TEST REPORT

REPORT NUMBER:	R12053557-E8d
COMPANY NAME:	Bose Corporation
EUT DESCRIPTION:	Wireless Module
MODEL:	424821
SERIAL NUMBER:	0122
ISSUE DATE:	2018-08-07
DATE TESTED:	2018-04-05 to 2018-04-06
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 LLC 12 Laboratory Drive, RTP, NC 27709, USA
Test Result:	Compliant
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) MIMO	0.002777W/MHz
		2422-2462MHz (Interval of 5MHz 9ch) SISO (Max Chain)	0.001443W/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 LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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, or any agency of the U.S. Government.

Approved & Released For UL LLC By:

Jeffrey Moser
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UL LLC

Prepared By:

Brian T. Kiewra
Project Engineer
UL LLC

NVLAP TESTING
NVLAP Lab code: 200246-0

1. EUT Information

Report No. :	R12053557-E8d
Applicant :	Bose Corporation
Equipment Description:	Wireless Module
Model No. :	424821
SerialNo. :	0122
The number of Tx Antenna :	2
Max Antenna Gain :	4.0dBi
Mode :	IEEE802.11n HT40
Type of Radio wave :	G1D, D1D

Supply Voltage
◉DC ○AC 4.00V
-

Voltage Condition
◉Non-Extreme ○Extreme

Normal DC4V
Normal-10% -
Normal+10% -

Modulation
○DS (e.g. WLAN 11b)
○OFDM & OBW≤ 26MHz (e.g. WLAN 11g, 11n HT20)
◉OFDM & OBW 26-38MHz (e.g. WLAN 11n HT40)
○Other Modulation (e.g. GFSK, Not BT)

EUT has
◉ANT Connector
○No ANT Connector distance -

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

		Other than for Power		For Power	
	[MHz]	Cable Loss [dB]	ATT/ [dB]	Cable Loss [dB]	ATT/ [dB]
Low Channel (Tx1)	2422	14.68	0.00	14.68	0.00
Middle Channel (Tx2)	2442	14.68	0.00	14.68	0.00
High Channel (Tx3)	2462	14.68	0.00	14.68	0.00

Report Version Info

Ver.	Issue Date	Description	Revised By
1	2018-06-05	Initial Release.	Brian T. Kiewra
2	2018-06-27	Revised nominal input voltage	Brian T. Kiewra
3	2018-07-25	Revised output power to include MIMO and SISO measurements.	Brian T. Kiewra
4	2018-08-07	Declared MIMO and worst-case SISO power.	Brian T. Kiewra

2.TEST Result

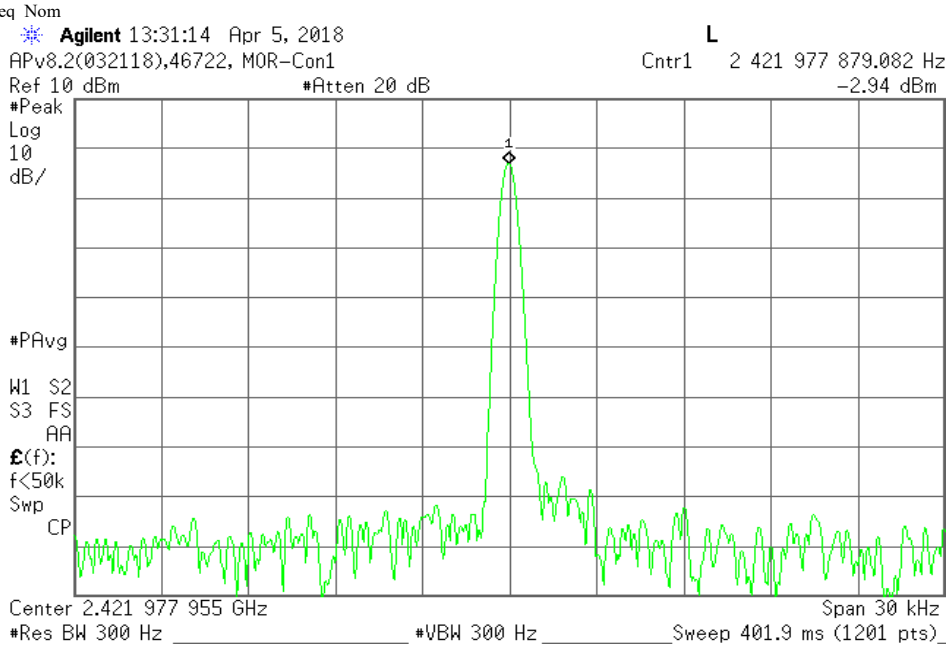
2.1. Frequency Tolerance

Job No.	R12053557-E8d
Remark1	
Remark2	

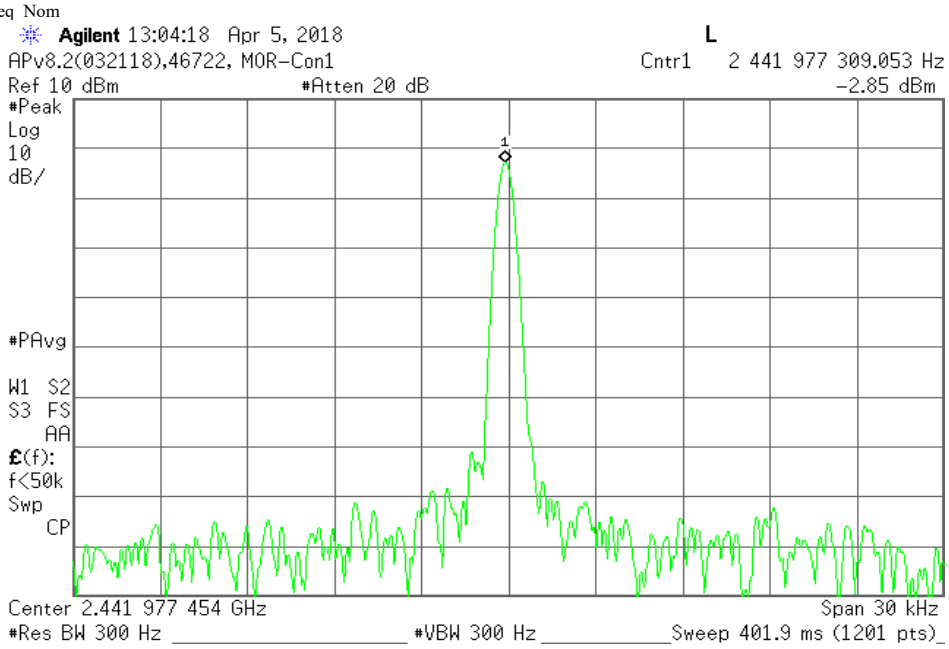
[DATA]

Voltage	Freq. [MHz]	Result [MHz]	Tolerance [kHz]	Tolerance [ppm]	Limit [ppm]
DC4V	2422	2421.9779	-22.1000	-9.12	±50.0
	2442	2441.9773	-22.7000	-9.30	±50.0
	2462	2461.9764	-23.6000	-9.59	±50.0

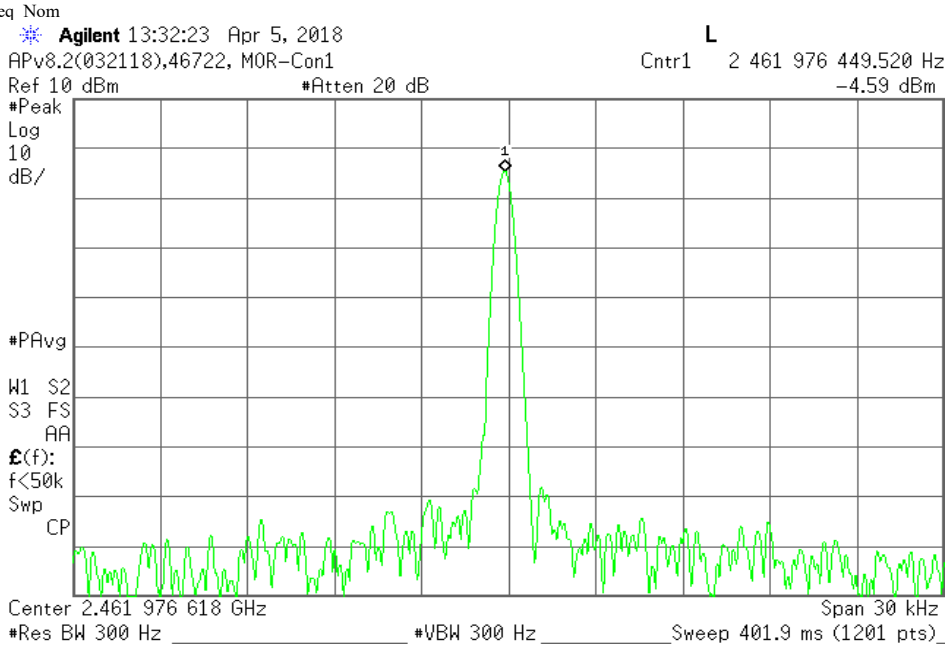
Tx1_Freq Nom



Tx2_Freq Nom



Tx3_Freq Nom



2.2. Occupied Bandwidth / Spreading Bandwidth

Job No.	R12053557-E8d
Remark1	
Remark2	

[DATA]

99% Occupied Frequency Bandwidth

Voltage	Freq. [MHz]	Result [MHz]	Limit [MHz]
DC4V	2422	36.0602	38
	2442	36.0138	38
	2462	36.1072	38

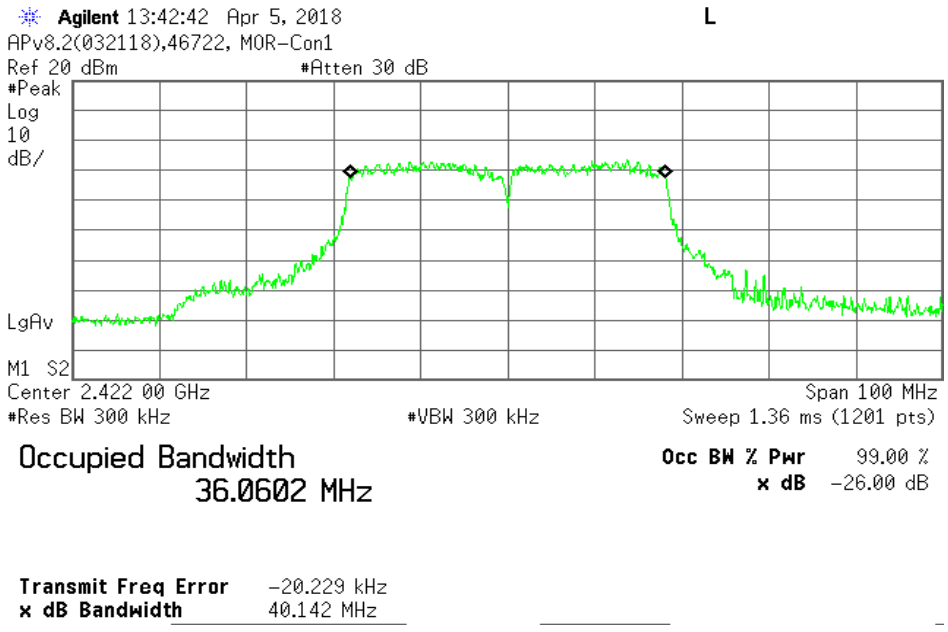
(Reference data)

