RF TEST REPORT

Test item	:	Industrial Image Processing Unit
Model No.	:	1012WGB
Order No.	:	DTNC1507-03747, DTNC1507-03750
Date of receipt	:	2015-07-28
Test duration	:	2015-07-29 ~ 2015-08-24
Date of issue	:	2015-09-07
Use of report	:	FCC & IC Original Grant

Applicant : Rayence Co., Ltd.
1F, 2F, 3F, #402, 14, Samsung 1ro 1-gil, Hwaseong-si, Gyeonggi-do, 445-170, Korea

Test laboratory : DT&C Co., Ltd.
42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935

Test specification	:	FCC Part 15 Subpart C 247 RSS-247 Issue 1: 2015 RSS-GEN Issue 4: 2014
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

Tested by:

Engineer
HyunSu Son

Reviewed by:

Technical Manager
GeunKi Son

Test Report Version

Test Report No.	Date	Description
DRTFCC1509-0187	Sep. 07, 2015	Initial issue

Table of Contents

1. EUT DESCRIPTION

FCC Equipment Class	Digital Transmission System(DTS)
Product	Industrial Image Processing Unit
Model Name	1012WGB
Add Model Name	N/A
Serial Number	Identical prototype
Hardware version	V9.0
Software version	V3.4
Power Supply	DC 11.1 V
Frequency Range	**2.4 GHz Band** ▪ 802.11b/g/n(HT20): 2412 MHz ~ 2462 MHz ▪ 802.11n(HT40): 2422 MHz ~ 2452 MHz
Modulation Type	▪ 802.11b: CCK, DSSS ▪ 802.11g/n: OFDM
Transmissions category	Completely uncorrelated signal
Antenna Specification	**Antenna type**: Internal Antenna **Antenna gain** ▪ 2.4 GHz Band: ANT 1 : - 7.01 dBi & ANT 2 : - 4.61 dBi **Antenna configuration** ▪ 802.11b/g: Multiple Transmitting (ANT 1 and ANT 2) ▪ 802.11n(MCS0 ~ 7) : Multiple Transmitting (ANT 1 and ANT 2)

2. INFORMATION ABOUT TESTING

2.1 Test mode

Test mode	Worst case data rate	Tested Frequency(MHz)		
		Lowest	Middle	Highest
TM 1	802.11b 1 Mbps	2412	2437	2462
TM 2	802.11g 6 Mbps	2412	2437	2462
TM 3	802.11n(HT20) MCS 0	2412	2437	2462
TM 4	802.11n(HT40) MCS 0	2422	2437	2452

The worst case data rate for each modulation is determined as above test mode. And all tests conducted in this report were made at the worst case data rate of each modulation.

2.3 Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
Laptop	PP22L	H7R1GBX	DELL	FCC DoC
-	-	-	-	-

2.4 Tested environment

Temperature	:	24 ~ 25 ºC
Relative humidity content	:	42 ~ 48 % R.H..
Details of power supply	:	DC 11.1V

2.5 EMI suppression Device(s) / Modifications

EMI suppression device(s) added and/or modifications made during testing
→ None

3. SUMMARY OF TESTS

FCC Part Section(s)	RSS Section(s)	Parameter	Limit	Test Condition	Status Note 1
I. Transmitter Mode (TX)					
15.247(a)	RSS-247 [5.2]	6 dB Bandwidth	> 500 kHz	Conducted	NT Note3
15.247(b)	RSS-247 [5.4]	Transmitter Output Power	< 1 Watt		C
15.247(d)	RSS-247 [5.5]	Out of Band Emissions / Band Edge	20 dBc in any 100 kHz BW		NT Note3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8 dBm / 3 kHz		NT Note3
-	RSS-Gen [6.6]	Occupied Bandwidth (99 %)	RSS-Gen(6.6)		C
15.205 15.209	RSS-247 [5.5] RSS-GEN[8.9] RSS-GEN[8.10]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C Note2
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions	FCC 15.207 limits	AC Line Conducted	NA Note4
15.203	RSS-Gen [6.7]	Antenna Requirements	FCC 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: This test item was performed in each axis and the worst case data was reported.

Note 3: These test items were not performed because this device uses the granted module.
(FCCID: PPD-AR5BHB116)
Please refer to the test report of the granted module.
The module test report number: FR080603A (By SPORTON INTERNATIONAL INC.)

Note 4: The EUT use only battery operating.

4. TEST METHODOLOGY

Generally the tests were performed according to the KDB 558074 D01 DTS Meas. Guidance v03r3, RSS-Gen Issue4 and KDB 662911 D01 v02r01 for the measure-and-sum technique. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing

4.1 EUT configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT exercise

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

4.3 General test procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB 558074. So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15MHz and 30MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB 558074. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10 as stated on section 12.1 of the KDB 558074.

The EUT is placed on a non-conductive table, which is 0.8 m above ground plane. The turntable shall rotate360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axis.

4.4 Description of test modes

A test program is used to control the EUT for staying in continuous transmitting mode.

5. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

6. FACILITIES AND ACCREDITATIONS

6.1 Facilities

The open area test site(OATS) or semi anechoic chamber and conducted measurement facility used to collect the radiated and conducted test data are located at the 38, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935. The site is constructed in conformance with the requirements.

- Semi anechoic chamber registration Number : 165783 (FCC) & 5740A-3 (IC)

6.2 Equipment

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and peak, quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

7. ANTENNA REQUIREMENTS

7.1 According to FCC 47 CFR §15.203 & RSS-Gen [6.7]:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The internal antennas of this E.U.T are permanently attached using the unique connectors.
(Please refer to the internal photo.)
Therefore this E.U.T Complies with the requirement of §15.203

7.2 Directional antenna gain for MIMO :

Bands	ANT 1 [dBi]	ANT 2 [dBi]	Directional Gain for uncorrelated signals [dBi]
2.4 GHz	- 7.01	- 4.61	- 5.646

Directional gain = 10 log[($10^{G1/10}$ + $10^{G2/10}$ + … + $10^{GN/10}$) /N_{ANT}] dBi for MIMO uncorrelated signal

8. TEST RESULT

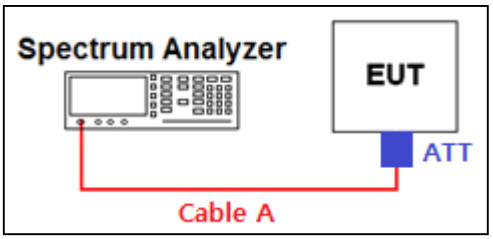
8.1 6dB bandwidth

Test Requirements and limit, §15.247(a) & RSS-247 [5.2]

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6dB bandwidth is 500 kHz.

▣ **TEST CONFIGURATION**



▣ **TEST PROCEDURE**

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB558074**.

1. Set resolution bandwidth (RBW) = 100 KHz
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
   (RBW:100KHz/VBW:300KHz)
3. Detector = **Peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

▣ **TEST RESULTS: N/T**

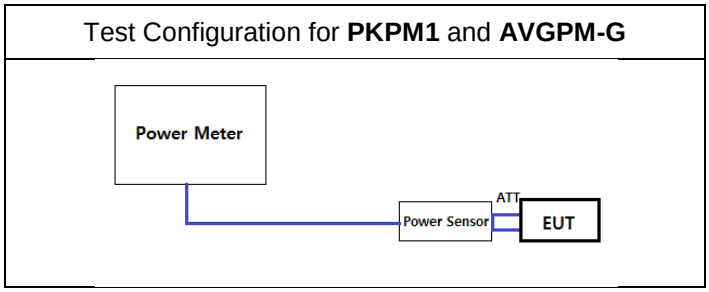
8.2 Maximum peak conducted output power

Test Requirements and limit, §15.247(b) & RSS-247 [5.4]

The maximum permissible conducted output power is **1 Watt**.

▣ TEST CONFIGURATION

Test Configuration for **PKPM1** and **AVGPM-G**



▣ TEST PROCEDURE:

1. **PKPM1 Peak power meter method of KDB558074**

   The maximum conducted output powers were measured using a broadband peak RF power meter which has greater video bandwidth than DUT's DTS bandwidth and utilize a fast-responding diode detector.

2. **Method AVGPM-G (Measurement using a gated RF average power meter) of KDB558074**

   The average conducted output powers were measured using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

   Note: The measure-and-sum technique is used for test mode with multiple transmitting.

▣ TEST RESULTS: Comply

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for ***802.11b***			
			Data Rate [Mbps]			
			1	2	5.5	11
ANT 1	2412	PK	17.230	17.190	17.130	17.080
		AV	15.220	15.180	15.150	15.110
	2437	PK	**18.140**	18.090	18.030	17.980
		AV	16.130	16.080	16.020	15.960
	2462	PK	15.330	15.280	15.260	15.230
		AV	13.210	13.180	13.160	13.120
ANT 2	2412	PK	18.900	18.870	18.860	18.830
		AV	16.050	16.000	15.980	15.960
	2437	PK	**18.920**	18.870	18.810	18.740
		AV	16.760	16.710	16.660	16.640
	2462	PK	16.870	16.850	16.790	16.790
		AV	14.770	14.740	14.690	14.650
Sum (ANT 1+2)	2412	PK	21.156	21.122	21.091	21.053
	2437	PK	**21.558**	21.508	21.448	21.387
	2462	PK	19.179	19.146	19.103	19.090

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for ***802.11g***							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
ANT 1	2412	PK	17.630	17.580	17.570	17.560	17.540	17.480	17.470	17.450
		AV	10.720	10.700	10.700	10.670	10.660	10.660	10.590	10.530
	2437	PK	**23.250**	23.230	23.210	23.180	23.180	23.140	23.050	22.970
		AV	16.660	16.640	16.610	16.610	16.610	16.560	16.540	16.530
	2462	PK	17.540	17.490	17.480	17.420	17.400	17.340	17.260	17.260
		AV	10.390	10.370	10.330	10.300	10.230	10.200	10.110	10.080
ANT 2	2412	PK	18.830	18.820	18.760	18.750	18.720	18.710	18.700	18.640
		AV	10.860	10.850	10.840	10.780	10.750	10.700	10.670	10.660
	2437	PK	**23.480**	23.430	23.410	23.400	23.360	23.320	23.320	23.250
		AV	17.140	17.110	17.070	17.020	17.010	16.980	16.950	16.940
	2462	PK	18.460	18.420	18.410	18.400	18.340	18.300	18.240	18.160
		AV	10.940	10.930	10.900	10.880	10.870	10.840	10.780	10.720
Sum (ANT 1+2)	2412	PK	21.282	21.255	21.216	21.206	21.181	21.149	21.139	21.096
	2437	PK	**26.377**	26.342	26.322	26.302	26.282	26.242	26.198	26.123
	2462	PK	21.035	20.991	20.981	20.948	20.906	20.857	20.788	20.744

