6.7 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.09000 – 0.11000	16.42000 – 16.42300	399.9 – 410.0	4.500 – 5.250
0.49500 – 0.505**	16.69475 – 16.69525	608.0 – 614.0	5.350 – 5.460
2.17350 – 2.19050	16.80425 – 16.80475	960.0 – 1240.0	7.250 – 7.750
4.12500 – 4.12800	25.50000 – 25.67000	1300.0 – 1427.0	8.025 – 8.500
4.17725 – 4.17775	37.50000 – 38.25000	1435.0 – 1626.5	9.000 – 9.200
4.20725 – 4.20775	73.00000 – 74.60000	1645.5 – 1646.5	9.300 – 9.500
6.21500 – 6.21800	74.80000 – 75.20000	1660.0 – 1710.0	10.600 – 12.700
6.26775 – 6.26825	108.00000 – 121.94000	1718.8 – 1722.2	13.250 – 13.400
6.31175 – 6.31225	123.00000 – 138.00000	2200.0 – 2300.0	14.470 – 14.500
8.29100 – 8.29400	149.90000 – 150.05000	2310.0 – 2390.0	15.350 – 16.200
8.36200 – 8.36600	156.52475 – 156.52525	2483.5 – 2500.0	17.700 – 21.400
8.37625 – 8.38675	156.70000 – 156.90000	2655.0 – 2900.0	22.010 – 23.120
8.41425 – 8.41475	162.01250 – 167.17000	3260.0 – 3267.0	23.600 – 24.000
12.29000 – 12.29300	167.72000 – 173.20000	3332.0 – 3339.0	31.200 – 31.800
12.51975 – 12.52025	240.00000 – 285.00000	3345.8 – 3358.0	36.430 – 36.500
12.57675 – 12.57725	322.00000 – 335.40000	3600.0 – 4400.0	Above 38.6
13.36000 – 13.41000			

**: Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

7. Test of Conducted Spurious Emission

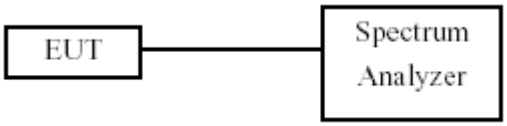
7.1 Test Limit

Below –30dB of the highest emission level of operating band (In 100 kHz Resolution Bandwidth)

7.2 Test Procedure

a. The transmitter output was connected to the spectrum analyzer via a low lose cable.
b. Set RBW of spectrum analyzer to 100 KHz and VBW of spectrum analyzer to 300 KHz with convenient frequency span including 100 KHz bandwidth from band edge.
c. Peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 30dB relative to the maximum measured in-band peak PSD level.
d. The band edges was measured and recorded.

7.3 Test Setup Layout



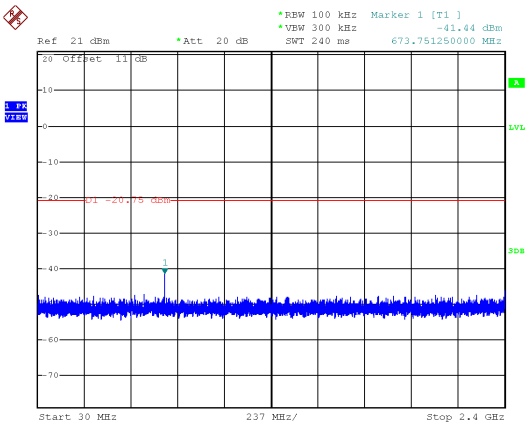
7.4 Test Result and Data

Test Result	:	PASS	Temperature	:	23°C
Test Date	:	Jan. 23, 2019	Humidity	:	64%

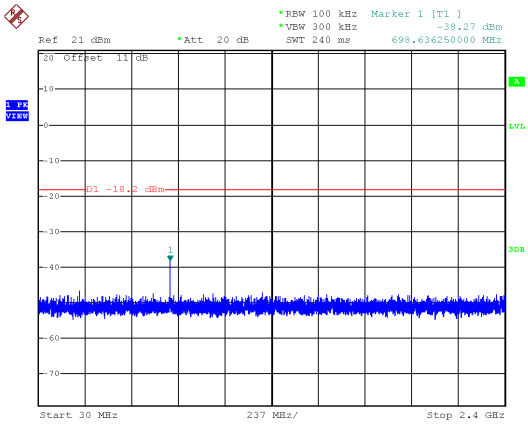
Note: Test plots refers to the following pages.

