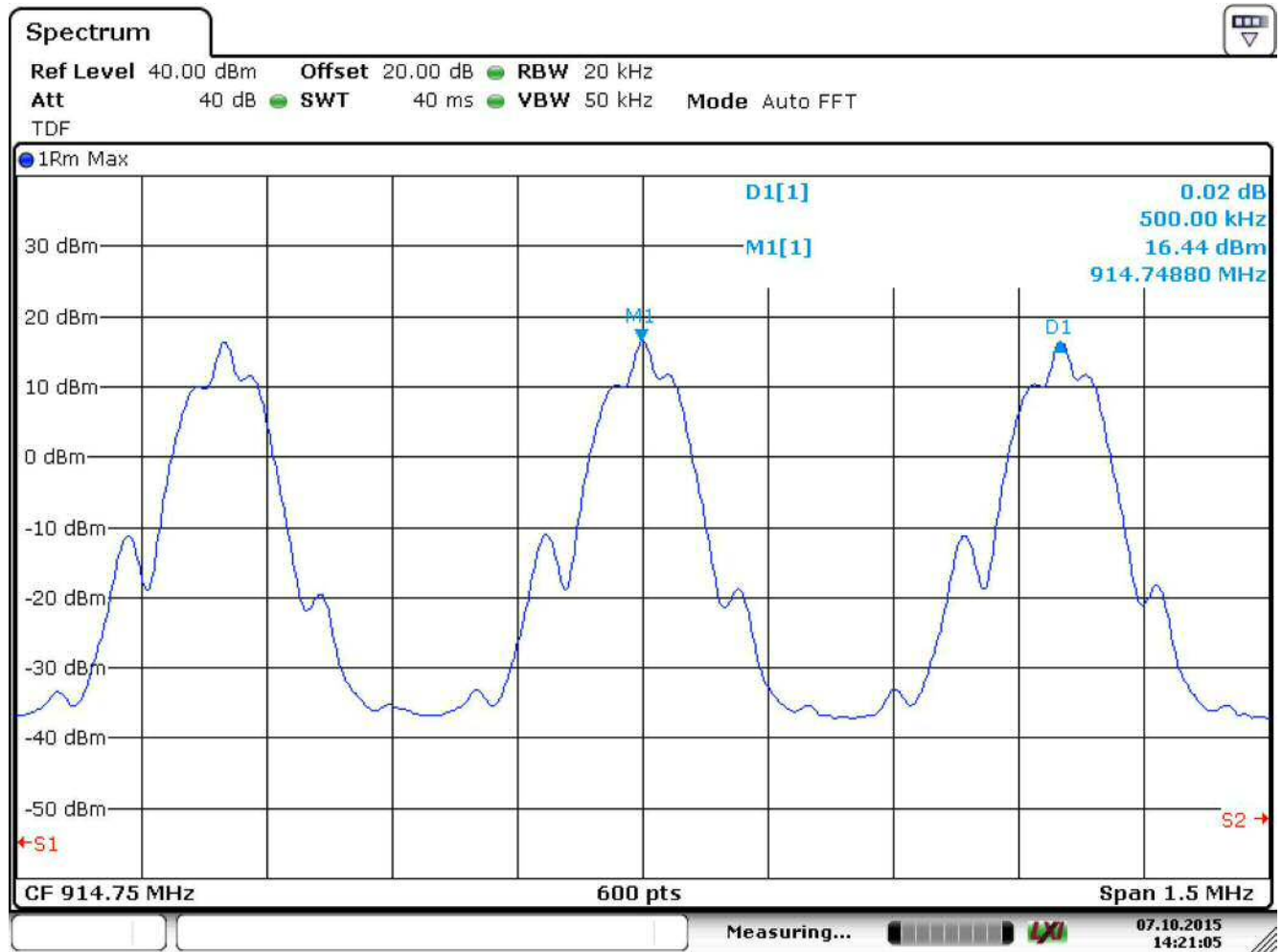
FCC Rule: 15.247(a)(1)(i)
RSS-247 5.1

Test result

Table 4. Hopping channel carrier frequencies separation test result.

