7 Conduct Band Edge And Spurious Emissions Measurement

Test Requirement	:	RSS-247 §5.5 &Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (d),In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

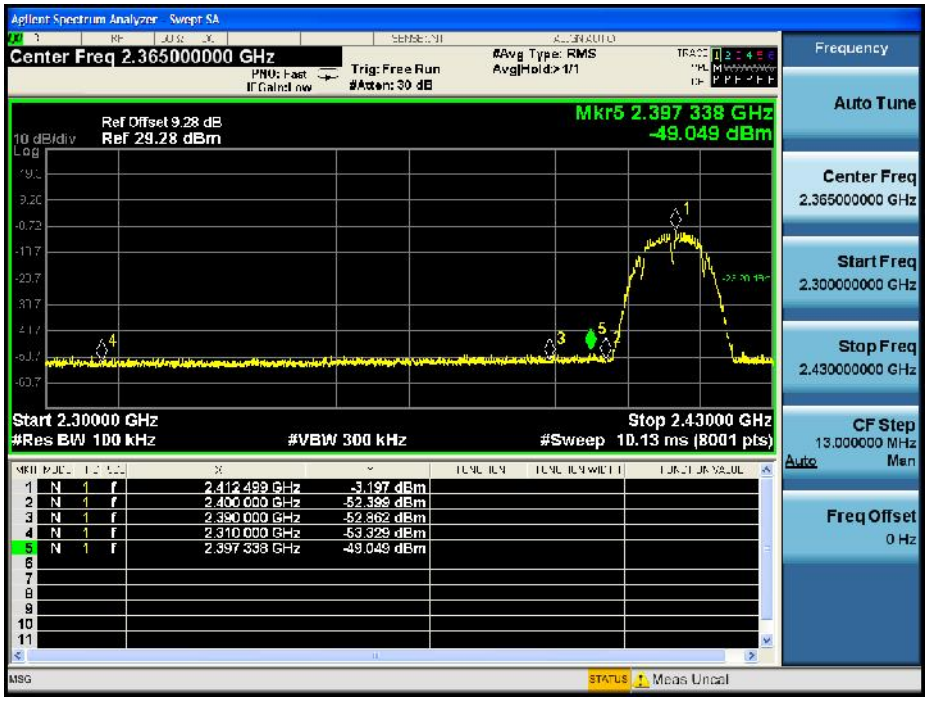
7.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

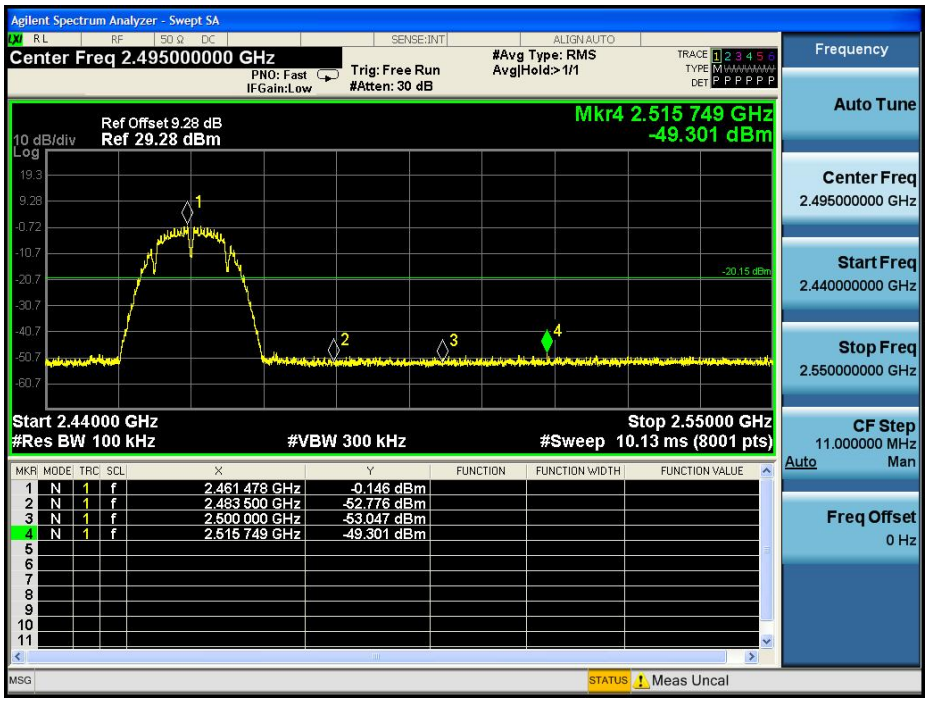
7.2 Test Result

Conduct Band Edge (WIFI 2.4G)

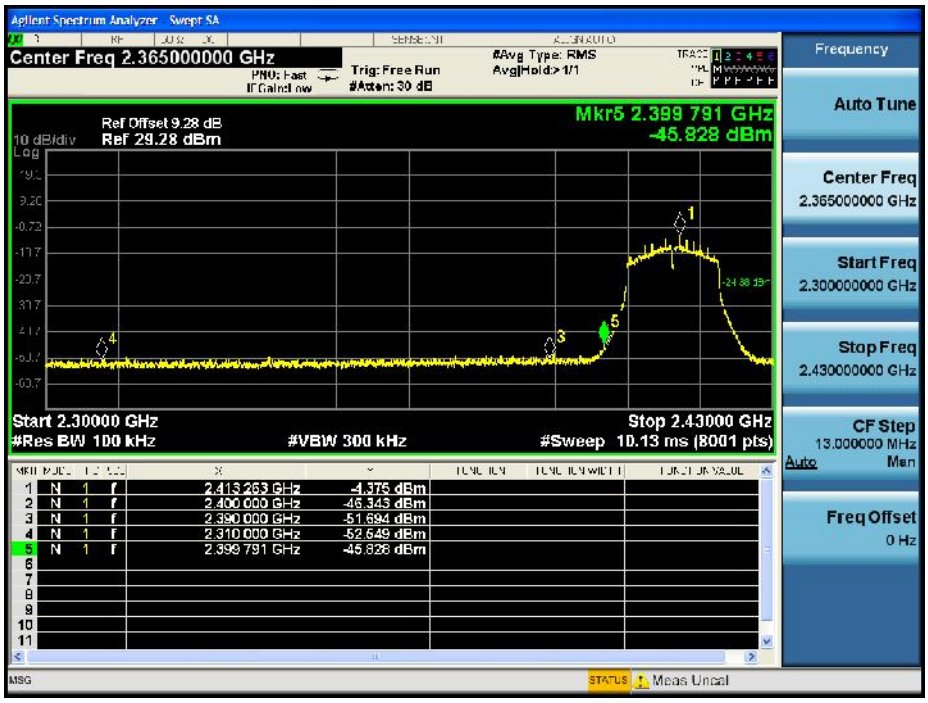
802.11b CH01 (Lower)



802.11b CH 11(Upper)

