

# TEST REPORT

REPORT NUMBER: 15U20917-E29V2

COMPANY NAME: Google Inc.

EUT DESCRIPTION: Multimedia Device with BLE, 2.4GHz and 5GHz Radios

MODEL: NC2-6A5

SERIAL NUMBER: PROTO 1

ISSUE DATE: 13-Nov-15

DATE TESTED: 8/06/2015 to 9/10/2015

APPLICABLE STANDARDS: JAPAN RADIO LAW RADIO EQUIPMENT REGULATIONS

TEST METHOD: Notice 88 of Ordinance Concerning Technical Regulations Conformity Certification of Specified Radio Equipment

Place of Testing: UL Verification Services Inc.  
47173 BENICIA ST, FREMONT, CA 94538, USA

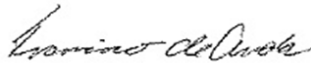
Test Result: Pass

Classification of Specified Radio Equipment: Article 2 Clause 1 Item 19

Type of radio wave, Frequency and antenna power: G1D 2412-2472MHz (Interval of 5MHz 13ch) 0.007695W/MHz

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL Verification Services Inc. By:



Francisco de Anda  
EMC SUPERVISOR  
UL Verification Services Inc.

Tested By:



Clifford Susa  
EMC ENGINEER  
UL Verification Services Inc.



NVLAP LAB CODE 200065-0

## 1. EUT Information

Report No. : 15U20917-E29V2
Applicant : Google Inc.
Equipment Description: Multimedia Device with BLE, 2.4GHz and 5GHz Radios
Model No. : NC2-6A5
SerialNo. : PROTO 1
The number of Tx Antenna : 1
Max Antenna Gain : 2.30dBi
Mode : IEEE802.11b
Type of Radio wave : G1D

<b>Supply Voltage</b> <input checked="" type="radio"/> DC <input type="radio"/> AC    5.00V Voltage Condition <input checked="" type="radio"/> Non-Extreme <input type="radio"/> Extreme Normal DC5V Normal-10% - Normal+10% -	<b>Modulation</b> <input checked="" type="radio"/> DS ( e.g. WLAN 11b) <input type="radio"/> OFDM & OBW≤ 26MHz ( e.g. WLAN 11g, 11n HT20) <input type="radio"/> OFDM & OBW 26-38MHz (e.g. WLAN 11n HT40) <input type="radio"/> Other Modulation (e.g. GFSK, Not BT) EUT has <input checked="" type="radio"/> ANT Connector    distance - <input type="radio"/> No ANT Connector
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The worst-case data rate for each mode is determined to be as follows, based on preliminary test of the chipset utilized in this radio.

All final tests were made at the Lowest Rate.

### Factors

	[MHz]	Other than for Power		For Power	
		Cable Loss [dB]	ATT/[dB]	Cable Loss [dB]	ATT/[dB]
Low Channel (Tx1)	2412	3.30	10.00	3.30	10.00
Middle Channel (Tx2)	2442	3.30	10.00	3.30	10.00
High Channel (Tx3)	2472	3.30	10.00	3.30	10.00

## 2.TEST Result

### 2.1. Frequency Tolerance

Job No. 15U20917-E29V2

Remark1

Remark2

#### [ DATA ]

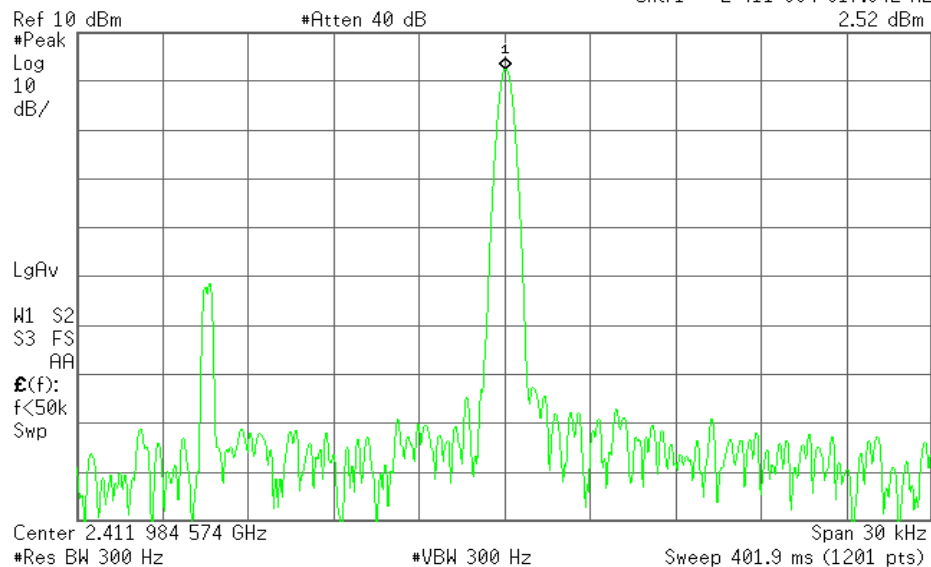
Voltage	Freq. [MHz]	Result [MHz]	Tolerance [kHz]	Tolerance [ppm]	Limit [ppm]
DCSV	2412	2411.9846	-15.3822	-6.38	±50.0
	2442	2441.9851	-14.9219	-6.11	±50.0
	2472	2471.9848	-15.2361	-6.16	±50.0

