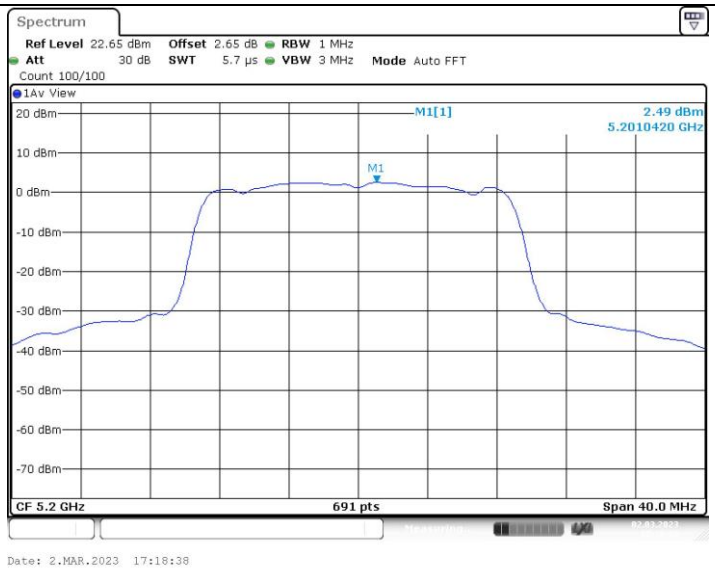
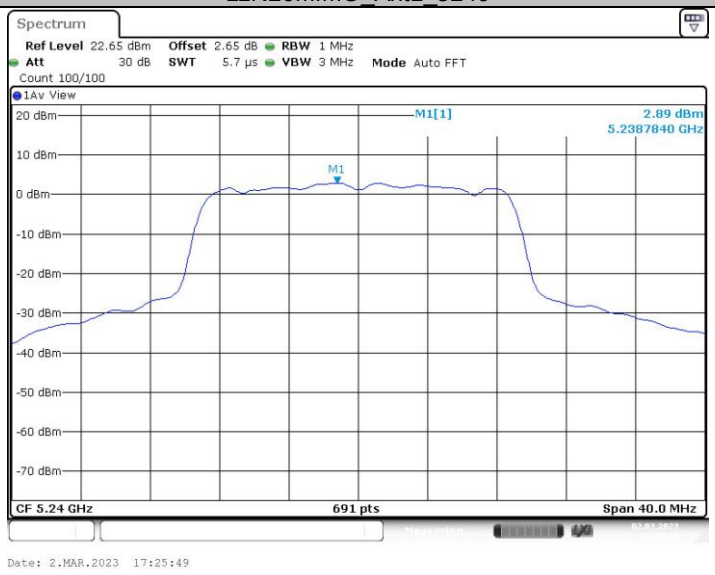
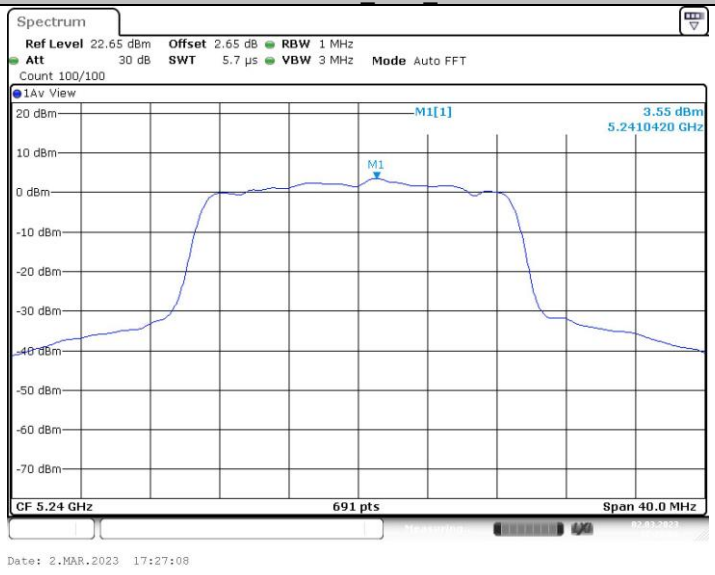


11N20MIMO_Ant1_5240



11N20MIMO_Ant2_5240



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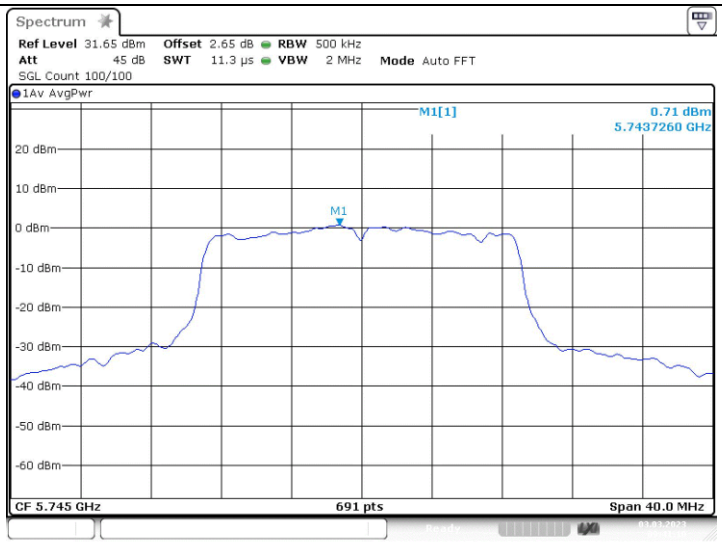