Spreading Bandwidth

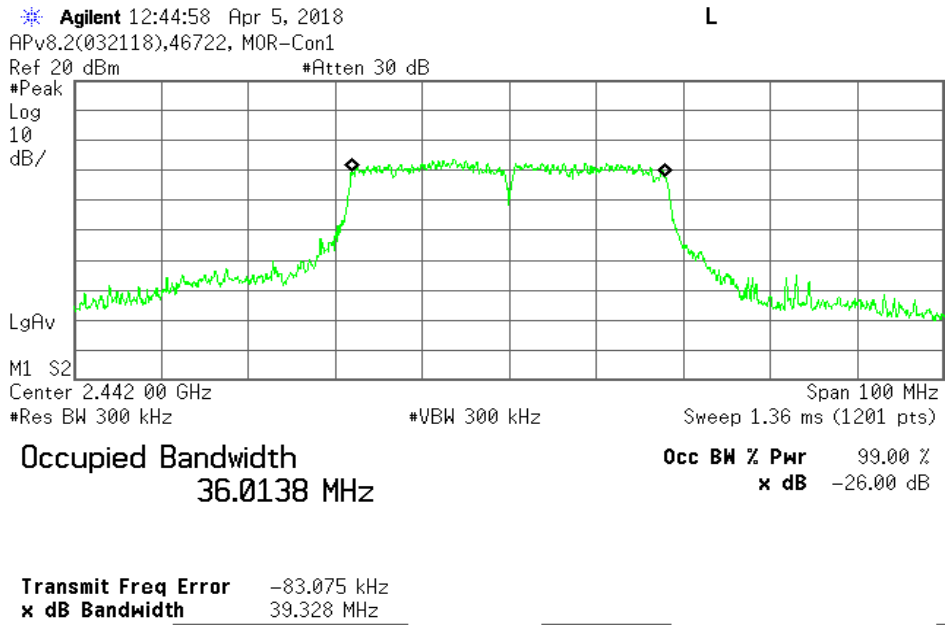
Voltage	Freq. [MHz]	Result [MHz]	Result [kHz]	Limit [kHz]
DC4V	2422	32.2980	32298.0	500
	2442	31.6820	31682.0	500
	2462	32.1613	32161.3	500

99% Occupied Frequency Bandwidth

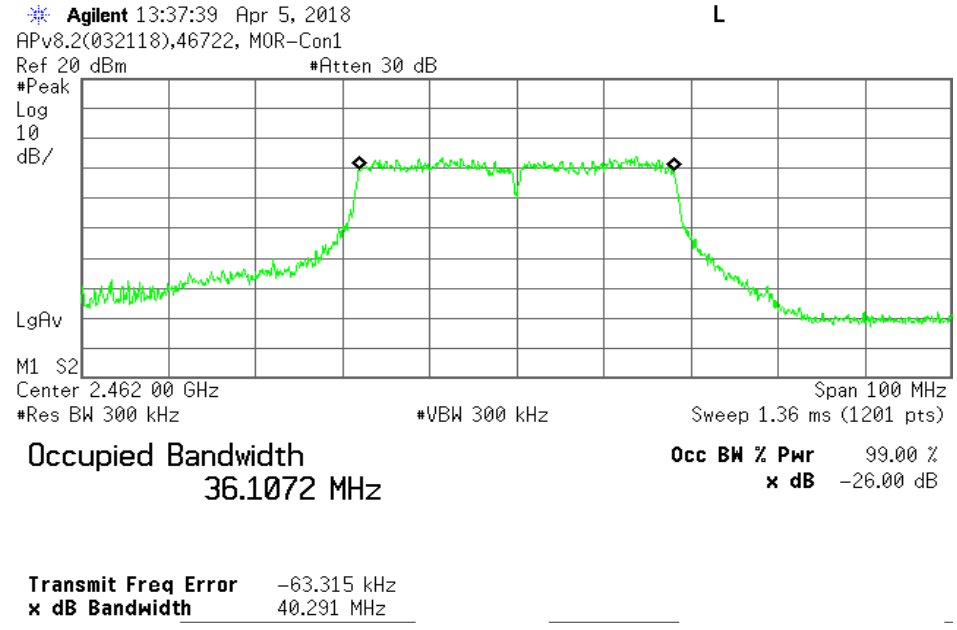
Tx1_99OBW_Nom



Tx2_99OBW_Nom

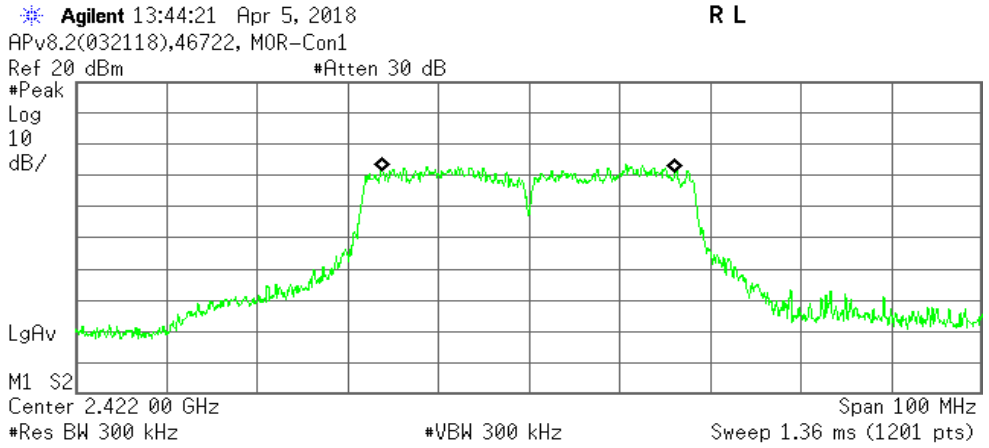


Tx3_99OBW_Nom

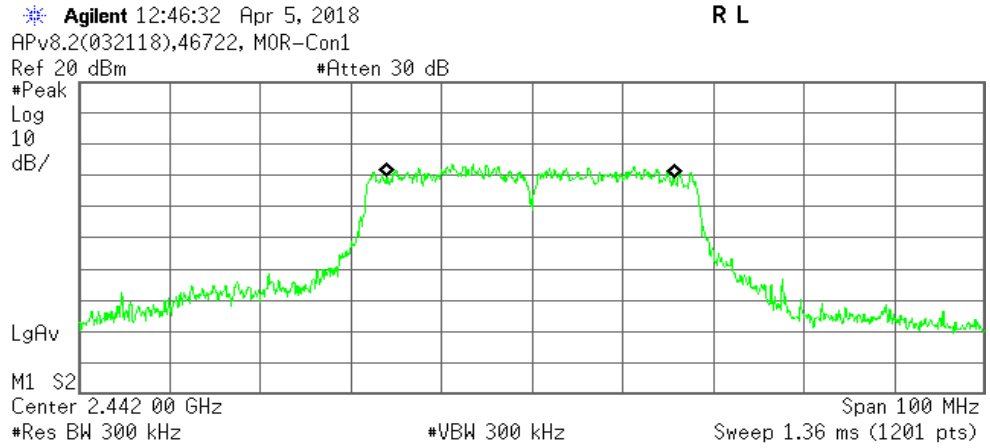


Spreading Bandwidth

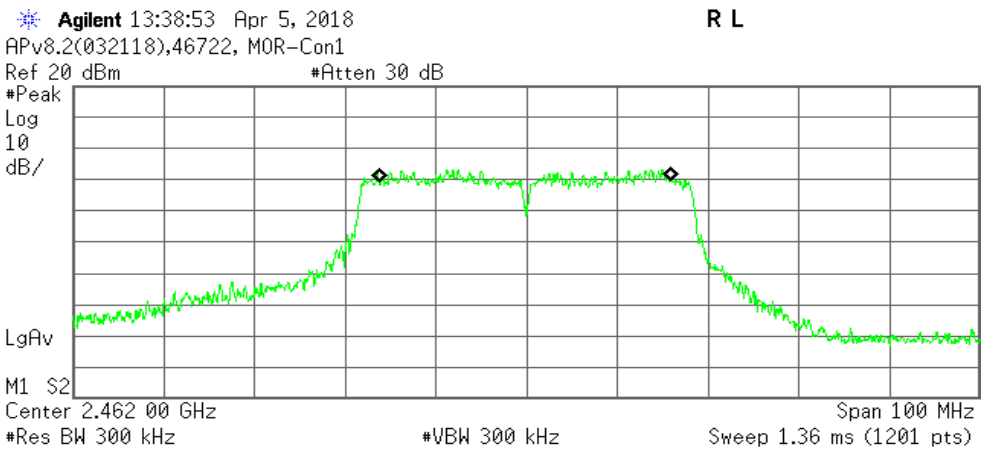
Tx1_90OBW_Nom



Tx2_90OBW_Nom



Tx3_90OBW_Nom



Occupied Bandwidth
32.1613 MHz

Occ BW % Pwr 90.00 %
x dB -26.00 dB

Transmit Freq Error -201.813 kHz
x dB Bandwidth 40.563 MHz

2.3. Unwanted Emission Strength (Normal Voltage)

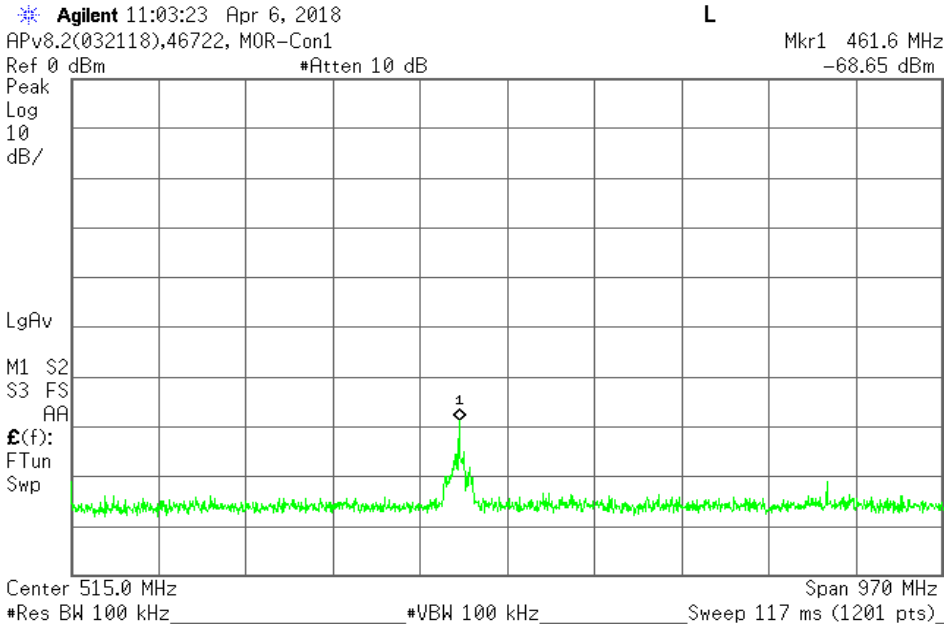
Job No.	R12053557-E8d
Remark1	
Remark2	

[DATA]

