

TEST REPORT



REPORT NUMBER: R12161950-E7
COMPANY NAME: Bose Corp
EUT DESCRIPTION: Wireless Headset
MODEL: 424411
SERIAL NUMBER: DP2 A144
ISSUE DATE: 2018-04-06
DATE TESTED: 2018-02-22 and 2018-03-01
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, Research Triangle Park, 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: FID 2402-2480MHz (Interval of 2MHz 40ch) 0.002307W

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:

Prepared By:

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UL LLC

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Project Engineer
UL LLC



NVLAP LAB CODE 200246-0

1. EUT Information

| |
|---|
| Report No. : R12161950-E7 |
| Applicant : Bose Corp |
| Equipment Description: Wireless Headset |
| Model No. : 424411 |
| SerialNo. : DP2 A144 |
| The number of Tx Antenna : 1 |
| Max Antenna Gain : 2.20dBi |
| Mode : GFSK |
| Type of Radio wave : F1D |

| | |
|--|--|
| Supply Voltage <input checked="" type="radio"/> DC <input type="radio"/> AC 24.00V - | Modulation <input 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 checked="" type="radio"/> Other Modulation (e.g. GFSK, Not BT) |
| Voltage Condition <input checked="" type="radio"/> Non-Extreme <input type="radio"/> Extreme Normal DC24V Normal-10% - Normal+10% - | EUT has <input checked="" type="radio"/> ANT Connector <input type="radio"/> 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

| | [MHz] | Other than for Power | | For Power | |
|----------------------|-------|----------------------|-----------|-----------------|-----------|
| | | Cable Loss [dB] | ATT/ [dB] | Cable Loss [dB] | ATT/ [dB] |
| Low Channel (Tx1) | 2402 | 1.84 | 10.00 | 1.84 | 10.00 |
| Middle Channel (Tx2) | 2440 | 1.84 | 10.00 | 1.84 | 10.00 |
| High Channel (Tx3) | 2480 | 1.84 | 10.00 | 1.84 | 10.00 |

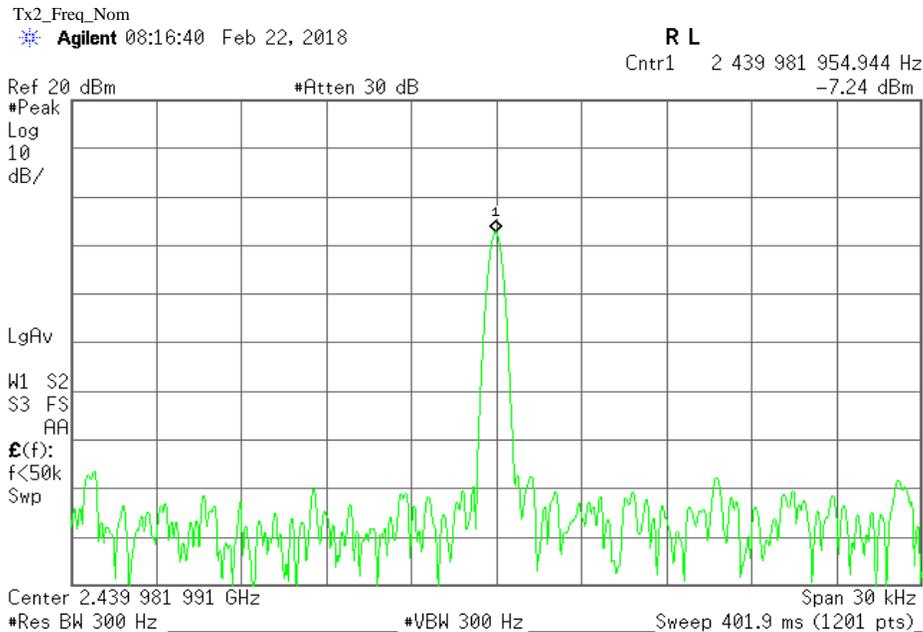
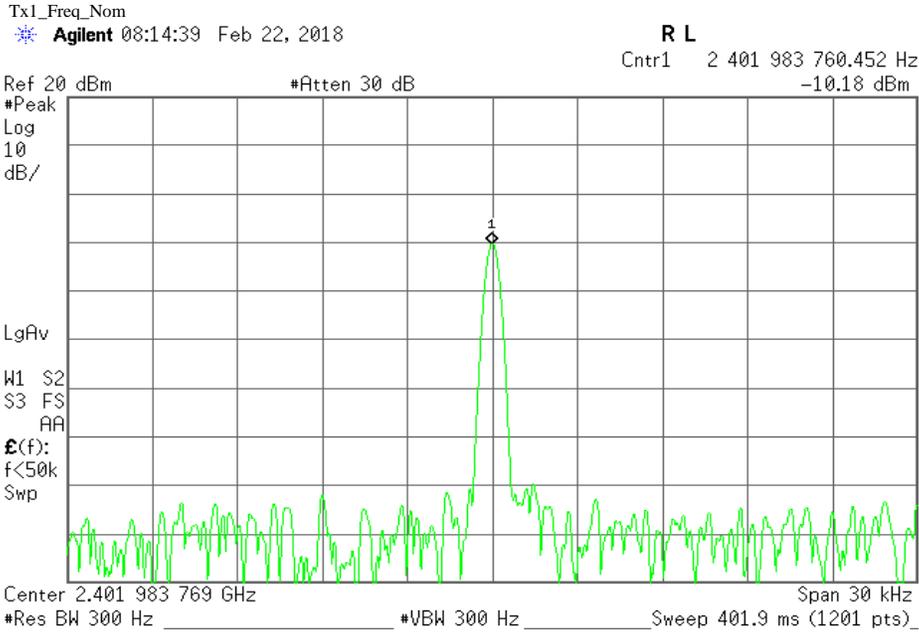
| Ver. | Issue Date | Description | Revised By |
|------|------------|--|-----------------|
| 1 | 2018-03-02 | Initial Release. | Brian T. Kiewra |
| | 2018-04-05 | Corrected Tx Spur Frequency and revised mode to GFSK | Brian T. Kiewra |
| | | | |

2. TEST Result

2.1. Frequency Tolerance

Job No. R12161950-E7
 Remark1
 Remark2

| [DATA] | | | | | |
|----------|-------------|--------------|-----------------|-----------------|-------------|
| Voltage | Freq. [MHz] | Result [MHz] | Tolerance [kHz] | Tolerance [ppm] | Limit [ppm] |
| DC24V | 2402 | 2401.9838 | -16.2395 | -6.76 | ±50.0 |
| | 2440 | 2439.9820 | -18.0451 | -7.40 | ±50.0 |
| | 2480 | 2479.9814 | -18.6106 | -7.50 | ±50.0 |



Ref 20 dBm

#Atten 30 dB

#Peak
Log
10
dB/

LgAv

M1 S2
S3 FS
AA

E(f):
f<50k
Swp

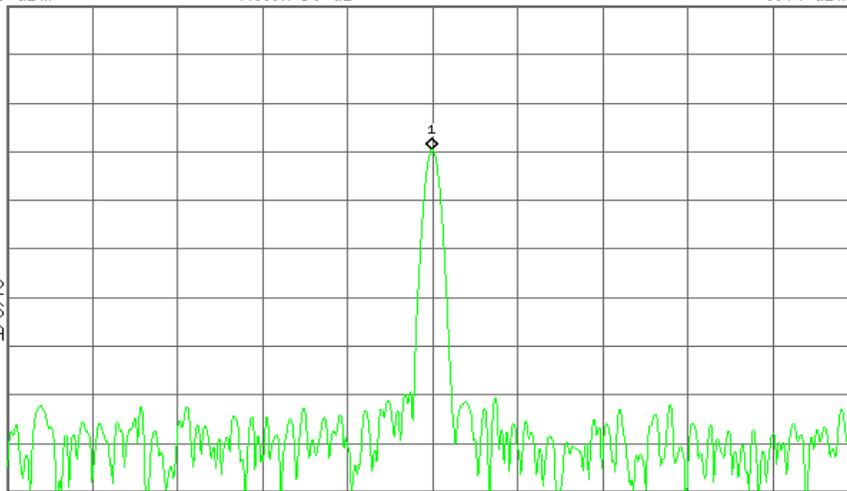
Center 2.479 981 398 GHz

Span 30 kHz

#Res BW 300 Hz

#VBW 300 Hz

Sweep 401.9 ms (1201 pts)