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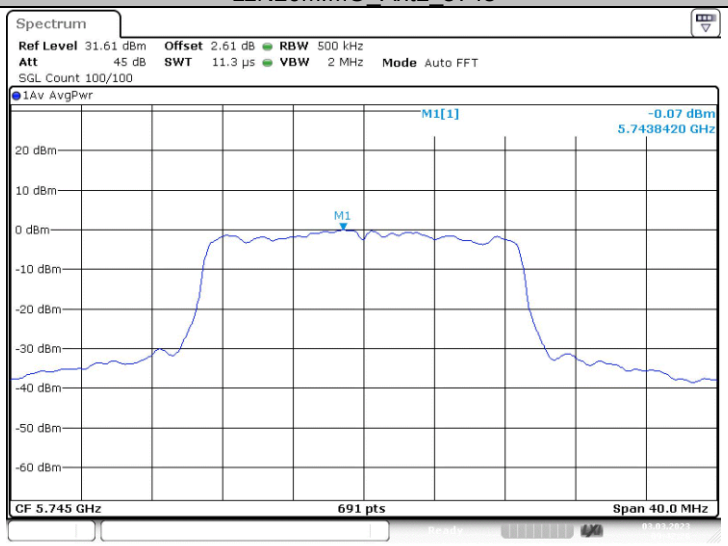

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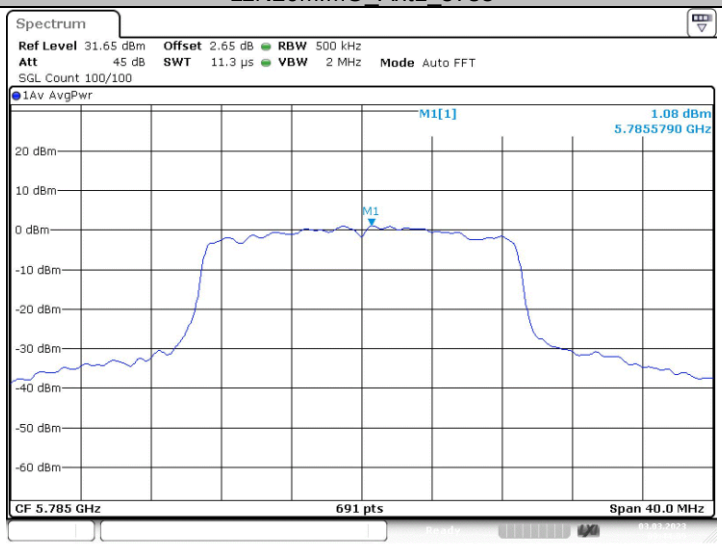

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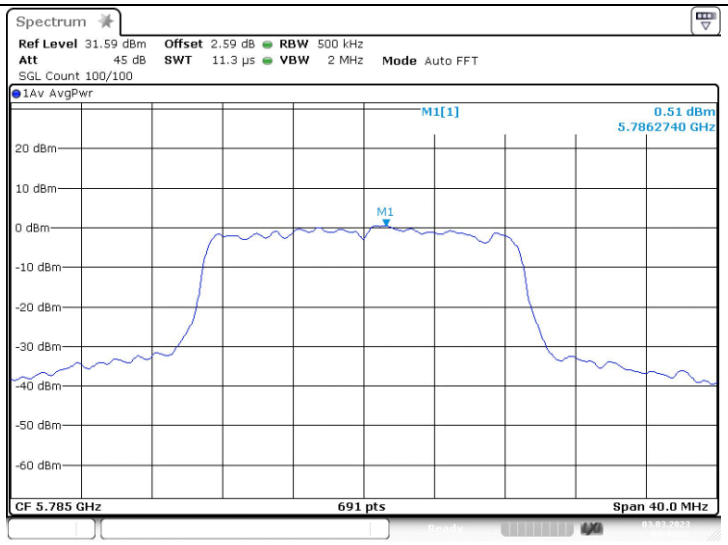

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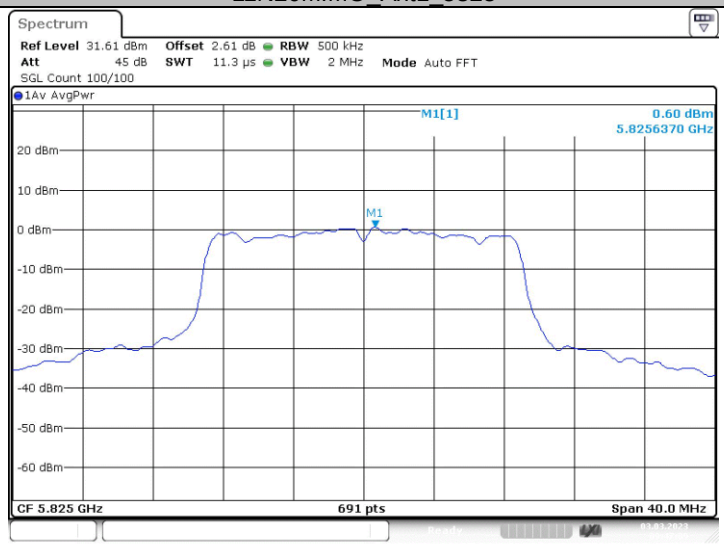