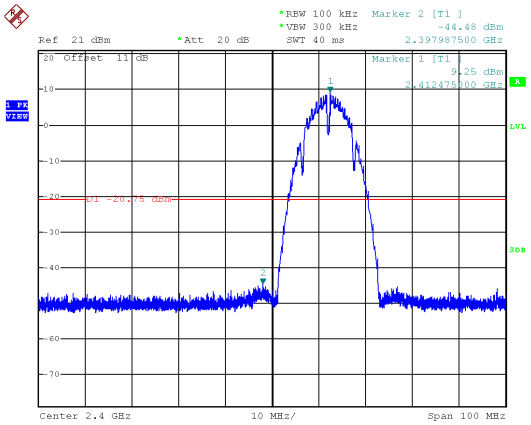
ANT A

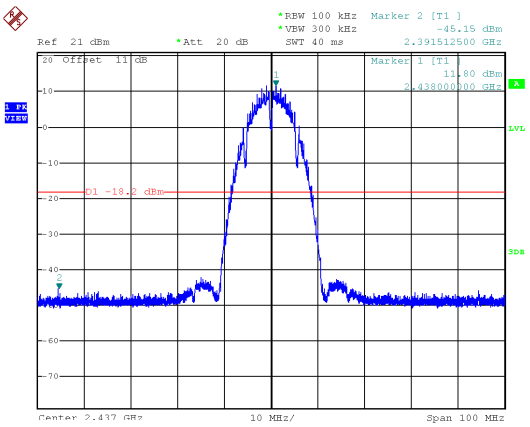
Modulation Type: 802.11b, CH 01

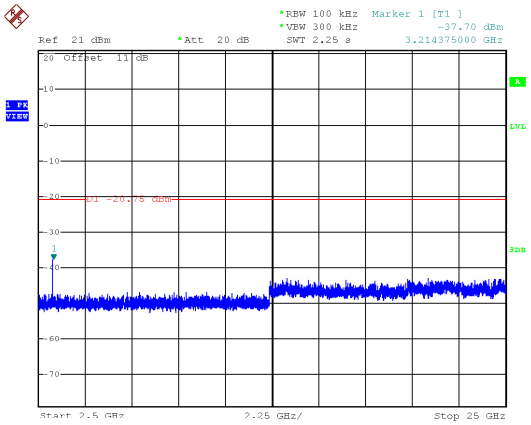


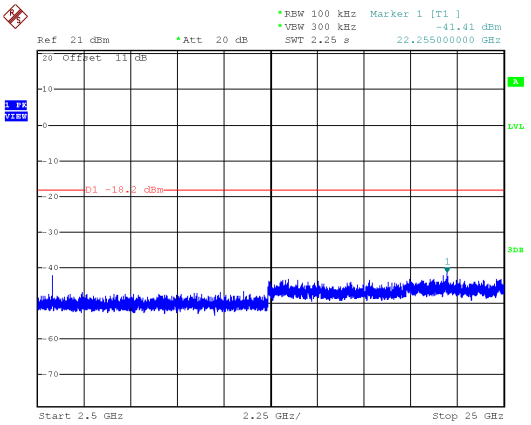
Modulation Type: 802.11b, CH 06



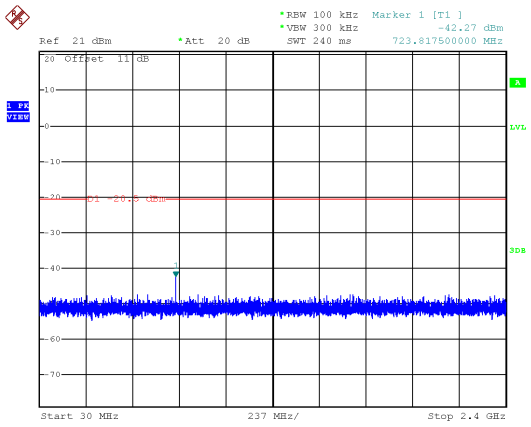


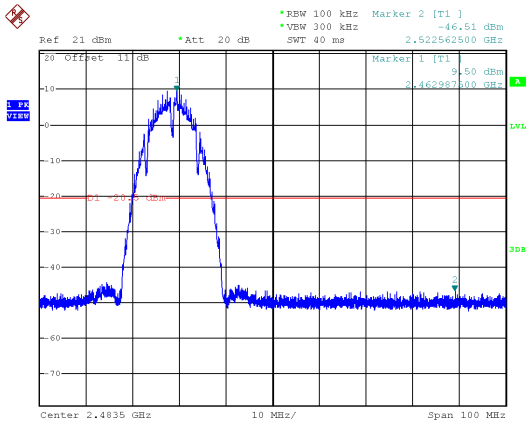


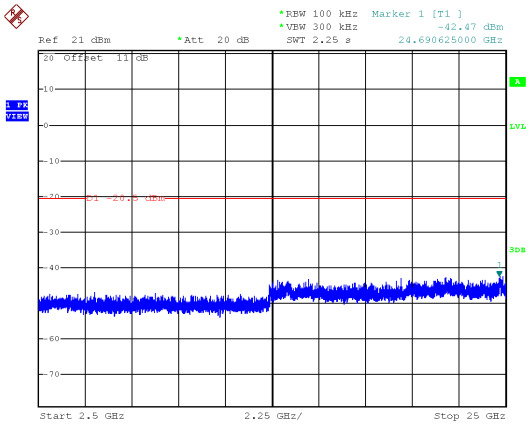




ANT A
Modulation Type: 802.11b, CH 11

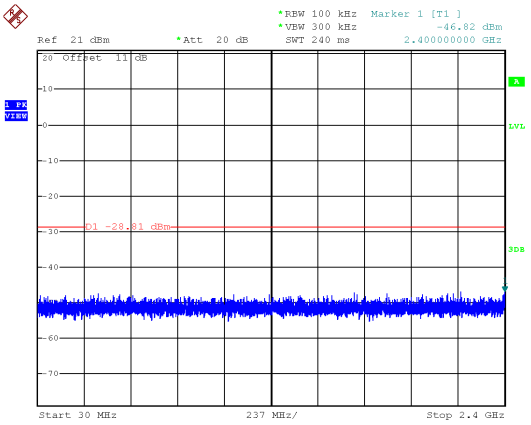




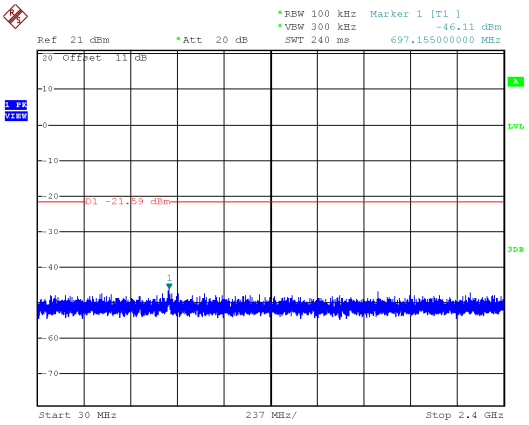


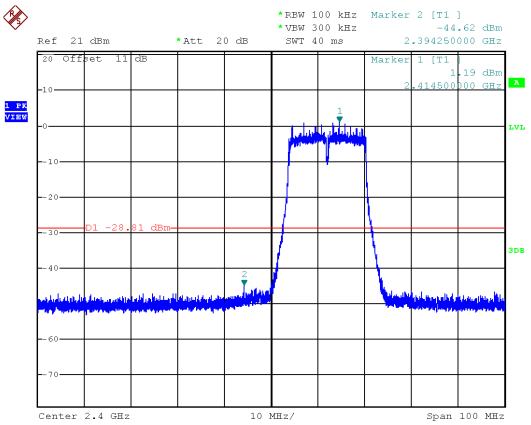
ANT A

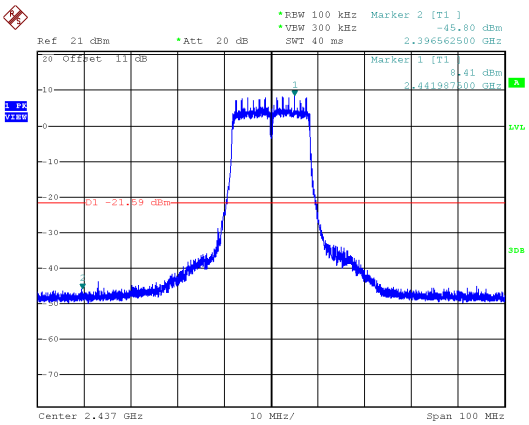
Modulation Type: 802.11g, CH 01

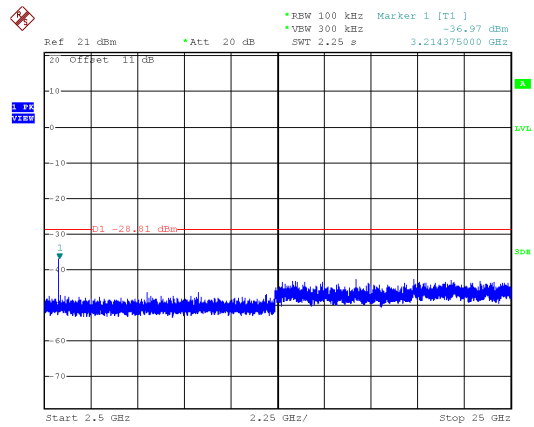


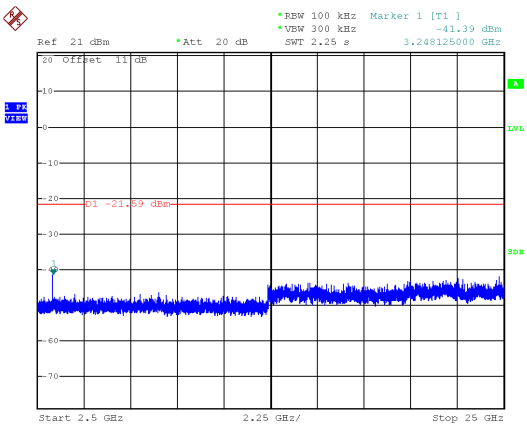
Modulation Type: 802.11g, CH 06



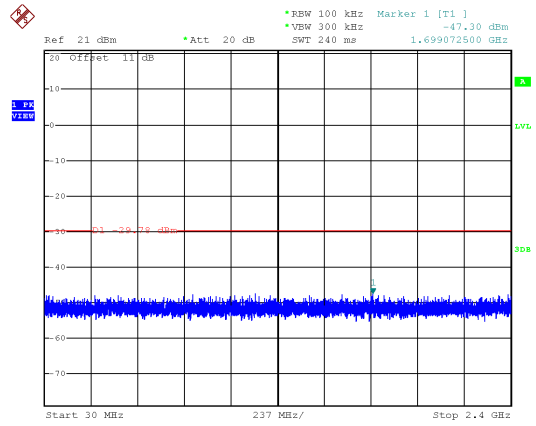


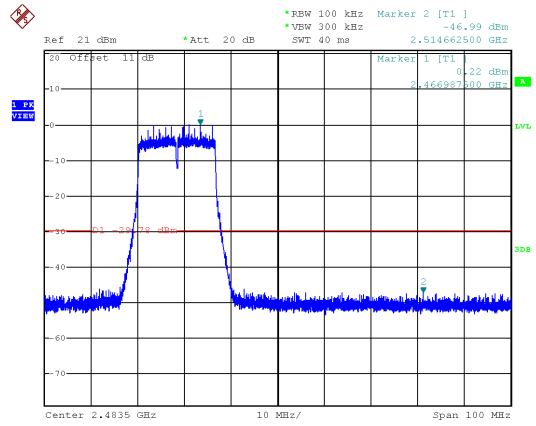


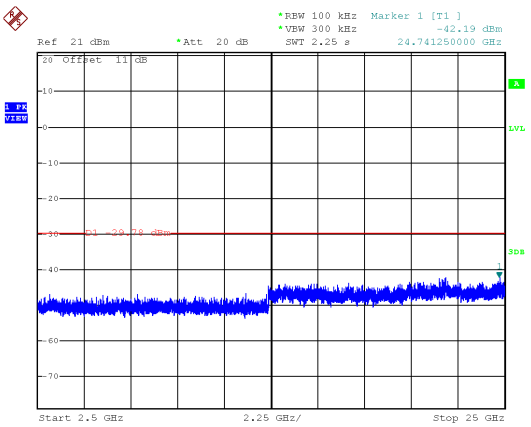




ANT A
Modulation Type: 802.11g, CH 11

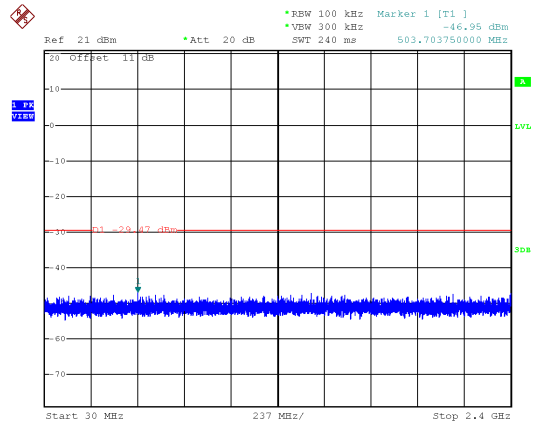




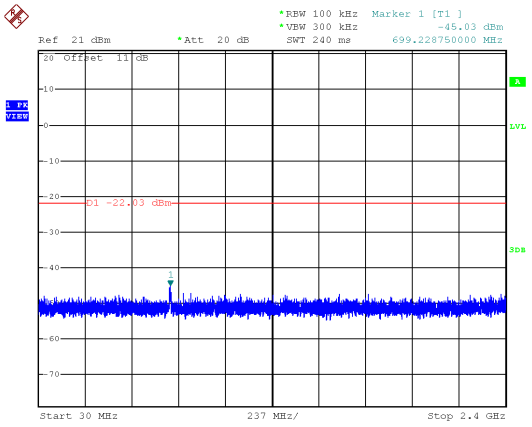


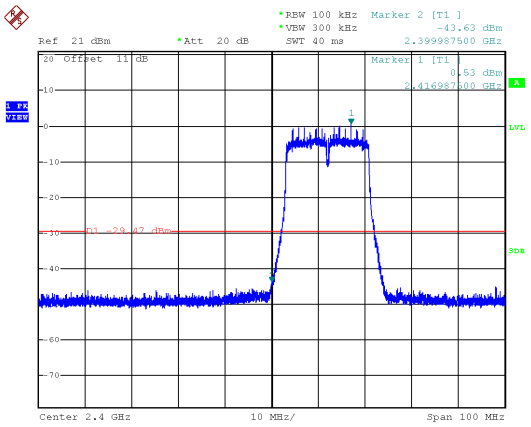
ANT A

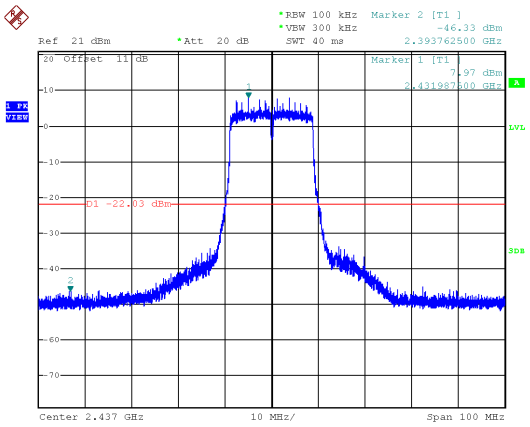
Modulation Type: VHT20, CH01

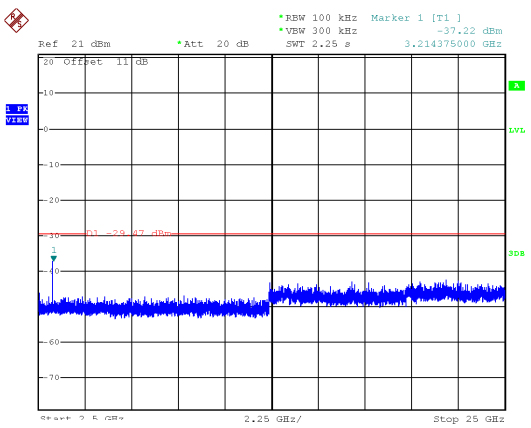


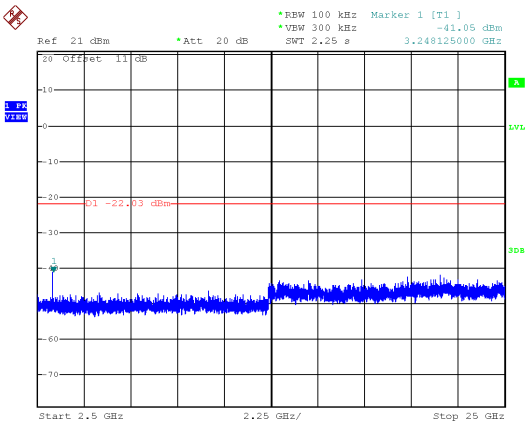
Modulation Type: VHT20, CH06



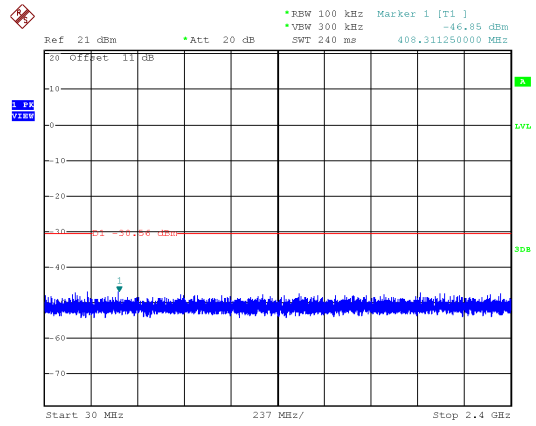


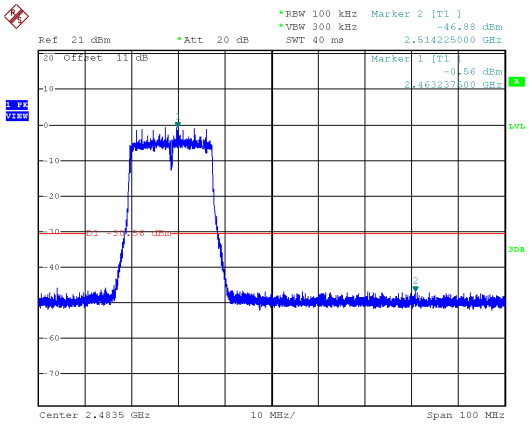


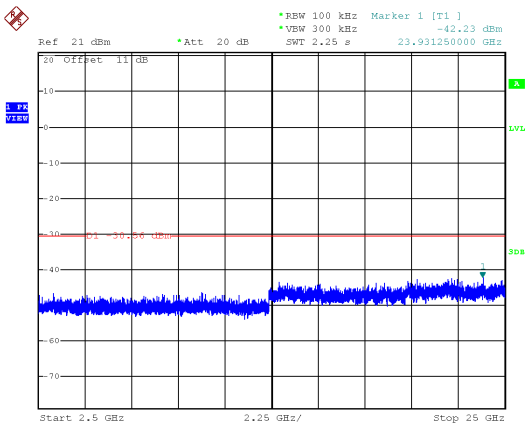




ANT A
Modulation Type: VHT20, CH11

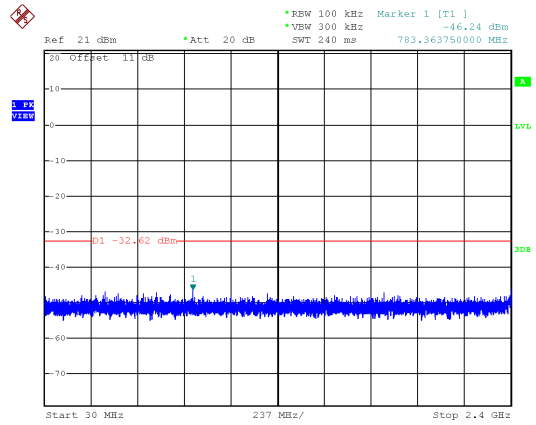




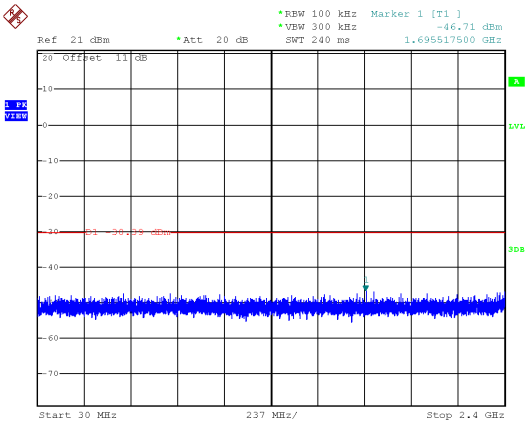


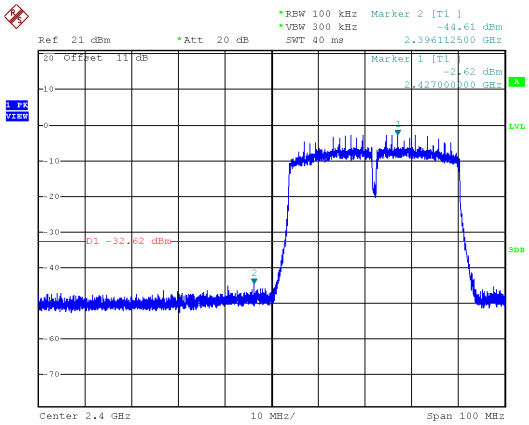
ANT A

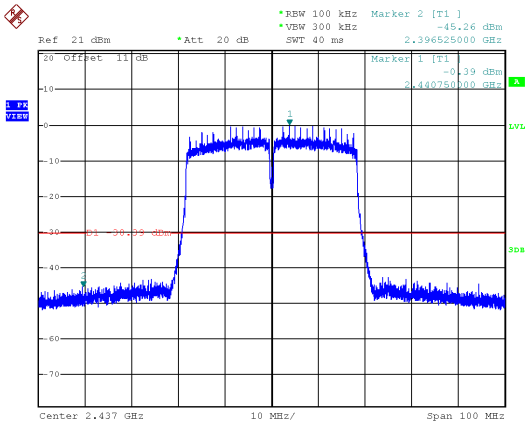
Modulation Type: VHT40, CH03

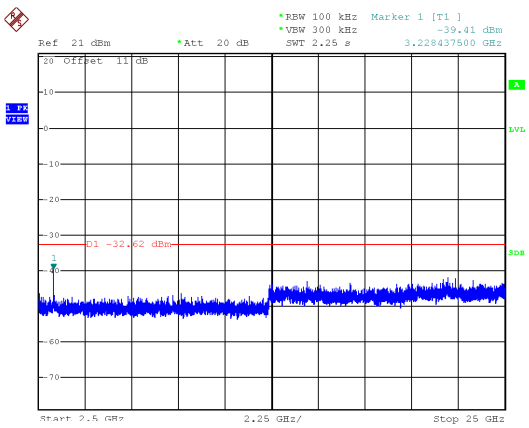


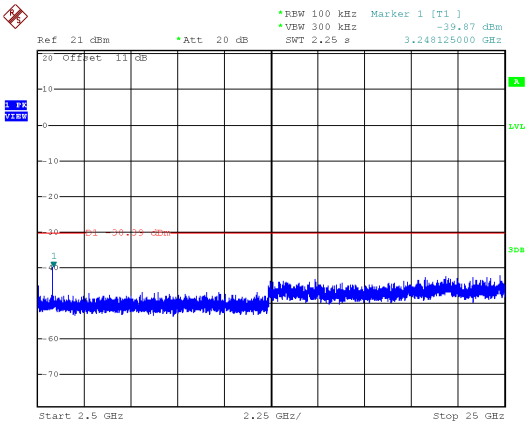
Modulation Type: VHT40, CH06