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for *802.11n(HT20)*							
			Modulation and Coding Scheme [MCS]							
			0	1	2	3	4	5	6	7
ANT 1	2412	PK	17.940	17.890	17.840	17.790	17.780	17.760	17.730	17.720
		AV	10.370	10.330	10.260	10.210	10.190	10.130	10.100	10.080
	2437	PK	**22.940**	22.880	22.850	22.790	22.740	22.680	22.660	22.650
		AV	16.240	16.230	16.160	16.130	16.070	16.040	16.010	15.960
	2462	PK	18.940	18.890	18.880	18.870	18.790	18.710	18.670	18.610
		AV	11.140	11.130	11.130	11.050	11.050	10.990	10.970	10.880
ANT 2	2412	PK	18.760	18.720	18.660	18.660	18.640	18.570	18.490	18.480
		AV	10.820	10.780	10.730	10.700	10.630	10.610	10.560	10.500
	2437	PK	**23.300**	23.260	23.200	23.170	23.170	23.160	23.140	23.070
		AV	16.520	16.470	16.430	16.360	16.360	16.290	16.250	16.230
	2462	PK	18.310	18.270	18.230	18.170	18.160	18.100	18.060	18.030
		AV	9.930	9.890	9.880	9.810	9.810	9.790	9.750	9.690
Sum (ANT 1+2)	2412	PK	21.380	21.336	21.280	21.258	21.242	21.195	21.137	21.127
	2437	PK	**26.135**	26.085	26.039	25.995	25.971	25.937	25.917	25.876
	2462	PK	21.647	21.602	21.578	21.545	21.497	21.427	21.387	21.340

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for *802.11n(HT40)*							
			Modulation and Coding Scheme [MCS]							
			0	1	2	3	4	5	6	7
ANT 1	2422	PK	16.680	16.670	16.620	16.570	16.490	16.450	16.410	16.340
		AV	8.130	8.120	8.100	8.050	8.000	8.000	7.930	7.870
	2437	PK	**21.030**	21.020	20.960	20.950	20.900	20.870	20.840	20.770
		AV	13.070	13.040	12.990	12.960	12.910	12.890	12.820	12.800
	2452	PK	17.310	17.290	17.280	17.250	17.210	17.190	17.110	17.080
		AV	8.820	8.780	8.740	8.670	8.600	8.590	8.540	8.520
ANT 2	2422	PK	16.900	16.860	16.800	16.750	16.740	16.730	16.720	16.670
		AV	8.030	7.980	7.920	7.850	7.830	7.750	7.700	7.650
	2437	PK	**21.310**	21.260	21.240	21.180	21.120	21.060	21.030	20.940
		AV	12.890	12.870	12.860	12.800	12.800	12.790	12.750	12.690
	2452	PK	18.190	18.140	18.120	18.100	18.090	18.070	18.040	17.980
		AV	9.940	9.930	9.870	9.860	9.810	9.750	9.670	9.580
Sum (ANT 1+2)	2422	PK	19.802	19.777	19.722	19.672	19.628	19.603	19.579	19.519
	2437	PK	**24.183**	24.152	24.113	24.077	24.022	23.977	23.947	23.867
	2452	PK	20.783	20.747	20.731	20.707	20.683	20.663	20.611	20.564

Note: This result of PK was tested using the PKPM1 Peak power meter method.

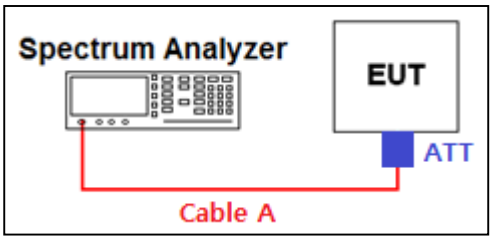
8.3 Maximum power spectral density

Test requirements and limit, §15.247(e) & RSS-247 [5.2]

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard –specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz band segment within the fundamental EBW during any time interval of continuous transmission.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE:

The Measurement Procedure **Method PKPSD of KDB558074** is used.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to **1.5 times** the DTS bandwidth.
3. Set the RBW to: **3 kHz** ≤ RBW ≤ **100 kHz**
4. Set the VBW ≥ **3 x RBW**
5. Detector = **peak**
6. Sweep time = **auto couple**
7. Trace mode = **max hold.**
8. Allow trace to fully stabilize.
9. Use the **peak marker function** to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

▣ TEST RESULTS: N/T

8.4 Out of band emissions at the band edge / conducted spurious emissions

Test requirements and limit, §15.247(d) & RSS-247 [5.5]

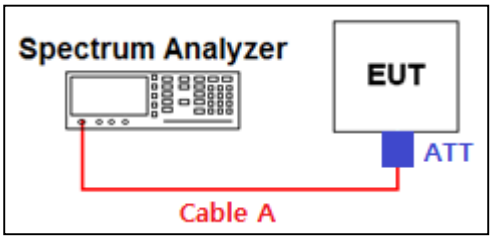
§15.247(d) specifies that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

If **the peak output power procedure** is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated **by at least 20 dB** relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in band average PSD level.

In either case, attenuation to levels below the general emission limits specified in **§15.209(a)** is not required.

▣TEST CONFIGURATION



▣TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer.

- Measurement Procedure 1 – Reference Level

1. Set instrument center frequency to DTS channel center frequency.
2. Set the span to ≥ 1.5 times the DTS bandwidth.
3. Set the RBW = 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum PSD level

- Measurement Procedure 2 - Unwanted Emissions

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = **100 kHz for below 1GHz , 1MHz for above 1GHz**
3. Set the VBW ≥ **3 x RBW(Actual 3 MHz, See below note)**
4. Detector = **peak**.
5. Ensure that the number of measurement points ≥ span/RBW
6. Sweep time = **auto couple.**
7. Trace mode = **max hold.**
8. **Allow the trace to stabilize** (this may take some time, depending on the extent of the span).
9. Use the peak marker function to determine the maximum amplitude level.

▣ TEST RESULTS: N/T

8.5 Radiated spurious emissions

Test Requirements and limit, §15.247(d), §15.205, §15.209 & RSS-247 [5.5], RSS-GEN[8.9], RSS-GEN[8.10]

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) and (b), then the 15.209(a) limit in the table below has to be followed

▪ **FCC Part 15.209(a) and (b)**

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 – 0.490	2400/F(KHz)	300
0.490 – 1.705	24000/F(KHz)	30
1.705 – 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

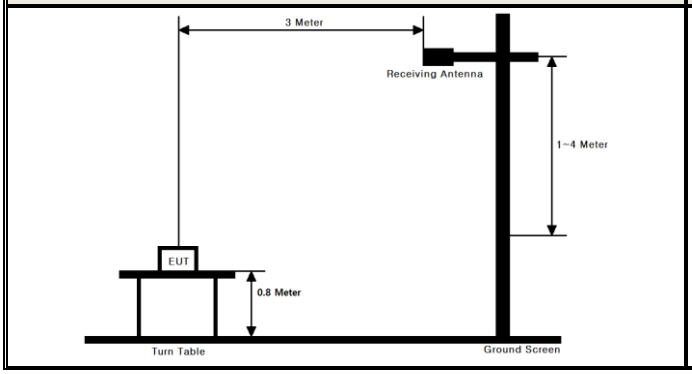
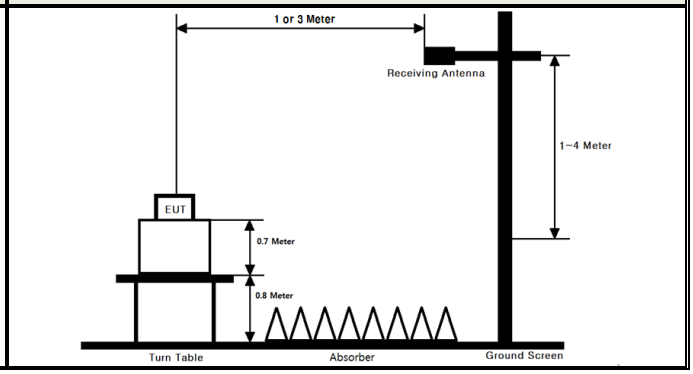
** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ **FCC Part 15.205 (a):** Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.52025	156.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	12.57675 ~	156.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	12.57725	156.7 ~ 156.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	13.36 ~ 13.41	162.0125 ~ 167.17	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.42 ~ 16.423	167.72 ~ 173.2	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	16.69475 ~	240 ~ 285	2655 ~ 2900		
8.291 ~ 8.294	16.69525	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	16.80425 ~	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	16.80475	608 ~ 614	3345.8 ~ 3358		
	25.5 ~ 25.67	960 ~ 1240	3600 ~ 4400		
	37.5 ~ 38.25				
	73 ~ 74.6				
	74.8 ~ 75.2				

▪ **FCC Part 15.205(b):** The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

Test Configuration

Below 1 GHz	Above 1 GHz
	

▣ TEST PROCEDURE

1. The EUT is placed on a non-conductive table, emission measurements at below 1 GHz, the table height is 80 cm and above 1 GHz, the table height is 1.5 m.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

▣ Measurement Instrument Setting for Radiated Emission Measurements.

The radiated emission was tested according to the section 6.3, 6.4, 6.5 and 6.6 of the ANSI C63.10-2013 with following settings.

Peak Measurement:

RBW = As specified in below table , VBW ≥ 3 x RBW, Sweep = Auto, Detector = Peak, Trace mode = Max Hold until the trace stabilizes.

