

TEST REPORT

REPORT NUMBER: 15U20917-E33

COMPANY NAME: Google Inc.

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

MODEL: NC2-6A5

SERIAL NUMBER: PROTO 1

ISSUE DATE: 10-Sep-15

DATE TESTED: 8/6/2015 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

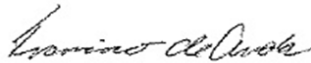
Test Result: Pass

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

Type of radio wave, Frequency and antenna power: G1D, D1D 2412-2472MHz (Interval of 5MHz 13ch) 0.001994W/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-E33
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 : IEEE802.11n HT20
Type of Radio wave : G1D, D1D

Supply Voltage <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% - _____	Modulation <input type="radio"/> DS (e.g. WLAN 11b) <input checked="" 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 <input type="radio"/> No ANT Connector distance - _____
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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-E33

Remark1

Remark2

[DATA]

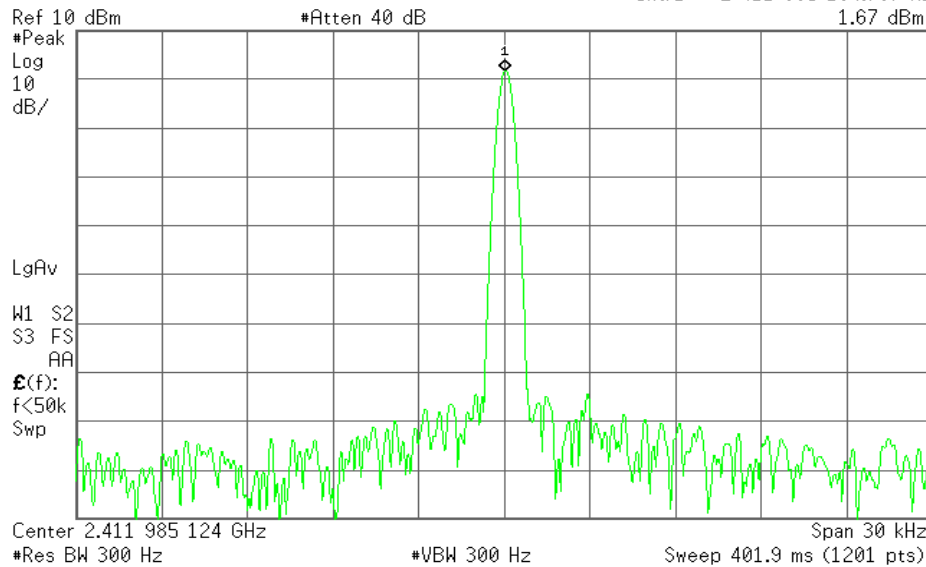
Voltage	Freq. [MHz]	Result [MHz]	Tolerance [kHz]	Tolerance [ppm]	Limit [ppm]
DCSV	2412	2411.9852	-14.8152	-6.14	±50.0
	2442	2441.9850	-14.9765	-6.13	±50.0
	2472	2471.9848	-15.1651	-6.13	±50.0

