

Application for FCC Certification
On behalf of

ZHEJIANG REXENSE TECHNOLOGY CO., LTD.

Product Name: 802.15.4 / ZigBee Module

Model No.: REX3

Serial No.: 1016BCE3, 1016BCE7

FCC ID: O46RY12M01

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TEST REPORT FOR FCC CERTIFICATE

Applicant : ZHEJIANG REXENSE TECHNOLOGY CO., LTD.
Manufacturer : ZHEJIANG REXENSE TECHNOLOGY CO., LTD.
EUT Description : 802.15.4 / ZigBee Module
(A) Model No. : REX3
(B) Serial No. : 1016BCE3, 1016BCE7
(C) Test Voltage : DC 3.3V

Test Procedure Used:

*FCC RULES AND REGULATIONS PART 15 SUBPART C OCTOBER 2011
AND ANSI C63.4-2003*

The device described above is tested by Audix Technology (Shanghai) Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C limits.

The test results are contained in this test report and Audix Technology (Shanghai) Co., Ltd. is assumed full responsibility for the accuracy and completeness of these measurements. This report also shows that the EUT (M/N: see Sec. 2.1, S/N: see Sec. 2.1), which was tested on May. 07 - 21, 2012 is technically compliance with the FCC limits.

This report applies to above tested sample only. This report shall not be reproduced in part without written approval of Audix Technology (Shanghai) Co., Ltd.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Date of Test : May. 07 - 21, 2012 Date of Report : May. 22, 2012

Producer : Alan He
ALAN HE / Assistant

Review : Dio Yang
DIO YANG / Assistant Manager

AUDIX[®] For and on behalf of
Audix Technology (Shanghai) Co., Ltd.

Signatory : Sammy Chen
Authorized Signature EMC SAMMY CHEN / Deputy Manager

1 SUMMARY OF STANDARDS AND RESULTS

1.1 Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

Description / Test Item	Test Standard	Results	Meets Limit
EMISSION			
Conducted Emission	FCC RULES AND REGULATIONS PART 15 SUBPART C October 2011 AND ANSI C63.4:2003 AND KDB558074 v01:2012	N/A	N/A
Radiated Emission	FCC RULES AND REGULATIONS PART 15 SUBPART C October 2011 AND ANSI C63.4:2003 AND KDB558074 v01:2012	Pass	15.209(a) 15.205(a)(c)
6 dB Bandwidth Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C October 2011 AND ANSI C63.4:2003 AND KDB558074 v01:2012	Pass	15.247(a)(2)
Maximum Peak Output Power Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C October 2011 AND ANSI C63.4:2003 AND KDB558074 v01:2012	Pass	15.247(b)(3)
Emission Limitations Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C October 2011 AND ANSI C63.4:2003 AND KDB558074 v01:2012	Pass	15.247(d)
Band Edge Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C October 2011 AND ANSI C63.4:2003 AND KDB558074 v01:2012	Pass	15.247(d)
Power Spectral Density Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C October 2011 AND ANSI C63.4:2003 AND KDB558074 v01:2012	Pass	15.247(e)

2 GENERAL INFORMATION

2.1 Description of Equipment Under Test

Description	:	802.15.4 / ZigBee Module
Type of EUT		☒ Production ☐ Pre-product ☐ Pro-type
Model Number	:	REX3
Note 1	:	The REX3 has 2 types of antenna: one is the PCB antenna on board, the other is the external SMA antenna.
Serial Number	:	1016BCE3 (PCB antenna type), 1016BCE7 (SMA antenna type)
Note 2	:	The only difference of above 2 samples is using PCB antenna or SMA antenna, so we select 1 sample to perform the RF conducted test and both 2 samples to perform the RF radiated test.
Radio Tech	:	IEEE 802.15.4 (ZigBee®)
Freq. Band	:	2405 MHz ~ 2480 MHz Total 16 Channels in 5 MHz Separation
Tested Freq.	:	2405 MHz (Channel 11) 2440 MHz (Channel 18) 2480 MHz (Channel 26)
Antenna Gain	:	2.0 dBi (for both PCB antenna and SMA antenna)
Applicant	:	ZHEJIANG REXENSE TECHNOLOGY CO., LTD. Room 105, Hangzhou E-Commerce Industry Park, No.7 Cuibai Road, Hangzhou 310012 P.R.C
Manufacturer	:	ZHEJIANG REXENSE TECHNOLOGY CO., LTD. Room 105, Hangzhou E-Commerce Industry Park, No.7 Cuibai Road, Hangzhou 310012 P.R.C

2.2 Description of Test Facility

Site Description (Semi-Anechoic Chamber) : Sept. 17, 1998 file on
Apr 29, 2009 Renewed
Federal Communications Commission
FCC Engineering Laboratory
7435 Oakland Mills Road
Columbia, MD 21046, USA

Name of Firm : Audix Technology (Shanghai) Co., Ltd.

Site Location : 3 F 34 Bldg 680 Guiping Rd.,
Caohejing Hi-Tech Park,
Shanghai 200233, China

FCC registration Number : 91789

Accredited by NVLAP, Lab Code : 200371-0

2.3 Measurement Uncertainty

Radiated Emission Expanded Uncertainty (30-200MHz):
U = 4.58dB (Horizontal)
U = 4.70dB (Vertical)

Radiated Emission Expanded Uncertainty (200M-1GHz):
U = 4.84dB (Horizontal)
U = 4.70dB (Vertical)

Radiated Emission Expanded Uncertainty (Above 1GHz):
U= 4.60 dB (Horizontal)
U= 4.18 dB (Vertical)

6 dB Bandwidth Expanded Uncertainty : U = 0.05 kHz

Maximum Peak Output Power Expanded Uncertainty: U = 0.30 dB

Emission Limitations Expanded Uncertainty : U = 0.15 dB

Band Edge Expanded Uncertainty : U = 0.15 dB

Power Spectral Density Expanded Uncertainty : U = 0.15 dB

3 RADIATED EMISSION TEST

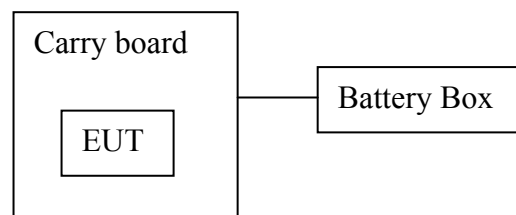
3.1 Test Equipment

The following test equipment are used during the radiated emission test in a semi-anechoic chamber:

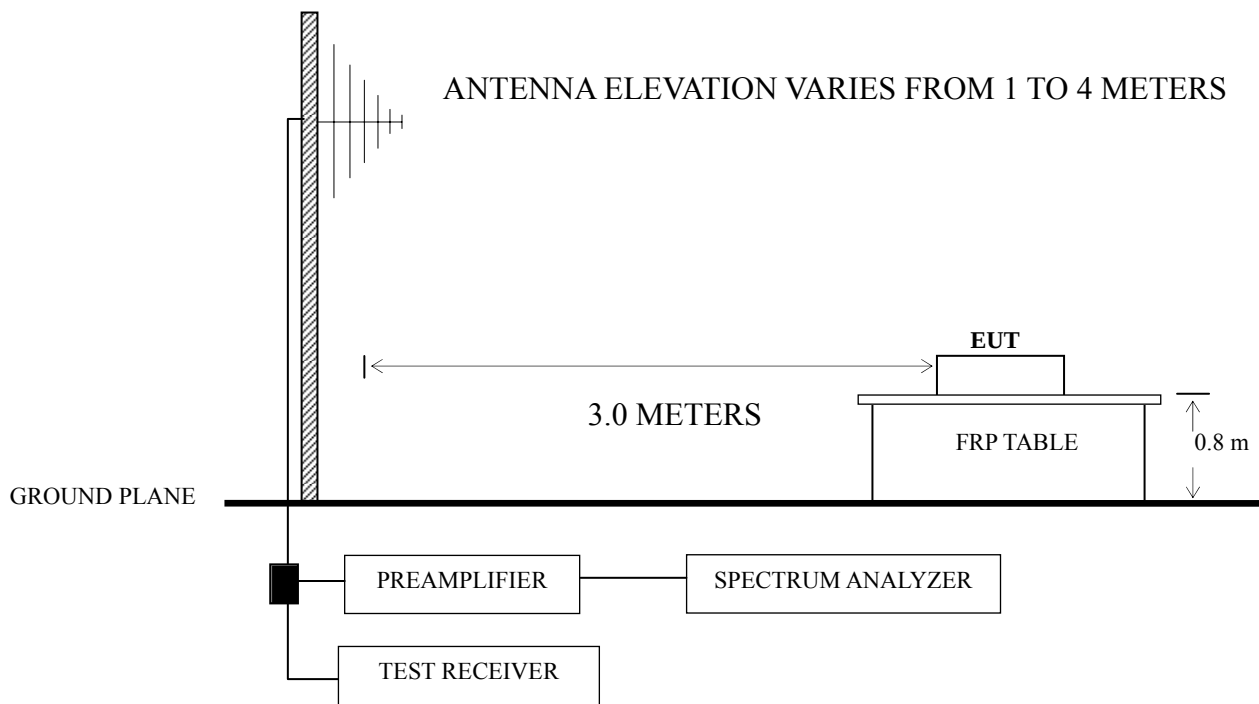
Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Preamplifier	Agilent	8447D	2944A10548	Mar 18, 2012	Sep 18, 2012
2.	Preamplifier	HP	8449B	3008A00864	Mar 22, 2012	Mar 22, 2013
3.	Spectrum Analyzer	Agilent	E7405A	MY45106600	Mar 22, 2012	Mar 22, 2013
4.	Test Receiver	R&S	ESVS10	844594/001	Mar 22, 2012	Mar 22, 2013
5.	Bi-log Antenna	TESEQ	CBL6112D	23192	Dec 01, 2011	Dec 01, 2012
6.	Horn Antenna	EMCO	3115	9607-4878	May 06, 2012	May 06, 2013
7.	Horn Antenna	EMCO	3116	00062643	May 13, 2011	May 13, 2012
8.	50 Ω Coaxial Switch	Anritsu	MP59B	6200426390	Mar 18, 2012	Sep 18, 2012
9.	Software	Audix	E3	SET00200 9912M295-2	-	-

3.2 Block Diagram of Test Setup

3.2.1 EUT & Peripherals



3.2.2 Test Setup



■ : 50 ohm Coaxial Switch

3.3 Radiated Emission Limit [FCC Part 15 Subpart C 15.209]

Frequency (MHz)	Distance (m)	Field strength limits ($\mu\text{V/m}$)	
		($\mu\text{V/m}$)	$\text{dB}(\mu\text{V/m})$
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
Above 960	3	500	54.0

NOTE 1 - Emission Level $\text{dB}(\mu\text{V/m}) = 20 \log \text{Emission Level}(\mu\text{V/m})$
NOTE 2 - The tighter limit applies at the band edges.
NOTE 3 - Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
NOTE 4 - The limits shown are based on Quasi-peak value detector below or equal to 1GHz and Average value detector above 1GHz.
NOTE 5 - Above 1 GHz, the limit on peak emission is 20 dB above the maximum permitted average emission limit applicable to the EUT

3.4 Test Configuration

The EUT (listed in Sec.2.1) and the simulators (listed in Sec.2.2) were installed as shown on Sec.3.2 to meet FCC requirements and operating in a manner that tends to maximize its emission level in a normal application.

3.5 Operating Condition of EUT

3.5.1 Setup the EUT as shown in Sec. 3.2.

3.5.2 Turn on the power of all equipment.

3.5.3 Turn the EUT on the test mode, and then test.

3.5.4 Configured the EUT in three axis: Lying / Side / Stand, and test separately.

3.6 Test Procedures

Radiated emission test applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. A pre-amp is necessary for this measurement. For measurement above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

The EUT was placed on a turntable that is 0.8 meter above ground. The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna, which was mounted on an antenna tower. The antenna moved up and down between 1 meter and 4 meters to find out the maximum emission level. Broadband antenna (Calibrated Bilog Antenna) or Horn antenna was used as receiving antenna. Both horizontal and vertical polarizations of the antenna were set on measurement. In order to find the maximum emission, all of the interference cables were manipulated according to ANSI C63.4:2003 requirements during radiated emission test.

The bandwidth of Test Receiver R&S ESVS10 was set at 120 kHz from 30MHz to 1000MHz.

The bandwidth of the VBW was set at 1MHz and RBW was set at 1MHz for peak emission measurement above 1GHz for Spectrum Agilent E7405A.

The frequency range from 30 MHz to 25 GHz (Up to 10th harmonics from fundamental frequency) was checked.

The EUT was tested under the following test modes:

Mode	Operation	Channel	Frequency
1.	Transmitting	11	2405 MHz
2.		18	2440 MHz
3.		26	2480 MHz
4.	Receiving	18	2440 MHz
5.	Transmitting	11	2405 MHz
6.	Band-Edge	26	2480 MHz

All the test results are listed in Sec.3.7.

3.7 Test Results

<PASS>

The frequency and amplitude of the highest radiated emission relative the limit is reported. All the emissions not reported below are too low against the FCC limit.

No.	Operation	Antenna	Channel	Frequency	Data Page	
1.	Transmitting	PCB	11	2405 MHz	P12	
2.			18	2440 MHz	P13	
3.			26	2480 MHz	P14	
4.		SMA	11	2405 MHz	P15	
5.			18	2440 MHz	P16	
6.			26	2480 MHz	P17	
7.	Receiving	PCB	18	2440 MHz	P18	
8.		SMA	18	2440 MHz	P19	
9.	Transmitting	--	Duty Cycle			P21-22
10.			11	2405 MHz	Band	P23-P24
11.			26	2480 MHz	Edge	P25-P26

NOTE 1 – Level = Read Level + Antenna Factor + Cable Loss (<1GHz)

NOTE 2 – Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor (>1GHz)

NOTE 3 – All reading are Quasi-Peak values below or equal to 1GHz, Peak and Average values above 1GHz.

For above 1GHz test, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.

NOTE 4 – For Receiving Mode, we selected Receiving Ch18 mode to perform the test.

NOTE 5 – The emission levels recorded below is data of EUT configured in Lying direction, for Lying direction was the maximum emission direction during the test. The data of Side & Stand direction are too low against the official limit to be reported.

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE3 Date of Test : May 07, 2012

Test Mode : Transmitting Ch11 Antenna : PCB

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	30.97	-0.24	17.78	0.81	--	18.35	40.00	21.65	QP
	84.32	-5.07	10.75	1.64	--	7.32	40.00	32.68	
	134.76	-1.42	10.72	2.14	--	11.44	43.50	32.06	
	306.45	-0.80	13.87	2.77	--	15.84	46.00	30.16	
	567.38	0.14	18.02	3.40	--	21.56	46.00	24.44	
	739.07	0.09	19.94	3.78	--	23.81	46.00	22.19	
	1852.00	51.24	27.30	6.26	36.37	48.43	74.00	25.57	PK
	3184.00	45.93	31.98	6.72	35.84	48.79	74.00	25.21	
	5032.00	44.20	36.69	9.25	35.18	54.96	74.00	19.04	
	7492.00	44.19	38.70	10.14	34.72	58.31	74.00	15.69	
	5032.00	25.96	36.69	9.25	35.18	36.72	54.00	17.28	AV
	7492.00	25.26	38.70	10.14	34.72	39.38	54.00	14.62	
Vertical	31.94	-0.87	17.29	0.82	--	17.24	40.00	22.76	QP
	75.59	-5.82	10.27	1.53	--	5.98	40.00	34.02	
	133.79	-0.58	10.74	2.12	--	12.28	43.50	31.22	
	257.95	0.15	12.31	2.63	--	15.09	46.00	30.91	
	550.89	1.09	17.92	3.37	--	22.38	46.00	23.62	
	800.18	0.79	20.60	3.88	--	25.27	46.00	20.73	
	1312.00	54.36	26.38	5.49	37.49	48.74	74.00	25.26	PK
	2488.00	51.05	29.55	6.99	36.06	51.53	74.00	22.47	
	5272.00	43.62	36.59	9.40	35.06	54.55	74.00	19.45	
	7312.00	45.58	38.03	9.91	34.73	58.79	74.00	15.21	
	5272.00	27.34	36.59	9.40	35.06	38.27	54.00	15.73	AV
	7312.00	27.94	38.03	9.91	34.73	41.15	54.00	12.85	

TEST ENGINEER: RAVEN JIN

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE3 Date of Test : May 07, 2012

Test Mode : Transmitting Ch18 Antenna : PCB

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	32.91	-1.21	16.79	0.82	--	16.40	40.00	23.60	QP
	86.26	-4.00	10.83	1.68	--	8.51	40.00	31.49	
	125.06	0.23	10.91	2.05	--	13.19	43.50	30.31	
	228.85	-1.47	11.01	2.53	--	12.07	46.00	33.93	
	374.35	1.07	15.75	2.93	--	19.75	46.00	26.25	
	627.52	1.58	18.56	3.53	--	23.67	46.00	22.33	
	1588.00	48.36	27.07	5.93	36.78	44.58	74.00	29.42	PK
	2956.00	48.11	31.74	6.53	35.90	50.48	74.00	23.52	
	5008.00	44.07	36.70	9.25	35.20	54.82	74.00	19.18	
	7480.00	44.61	38.63	10.02	34.72	58.54	74.00	15.46	
	5008.00	26.19	36.70	9.25	35.20	36.94	54.00	17.06	AV
	7480.00	26.77	38.63	10.02	34.72	40.70	54.00	13.30	
Vertical	44.55	2.95	10.47	0.89	--	14.31	40.00	25.69	QP
	102.75	-1.24	11.31	1.88	--	11.95	43.50	31.55	
	227.88	-1.74	10.97	2.53	--	11.76	46.00	34.24	
	417.03	1.78	16.52	3.04	--	21.34	46.00	24.66	
	770.11	0.93	20.30	3.84	--	25.07	46.00	20.93	
	939.86	0.33	20.51	5.10	--	25.94	46.00	20.06	
	1336.00	53.04	26.47	5.53	37.42	47.62	74.00	26.38	PK
	2488.00	50.29	29.55	6.99	36.06	50.77	74.00	23.23	
	4816.00	46.62	35.74	9.09	35.30	56.15	74.00	17.85	
	7468.00	44.35	38.63	10.02	34.72	58.28	74.00	15.72	
	4816.00	26.31	35.74	9.09	35.30	35.84	54.00	18.16	AV
	7468.00	25.45	38.63	10.02	34.72	39.38	54.00	14.62	

TEST ENGINEER: RAVEN JIN

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE3 Date of Test : May 07, 2012

Test Mode : Transmitting Ch26 Antenna : PCB

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	40.67	-0.84	12.33	0.87	--	12.36	40.00	27.64	QP
	109.54	-1.09	11.19	1.93	--	12.03	43.50	31.47	
	218.18	-3.15	10.52	2.50	--	9.87	46.00	36.13	
	374.35	-0.15	15.75	2.93	--	18.53	46.00	27.47	
	577.08	1.51	18.08	3.42	--	23.01	46.00	22.99	
	806.00	0.29	20.58	3.99	--	24.86	46.00	21.14	
	1060.00	50.17	25.15	5.26	38.07	42.51	74.00	31.49	PK
	2500.00	49.15	29.60	6.99	36.06	49.68	74.00	24.32	
	4876.00	44.12	36.04	9.14	35.27	54.03	74.00	19.97	
	7324.00	44.53	38.11	9.91	34.73	57.82	74.00	16.18	AV
	4876.00	26.29	36.04	9.14	35.27	36.20	54.00	17.80	
	7324.00	26.62	38.11	9.91	34.73	39.91	54.00	14.09	
Vertical	40.67	-0.17	12.33	0.87	--	13.03	40.00	26.97	QP
	94.02	-1.55	11.15	1.78	--	11.38	43.50	32.12	
	230.79	-1.72	11.10	2.55	--	11.93	46.00	34.07	
	439.34	0.08	16.82	3.09	--	19.99	46.00	26.01	
	587.75	0.24	18.13	3.44	--	21.81	46.00	24.19	
	800.18	1.14	20.60	3.88	--	25.62	46.00	20.38	
	1588.00	51.46	27.07	5.93	36.78	47.68	74.00	26.32	PK
	2980.00	48.40	31.84	6.49	35.90	50.83	74.00	23.17	
	5044.00	43.72	36.68	9.25	35.17	54.48	74.00	19.52	
	7264.00	44.84	37.88	9.83	34.73	57.82	74.00	16.18	
	5044.00	25.67	36.68	9.25	35.17	36.43	54.00	17.57	AV
	7264.00	26.94	37.88	9.83	34.73	39.92	54.00	14.08	

TEST ENGINEER: RAVEN JIN

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE7 Date of Test : May 07, 2012

Test Mode : Transmitting Ch11 Antenna : SMA

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	34.85	-1.31	15.70	0.84	--	15.23	40.00	24.77	QP
	82.38	-3.85	10.67	1.63	--	8.45	40.00	31.55	
	135.73	1.07	10.71	2.14	--	13.92	43.50	29.58	
	248.25	0.20	11.90	2.61	--	14.71	46.00	31.29	
	486.87	1.44	17.46	3.23	--	22.13	46.00	23.87	
	674.08	0.33	19.19	3.64	--	23.16	46.00	22.84	
	2236.00	49.06	28.50	6.72	36.14	48.14	74.00	25.86	PK
	2992.00	48.42	31.87	6.49	35.90	50.88	74.00	23.12	
	4900.00	45.59	36.19	9.14	35.25	55.67	74.00	18.33	
	7600.00	46.25	38.41	10.22	34.72	60.16	74.00	13.84	AV
	4900.00	24.68	36.19	9.14	35.25	34.76	54.00	19.24	
	7600.00	27.18	38.41	10.22	34.72	41.09	54.00	12.91	
Vertical	37.76	-0.64	14.00	0.86	--	14.22	40.00	25.78	QP
	96.93	-1.51	11.24	1.82	--	11.55	43.50	31.95	
	233.70	-1.37	11.23	2.56	--	12.42	46.00	33.58	
	408.30	1.02	16.41	3.01	--	20.44	46.00	25.56	
	595.51	1.22	18.19	3.45	--	22.86	46.00	23.14	
	754.59	0.69	20.12	3.80	--	24.61	46.00	21.39	
	1336.00	57.02	26.47	5.53	37.42	51.60	74.00	22.40	PK
	2932.00	49.19	31.64	6.53	35.91	51.45	74.00	22.55	
	4816.00	47.10	35.74	9.09	35.30	56.63	74.00	17.37	
	7276.00	45.81	37.96	9.91	34.73	58.95	74.00	15.05	
	4816.00	28.20	35.74	9.09	35.30	37.73	54.00	16.27	AV
	7276.00	25.27	37.96	9.91	34.73	38.41	54.00	15.59	

TEST ENGINEER: RAVEN JIN

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE7 Date of Test : May 07, 2012