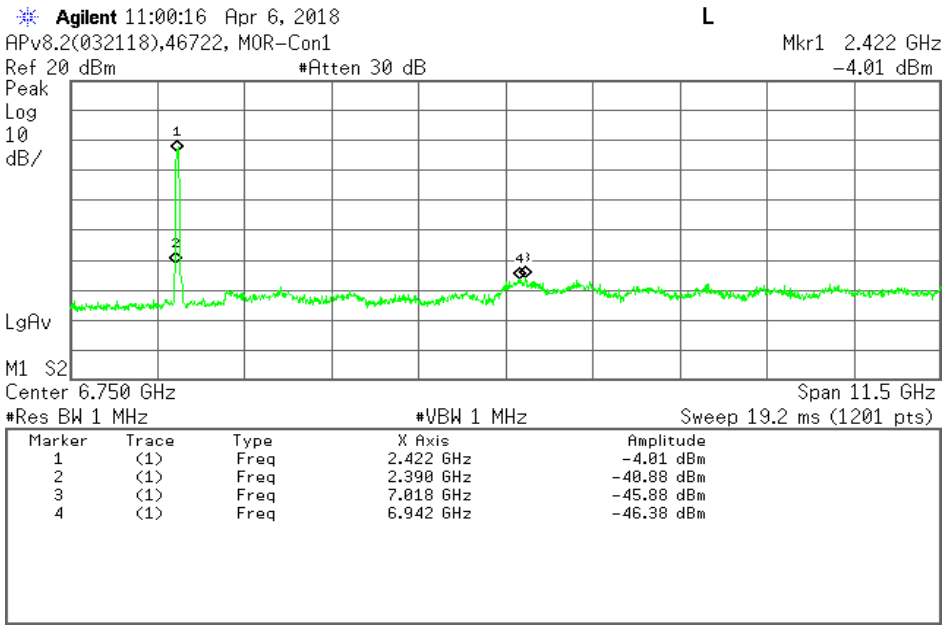
Voltage	Freq. [MHz]	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Result [uW]	Limit [uW]	Remark
DC4V	2422	461.60	-68.65	14.68	0.00	-43.97	0.040	2.500	♦1
		2386.99	-46.07	14.68	0.00	-31.39	0.726	2.500	♦1
		2390.00	-40.88	14.68	0.00	-26.20	2.399	25.000	♦2
		2399.92	-45.27	14.68	0.00	-30.59	0.873	25.000	♦2
		2399.99	-45.20	14.68	0.00	-30.52	0.887	25.000	♦2
		6942.00	-46.38	14.68	0.00	-31.70	0.676	2.500	♦4
		7018.00	-45.88	14.68	0.00	-31.20	0.759	2.500	♦4
	2442	477.00	-74.07	14.68	0.00	-49.39	0.012	2.500	♦1
		6951.00	-45.57	14.68	0.00	-30.89	0.815	2.500	♦4
		6980.00	-45.76	14.68	0.00	-31.08	0.780	2.500	♦4
		7009.00	-45.90	14.68	0.00	-31.22	0.755	2.500	♦4
	2462	502.10	-74.68	14.68	0.00	-50.00	0.010	2.500	♦1
		2483.51	-43.34	14.68	0.00	-28.66	1.361	25.000	♦3
		2483.67	-43.94	14.68	0.00	-29.26	1.186	25.000	♦3
		2495.00	-40.62	14.68	0.00	-25.94	2.547	25.000	♦3
		2496.51	-54.72	14.68	0.00	-40.04	0.099	2.500	♦4
		6932.00	-45.36	14.68	0.00	-30.68	0.855	2.500	♦4
		7200.00	-46.30	14.68	0.00	-31.62	0.689	2.500	♦4

Sample Calculation :
Result = Reading + Cable Loss + Attenuator + RBW Correction (<1000MHz)
♦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)