Measured separation
500.00 kHz

Hopping Channel Carrier Frequencies Separation



Date: 7.OCT.2015 14:21:05

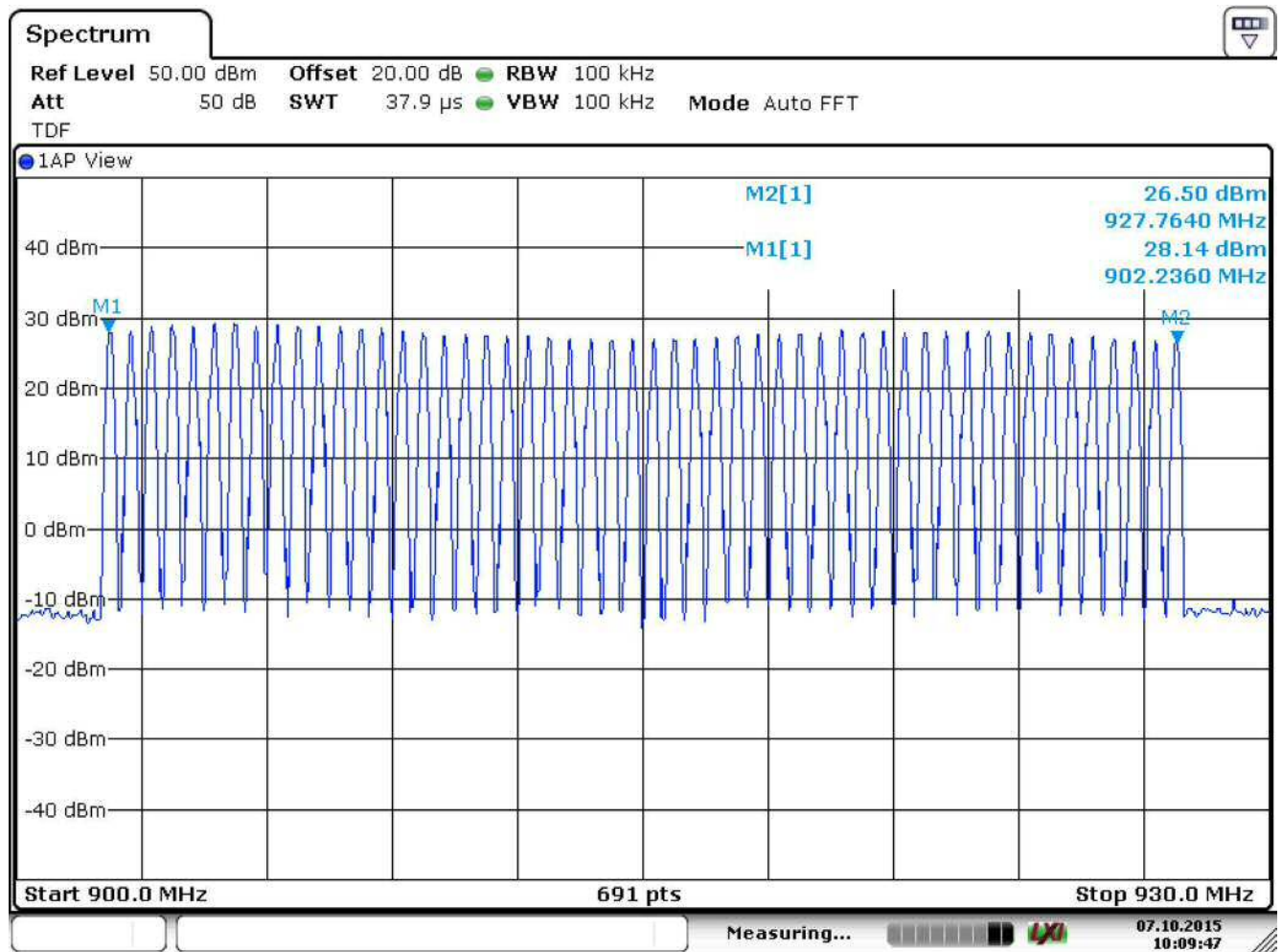
Figure 29. Measured hopping channels carrier frequency separation.

Number of Hopping Channels

Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 7.10.2015
Temperature: 21 °C
Humidity: 23 % RH

FCC Rule: 15.247(a)(1)(i) RSS-247 5.1

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping



Date: 7.OCT.2015 10:09:47

Figure 30. 52 channels.