Test Mode : Transmitting Ch18 Antenna : SMA

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	32.91	-0.73	16.79	0.82	--	16.88	40.00	23.12	QP
	49.40	-0.47	8.69	0.91	--	9.13	40.00	30.87	
	97.90	-1.51	11.28	1.83	--	11.60	43.50	31.90	
	223.03	-1.47	10.76	2.51	--	11.80	46.00	34.20	
	387.93	0.22	16.04	2.97	--	19.23	46.00	26.77	
	633.34	1.91	18.63	3.53	--	24.07	46.00	21.93	
	1336.00	53.32	26.47	5.53	37.42	47.90	74.00	26.10	PK
	2980.00	48.08	31.84	6.49	35.90	50.51	74.00	23.49	
	5032.00	44.87	36.69	9.25	35.18	55.63	74.00	18.37	
	5032.00	24.77	36.69	9.25	35.18	35.53	54.00	18.47	
	7480.00	27.39	38.63	10.02	34.72	41.32	54.00	12.68	AV
	7480.00	46.45	38.63	10.02	34.72	60.38	74.00	13.62	
Vertical	35.82	1.07	15.19	0.84	--	17.10	40.00	22.90	QP
	100.81	-1.03	11.34	1.86	--	12.17	43.50	31.33	
	124.09	-0.91	10.93	2.05	--	12.07	43.50	31.43	
	239.52	-0.51	11.51	2.57	--	13.57	46.00	32.43	
	410.24	0.77	16.43	3.01	--	20.21	46.00	25.79	
	526.64	0.49	17.76	3.33	--	21.58	46.00	24.42	
	1372.00	53.43	26.60	5.57	37.32	48.28	74.00	25.72	PK
	2980.00	48.58	31.84	6.49	35.90	51.01	74.00	22.99	
	4816.00	46.27	35.74	9.09	35.30	55.80	74.00	18.20	
	7432.00	46.35	38.48	10.02	34.72	60.13	74.00	13.87	
	4816.00	24.36	35.74	9.09	35.30	33.89	54.00	20.11	AV
	7432.00	24.45	38.48	10.02	34.72	38.23	54.00	15.77	

TEST ENGINEER: RAVEN JIN

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE7 Date of Test : May 07, 2012

Test Mode : Transmitting Ch26 Antenna : SMA

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	35.82	-1.74	15.19	0.84	--	14.29	40.00	25.71	QP
	93.05	-2.94	11.12	1.77	--	9.95	43.50	33.55	
	161.92	-1.19	10.23	2.28	--	11.32	43.50	32.18	
	245.34	-0.61	11.75	2.60	--	13.74	46.00	32.26	
	329.73	-0.04	14.54	2.83	--	17.33	46.00	28.67	
	644.98	0.70	18.81	3.58	--	23.09	46.00	22.91	
	1792.00	53.59	27.26	6.20	36.45	50.60	74.00	23.40	PK
	2992.00	48.78	31.87	6.49	35.90	51.24	74.00	22.76	
	5248.00	45.48	36.60	9.40	35.07	56.41	74.00	17.59	
	7276.00	46.44	37.96	9.91	34.73	59.58	74.00	14.42	
	5248.00	24.36	36.60	9.40	35.07	35.29	54.00	18.71	AV
	7276.00	24.33	37.96	9.91	34.73	37.47	54.00	16.53	
Vertical	39.70	-2.04	12.80	0.87	--	11.63	40.00	28.37	QP
	101.78	-1.54	11.32	1.86	--	11.64	43.50	31.86	
	137.67	-0.95	10.66	2.15	--	11.86	43.50	31.64	
	255.04	-0.31	12.22	2.63	--	14.54	46.00	31.46	
	371.44	-0.49	15.68	2.93	--	18.12	46.00	27.88	
	599.39	0.60	18.20	3.47	--	22.27	46.00	23.73	
	1336.00	53.74	26.47	5.53	37.42	48.32	74.00	25.68	PK
	2980.00	48.85	31.84	6.49	35.90	51.28	74.00	22.72	
	4816.00	48.15	35.74	9.09	35.30	57.68	74.00	16.32	
	7636.00	45.58	38.35	10.22	34.71	59.44	74.00	14.56	
	4816.00	29.26	35.74	9.09	35.30	38.79	54.00	15.21	AV
	7636.00	24.48	38.35	10.22	34.71	38.34	54.00	15.66	

TEST ENGINEER: RAVEN JIN

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE3 Date of Test : May 07, 2012

Test Mode : Receiving Ch18 Antenna : PCB

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	93.05	-3.11	11.12	1.77	--	9.78	43.50	33.72	QP
	117.30	-1.04	11.05	2.00	--	12.01	43.50	31.49	
	218.18	-2.97	10.52	2.50	--	10.05	46.00	35.95	
	341.37	-0.28	14.87	2.86	--	17.45	46.00	28.55	
	512.09	0.69	17.68	3.30	--	21.67	46.00	24.33	
	744.89	0.87	20.01	3.78	--	24.66	46.00	21.34	
	1636.00	48.19	27.11	6.00	36.69	44.61	74.00	29.39	PK
	3328.00	47.51	32.04	6.92	35.81	50.66	74.00	23.34	
	5152.00	45.59	36.64	9.35	35.12	56.46	74.00	17.54	
	7540.00	47.80	38.59	10.14	34.72	61.81	74.00	12.19	
	5152.00	26.61	36.64	9.35	35.12	37.48	54.00	16.52	AV
	7540.00	26.74	38.59	10.14	34.72	40.75	54.00	13.25	
Vertical	36.79	-1.39	14.57	0.85	--	14.03	40.00	25.97	QP
	129.91	-1.05	10.82	2.10	--	11.87	43.50	31.63	
	256.01	-0.31	12.27	2.63	--	14.59	46.00	31.41	
	408.30	1.02	16.41	3.01	--	20.44	46.00	25.56	
	618.79	0.67	18.46	3.51	--	22.64	46.00	23.36	
	822.49	0.01	20.54	4.11	--	24.66	46.00	21.34	
	1900.00	47.44	27.34	6.32	36.31	44.79	74.00	29.21	PK
	3640.00	47.30	32.45	7.42	35.75	51.42	74.00	22.58	
	5080.00	45.32	36.67	9.30	35.15	56.14	74.00	17.86	
	7372.00	47.17	38.26	9.91	34.73	60.61	74.00	13.39	
	5080.00	24.84	36.67	9.30	35.15	35.66	54.00	18.34	AV
	7372.00	26.27	38.26	9.91	34.73	39.71	54.00	14.29	

TEST ENGINEER: RAVEN JIN

EUT : 802.15.4 / ZigBee Module Temperature : 25°C

Model No. : REX3 Humidity : 45%RH

Serial No. : 1016BCE7 Date of Test : May 07, 2012

Test Mode : Receiving Ch18 Antenna : SMA

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	32.91	-1.23	16.79	0.82	--	16.38	40.00	23.62	QP
	86.26	-4.51	10.83	1.68	--	8.00	40.00	32.00	
	158.04	-1.81	10.28	2.27	--	10.74	43.50	32.76	
	327.79	-0.40	14.46	2.83	--	16.89	46.00	29.11	
	545.07	0.21	17.87	3.36	--	21.44	46.00	24.56	
	822.49	-0.03	20.54	4.11	--	24.62	46.00	21.38	
	1516.00	48.62	27.01	5.79	36.93	44.49	74.00	29.51	PK
	2944.00	47.91	31.71	6.53	35.91	50.24	74.00	23.76	
	4792.00	45.78	35.58	9.09	35.31	55.14	74.00	18.86	
	7192.00	47.77	37.64	9.83	34.73	60.51	74.00	13.49	
	4792.00	24.93	35.58	9.09	35.31	34.29	54.00	19.71	AV
	7192.00	25.55	37.64	9.83	34.73	38.29	54.00	15.71	
Vertical	32.91	-2.28	16.79	0.82	--	15.33	40.00	24.67	QP
	104.69	-1.90	11.27	1.89	--	11.26	43.50	32.24	
	248.25	-1.01	11.90	2.61	--	13.50	46.00	32.50	
	390.84	-0.53	16.10	2.97	--	18.54	46.00	27.46	
	567.38	0.50	18.02	3.40	--	21.92	46.00	24.08	
	794.36	-0.92	20.54	3.88	--	23.50	46.00	22.50	
	1540.00	48.77	27.03	5.86	36.87	44.79	74.00	29.21	PK
	2980.00	47.35	31.84	6.49	35.90	49.78	74.00	24.22	
	5044.00	45.27	36.68	9.25	35.17	56.03	74.00	17.97	
	7516.00	47.12	38.64	10.14	34.72	61.18	74.00	12.82	
	5044.00	24.23	36.68	9.25	35.17	34.99	54.00	19.01	AV
	7516.00	25.43	38.64	10.14	34.72	39.49	54.00	14.51	

TEST ENGINEER: RAVEN JIN

Band edge using conducted measurement:

According to the KDB 558074 D01 DTS Meas Guidance v01 5.4.2.1, antenna-port conducted measurements is also be permitted as an alternative to radiated measurements in the restricted frequency bands.

The transmitter output was connected to the spectrum analyzer. The EUT was set to transmit continuously ($\geq 98\%$ duty cycle).

The test procedure is defined in KDB558074 v01:2012 (the 5.4.2.2.1 Measurement Procedure RBAVG1 (Power Averaging) was used for average measurement & the 5.4.2.2.3 was used for peak measurement).

Note1 – The additional radiated test was performed to prove that the cabinet emissions (transmit antenna be replaced with a termination) also meets the requirement.

Cabinet Emission:

Polarization	Frequency (MHz)	Meter Reading dB (μ V)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Emission Level dB (μ V/m)	Limits dB (μ V/m)	Margin (dB)	Remark
Horizontal	2390.00	50.08	29.19	6.89	36.09	50.07	74.00	23.93	PK
	2483.50	49.33	29.55	6.96	36.07	49.77	74.00	24.23	
	2390.00	40.90	29.19	6.89	36.09	40.89	54.00	13.11	AV
	2483.50	39.69	29.55	6.96	36.07	40.13	54.00	13.87	
Vertical	2390.00	50.57	29.19	6.89	36.09	50.56	74.00	23.44	PK
	2483.50	53.89	29.55	6.96	36.07	54.33	74.00	19.67	
	2390.00	41.98	29.19	6.89	36.09	41.97	54.00	12.03	AV
	2483.50	43.74	29.55	6.96	36.07	44.18	54.00	9.82	

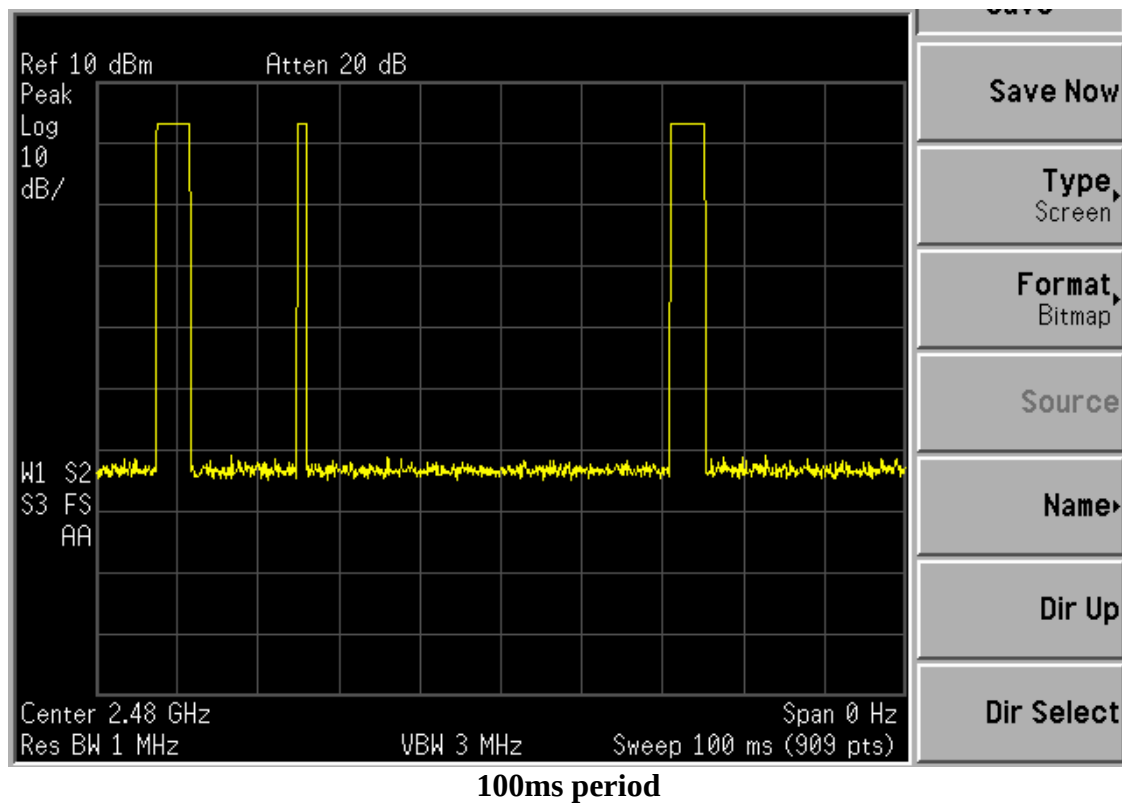
Note2 - Under normal operating conditions according to IEEE Std 802.15.4-2006, the transmitter dwell time on one channel is below 10% , therefore average detector reading are reduced by the duty cycle correction factor of **20 dB**. (the duty cycle plot refer to the next page.)

Note3 - The antenna gain (2dBi) and cable loss (2dB) were set as offset (4dB) in the spectrum.

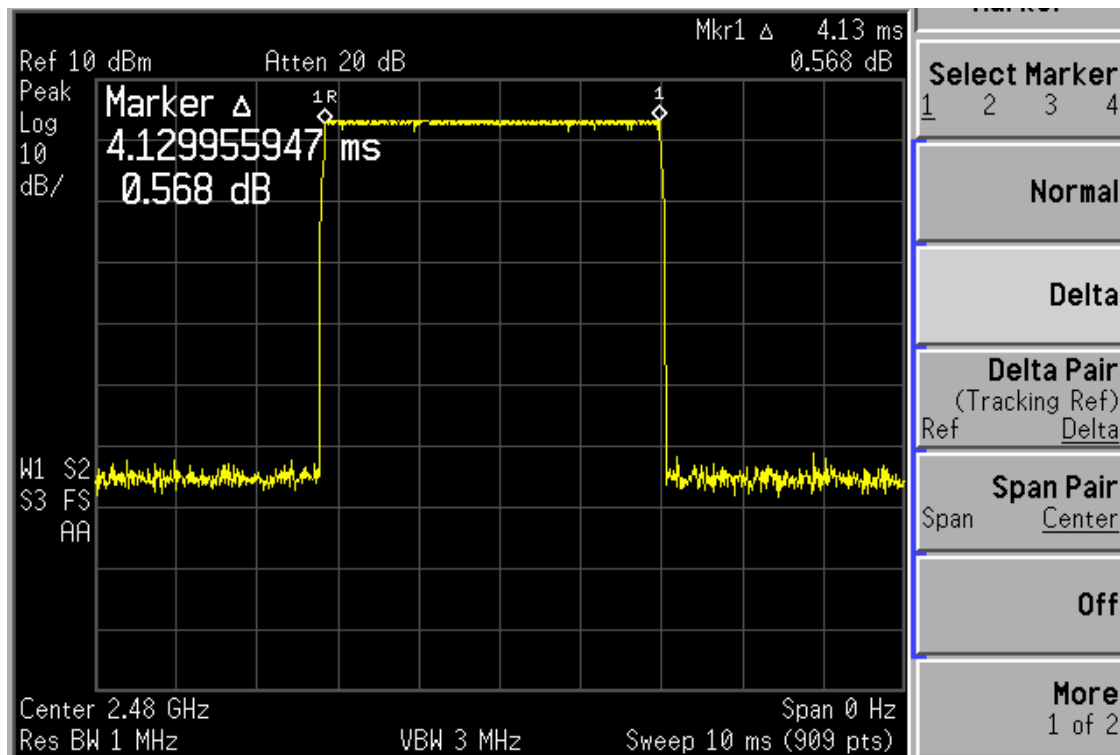
Duty Cycle

The worst-case duty cycle for typical EUT operation is shown below.

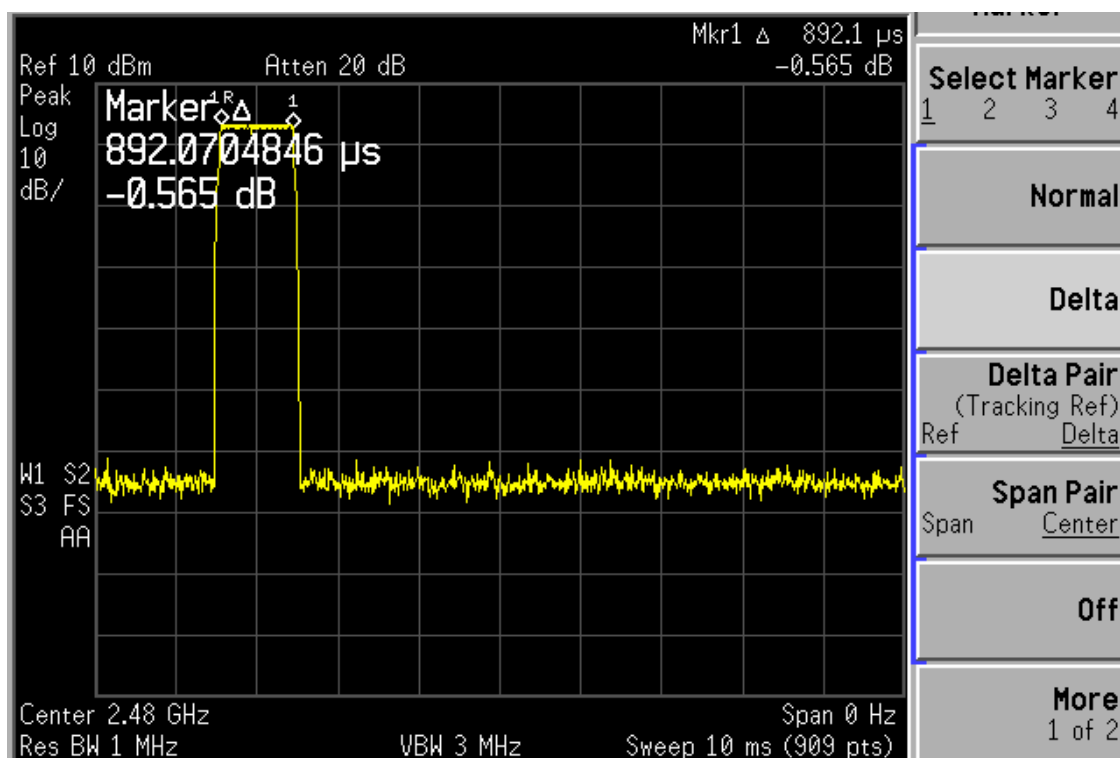
The pulse train of the EUT extends beyond 100 ms as shown in the following plot:



This period contains two kinds of typical pulse, the long one and the short one.



Typical pulse 1 width (4.13 ms)



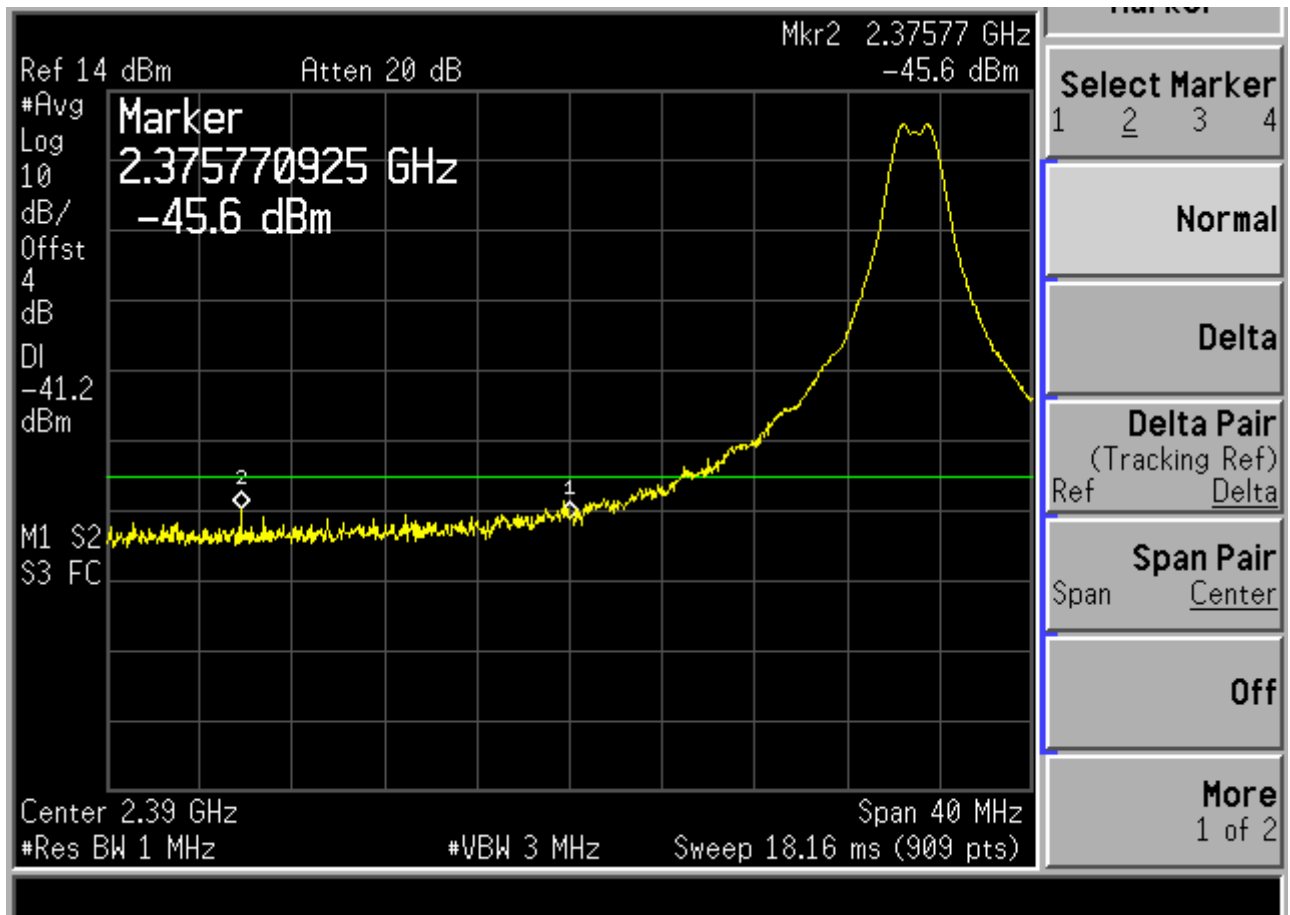
Typical pulse 2 width (0.8921 ms)

Duty cycle = $2(4.13\text{ms}) + 1(0.8921\text{ms}) = 9.1521\text{ ms}$ in a 100ms period

Duty cycle factor = $|20\log(9.1521 / 100)| = 20.77\text{ dB}$

We use 20 dB as the duty cycle factor in the average value calculation.