Tx1_Freq_Nom

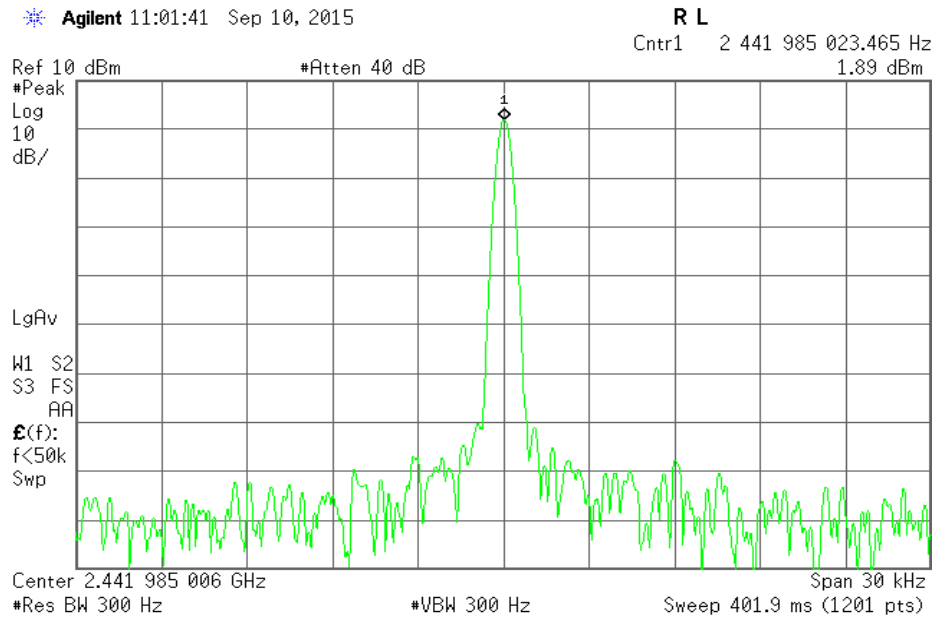
Agilent 11:00:36 Sep 10, 2015

R L

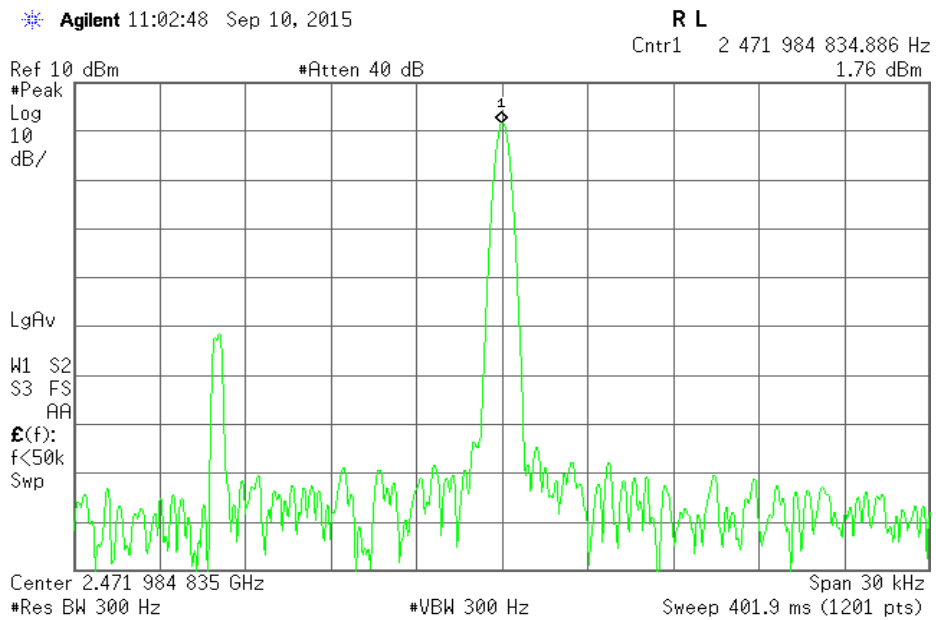
Cntr1 2 411 985 184.797 Hz



Tx2_Freq_Nom



Tx3_Freq_Nom



2.2. Occupied Bandwidth / Spreading Bandwidth

Job No. 15U20917-E33

Remark1

Remark2

[DATA]

99% Occupied Frequency Bandwidth

Voltage	Freq. [MHz]	Result [MHz]	Limit [MHz]
DC5V	2412	17.6532	38
	2442	17.6441	38
	2472	17.6544	38

(Reference data)

Spreading Bandwidth

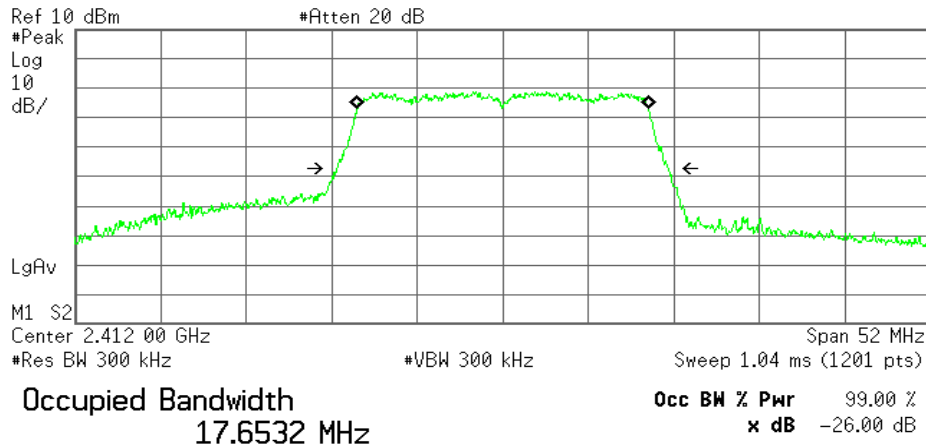
Voltage	Freq. [MHz]	Result [MHz]	Result [kHz]	Limit [kHz]
DC5V	2412	15.7707	15770.7	500
	2442	15.7197	15719.7	500
	2472	15.7885	15788.5	500

99% Occupied Frequency Bandwidth

Tx1_99OBW_Nom

Agilent 23:46:03 Aug 6, 2015

R L



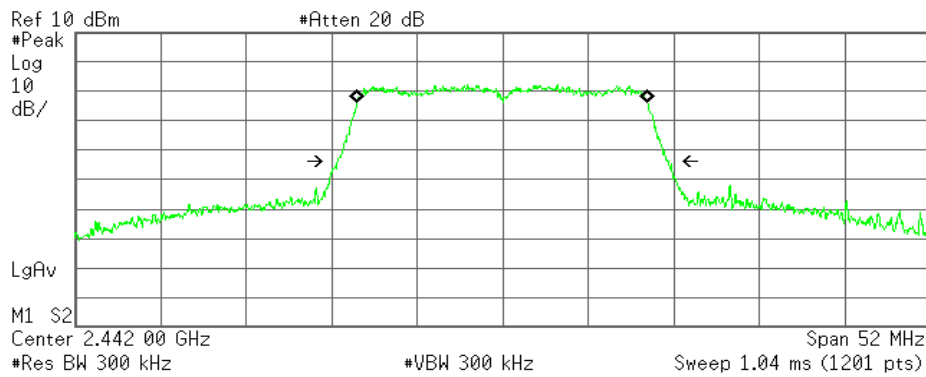
Transmit Freq Error 3.662 kHz

x dB Bandwidth 20.087 MHz

Tx2_99OBW_Nom

Agilent 23:50:49 Aug 6, 2015

R L



Occupied Bandwidth
17.6441 MHz

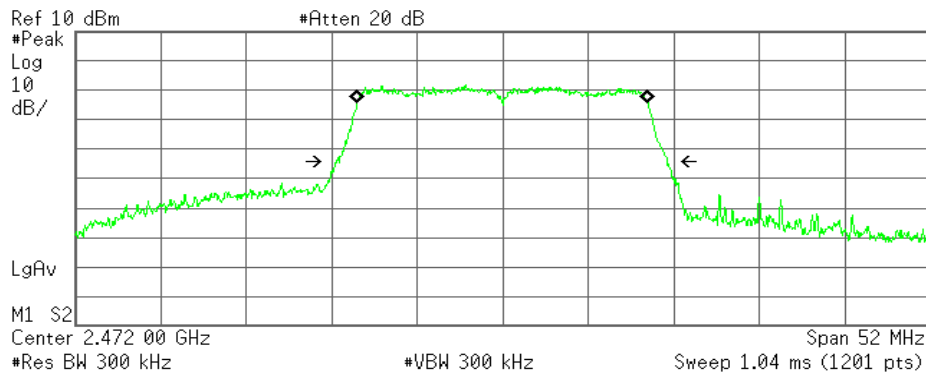
Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -7.131 kHz
x dB Bandwidth 20.102 MHz