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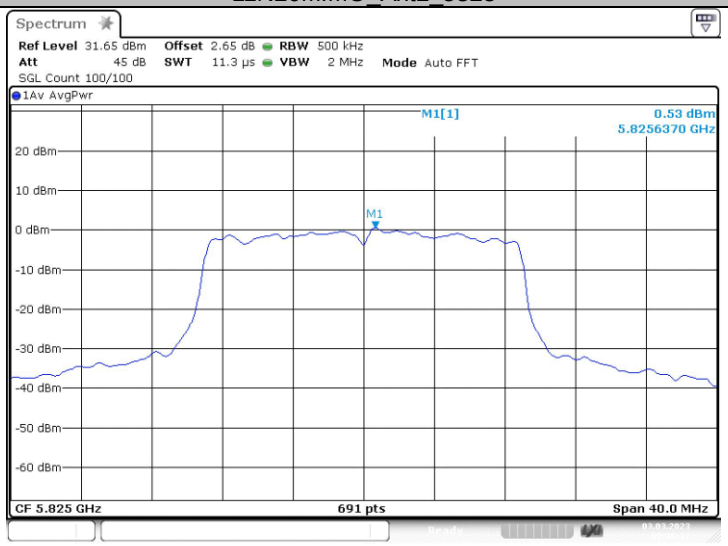

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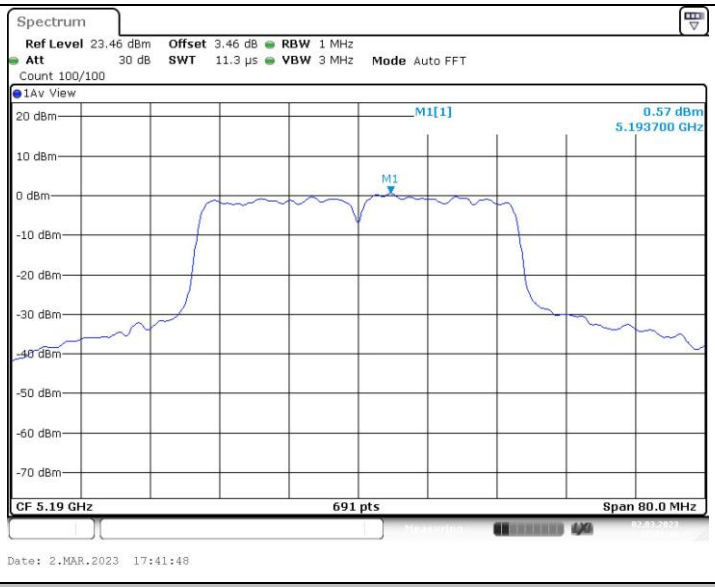
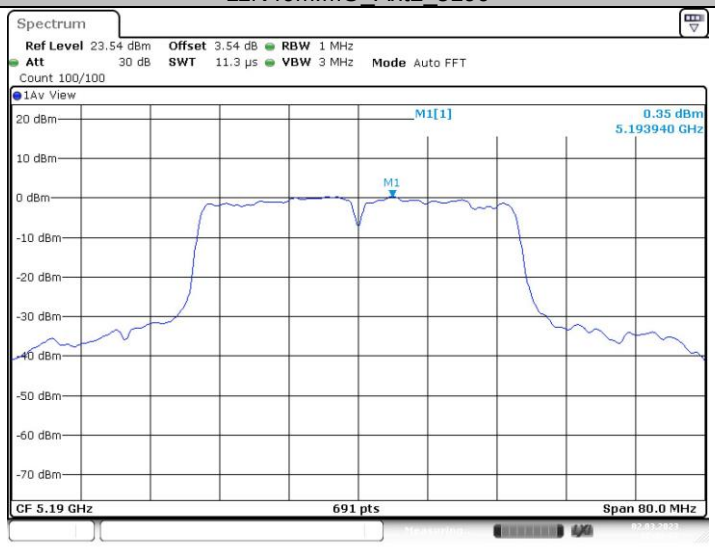