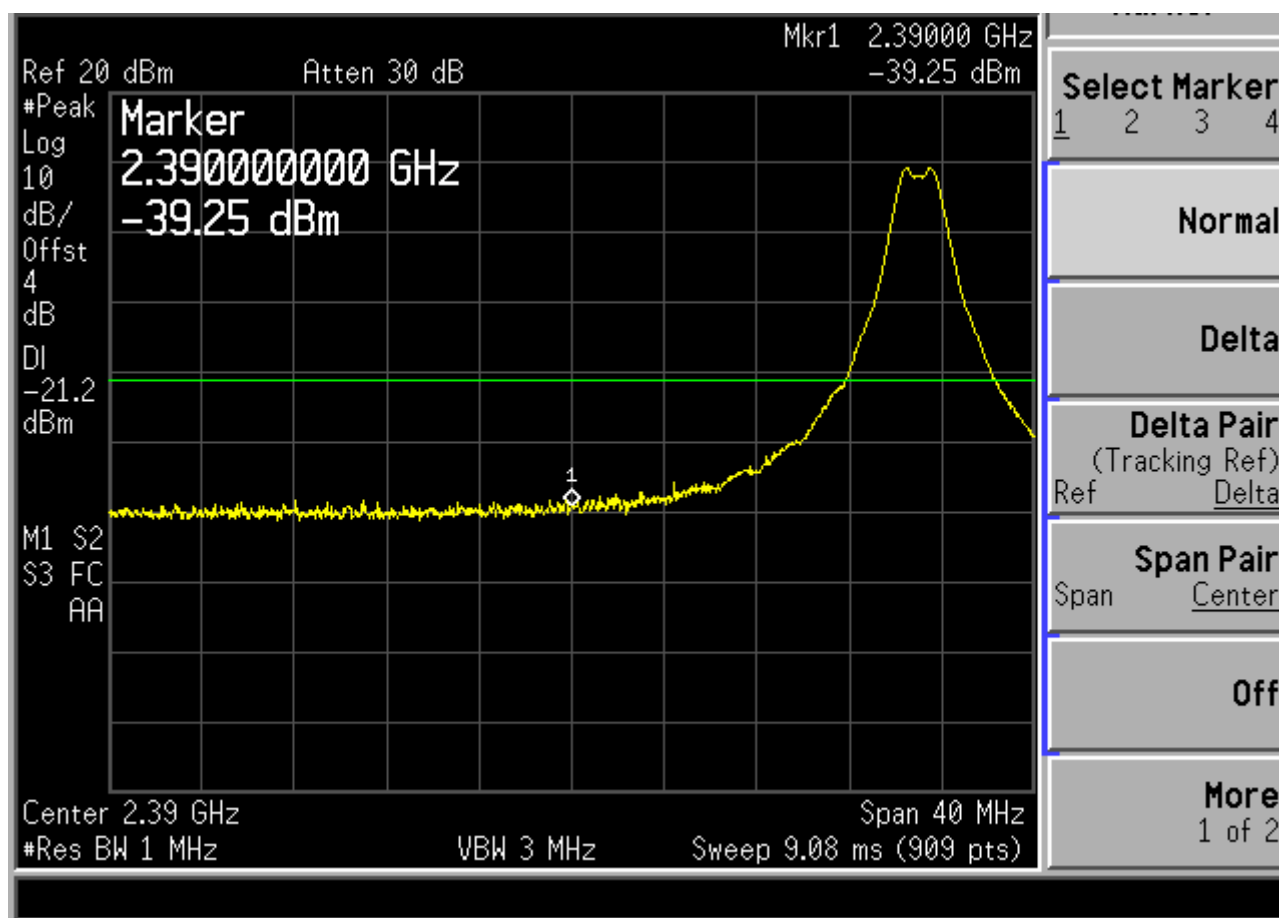
AV Result on CH 11



Maximum AV value @ 2375.77MHz = -45.6 dBm
Limit = -41.2 dBm

Result is **PASS**

PK Result on CH 11

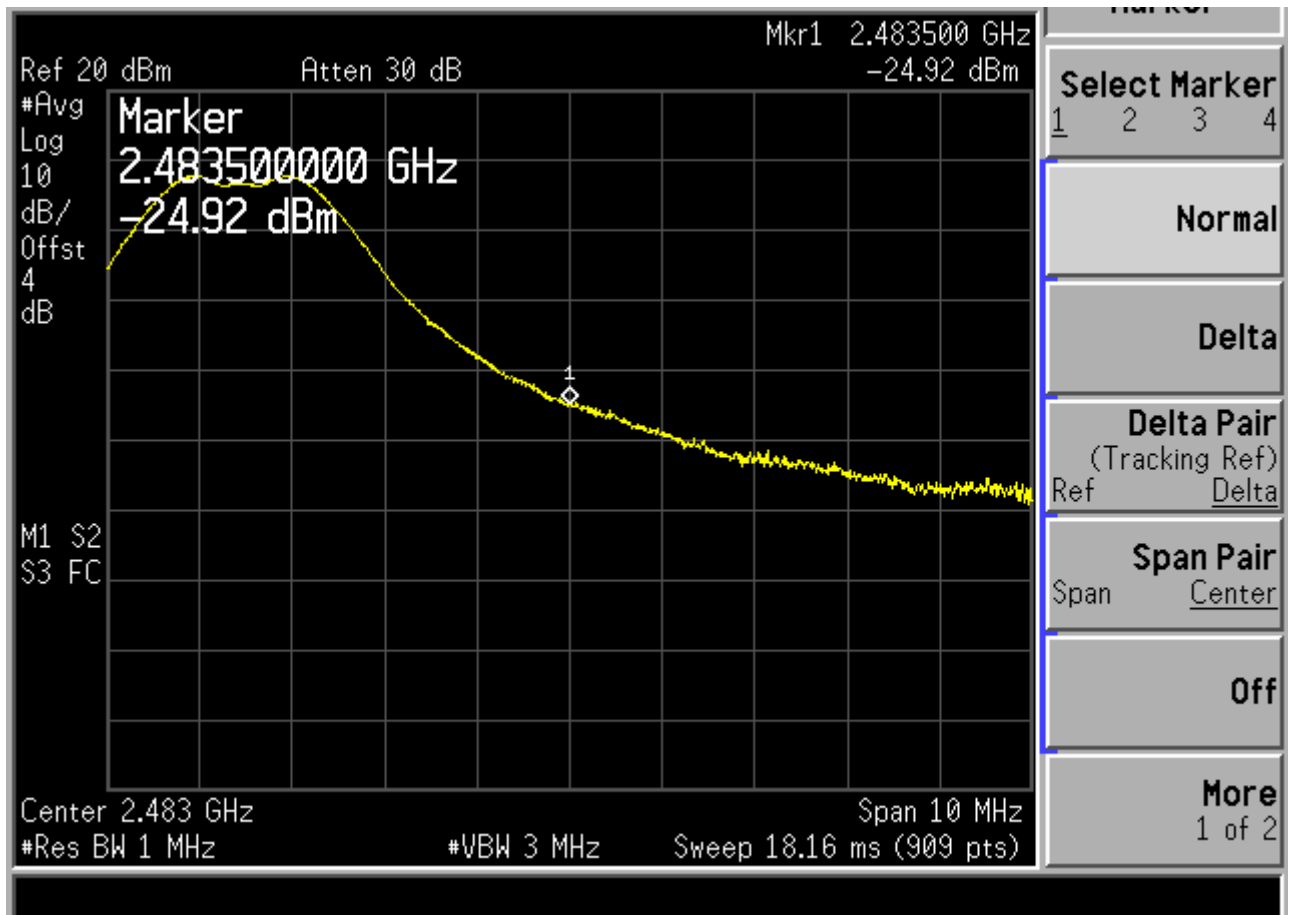


PK Result = -39.25 dBm

Limit = -21.2 dBm

Result is **PASS**

AV Result on CH 26



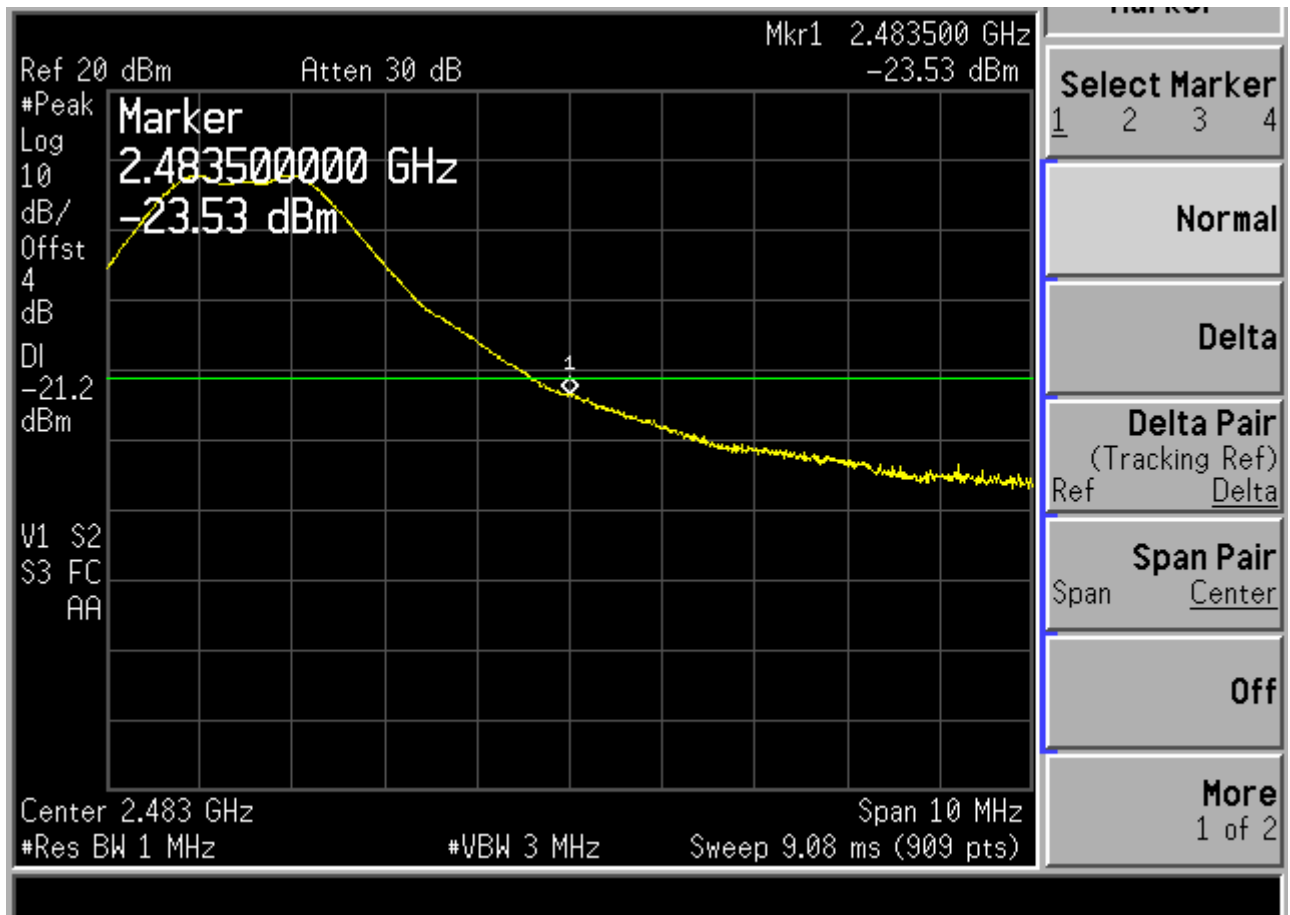
Maximum AV value @ 2483.5MHz = -24.92 dBm

AV Final Result = AV Reading - Duty cycle Factor (Note 2)
= -24.92 - 20 = -44.92 dBm

Limit = -41.2 dBm

Result is **PASS**

PK Result on CH 26



PK Result = -23.53 dBm

Limit = -21.2 dBm

Result is **PASS**

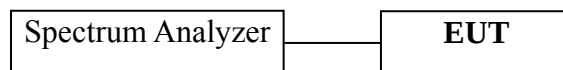
4 6 dB BANDWIDTH MEASUREMENT

4.1 Test Equipment

The following test equipment was used during the Emission Bandwidth measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	E7405A	MY45106600	Mar 22, 2012	Mar 22, 2013

4.2 Block Diagram of Test Setup



4.3 Specification Limits (§15.247(a)(2))

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.4 Operating Condition of EUT

The test program “Hyper-Terminal” was used to enable the EUT to transmit data at different channel frequency individually.

4.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measure by spectrum analyzer with 100 kHz RBW / 100 kHz VBW.

The 6 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB.

In addition, the Emission Bandwidth (EBW) is required information. The test procedure is defined in KDB558074 v01:2012 (the 5.1.1 EBW Measurement Procedure was used). The RBW/EBW ratio should be 1-5%.

4.6 Test Results

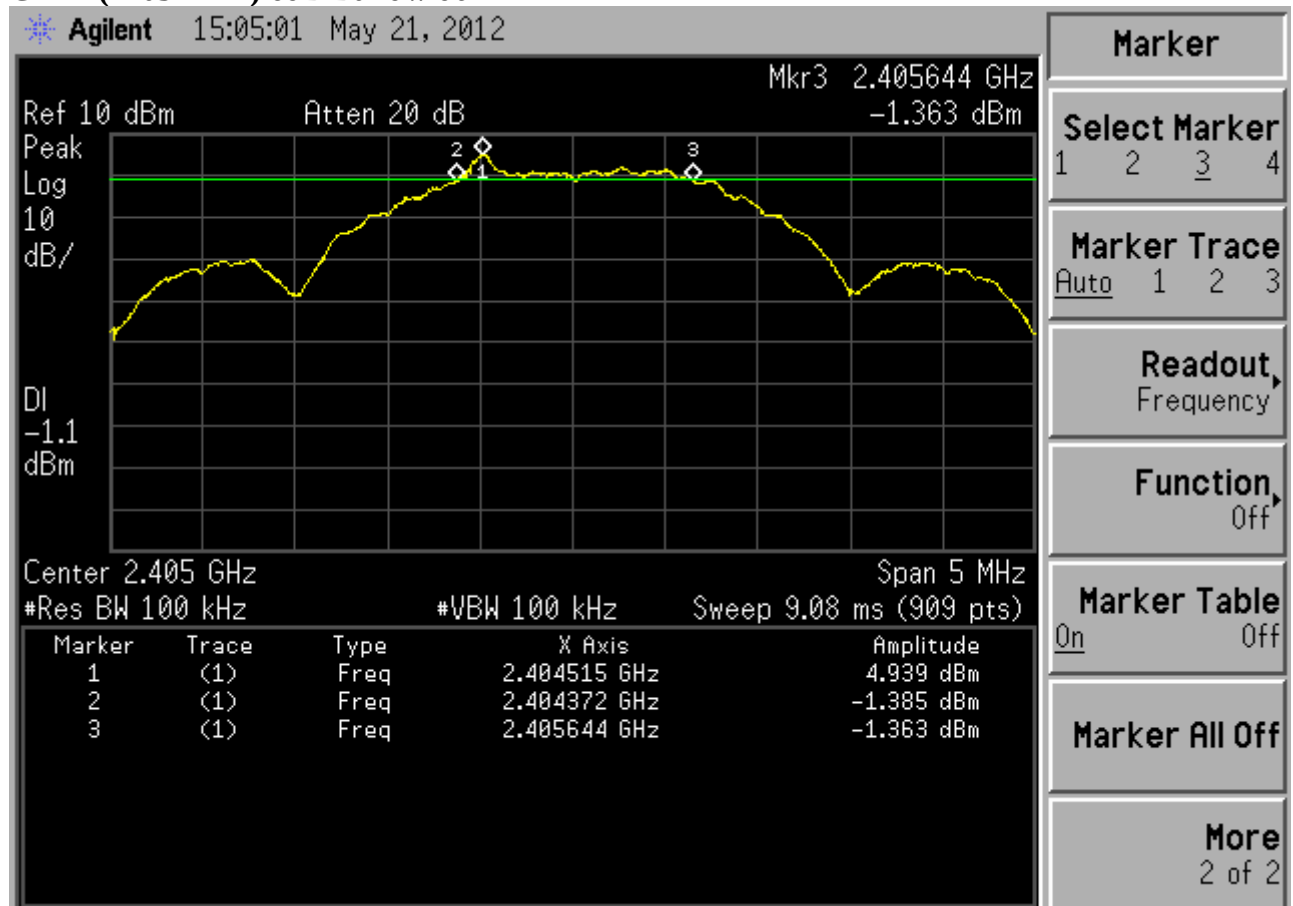
PASSED.

All the test results are attached in next pages.

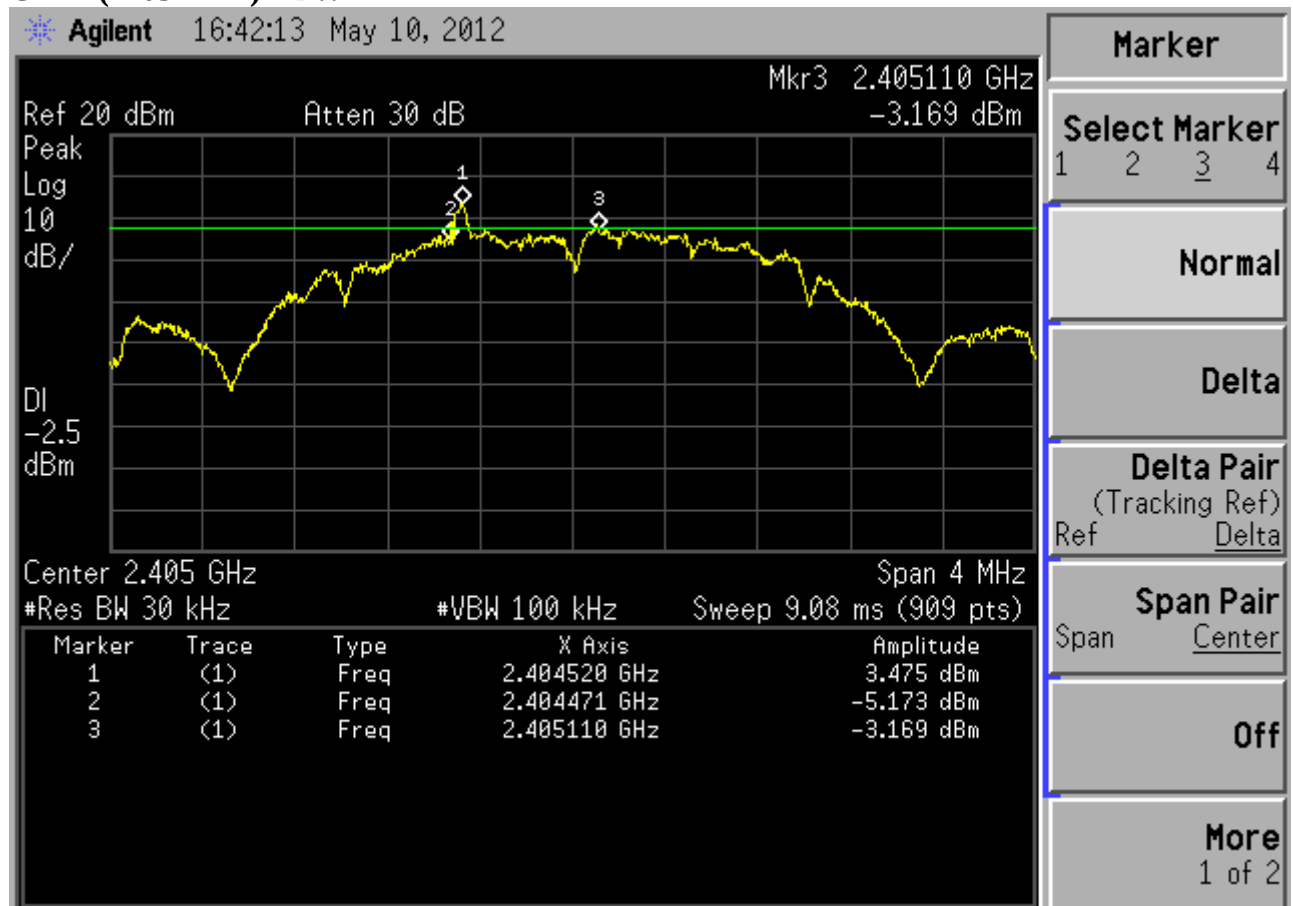
(Test Date: May. 10 - 21, 2012 Temperature: 25°C Humidity: 48 %)

Channel	Frequency	6dB Bandwidth	Emission Bandwidth (EBW)
11	2405 MHz	1.272 MHz	639 kHz
18	2440 MHz	1.250 MHz	652 kHz
26	2480 MHz	1.140 MHz	630 kHz

