

TEST REPORT

REPORT NUMBER: 15U20917-E35

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: 8/06/2015 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

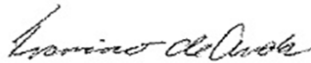
Test Result: Pass

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

Type of radio wave, Frequency and antenna power: G1D, D1D 2422-2462MHz (Interval of 5MHz 9ch) 0.000507W/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-E35
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 HT40
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 type="radio"/> OFDM & OBW ≤ 26MHz (e.g. WLAN 11g, 11n HT20) <input checked="" 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)	2422	3.30	10.00	3.30	10.00
Middle Channel (Tx2)	2442	3.30	10.00	3.30	10.00
High Channel (Tx3)	2462	3.30	10.00	3.30	10.00

2.TEST Result

2.1. Frequency Tolerance

Job No. 15U20917-E35

Remark1

Remark2

[DATA]

Voltage	Freq. [MHz]	Result [MHz]	Tolerance [kHz]	Tolerance [ppm]	Limit [ppm]
DCSV	2422	2421.9852	-14.8054	-6.11	±50.0
	2442	2441.9851	-14.9317	-6.11	±50.0
	2462	2461.9850	-14.9709	-6.08	±50.0

Tx1_Freq_Nom

Agilent 11:09:43 Sep 10, 2015

R L

Cntr1 2 421 985 194.644 Hz

Ref 10 dBm

#Atten 40 dB

-0.58 dBm

#Peak
Log
10
dB/

LgRv

W1 S2
S3 FS
AA

E(f):
f<50k
Swp

Center 2.421 985 109 GHz

#Res BW 300 Hz

#VBW 300 Hz

Sweep 401.9 ms (1201 pts)

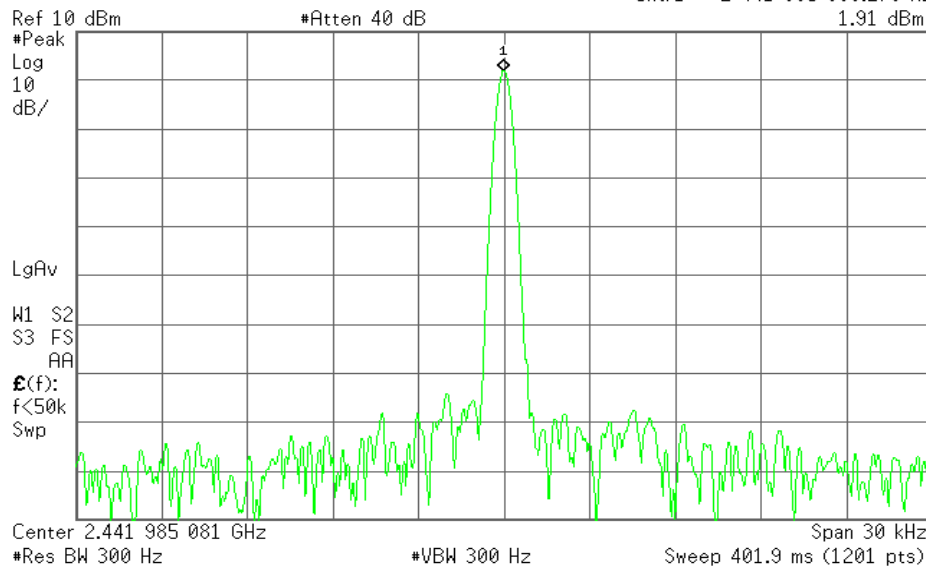
Span 30 kHz

Tx2_Freq_Nom

Agilent 11:11:50 Sep 10, 2015

R L

Cntr1 2 441 985 068.279 Hz

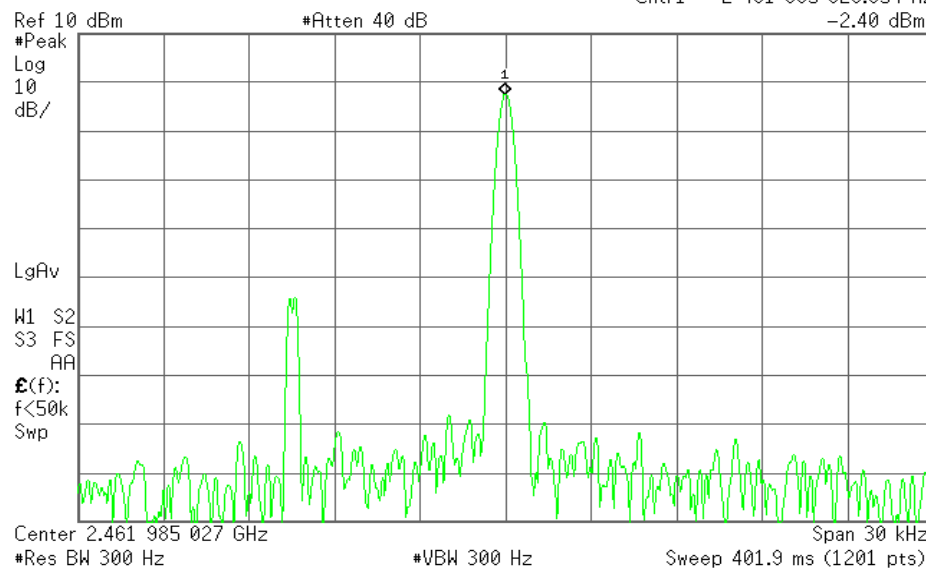


Tx3_Freq_Nom

Agilent 11:13:41 Sep 10, 2015

R L

Cntr1 2 461 985 029.054 Hz



2.2. Occupied Bandwidth / Spreading Bandwidth

Job No. 15U20917-E35

Remark1

Remark2

[DATA]

99% Occupied Frequency Bandwidth

Voltage	Freq. [MHz]	Result [MHz]	Limit [MHz]
DC5V	2422	36.0096	38
	2442	36.0032	38
	2462	36.0144	38

(Reference data)