Frequency	RBW
9 - 150 kHz	200 - 300 Hz
0.15 - 30 MHz	9 - 10 kHz
30 - 1000 MHz	100 - 120 kHz
> 1000 MHz	1 MHz

Average Measurement:

1. RBW = 1 MHz (unless otherwise specified).
2. VBW ≥ 3 x RBW.
3. Detector = RMS (Number of points ≥ 2 x Span / RBW)
4. Averaging type = power. (i.e., RMS)
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.
7. A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step 4, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
2) If linear voltage averaging mode was used in step 4, then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

Duty Cycle Corrections (Refer to appendix II for duty cycle measurement procedure and plots)

Test Mode	Duty Cycle (%)	T_{on} (ms)	T_{on}+ T_{off} (ms)	DCF = 10log(1 / Duty) (dB)
TM 1	99.49	8.190	8.232	-
TM 2	96.45	1.360	1.410	0.16
TM 3	96.21	1.270	1.320	0.17
TM 4	94.62	0.633	0.669	0.25

Radiated Spurious Emissions data(9kHz ~ 25GHz) : *Test Mode 1(TM 1)*

Tested ANT	Tested Frequency	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
ANT 1 + ANT 2	Lowest	2389.94	H	Y	PK	54.15	3.86	N/A	N/A	58.01	74.00	15.99
		2389.91	H	Y	AV	47.02	3.86	N/A	N/A	50.88	54.00	3.12
		4824.54	H	Y	PK	45.15	10.52	N/A	N/A	55.67	74.00	18.33
		4824.33	H	Y	AV	41.11	10.52	N/A	N/A	51.63	54.00	2.37
		-	-	-	-	-	-	-	-	-	-	-
	Middle	4874.25	H	Y	PK	46.84	10.81	N/A	N/A	57.65	74.00	16.35
		4874.04	H	Y	AV	41.35	10.81	N/A	N/A	52.16	54.00	1.84
		-	-	-	-	-	-	-	-	-	-	-
	Highest	2483.58	H	Y	PK	54.21	4.37	N/A	N/A	58.58	74.00	15.42
		2483.52	H	Y	AV	47.10	4.37	N/A	N/A	51.47	54.00	2.53
		4924.03	H	Y	PK	45.25	11.11	N/A	N/A	56.36	74.00	17.64
		4924.11	H	Y	AV	40.61	11.11	N/A	N/A	51.72	54.00	2.28
		-	-	-	-	-	-	-	-	-	-	-

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Measurement Distance = 3 m for below 10 GHz, Measurement Distance = 1 m for above 10 GHz.
   Therefore Distance Correction Factor(DCF) : - 9.54 dB = 20*log(1m/3m)

Radiated Spurious Emissions data(9kHz ~ 25GHz) : *Test Mode 2(TM 2)*

Tested ANT	Tested Frequency	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
ANT 1 + ANT 2	Lowest	2389.89	H	Y	PK	63.81	3.86	N/A	N/A	67.67	74.00	6.33
		2389.92	H	Y	AV	47.34	3.86	0.16	N/A	51.36	54.00	2.64
		4824.85	H	Y	PK	43.66	10.52	N/A	N/A	54.18	74.00	19.82
		4824.63	H	Y	AV	34.84	10.52	0.16	N/A	45.52	54.00	8.48
		-	-	-	-	-	-	-	-	-	-	-
	Middle	4874.12	H	Y	PK	45.36	10.81	N/A	N/A	56.17	74.00	17.83
		4874.31	H	Y	AV	36.18	10.81	0.16	N/A	47.15	54.00	6.85
		-	-	-	-	-	-	-	-	-	-	-
	Highest	2383.52	H	Y	PK	64.31	4.37	N/A	N/A	68.68	74.00	5.32
		2483.52	H	Y	AV	47.48	4.37	0.16	N/A	52.01	54.00	1.99
		4924.36	H	Y	PK	44.71	11.11	N/A	N/A	55.82	74.00	18.18
		4924.29	H	Y	AV	34.98	11.11	0.16	N/A	46.25	54.00	7.75
		-	-	-	-	-	-	-	-	-	-	-

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Measurement Distance = 3 m for below 10 GHz, Measurement Distance = 1 m for above 10 GHz.
   Therefore Distance Correction Factor(DCF) : - 9.54 dB = 20*log(1m/3m)

Radiated Spurious Emissions data(9kHz ~ 25GHz) : *Test Mode 3(TM 3)*

Tested ANT	Tested Frequency	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
ANT 1 + ANT 2	Lowest	2389.84	H	Y	PK	64.84	3.86	N/A	N/A	68.70	74.00	5.30
		2389.91	H	Y	AV	47.88	3.86	0.17	N/A	51.91	54.00	2.09
		4823.89	H	Y	PK	44.84	10.52	N/A	N/A	55.36	74.00	18.64
		4823.97	H	Y	AV	35.03	10.52	0.17	N/A	45.72	54.00	8.28
		-	-	-	-	-	-	-	-	-	-	-
	Middle	4873.95	H	Y	PK	47.85	10.81	N/A	N/A	58.66	74.00	15.34
		4874.03	H	Y	AV	36.18	10.81	0.17	N/A	47.16	54.00	6.84
		-	-	-	-	-	-	-	-	-	-	-
	Highest	2483.53	H	Y	PK	62.34	4.37	N/A	N/A	66.71	74.00	7.29
		2483.53	H	Y	AV	47.19	4.37	0.17	N/A	51.73	54.00	2.27
		4924.03	H	Y	PK	45.36	11.11	N/A	N/A	56.47	74.00	17.53
		4923.89	H	Y	AV	34.84	11.11	0.17	N/A	46.12	54.00	7.88
		-	-	-	-	-	-	-	-	-	-	-

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Measurement Distance = 3 m for below 10 GHz, Measurement Distance = 1 m for above 10 GHz.
   Therefore Distance Correction Factor(DCF) : - 9.54 dB = 20*log(1m/3m)

Radiated Spurious Emissions data(9kHz ~ 25GHz) : *Test Mode 4(TM 4)*

Tested ANT	Tested Frequency	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
ANT 1 + ANT 2	Lowest	2389.84	H	Y	PK	64.24	3.86	N/A	N/A	68.10	74.00	5.90
		2389.94	H	Y	AV	47.49	3.86	0.25	N/A	51.60	54.00	2.40
		4844.36	H	Y	PK	45.36	10.63	N/A	N/A	55.99	74.00	18.01
		4844.11	H	Y	AV	36.13	10.63	0.25	N/A	47.01	54.00	6.99
		-	-	-	-	-	-	-	-	-	-	-
	Middle	4874.31	H	Y	PK	47.13	10.81	N/A	N/A	57.94	74.00	16.06
		4874.24	H	Y	AV	37.41	10.81	0.25	N/A	48.47	54.00	5.53
		-	-	-	-	-	-	-	-	-	-	-
	Highest	2483.53	H	Y	PK	62.67	4.37	N/A	N/A	67.04	74.00	6.96
		2483.52	H	Y	AV	47.36	4.37	0.25	N/A	51.98	54.00	2.02
		4903.98	H	Y	PK	44.94	11.00	N/A	N/A	55.94	74.00	18.06
		4904.10	H	Y	AV	35.61	11.00	0.25	N/A	46.86	54.00	7.14
		-	-	-	-	-	-	-	-	-	-	-

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Measurement Distance = 3 m for below 10 GHz, Measurement Distance = 1 m for above 10 GHz.
   Therefore Distance Correction Factor(DCF) : - 9.54 dB = 20*log(1m/3m)

8.6 Power-line conducted emissions

Test Requirements and limit, §15.207 & RSS-Gen [8.8]

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

▣ **TEST PROCEDURE**

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to the test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

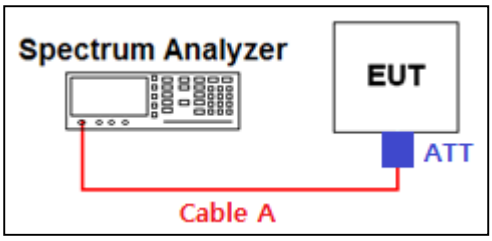
▣ **Test Results: N/A**

8.7 Occupied bandwidth

Test Requirements, RSS-Gen [6.6]

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.
The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 × RBW.
Spectrum analyzer plots are included on the following pages.

▣ TEST RESULTS: Comply

Test Mode	Frequency	Test Results[MHz]	
		ANT 1	ANT 2
TM 1	Lowest	14.360	13.943
	Middle	14.264	13.931
	Highest	14.158	13.984
TM 2	Lowest	17.508	17.094
	Middle	17.584	17.026
	Highest	17.472	17.026
TM 3	Lowest	18.360	18.207
	Middle	18.360	18.201
	Highest	18.349	18.159
TM 4	Lowest	37.973	37.714
	Middle	38.137	37.656
	Highest	37.551	37.501

