

TEST REPORT

REPORT NUMBER: 15U20917-E53V2

COMPANY NAME: Google Inc.

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

MODEL: NC2-6A5

SERIAL NUMBER: PROTO 1

ISSUE DATE: 12-Nov-15

DATE TESTED: 8/06/2015 to 9/3/2015

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

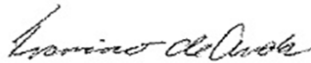
Test Result: Pass

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

Type of radio wave, Frequency and antenna power: FID 2402-2480MHz (Interval of 2MHz 40ch) 0.004526W

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-E53V2
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 :	BLE
Type of Radio wave :	FID

Supply Voltage	Modulation
<input checked="" type="radio"/> DC <input type="radio"/> AC 5.00V	<input type="radio"/> DS (e.g. WLAN 11b)
	<input type="radio"/> OFDM & OBW \leq 26MHz (e.g. WLAN 11g, 11n HT20)
	<input type="radio"/> OFDM & OBW 26-38MHz (e.g. WLAN 11n HT40)
Voltage Condition	<input checked="" type="radio"/> Other Modulation (e.g. GFSK, Not BT)
<input checked="" type="radio"/> Non-Extreme <input type="radio"/> Extreme	EUT has
Normal DC5V	<input checked="" type="radio"/> ANT Connector
Normal-10% -	<input type="radio"/> No ANT Connector distance -
Normal+10% -	

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)	2402	3.30	10.00	3.30	10.00
Middle Channel (Tx2)	2440	3.30	10.00	3.30	10.00
High Channel (Tx3)	2480	3.30	10.00	3.30	10.00

2.TEST Result

2.1. Frequency Tolerance

Job No. 15U20917-E53V2

Remark1

Remark2

[DATA]

Voltage	Freq. [MHz]	Result [MHz]	Tolerance [kHz]	Tolerance [ppm]	Limit [ppm]
DC5V	2402	2401.9882	-11.8235	-4.92	±50.0
	2440	2439.9880	-12.0167	-4.92	±50.0
	2480	2479.9878	-12.2325	-4.93	±50.0

