



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

Test Type: Emissions  Immunity

Product Type: Wireless Bluetooth headphones

Product Name/Number: BH1

Test Results: Pass  Fail

Applicable Standards: FCC part 15, RSS210, RSS-gen and ICES-003

Report number: EMC.415246.14.119.1

Applicable Standards: FCC part 15, RSS210, RSS-gen and ICES-003

### General Comments/Special Test Conditions:

This report relates only to the items tested. This report covers EMC marking requirements for *BH1 which was tested as received without modification.*

	Print Name	Signature	Date
Prepared By:	Chad Bell		4/30/14
Electrical Engineer Review* By:	Bryan Cerqua		4/30/14

\* Since every test result is separately reviewed after its completion, the electrical engineer review indicated above represents a higher level review to ensure this report lists and contains all applicable and appropriate requirements.

*If the report carries the "accredited" symbol, the reviewer must verify all the tests in this report are covered under the current ISO17025 accreditation. The A2LA-accredited symbol must be removed if any of the tests in the report are not performed under the current scope of accreditation. It is the responsibility or the reviewer to ensure the A2LA advertising policy is followed.*



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## 1.0 Test Report Summary

### Product Information:

Wireless Bluetooth headphones that allows user to listen to music from Bluetooth source, such as an iPod, iPhone.

### EUT Configuration:

A USB charging cable is supplied and any standard USB charger can be used for charging the internal non user replaceable lithium ion battery. The EUT is not active while charging the battery, however the headphones can be listened to passively during battery charging. In addition to operating in Bluetooth mode, the EUT also has a 3.5 mm stereo auxiliary rear panel jack input to allow audio to be supplied using an external audio source such as an MP3 player, in this mode all active circuitry is disabled. The 3.5 mm cable is supplied with the EUT.

For any conducted RF testing on transmitter a Mini-Circuits® part number 086-9SM+ cable was used and cut exactly in half. The loss of half of this cable was rounded up to 0.2dB and was accounted for on the spectrum analyzer.

### 1.2 Scope

This report covers EMC requirements as defined by the standards indicated in section 2 of this report.

### 1.3 Test Objective

Verify product meets all applicable EMC requirements.

### 1.4 Results

Product complies with all applicable EMC requirements. All final results represent worst-case emissions and/or immunity.

### 1.5 Conclusions

The device under test (D.U.T.):

meets all test standards selected in section 2 of this report.

does not meet all test standards selected in section 2 of this report.

	Print Name	Signature	Date
Testing Engineer/Technician	Chad Bell		5/5/2014
Testing Engineer/Technician	Kevin Thibodeau		5/5/2014

Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA

Tel: (508) 766-6000 Fax: (508) 766-1145

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## 2.0 Test Standards

### 2.1 Emissions:

- Standard
- FCC Part 15B/Canada ICES-003 **Class A**  **B**
- FCC Part 15C
- Canada RSS-210/RSS-310/RSS-GEN
- EN 55013/CISPR-13/AS-NZS CISPR13/GB13837/CNS13439
- EN 55022/CISPR-22/AS-NZS CISPR22 **Class A**  **B**
- EN 55103-1
- EN 61000-3-2/GB17625.1
- EN 61000-3-3/GB17625.2
- EN 61000-6-3
- EN 61000-6-4
- EN 300 220/AS 4268.2
- EN 300 328
- EN 300 440
- EN 301 489

### 2.2 Immunity:

- Standard
- EN 55020/CISPR-20
- EN 55024/CISPR-24
- EN 55103-2
- EN 61000-4-2
- EN 61000-4-3
- EN 61000-4-4
- EN 61000-4-5
- EN 61000-4-6
- EN 61000-4-8
- EN 61000-4-11
- EN 61000-6-1
- EN 61000-6-2
- EN 301 489

## 3.0 Environmental Conditions

### 3.1 Ambient:

- Temperature: 22±4°C
- Humidity: 30-60%RH
- Mains Voltage:  100VAC
- 120VAC
- 230VAC



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## 4.0 Test Results Summary

FCC part 15	RSS210	RSS-Gen	Test references.	Result / Data section
15.15(b)		5.4	There are no user-accessible controls for the adjustment of any transmitter parameters in the device under test.	Complies
15.27			There are no special devices such as shielded cables or special connectors required for compliance to the applicable standards.	Complies
15.203			An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The antenna is not accessible by the user.	Complies
15.205	2.2		The device does not operate in either the US or Canadian restricted bands.	Complies
15.107 15.207		7.2.4	Conducted emissions, 150kHz–30 MHz	Complies Section 6.1
15.109 15.209			Radiated emissions, 30MHz–1GHz	Complies Section 6.2
15.247 (b)(1)	A8.4 (2)		Output power	Complies Section 6.3
15.247 (a)(1)	A8.1 (b)		Occupied Bandwidth / Channel Spacing	Complies Section 6.4
15.247(a) (1) iii	A8.1 (d)		Time of Occupancy	Complies Section 6.5
15.247(d)	A8.5	4.9	Spurious emissions - Conducted	Complies Section 6.6
15.247(d)		4.9	Harmonics - Radiated.	Complies Section 6.7
15.247(d)		7.2.5	Spurious radiated emissions 1 – 25 GHz	Complies Section 6.8
		4.10, 6.2	Receiver mode radiated spurious emissions	Complies Section 6.9
OET65	Canada Health and Safety code 6		SAR exemption calculation	Complies Section 6.10



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## 5.0 Detailed Test Results

### 5.1 Conducted Emissions

#### 5.1.1 Requirements

47CFR15.207, RSS 210 section 7.2.4

Frequency	Limits dB(μV)	
	MHz	Average
0.15 -0.5	66-56	56-46
0.5 – 1.6	56	46
1.6 – 30	60	50

#### 5.1.2 Test setup details

The EUT was tested in accordance with ANSI C63.4 test setup conditions. Worst case was using an optional power supply to charge the internal EUT battery, audio playback did not affect emissions since during battery charging the audio is passive.

The R&S ESR receiver has a feature that performs FFT based quasi-peak and average measurements over the entire 150 kHz to 30 MHz range.



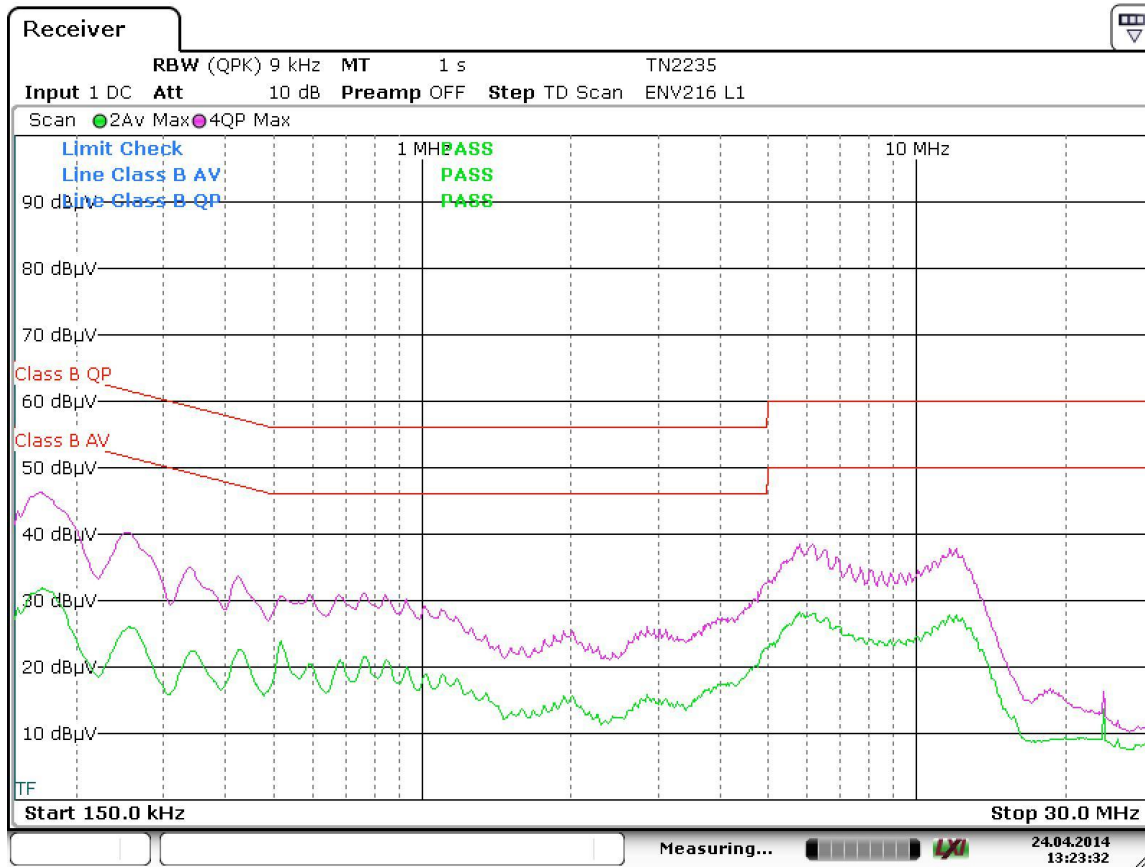
# Wireless Transceiver Test Report

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## 5.1.3 Test data



Date: 24.APR.2014 13:23:31

**120VAC 60Hz Line side of AC line. EUT charging.**

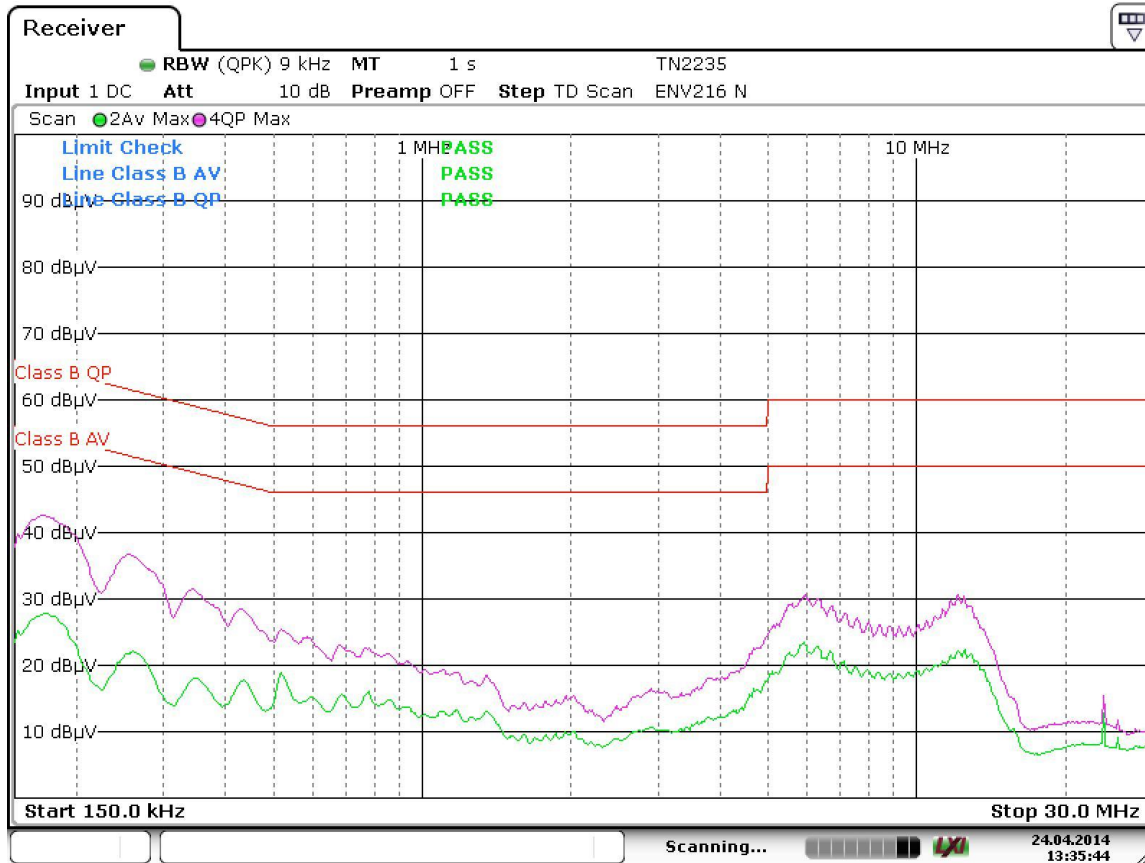


# Wireless Transceiver Test Report

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Date: 24.APR.2014 13:35:44

120VAC 60Hz Neutral side of AC line. EUT charging.





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FCC 15B Class B, CISPR 13, CISPR 22 Class B Product							
Frequency MHz	MEASURED		LIMIT		MARGIN		Notes
	dBµV QP	dBµV AVG	dBµV QP	dBµV AVG	dB QP	dB AVG	
0.1500		27.23	66.0	56.0		28.8	Line
0.1703		31.94	64.9	54.9		23.0	Line
0.2558		25.99	61.6	51.6		25.6	Line
0.4268		22.69	57.3	47.3		24.6	Line
0.5190		23.83	56.0	46.0		22.2	Line
5.8043		28.26	60.0	50.0		21.7	Line
0.1500	41.61		66.0	56.0	24.4		Line
0.1703	46.21		64.9	54.9	18.7		Line
0.2535	40.32		61.6	51.6	21.3		Line
0.3413	34.88		59.2	49.2	24.3		Line
6.1485	38.56		60.0	50.0	21.4		Line
11.9800	37.35		60.0	50.0	22.7		Line
0.1500		23.69	66.0	56.0		32.3	Neutral
0.1725		27.99	64.8	54.8		26.8	Neutral
0.2535		36.70	61.6	51.6		14.9	Neutral
0.3413		23.69	59.2	49.2		25.5	Neutral
5.9033		23.52	60.0	50.0		26.5	Neutral
23.8965		12.91	60.0	50.0		37.1	Neutral
0.1500	37.88		66.0	56.0	28.1		Neutral
0.1703	42.63		64.9	54.9	22.3		Neutral
0.2620	22.30		61.4	51.4	39.1		Neutral
0.3458	18.25		59.1	49.1	40.8		Neutral
5.9775	30.59		60.0	50.0	29.4		Neutral
12.1178	30.59		60.0	50.0	29.4		Neutral

**BH1 passes conducted emissions by 14.9dB at 254 kHz (average reading)**



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## 5.1.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				Last	Due
LISN	Rohde & Schwarz	ENV216	TN2235	11/15/2013	11/15/2014
EMI Test Receiver	Rohde & Schwarz	ESR	TN2247	12/2/2013	12/2/2014
iPod	Apple	4 <sup>th</sup> gen.	TN2005	Verify before use	

## 5.1.5 Test information

<b>Date of test:</b>	4/24/2014	<b>Test location :</b>	DCE lab – Henry room
<b>EUT serial:</b>	FCC #4	<b>Tested by:</b>	C. Bell
<b>Test Conclusion:</b>	Pass		



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## 5.2 Radiated emissions 30 MHz – 1 GHz

### 5.2.1 Requirements

FCC rules part 15.109 (g), 15.209,

ICES-003 issue 5 and CAN/CSA-CEI/IEC CISPR 22:02

Frequency	Limit in dB $\mu$ V/m @3m
MHz	Quasi-peak
30 – 230	40
230 - 1000	47
Above 1000	54

### 5.2.2 Test setup details

The EUT was placed on an 80 cm high table and configured for worst case emissions based on previous testing. Worst case was using an optional power supply to charge the internal EUT battery, audio playback did not affect emissions since during battery charging the audio is passive.

### 5.2.3 Test data

#### Summary:

The BH1 headset passes FCC Class B radiated emissions by 15dB at 37MHz.

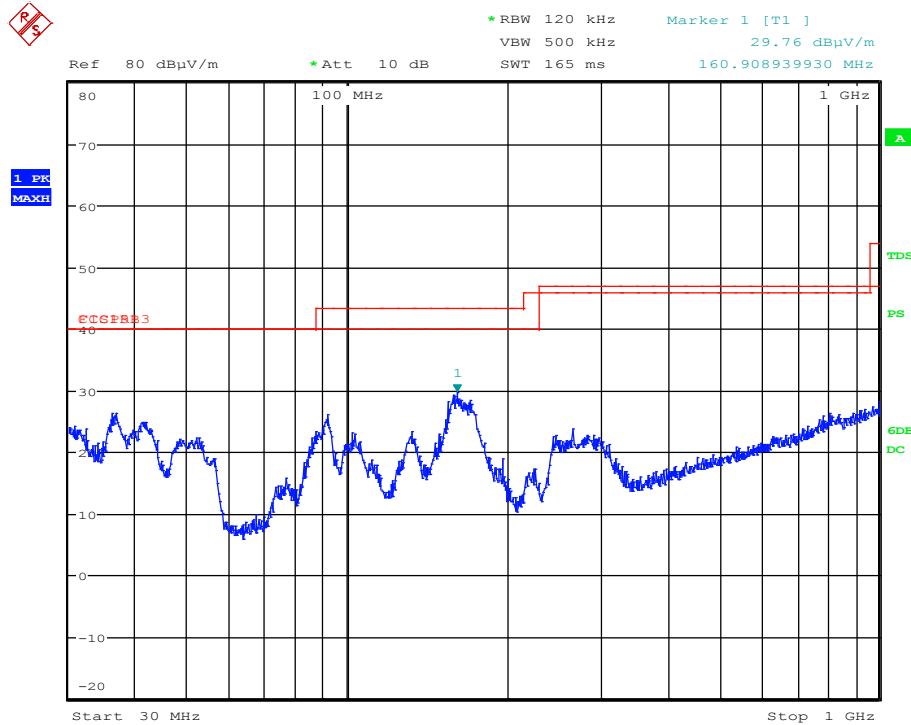


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Max-Hold Peak Pre-scan, 30MHz – 1GHz in battery charging mode. Other operating modes were investigated but battery charging mode was the only mode with emissions above the noise floor of the test instrumentation.