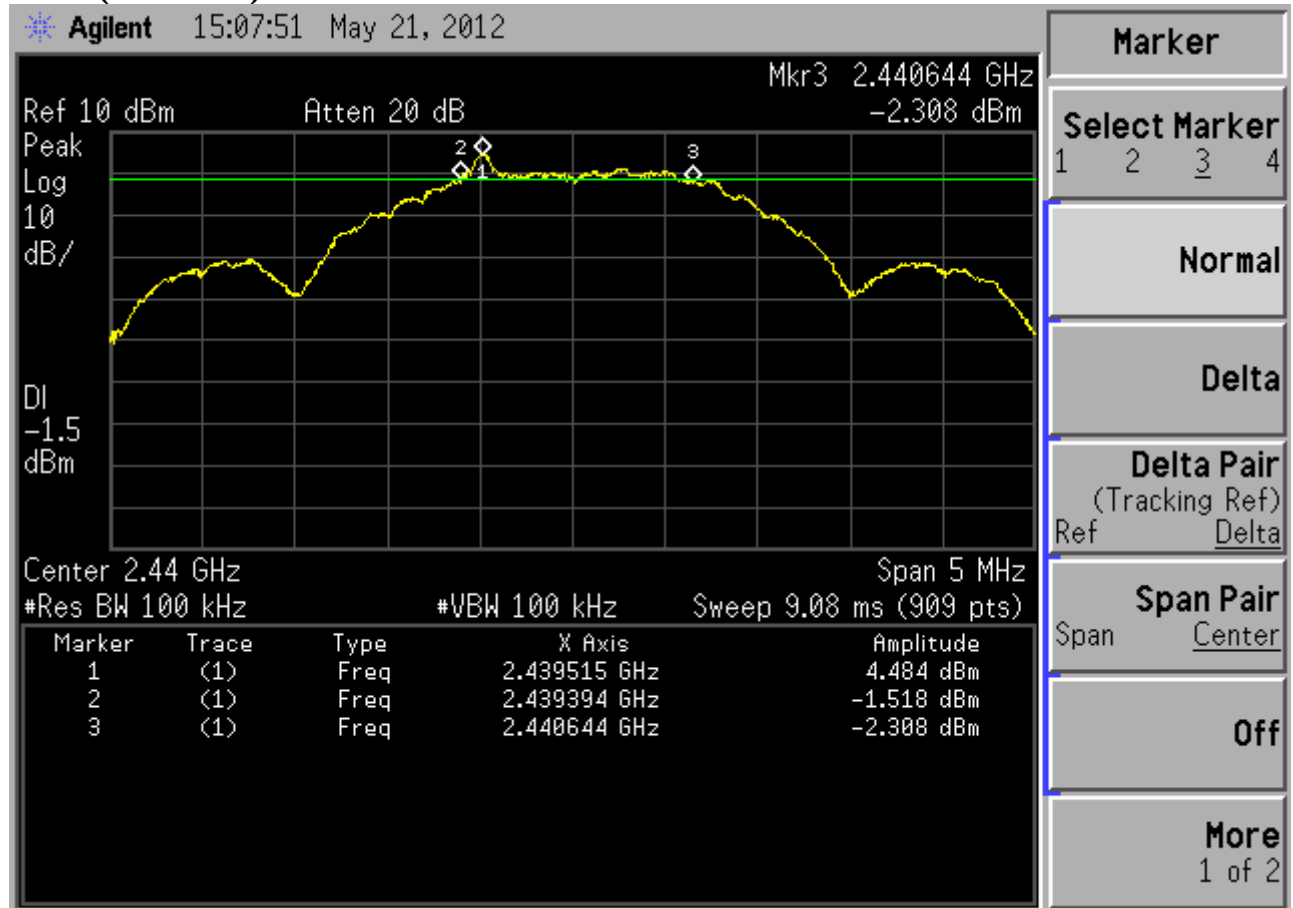
Ch 11 (2405 MHz) 6dB Bandwidth



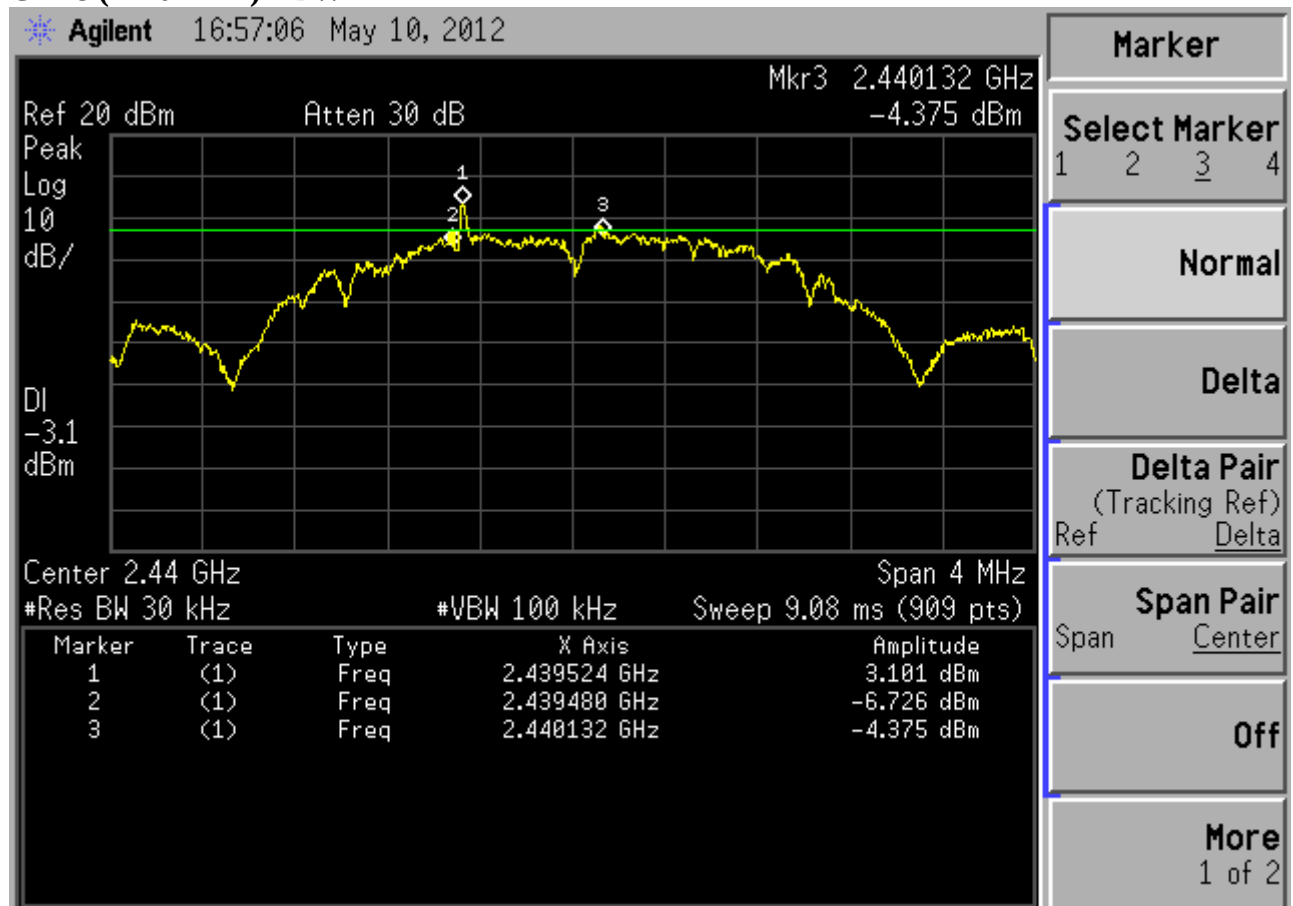
Ch 11 (2405 MHz) EBW



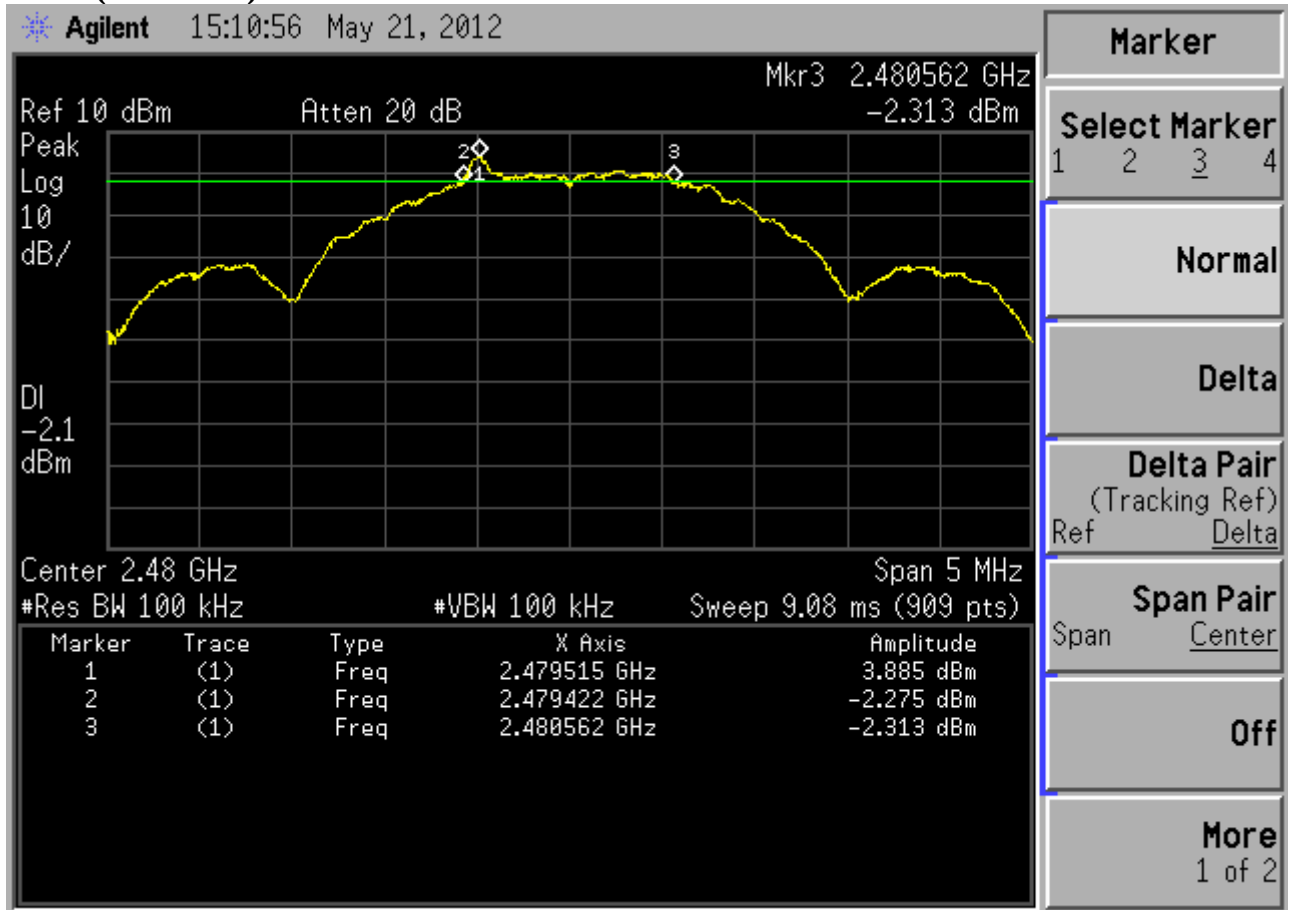
Ch 18 (2440 MHz) 6dB Bandwidth



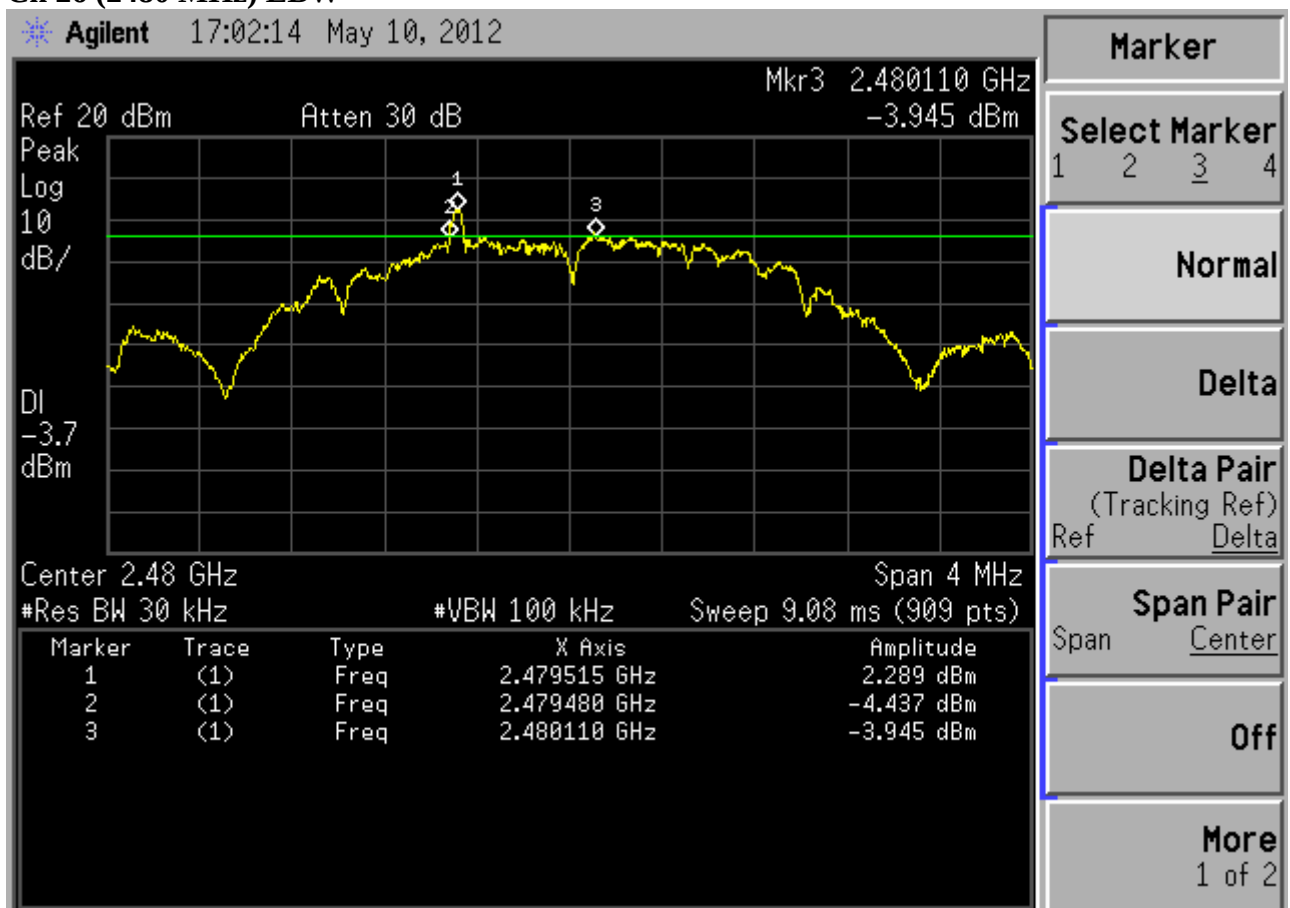
Ch 18 (2440 MHz) EBW



Ch 26 (2480 MHz) 6dB Bandwidth



Ch 26 (2480 MHz) EBW



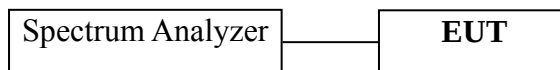
5 MAXIMUM PEAK OUTPUT POWER MEASUREMENT

5.1 Test Equipment

The following test equipment was used during the maximum peak output power measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	E7405A	MY45106600	Mar 22, 2012	Mar 22, 2013

5.2 Block Diagram of Test Setup



5.3 Specification Limits ((§15.247(b)(3))

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5 MHz is: 1 Watt. (30 dBm)

5.4 Operating Condition of EUT

The test program “Hyper-Terminal” was used to enable the EUT to transmit data at different channel frequency individually.

5.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. The spectrum analyzer was set as RBW = 1MHz ($\geq$ EBW), VBW = 3MHz ($\geq 3 \times$ RBW), span = zero.

The test procedure is defined in KDB558074 v01:2012 (the 5.2.2.1 Measurement Procedure PK1 was used).

5.6 Test Results

PASSED.

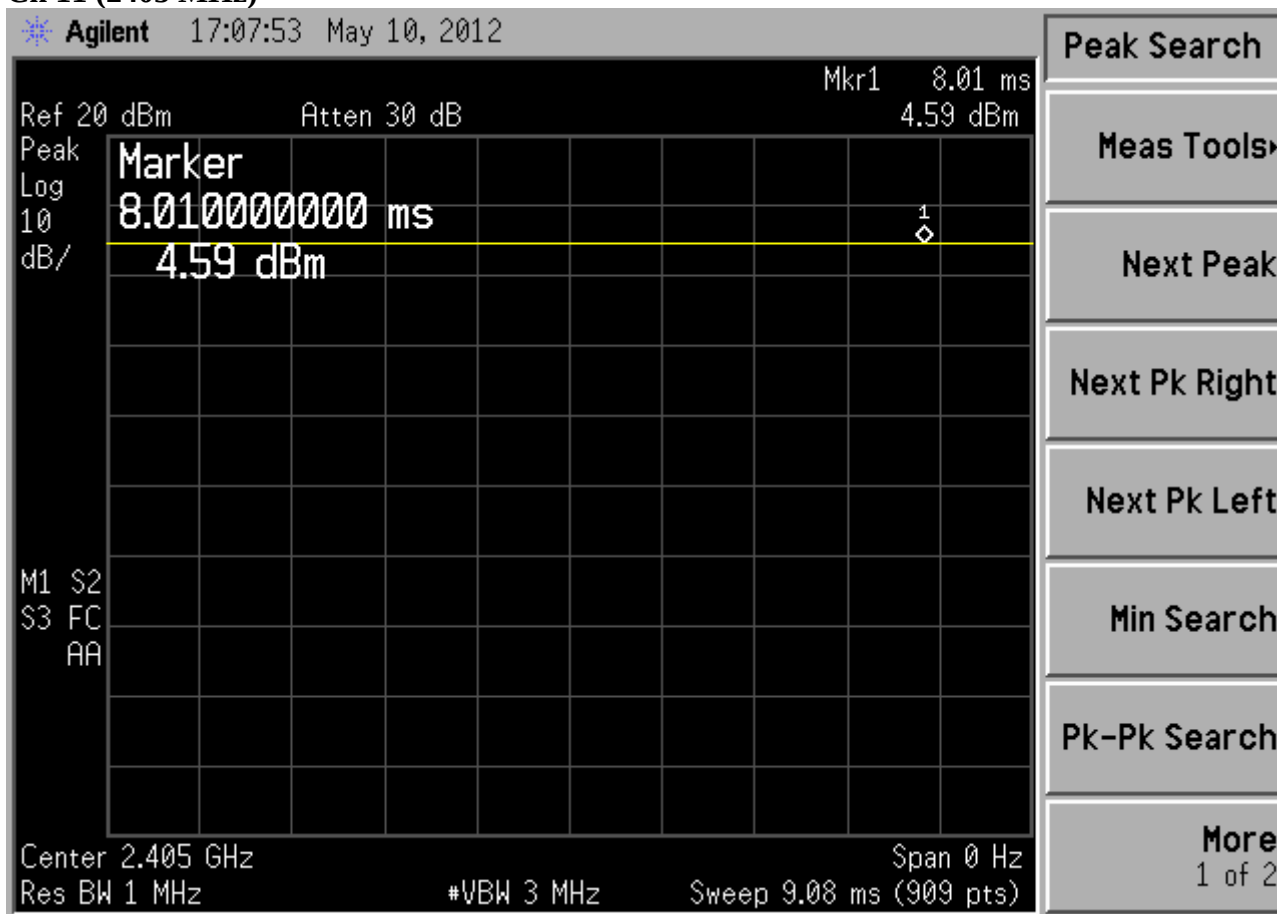
All the test results are attached in next pages.

(Test Date: May. 10, 2012 Temperature: 23°C Humidity: 48 %)

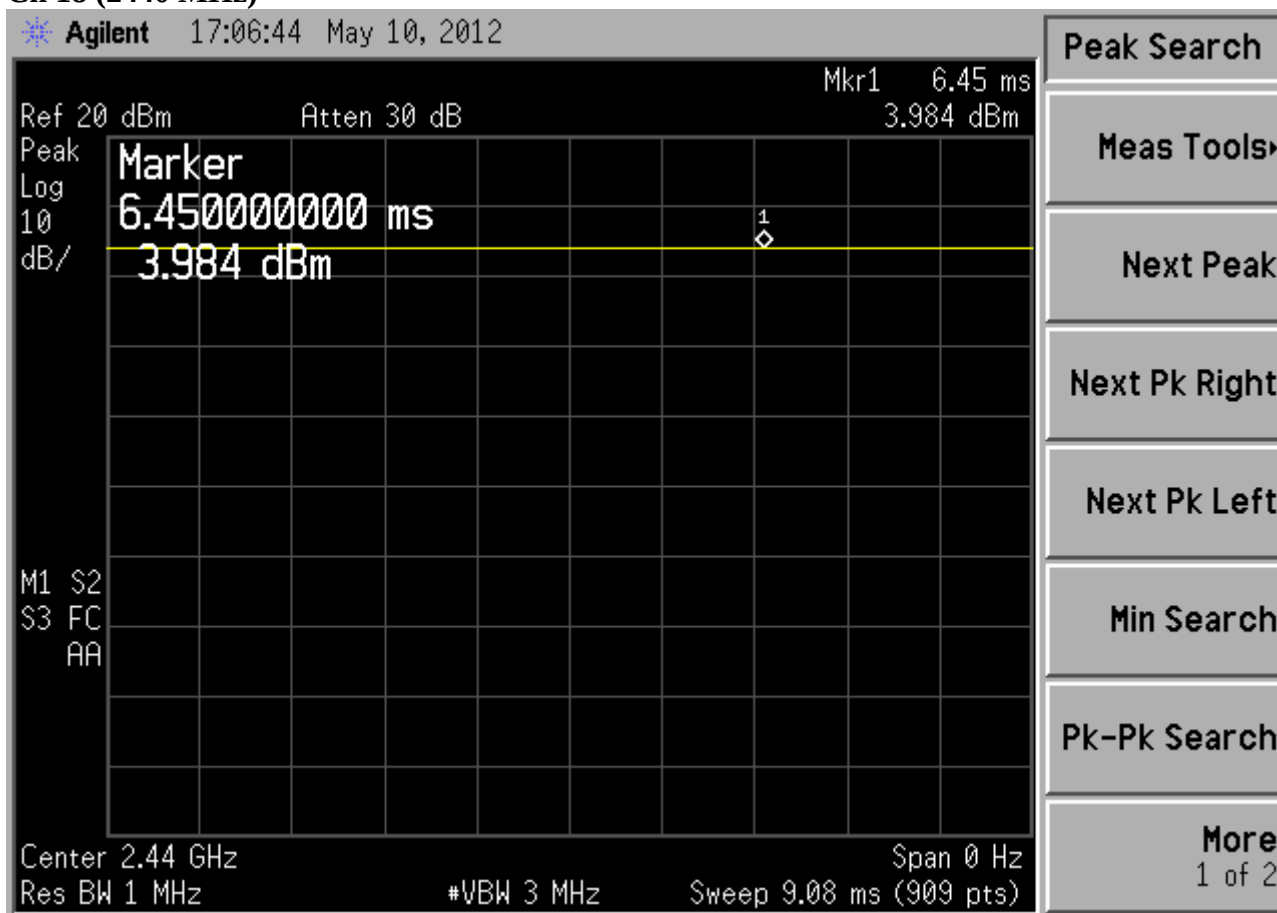
Channel	Frequency	Peak Output Power (reading value)	Peak Output Power (final value)	Limit
11	2405 MHz	4.590 dBm	6.590 dBm	30 dBm
18	2440 MHz	3.984 dBm	5.984 dBm	30 dBm
26	2480 MHz	3.359 dBm	5.359 dBm	30 dBm

Note – The final value = reading value + cable loss (2dB)

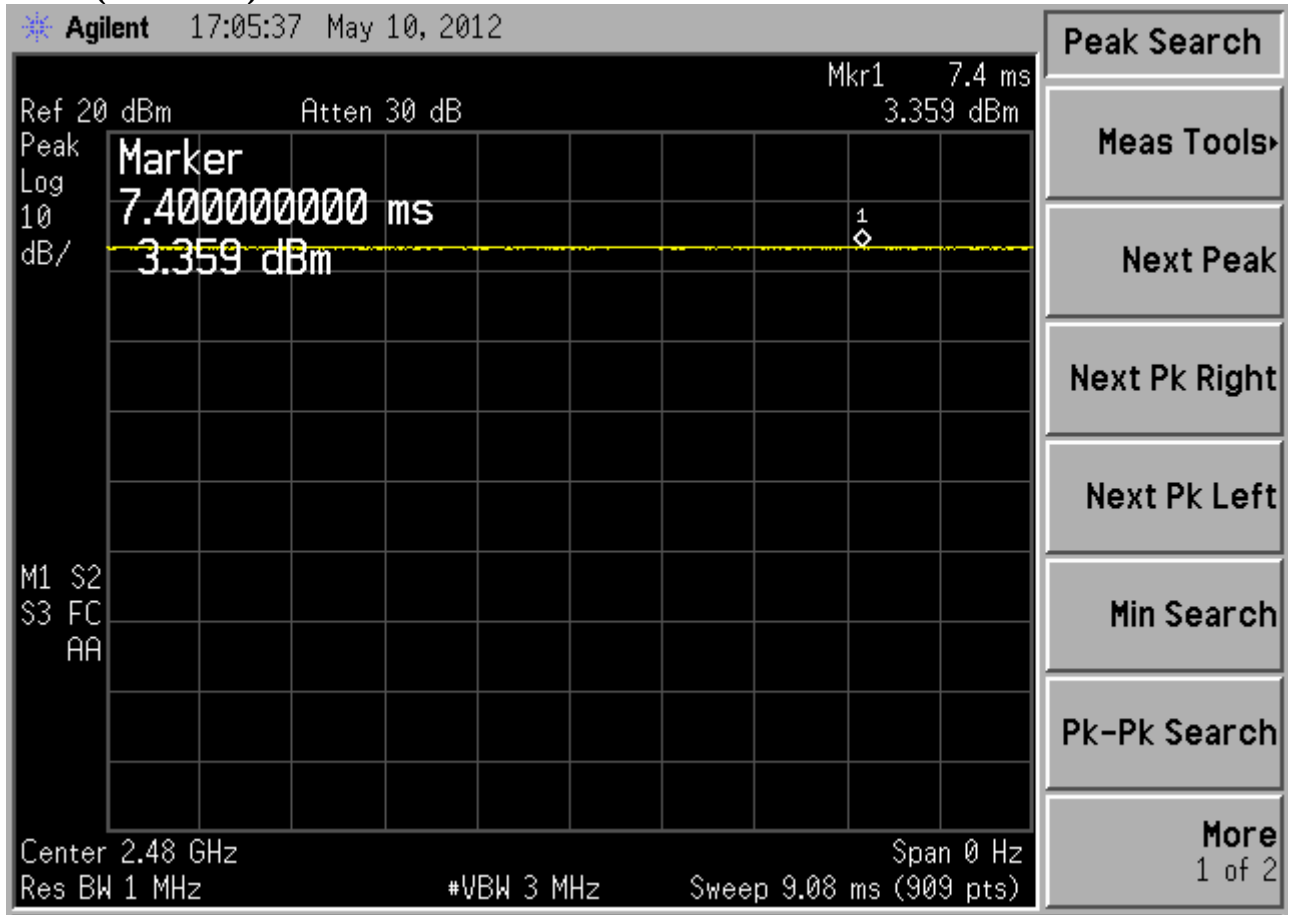
Ch 11 (2405 MHz)



Ch 18 (2440 MHz)



Ch 26 (2480 MHz)



6 EMISSION LIMITATIONS MEASUREMENT

6.1 Test Equipment

The following test equipment was used during the emission limitations test :

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	E7405A	MY45106600	Mar 22, 2012	Mar 22, 2013

6.2 Block Diagram of Test Setup

The same as Section. 4.2.

