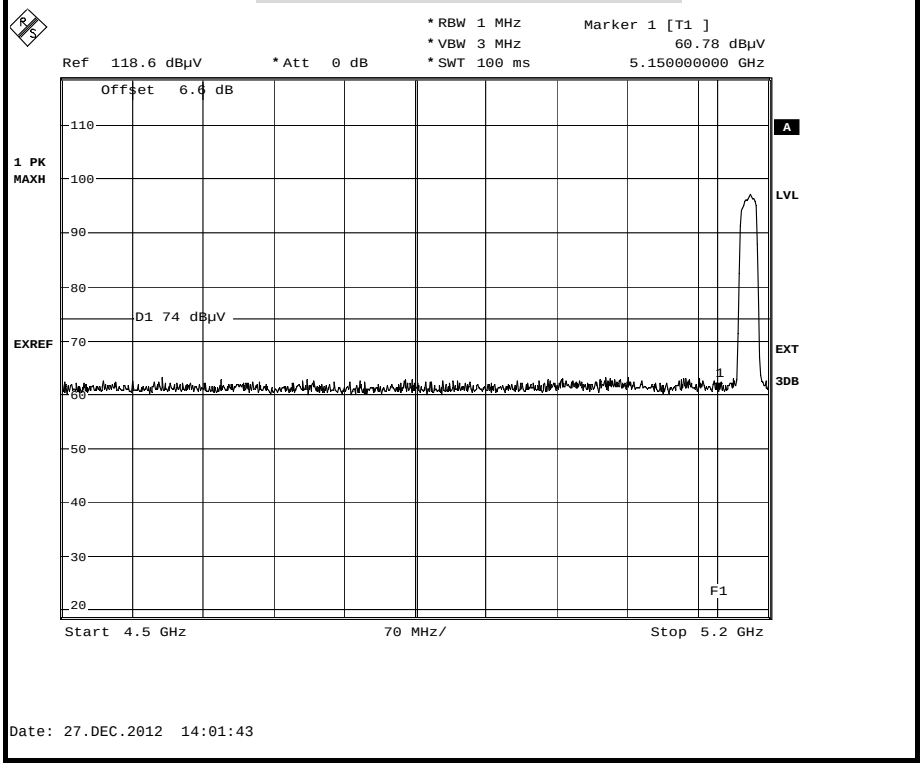
Restricted Band Edges

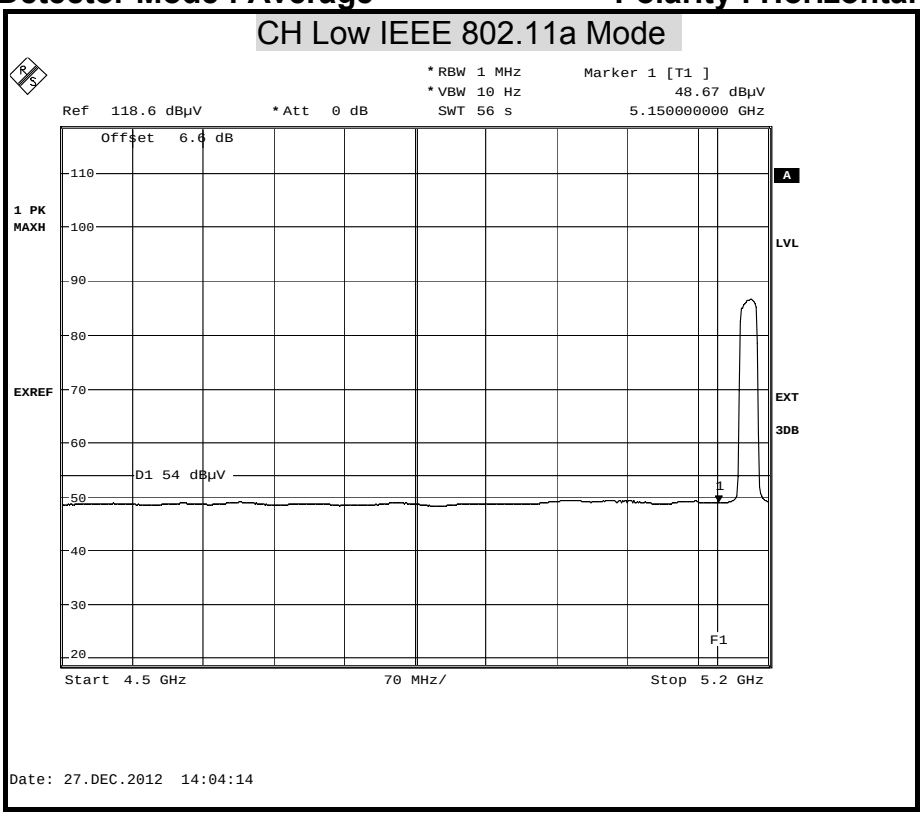
Detector Mode : Peak **Polarity : Horizontal**

CH Low IEEE 802.11a Mode



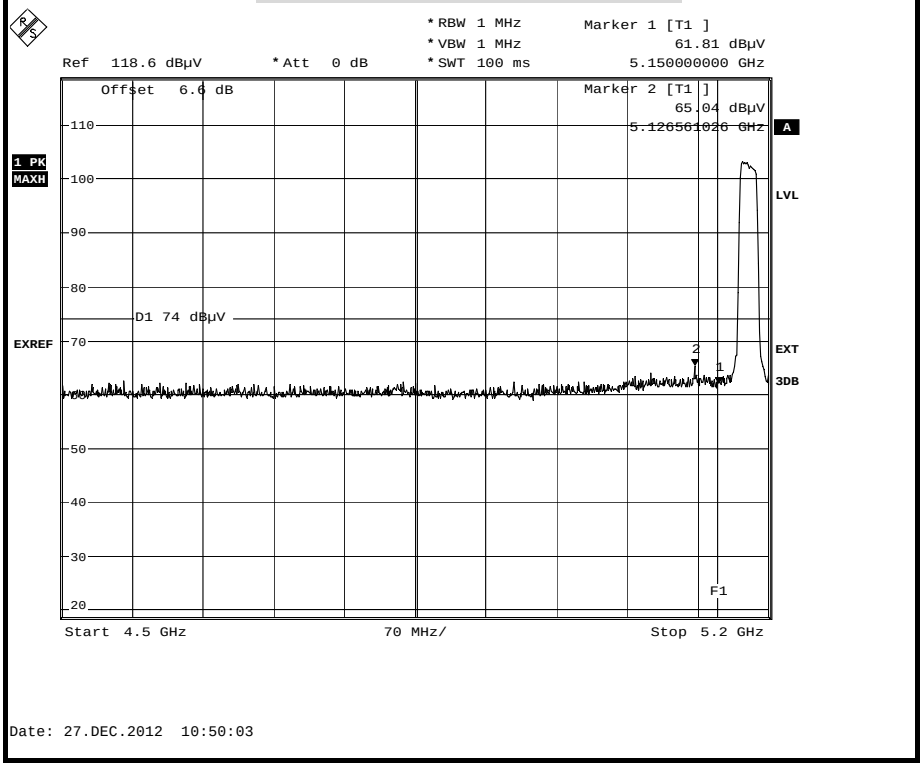
Detector Mode : Average **Polarity : Horizontal**

CH Low IEEE 802.11a Mode



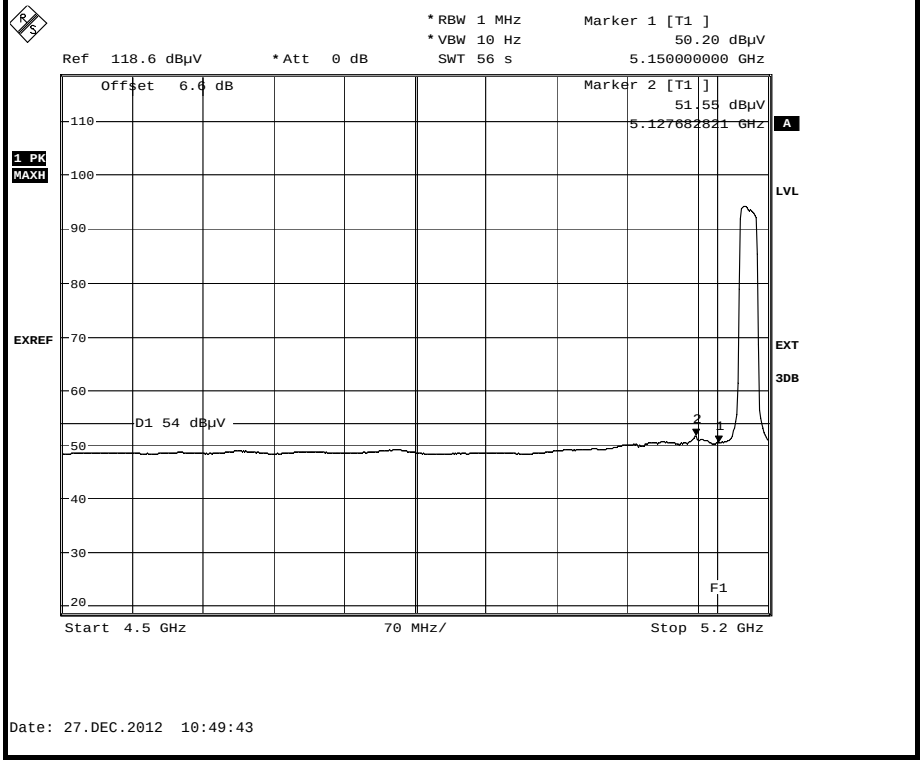
Detector Mode : Peak **Polarity : Vertical**