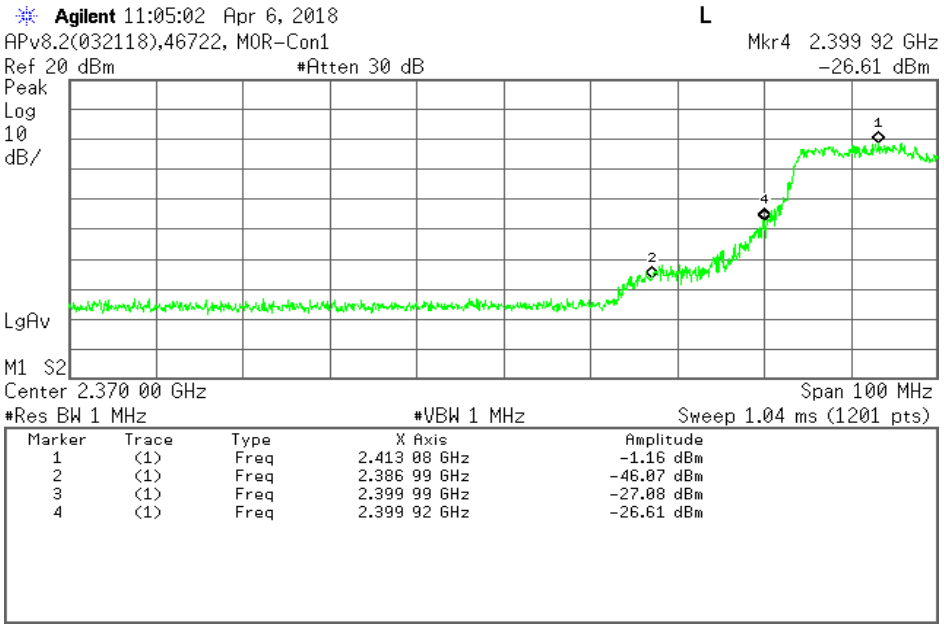
Tx1_SpuriousM_Nom



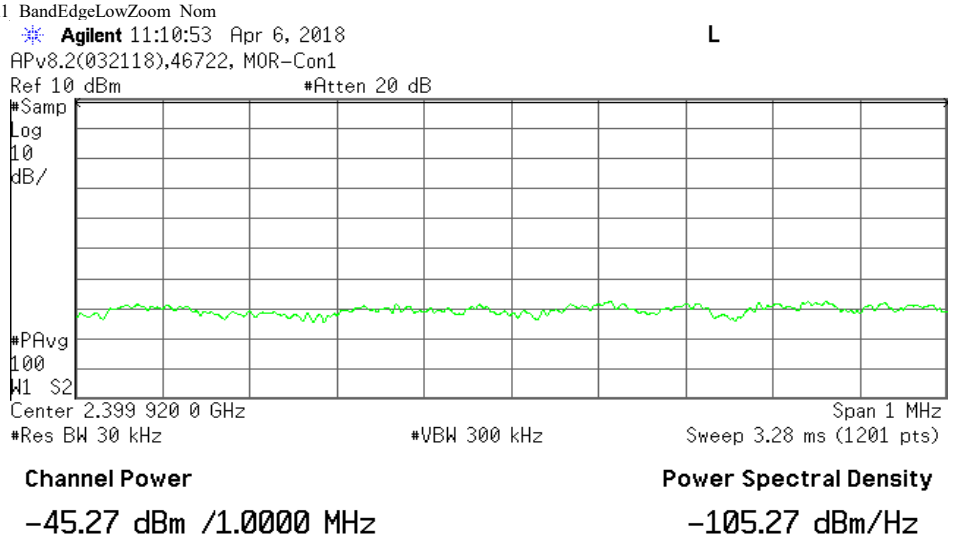
Tx1_SpuriousG_Nom



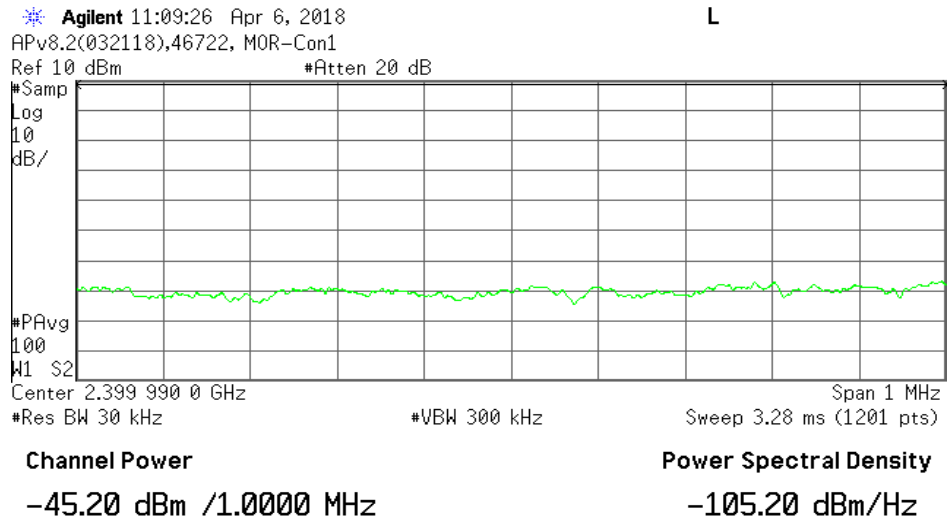
Tx1_BandEdgeLow_Nom



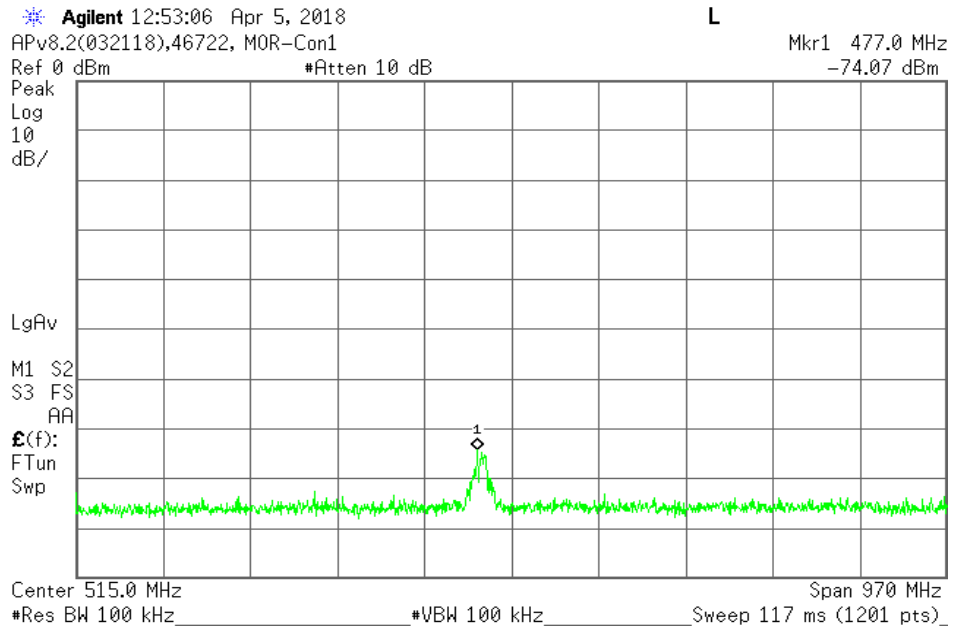
Tx1 BandEdgeLowZoom Nom



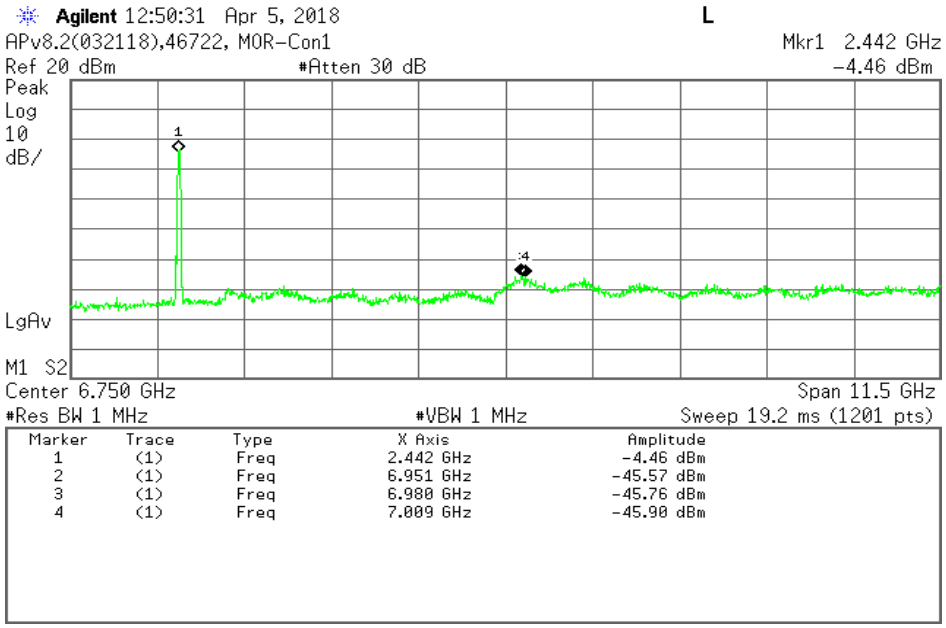
Tx1_BandEdgeLowZoom_Nom_2



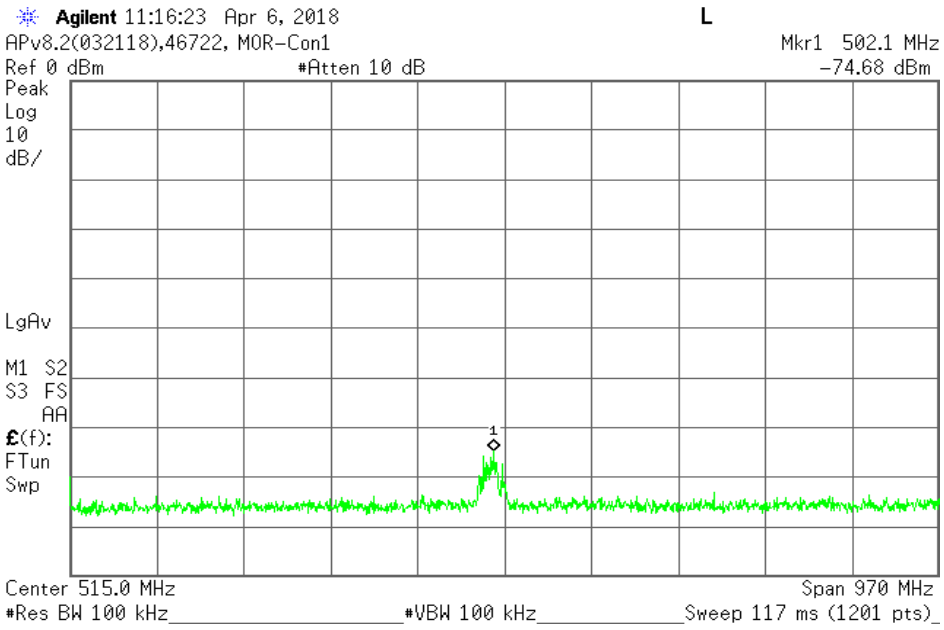
Tx2_SpuriousM_Nom



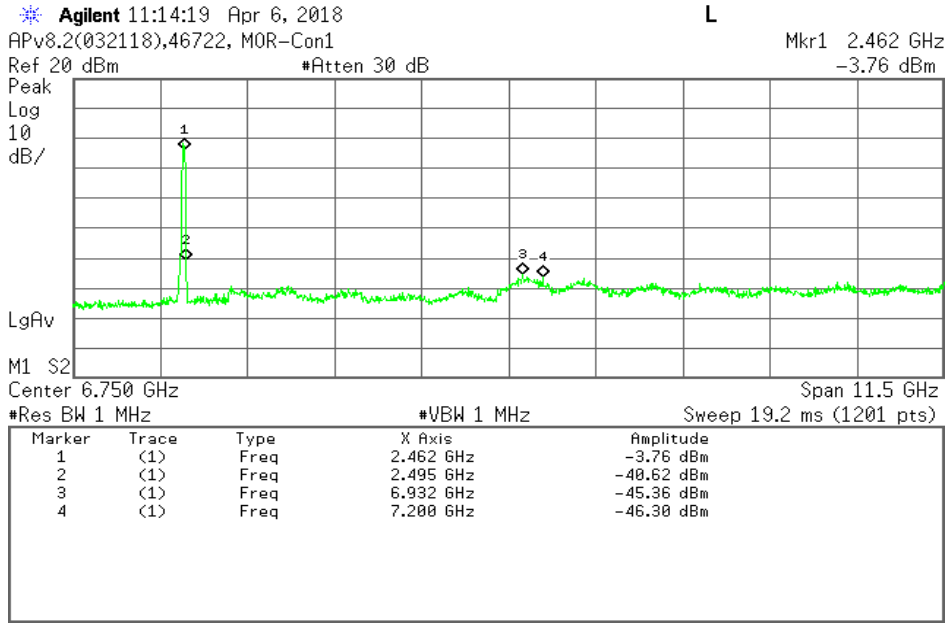
Tx2_SpuriousG_Nom



Tx3_SpuriousM_Nom

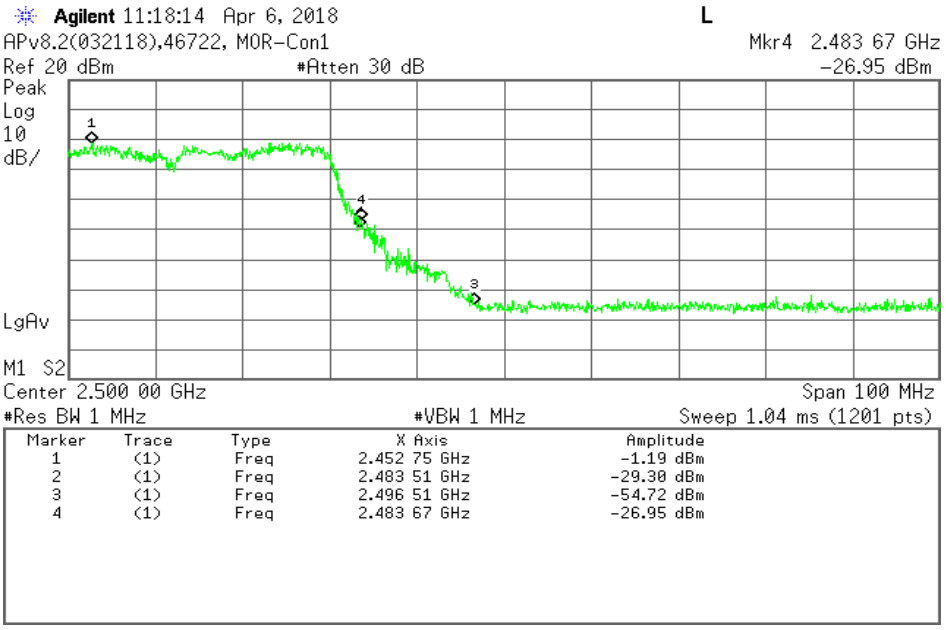


Tx3_SpuriousG_Nom

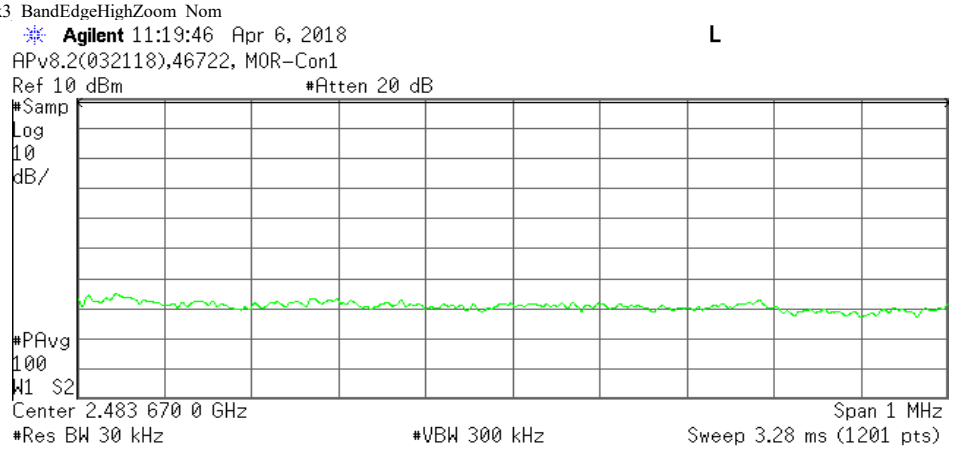


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.462 GHz	-3.76 dBm
2	(1)	Freq	2.495 GHz	-40.62 dBm
3	(1)	Freq	6.932 GHz	-45.36 dBm
4	(1)	Freq	7.200 GHz	-46.30 dBm

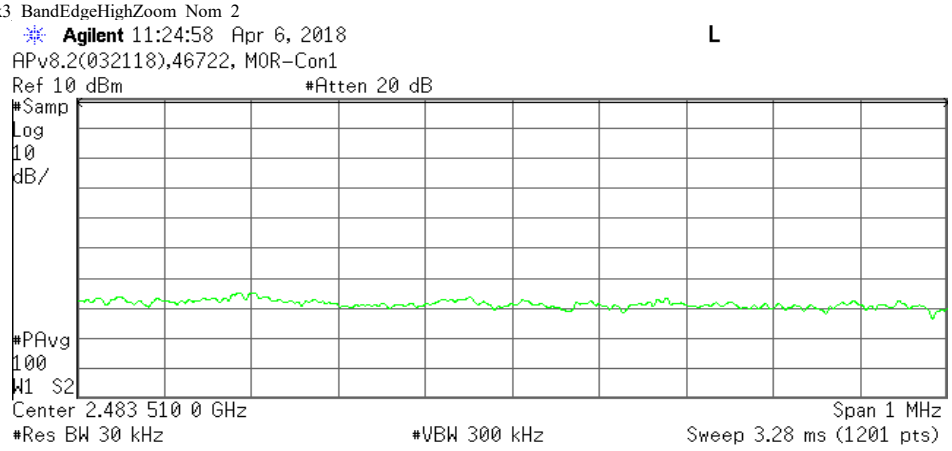
Tx3_BandEdgeHigh_Nom



Tx3 BandEdgeHighZoom Nom



Tx3 BandEdgeHighZoom Nom 2



Channel Power

−43.34 dBm /1.0000 MHz

Power Spectral Density

−103.34 dBm/Hz

2.4.1. Output Power (MIMO)

Job No.	R12053557-E8d
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]
DC4V	0	2422	-16.94	14.68	0.00	0.000594	2.28	0.001355	4.00	0.003404
		2442	-17.72	14.68	0.00	0.000497	2.28	0.001134	4.00	0.002849
		2462	-16.66	14.68	0.00	0.000634	2.28	0.001447	4.00	0.003634
DC4V	1	2422	-17.57	14.68	0.00	0.000514	2.28	0.001173	4.00	0.002947
		2442	-17.61	14.68	0.00	0.000509	2.28	0.001163	4.00	0.002920
		2462	-17.12	14.68	0.00	0.000570	2.28	0.001302	4.00	0.003270
DC4V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
DC4V	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-

Sample Calculation :
Output Power (A) = 10 ^ ((Reading [dBm] + Cable Loss + Atten. Loss) / 10) * Burst Rate
E.I.R.P. (A) = Output Power (A) * 10^(Antenna Gain[dBi]/10)

[Total Power / Result and Limit]

Voltage	Freq.	Output Power				E.I.R.P.		
		Result (B)	Tolerance Result	Limit	Tolerance Limit	Result (B)	Result	Limit
	[MHz]	[W/MHz]	[%]	[W/MHz]	[%]	[W/MHz]	[dBm/MHz]	[dBm/MHz]
DC4V	2422	0.002528	-8.9	0.010000	+20 ～ -80	0.006351	8.03	12.14
	2442	0.002297	-17.3	0.010000	+20 ～ -80	0.005769	7.61	12.14
	2462	0.002748	-1.0	0.010000	+20 ～ -80	0.006903	8.39	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.