Tx1\_Freq\_Nom

✱ Agilent 10:40:34 Sep 10, 2015

R L

Cntr1 2 411 984 617.842 Hz

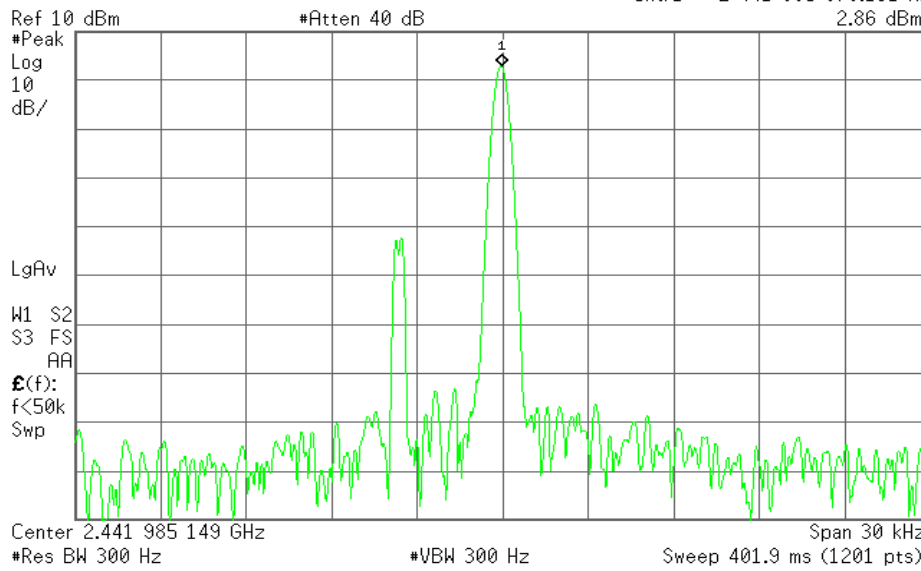


Tx2\_Freq\_Nom

✴ Agilent 10:48:19 Sep 10, 2015

R L

Cntr1 2 441 985 078.131 Hz  
2.86 dBm

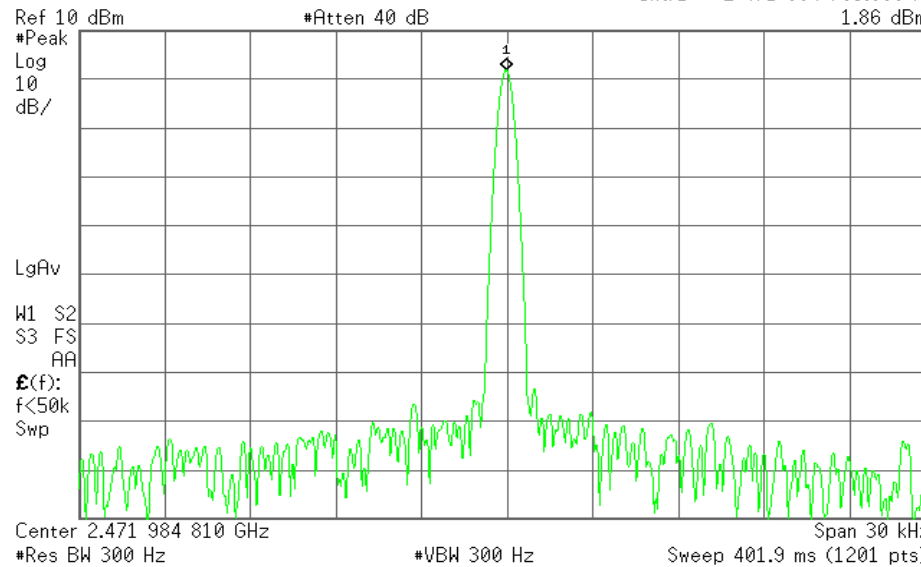


Tx3\_Freq\_Nom

✴ Agilent 10:50:00 Sep 10, 2015

R L

Cntr1 2 471 984 763.880 Hz  
1.86 dBm



## 2.2. Occupied Bandwidth / Spreading Bandwidth

Job No. 15U20917-E29V2  
 Remark1  
 Remark2

### [ DATA ]

#### 99% Occupied Frequency Bandwidth

Voltage	Freq. [MHz]	Result [MHz]	Limit [MHz]
DC5V	2412	13.2704	26
	2442	13.2515	26
	2472	13.2687	26

#### Spreading Bandwidth

Voltage	Freq. [MHz]	Result [MHz]	Result [kHz]	Limit [kHz]
DC5V	2412	9.2510	9251.0	500
	2442	9.2436	9243.6	500
	2472	9.2548	9254.8	500

#### Spreading Factor

1Mbps, 2Mbps 9.24 (Limit: >5)  
 5.5Mbps, 11Mbps 6.72 (Limit: >5)

#### Symbol Rate

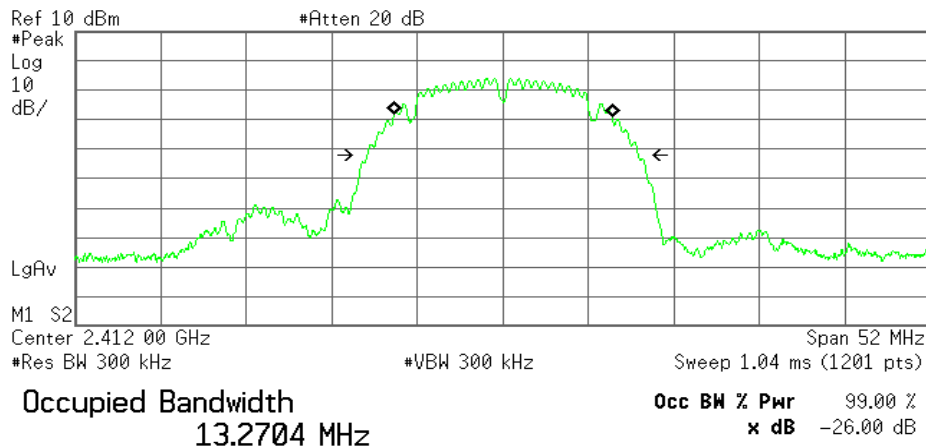
1 Msps  
 1.375 Msps

#### 99% Occupied Frequency Bandwidth

Tx1\_99OBW\_Nom

Agilent 18:02:20 Aug 6, 2015

R L



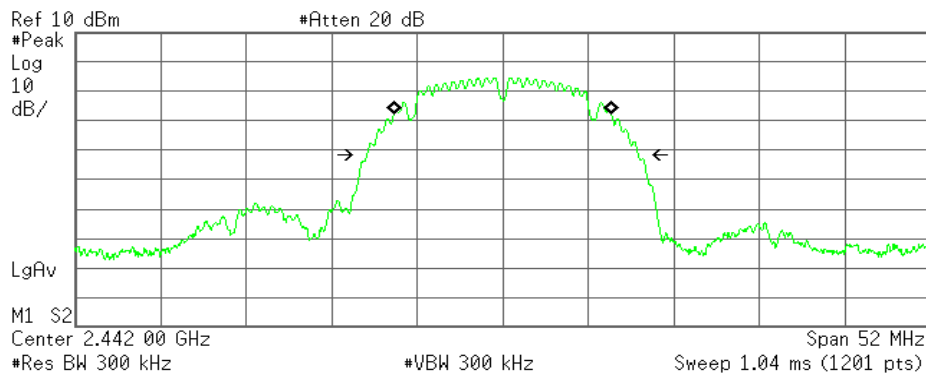
Transmit Freq Error 18.898 kHz  
 x dB Bandwidth 16.454 MHz