2.2. Occupied Bandwidth / Spreading Bandwidth

Job No. R12161950-E7
 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] |
|---------|-------------|--------------|-------------|
| DC24V | 2402 | 1.2382 | 26 |
| | 2440 | 1.2288 | 26 |
| | 2480 | 1.2299 | 26 |

(Reference data)

Spreading Bandwidth

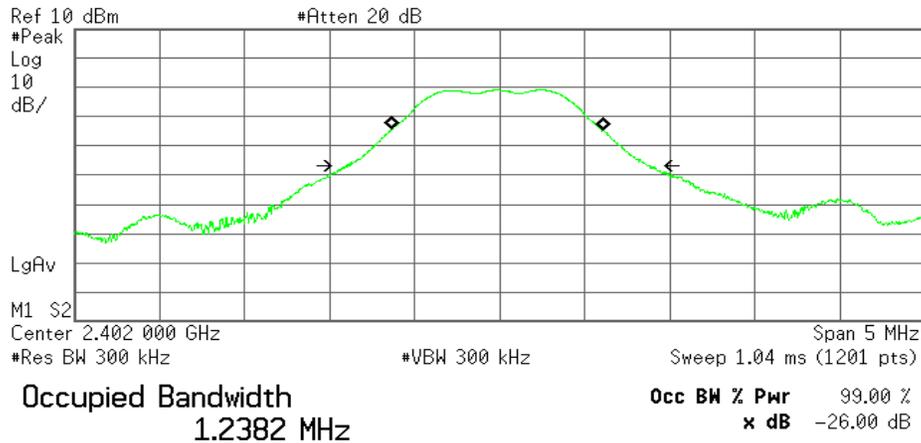
| Voltage | Freq. [MHz] | Result [MHz] | Result [kHz] | Limit [kHz] |
|---------|-------------|--------------|--------------|-------------|
| DC24V | 2402 | 0.8421 | - | - |
| | 2440 | 0.8398 | - | - |
| | 2480 | 0.8417 | - | - |