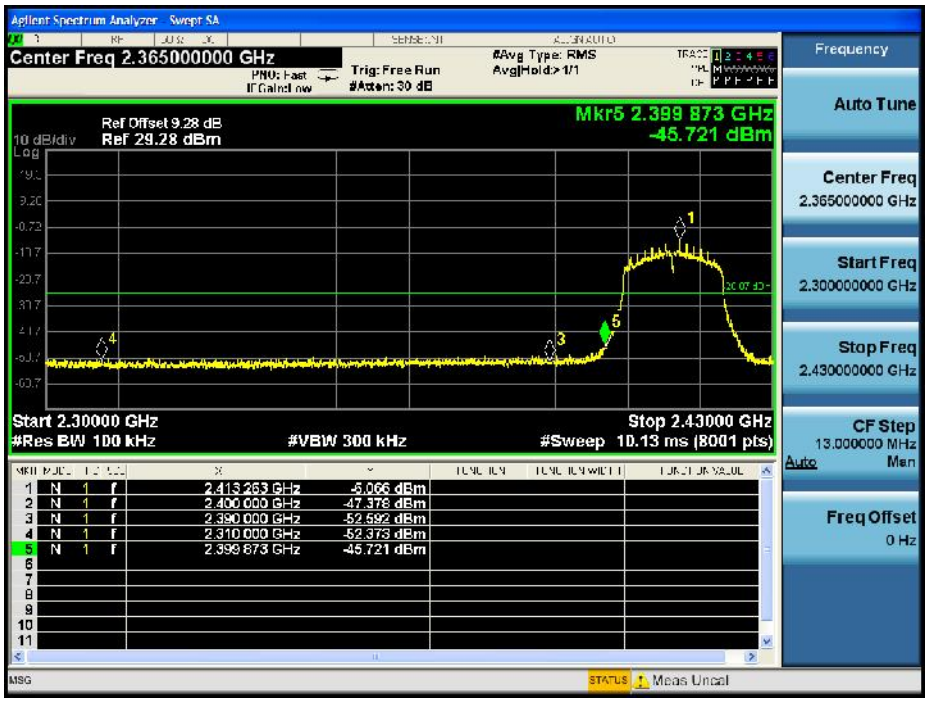


802.11g CH01 (Lower)



802.11g CH 11(Upper)

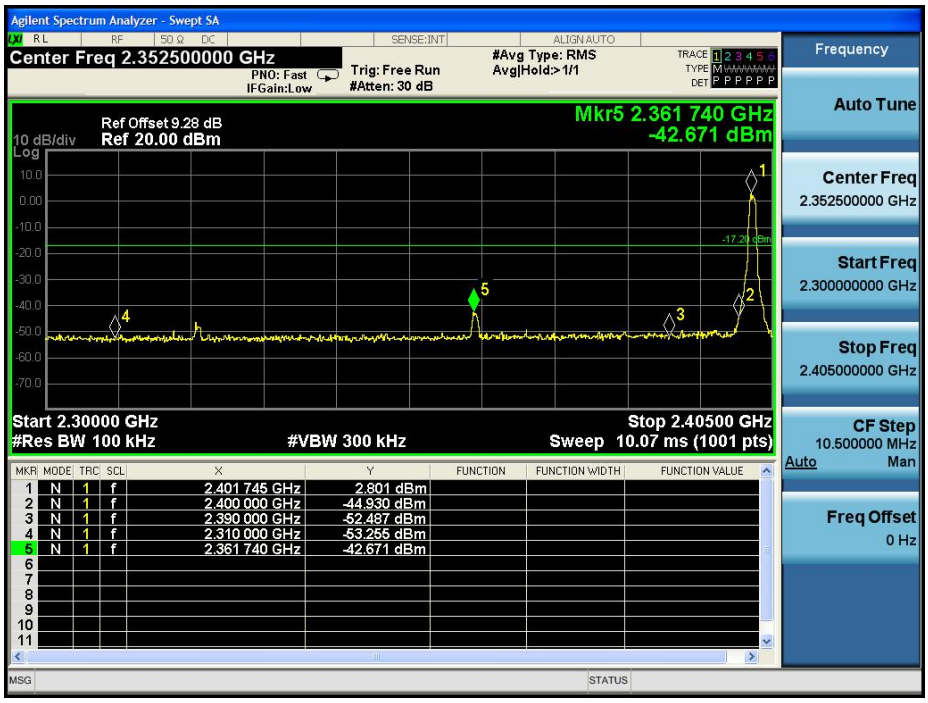
802.11n CH01 (Lower)



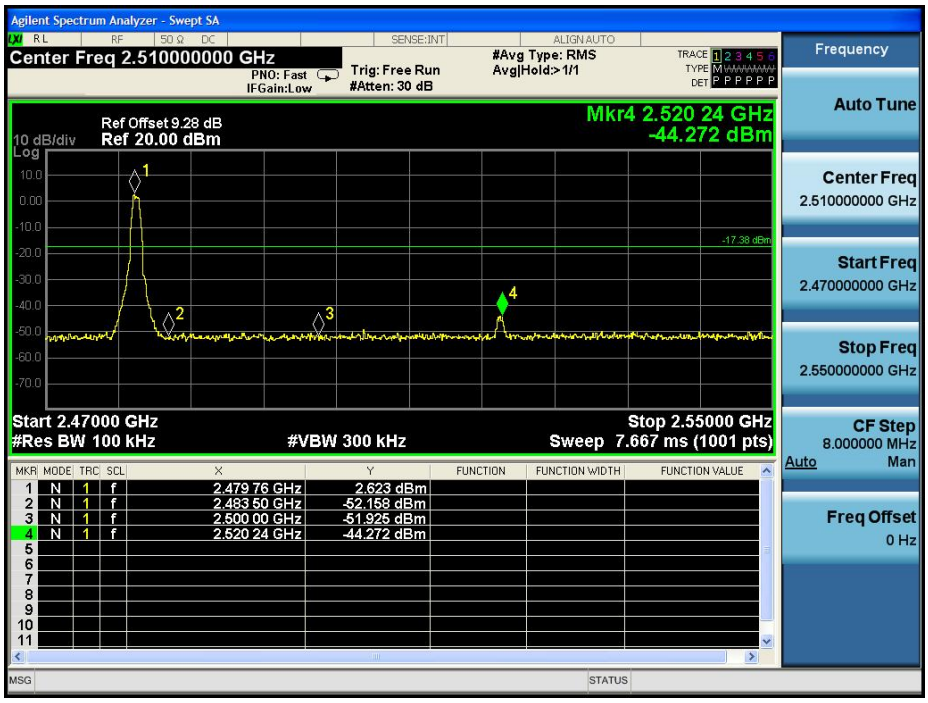
802.11n CH 11(Upper)

Conduct Band Edge (BLE)

GFSK CH00 (Lower)