Emission Frequency (MHz)	Measured Amplitude (dBμV/m) QP/AVG*	Measured Amplitude (dBμV/m) Peak	FCC 15B			
			Limit (dBμV/m) QP/AVG*	Limit (dBμV/m) Peak	Margin (dB) QP/AVG*	Margin (dB) Peak
37.000	25.00	25.00	40.0	N/A	15.0	N/A
92.000	26.00	26.00	43.5	N/A	17.5	N/A
160.908	24.70	29.76	43.5	N/A	18.8	N/A
300.000	22.00	22.00	46.0	N/A	24.0	N/A
1000.000	27.00	27.00	54.0	N/A	27.0	N/A

The BH1 headset passes FCC Class B radiated emissions by 15dB at 37MHz.



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## 5.2.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				Last	Due
Antenna	Sunol Sciences	JB6	TN1541	7/24/2013	7/24/2014
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/5/2013	4/5/2014
Maxwell House Radiated Emissions Cable Set	Bose Corporation	N/A	TN1445	3/5/2013	3/5/2014
Pre-amp	Mini-Circuits	ZX60-3018G+	TN2077	4/8/2013	4/8/2014
Reference source	Com-Power	CG 520	TN1569	9/9/2013	9/9/2014

## 5.2.5 Test information

<b>Date of test:</b>	3/4/2014	<b>Test location :</b>	DCE - Maxwell House
<b>EUT serial:</b>	152	<b>Tested by:</b>	Kevin Thibodeau
<b>Test Conclusion:</b>	Pass		



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## 5.3 Output power

### 5.3.1 Requirements:

FCC 15.247(a)(1) , RSS 210 A8.4 (2)

Frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125 W.

### 5.3.2 Test setup details:

The EUT is controlled via the USB port with CSR's Blue Suite software which is used to set the test modes of the Bluetooth device. The EUT antenna is disconnected. A temporary test connector is mounted to the PCB. An 8 inch u.FL to SMA adapter cable with 0.7 dB loss was used for all conducted measurements. To compensate for the cable loss the reference level offset feature of the spectrum analyzer was used. The EUT is programmed to operate on fixed frequencies at the low, middle, and high end of the authorized frequency band.

The spectrum analyzer resolution bandwidth is set to 3 MHz (higher than the occupied bandwidth), peak detector and max hold. The maximum output power is recorded for each of the three frequencies in both basic and enhanced data rates.

### 5.3.3 Test data.

#### Summary:

RBW = 3 MHz, detector = peak, max power = 9.49 dBm (8.89 mW) (Basic Rate)

Channel	Center Frequency (MHz)	Basic Rate: DH5 (dBm)	EDR: 3-DH5 (dBm)
0	2402	9.49	8.28
39	2441	7.89	7.17
78	2480	6.40	4.66



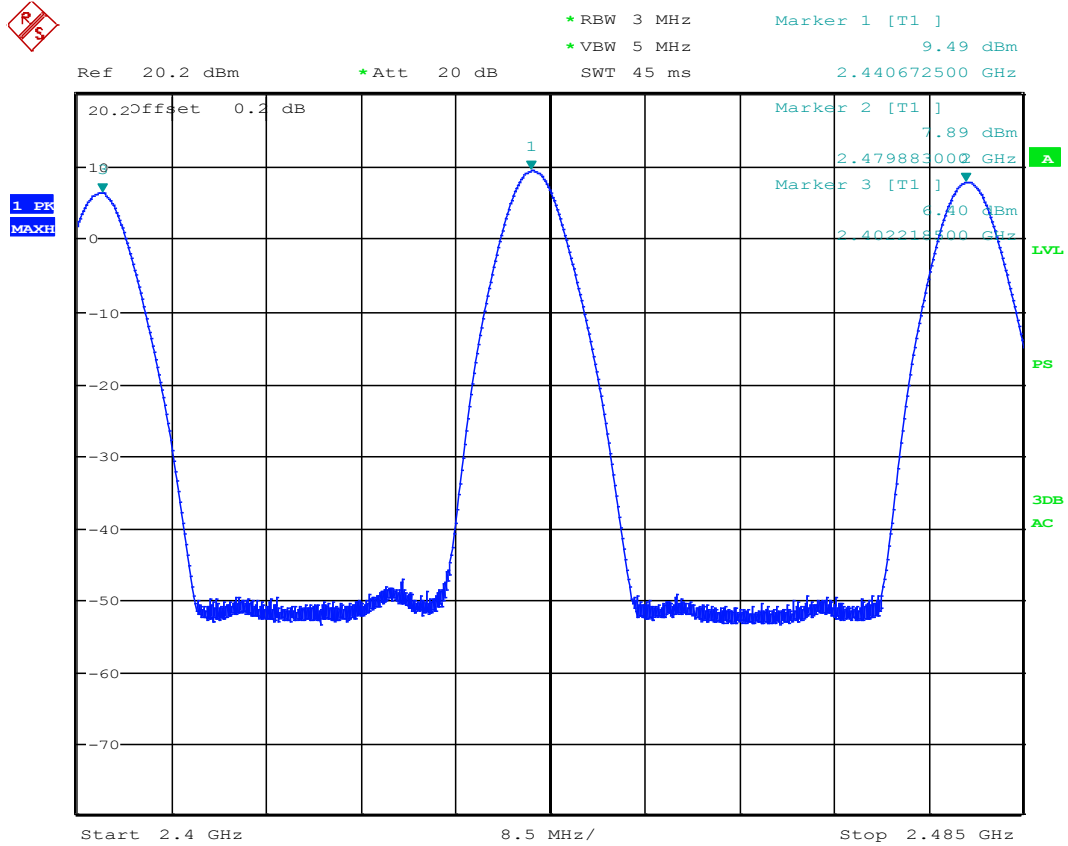
# Wireless Transceiver Test Report

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## Output power for basic rate: (DH5)





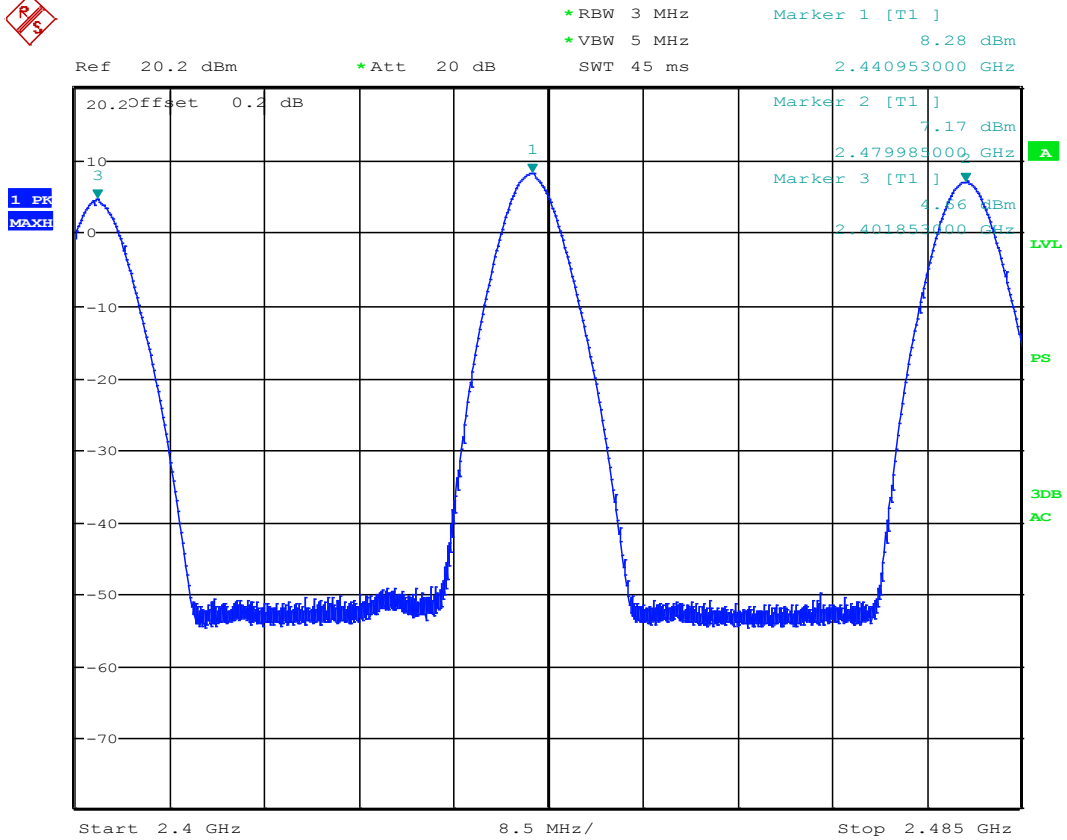
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Output power for enhanced rate: (3-DH5)







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## 5.3.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/11/2014	4/11/2015

## 5.3.5 Test information

<b>Date of test:</b>	4/22/2014	<b>Test location:</b>	Transmitter Test Bench
<b>EUT serial:</b>	FCC#2	<b>Tested by:</b>	C. Bell
<b>Test Conclusion:</b>	Pass		



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## 5.4 Occupied Bandwidth/Channel Spacing

### 5.4.1 Requirements

RSS210 section A8.1 (b)

The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system RF bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopping frequency set.

FCC part 15.247(a)(1)

The hopping channel carrier frequencies are separated by at least 2/3<sup>rd</sup> of the 20dB bandwidth provided the output power is less than 125 mW (20.96 dBm)

### 5.4.2 Test setup details

The test setup is described in section 6.3.2 except that the RBW is set to 100 kHz

#### Bandwidth summary table:

##### EDR mode packet 3-DH5 (showed widest bandwidth)

BT Channel	Center Frequency (MHz)	-20dB OBW (MHz)	99% OBW (MHz)
0	2402	1.394	1.234
39	2441	1.394	1.234
78	2480	1.394	1.234

Conclusion: 2/3<sup>rd</sup> of the highest 20 dB bandwidth = 2/3 X (1.422 MHz) = 929 kHz, which is less than the carrier channel separation of 1 MHz. In addition, the output power is less than 125 mW. See section 6.3 for the measurement of output power.

The system RF bandwidth as defined in RSS 210 A8.1 (a) is:

Channel bandwidth multiplied by the number of channels in the hop set.

(79 channels) X (1.394 MHz) = 110.13 MHz.



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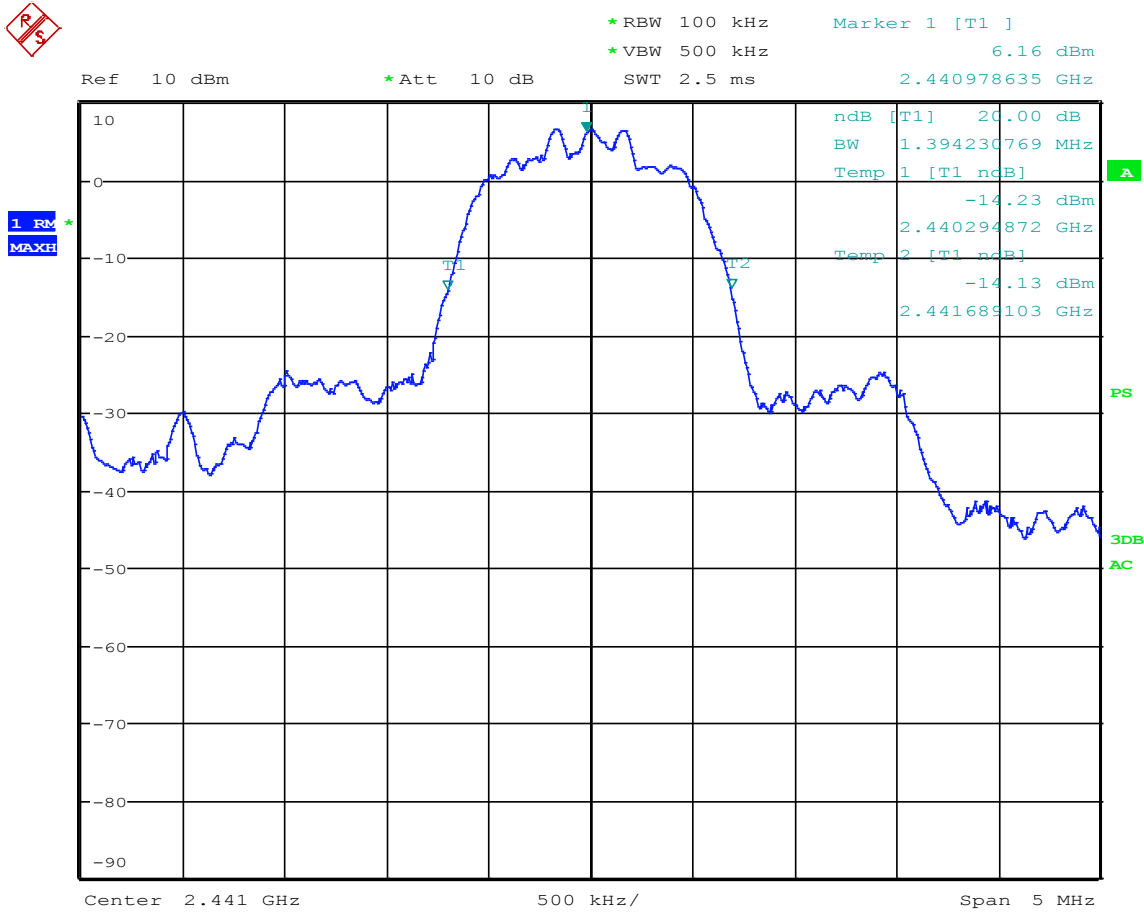
FCC ID: A94BH1 IC: 3232A BH1



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Example spectrum analyzer plot showing how the 20 dB bandwidth was measured. Used the R&S ESU40's built in n dB down measurement.

20 dB OBW = 1.39 MHz. (EDR 3-DH5)





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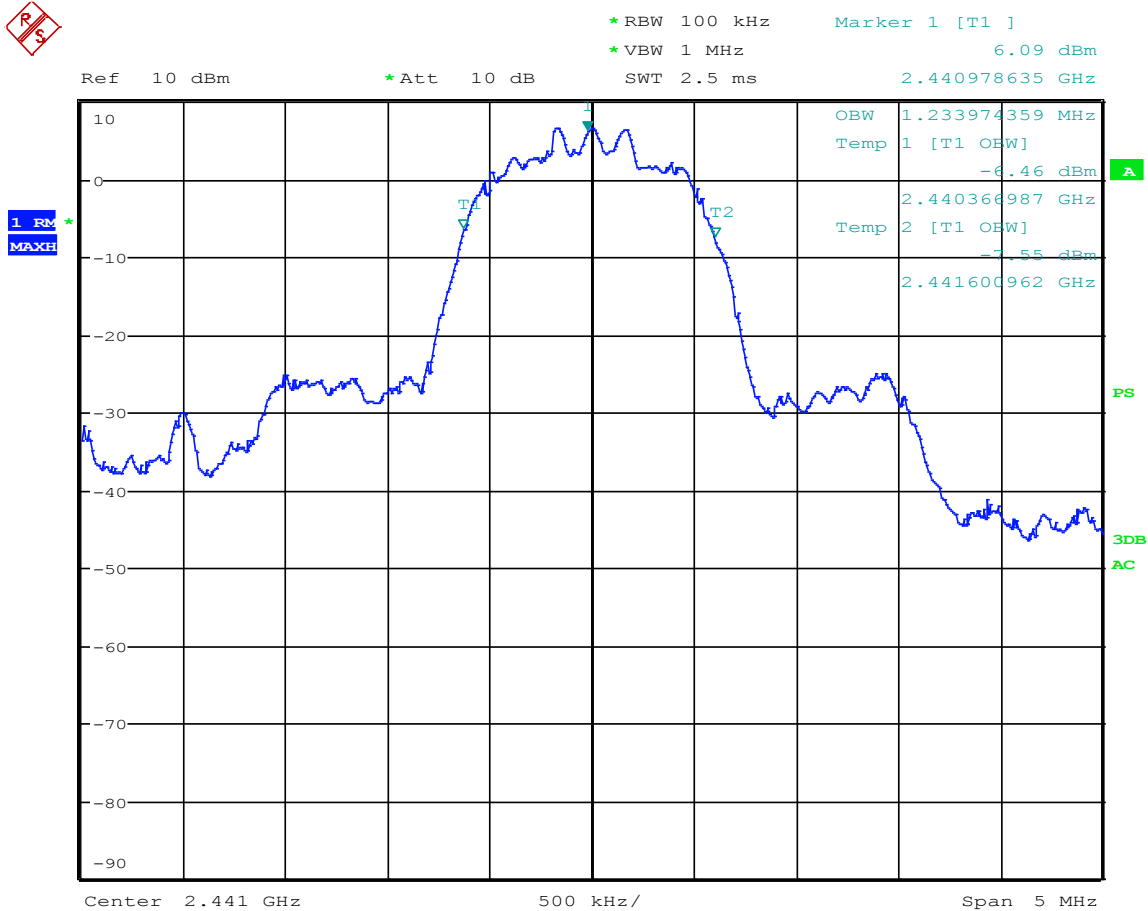
FCC ID: A94BH1 IC: 3232A BH1



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Example spectrum analyzer plot showing how the 99% bandwidth was measured.  
Used the R&S ESU40's built in 99% OBW measurement.