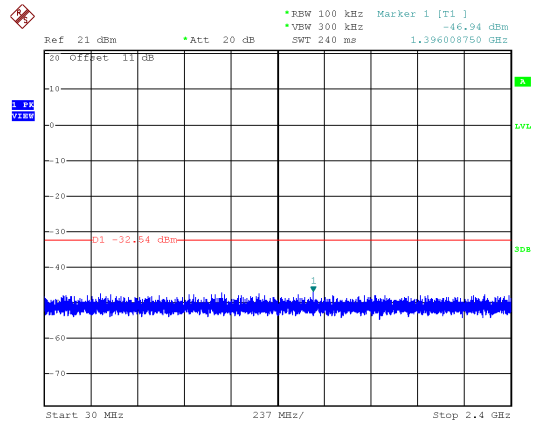


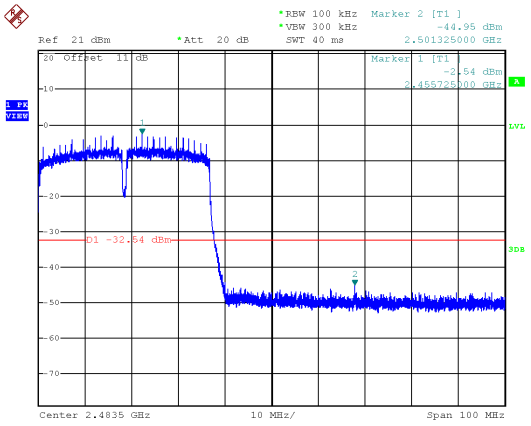


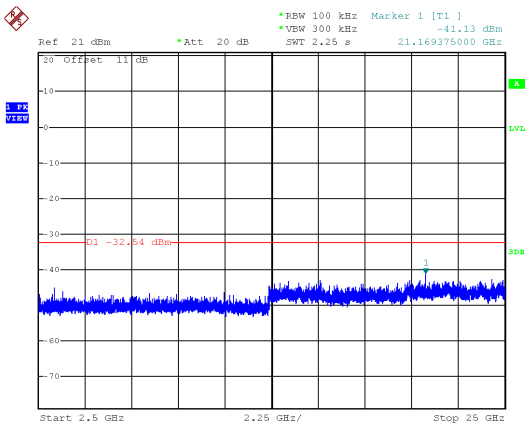




ANT A
Modulation Type: VHT40, CH09

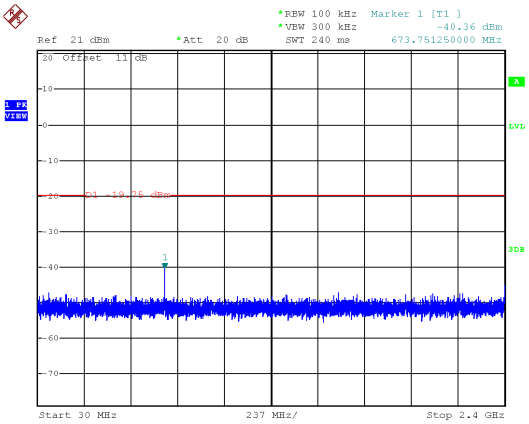




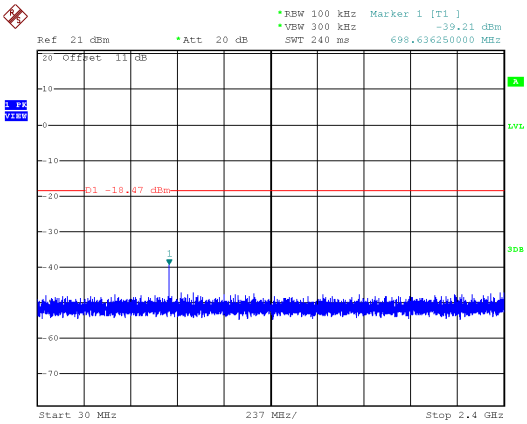


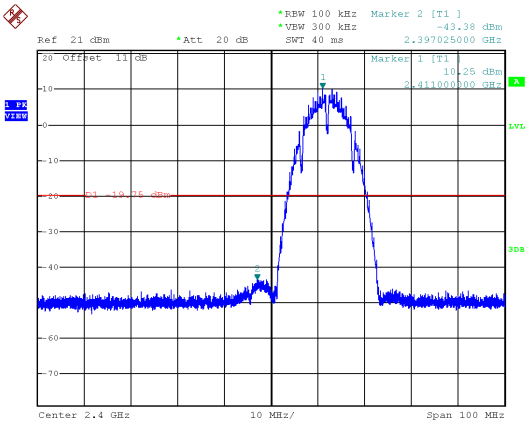
ANT B

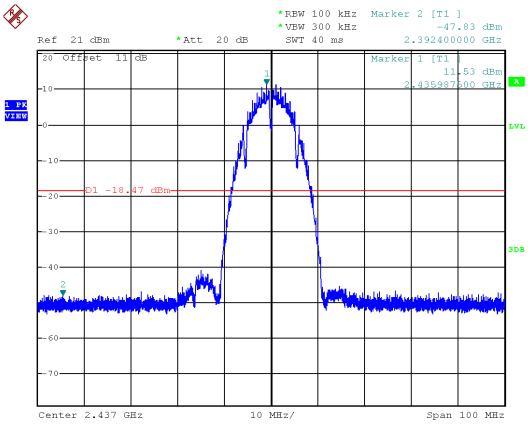
Modulation Type: 802.11b, CH 01

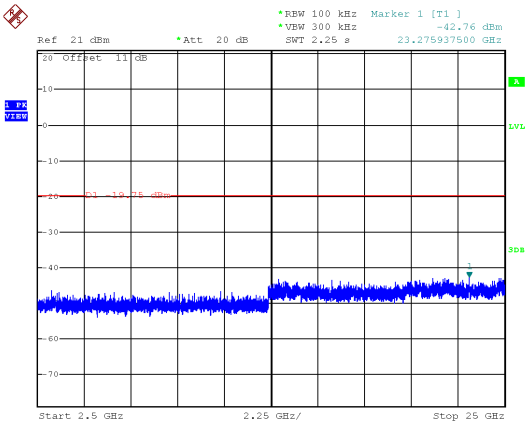


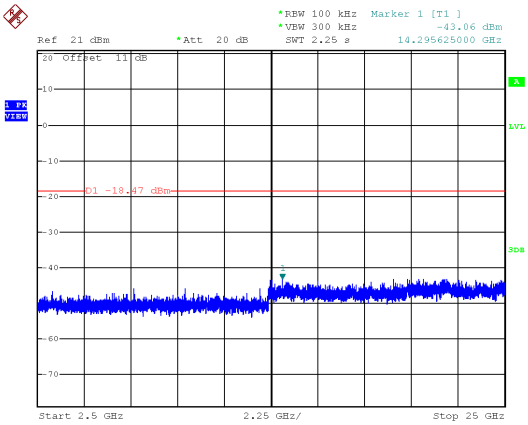
Modulation Type: 802.11b, CH 06



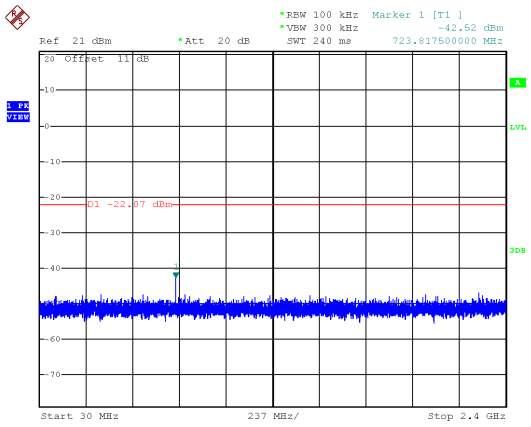


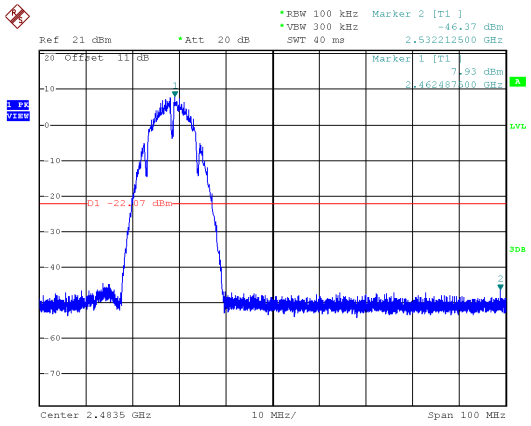


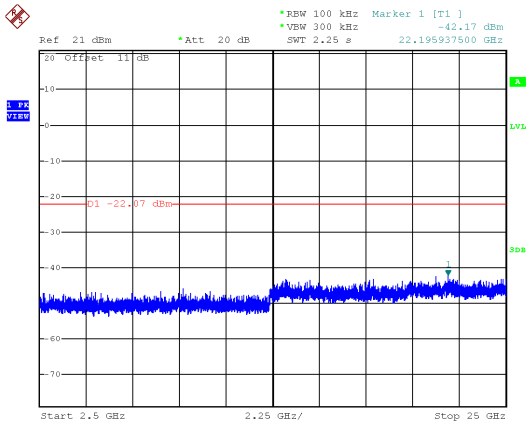




ANT B
Modulation Type: 802.11b, CH 11

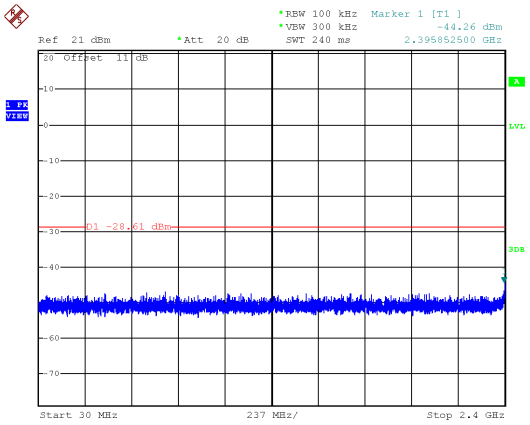




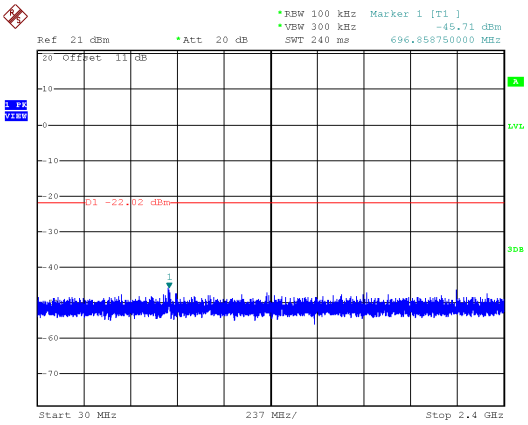


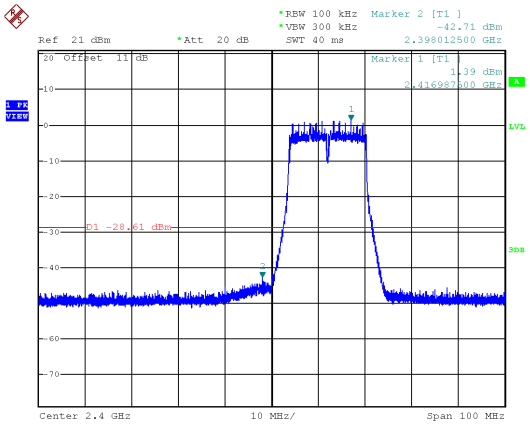
ANT B

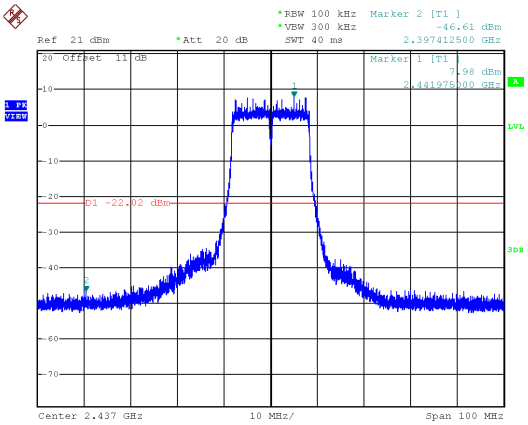
Modulation Type: 802.11g, CH 01

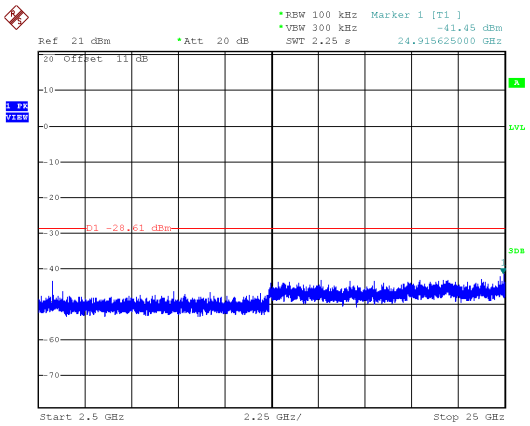


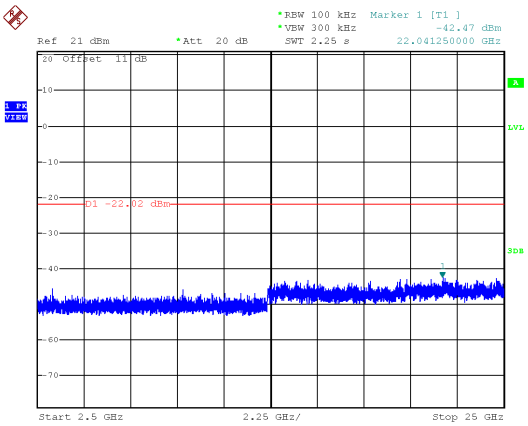
Modulation Type: 802.11g, CH 06



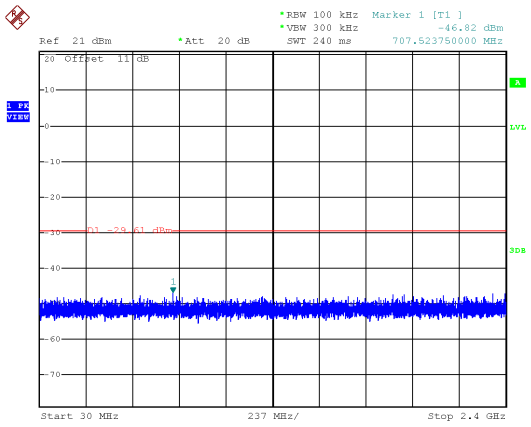


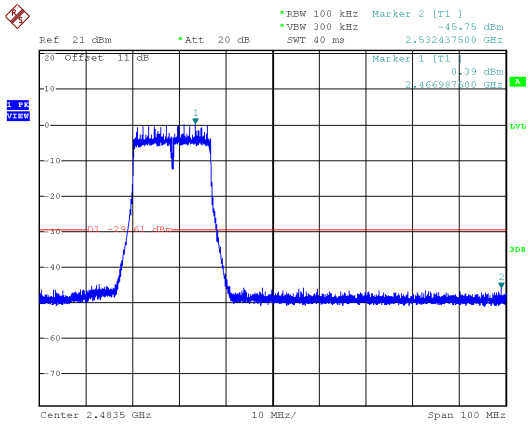


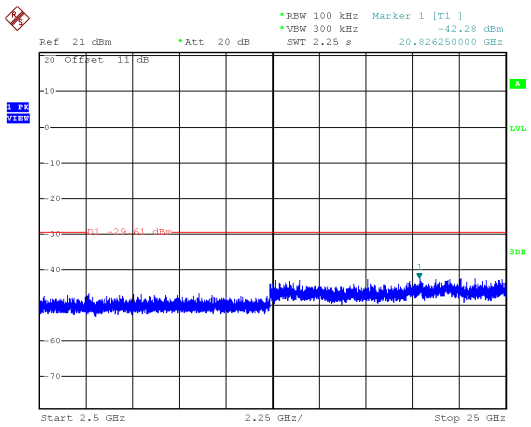




ANT B
Modulation Type: 802.11g, CH 11

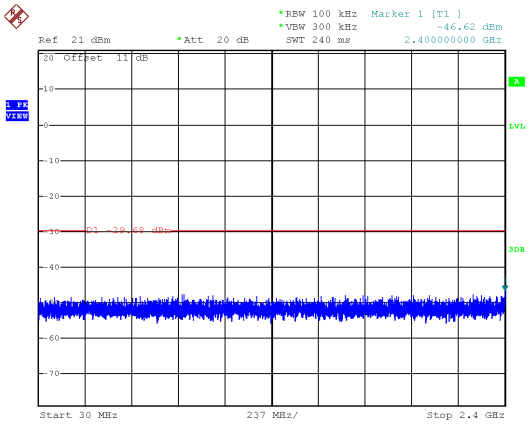




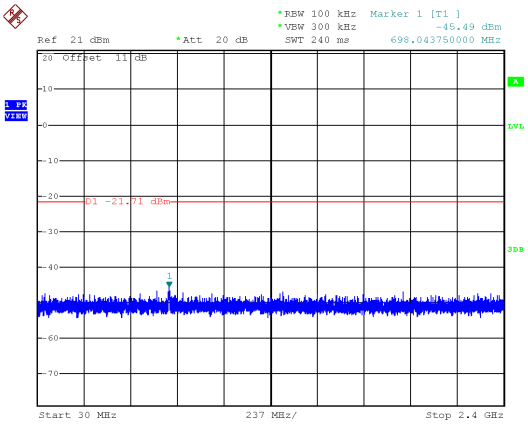


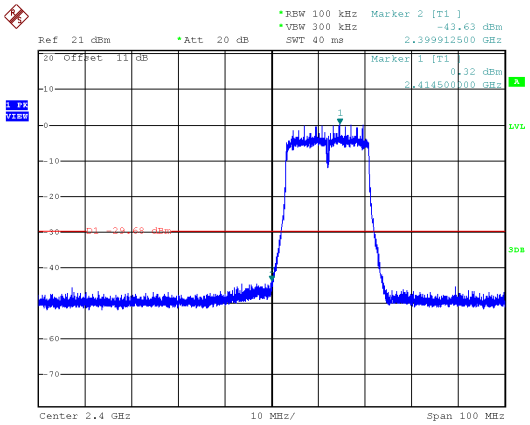
ANT B

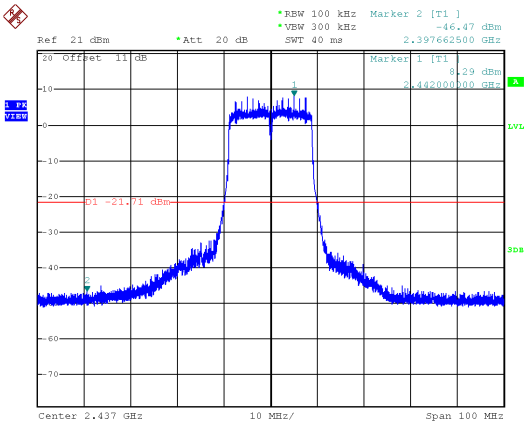
Modulation Type: VHT20, CH01

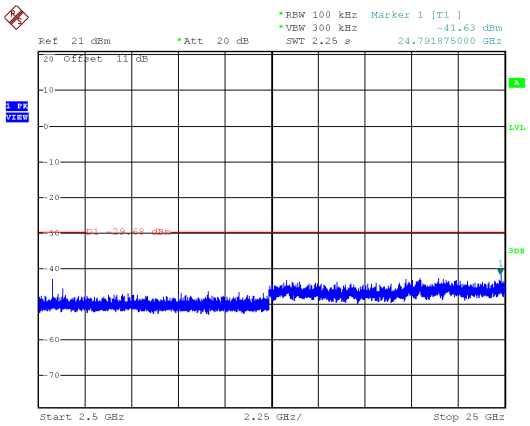


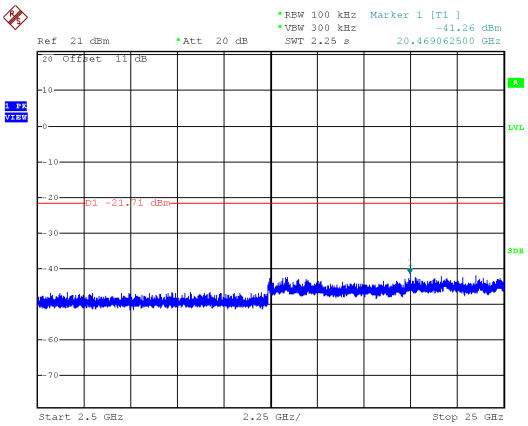
Modulation Type: VHT20, CH06



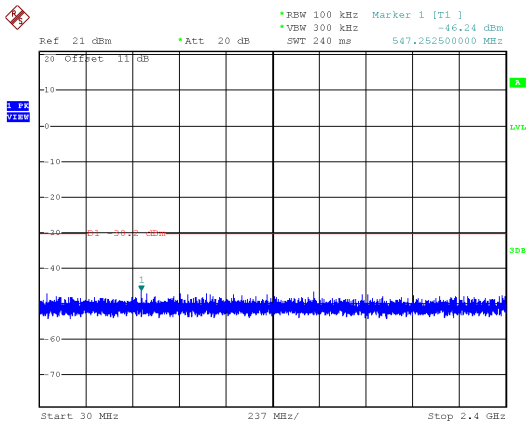


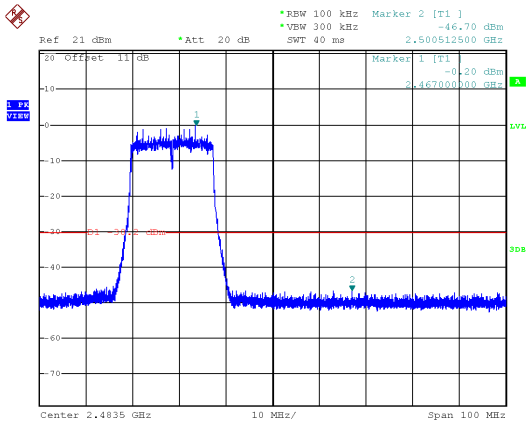


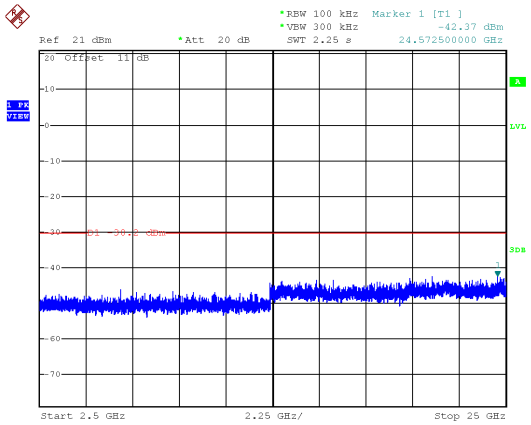




ANT B
Modulation Type: VHT20, CH11

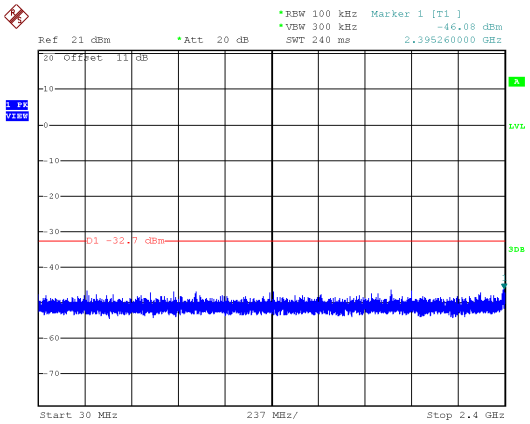