Average Time of Occupancy of Hopping Frequency

Average Time of Occupancy of Hopping Frequency

Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 7.10.2015
Temperature: 21 °C
Humidity: 23 % RH

FCC Rule: 15.247(a)(1)(i)
RSS-247 5.1

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period

Time of occupancy calculation:

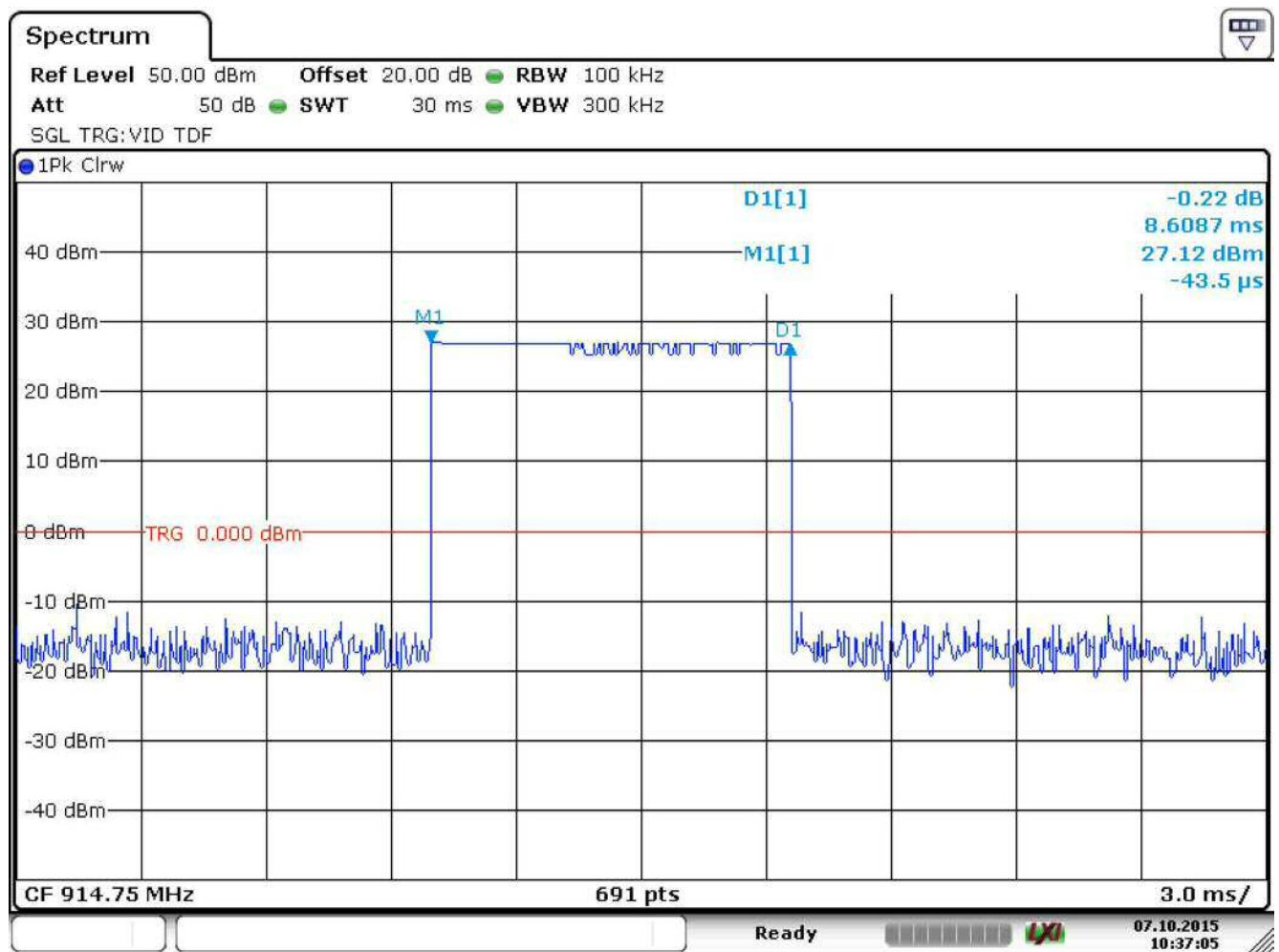