99% OBW = 1.23 MHz. (EDR 3-DH5)





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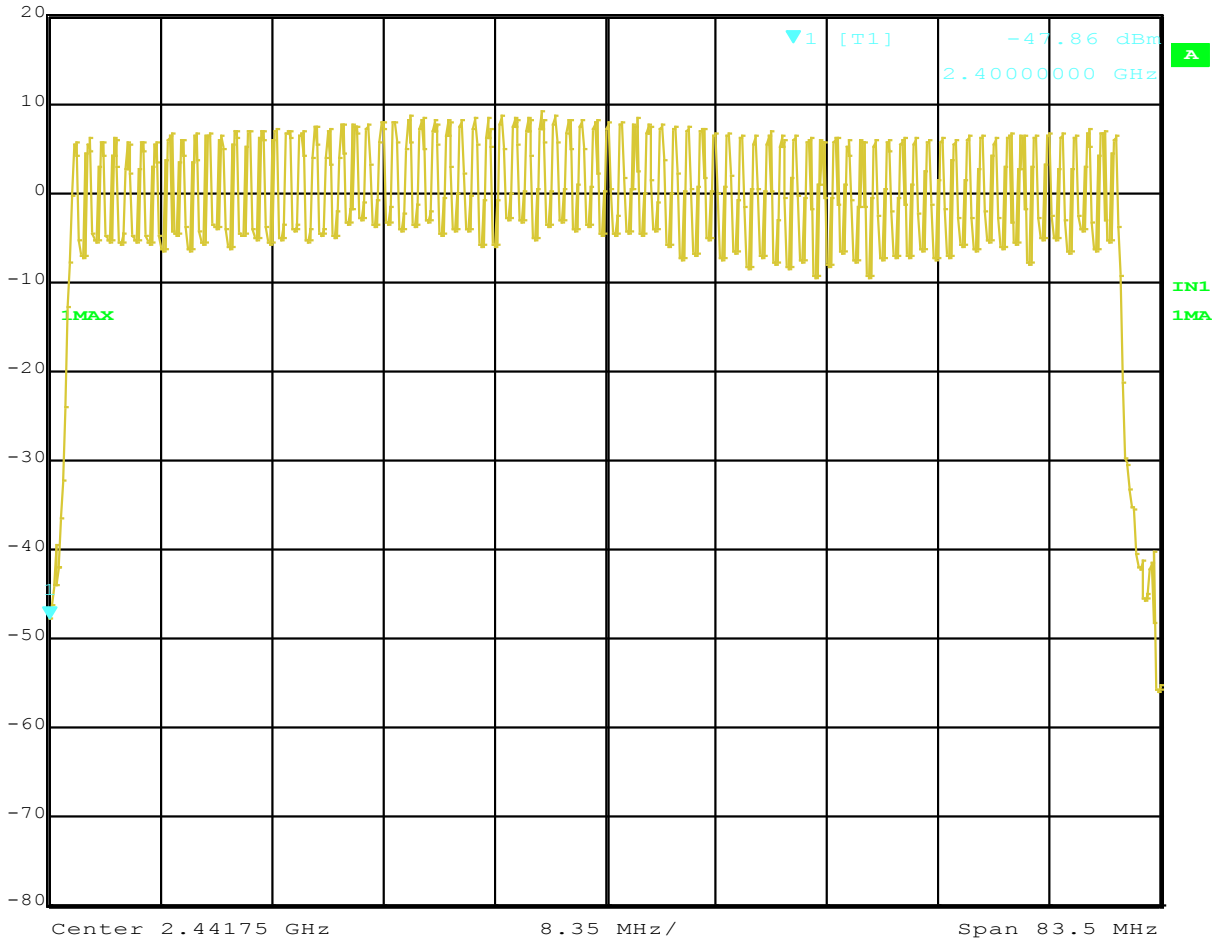


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## Channel Spacing

79 channels between 2402 MHz and 2480 MHz = 1 MHz channel spacing

	Ref Lvl	Marker 1 [T1]	RBW	100 kHz	RF Att	30 dB
	20 dBm	-47.86 dBm	VBW	500 kHz		
		2.40000000 GHz	SWT	21 ms	Unit	dBm



Date: 17.MAR.2014 14:27:38



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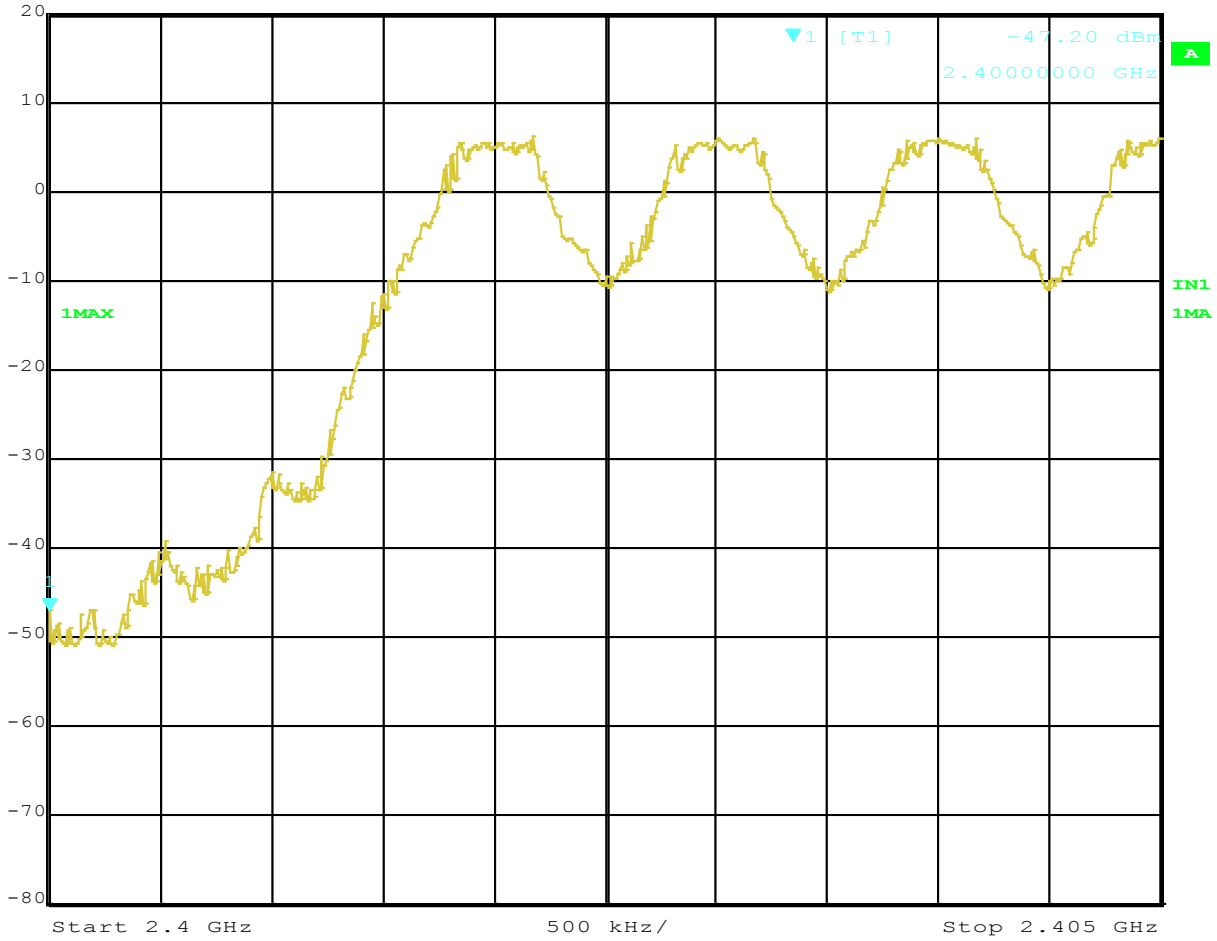
FCC ID: A94BH1 IC: 3232A BH1

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## Low band end channel spacing detail.



Ref Lvl	20 dBm	Marker 1 [T1]	-47.20 dBm	RBW	100 kHz	RF Att	30 dB
			2.40000000 GHz	VBW	500 kHz	Unit	dBm
				SWT	5 ms		



Date: 17.MAR.2014 14:29:08



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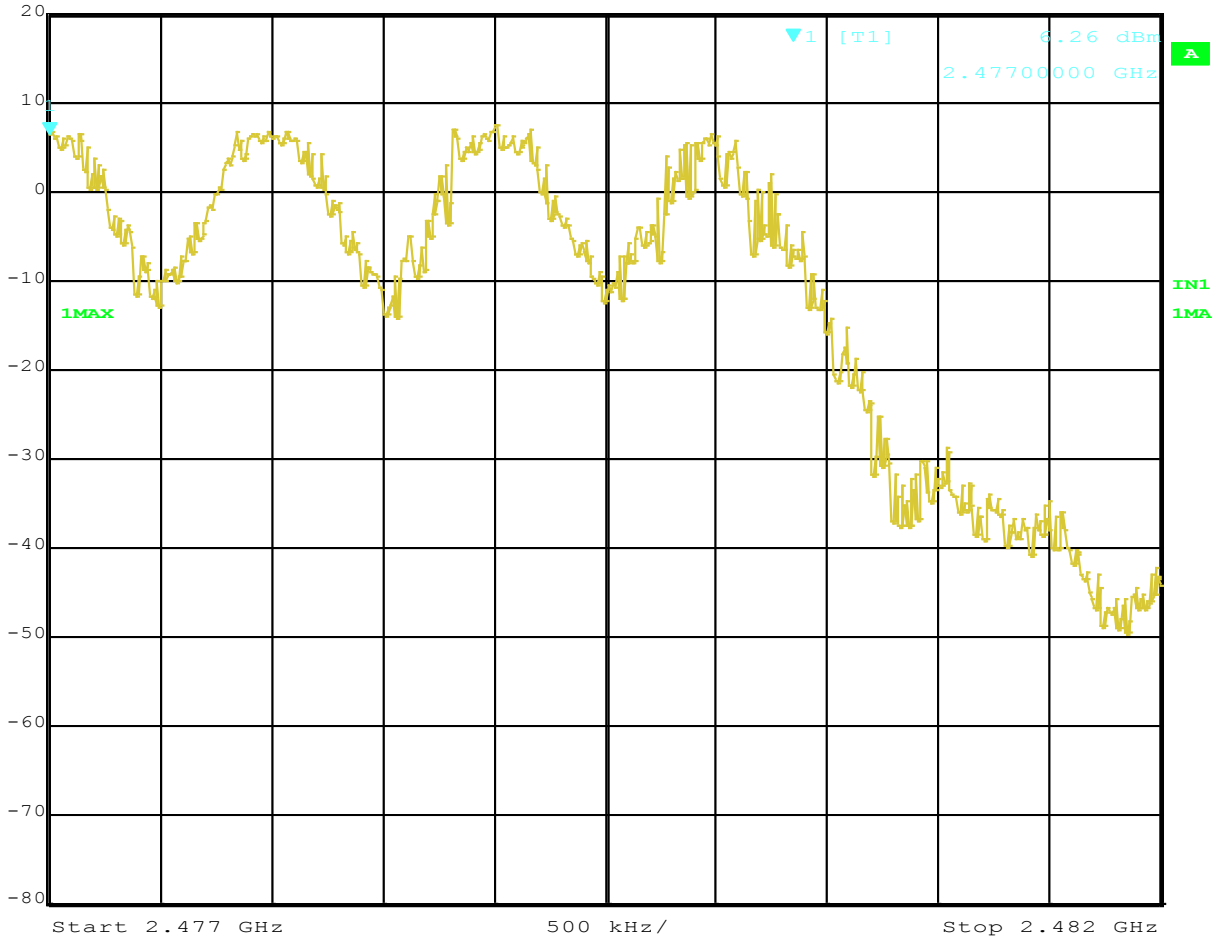
FCC ID: A94BH1 IC: 3232A BH1

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## High band end channel spacing detail



Ref Lvl	6.26 dBm	RBW	100 kHz	RF Att	30 dB
20 dBm	2.47700000 GHz	VBW	500 kHz	Unit	dBm
		SWT	5 ms		



Date: 17.MAR.2014 14:29:58



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## 5.4.3 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESIB 40	TN1560	4/11/2014	4/11/2015
EMI Test Receiver	Rohde & Schwarz	ESU 40	TN1663	4/11/2014	4/11/2015

## 5.4.4 Test information

<b>Date of test:</b>	3/17/2014 and 4/29/2014	<b>Test location:</b>	Transmitter Test Bench
<b>EUT serial:</b>	FCC#1 and FCC #2	<b>Test by:</b>	C. Bell
<b>Test Conclusion:</b>	Pass		





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## 5.5 Time of occupancy

### 5.5.1 Requirements

FCC 15.247 (a) (1) iii, RSS210 A8.1 (d)

The frequency hopping operation shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within the duration in seconds equal to the number of hopping frequencies employed multiplied by 0.4

### 5.5.2 Test setup details

The EUT is controlled via the USB cable with CSR's Blue Suite software which is used to set the test modes of EUT. The EUT is programmed to operate at fixed frequencies at the low, middle, and high end of the authorized frequency band.

Using zero span mode on the channel center frequency the transmit pulse width was measured for each of the following modes, DH1, DH3 & DH5 with the maximum payload size for basic and enhanced data rates.

### 5.5.3 Test data

$$\text{Dwell Time} = (\text{TX Pulse Width}) * (\text{Hop Rate}) / (\# \text{ of Channels}) / (\# \text{ of slots}) * 31.6$$

$$= (\text{TX Pulse Width}) * 1600 / 79 / (\# \text{ of Slots}) * 31.6$$

$$= (\text{TX Pulse Width}) * 640 / (\# \text{ Slots})$$

$$\text{Hop Rate} = 1600 \text{ hops} / \text{S}$$

$$\# \text{ of channels} = 79$$

$$\# \text{ of slots} = \text{number of slots used per packet in a given mode: DH1} = 2, \text{ DH3} = 4, \text{ DH5} = 6$$

$$31.6 \text{ Seconds} = (79 \text{ channels}) * 0.4 \text{ Seconds}$$

### Dwell time summary table.

(Measured at 2480 MHz)

Mode	# of Slots	Pulse Width (uS)	Dwell Time (s)	Limit (s)	Result
DH1	2	408	0.133	0.400	Pass
DH3	4	1671	0.270	0.400	Pass
DH5	6	2925	0.312	0.400	Pass
2DH1	2	408	0.133	0.400	Pass
2DH3	4	1671	0.270	0.400	Pass
2DH5	6	2925	0.312	0.400	Pass
3DH1	2	408	0.133	0.400	Pass
3DH3	4	1671	0.270	0.400	Pass
3DH5	6	2925	0.312	0.400	Pass