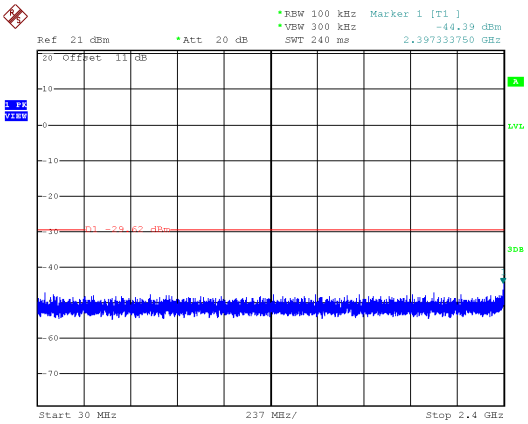


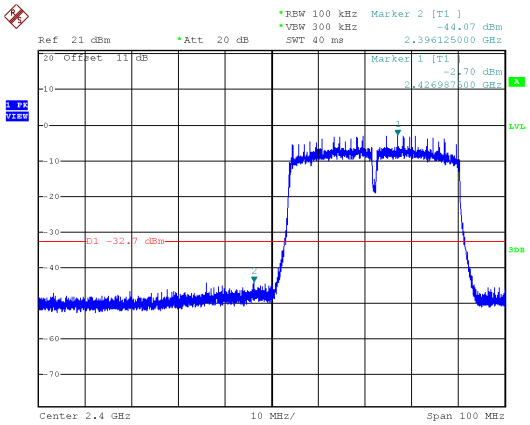
ANT B

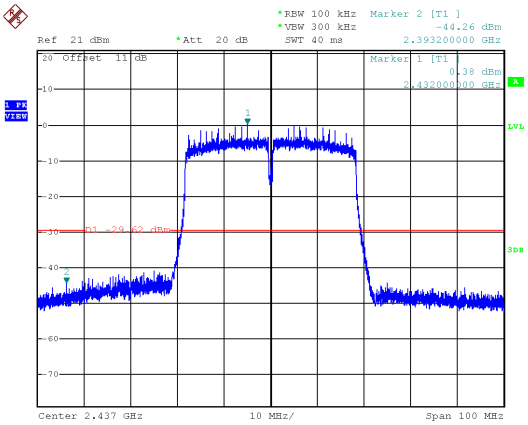
Modulation Type: VHT40, CH03

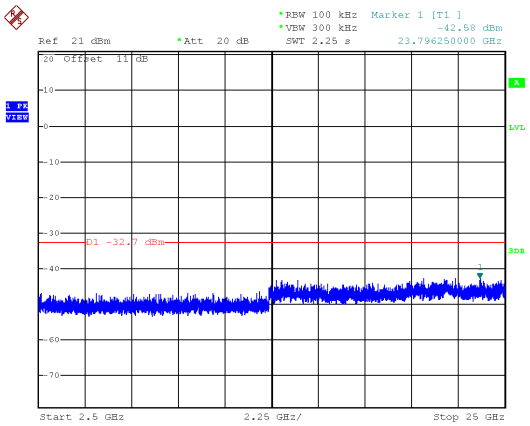


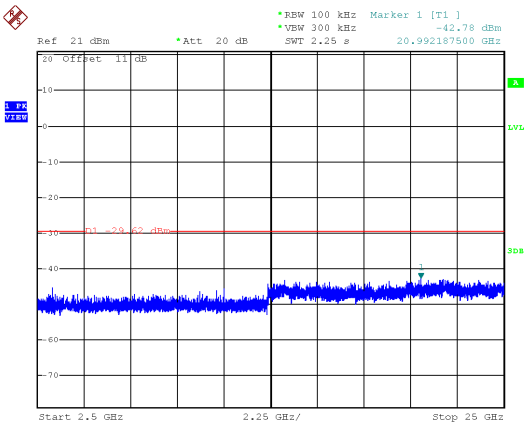
Modulation Type: VHT40, CH06



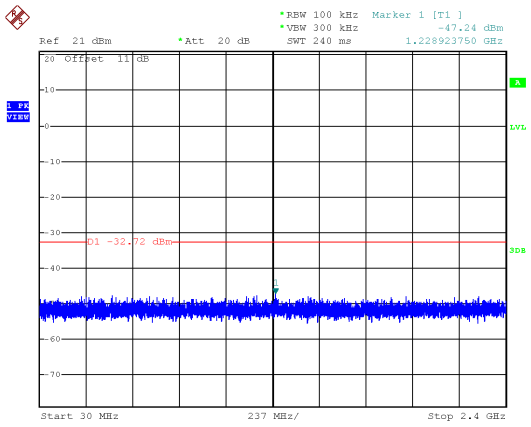


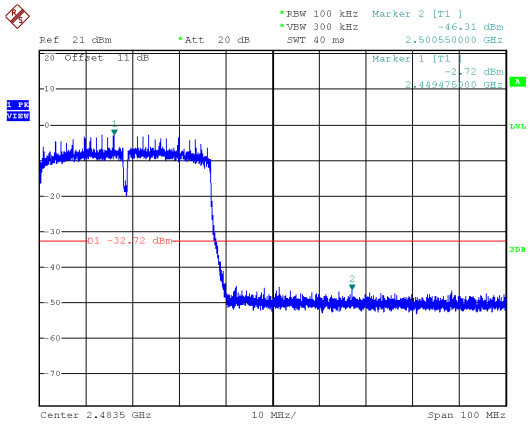


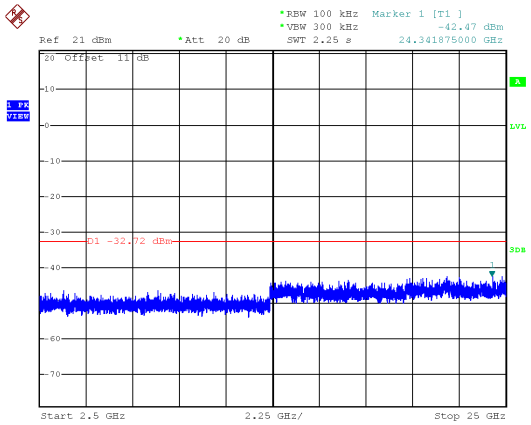




ANT B
Modulation Type: VHT40, CH09







8. On Time, Duty Cycle and Measurement methods

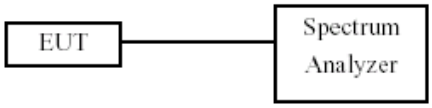
8.1 Test Limit

None; for reporting purposes only.

8.2 Test Procedure

KDB 558074 Zero-Span Spectrum Analyzer Method.

8.3 Test Setup Layout



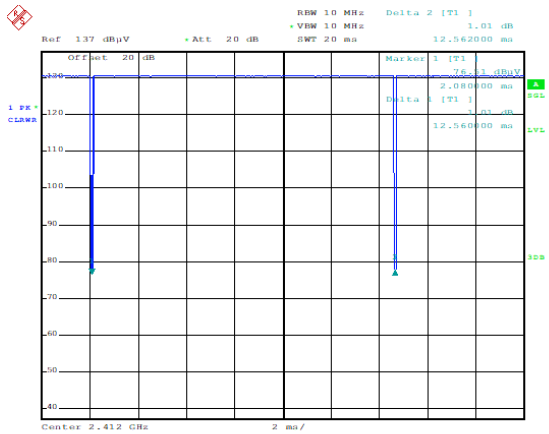
8.4 Test Result and Data

Temperature : 23°C Humidity : 64%

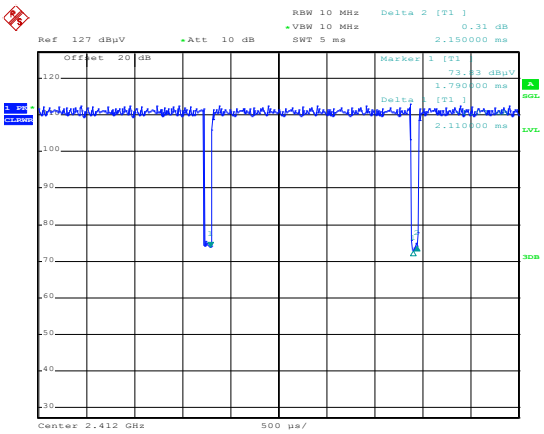
Test Date : Jan. 23, 2019 :

Modulation Type	On Time (msec)	Period Time (msec)	Duty Cycle (%)
802.11b	12.56	12.56	99.98%
802.11g	2.11	2.15	98.14%
VHT20	5.10	5.14	99.22%
VHT40	2.47	2.52	98.02%

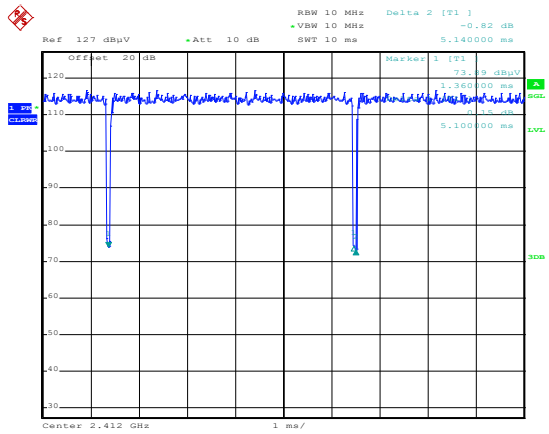
Modulation Standard: 802.11b (1Mbps)



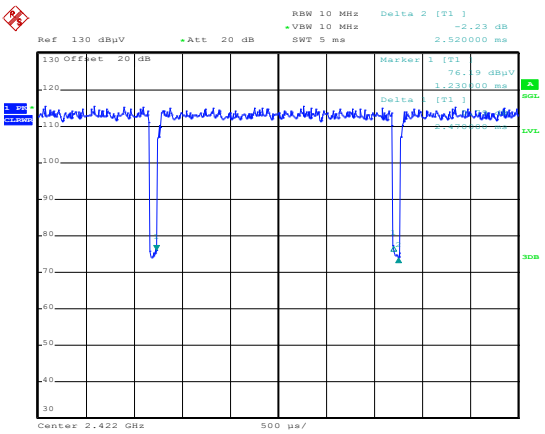
Modulation Standard: 802.11g (6Mbps)



Modulation Standard: VHT20 (6.5Mbps)



Modulation Standard: VHT40 (13.5Mbps)



9. 6dB & 99% Bandwidth Measurement Data

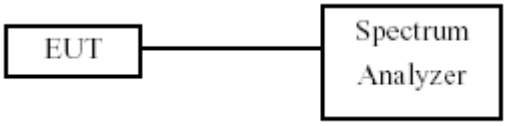
9.1 Test Limit

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

9.2 Test Procedures

a. The transmitter output was connected to the spectrum analyzer.
b. Set RBW of spectrum analyzer to 1~5% of the emission bandwidth and VBW ≥ 3x RBW.
c. The 6 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB.
d. The 6dB Bandwidth was measured and recorded.