Tx3_99OBW_Nom

Agilent 23:56:55 Aug 6, 2015

R L



Occupied Bandwidth
17.6544 MHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

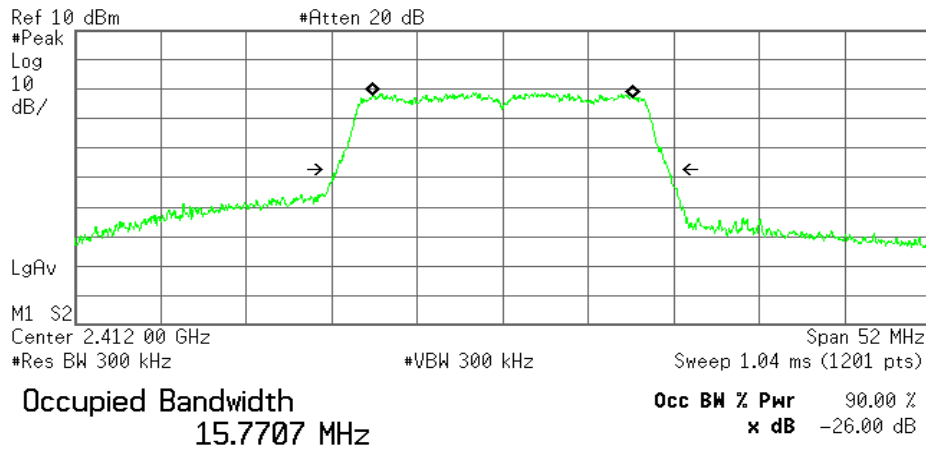
Transmit Freq Error -12.478 kHz
x dB Bandwidth 20.113 MHz

