

Test Report

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

Equipment Under Test: 2.4 GHz Transceiver

Type/ Model: DRC-10 D3

Manufacturer: Scanreco AB
Årsta Skolgränd 22
SE-47144 Stockholm
SWEDEN

Customer: Scanreco AB
Årsta Skolgränd 22
SE-47144 Stockholm
SWEDEN

FCC Rule Part: 15.247: 2012
IC Rule Part: RSS-210, Issue 8, 2010
RSS-GEN Issue 4, 2014

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

Date: February 6, 2015

Issued by:



Timo Hietala
Testing Engineer

Date: February 6, 2015

Checked by:



Janne Nyman
Compliance Specialist

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Equipment Under Test (EUT)

Wireless System-final product

Type/ Model: DRC-10 D3

Serial Number: -

DRC-10 D3 is an industrial hand-held 2.4 GHz transceiver that supports frequency hopping.

Two samples were tested: one sample with a temporary antenna connector (SMA, conducted measurements) and one sample with an internal antenna (radiated measurements).

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 (OFR):	2405 – 2480 MHz
Channels:	16
Channel separation:	5 MHz
Conducted power:	19.94 dBm
Transmission technique:	FHSS
Modulation:	GFSK
Integrated antenna gain:	-
External antenna gain:	0.0 dBi

Power Supply

2 x 1.32 VDC Ni-MH batteries, new batteries were used when testing the EUT.

Disclaimer

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Summary of Testing

SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.207(a) / RSS-GEN 8.8	Conducted Emissions on Power Supply Lines	N/A
§15.247(b)(1) / RSS-210 8.4	Maximum Peak Conducted Output Power	PASS
15.247(a)(1) / RSS-210 A8.1	Hopping Channel Carrier Frequency Separation	N/T ¹⁾
§15.247(a)(1)(iii) / RSS-210 A8.1	Number of Hopping Frequencies	N/T ¹⁾
§15.247(a)(1)(iii) / RSS-210 A8.1	Average Time of Occupancy of Hopping Frequency	N/T ¹⁾
§15.247(a)(1) / RSS-210 A8.1	20 dB Bandwidth	PASS
RSS-GEN 6.6	99 % Occupied Bandwidth	PASS
§15.247(d) / RSS-210 A8.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	PASS
§15.209(a), §15.247(d) / RSS-210 A8.5 / RSS-GEN 8.10	Radiated Emissions Within The Restricted Bands	PASS
§15.209 / RSS-GEN 8.9	Unintentional Radiated Emissions	PASS

N/A: Battery operated EUT.

N/T ¹⁾: Not Tested, test data from the test report 277830-1B has been re-used for the EUT. The radio circuitry in both test reports is the same.

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	2405
MID	2440
HIGH	2480

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

Maximum Peak Conducted Output Power

Maximum Peak Conducted Output Power

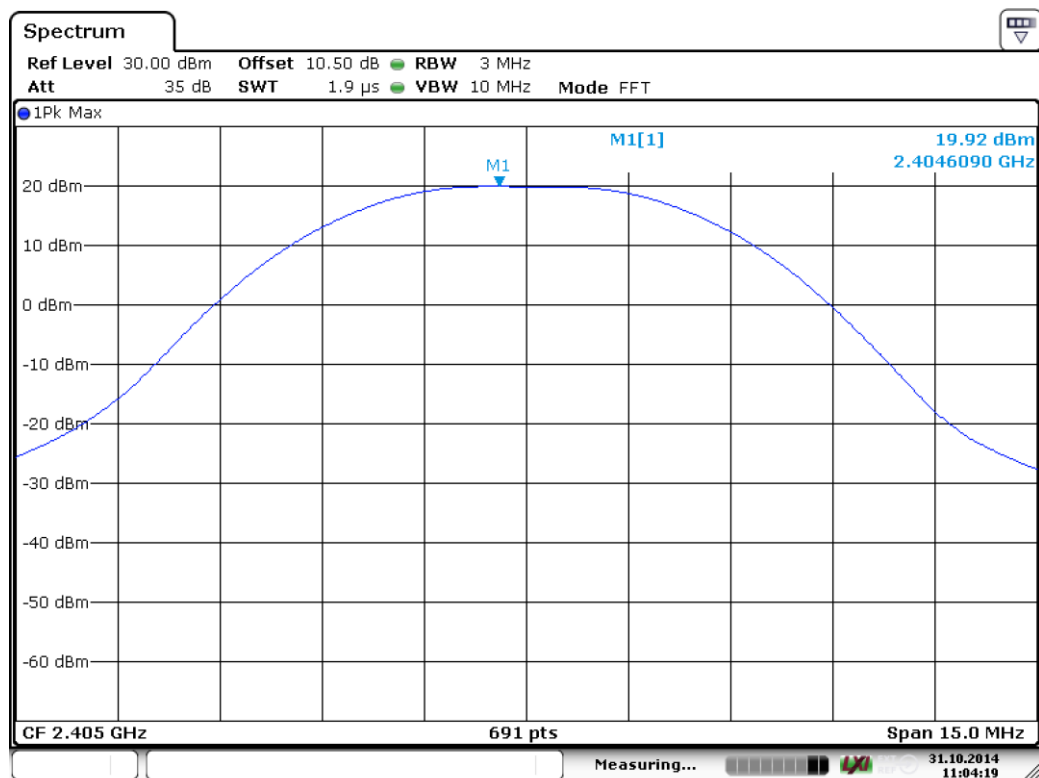
Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 31.10.2014
Humidity: 40 % RH
Temperature: 22.7 °C
Measurement uncertainty $\pm 2.87\text{dB}$ Level of confidence 95 % (k = 2)

FCC Rule: 15.247(b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz, employing at least 75 channels limit is 1.0 Watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts. 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]	Margin [dBm]	Result
Low	19.92	20.97	1.05	PASS
Mid	19.60	20.97	1.37	PASS
High	19.10	20.97	1.87	PASS



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Figure 1. Channel LOW.

Maximum Peak Conducted Output Power

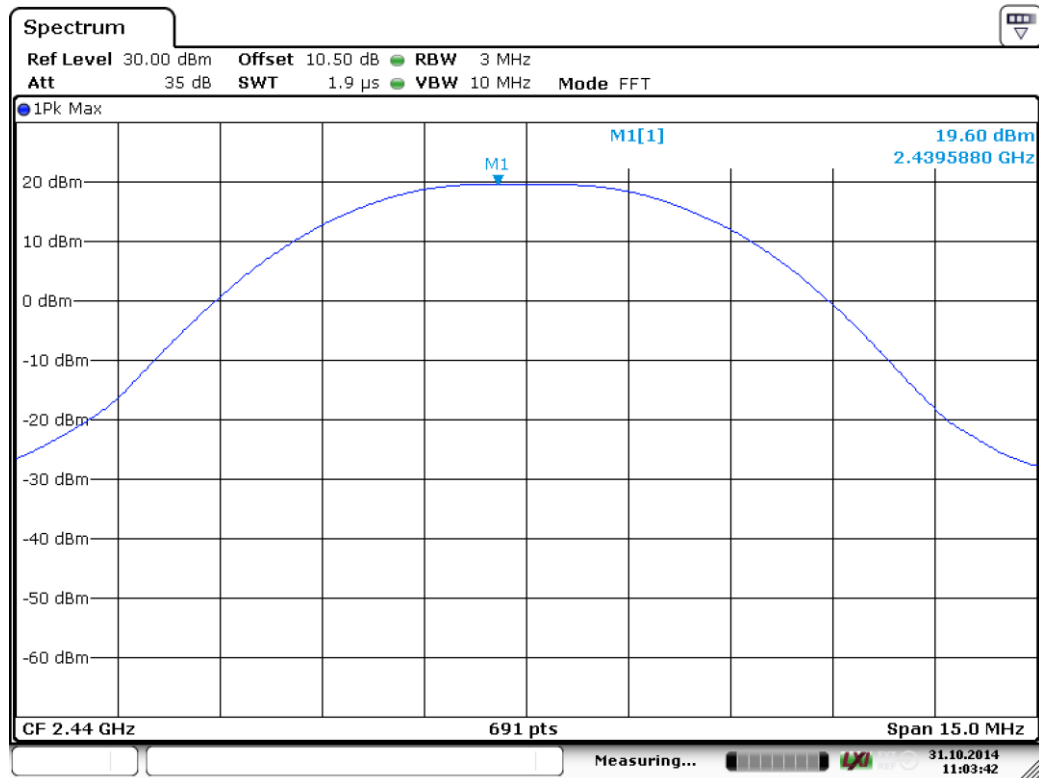


Figure 2. Channel MID.