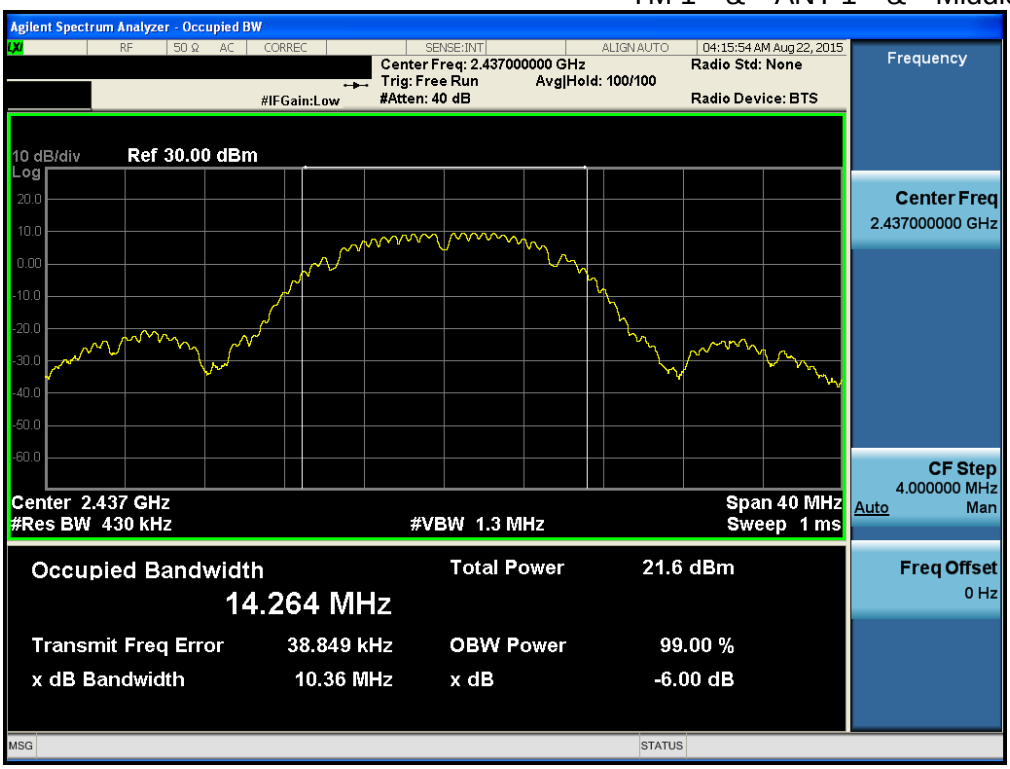
▣ RESULT PLOTS

Occupied Bandwidth

TM 1 & ANT 1 & Lowest

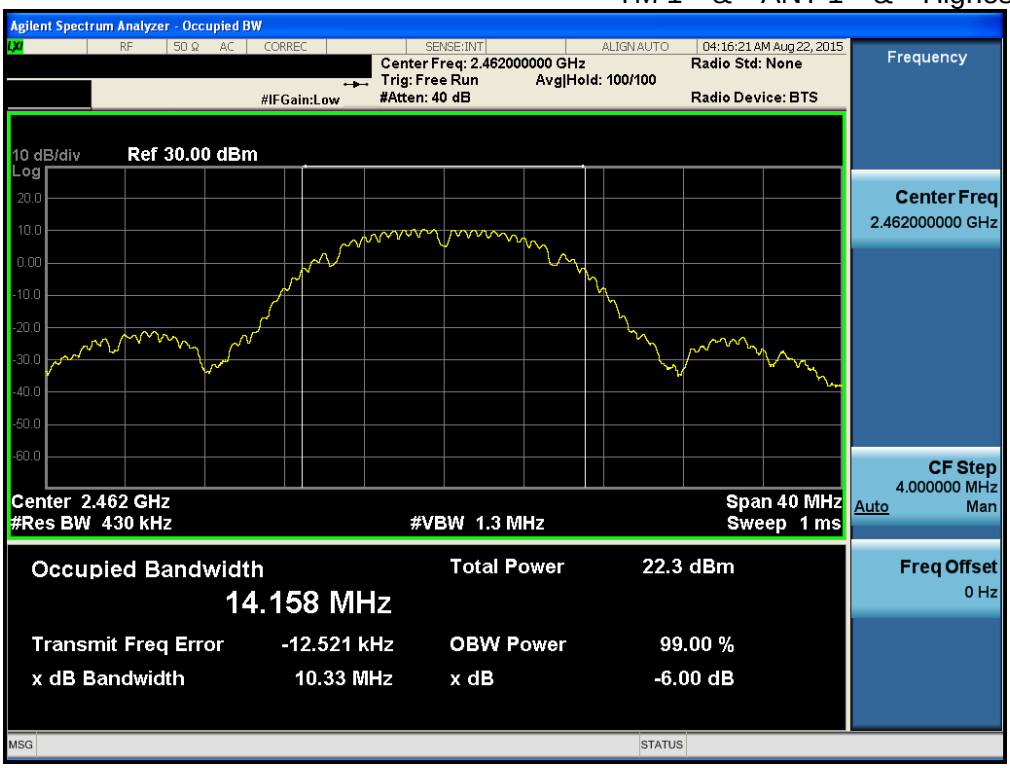
Occupied Bandwidth

TM 1 & ANT 1 & Middle



Occupied Bandwidth

TM 1 & ANT 1 & Highest



Occupied Bandwidth

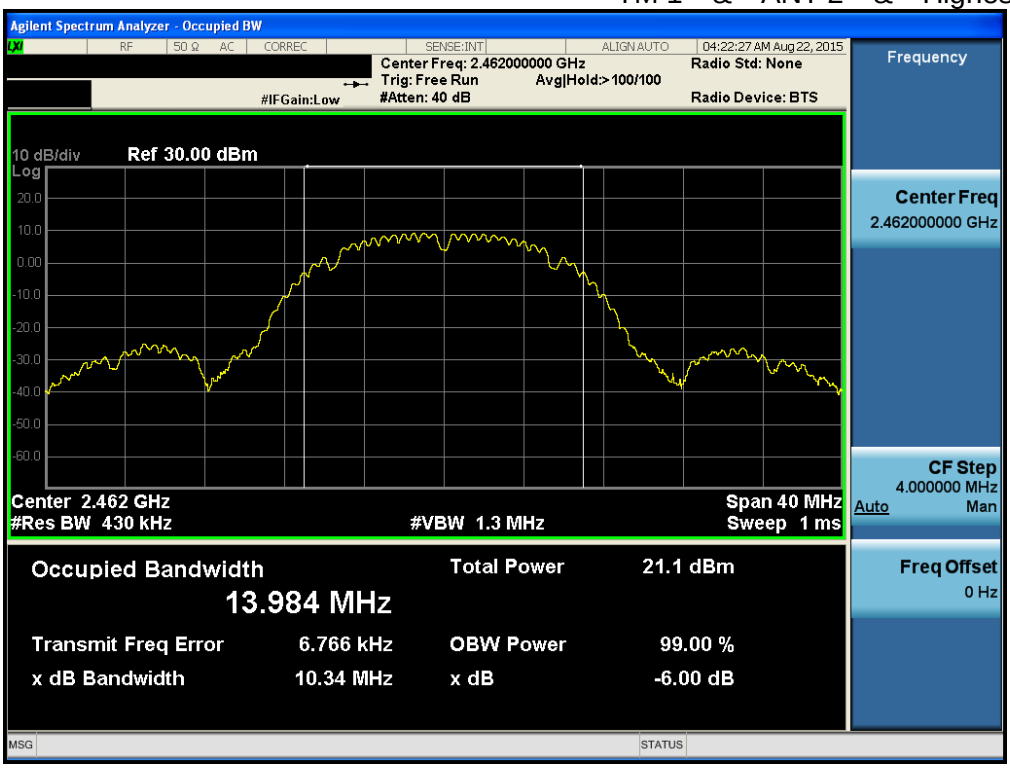
TM 1 & ANT 2 & Lowest

Occupied Bandwidth

TM 1 & ANT 2 & Middle

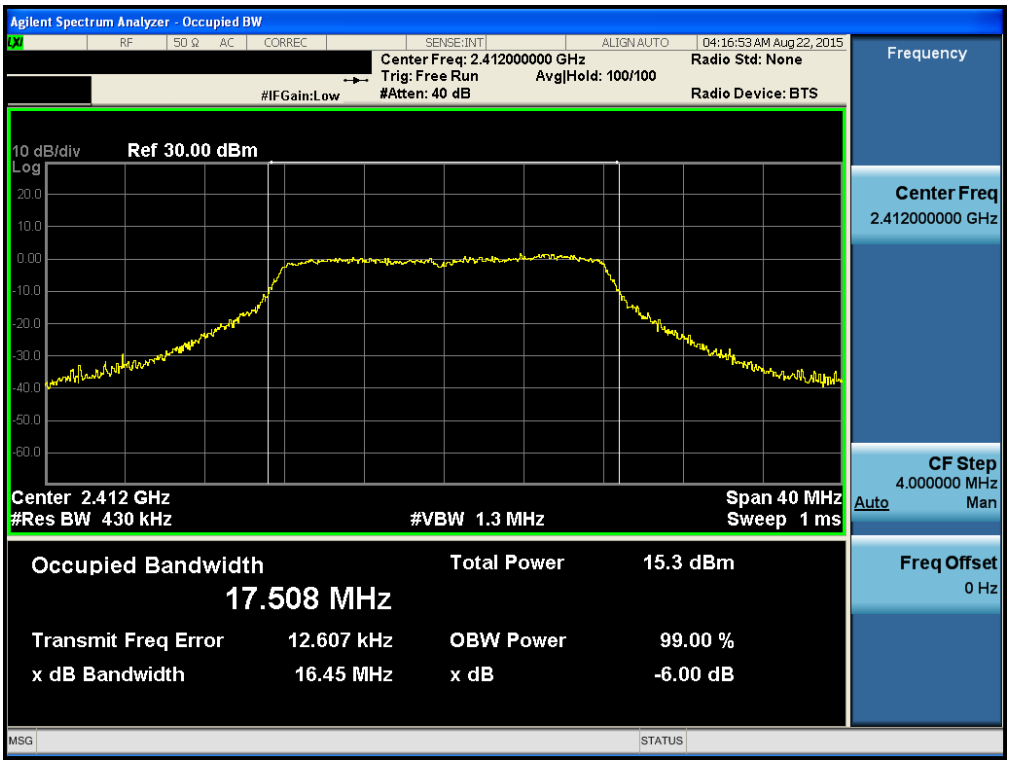
Occupied Bandwidth

TM 1 & ANT 2 & Highest



Occupied Bandwidth

TM 2 & ANT 1 & Lowest

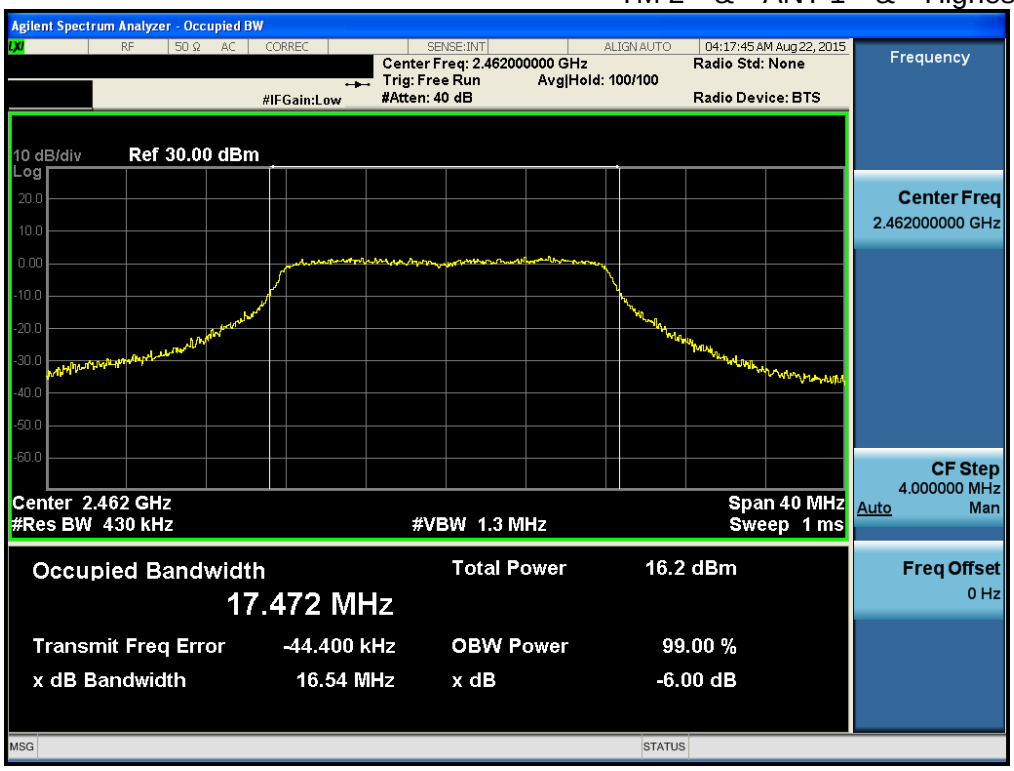


Occupied Bandwidth

TM 2 & ANT 1 & Middle

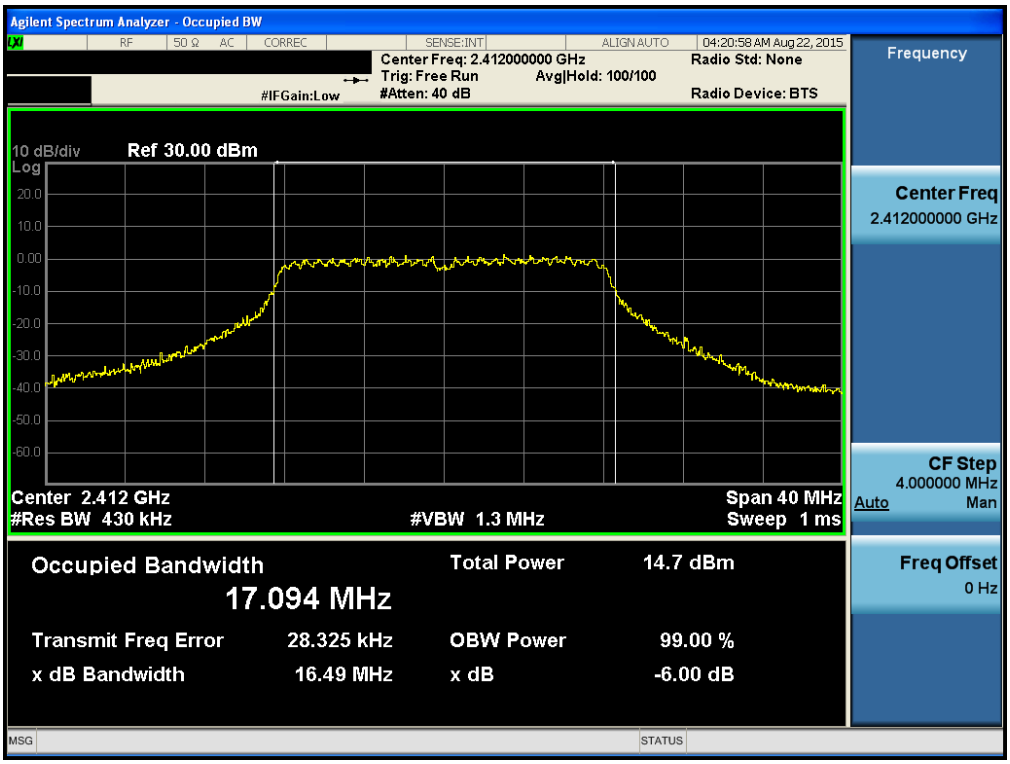
Occupied Bandwidth

TM 2 & ANT 1 & Highest



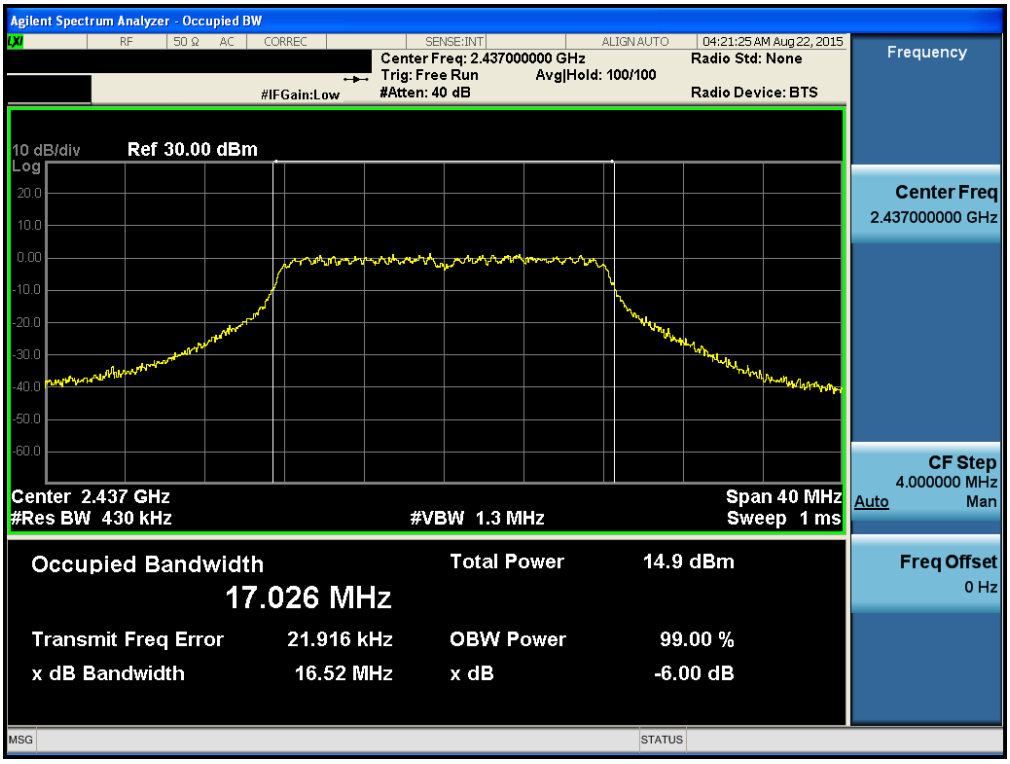
Occupied Bandwidth

TM 2 & ANT 2 & Lowest