99% Occupied Frequency Bandwidth

Tx1_99OBW_Nom

* Agilent 07:55:37 Feb 22, 2018

R L

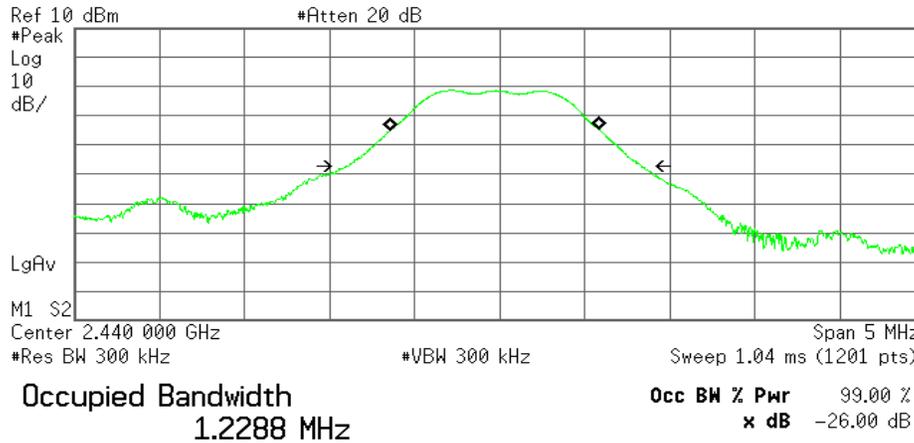


Transmit Freq Error -12.111 kHz
x dB Bandwidth 1.789 MHz

Tx2_99OBW_Nom

Agilent 08:00:23 Feb 22, 2018

R L



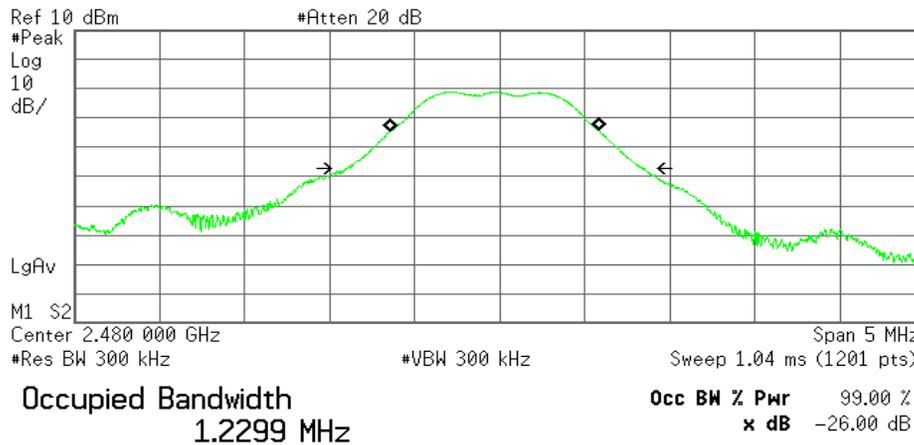
Transmit Freq Error -28.437 kHz

x dB Bandwidth 1.736 MHz

Tx3_99OBW_Nom

Agilent 08:06:32 Feb 22, 2018

R L



Transmit Freq Error -27.926 kHz

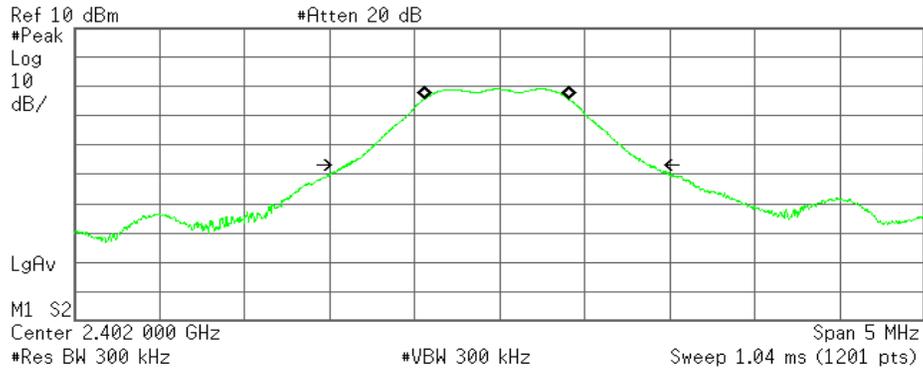
x dB Bandwidth 1.748 MHz

Spreading Bandwidth

Tx1_900BW_Nom

Agilent 07:55:43 Feb 22, 2018

R L



Occupied Bandwidth
842.1171 kHz

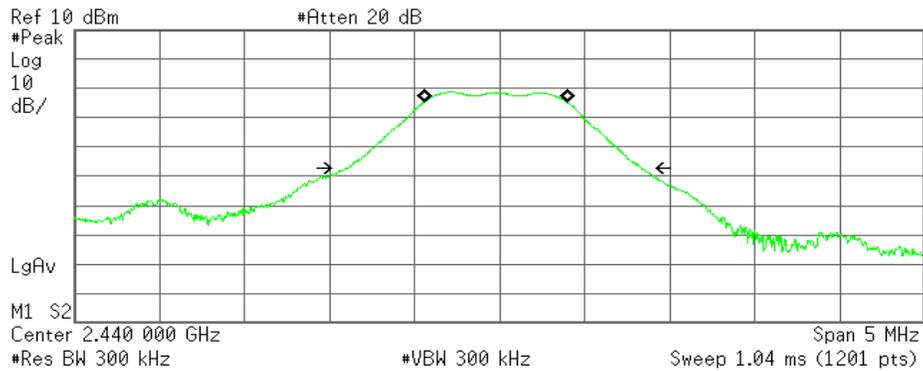
Occ BW % Pwr 90.00 %
x dB -26.00 dB

Transmit Freq Error -16.177 kHz
Occupied Bandwidth 1.789 MHz

Tx2_900BW_Nom

Agilent 08:00:30 Feb 22, 2018

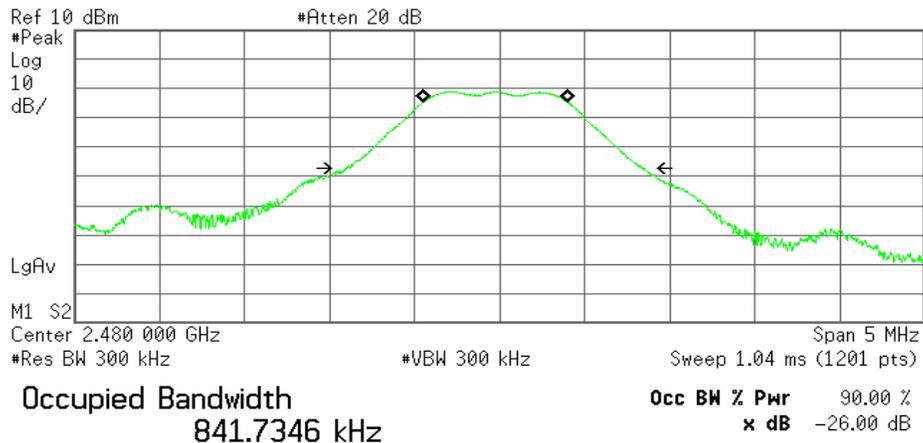
R L



Occupied Bandwidth
839.7941 kHz

Occ BW % Pwr 90.00 %
x dB -26.00 dB

Transmit Freq Error -23.749 kHz
Occupied Bandwidth 1.736 MHz



Transmit Freq Error -23.404 kHz
Occupied Bandwidth 1.748 MHz

2.3. Unwanted Emission Strength (Normal Voltage)

Job No. R12161950-E7

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] | |
| DC24V | 2402 | 638.70 | -81.22 | 1.84 | 10.00 | -59.38 | 0.001 | 2.500 | ♠1 |
| | | 1920.00 | -70.41 | 1.84 | 10.00 | -58.57 | 0.001 | 2.500 | ♠1 |
| | | 2359.83 | -61.00 | 1.84 | 10.00 | -49.16 | 0.012 | 2.500 | ♠1 |
| | | 2399.99 | -45.60 | 1.84 | 10.00 | -33.76 | 0.421 | 25.000 | ♠2 |
| | | 2399.99 | -45.60 | 1.84 | 10.00 | -33.76 | 0.421 | 25.000 | ♠2 |
| | | 3137.00 | -68.39 | 1.84 | 10.00 | -56.55 | 0.002 | 2.500 | ♠4 |
| | 2440 | 12011.00 | -66.13 | 1.84 | 10.00 | -54.29 | 0.004 | 2.500 | ♠4 |
| | | 736.50 | -80.65 | 1.84 | 10.00 | -58.81 | 0.001 | 2.500 | ♠1 |
| | | 2399.00 | -71.38 | 1.84 | 10.00 | -59.54 | 0.001 | 25.000 | ♠2 |
| | | 3175.00 | -69.80 | 1.84 | 10.00 | -57.96 | 0.002 | 2.500 | ♠4 |
| | 2480 | 7315.00 | -66.78 | 1.84 | 10.00 | -54.94 | 0.003 | 2.500 | ♠4 |
| | | 846.40 | -71.84 | 1.84 | 10.00 | -50.00 | 0.010 | 2.500 | ♠1 |
| | | 2198.00 | -71.58 | 1.84 | 10.00 | -59.74 | 0.001 | 2.500 | ♠1 |
| | | 2483.51 | -64.14 | 1.84 | 10.00 | -52.30 | 0.006 | 25.000 | ♠3 |
| | | 2485.42 | -60.81 | 1.84 | 10.00 | -48.97 | 0.013 | 25.000 | ♠3 |
| | | 2518.17 | -60.22 | 1.84 | 10.00 | -48.38 | 0.015 | 2.500 | ♠4 |
| | | 3060.00 | -69.56 | 1.84 | 10.00 | -57.72 | 0.002 | 2.500 | ♠4 |
| | 12030.00 | -66.90 | 1.84 | 10.00 | -55.06 | 0.003 | 2.500 | ♠4 | |

Sample Calculation :

Result = Reading + Cable Loss + Attenuator + RBW Correction (below 1000MHz)

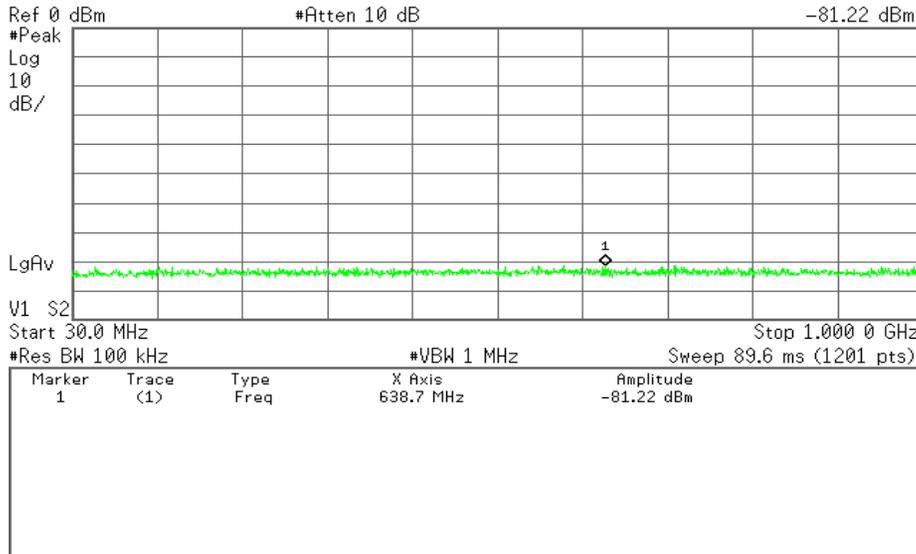
- ◆1:Freq Range1 (≥ 30MHz, < 2,387MHz)
 - ◆2:Freq Range2 (2,387MHz以上, < 2,400MHz)
 - ◆3:Freq Range3 (> 2,483.5MHz, ≤ 2,496.5MHz)
 - ◆4:Freq Range4 (> 2,496.5MHz, ≤ 12.5GHz)
- RBW Correction = 10*log(1MHz/100kHz)

