

TEST REPORT

EUT Description	WLAN and BT, 2x2 PCIe M.2 2230 adapter card
Brand Name	Intel® Wi-Fi 6E AX211
Model Name	AX211NGW
Date of Test Start/End	2020-11-30 / 2021-01-04
Features	802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth® 5.2 (see section 5)

Applicant	Intel Corporation SAS
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Reference Standards	ETSI EN 300 328 V2.2.2 (see section 1)
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Test Report identification	200611-01.TR11
Revision Control	Rev. 00 This test report revision replaces any previous test report revision (see section 8)

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1. Standards, reference documents and applicable test methods

1. ETSI EN300 328 v2.2.2, Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum

2. General conditions, competences and guarantees

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3. Environmental Conditions

- ✓ At the site where the measurements were performed the following limits were not exceeded during the tests:

Temperature	20.2°C ± 3.9°C
Humidity	46.0% ± 8.1%

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#01	200611-01.S14	WiFi 6E Module	AX211NGW	WFM: D8F883596D5C	2020-01-12	Conducted tests
	170000-01.S19	Laptop	Latitude E5450	4TXV562	2020-02-04	
	200611-01.S12	Extender	PCB00651_01	-	2020-11-30	
#02	200611-01.S04	WiFi 6E Module	AX211NGW	WFM:D8F8835981DE	2020-11-23	Used for 30MHz-12.75GHz Tx Radiated Spurious Emission tests and 30MHz-1GHz Rx Radiated Spurious Emission tests
	200611-03.S26	Extender	ADEXELEC	-	2020-07-01	
	200611-01.S07	Adaptor	PowerBy SNJ A4	-	2020-11-30	
	200602-03.S06	Absorber	MCS0	-	2020-07-03	
	170000-01.S01	Laptop	Latitude E5470	DBPLMC2	2017-03-28	
	200928-03.S08	Main Antenna	SkyCross	-	2020-09-01	
	200928-03.S09	Aux Antenna	SkyCross	-	2020-09-01	
#03	200611-01.S03	WiFi 6E Module	AX211NGW	WFM:D8F8835981A7	2020-11-23	Used for 1GHz-12.75GHz Rx Radiated Spurious Emission tests
	200611-01.S06	Adaptor	PowerBy SNJ A4	-	2020-11-30	
	200602-03.S06	Absorber	MCS0	-	2020-07-03	
	200615-05.S06	Host	Latitude 7490	63QMRQ2	2020-06-12	

5. EUT Features

The herein information is provided by the customer

Brand Name	Intel® Wi-Fi 6E AX211		
Model Name	AX211NGW		
Software Version	DRTU version: 11195_99_2100_51G		
Driver Version	99.0.58.3_t64		
Prototype / Production	Production		
Supported Radios	802.11b/g/n/ax 2.4GHz (2400.0 – 2483.5 MHz) 802.11a/n/ac/ax 5.2GHz (5150.0 – 5350.0 MHz) 5.6GHz (5470.0 – 5725.0 MHz) 5.8GHz (5725.0 – 5875.0 MHz) Bluetooth 5.2 2.4GHz (2400.0 – 2483.5 MHz)		
Antenna Information	Transmitter	Main (chain A)	Aux (chain B)
	Manufacturer	SkyCross	Skycross
	Antenna type	PIFA antenna	PIFA antenna
	Part number	N/A	N/A
	Declared antenna gain (dBi)	+3	+3
Document	Filename		Date of receipt
	Intel_Ref_Antenna data_HMC-M2 Ant_Spec_Universe_SkyCross Antenna		2013-01-28
	Annex E_EN300328 V2 2 2 for 2x2		2020-08-13

6. Remarks and comments

1. According to the applicant declaration the device AX211NGW operating in 802.11b/g/n/a/ac/ax mode is an adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. so it is considered as receiver category 1.

7. Test Verdicts summary

The statement of conformity to applicable standards in the table below are based on the measured values, without taking into account the measurement uncertainties.

7.1. 802.11b/g/n/ax

Mode	ETSI clause	Test	Verdict
2.4GHz	4.3.2.2	RF output power	P
	4.3.2.3	Power Spectral Density	P
	4.3.2.4	Duty Cycle, Tx-sequence, TX gap	NA
	4.3.2.5	Medium Utilization (MU) factor.	NA
	4.3.2.6	Adaptivity (adaptive equipment using modulations other than FHSS)	P
	4.3.2.7	Occupied Channel Bandwidth	P
	4.3.2.8	Transmitter unwanted emissions in the out-of-band domain	P
	4.3.2.9	Transmitter unwanted emissions in the spurious domain	P
	4.3.2.10	Receiver spurious emissions	P
	4.3.2.11	Receiver Blocking	P

P: Pass
F: Fail
NM: Not Measured
NA: Not Applicable

8. Document Revision History

Revision #	Modified by	Revision Details
Rev. 00	G. Roustan	First Issue

Annex A. Test & System Description

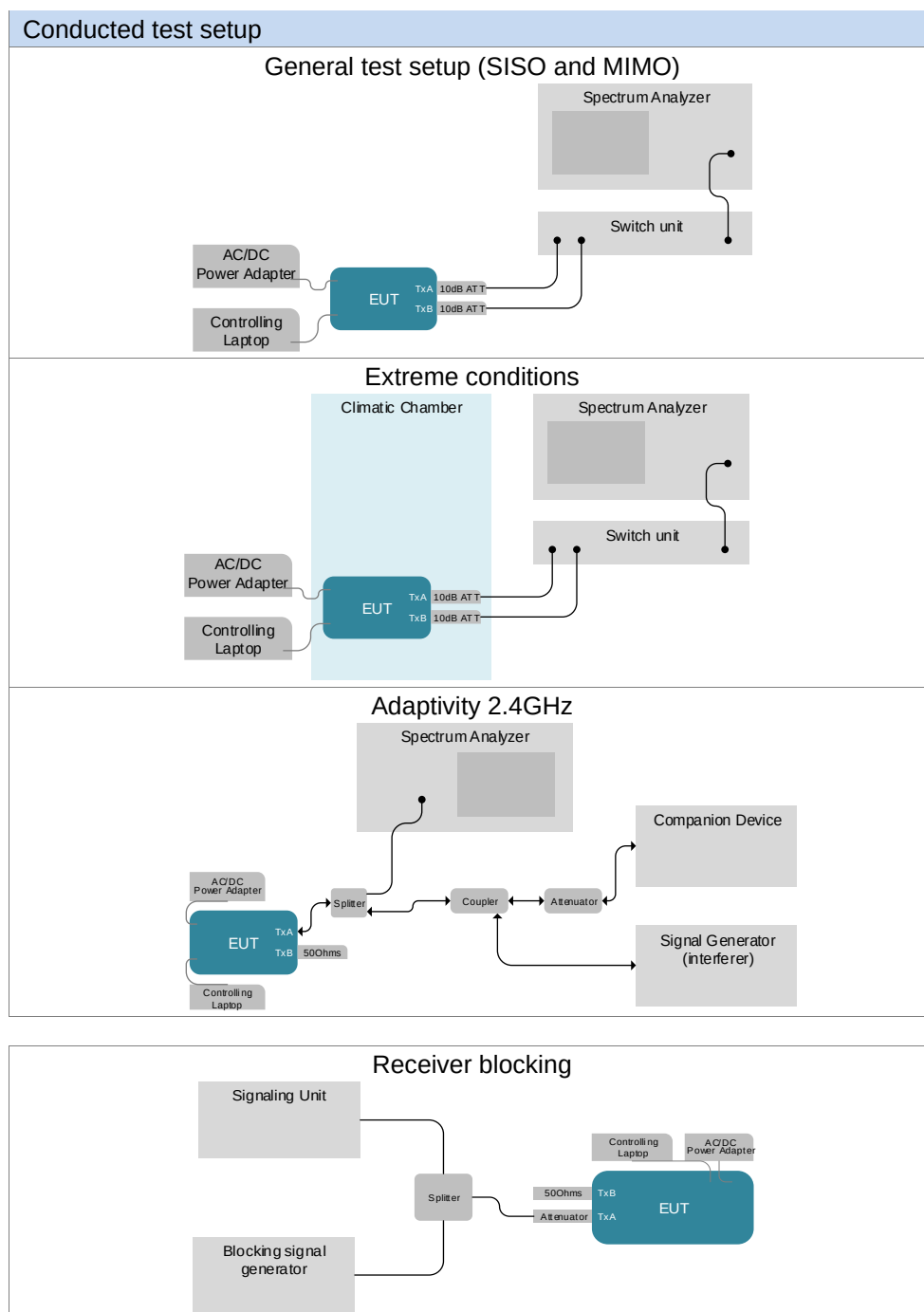
A.1 Measurement System

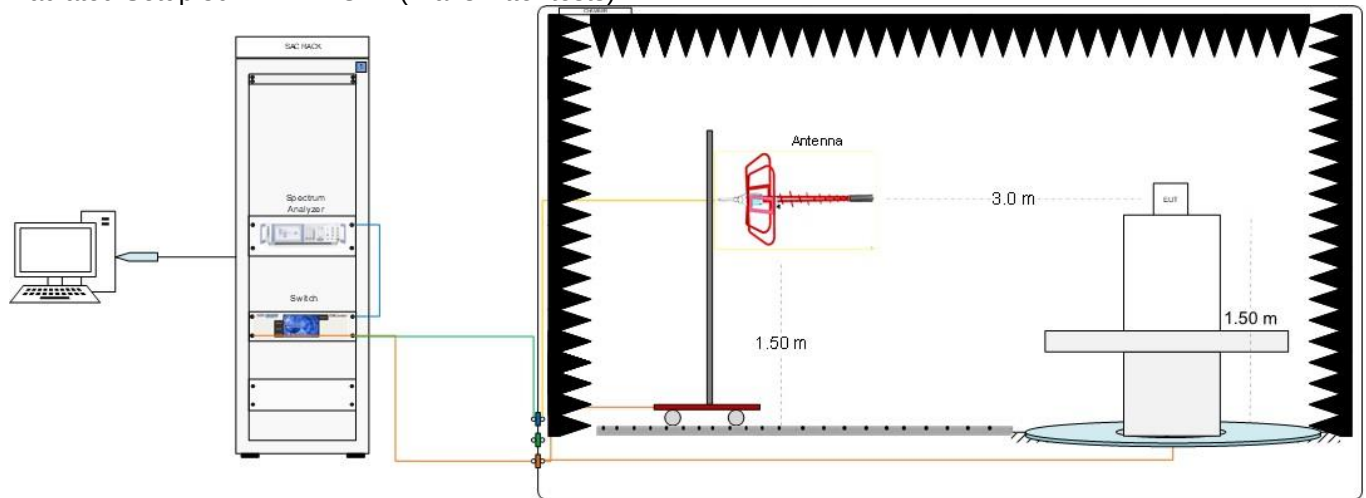
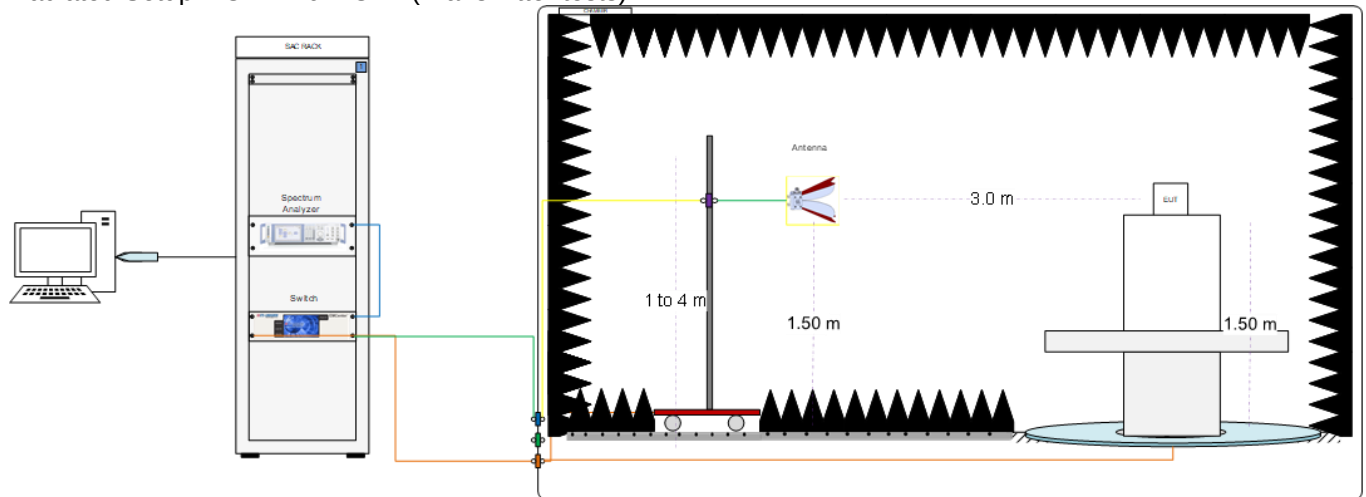
Measurements were performed using the following setups and made in accordance to the general provisions of ETSI EN 300 328 V2.2.2

Rohde & Schwarz TS8997 system with the switching unit OSP120, OSP B-157 and software EMC32 were employed.

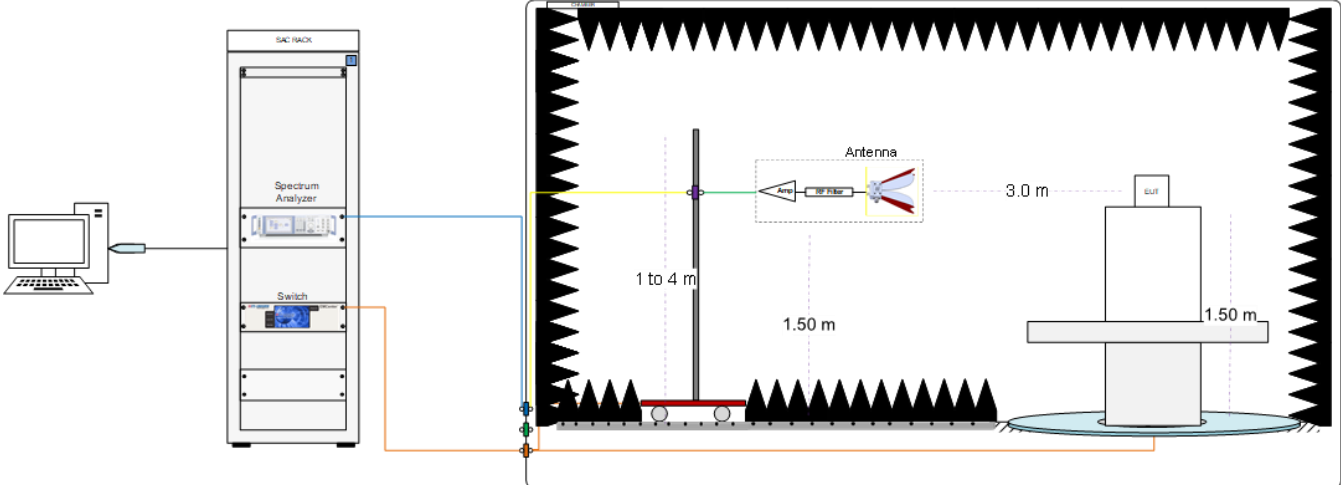
The DUT was installed in a test fixture and then connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using all different modes and modulation schemes, using the Intel proprietary tool DRTU.

Setups for conducted and radiated measurements are shown below.