(Reference data)
Spreading Bandwidth

Tx1_900BW_Nom

Agilent 23:46:09 Aug 6, 2015

R L

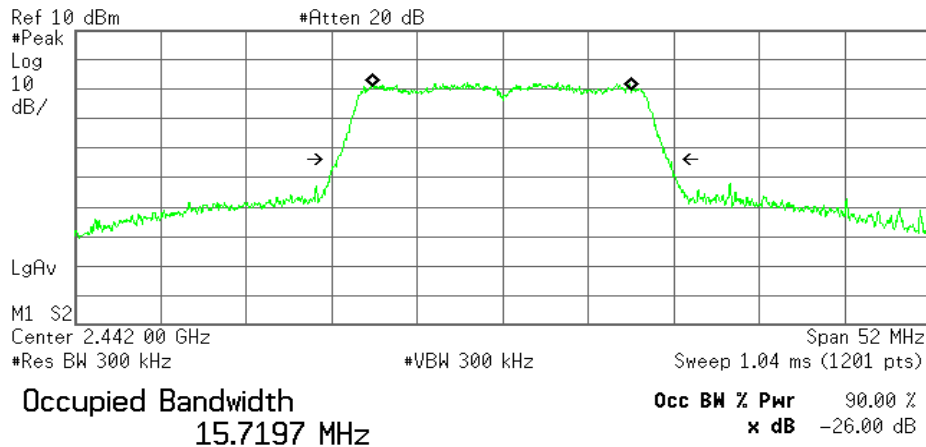


Transmit Freq Error 18.936 kHz
Occupied Bandwidth 20.086 MHz

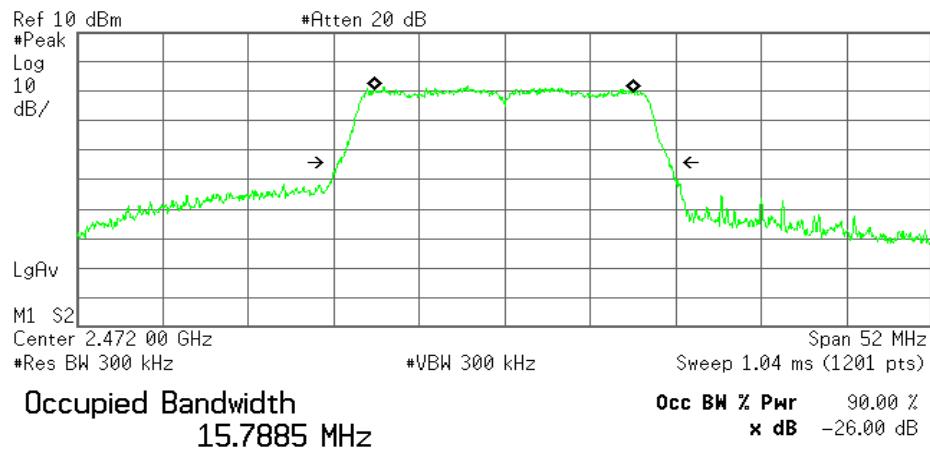
Tx2_900BW_Nom

Agilent 23:50:55 Aug 6, 2015

R L



Transmit Freq Error -48.012 kHz
Occupied Bandwidth 20.101 MHz



Transmit Freq Error -35.761 kHz
Occupied Bandwidth 20.113 MHz

2.3. Unwanted Emission Strength (Normal Voltage)

Job No. 15U20917-E33

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	943.40	-61.53	3.30	10.00	-48.23	0.015	2.500	♣1
		2342.00	-58.81	3.30	10.00	-45.51	0.028	2.500	♣1
		2386.99	-51.76	3.30	10.00	-38.46	0.143	2.500	♣1
		2398.00	-51.78	3.30	10.00	-38.48	0.142	25.000	♣2
		2399.99	-41.87	3.30	10.00	-28.57	1.391	25.000	♣2
		3128.00	-58.60	3.30	10.00	-45.30	0.030	2.500	♣4
		6827.00	-55.63	3.30	10.00	-42.33	0.058	2.500	♣4
	2442	513.40	-61.98	3.30	10.00	-48.68	0.014	2.500	♣1
		2361.00	-55.95	3.30	10.00	-42.65	0.054	2.500	♣1
		2514.00	-56.87	3.30	10.00	-43.57	0.044	2.500	♣4
		6903.00	-55.41	3.30	10.00	-42.11	0.061	2.500	♣4
	2472	464.90	-60.70	3.30	10.00	-47.40	0.018	2.500	♣1
		2399.00	-54.57	3.30	10.00	-41.27	0.075	25.000	♣2
		2483.51	-43.23	3.30	10.00	-29.93	1.016	25.000	♣3
		2485.67	-58.31	3.30	10.00	-45.01	0.032	25.000	♣3
		2496.83	-50.71	3.30	10.00	-37.41	0.182	2.500	♣4
		3405.00	-58.51	3.30	10.00	-45.21	0.030	2.500	♣4
		6884.00	-55.56	3.30	10.00	-42.26	0.059	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 23:47:05 Aug 6, 2015

R L

Mkr1 943.4 MHz

-61.53 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)

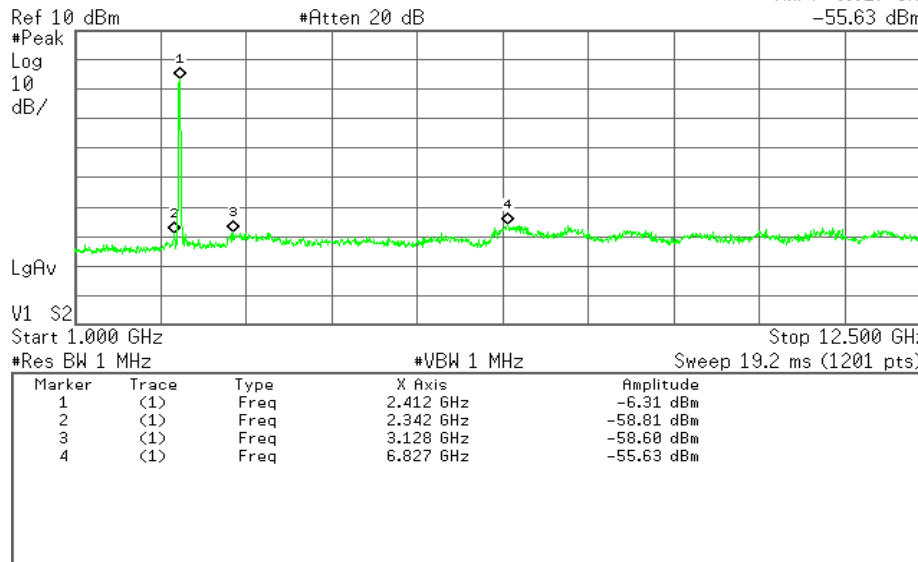
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	943.4 MHz	-61.53 dBm