11N40MIMO_Ant2_5190



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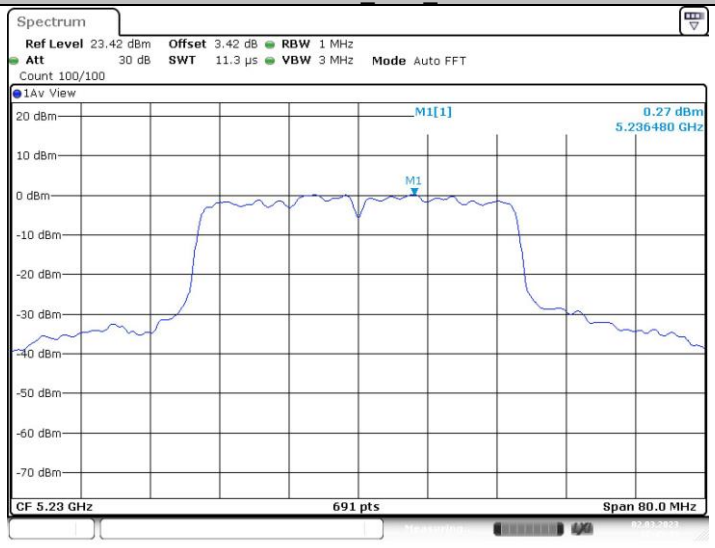
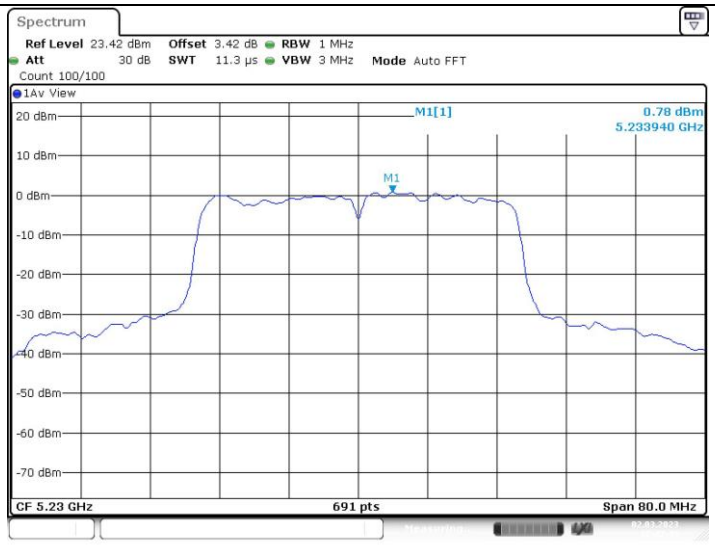


11N40MIMO_Ant2_5230



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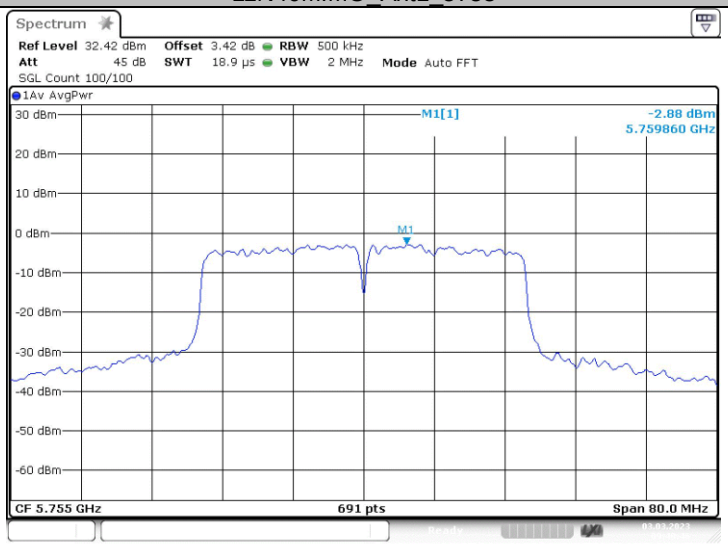
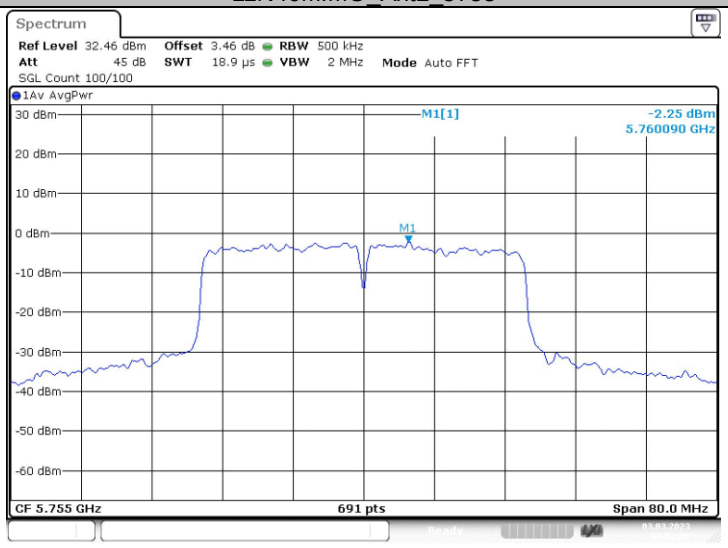
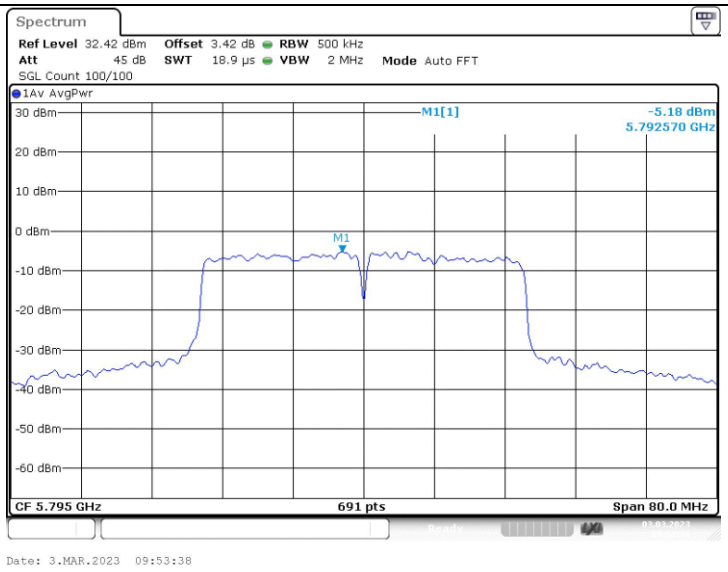