Tx1_SpuriousM_Nom

Agilent 09:12:03 Feb 22, 2018

R L

Mkr1 638.7 MHz
-81.22 dBm

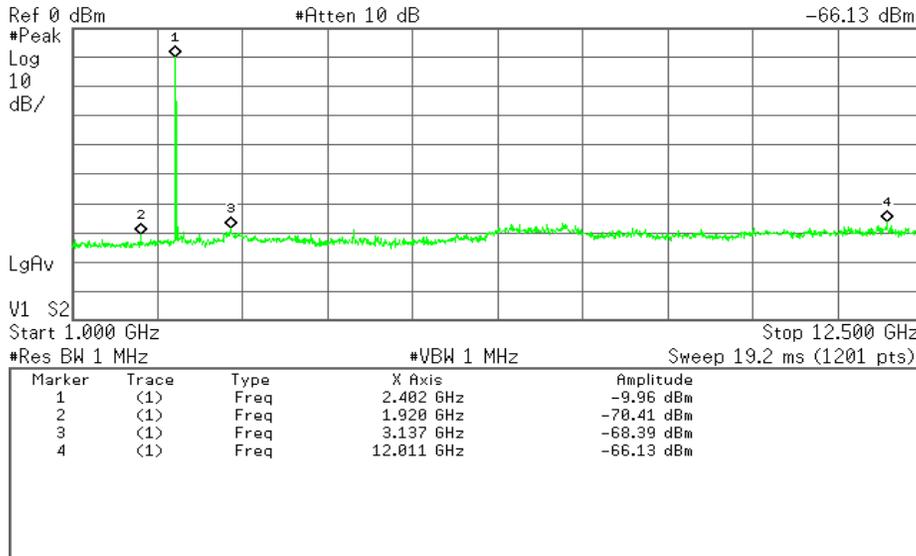


Tx1_SpuriousG_Nom

Agilent 08:21:25 Mar 1, 2018

R L

Mkr4 12.011 GHz
-66.13 dBm

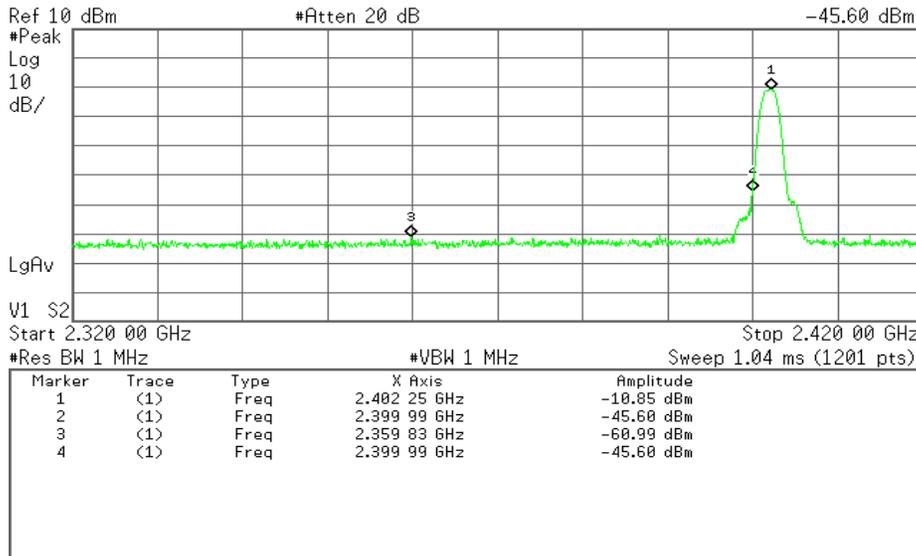


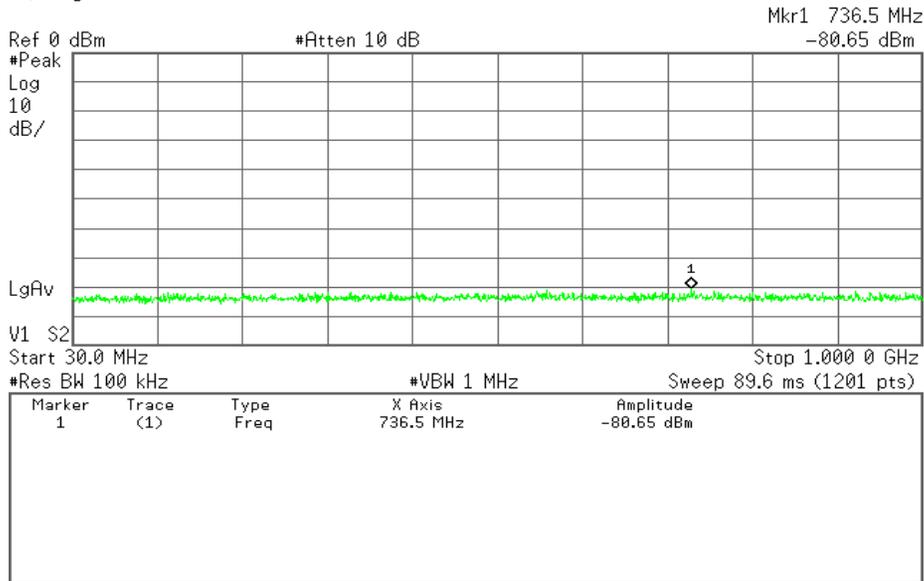
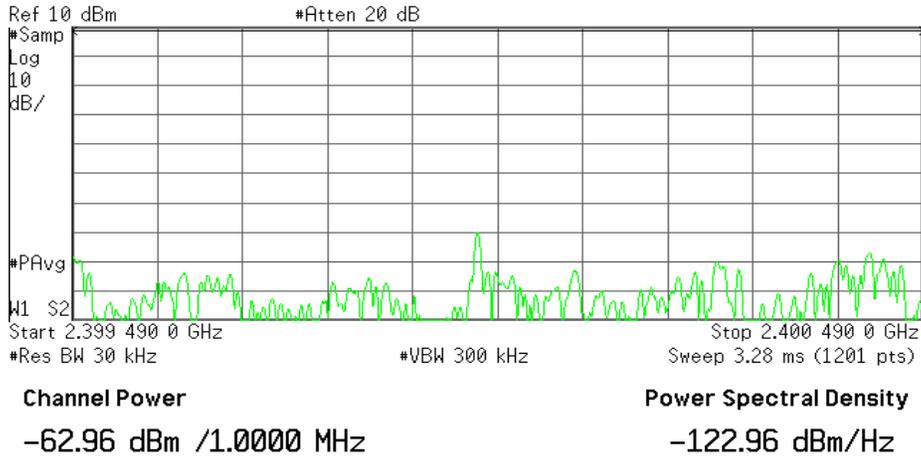
Tx1_BandEdgeLow_Nom