Tx2\_99OBW\_Nom

Agilent 18:08:35 Aug 6, 2015

R L



Occupied Bandwidth  
13.2515 MHz

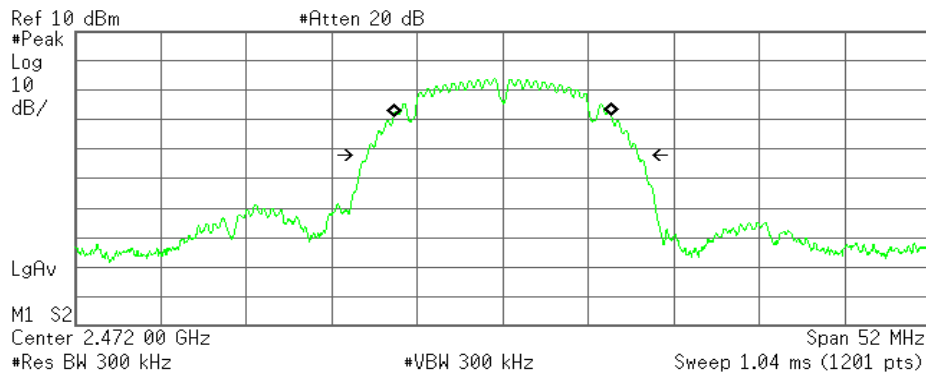
Occ BW % Pwr 99.00 %  
x dB -26.00 dB

Transmit Freq Error -661.599 Hz  
x dB Bandwidth 16.448 MHz

Tx3\_99OBW\_Nom

Agilent 18:17:36 Aug 6, 2015

R L



Occupied Bandwidth  
13.2687 MHz

Occ BW % Pwr 99.00 %  
x dB -26.00 dB

Transmit Freq Error -4.290 kHz  
x dB Bandwidth 16.474 MHz



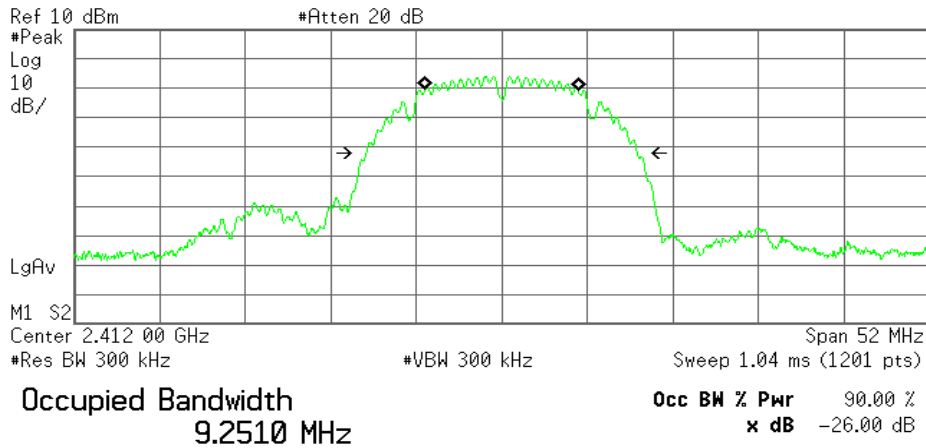


## Spreading Bandwidth

Tx1\_900BW\_Nom

Agilent 18:02:26 Aug 6, 2015

R L

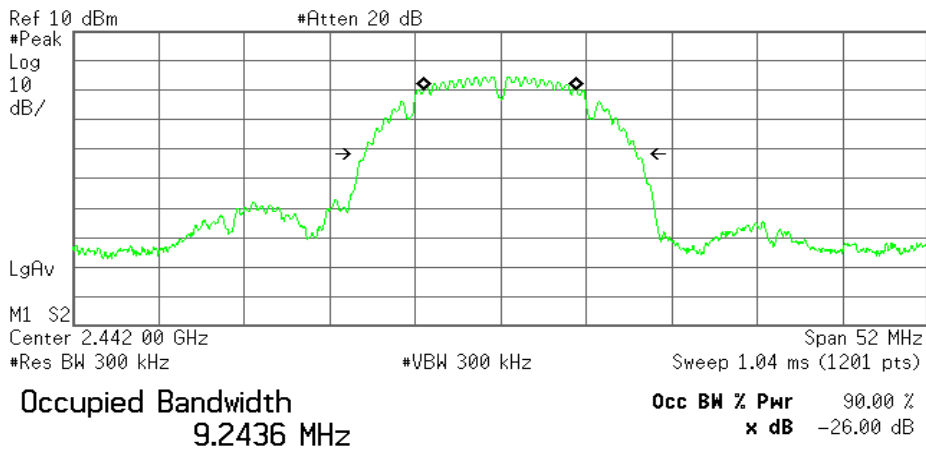


Transmit Freq Error 5.440 kHz  
Occupied Bandwidth 16.455 MHz

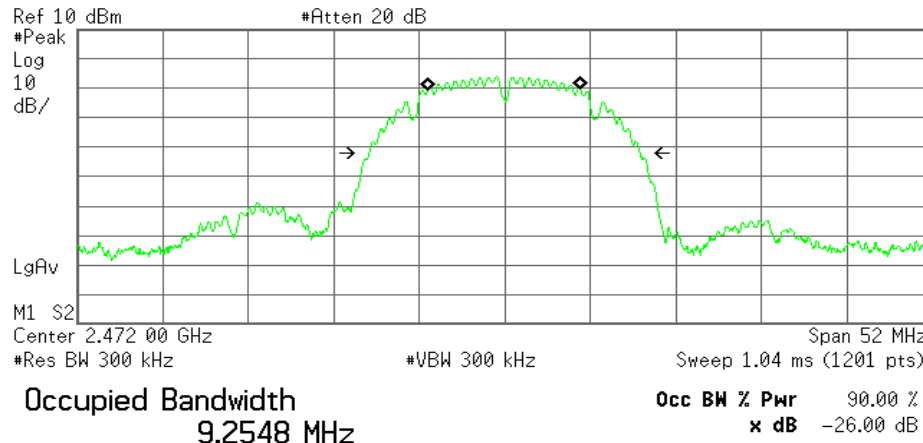
Tx2\_900BW\_Nom

Agilent 18:08:41 Aug 6, 2015

R L



Transmit Freq Error -18.709 kHz  
Occupied Bandwidth 16.448 MHz



Transmit Freq Error -27.384 kHz  
Occupied Bandwidth 16.474 MHz

## 2.3. Unwanted Emission Strength (Normal Voltage)

Job No. 15U20917-E29V2

Remark1

Remark2

### [ DATA ]

Voltage	Freq.	Freq.	S/A Reading	Cable Loss	Atten. Loss	Result	Result	Limit	Remark
	[MHz]	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[uW]	[uW]	
DCSV	2412	466.50	-61.07	3.30	10.00	-47.77	0.017	2.500	♣1
		2332.00	-57.22	3.30	10.00	-43.92	0.041	2.500	♣1
		2336.50	-56.70	3.30	10.00	-43.40	0.046	2.500	♣1
		2397.17	-50.41	3.30	10.00	-37.11	0.194	25.000	♣2
		2399.99	-50.93	3.30	10.00	-37.63	0.173	25.000	♣2
		2485.00	-58.06	3.30	10.00	-44.76	0.033	25.000	♣3
	2442	6817.00	-55.20	3.30	10.00	-41.90	0.065	2.500	♣4
		460.00	-61.36	3.30	10.00	-48.06	0.016	2.500	♣1
		2370.00	-56.80	3.30	10.00	-43.50	0.045	2.500	♣1
		2514.00	-57.32	3.30	10.00	-44.02	0.040	2.500	♣4
	2472	6980.00	-55.73	3.30	10.00	-42.43	0.057	2.500	♣4
		869.90	-61.64	3.30	10.00	-48.34	0.015	2.500	♣1
		2399.00	-56.73	3.30	10.00	-43.43	0.045	25.000	♣2
		2483.51	-58.41	3.30	10.00	-45.11	0.031	25.000	♣3
		2487.33	-55.69	3.30	10.00	-42.39	0.058	25.000	♣3
		2497.42	-56.71	3.30	10.00	-43.41	0.046	2.500	♣4
		2543.00	-57.70	3.30	10.00	-44.40	0.036	2.500	♣4
		6999.00	-55.36	3.30	10.00	-42.06	0.062	2.500	♣4