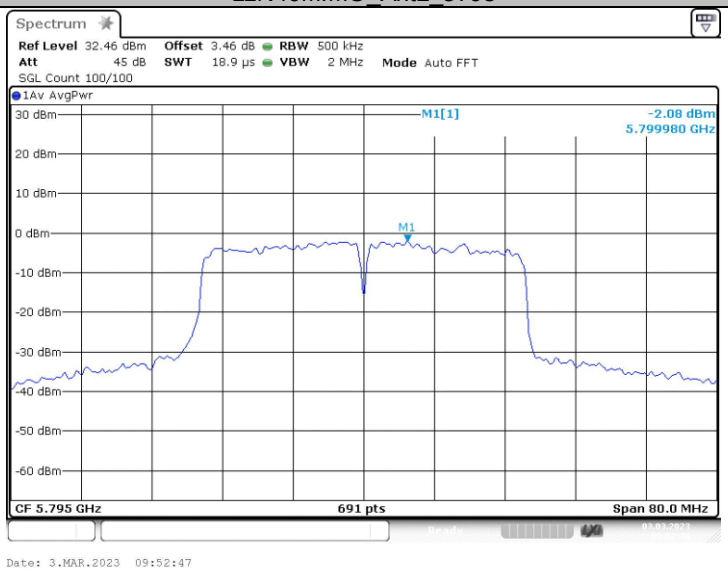
11N40MIMO_Ant2_5755



11N40MIMO_Ant1_5795



11N40MIMO_Ant2_5795

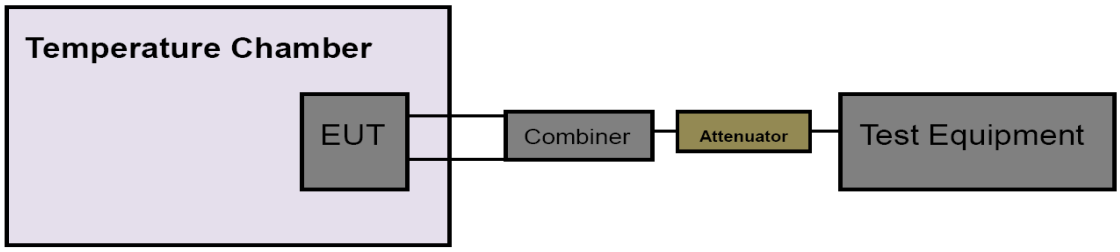


3.7. Frequency Stability Measurement

Limit

FCC Part 15 Subpart C(15.407)		
Test Item	**Limit**	**Frequency Range(MHz)**
Peak Excursion Measurement	Specified in the user's manual, the transmitter center frequency tolerance shall be ±20 ppm maximum for the 5 GHz band (IEEE 802.11n specification)	5150~5250
		5250~5350
		5500~5700
		5725~5850

Test Configuration



Test Procedure

The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above.

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
(2) Set analyzer center frequency to transmitting frequency.
(3) Set the span to encompass the entire emissions bandwidth (EBW) of the signal.
(4) Set the RBW to: 10MHz, VBW=10MHz with peak detector and maxhold settings.
(5) The test extreme voltage is to change the primary supply voltage from 6.66V to 8.14V percent of the nominal value.
(6) Extreme temperature is -10℃~40℃

NOTE: The EUT was set to continuously transmitting in continuously un-modulation transmitting mode. The limit for frequency stability is maintained within the band of operation.

Test Mode

Please refer to the clause 2.4.