Tx1_SpuriousG_Nom

Agilent 23:46:53 Aug 6, 2015

R L

Mkr4 6.827 GHz
-55.63 dBm

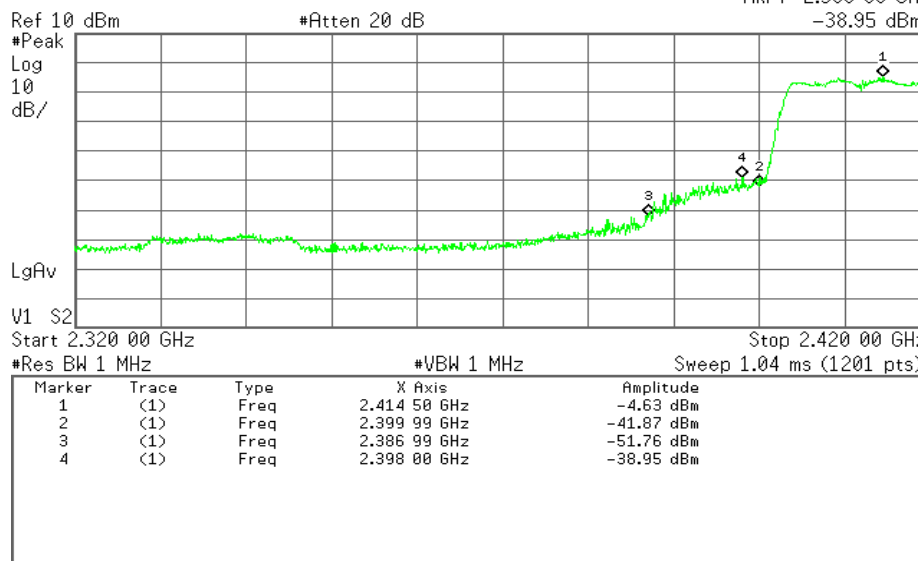


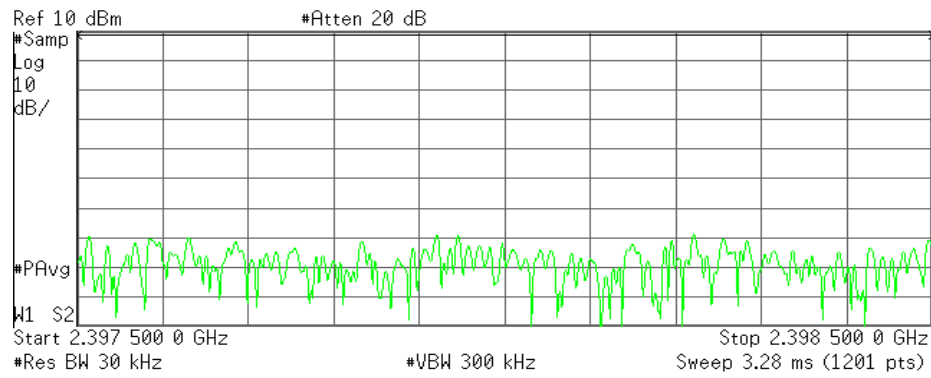
Tx1_BandEdgeLow_Nom

Agilent 23:47:26 Aug 6, 2015

R L

Mkr4 2.398 00 GHz
-38.95 dBm



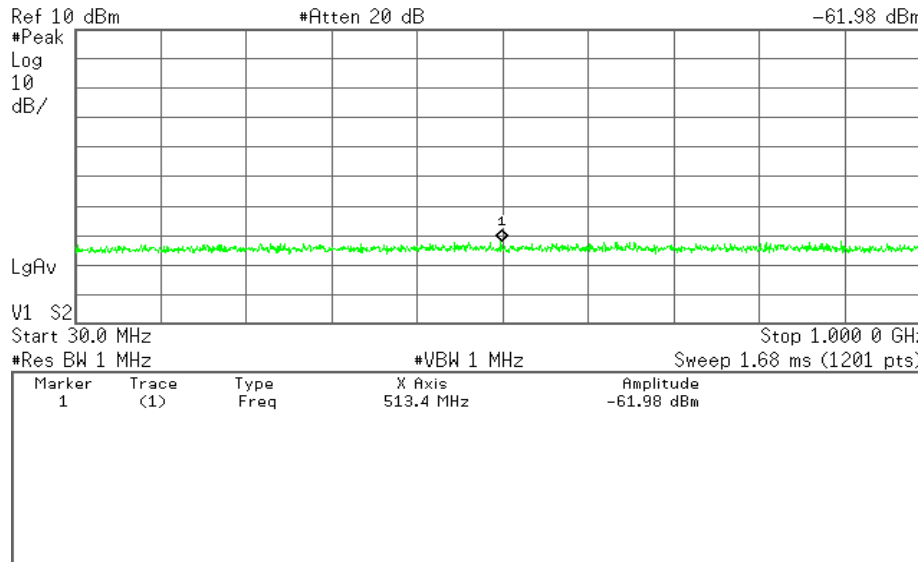
**Channel Power****-51.78 dBm /1.0000 MHz****Power Spectral Density****-111.78 dBm/Hz**