Spreading Bandwidth

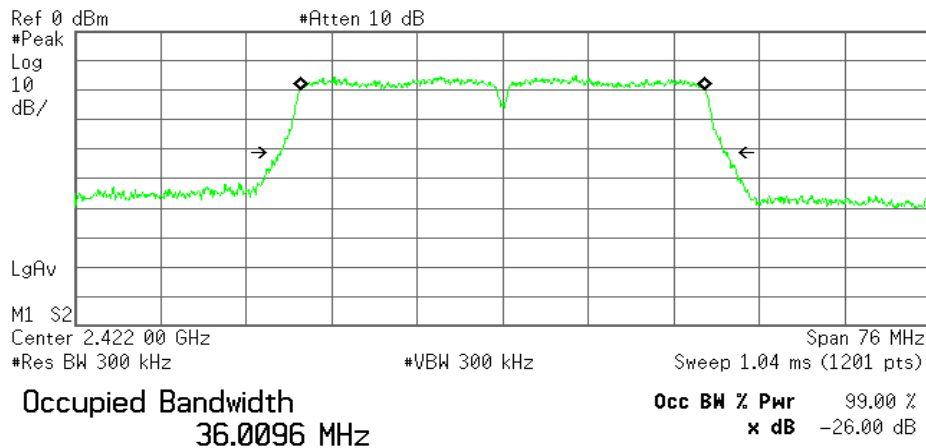
Voltage	Freq. [MHz]	Result [MHz]	Result [kHz]	Limit [kHz]
DC5V	2422	32.3286	32328.6	500
	2442	32.3184	32318.4	500
	2462	32.3356	32335.6	500

99% Occupied Frequency Bandwidth

Tx1_99OBW_Nom

Agilent 21:30:09 Aug 11, 2015

R L



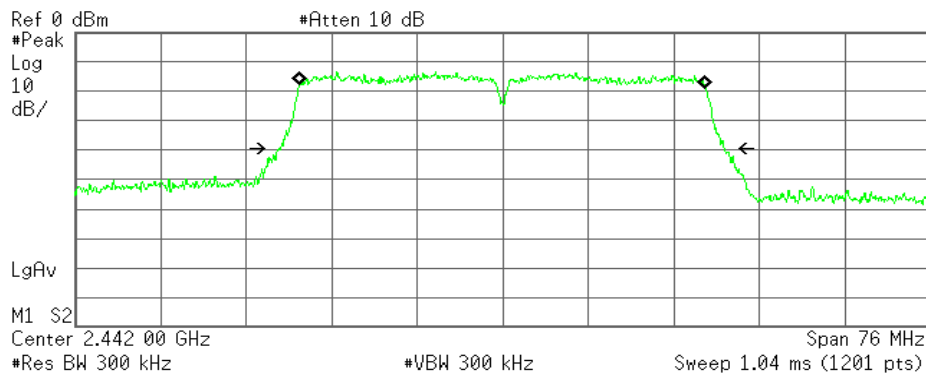
Transmit Freq Error -14.075 kHz

x dB Bandwidth 39.459 MHz

Tx2_99OBW_Nom

Agilent 21:33:55 Aug 11, 2015

R L



Occupied Bandwidth
36.0032 MHz

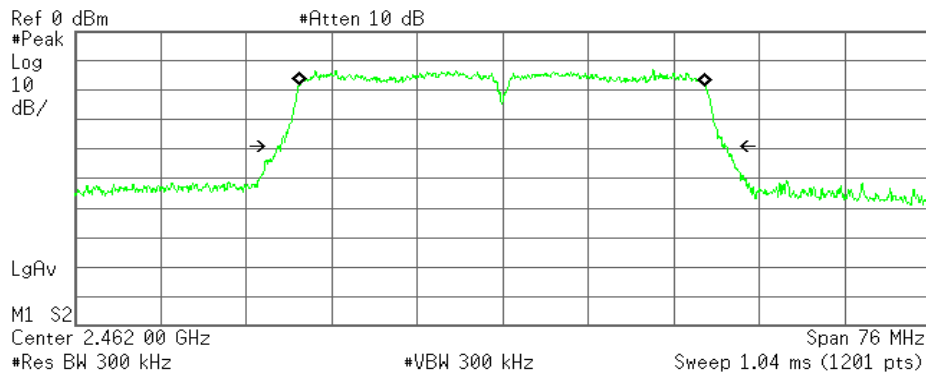
Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -32.637 kHz
x dB Bandwidth 39.546 MHz

Tx3_99OBW_Nom

Agilent 21:36:36 Aug 11, 2015

R L



Occupied Bandwidth
36.0144 MHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

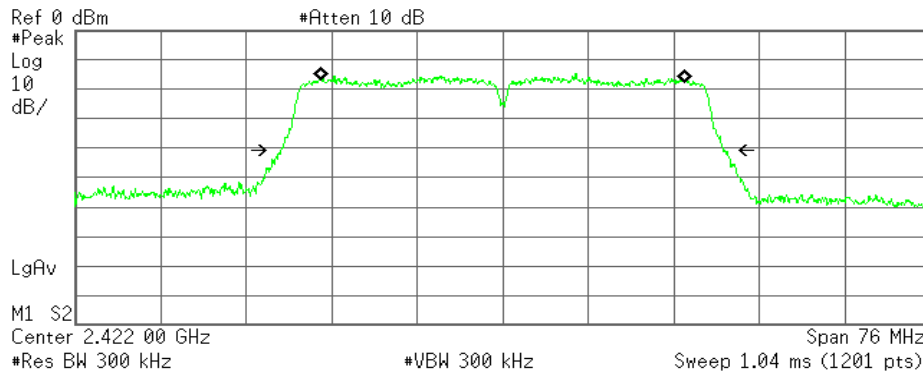
Transmit Freq Error -21.171 kHz
x dB Bandwidth 39.809 MHz