Sample Calculation :

Result = Reading + Cable Loss + Attenuator

♣1:Freq Range1 ( ≥ 30MHz, < 2,387MHz)

♣2:Freq Range2 (2,387MHz以上, < 2,400MHz)

♣3:Freq Range3 (> 2,483.5MHz, ≤ 2,496.5MHz)

♣4:Freq Range4 (> 2,496.5MHz, ≤ 12.5GHz)

Tx1\_SpuriousM\_Nom

Agilent 18:03:01 Aug 6, 2015

R L

Mkr1 466.5 MHz

-61.07 dBm

Ref 10 dBm

#Atten 20 dB

#Peak

Log

10

dB/

LgAv

V1 S2

Start 30.0 MHz

Stop 1.000 0 GHz

#Res BW 1 MHz

#VBW 1 MHz

Sweep 1.68 ms (1201 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	466.5 MHz	-61.07 dBm

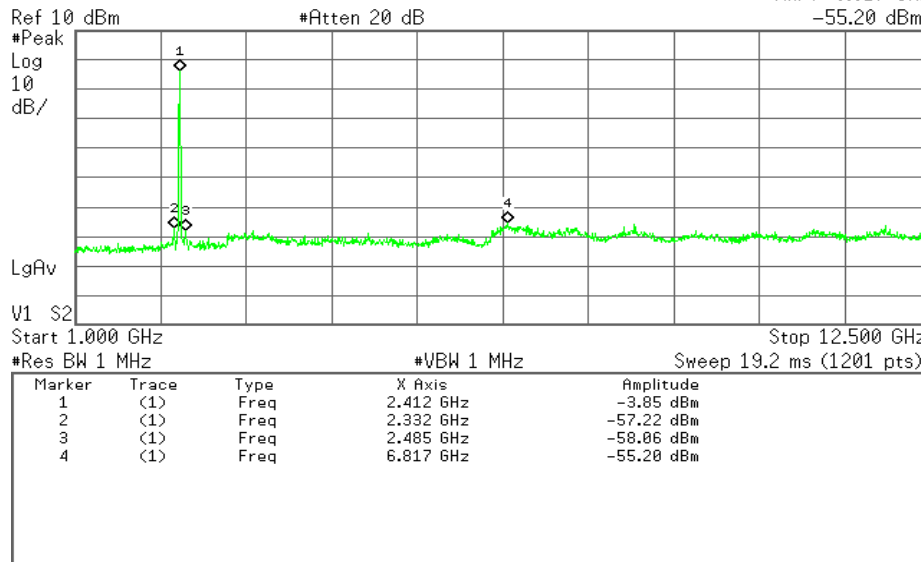


Tx1\_SpuriousG\_Nom

Agilent 18:02:49 Aug 6, 2015

R L

Mkr4 6.817 GHz  
-55.20 dBm

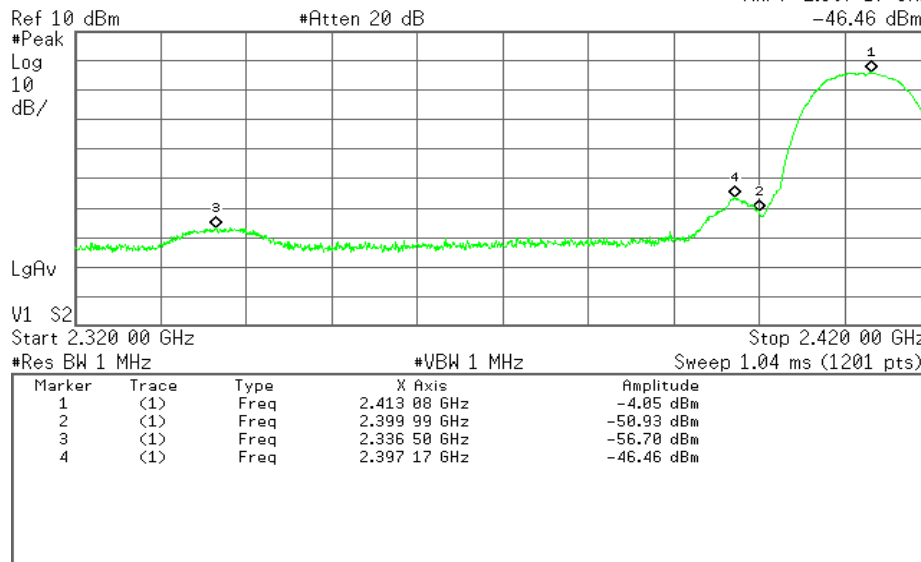


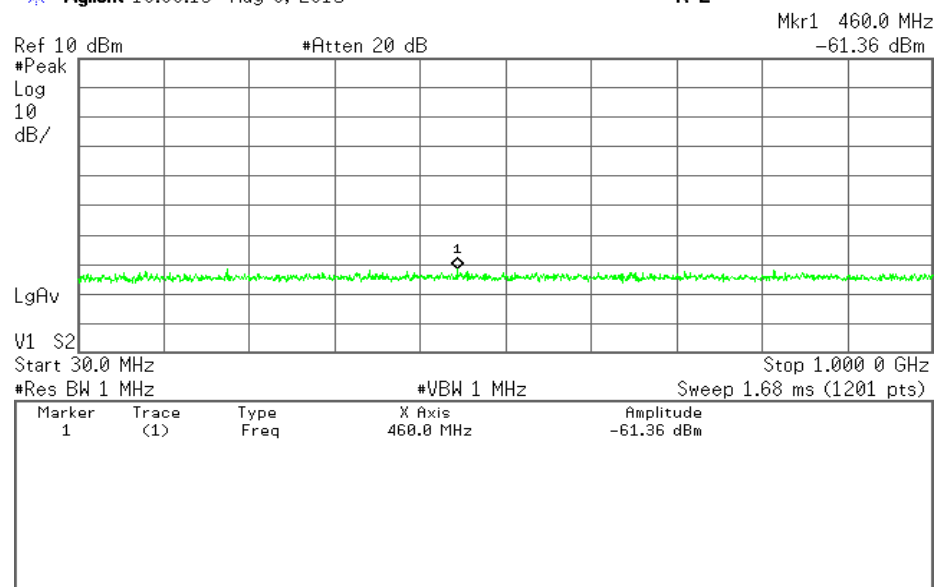
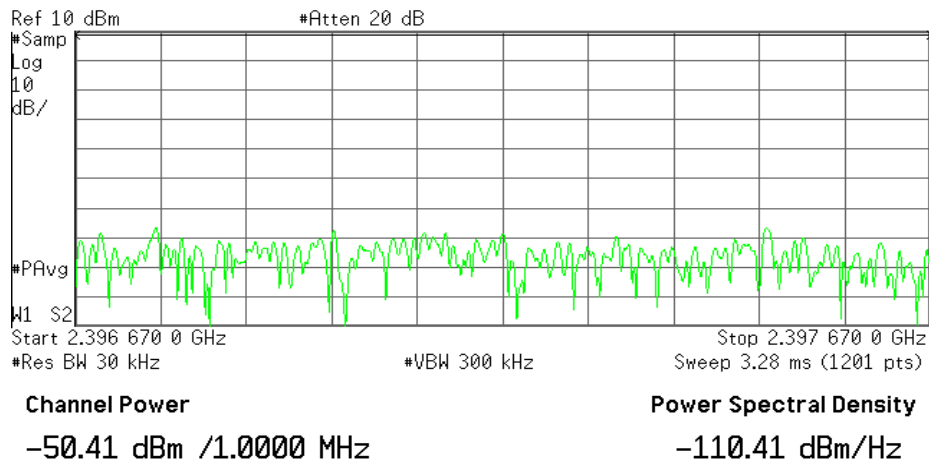
Tx1\_BandEdgeLow\_Nom