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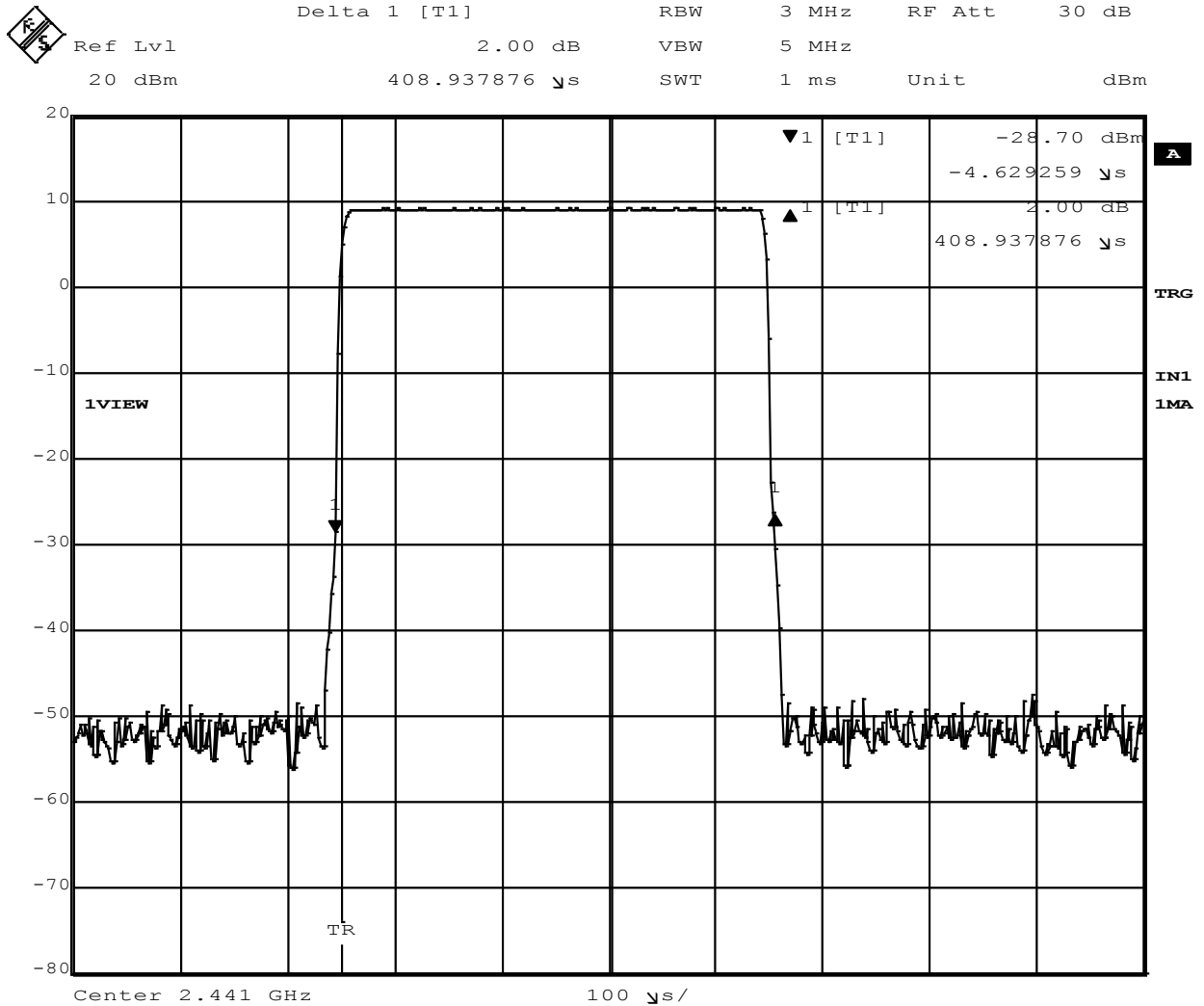
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Representative plot for DH1 with maximum payload size  
Channel frequency 2480 MHz

Measured TX pulse width is 408 uS



Date: 21.MAR.2014 13:27:50



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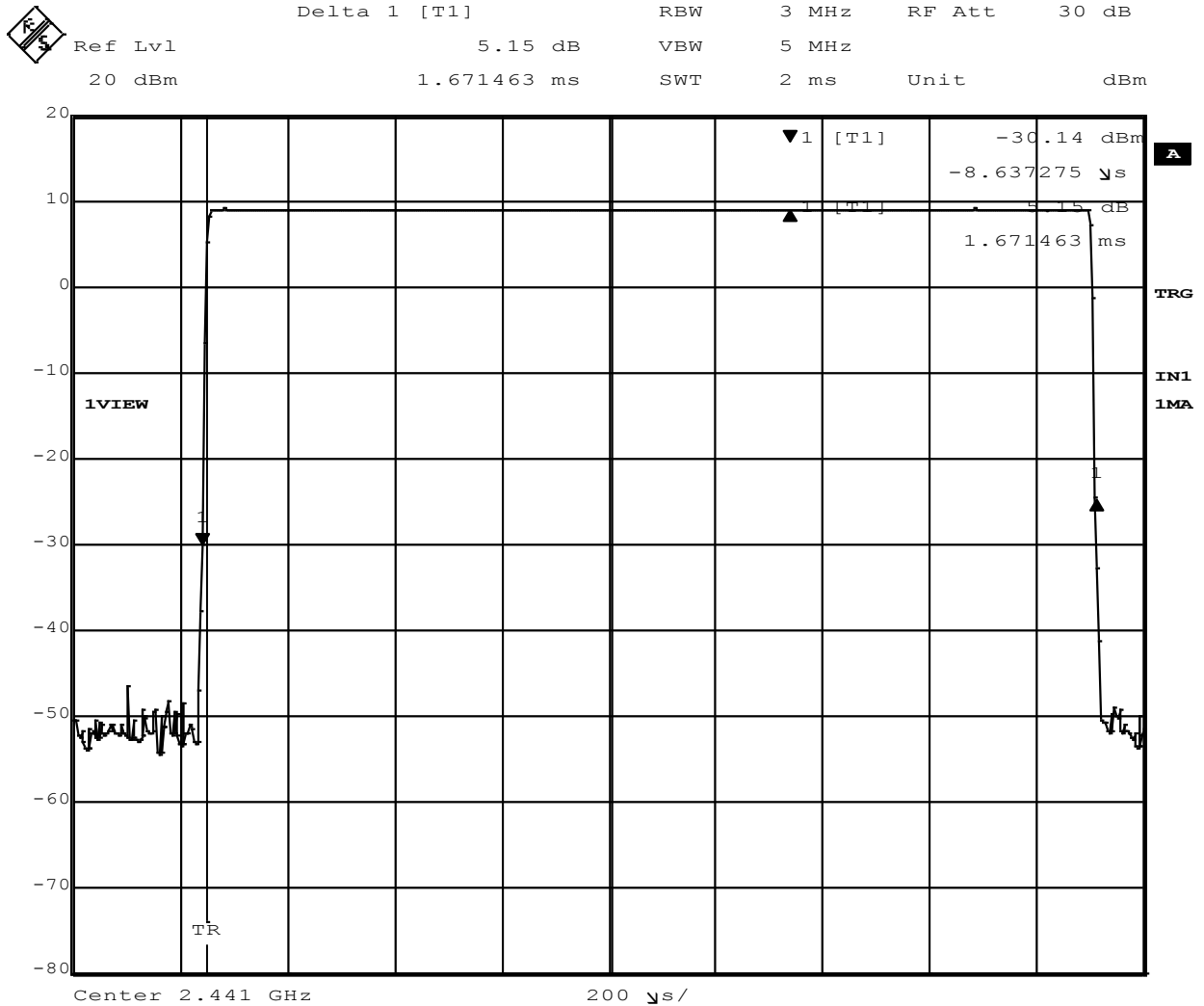
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Representative plot for DH3 with maximum payload size  
Channel frequency 2480 MHz

Measured TX pulse width is 1.67 mS



Date: 21.MAR.2014 13:29:12



# Wireless Transceiver Test Report

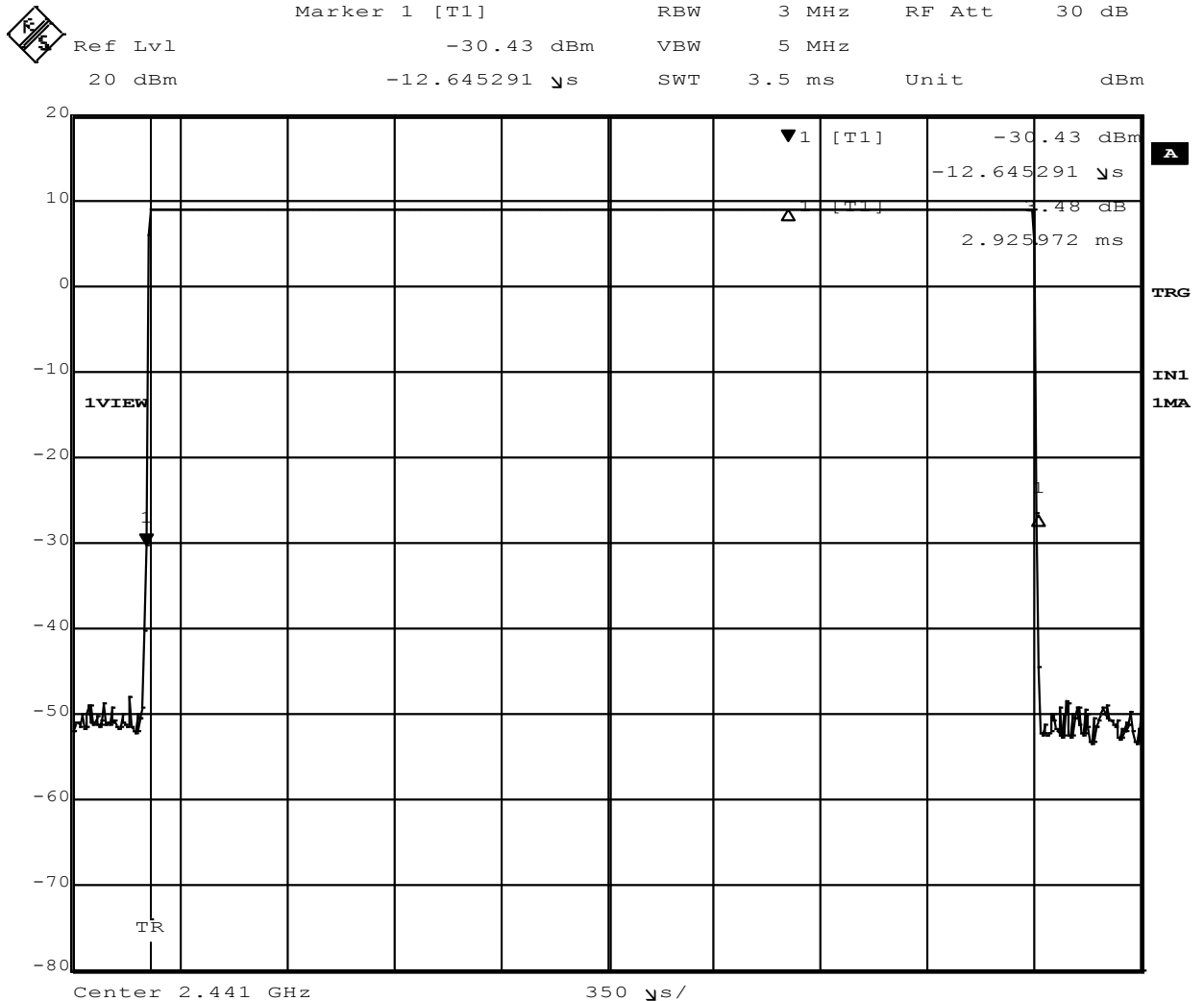
FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

Representative plot for DH5 with maximum payload size  
Channel frequency 2441 MHz

Measured TX pulse width is 2.92 mS



Date: 21.MAR.2014 13:26:04



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.5.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESIB40	TN1560	4/4/2013	4/4/2014

## 5.5.5 Test information

<b>Date of test:</b>	3/21/2014	<b>Test location:</b>	Transmitter Test Bench
<b>Serial number:</b>	FCC#1	<b>Tested by:</b>	C. Bell
<b>Test Conclusion:</b>	Pass		



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.6 Spurious emissions- Conducted

### 5.6.1 Requirements

FCC part 15.247(d), RSS210 A8.5

In any 100 kHz bandwidth, the conducted spurious emissions shall be attenuated at least 20dB below the level of the wanted signal.

### 5.6.2 Test Setup

The test setup is described section 6.3.2

EUT is controlled by CSR's Blue Suite software to enable testing of the spurious output in specific operational modes.

Measurements are made with the EUT in normal operation (hopping through all available channels) in basic and enhanced data rate modes.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.6.3 Test data

### Conducted spurious for transmit mode:

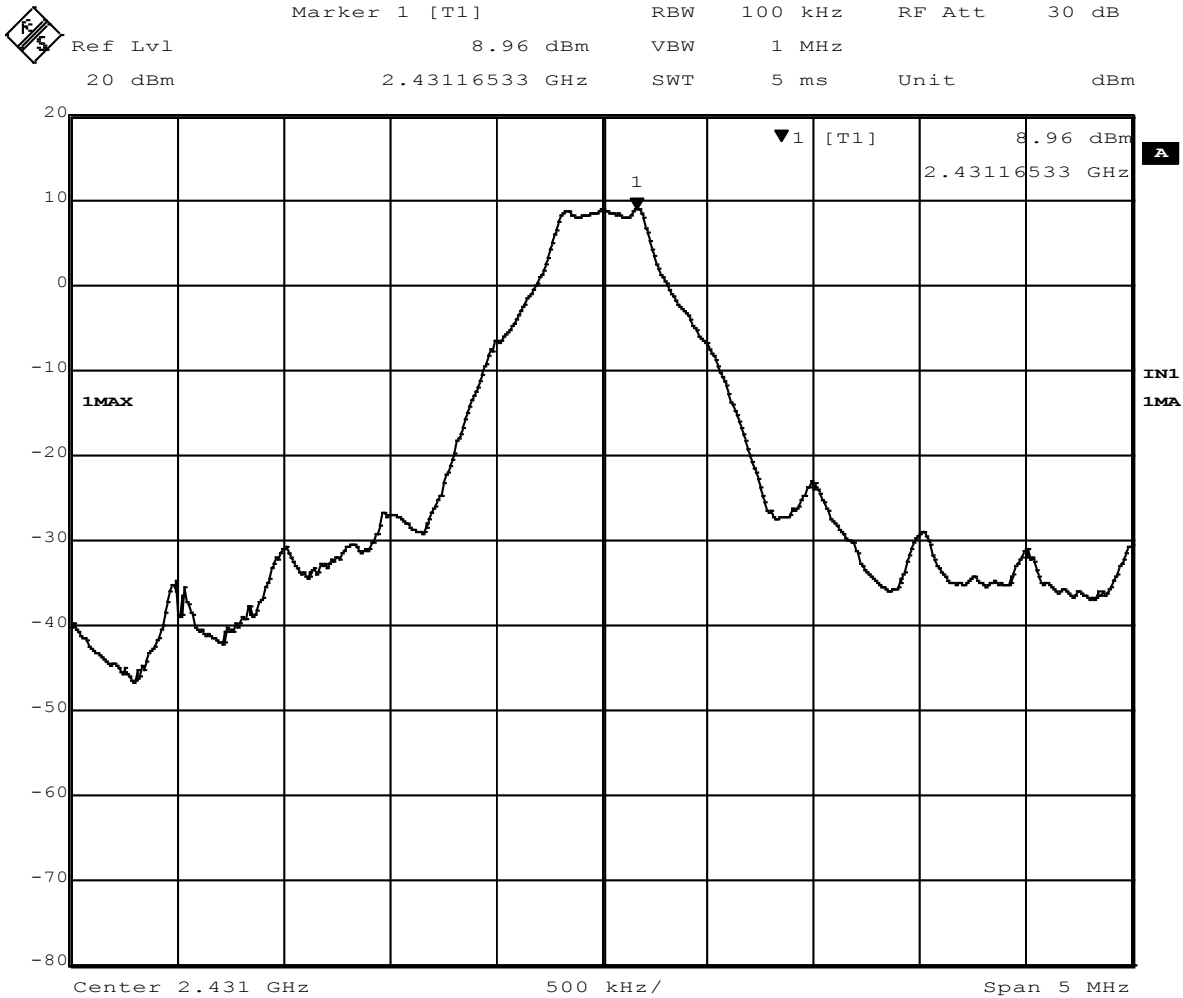
30 MHz – 25 GHz conducted spurious scan, 100 kHz RBW, peak detector.

### Basic data rate, DH5, hopping stopped.

Highest power frequency found at 2412 MHz.

Maximum in band peak measured 8.96 dBm ~ 9 dBm.

(Used to determine the display line values on the following plots.)