(Reference data)
Spreading Bandwidth

Tx1_900BW_Nom

Agilent 21:30:15 Aug 11, 2015

R L



Occupied Bandwidth
32.3286 MHz

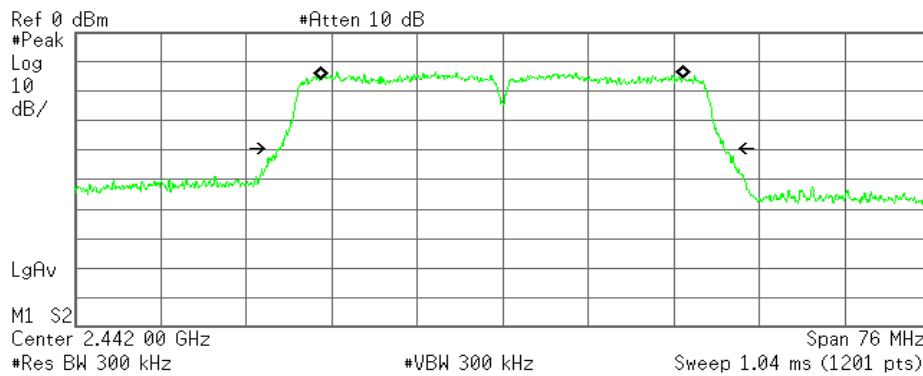
Occ BW % Pwr 90.00 %
x dB -26.00 dB

Transmit Freq Error -40.468 kHz
Occupied Bandwidth 39.446 MHz

Tx2_900BW_Nom

Agilent 21:34:01 Aug 11, 2015

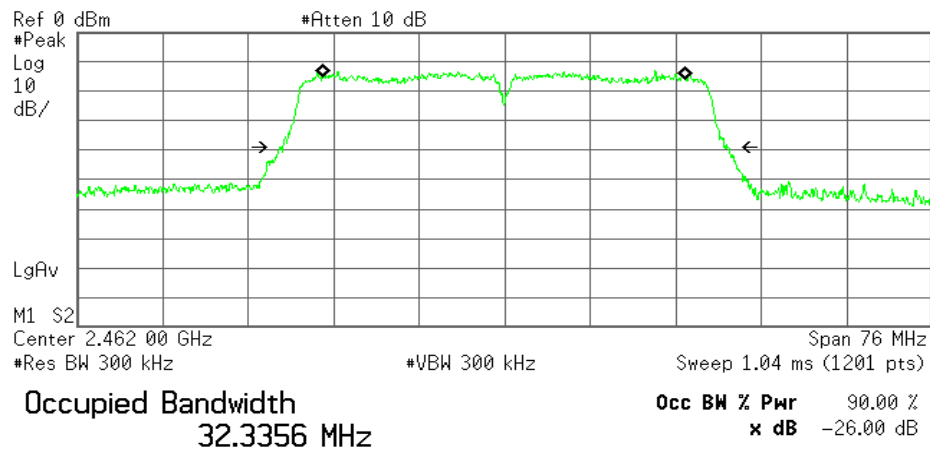
R L



Occupied Bandwidth
32.3184 MHz

Occ BW % Pwr 90.00 %
x dB -26.00 dB

Transmit Freq Error -78.244 kHz
Occupied Bandwidth 39.546 MHz



Transmit Freq Error -60.213 kHz
Occupied Bandwidth 39.809 MHz

2.3. Unwanted Emission Strength (Normal Voltage)

Job No. 15U20917-E35

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	2422	87.40	-71.94	3.30	10.00	-58.64	0.001	2.500	♣1
		2342.00	-62.92	3.30	10.00	-49.62	0.011	2.500	♣1
		2384.50	-47.14	3.30	10.00	-33.84	0.413	2.500	♣1
		2395.92	-58.12	3.30	10.00	-44.82	0.033	25.000	♣2
		2399.99	-45.38	3.30	10.00	-32.08	0.619	25.000	♣2
		2498.00	-61.62	3.30	10.00	-48.32	0.015	2.500	♣4
		7018.00	-65.45	3.30	10.00	-52.15	0.006	2.500	♣4
	2442	44.60	-70.58	3.30	10.00	-57.28	0.002	2.500	♣1
		2366.00	-58.42	3.30	10.00	-45.12	0.031	2.500	♣1
		2518.00	-61.01	3.30	10.00	-47.71	0.017	2.500	♣4
		7612.00	-66.05	3.30	10.00	-52.75	0.005	2.500	♣4
	2462	387.30	-71.43	3.30	10.00	-58.13	0.002	2.500	♣1
		2386.00	-58.90	3.30	10.00	-45.60	0.028	2.500	♣1
		2483.51	-41.93	3.30	10.00	-28.63	1.371	25.000	♣3
		2483.75	-57.19	3.30	10.00	-43.89	0.041	25.000	♣3
		2496.75	-45.29	3.30	10.00	-31.99	0.633	2.500	♣4
		2538.00	-59.45	3.30	10.00	-46.15	0.024	2.500	♣4
		6836.00	-65.27	3.30	10.00	-51.97	0.006	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)