CH Low IEEE 802.11a Mode



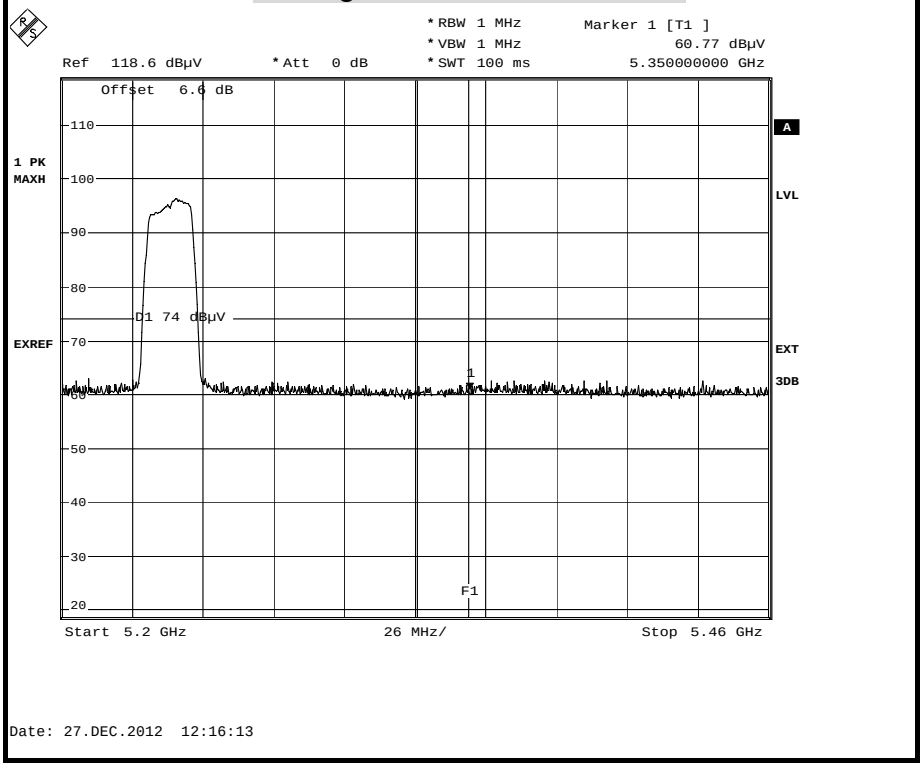
Detector Mode : Average **Polarity : Vertical**

CH Low IEEE 802.11a Mode



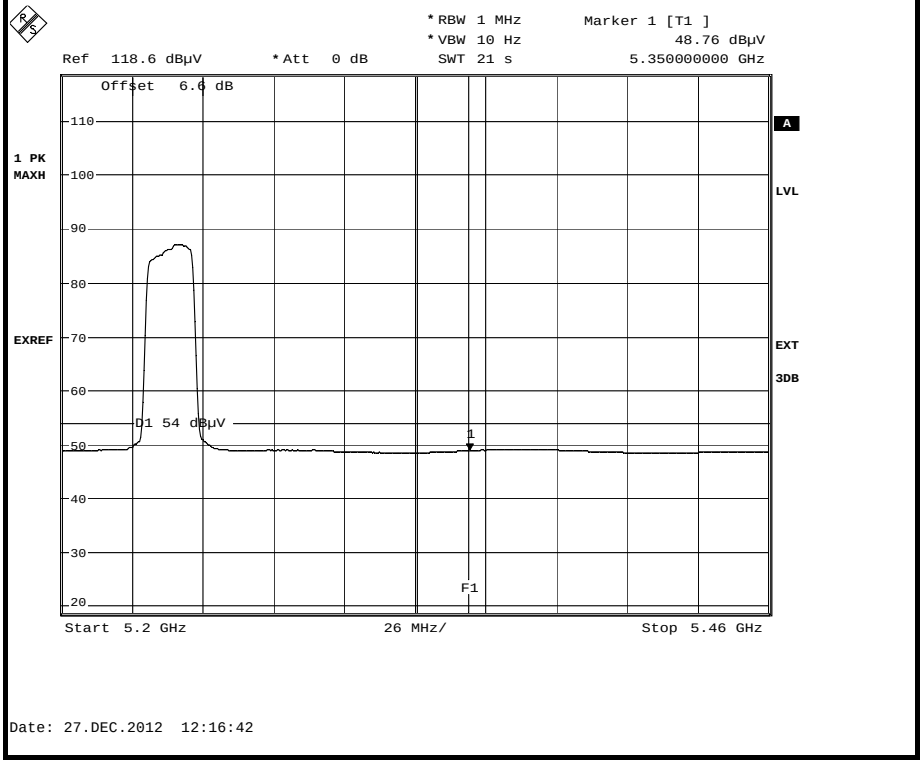
Detector Mode : Peak **Polarity : Horizontal**

CH High IEEE 802.11a Mode



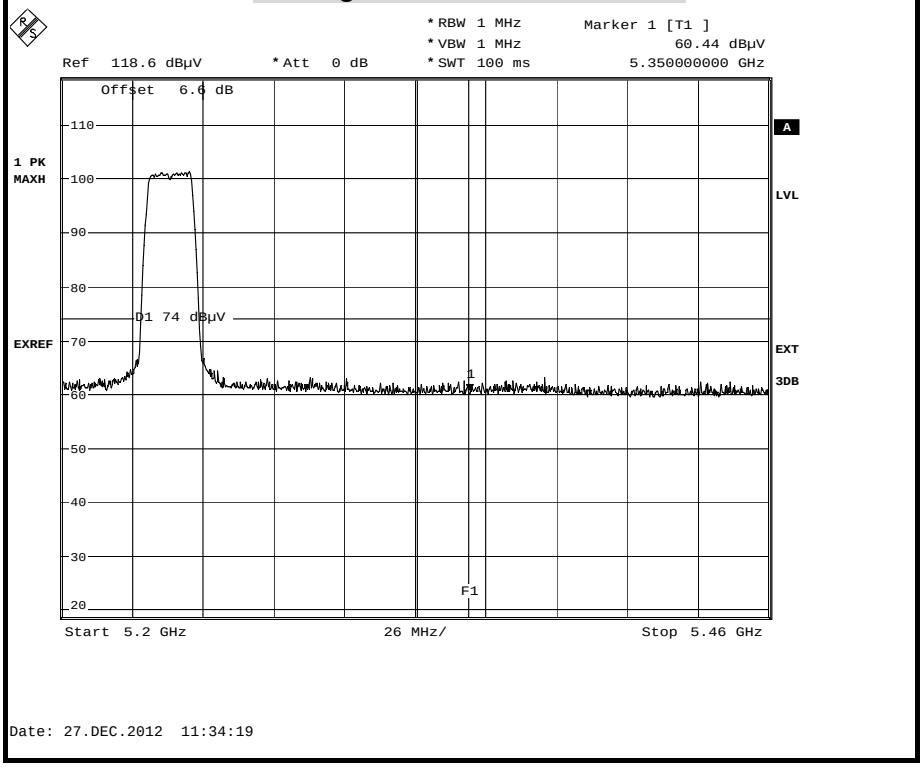
Detector Mode : Average **Polarity : Horizontal**

CH High IEEE 802.11a Mode



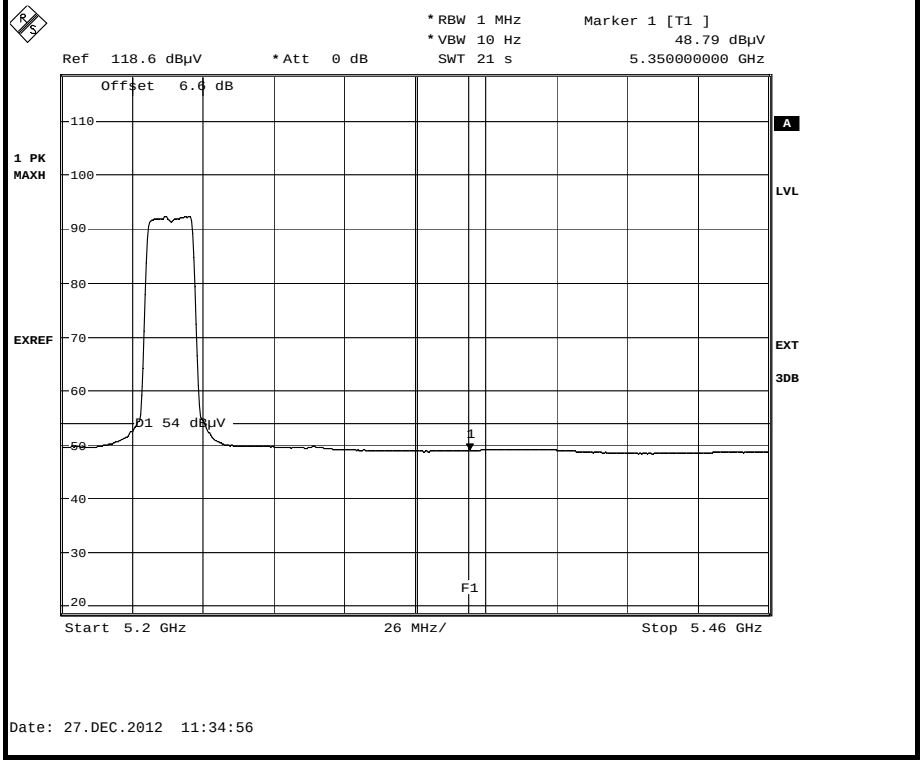
Detector Mode : Peak **Polarity : Vertical**