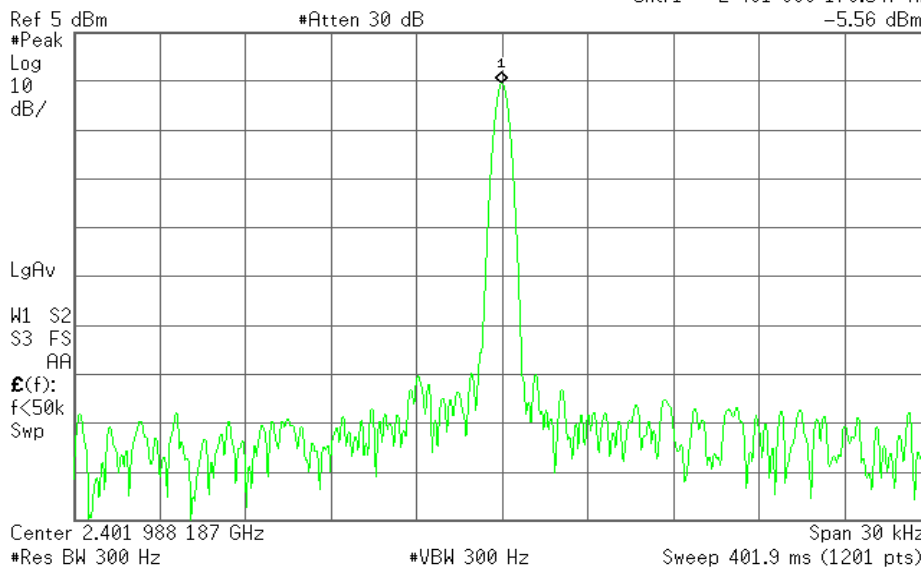
Tx1_Freq_Nom

Agilent 11:12:34 Sep 3, 2015

R L

Cntr1 2 401 988 176.547 Hz

-5.56 dBm



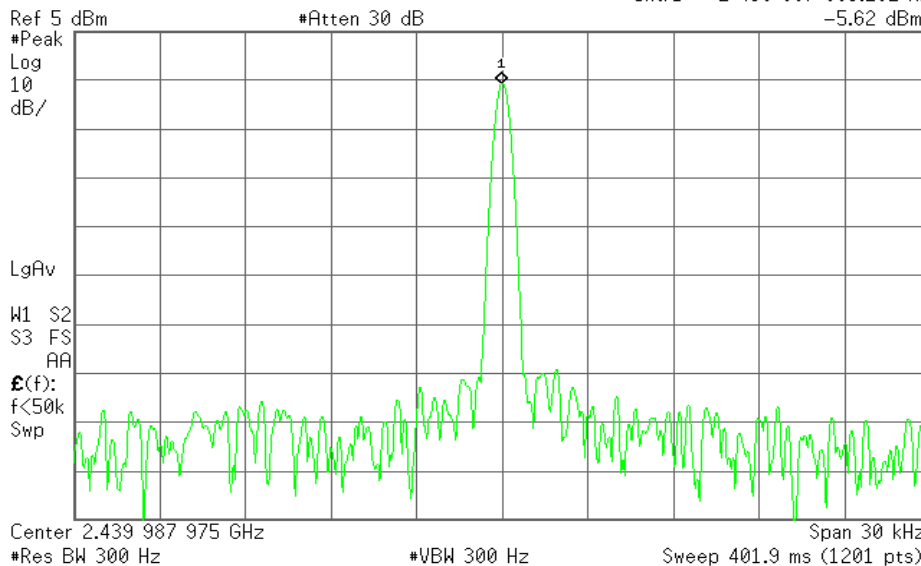
Tx2_Freq_Nom

Agilent 11:18:43 Sep 3, 2015

R L

Cntr1 2 439 987 983.282 Hz

-5.62 dBm



Tx3_Freq_Nom

Agilent 11:21:17 Sep 3, 2015

R L

Cntr1 2 479 987 767.502 Hz

Ref 5 dBm

#Atten 30 dB

-5.85 dBm

#Peak
Log
10
dB/

LgAv

W1 S2
S3 FS
AA

$\mathcal{E}(f)$:
f<50k
Swp

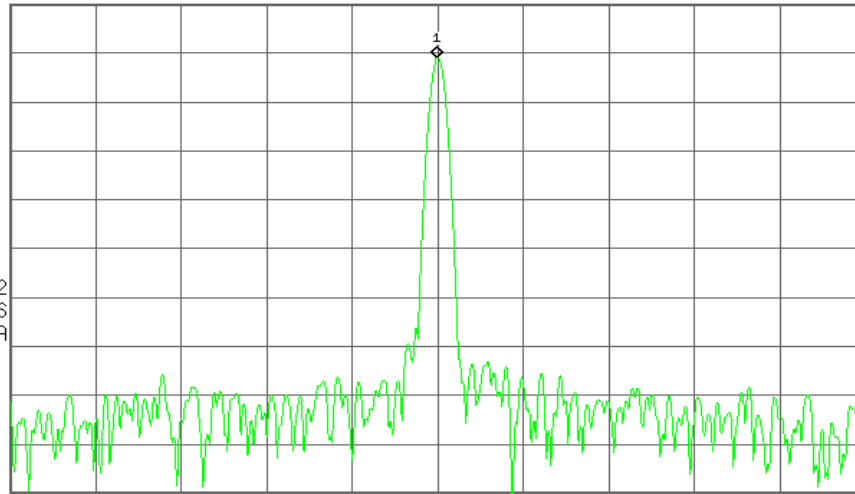
Center 2.479 987 765 GHz

#Res BW 300 Hz

#VBW 300 Hz

Span 30 kHz

Sweep 401.9 ms (1201 pts)



2.2. Occupied Bandwidth / Spreading Bandwidth

Job No. 15U20917-E53V2

Remark1

Remark2 The Span was set suitably instead of 2 - 3.5 times the limit of OBW.

[DATA]

99% Occupied Frequency Bandwidth

Voltage	Freq. [MHz]	Result [MHz]	Limit [MHz]
DC5V	2402	1.2200	26
	2440	1.2184	26
	2480	1.2208	26

(Reference data)

Spreading Bandwidth

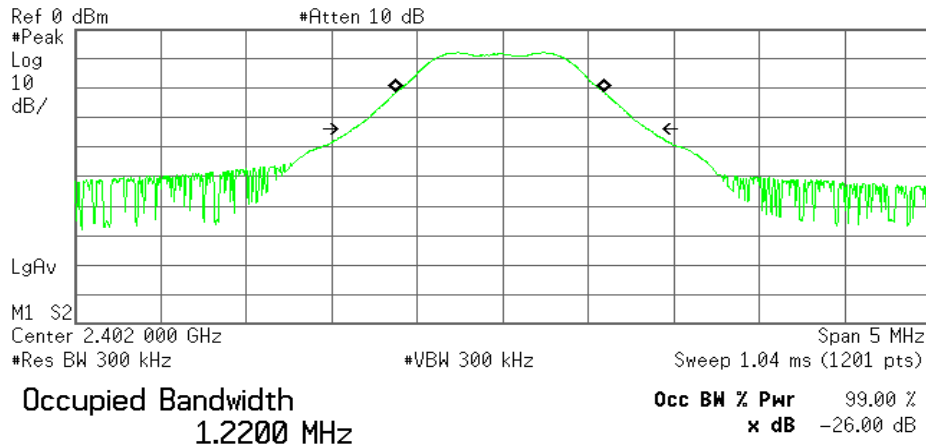
Voltage	Freq. [MHz]	Result [MHz]	Result [kHz]	Limit [kHz]
DC5V	2402	0.8268	-	-
	2440	0.8260	-	-
	2480	0.8269	-	-