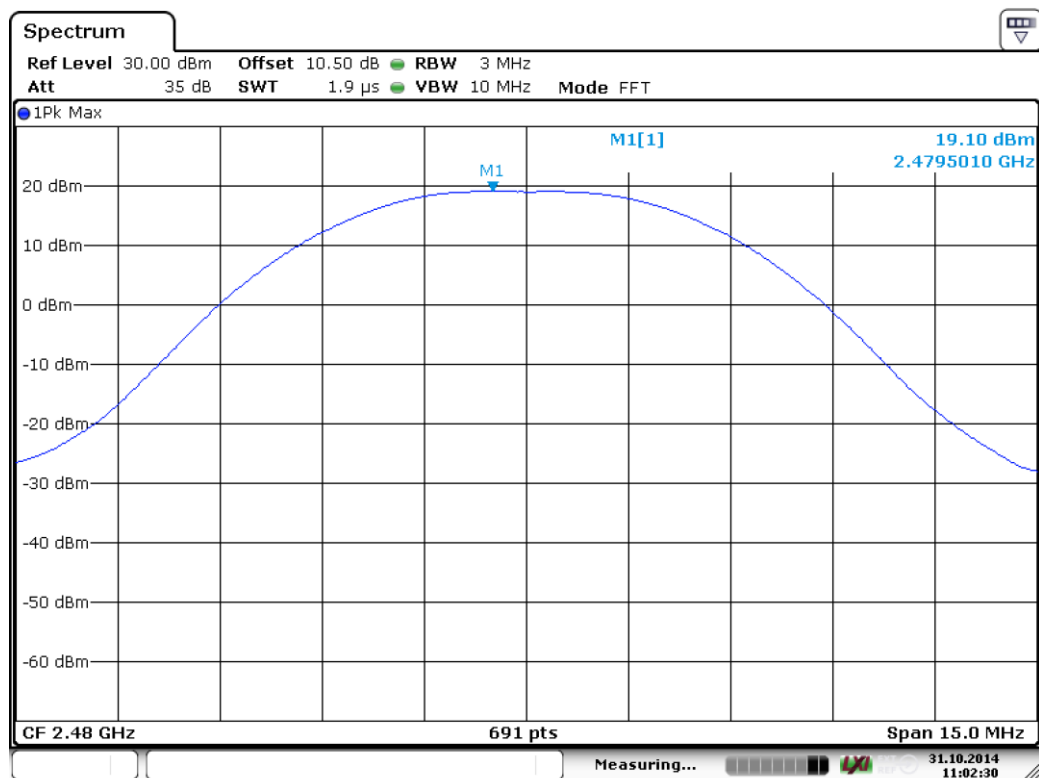


Figure 3. Channel HIGH.

Transmitter Radiated Emissions 30 MHz to 26.5 GHz

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	14.11.2014	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % 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, 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.

The measurements above 1 GHz were performed by using a peak detector and a Duty Cycle correction factor(dB) -21.35 dB, see test report 277830-1 chapter: Duty cycle correction factor, Transmit time in 100 ms.

The measurements were performed with the EUT being in three orthogonal positions (X, Y, Z). Below 1 GHz the measurements were performed at MID channel, above 1 GHz the measurements were performed at LOW, MID and HIGH channels.

Test results with internal antenna

Final results 30 – 1000 MHz:

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

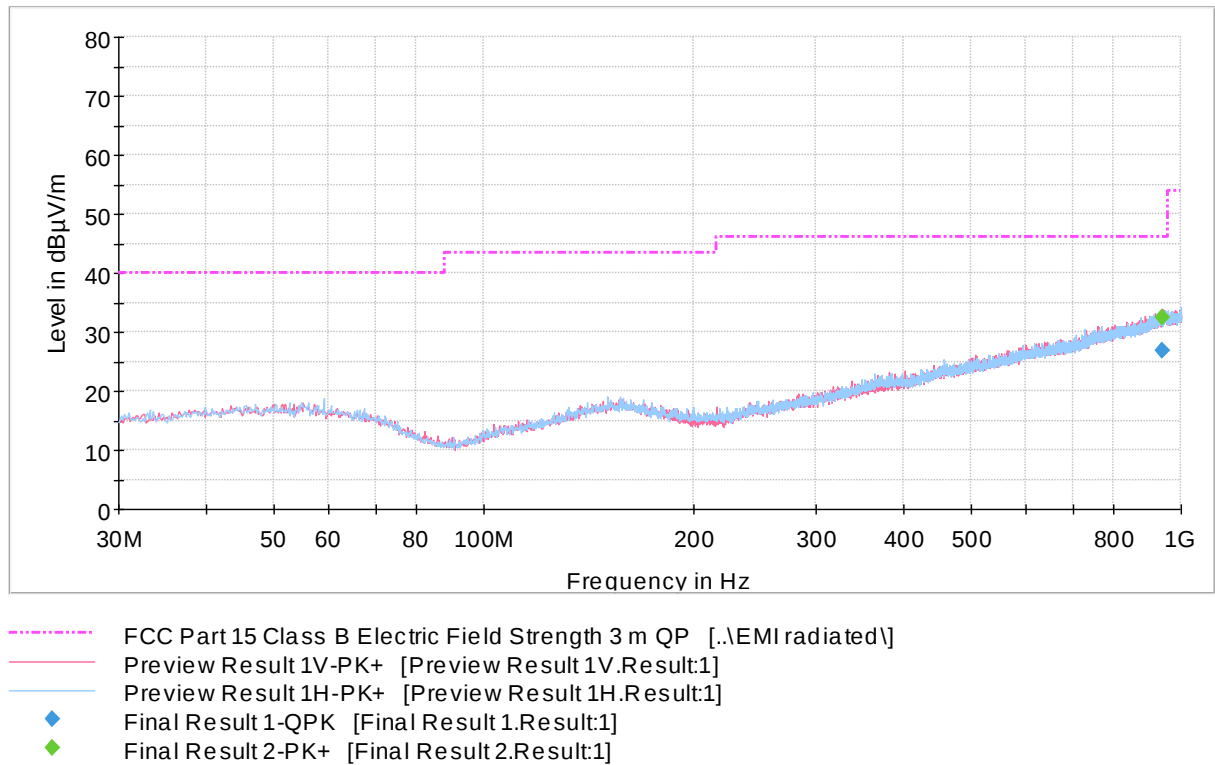


Figure 4. Measured curve with peak-detector. Channel MID.

Final measurements from the worst frequencies

Table 1. Final results 30 – 1000 MHz (QP).

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
940.555000	26.9	1000.0	120.000	100.0	V	140.0	28.0	19.1	46.0	

Transmitter Radiated Emissions 30 MHz to 26.5 GHz

Final results 1.0 – 26.5 GHz:

Table 2. LOW channel (RBW 1000 kHz, VBW 3000 kHz)

Frequency (MHz)	Peak			Average		
	Result (dBµV/m)	Limit (dBµV/m)	Margin dB	Result (dBµV/m)	Limit (dBµV/m)	Margin dB
7213.20	70.8	74.0	3.2	49.5	54.0	4.5

Radiated emissions in restricted bands 1 GHz – 26.5 GHz

Table 3. HIGH channel (RBW 1000 kHz, VBW 3000 kHz)

Frequency (MHz)	Peak			Average		
	Result (dBµV/m)	Limit (dBµV/m)	Margin dB	Result (dBµV/m)	Limit (dBµV/m)	Margin dB
7438.20	58.1	74.0	15.9	36.8	54.0	17.2

Band edge compliance:

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

LOW (2405 MHz), below 2390 MHz:

Detector (RBW: 1MHz)	Result (dBµV/m)	Margin (dB)	Limit (dBµV/m)	Comment
Peak	61.8	12.2	74.0	PASS
Average	40.5	13.5	54.0	PASS

LOW (2405 MHz), 2390-2400 MHz:

Detector (RBW: 100 kHz)	Result (dBc)	Margin (dB)	Limit (dBc)	Comment
Peak	-50.9	30.9	-20.0	PASS

HIGH (2480 MHz), above 2483.5 MHz:

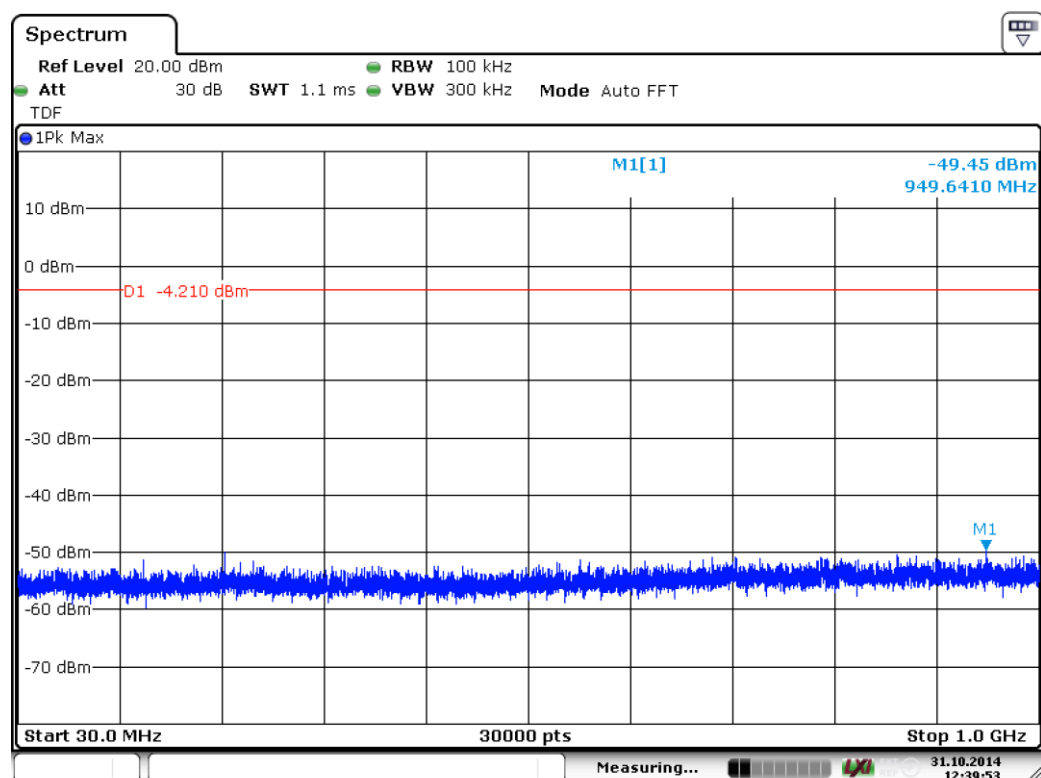
Detector (RBW: 1MHz)	Result (dBµV/m)	Margin (dB)	Limit (dBµV/m)	Comment
Peak	73.3	0.7	74.0	PASS
Average	52.0	2.0	54.0	PASS