Date: 21.MAR.2014 13:34:52



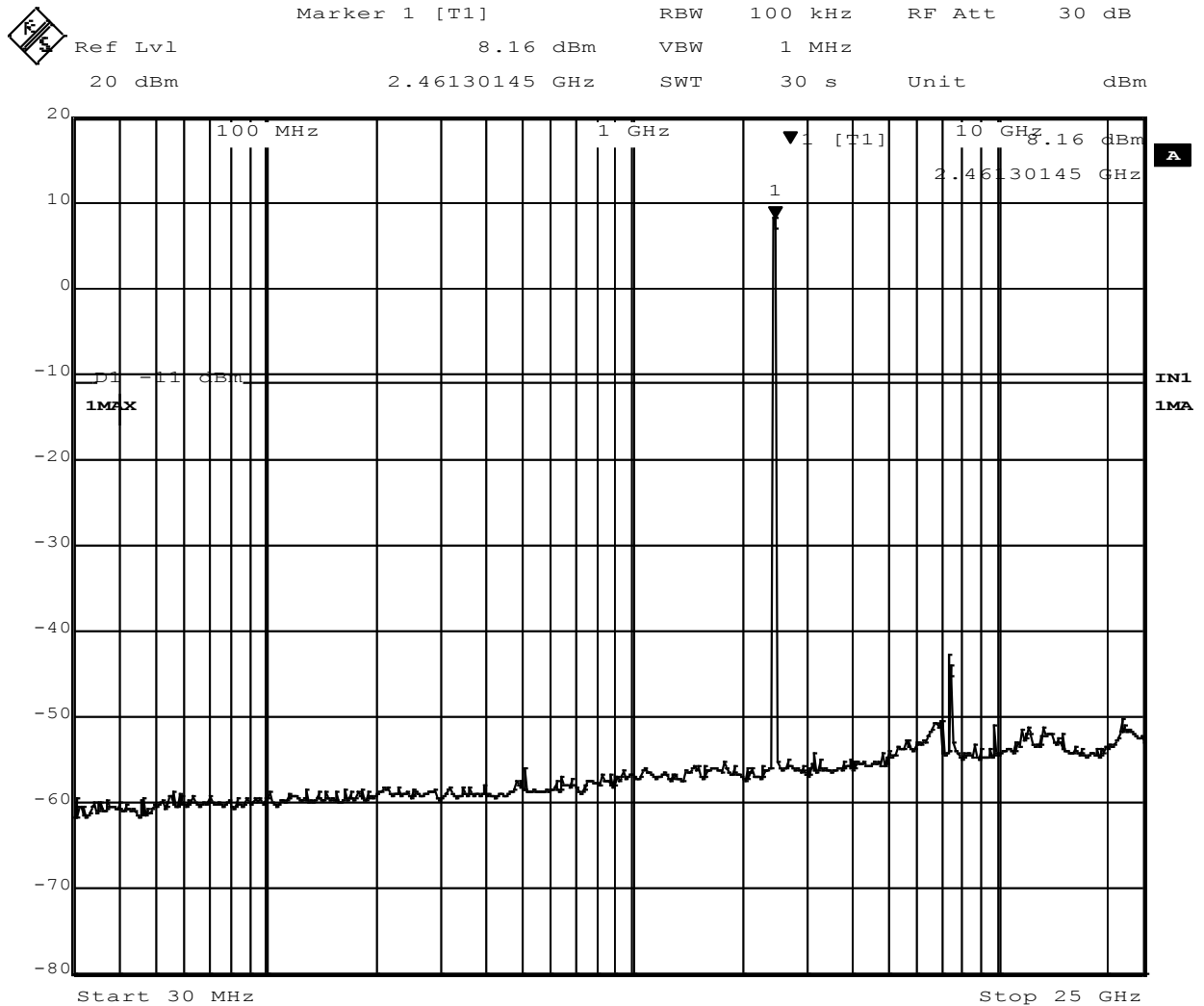
# Wireless Transceiver Test Report



FCC ID: A94BH1 IC: 3232A BH1

Certificate # 1514.1

Basic data rate hopping on all channels



Date: 21.MAR.2014 13:37:41

Spurious peak emissions are more than 20 dB below maximum in band peak.





# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

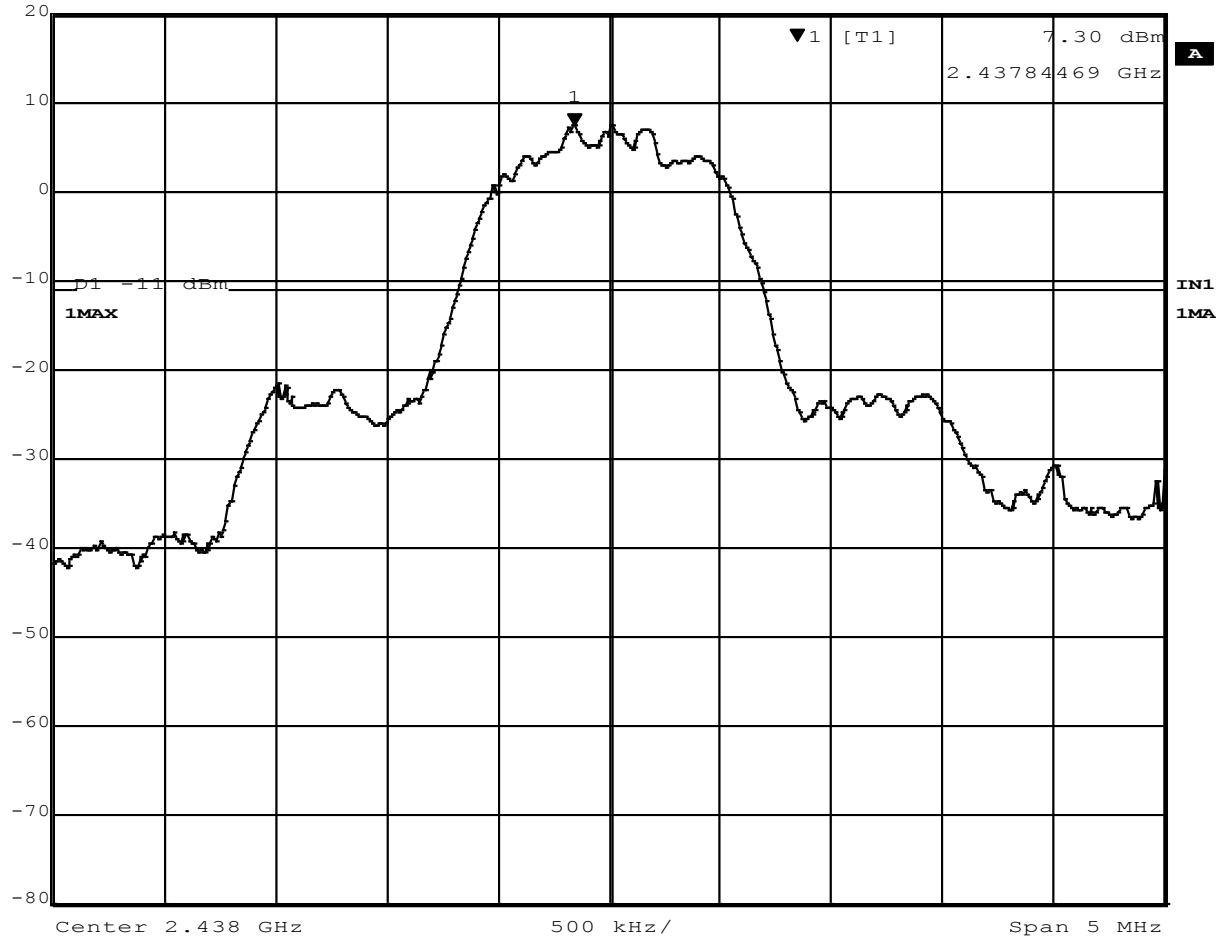
Enhanced data rate, 3-DH5, hopping stopped.

Maximum in band peak measured 7.3 dBm

(Used to determine the display line values on the following plots.)



Ref Lvl	Marker 1 [T1]	RBW	100 kHz	RF Att	30 dB
20 dBm	7.30 dBm	VBW	1 MHz		
	2.43784469 GHz	SWT	5 ms	Unit	dBm



Date: 21.MAR.2014 13:40:55



# Wireless Transceiver Test Report

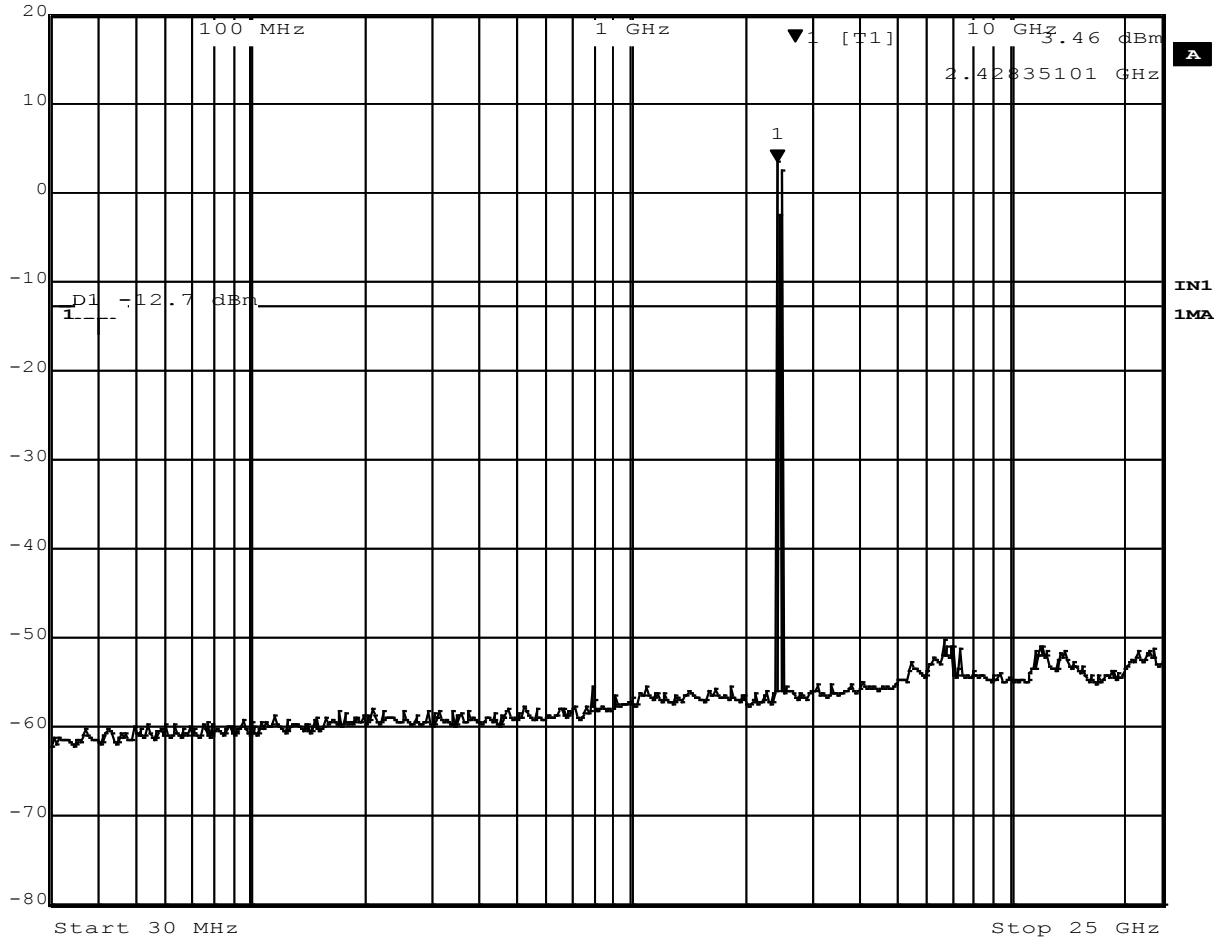
FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## Enhanced data rate hopping on all channels

	Marker 1 [T1]	RBW	100 kHz	RF Att	30 dB
	Ref Lvl	3.46 dBm	VBW	1 MHz	
	20 dBm	2.42835101 GHz	SWT	30 s	Unit dBm



Date: 21.MAR.2014 13:43:14

Spurious peak emissions are more than 20 dB below maximum in band peak.



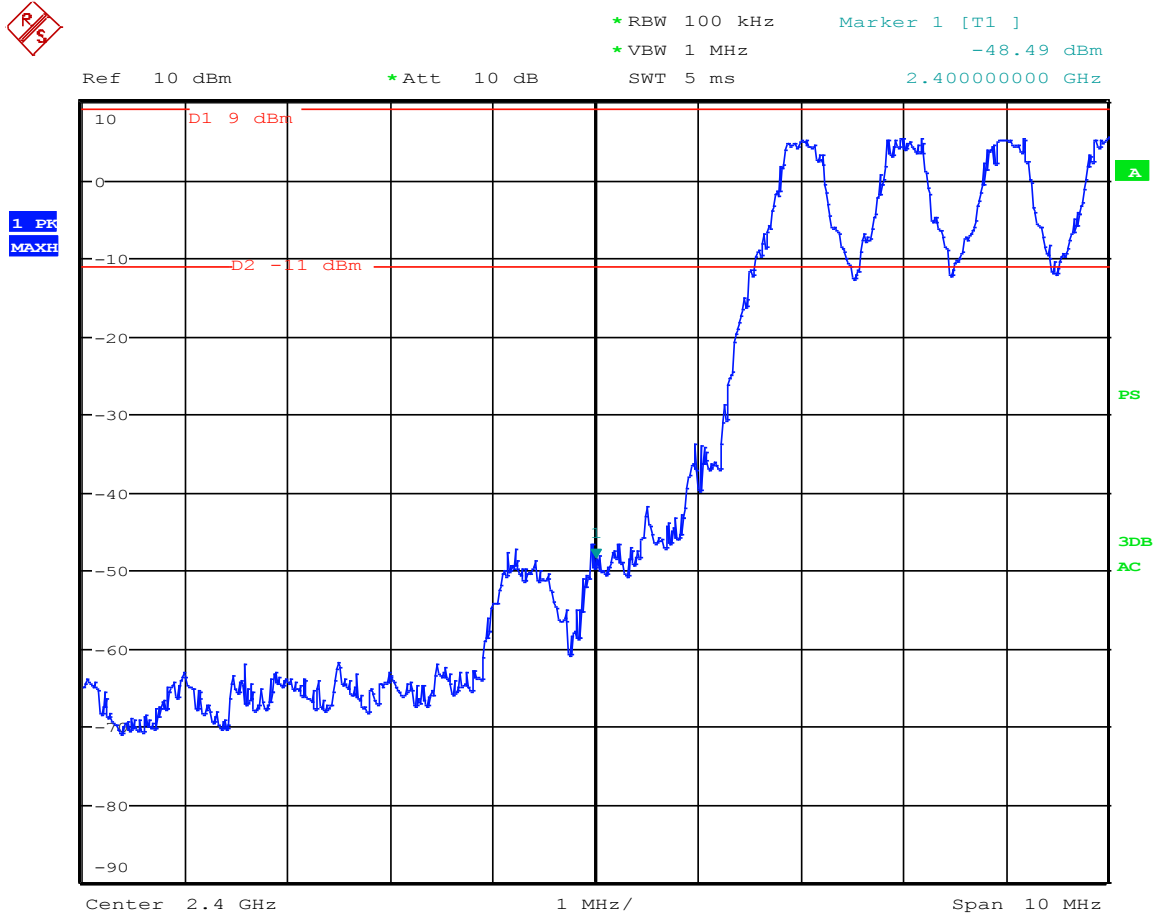
# Wireless Transceiver Test Report

FCC ID: A94BH1    IC: 3232A BH1



Certificate # 1514.1

## Lower band edge (Basic data rate, hopping on all channels)



Out of band peak emissions are more than 20 dB below in band peak.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1

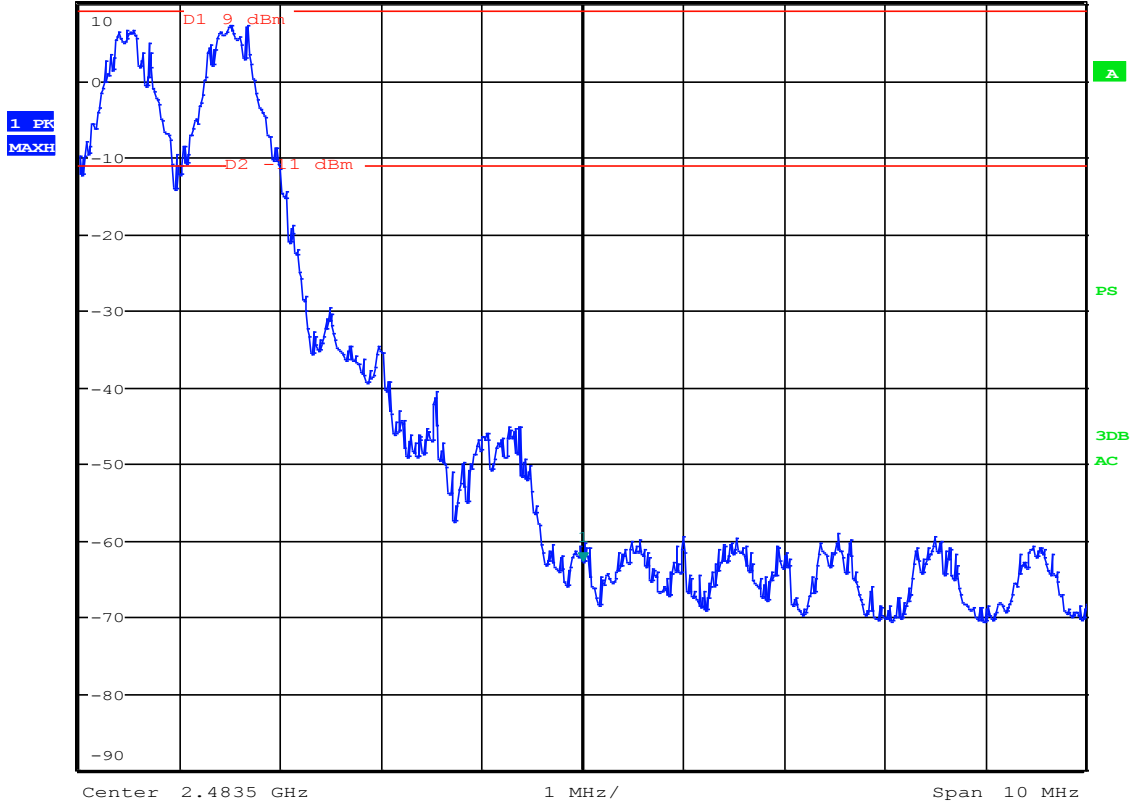


Certificate # 1514.1

## Upper band edge (Basic data rate, hopping on all channels)



\*RBW 100 kHz      Marker 1 [T1 ]  
\*VBW 1 MHz      -62.73 dBm  
Ref 10 dBm      \*Att 10 dB      SWT 5 ms      2.48350000 GHz