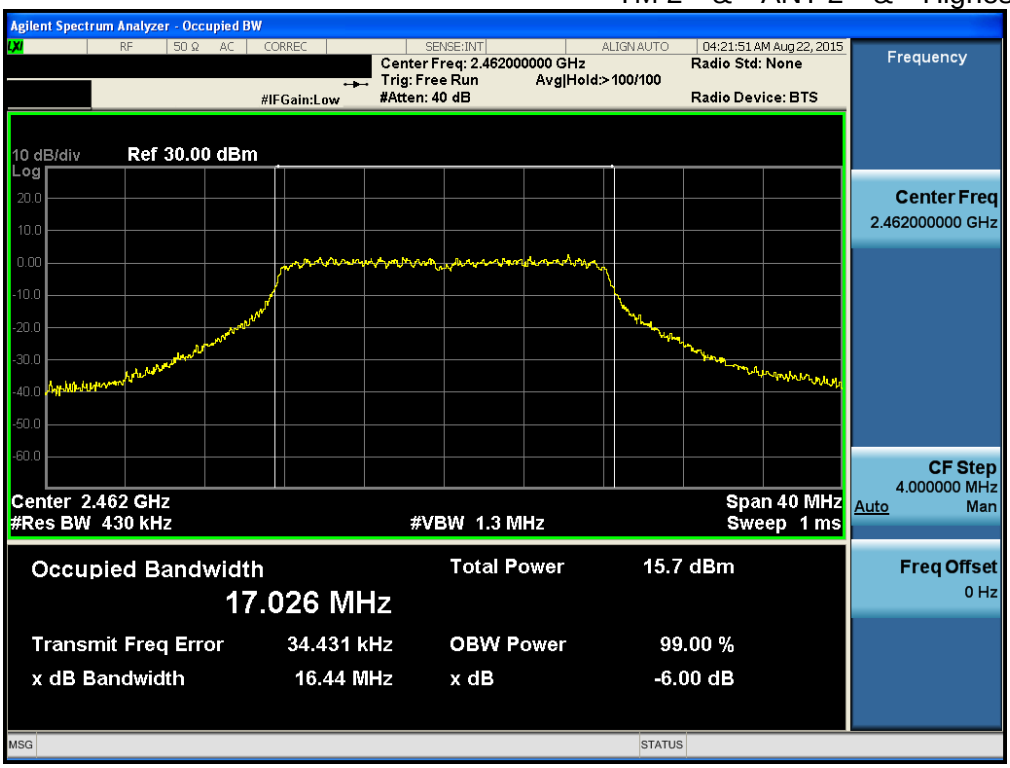
Occupied Bandwidth

TM 2 & ANT 2 & Middle



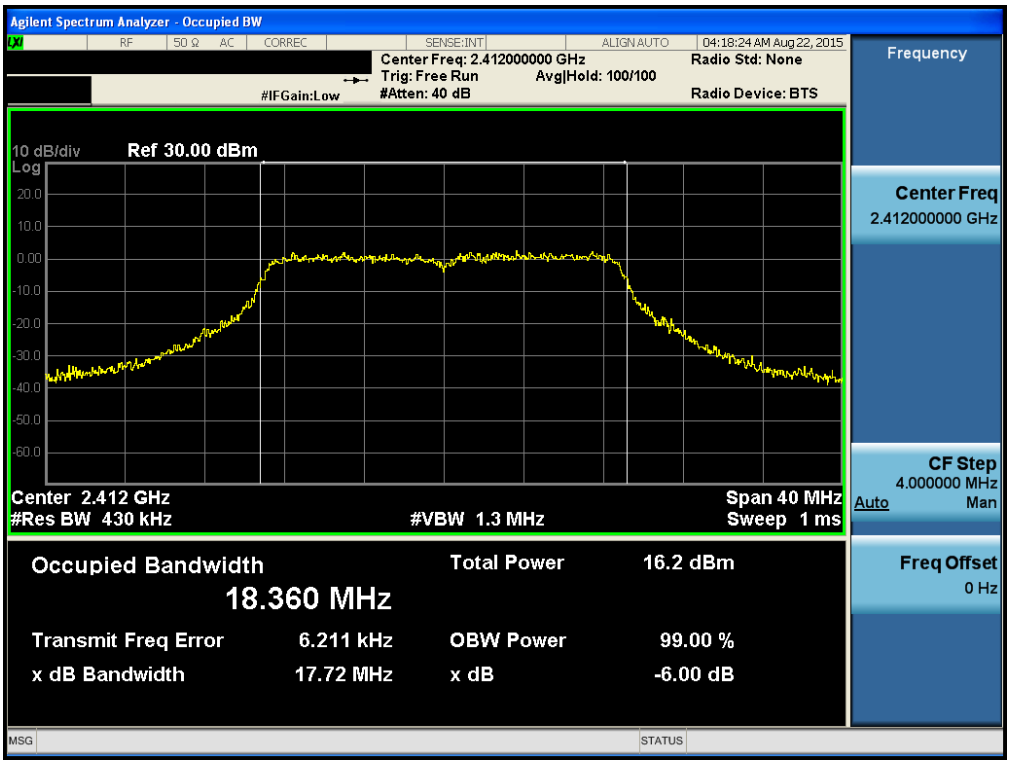
Occupied Bandwidth

TM 2 & ANT 2 & Highest



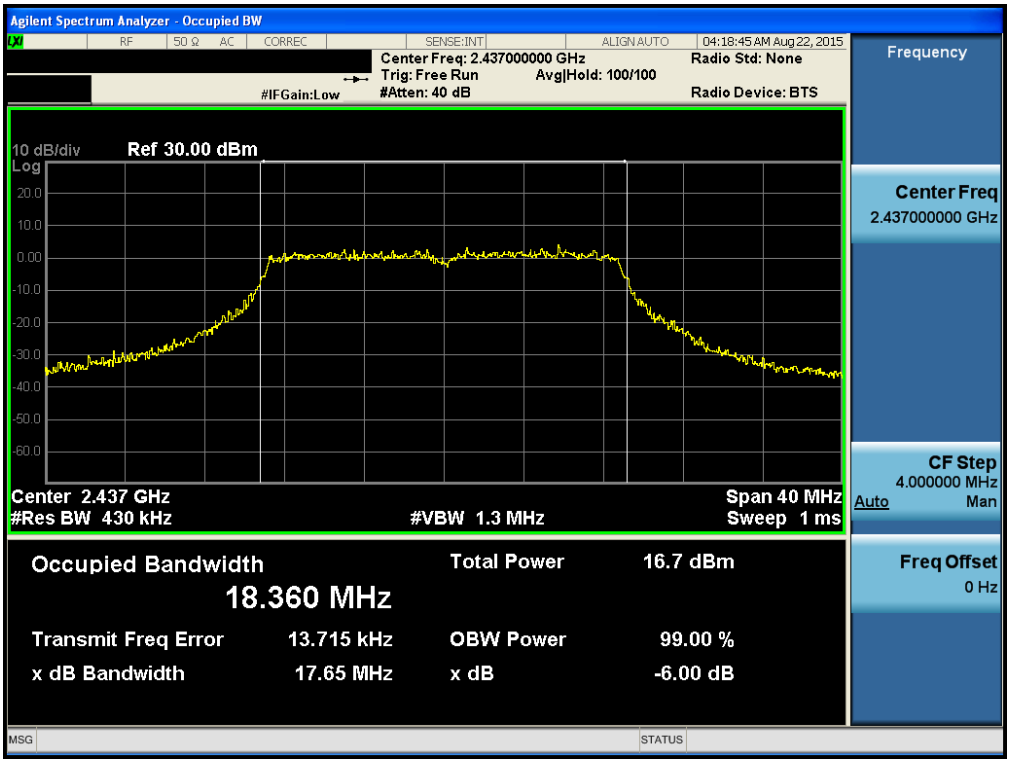
Occupied Bandwidth

TM 3 & ANT 1 & Lowest



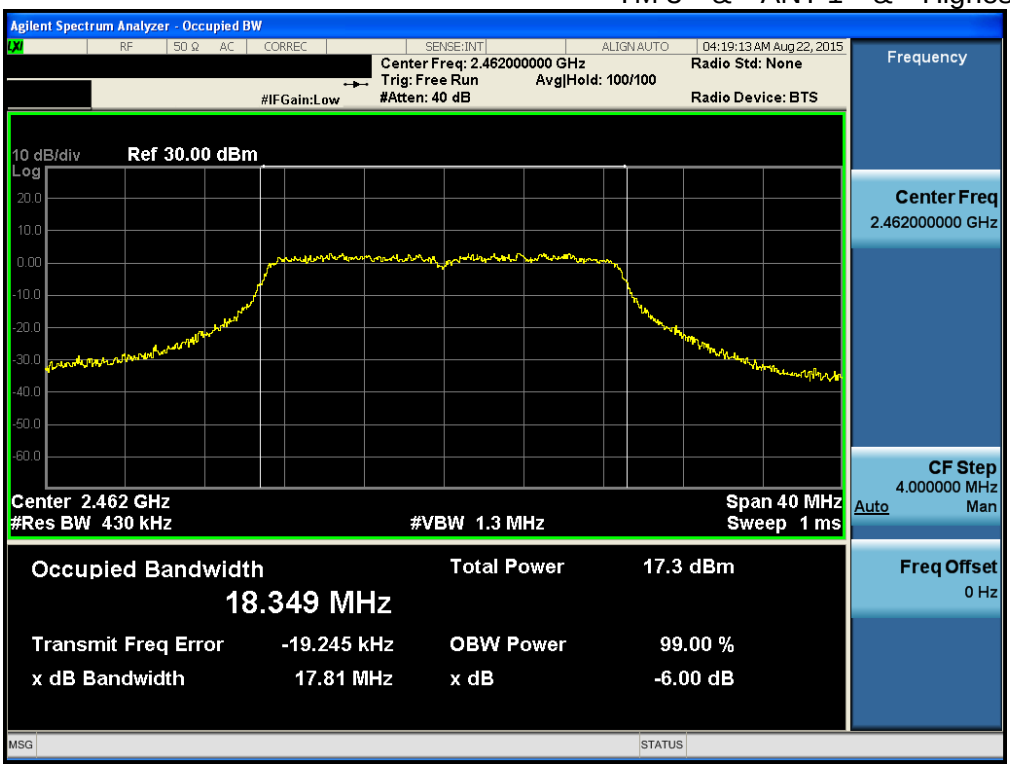
Occupied Bandwidth

TM 3 & ANT 1 & Middle



Occupied Bandwidth

TM 3 & ANT 1 & Highest

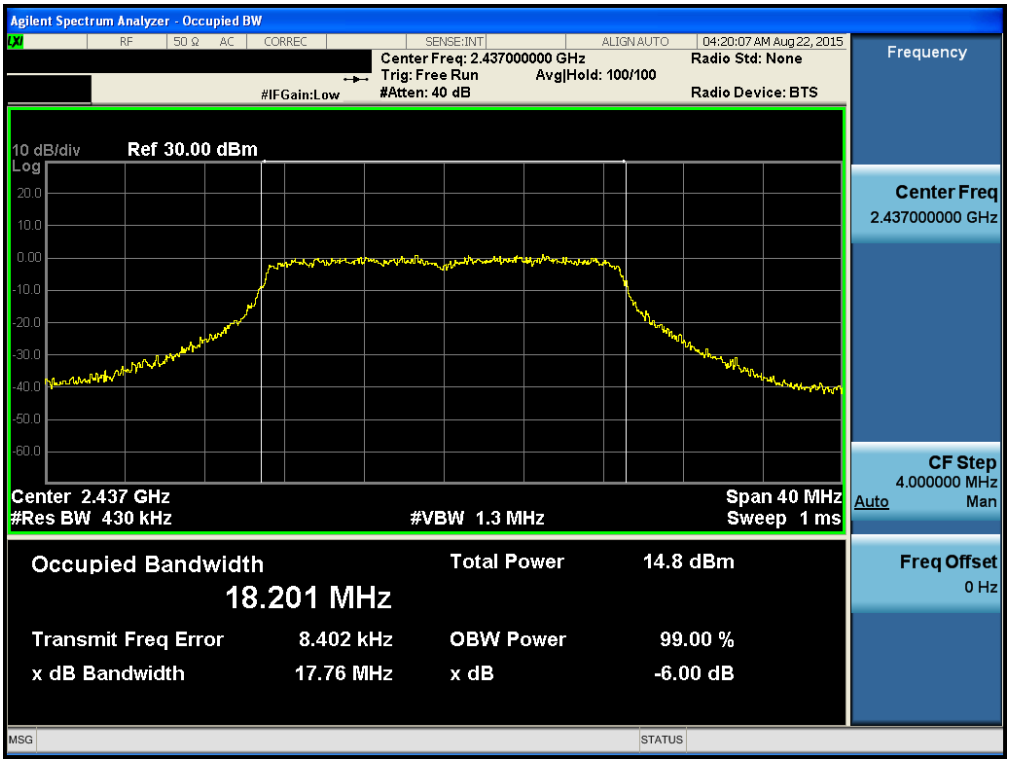


Occupied Bandwidth

TM 3 & ANT 2 & Lowest

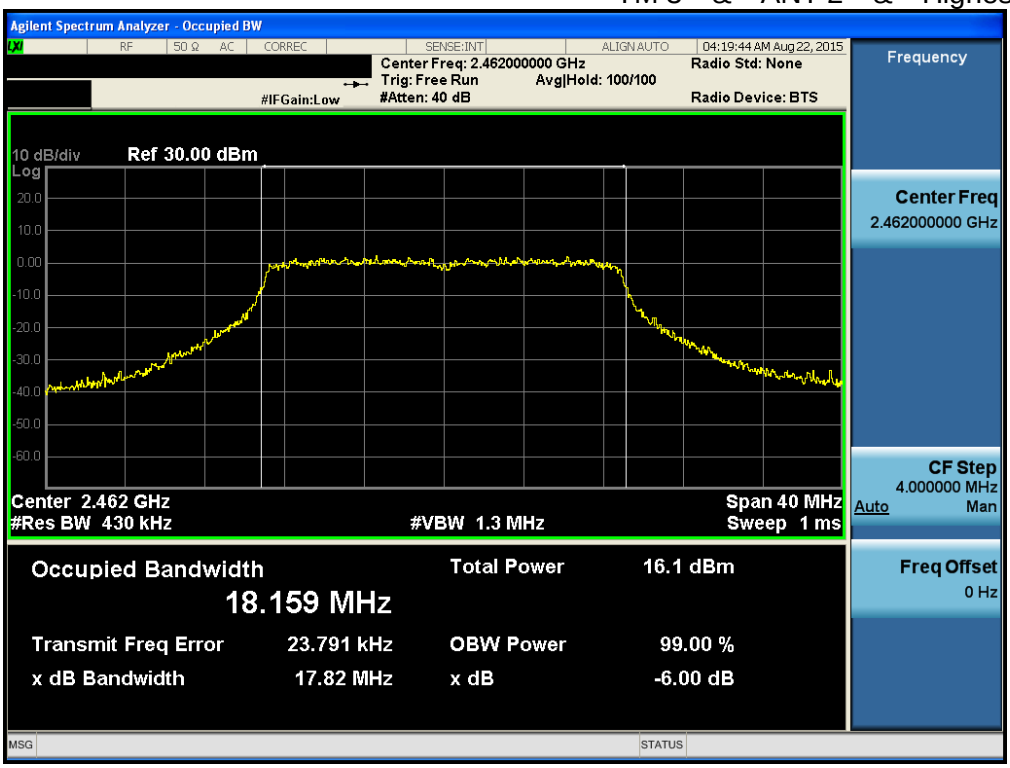
Occupied Bandwidth

TM 3 & ANT 2 & Middle



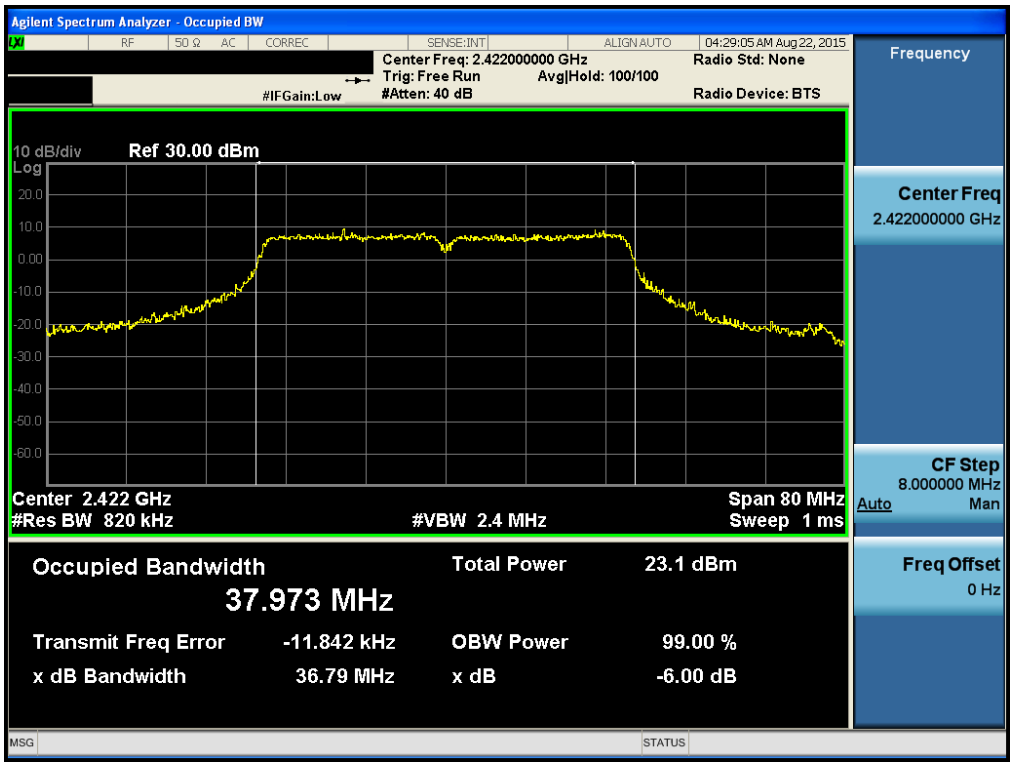
Occupied Bandwidth

TM 3 & ANT 2 & Highest



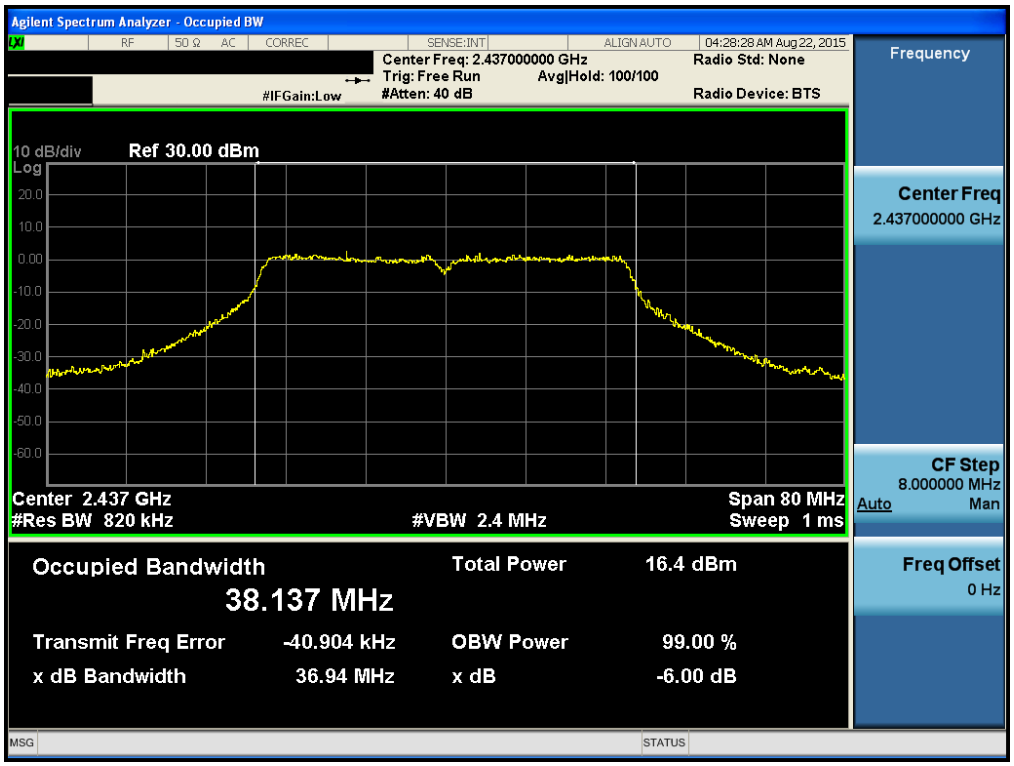
Occupied Bandwidth

TM 4 & ANT 1 & Lowest