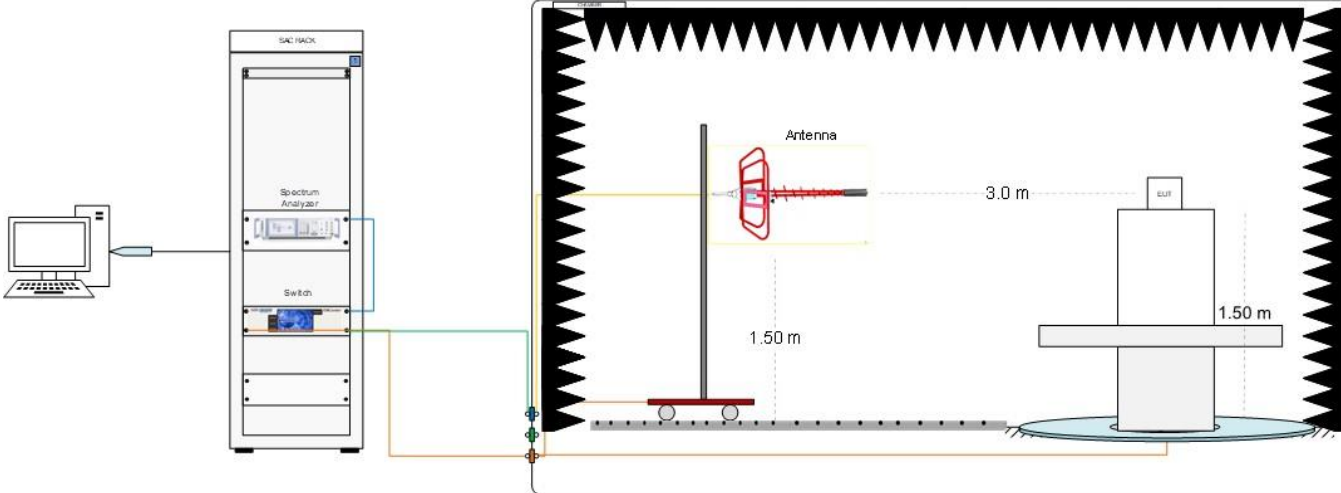


Radiated test setup**Radiated Setup 30 MHz - 1 GHz (Transmitter tests)****Radiated Setup 1 GHz – 6.4 GHz (Transmitter tests)**

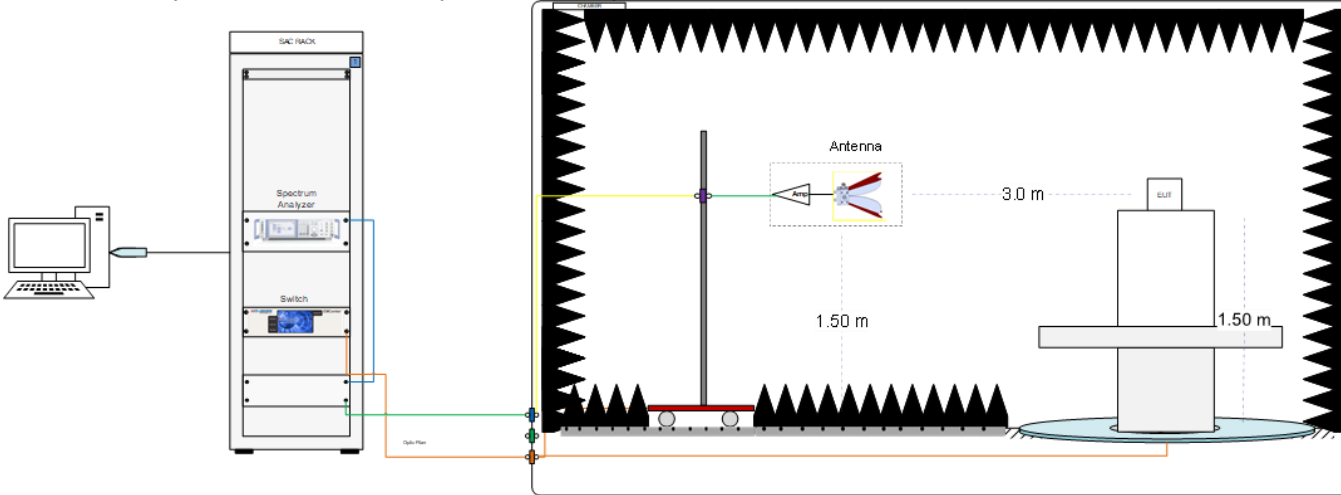
Radiated Setup 6.4 GHz – 12.75 GHz (Transmitter tests)



Radiated Setup 30 MHz - 1 GHz (Receiver tests)



Radiated Setup 1 GHz – 12.75 GHz (Receiver tests)



A.2 Test Equipment List

Conducted Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0017	Vector signal generator	SMJ100A	100458	Rohde & Schwarz	2019-04-23	2021-04-23
0016	Signal Generator	SMF100A	102117	Rohde & Schwarz	2020-05-14	2022-05-14
0056	Switch unit	OSP 120	100945	Rohde & Schwarz	2020-04-21	2022-04-21
0261	Access point	Aironet IOS	FTX134390GV	Cisco	N/A	N/A
0293	DC Power supply	E3640A	MY40006885	Agilent	N/A	N/A
0299	Multimeter	34401A	US36065790	HP	2019-12-11	2021-12-11
0300	Climatic chamber	SLT34/40	56746020930010	Secasi	2019-11-20	2021-11-20
0318	Spectrum analyzer	FSV30	103310	Rohde & Schwarz	2020-06-03	2022-06-03
0581	Temp & Humidity Logger	RA12E-TH1-RAS	RA12-B89BE3	Avtech	2020-01-23	2022-01-23
0741	Measurement Software	EMC32 v11.00.00	200226	Rohde & Schwarz	N/A	N/A
0847	RF Cable 0.5m	PE3CA1039	-	Pasternack	2020-08-26	2021-02-26
0848	RF Cable 1.2m	PE3C0666	-	Pasternack	2020-08-26	2021-02-26
0869	Cable SMA Male to ML51-P	HRMP-ML51LP	DTR178-100RS	Hirose	2020-08-26	2021-02-26
0870	Cable SMA Male to ML51-P	HRMP-ML51LP	DTR178-100RS	Hirose	2020-08-26	2021-02-26
0876	Thermometer	t3000FC	-	Fluke	2019-11-29	2021-11-29
0991	RF Cable 2m + 10dB ATT	0900670672000PJ	1936949	Radiall	2020-08-26	2021-02-26
0992	RF Cable 2m + 10dB ATT	0900670672000PJ	1936947	Radiall	2020-08-26	2021-02-26

N/A: Not Applicable

Receiver blocking Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0100	Communication tester	CMW500	129337	Rohde & Schwarz	2019-04-02	2021-04-02
0309	Signal generator	SMB100A	178217	Rohde & Schwarz	2020-04-17	2022-04-17
0378	RF Cable 1.2m	UFA147A-0-0480-200200	MFR 64639 223720-001	Micro-coax	2020-08-26	2021-02-26
0796	Temp & Humidity Logger	RA12E-TH1-RAS	RA12-D4F316	Avtech	2019-07-05	2021-07-05
0866	RF Cable 0.5m	FMC0202085-18	-	Fairview	2020-08-26	2021-02-26
0873	RF splitter	PE2083	-	Pasternack	N/A	N/A
0874	RF Cable 0.9m	PE3CA 1039-36	-	Pasternack	2020-08-26	2021-02-26

N/A: Not Applicable

Radiated Setup #1

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0135	Anechoic Chamber	FACT3	5720	ETS-Lindgren	2020-01-07	2022-01-07
0136	Turn Table	ETS	-	ETS-Lindgren	N/A	N/A
1076	Spectrum Analyzer	FSW43	101847	Rohde & Schwarz	2020-11-02	2022-11-02
0530	Measurement SW	EMC32, v10.40.10	100623	Rohde & Schwarz	N/A	N/A
0147	Switch & Positioning systems	EMC Center	00159757	ETS-Lindgren	N/A	N/A
0137	Biconilog Antenna	3142E	00156946	ETS-Lindgren	2020-03-12	2022-03-12
0141	Horn Antenna+ Amplifier + HPF6.4	3117	00157736	ETS-Lindgren	2020-04-02	2022-04-02
0325	Horn antenna 3117	3117	00157734	ETS-Lindgren	2019-08-12	2021-08-12
0343	Double-Ridged Horn Antenna with Pre-Amplifier	3117-PA	00201542	ETS-Lindgren	2019-08-16	2021-08-16
1098	Cable 1.5m - DC-18GHz	CBL-1.5M-SMSM+	202879	Mini-Circuits	2020-11-27	2021-05-27
0263	Cable 1m - 1GHz to 18GHz	UFA147A	-	Utilflex	2020-08-25	2021-02-25
0371	Cable 1m – 30 MHz - 18GHz	UFB311A-0-0590-50U50U	MFR 64639 223230-001	Micro-coax	2020-08-25	2021-02-25
1099	Cable 7m DC-18 GHz	0501051057000GX	19.35.850	Radial	2020-11-27	2021-05-27
0859	Cable 2.5m - 30MHz to 18GHz	0500990992500KE	19.23.395	Radiall	2020-11-27	2021-05-27
1033	Boresight antenna mast	BAM 4.0-P	P/278/2890.01	Maturo	N/A	N/A
0797	Temp & Humidity Logger	RA12E-TH1-RAS	RA12-D0EB1A	Avtech	2019-07-04	2021-07-04

N/A: Not Applicable

Radiated Setup #2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0337	Anechoic chamber	RFD-FA-100	5996	ETS Lindgren	2020-07-06	2022-07-06
0238	Switch & Positioner	EMCenter	00151232	ETS Lindgren	N/A	N/A
0382	Antenna Tower	2171B-3.0M	00150123	ETS Lindgren	N/A	N/A
0383	Turntable	-	-	ETS Lindgren	N/A	N/A
0329	Measurement SW	EMC32, v10.50.10	100401	Rohde & Schwarz	N/A	N/A
0133	Spectrum Analyzer	FSV40	101358	Rohde & Schwarz	2020-02-25	2022-02-25
0138	Double Ridge Horn (1-18GHz)	3117	00152266	ETS Lindgren	2020-03-08	2022-03-08
0141	Horn Antenna 3117 + Amplifier + HPF6.4	3117	00157736	ETS-Lindgren	2020-04-01	2022-04-01
0343	Double-Ridged Horn Antenna with Pre-Amplifier	3117-PA	00201542	ETS-Lindgren	2019-08-16	2021-08-16
0871	RF Cable 1-18GHz, 1.5 m	0501050991200GX	19.21.710	Radiall	2020-08-20	2021-02-20
0860	RF Cable 1-18GHz, 1.2 m	2301761761200PJ	12.22.1104	Radiall	2020-08-20	2021-02-20
0275	RF Cable 1-18GHz - 6.5m	140-8500-11-51	001	Spectrum	2020-08-20	2021-02-20
0684	RF Cable 1GHz-18GHz 1.5m	-	-	Spirent	2020-08-20	2021-02-20
0725	RF Cable 1-9.5GHz 1.2m	0500990991200KE	-	Radiall	2020-08-20	2021-02-20
0796	Temp & Humidity Logger	RA12E-TH1-RAS	RA12-D4F316	Avtech	2019-07-05	2021-07-05

Shared Radiated Equipment

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0616	Power Sensor	NRP-Z81	104385	Rohde & Schwarz	2020-04-08	2022-04-08
0617	Power Sensor	NRP-Z81	104386	Rohde & Schwarz	2020-04-08	2022-04-08
0618	Power Sensor	NRP-Z81	104382	Rohde & Schwarz	2020-04-08	2022-04-08

A.3 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the table below with a coverage factor of $k = 2$ to indicate a 95% level of confidence:

Measurement type	Uncertainty	Unit
Occupied Channel Bandwidth	± 2.08	%
RF Output Power, conducted	± 0.99	dB
Power Spectral Density, conducted	± 0.99	dB
Unwanted Emission, conducted	± 1.53	dB
Radiated test < 1GHz	± 4.04	dB
Radiated test 1GHz –12.75 GHz	± 4.01	dB
Temperature	± 0.30	°C
Supply voltages	$< \pm 0.01$	%
Time	± 0.12	%

Annex B. Test Results

The herein test results were performed by:

Test case measurement	Test Engineer
RF output power	G. Roustan
Power spectral density	G. Roustan
Adaptivity (adaptive equipment using modulations other than FHSS)	G. Roustan
Occupied channel bandwidth	G. Roustan
Transmitter unwanted emission in the out-of-band domain	G. Roustan
Transmitter unwanted emissions in the spurious domain	N. Nachabe, A. Lounes, N. Bui
Receiver spurious emissions	A. Lounes, N. Bui
Receiver blocking	Z. Ouachicha

B.1 Test conditions

ETSI clause	Conditions	ETSI EN 300 328 V2.2.2 Annex E
5.1.2.1	The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges: • Temperature: +15 °C to +35 °C; • Relative humidity: 20 % to 75 %.	 "Information provided by the customer"
5.1.2.2	The normal test voltage for the equipment shall be the nominal voltage for which the equipment was designed.	
5.1.3	Some tests in the present document need to be repeated at extreme temperatures. Where that is the case, measurements shall be made over the extremes of the operating temperature range as declared by the manufacturer.	

For 802.11b mode the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually, but not simultaneously.

For 802.11n20, 802.11ax20 (20 MHz channel bandwidth), 802.11n40, 802.11ax40 (40MHz channel bandwidth), modes the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually, and also simultaneously.

The conducted RF output power at each chain was adjusted according to the client's supplied target values (see following table) using the Intel DRTU tool and measuring the power by using a calibrated average power meter. Measured values for adjustment were within ± 0.25 dB from the declared target values.

2.4GHz					Conducted Power, Target Value (dBm)		
Mode	BW (MHz)	Data Rate	CH #	Freq. (MHz)	SISO Chain A	SISO Chain B	MIMO A + B
802.11b	20	1Mbps	1	2412	16.0	16.0	-
			7	2442	16.0	16.0	-
			13	2472	16.0	16.0	-
802.11g	20	6 Mbps	1	2412	16.5	16.5	-
			7	2442	16.5	16.5	-
			13	2472	16.5	16.5	-
802.11n	20	HT0 HT8*	1	2412	16.5	16.5	16.5
			7	2442	16.5	16.5	16.5
			13	2472	16.5	16.5	16.5
	40	HT0 HT8*	3	2422	16.5	16.0	16.5
			7	2442	16.5	16.5	16.5
			11	2462	16.5	16.5	16.5
802.11ax	20	HE0	1	2412	16.5	16.5	16.5
			7	2442	16.5	16.5	16.5
			13	2472	16.5	16.5	16.5
	40	HE0	3	2422	16.5	16.5	16.5
			7	2442	16.5	16.5	16.5
			11	2462	16.5	16.5	16.5

* Note: HT8 for MIMO modes only.

The following data rates were selected based on preliminary testing that identified those rates as the worst cases for output power and spurious levels at the band edges:

Transmission	Mode	Bandwidth (MHz)	Worst Case Data Rate
SISO	802.11b	20	1Mbps
	802.11g	20	6Mbps
	802.11n	20	HT0
		40	HT0
	802.11ax	20	HE0
		40	HE0
MIMO	802.11n	20/40	HT8
	802.11ax	20/40	HE0

B.2 RF output power

Test limits

ETSI clause	Limits
4.3.2.2.3	The RF output power for non-FHSS equipment shall be equal to or less than 20 dBm. This limit shall apply for any combination of power level and intended antenna assembly.

Test conditions

ETSI clause	Conditions
5.4.2.1	The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range. For non-FHSS equipment, the measurement shall be performed at the lowest, the middle, and the highest channel on which the equipment can operate. These frequencies shall be recorded.

Test procedure

The conducted setups shown in section *Test & System Description* were used to measure the RF output power. The antenna terminal of the EUT is connected to the OSP120 through a 10dB attenuator and a cable, the spectrum analyzer is connected to the receiver port of the OSP. System connection cable loss is compensated by the EMC32 software

Antenna gain is taken into account and added by the software to the measurements. The E.I.R.P. power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power. The declared maximum antenna gain is +3dBi.

For MIMO modes, according to the test procedure described in ETSI EN 300 328 V2.2.2 §5.4.2.2.1.2, the measurement is done synchronously on all transmit ports, the power of the individual samples is sum for all ports and then the reported power is the highest calculated RMS power for the active bursts.

Results tables

RF Output Power						Normal condition Ambient Temperature +23°C		Extreme condition High Temperature +70 °C		Extreme condition Low Temperature -10 °C	
Mode	Meas Duty Cycle %	Rate	#Ch	Freq [MHz]	Chain	Measured Conducte d [dBm]	EIRP [dBm]	Measured Conducte d [dBm]	EIRP [dBm]	Measured Conducte d [dBm]	EIRP [dBm]
802.11b	99.5	1Mbps	1	2412	A	15.9	18.9	15.7	18.7	16.1	19.1
					B	15.8	18.8	15.8	18.8	15.9	18.9
			7	2442	A	15.8	18.8	15.7	18.7	16.1	19.1
					B	15.9	18.9	15.7	18.7	16.0	19.0
			13	2472	A	15.9	18.9	15.8	18.8	16.2	19.2
					B	15.9	18.9	15.8	18.8	16.0	19.0
802.11g	97.9	6Mbps	1	2412	A	16.5	19.5	16.4	19.4	16.6	19.6
					B	16.4	19.4	16.2	19.2	16.4	19.4
			7	2442	A	16.3	19.3	16.3	19.3	16.5	19.5
					B	16.3	19.3	16.2	19.2	16.4	19.4
			13	2472	A	16.4	19.4	16.3	19.3	16.6	19.6
					B	16.3	19.3	16.1	19.1	16.4	19.4
802.11n20	98.9	HT0	1	2412	A	16.5	19.5	16.4	19.4	16.6	19.6
					B	16.2	19.2	16.2	19.2	16.4	19.4
			7	2442	A	16.4	19.4	16.4	19.4	16.5	19.5
					B	16.3	19.3	16.1	19.1	16.4	19.4
	98.8	HT8	13	2472	A	16.5	19.5	16.4	19.4	16.7	19.7
					B	16.3	19.3	16.2	19.2	16.4	19.4
802.11n40	97.9	HT0	3	2422	A	16.3	19.3	16.3	19.3	16.4	19.4
					B	16.1	19.1	16.0	19.0	16.2	19.2
			7	2442	A	16.3	19.3	16.3	19.3	16.4	19.4
					B	16.3	19.3	16.2	19.2	16.3	19.3
	97.9	HT8	11	2462	A	16.5	19.5	16.5	19.5	16.6	19.6
					B	16.3	19.3	16.1	19.1	16.2	19.2
802.11ax20	98.8	HE0	3	2422	A+B	16.4	19.4	16.3	19.3	16.4	19.4
					A+B	16.4	19.4	16.3	19.3	16.4	19.4
			7	2442	A+B	16.4	19.4	16.3	19.3	16.4	19.4
					A+B	16.4	19.4	16.3	19.3	16.4	19.4
	99.4	HE0	13	2472	A+B	16.4	19.4	16.2	19.2	16.4	19.4
					A+B	16.4	19.4	16.2	19.2	16.4	19.4
802.11ax40	98.9	HE0	1	2412	A	16.6	19.6	16.3	19.3	16.6	19.6
					B	16.4	19.4	16.2	19.2	16.4	19.4
			7	2442	A	16.3	19.3	16.1	19.1	16.5	19.5
					B	16.3	19.3	16.1	19.1	16.3	19.3
	99.4	HE0	13	2472	A	16.5	19.5	16.4	19.4	16.6	19.6
					B	16.2	19.2	16.1	19.1	16.4	19.4

B.3 Power Spectral Density

Test limits

ETSI clause	Limits
4.3.2.3.3	The maximum Power Spectral Density for non-FHSS equipment is 10 dBm per MHz.

Test conditions

ETSI clause	Conditions
5.4.3.1	These measurements shall only be performed at normal test conditions. The measurement shall be repeated for the equipment being configured to operate at the lowest, the middle, and the highest frequency of the stated frequency range. For the duration of the test, the equipment shall not change its operating frequency.