99% Occupied Frequency Bandwidth

Tx1_99OBW_Nom

* Agilent 13:11:37 Aug 12, 2015

R L

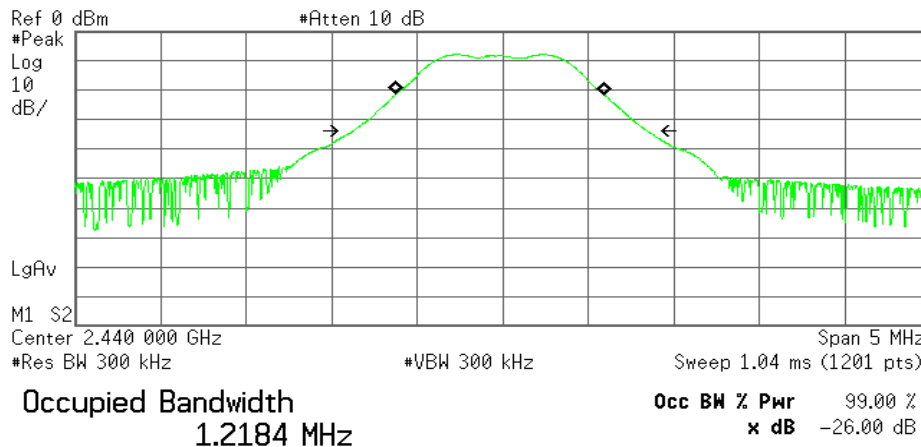


Transmit Freq Error -13.770 kHz
x dB Bandwidth 1.733 MHz

Tx2_99OBW_Nom

✴ Agilent 13:14:37 Aug 12, 2015

R L

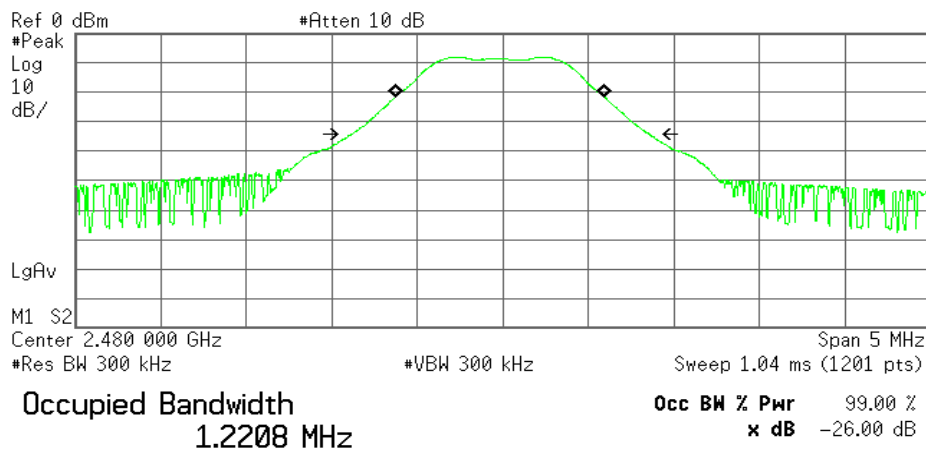


Transmit Freq Error -14.544 kHz
x dB Bandwidth 1.724 MHz

Tx3_99OBW_Nom

✴ Agilent 13:16:11 Aug 12, 2015

R L



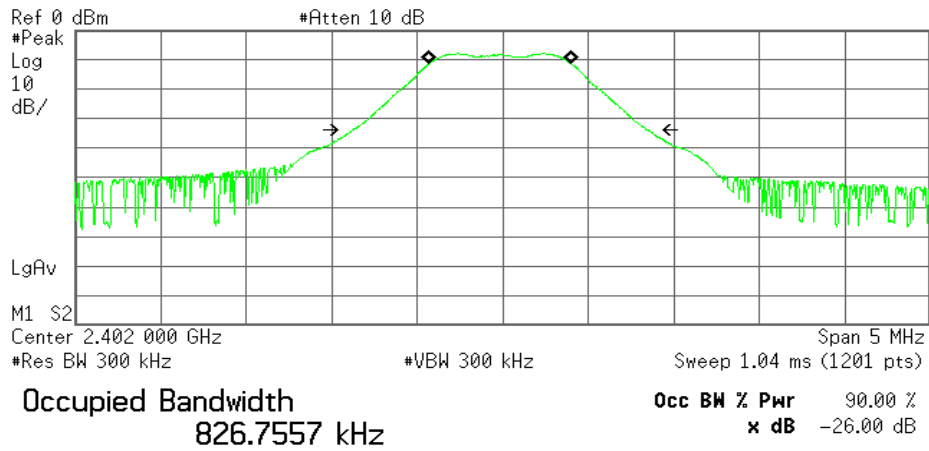
Transmit Freq Error -15.532 kHz
x dB Bandwidth 1.733 MHz