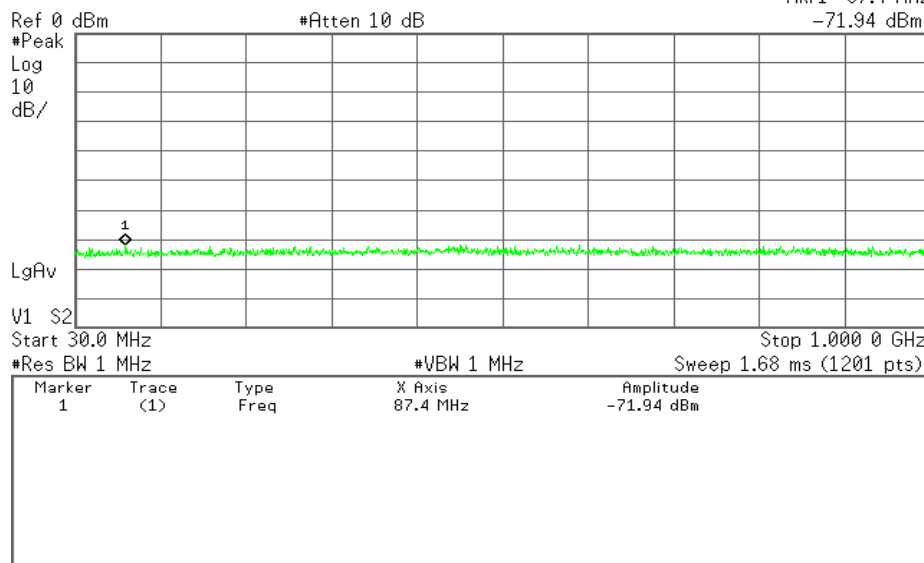
Tx1_SpuriousM_Nom

Agilent 21:30:53 Aug 11, 2015

R L

Mkr1 87.4 MHz

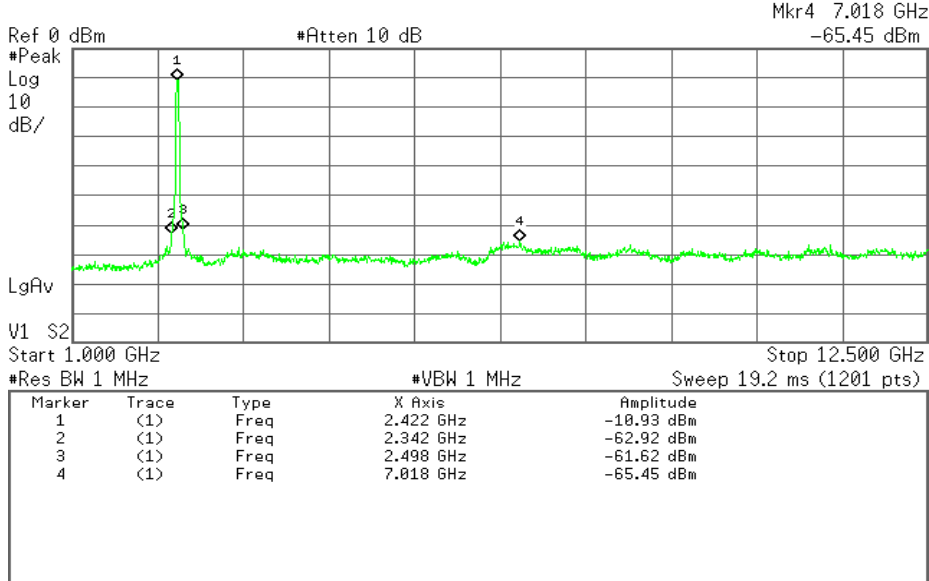
-71.94 dBm



Tx1_SpuriousG_Nom

Agilent 21:30:40 Aug 11, 2015

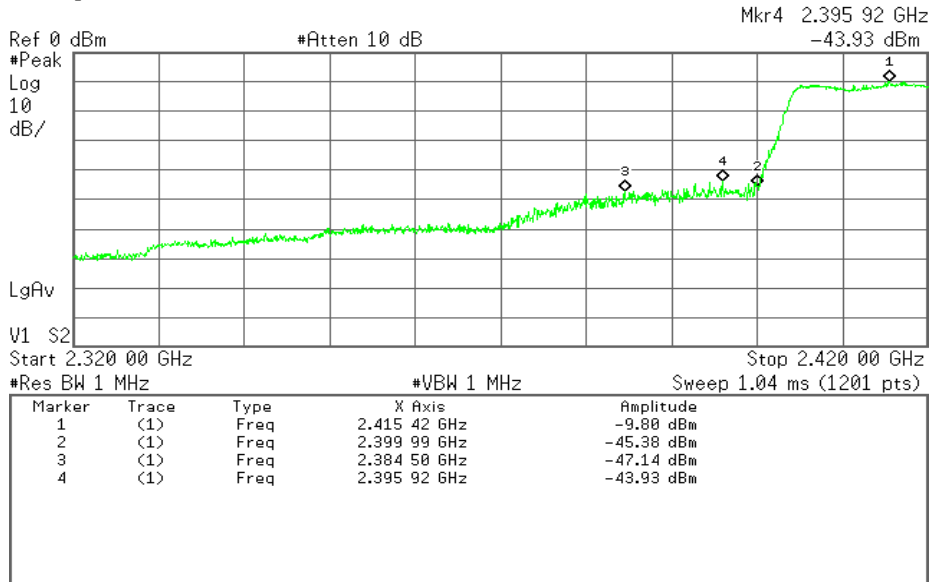
R L



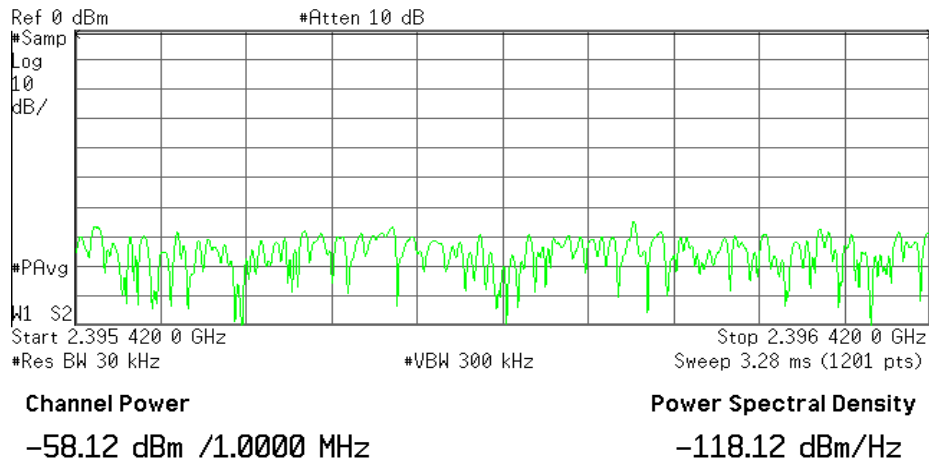
Tx1_BandEdgeLow_Nom

Agilent 21:31:35 Aug 11, 2015

R L



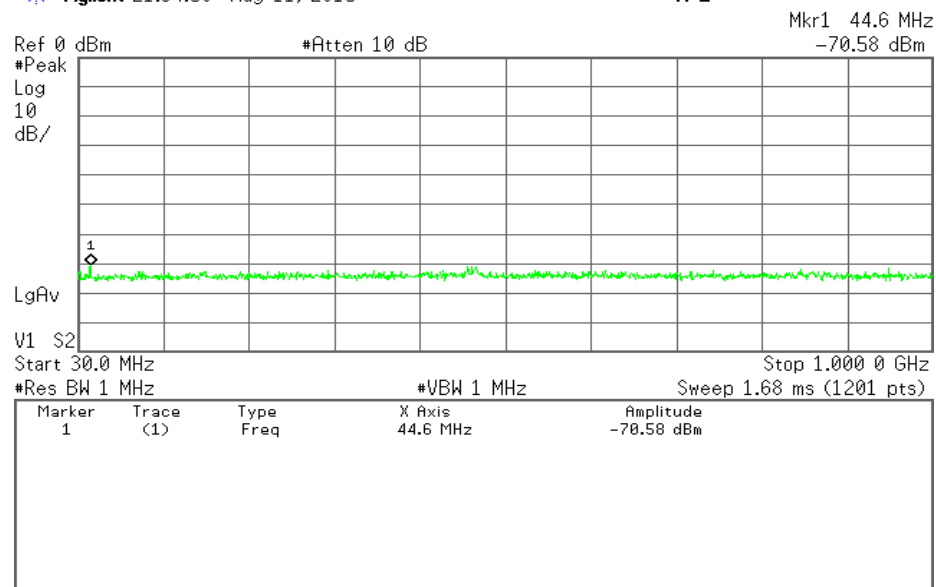
R L



Tx2_SpuriousM_Nom

Agilent 21:34:59 Aug 11, 2015

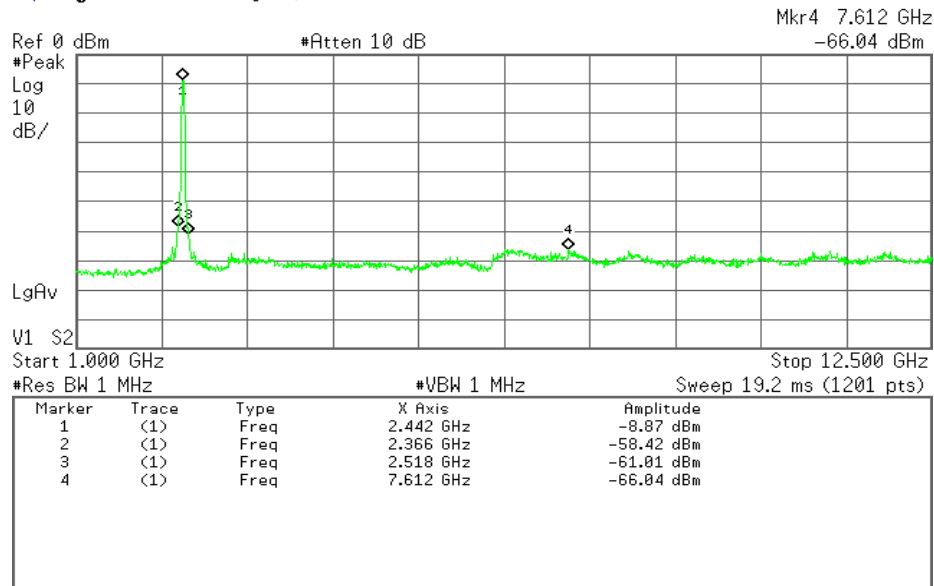
R L



Tx2_SpuriousG_Nom

Agilent 21:34:46 Aug 11, 2015

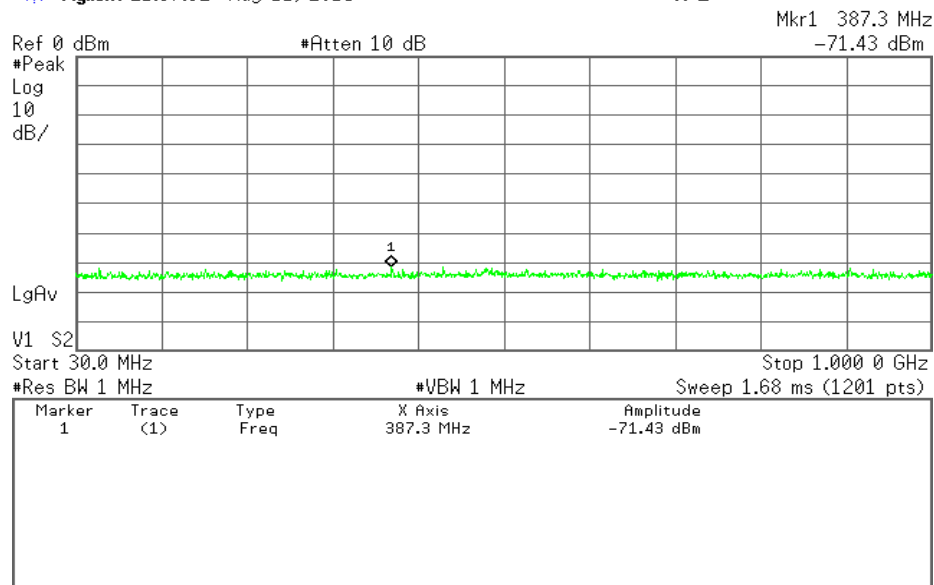
R L