9.3 Test Setup Layout



9.4 Test Result and Data (6dB Bandwidth)

Temperature : 23°C Humidity : 64%
Test Date : Jan. 23, 2019 :

Modulation Type	Channel	Frequency (MHz)	6dB Bandwidth (MHz)		Limit (MHz)
			ANT A	ANT B	
IEEE 802.11b (1Mbps)	01	2412	8.00	8.00	0.5
	06	2437	8.10	8.10	0.5
	11	2462	8.10	8.10	0.5
IEEE 802.11g (6Mbps)	01	2412	16.40	16.40	0.5
	06	2437	16.40	16.40	0.5
	11	2462	16.40	16.40	0.5
VHT20 (6.5Mbps)	01	2412	17.60	17.60	0.5
	06	2437	17.60	17.60	0.5
	11	2462	17.60	17.60	0.5
VHT40 (13.5Mbps)	03	2422	35.20	35.20	0.5
	06	2437	35.20	35.20	0.5
	09	2452	35.00	35.20	0.5

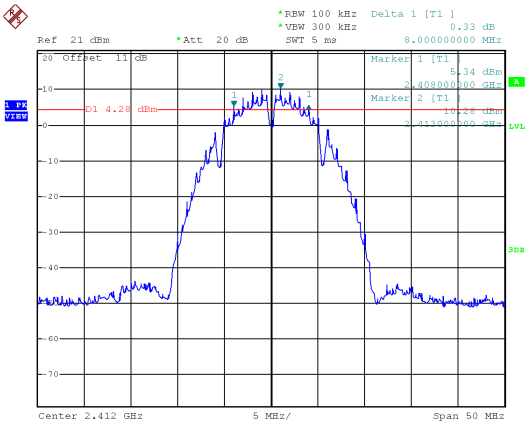
9.5 Test Result and Data (99% Bandwidth)

Temperature : 23°C Humidity : 64%

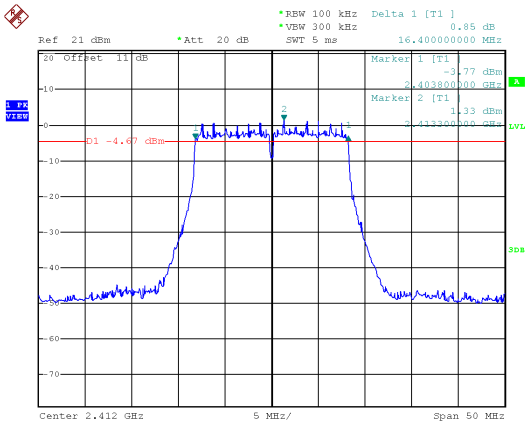
Test Date : Jan. 23, 2019 :

Modulation Type	Channel	Frequency (MHz)	99% Bandwidth (MHz)	
			ANT A	ANT B
IEEE 802.11b (1Mbps)	01	2412	12.80	12.80
	06	2437	12.90	12.90
	11	2462	12.80	12.80
IEEE 802.11g (6Mbps)	01	2412	16.60	16.50
	06	2437	16.50	16.50
	11	2462	16.60	16.50
VHT20 (6.5Mbps)	01	2412	17.70	17.70
	06	2437	17.60	17.60
	11	2462	17.70	17.70
VHT40 (13.5Mbps)	03	2422	36.00	36.00
	06	2437	36.00	36.00
	09	2452	36.00	36.20

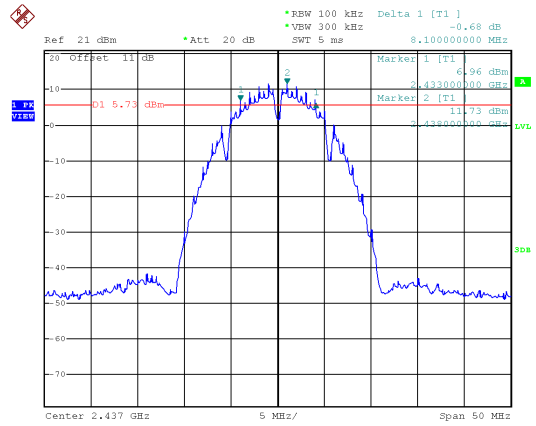
6dB Bandwidth
ANT A
Modulation Type: 802.11b
CH01