Agilent 18:03:23 Aug 6, 2015

R L

Mkr4 2.397 17 GHz  
-46.46 dBm

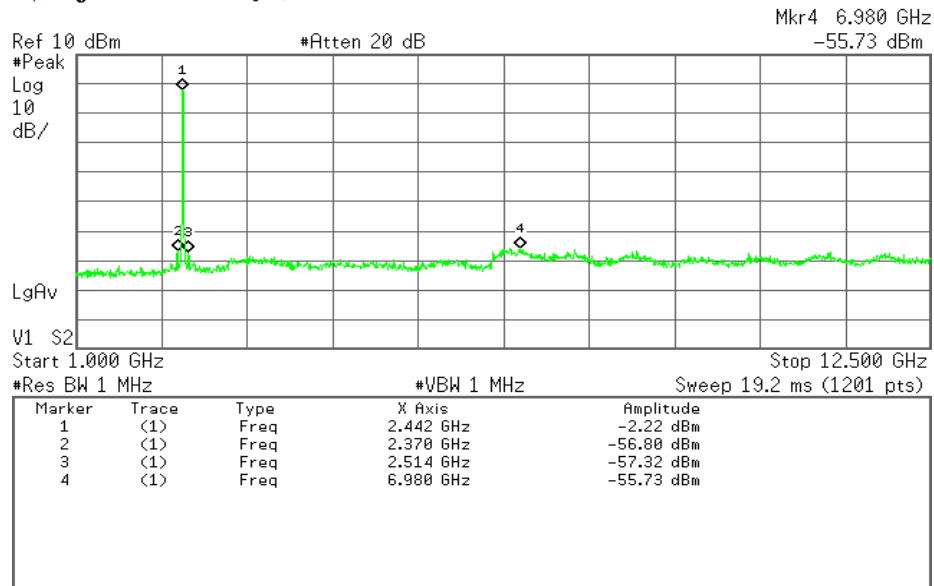




Tx2\_SpuriousG\_Nom

Agilent 18:09:01 Aug 6, 2015

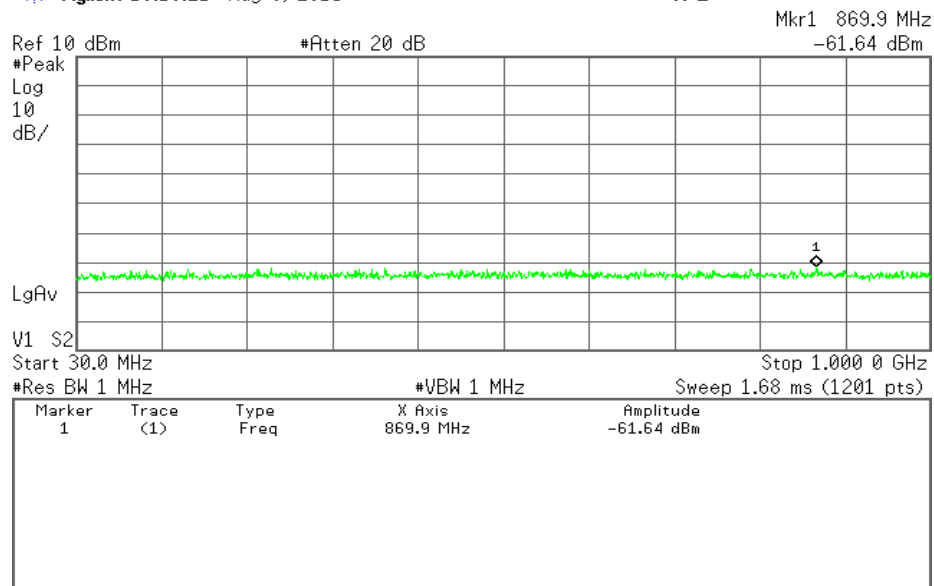
R L



Tx3\_SpuriousM\_Nom

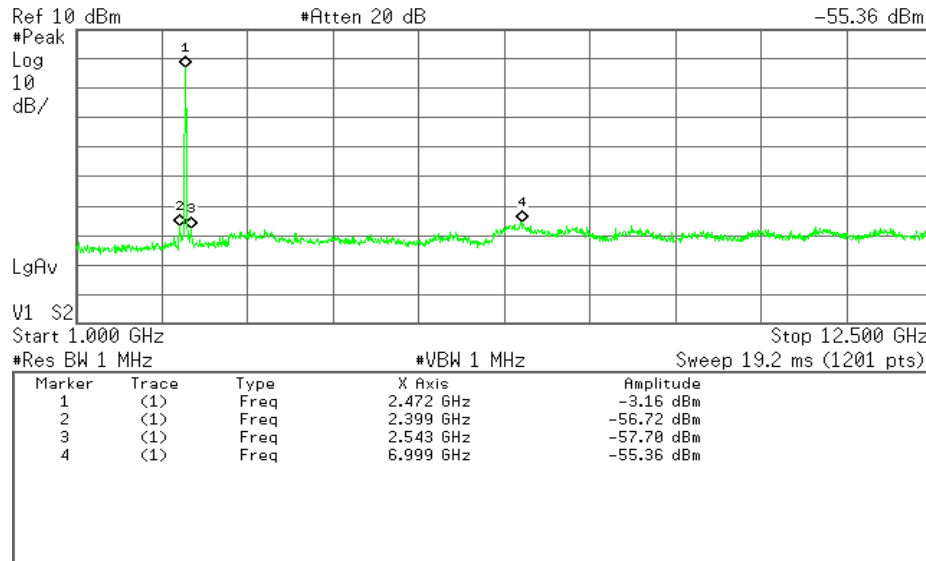
Agilent 18:18:21 Aug 6, 2015

R L



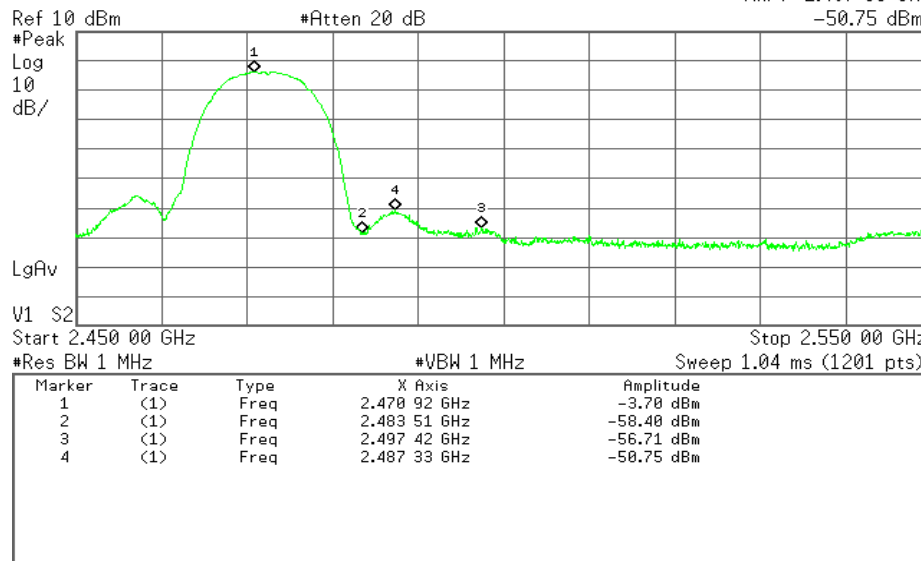
Agilent 18:18:08 Aug 6, 2015

R L

Mkr4 6.999 GHz  
-55.36 dBm

Agilent 18:18:40 Aug 6, 2015

R L

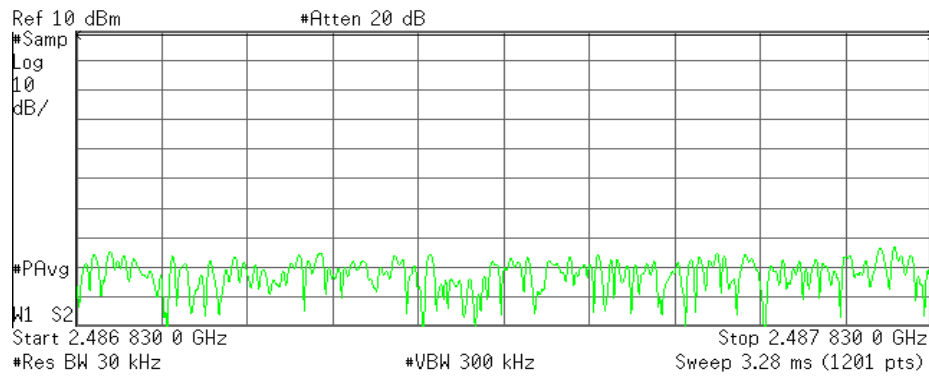
Mkr4 2.487 33 GHz  
-50.75 dBm





✧ Agilent 18:18:54 Aug 6, 2015

R L

**Channel Power****-55.69 dBm /1.0000 MHz****Power Spectral Density****-115.69 dBm/Hz**

## 2.4. Output Power

Job No. 15U20917-E29V2

Remark1

Remark2

### [ DATA ]

Voltage	Chain	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [W/MHz]	Burst Rate	Output Power (A) [W/MHz]	Antenna Gain [dBi]	E.I.R.P. (A) [W/MHz]
DC5V	0	2412	-6.41	3.30	10.00	0.004891	1.00	0.004891	2.30	0.008306
		2442	-5.34	3.30	10.00	0.006247	1.00	0.006247	2.30	0.010609