Tx3_SpuriousM_Nom

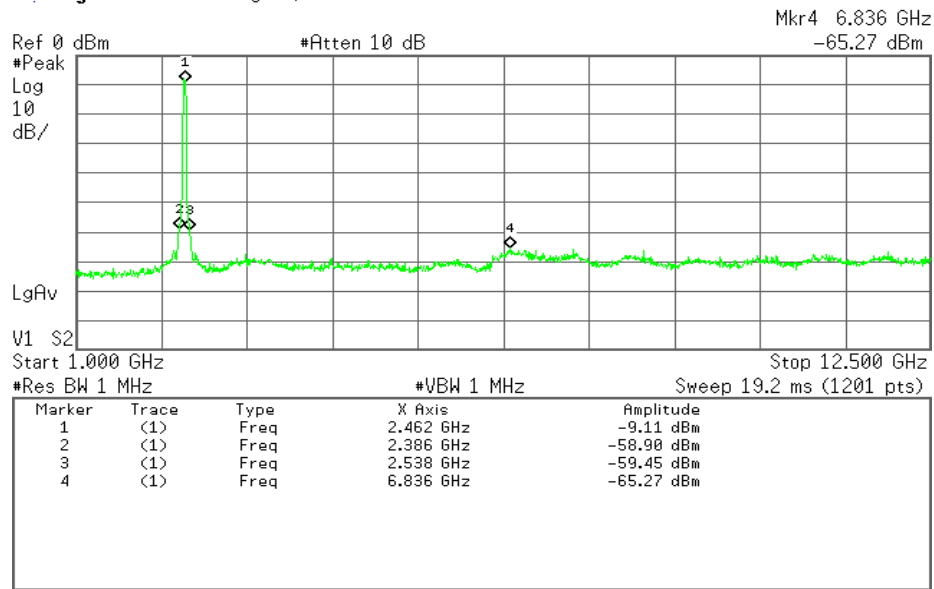
Agilent 21:37:32 Aug 11, 2015

R L



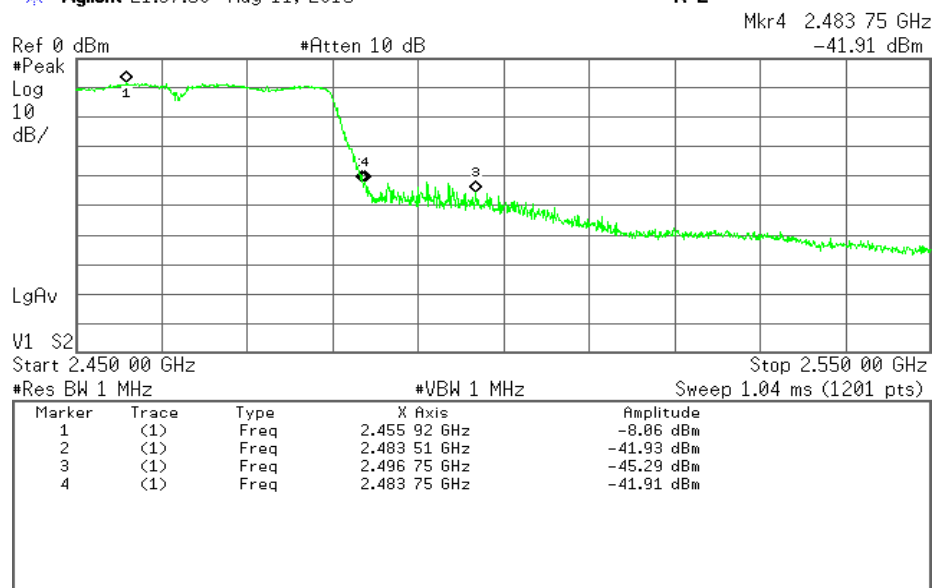
Agilent 21:37:19 Aug 11, 2015

R L



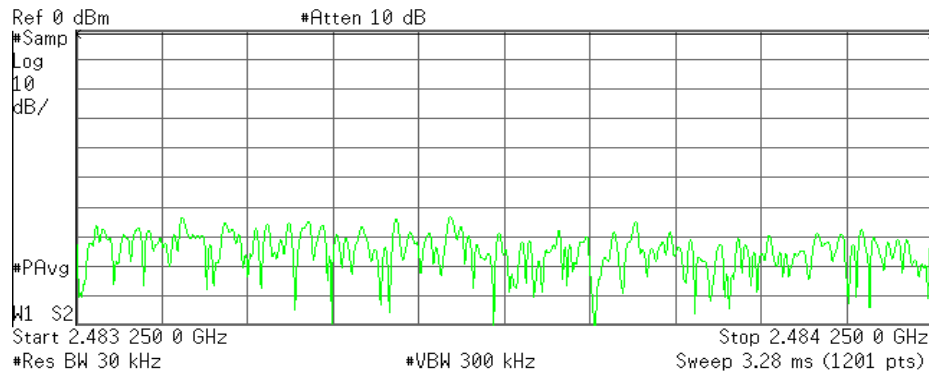
Agilent 21:37:56 Aug 11, 2015

R L



* Agilent 21:38:09 Aug 11, 2015

R L

**Channel Power****-57.19 dBm /1.0000 MHz****Power Spectral Density****-117.19 dBm/Hz**

2.4. Output Power

Job No. 15U20917-E35

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	2422	-19.39	3.30	10.00	0.000246	1.01	0.000249	2.30	0.000423
		2442	-17.28	3.30	10.00	0.000400	1.01	0.000405	2.30	0.000688
		2462	-17.21	3.30	10.00	0.000406	1.01	0.000411	2.30	0.000698
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	2422	0.000249	-50.9	0.010000	+20 ~ -80	0.000423	-3.74	12.14
	2442	0.000405	-20.1	0.010000	+20 ~ -80	0.000688	-1.62	12.14
	2462	0.000411	-19.0	0.010000	+20 ~ -80	0.000698	-1.56	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)	0.000355	[W/MHz]	Average of E.I.R.P. Result(B)	0.000603	[W/MHz]
Declared Output Power	0.000507	[W/MHz]	E.I.R.P. for Declared Output Power	-0.65	[dBm/MHz]
+20	0.000609	[W/MHz]			
Middle (Declared Output Power -30%)	0.000355	[W/MHz]			
-80	0.000101	[W/MHz]			

Sample Calculation :