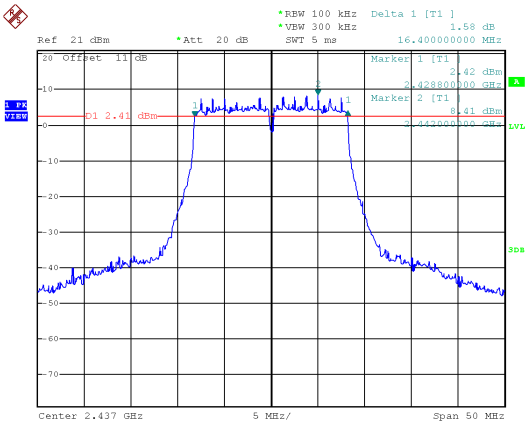
Modulation Type: 802.11g
CH01



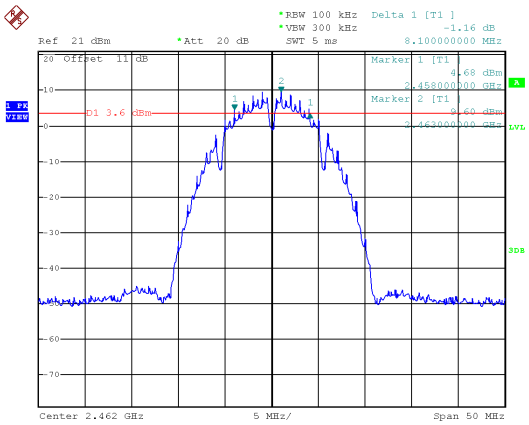
CH06



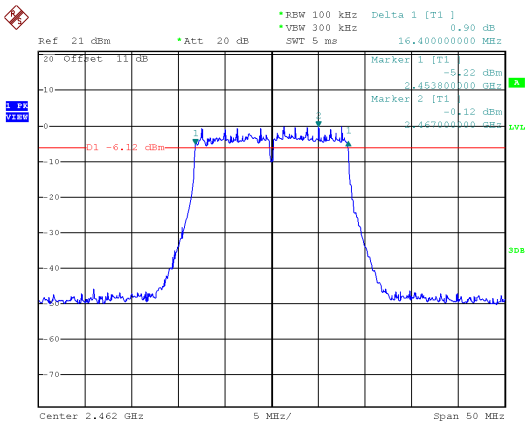
CH06



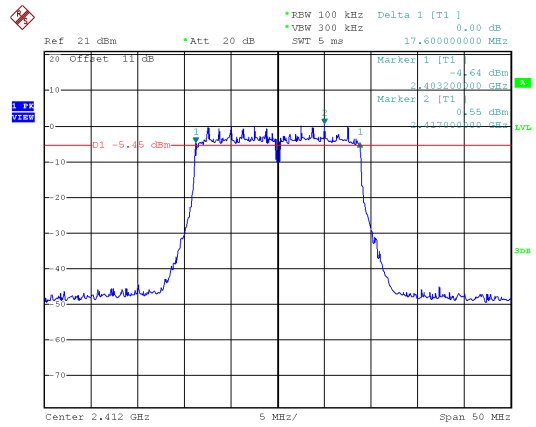
CH11



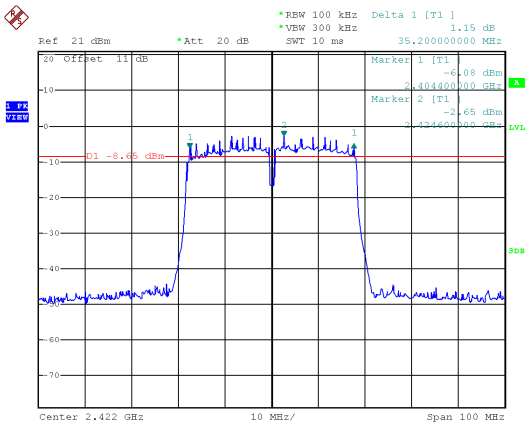
CH11



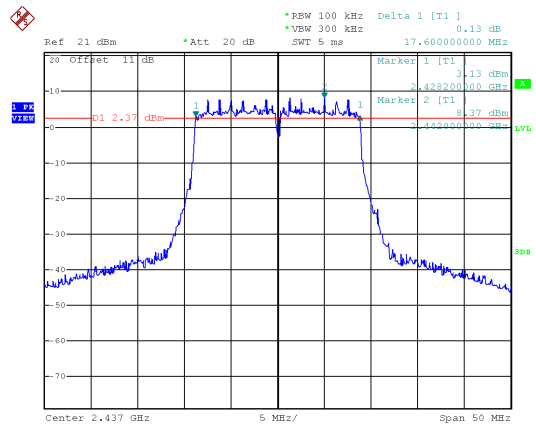
ANT A
Modulation Type: VHT20
CH01



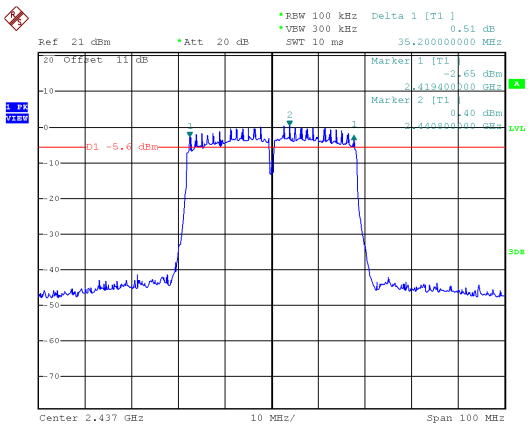
Modulation Type: VHT40
CH03



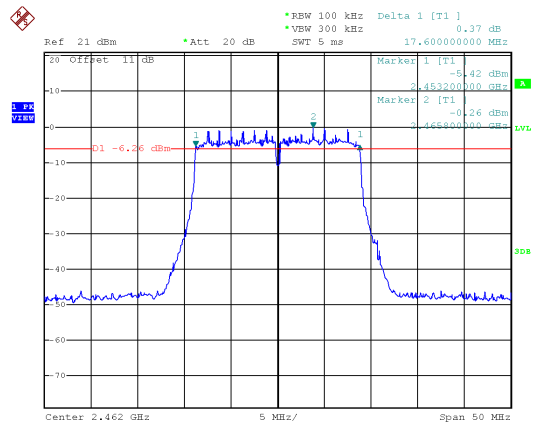
CH06



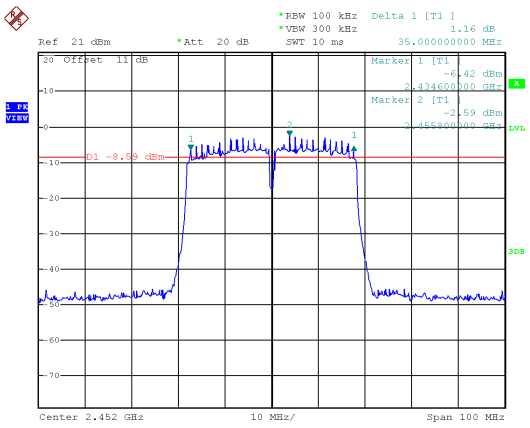
CH06



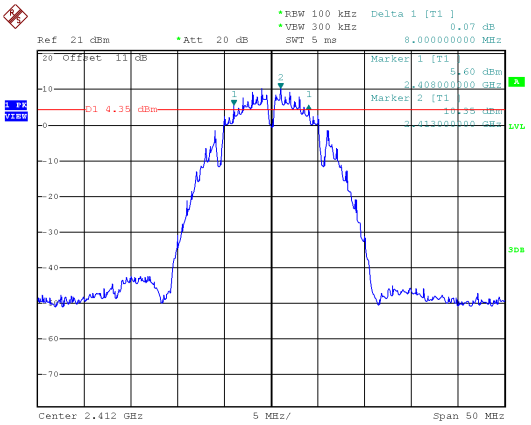
CH11



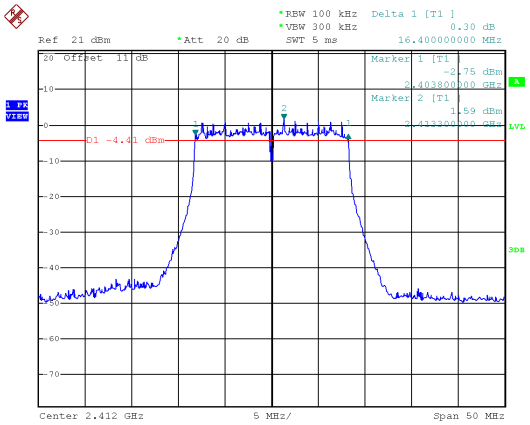
CH09



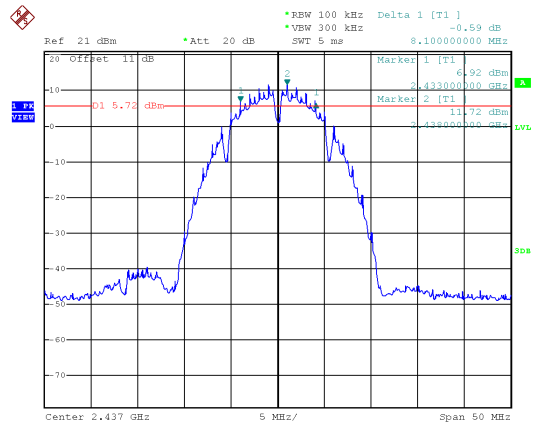
ANT B
Modulation Type: 802.11b
CH01



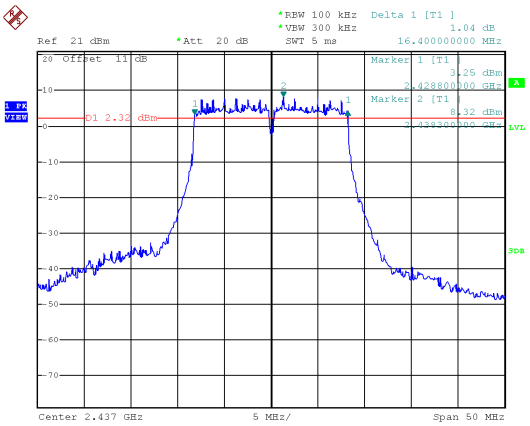
Modulation Type: 802.11g
CH01



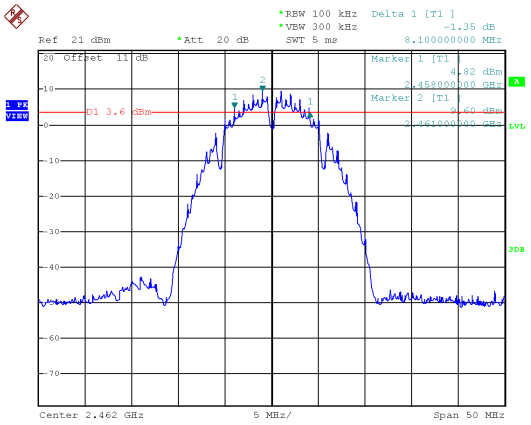
CH06



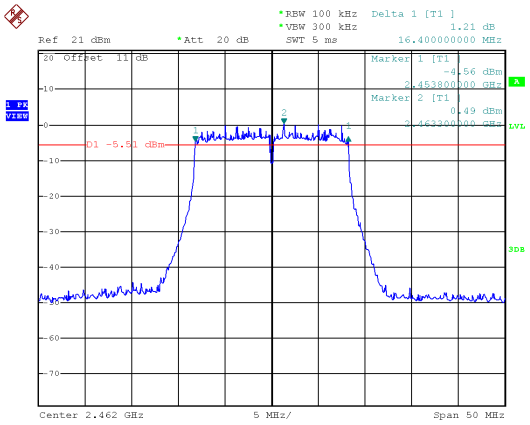
CH06



CH11

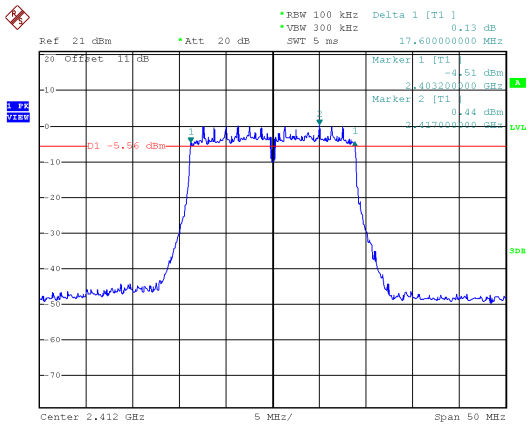


CH11

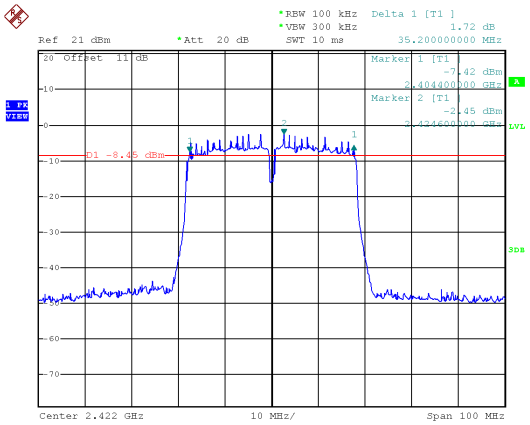


D

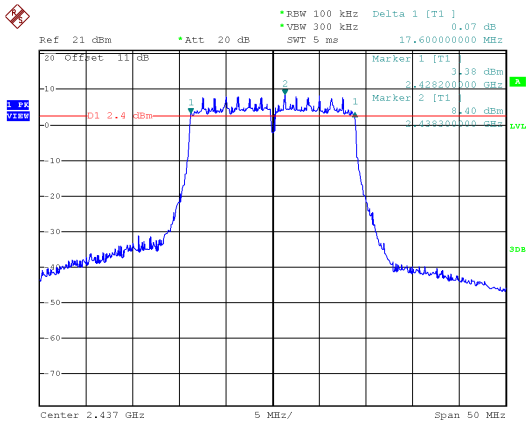
ANT B
Modulation Type: VHT20
CH01



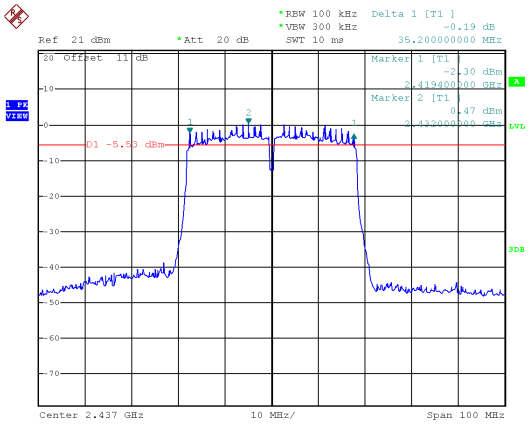
Modulation Type: VHT40
CH03



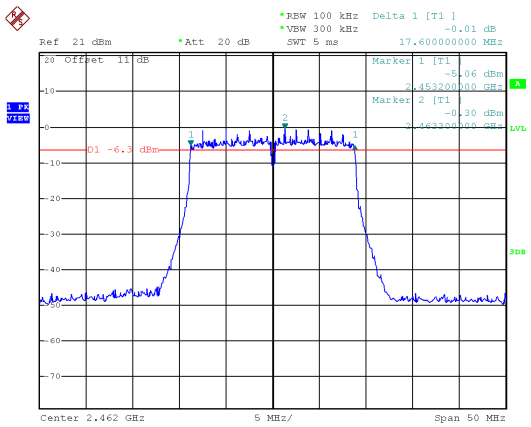
CH06



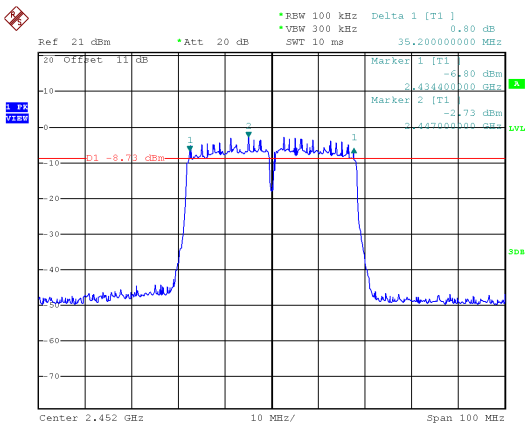
CH06



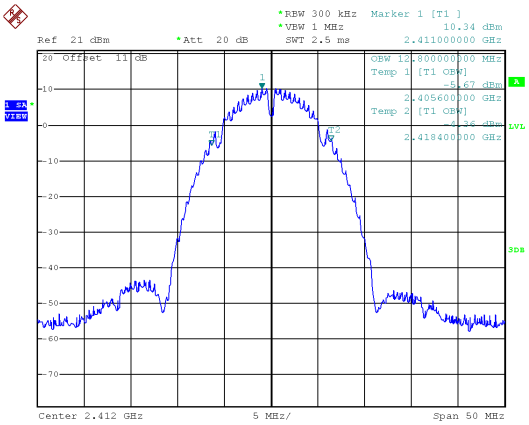
CH11



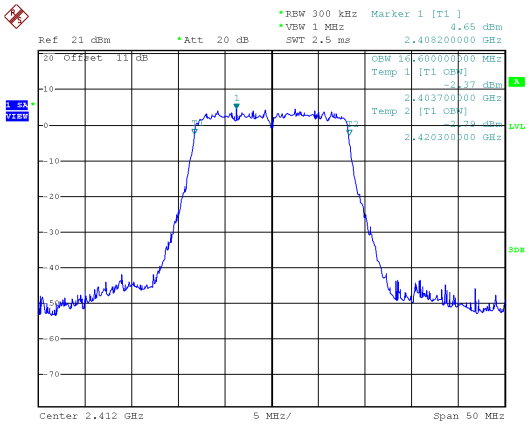
CH09



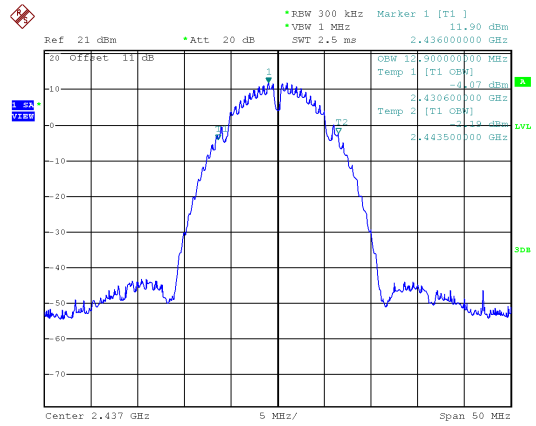
99% Bandwidth
ANT A
Modulation Type: 802.11b
CH01



