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Project Number: 13E4370-2

Prepared for:

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By

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**FCC Site Registration: 92592**

**Industry Canada Assigned Code: 8517A**

**Date**

5 July 2013

FCC EQUIPMENT AUTHORISATION

Test Report

**EUT Description**

Low Power Transceiver

Authorised:

A handwritten signature in blue ink, appearing to read 'John Mc Anley', written over the word 'Authorised:'.



**TEST SUMMARY**

The equipment complies with the requirements according to the following standards.

TEST SPECIFICATION	TEST PARAMETERS	RESULT
15.247(b), (c) / RSS-210 A8.4	Maximum peak output power	Pass
15.247(e) / RSS-210 A8.1	Hopping channel carrier frequencies separation	Pass
15.247(a) / RSS-210 A8.1	20dB bandwidth of the hopping channel	Pass
15.247(e) / RSS-210 A8.1	Number of hopping frequencies	Pass
15.247(e) / RSS-210 A8.1	Average time of occupancy of hopping frequency	Pass
15.247(d) / RSS-210 A8.5	Antenna conducted spurious and band edge emissions	Pass
15.247(d) / RSS-210 A8.5	Radiated spurious emissions	Pass
15.109 / ICES-003	Receiver/digital device radiated emissions	Pass

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE  
WRITTEN APPROVAL OF COMPLIANCE ENGINEERING IRELAND LTD

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## 1.0 EUT Description

The EUT was a module using a short range 915 MHz band transceiver as the basis for detector modules used in temperature sensing and similar applications.

<b>Model:</b>	Wireless Sensor Module K114
<b>Type:</b>	915 MHz Sensor Module
<b>FCC ID:</b>	2AAN2K114
<b>Company:</b>	Logpro
<b>Contact</b>	Dr David Gray
<b>Address:</b>	Moyra Falcarragh Co. Donegal Republic of Ireland
<b>Phone:</b>	+353 7491 62982 extn 223
<b>e-mail:</b>	<a href="mailto:david.gray.phd@gmail.com">david.gray.phd@gmail.com</a>
<b>Test Standards:</b>	47 CFR, Part 15.247
<b>Type of radio:</b>	Stand-alone
<b>Transmitter Type:</b>	FHSS
<b>Operating Frequency Range(s):</b>	902 to 928 MHz
<b>Number of Channels:</b>	53
<b>Antenna:</b>	Internal
<b>Transmitter power configuration:</b>	3VDC battery
<b>Test Methodology:</b>	Measurements performed according to the procedures in ANSI C63.4-2003

## 1.1 EUT Operation

### Operating Conditions during Test:

The equipment under test was operated during the measurement under the following conditions:

- ☐ Standby
- ☒ Continuous transmissions with hopping function enabled
- ☐ Continuous transmissions with hopping function disabled (modulated signal)
- ☐ Continuous transmissions with hopping function disabled (un-modulated signal)
- ☐ Continuous receiving
- ☐ Test program (customer specific)

No.	Description
1.	Test was performed at low channel, middle channel, and upper channel

The module transmits once every 5 seconds under internal control.

### **Environmental conditions**

During the measurement the environmental conditions were within the listed ranges:

- ☒ Normal

Temperature: +15 to +35 ° C

Humidity: 20-75 %

## 1.2 Modifications

No modifications were required in order to pass the test specifications.

### **1.3 Date of Test**

The tests were carried out on one sample of the EUT during the month of June 2013.

### **1.4 Electromagnetic Emissions Testing**

The guidelines of CISPR 16-4 were used for all uncertainty calculations, estimates and expressions thereof for EMC testing. A copy of Compliance Engineering Ireland Ltd.'s policy for EMC Measurement Uncertainty is available on request.

RF Requirements: Spurious emissions in accordance with FCC CFR 15.107, 15.109 and 15.209. Tests were carried out to the requirements of CISPR 16-4 and ANSI C63.4-2009.

#### **1.4.1 Measurement Uncertainty**

The measurement uncertainty (with a 95% confidence level) for the conducted emissions test was  $\pm 3.5$  dB.

The measurement uncertainty (with a 95% confidence level) for the radiated emissions test was  $\pm 5.3$  dB (from 30 to 100 MHz),  $\pm 4.7$  dB (from 100 to 300 MHz),  $\pm 3.9$  dB (from 300 to 1000 MHz) and  $\pm 3.8$  dB (from 1 GHz to 40 GHz).

## **2.0 Emissions Measurements**

### **2.1 Conducted Emissions Measurements**

The measurements were taken using a Line Impedance Stabilisation Network (LISN). A Rohde and Schwarz ESHS30 Receiver with a bandwidth of 9 kHz is used to measure the conducted emissions when applicable. The measurements were carried out using the receiver analysis feature, which uses three detectors; peak, quasi peak and average. Using this mode the voltage emission spectrum was scanned in peak detection mode and the emissions which exceeded a sub range margin relevant to the respective limits were further measured using the quasi peak and average detectors. The live and neutral conductors were examined individually to determine the maximum. The receiver bandwidth was set to 10 kHz. Appendix A shows the plots from the test.

The excess interface cables were bundled in a non-inductive arrangement at the approximate centre of the cable with the bundle 30 to 40 centimetres in length. The conducted emissions were maximised by varying the operating states and configuration of the EUT.

The results of conducted emissions are shown in Appendix A, Figures 21 and 22.

### **2.2 Radiated Emissions Measurements**

Radiated Power measurements were made at the Compliance Engineering Ireland Ltd anechoic chamber located in Dunshaughlin, Co. Meath, Ireland to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

The EUT was centred on a motorised turntable, which allows 360 degree rotation. From frequencies between 30 MHz and 1000 MHz, a measurement antenna was positioned at a distance of 10 meters as measured from the closest point of the EUT. The radiated emissions were maximised by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 meters.

Emissions above 1 GHz were made at a 3 metre distance and a measurement bandwidth of 1 MHz. For peak measurements the video bandwidth was set to 1 MHz and for average measurements was set to 100 Hz.

A measuring receiver with peak detection was used to find the maximums of the radiated emissions during the variability testing below 1 GHz. All final measurements below 1 GHz were taken using the quasi peak detector with a measurement bandwidth of 120 kHz. A drawing showing the test setup is given as Figure 1.

### 2.3 Test Criteria

The FCC Part 15.209 radiated limits are given below extrapolated to a measurement distance of 10 meters.

Frequency (MHz)	Field Strength $\mu\text{V/m}$	Field Strength (dB $\mu\text{V/m}$ )
30-88	100	30.0
88-216	150	33.52
216-960	200	36.0
above 960	500	44.0



### 3.0 Field Strength of Spurious Radiated Emissions

#### Test Specification: FCC PART 15, SECTION 47 CFR 15.209

For the spurious and harmonics measurements, the EUT was set up in an Anechoic Chamber, with the EUT running in a continuous low channel mode. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4m in order to maximize the emissions. Significant peaks from the EUT were then recorded to determine margin to the limits. Distance of EUT to the measurement antenna specified in **section 2.2**.

Testing was repeated with EUT in continuous mid channel and high channel modes.

Appendix A shows the results of the scans in the anechoic chamber.

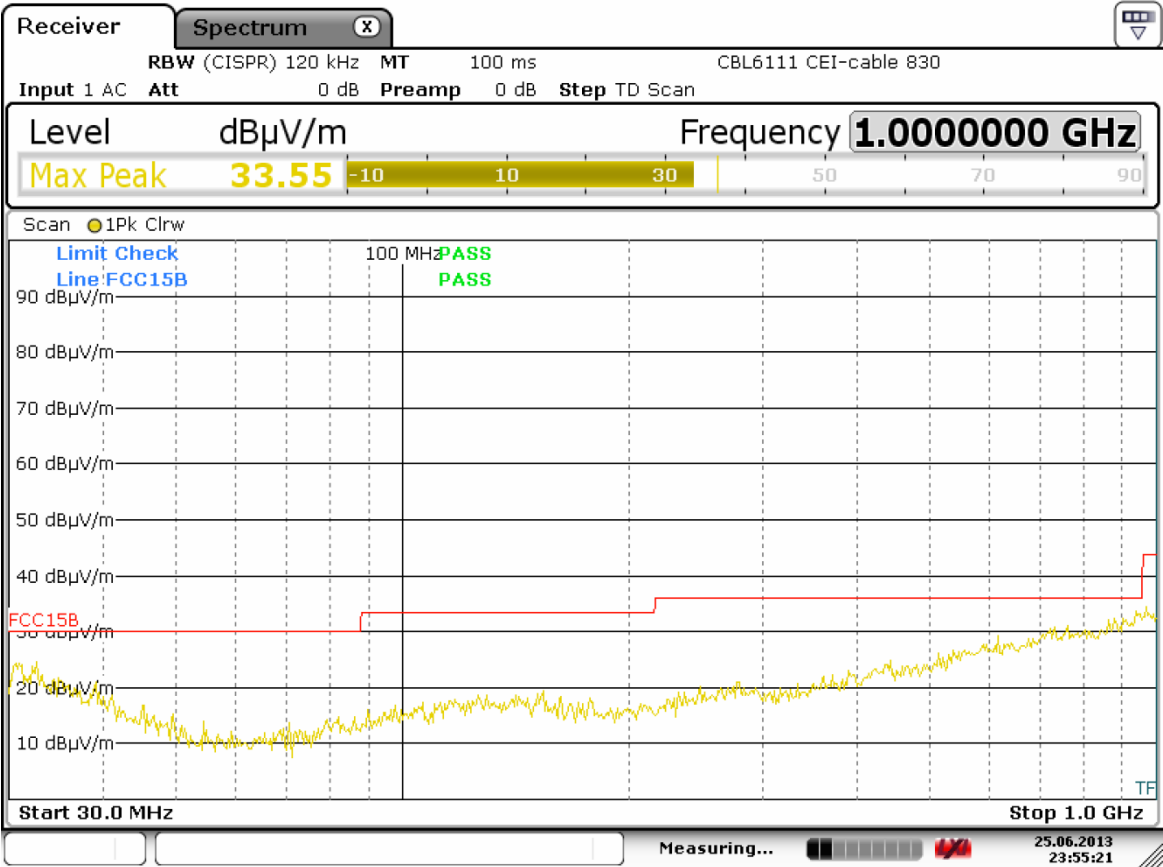
No emissions were evident in the frequency range 30 MHz to 1000 MHz.