Test Result

Voltage								
TestMode	Antenna	Channel	Voltage [Vdc]	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
11N20MIMO	Ant1	5180	NV	NT	23000	4.440154	20	PASS
			LV	NT	25000	4.826255	20	PASS
			HV	NT	26000	5.019305	20	PASS
	Ant2	5180	NV	NT	-24000	-4.633205	20	PASS
			LV	NT	-13000	-2.509653	20	PASS
			HV	NT	-5000	-0.965251	20	PASS
	Ant1	5200	NV	NT	7000	1.346154	20	PASS
			LV	NT	13000	2.5	20	PASS
			HV	NT	17000	3.269231	20	PASS
	Ant2	5200	NV	NT	21000	4.038462	20	PASS
			LV	NT	24000	4.615385	20	PASS
			HV	NT	26000	5	20	PASS
	Ant1	5240	NV	NT	17000	3.244275	20	PASS
			LV	NT	23000	4.389313	20	PASS
			HV	NT	25000	4.770992	20	PASS
	Ant2	5240	NV	NT	28000	5.343511	20	PASS
			LV	NT	27000	5.152672	20	PASS
			HV	NT	26000	4.961832	20	PASS
	Ant1	5745	NV	NT	13000	2.262837	20	PASS
			LV	NT	16000	2.78503	20	PASS
			HV	NT	18000	3.133159	20	PASS
	Ant2	5745	NV	NT	23000	4.003481	20	PASS
			LV	NT	23000	4.003481	20	PASS
			HV	NT	24000	4.177546	20	PASS
	Ant1	5785	NV	NT	19000	3.284356	20	PASS
			LV	NT	25000	4.321521	20	PASS
			HV	NT	26000	4.494382	20	PASS
	Ant2	5785	NV	NT	34000	5.877269	20	PASS
			LV	NT	35000	6.05013	20	PASS
			HV	NT	36000	6.22299	20	PASS
	Ant1	5825	NV	NT	29000	4.978541	20	PASS
			LV	NT	31000	5.321888	20	PASS
			HV	NT	36000	6.180258	20	PASS
	Ant2	5825	NV	NT	47000	8.06867	20	PASS
			LV	NT	47000	8.06867	20	PASS
			HV	NT	48000	8.240343	20	PASS
11N40MIMO	Ant1	5190	NV	NT	18000	3.468208	20	PASS
			LV	NT	28000	5.39499	20	PASS
			HV	NT	33000	6.358382	20	PASS
	Ant2	5190	NV	NT	44000	8.477842	20	PASS
			LV	NT	41000	7.899807	20	PASS
			HV	NT	40000	7.707129	20	PASS
	Ant1	5230	NV	NT	19000	3.632887	20	PASS
			LV	NT	27000	5.162524	20	PASS
			HV	NT	30000	5.736138	20	PASS
	Ant2	5230	NV	NT	34000	6.500956	20	PASS
			LV	NT	31000	5.927342	20	PASS
			HV	NT	30000	5.736138	20	PASS
	Ant1	5755	NV	NT	15000	2.606429	20	PASS
			LV	NT	20000	3.475239	20	PASS
			HV	NT	22000	3.822763	20	PASS
	Ant2	5755	NV	NT	29000	5.039096	20	PASS
			LV	NT	30000	5.212858	20	PASS
			HV	NT	31000	5.38662	20	PASS
	Ant1	5795	NV	NT	16000	2.761001	20	PASS
			LV	NT	23000	3.968939	20	PASS
			HV	NT	25000	4.314064	20	PASS
	Ant2	5795	NV	NT	34000	5.867127	20	PASS
			LV	NT	35000	6.039689	20	PASS
			HV	NT	35000	6.039689	20	PASS

Temperature								
TestMode	Antenna	Channel	Voltage [Vdc]	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
11N20MIMO	Ant1	5180	NV	-10	27000	5.212355	20	PASS
			NV	0	29000	5.598456	20	PASS
			NV	10	31000	5.984556	20	PASS
			NV	20	32000	6.177606	20	PASS
			NV	30	34000	6.563707	20	PASS
			NV	40	34000	6.563707	20	PASS
	Ant2	5180	NV	-10	-2000	-0.3861	20	PASS
			NV	0	2000	0.3861	20	PASS
			NV	10	5000	0.965251	20	PASS
			NV	20	8000	1.544402	20	PASS
			NV	30	10000	1.930502	20	PASS
			NV	40	10000	1.930502	20	PASS
	Ant1	5200	NV	-10	19000	3.653846	20	PASS
			NV	0	22000	4.230769	20	PASS
			NV	10	25000	4.807692	20	PASS
			NV	20	27000	5.192308	20	PASS
			NV	30	29000	5.576923	20	PASS
			NV	40	31000	5.961538	20	PASS
	Ant2	5200	NV	-10	26000	5	20	PASS
			NV	0	27000	5.192308	20	PASS
			NV	10	28000	5.384615	20	PASS
			NV	20	29000	5.576923	20	PASS
			NV	30	29000	5.576923	20	PASS
			NV	40	29000	5.576923	20	PASS
	Ant1	5240	NV	-10	26000	4.961832	20	PASS
			NV	0	28000	5.343511	20	PASS
			NV	10	29000	5.534351	20	PASS
			NV	20	30000	5.725191	20	PASS
			NV	30	30000	5.725191	20	PASS
			NV	40	31000	5.916031	20	PASS
	Ant2	5240	NV	-10	26000	4.961832	20	PASS
			NV	0	26000	4.961832	20	PASS
			NV	10	26000	4.961832	20	PASS
			NV	20	25000	4.770992	20	PASS
			NV	30	25000	4.770992	20	PASS
			NV	40	25000	4.770992	20	PASS
	Ant1	5745	NV	-10	19000	3.307224	20	PASS
			NV	0	20000	3.481288	20	PASS
			NV	10	20000	3.481288	20	PASS
			NV	20	21000	3.655352	20	PASS
			NV	30	21000	3.655352	20	PASS
			NV	40	22000	3.829417	20	PASS
	Ant2	5745	NV	-10	24000	4.177546	20	PASS
			NV	0	25000	4.35161	20	PASS
			NV	10	25000	4.35161	20	PASS
			NV	20	26000	4.525674	20	PASS
			NV	30	25000	4.35161	20	PASS
			NV	40	26000	4.525674	20	PASS
	Ant1	5785	NV	-10	27000	4.667243	20	PASS
			NV	0	28000	4.840104	20	PASS
			NV	10	29000	5.012965	20	PASS
			NV	20	30000	5.185825	20	PASS
			NV	30	31000	5.358686	20	PASS
			NV	40	32000	5.531547	20	PASS
	Ant2	5785	NV	-10	37000	6.395851	20	PASS
			NV	0	38000	6.568712	20	PASS
			NV	10	38000	6.568712	20	PASS
			NV	20	38000	6.568712	20	PASS
			NV	30	38000	6.568712	20	PASS
			NV	40	38000	6.568712	20	PASS
	Ant1	5825	NV	-10	38000	6.523605	20	PASS