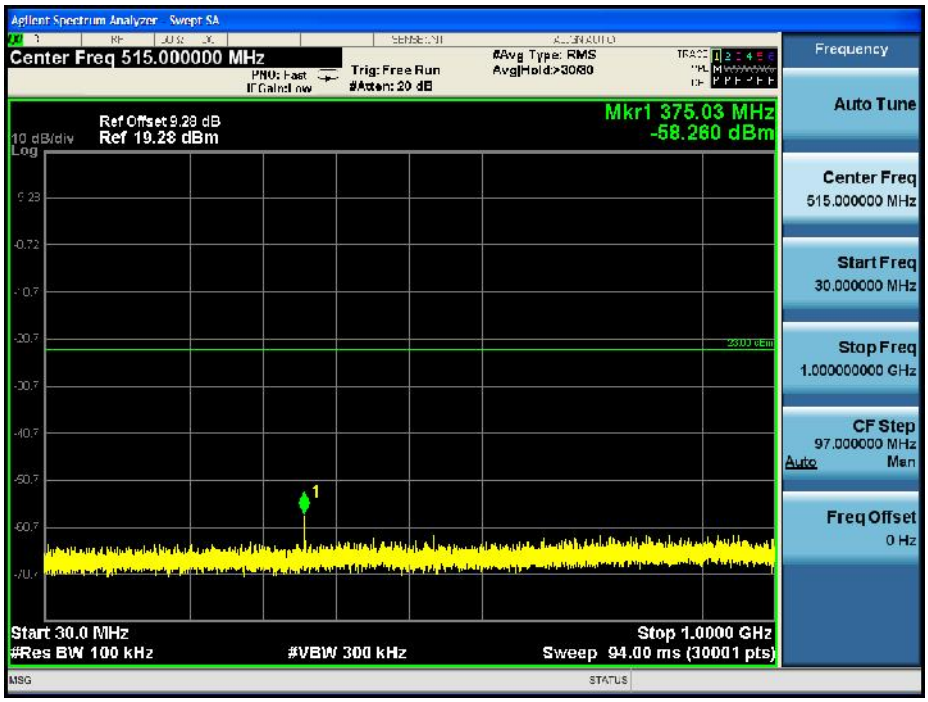
GFSK CH 39(Upper)

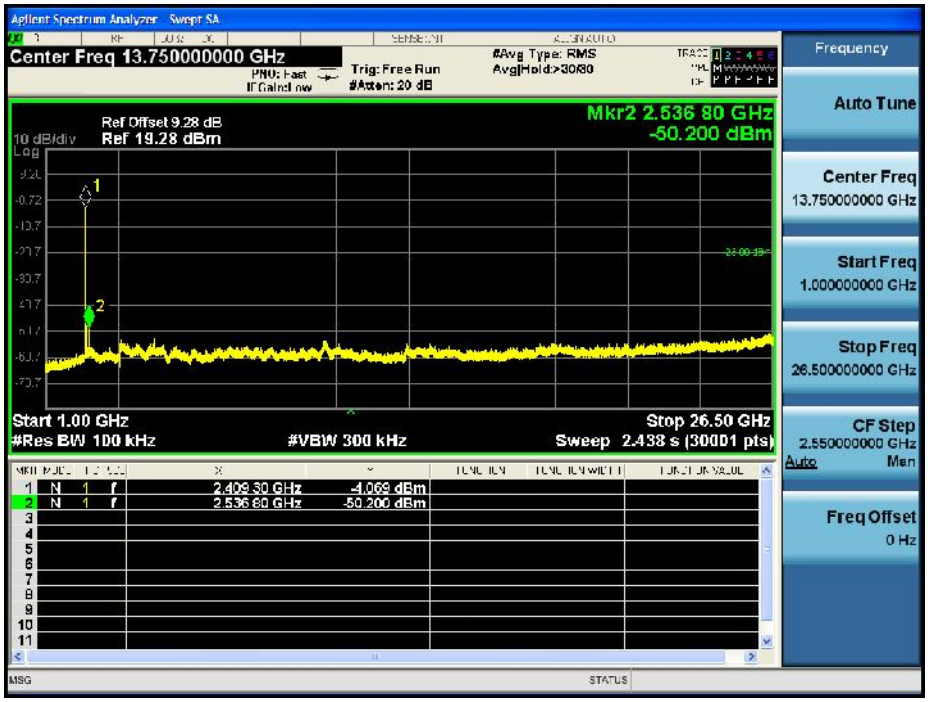


SPURIOUS RF CONDUCTED EMISSION (WIFI 2.4G)