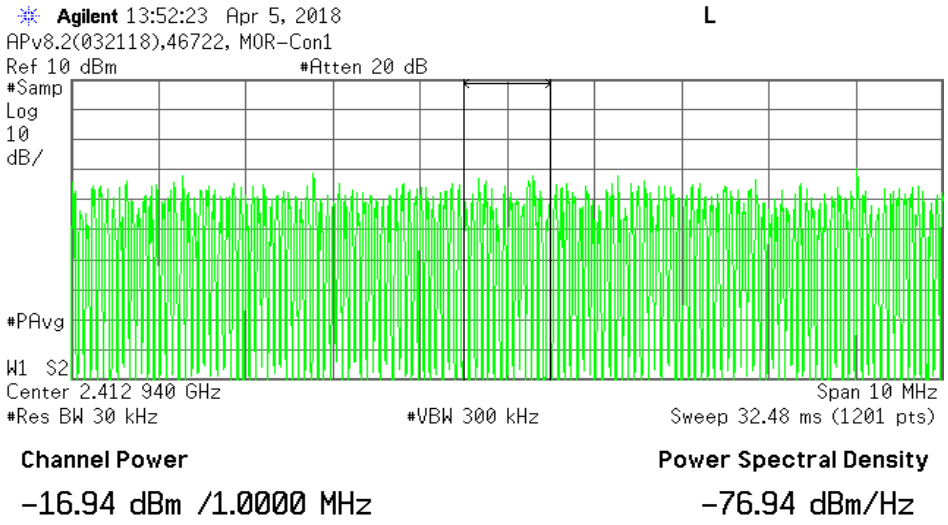
[Declared Output Power]

Average of Output Power Result (B)	0.002524	[W/MHz]
Declared Output Power	0.002777	[W/MHz]
+20	0.003332	[W/MHz]
Middle (Declared Output Power -30%)	0.001944	[W/MHz]
-80	0.000555	[W/MHz]

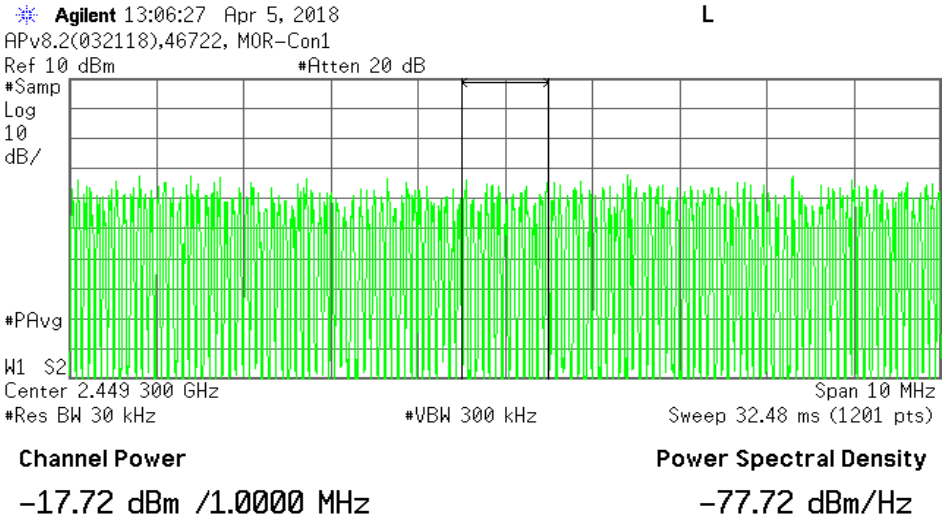
Average of E.I.R.P. Result(B)	0.006341	[W/MHz]
E.I.R.P. for Declared Output Power	8.44	[dBm/MHz]

Sample Calculation :
E.I.R.P. for Declared Output Power
= 10 * Log (Average of E.I.R.P. Result (B) * (Declared Output Power / Average of Output Power Result (B)) * 1000)

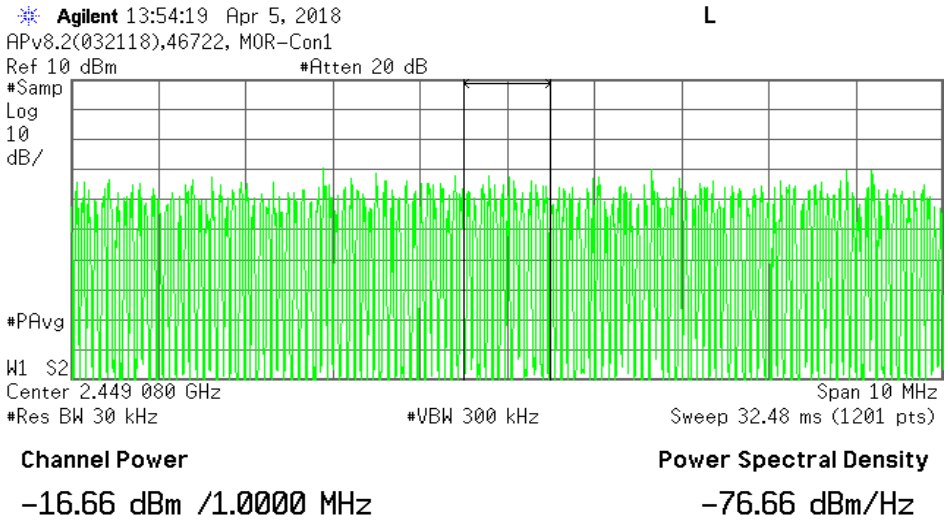
Tx1_Power_Chain0_Nom



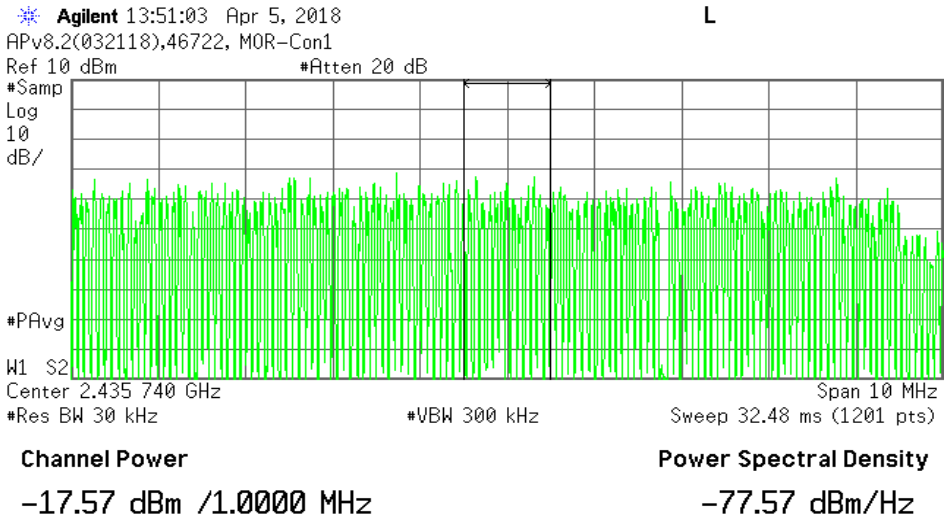
Tx2_Power_Chain0_Nom



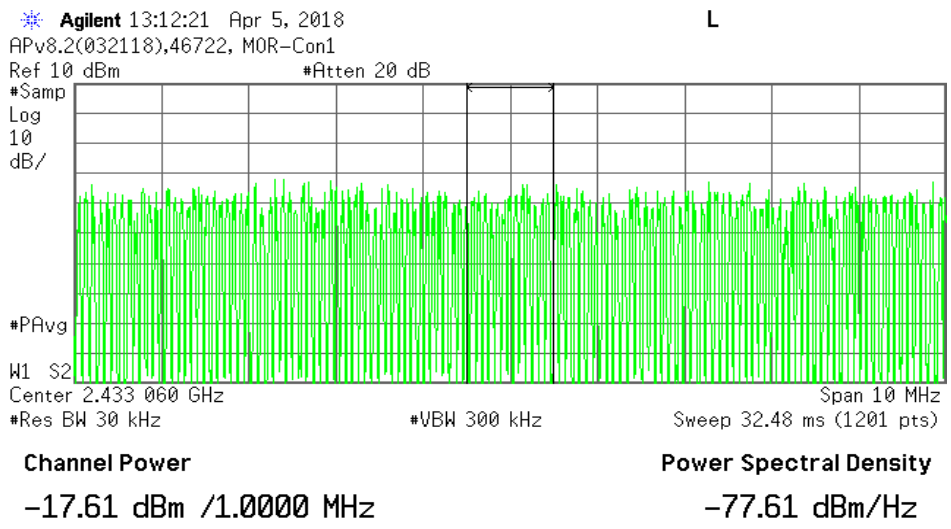
Tx3_Power_Chain0_Nom



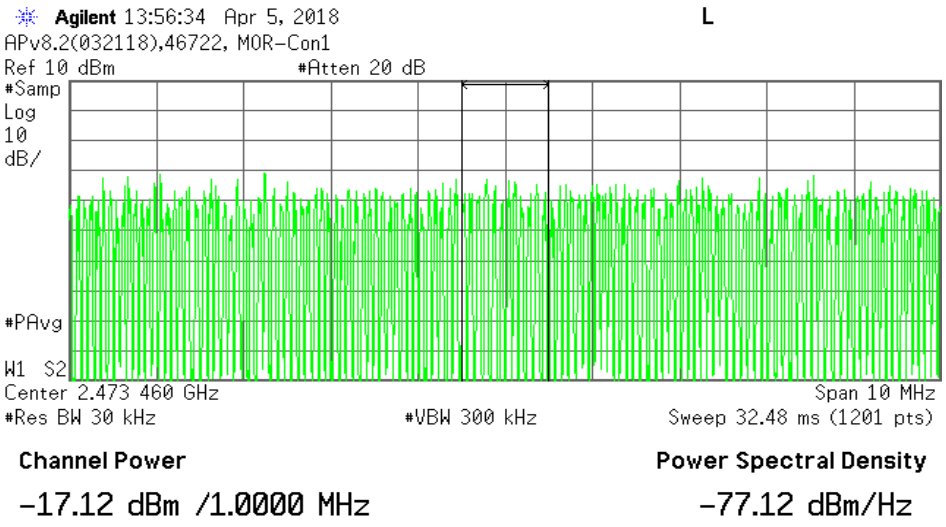
Tx1_Power_Chain1_Nom



Tx2_Power_Chain1_Nom



Tx3_Power_Chain1_Nom



2.4.2. Output Power (SISO CH0)

Job No.	R12053557-E8d
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]
DC4V	0	2422	-16.94	14.68	0.00	0.000594	2.28	0.001355	4.00	0.003404
		2442	-17.72	14.68	0.00	0.000497	2.28	0.001134	4.00	0.002849
		2462	-16.66	14.68	0.00	0.000634	2.28	0.001447	4.00	0.003634
-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-

Sample Calculation :
Output Power (A) = 10 ^ ((Reading [dBm] + Cable Loss + Atten. Loss) / 10) * Burst Rate
E.I.R.P. (A) = Output Power (A) * 10^(Antenna Gain[dBi]/10)

[Total Power / Result and Limit]

Voltage	Freq.	Output Power				E.I.R.P.		
		Result (B)	Tolerance Result	Limit	Tolerance Limit	Result (B)	Result	Limit
	[MHz]	[W/MHz]	[%]	[W/MHz]	[%]	[W/MHz]	[dBm/MHz]	[dBm/MHz]
DC4V	2422	0.001355	-6.1	0.010000	+20 ～ -80	0.003404	5.32	12.14
	2442	0.001134	-21.4	0.010000	+20 ～ -80	0.002849	4.55	12.14
	2462	0.001447	0.2	0.010000	+20 ～ -80	0.003634	5.60	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.