Agilent 07:58:52 Feb 22, 2018

R L

Mkr4 2.399 99 GHz
-45.60 dBm



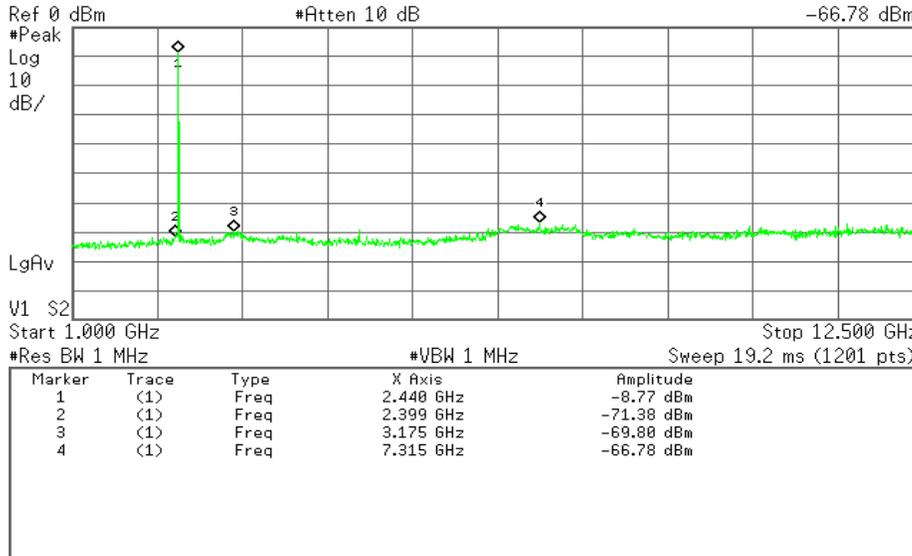


Tx2_SpuriousG_Nom

Agilent 08:22:19 Mar 1, 2018

R L

Mkr4 7.315 GHz
-66.78 dBm

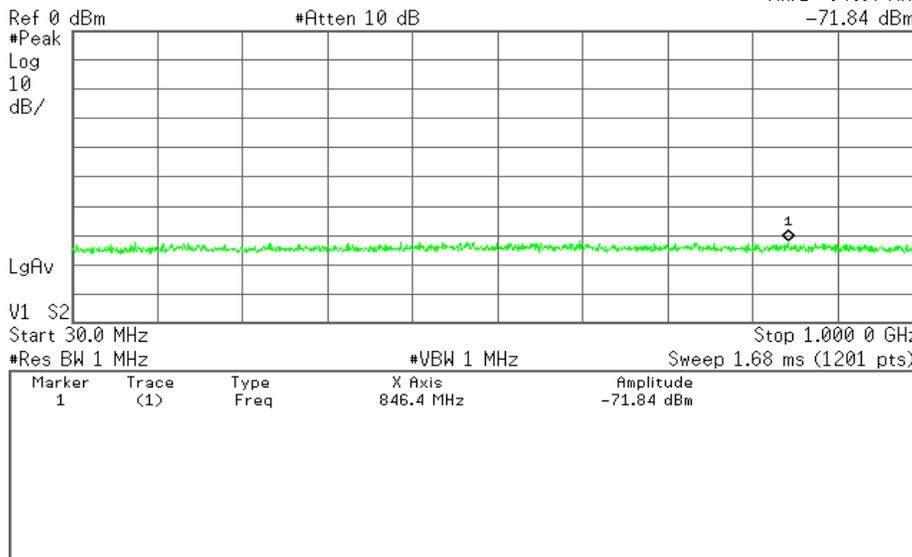


Tx3_SpuriousM_Nom

Agilent 08:23:19 Mar 1, 2018

R L

Mkr1 846.4 MHz
-71.84 dBm



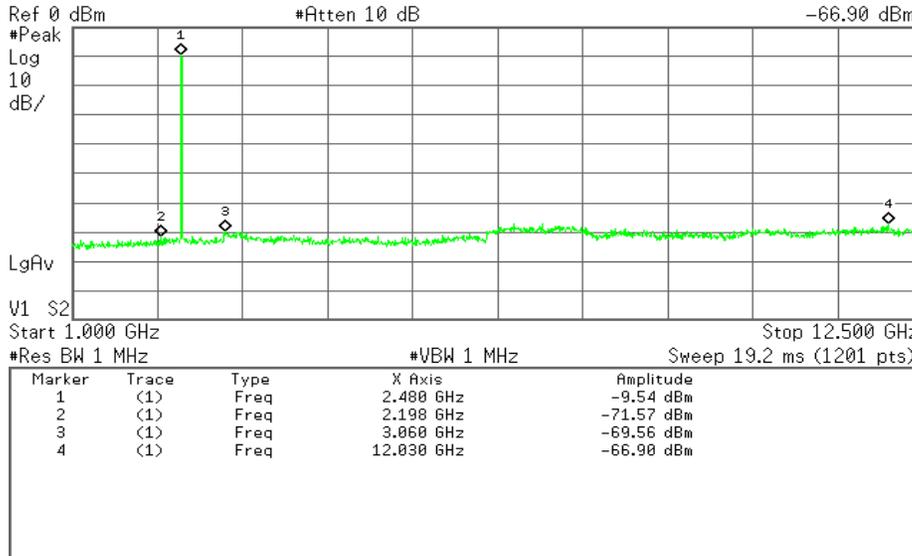
Tx3_SpuriousG_Nom

Agilent 08:23:06 Mar 1, 2018

R L

Mkr4 12.030 GHz

-66.90 dBm



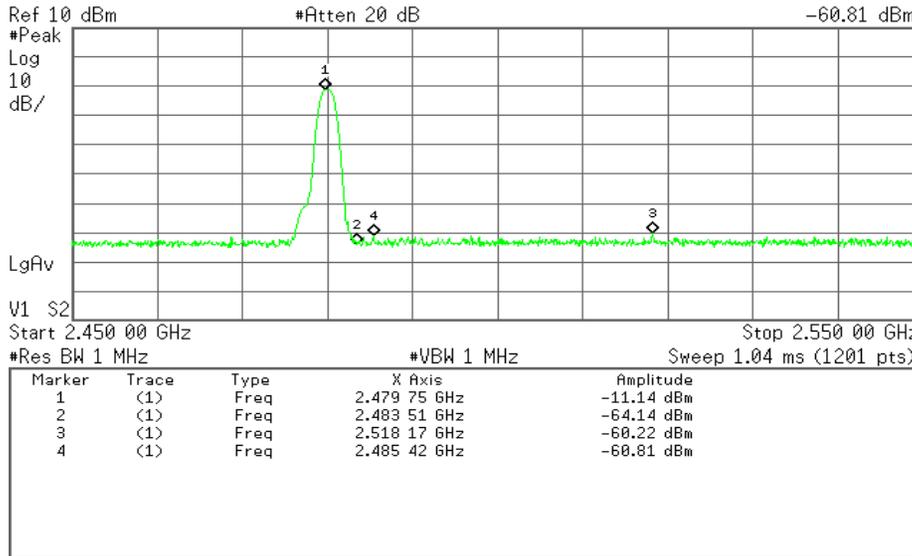
Tx3_BandEdgeHigh_Nom

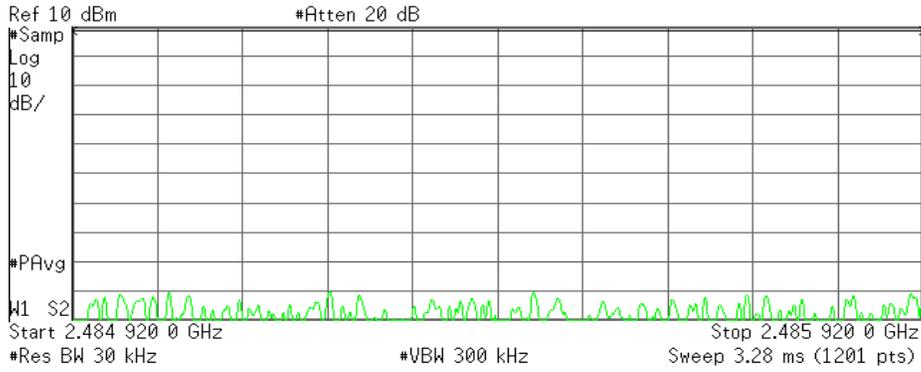
Agilent 08:08:42 Feb 22, 2018

R L

Mkr4 2.485 42 GHz

-60.81 dBm





Channel Power
-72.32 dBm /1.0000 MHz

Power Spectral Density
-132.32 dBm/Hz

2.4. Output Power

Job No. R12161950-E7

Remark1

Remark2

[DATA]

| Voltage | Chain | Freq. | Reading | Cable Loss | Atten. Loss | Result | Burst Rate | Output Power (A) | Antenna Gain | E.I.R.P. (A) |
|---------|-------|-------|---------|------------|-------------|----------|------------|------------------|--------------|--------------|
| | | [MHz] | [dBm] | [dB] | [dB] | [W] | | [W] | [dBi] | [W] |
| DC24V | 0 | 2402 | -12.32 | 1.84 | 10.00 | 0.000895 | 1.60 | 0.001431 | 2.20 | 0.002374 |
| | | 2440 | -11.43 | 1.84 | 10.00 | 0.001099 | 1.60 | 0.001756 | 2.20 | 0.002914 |
| | | 2480 | -11.68 | 1.84 | 10.00 | 0.001038 | 1.60 | 0.001658 | 2.20 | 0.002751 |
| DC24V | - | - | - | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - | - | - | - |
| DC24V | - | - | - | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - | - | - | - |
| DC24V | - | - | - | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - | - | - | - |

Sample Calculation :

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

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) [W] | Tolerance Result [%] | Limit [W] | Tolerance Limit [%] | Result (B) [W] | Result [dBm] | Limit [dBm] |
| | | DC24V | 2402 | 0.001431 | -38.0 | 0.010000 | +20 ~ -80 | 0.002374 |
| | 2440 | 0.001756 | -23.9 | 0.010000 | +20 ~ -80 | 0.002914 | 4.64 | 12.14 |
| | 2480 | 0.001658 | -28.1 | 0.010000 | +20 ~ -80 | 0.002751 | 4.39 | 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) | 0.001615 | [W] | Average of E.I.R.P. Result(B) | 0.002680 | [W] |
| Declared Output Power | 0.002307 | [W] | E.I.R.P. for Declared Output Power | 5.83 | [dBm] |
| +20 | 0.002768 | [W] | | | |
| Middle (Declared Output Power -30%) | 0.001615 | [W] | | | |
| -80 | 0.000461 | [W] | | | |

Sample Calculation :

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

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

2.5. Secondary Radiated Emission Strength

Job No. R12161950-E7

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] | |
| DC24V | 2402 | 238.2 | -81.50 | 1.84 | 10.00 | -69.66 | 0.108 | 4.000 | ◆5 |
| | | 7488.0 | -67.12 | 1.84 | 10.00 | -55.28 | 2.965 | 20.000 | ◆6 |

The sum of the results exceeding 1/10 of the Limit [nW] : 2.965

Sample Calculation :

Result = Reading + Cable Loss + Atten Loss

◆5:Freq Range5 (≥ 30MHz, <1GHz)

◆6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

Rx1_SpuriousM_Nom

Agilent 08:34:18 Feb 22, 2018

R L

Mkr1 283.8 MHz

-81.50 dBm

Ref -20 dBm

Atten 10 dB

#Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
RA

£(f):
FTun
Swp

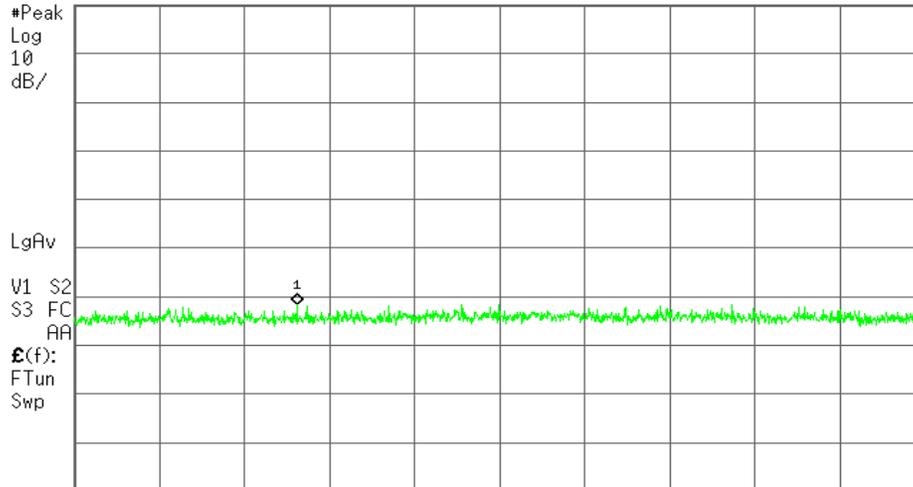
Start 30.0 MHz

Stop 1.000 0 GHz

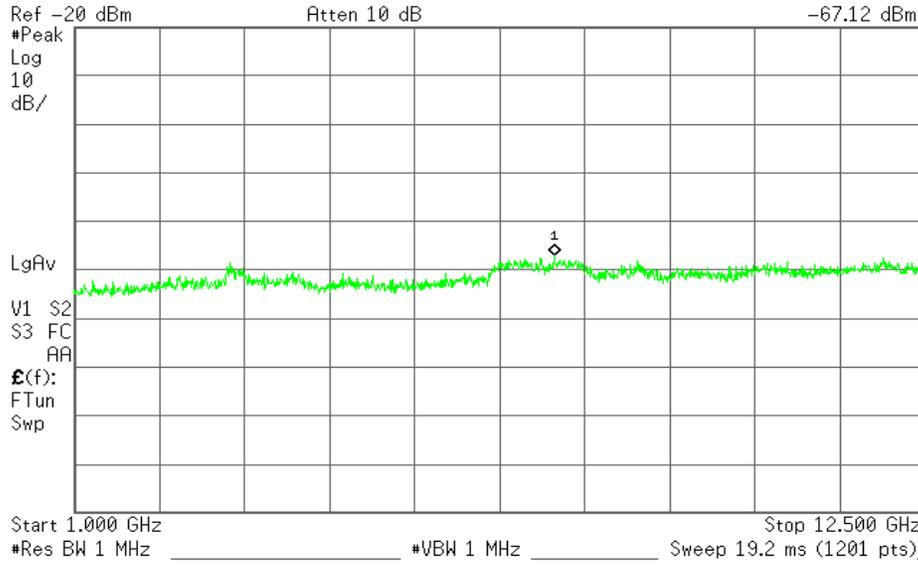
#Res BW 100 kHz

#VBW 100 kHz

Sweep 117 ms (1201 pts)



Mkr1 7.488 GHz
-67.12 dBm



2.5. Secondary Radiated Emission Strength

Job No. R12161950-E7

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] | |
| DC24V | 2440 | 497.2 | -81.55 | 1.84 | 10.00 | -69.71 | 0.107 | 4.000 | ◆5 |
| | | 7258.0 | -66.66 | 1.84 | 10.00 | -54.82 | 3.297 | 20.000 | ◆6 |

The sum of the results exceeding 1/10 of the Limit [nW] : 3.297

Sample Calculation :

Result = Reading + Cable Loss + Atten Loss

◆5:Freq Range5 (≥ 30MHz, <1GHz)