			NV	0	41000	7.038627	20	PASS
			NV	10	42000	7.2103	20	PASS
			NV	20	43000	7.381974	20	PASS
			NV	30	44000	7.553648	20	PASS
			NV	40	45000	7.725322	20	PASS
	Ant2	5825	NV	-10	48000	8.240343	20	PASS
			NV	0	47000	8.06867	20	PASS
			NV	10	48000	8.240343	20	PASS
			NV	20	48000	8.240343	20	PASS
			NV	30	47000	8.06867	20	PASS
			NV	40	48000	8.240343	20	PASS
11N40MIMO	Ant1	5190	NV	-10	36000	6.936416	20	PASS
			NV	0	38000	7.321773	20	PASS
			NV	10	41000	7.899807	20	PASS
			NV	20	43000	8.285164	20	PASS
			NV	30	44000	8.477842	20	PASS
			NV	40	45000	8.67052	20	PASS
	Ant2	5190	NV	-10	39000	7.514451	20	PASS
			NV	0	39000	7.514451	20	PASS
			NV	10	38000	7.321773	20	PASS
			NV	20	37000	7.129094	20	PASS
			NV	30	38000	7.321773	20	PASS
			NV	40	37000	7.129094	20	PASS
	Ant1	5230	NV	-10	32000	6.118547	20	PASS
			NV	0	33000	6.309751	20	PASS
			NV	10	34000	6.500956	20	PASS
			NV	20	35000	6.692161	20	PASS
			NV	30	35000	6.692161	20	PASS
			NV	40	35000	6.692161	20	PASS
	Ant2	5230	NV	-10	29000	5.544933	20	PASS
			NV	0	28000	5.353728	20	PASS
			NV	10	28000	5.353728	20	PASS
			NV	20	28000	5.353728	20	PASS
			NV	30	27000	5.162524	20	PASS
			NV	40	27000	5.162524	20	PASS
	Ant1	5755	NV	-10	23000	3.996525	20	PASS
			NV	0	24000	4.170287	20	PASS
			NV	10	25000	4.344049	20	PASS
			NV	20	26000	4.517811	20	PASS
			NV	30	26000	4.517811	20	PASS
			NV	40	27000	4.691573	20	PASS
	Ant2	5755	NV	-10	32000	5.560382	20	PASS
			NV	0	33000	5.734144	20	PASS
			NV	10	32000	5.560382	20	PASS
			NV	20	32000	5.560382	20	PASS
			NV	30	33000	5.734144	20	PASS
			NV	40	32000	5.560382	20	PASS
	Ant1	5795	NV	-10	27000	4.659189	20	PASS
			NV	0	29000	5.004314	20	PASS
			NV	10	29000	5.004314	20	PASS
			NV	20	31000	5.349439	20	PASS
			NV	30	31000	5.349439	20	PASS
			NV	40	32000	5.522002	20	PASS
	Ant2	5795	NV	-10	36000	6.212252	20	PASS
			NV	0	36000	6.212252	20	PASS
			NV	10	36000	6.212252	20	PASS
			NV	20	37000	6.384814	20	PASS
			NV	30	38000	6.557377	20	PASS
			NV	40	37000	6.384814	20	PASS

3.8. Antenna Requirement

Standard Requirement

FCC CFR Title 47 Part 15 Subpart C 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Test Result

Complies

3.9. Dynamic Frequency Selection(DFS)

Requirement

Table 1: Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

LIMIT

1. DFS Detection Thresholds

Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

2. DFS Response Requirements

Table 4: DFS Response Requirement Values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required facilitating a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

RADAR TEST WAVEFORMS

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

Table 5 Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

For example if in Short Pulse Radar Type 1 Test B a PRI of 3066 μsec is selected, the number of pulses would be Round up $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot10^6}{3066}\right)\right\}$ = Round up {17.2} = 18.

Table 5a - Pulse Repetition Intervals Values for Test A

Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (Microseconds)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698

11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Table 6 – Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveforms are randomly chosen. Thirty unique waveforms are required for the Long Pulse Radar Type waveforms. If more than 30 waveforms are used for the Long Pulse Radar Type wave forms, then each additional waveform must also be unique and not repeated from the previous waveforms.

Table 7 – Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

For the Frequency Hopping Radar Type, the same Burst parameters are used for each wave form. The hopping sequence is different for each wave form and a 100-length segment is selected from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250–5724MHz.Next,the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

Calibration of Radar Waveform

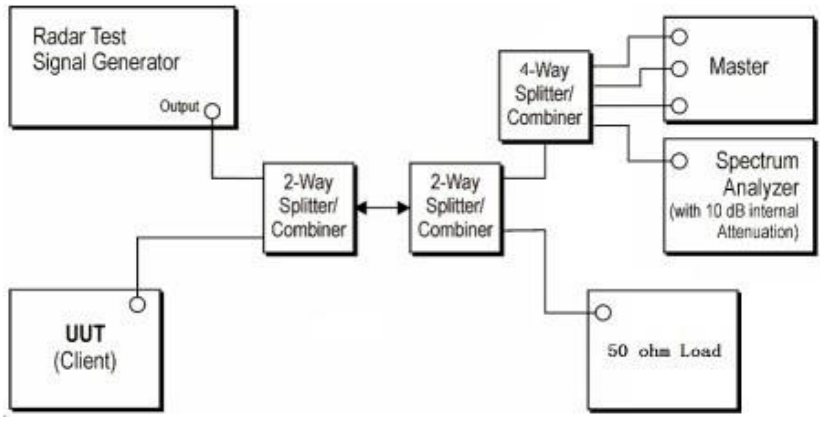
Radar Waveform Calibration Procedure

1) A 50 ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected to place of the master
2) The interference Radar Detection Threshold Level is -62dBm + 0dBi +1dB = -61dBm that had been taken into account the output power range and antenna gain.
3) The following equipment setup was used to calibrate the conducted radar waveform. A vector signal generator was utilized to establish the test signal level for radar type 0. During this process there were no transmissions by either the master or client device. The spectrum analyzer was switched to the zero spans (time domain) at the frequency of the radar waveform generator. Peak detection was

used. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3 MHz. The spectrum analyzer had offset -1.0dB to compensate RF cable loss 1.0dB.

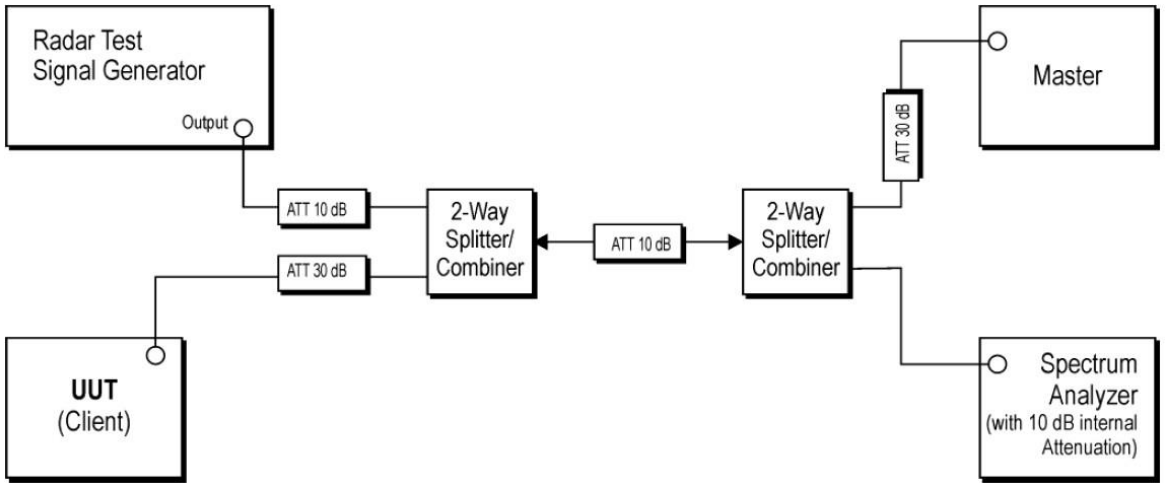
4) The vector signal generator amplitude was set so that the power level measured at the spectrum analyzer was - -62dBm + 0dBi +1dB = -61dBm. Capture the spectrum analyzer plots on short pulse radar waveform.

Conducted Calibration Setup



Test Configuration

Setup for Client with injection at the Master



Radar Waveform Calibration Result

☒ **Not Applicable**

Test Procedure

1. The radar pulse generator is setup to provide a pulse at frequency that the master and client are operating. A type 0 radar pulse with a 1us pulse width and a 1428us PRI is used for the testing.
2. The vector signal generator is adjusted to provide the radar burst (18 pulses) at the level of approximately -61dBm at the antenna port of the master device
3. A trigger is provided from the pulse generator to the DFS monitoring system in order to capture the traffic and the occurrence of the radar pulse.
4. EUT will associate with the master at channel. The file “iperf.exe” specified by the FCC is streamed from the PC 2 through the master and the client device to the PC 1 and played in full motion video using Media Player Classic Ver. 6.4.8.6 in order to properly load the network for the entire period of the test.
5. When radar burst with a level equal to the DFS Detection Threshold +1dB is generated on the operating channel of the U-NII device. At time T0 the radar waveform generator sends a burst of pulse of the radar waveform at Detection Threshold +1dB.
6. Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel Measure and record the transmissions from the UUT during the observation time (Channel Move Time). One 15 seconds plot is reported for the Short Pulse Radar Type 0. The plot for the Short Pulse Radar Types start at the end of the radar burst. The Channel Move Time will be calculated based on the zoom in 600ms plot of the Short Pulse Radar Type
7. Measurement of the aggregate duration of the Channel Closed Transmission Time method. With the spectrum analyzer set to zero span tuned to the center frequency of the EUT operating channel at the radar simulated frequency, peak detection, and max hold, the dwell time per bin is given by: Dwell (0.3ms) =S (12000ms) / B (4000); where Dwell is the dwell time per spectrum analyzer sampling bin, S is sweep time and B is the number of spectrum analyzer sampling bins. An upper bound of the aggregate duration of the intermittent control signals of Channel Closing Transmission Time is calculated by: C (ms)= N X Dwell (0.3ms); where C is the Closing Time, N is the number of spectrum analyzer sampling bins (intermittent control signals) showing a U-NII transmission and Dwell is the dwell time per bin.
8. Measurement the EUT for more than 30 minutes following the channel move time to verify that no transmission or beacons occur on this channel.

Test Mode

Please refer to the clause 2.4.

Test Results

☐ **Passed** ☒ **Not Applicable**

**************************THE END**************************