6.3 Specification Limits (§15.247(d))

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. Attenuation below the general limits specified in Section 15.209(a) is not required.

In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (See Section 15.205(c)).(※This test result attaching to Section. 4.7)

6.4 Operating Condition of EUT

The test program “Hyper-Terminal” was used to enable the EUT to transmit data at different channel frequency individually.

6.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. Set RBW = 100 kHz, VBW = 300 kHz, scan up through 10th harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

The test procedure is defined in KDB558074 v01:2012 (the 5.4.1.1 Measurement Procedure – Reference Level & 5.4.1.2 Measurement Procedure – Unwanted Emission was used).

6.6 Test Results

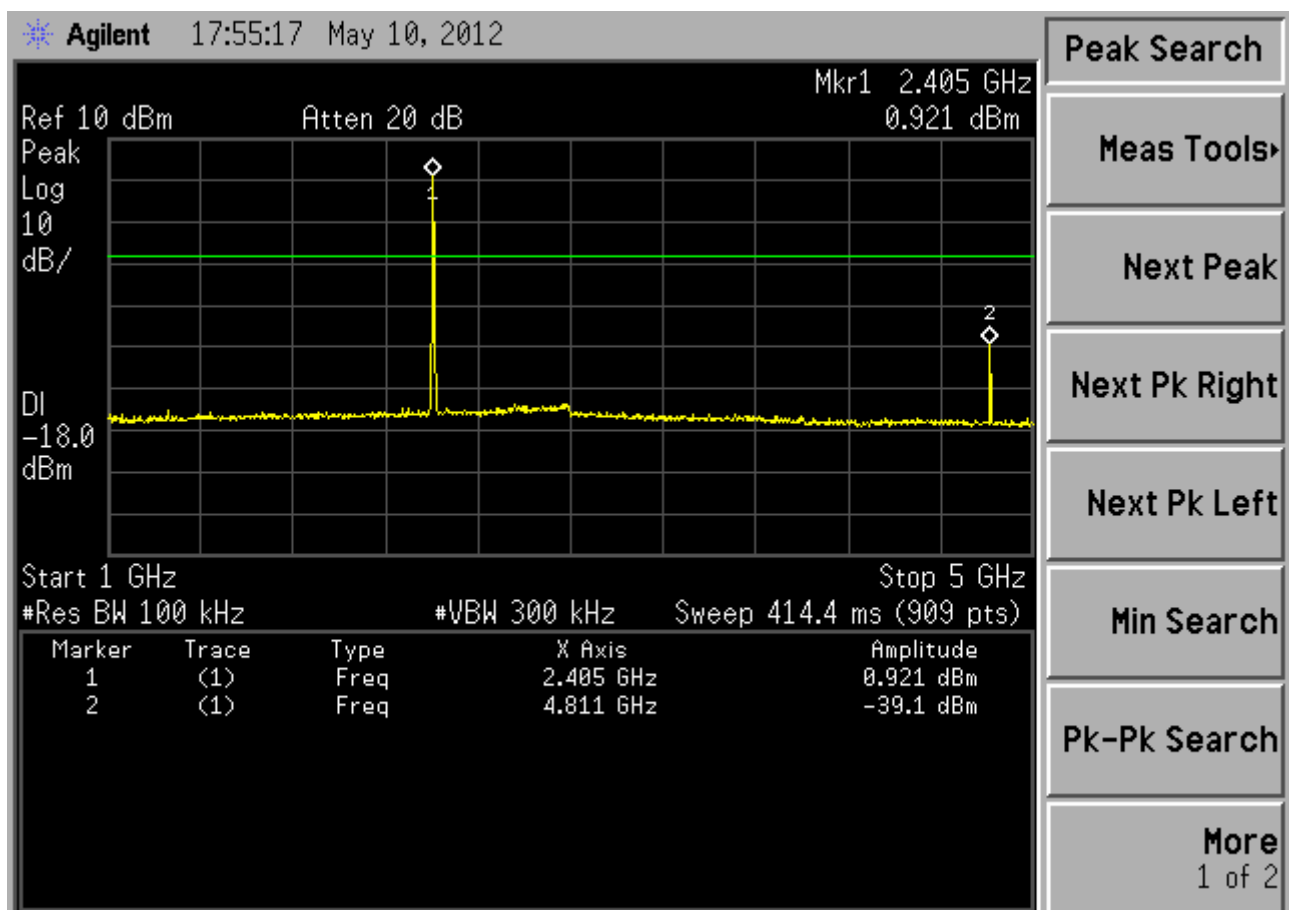
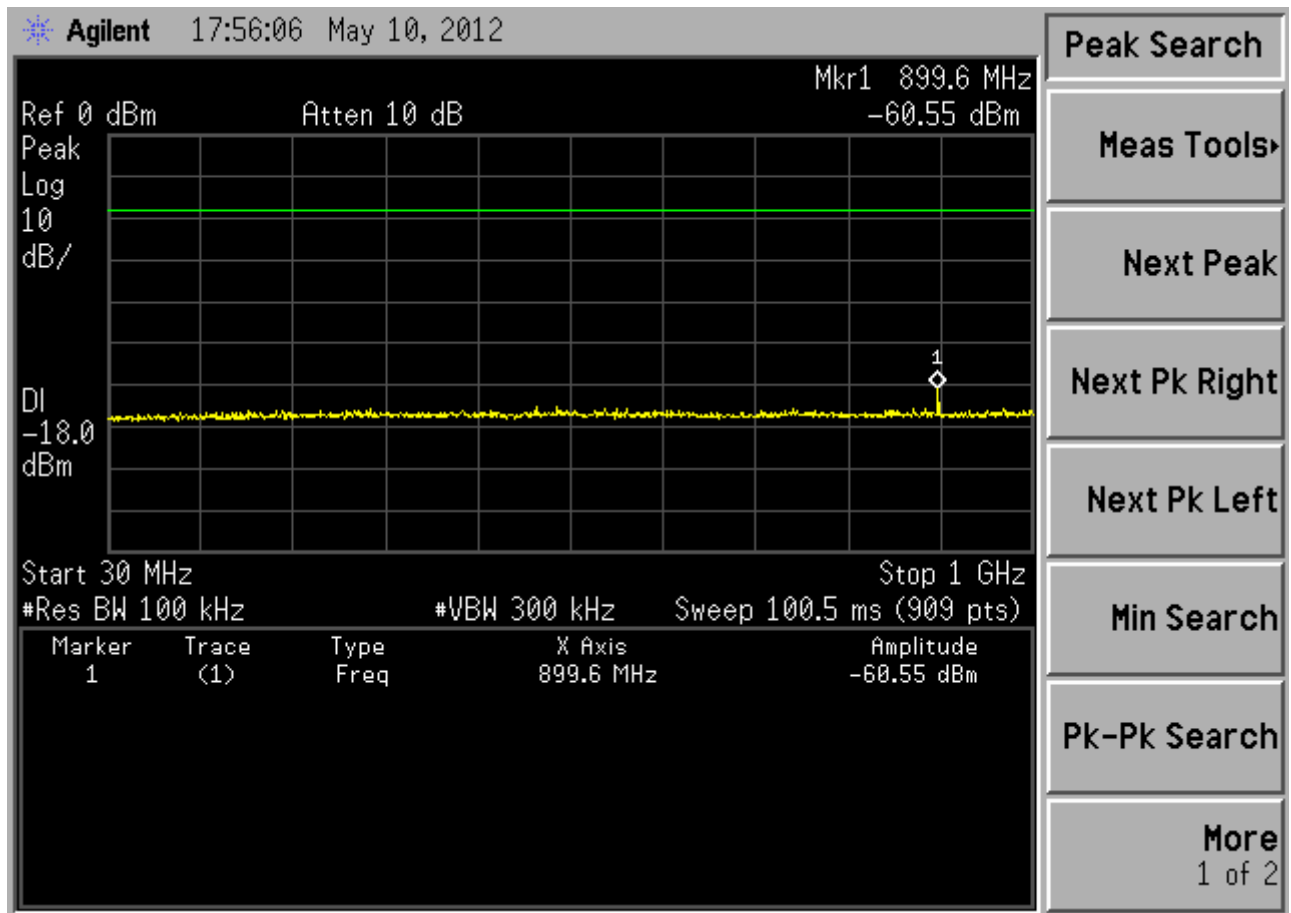
PASSED.

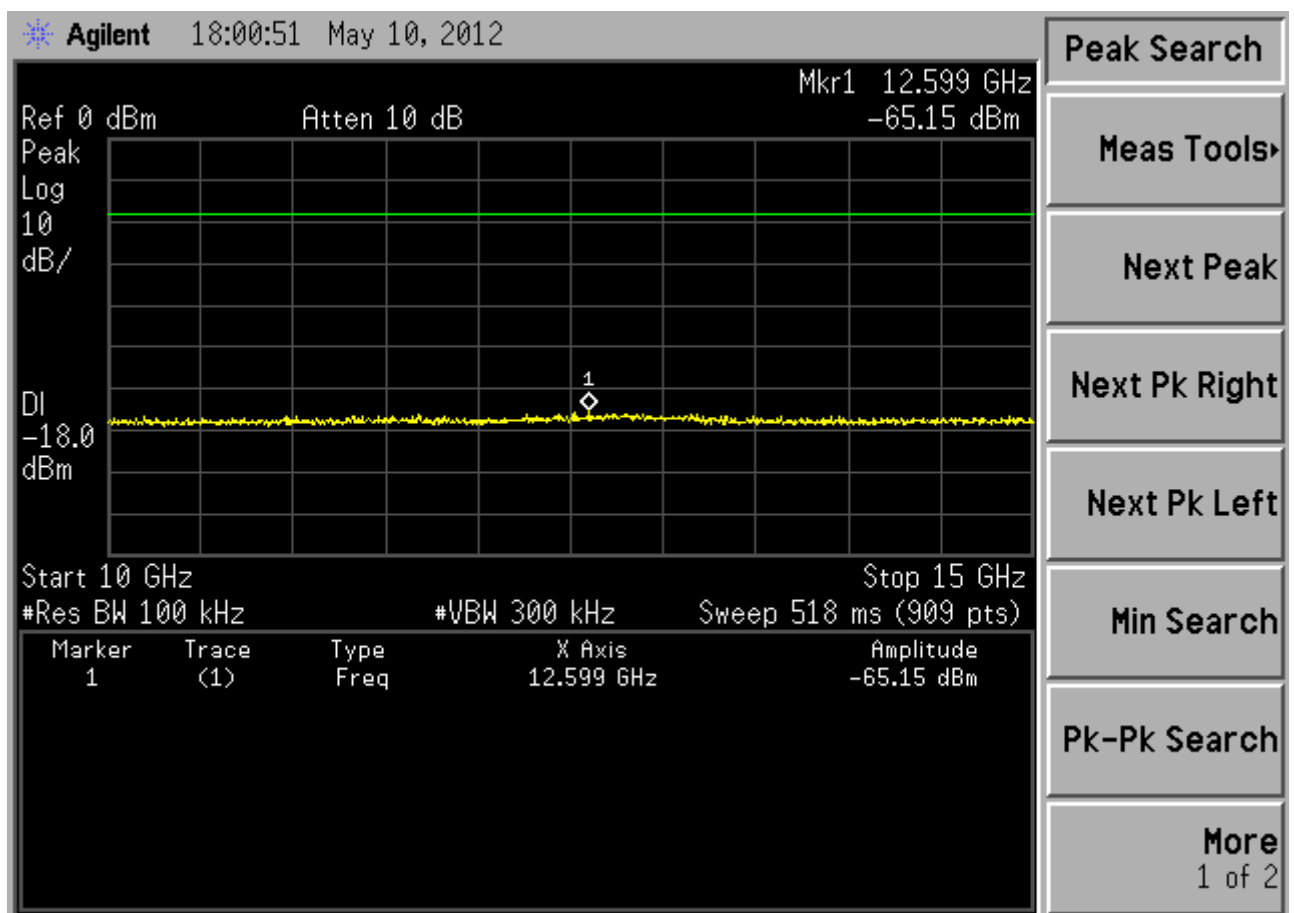
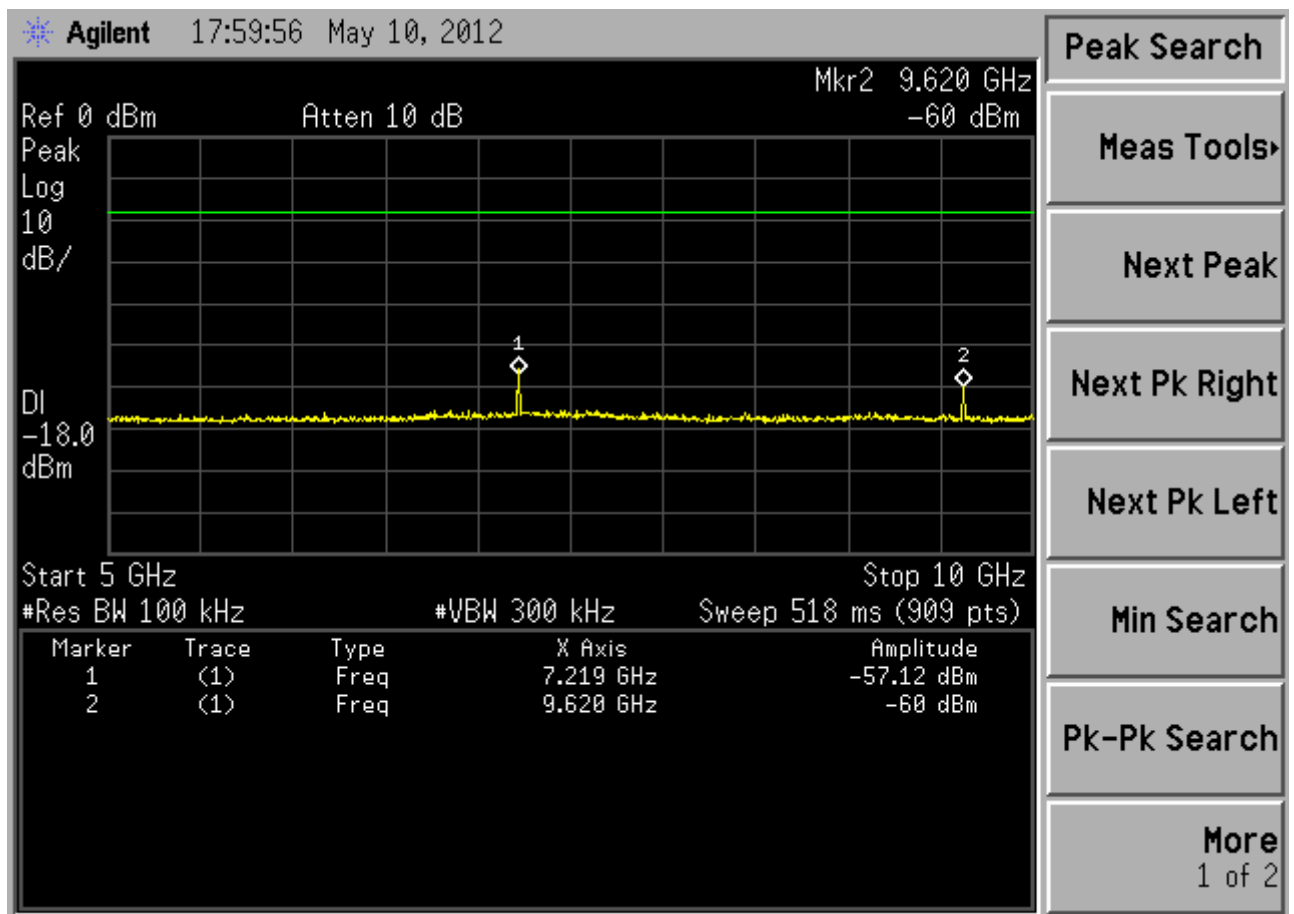
The test data was attached in the next pages.

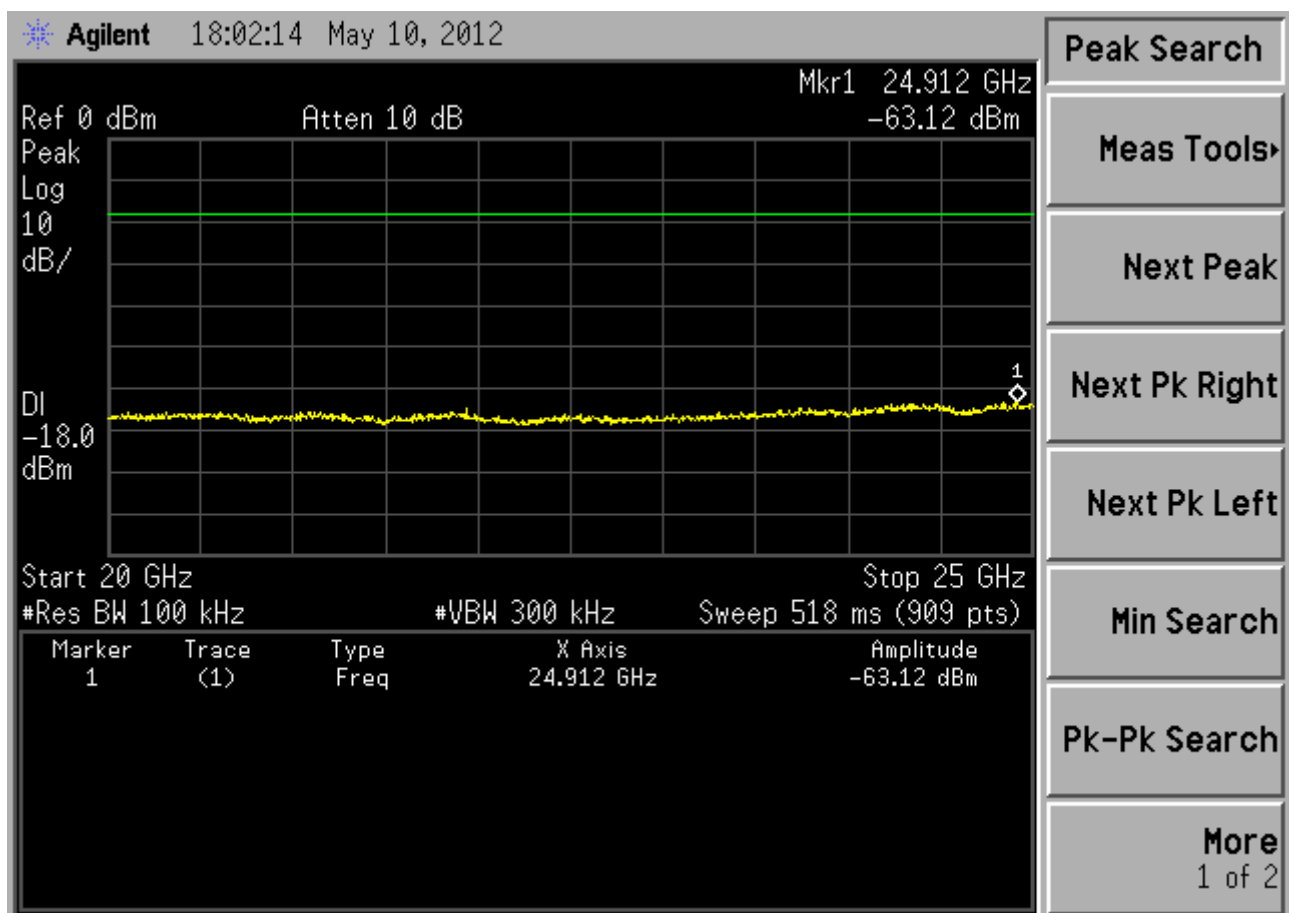
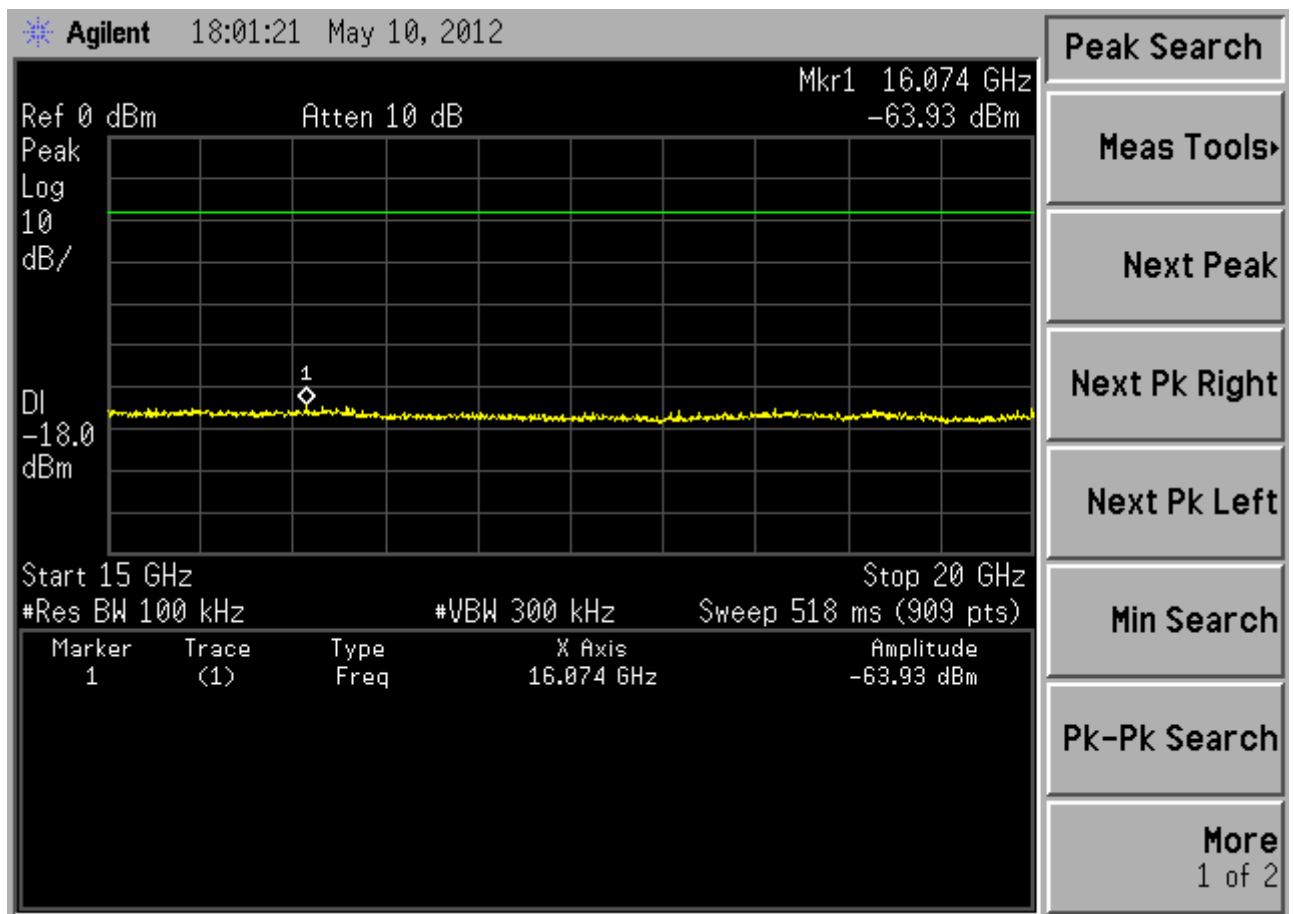
Note – The Reference Level refer to Sec. 8.6 PSD (in 100kHz) which tested according to “5.4.1.1 Measurement Procedure – Reference Level” of KDB558074 v01:2012