(Reference data)
Spreading Bandwidth

Tx1_900BW_Nom

Agilent 13:11:43 Aug 12, 2015

R L

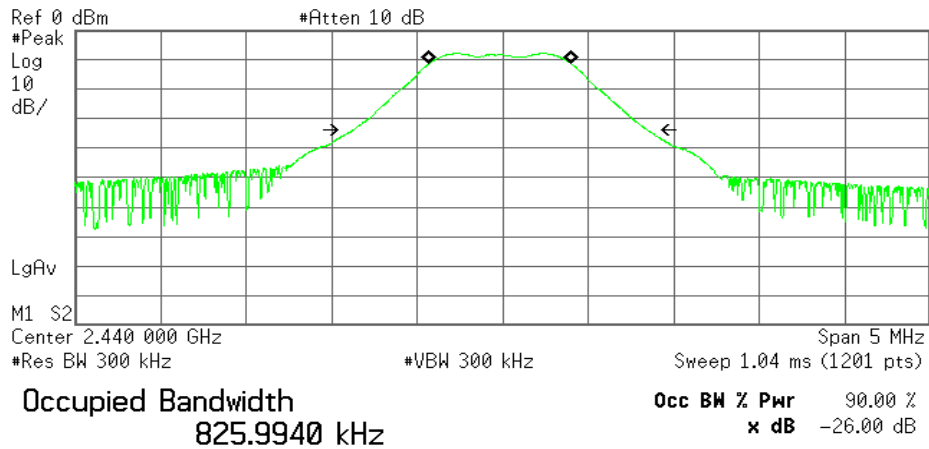


Transmit Freq Error -14.224 kHz
Occupied Bandwidth 1.733 MHz

Tx2_900BW_Nom

Agilent 13:14:43 Aug 12, 2015

R L

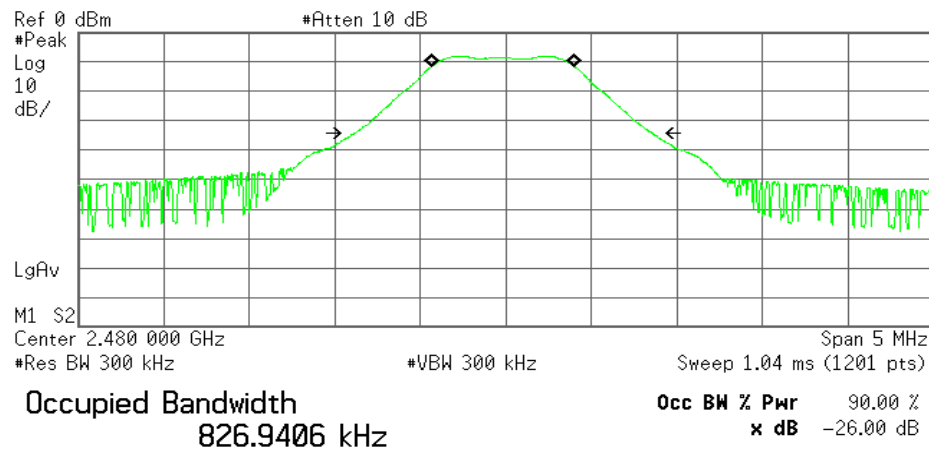


Transmit Freq Error -14.346 kHz
Occupied Bandwidth 1.724 MHz

Tx3_900BW_Nom

✱ Agilent 13:16:17 Aug 12, 2015

R L



Transmit Freq Error -14.861 kHz
Occupied Bandwidth 1.733 MHz

2.3. Unwanted Emission Strength (Normal Voltage)

Job No. 15U20917-E53V2

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	2402	677.50	-71.46	3.30	10.00	-58.16	0.002	2.500	♣1
		2265.00	-69.15	3.30	10.00	-55.85	0.003	2.500	♣1
		2386.92	-58.01	3.30	10.00	-44.71	0.034	2.500	♣1
		2399.99	-66.55	3.30	10.00	-53.25	0.005	25.000	♣2
		2399.99	-38.93	3.30	10.00	-25.63	2.733	25.000	♣2
		2533.00	-66.92	3.30	10.00	-53.62	0.004	2.500	♣4
		6855.00	-65.58	3.30	10.00	-52.28	0.006	2.500	♣4
	2440	436.60	-71.11	3.30	10.00	-57.81	0.002	2.500	♣1
		2313.00	-67.75	3.30	10.00	-54.45	0.004	2.500	♣1
		2562.00	-66.96	3.30	10.00	-53.66	0.004	2.500	♣4
		6846.00	-64.49	3.30	10.00	-51.19	0.008	2.500	♣4
	2480	323.40	-71.40	3.30	10.00	-58.10	0.002	2.500	♣1
		2342.00	-67.65	3.30	10.00	-54.35	0.004	2.500	♣1
		2483.51	-46.26	3.30	10.00	-32.96	0.505	25.000	♣3
		2483.51	-71.54	3.30	10.00	-58.24	0.002	25.000	♣3
		2496.83	-59.01	3.30	10.00	-45.71	0.027	2.500	♣4
		3329.00	-68.31	3.30	10.00	-55.01	0.003	2.500	♣4
		6836.00	-65.78	3.30	10.00	-52.48	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 13:12:32 Aug 12, 2015

R L

Mkr1 677.5 MHz

-71.46 dBm

Ref 0 dBm

#Atten 10 dB

#Peak

Log

10

dB/

LgAv

V1 S2

Start 30.0 MHz

Stop 1.000 0 GHz

#Res BW 1 MHz

#VBW 1 MHz

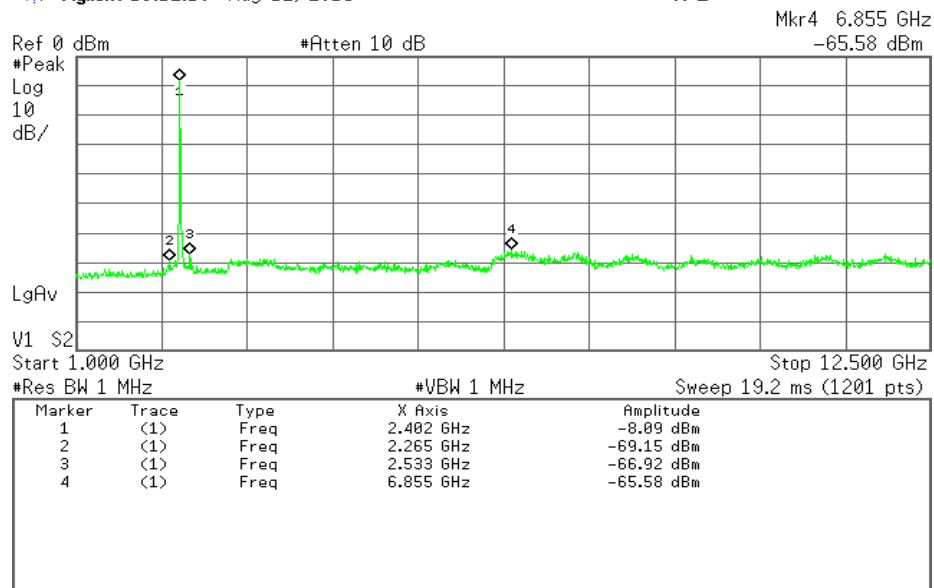
Sweep 1.68 ms (1201 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	677.5 MHz	-71.46 dBm