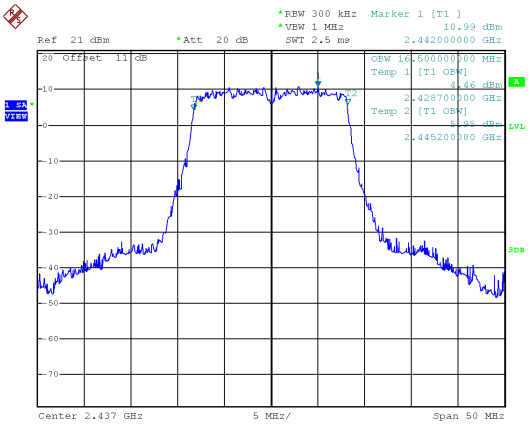
Modulation Type: 802.11g
CH01



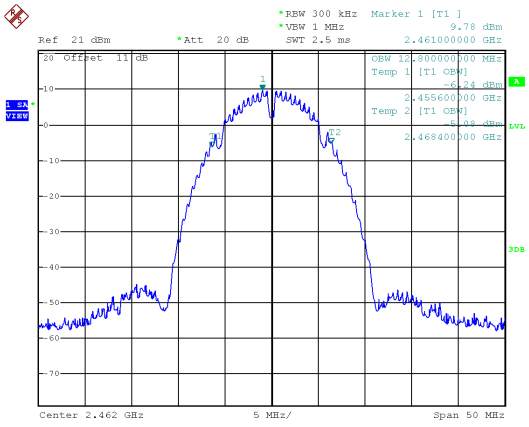
CH06



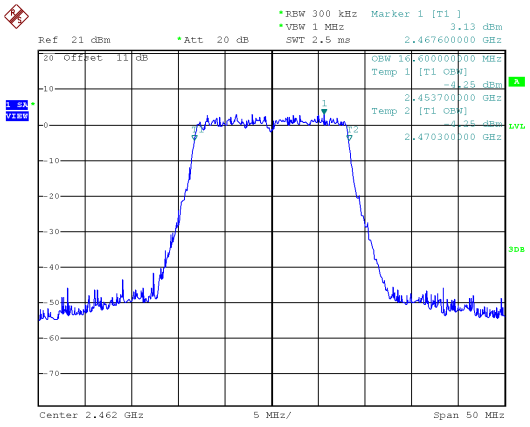
CH06



CH11



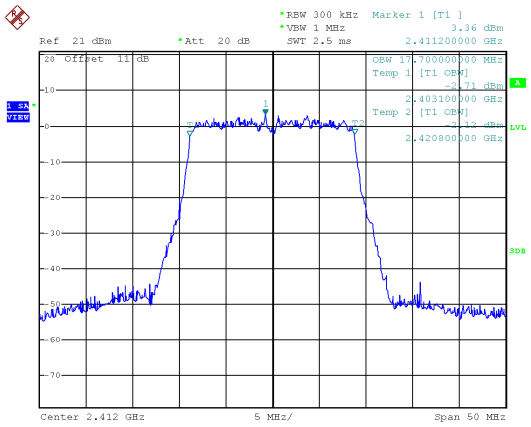
CH11



ANT A

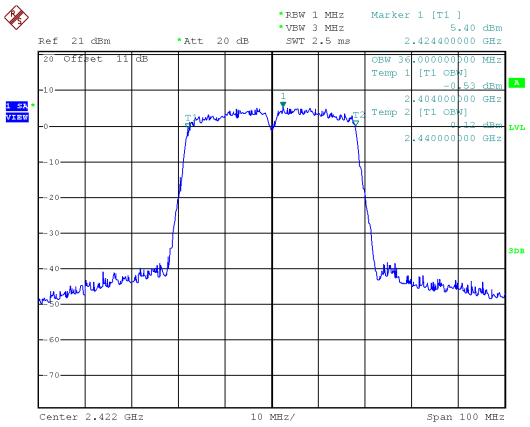
Modulation Type: VHT20

CH01

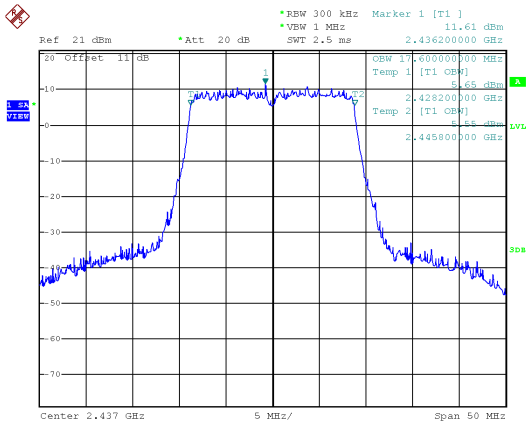


Modulation Type: VHT40

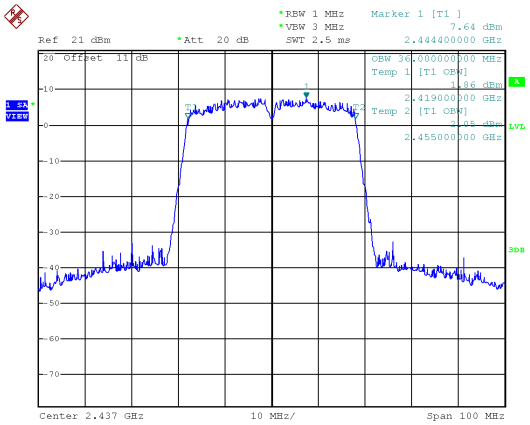
CH03



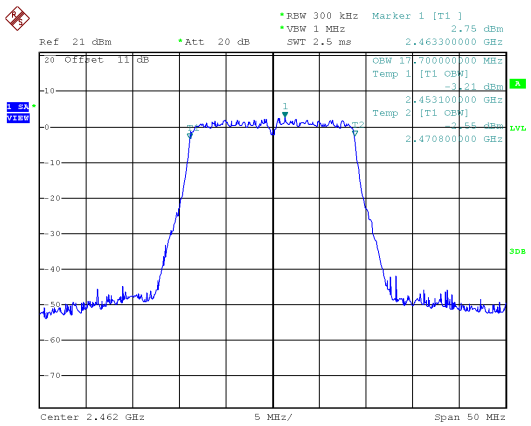
CH06



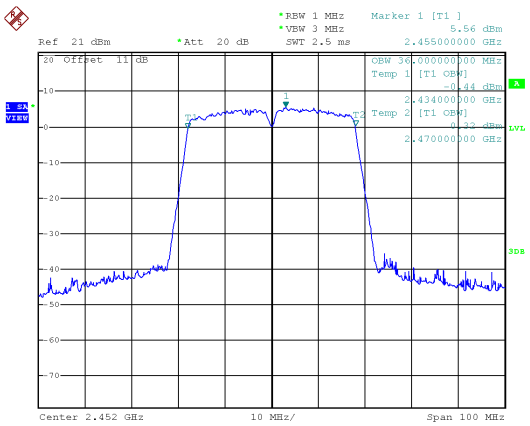
CH06



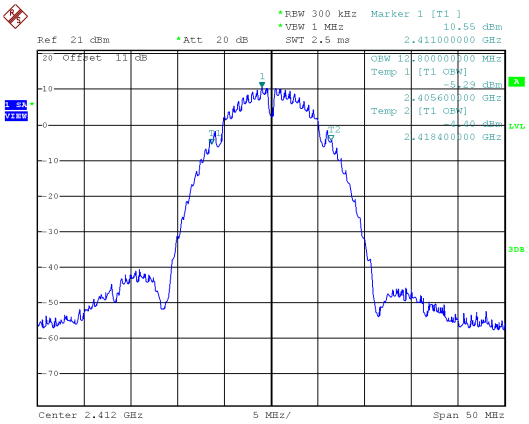
CH11



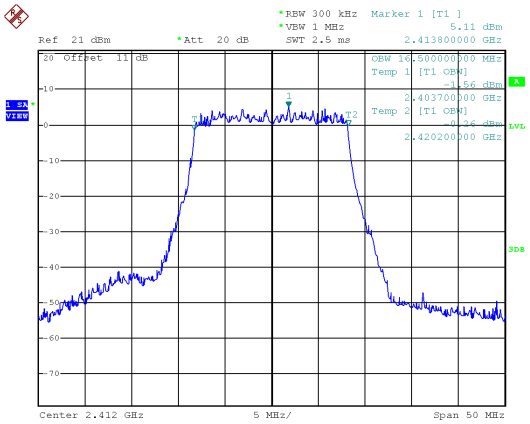
CH09



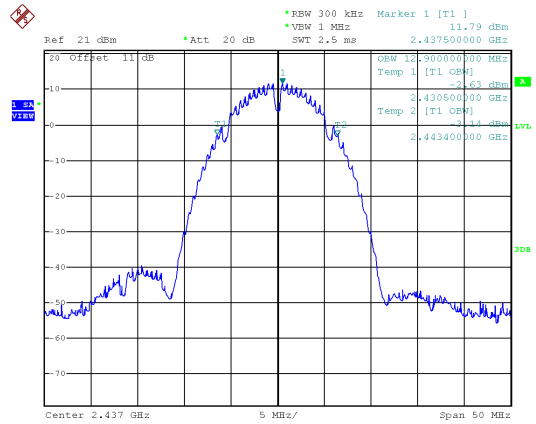
ANT B
Modulation Type: 802.11b
CH01



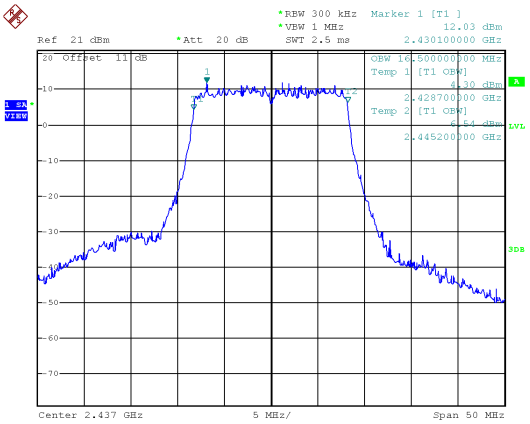
Modulation Type: 802.11g
CH01



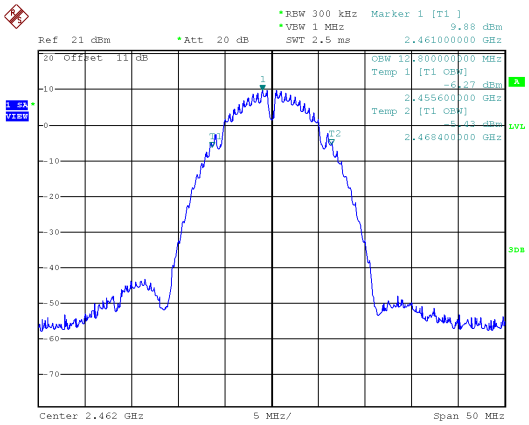
CH06



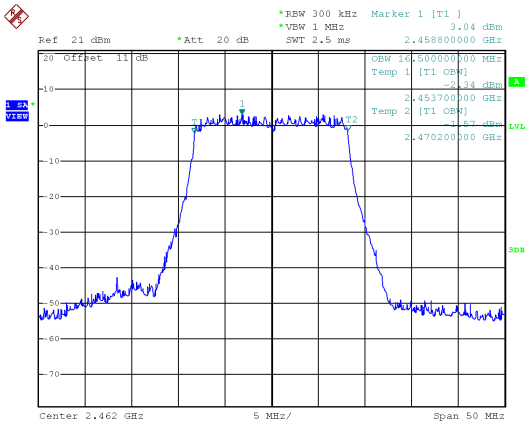
CH06



CH11



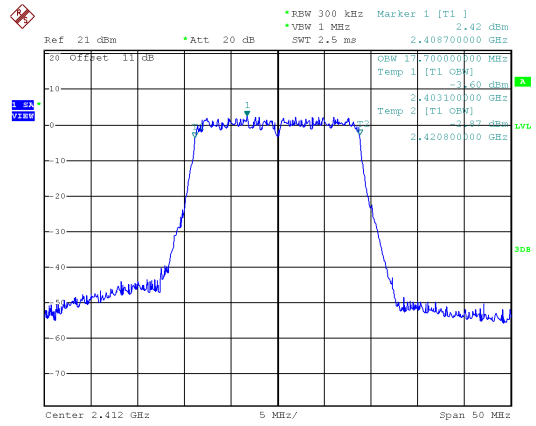
CH11



ANT B

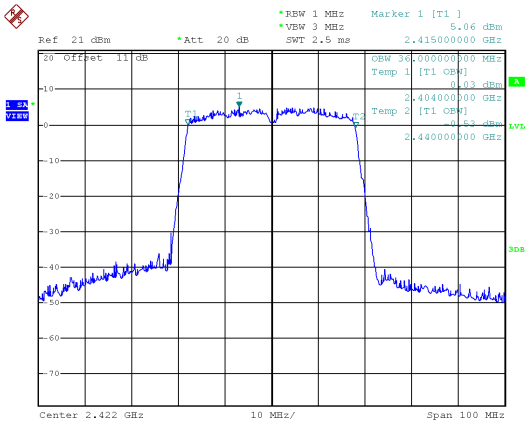
Modulation Type: VHT20

CH01

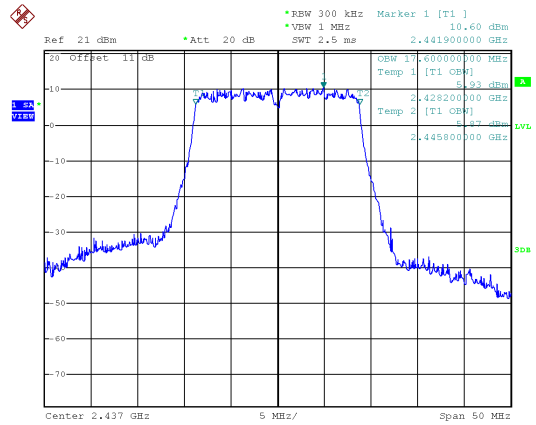


Modulation Type: VHT40

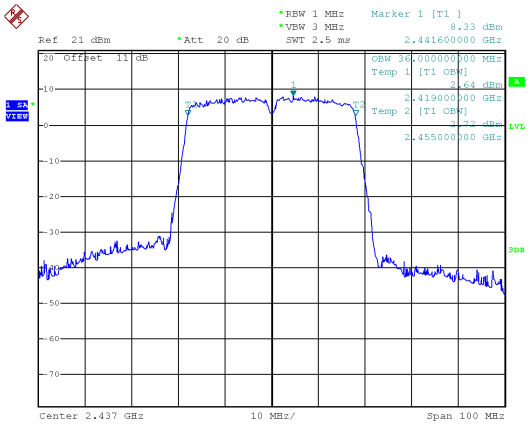
CH03



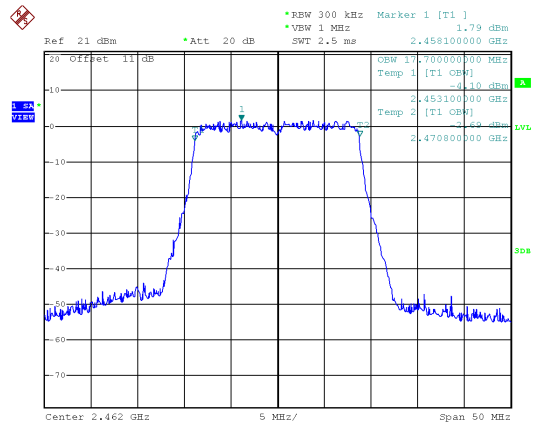
CH06



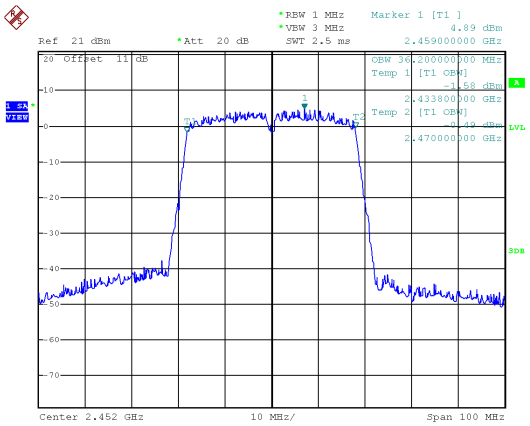
CH06



CH11



CH09



10. Maximum Average Output Power

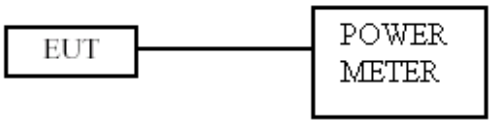
10.1 Test Limit

The Maximum Average Output Power Measurement is 30dBm.
If transmitting antennas of directional gain greater than 6 dBi are used, the average output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi

10.2 Test Procedures

The antenna port (RF output) of the EUT was connected to the input (RF input) of a power meter. Power was read directly from the meter and cable loss connection was added to the reading to obtain power at the EUT antenna terminal. The EUT Output Power was set to maximum to produce the worse case test result.

10.3 Test Setup Layout



10.4 Test Result and Data

Temperature : 23°C Humidity : 64%

Test Date : Jan. 23, 2019 Test Mode : Non-Beamforming

Modulation Type	Channel	Frequency (MHz)	Avg. Power Output (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)
			ANT A	ANT B			
IEEE 802.11b (1Mbps)	01	2412	18.01	18.01	126.482	21.02	30.00
	06	2437	19.62	19.43	179.322	22.54	30.00
	11	2462	17.37	17.23	107.420	20.31	30.00
IEEE 802.11g (6Mbps)	01	2412	12.56	12.58	36.144	15.58	30.00
	06	2437	19.55	19.38	176.853	22.48	30.00
	11	2462	11.39	11.40	27.576	14.41	30.00
IEEE 802.11an HT20 (6.5Mbps)	01	2412	11.54	11.63	28.811	14.60	30.00
	06	2437	19.41	19.37	173.794	22.40	30.00
	11	2462	11.02	10.96	25.121	14.00	30.00
IEEE 802.11an HT40 (13.5Mbps)	03	2422	11.26	11.20	26.549	14.24	30.00
	06	2437	14.03	14.00	50.412	17.03	30.00
	09	2452	11.18	11.01	25.740	14.11	30.00
VHT20 (6.5Mbps)	01	2412	11.56	11.64	28.910	14.61	30.00
	06	2437	19.45	19.41	175.402	22.44	30.00
	11	2462	11.04	10.97	25.208	14.02	30.00
VHT40 (13.5Mbps)	03	2422	11.30	11.21	26.703	14.27	30.00
	06	2437	14.04	14.03	50.644	17.05	30.00
	09	2452	11.20	11.03	25.859	14.13	30.00

Temperature : 23°C Humidity : 64%
Test Date : Jan. 23, 2019 Test Mode : Beamforming

Modulation Type	Channel	Frequency (MHz)	Avg. Power Output (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)
			ANT A	ANT B			
IEEE 802.11g (6Mbps)	01	2412	9.55	9.57	18.073	12.57	27.79
	06	2437	16.54	16.37	88.433	19.47	27.79
	11	2462	8.38	8.39	13.789	11.40	27.79
IEEE 802.11an HT20 (6.5Mbps)	01	2412	8.53	8.62	14.406	11.59	27.79
	06	2437	16.40	16.36	86.903	19.39	27.79
	11	2462	8.01	7.95	12.561	10.99	27.79
IEEE 802.11an HT40 (13.5Mbps)	03	2422	8.25	8.19	13.275	11.23	27.79
	06	2437	11.02	10.99	25.208	14.02	27.79
	09	2452	8.17	8.00	12.871	11.10	27.79
VHT20 (6.5Mbps)	01	2412	8.55	8.63	14.456	11.60	27.79
	06	2437	16.44	16.40	87.707	19.43	27.79
	11	2462	8.03	7.96	12.605	11.01	27.79
VHT40 (13.5Mbps)	03	2422	8.29	8.20	13.352	11.26	27.79
	06	2437	11.03	11.02	25.324	14.04	27.79
	09	2452	8.19	8.02	12.930	11.12	27.79

11. Power Spectral Density

11.1 Test Limit

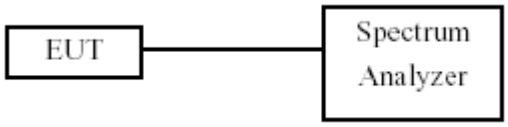
The Maximum of Power Spectral Density Measurement is 8dBm.

If transmitting antennas of directional gain greater than 6 dBi are used, the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi

11.2 Test Procedures

Reference to KDB558074 DTS Meas Guidance v04 D01

11.3 Test Setup Layout



11.4 Test Result and Data

Temperature : 23°C Humidity : 64%

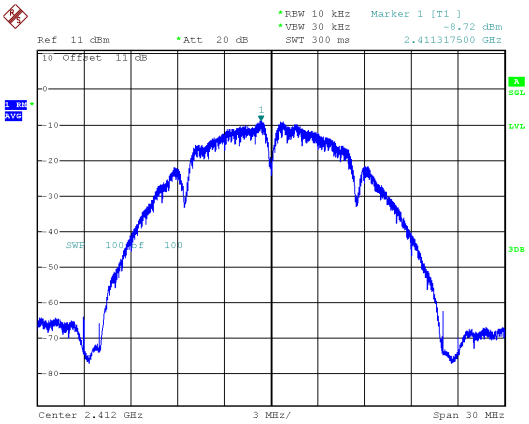
Test Date : Jan. 23, 2019 :

Modulation Type	Channel	Frequency (MHz)	Maximum Power Density of 10 kHz Bandwidth (dBm)		Sum chain (dBm)	Duty Cycle CF(dB)	Total PSD (dBm)	Limit (dBm)
			ANT A	ANT B				
IEEE 802.11b (1Mbps)	01	2412	-8.72	-8.36	-5.53	0.00	-5.53	5.79
	06	2437	-7.14	-7.11	-4.11	0.00	-4.11	5.79
	11	2462	-9.29	-9.26	-6.26	0.00	-6.26	5.79
IEEE 802.11g (6Mbps)	01	2412	-16.66	-17.17	-13.90	0.00	-13.90	5.79
	06	2437	-10.39	-10.68	-7.52	0.00	-7.52	5.79
	11	2462	-18.45	-18.57	-15.50	0.00	-15.50	5.79
VHT20 (6.5Mbps)	01	2412	-17.93	-17.74	-14.82	0.00	-14.82	5.79
	06	2437	-10.03	-10.06	-7.03	0.00	-7.03	5.79
	11	2462	-18.57	-18.56	-15.55	0.00	-15.55	5.79
VHT40 (6.5Mbps)	03	2422	-21.31	-21.1	-18.19	0.00	-18.19	5.79
	06	2437	-17.95	-18.46	-15.19	0.00	-15.19	5.79
	09	2452	-21.43	-21.15	-18.28	0.00	-18.28	5.79