Test procedure

The conducted setups shown in section *Test & System Description* were used to measure the power spectral density (PSD). The antenna terminal of the EUT is connected to the OSP120 through a 10dB attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software to measure all parameters.

Antenna gain is taken into account and added by the software to the measurements. The E.I.R.P. power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power. The declared maximum antenna gain is +3dBi.

For MIMO modes, accordingly to the test procedure described in ETSI EN 300 328 V2.2.2 §5.4.3.2.1, the measurement is done separately on each transmit ports and the power of the individual samples per frequency is sum for all ports. From all the recorded results, the highest value is the maximum Power Spectral Density.

Results tables

Mode	Meas. Duty cycle %	Rate	CH Number	Frequency [dBm]	Chain	PSD [dBm/MHz]
802.11b	99.5	1Mbps	1	2412	A	9.70
					B	9.81
			7	2442	A	9.74
					B	9.81
			13	2472	A	9.82
					B	9.78
802.11g	97.9	6Mbps	1	2412	A	7.60
					B	7.58
			7	2442	A	7.45
					B	7.51
			13	2472	A	7.53
					B	7.45
802.11n20	98.9	HT0	1	2412	A	7.63
					B	7.16
			7	2442	A	7.22
					B	7.21
			13	2472	A	7.36
					B	7.15
	98.8	HT8	1	2412	A+B	7.34
			7	2442	A+B	7.17
			13	2472	A+B	7.18
802.11n40	97.9	HT0	3	2422	A	4.30
					B	4.02
			7	2442	A	4.23
					B	4.15
			11	2462	A	4.40
					B	4.08
	97.9	HT8	3	2422	A+B	4.32
			7	2442	A+B	4.34
			11	2462	A+B	4.23
802.11ax20	98.8	HE0	1	2412	A	7.02
					B	6.90
			7	2442	A	6.83
					B	6.79
			13	2472	A	7.08
					B	6.75
	99.4	HE0	1	2412	A+B	6.93
			7	2442	A+B	6.96
			13	2472	A+B	6.91
802.11ax40	98.9	HE0	3	2422	A	3.98
					B	3.80
			7	2442	A	4.01
					B	3.80
			11	2462	A	3.85
					B	3.80
	99.4	HE0	3	2422	A+B	4.08
			7	2442	A+B	3.97
			11	2462	A+B	3.88

B.4 Adaptivity (adaptive equipment using modulations other than FHSS)

Test limits

ETSI clause	Limits
4.3.2.6.3.2.3	<i>Load Based Equipment</i> Load Based Equipment may implement an LBT based spectrum sharing mechanism based on the Clear Channel Assessment (CCA) mode using energy detect as described in IEEE 802.11™-2012 [i.3], clause 9, clause 10, clause 16, clause 17, clause 19 and clause 20, or in IEEE 802.15.4™-2011 [i.4], clause 4, clause 5 and clause 8 providing the equipment complies with the conformance requirements referred to in clause 4.3.2.6.3.4. Load Based Equipment not using any of the mechanisms referenced above shall comply with the following minimum set of requirements: 1) Before a transmission or a burst of transmissions, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The equipment shall observe the operating channel for the duration of the CCA observation time which shall be not less than 18 µs. The channel shall be considered occupied if the energy level in the channel exceeds the threshold given in step 5 below. If the equipment finds the channel to be clear, it may transmit immediately. 2) If the equipment finds the channel occupied, it shall not transmit on this channel (see also the next paragraph). The equipment shall perform an Extended CCA check in which the channel is observed for a random duration in the range between 18 µs and at least 160 µs. If the extended CCA check has determined the channel to be no longer occupied, the equipment may resume transmissions on this channel. If the Extended CCA time has determined the channel still to be occupied, it shall perform new Extended CCA checks until the channel is no longer occupied. NOTE: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check as there are no transmissions during this period. The equipment is allowed to switch to a non-adaptive mode and to continue transmissions on this channel providing it complies with the requirements applicable to non-adaptive equipment. Alternatively, the equipment is also allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements given in clause 4.3.2.6.4. 3) The total time that an equipment makes use of a RF channel is defined as the Channel Occupancy Time. This Channel Occupancy Time shall be less than 13 ms, after which the device shall perform a new CCA as described in step 1 above. 4) The equipment, upon correct reception of a packet which was intended for this equipment can skip CCA and immediately (see also next paragraph) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames are allowed but data frames are not allowed). A consecutive sequence of transmissions by the equipment without a new CCA shall not exceed the maximum channel occupancy time as defined in step 3 above. For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence. 5) The energy detection threshold for the CCA shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power levels less than 20 dBm e.i.r.p., the CCA threshold level may be relaxed to: $TL = -70 \text{ dBm/MHz} + 10 \times \log_{10} (100 \text{ mW} / P_{out}) \text{ (Pout in mW e.i.r.p.)}$ 6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in table 11.

4.3.2.6.4.2	Table11: Unwanted Signal parameters		
	Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted signal power (dBm)
	sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)
	NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1. NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna.		
	If implemented, Short Control Signalling Transmissions of adaptive non-FHSS equipment shall have a maximum TxOn / (TxOn + TxOff) ratio of 10 % within any observation period of 50 ms.		

Test conditions

ETSI clause	Conditions
5.4.6.1	These measurements shall only be performed at normal test conditions.

Test procedure

The adaptivity setup shown in section *Test & System Description* was used to measure adaptivity. The EUT (client) is connected to an access point through a power splitter and an attenuator. Proprietary software was used on the EUT to configure a normal transmission with sufficient payload.

Interference and unwanted signals are emulated by using a modulated signal and a continuous wave (CW) respectively, generated by the vector signal generator (VSG) and the continuous wave generator.

The power levels for the signals at the input of the receiver are as follows:

- EUT = max power level
- Companion device = -30dBm/MHz
- Interference signal = **TL + Antenna gain - Margin** = -72dBm/MHz
- Unwanted signal (CW) = **cwPower + Antenna gain - Margin** = -37dBm
 - TL** = -70 dBm/MHz, limit of the ED Threshold Level assuming 0dBi antenna gain
 - cwPower** = -35dBm, assuming 0dBi antenna gain
 - Antenna gain** = Antenna gain declared by the applicant (+3dBi)
 - Margin** = Additional margin requested by the applicant (5dB)

The frequency used for the interference signal is the same as the transmission frequency of the tested channel. The unwanted signal is fixed at 2488.5 MHz for the lowest channel tested and at 2395 MHz for the highest channel tested.

Results tables**802.11b Channel 3 – 2422 MHz, 1Mbps****Normal Operation**

DutyCycle DUT (%)	Monitoring Length (ms)	COT Max (ms)	Limit Max (ms)	COT Min (ms)	Number of COTs	CCA Time Min (ms)	CCA Time Max (ms)	CCA Time Limit Min (ms)
94.868	10000.000	12.798	13.000	0.291	805	0.025	49.101	0.018

Reaction on Interferer and Blocker

DC* in max DC Evaluation Window (%)	Limit Max (%)	Result	Length of max DC Evaluation Window (ms)	Start of max DC Evaluation Window (ms)
3.474	10.000	PASS	50.000	1710.499

Stop of max DC Evaluation Window (ms)	Interferer On (ms)	Blocker On (ms)	Monitoring Offset (ms)	Monitoring Start (ms)	Monitoring Length (ms)
1760.499	1000.000	62000.000	13.000	1013.000	121987.000

*Note: the DC is TxOn / (TxOn + TxOff) ratio of short control signaling transmissions.

802.11b Channel 11 – 2462 MHz, 1Mbps**Normal Operation**

DutyCycle DUT (%)	Monitoring Length (ms)	COT Max (ms)	Limit Max (ms)	COT Min (ms)	Number of COTs	CCA Time Min (ms)	CCA Time Max (ms)	CCA Time Limit Min (ms)
100	10000.000	12.798	13.000	0.308	878	0.024	13.037	0.018

Reaction on Interferer and Blocker

DC in max DC Evaluation Window (%)	Limit Max (%)	Result	Length of max DC Evaluation Window (ms)	Start of max DC Evaluation Window (ms)
3.574	10.000	PASS	50.000	6049.603

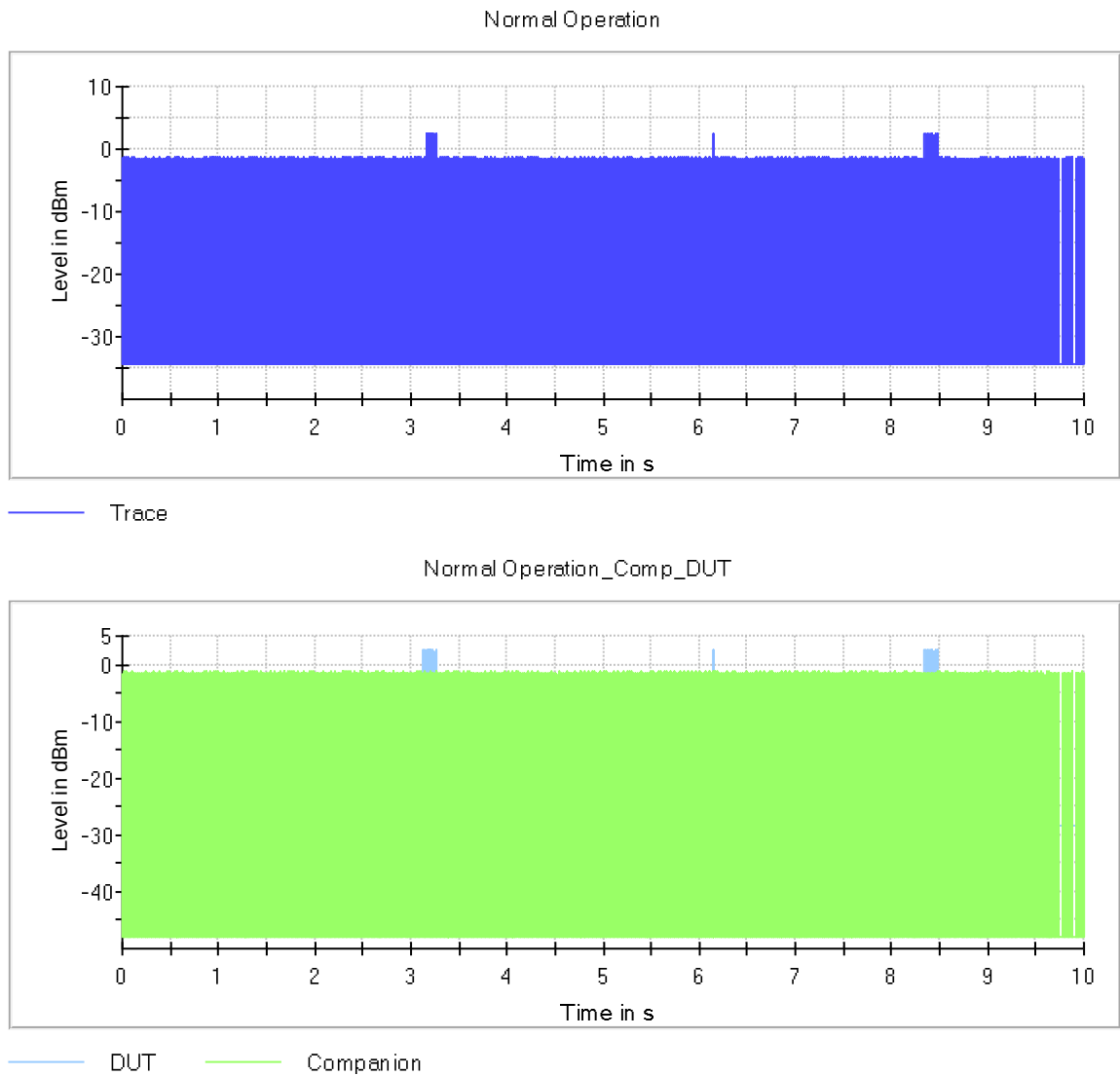
Stop of max DC Evaluation Window (ms)	Interferer On (ms)	Blocker On (ms)	Monitoring Offset (ms)	Monitoring Start (ms)	Monitoring Length (ms)
6099.603	1000.000	62000.000	13.000	1013.000	121987.000

*Note: the DC is TxOn / (TxOn + TxOff) ratio of short control signaling transmissions.