Tx1_SpuriousG_Nom

Agilent 13:12:19 Aug 12, 2015

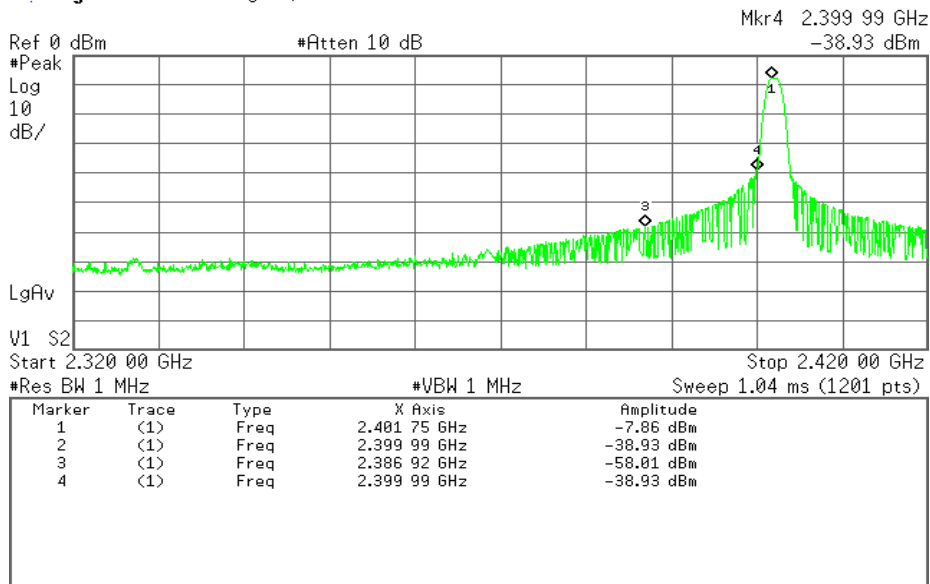
R L



Tx1_BandEdgeLow_Nom

Agilent 13:13:10 Aug 12, 2015

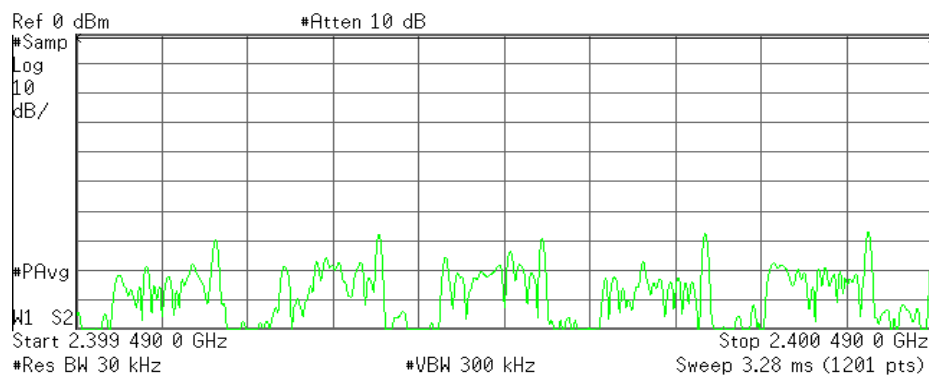
R L



Tx1_BandEdgeLowZoom_Nom

Agilent 13:13:23 Aug 12, 2015

R L



Channel Power

-66.55 dBm /1.0000 MHz

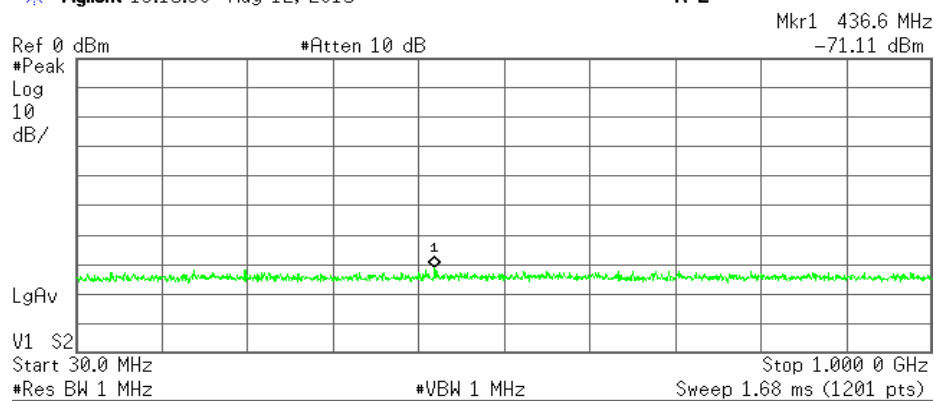
Power Spectral Density

-126.55 dBm/Hz

Tx2_SpuriousM_Nom

Agilent 13:15:38 Aug 12, 2015

R L

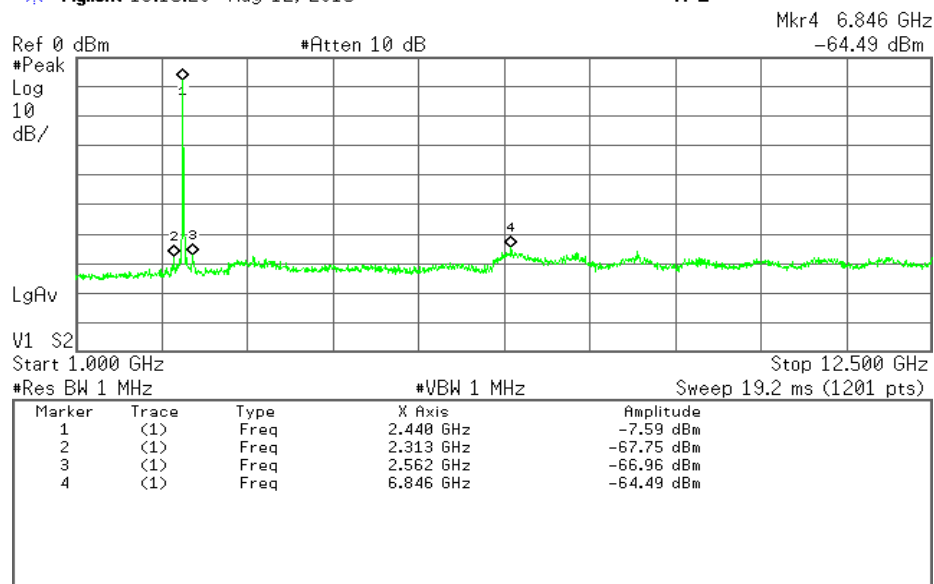


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	436.6 MHz	-71.11 dBm

Tx2_SpuriousG_Nom

Agilent 13:15:26 Aug 12, 2015

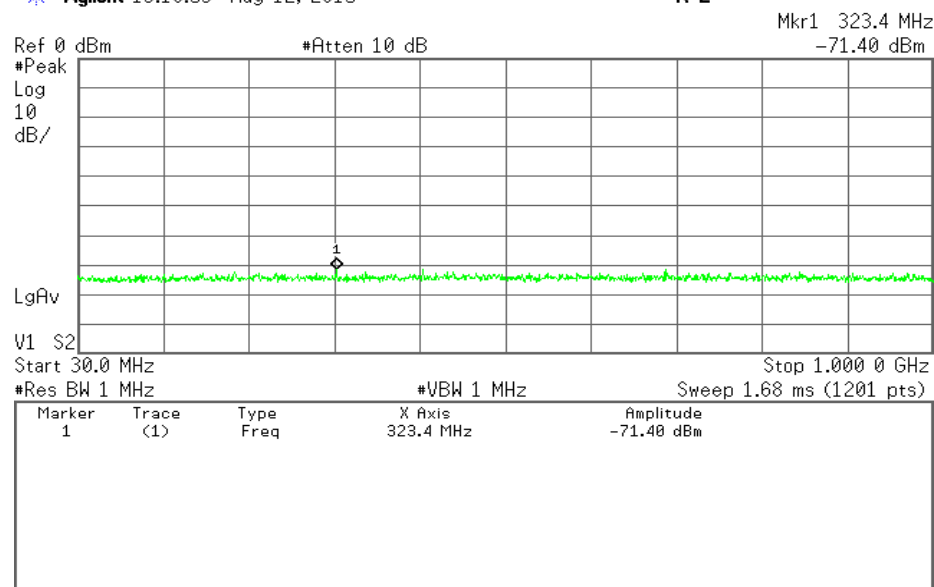
R L



Tx3_SpuriousM_Nom

Agilent 13:16:53 Aug 12, 2015

R L

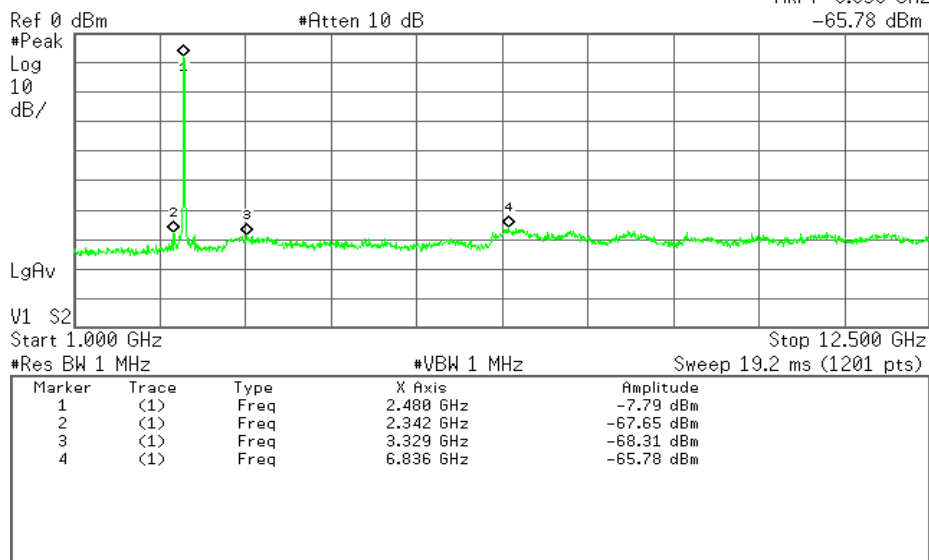


Tx3_SpuriousG_Nom

Agilent 13:16:41 Aug 12, 2015

R L

Mkr4 6.836 GHz
-65.78 dBm

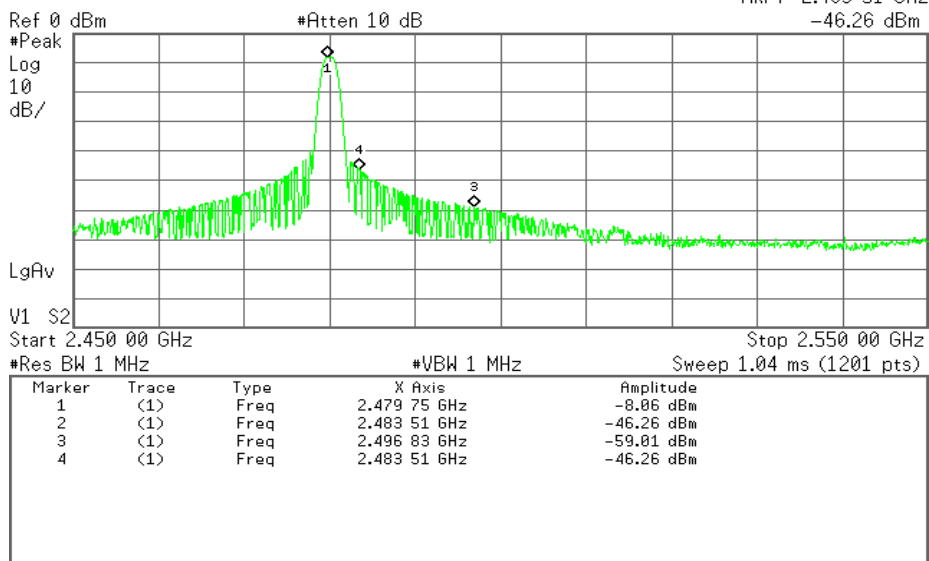


Tx3_BandEdgeHigh_Nom

Agilent 13:17:43 Aug 12, 2015

R L

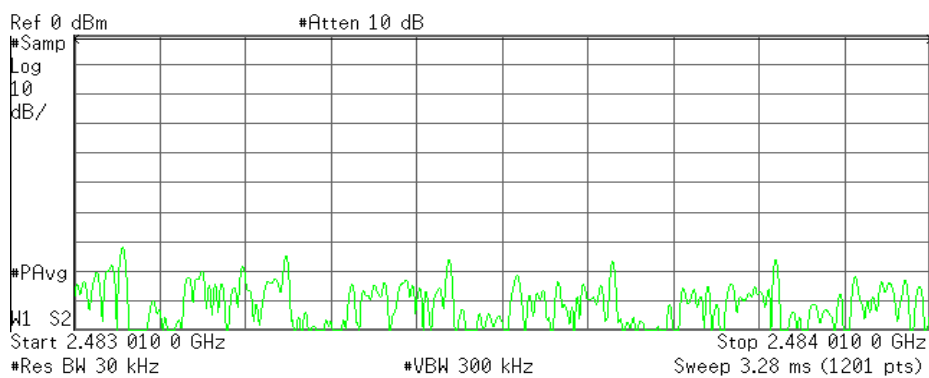
Mkr4 2.483 51 GHz
-46.26 dBm



Tx3_BandEdgeHighZoom_Nom

Agilent 13:17:57 Aug 12, 2015

R L



Channel Power

-71.54 dBm /1.0000 MHz