802.11b Worst Case

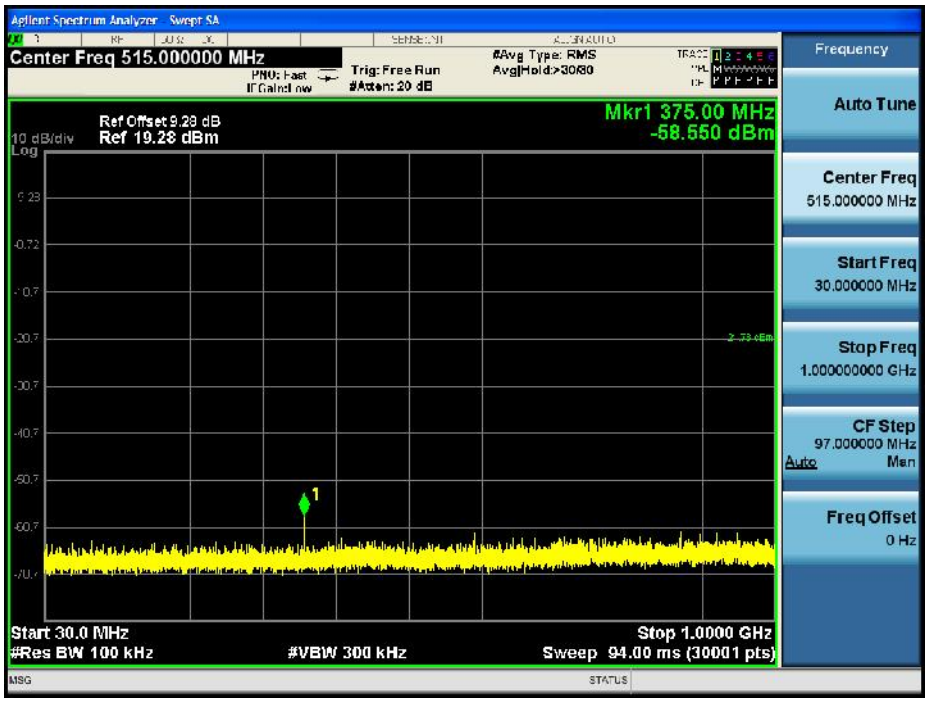
802.11b CH01

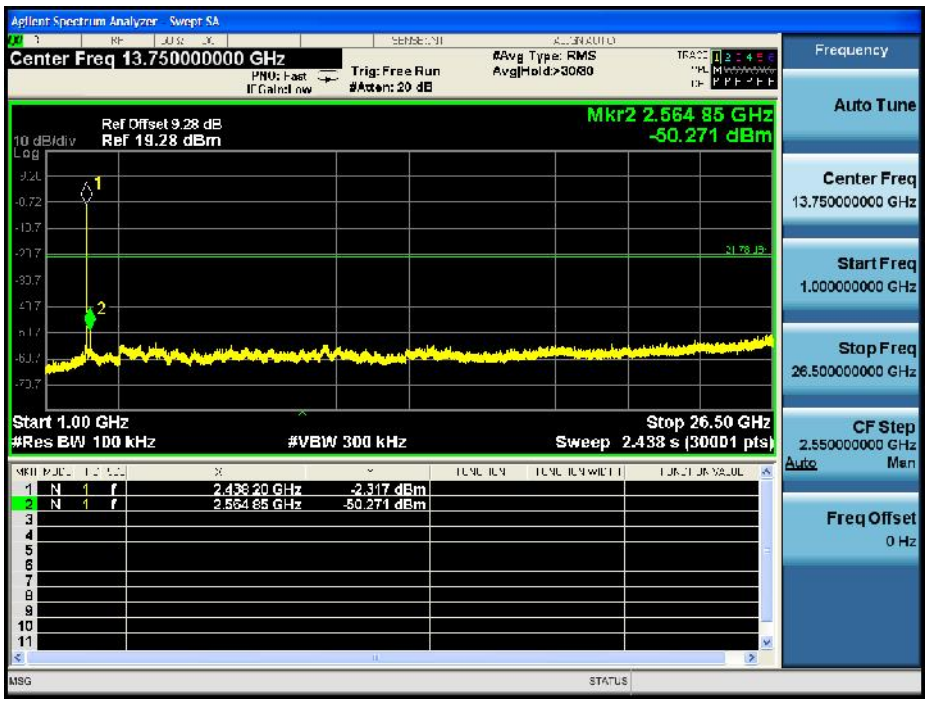



Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Frequency
Auto Tune
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Mkr2 2.536 80 GHz
-50.200 dBm
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.409 30 GHz -4.069 dBm
2 N 1 f 2.536 80 GHz -50.200 dBm
MSG
STATUS

802.11b CH06

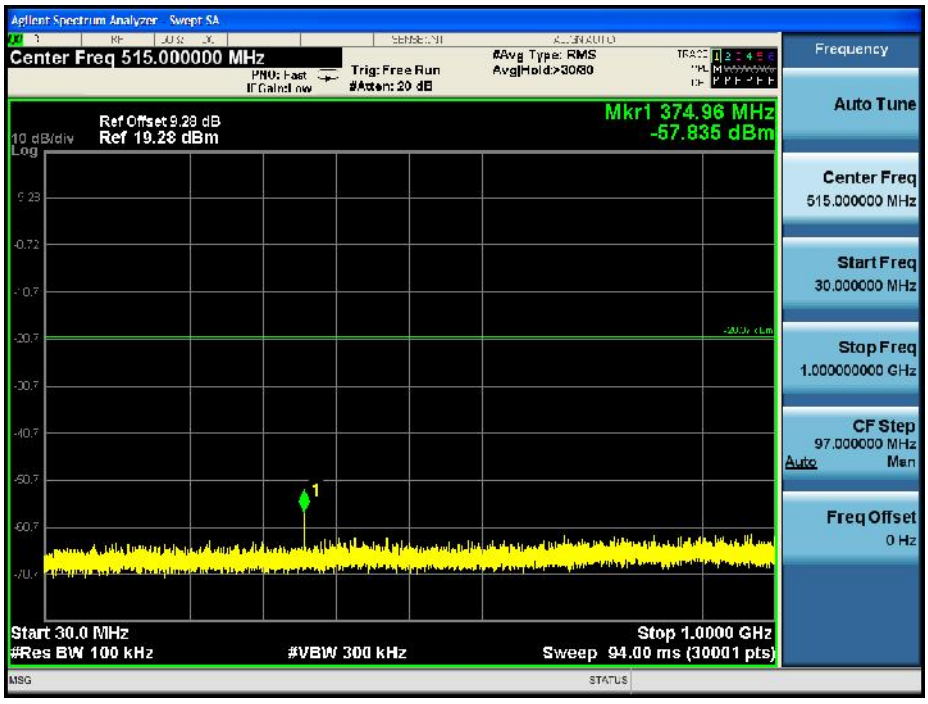

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.437000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold:>10/10
Frequency
Auto Tune
Ref Offset 9.28 dB
10 dB/div
Ref 29.28 dBm
Log
Mkr1 2.436 49 GHz
-1.783 dBm
Center Freq
2.437000000 GHz
Start Freq
2.422000000 GHz
Stop Freq
2.452000000 GHz
CF Step
3.000000 MHz
Auto
Man
Freq Offset
0 Hz
Center 2.43700 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 30.00 MHz
Sweep 2.933 ms (1001 pts)
MSG
STATUS

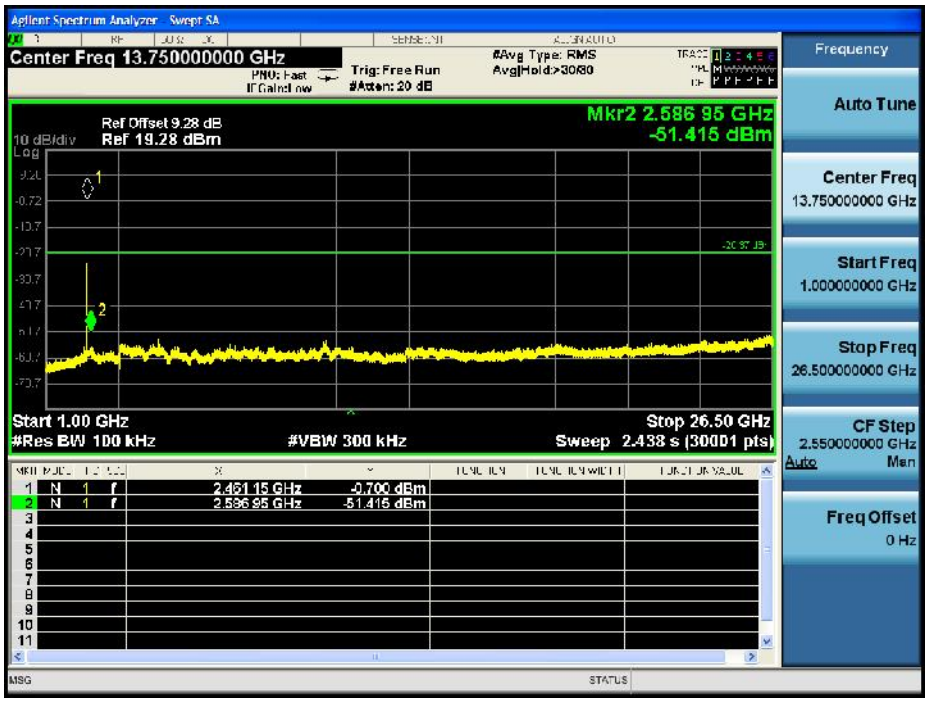

Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Mkr1 375.00 MHz
-58.550 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.0000 GHz
Sweep 94.00 ms (30001 pts)
Frequency
Auto Tune
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Mkr2 2.564 85 GHz
-50.271 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.438 20 GHz -2.317 dBm
2 N 1 f 2.564 85 GHz -50.271 dBm
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