Tx2_SpuriousM_Nom

Agilent 23:51:32 Aug 6, 2015

R L

Mkr1 513.4 MHz
-61.98 dBm

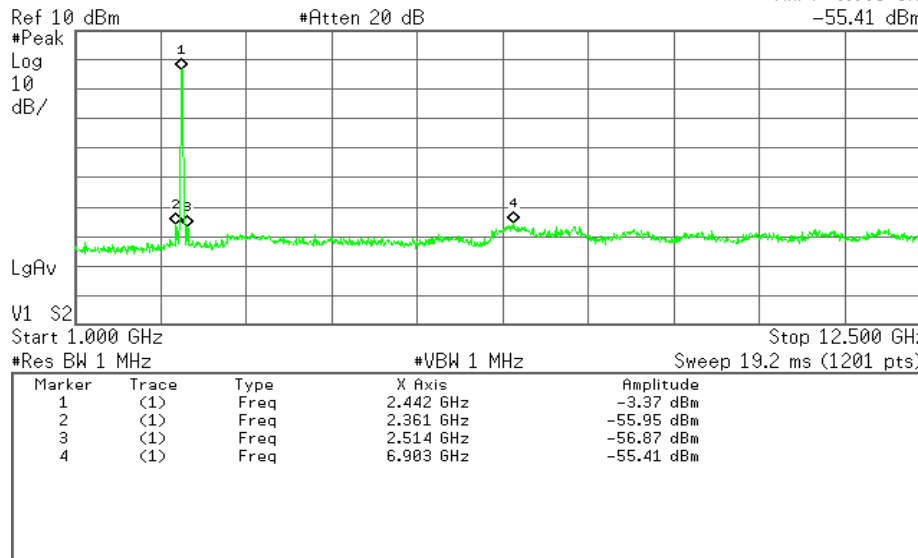


Tx2_SpuriousG_Nom

Agilent 23:51:19 Aug 6, 2015

R L

Mkr4 6.903 GHz
-55.41 dBm

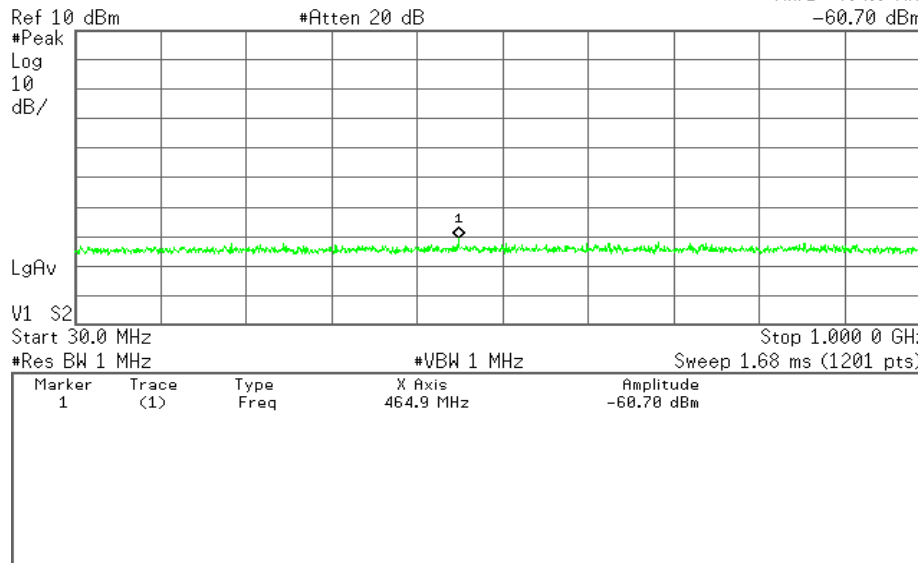


Tx3_SpuriousM_Nom

Agilent 23:58:02 Aug 6, 2015

R L

Mkr1 464.9 MHz
-60.70 dBm

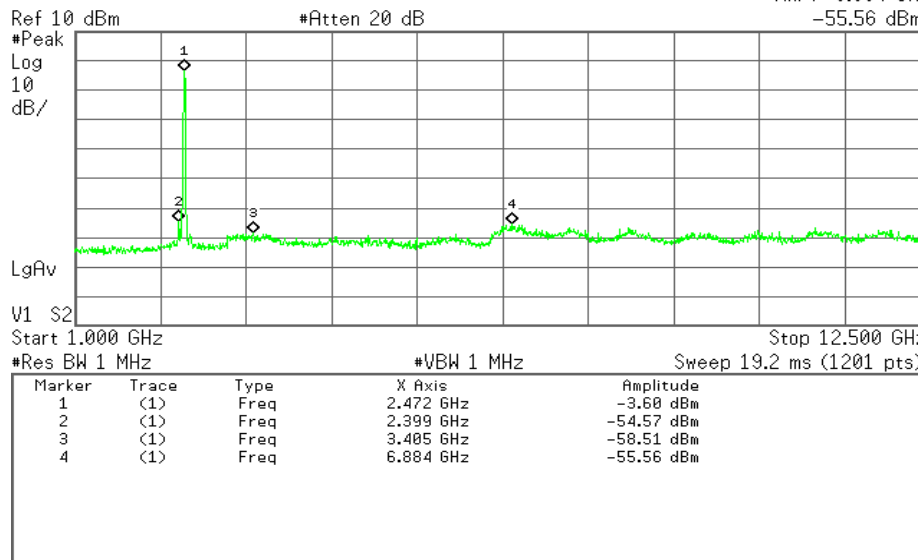


Tx3_SpuriousG_Nom

Agilent 23:57:50 Aug 6, 2015

R L

Mkr4 6.884 GHz
-55.56 dBm

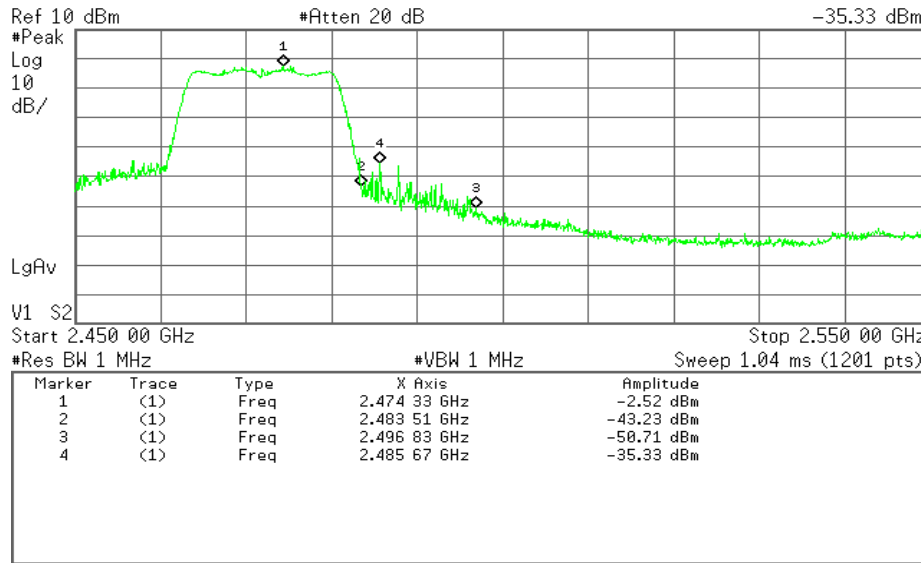


Tx3_BandEdgeHigh_Nom

Agilent 23:58:23 Aug 6, 2015

R L

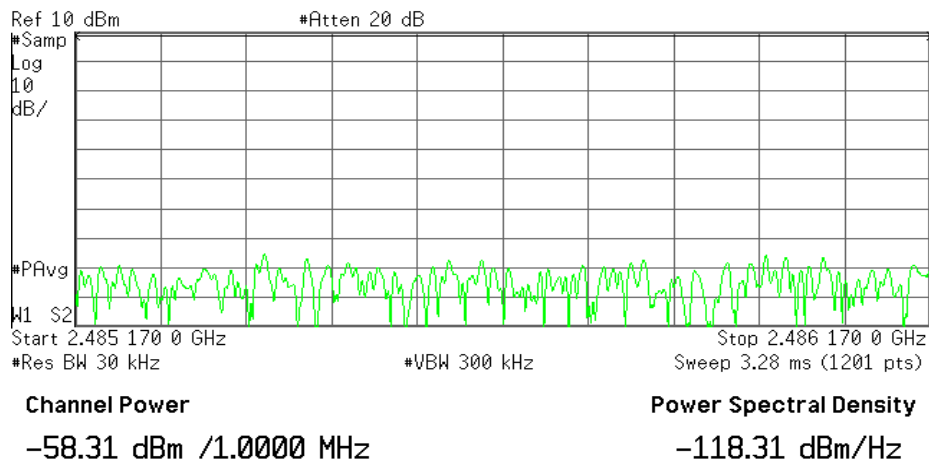
Mkr4 2.485 67 GHz
-35.33 dBm



Tx3_BandEdgeHighZoom_Nom

Agilent 23:58:37 Aug 6, 2015

R L



2.4. Output Power

Job No. 15U20917-E33

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	-14.18	3.30	10.00	0.000816	1.00	0.000820	2.30	0.001392
		2442	-10.76	3.30	10.00	0.001796	1.00	0.001805	2.30	0.003065
		2472	-11.38	3.30	10.00	0.001555	1.00	0.001563	2.30	0.002654
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	0.000820	-58.9	0.010000	+20 ~ -80	0.001392	1.44	12.14
	2442	0.001805	-9.5	0.010000	+20 ~ -80	0.003065	4.86	12.14