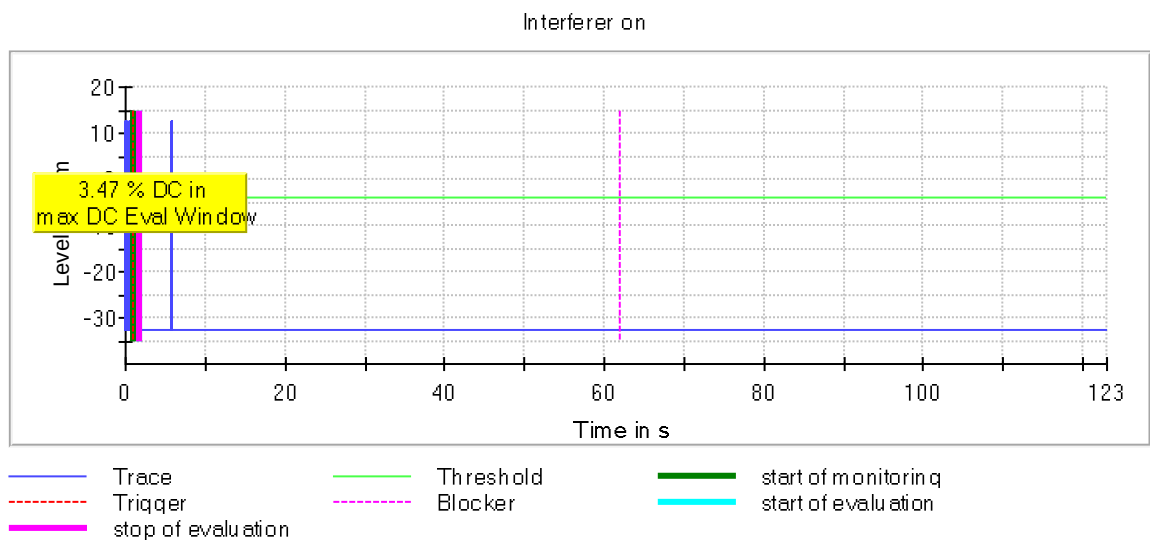
Results Screenshot

802.11b Channel 3 – 2422 MHz, 1Mbps

Normal Operation

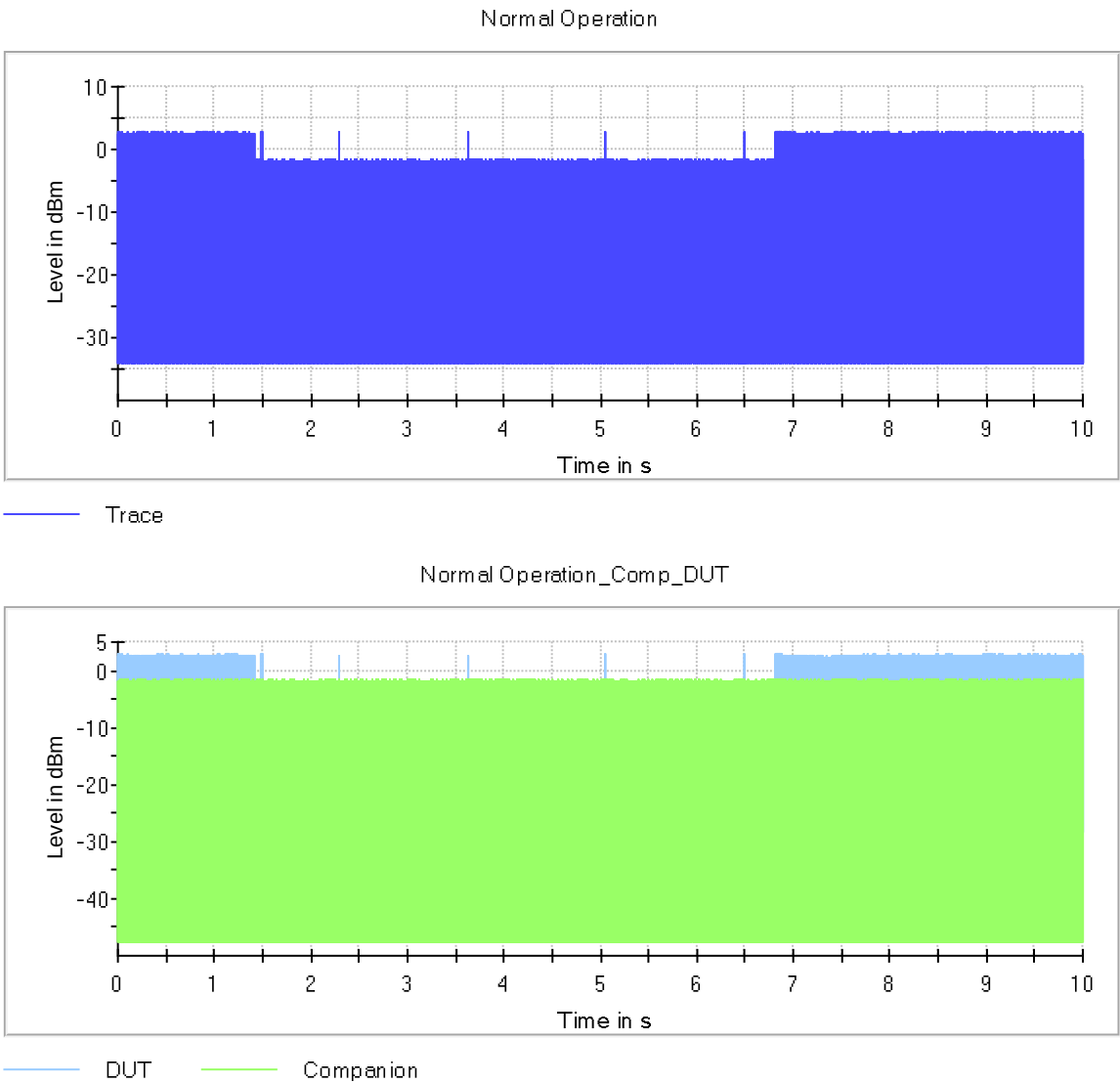


Reaction on Interferer and Blocker

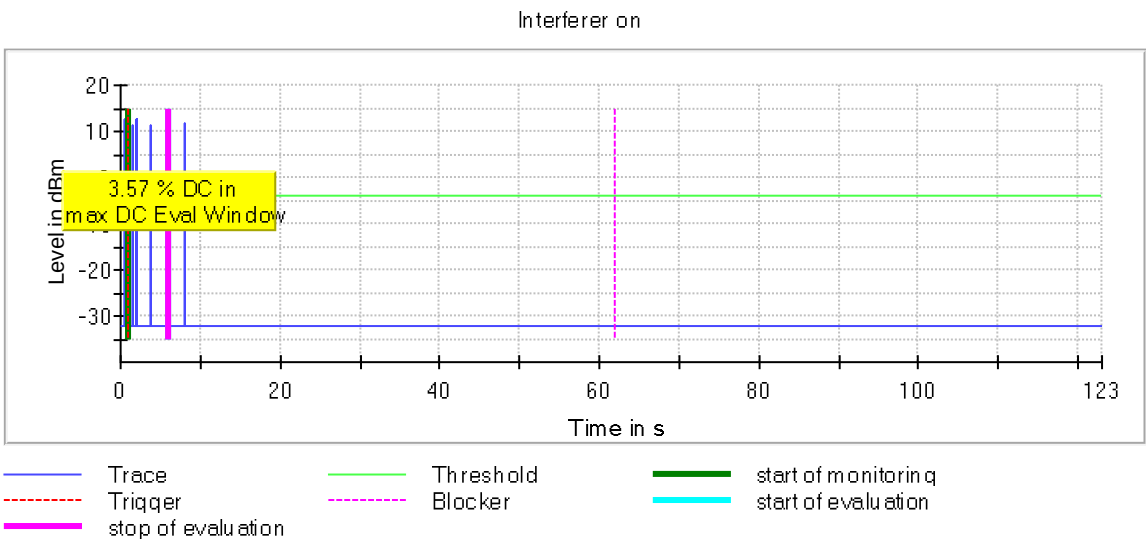


802.11b Channel 11 – 2462 MHz, 1Mbps

Normal Operation



Reaction on Interferer and Blocker



B.5 Occupied Channel Bandwidth

Tests limits

ETSI clause	Limits						
4.3.2.7.3	The Occupied Channel Bandwidth shall fall completely within the band given in Table 1 (2.4 GHz to 2.4835 GHz). Table 1: Service frequency bands <table> <tr> <th></th><th>Service frequency bands</th></tr> <tr> <td>Transmit</td><td>2 400 MHz to 2 483,5 MHz</td></tr> <tr> <td>Receive</td><td>2 400 MHz to 2 483,5 MHz</td></tr> </table> In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.		Service frequency bands	Transmit	2 400 MHz to 2 483,5 MHz	Receive	2 400 MHz to 2 483,5 MHz
	Service frequency bands						
Transmit	2 400 MHz to 2 483,5 MHz						
Receive	2 400 MHz to 2 483,5 MHz						

Test conditions

ETSI clause	Conditions
5.4.7.1	These measurements shall only be performed at normal test conditions. In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains) measurements need only to be performed on one of the active transmit chains (antenna outputs). The measurement shall be performed only on the lowest and the highest frequency within the stated frequency range. If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then each channel bandwidth shall be tested separately.

Test procedure

The conducted setups shown in section *Test & System Description* were used to measure the occupied bandwidth accordingly to the test method described in ETSI EN 300 328 V2.2.2 §5.4.7.2.1. The antenna terminal of the EUT is connected to the OSP120 through a 10 dB attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on measured parameters.

For MIMO modes, occupied bandwidth measurements are performed on Chain A.

Results tables**Low channel**

Mode	Rate	#Ch	Freq [MHz]	Chain	99% BW [MHz]	Lowest Freq [MHz]
802.11b	1Mbps	1	2412	A	13.42	2405.2919
				B	13.42	2405.2919
802.11g	6Mbps			A	16.89	2403.5528
				B	16.89	2403.5528
802.11n20	HT0			A	17.89	2403.0559
				B	17.89	2403.0559
	HT8			A+B	17.89	2403.0559
802.11n40	HT0	3	2422	A	36.77	2403.6149
	B			36.77	2403.6149	
	HT8			A+B	36.77	2403.6149
802.11ax20	HE0	1	2412	A	19.38	2402.3106
	HE0			B	19.13	2402.5590
				A+B	19.13	2402.3106
802.11ax40	HE0	3	2422	A	37.76	2403.1180
	B			37.76	2403.1200	
	HE0			A+B	37.76	2403.1180

High channel

Mode	Rate	#Ch	Freq [MHz]	Chain	99% BW [MHz]	Highest Freq [MHz]
802.11b	1Mbps	13	2472	A	13.42	2478.7080
				B	13.42	2478.7080
802.11g	6Mbps			A	16.40	2480.1987
				B	16.40	2480.1987
802.11n20	HT0			A	17.89	2480.9440
				B	17.89	2480.9440
	HT8			A+B	17.89	2480.9440
802.11n40	HT0	11	2462	A	36.77	2480.3850
				B	36.77	2480.3850
	HT8			A+B	36.77	2480.3850
802.11ax20	HE0	13	2472	A	18.88	2481.4409
				B	18.88	2481.4409
	HE0			A+B	18.88	2481.4409
802.11ax40	HE0	11	2462	A	37.76	2480.8819
				B	37.76	2480.8819
	HE0			A+B	37.76	2480.8819

B.6 Transmitter unwanted emissions in the out-of-band domain

Test limits

ETSI clause	Limits
4.3.2.8.3	The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask below A: -10 dBm/MHz e.i.r.p. B: -20 dBm/MHz e.i.r.p. C: Spurious Domain limits BW = Occupied Channel Bandwidth in MHz or 1 MHz whichever is greater

Test conditions

ETSI clause	Conditions
5.4.8.1	These measurements shall only be performed at normal test conditions. For non-FHSS equipment, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These operating channels shall be recorded. The equipment shall be configured to operate under its worst case situation with respect to output power. If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then each channel bandwidth shall be tested separately.

Test procedure

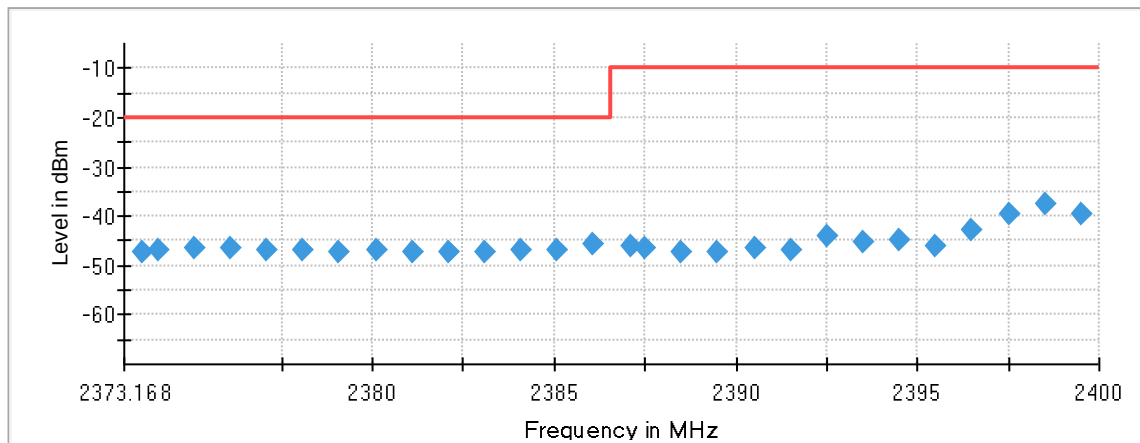
The conducted setups shown in section *Test & System Description* were used to measure the unwanted emissions in the out of band domain accordingly to the test method described in ETSI EN 300 328 V2.2.2 §5.4.8.2.1. The antenna terminal of the EUT is connected to the OSP120 through a 10dB attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on measured parameters.

EMC32 provides the mask and the frequency limits based on the measured channel bandwidth. Maximum values for each limit level (-10dBm and -20dBm) are pointed using markers.

For MIMO modes the measurement is done separately on each transmit ports and the power of the individual 1MHz segments is sum for all ports.

Results Screenshot**802.11b, 1Mbps – Chain A****UNWANTED OOB Low Freq Section, Channel 1**

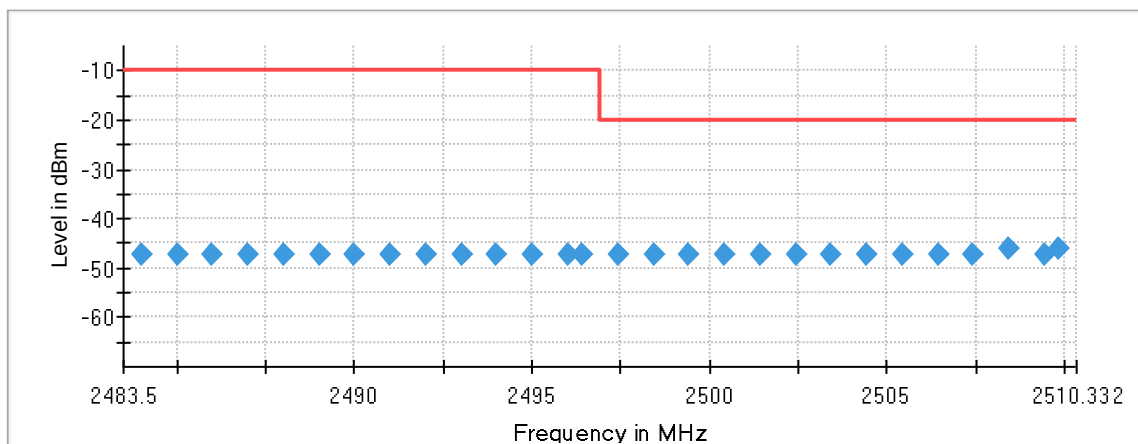
Out of band low



◆ Level — Limit

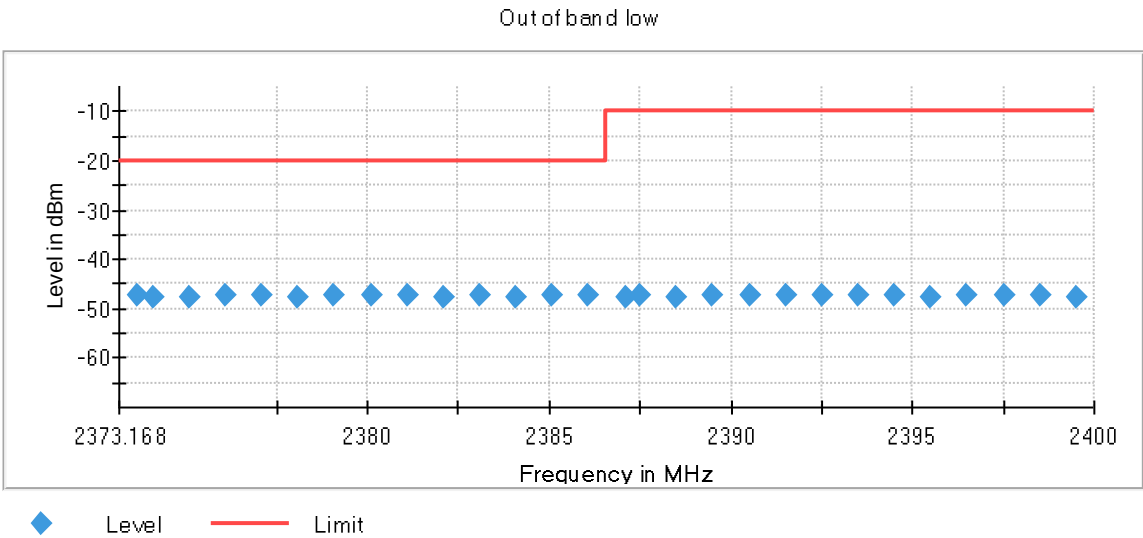
UNWANTED OOB High Freq Section, Channel 1

Out of band high

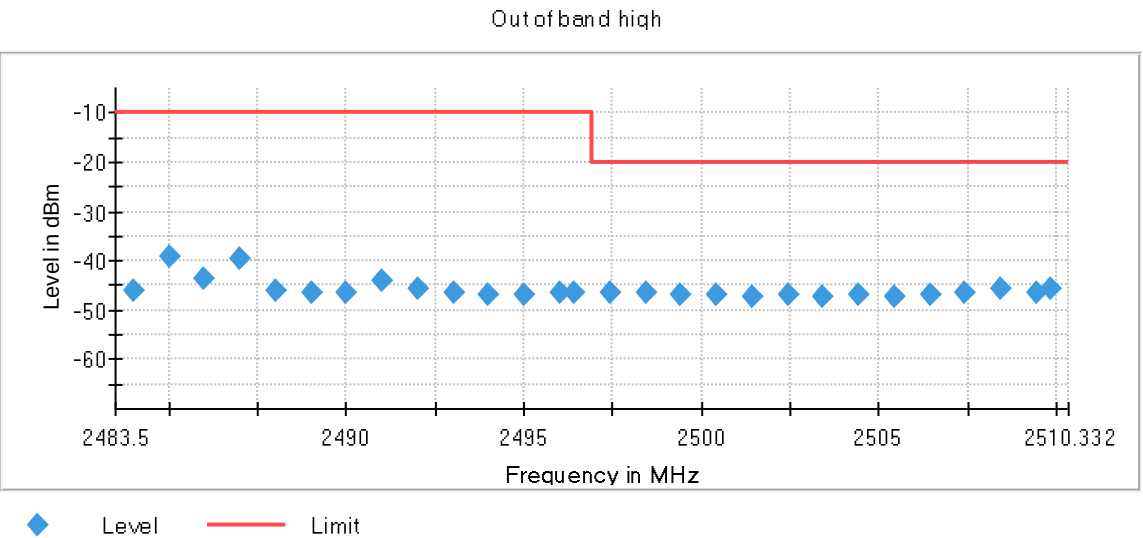


◆ Level — Limit

UNWANTED OOB Low Freq Section, Channel 13



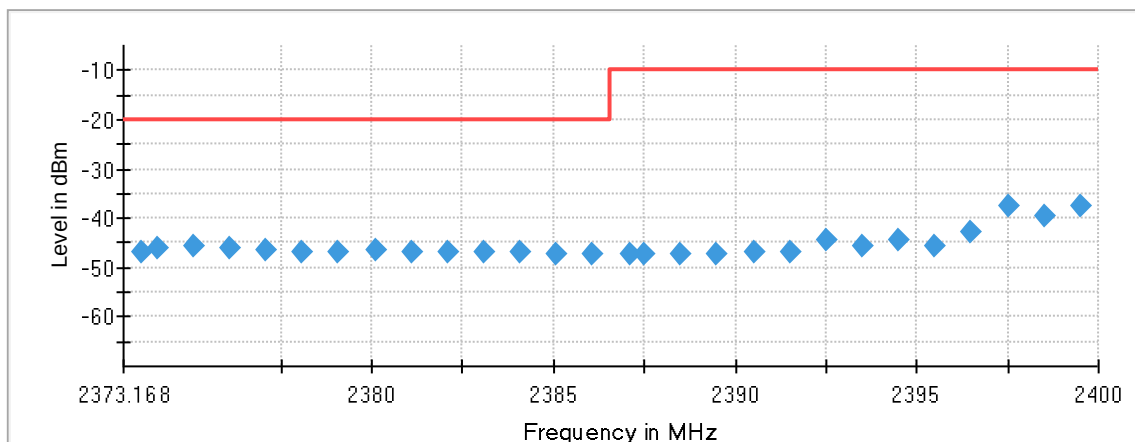
UNWANTED OOB High Freq Section, Channel 13