		2472	-6.29	3.30	10.00	0.005023	1.00	0.005023	2.30	0.008530
DC5V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-

Sample Calculation :

Output Power (A) =  $10^{((\text{Reading [dBm]} + \text{Cable Loss} + \text{Atten. Loss}) / 10)} \times \text{Burst Rate}$

E.I.R.P. (A) = Output Power (A) \*  $10^{(\text{Antenna Gain[dBi]}/10)}$

### [Total Power / Result and Limit]

Voltage	Freq. [MHz]	Output Power				E.I.R.P.		
		Result (B)	Tolerance Result	Limit	Tolerance Limit	Result (B)	Result	Limit
		[W/MHz]	[%]	[W/MHz]	[%]	[W/MHz]	[dBm/MHz]	[dBm/MHz]
DC5V	2412	0.004891	-36.4	0.010000	+20 ~ -80	0.008306	9.19	12.14
	2442	0.006247	-18.8	0.010000	+20 ~ -80	0.010609	10.26	12.14
	2472	0.005023	-34.7	0.010000	+20 ~ -80	0.008530	9.31	12.14

Sample Calculation :

Tolerance = Output Power Result (B) / Declared Output Power \* 100 - 100.

Output Power Result (B) : Sum of all "Output Power (A)" at same Freq.

E.I.R.P. Result (B): Sum of all "E.I.R.P. (A)" at same Freq.