Out of band peak emissions are more than 20 dB below in band peak.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1

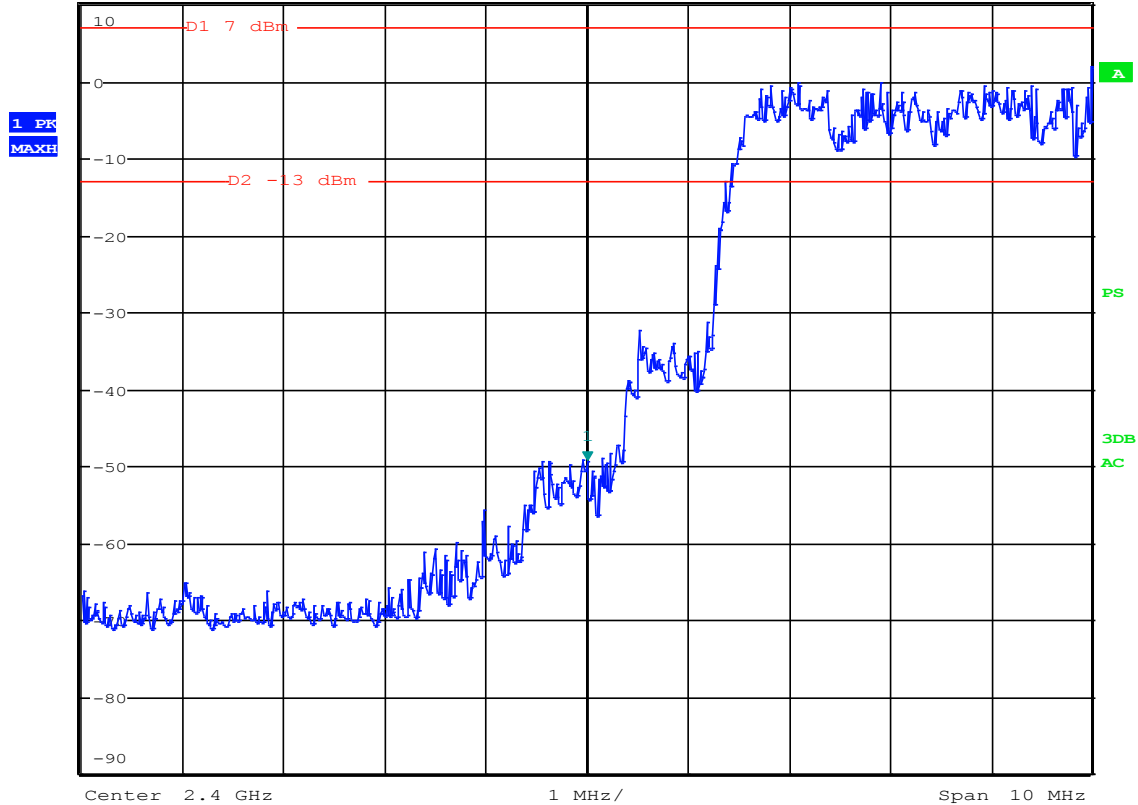


Certificate # 1514.1

Lower band edge (Enhanced data rate), hopping on all channels



\*RBW 100 kHz      Marker 1 [T1 ]  
\*VBW 1 MHz      -49.31 dBm  
Ref 10 dBm      \*Att 10 dB      SWT 5 ms      2.400000000 GHz



Out of band peak emissions are more than 20 dB below in band peak.



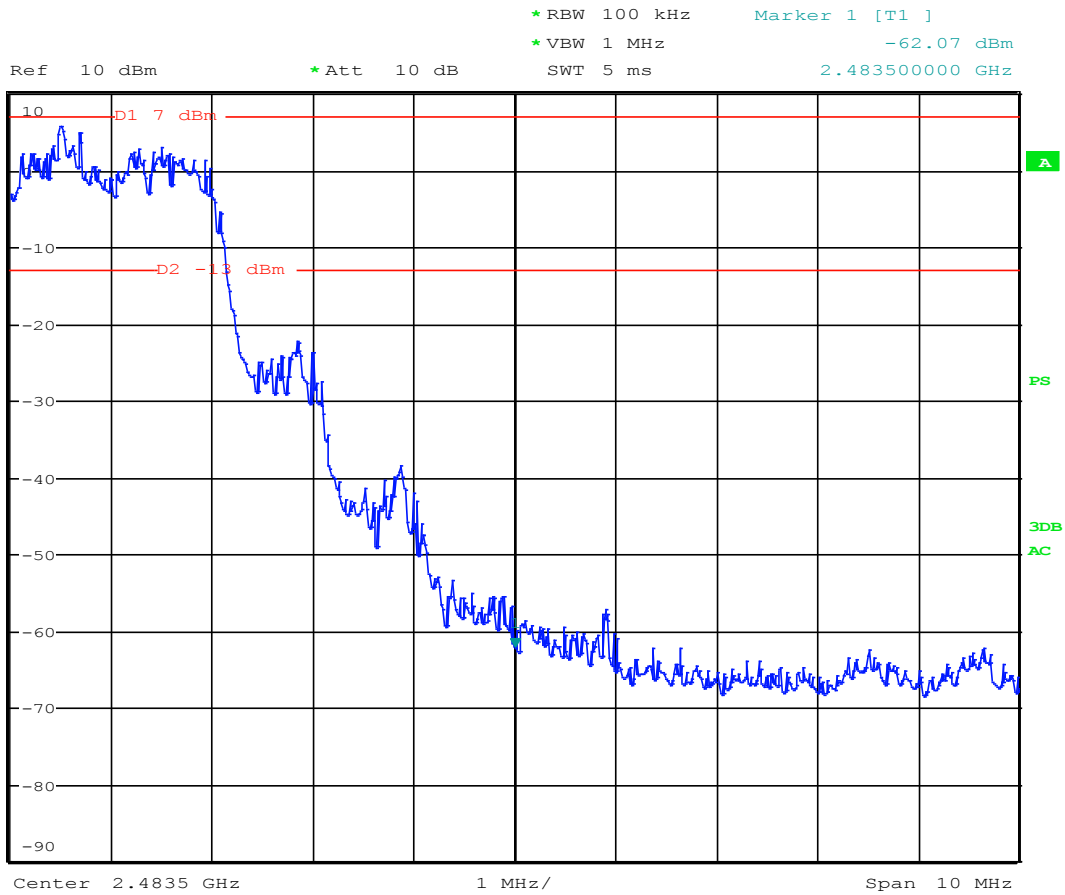
# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## Upper band edge (Enhanced data rate, hopping on all channels)



Out of band peak emissions are more than 20 dB below in band peak.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.6.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1560	4/11/2014	4/11/2015

## 5.6.5 Test information

<b>Date of test:</b>	4/29/2014	<b>Test Location:</b>	Transmitter Test Bench
<b>EUT serial:</b>	FCC#1	<b>Tested by:</b>	C. Bell
<b>Test Conclusion:</b>	Pass		



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.7 Harmonics - Radiated

### 5.7.1 Requirements

FCC part 15.247(d) RSS-Gen 4.9, 4.10

In any of the restricted bands defined in FCC part 15.209(a), the field strength at a distance of 3 meters shall not exceed 54dB $\mu$ V/m (average) or 74dB $\mu$ V/m (peak)

### 5.7.2 Test Setup

The EUT is placed in a standard ANSI C63.10 test setup. Standard antennas and gain horns with suitable pre-amps mounted directly on the horn antennas are used for the measurement of the harmonics. The EUT hopping is stopped and measurements are made in the low, mid and high end of the frequency range at the defined limit distance of 3 meters. The EUT is rotated around the vertical axis, the antenna polarization changed from H to V and the antenna height is varied from 1 to 4 meters in order to find the maximum value of the harmonic emission. Account is taken of the beam width of the horn antennas to make sure the EUT remains in the main lobe of the antenna.

### 5.7.3 Test data

2<sup>nd</sup> & 3<sup>rd</sup> Harmonics of transmitter at (2402, 2441, 2480) MHz

2nd Harmonic						Table	Receiving Antenna	
Measured Values			Limits			Azimuth	Pol	Height
Frequency (MHz) Packet Type = DH5	Peak detector dB $\mu$ V/m @ 3m	Average detector dB $\mu$ V/m @ 3m *	Peak dB $\mu$ V/m	Average dB $\mu$ V/m	Margin dB	0° face ant	H/V	Meters
4804, DH5	51.6	39.8	74	54	14.2	139	H	1
4882, DH5	50.7	38.6	74	54	15.4	130	H	1
4960, DH5	47.6	35	74	54	19	142	H	1
3rd Harmonic						Table	Receiving Antenna	
Measured Values			Limits			Azimuth	Pol	Height
Frequency (MHz) Packet Type = DH5	Peak detector dB $\mu$ V/m @ 3m	Average detector dB $\mu$ V/m @ 3m	Peak dB $\mu$ V/m	Average dB $\mu$ V/m	Margin dB	0° face ant	H/V	Meters
7206, DH5	51.9	38.5	74	54	15.5	118	H	1
7323, DH5	50.8	37.5	74	54	16.5	115	H	1
7440, DH5	53.1	39.9	74	54	14.1	304	H	1

EUT was set to DH5 with 30 packets which causes 34.7% duty cycle which is the highest real life duty possible for this product.





# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

4 <sup>th</sup> – 10 <sup>th</sup> harmonic instrumentation noise floor					
Frequency (GHz)	Measured Values		Limits		
	Peak detector dB $\mu$ V/m @ 3m	Average detector dB $\mu$ V/m @ 3m	Peak dB $\mu$ V/m	Average dB $\mu$ V/m	Margin dB
9.9 (4th Harmonic)	42.2	28.7	Not in restricted band		
12.4 (5th Harmonic)	42	28.9	74	54	25.1
14.8 (6th Harmonic)	44.1	31.1	74	54	22.9
17.3 (7th Harmonic)	37	24	Not in restricted band		
19.5 (8th Harmonic)	51	39	74	54	15
22.1 (9th Harmonic)	52.8	39.6	74	54	14.4
24.5 (10th Harmonic)	54.3	41.1	Not in restricted band		

\* Higher order harmonics are in the measurement noise floor.  
In all cases the noise floor was in excess of 10dB below the limit value.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.7.4 Test Equipment

Equipment Type	Manufacturer	Model	Tracking Number	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/5/2013	4/5/2014
Antenna 4 – 8G	AR	AT4003	TN727	12/5/2011	12/5/2014
Antenna 0.8 - 18 G	EMCO	3115	TN478	7/12/2012	7/12/2015
Antenna 8 – 18G	AR	AT4004	TN728	12/1/2011	11/30/2014
Antenna 18 – 26.5G	AR	AT4640	TN1596	Verify before use	
20 GHz Pre-amp	MITEQ	AFS4-00102000-30-10P-4	TN1672	10/8/2013	10/8/2014
40 GHz pre-amp	MITEQ	JS4018004000-30-8P-A1	TN1757	9/18/2013	9/18/2014
Cable	Florida Labs	NMS-290-360	TN2165	3/25/2014	3/25/2015

## 5.75 Test information

<b>Date of test:</b>	3/18/2014	<b>Test Location:</b>	Hertz Lodge
<b>EUT serial:</b>	FCC#1	<b>Tested by:</b>	C. Bell
<b>Test Conclusion:</b>	Pass		



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.8 Spurious radiated emissions 1-25 GHz

### 5.8.1 Requirements

FCC part 15.247(d), RSS-Gen7.2.5

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

In any of the restricted bands defined in FCC part 15.205(a), the field strength at a distance of 3 meters shall not exceed limits shown in 15.209, 54dB $\mu$ V/m (average) or 74dB $\mu$ V/m (peak).

### 5.8.2 Test Setup

The EUT is placed in a standard ANSI C63.10 test setup. From 1 to 4 GHz a Double-Ridged Guide Horn Antenna is used. Above 4 GHz, standard gain horns with suitable pre-amps mounted directly on the horn antennas are used for the measurement of the emissions.

The EUT is operating normally (hopping), and measurements are made at the defined limit distance of 3 meters. Above 18GHz the measurement distance may be reduced to make sure the emissions are well below the limit. Measurements are made with a 1 MHz resolution bandwidth and an average detector. There is an implied peak limit 20dB above the average limit.

The EUT is rotated around the vertical axis, the antenna polarization changed from H to V and the antenna height is varied from 1 to 4 meters in order to find the maximum value of the emissions. EUT was positioned in the worst case upright orientation. Account is taken of the beam width of the horn antennas to make sure the EUT remains in the main lobe of the antenna.

### 5.8.3 Test Setup

Frequency range 30MHz – 1 GHz. Passes, see section 6.2 of this report

Note upper and lower band edge measurements are covered in section 6.8.4



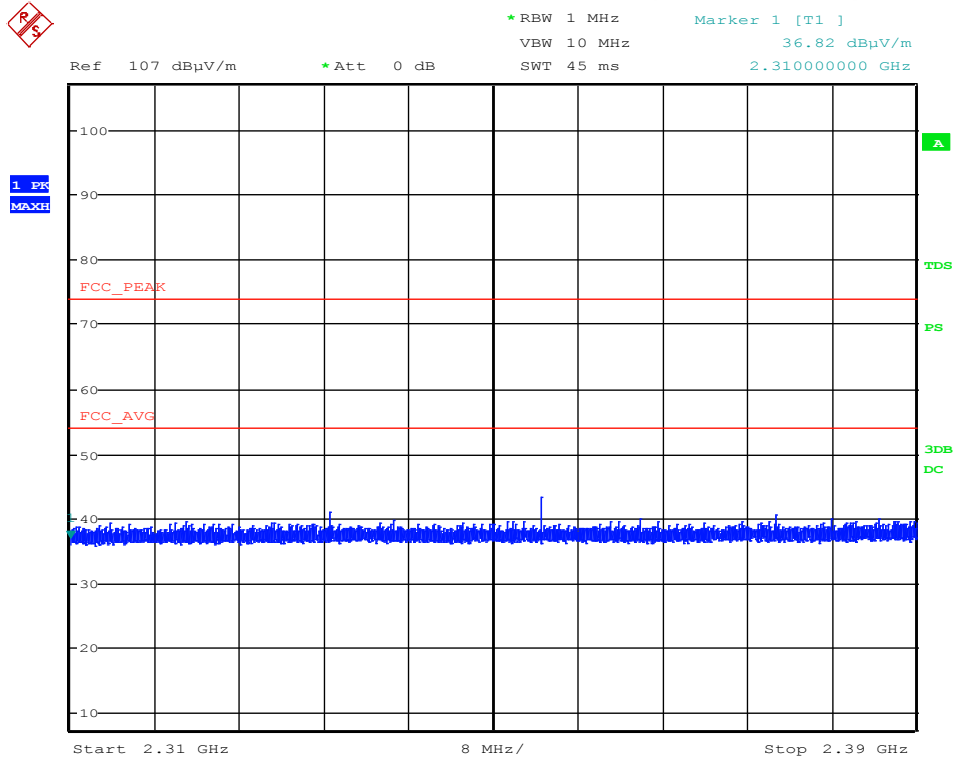
# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## Lower restricted band 2310 – 2390 MHz: (Basic data rate)



Max peak hold emissions are more than 10 dB below the peak limit and maximum average readings are greater than 10dB below the average limit.