CH High IEEE 802.11a Mode



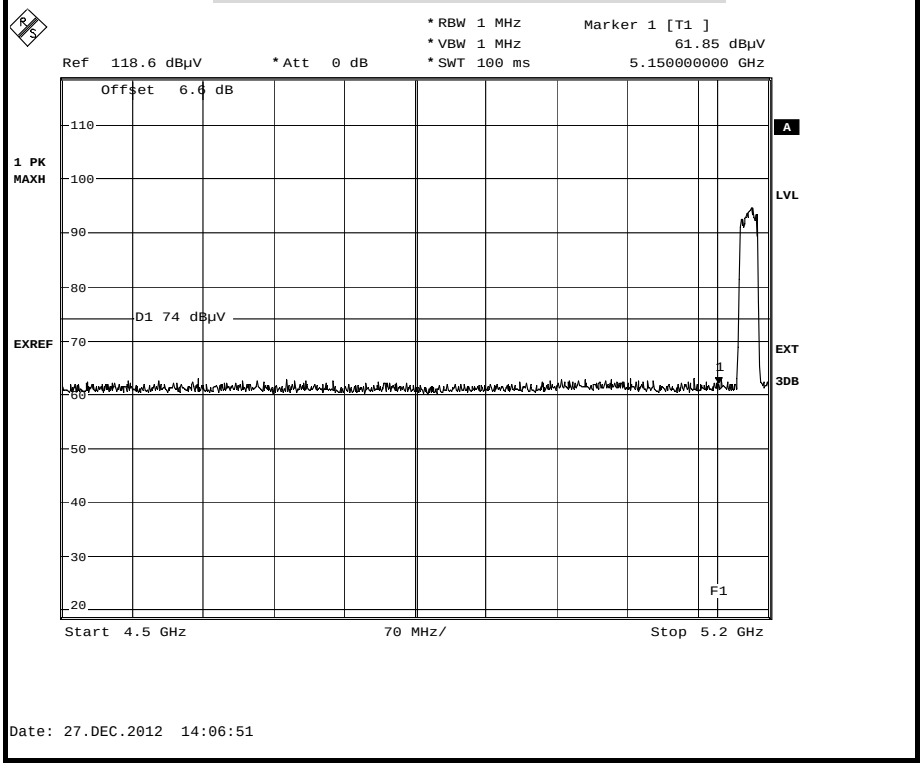
Detector Mode : Average **Polarity : Vertical**

CH High IEEE 802.11a Mode



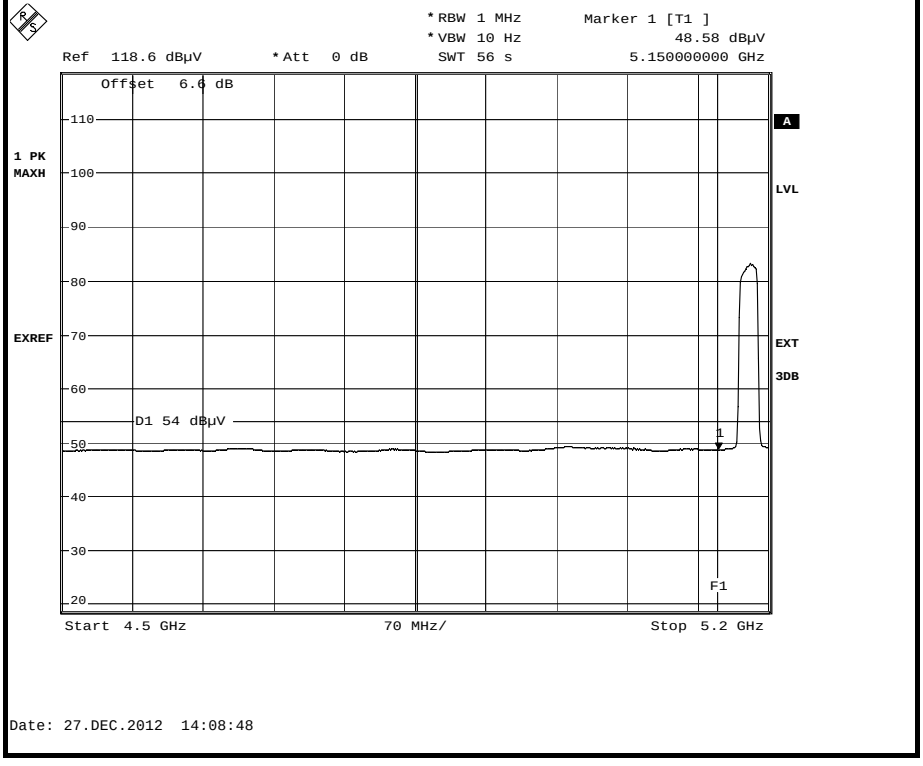
Detector Mode : Peak **Polarity : Horizontal**

CH Low IEEE 802.11n HT20 Mode



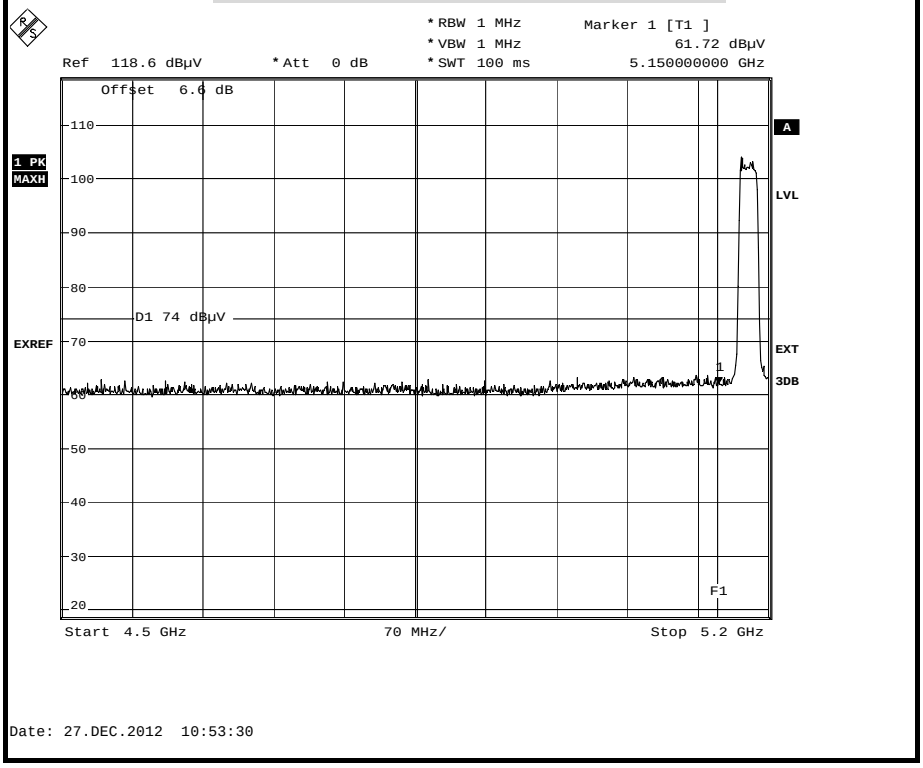
Detector Mode : Average **Polarity : Horizontal**

CH Low IEEE 802.11n HT20 Mode



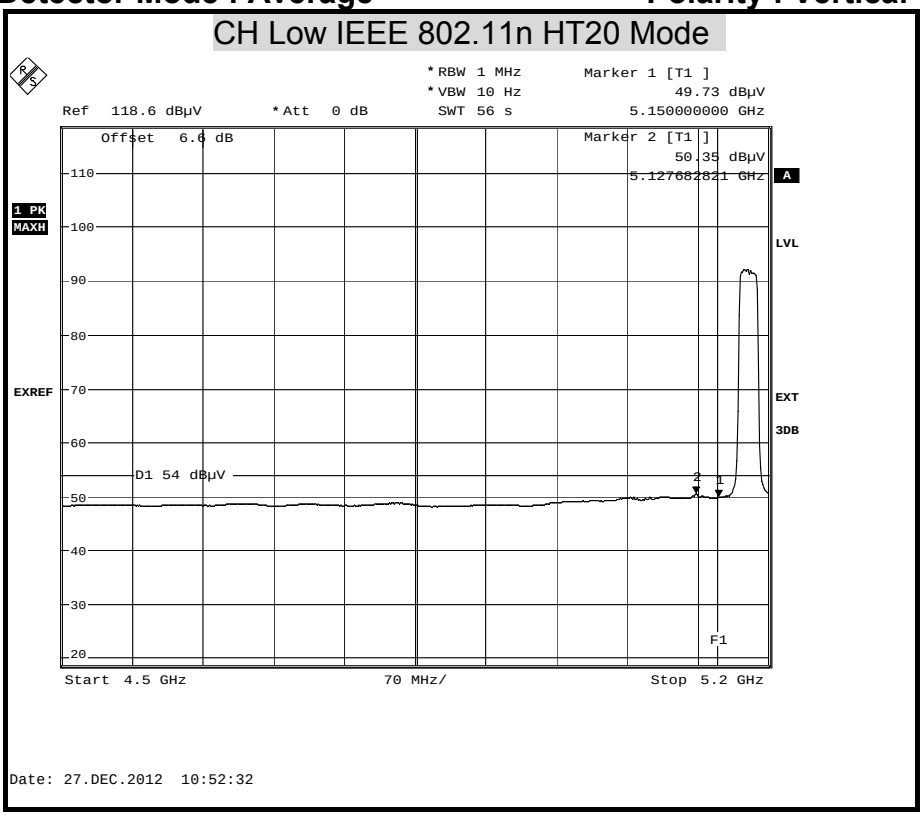
Detector Mode : Peak **Polarity : Vertical**