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 31.10.2014
Temperature: 22.7 °C / 22.9 °C
Humidity: 40 % / 41 % RH

FCC Rule: 15.247 (d)



Date: 31.OCT.2014 12:39:53

Figure 5. Low channel conductive emission 30 MHz to 1000 MHz.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

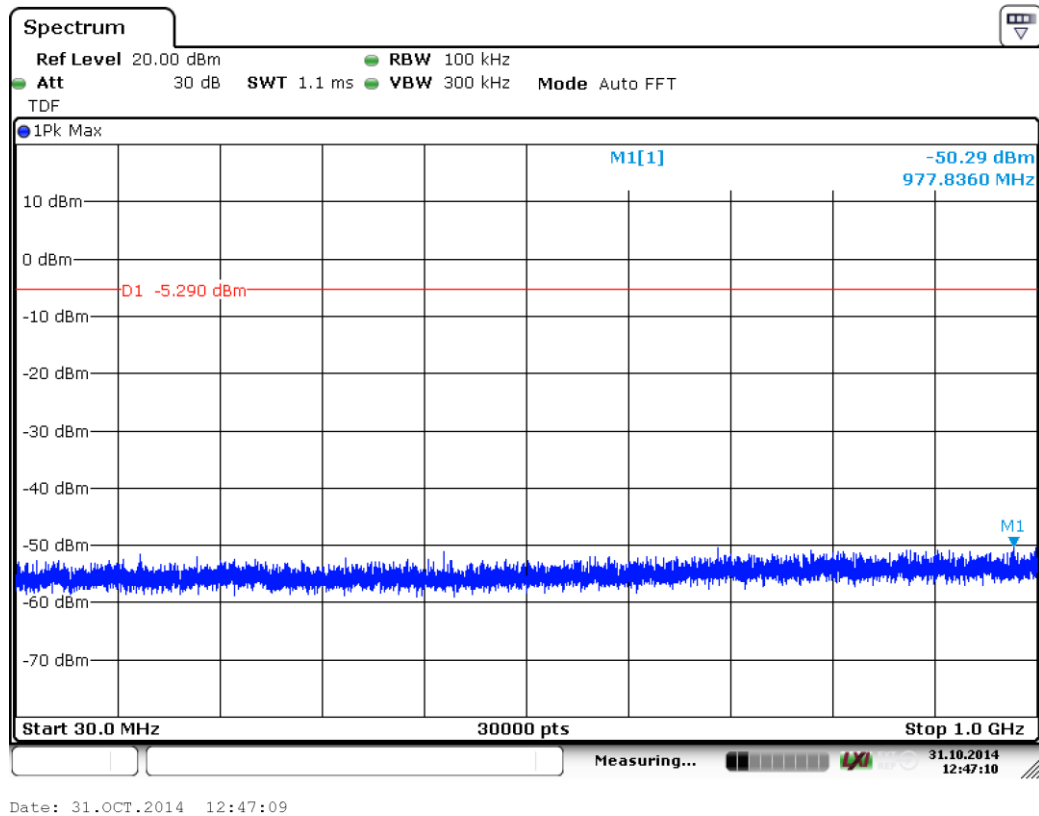


Figure 6. Mid channel conductive emission 30 MHz to 1000 MHz.

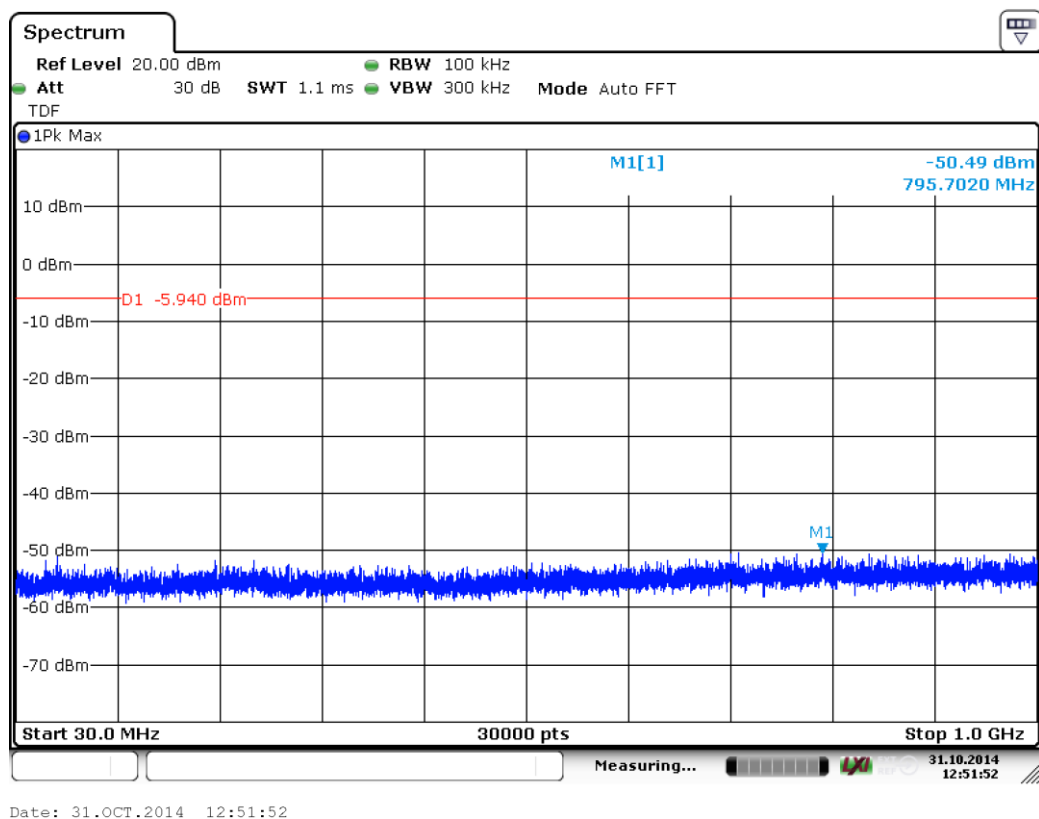


Figure 7. High channel conductive emission 30 MHz to 1000 MHz.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

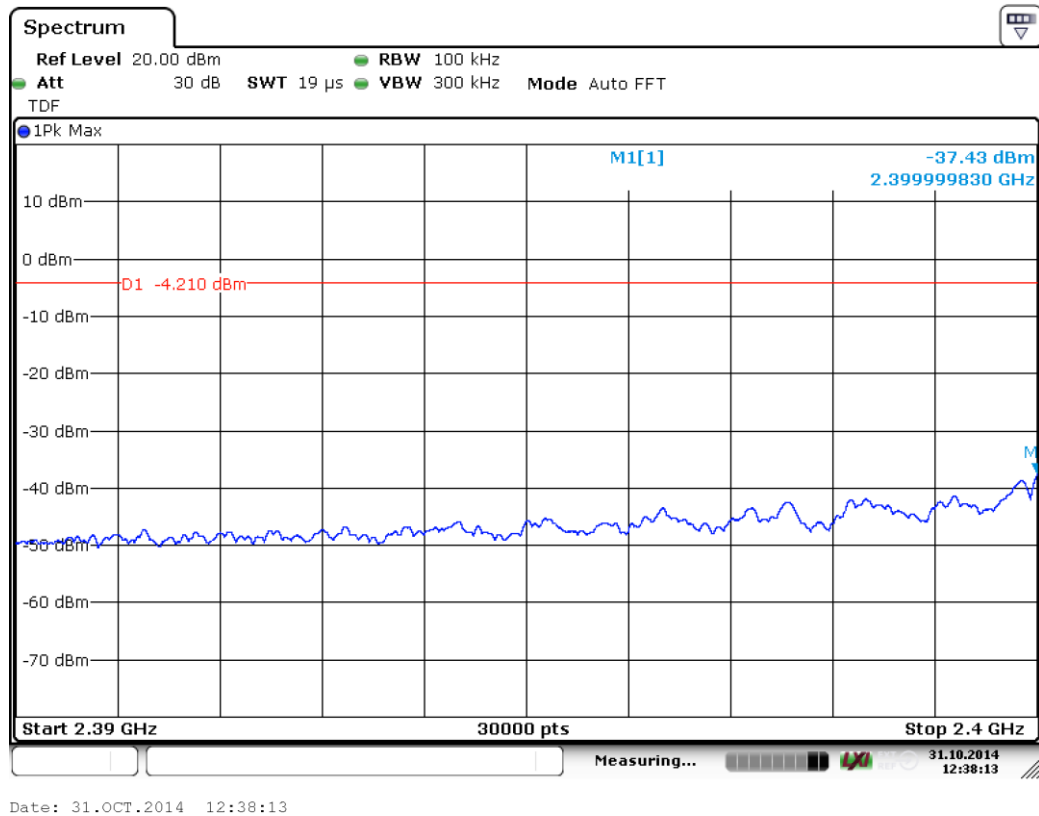


Figure 8. Low channel conductive emission at low band edge.