### [Declared Output Power]

Average of Output Power Result (B)	0.005387	[W/MHz]	Average of E.I.R.P. Result(B)	0.009148	[W/MHz]
Declared Output Power	0.007695	[W/MHz]	E.I.R.P. for Declared Output Power	11.16	[dBm/MHz]
+20	0.009234	[W/MHz]			
Middle (Declared Output Power -30%)	0.005387	[W/MHz]			
-80	0.001539	[W/MHz]			

Sample Calculation :

E.I.R.P. for Declared Output Power

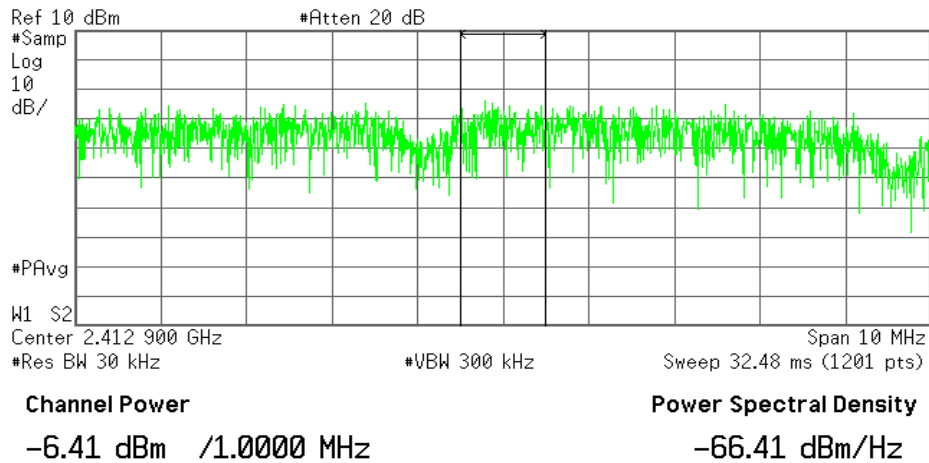
=  $10 * \log (\text{Average of E.I.R.P. Result (B)} * (\text{Declared Output Power} / \text{Average of Output Power Result (B)}) * 1000)$



Tx1\_Power\_Chain0\_Nom

✱ Agilent 18:01:55 Aug 6, 2015

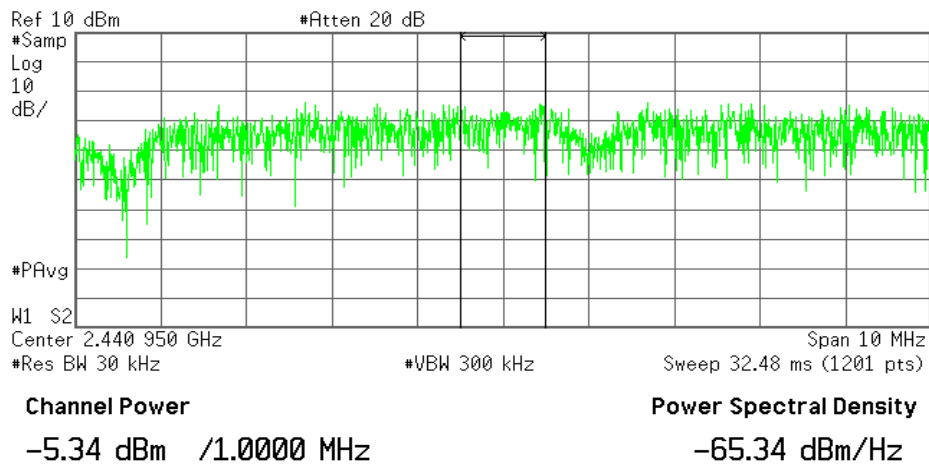
R L

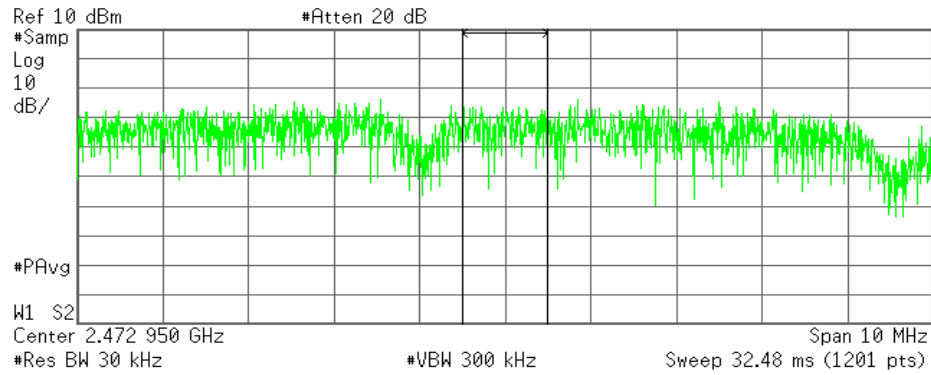


Tx2\_Power\_Chain0\_Nom

✱ Agilent 18:08:11 Aug 6, 2015

R L





Channel Power

-6.29 dBm /1.0000 MHz

Power Spectral Density

-66.29 dBm/Hz

## 2.5. Secondary Radiated Emission Strength

Job No. 15U20917-E29V2

Remark1

Remark2

### [ DATA ]

Voltage	Freq.	Freq.	S/A Reading	Cable Loss	Atten. Loss	Result	Result	Limit	Remark
[V]	[MHz]	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[nW]	[nW]	
DC5V	2442	550.6	-81.64	3.30	10.00	-68.34	0.146	4.000	◆5
		6855.0	-64.25	3.30	10.00	-50.95	8.035	20.000	◆6

The sum of the results exceeding 1/10 of the Limit [nW] : 8.035

Sample Calculation :

Result = Reading + Cable Loss

◆5:Freq Range5 (≥ 30MHz, <1GHz)

◆6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1\_SpuriousM\_Nom

Agilent 18:20:23 Aug 6, 2015

R L

Mkr1 550.6 MHz

-81.64 dBm

Ref 0 dBm

Atten 10 dB

#Peak  
Log  
10  
dB/

LgAv

V1 S2  
S3 FC  
AA

Ⓔ(f):  
FTun  
Swp

Start 30.0 MHz

Stop 1.000 0 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 117 ms (1201 pts)





Ref 0 dBm

Atten 10 dB

#Peak

Log

10

dB/

LgAv

V1 S2

S3 FC

AA

E(f):

FTun

Swp

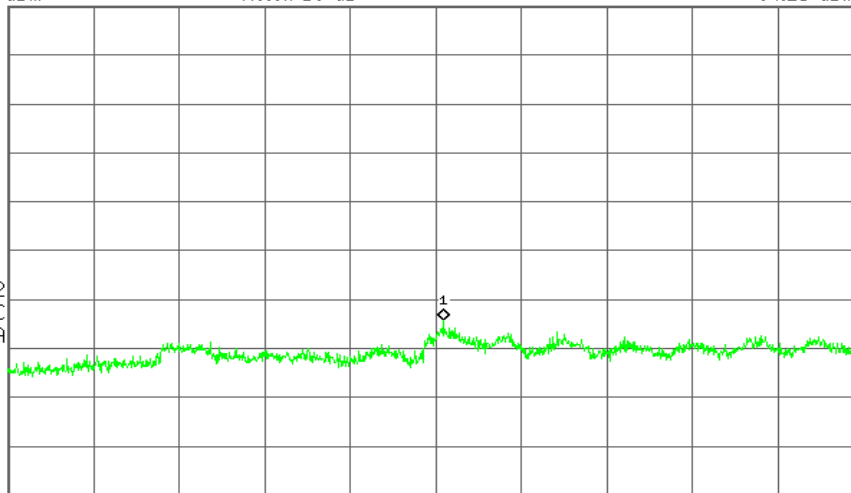
Start 1.000 GHz

Stop 12.500 GHz

#Res BW 1 MHz

#VBW 1 MHz

Sweep 19.2 ms (1201 pts)