802.11b, 1Mbps – Chain B

UNWANTED OOB Low Freq Section, Channel 1

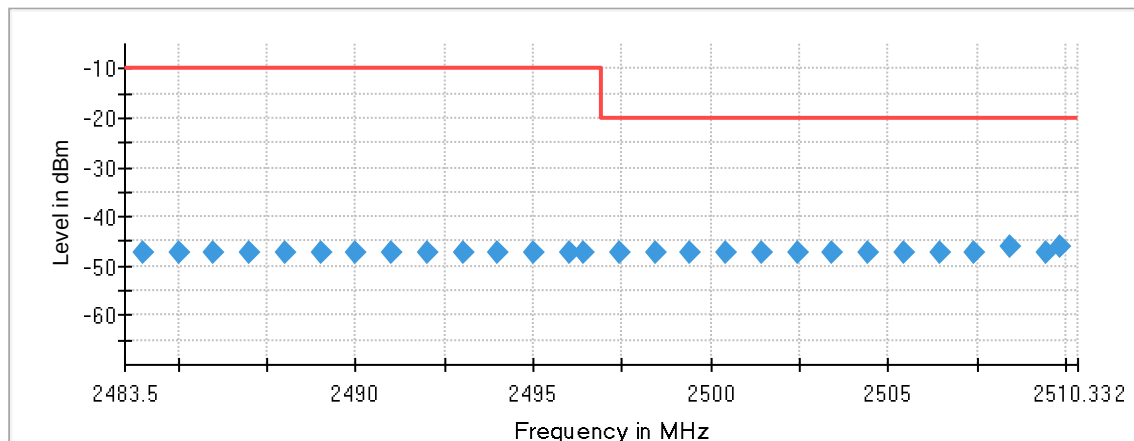
Out of band low



◆ Level — Limit

UNWANTED OOB High Freq Section, Channel 1

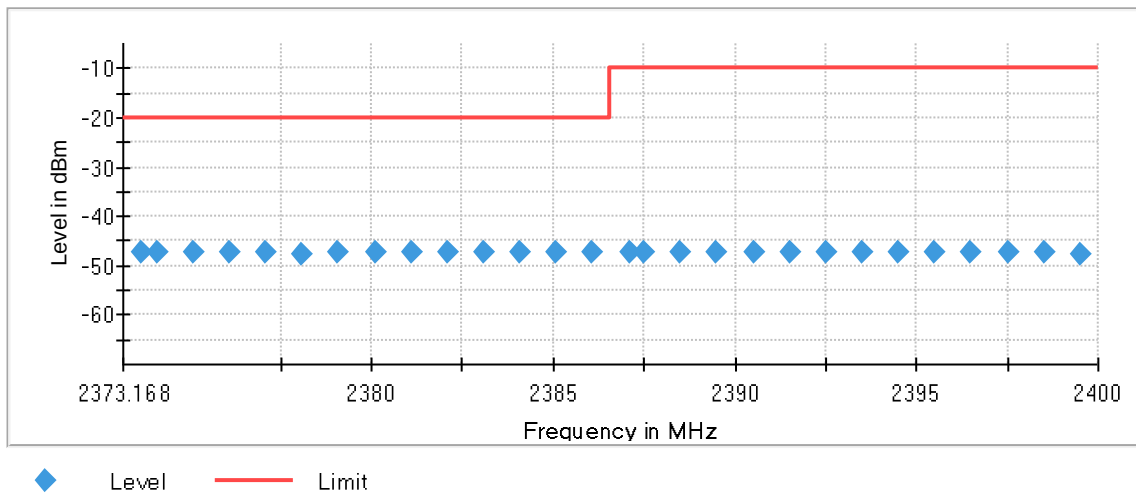
Out of band high



◆ Level — Limit

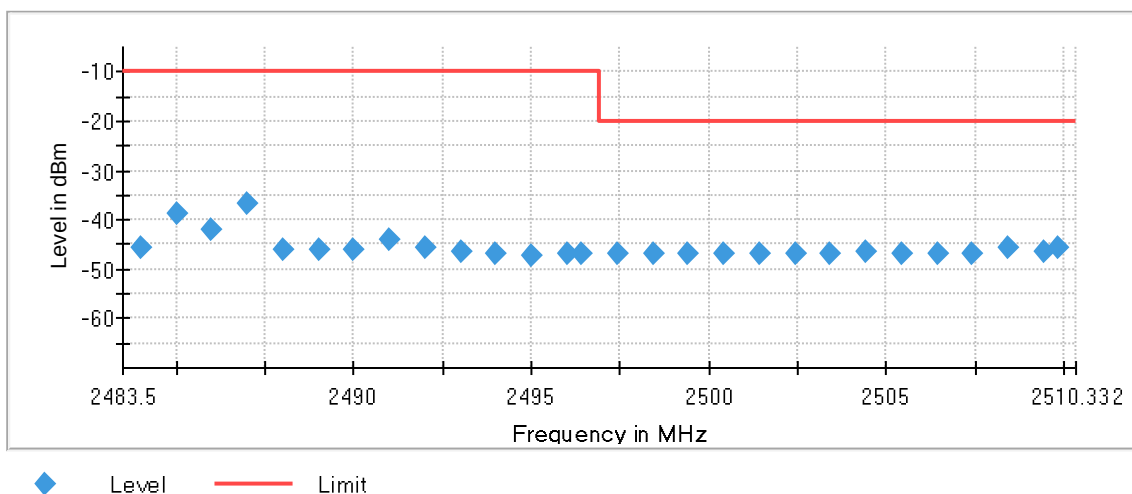
UNWANTED OOB Low Freq Section, Channel 13

Out of band low



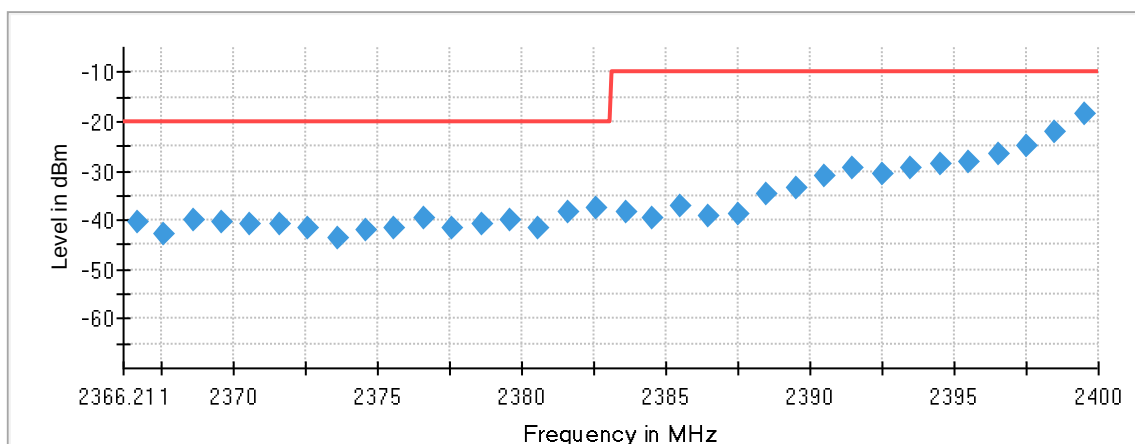
UNWANTED OOB High Freq Section, Channel13

Out of band high



802.11g, 6 Mbps – Chain A**UNWANTED OOB Low Freq Section, Channel 1**

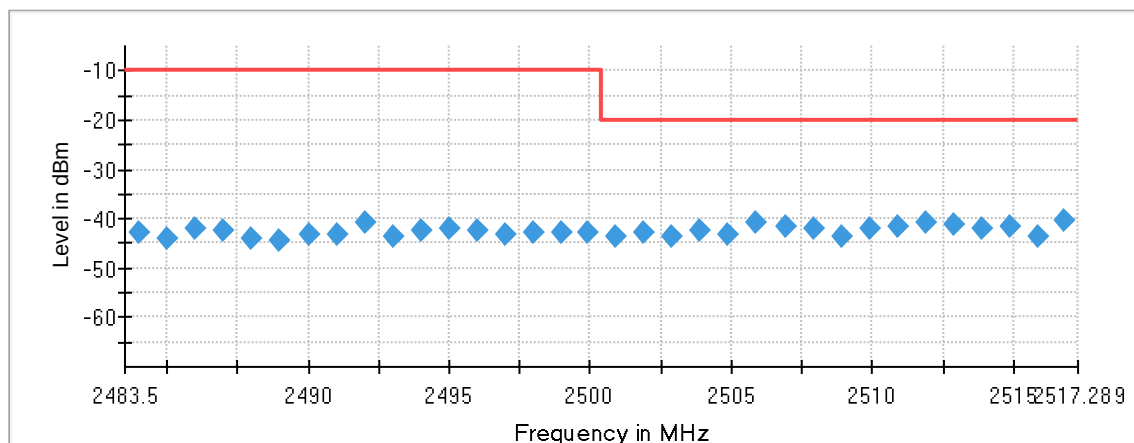
Out of band low



◆ Level — Limit

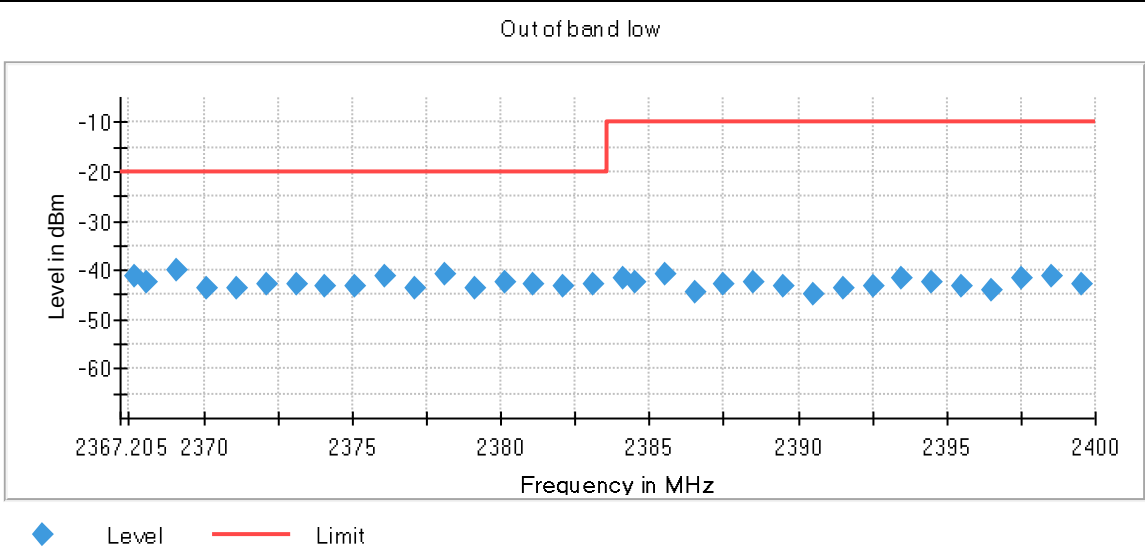
UNWANTED OOB High Freq Section, Channel 1

Out of band high

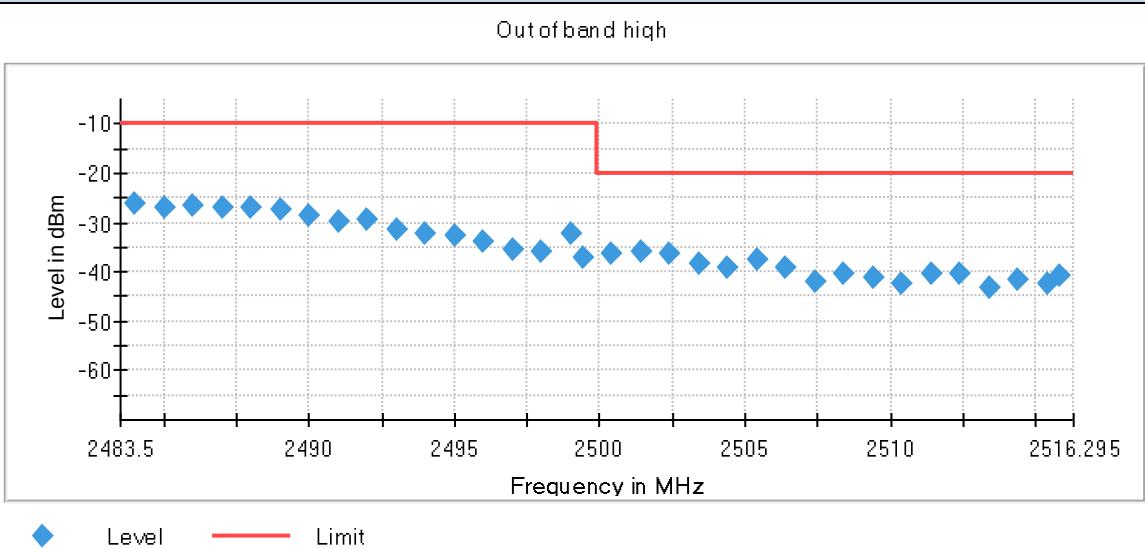


◆ Level — Limit

UNWANTED OOB Low Freq Section, Channel 13

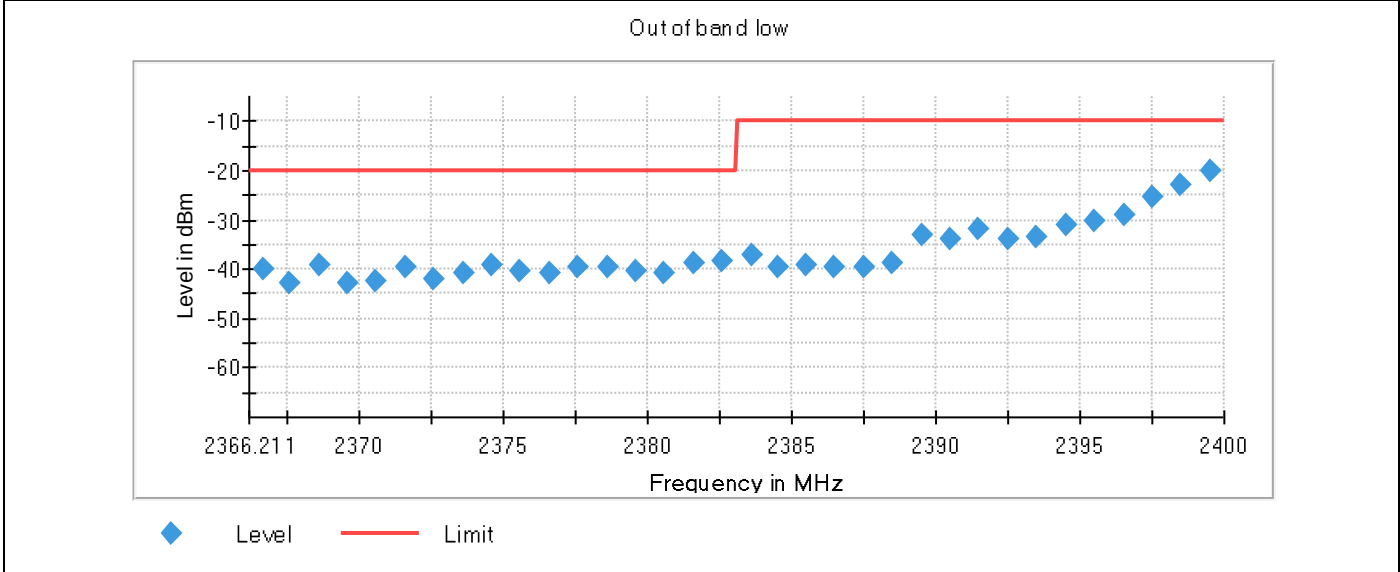


UNWANTED OOB High Freq Section, Channel 13

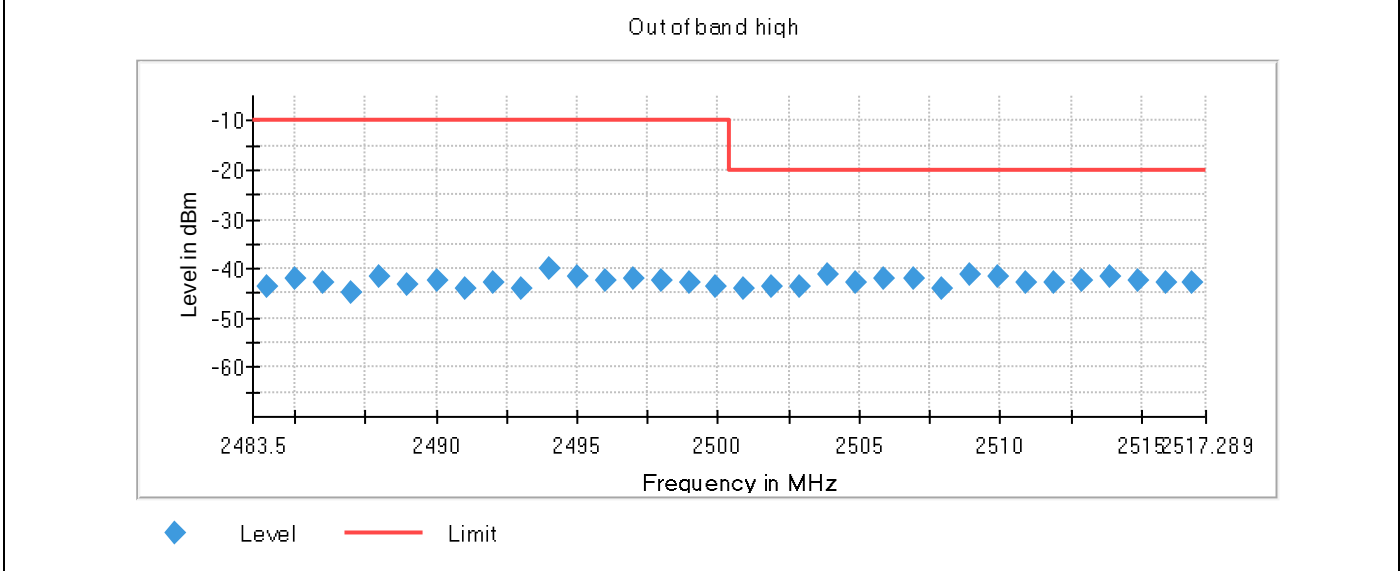


802.11g, 6 Mbps – Chain B

UNWANTED OOB Low Freq Section, Channel 1

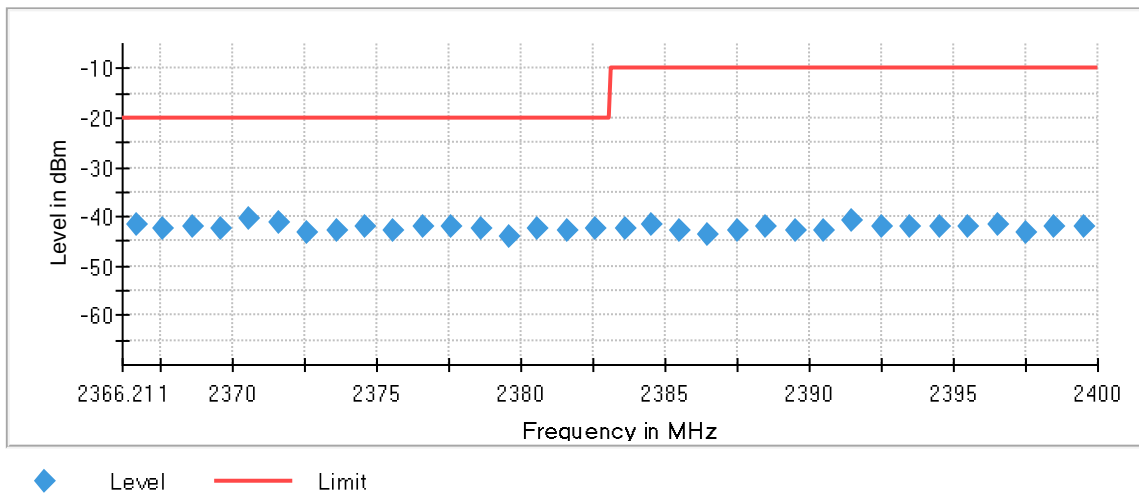


UNWANTED OOB High Freq Section, Channel 1



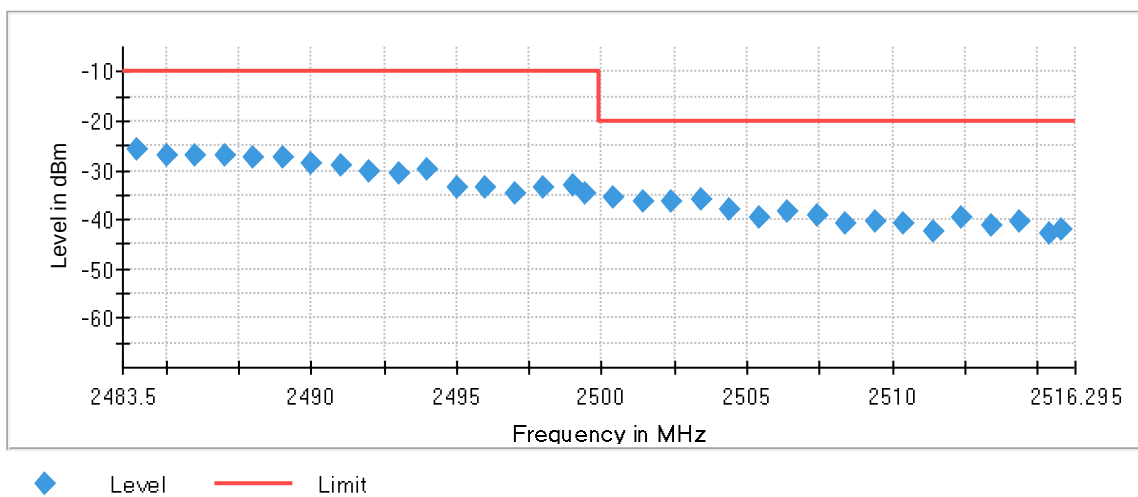
UNWANTED OOB Low Freq Section, Channel 13