Power Spectral Density

-131.54 dBm/Hz

2.4. Output Power

Job No. 15U20917-E53V2

Remark1

Remark2

[DATA]

Voltage	Chain	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [W]	Burst Rate	Output Power (A) [W]	Antenna Gain [dBi]	E.I.R.P. (A) [W]
DC5V	0	2402	-10.45	3.30	10.00	0.001928	1.66	0.003194	2.30	0.005425
		2440	-10.43	3.30	10.00	0.001936	1.66	0.003209	2.30	0.005450
		2480	-10.58	3.30	10.00	0.001871	1.66	0.003100	2.30	0.005265
DC5V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
DC5V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-

Sample Calculation :

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

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

[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]	[%]	[W]	[%]	[W]	[dBm]	[dBm]
DC5V	2402	0.003194	-29.4	0.010000	+20 ~ -80	0.005425	7.34	12.14
	2440	0.003209	-29.1	0.010000	+20 ~ -80	0.005450	7.36	12.14
	2480	0.003100	-31.5	0.010000	+20 ~ -80	0.005265	7.21	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)	0.003168	[W]	Average of E.I.R.P. Result(B)	0.005380	[W]
Declared Output Power	0.004526	[W]	E.I.R.P. for Declared Output Power	8.86	[dBm]
+20	0.005431	[W]			
Middle (Declared Output Power -30%)	0.003168	[W]			
-80	0.000905	[W]			

Sample Calculation :

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

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

2.5. Secondary Radiated Emission Strength

Job No. 15U20917-E53V2

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	2440	975.8	-92.12	3.30	10.00	-78.82	0.013	4.000	◆5
		6760.0	-75.91	3.30	10.00	-62.61	0.549	20.000	◆6

Sample Calculation :

Result = Reading + Cable Loss

◆5:Freq Range5 (≥ 30MHz, <1GHz)

◆6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1_SpuriousM_Nom

Agilent 13:18:50 Aug 12, 2015

R L

Mkr1 975.8 MHz

-92.11 dBm

Ref -20 dBm

#Atten 0 dB

#Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
RA

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 13:18:37 Aug 12, 2015

R L

Mkr1 6.760 GHz

-75.91 dBm

Ref -20 dBm

#Atten 0 dB

#Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
RA

E(f):
FTun
Swp

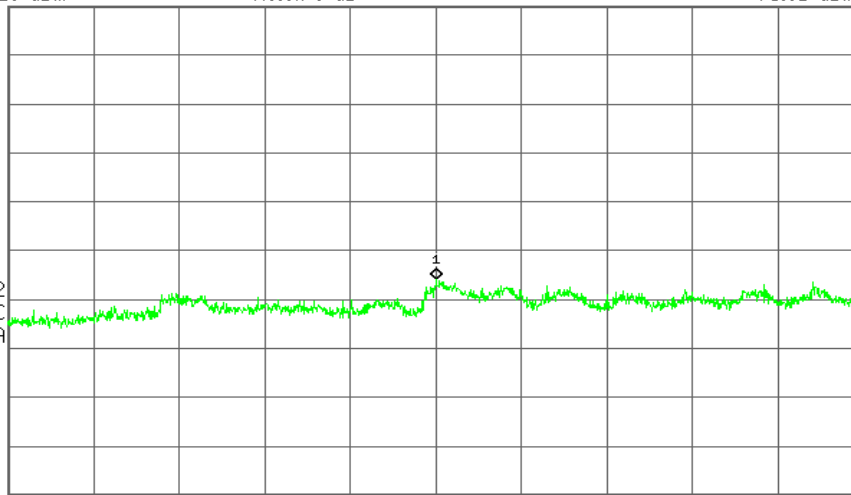
Start 1.000 GHz

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-E53V2

Remark1

Remark2

[DATA]