CH Low IEEE 802.11n HT20 Mode



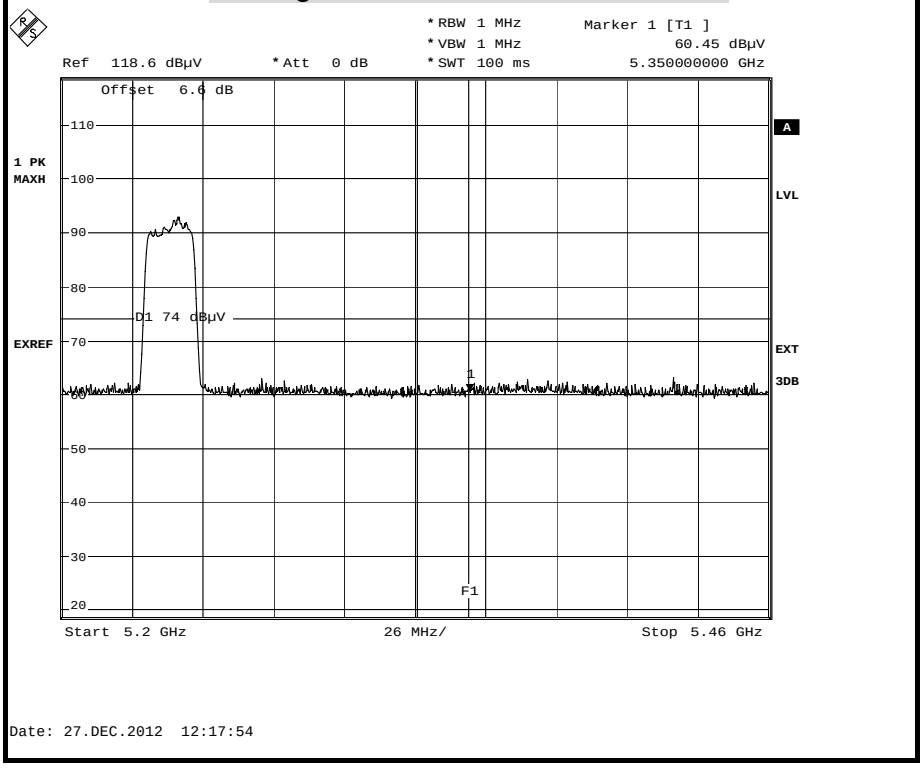
Detector Mode : Average **Polarity : Vertical**

CH Low IEEE 802.11n HT20 Mode



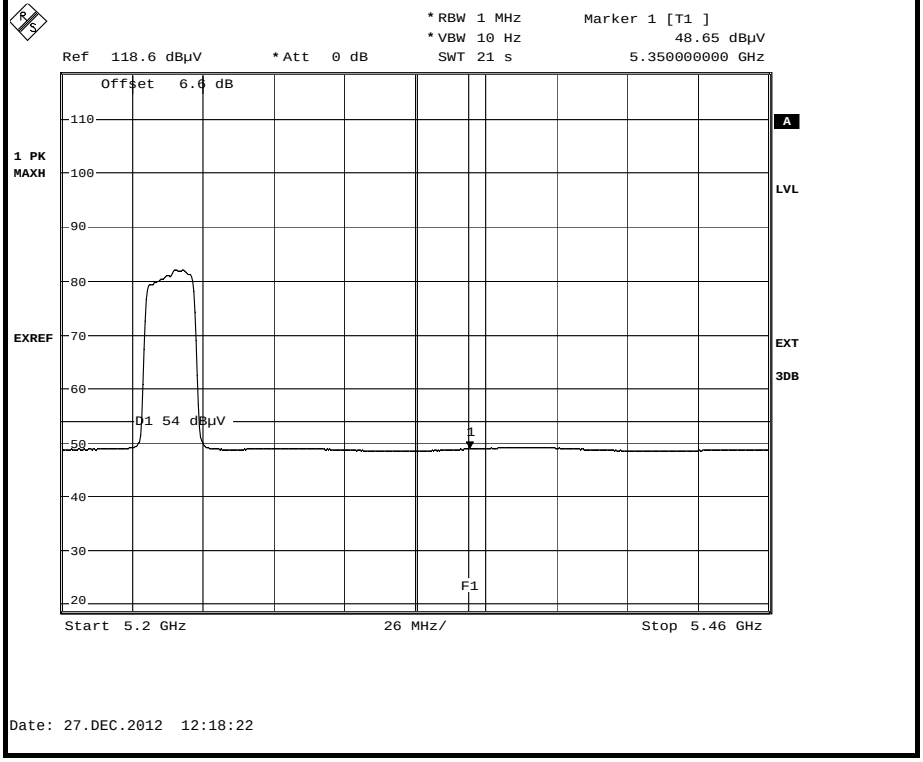
Detector Mode : Peak **Polarity : Horizontal**

CH High IEEE 802.11n HT20 Mode



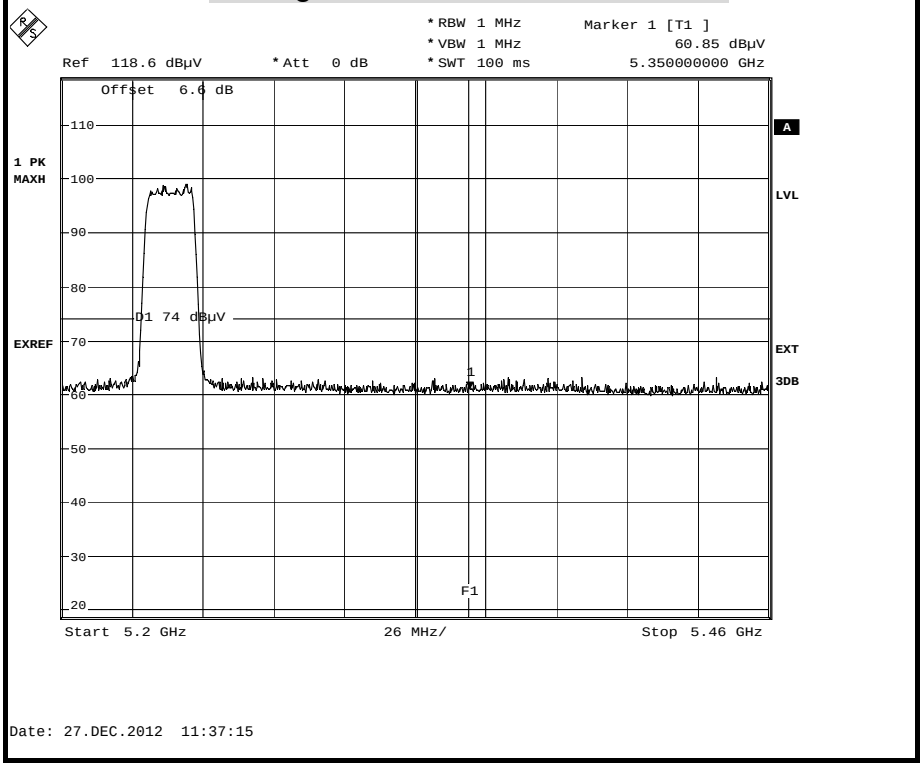
Detector Mode : Average **Polarity : Horizontal**

CH High IEEE 802.11n HT20 Mode



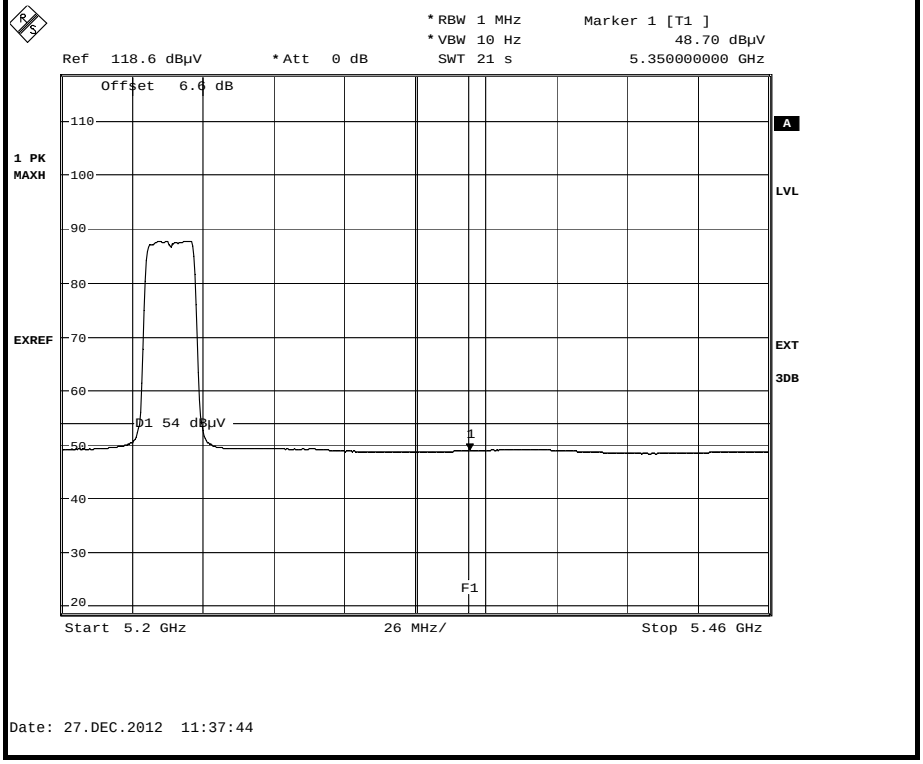
Detector Mode : Peak **Polarity : Vertical**