**Table 1 – Final Radiated Emissions**

Indicated		Correction			Corr	Turntable/Antenna			Limit		Det	EUT
Freq	Ampl	Ant	Cabl	Amp	Ampl	Ang	Ht	Pol		Marg		Orien
MHz	dB $\mu$ V	dB	dB	dB	dB $\mu$ V/m	deg	m	V/H		dB		
1827.6	30.2	26.6	2.5	0	59.3	0	1	V	97	37.7	Pk	V
2741	14.6	28.7	4	0	47.3	0	1	V	54	6.7	Pk	V
3500	45.7	30.6	4.5	-36.7	44.1	0	1	V	54	9.9	Pk	V
2741	19.47	28.7	4	0	52.17	0	1	V	54	1.83	Av	V

\*The fundamental signal was 117 dB( $\mu$ V/m). The limit at 1845 MHz was -20dBc or 97 dB( $\mu$ V/m).

**Result: Pass**



Date: 25.JUN.2013 23:55:21

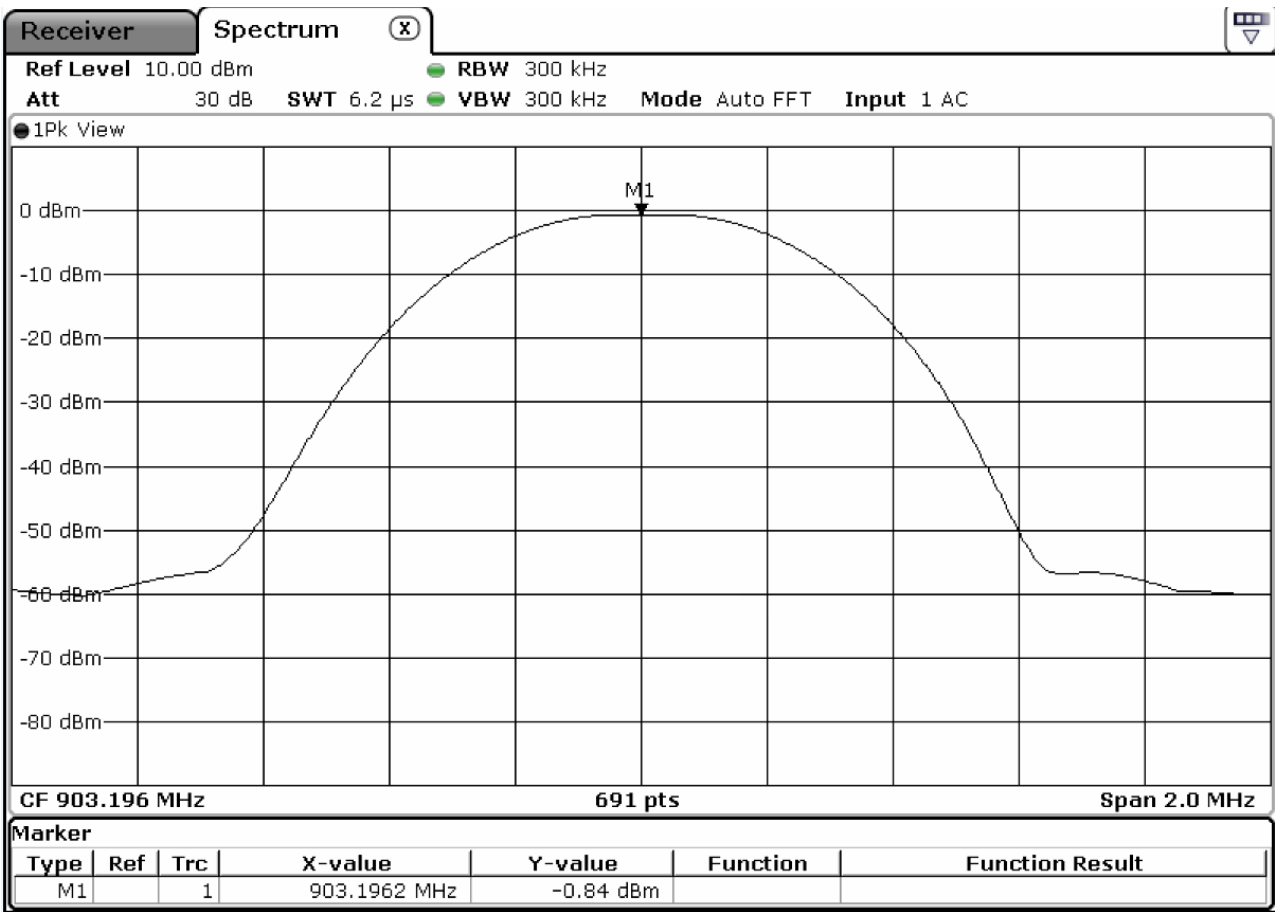
Note: Radiated Spurious Emissions above 1 GHz are shown in Appendix A.

**4.0 Maximum peak output power****Test result: Pass**

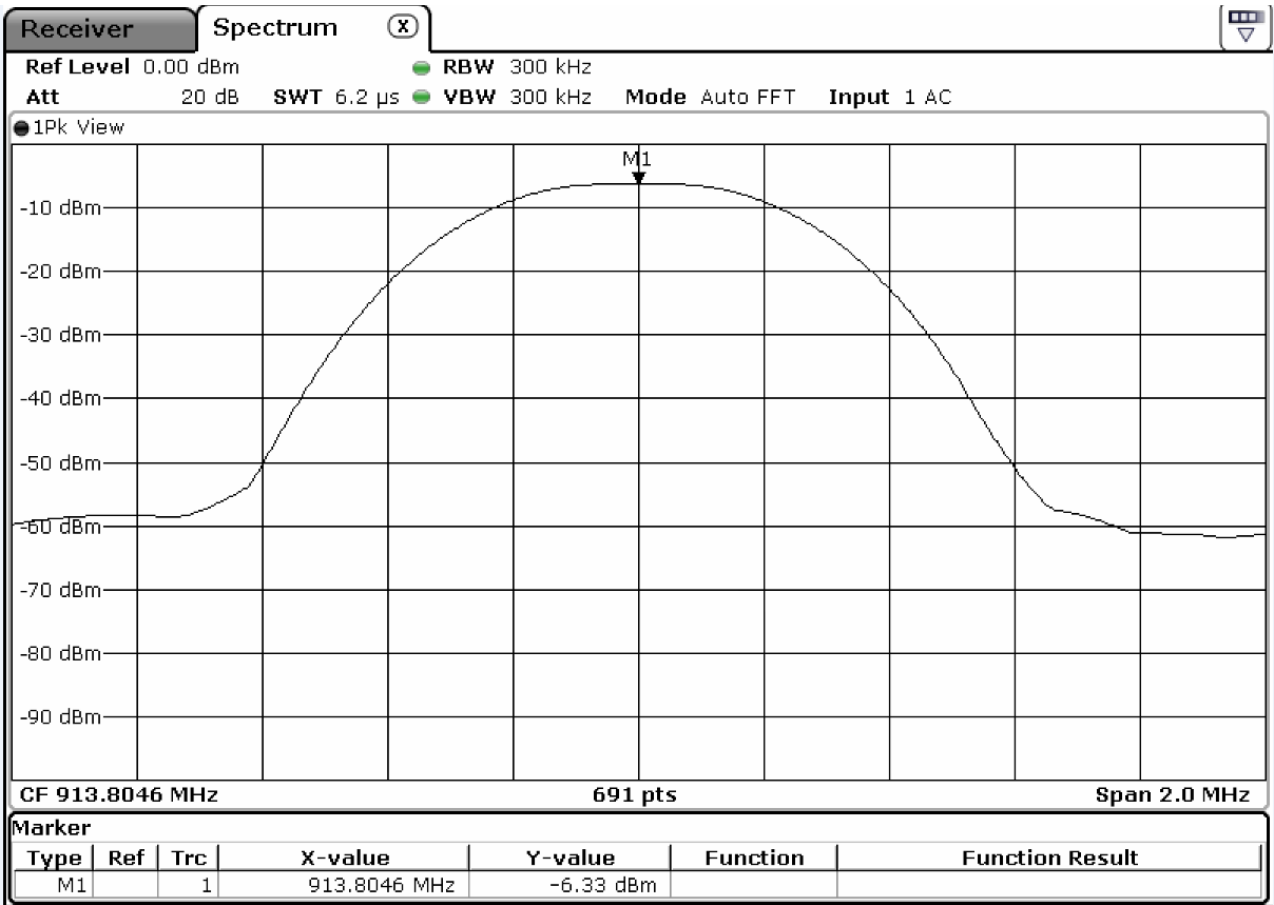
Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz					
Low Frequency Channel (MHz)	Measured power W	Attenuation dB	Power at Antenna W	Limit W	Limit Reduction dB	Margin W
903.171	0.0008	0	.0008	1	0	0.99
Middle Frequency MHz						
913.542	0.0006	0	0.0006	1	0	0.99
Upper Frequency MHz						
923.98	0.0006	0	0.0006	1	0	0.99
Antenna Gain:	<input checked="" type="checkbox"/> < 6dBi <input type="checkbox"/> > 6 dBi and =      dBi, output power reduction =      dB					