◆6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

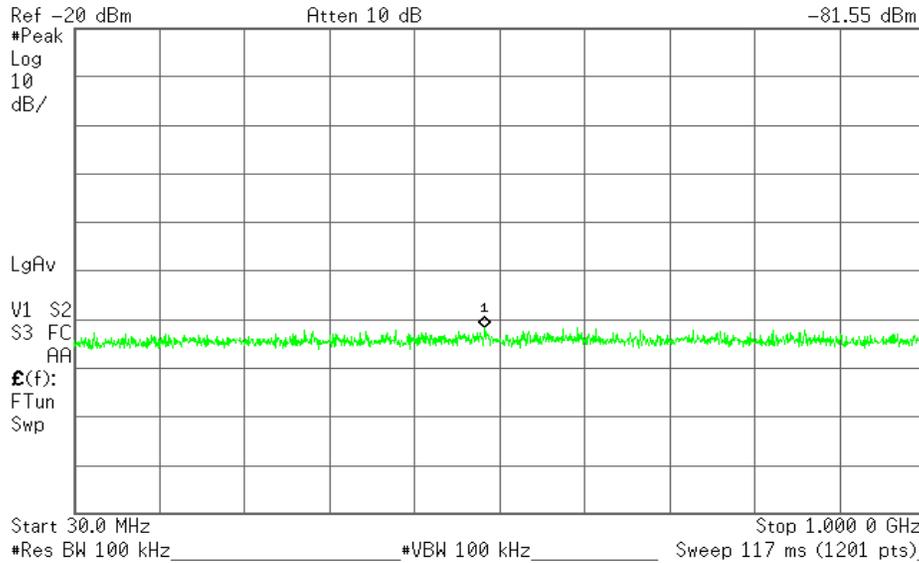
Rx1_SpuriousM_Nom

Agilent 08:42:05 Feb 22, 2018

R L

Mkr1 497.2 MHz

-81.55 dBm



Ref -20 dBm

Atten 10 dB

*Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
RA

Ⓔ(f):
FTun
Swp

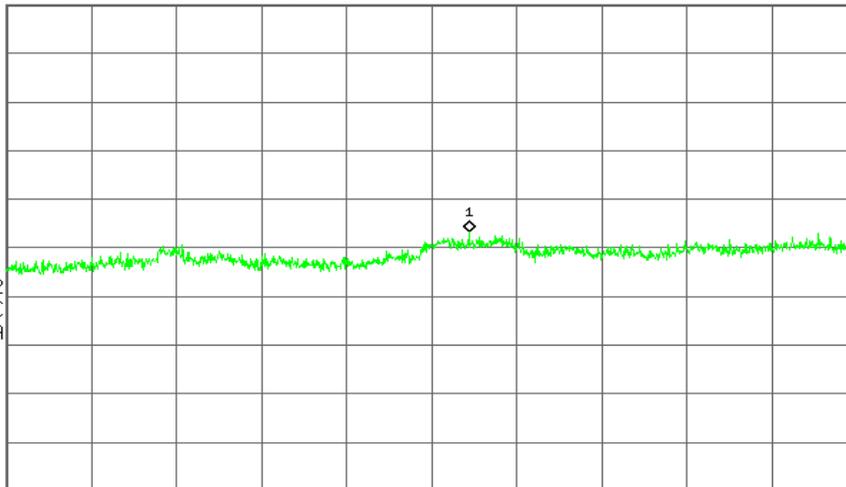
Start 1.000 GHz

Stop 12.500 GHz

*Res BW 1 MHz

*VBW 1 MHz

Sweep 19.2 ms (1201 pts)



2.5. Secondary Radiated Emission Strength

Job No. R12161950-E7

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] | |
| DC24V | 2480 | 460.0 | -81.15 | 1.84 | 10.00 | -69.31 | 0.117 | 4.000 | ◆5 |
| | | 7085.0 | -66.63 | 1.84 | 10.00 | -54.79 | 3.319 | 20.000 | ◆6 |

The sum of the results exceeding 1/10 of the Limit [nW] : 3.319

Sample Calculation :

Result = Reading + Cable Loss + Atten Loss

◆5:Freq Range5 (≥ 30MHz, <1GHz)

◆6:Freq Range6 (≥ 1GHz, ≤ 12.5GHz)

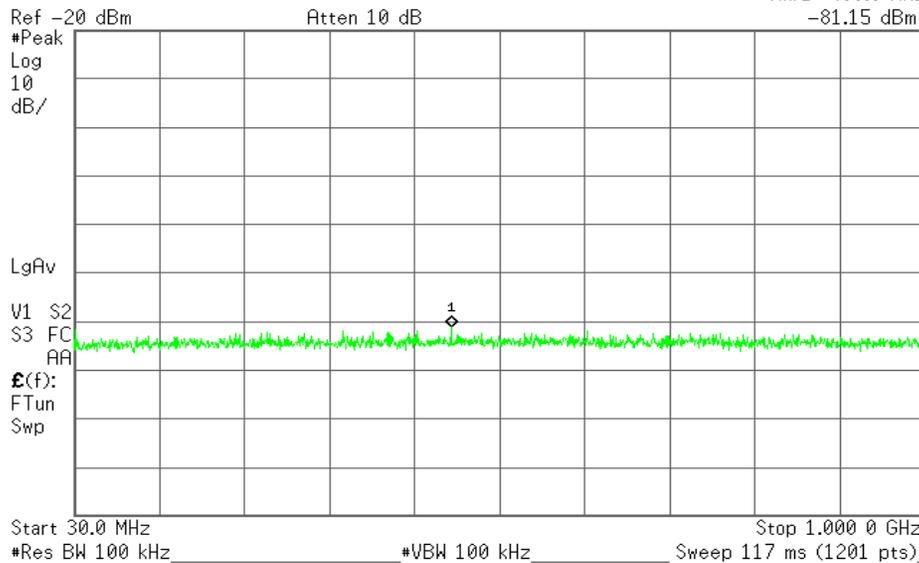
Rx1_SpuriousM_Nom

Agilent 08:10:25 Feb 22, 2018

R L

Mkr1 460.0 MHz

-81.15 dBm



Ref -20 dBm

Atten 10 dB

*Peak
Log
10
dB/

LgAv

V1 S2
S3 FC
AA

Ⓔ(f):
FTun
Swp

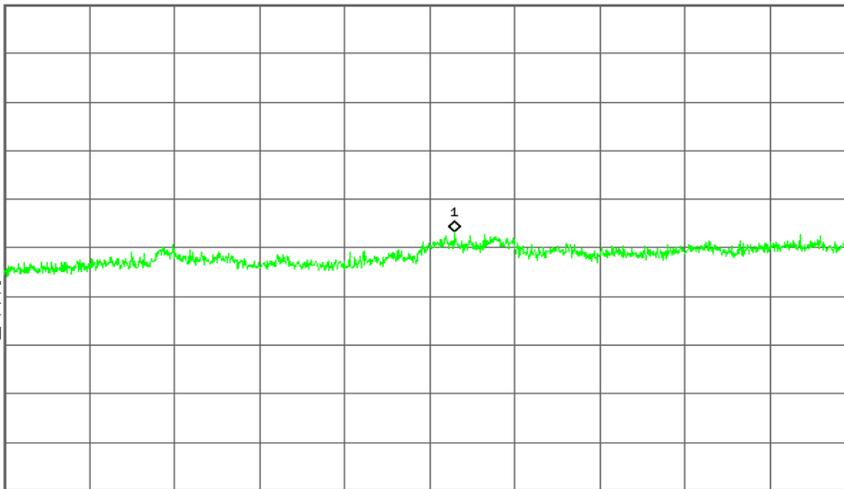
Start 1.000 GHz

Stop 12.500 GHz

*Res BW 1 MHz

*VBW 1 MHz

Sweep 19.2 ms (1201 pts)



2.6. Duty / Burst Rate

Job No. R12161950-E7

Remark1

Remark2

[DATA]

| Voltage | Freq. | On Time | Period | Result (Duty) | Result (Burst Rate) |
|---------|-------|---------|--------|---------------|---------------------|
| [V] | [MHz] | [msec] | [msec] | [%] | |
| DC24V | 2440 | 0.390 | 0.623 | 62.6 | 1.598 |

Sample Calculation :