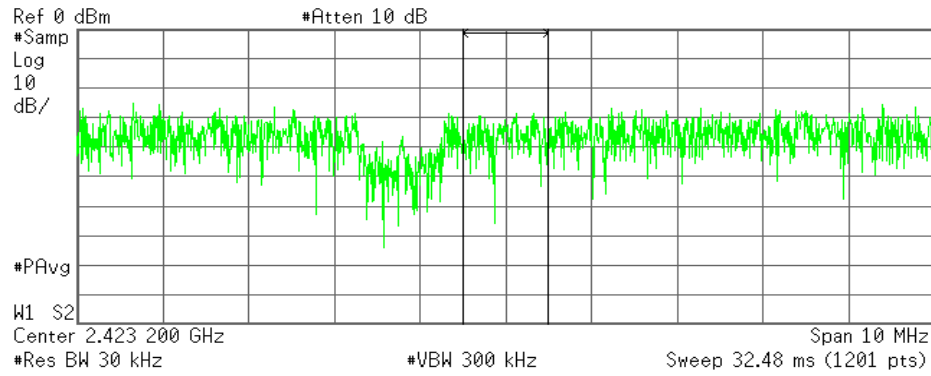
E.I.R.P. for Declared Output Power

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

Tx1_Power_Chain0_Nom

✧ Agilent 21:29:26 Aug 11, 2015

R L



Channel Power

-19.39 dBm /1.0000 MHz

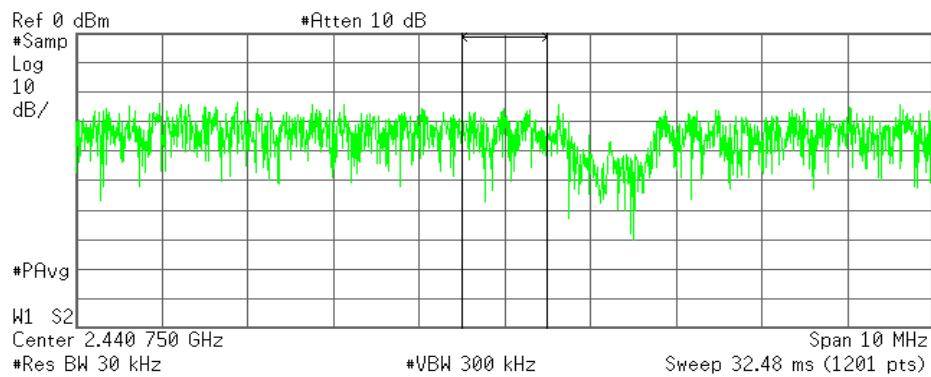
Power Spectral Density

-79.39 dBm/Hz

Tx2_Power_Chain0_Nom

✧ Agilent 21:33:23 Aug 11, 2015

R L

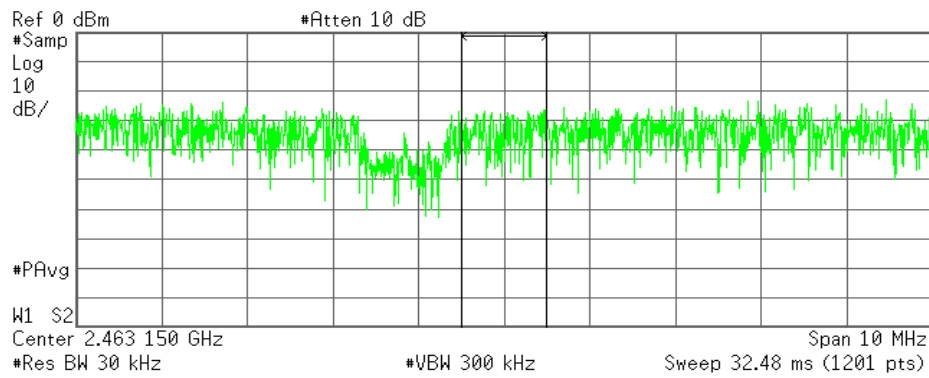


Channel Power

-17.28 dBm /1.0000 MHz

Power Spectral Density

-77.28 dBm/Hz



Channel Power

-17.21 dBm /1.0000 MHz

Power Spectral Density

-77.21 dBm/Hz

2.5. Secondary Radiated Emission Strength

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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	498.0	-91.89	3.30	10.00	-78.59	0.014	4.000	◆5
		6980.0	-75.67	3.30	10.00	-62.37	0.580	20.000	◆6

Sample Calculation :

Result = Reading + Cable Loss

◆5:Freq Range5 (≥ 30MHz, <1GHz)

◆6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1_SpuriousM_Nom

Agilent 21:39:38 Aug 11, 2015

R L

Mkr1 498.0 MHz

-91.89 dBm

Ref -20 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)

Rx1_SpuriousG_Nom

Agilent 21:39:26 Aug 11, 2015

R L

Mkr1 6.980 GHz

-75.67 dBm

Ref -20 dBm

#Atten 0 dB

#Peak
Log
10
dB/

LgAv

V1 S2

S3 FC

RA

E(f):

FTun

Swp

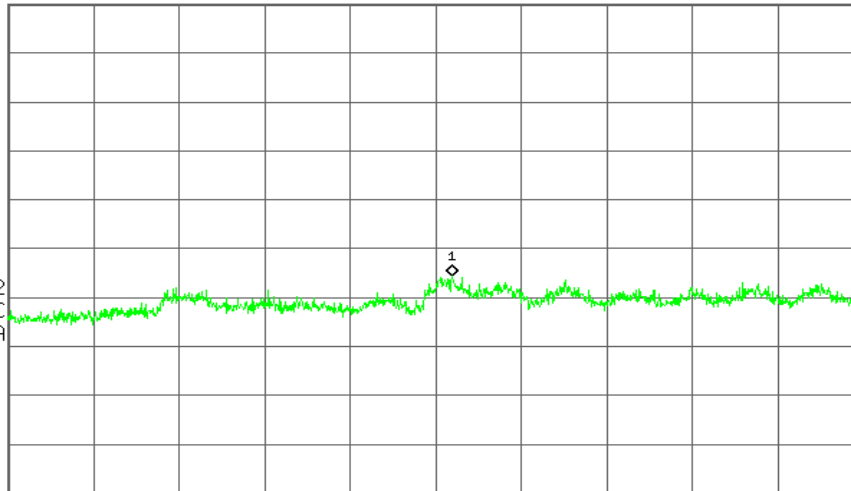
Start 1.000 GHz

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-E35

Remark1

Remark2

[DATA]