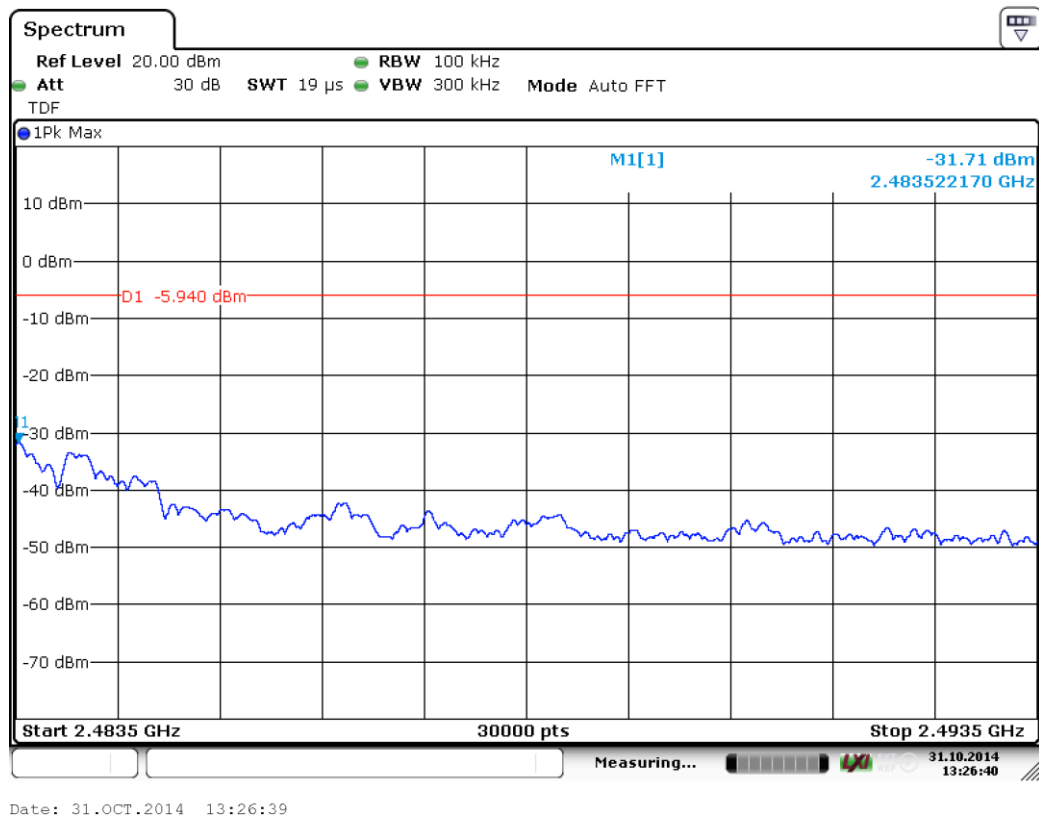


Figure 9. High channel conductive emission at high band edge.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

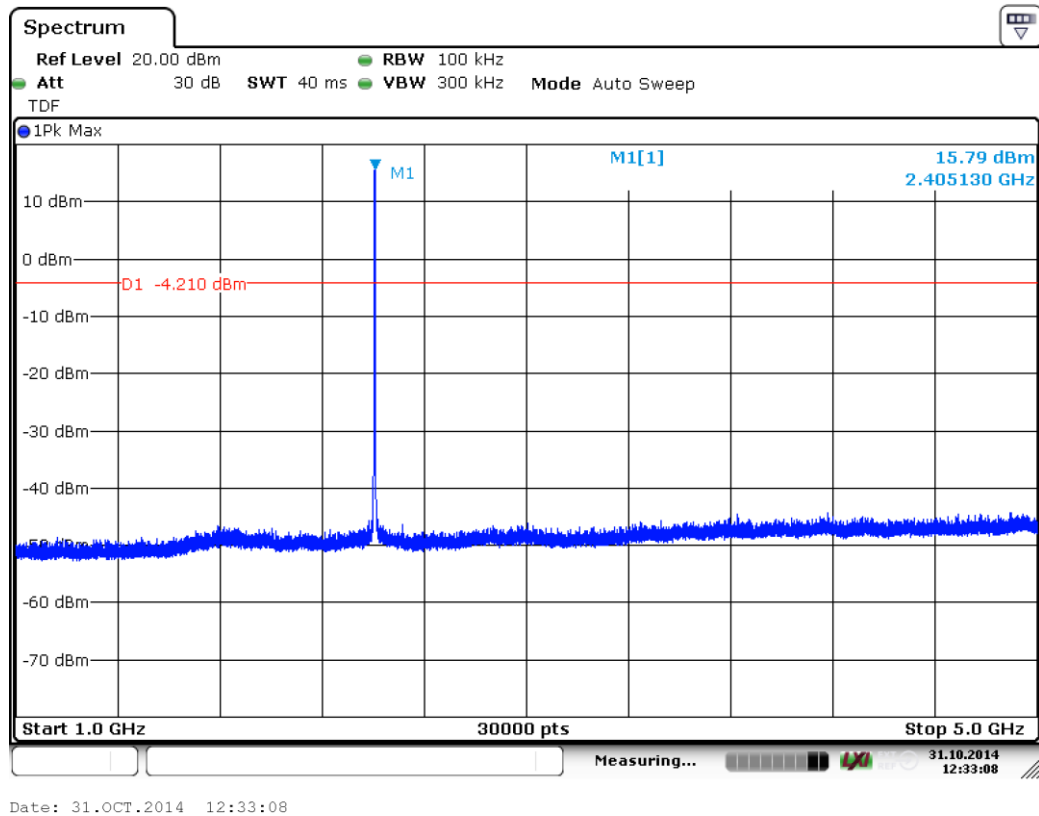


Figure 10. Low channel conductive emission 1 GHz to 5 GHz.

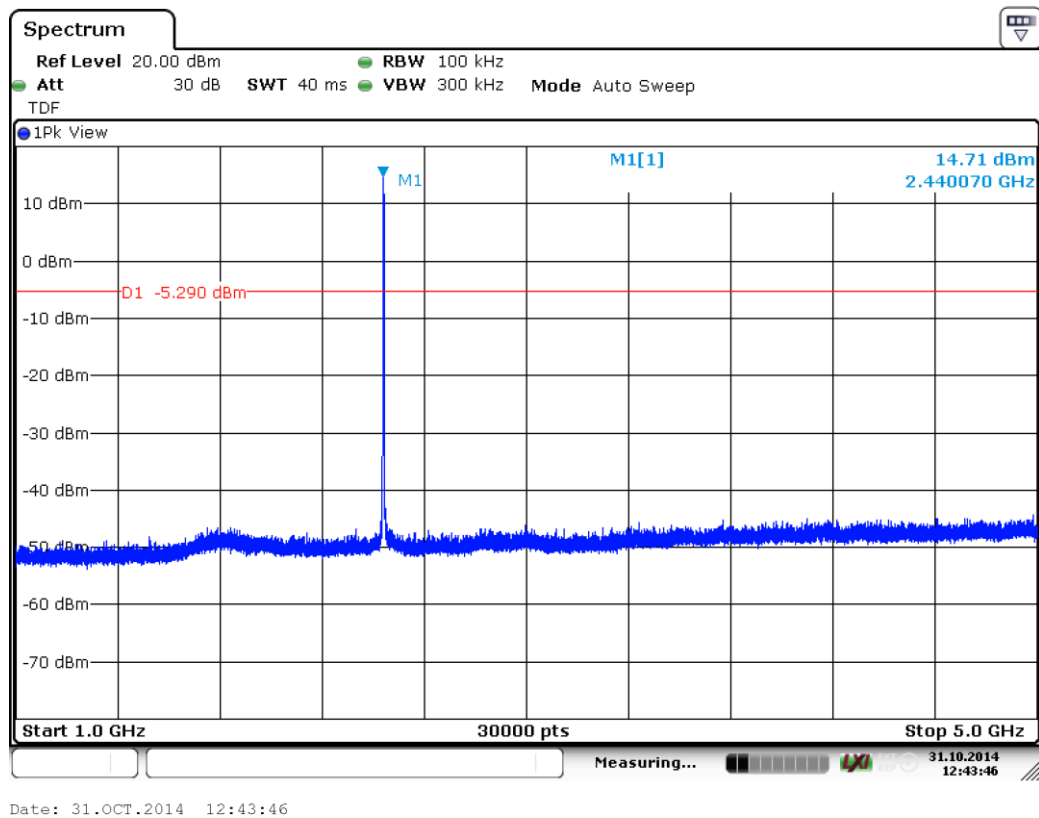


Figure 11. Mid channel conductive emission 1 GHz to 5 GHz.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