RBW: 300 kHz

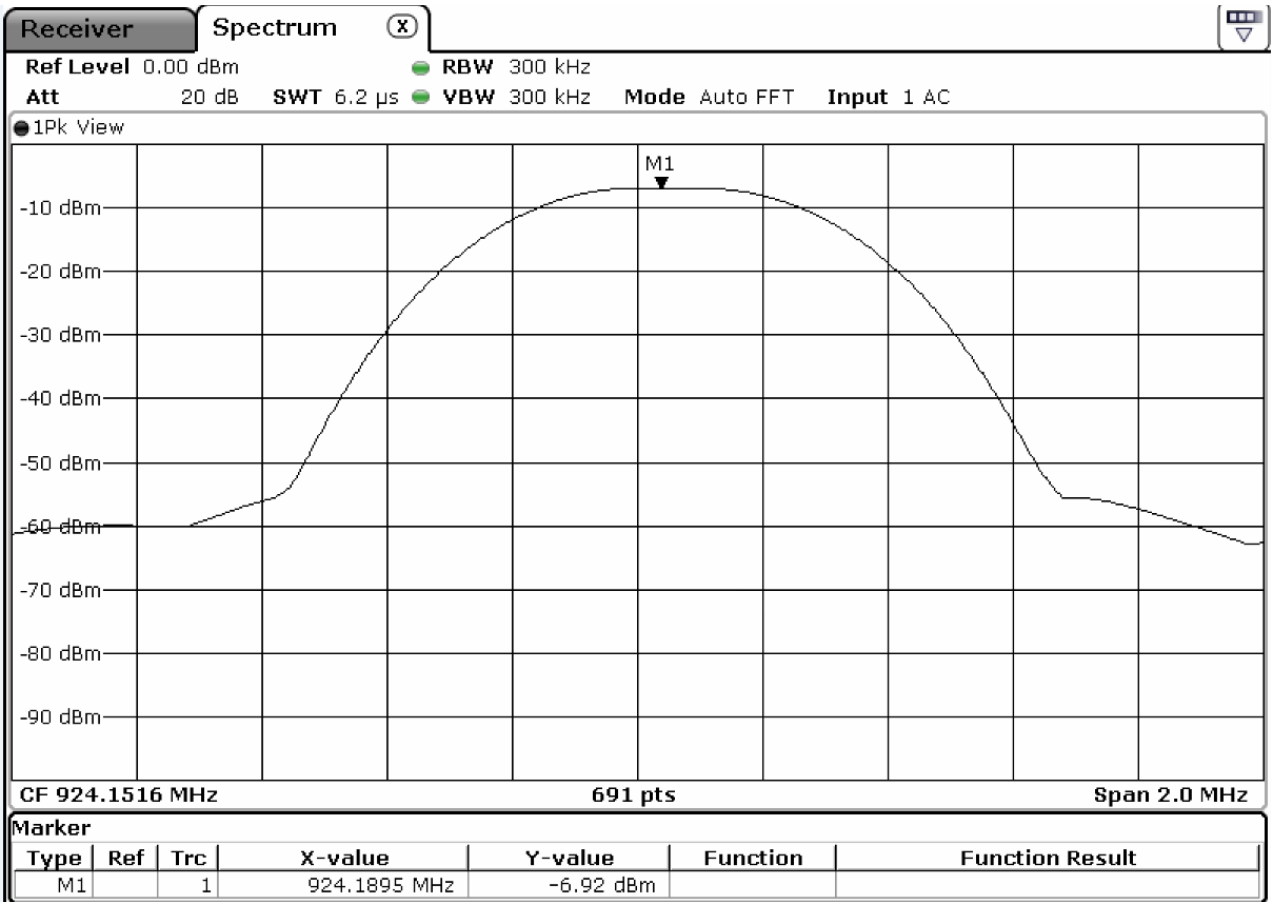
VBW: 300 kHz



Graph 1 Channel 1 (Low)



Graph 2 Channel 26 (Mid)



Graph 3

Channel 50 (High)

## 5.0 Hopping channel carrier frequencies separation

Frequency Range	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz	
Measured Separation (kHz)	Limit (kHz)	Result
400	>234	Pass
Limit:	20dB channel bandwidth	
Span:	5 MHz	
RBW:	100 kHz	
VBW:	100 kHz	

Notes:



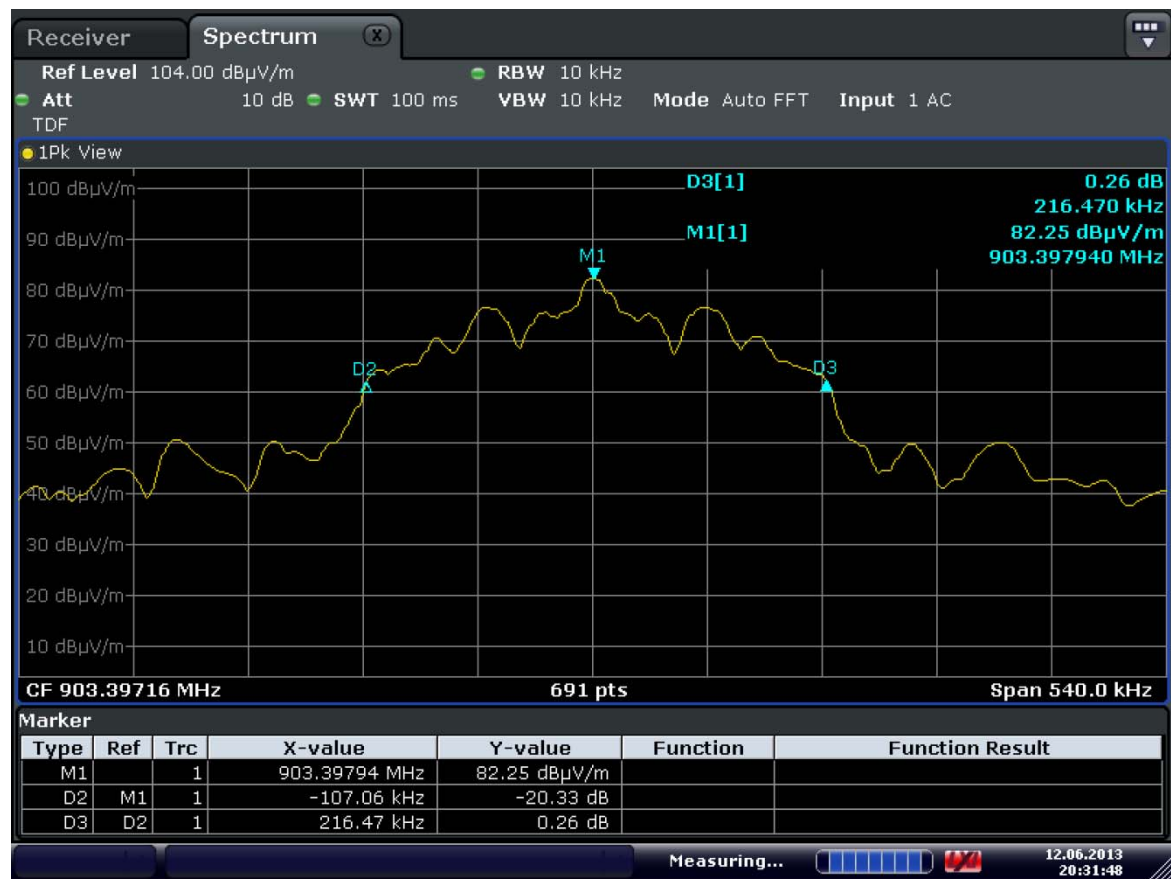
Graph 4  
Hopping Channel Carrier Frequency Separation



**6.0 20dB bandwidth of the hopping channel**

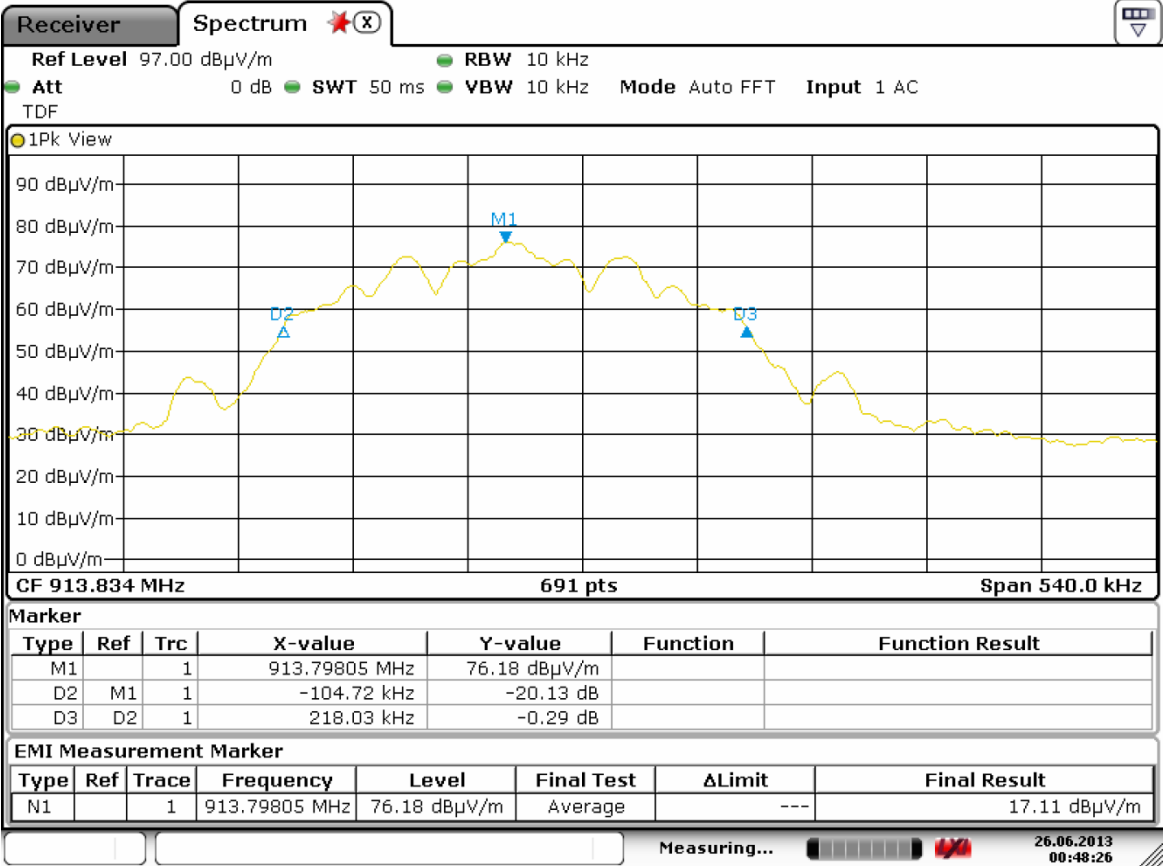
<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz			
<b>Low Frequency Channel (kHz)</b>	<b>Middle Frequency Channel (kHz)</b>	<b>Upper Frequency Channel (kHz)</b>	<b>Limit (kHz)</b>	<b>Result</b>
216.5	218	220.4		Pass
<b>Span:</b>	540 kHz			
<b>RBW:</b>	10 kHz			
<b>VBW:</b>	10 kHz			