CH High IEEE 802.11n HT20 Mode

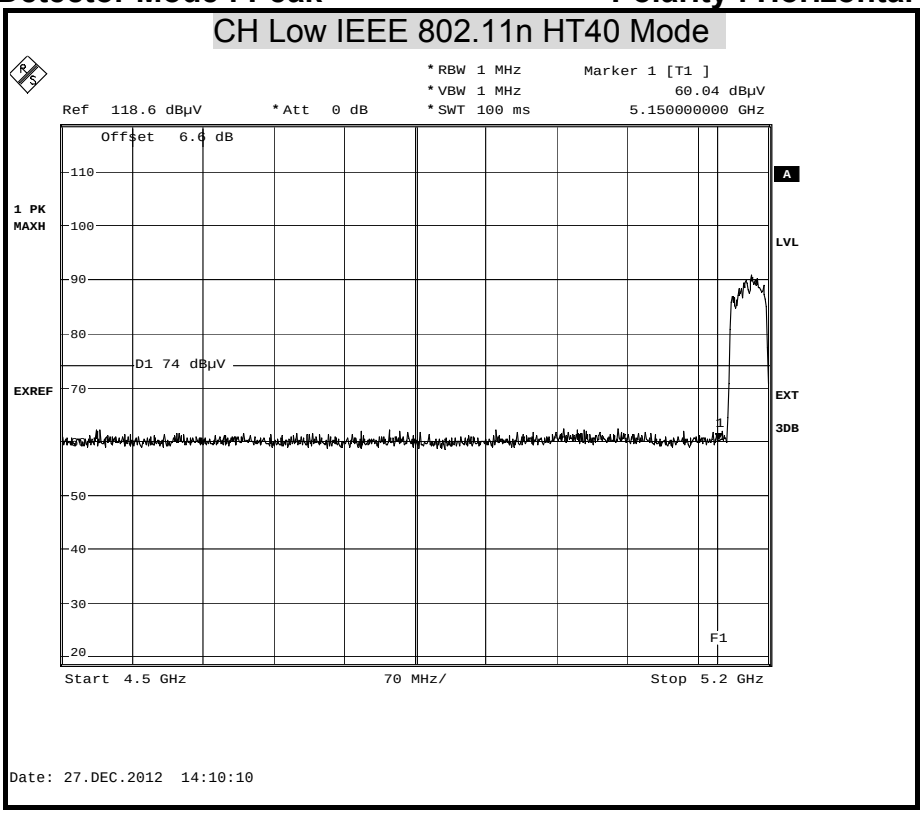


Detector Mode : Average **Polarity : Vertical**

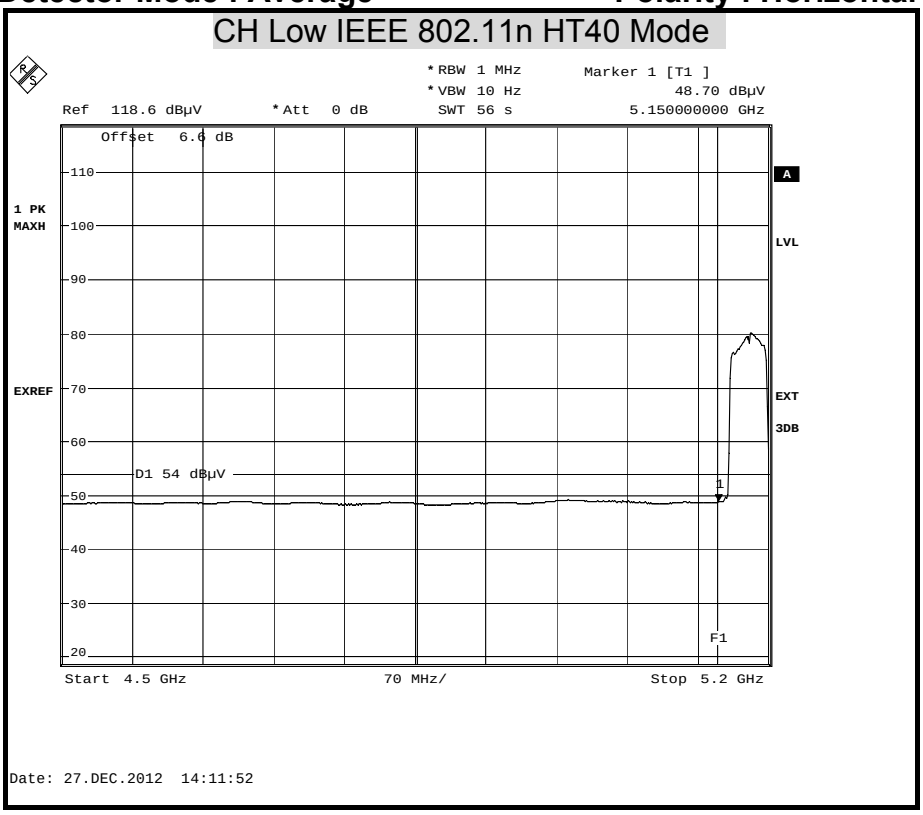
CH High IEEE 802.11n HT20 Mode



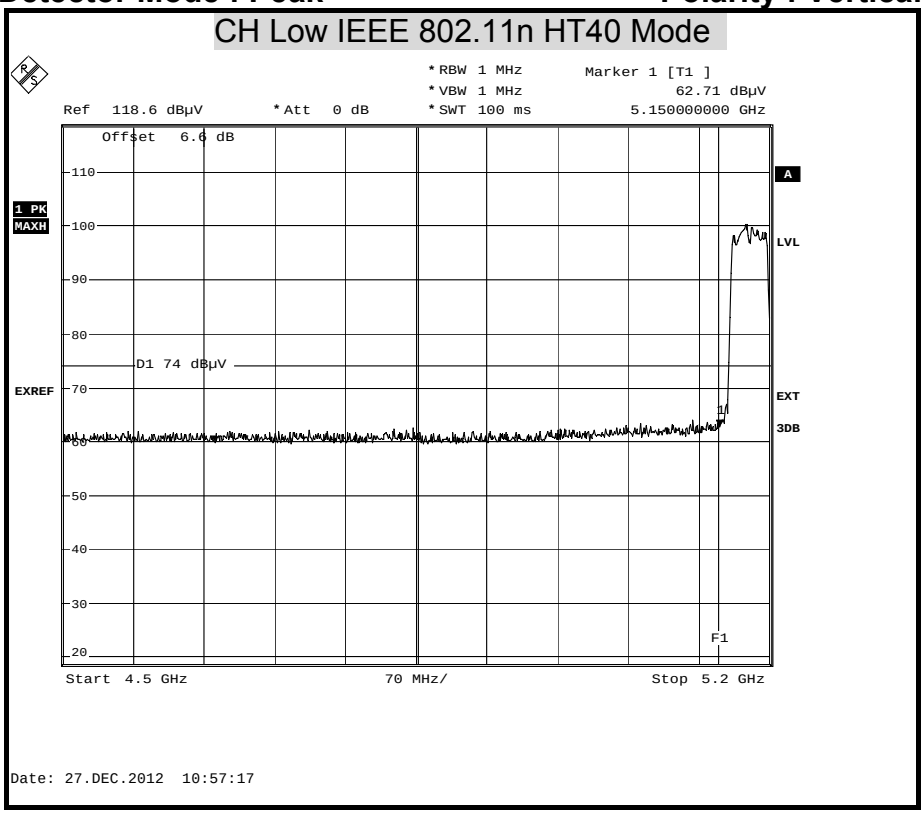
Detector Mode : Peak **Polarity : Horizontal**



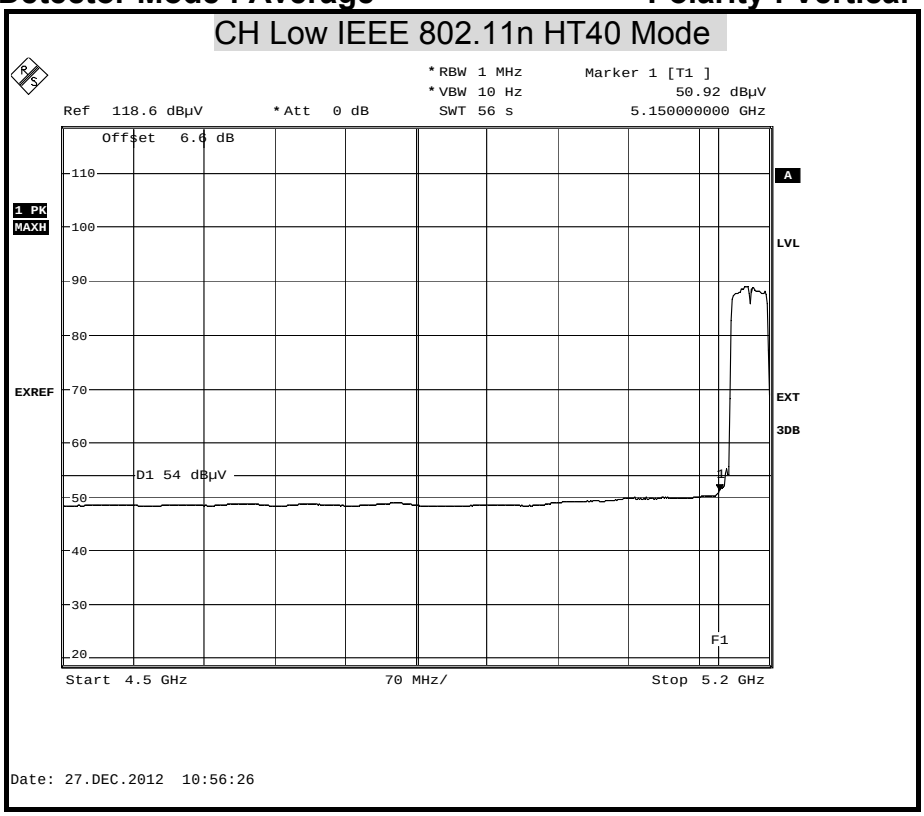
Detector Mode : Average **Polarity : Horizontal**