(Test Date: May. 10, 2012 Temperature: 23°C Humidity: 48 %)

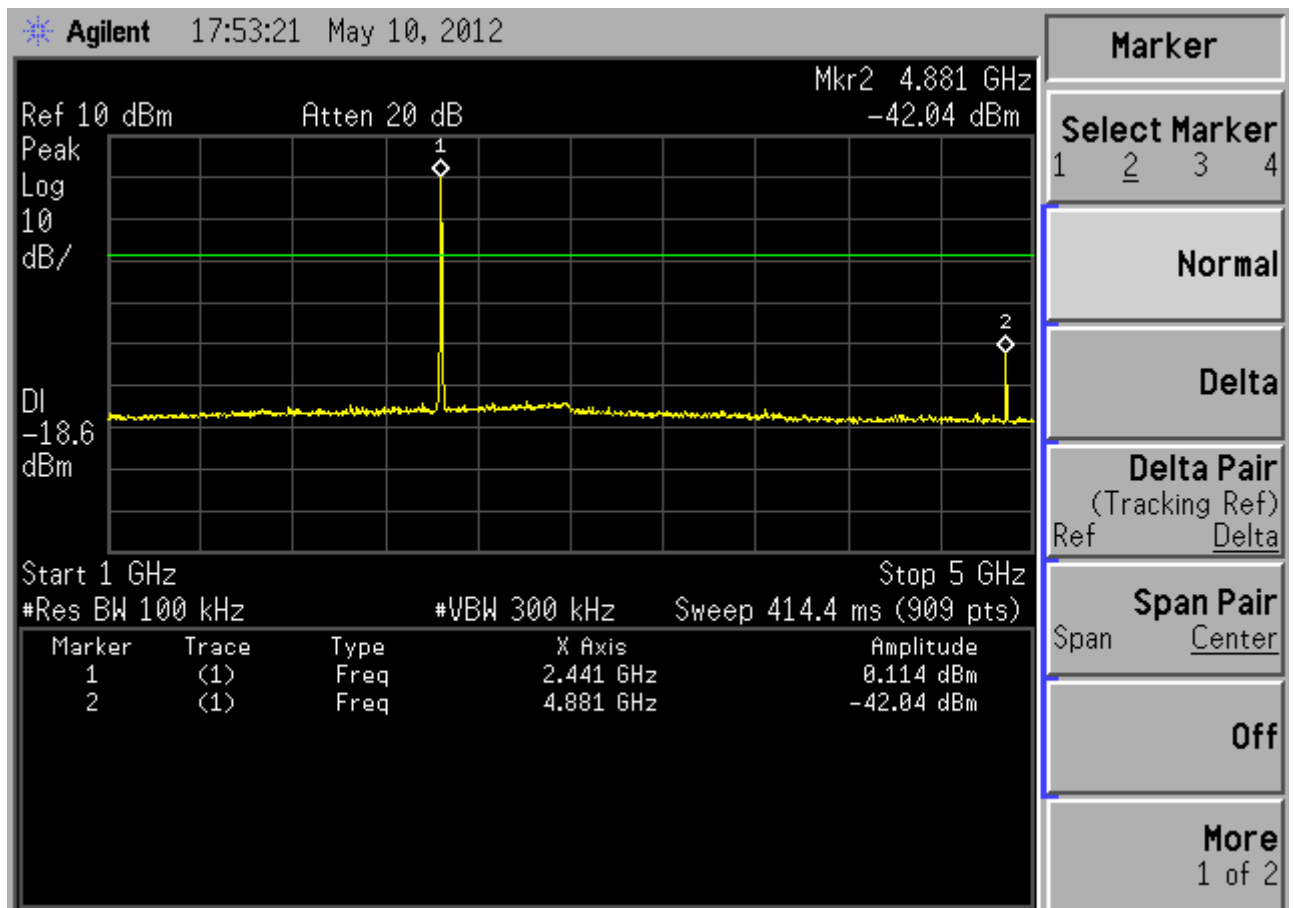
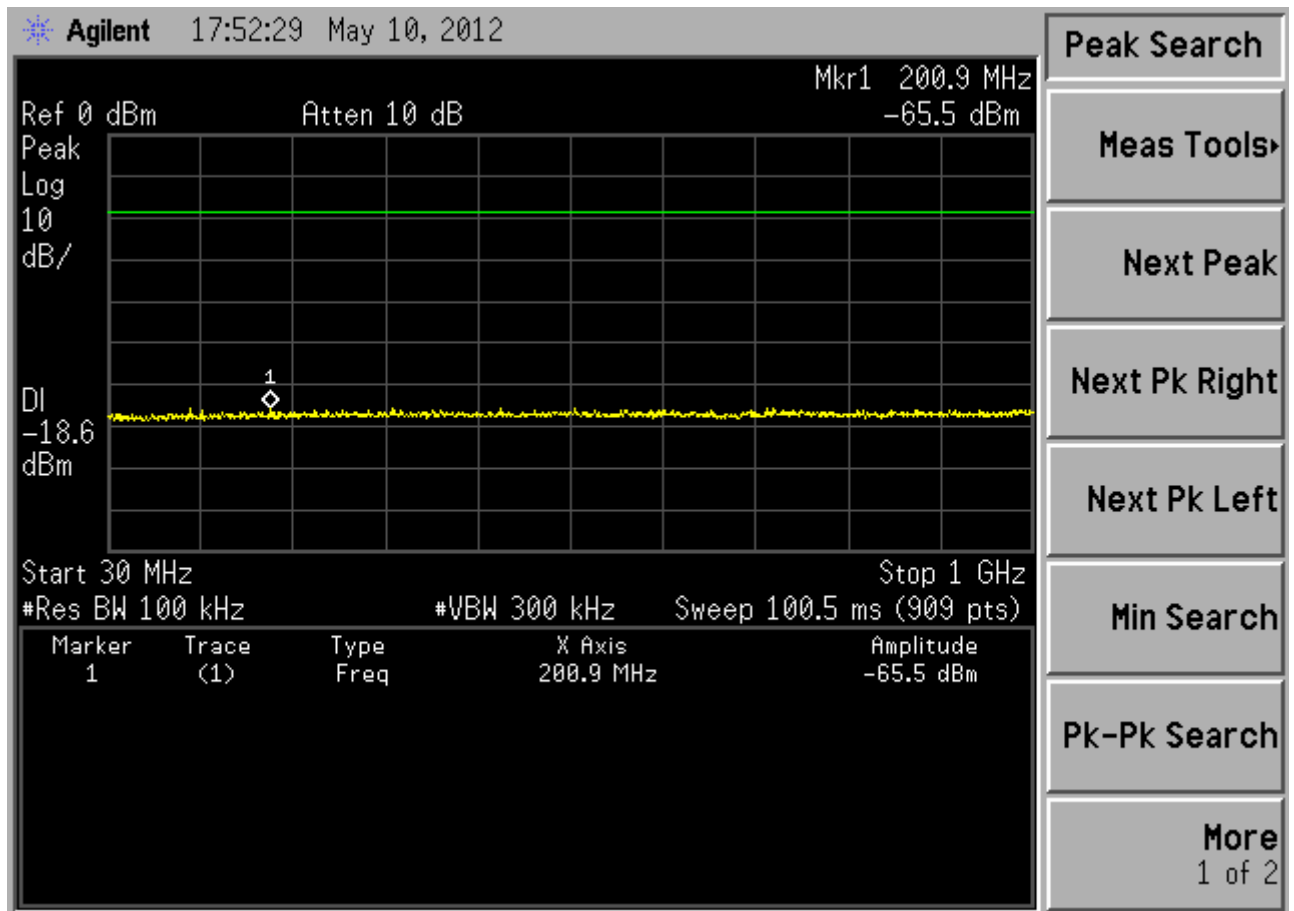
Ch 11 (2405 MHz)

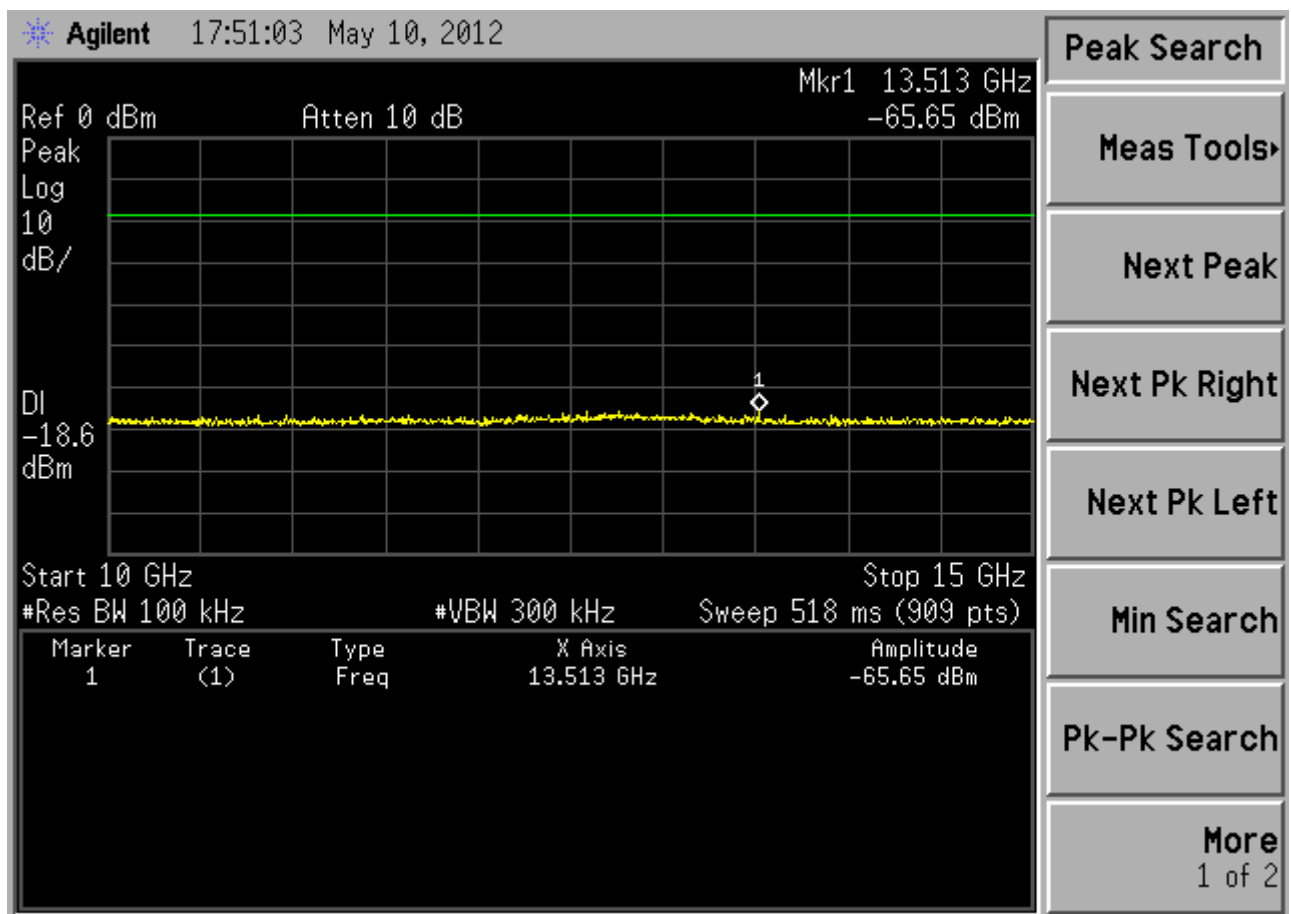
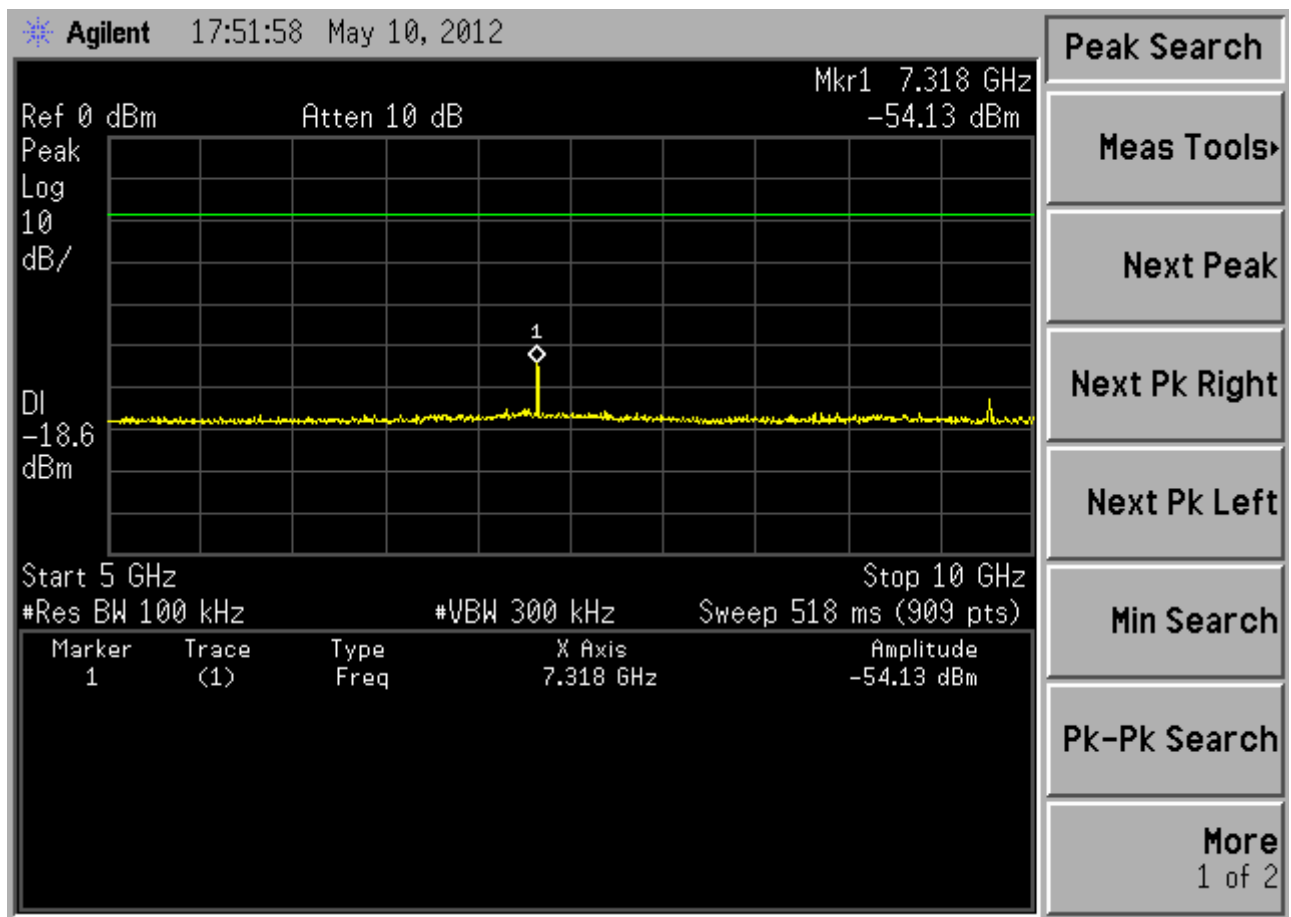


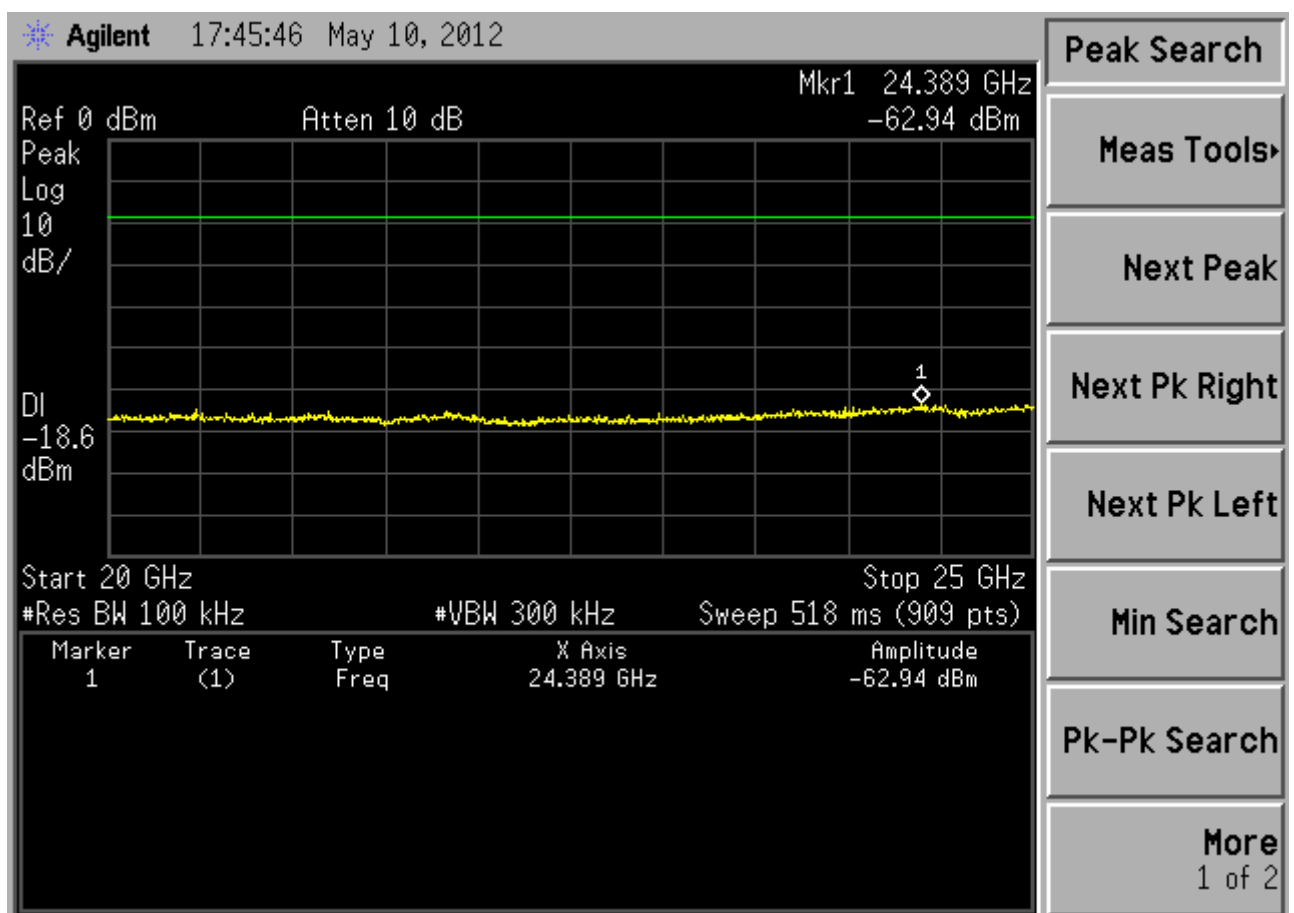
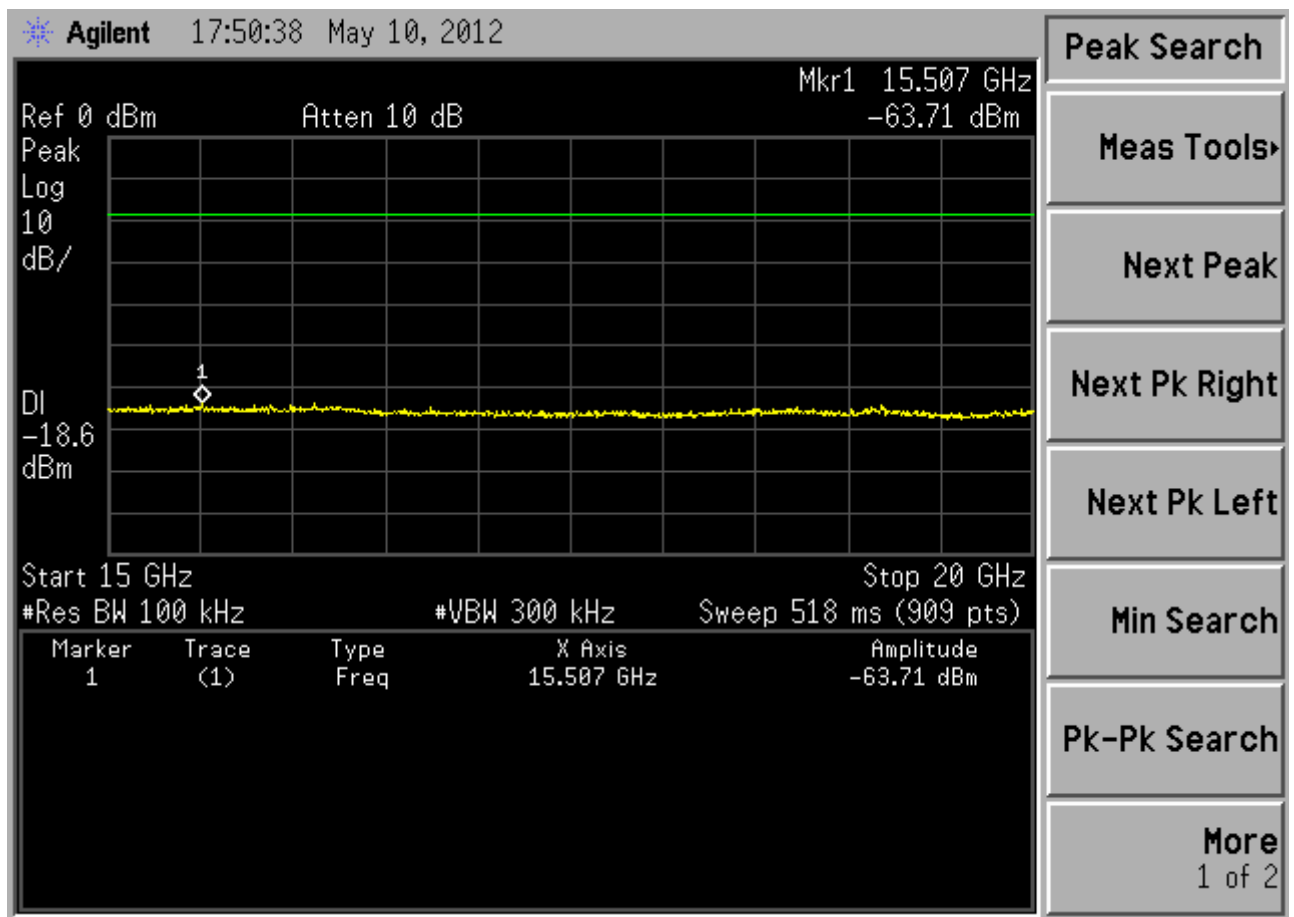