Out of band low



UNWANTED OOB High Freq Section, Channel 13

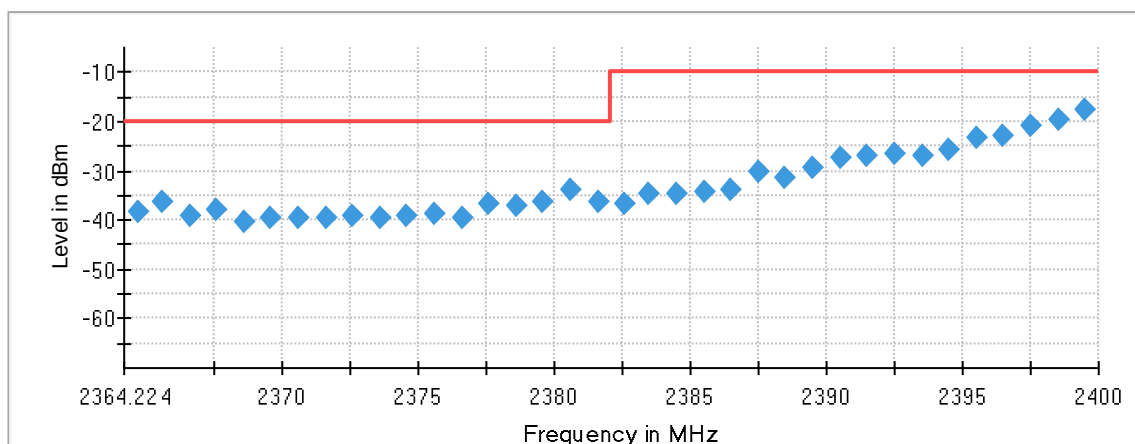
Out of band high



802.11n20, HT0 (SISO) – Chain A

UNWANTED OOB Low Freq Section, Channel 1

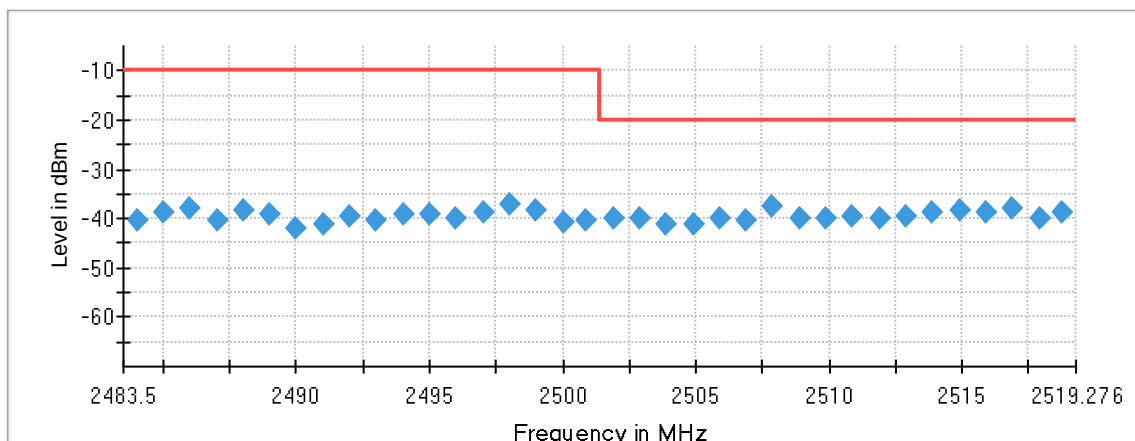
Out of band low



◆ Level — Limit

UNWANTED OOB High Freq Section, Channel 1

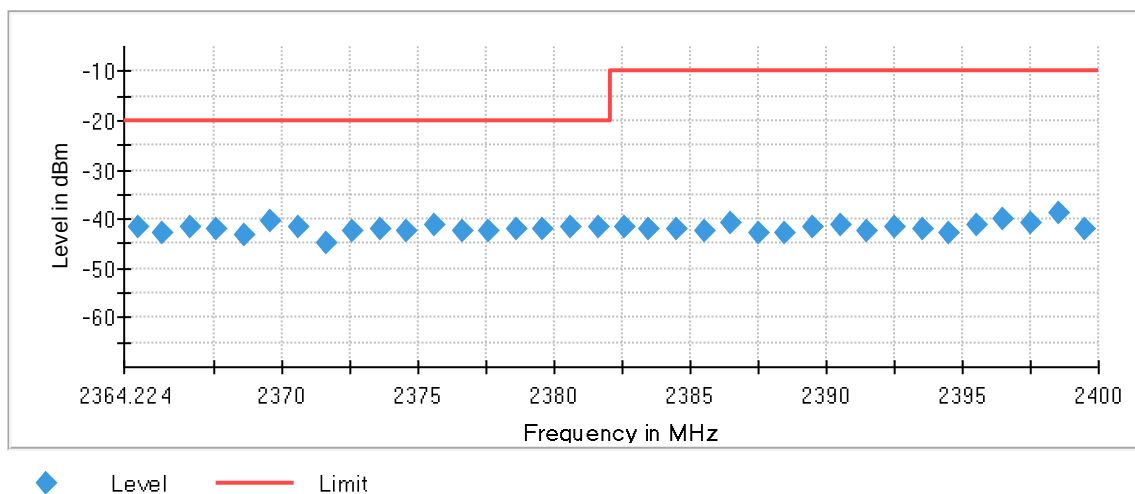
Out of band high



◆ Level — Limit

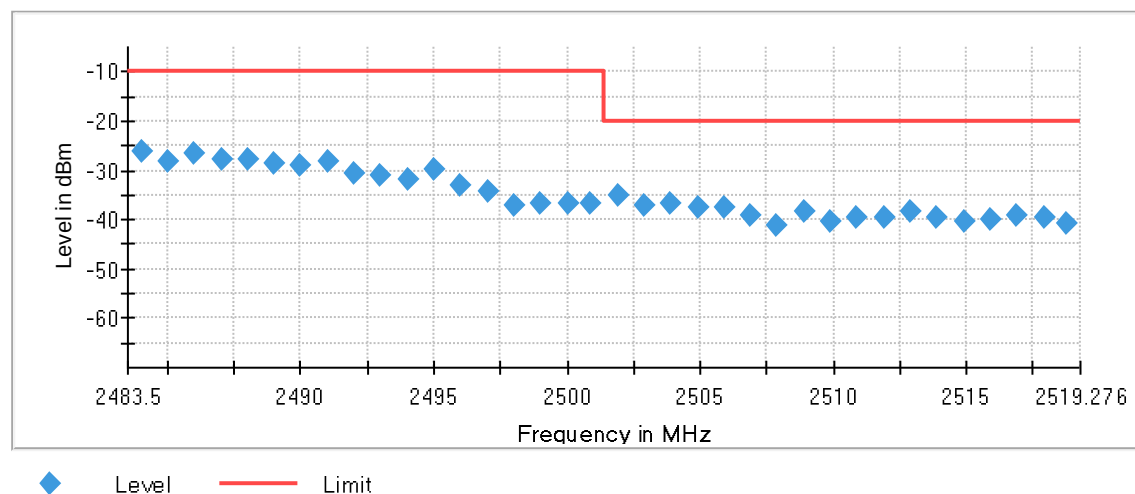
UNWANTED OOB Low Freq Section, Channel 13

Out of band low



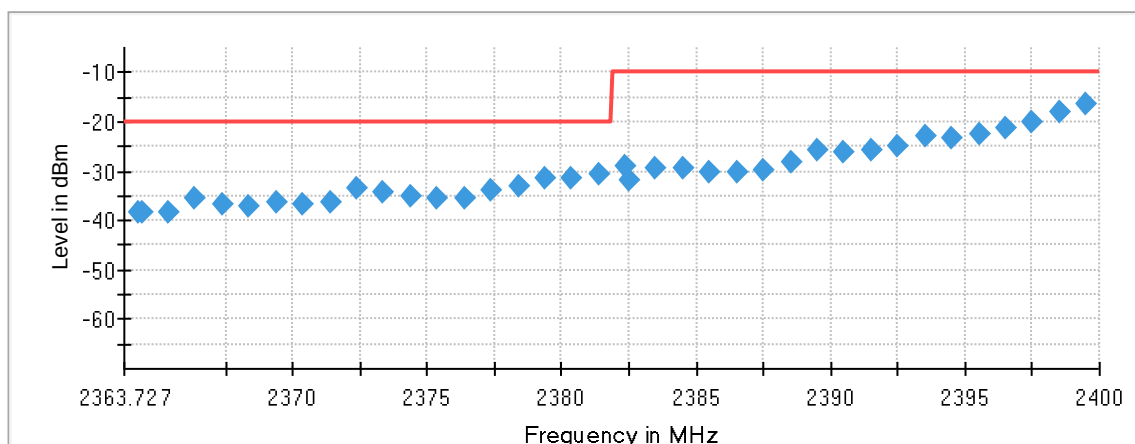
UNWANTED OOB High Freq Section, Channel 13

Out of band high



802.11n20, HT0 (SISO) – Chain B**UNWANTED OOB Low Freq Section, Channel 1**

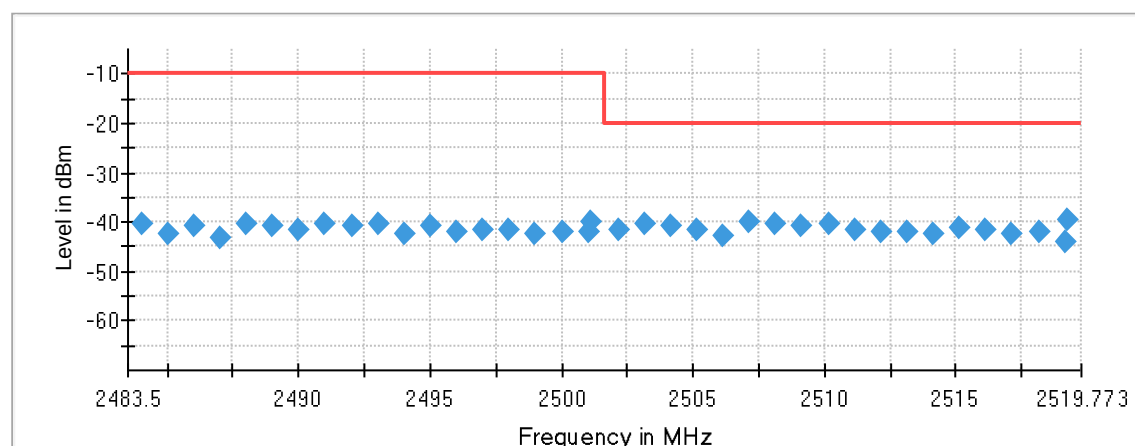
Out of band low



◆ Level — Limit

UNWANTED OOB High Freq Section, Channel 1

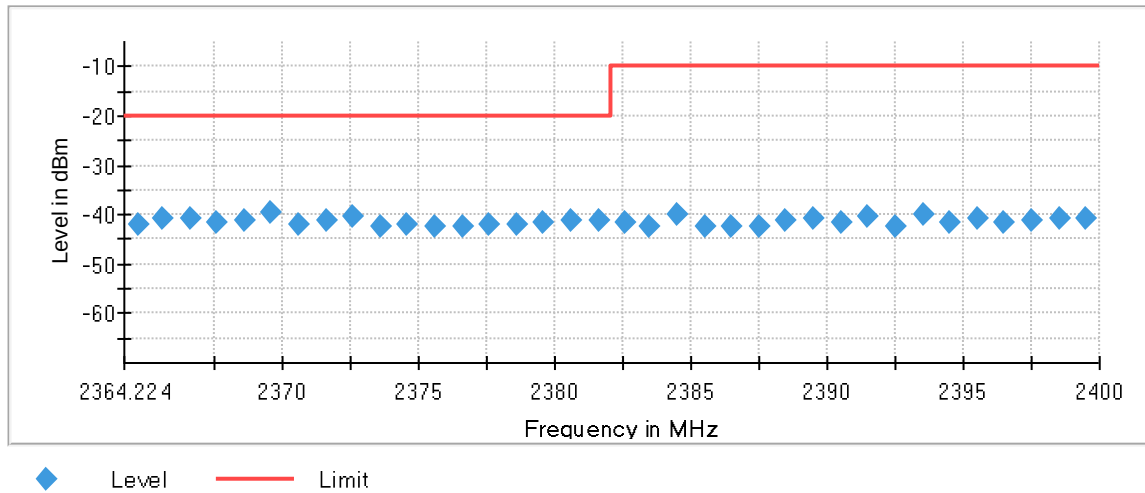
Out of band high



◆ Level — Limit

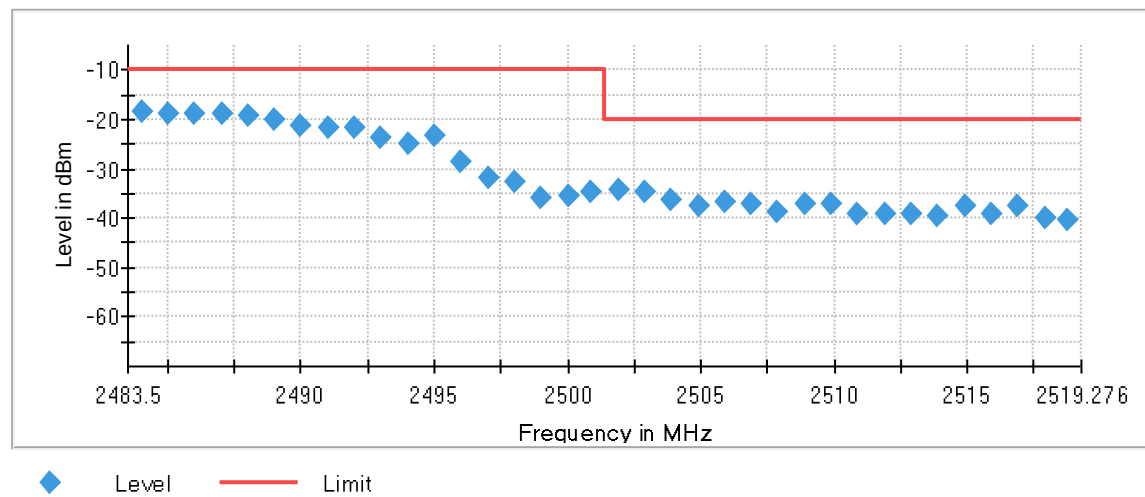
UNWANTED OOB Low Freq Section, Channel 13