Detector Mode : Peak **Polarity : Vertical**

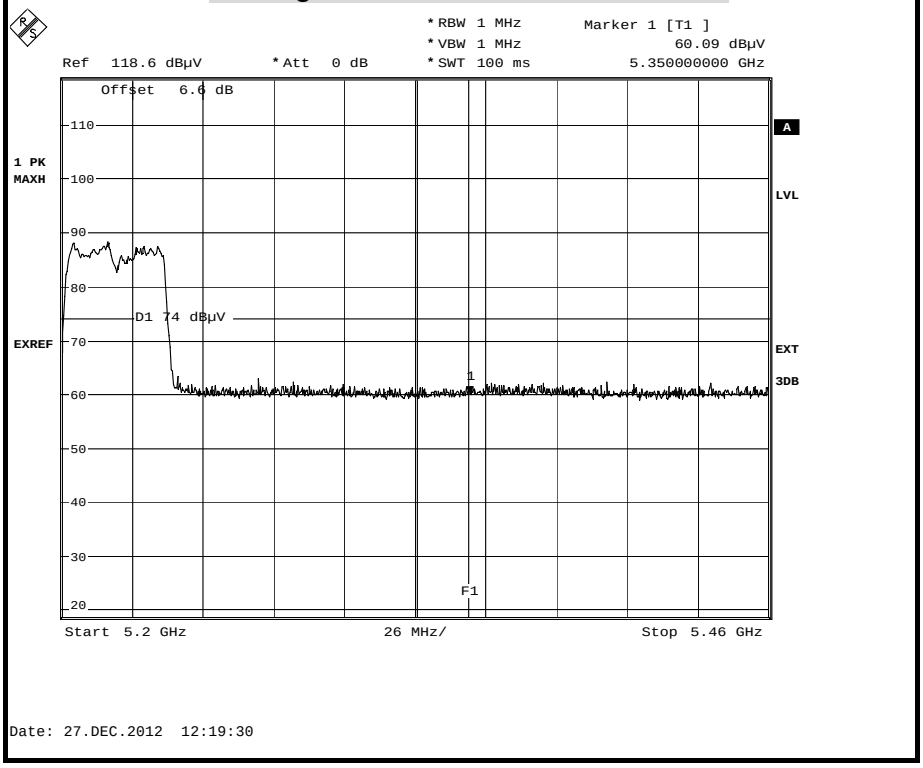


Detector Mode : Average **Polarity : Vertical**



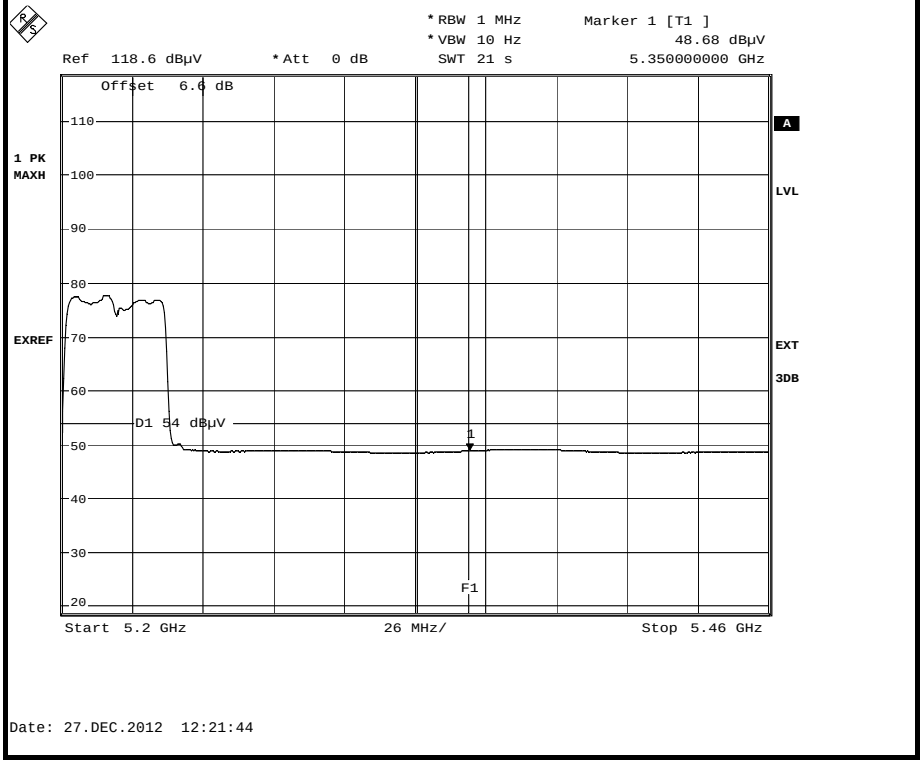
Detector Mode : Peak **Polarity : Horizontal**

CH High IEEE 802.11n HT40 Mode



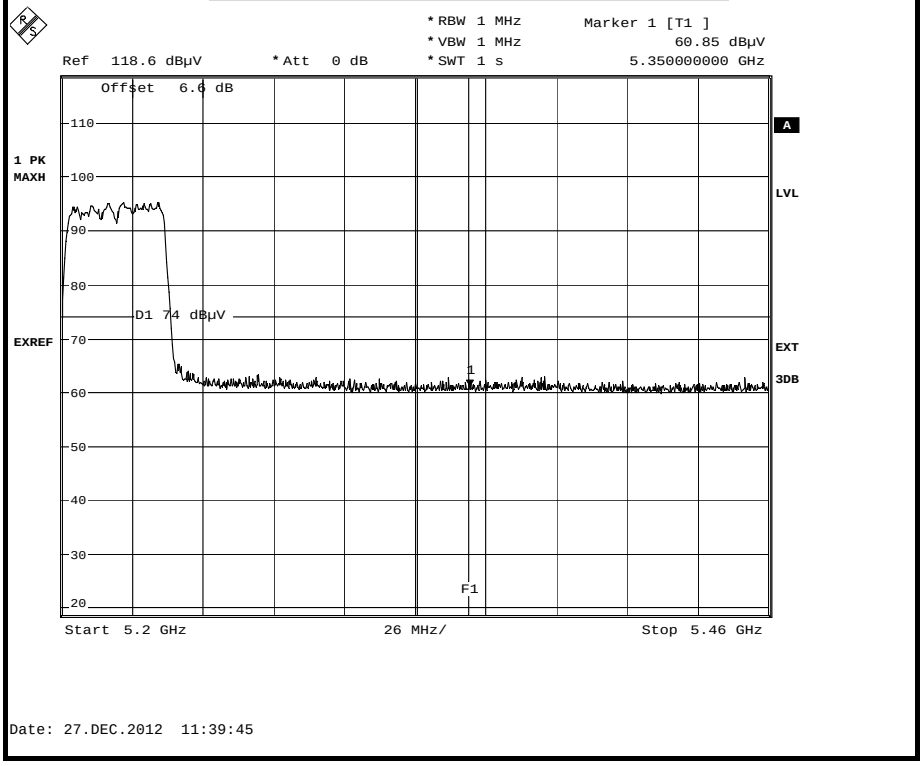
Detector Mode : Average **Polarity : Horizontal**

CH High IEEE 802.11n HT40 Mode



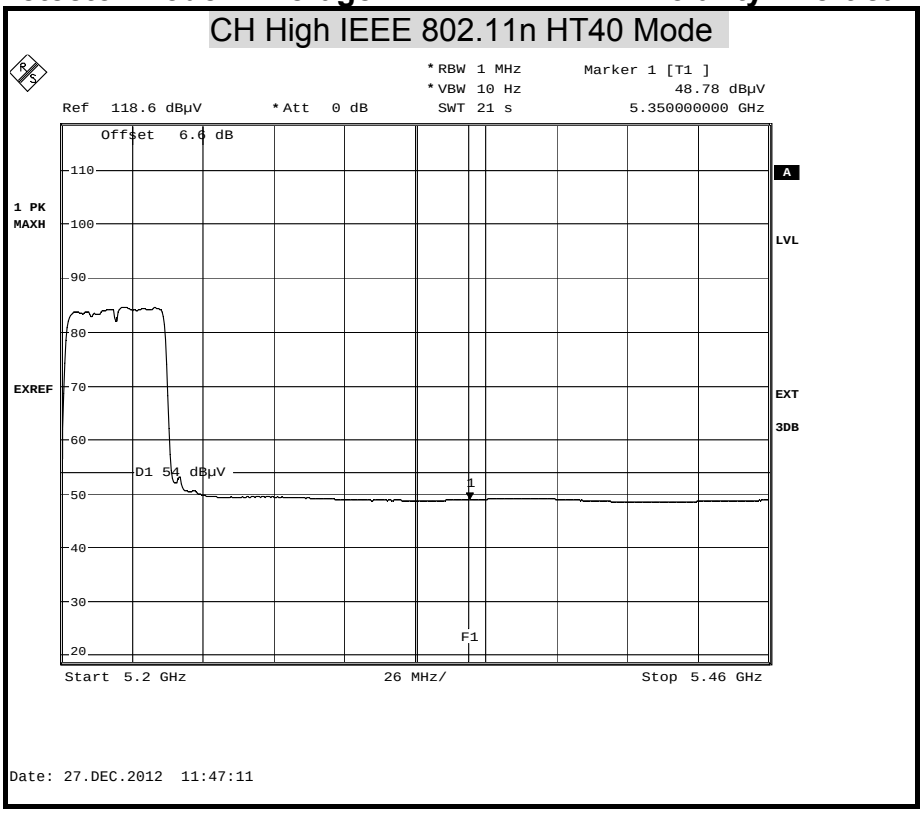
Detector Mode : Peak **Polarity : Vertical**

CH High IEEE 802.11n HT40 Mode



Detector Mode : Average **Polarity : Vertical**

CH High IEEE 802.11n HT40 Mode



7.7 CONDUCTED EMISSION

LIMITS

§ 15.207 (a) Except as shown in paragraph (b) and (c) this section, for an intentional radiator that 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 the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

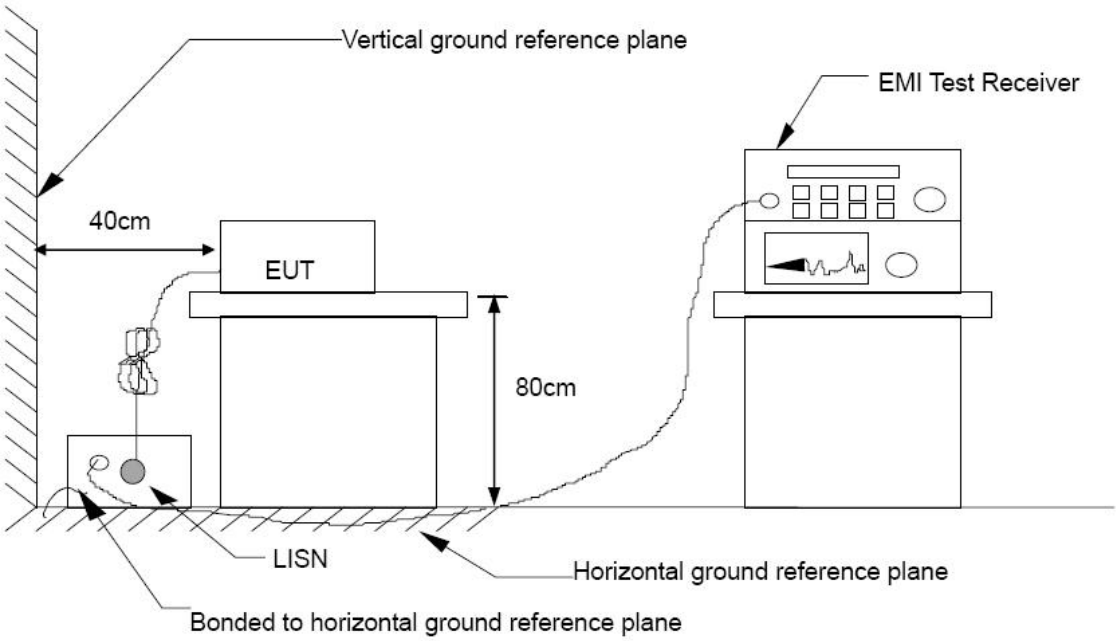
Frequency Range (MHz)	Conducted Limit (dBμv)	
	Quasi-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5.00	56	46
5.00 - 30.0	60	50