802.11b CH11

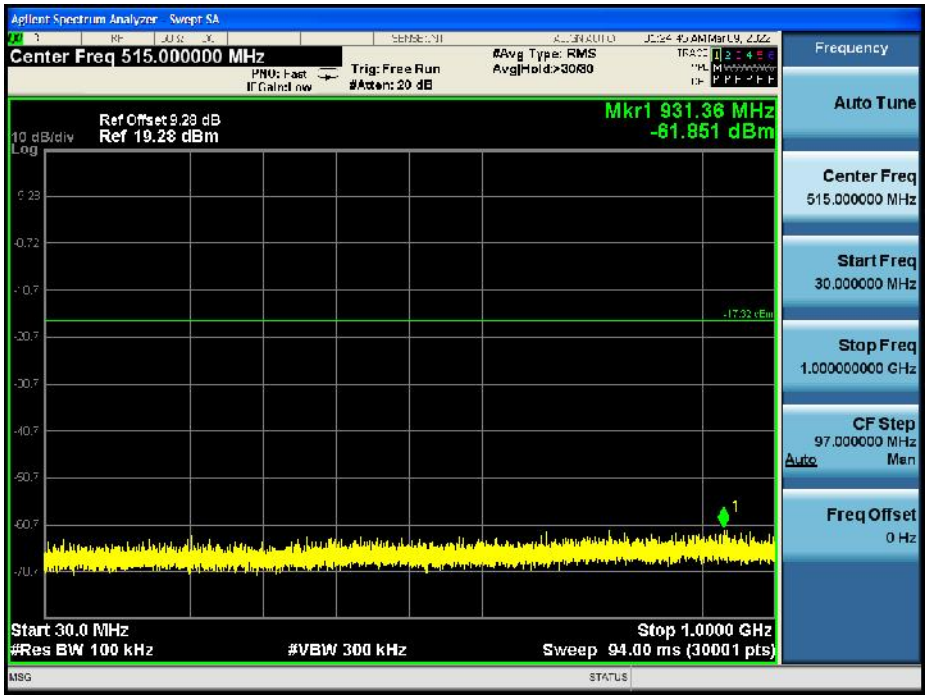

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.462000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold:>10/10
Ref Offset 9.28 dB
10 dB/div
Ref 29.28 dBm
Log
Mkr1 2.462 48 GHz
-0.373 dBm
Center 2.46200 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 30.00 MHz
Sweep 2.933 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.462000000 GHz
Start Freq
2.447000000 GHz
Stop Freq
2.477000000 GHz
CF Step
3.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

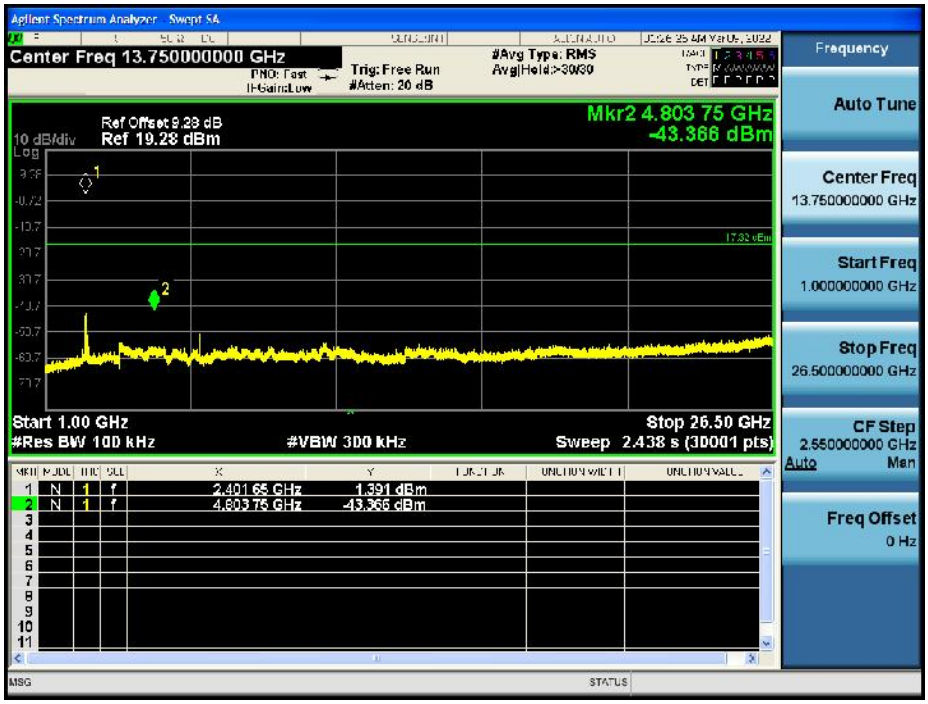

Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Mkr1 374.96 MHz
-57.835 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.0000 GHz
Sweep 94.00 ms (30001 pts)
Frequency
Auto Tune
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS



SPURIOUS RF CONDUCTED EMISSION (BLE)