Number of channels = 52

Measurement period = 20 s

One channel occupancy time = 8.6087 ms

Number of transmission cycles in measurement period = 20

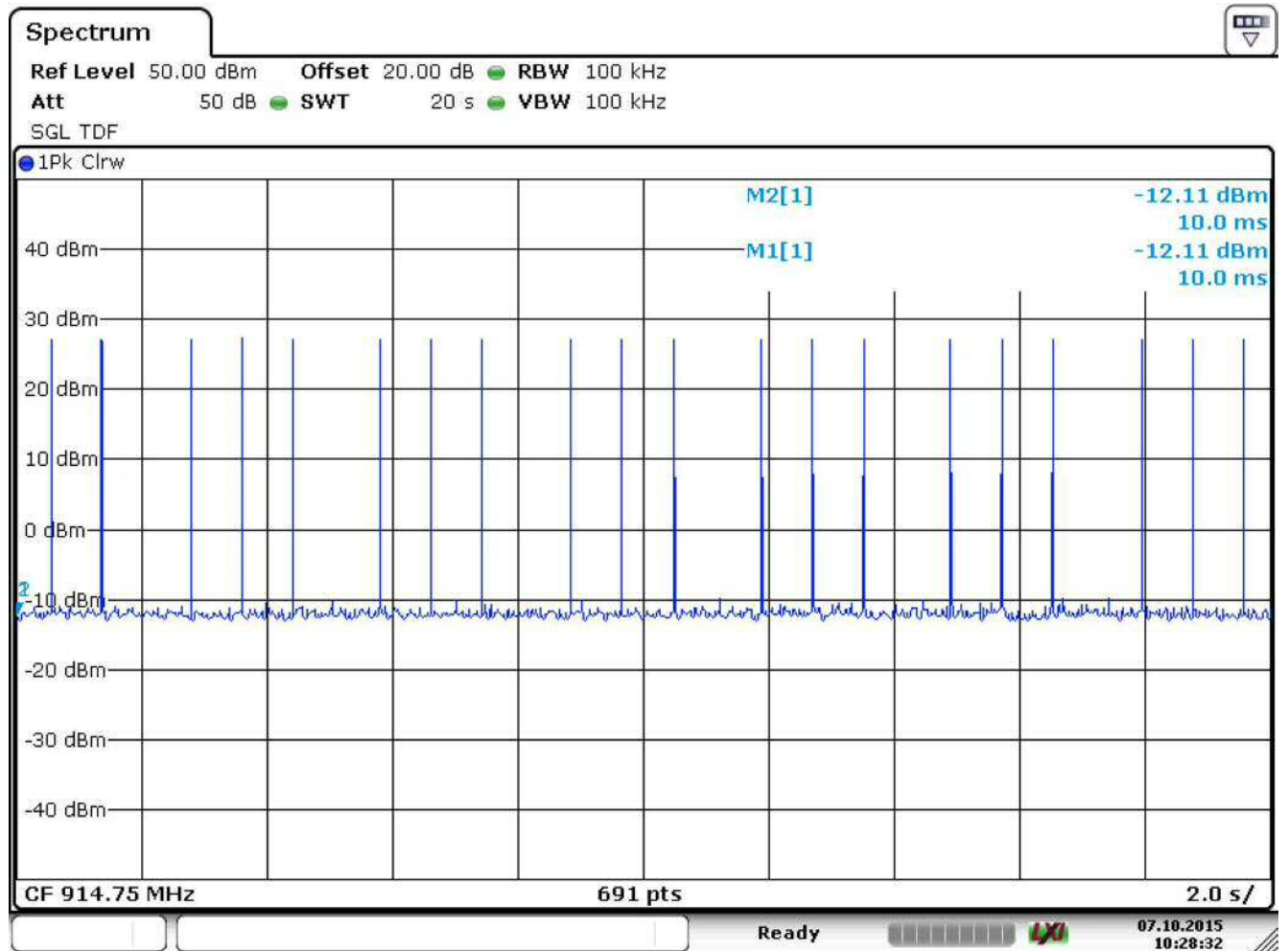
Time of occupancy = (single duration) x (repetition) = 8.6087 ms x 20 = 172.174 ms



Date: 7.OCT.2015 10:37:05

Figure 31. One channel dwell time.