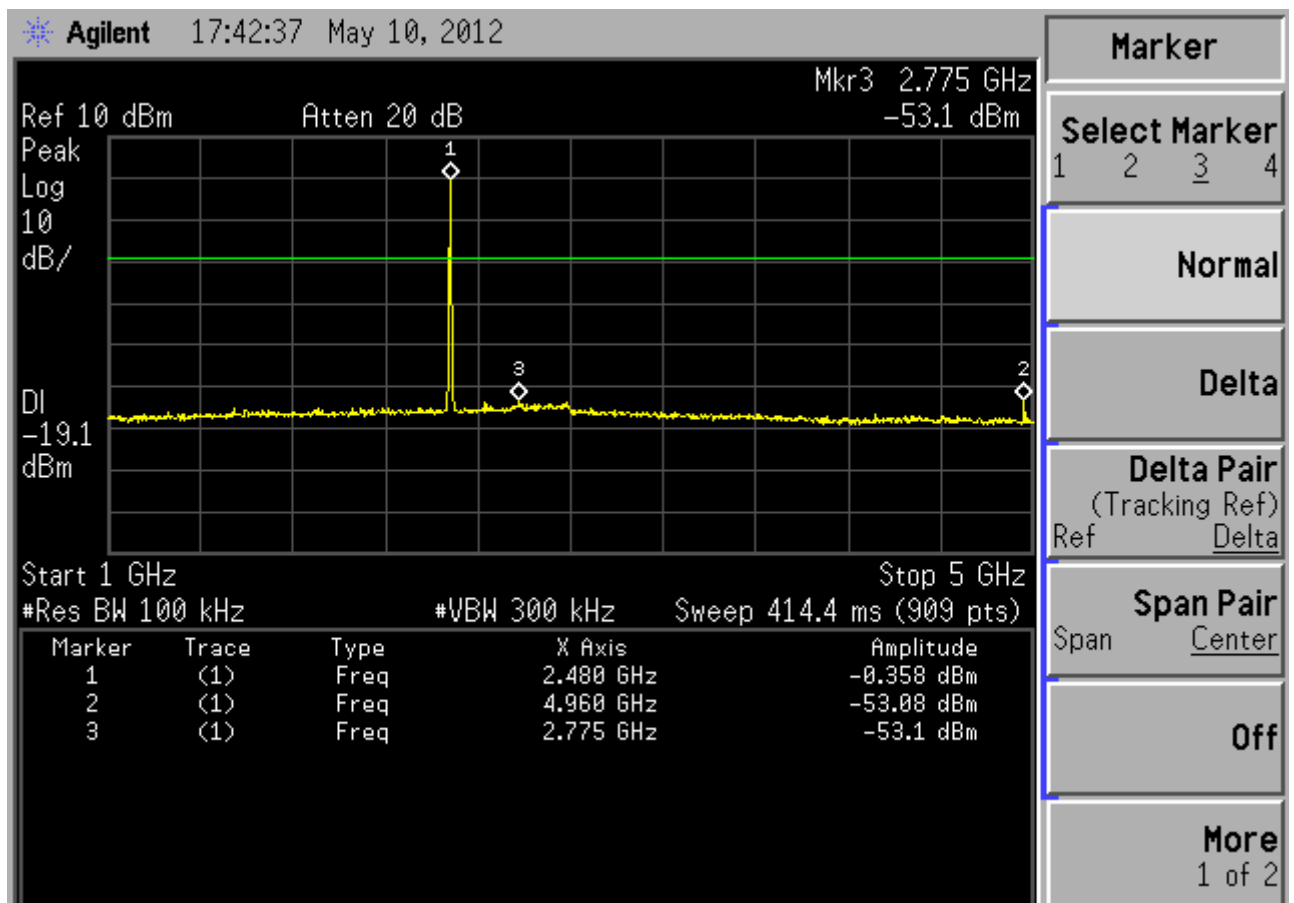
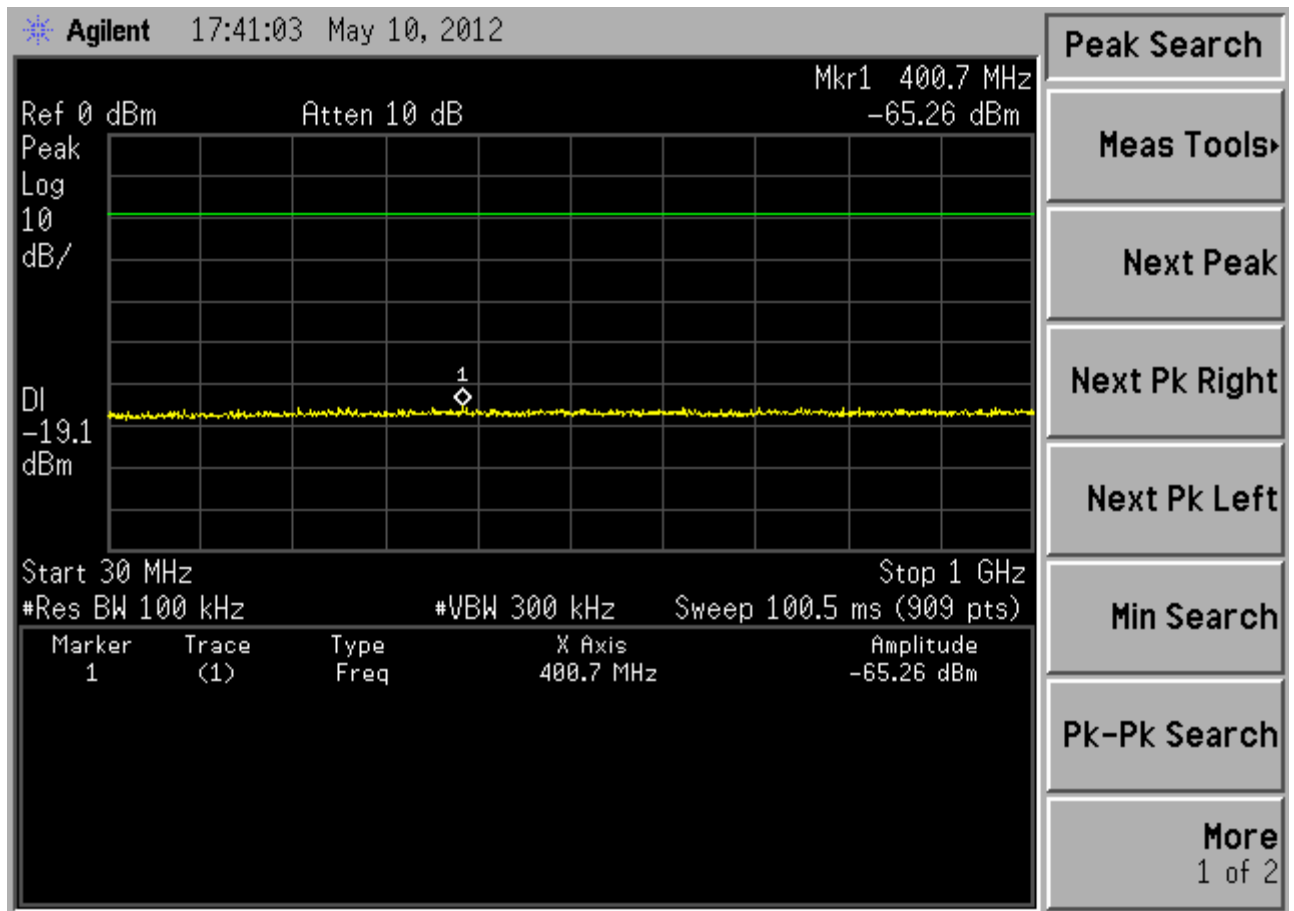
Ch 18 (2440 MHz)

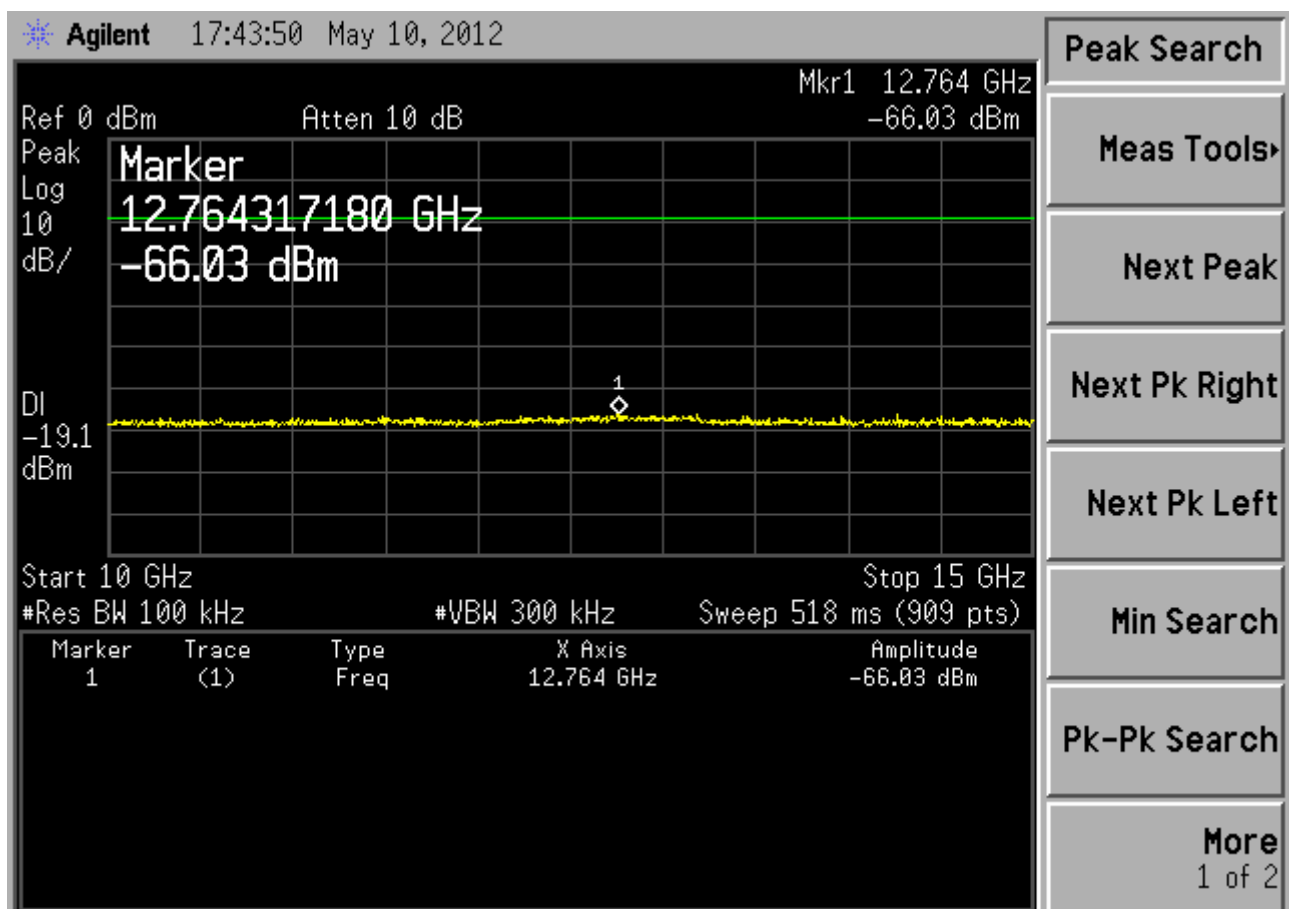
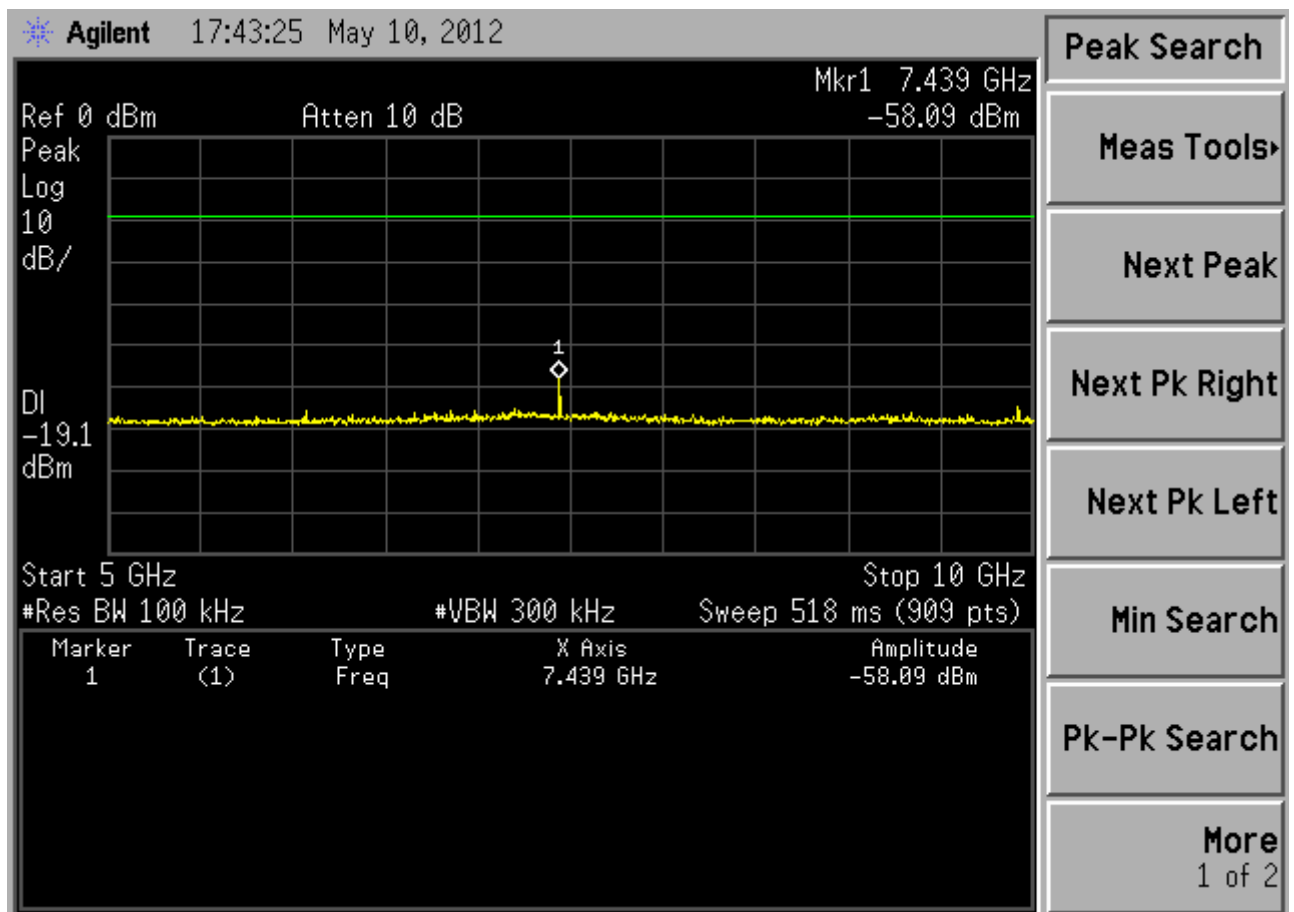


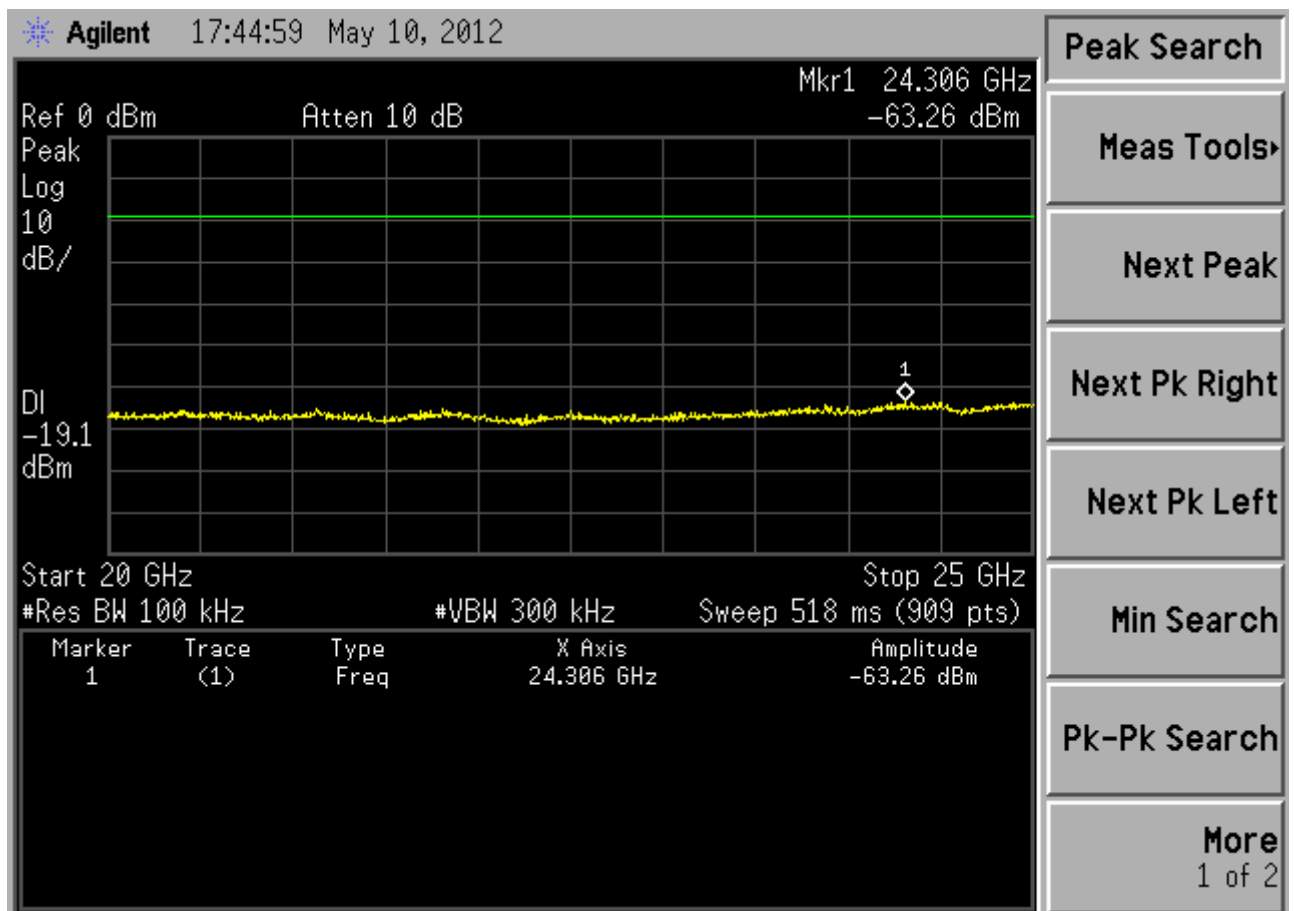
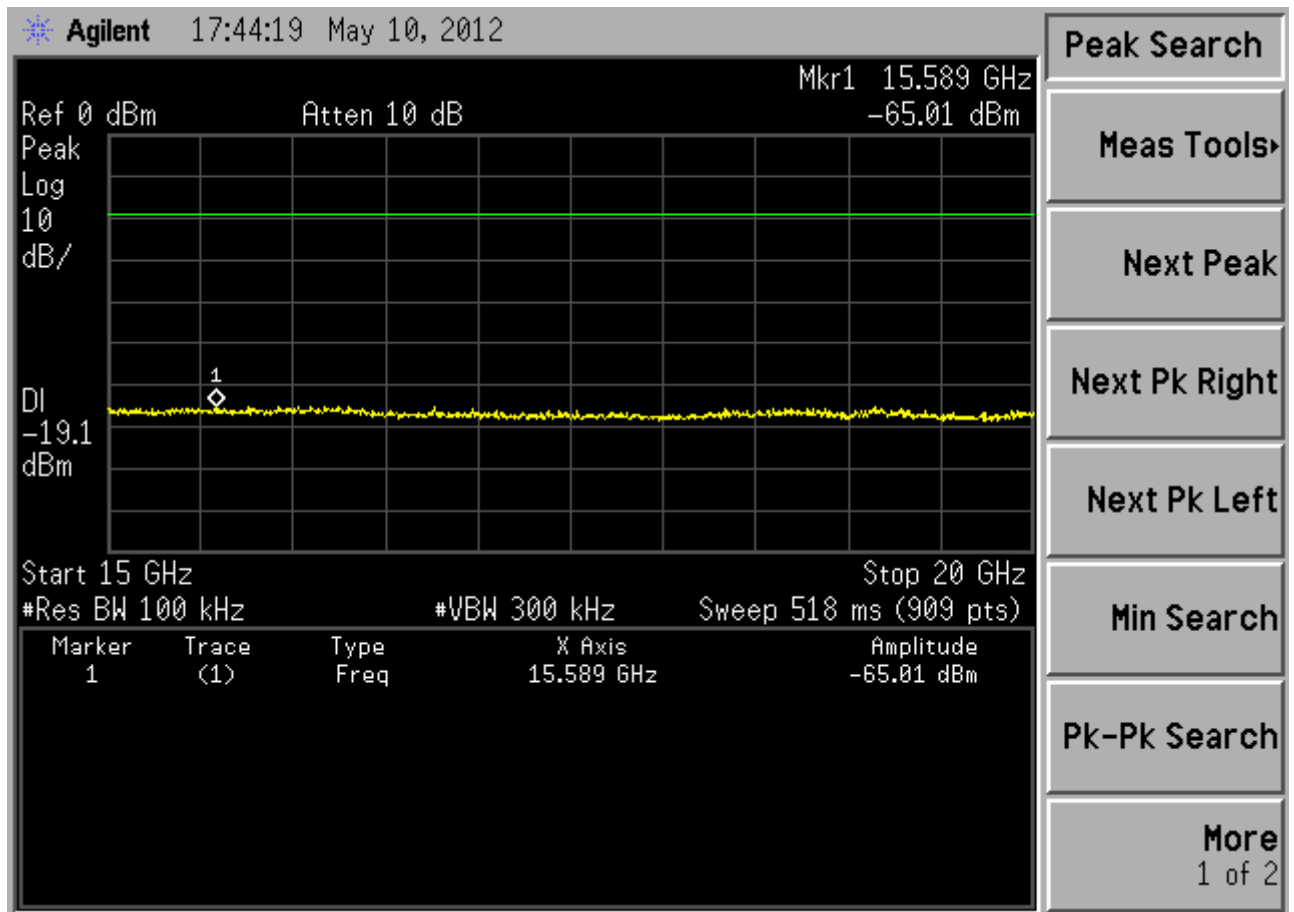




Ch 26 (2480 MHz)







7 BAND EDGES MEASUREMENT

7.1 Test Equipment

The following test equipment was used during the band edges measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	E7405A	MY45106600	Mar 22, 2011	Mar 22, 2012

7.2 Block Diagram of Test Setup

The same as section.4.2.