	2472	0.001563	-21.6	0.010000	+20 ~ -80	0.002654	4.24	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)	0.001396	[W/MHz]	Average of E.I.R.P. Result(B)	0.002370	[W/MHz]
Declared Output Power	0.001994	[W/MHz]	E.I.R.P. for Declared Output Power	5.30	[dBm/MHz]
+20	0.002393	[W/MHz]			
Middle (Declared Output Power -30%)	0.001396	[W/MHz]			
-80	0.000399	[W/MHz]			

Sample Calculation :

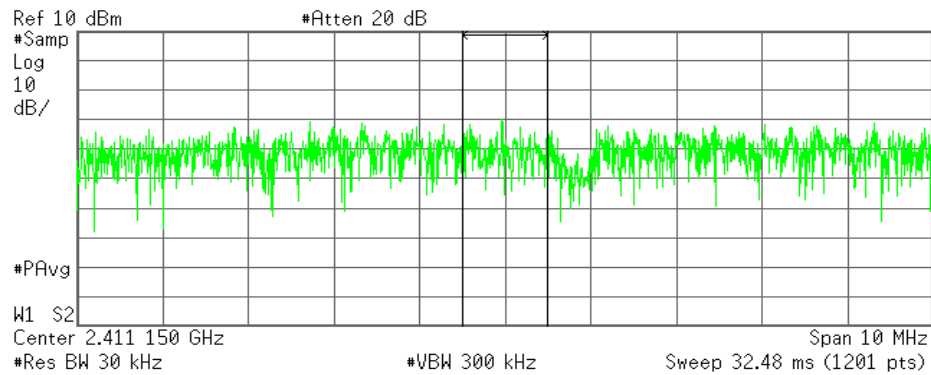
E.I.R.P. for Declared Output Power

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

Tx1_Power_Chain0_Nom

✱ Agilent 23:45:35 Aug 6, 2015

R L



Channel Power

-14.18 dBm /1.0000 MHz

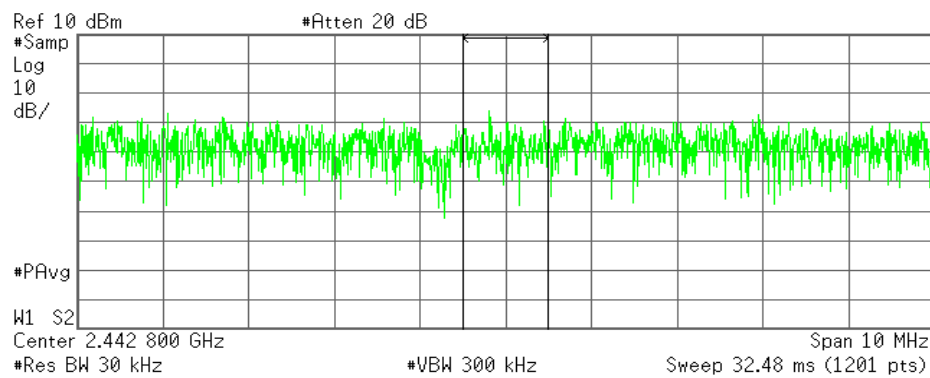
Power Spectral Density

-74.18 dBm/Hz

Tx2_Power_Chain0_Nom

✱ Agilent 23:50:20 Aug 6, 2015

R L

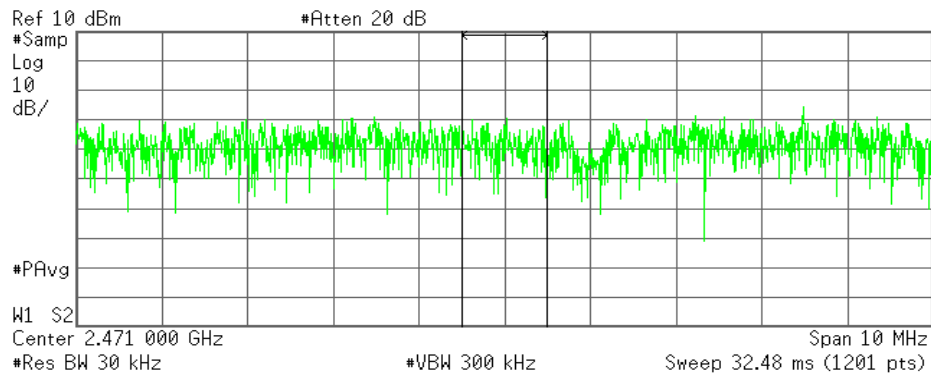


Channel Power

-10.76 dBm /1.0000 MHz

Power Spectral Density

-70.76 dBm/Hz

**Channel Power****-11.38 dBm /1.0000 MHz****Power Spectral Density****-71.38 dBm/Hz**

2.5. Secondary Radiated Emission Strength

Job No. 15U20917-E33

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	613.6	-91.90	3.30	10.00	-78.60	0.014	4.000	◆5
		6808.0	-75.18	3.30	10.00	-61.88	0.649	20.000	◆6