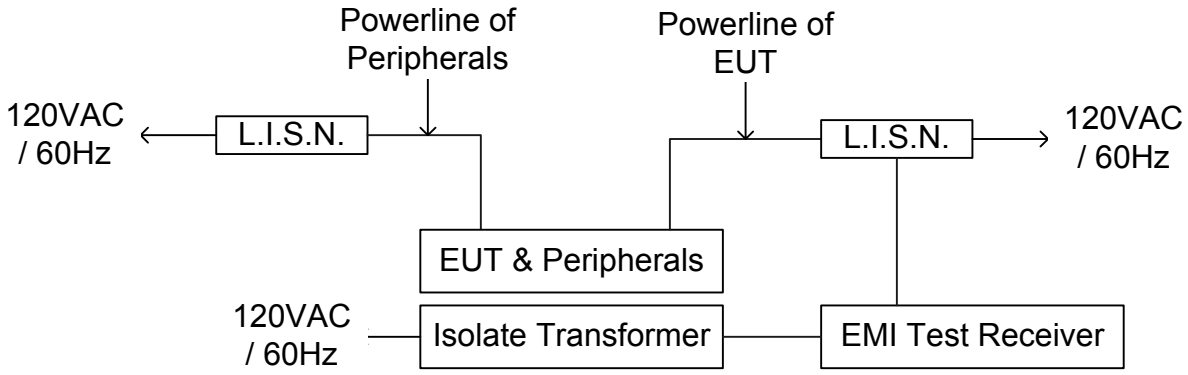
TEST EQUIPMENT

Conducted Emission room #1				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
L.I.S.N.	SCHWARZBECK	NNLK 8130	8130124	SEP. 30, 2013
	Rohde & Schwarz	ESH 3-Z5	840062/021	JUL. 31, 2013
TEST RECEIVER	Rohde & Schwarz	ESCS 30	100348	JUL. 23, 2013
BNC COAXIAL CABLE	CCS	BNC50	11	OCT. 30, 2013
Test S/W	e-3 (5.04211c) R&S (2.27)			

Remark: *Each piece of equipment is scheduled for calibration once a year.*

TEST SETUP





TEST PROCEDURE

The basic test procedure was in accordance with ANSI C63.4:2003.

The test procedure is performed in a 4m × 3m × 2.4m (L×W×H) shielded room.

The EUT along with its peripherals were placed on a 1.0m (W) × 1.5m (L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.

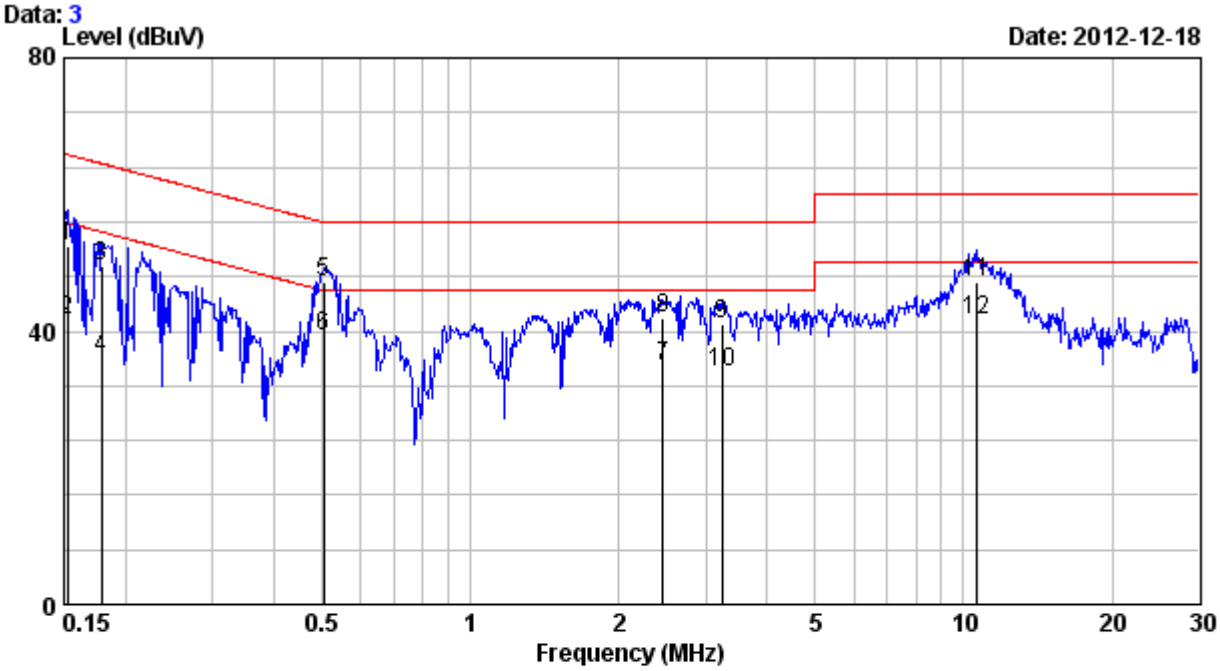
The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.

The EUT was located so that the distance between the boundary of the EUT and the closest surface of the LISN is 0.8 m. Where a mains flexible cord was provided by the manufacturer shall be 1 m long, or if in excess of 1 m, the excess cable was folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

TEST RESULTS

Model	NBG5615	Test By	Weici Lo
Temp. & Humidity	22°C, 60%	Test Date	2012/12/18
Test Mode	Normal Operation		

LINE



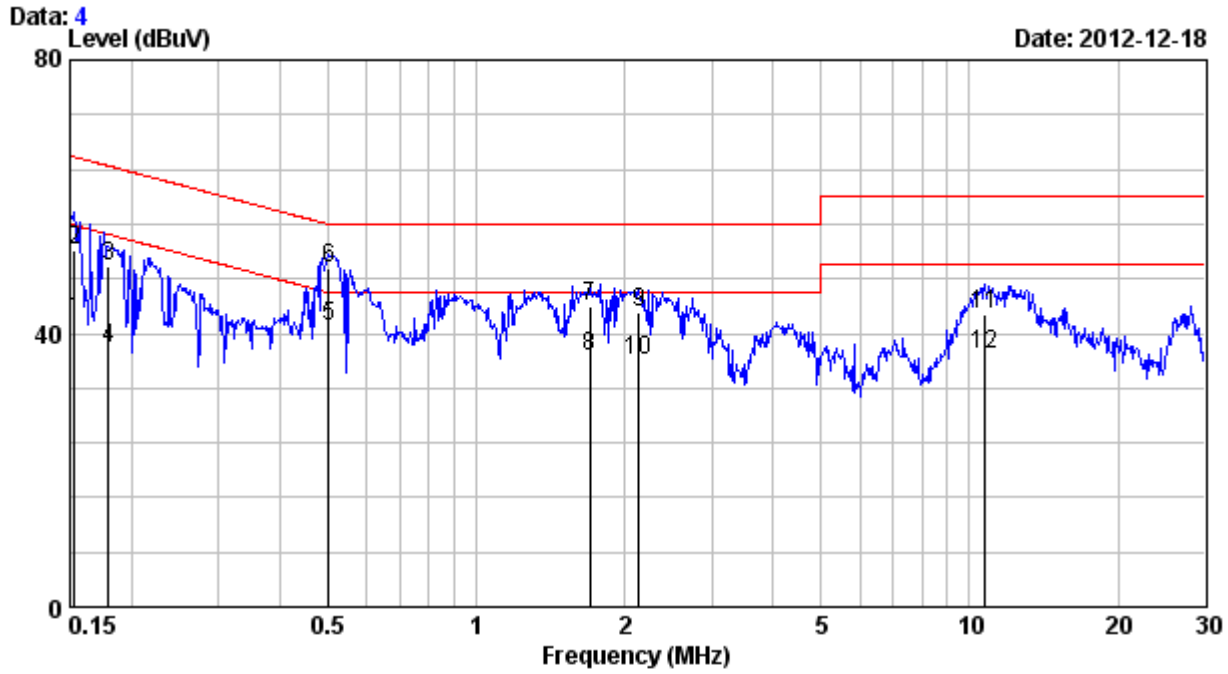
Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.15	8.87	0.05	43.39	52.31	65.87	-13.56	QP
0.15	8.87	0.05	32.70	41.62	55.87	-14.25	AVERAGE
0.18	8.88	0.05	40.65	49.58	64.55	-14.97	QP
0.18	8.88	0.05	27.11	36.04	54.55	-18.51	AVERAGE
0.50	8.92	0.07	38.12	47.11	56.00	-8.89	QP
0.50	8.92	0.07	30.27	39.26	46.00	-6.74	AVERAGE
2.46	9.03	0.08	25.90	35.01	46.00	-10.99	AVERAGE
2.46	9.03	0.08	32.93	42.04	56.00	-13.96	QP
3.24	9.06	0.08	31.78	40.92	56.00	-15.08	QP
3.24	9.06	0.08	24.93	34.07	46.00	-11.93	AVERAGE
10.62	9.27	0.09	37.76	47.13	60.00	-12.87	QP
10.62	9.27	0.09	32.18	41.55	50.00	-8.45	AVERAGE