Average Time of Occupancy of Hopping Frequency



Date: 7.OCT.2015 10:28:32

Figure 32. Measured repetition of the channel occupancy

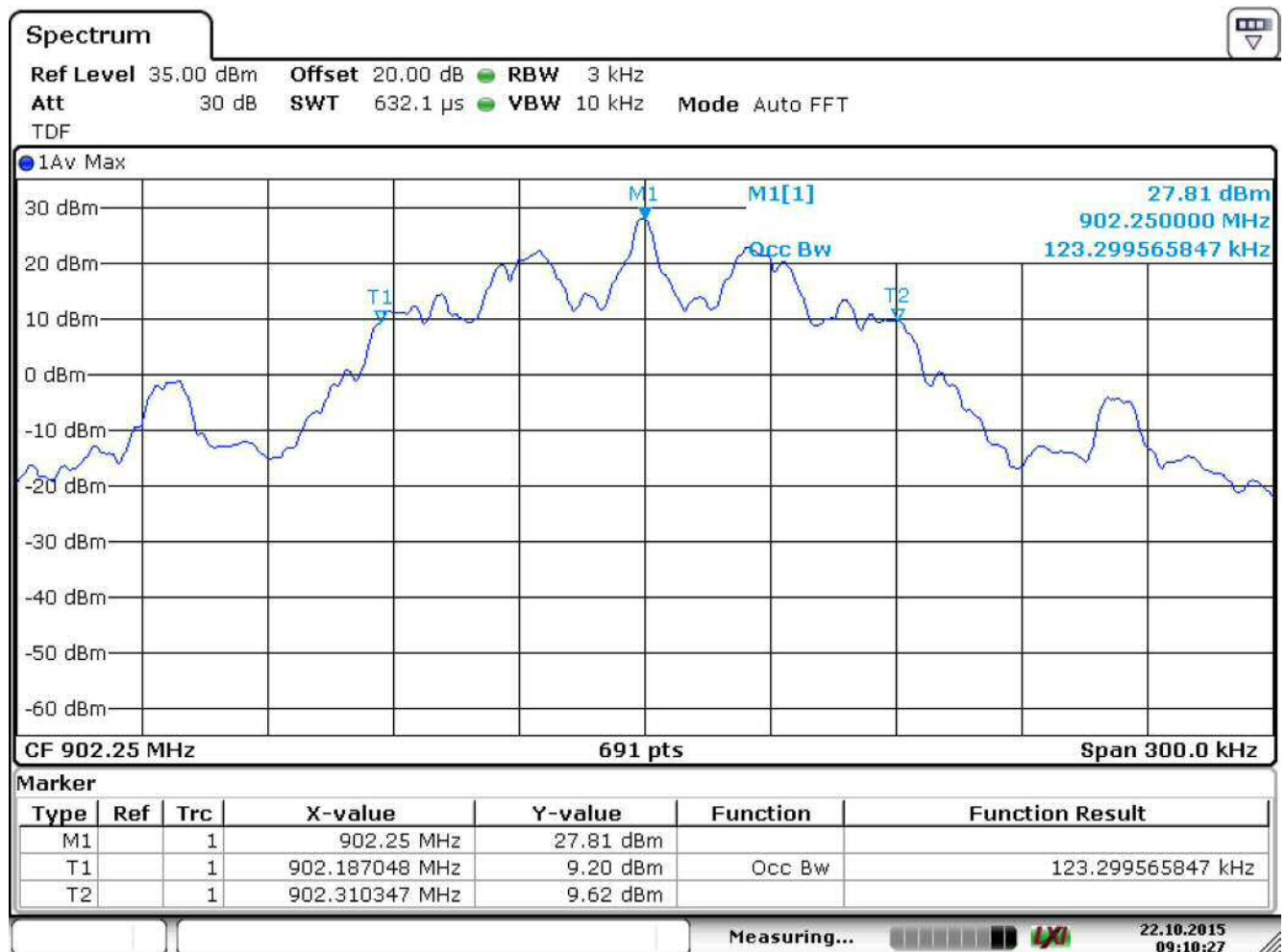
99% Occupied Power Bandwidth

Standard: RSS-GEN (2013)
Tested by: PKA
Date: 22.10.2015
Temperature: 21 °C
Humidity: 36 % RH