ANT A

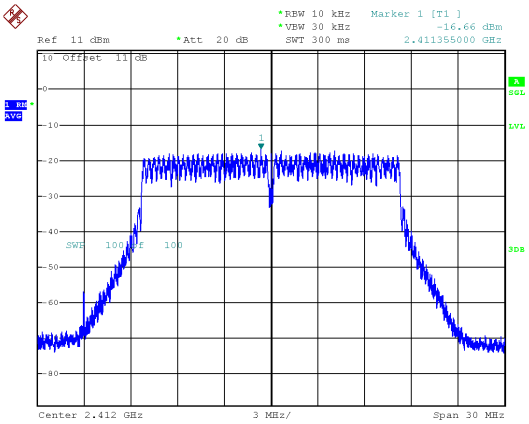
Modulation Type: 802.11b

CH01

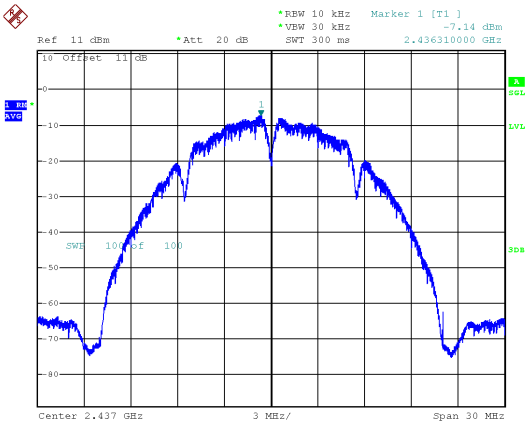


Modulation Type: 802.11g

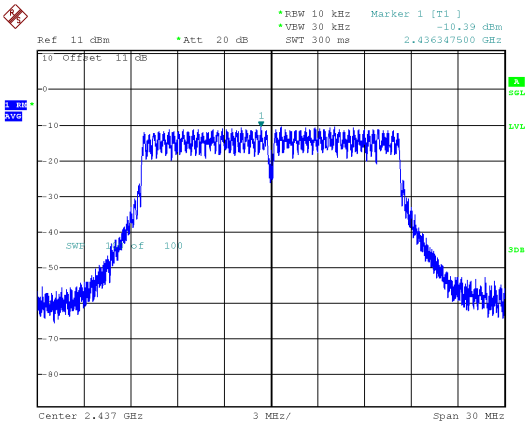
CH01



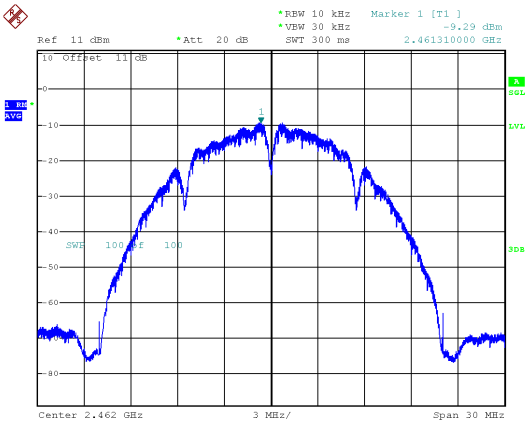
CH06



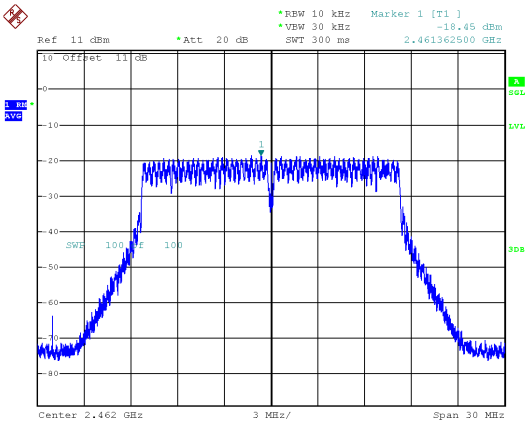
CH06



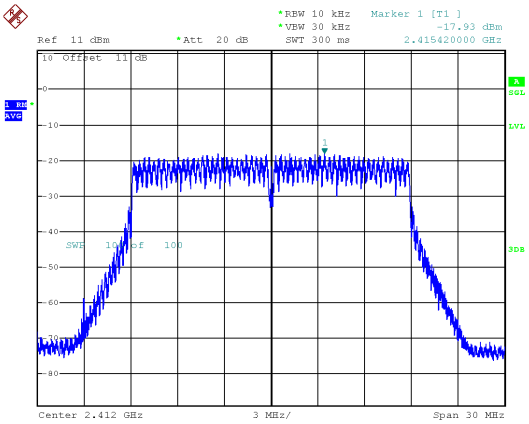
CH11



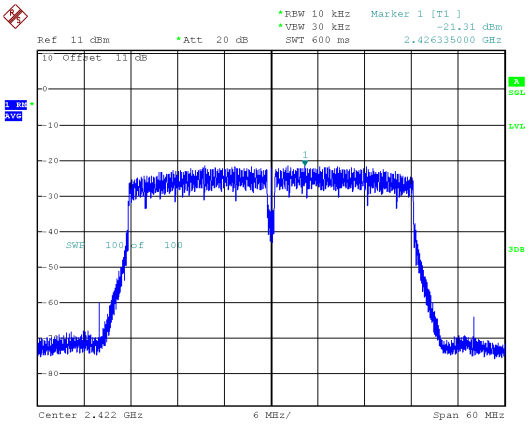
CH11



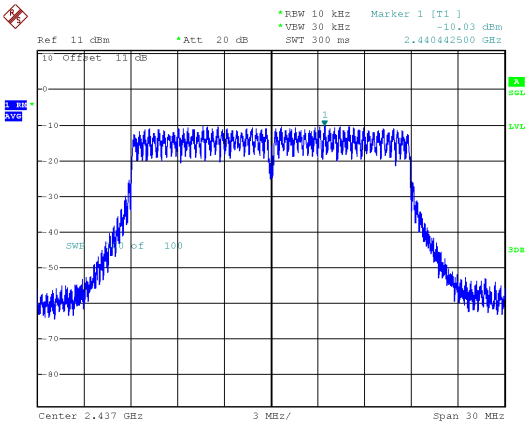
ANT A
Modulation Type: VHT20
CH01



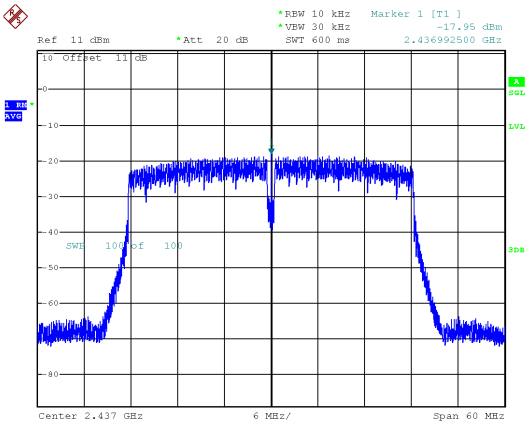
Modulation Type: VHT40
CH03



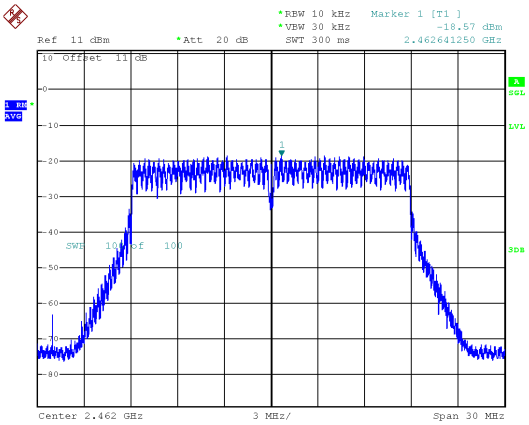
CH06



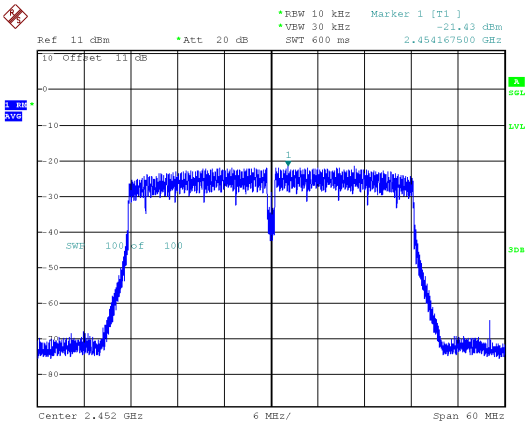
CH06



CH11



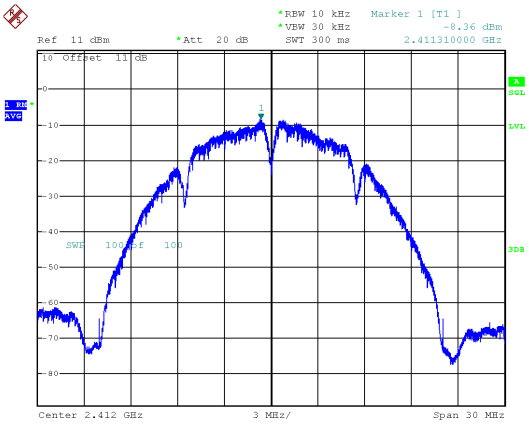
CH09



ANT B

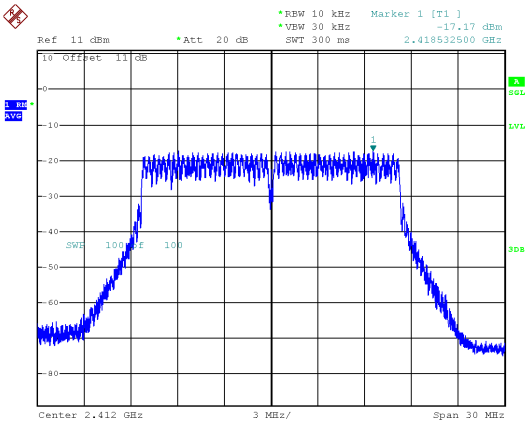
Modulation Type: 802.11b

CH01

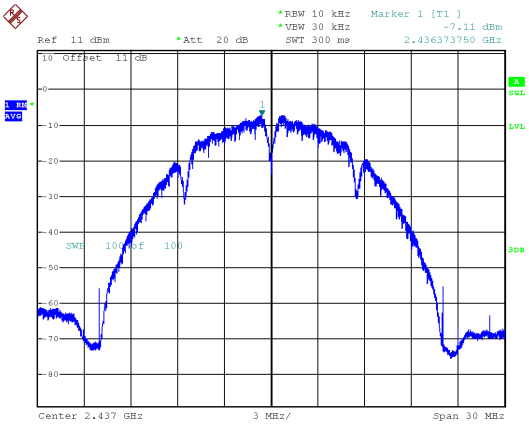


Modulation Type: 802.11g

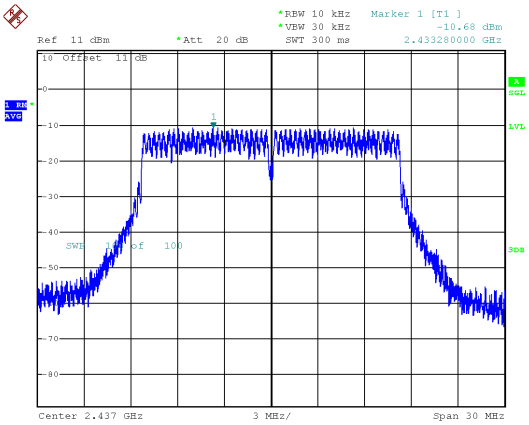
CH01



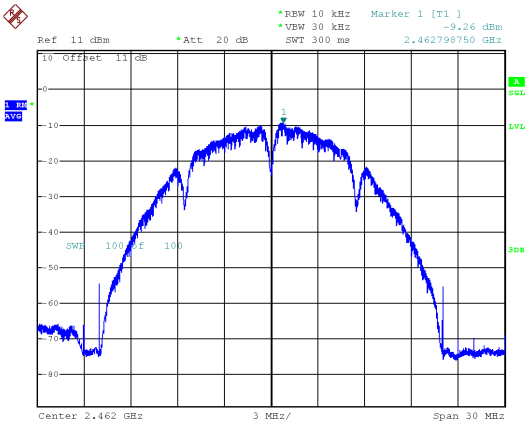
CH06



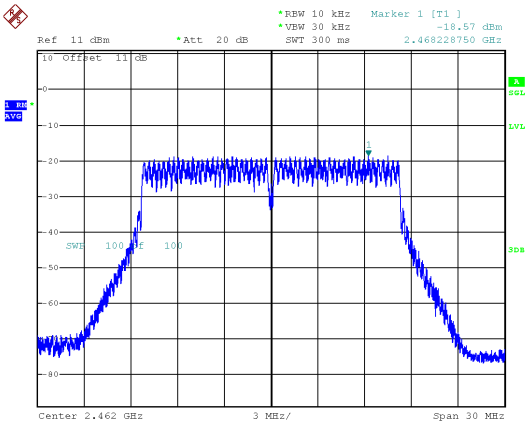
CH06



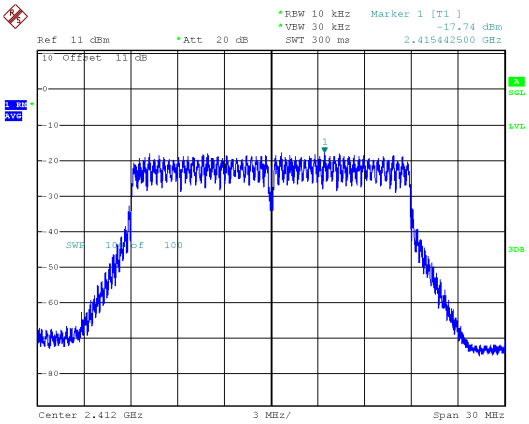
CH11



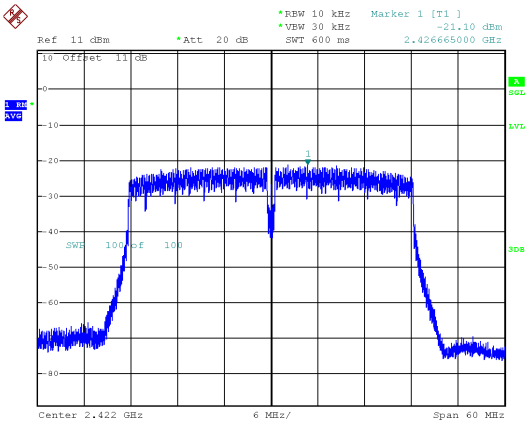
CH11



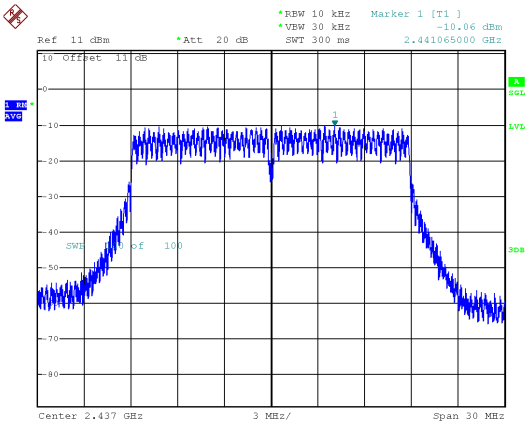
ANT B
Modulation Type: VHT20
CH01



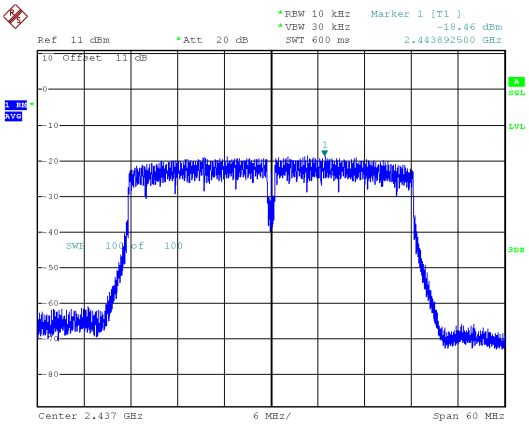
Modulation Type: VHT40
CH03



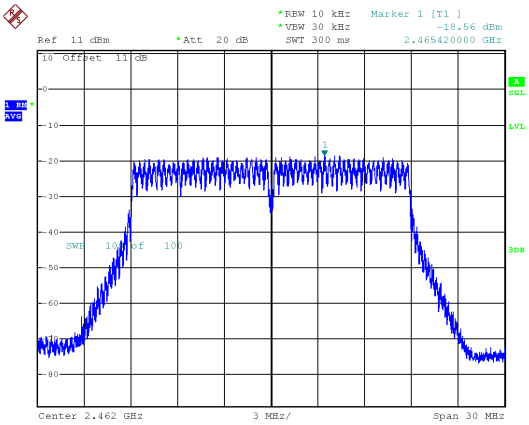
CH06



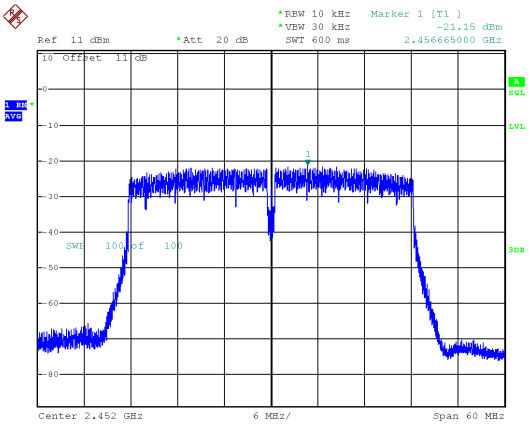
CH06



CH11



CH09



12. Radio Frequency Exposure

12.1 Applicable Standards

The measurements shown in this test report were made in accordance with the procedures given in FCC Part 2 (Section 2.1091)

KDB 447498

12.2 EUT Specification

Frequency band (Operating)	☒ WLAN: 2412MHz ~ 2462MHz ☒ WLAN: 5150MHz ~ 5250MHz ☐ WLAN: 5250MHz ~ 5350MHz ☐ WLAN: 5470MHz ~ 5725MHz ☒ WLAN: 5725MHz ~ 5850MHz ☐ Bluetooth: 2402MHz ~ 2480MHz
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation)
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm^2) ☒ General Population/Uncontrolled exposure (S=1mW/cm^2)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A
Remark: *1. The maximum output power is 22.54dBm at 2437MHz (with 5.2 antenna gain.)* *2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.* *3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 0.118 mW/cm^2 even if the calculation indicates that the power density would be larger.*	

12.3 Test Results

No non-compliance noted.

12.4 Calculation

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$

Where *E = Field strength in Volts / meter*

P = Power in Watts
G = Numeric antenna gain

d = Distance in meters

S = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and
d (cm) = d(m) / 100

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$ ***Equation 1***

Where *d = Distance in cm*
P = Power in mW
G = Numeric antenna gain
S = Power density in mW / cm²

12.5 Maximum Permissible Exposure

Maximum Permissible Exposure (Non-Beamforming)

Channel Frequency (MHz)	Max. Conducted output power(dBm)	Antenna Gain(dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2412-2462	22.54	5.2	20	0.118	1

Maximum Permissible Exposure (Beamforming)

Channel Frequency (MHz)	Max. Conducted output power(dBm)	Antenna Gain(dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
2412-2462	19.47	8.21	20	0.117	1

Maximum Permissible Exposure (Co-location)

(Non-Beamforming)

Modulation Mode	Channel Frequency (MHz)	Max. Conducted output power (dBm)	Antenna Gain(dBi)	Distance (cm)	Power Density (mW/cm2)
802.11b	2412-2462	22.54	5.2	20	0.118
802.11a	5180-5240	23	6.91	20	0.195
802.11a	5745-5825	22.67	7.08	20	0.188
Co-location Total					0.501
Maximum Permissible Exposure Limit					1

(Beamforming)

Modulation Mode	Channel Frequency (MHz)	Max. Conducted output power (dBm)	Antenna Gain(dBi)	Distance (cm)	Power Density (mW/cm^2)
802.11g	2412-2462	19.47	8.21	20	0.117
802.11a	5180-5240	19.99	9.92	20	0.195
802.11a	5500-5700	19.66	10.09	20	0.188
Co-location Total					0.500
Maximum Permissible Exposure Limit					1