Remark:

1. Correction Factor = Insertion loss + Cable loss
2. Emission level = Reading Value + Correction factor
3. Margin value = Emission level – Limit value

Model	NBG5615	Test By	Weici Lo
Temp. & Humidity	22°C, 60%	Test Date	2012/12/18
Test Mode	Normal Operation		

NEUTRAL



Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.15	8.85	0.05	33.06	41.96	55.82	-13.86	AVERAGE
0.15	8.85	0.05	43.28	52.18	65.82	-13.64	QP
0.18	8.86	0.05	40.93	49.84	64.50	-14.67	QP
0.18	8.86	0.05	28.91	37.82	54.50	-16.69	AVERAGE
0.50	8.88	0.07	32.09	41.04	46.00	-4.96	AVERAGE
0.50	8.88	0.07	40.49	49.44	56.00	-6.56	QP
1.70	8.90	0.07	34.95	43.92	56.00	-12.08	QP
1.70	8.90	0.07	27.70	36.67	46.00	-9.33	AVERAGE
2.13	8.91	0.07	34.13	43.11	56.00	-12.89	QP
2.13	8.91	0.07	26.96	35.94	46.00	-10.06	AVERAGE
10.73	9.11	0.10	33.53	42.74	60.00	-17.26	QP
10.73	9.11	0.10	27.71	36.92	50.00	-13.08	AVERAGE

Remark:

1. *Correction Factor = Insertion loss + Cable loss*
2. *Emission level = Reading Value + Correction factor*
3. *Margin value = Emission level – Limit value*

7.8 FREQUENCY STABILITY

LIMITS

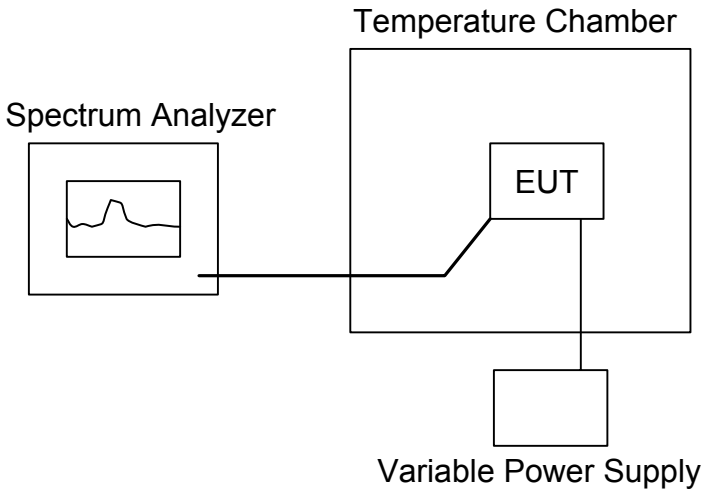
§ 15.407 (g) manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

TEST EQUIPMENT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	R&S	FSU	200789	SEP. 29, 2013
Temp./Humidity Chamber	K.SON	THS-M1	242	AUG. 09, 2013

Remark: *Each piece of equipment is scheduled for calibration once a year*

TEST SETUP



TEST PROCEDURE

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20℃ operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -20℃. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10℃ increased per stage until the highest temperature of +50℃ reached.

TEST RESULTS

IEEE 802.11a mode

CH Low				
Environment Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Limit Range	Test Result
50	120	5180.066560	5150-5250	PASS
40		5180.068800	5150~5250	
30		5180.066720	5150~5250	
20		5180.066720	5150~5250	
10		5180.071040	5150~5250	
0		5180.067040	5150~5250	
-10		5180.066560	5150~5250	
-20		5180.071040	5150~5250	
20	108	5180.071040	5150~5250	PASS
	120	5180.066720	5150~5250	
	132	5180.068800	5150~5250	

CH Middle				
Environment Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Limit Range	Test Result
50	120	5200.067520	5150~5250	PASS
40		5200.067520	5150~5250	
30		5200.071680	5150~5250	
20		5200.066040	5150~5250	
10		5200.068800	5150~5250	
0		5200.071040	5150~5250	
-10		5200.067040	5150~5250	
-20		5200.068800	5150~5250	
20	108	5200.069600	5150~5250	PASS
	120	5200.068800	5150~5250	
	132	5200.069600	5150~5250	

CH High				
Environment Temperature (°C)	**Voltage (V)**	**Measured Frequency (MHz)**	**Limit Range**	**Test Result**
50	120	5240.071040	5150~5250	PASS
40		5240.074720	5150~5250	
30		5240.069600	5150~5250	
20		5240.071680	5150~5250	
10		5240.071040	5150~5250	
0		5240.071680	5150~5250	
-10		5240.067520	5150~5250	
-20		5240.068800	5150~5250	
20	108	5240.071040	5150~5250	PASS
	120	5240.072380	5150~5250	
	132	5540.071880	5150~5250	

IEEE 802.11n HT20 mode

CH Low				
Environment Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Limit Range	Test Result
50	120	5180.068060	5150~5250	PASS
40		5180.067480	5150~5250	
30		5180.066960	5150~5250	
20		5180.067420	5150~5250	
10		5180.070880	5150~5250	
0		5180.068360	5150~5250	
-10		5180.069540	5150~5250	
-20		5180.071220	5150~5250	
20	108	5180.071240	5150~5250	PASS
	120	5180.069580	5150~5250	
	132	5180.068800	5150~5250	

CH Middle				
Environment Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Limit Range	Test Result
50	120	5200.068600	5150~5250	PASS
40		5200.069340	5150~5250	
30		5200.067840	5150~5250	
20		5200.068080	5150~5250	
10		5200.069020	5150~5250	
0		5200.070360	5150~5250	
-10		5200.067420	5150~5250	
-20		5200.063800	5150~5250	
20	108	5200.069800	5150~5250	PASS
	120	5200.068840	5150~5250	
	132	5200.069740	5150~5250	

CH High				
Environment Temperature (°C)	**Voltage (V)**	**Measured Frequency (MHz)**	**Limit Range**	**Test Result**
50	120	5240.071040	5150~5250	PASS
40		5240.074720	5150~5250	
30		5240.069600	5150~5250	
20		5240.071680	5150~5250	
10		5240.071040	5150~5250	
0		5240.071680	5150~5250	
-10		5240.067520	5150~5250	
-20		5240.068800	5150~5250	
20	108	5240.070240	5150~5250	PASS
	120	5240.069800	5150~5250	
	132	5240.071220	5150~5250	

IEEE 802.11n HT40 mode

CH Low				
Environment Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Limit Range	Test Result
50	120	5180.069680	5150~5250	PASS
40		5180.068520	5150~5250	
30		5180.066960	5150~5250	
20		5180.067840	5150~5250	
10		5180.070220	5150~5250	
0		5180.068920	5150~5250	
-10		5180.071240	5150~5250	
-20		5180.070480	5150~5250	
20	108	5180.070680	5150~5250	PASS
	120	5180.070900	5150~5250	
	132	5180.069580	5150~5250	

CH Middle				
Environment Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Limit Range	Test Result
50	120	5200.069560	5150~5250	PASS
40		5200.068660	5150~5250	
30		5200.067520	5150~5250	
20		5200.068580	5150~5250	
10		5200.069540	5150~5250	
0		5200.070520	5150~5250	
-10		5200.069540	5150~5250	
-20		5200.068200	5150~5250	
20	108	5200.069660	5150~5250	PASS
	120	5200.068560	5150~5250	
	132	5200.070080	5150~5250	

CH High				
Environment Temperature (°C)	**Voltage (V)**	**Measured Frequency (MHz)**	**Limit Range**	**Test Result**
50	120	5220.066920	5150~5250	PASS
40		5220.068400	5150~5250	
30		5220.067720	5150~5250	
20		5220.068520	5150~5250	
10		5220.069940	5150~5250	
0		5220.070580	5150~5250	
-10		5220.071220	5150~5250	
-20		5220.069580	5150~5250	
20	108	5220.068500	5150~5250	PASS
	120	5220.069680	5150~5250	
	132	5220.068800	5150~5250	

APPENDIX I MAXIMUM PERMISSIBLE EXPOSURE

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate theenvironment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time
(A) Limits for Occupational / Control Exposures				
300-1,500	--	--	F/300	6
1,500-100,000	--	--	5	6
(B) Limits for General Population / Uncontrol Exposures				
300-1,500	--	--	F/1500	6
1,500-100,000	--	--	1	30

CALCULATIONS

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

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

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

LIMIT

Power Density Limit, S=1.0mW/cm^2

TEST RESULTS

Numeric antenna gain :

Antenna Gain 1 (5G):	4.00	dBi =	2.51188643
Antenna Gain 1 (5G):	4.00	dBi =	2.51188643
Antenna Gain 1 (5G):	4.00	dBi =	2.51188643
Array Gain (5G):	8.77	dBi =	7.53565929

No non-compliance noted: (MPE distance equals 20 cm)

IEEE 802.11a	=	0.0796 *	23.7137	*	2.51188643	÷ 400 =	0.01185
IEEE 802.11n HT20	=	0.0796 *	13.0038	*	7.53565929	÷ 400 =	0.0195
IEEE 802.11n HT40	=	0.0796 *	12.9972	*	7.53565929	÷ 400 =	0.01949

Mode	Antenna Gain (dBi)	Minimum separation distance (cm)	Output Power (dBm)	Output Power (mW)	Power Density Limit (mW/cm^2)	Power Density at 20cm (mW/cm^2)
IEEE 802.11a	4.0	20.0	13.75	23.71	1.00	0.011854
IEEE 802.11n HT20	8.77	20.0	11.14	13.00	1.00	0.019500
IEEE 802.11n HT40	8.77	20.0	11.14	13.00	1.00	0.019491

Remark: *For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm^2 even if the calculation indicates that the power density would be larger.*