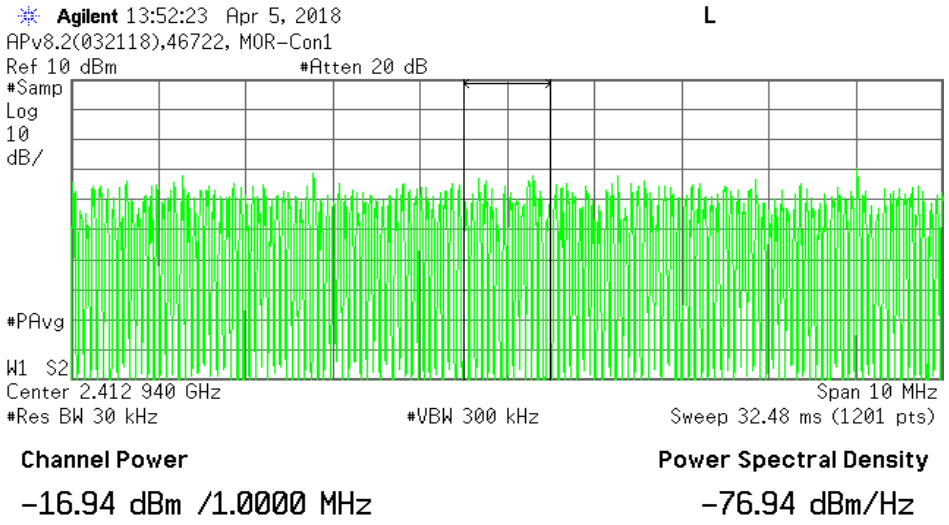
[Declared Output Power]

Average of Output Power Result (B)	0.001312	[W/MHz]
Declared Output Power	0.001443	[W/MHz]
+20	0.001732	[W/MHz]
Middle (Declared Output Power -30%)	0.001010	[W/MHz]
-80	0.000289	[W/MHz]

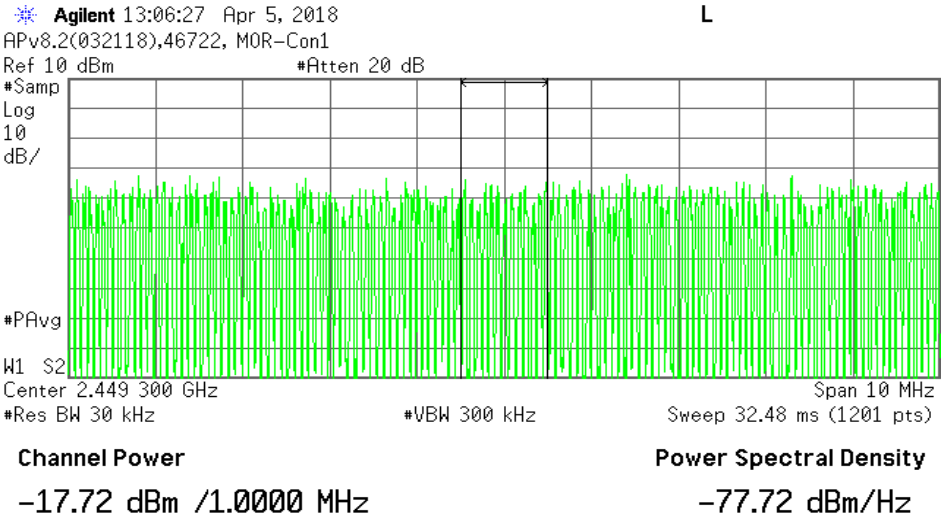
Average of E.I.R.P. Result(B)	0.003295	[W/MHz]
E.I.R.P. for Declared Output Power	5.59	[dBm/MHz]

Sample Calculation :
E.I.R.P. for Declared Output Power
= 10 * Log (Average of E.I.R.P. Result (B) * (Declared Output Power / Average of Output Power Result (B)) * 1000)

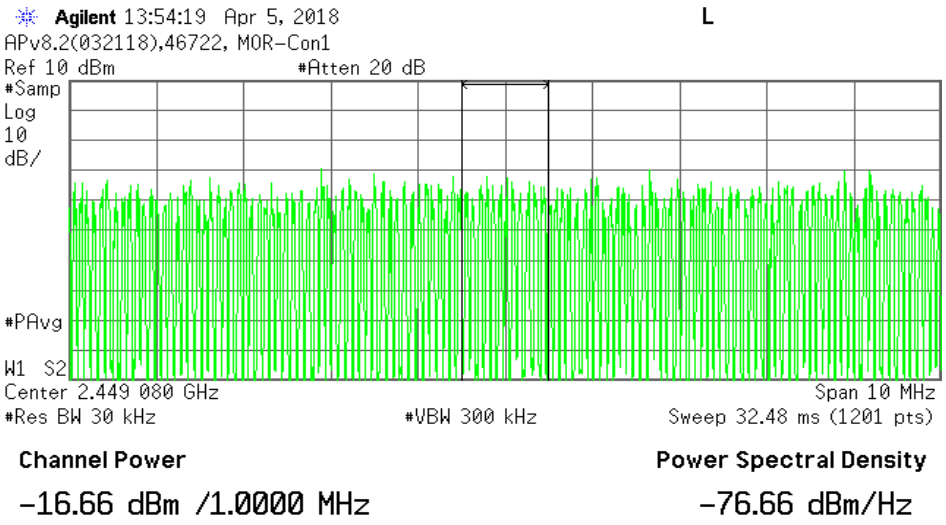
Tx1_Power_Chain0_Nom



Tx2_Power_Chain0_Nom



Tx3_Power_Chain0_Nom



2.4.3. Output Power (SISO CH1)

Job No.	R12053557-E8d
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]
-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
DC4V	1	2422	-17.57	14.68	0.00	0.000514	2.28	0.001173	4.00	0.002947
		2442	-17.61	14.68	0.00	0.000509	2.28	0.001163	4.00	0.002920
		2462	-17.12	14.68	0.00	0.000570	2.28	0.001302	4.00	0.003270
-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-

Sample Calculation :
Output Power (A) = 10 ^ ((Reading [dBm] + Cable Loss + Atten. Loss) / 10) * Burst Rate
E.I.R.P. (A) = Output Power (A) * 10^(Antenna Gain[dBi]/10)

[Total Power / Result and Limit]

Voltage	Freq.	Output Power				E.I.R.P.		
		Result (B)	Tolerance Result	Limit	Tolerance Limit	Result (B)	Result	Limit
	[MHz]	[W/MHz]	[%]	[W/MHz]	[%]	[W/MHz]	[dBm/MHz]	[dBm/MHz]
DC4V	2422	0.001173	-18.7	0.010000	+20 ～ -80	0.002947	4.69	12.14
	2442	0.001163	-19.4	0.010000	+20 ～ -80	0.002920	4.65	12.14
	2462	0.001302	-9.8	0.010000	+20 ～ -80	0.003270	5.15	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.

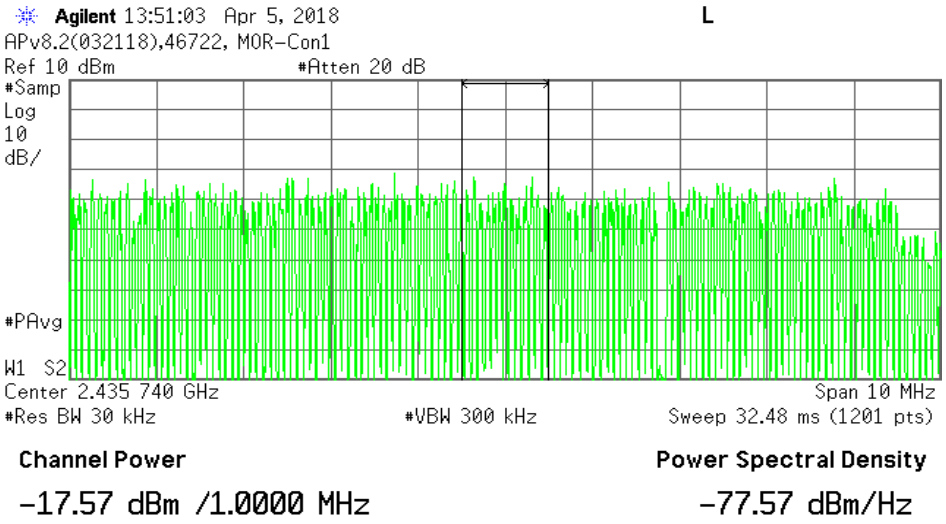
[Declared Output Power]

Average of Output Power Result (B)	0.001312	[W/MHz]
Declared Output Power	0.001443	[W/MHz]
+20	0.001732	[W/MHz]
Middle (Declared Output Power -30%)	0.001010	[W/MHz]
-80	0.000289	[W/MHz]

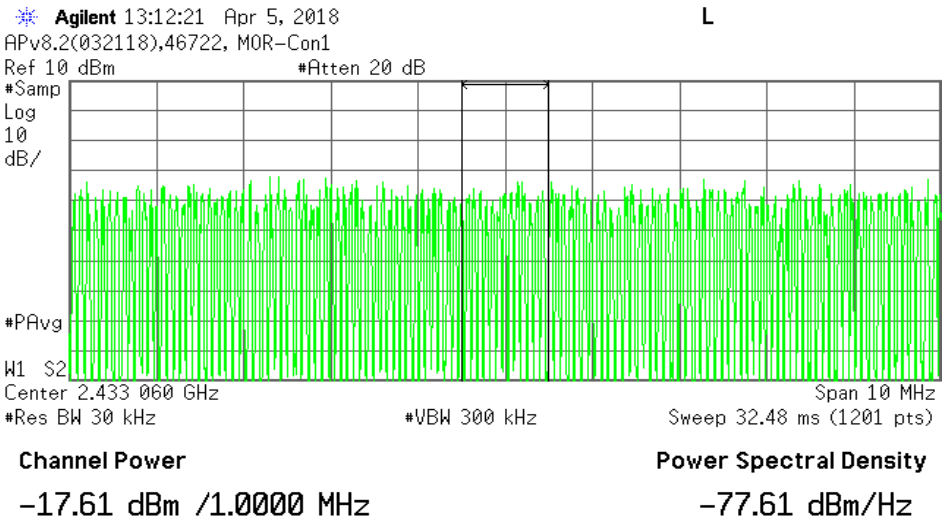
Average of E.I.R.P. Result(B)	0.003295	[W/MHz]
E.I.R.P. for Declared Output Power	5.59	[dBm/MHz]