Result(Duty) = On Time / Period * 100

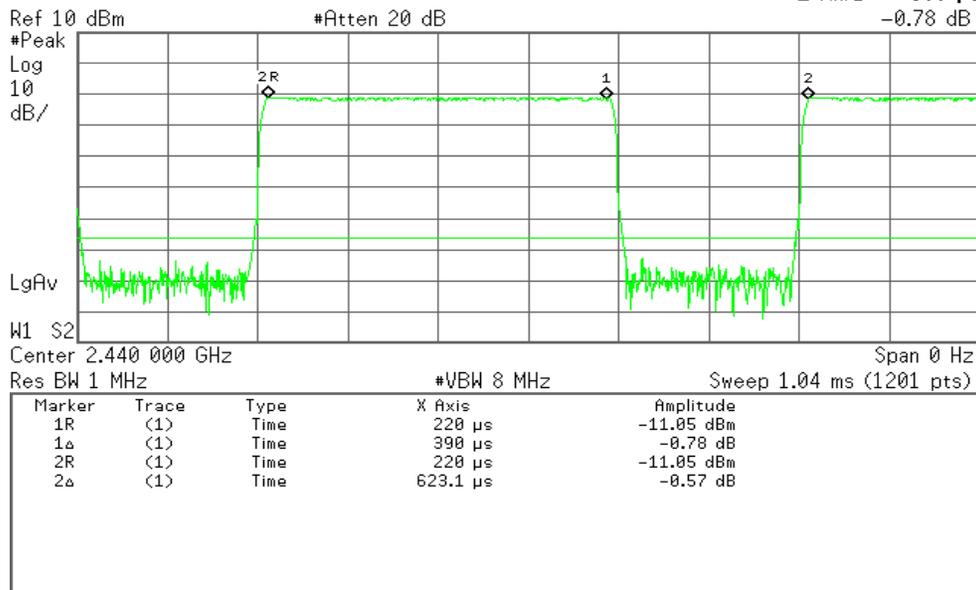
Result(Burst Rate) = Period / On Time

Tx2_Duty_Nom

Agilent 08:02:14 Feb 22, 2018

R L

Δ Mkr1 390 μs
-0.78 dB



Average Power

Job No. R12161950-E7

Remark1

Remark2

[DATA]

| Voltage | Port No. | Freq. | Reading | Cable Loss | Atten. Loss | Burst Rate | Output Power Result |
|---------|----------|-------|---------|------------|-------------|------------|---------------------|
| | | [MHz] | [dBm] | [dB] | [dB] | | [dBm] |
| DC24V | 0 | 2402 | -12.32 | 1.84 | 10.00 | 1.60 | 1.55 |
| | | 2440 | -11.43 | 1.84 | 10.00 | 1.60 | 2.44 |
| | | 2480 | -11.68 | 1.84 | 10.00 | 1.60 | 2.19 |
| DC24V | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - |
| | | - | - | - | - | - | - |
| DC24V | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - |
| | | - | - | - | - | - | - |
| DC24V | - | - | - | - | - | - | - |
| | | - | - | - | - | - | - |
| | | - | - | - | - | - | - |

Total Output Power

| Voltage | Freq. | Power |
|---------|-------|-------|
| | [MHz] | [mW] |
| DC24V | 2402 | 1.43 |
| | 2440 | 1.76 |
| | 2480 | 1.66 |

3. Measurement Equipment

| Use | Int. No. | Kind of Equipment | Model No. | Manufacturer | Serial No. | Calibration Authority | Calibration Date |
|-----|-----------|---------------------|------------|---------------------|------------|-----------------------|------------------|
| X | SA0020 | Spectrum Analyzer | E4446A | Agilent | MY22110003 | Keysight Calibration | 2017-11-06 |
| X | PWM002 | Power Meter | N1911A | Keysight | MY55116001 | World Cal Inc | 2017-07-17 |
| X | PWS004 | Power Sensor | E9323A | Keysight | MY55110008 | World Cal Inc | 2017-07-17 |
| X | EC0225 | Temp Chamber | Z8 Plus | Cincinnati Sub-Zero | 1100502 | C & C Technologies | 2017-06-06 |
| X | 161016511 | Environmental Meter | 15-077-963 | Fisher Scientific | 161016511 | Traceable Calibration | 2016-12-21 |

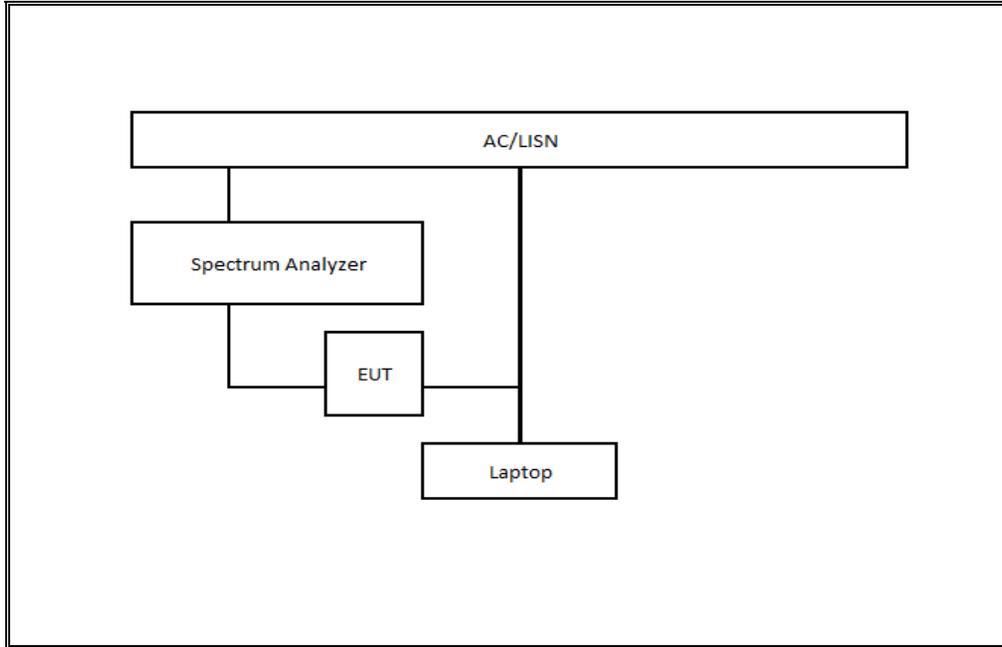
- Note :
1. The calibration of measurement equipment is valid for a one year period.
Except for the environmental meter, which is on a 2yr calibration cycle.
 2. "X" used equipment.
 3. All equipment is calibrated and traceable to ISO17025

4. Test Condition

| Test Item | Date | Temp | Hum | Engineer | Test Room |
|--------------------------------------|------------------------------|------|-----|-----------------|-----------|
| Frequency Tolerance | 2018-02-22 | 25 | 61 | Jeffrey Cabrera | MOR CON 2 |
| Occupied Bandwidth | 2018-02-22 | 25 | 61 | Jeffrey Cabrera | MOR CON 2 |
| Unwanted Emission Strength | 2018-02-22 and 2018-03-01 | 25 | 61 | Jeffrey Cabrera | MOR CON 2 |
| Output Power/ E.I.R.P | 2018-02-22 | 25 | 61 | Jeffrey Cabrera | MOR CON 2 |
| Secondary Radiated Emission Strength | 2018-02-22 | 25 | 61 | Jeffrey Cabrera | MOR CON 2 |
| Burst Length / Duty | 2018-02-22 | 25 | 61 | Jeffrey Cabrera | MOR CON 2 |

5. TEST CONFIGURATION

Test Circuit



Photo