**Notes:**



Date: 12.JUN.2013 20:31:48

Graph 5 20dB bandwidth (low frequency channel)



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Graph 6 20dB bandwidth (mid frequency channel)

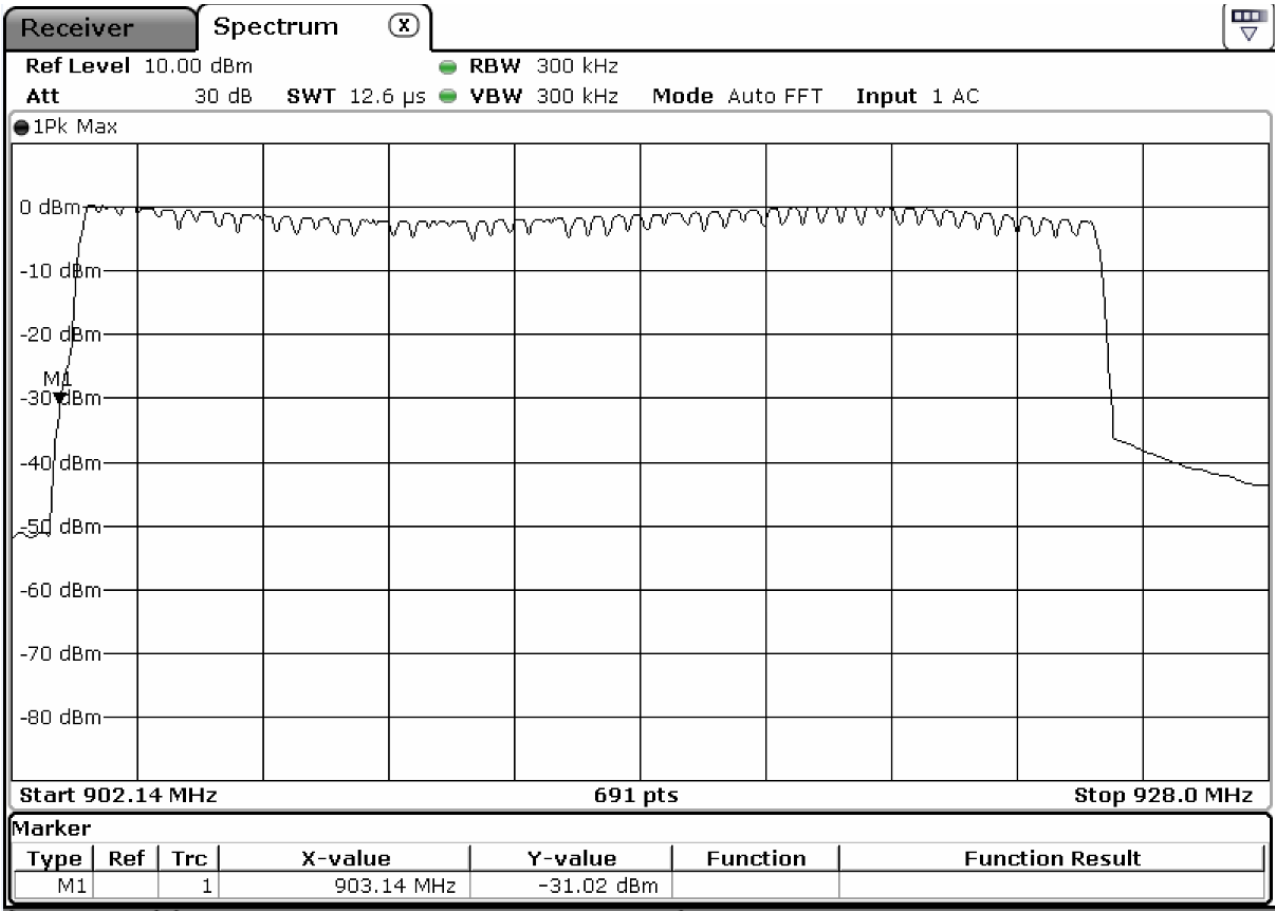


Date: 12.JUN.2013 20:55:03

Graph 7 20dB bandwidth (upper frequency channel)

**7.0 Number of hopping frequencies**

<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz	
<b>Measured Number</b>	<b>Requirements</b>	<b>Result</b>
53	At least 50	<b>Pass</b>
<b>Channel 20dB Bandwidth:</b>	<250kHz ≥250kHz	



Graph 8  
Number of hopping frequencies

**8.0 Average time of occupancy of hopping frequency**

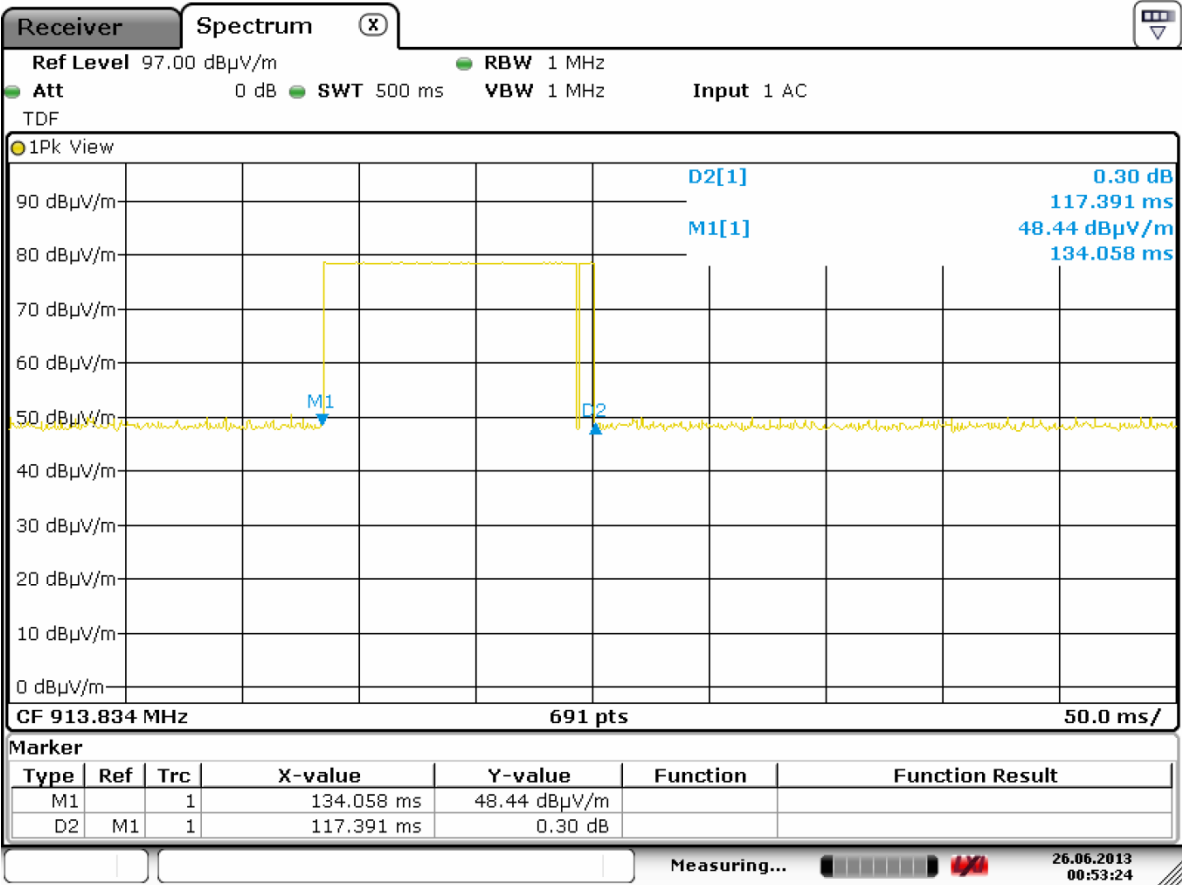
<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz		
<b>Measured Single Duration sec</b>	<b>Time of Occupancy Sec</b>	<b>Limit Sec</b>	<b>Result</b>
<b>10 random channels</b>	<b>0.117</b>	<b>0.4</b>	<b>Pass</b>
<b>Period:</b>	<input type="checkbox"/> 10s <input type="checkbox"/> 20s <input type="checkbox"/> 30s <input type="checkbox"/> 0.4s multiplied by the channel number		
<b>Channel 20dB Bandwidth:</b>	<input checked="" type="checkbox"/> <250kHz <input type="checkbox"/> ≥250kHz		

Time of occupancy calculation:

The minimum measured repetition of the channel occupancy (repetition) = 1

Single occupancy duration (single duration) = 0.117 sec

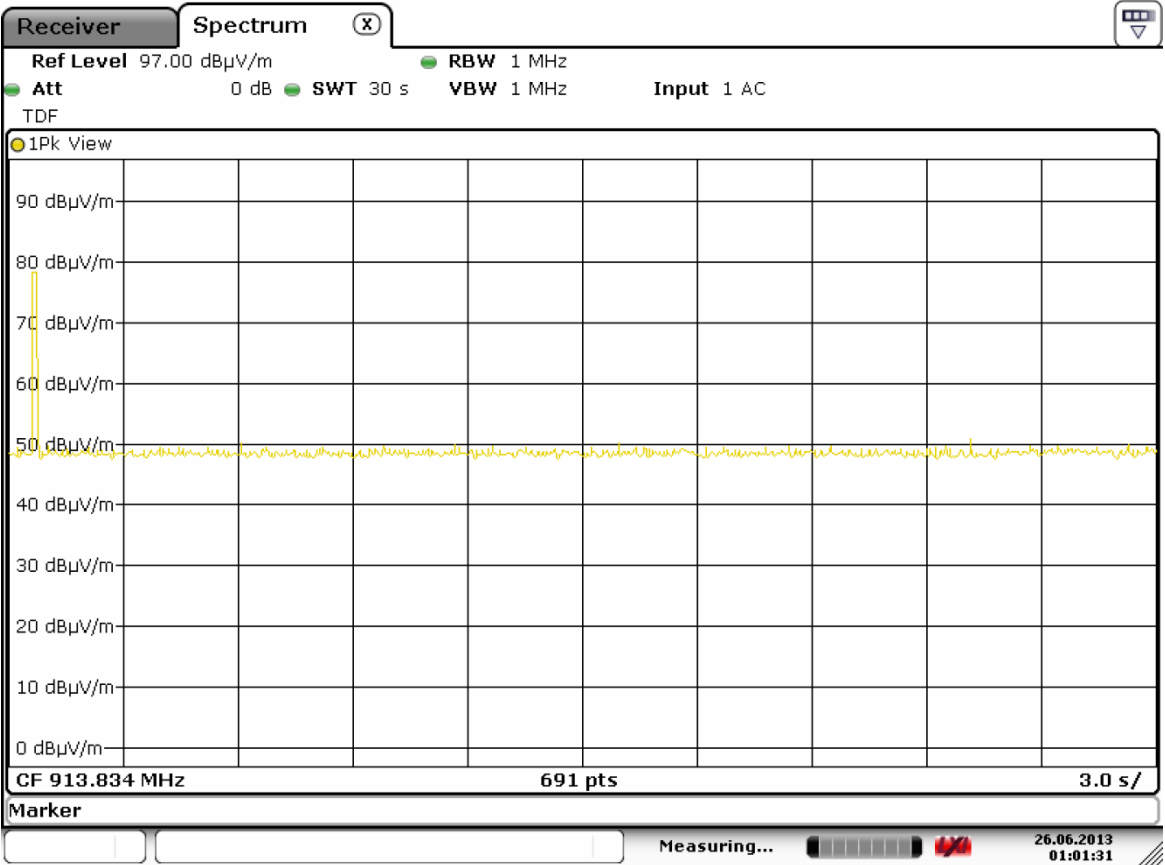
Time of occupancy = (single duration) x (repetition) = 0.117 x 1 = 0.117 sec



Date: 26.JUN.2013 00:53:24

Graph 9  
Average Time of occupancy of hopping frequency





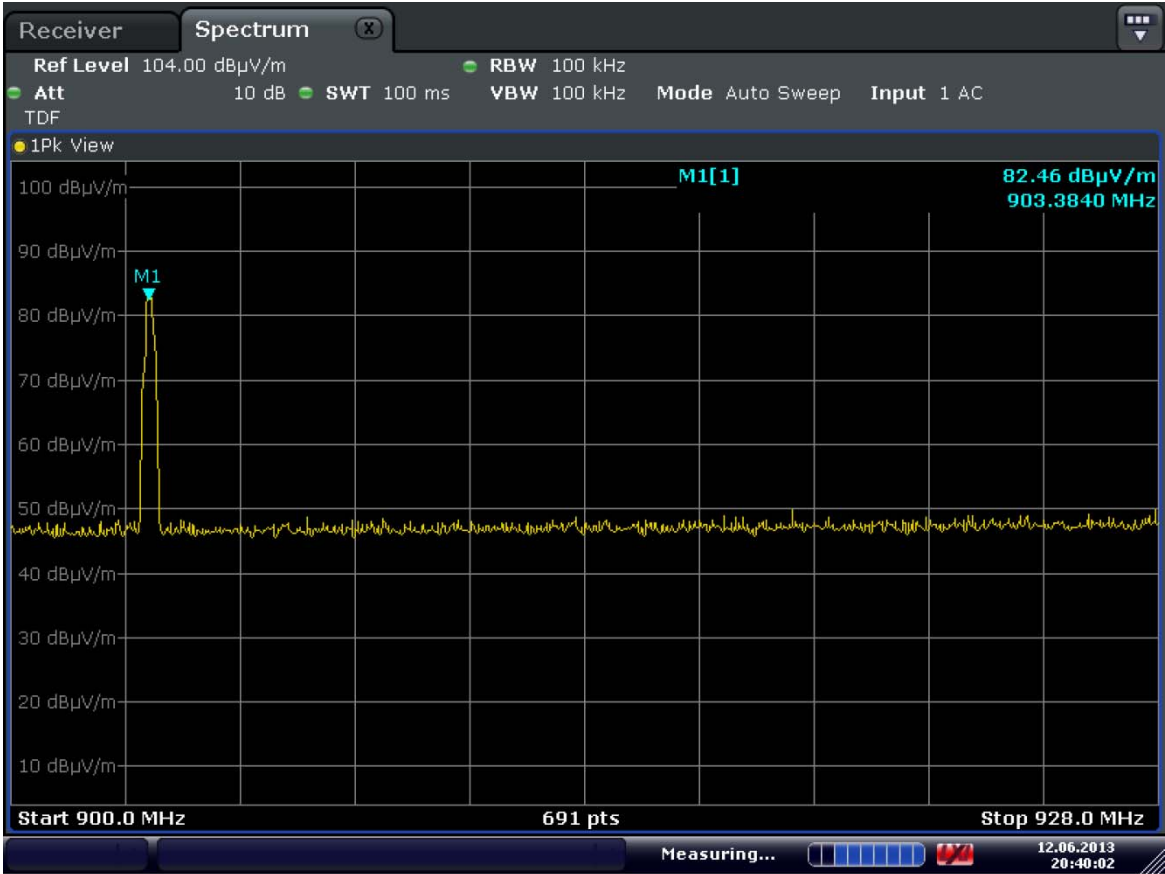
Date: 26.JUN.2013 01:01:31

Graph 10  
Number of repetitions

## 9.0 Antenna conducted spurious emissions

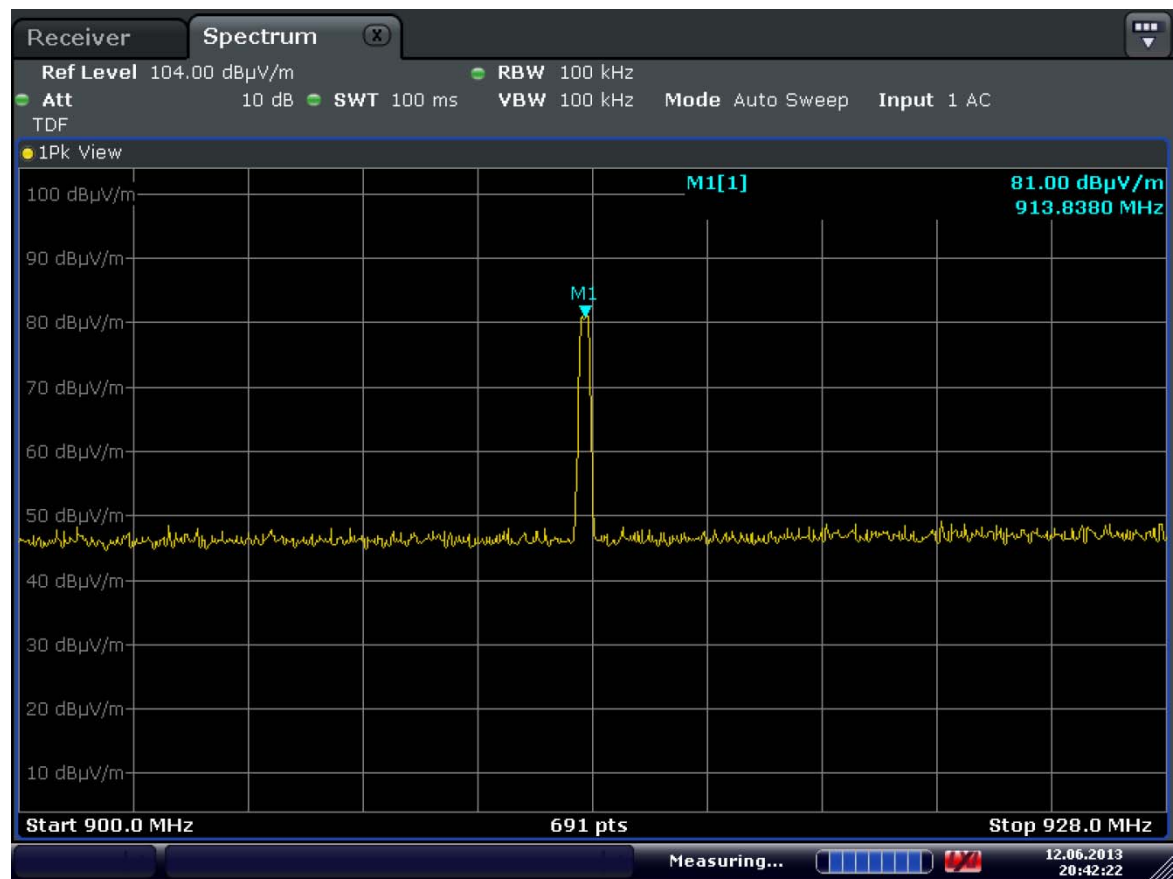
<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz		
	<b>Minimum Measured Attenuation dB</b>	<b>Minimum Allowed Attenuation dB</b>	<b>Margin dB</b>
<b>Low Frequency Channel</b>	<b>&gt;60</b>	<b>20</b>	<b>&gt;40</b>
<b>Middle Frequency Channel</b>	<b>&gt;60</b>	<b>20</b>	<b>&gt;40</b>
<b>Upper Frequency Channel</b>	<b>&gt;60</b>	<b>20</b>	<b>&gt;40</b>
<b>Analyzer Settings:</b>	<input checked="" type="checkbox"/> RBW=100KHz		
<b>Minimum Allowed Attenuation:</b>	<input checked="" type="checkbox"/> 20dB <input type="checkbox"/> 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