RSS-GEN 6.6

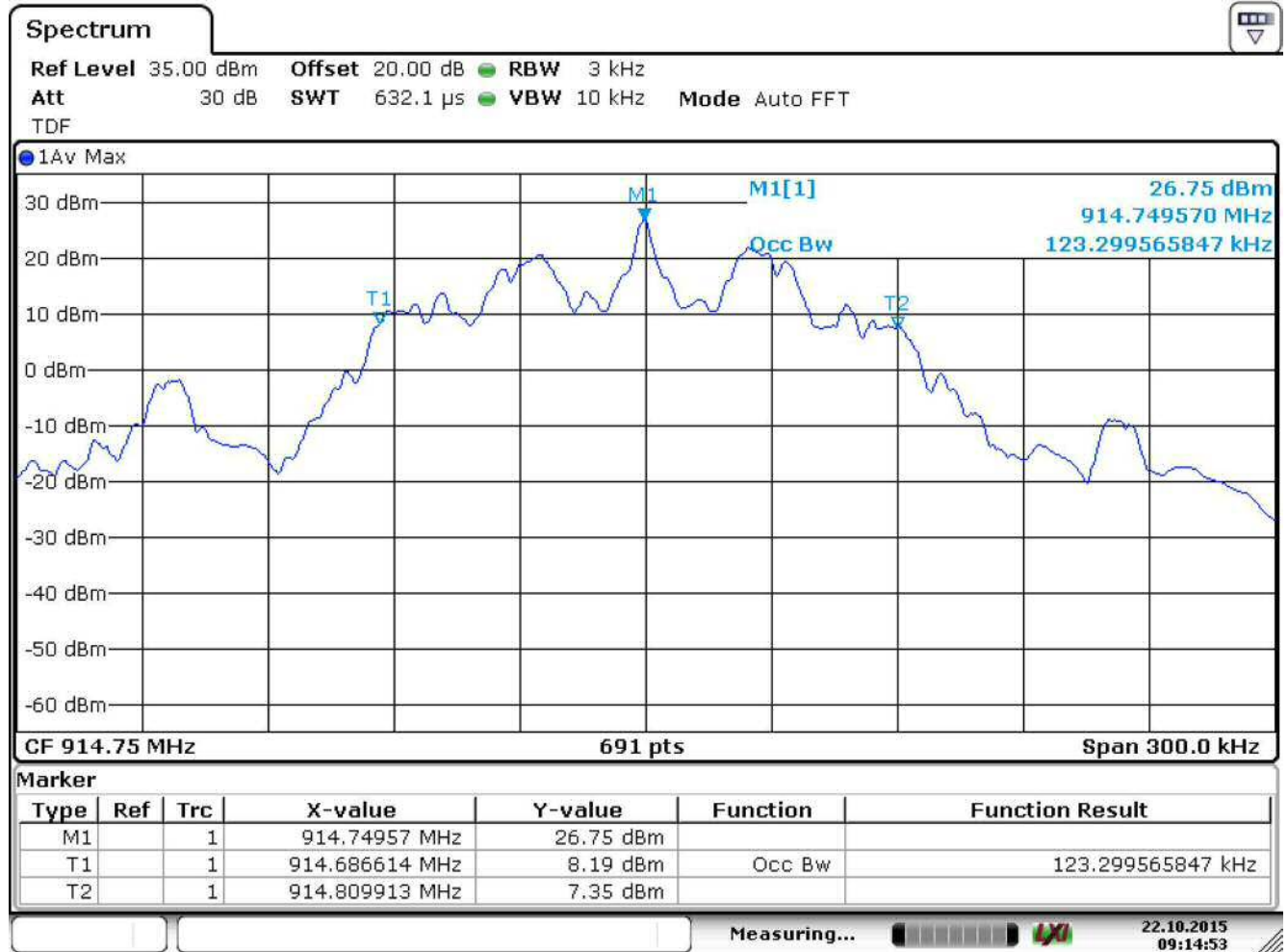
Table 5. Data rate 1 Mbps

Channel	99% BW [kHz]	Limit	Result
Low	123.300	-	PASS
Mid	123.300	-	PASS
High	122.431	-	PASS