Voltage	Freq.	On Time	Period	Result (Duty)	Result (Burst Rate)
[V]	[MHz]	[msec]	[msec]	[%]	
DC5V	2442	4.754	4.813	98.8	1.012

Sample Calculation :

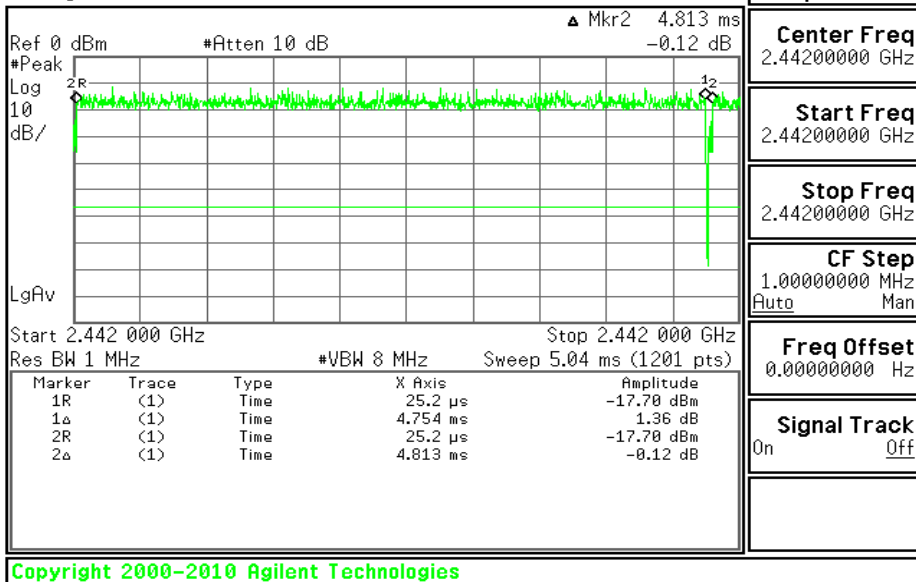
Result(Duty) = On Time / Period * 100

Result(Burst Rate) = Period / On Time

Tx2_Duty_Nom

Agilent 21:45:02 Aug 11, 2015

R L



Average Power

Job No. 15U20917-E35

Remark1

Remark2

[DATA]

Voltage	Port No.	Freq.	Reading	Cable Loss	Atten. Loss	Burst Rate	Output Power Result
		[MHz]	[dBm]	[dB]	[dB]		[dBm]
DC5V	0	2422	-3.86	3.30	10.00	1.01	9.49
		2442	-2.66	3.30	10.00	1.01	10.69
		2462	-1.94	3.30	10.00	1.01	11.41
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-

Total Output Power

Voltage	Freq.	Power
	[MHz]	[mW]
DC5V	2422	8.90
	2442	11.73
	2462	13.85

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

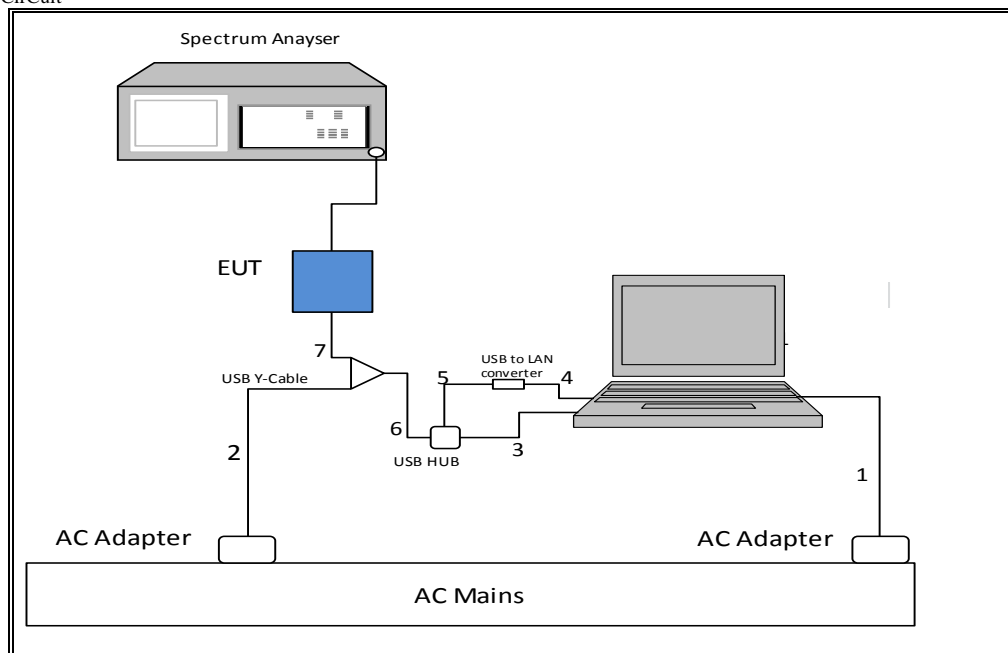
Note : 1. The calibration of measurement equipment is valid for a one year period.
2. "X" used equipment.
3. Calibrated per ISO/IEC 17025

4. Test Condition

Test Item	Date	Temp	Hum	Engineer	Test Room
Frequency Tolerance	8/11/2015	21.9	51		Temp Room B
Occupied Bandwidth	8/11/2015	21.9	51		Temp Room B
Unwanted Emission Strength	8/11/2015	21.9	51		Temp Room B
Output Power/ E.I.R.P	8/11/2015	21.9	51		Temp Room B
Secondary Radiated Emission Strength	8/11/2015	21.9	51		Temp Room B
Burst Length / Duty	8/11/2015	21.9	51		Temp Room B

5. TEST CONFIGURATION

TEST CirCuit



PHOTO