Voltage	Freq.	On Time	Period	Result (Duty)	Result (Burst Rate)
[V]	[MHz]	[msec]	[msec]	[%]	
DC5V	2440	0.377	0.625	60.3	1.657

Sample Calculation :

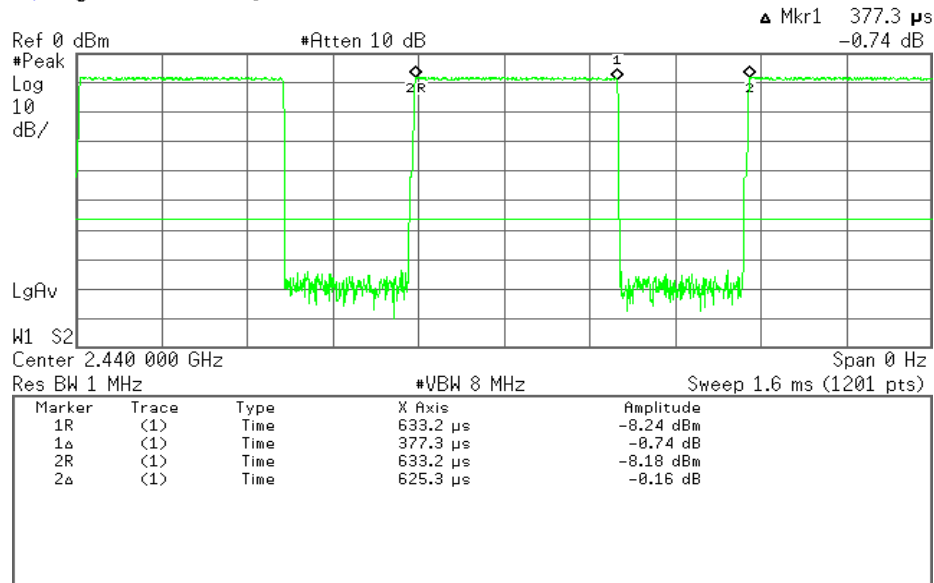
Result(Duty) = On Time / Period * 100

Result(Burst Rate) = Period / On Time

Tx2_Duty_Nom

Agilent 13:09:17 Aug 12, 2015

R L



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

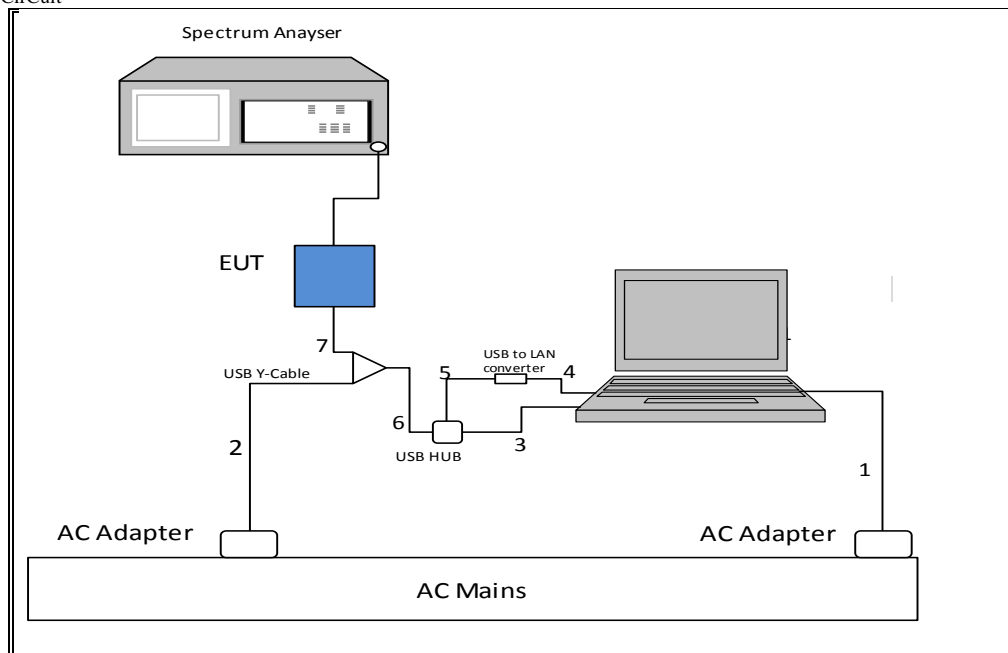
Note : 1. The calibration of measurement equipment is valid for a one year period.
2. "X" used equipment.
3. Calibrated per ISO/IEC 17025

4. Test Condition

Test Item	Date	Temp (°C)	Hum (%RH)	Engineer	Test Room
Frequency Tolerance	8/12/2015	23.1	47	C. Susa	Temp Room B
Occupied Bandwidth	8/12/2015	23.1	47	C. Susa	Temp Room B
Unwanted Emission Strength	8/12/2015	23.1	47	C. Susa	Temp Room B
Output Power/ E.I.R.P	8/12/2015	23.1	47	C. Susa	Temp Room B
Secondary Radiated Emission Strength	8/12/2015	23.1	47	C. Susa	Temp Room B
Burst Length / Duty	8/12/2015	23.1	47	C. Susa	Temp Room B

5. TEST CONFIGURATION

TEST CirCuit



PHOTO