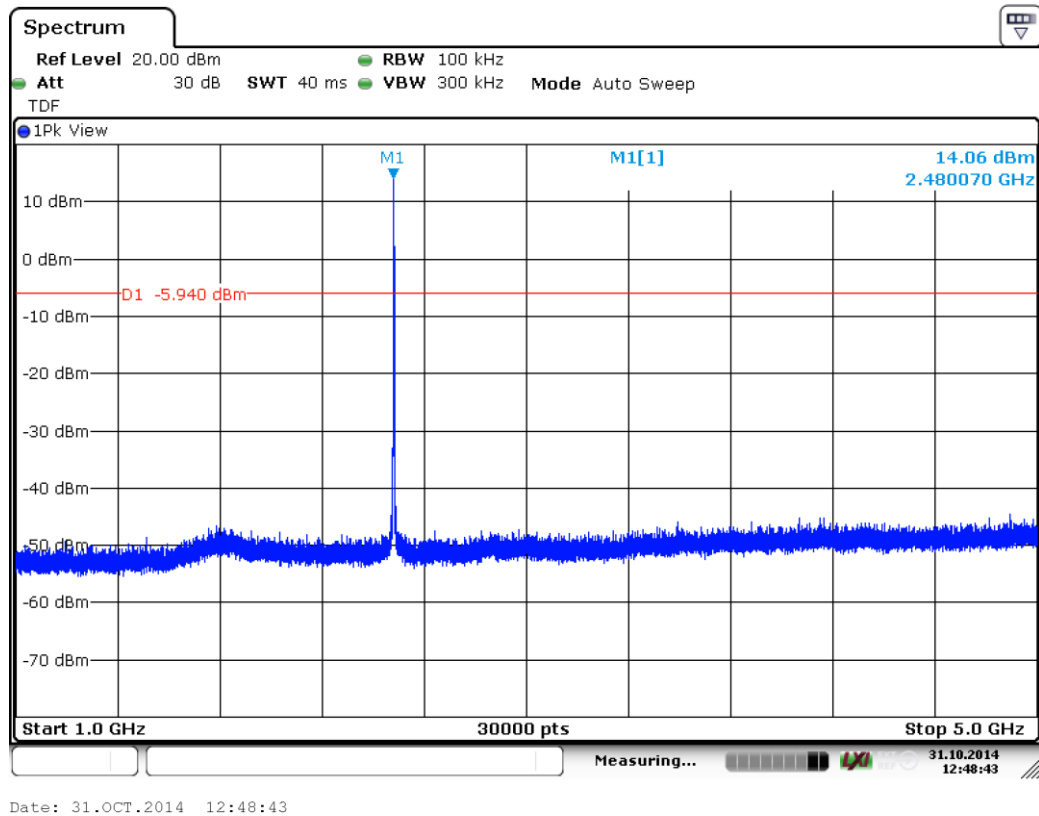


Figure 12. High channel conductive emission 1 GHz to 5 GHz.

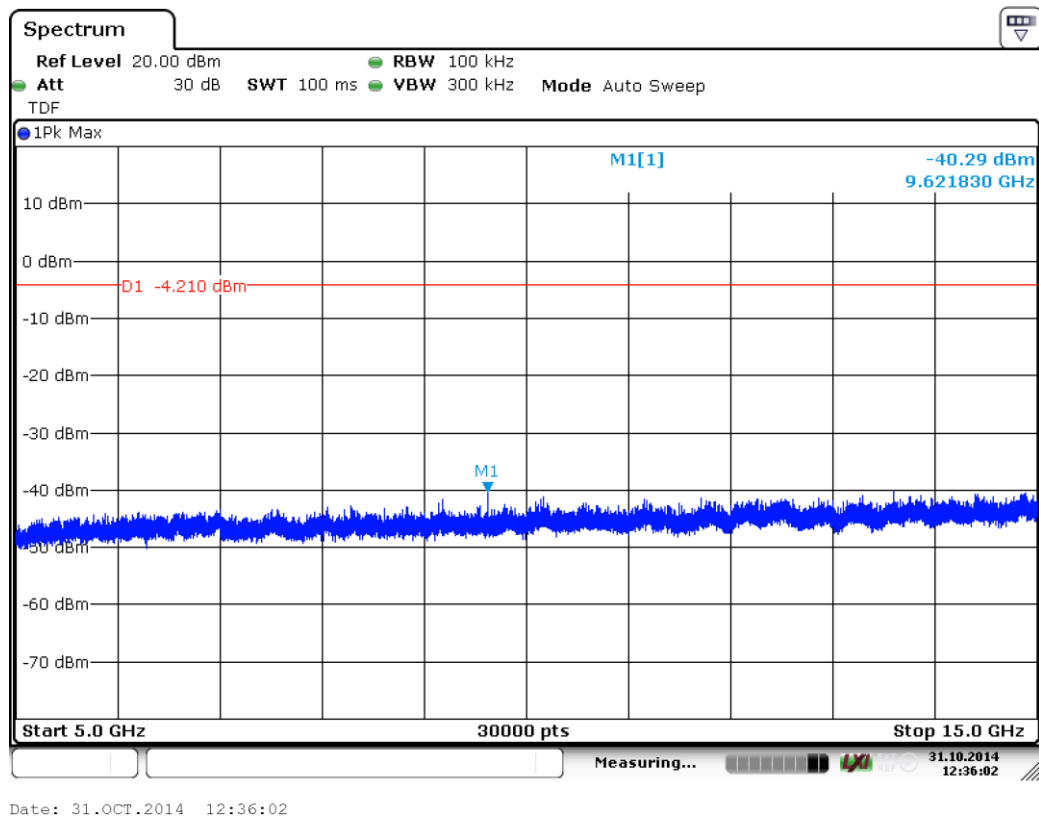
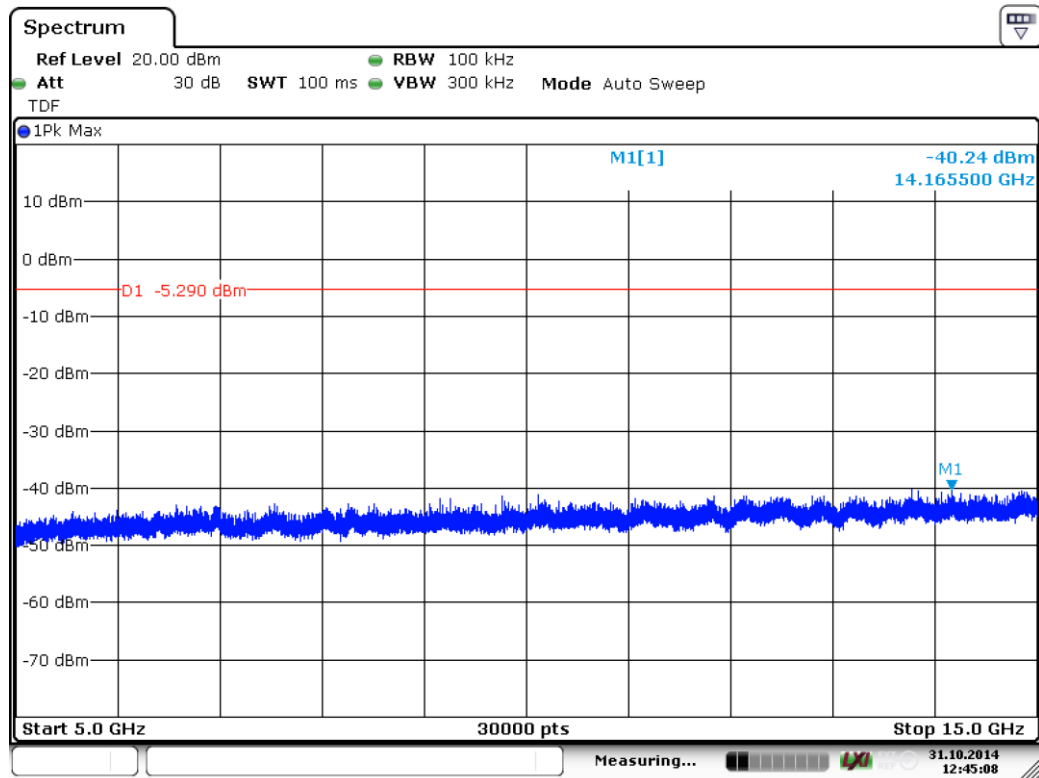