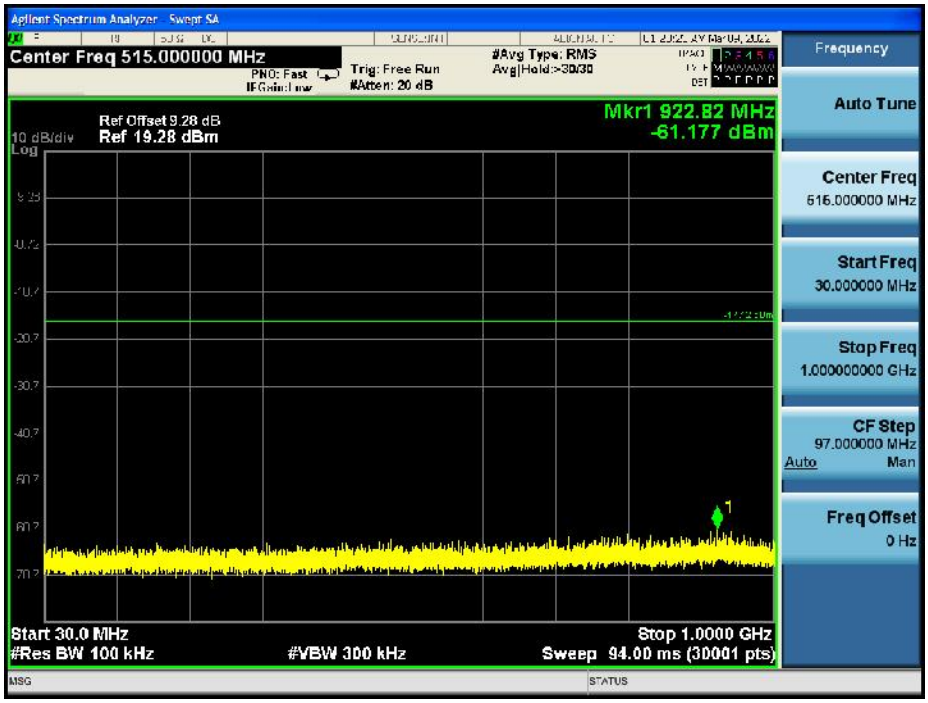
GFSK CH00

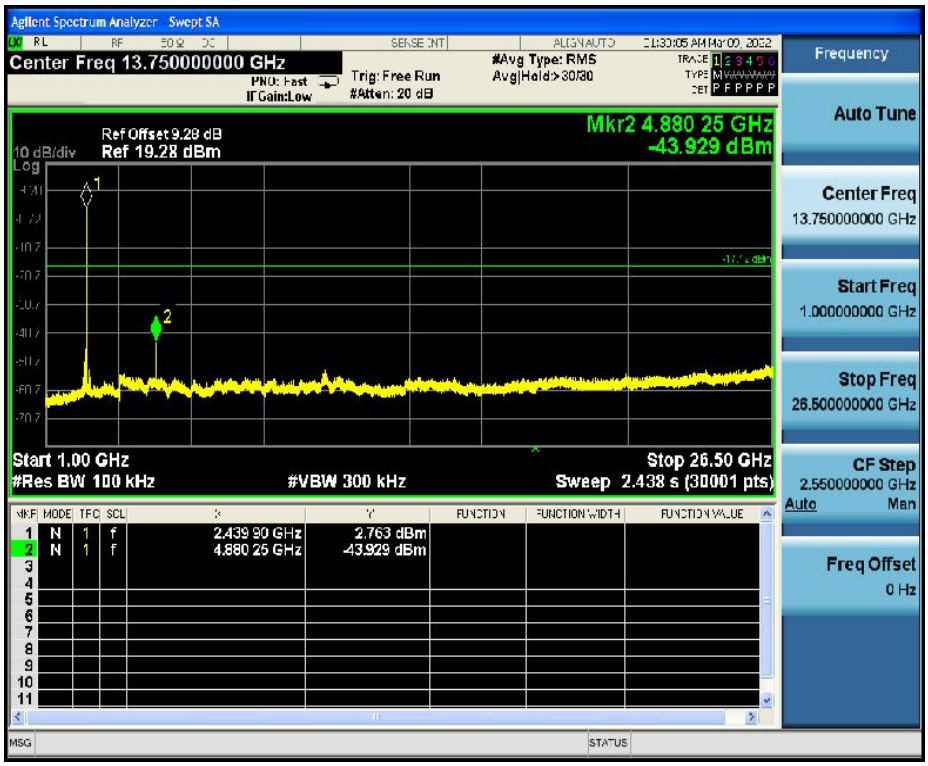

Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Mkr1 931.36 MHz
-61.851 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.0000 GHz
Sweep 94.00 ms (30001 pts)
Frequency
Auto Tune
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Mkr2 4.803 75 GHz
-43.366 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.401 65 GHz 1.391 dBm
2 N 1 f 4.803 75 GHz -43.366 dBm
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

GFSK CH19

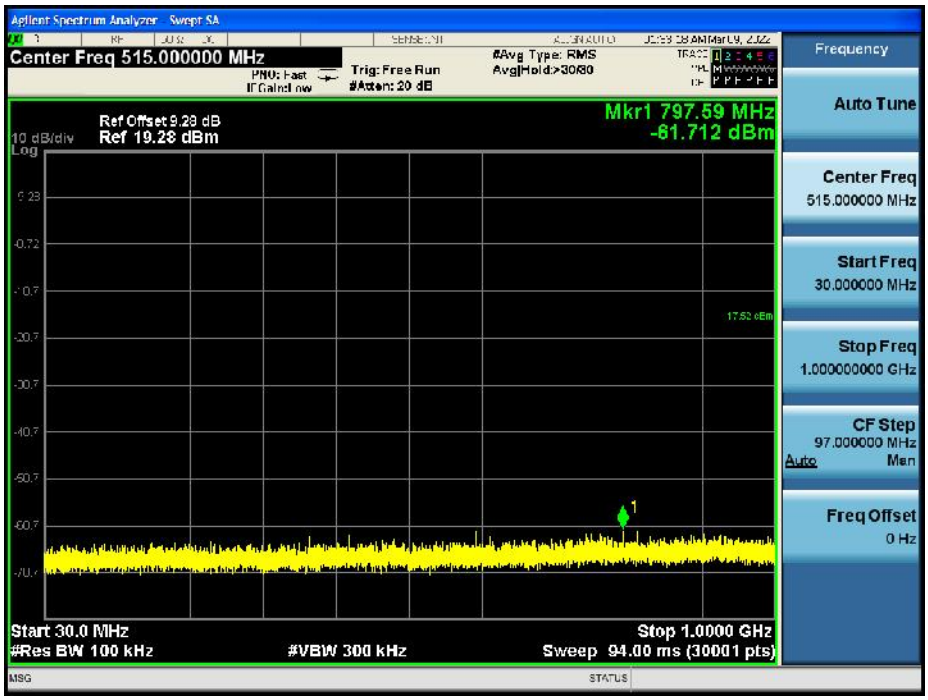

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.440000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold:>10/10
Mkr1 2.439 730 GHz
2.879 dBm
Ref Offset 9.28 dB
10 dB/div
Ref 29.28 dBm
Log
Center 2.440000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.440000000 GHz
Start Freq
2.438500000 GHz
Stop Freq
2.441500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Mkr1 922.82 MHz
-61.177 dBm
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.0000 GHz
Sweep 94.00 ms (30001 pts)
Frequency
Auto Tune
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

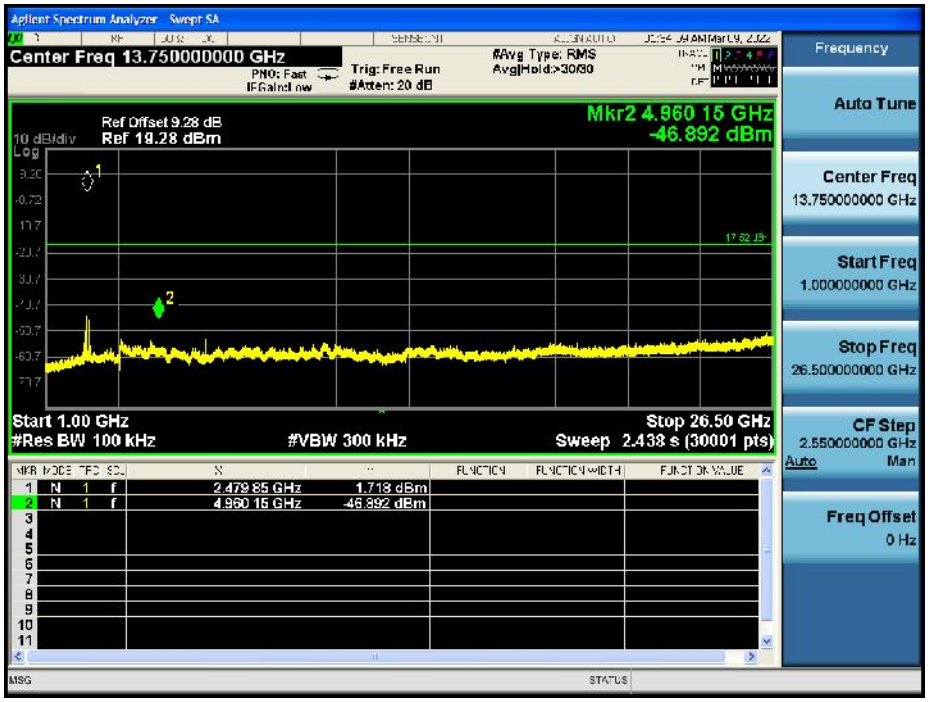

Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Mkr2 4.880 25 GHz
-43.929 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.439 90 GHz 2.763 dBm
2 N 1 f 4.880 25 GHz -43.929 dBm
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz

GFSK CH39


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold:>10/10
Ref Offset 9.28 dB
10 dB/div
Ref 29.28 dBm
Log
Mkr1 2.479 736 GHz
2.483 dBm
Center 2.480000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Frequency
Auto Tune
Mkr1 797.59 MHz
-61.712 dBm
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.0000 GHz
Sweep 94.00 ms (30001 pts)
MSG
STATUS

GFSK CH39


Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold:>30/30
Frequency
Auto Tune
Mkr2 4.960 15 GHz
-46.892 dBm
Ref Offset 9.28 dB
10 dB/div
Ref 19.28 dBm
Log
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.479 85 GHz 1.718 dBm
2 N 1 f 4.960 15 GHz -46.892 dBm
MSG
STATUS

8 6dB Bandwidth Measurement

Test Requirement	:	FCC CFR47 Part 15 Section 15.247&RSS-247 § 5.2
Test Method	:	ANSI C63.10:2013
Test Limit	:	Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

8.2 Test Result

WIFI 2.4G			
Test Mode	Channel frequency (MHz)	Measurement level (MHz)	Required Limit (KHz)
802.11b	2412	10.040	>500
	2437	10.040	>500
	2462	10.040	>500
802.11g	2412	15.040	>500
	2437	15.000	>500
	2462	12.560	>500
802.11n(20)	2412	15.000	>500
	2437	15.000	>500
	2462	15.040	>500

BLE			
Test Mode	Channel frequency (MHz)	Measurement level (MHz)	Required Limit (KHz)
GFSK	2402	0.700	>500
	2440	0.704	>500
	2480	0.704	>500

WIFI 2.4G DTS BW

802.11b Channel 2412

802.11b Channel 2437

802.11b Channel 2462

802.11g Channel 2412

802.11g Channel 2437

802.11g Channel 2462

802.11n(20) Channel 2412

802.11n(20) Channel 2437

802.11n(20) Channel 2462

BLE DTS BW

GFSK Channel 2402

GFSK Channel 2440

GFSK Channel 2480

9 Maximum Peak Output Power

Test Requirement	:	FCC CFR47 Part 15 Section 15.247&RSS-247 § 5.4
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

9.1 Test Procedure

1. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Measure the conducted output power and record the results in the test report.

9.2 Test Result

WIFI 2.4G			
Test Mode	Channel frequency (MHz)	Peak Output Power(dBm)	Required Limit (dBm)
802.11b	2412	8.16	30
	2437	8.44	30
	2462	8.12	30
802.11g	2412	7.54	30
	2437	8.11	30
	2462	7.65	30
802.11n(20)	2412	8.13	30
	2437	8.13	30
	2462	7.88	30

BLE			
Test Mode	Channel frequency (MHz)	Peak Output Power(dBm)	Required Limit (dBm)
GFSK	2402	3.14	30
	2440	3.02	30
	2480	2.98	30

10 Power Spectral density

Test Requirement	:	FCC CFR47 Part 15 Section 15.247&RSS-247 § 5.2
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247(f) The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz , Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

10.2 Test Result

WIFI 2.4G			
Test Mode	Channel frequency (MHz)	Power Spectral density (dBm)	Required Limit (dBm/3KHz)
802.11b	2412	-15.92	8
	2437	-14.23	8
	2462	-12.65	8
802.11g	2412	-18.47	8
	2437	-17.45	8
	2462	-15.60	8
802.11n(20)	2412	-19.47	8
	2437	-17.90	8
	2462	-18.03	8

BLE			
Test Mode	Channel frequency (MHz)	Power Spectral density (dBm)	Required Limit (dBm/3KHz)
GFSK	2402	-11.95	8
	2440	-11.13	8
	2480	-12.18	8