Sample Calculation :

Result = Reading + Cable Loss

◆5:Freq Range5 (≥ 30MHz, <1GHz)

◆6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1_SpuriousM_Nom

Agilent 23:59:42 Aug 6, 2015

R L

Mkr1 613.6 MHz

-91.90 dBm

Ref -10 dBm

#Atten 0 dB

#Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
AA

E(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 -10 dBm

#Atten 0 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-E33

Remark1

Remark2

[DATA]

Voltage	Freq.	On Time	Period	Result (Duty)	Result (Burst Rate)
[V]	[MHz]	[msec]	[msec]	[%]	
DC5V	2442	9.890	9.936	99.5	1.005

Sample Calculation :

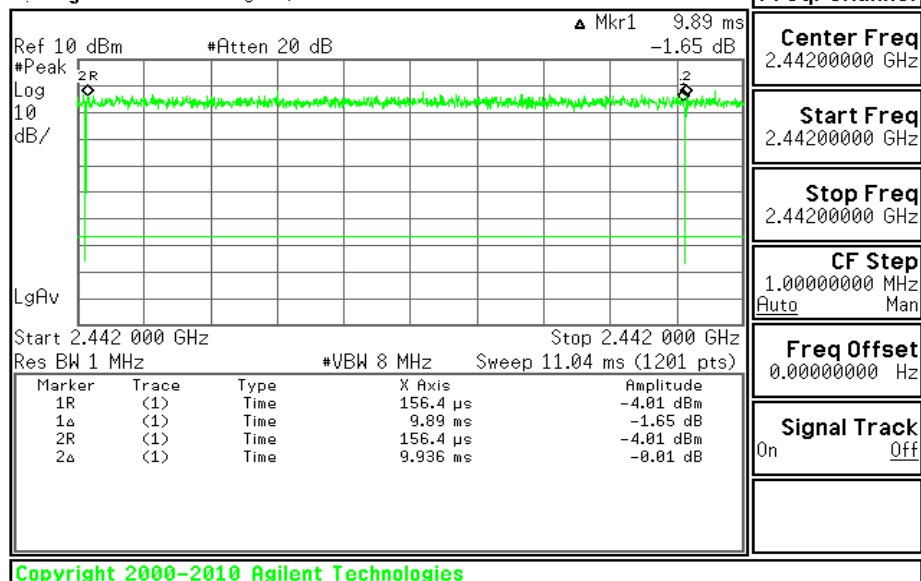
Result(Duty) = On Time / Period * 100

Result(Burst Rate) = Period / On Time

Tx2_Duty_Nom

Agilent 18:57:51 Aug 12, 2015

R L



Average Power

Job No. 15U20917-E33

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	-2.11	3.30	10.00	1.00	11.21
		2442	0.94	3.30	10.00	1.00	14.26
		2472	-0.10	3.30	10.00	1.00	13.22
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-

Total Output Power

Voltage	Freq.	Power
	[MHz]	[mW]
DC5V	2412	13.21
	2442	26.67
	2472	20.99

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

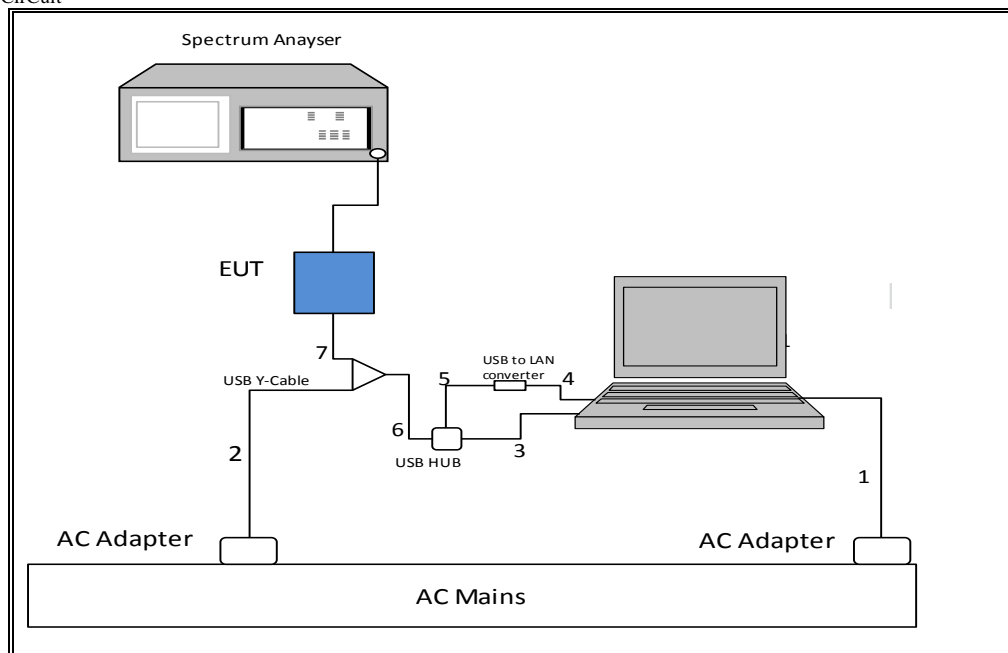
Note : 1. The calibration of measurement equipment is valid for a one year period.
2. "X" used equipment.
3. Calibrated per ISO/IEC 17025

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