**Notes:** Note measured using radiated test.



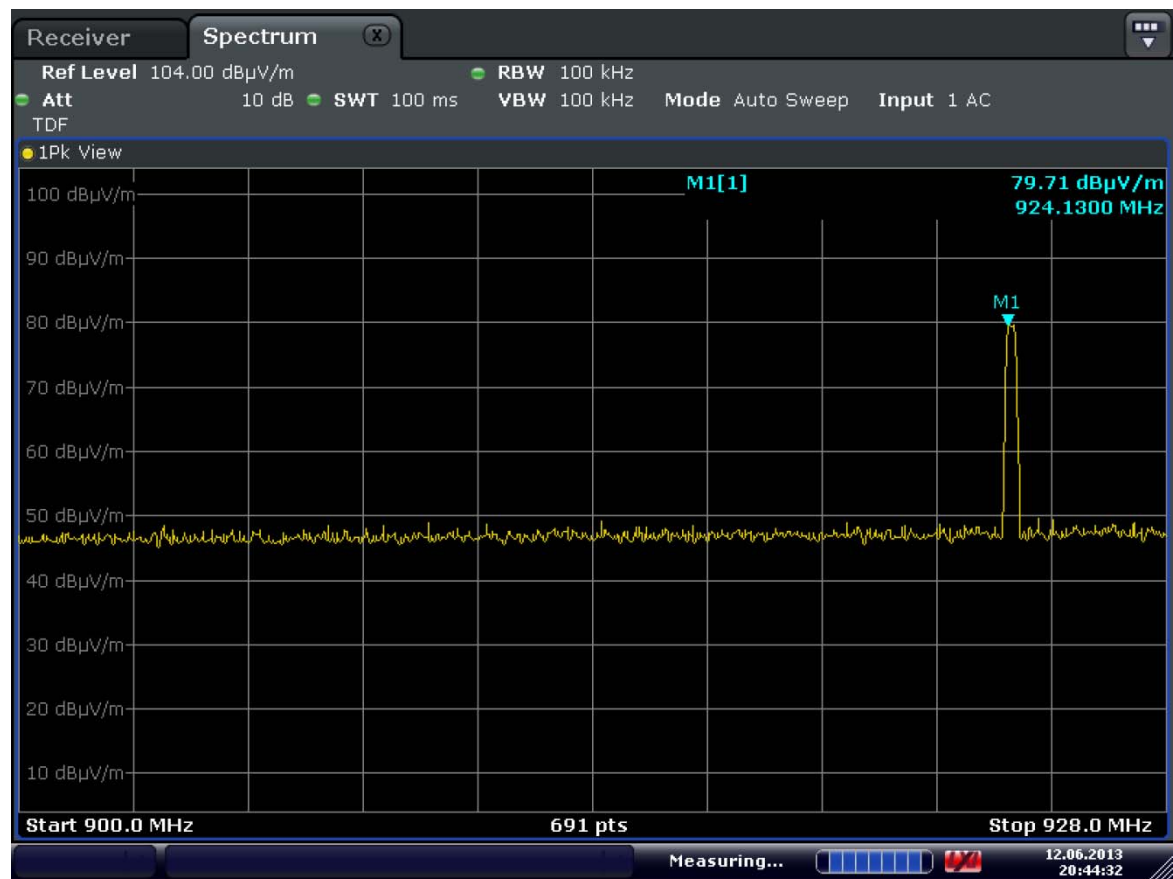
Date: 12.JUN.2013 20:40:02

Graph 11 (lower frequency channel)



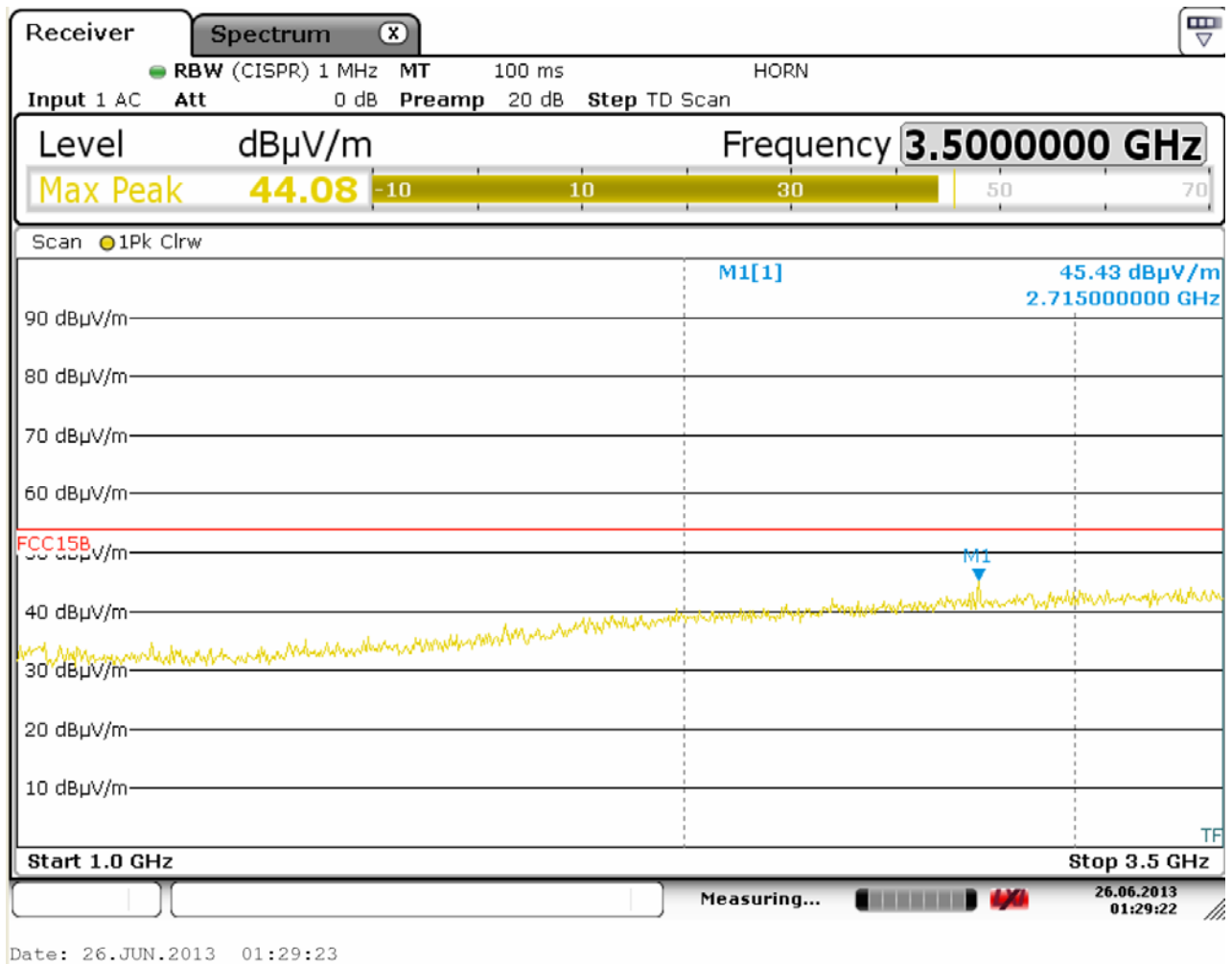
Date: 12.JUN.2013 20:42:22

Graph 12 (mid frequency channel)

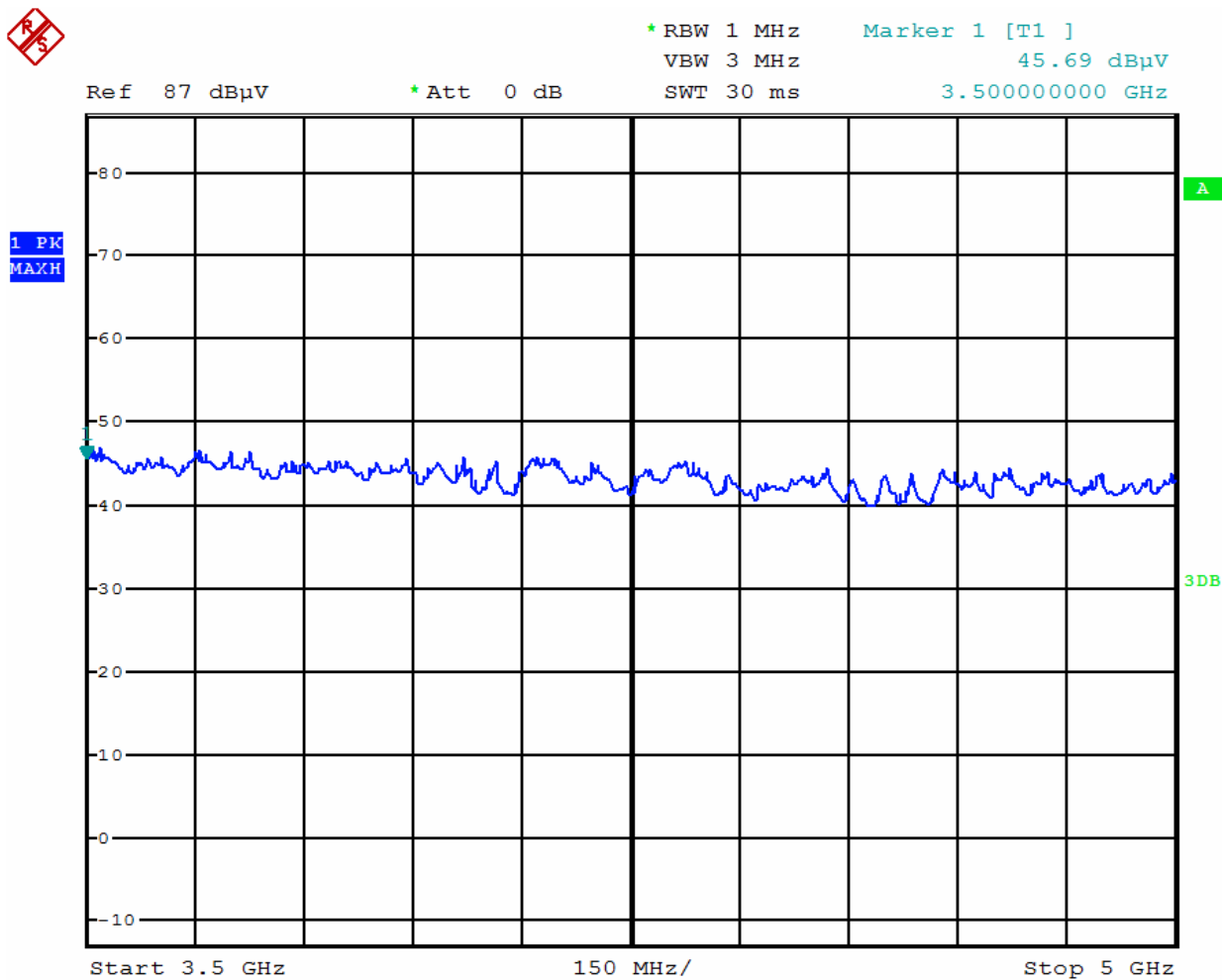


Date: 12.JUN.2013 20:44:33

Graph 13 (upper frequency channel)