Sample Calculation :
E.I.R.P. for Declared Output Power
= 10 * Log (Average of E.I.R.P. Result (B) * (Declared Output Power / Average of Output Power Result (B)) * 1000)

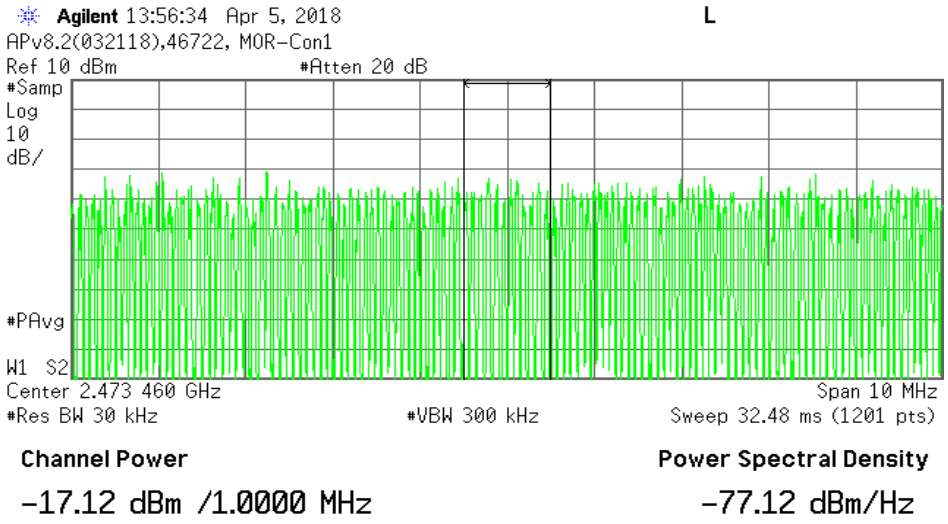
Tx1_Power_Chain1_Nom



Tx2_Power_Chain1_Nom



Tx3_Power_Chain1_Nom



2.5. Secondary Radiated Emission Strength

Job No.	R12053557-E8d
Remark1	
Remark2	

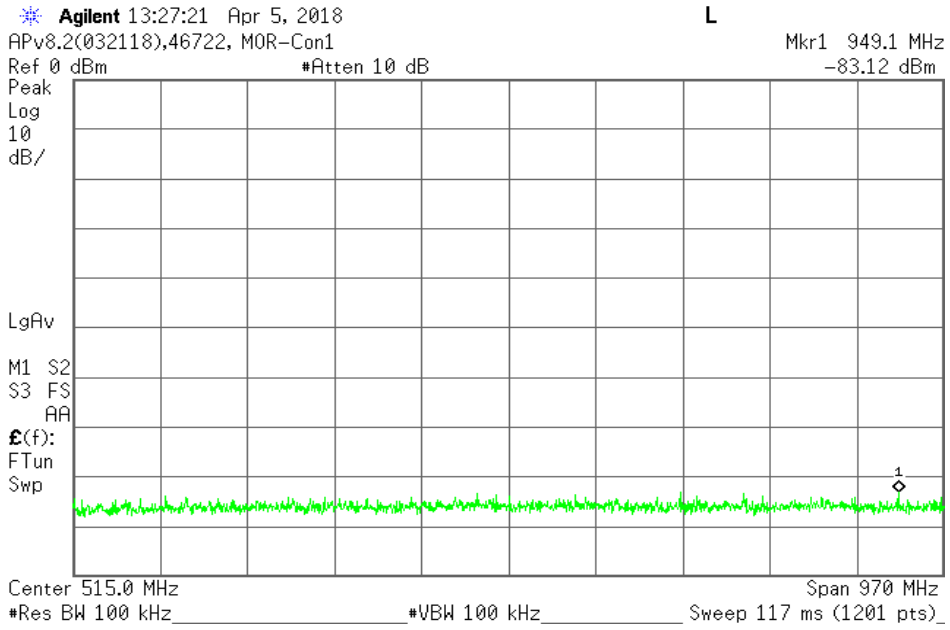
[DATA]

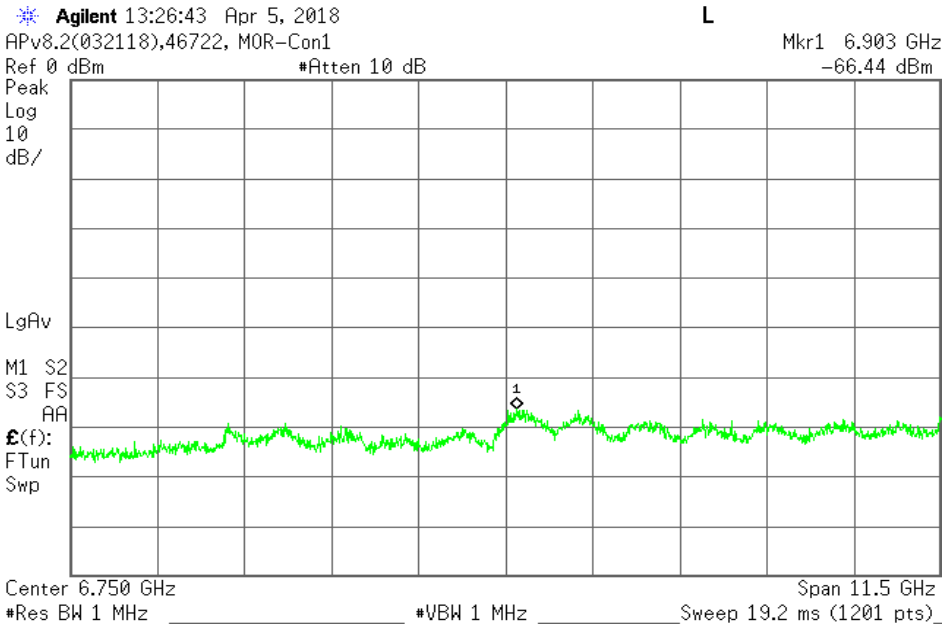
Voltage [V]	Freq. [MHz]	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Result [nW]	Limit [nW]	Remark
DC4V	2422	949.1	-83.12	14.68	0.00	-68.44	0.143	4.000	♦5
		6903.0	-66.44	14.68	0.00	-51.76	6.668	20.000	♦6

The sum of the results exceeding 1/10 of the Limit [nW] : 6.668

Sample Calculation :
Result = Reading + Cable Loss + Atten Loss
♦5:Freq Range5 (≥ 30MHz, <1GHz)
♦6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1_SpuriousM_Nom





2.6. Secondary Radiated Emission Strength

Job No.	R12053557-E8d
Remark1	
Remark2	

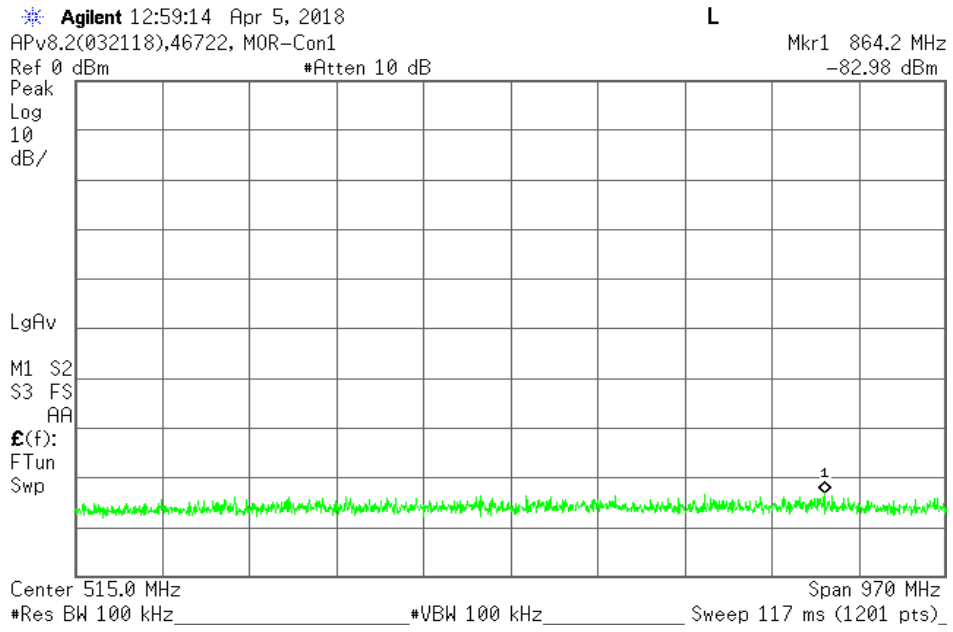
[DATA]

Voltage [V]	Freq. [MHz]	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Result [nW]	Limit [nW]	Remark
DC4V	2442	864.2	-82.98	14.68	0.00	-68.30	0.148	4.000	♦5
		6913.0	-66.05	14.68	0.00	-51.37	7.295	20.000	♦6

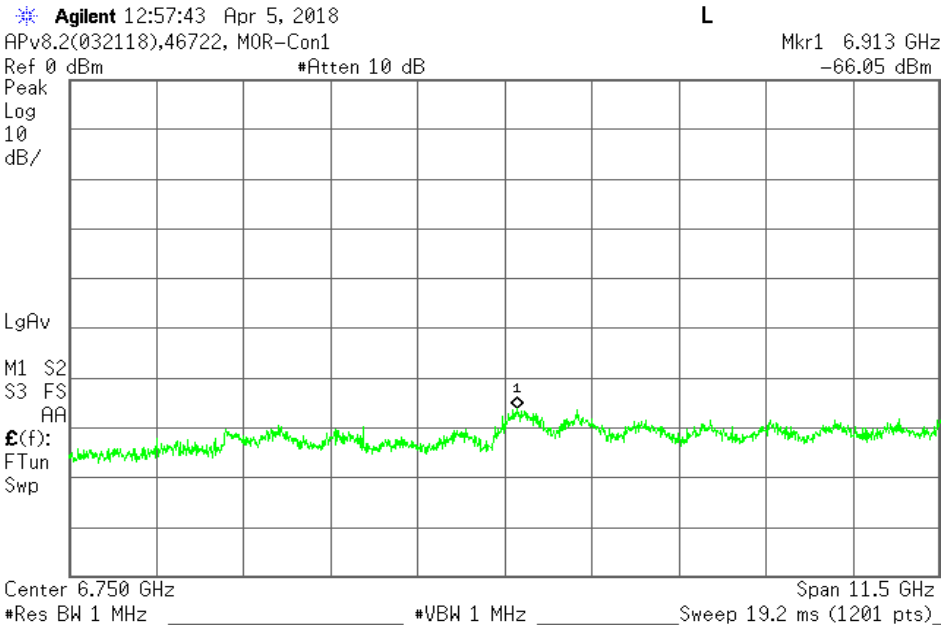
The sum of the results exceeding 1/10 of the Limit [nW] : 7.295

Sample Calculation :
Result = Reading + Cable Loss + Atten Loss
♦5:Freq Range5 (≥ 30MHz, <1GHz)
♦6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1_SpuriousM_Nom