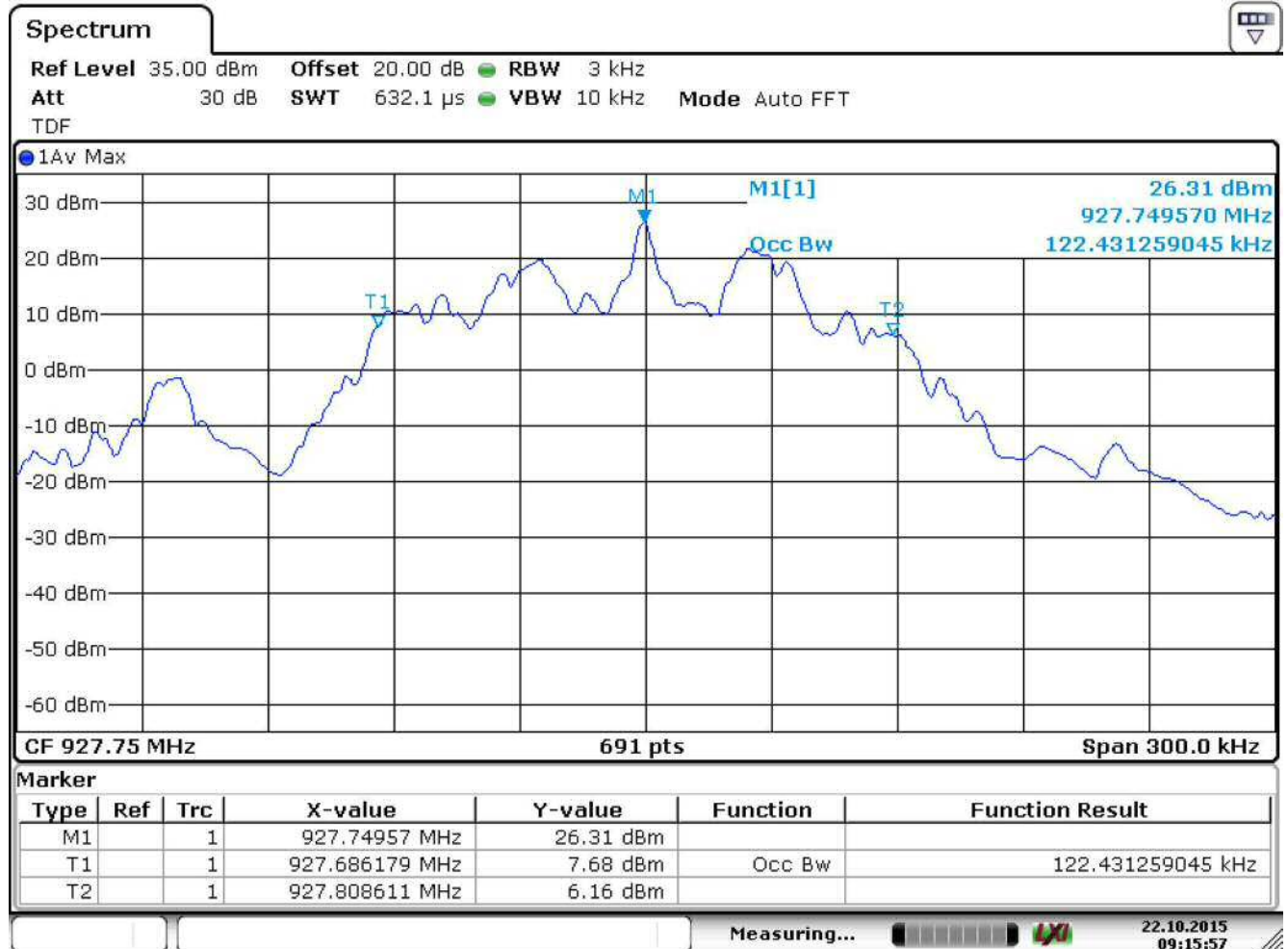
Date: 22.OCT.2015 09:10:27

Figure 33. Low channel 99% Occupied Power Bandwidth.



Date: 22.OCT.2015 09:14:53

Figure 34. Mid channel 99% Occupied Power Bandwidth.



Date: 22.OCT.2015 09:15:57

Figure 35. High channel 99% Occupied Power Bandwidth.

TEST EQUIPMENT

Equipment	Manufacturer	Type	Serial no	Inv.no
TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	100185	8453
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	101068	9093
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-
ANTENNA (30-1000 MHz)	SCHWARZBECK	VULB 9168	8168-503	8911
ANTENNA MAST	DEISEL	MA240	240/455	5017
TURNTABLE	DEISEL	DS420	-	5015
CONTROLLER	COMTEST	HD100	100/457	5018
ANTENNA (1-18 GHz)	EMCO	3117	29617	7293
ANTENNA (18-26.5 GHz)	EMCO	3160- 09	030232-022	7294
PREAMPLIFIER (0.5-26GHz)	HP	83017A	3950M00102	5226
ATTENUATOR 10 dB	HUBER & SUHNER	6810.17B	-	-
HIGH PASS FILTER	WAINWRIGHT	WHKX	10	8267
AC Power Source	CALIFORNIA INSTRUMENTS	5001 iX Series II	58209	7826

All used measurement equipment was calibrated (if required).