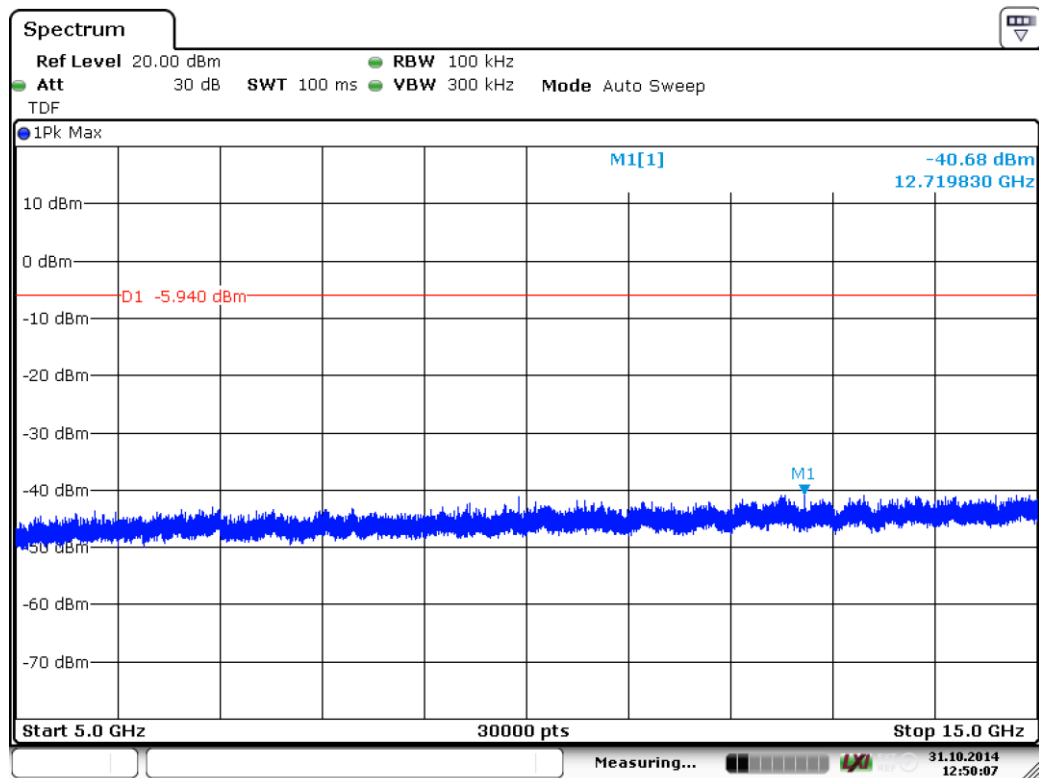
Figure 13. Low channel conductive emission 5 GHz to 15 GHz.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge



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Figure 14. Mid channel conductive emission 5 GHz to 15 GHz.



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Figure 15. High channel conductive emission 5 GHz to 15 GHz.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

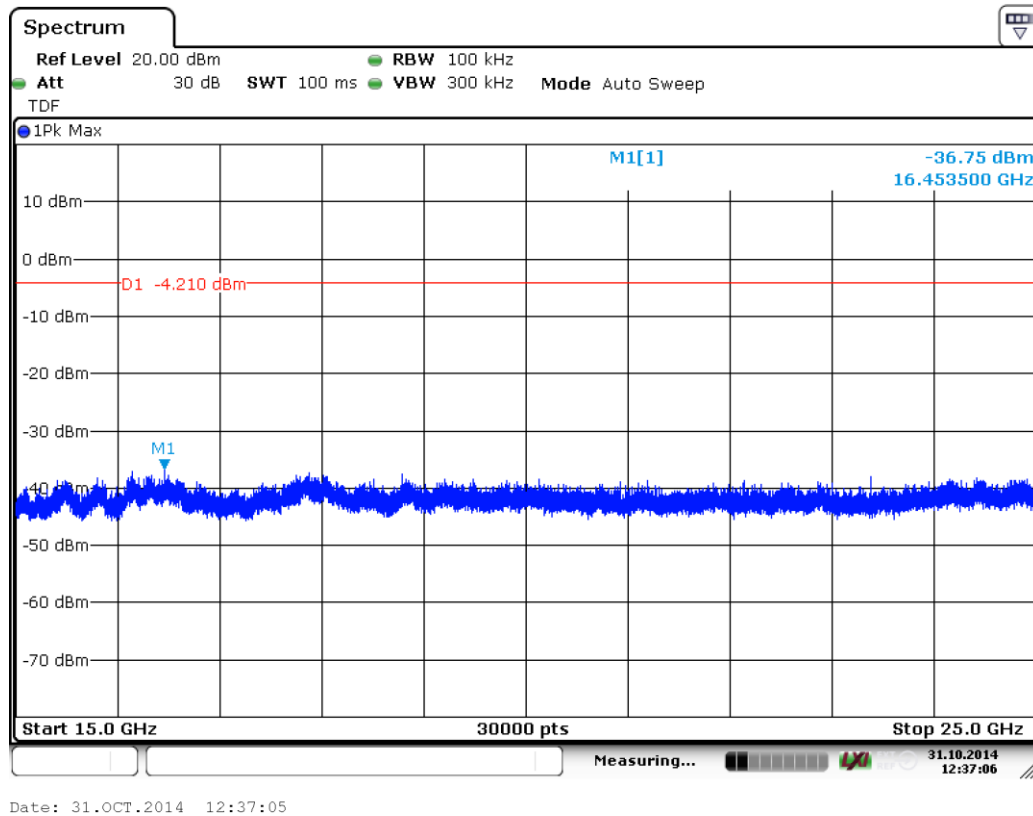


Figure 16. Low channel conductive emission 15 GHz to 25 GHz.

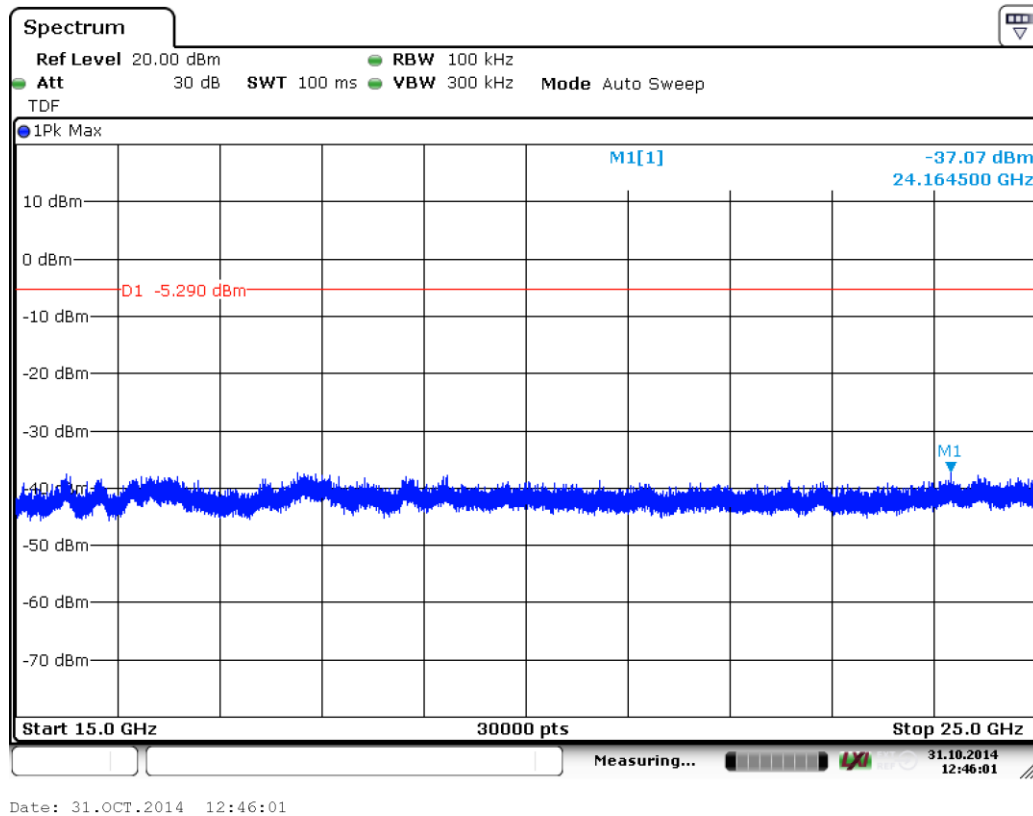
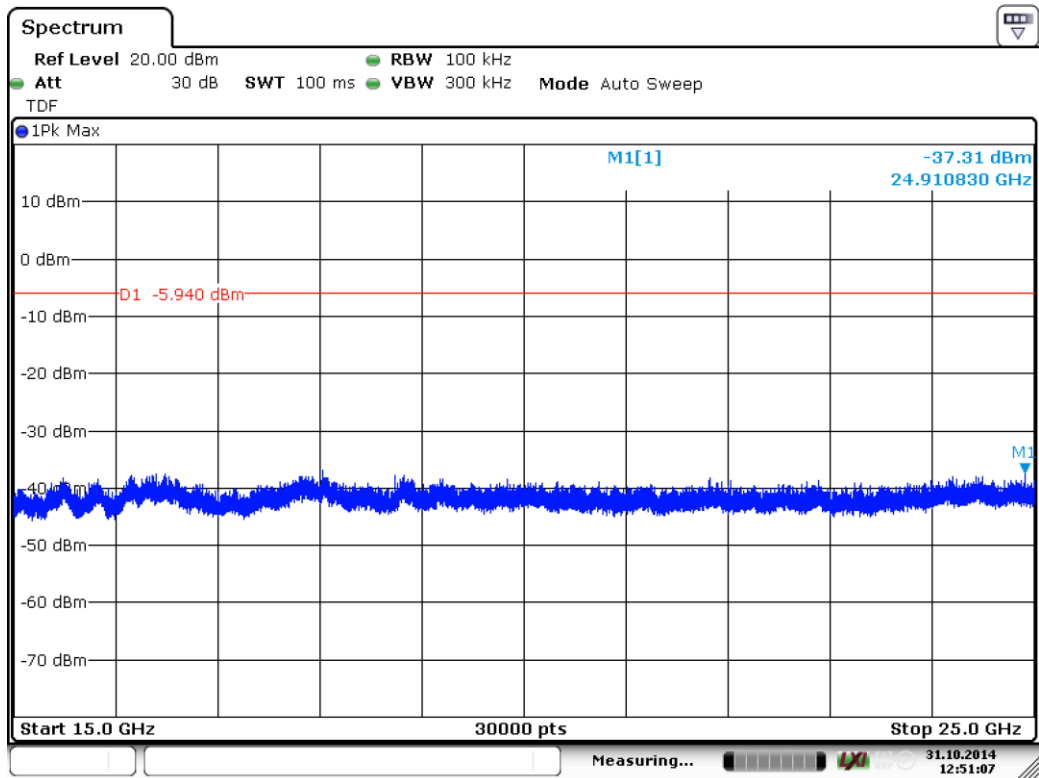


Figure 17. Mid channel conductive emission 15 GHz to 25 GHz.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge



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Figure 18. High channel conductive emission 15 GHz to 25 GHz.