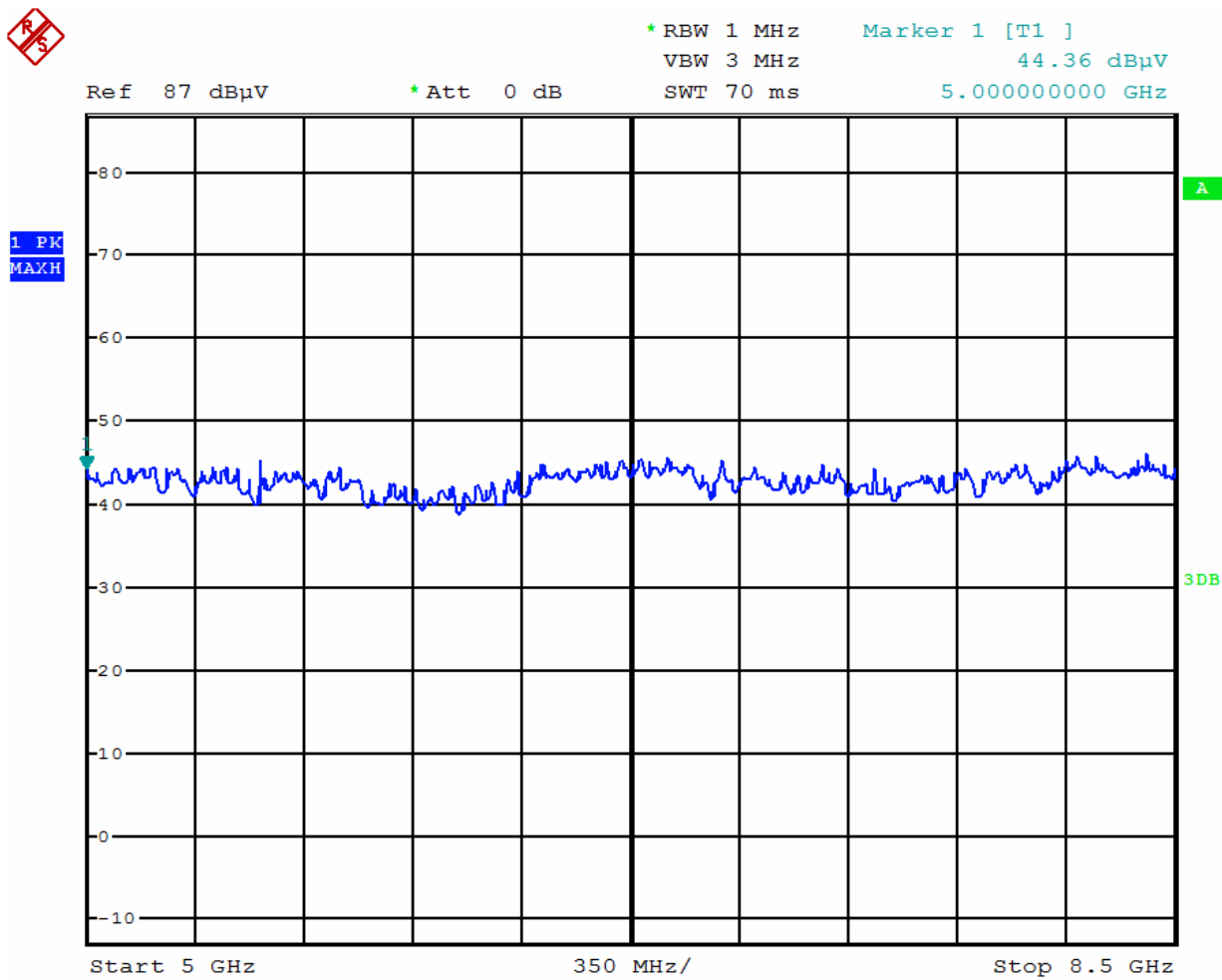


Graph 14 Radiated Spurious Emissions 1 -3.5 GHz



Date: 26.JUN.2013 02:21:20

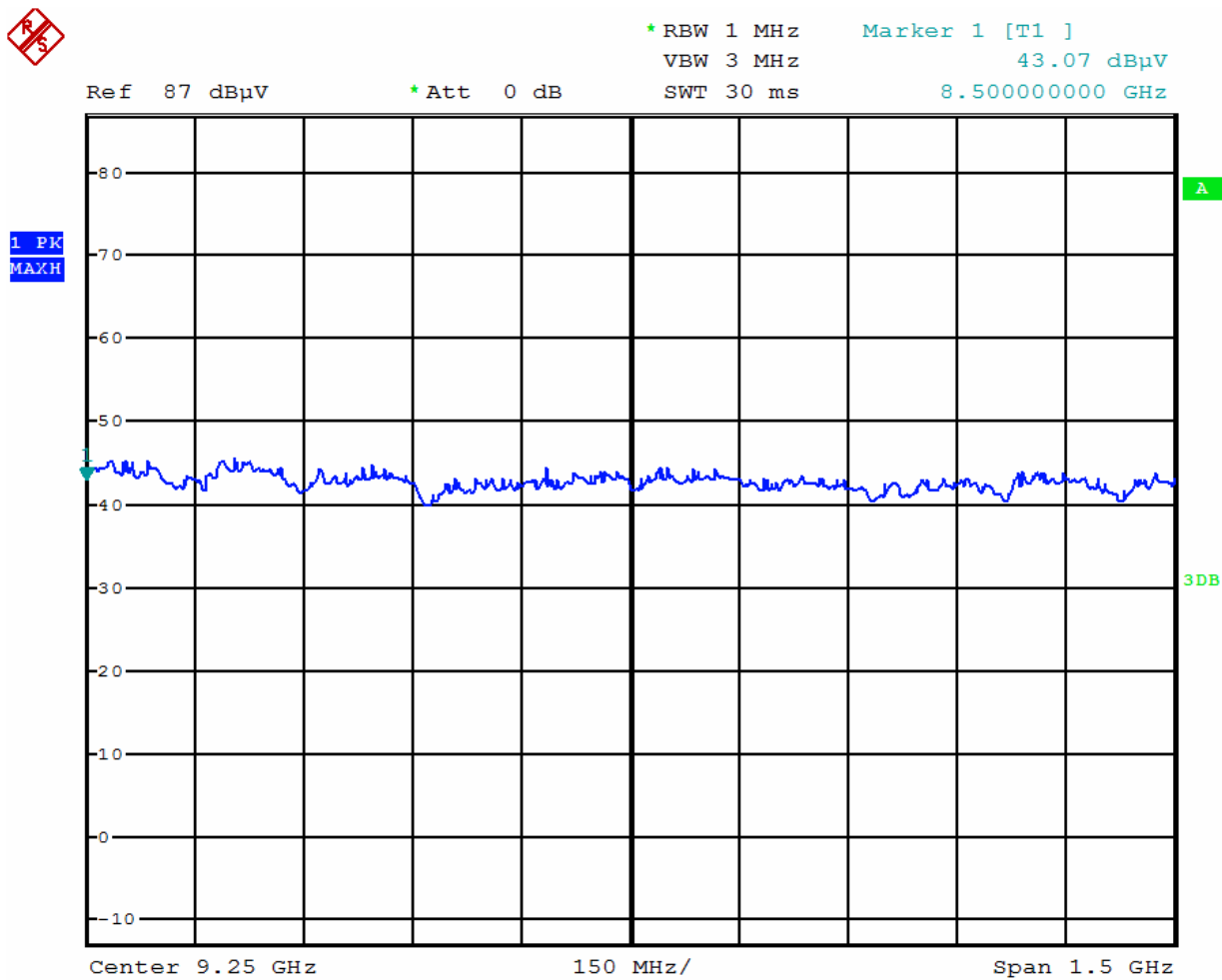
Graph 15 Radiated Spurious Emissions 3.5-5 GHz