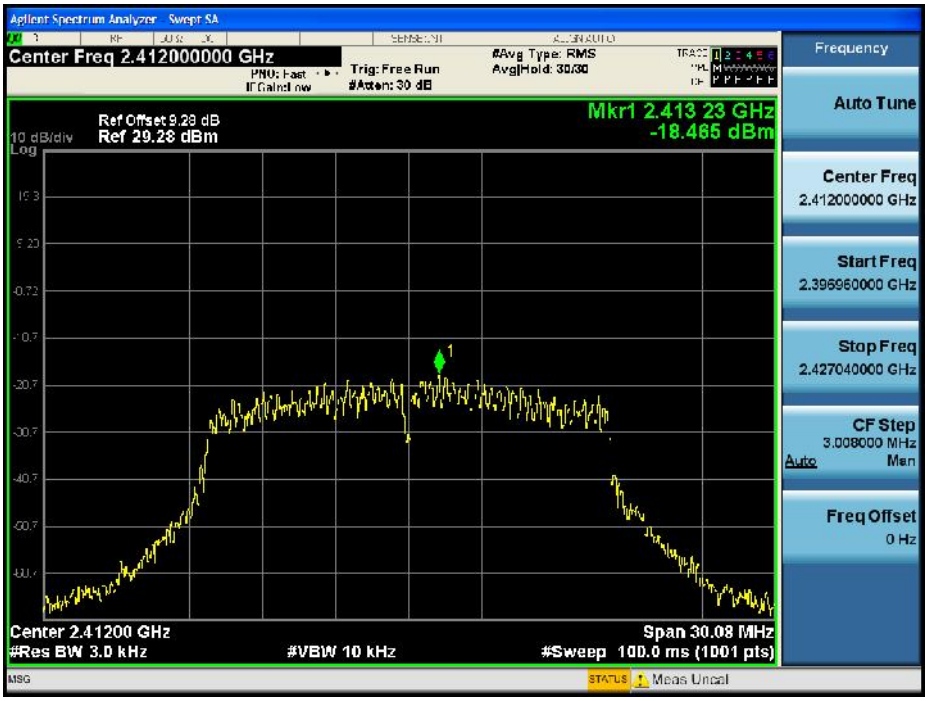
WIFI 2.4G PSD

802.11b Channel 2412

802.11b Channel 2437

802.11b Channel 2462

802.11g Channel 2412



802.11g Channel 2437

802.11g Channel 2462

802.11n(20) Channel 2412

802.11n(20) Channel 2437

802.11n(20) Channel 2462

BLE PSD

GFSK Channel 2402

GFSK Channel 2440

GFSK Channel 2480

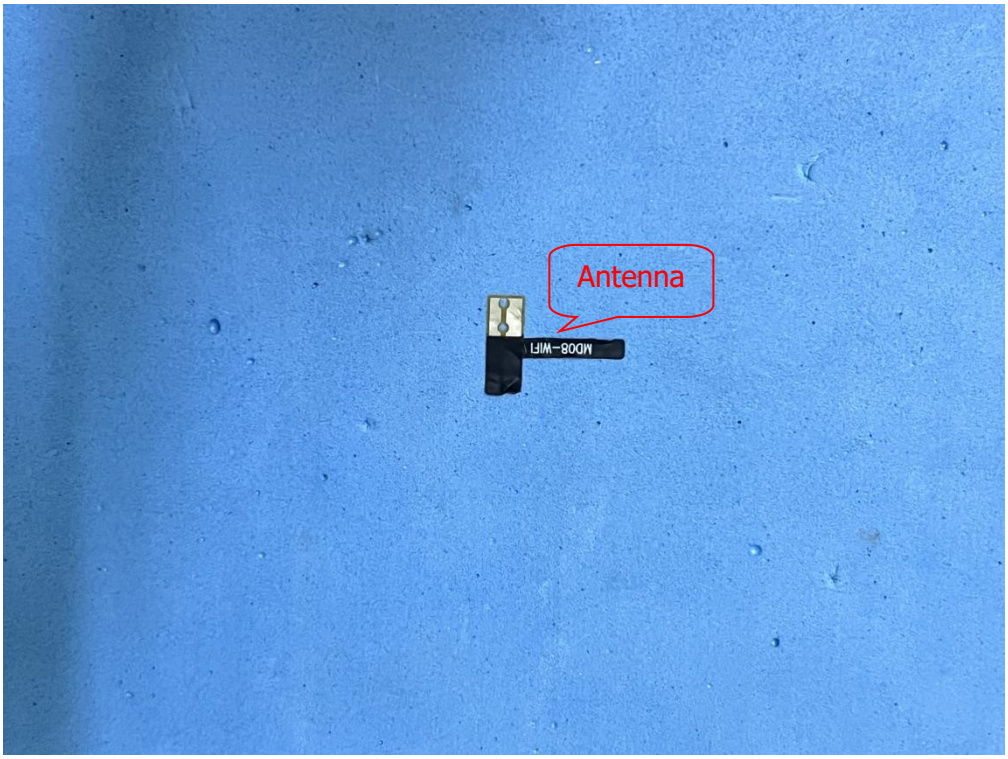
11 Antenna Application

11.1 Antenna Requirement

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

11.2 Result

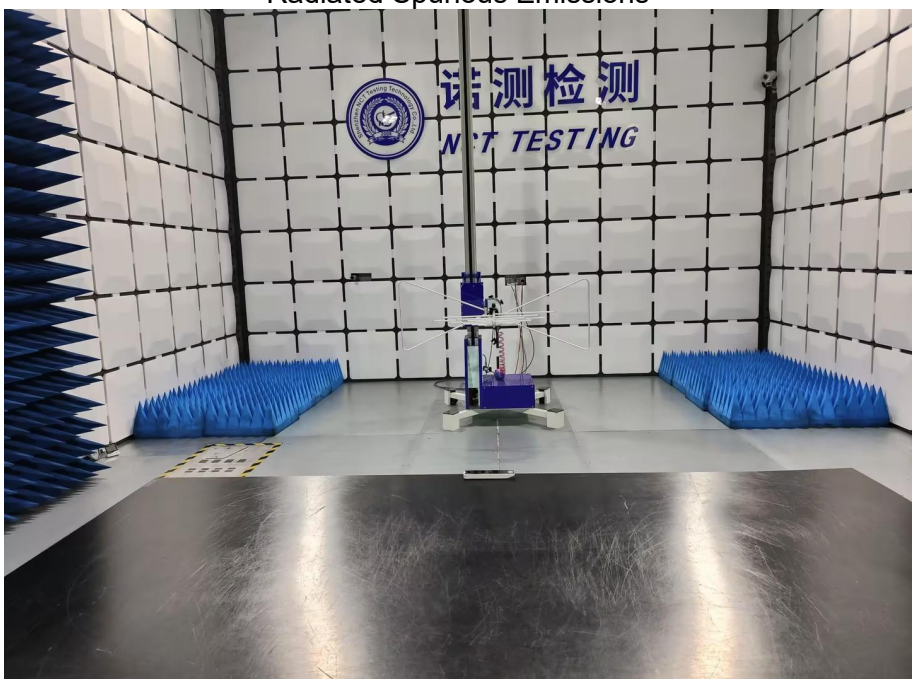
The EUT'S antenna, permanent attached antenna, is internal antenna. The antenna's gain is 3.09 dBi and meets the requirement.

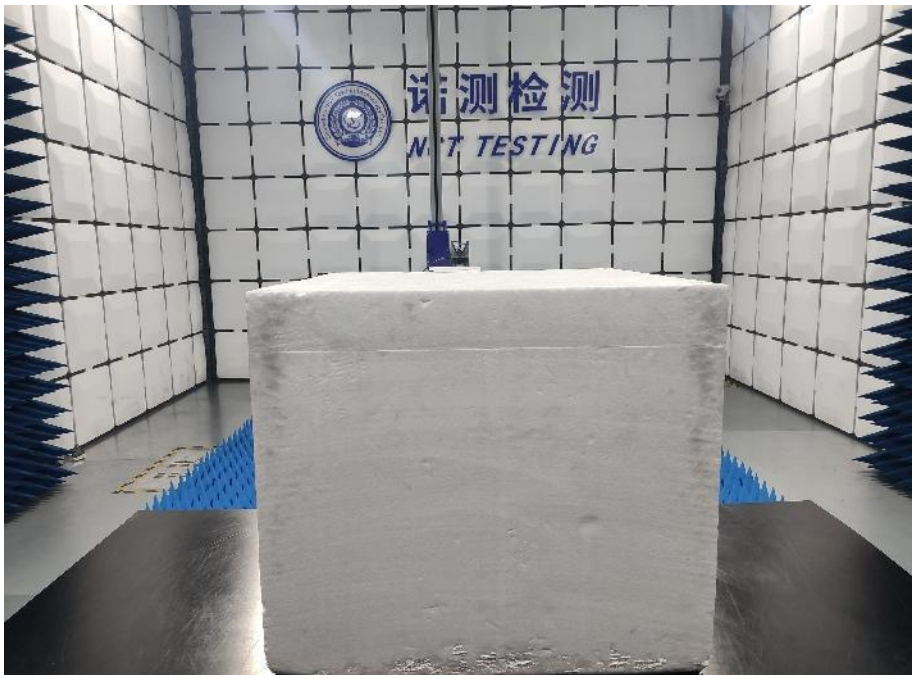


12 Test Setup

Conducted Emissions

Radiated Spurious Emissions





******THE END REPORT******