Out of band low



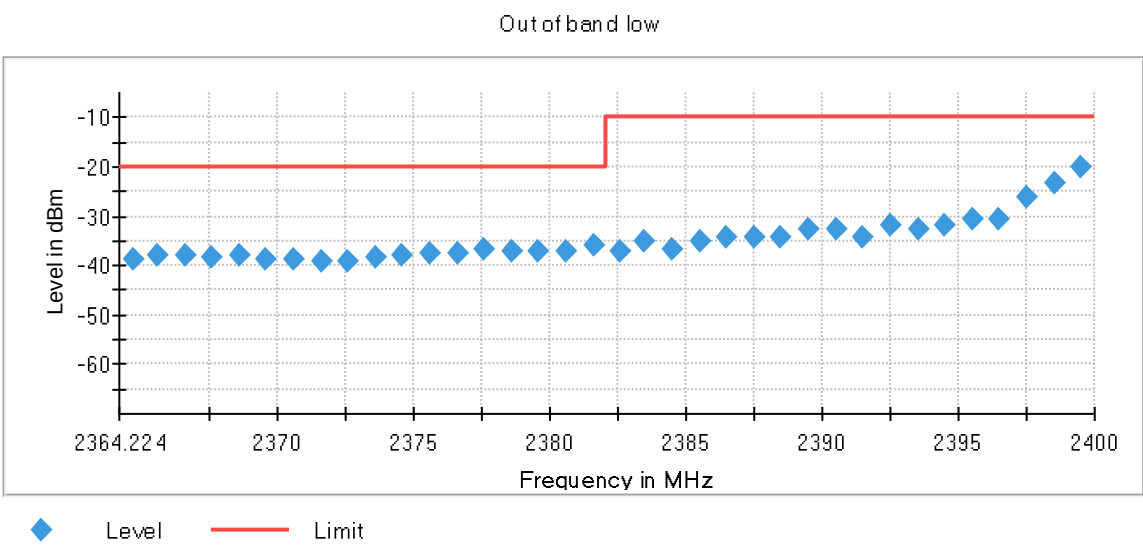
UNWANTED OOB High Freq Section, Channel 13

Out of band high

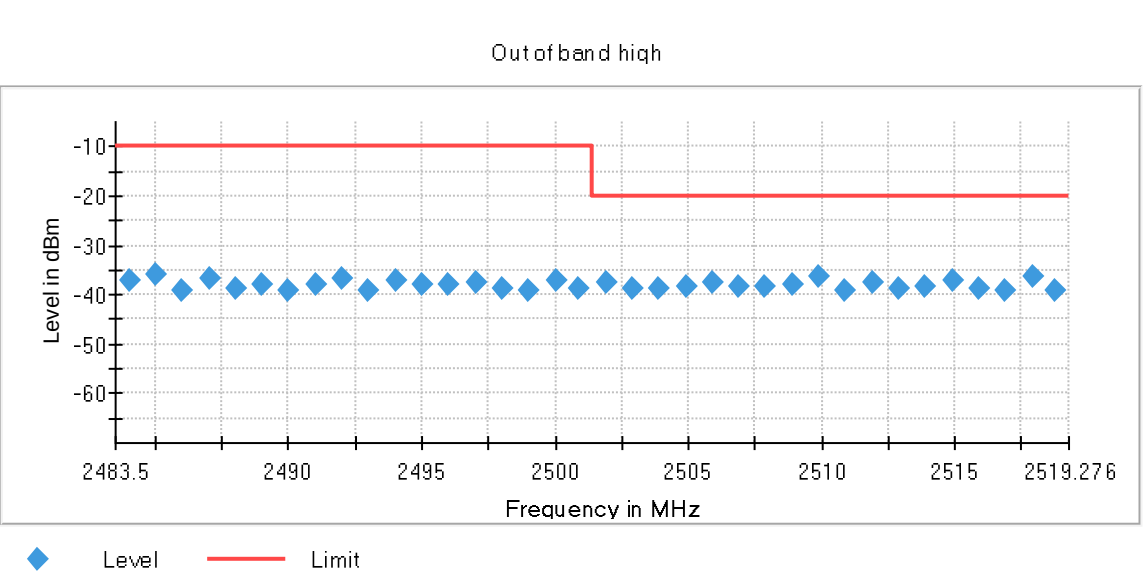


802.11n20, HT8 (MIMO)

UNWANTED OOB Low Freq Section, Channel 1

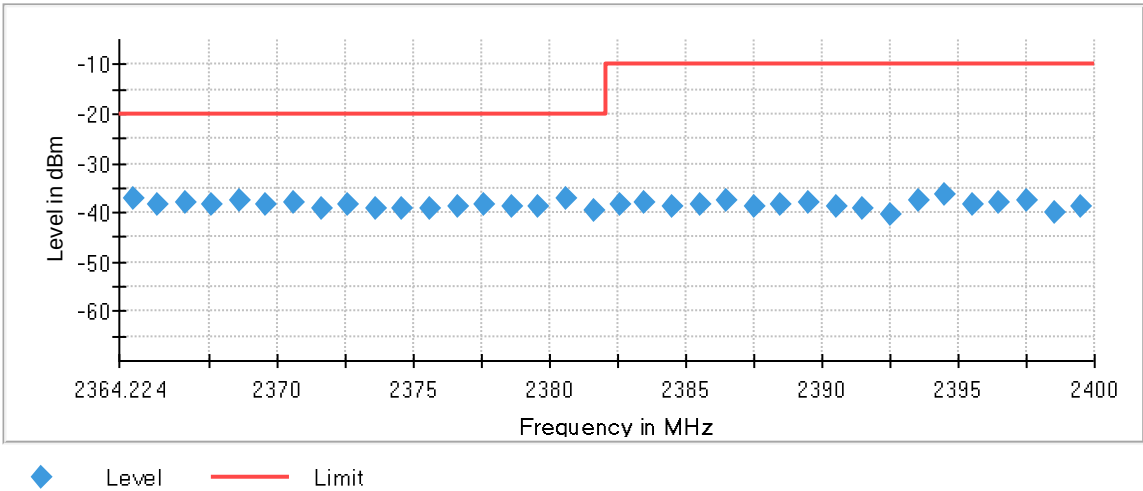


UNWANTED OOB High Freq Section , Channel 1



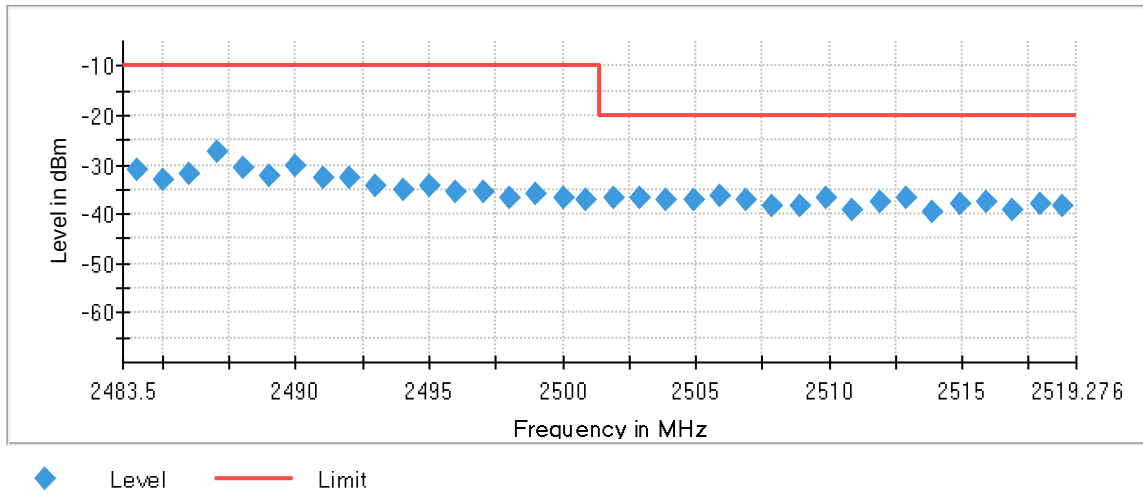
UNWANTED OOB Low Freq Section, Channel 13

Out of band low



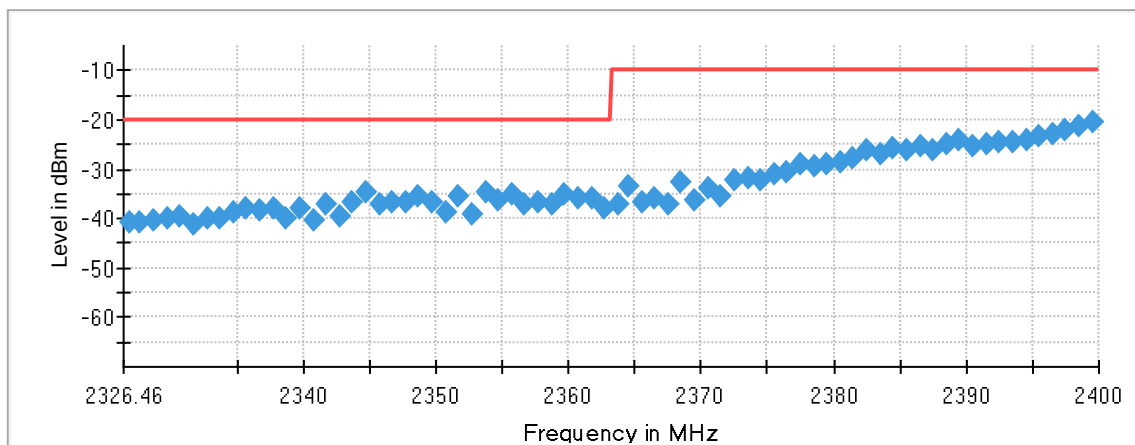
UNWANTED OOB High Freq Section, Channel 13

Out of band high



802.11n40, HT0 (SISO) – Chain A**UNWANTED OOB Low Freq Section, Channel 3**

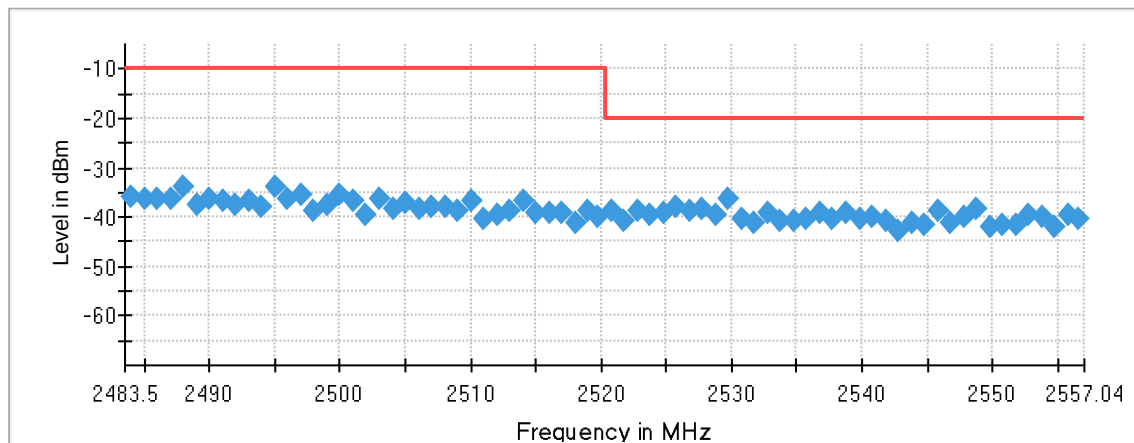
Out of band low



◆ Level — Limit

UNWANTED OOB High Freq Section, Channel 3

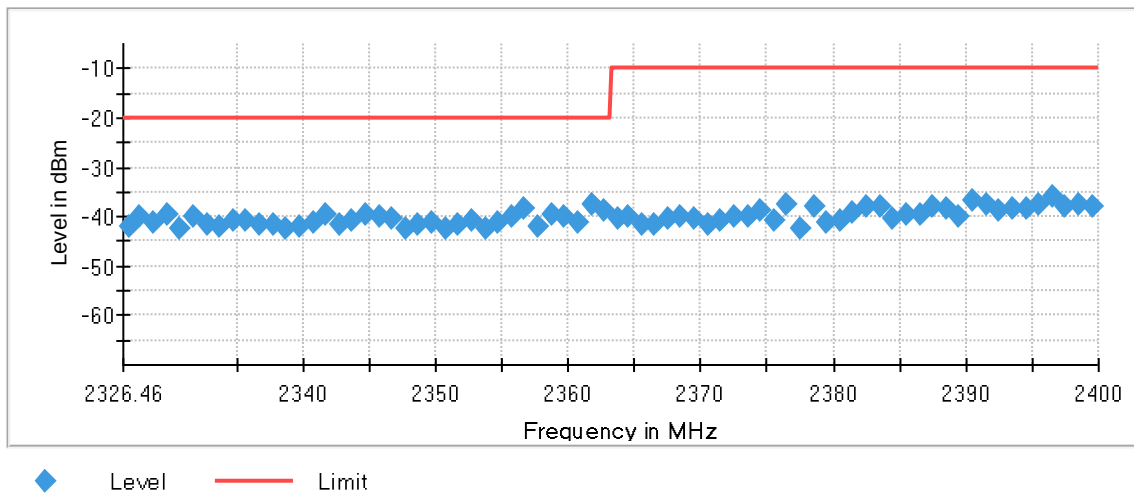
Out of band high



◆ Level — Limit

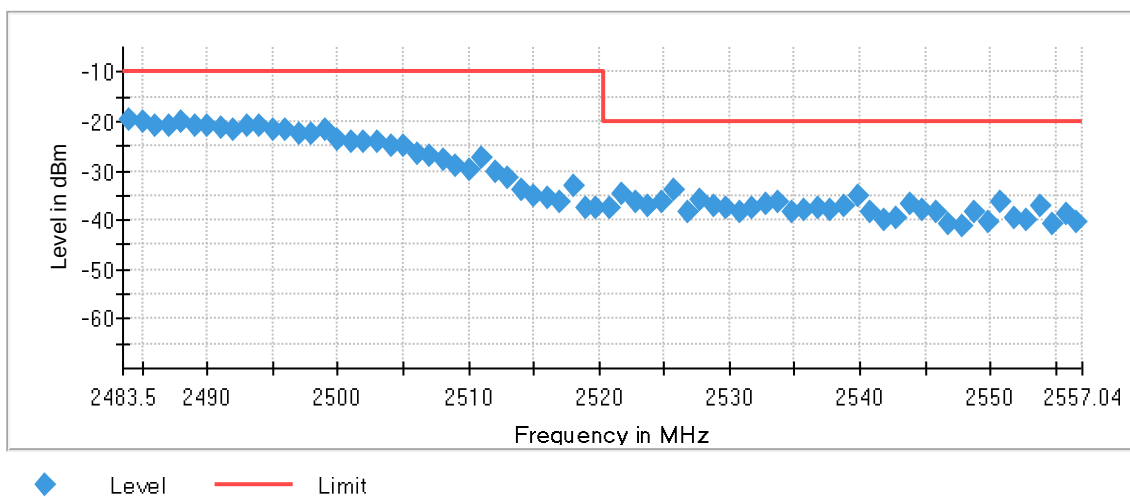
UNWANTED OOB Low Freq Section, Channel 11

Out of band low



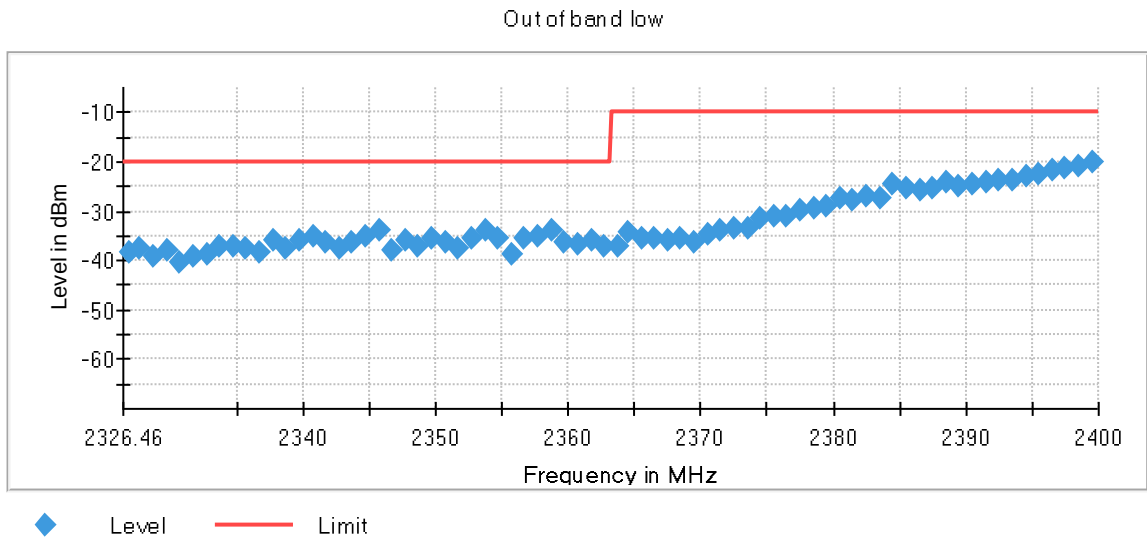
UNWANTED OOB High Freq Section, Channel 11