20 dB Bandwidth of the Hopping Channel

20 dB Bandwidth of the Hopping Channel

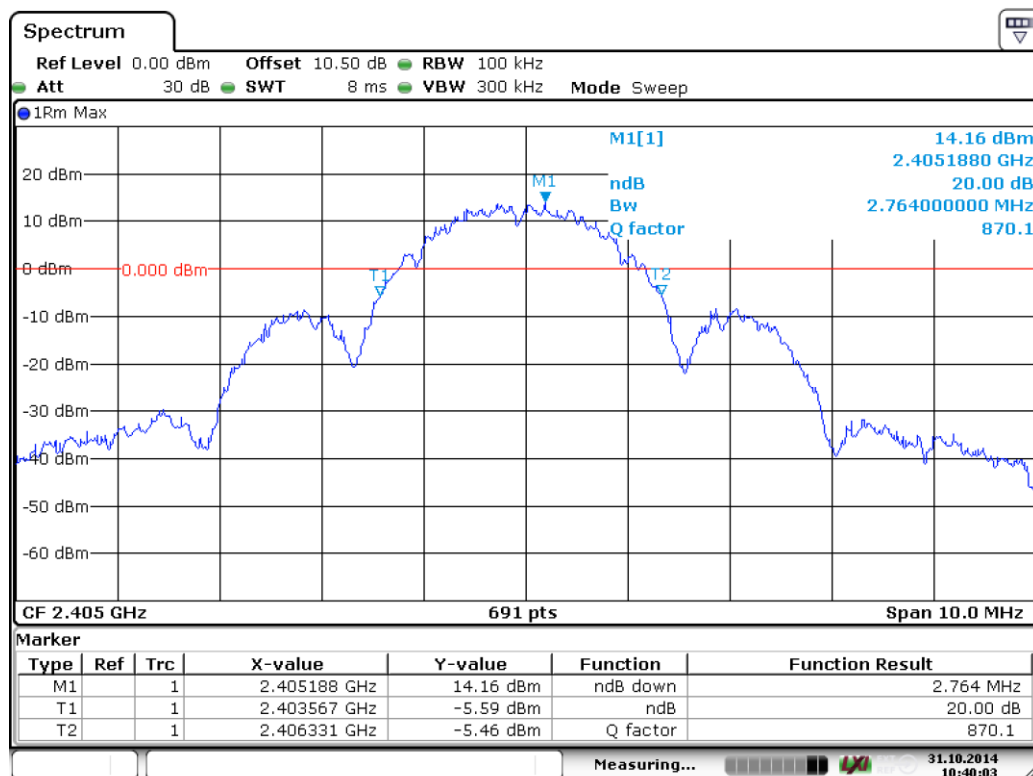
Standard: ANSI C63.10 (2013)
Tested by: PKA
Date: 31.10.2014
Temperature: 22.7 °C
Humidity: 37 % RH

FCC Rule: 15.247(a)(1)

Results:

Table 4. 20 dB bandwidth test results.

Channel	20 dB BW [kHz]
Low	2764.0
Mid	2808.0
High	2793.0



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Figure 19. 20 dB channel BW. Channel LOW.

20 dB Bandwidth of the Hopping Channel

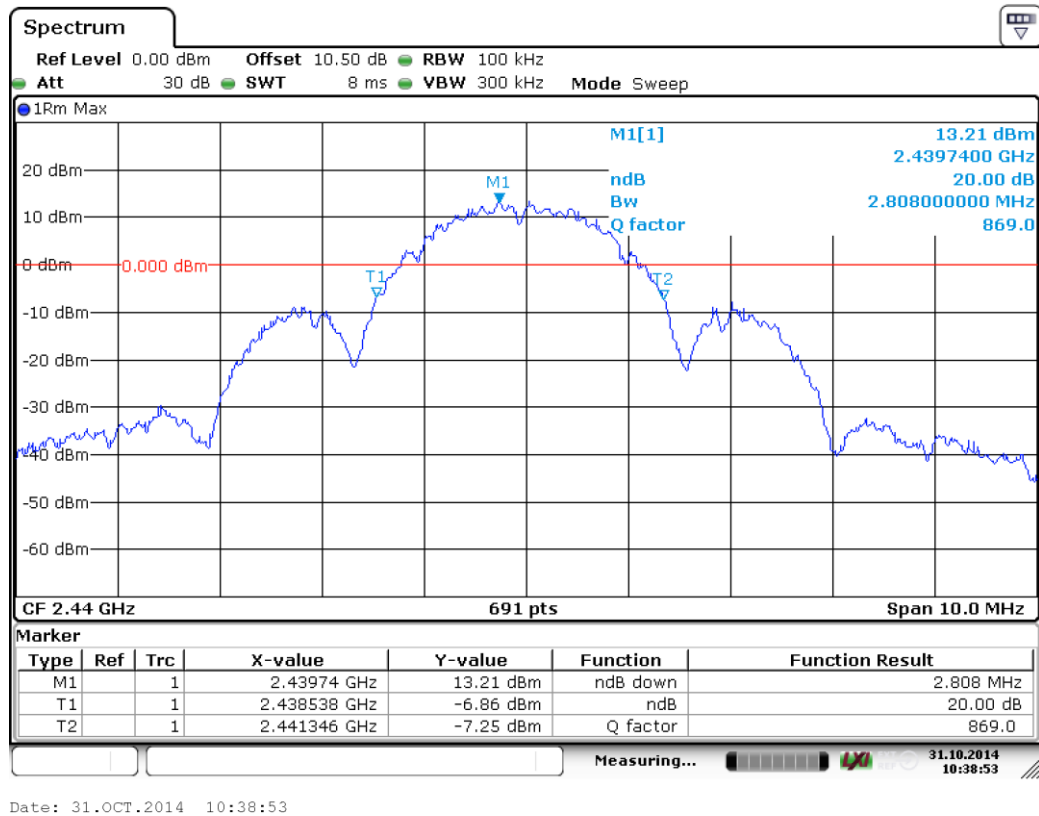


Figure 20. 20 dB channel BW. Channel MID.

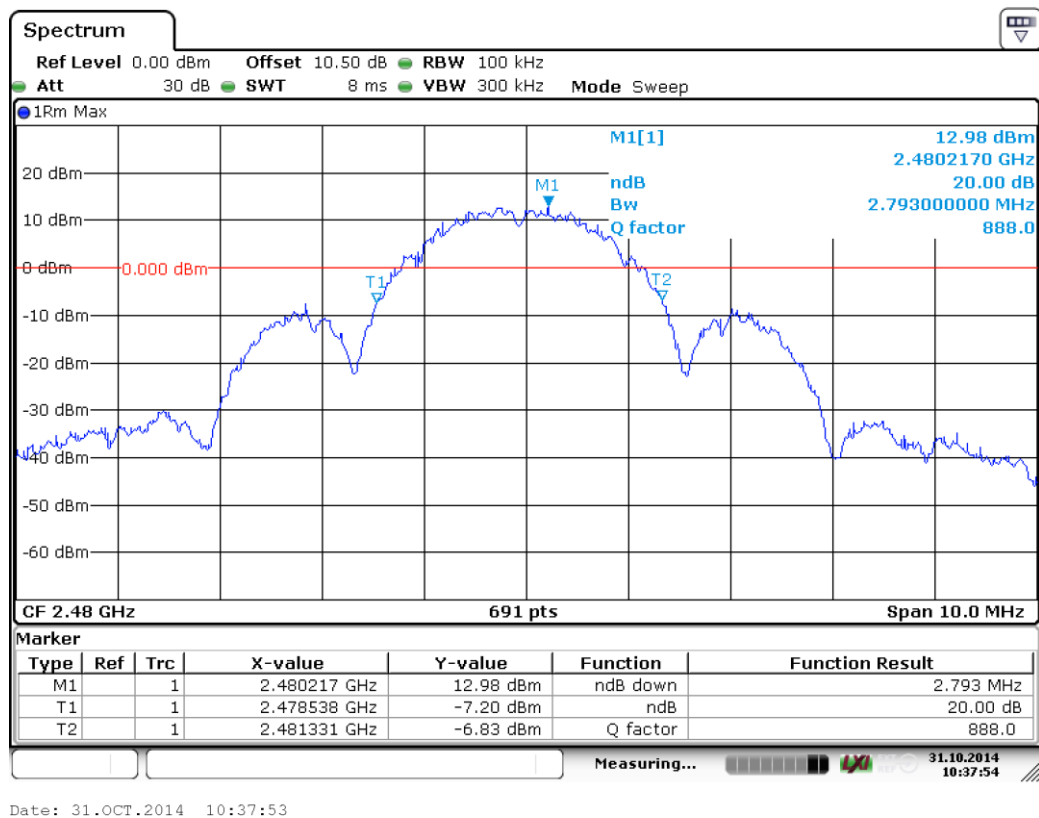


Figure 21. 20 dB channel BW. Channel HIGH.