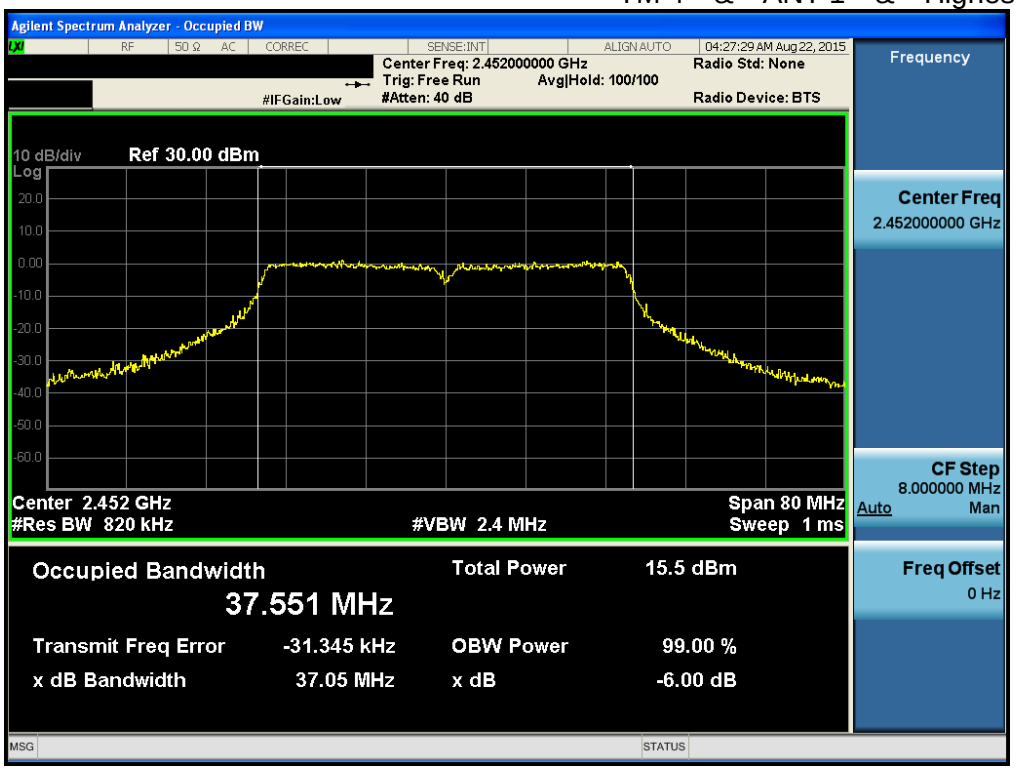
Occupied Bandwidth

TM 4 & ANT 1 & Middle



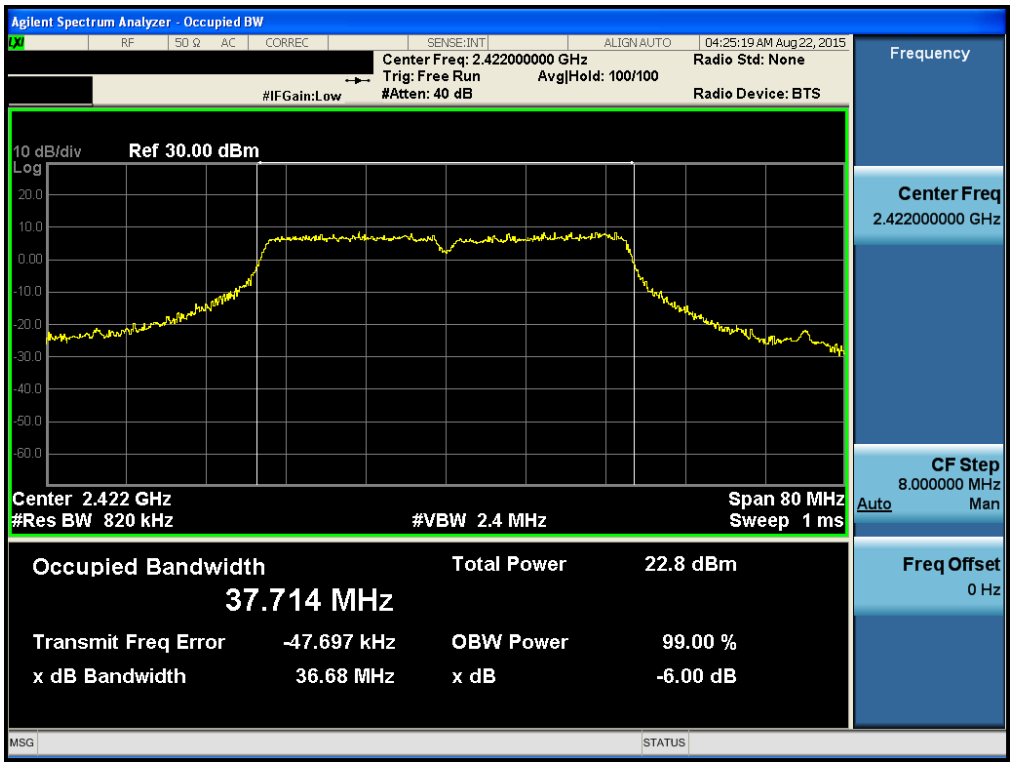
Occupied Bandwidth

TM 4 & ANT 1 & Highest



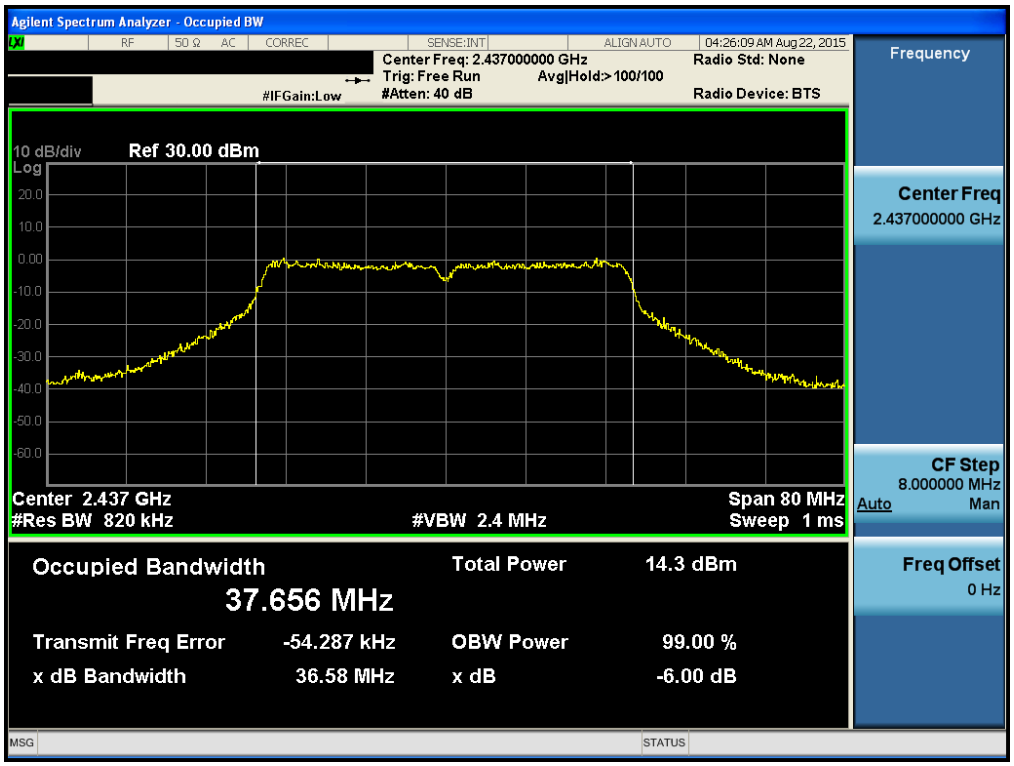
Occupied Bandwidth

TM 4 & ANT 2 & Lowest



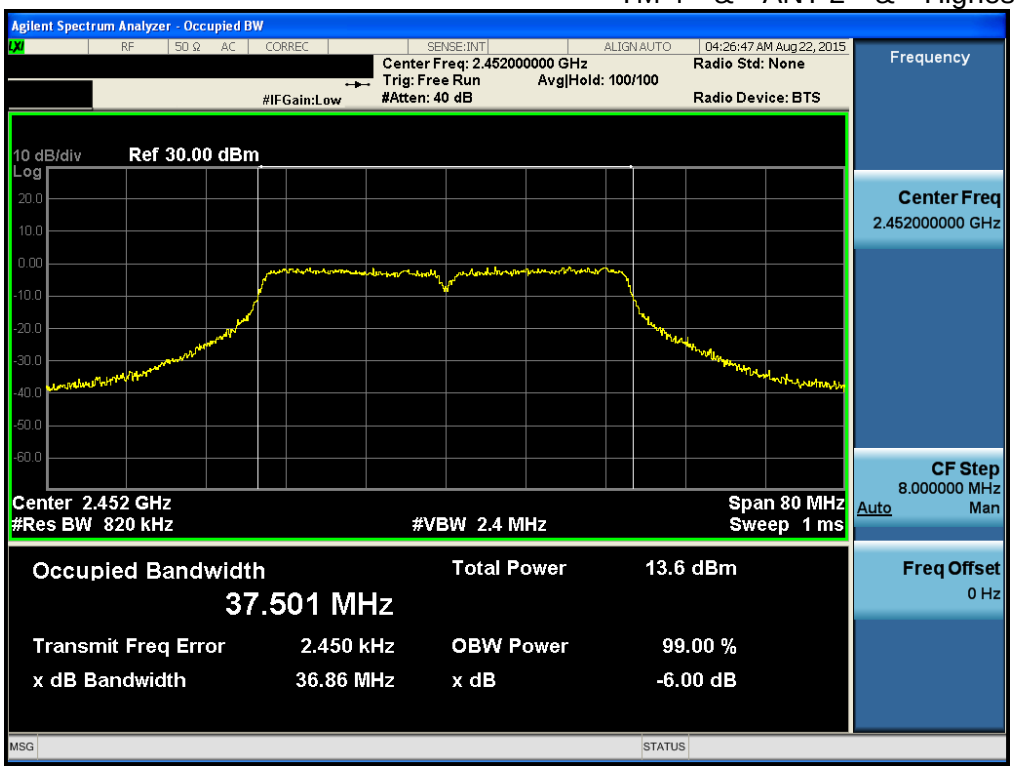
Occupied Bandwidth

TM 4 & ANT 2 & Middle



Occupied Bandwidth

TM 4 & ANT 2 & Highest



9. LIST OF TEST EQUIPMENT

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
MXA Signal Analyzer	Agilent	N9020A	14/09/15	15/09/15	MY50200834
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	15/03/26	16/03/26	1306007 1249001
Vector Signal Generator	Rohde Schwarz	SMBV100A	15/01/06	16/01/06	255571
Signal Generator	Rohde Schwarz	SMF100A	15/06/29	16/06/29	102341