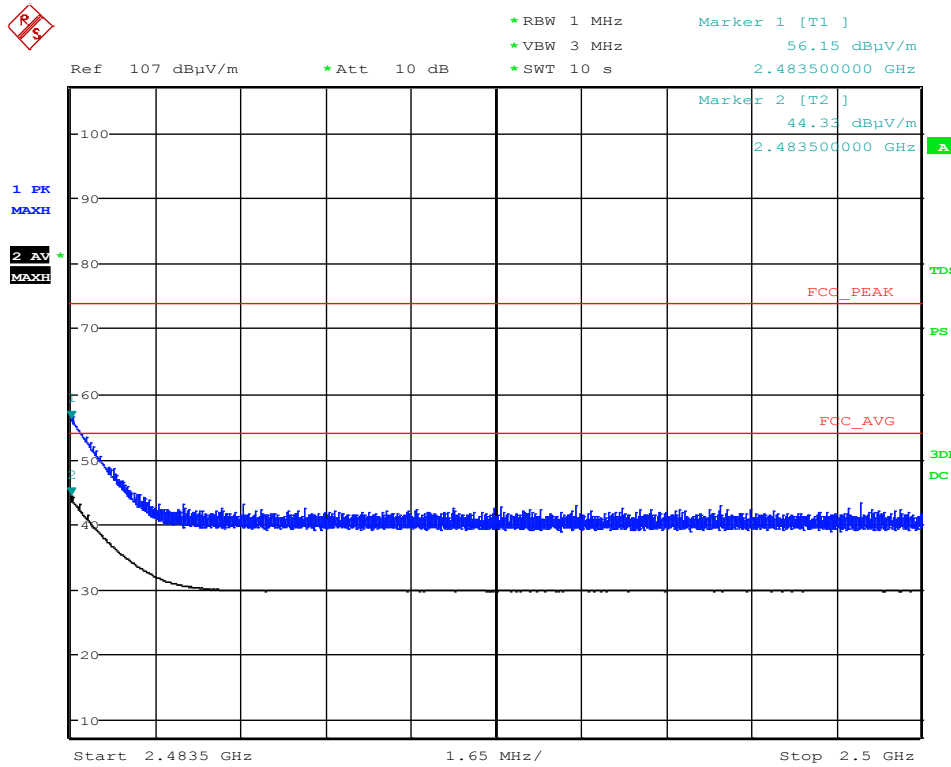
# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

Upper restricted band 2483.5 – 2500 MHz: (Basic data rate)



Max peak hold emissions are more than 10 dB below the peak limit and maximum average readings are greater than 10dB below the average limit.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1

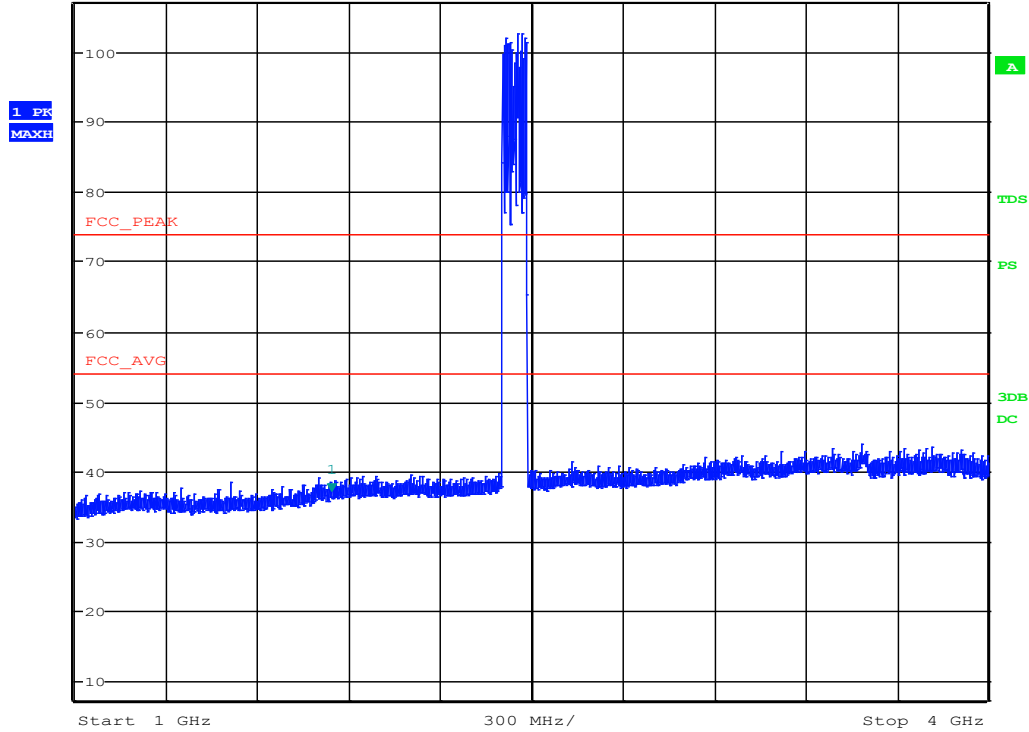


Certificate # 1514.1

1 to 4 GHz



\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 10 MHz      36.88 dBuV/m  
 SWT 45 ms      1.840300000 GHz  
 Ref 107 dBuV/m      \*Att 0 dB



Max peak hold emissions are more than 10 dB below the average limit, excluding the fundamental.



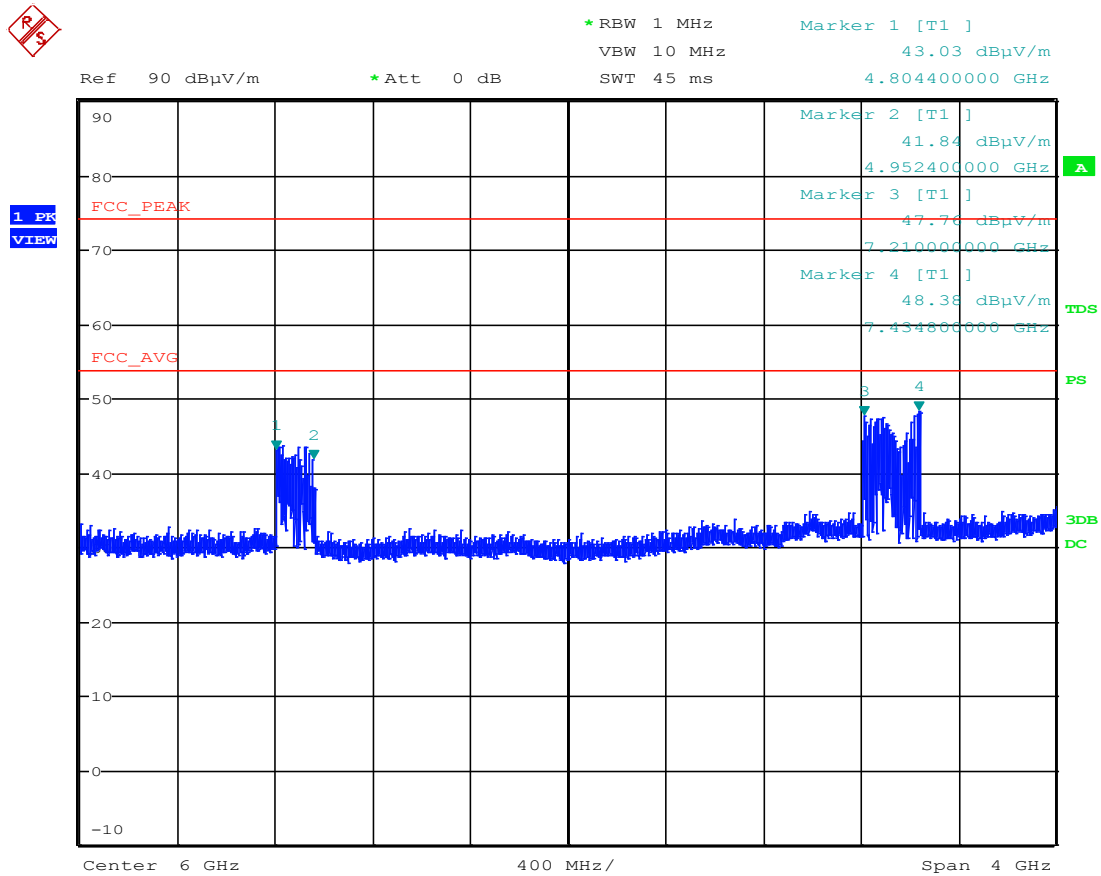
# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## Radiated Emissions 4 – 8 GHz



Emissions at the marker frequencies are covered in section 6.7, harmonics.

Other than the harmonics the maximum peak hold emissions are more than 10 dB below the average limit.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1

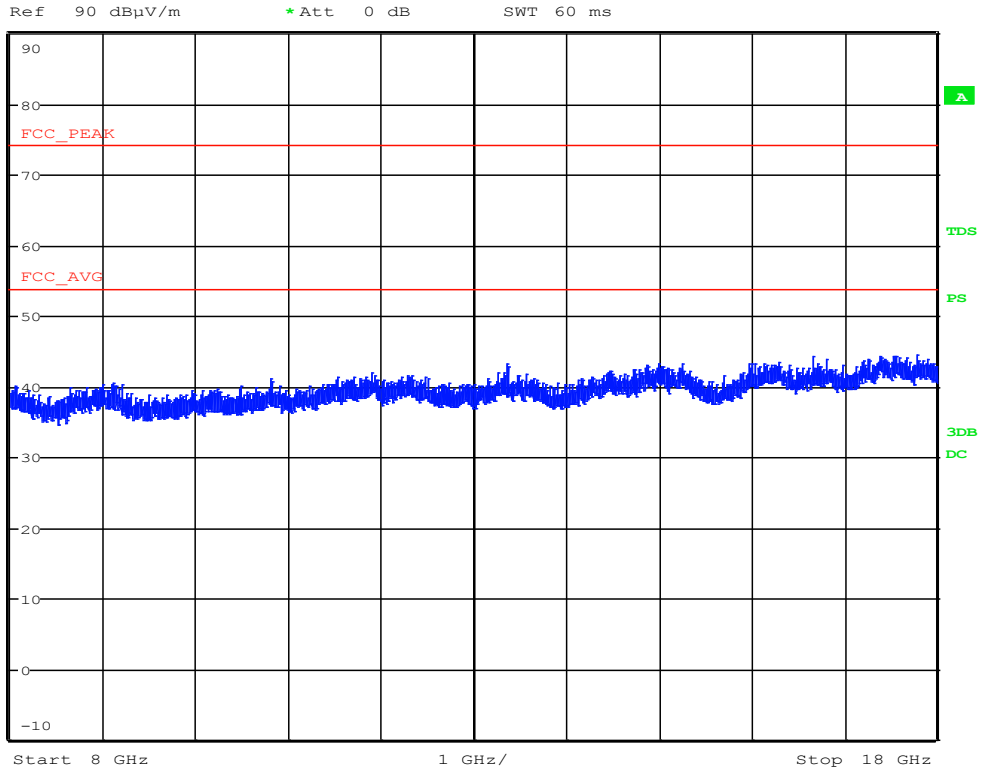


Certificate # 1514.1

## Radiated emissions 8 GHz to 18 GHz (Basic data rate)



\* RBW 1 MHz  
VBW 10 MHz  
SWT 60 ms



Max peak hold emissions are more than 10 dB below the peak limit.





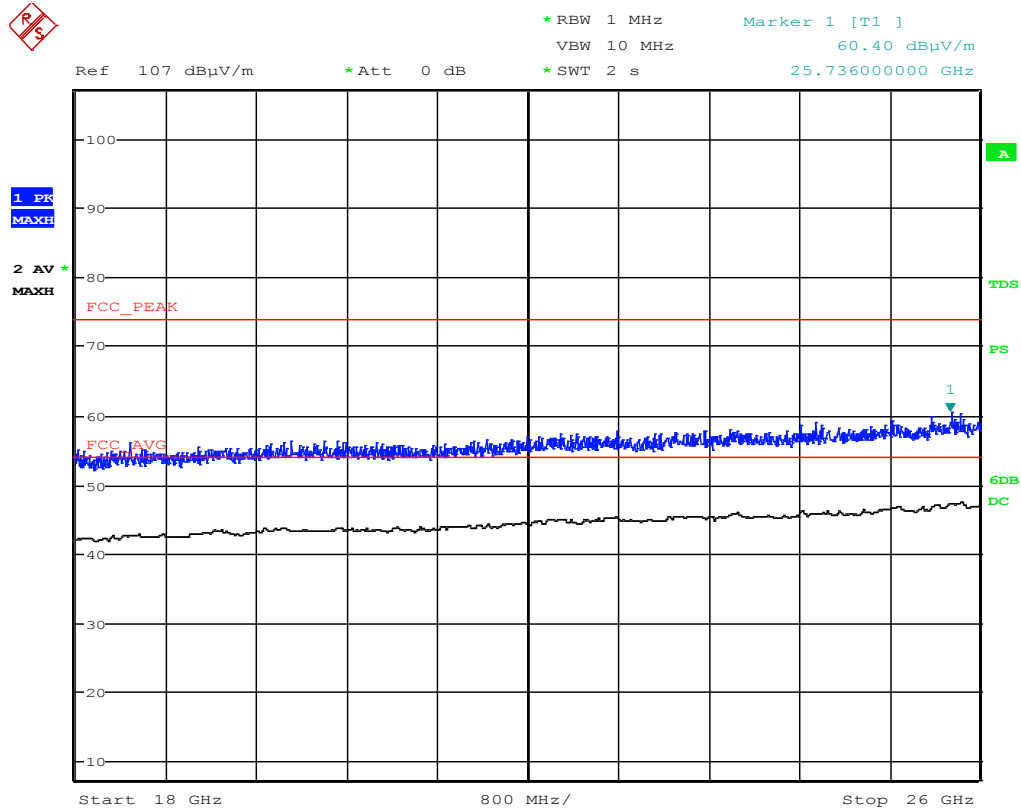
# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

Radiated Emission, 18 to 26 GHz (Basic data rate)  
3 meter distance



Max peak hold emissions are more than 10 dB below the peak limit and maximum average readings are greater than 10dB below the average limit.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



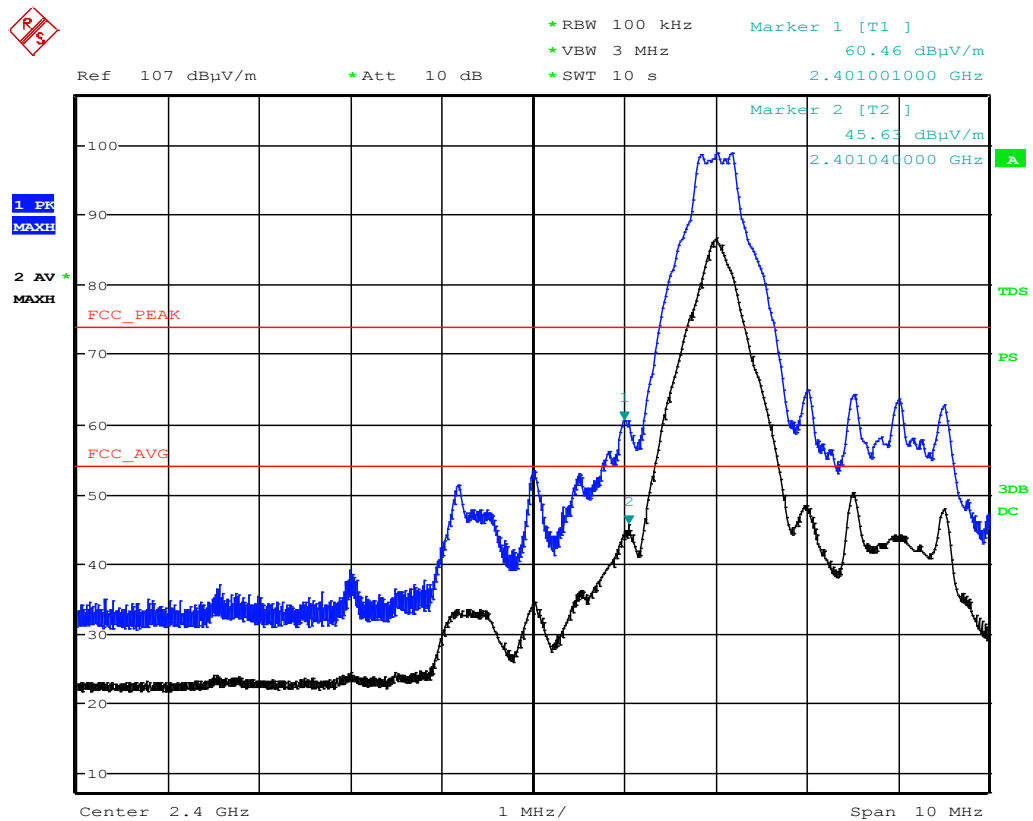
Certificate # 1514.1

## 5.8.4 Band edge radiated emission measurements, 15.247 (d)

Measured radiated at 3 meters, EUT is 80 cm off ground plane.

- (a) More than 20 dB down from in band peak, RBW = 100 kHz
- (b) Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emissions limits specified in 15.205(a).