Date: 26.JUN.2013 02:22:02

Graph 16 Spurious Emissions 5-8.5 GHz



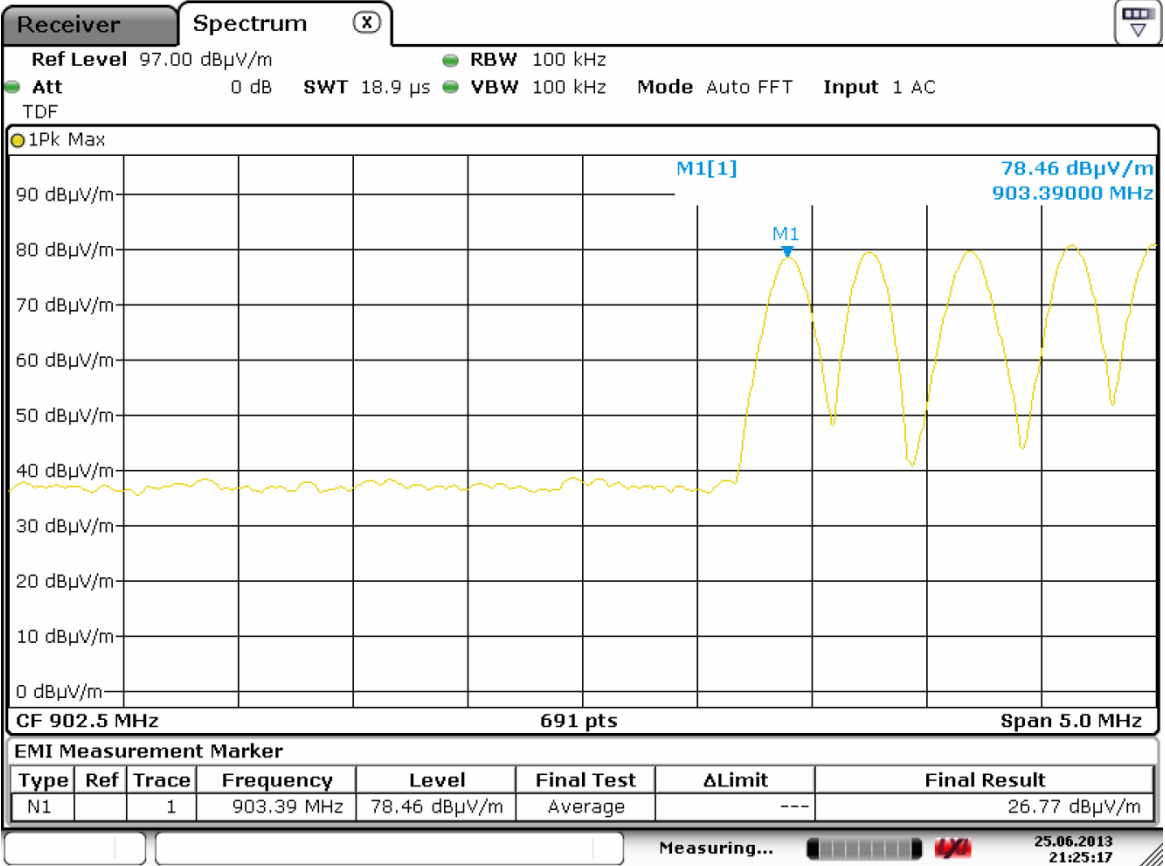


Date: 26.JUN.2013 02:23:01

Graph 17 Radiated Spurious Emissions 8.5-10 GHz

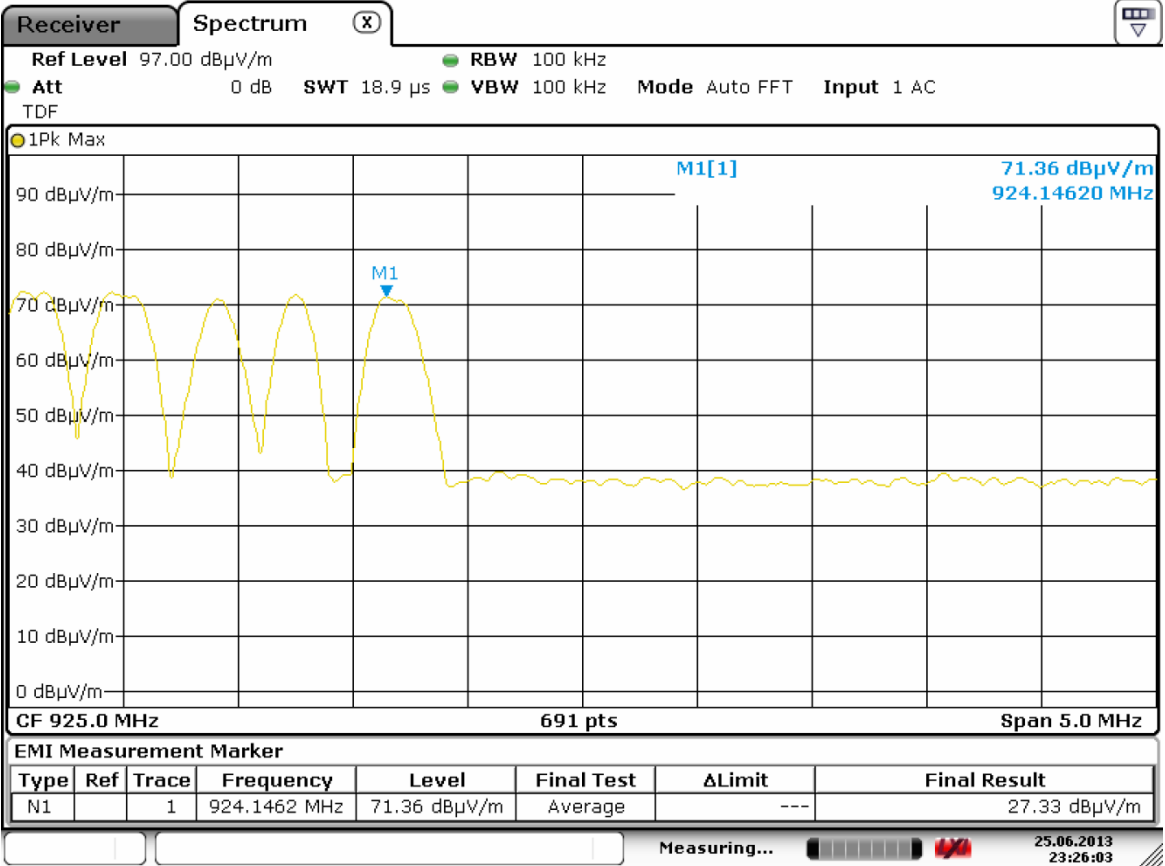
**10.0 Antenna Radiated band edge compliance**

<b>Frequency Range:</b>	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz		
	<b>Minimum Measured Attenuation dB</b>	<b>Minimum Allowed Attenuation dB</b>	<b>Margin dB</b>
<b>Low Frequency Channel</b>	<b>&gt;30</b>	<b>20</b>	<b>&gt;30</b>
<b>Upper Frequency Channel</b>	<b>&gt;30</b>	<b>20</b>	<b>&gt;30</b>
<b>Analyzer Settings:</b>	<input checked="" type="checkbox"/> RBW=100KHz		
<b>Minimum Allowed Attenuation:</b>	<input checked="" type="checkbox"/> 20dB <input type="checkbox"/> 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		



Date: 25.JUN.2013 21:25:18

Graph 16



Date: 25.JUN.2013 23:26:03

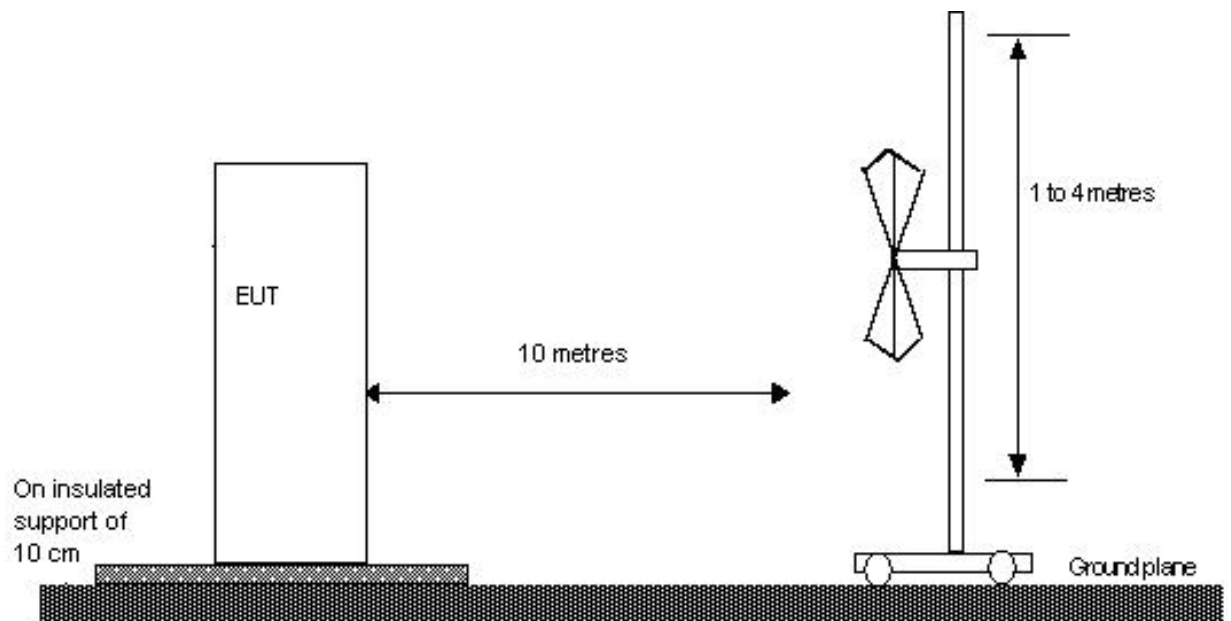
Graph 17

**11.0 List of Test Equipment**

<b>Instrument</b>	<b>Mftr.</b>	<b>Model</b>	<b>Calibration Due</b>
Measuring Receiver	Rohde and Schwarz	ESR3	28/05/14
Bilog Antenna	Chase	CBL6111	24/09/14
Spectrum Analyser	Rohde and Schwarz	FSP40	13/06/14
Measuring Receiver	Rohde and Schwarz	ESHS30	27/10/12
LISN	Rohde and Schwarz	ESH3-Z5	29/04/14
Horn Antenna	EMCO	3115	12/04/13
Preamplifier	Hewlett Packard	83017A	20/05/14
Horn Antenna	AH Systems	SAS 200/571	12/10/13
Signal Generator	Rohde and Schwarz	SME03	12/07/14

## Appendix B

### Test Setups



**FIGURE 1: Radiated Emissions Test Setup – Test Distance 10m**