DIGITAL MULTIMETER	Agilent	34401A	15/01/06	16/01/06	US36099541
Thermohygrometer	BODYCOM	BJ5478	15/05/08	16/05/08	120612-2
10dB Attenuator	Aeroflex/Weinschel	86-10-11	14/09/12	15/09/12	446
Low Noise Pre Amplifier	tsj	MLA-010K01-B01-27	15/04/09	16/04/09	1844538
PreAmplifier	Agilent	8449B	15/02/26	16/02/26	3008A00370
LOOP Antenna	Schwarzbeck	FMZB1513	14/04/29	16/04/29	1513-128
TRILOG Broadband Test-Antenna(30MHz-1GHz)	Schwarzbeck	VULB 9160	14/04/30	16/04/30	3358
Double-Ridged Guide Antenna	ETS	3117	14/05/12	16/05/12	140394
Horn Antenna	A.H.Systems	SAS-574	15/04/30	17/04/30	154
EMI TEST RECEIVER	R&S	ESR7	14/10/21	15/10/21	101109
High-pass filter (3GHz)	Wainwright Instruments	WHKX3.0	15/01/06	16/01/06	12

APPENDIX I

Duty cycle information

TEST PROCEDURE

Duty cycle measured using **section 6.0 b) of KDB558074 :**

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

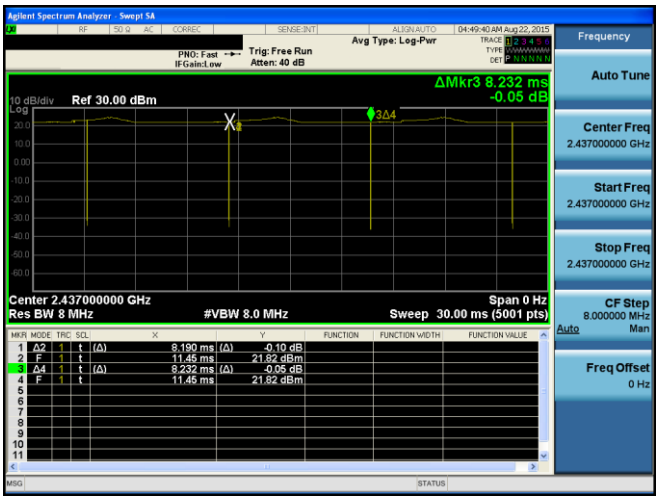
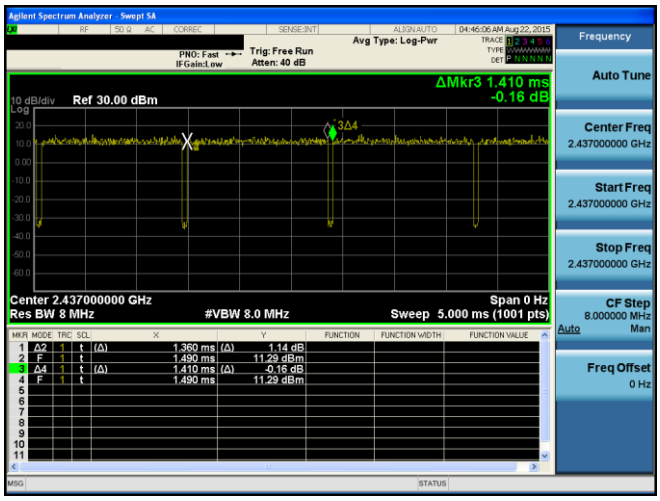
Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

TEST DATA

Test Mode	Tested frequency	T_{ON} (ms)	T_{ON+OFF} (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
TM 1	Lowest	8.190	8.232	99.49	-
TM 2	Lowest	1.360	1.410	96.45	0.16
TM 3	Lowest	1.270	1.320	96.21	0.17
TM 4	Lowest	0.633	0.669	94.62	0.25

Please refer to next page for actual test plot.

Duty cycle data : **TM 1** & **Middle**	Duty cycle data : **TM 2** & **Middle**
	

Duty cycle data : **TM 3** & **Middle**	Duty cycle data : **TM 4** & **Middle**