## 2.6. Duty / Burst Rate

Job No. 15U20917-E29V2

Remark1

Remark2

### [ DATA ]

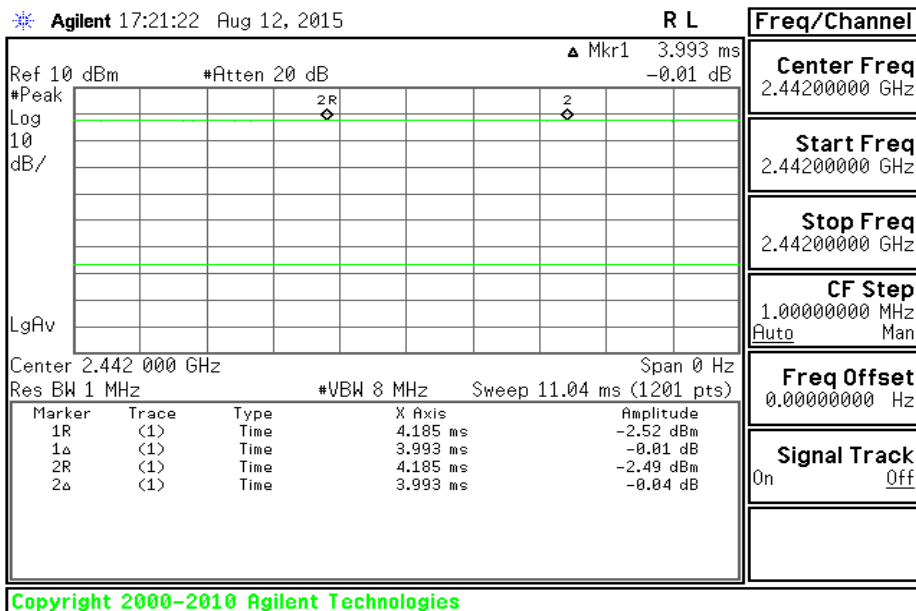
Voltage	Freq.	On Time	Period	Result (Duty)	Result (Burst Rate)
[V]	[MHz]	[msec]	[msec]	[ % ]	
DC5V	2442	1.000	1.000	100.0	1.000

Sample Calculation :

Result(Duty) = On Time / Period \* 100

Result(Burst Rate) = Period / On Time

Tx2\_Duty\_Nom



## Average Power

Job No. 15U20917-E29V2

Remark1

Remark2

### [ DATA ]

Voltage	Port No.	Freq.	Reading	Cable Loss	Atten. Loss	Burst Rate	Output Power Result
		[MHz]	[dBm]	[dB]	[dB]		[dBm]
DC5V	0	2412	1.42	3.30	10.00	1.00	14.72
		2442	2.65	3.30	10.00	1.00	15.95
		2472	1.92	3.30	10.00	1.00	15.22
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-

### Total Output Power

Voltage	Freq.	Power
	[MHz]	[mW]
DC5V	2412	29.65
	2442	39.36
	2472	33.27

### 3. Measurement Equipment

Use	Int. No.	Kind of Equipment	Model No.	Manufacturer	Serial No.	Calibration Authority	Calibration Date
X	T123	Spectrum Analyzer	E4446A	Agilent	MY43360112	Keysight	10/28/2014
X	T1265	Power Meter	N1911A	Keysight	MY55196011	Keysight	7/1/2015
X	T1227	Power Sensor	N1921A	Keysight	MY55200005	Keysight	7/7/2015
X	T910	Hygro-Thermometer	445703	Extech	N/A	SE Labs	5/8/2015

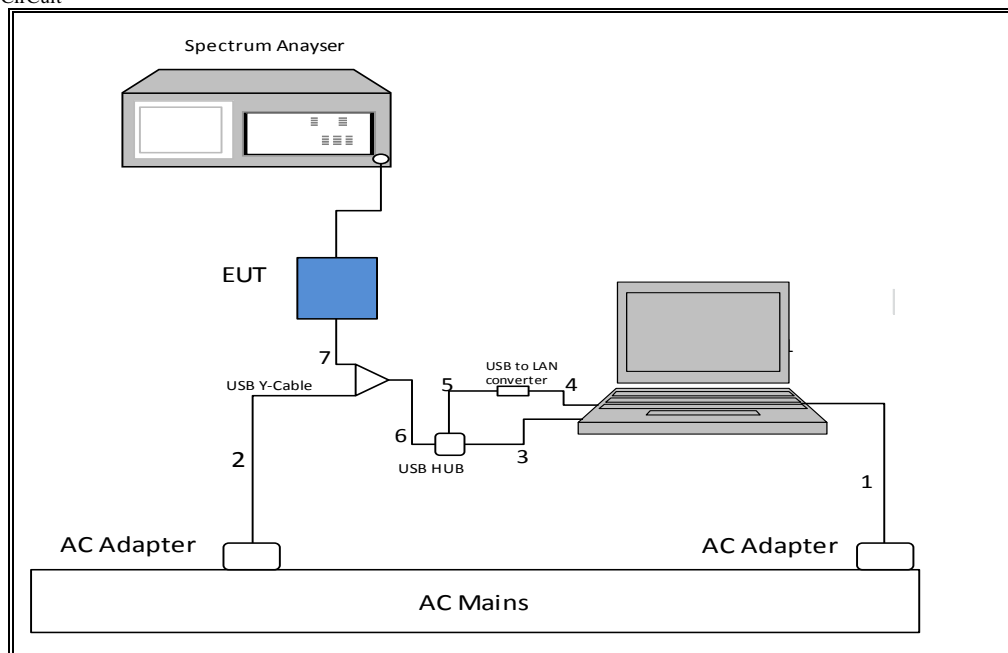
Note : 1. The calibration of measurement equipment is valid for a one year period.  
2. "X" used equipment.  
3. Calibrated per ISO/IEC 17025

### 4. Test Condition

Test Item	Date	Temp	Hum	Engineer	Test Room
Frequency Tolerance	8/6/2015	22	52		Temp Room B
Occupied Bandwidth	8/6/2015	22	52		Temp Room B
Unwanted Emission Strength	8/6/2015	22	52		Temp Room B
Output Power/ E.I.R.P	8/6/2015	22	52		Temp Room B
Secondary Radiated Emission Strength	8/6/2015	22	52		Temp Room B
Burst Length / Duty	8/6/2015	22	52		Temp Room B

## 5. TEST CONFIGURATION

TEST CirCuit



PHOTO