99% Occupied Power Bandwidth

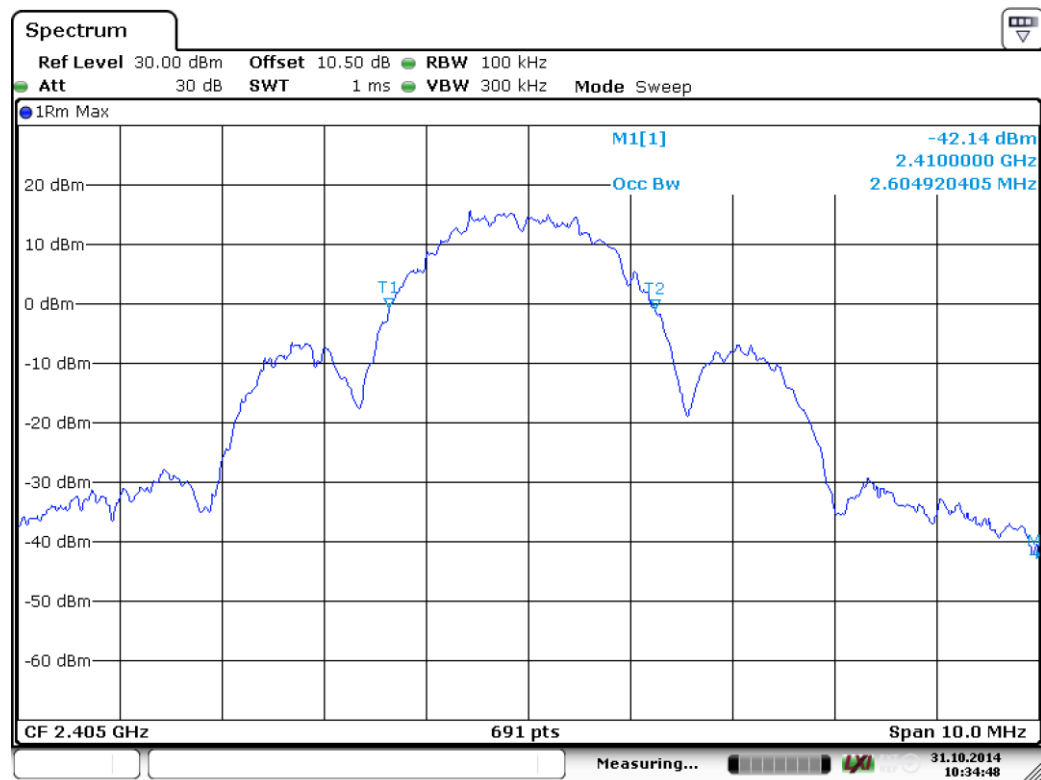
99% Occupied Power Bandwidth

Standard: RSS-GEN (2014)
Tested by: PKA
Date: 31.10.2014
Temperature: 22.7 °C
Humidity: 37 % RH

RSS-GEN 4.7.

Table 5.

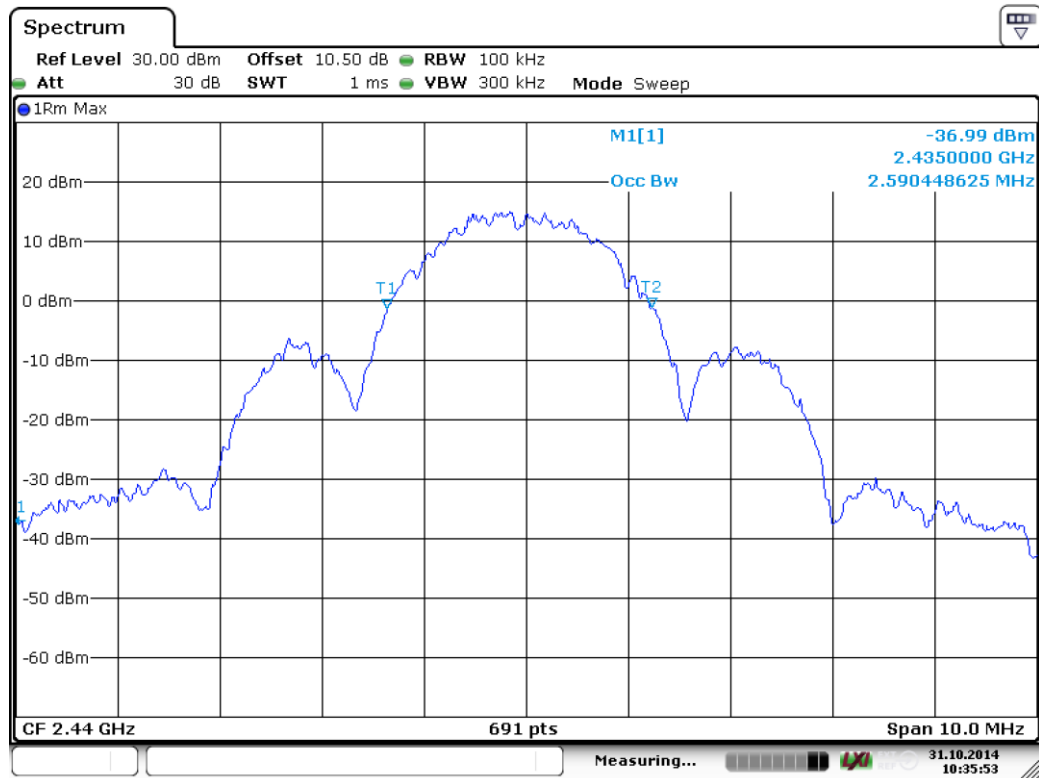
Channel	99% BW [MHz]	Limit	Result
Low	2.605	-	PASS
Mid	2.590	-	PASS
High	2.605	-	PASS



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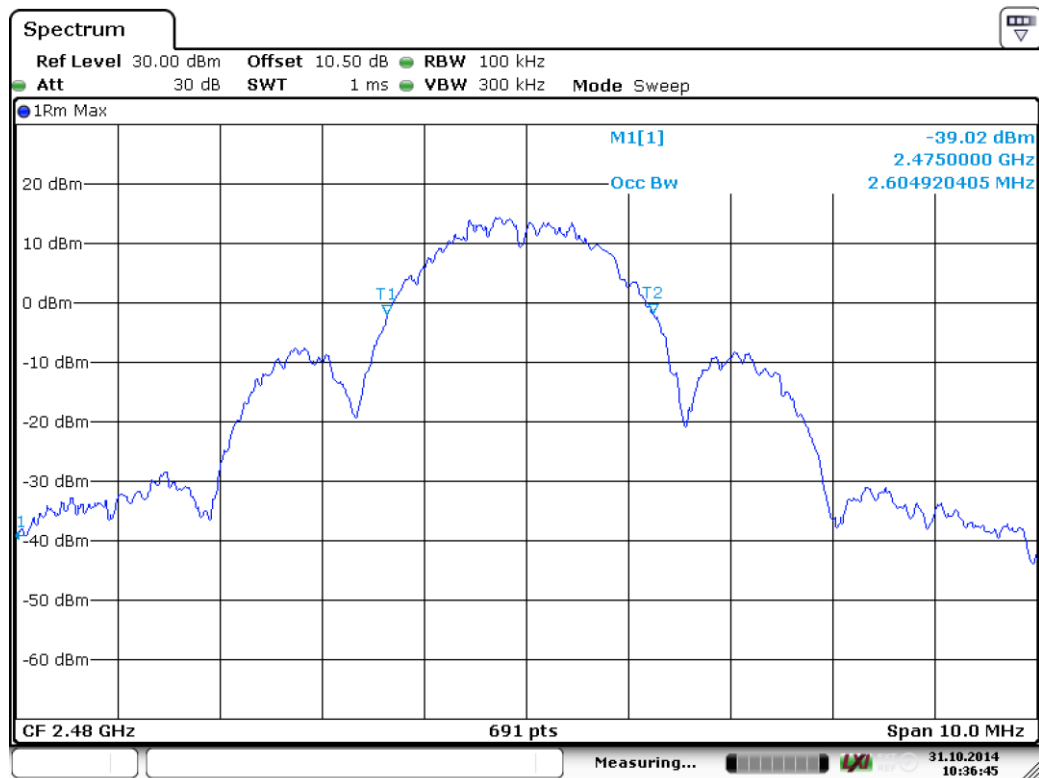
Figure 22. Low channel 99% Occupied Power Bandwidth.

99% Occupied Power Bandwidth



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Figure 23. Mid channel 99% Occupied Power Bandwidth.



Date: 31.OCT.2014 10:36:45

Figure 24. High channel 99% Occupied Power Bandwidth.

LIST OF TEST EQUIPMENT
LIST OF TEST EQUIPMENT
Conducted Emissions

Equipment	Manufacturer	Type	Serial no	Inv.no
TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	100185	8453
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-
PULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	#1	8359
LISN	ROHDE & SCHWARZ	ESH3-Z5	863794/014	8019
AC Power Source	CALIFORNIA INSTRUMENTS	5001 iX Series II	58209	7826

Radiated Emissions

Equipment	Manufacturer	Type	Serial no	Inv.no
TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	100185	8453
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
AC Power Source	CALIFORNIA INSTRUMENTS	5001 iX Series II	58209	7826

All used measurement equipment was calibrated (if required).