7.3 Specification Limits (§15.247(d))

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.

7.4 Operating Condition of EUT

The test program “Hyper-Terminal” was used to enable the EUT to transmit and receive data at different channel frequency individually.

7.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. Set both RBW and VBW of spectrum analyzer to 100kHz with suitable frequency span including 100kHz bandwidth from band edge.

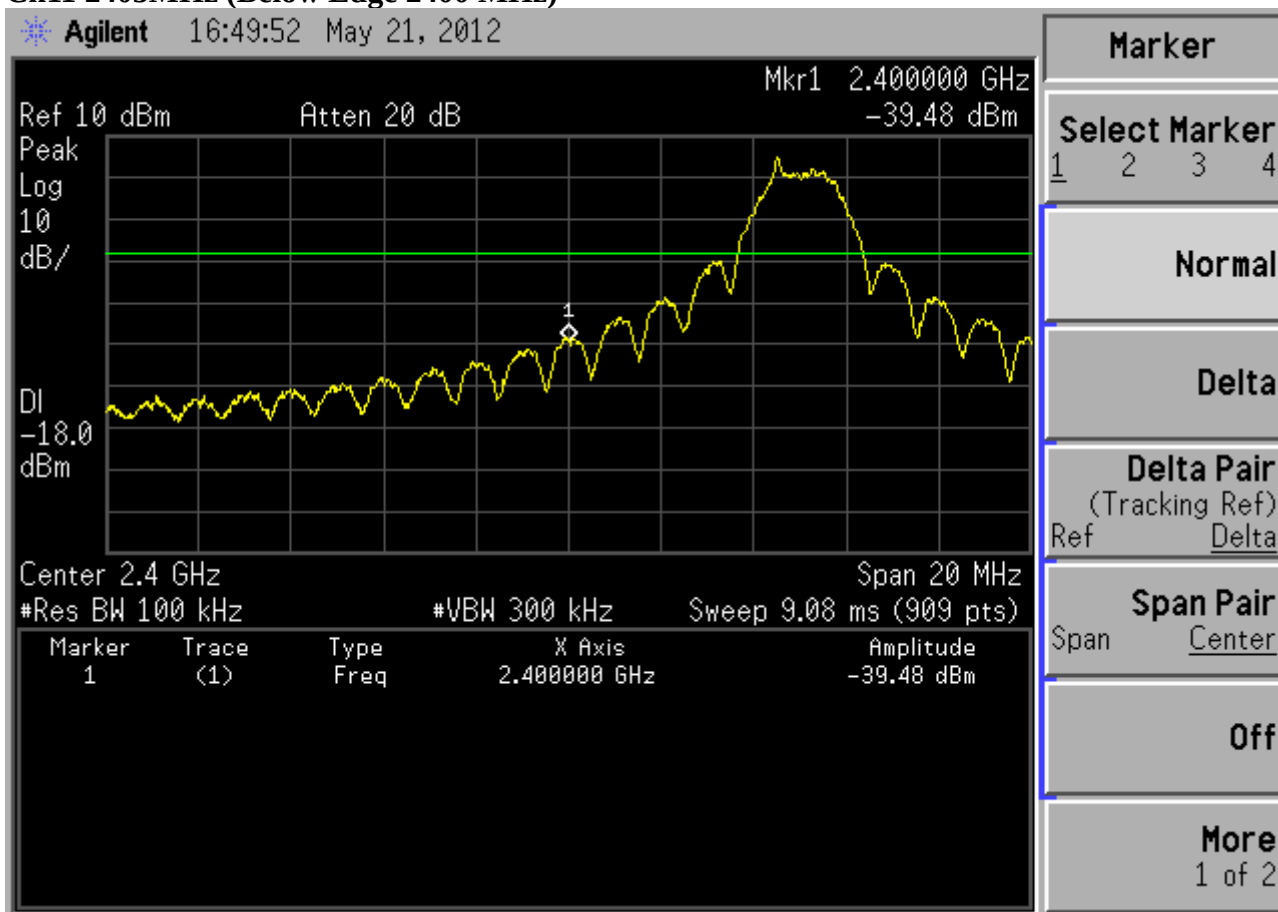
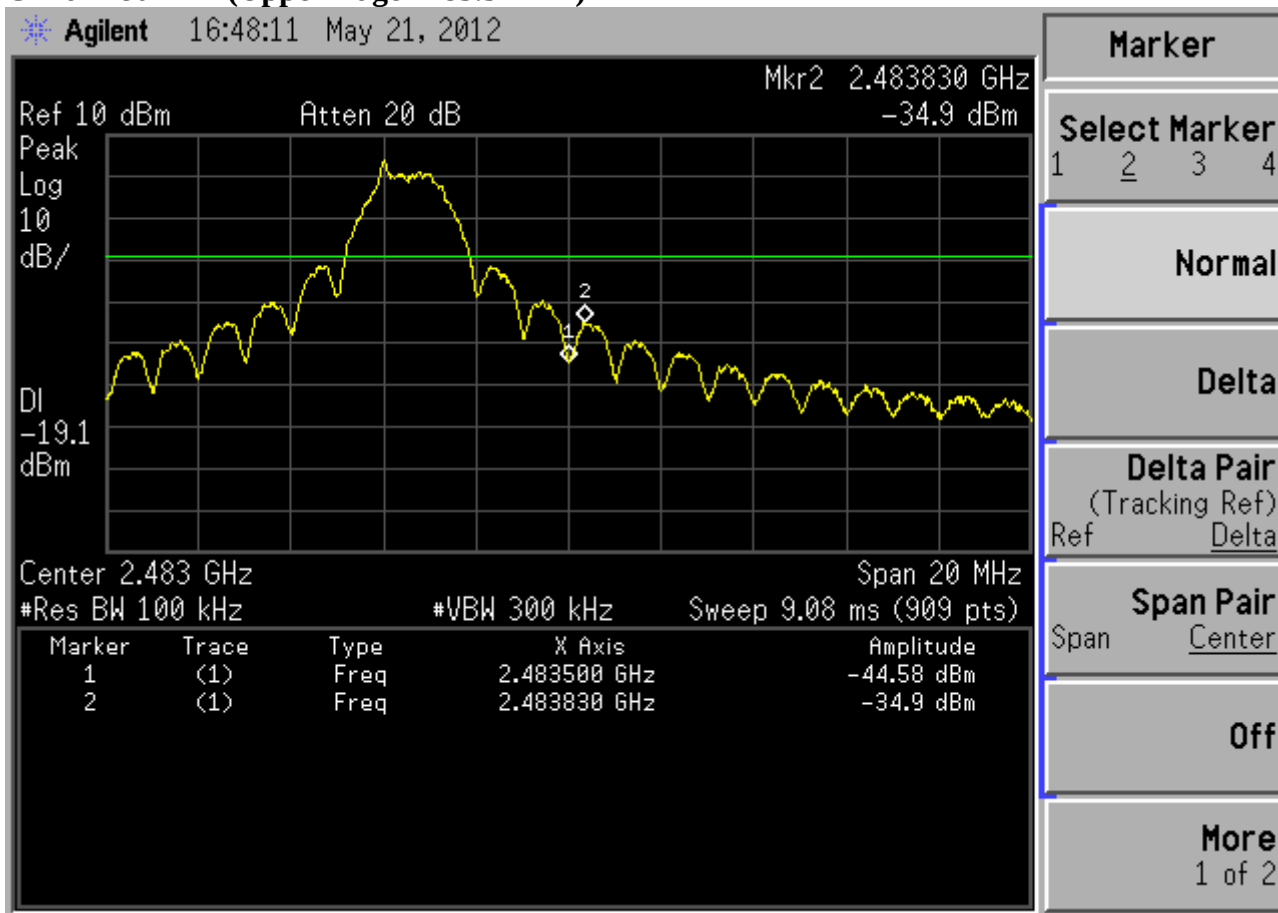
7.6 Test Results

PASSED. All the test results are attached in next pages.

Note – The Reference Level refer to Sec. 8.6 PSD (in 100kHz) which tested according to “5.4.1.1 Measurement Procedure – Reference Level” of KDB558074 v01: 2012

(Test Date: May. 21, 2012 Temperature: 23°C Humidity: 48 %%)

Location	Channel	Frequency	Delta Marker	Result
Below Band Edge	11	2405 MHz	41.456 dB	More than 20 dB below the highest level of the desired power
Upper Band Edge	26	2480 MHz	35.818 dB	

Ch11 2405MHz (Below Edge 2400 MHz)**Ch26 2480MHz (Upper Edge 2483.5 MHz)**

8 POWER SPECTRAL DENSITY MEASUREMENT

8.1 Test Equipment

The following test equipment was used during the power spectral density measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	E7405A	MY45106600	Mar 22, 2012	Mar 22, 2013

8.2 Block Diagram of Test Setup

The same as section.4.2.

8.3 Specification Limits (§15.247(e))

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band.

8.4 Operating Condition of EUT

The test program “Hyper-Terminal” was used to enable the EUT to transmit data at different channel frequency individually.

8.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. The spectrum analyzer was set as RBW = 100kHz, VBW = 300kHz, span = 800kHz (5 – 30% greater than the EBW).

The test procedure is defined in KDB558074 v01:2012 (the 5.3.1 Measurement Procedure PKPSD was used).

8.6 Test Results

PASSED. All the test results are attached in next pages.

(Test Date: May. 10, 2012 Temperature: 23°C Humidity: 48 %)

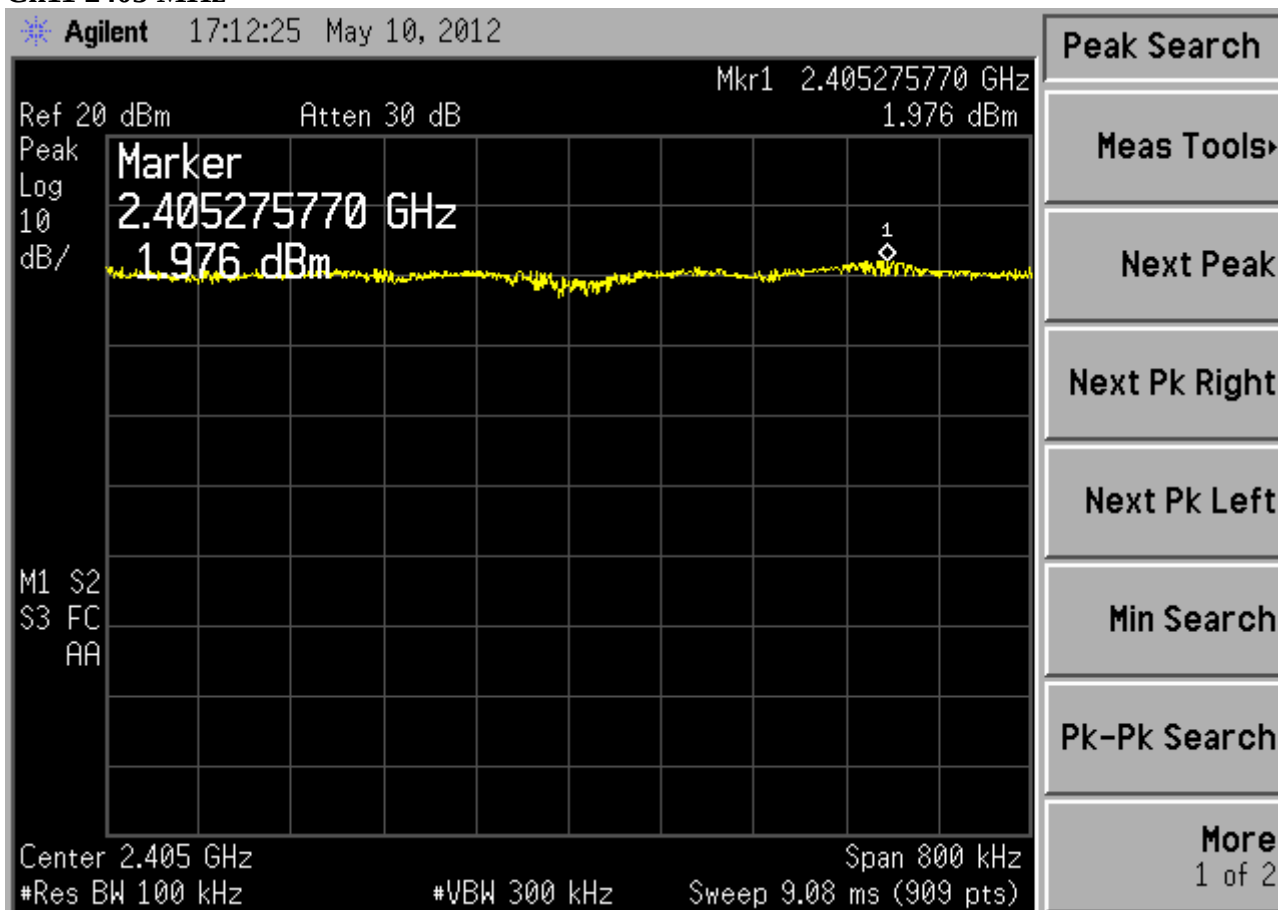
Channel	Frequency	Power Spectral Density reading value (in 100kHz)	Power Spectral Density reading value (in 3kHz)	Power Spectral Density final value (in 3kHz)	Limit
11	2405 MHz	1.976 dBm	-13.224 dBm	-11.224 dBm	8dBm
18	2440 MHz	1.435 dBm	-13.765 dBm	-11.765 dBm	8dBm
26	2480 MHz	0.918 dBm	-14.282 dBm	-12.282 dBm	8dBm

Note 1 – The PSD (in 3kHz) = PSD (in 100kHz) + BWCF

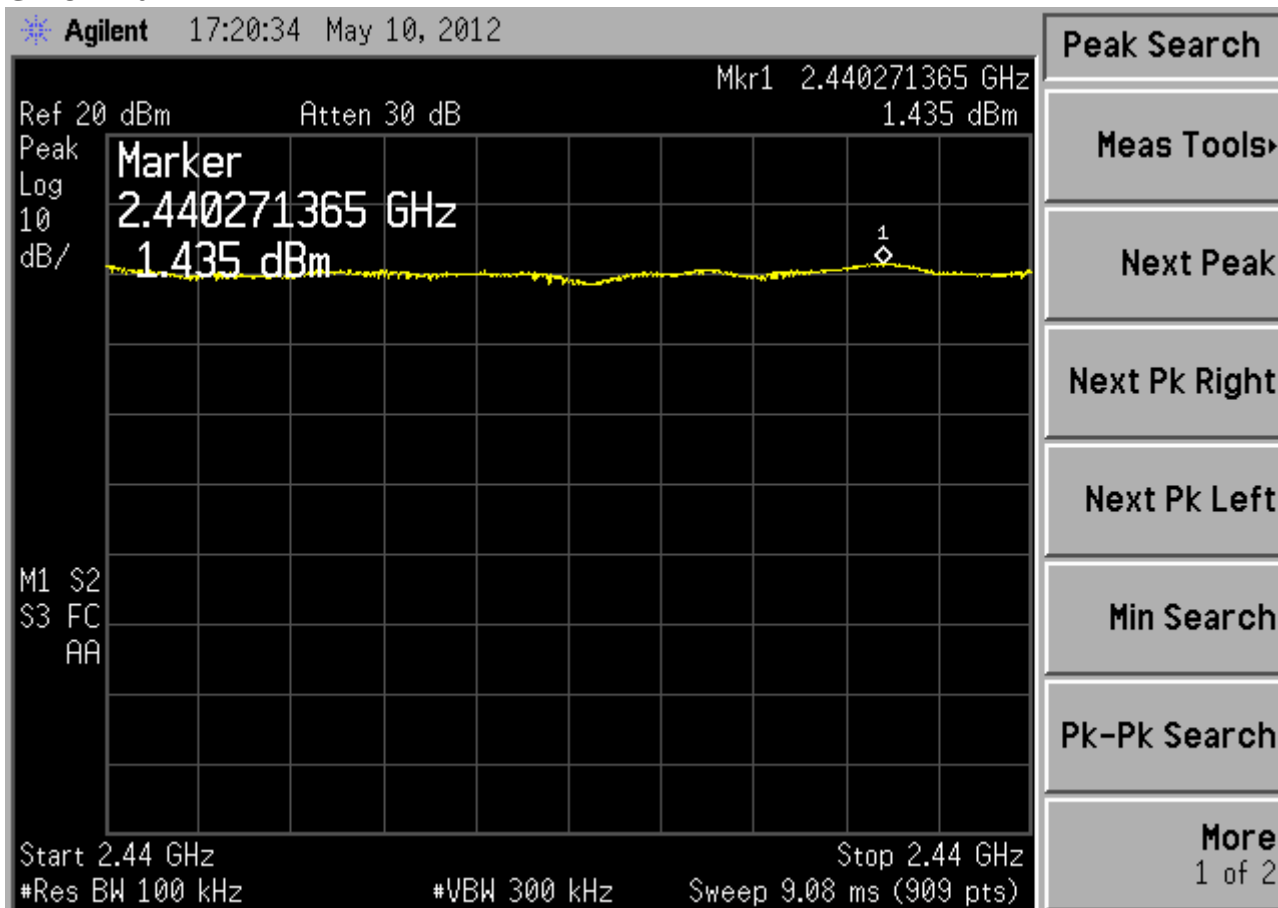
Where BWCF = $10\log(3\text{kHz}/100\text{kHz}) = -15.2\text{dB}$

Note 2 – The final value = reading value + cable loss (2dB)

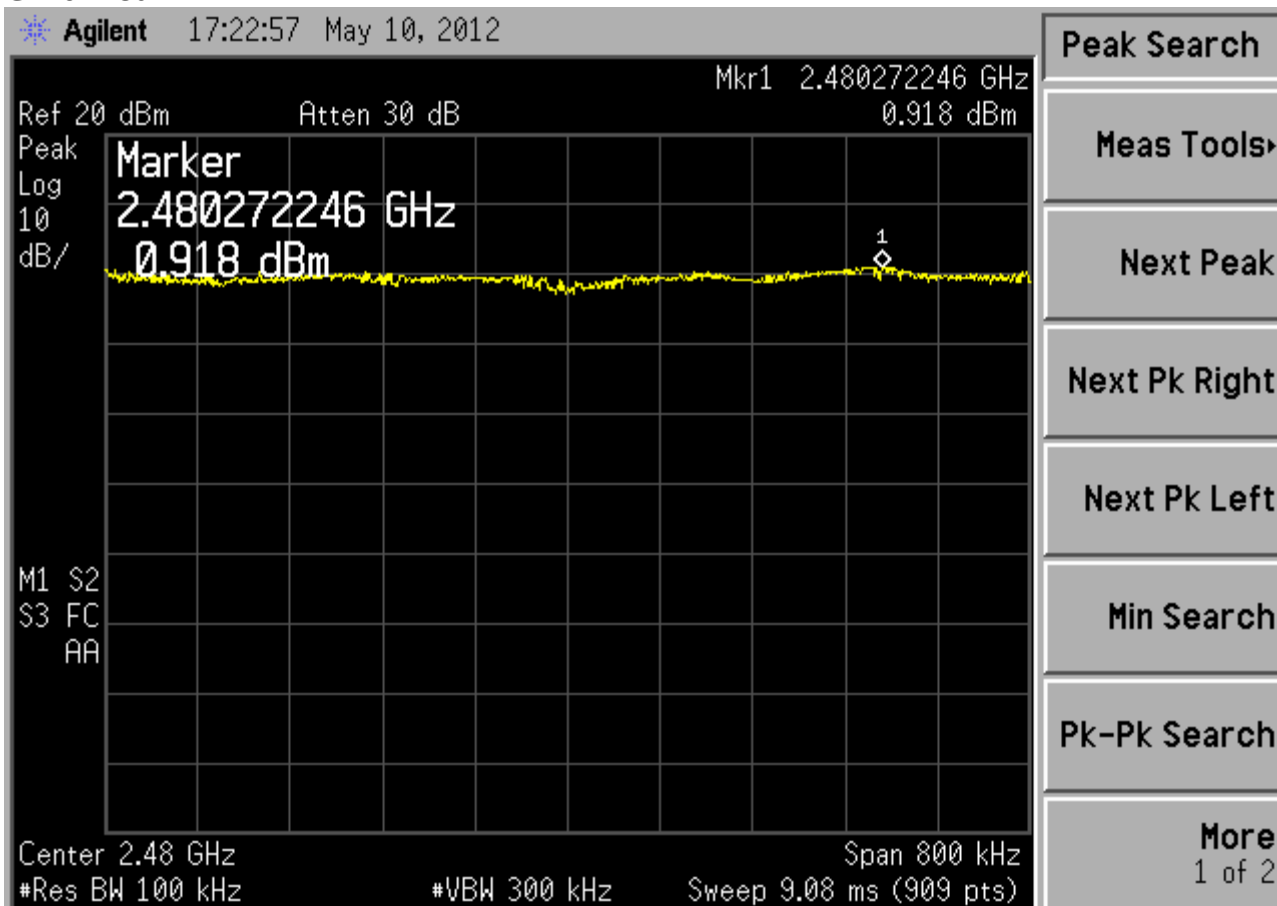
Ch11 2405 MHz



Ch18 2440 MHz



Ch26 2480 MHz



9 DEVIATION TO TEST SPECIFICATIONS

None.