Rx1_SpuriousG_Nom



2.7. Secondary Radiated Emission Strength

Job No.	R12053557-E8d
Remark1	
Remark2	

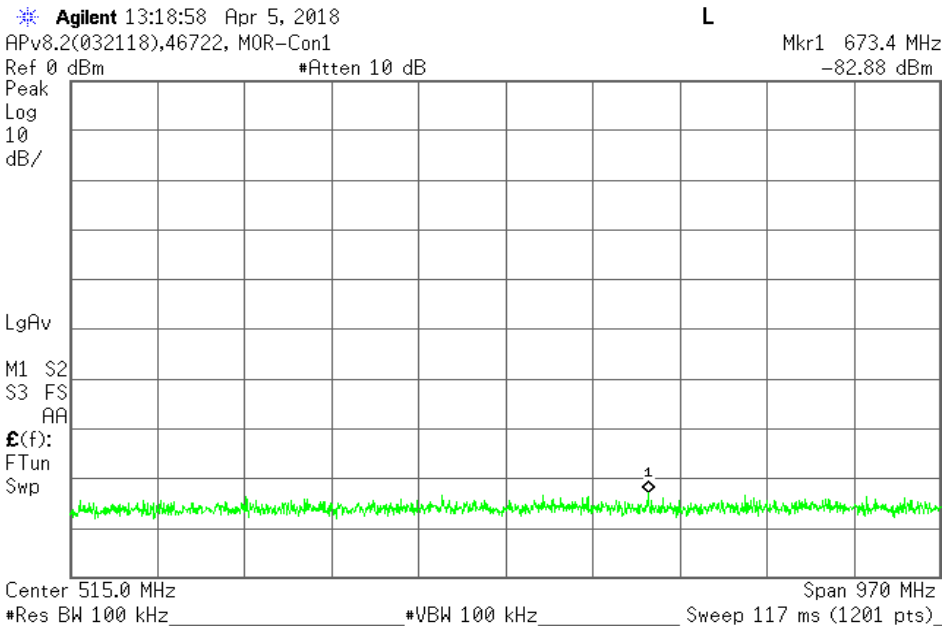
[DATA]

Voltage [V]	Freq. [MHz]	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Result [nW]	Limit [nW]	Remark
DC4V	2462	673.4	-82.88	14.68	0.00	-68.20	0.151	4.000	♦5
		7009.0	-66.38	14.68	0.00	-51.70	6.761	20.000	♦6

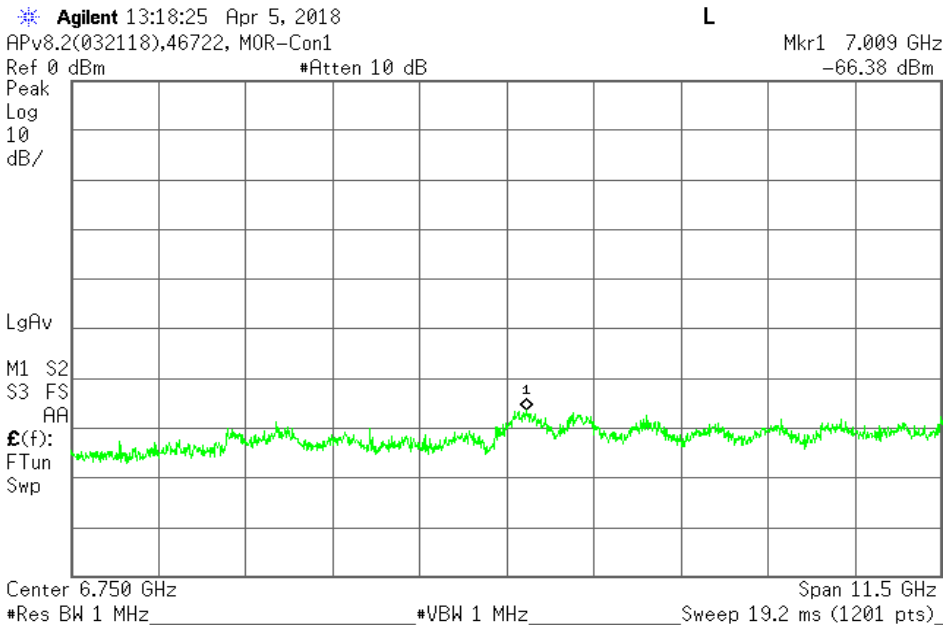
The sum of the results exceeding 1/10 of the Limit [nW] : 6.761

Sample Calculation :
Result = Reading + Cable Loss + Atten Loss
♦5:Freq Range5 (≥ 30MHz, <1GHz)
♦6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1_SpuriousM_Nom



Rx1_SpuriousG_Nom



2.8. Duty / Burst Rate

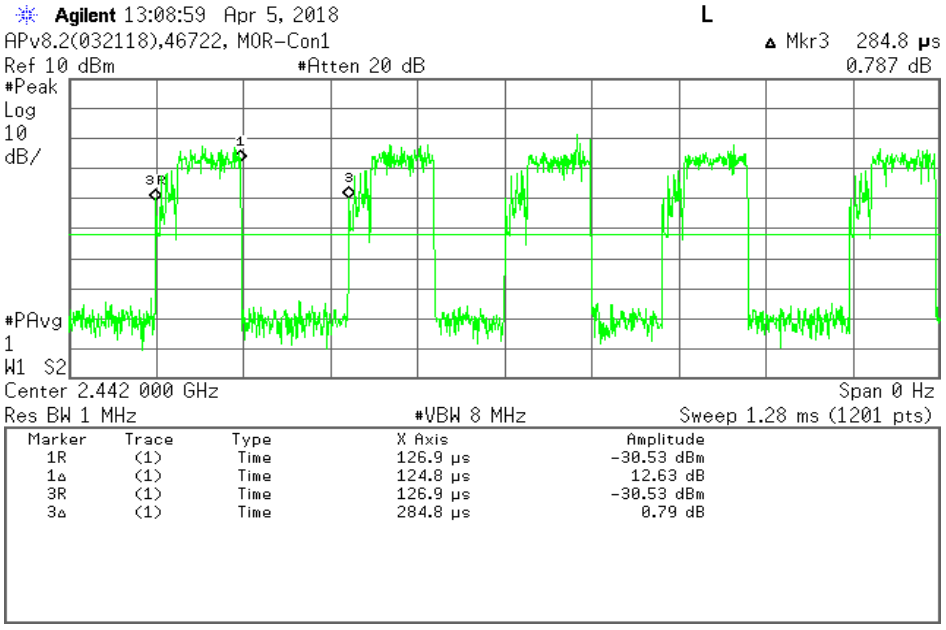
Job No.	R12053557-E8d
Remark1	
Remark2	

[DATA]

Voltage [V]	Freq. [MHz]	On Time [msec]	Period [msec]	Result (Duty) [%]	Result (Burst Rate)
DC4V	2442	0.125	0.285	43.8	2.282

Sample Calculation :
Result(Duty) = On Time / Period * 100
Result(Burst Rate) = Period / On Time

Tx2_Duty_Nom



Average Power

Job No.	R12053557-E8d
Remark1	
Remark2	

[DATA]

Voltage	Port No.	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Burst Rate	Output Power Result [dBm]
DC4V	0	2422	-3.20	14.68	0.00	2.28	15.06
		2442	-3.16	14.68	0.00	2.28	15.10
		2462	-2.82	14.68	0.00	2.28	15.44
DC4V	1	2422	-3.47	14.68	0.00	2.28	14.79
		2442	-3.19	14.68	0.00	2.28	15.07
		2462	-3.26	14.68	0.00	2.28	15.00
DC4V	-	-		-	-	-	-
		-		-	-	-	-
		-		-	-	-	-
DC4V	-	-		-	-	-	-
		-		-	-	-	-
		-		-	-	-	-

Total Output Power

Voltage	Freq. [MHz]	Power [mW]
DC5V	2422	62.24
	2442	64.54
	2462	66.67

3. Measurement Equipment

Use	Int. No.	Kind of Equipment	Model No.	Manufacturer	Serial No.	Calibration Authority	Calibration Date
X	72822	Spectrum Analyzer	E4446A	Agilent	MY51100032	World Cal	2017-08-21
X	PWM003	Power Meter	N1911A	Keysight	MY55110007	World Cal	2017-07-14
X	PWS003	Power Sensor	E9323A	Keysight	MY55116002	World Cal	2017-07-13

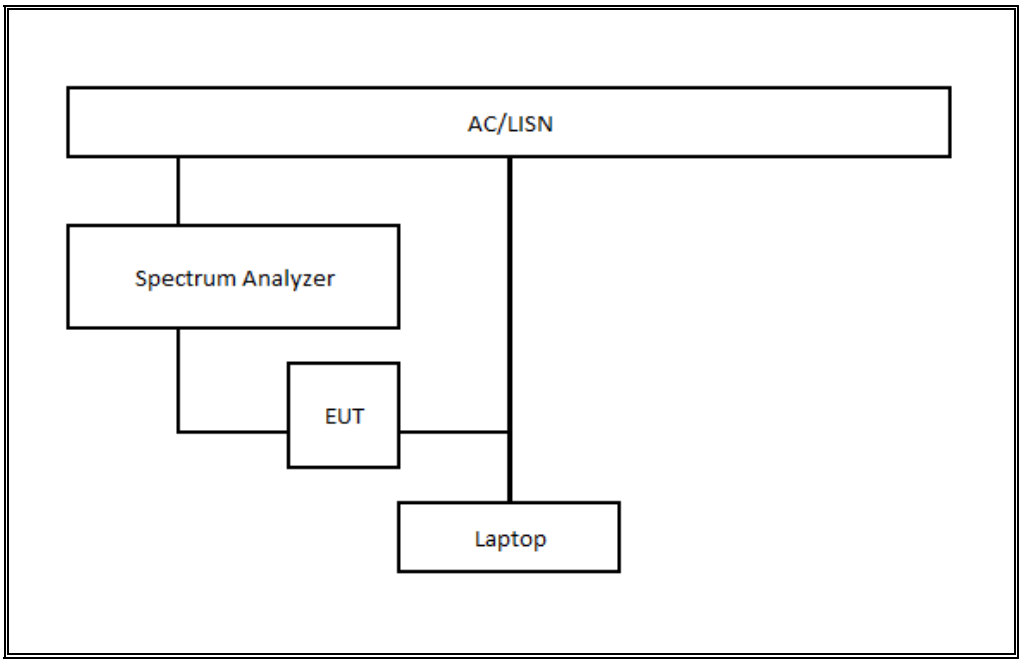
Note : 1. The calibration of measurement equipment is valid for a one year period.
2. "X" used equipment.
3. All equipment is calibrated and traceable to ISO17025

4. Test Condition

Test Item	Date	Temp	Hum	Engineer	Test Room
Frequency Tolerance	2018-04-05	23.7C	50.30%	46722	MOR-Con1
Occupied Bandwidth	2018-04-05	23.7C	50.30%	46722	MOR-Con1
Unwanted Emission Strength	2018-04-05 to 2018-04-06	23.7C	50.30%	46722	MOR-Con1
Output Power/ E.I.R.P	2018-04-05	20.7C	49.90%	46722	MOR-Con1
Secondary Radiated Emission Strength	2018-04-05	23.7C	50.30%	46722	MOR-Con1
Burst Length / Duty	2018-04-05	23.7C	50.30%	46722	MOR-Con1

5. TEST CONFIGURATION

Test Circuit



Photo