### Transmitting on 2402 MHz





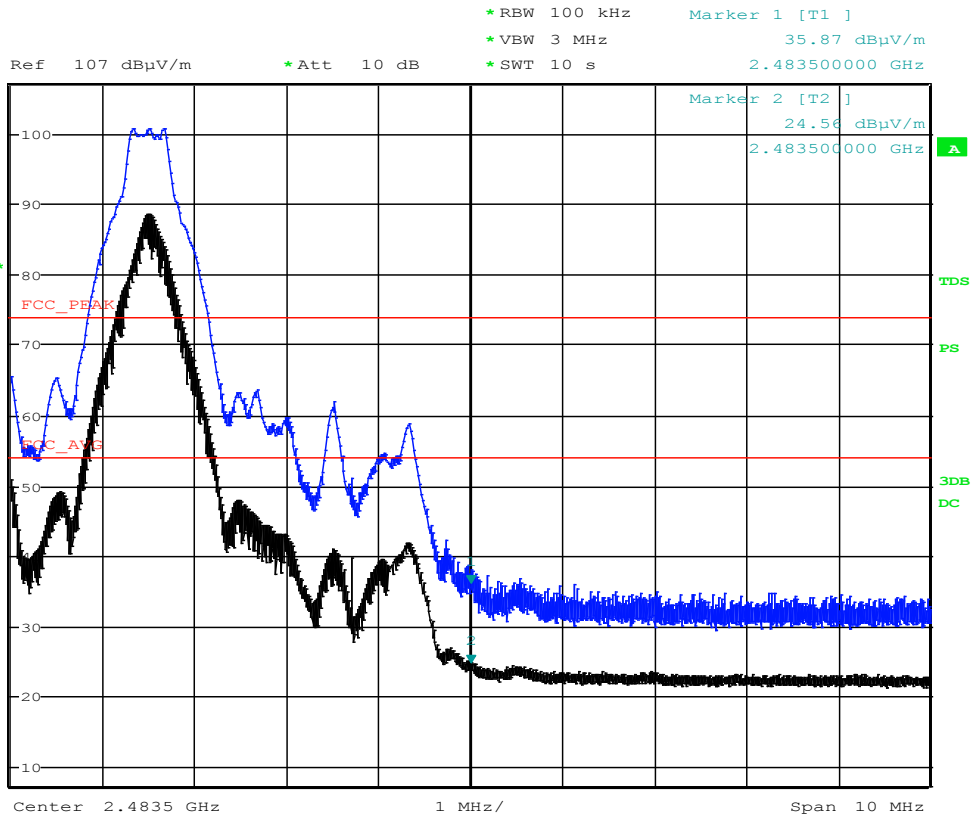
# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

### Transmitting on 2480 MHz





# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.8.5 Test Equipment

Equipment Type	Manufacturer	Model	Tracking Number	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/5/2013	4/5/2014
Antenna 4 – 8G	AR	AT4003	TN727	12/5/2011	12/5/2014
Antenna 0.8 - 18 G	EMCO	3115	TN478	7/12/2012	7/12/2015
Antenna 8 – 18G	AR	AT4004	TN728	12/1/2011	11/30/2014
Antenna 18 – 26.5G	AR	AT4640	TN1596	Verify before use	
20 GHz Pre-amp	MITEQ	AFS4-00102000-30-10P-4	TN1672	10/8/2013	10/8/2014
40 GHz pre-amp	MITEQ	JS4018004000-30-8P-A1	TN1757	9/18/2013	9/18/2014
Cable	Florida Labs	NMS-290-360	TN2076	3/25/2014	3/25/2015

## 5.8.6 Test information

<b>Date of test:</b>	3/18/2014	<b>Test Location:</b>	Hertz Lodge
<b>EUT serial:</b>	FCC#1	<b>Tested by:</b>	C. Bell
<b>Test Conclusion:</b>	Pass		



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.9 Receiver mode spurious emissions

### 5.9.1 Requirements

RSS-Gen section 4.10

If the antenna is detachable, a conducted measurement may be performed.

RSS-Gen section 6.2

No spurious output signals appearing at the antenna terminals shall exceed 2 nW (-57dBm) in the band 30-1000 MHz, or 5 nW (-53dBm) above 1 GHz.

### 5.9.2 Test Setup

The EUT is controlled via the USB cable with CSR's Blue Suite software which is used to set the test modes of the EUT. The EUT's RF test connector is fed to the spectrum analyzer using an 8 inch u.FL to SMA-Female adapter cable; the loss of this adapter cable is 0.7 dB and is accounted for using the reference level offset feature of the R&S ESIB40 spectrum analyzer. The EUT is programmed to receive on the target frequency. To help attenuate the ambient 2.4 & 5 GHz WiFi that are being picked up, the EUT was placed inside a shielded box with the USB cable and RF output cable passed through the box to the PC and spectrum analyzer. The ambient WiFi signals while attenuated greatly by the shielded box are still being picked up on the measurement.

The local oscillator for the radio IC is 1.5 MHz above the programmed receive frequency.

A spectrum scan is made from 30 MHz to 3 times the highest tunable or local oscillator frequency.  $2.4815 \text{ GHz} * 3 = 7.44 \text{ GHz} \sim 7.5 \text{ GHz}$ .

### 5.9.3 Test data

RX Frequency (MHz)	Receive local oscillator frequency (MHz)	Emission amplitude (dBm )	Margin (dB)
2402	2403.5	-77.0	24.0
2441	2442.5	-76.0	23.0
2480	2481.5	-76.5	23.5



# Wireless Transceiver Test Report

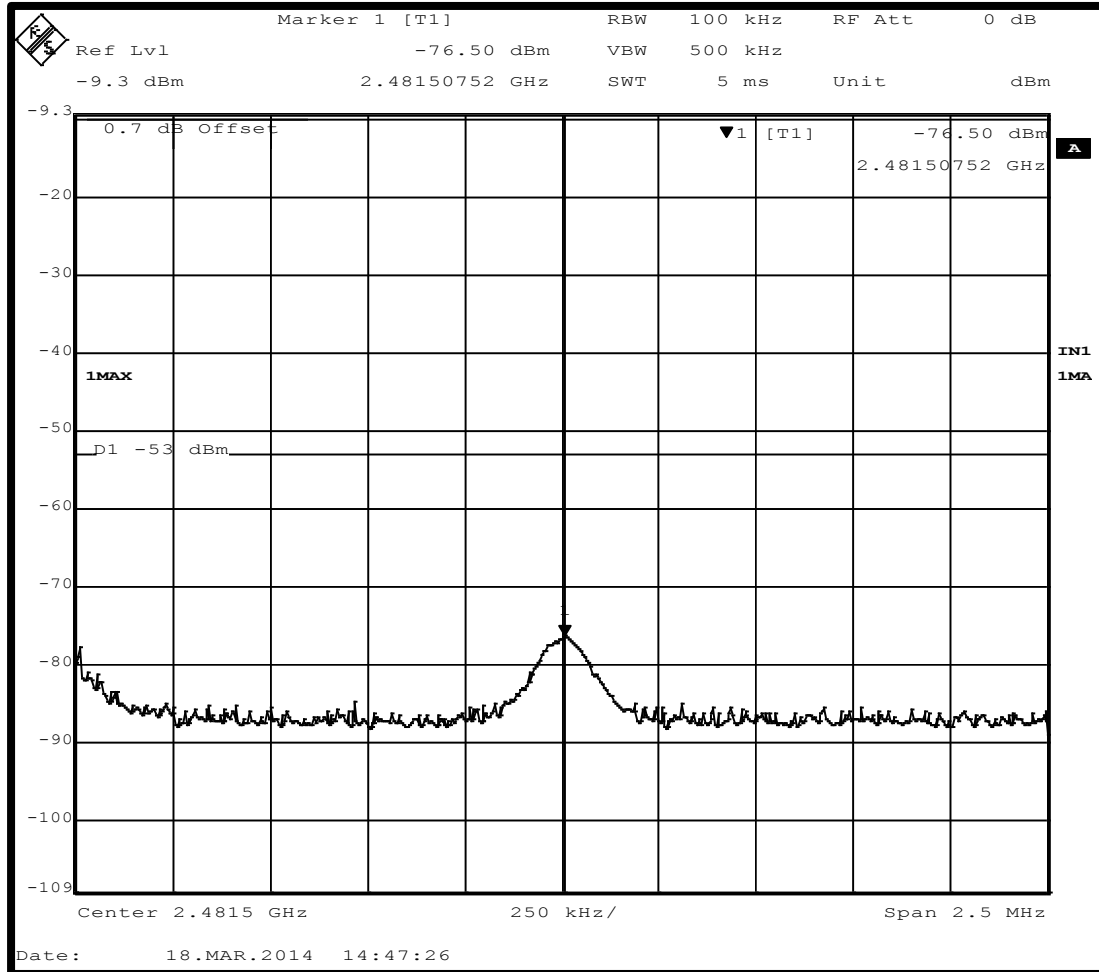
FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

Emissions due to local oscillator (2481.5 MHz)

Example measurement for EUT receiving on 2480 MHz.





# Wireless Transceiver Test Report

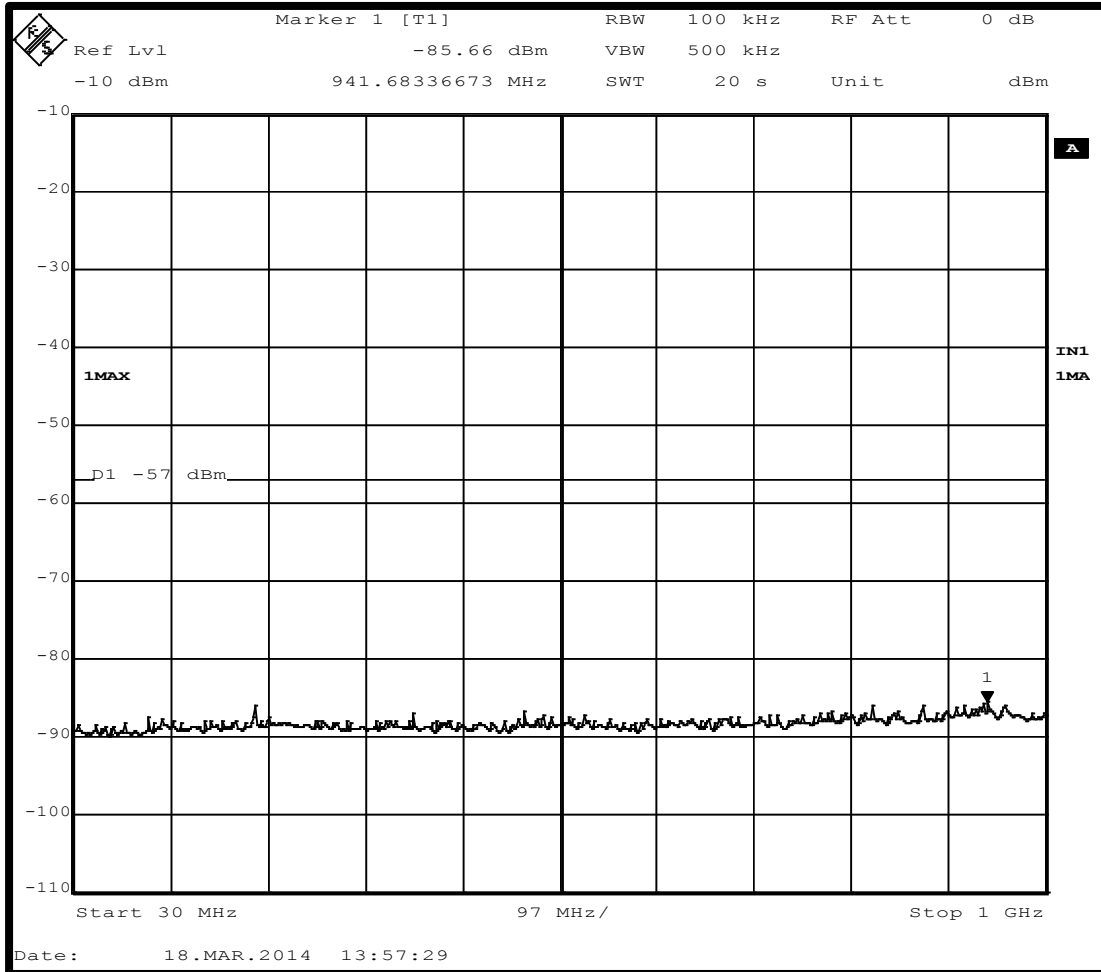
FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

Receiver mode on 2441 GHz

## 30 MHz to 1 GHz



Emissions are more than 10 dB below the limit.



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1

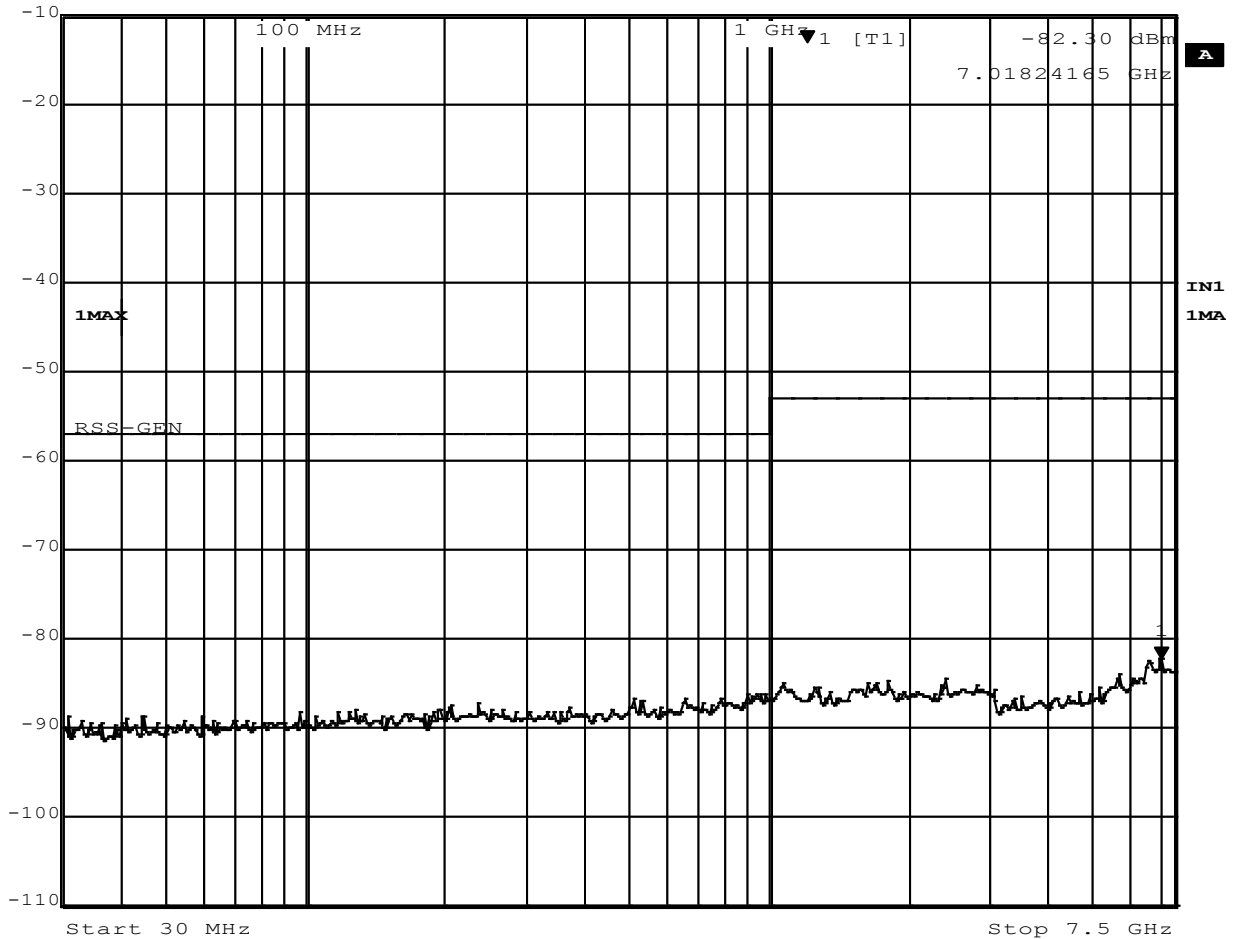


Certificate # 1514.1

Receiver mode on 2441 GHz

## 30 MHz to 7.5 GHz

	Marker 1 [T1]	RBW	100 kHz	RF Att	0 dB
	Ref Lvl	-82.30 dBm	VBW	1 MHz	
	-10 dBm	7.01824165 GHz	SWT	20 s	Unit dBm



Date: 24.MAR.2014 09:50:50

EUT was placed inside of a shielded enclosure for this measurement.





# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.9.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESIB40	TN1560	4/4/2013	4/4/2014

## 5.9.5 Test information

Date of test:	3/24/2014	Test location:	Transmitter Test Bench
EUT serial:	FCC#1	Tested by:	C. Bell
Test Conclusion:	Pass		



# Wireless Transceiver Test Report

FCC ID: A94BH1 IC: 3232A BH1



Certificate # 1514.1

## 5.10 SAR exemption calculation

Frequency Range: 2402-2480MHz

Based on FCC KDB 4447498 D01 General RF Exposure Guidance v05

### Equation 1:

$$\left[ \frac{\text{max. power of channel, including tune-up tolerance, mW}}{\text{min. test separation distance, mm}} \right] * \sqrt{f(\text{GHz})}$$

Distance between EUT and body is 10 mm

Maximum conducted output power measured (dBm) = 9.49 dBm (8.89 mW) (see section 6.3 of this report)

Applying equation 1:

$$(8.89/10) * \sqrt{f(2.480)} = 1.40 \leq 3.0$$

Equation one is below the 3.0 1-g SAR exemption limit, device complies with FCC exposure limits for general population/uncontrolled exposure as a portable device without SAR evaluation.