Out of band high

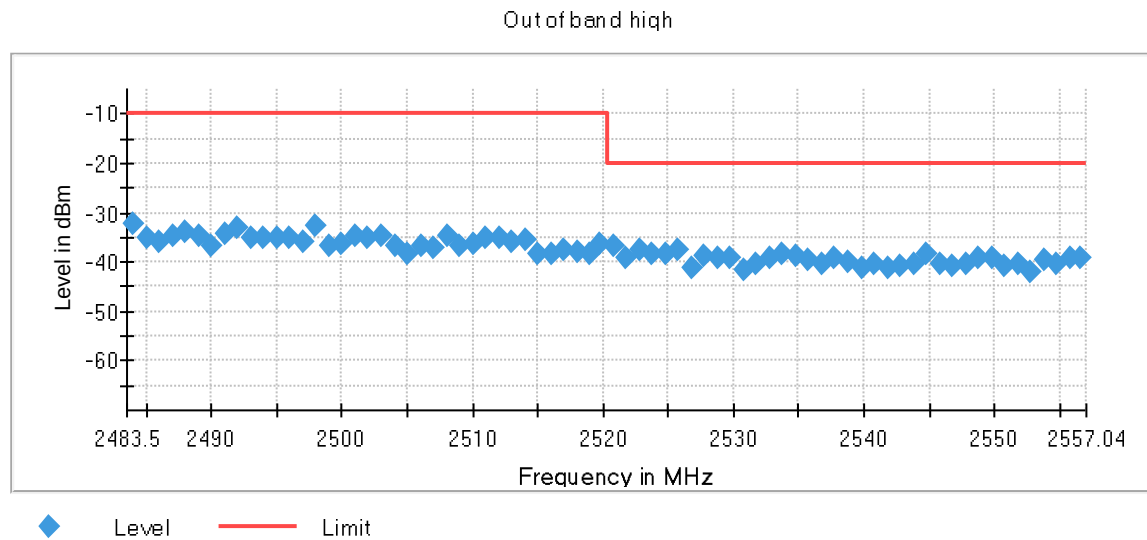


802.11n40, HT0 (SISO) – Chain B

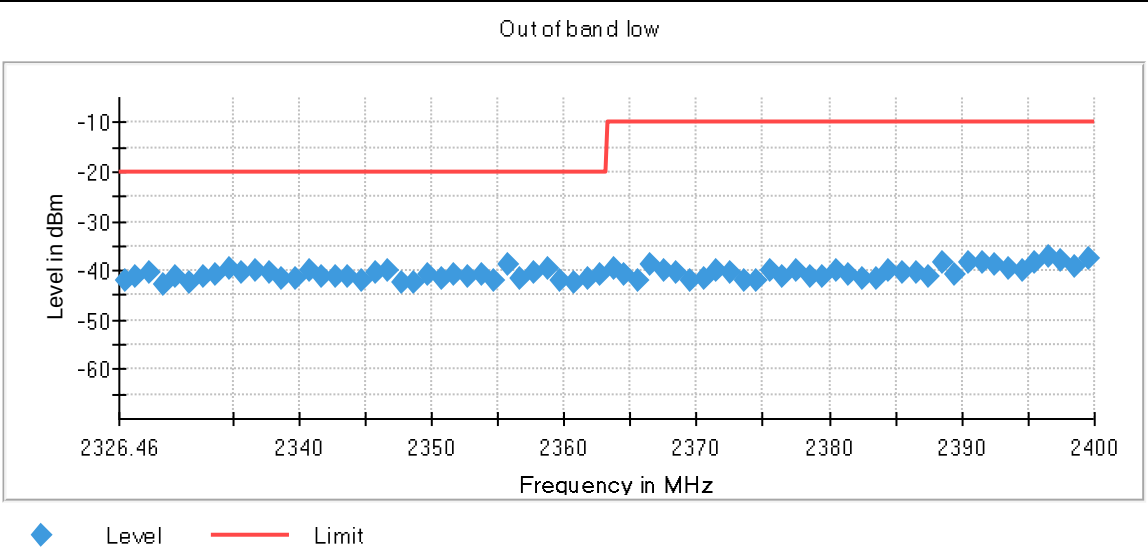
UNWANTED OOB Low Freq Section, Channel 3



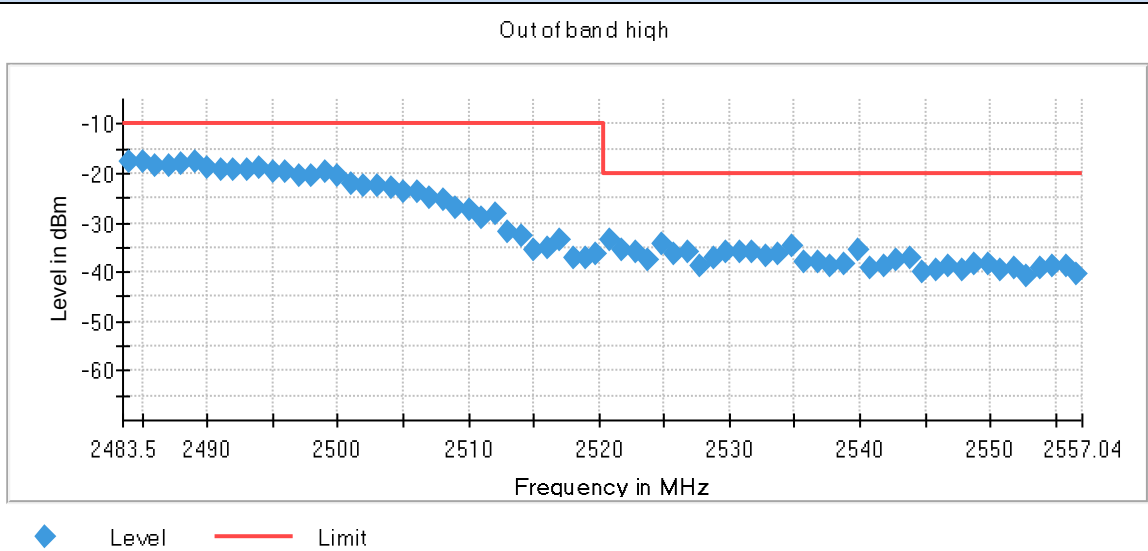
UNWANTED OOB High Freq Section, Channel 3



UNWANTED OOB Low Freq Section, Channel 11

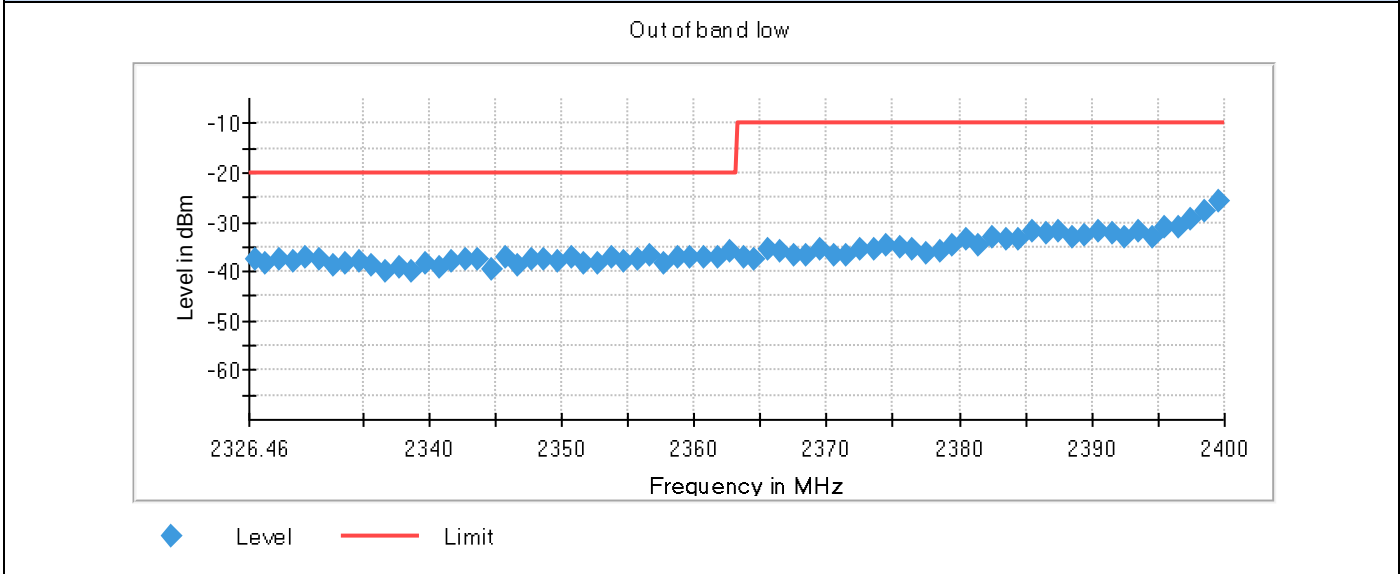


UNWANTED OOB High Freq Section, Channel 11

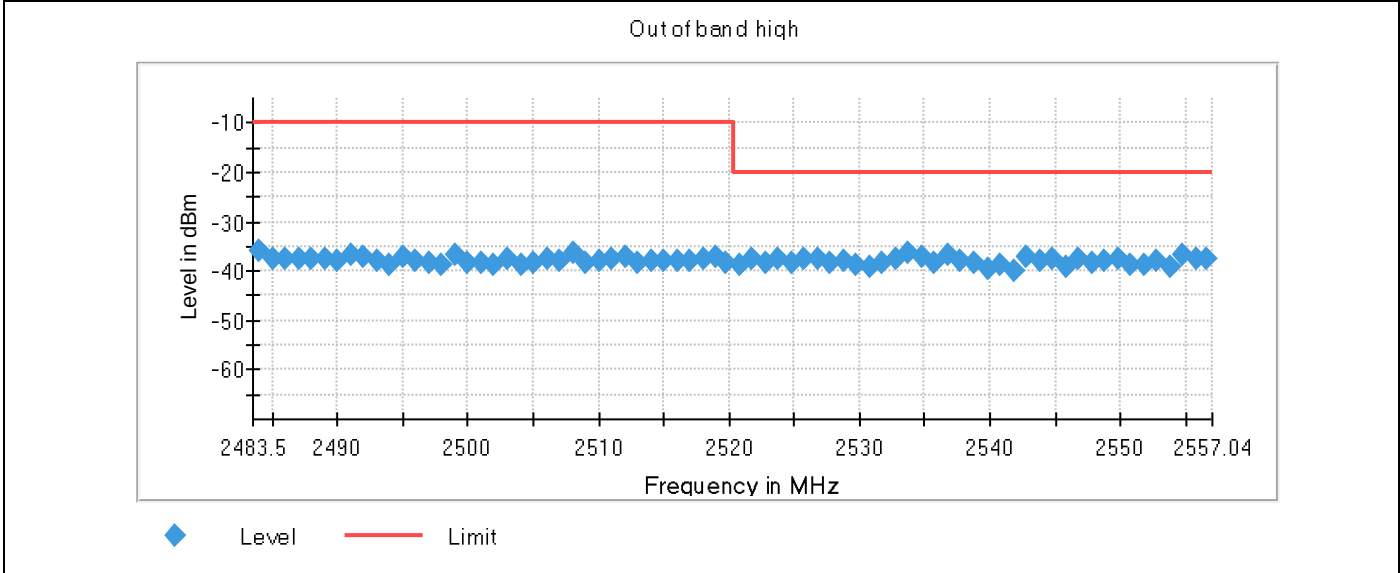


802.11n40, HT8 (MIMO)

UNWANTED OOB Low Freq Section, Channel 3

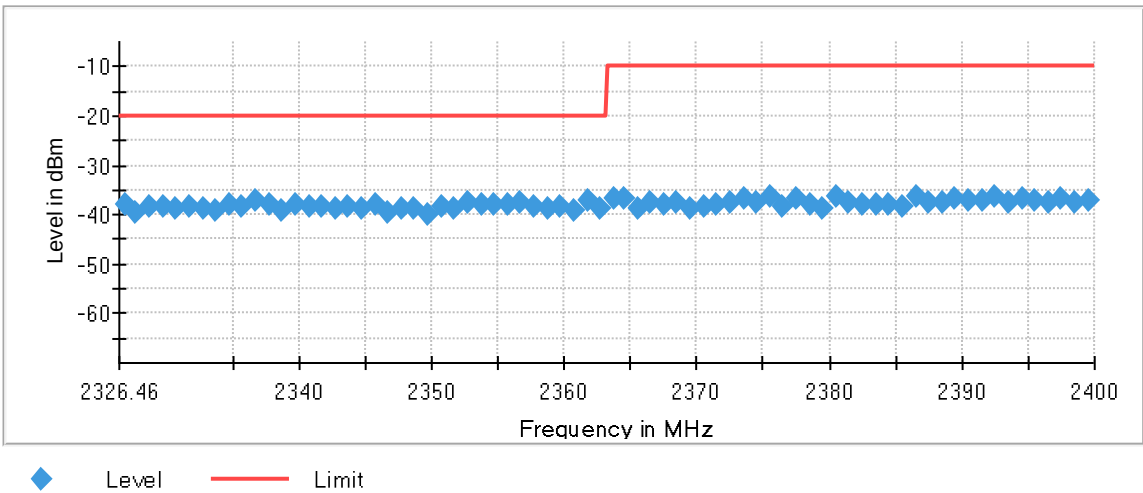


UNWANTED OOB High Freq Section , Channel 3



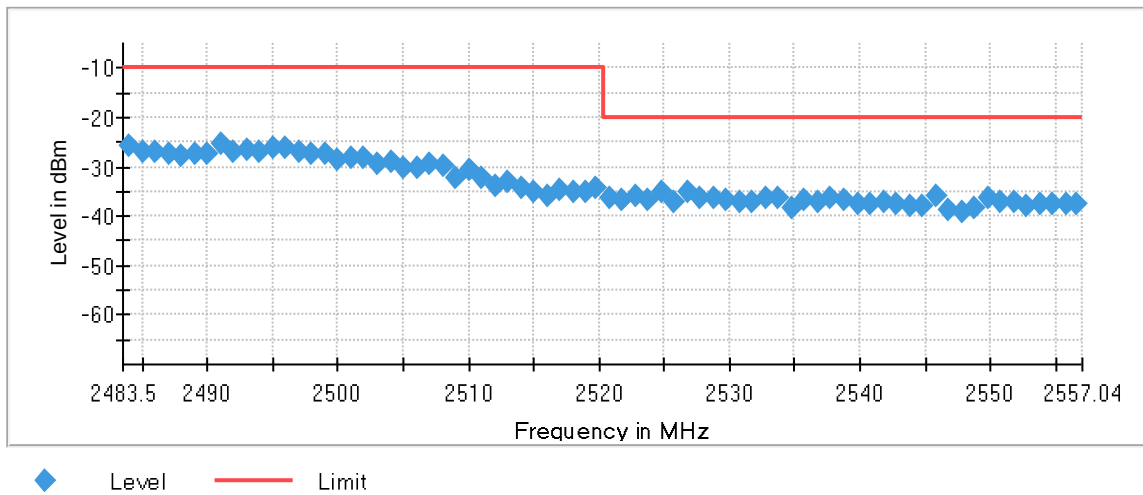
UNWANTED OOB Low Freq Section, Channel 11

Out of band low



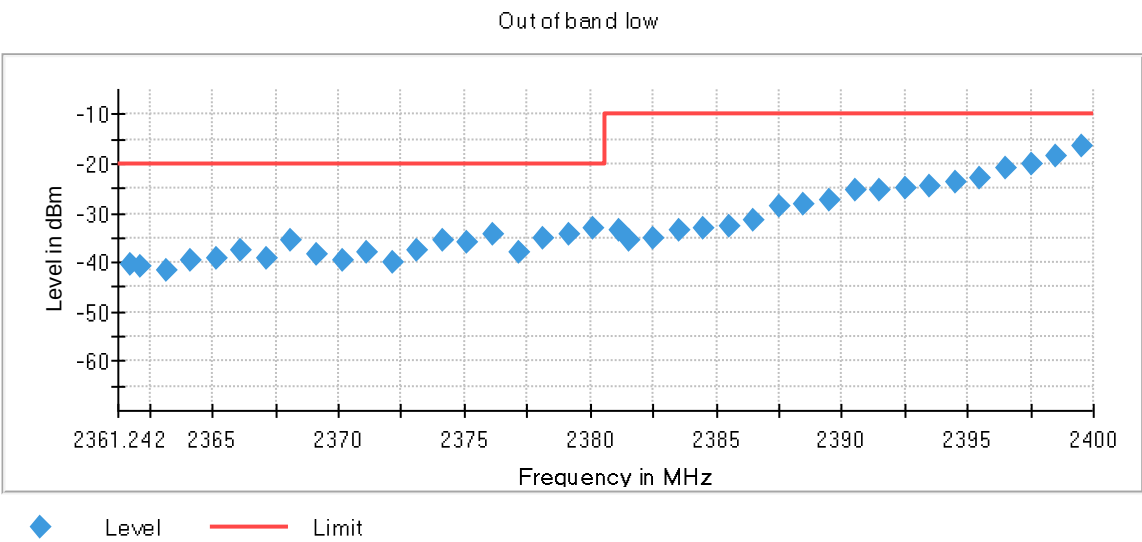
UNWANTED OOB High Freq Section, Channel 11

Out of band high

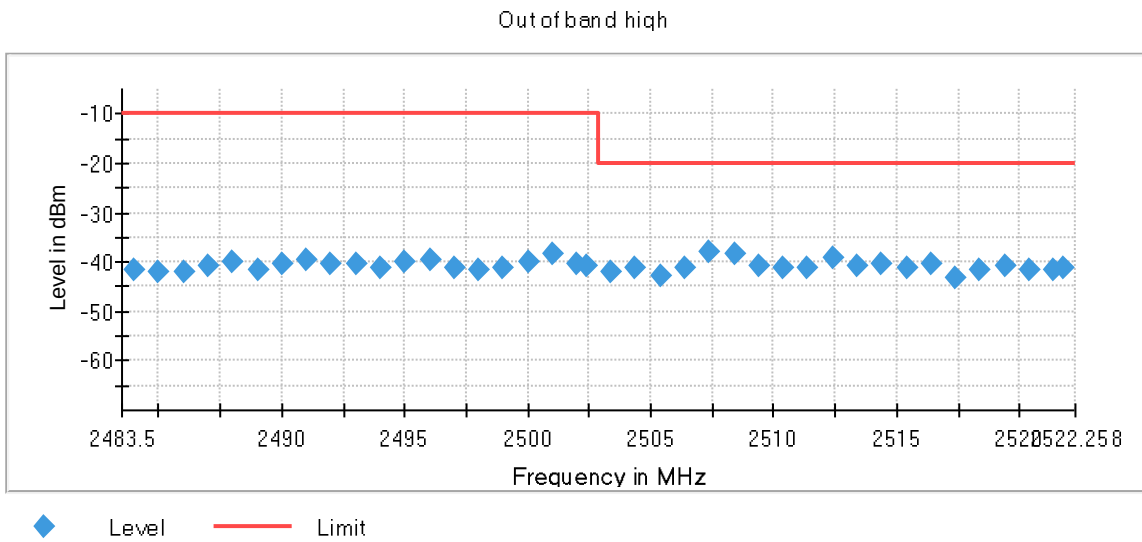


802.11ax20, HE0 (SISO) – Chain A

UNWANTED OOB Low Freq Section, Channel 1

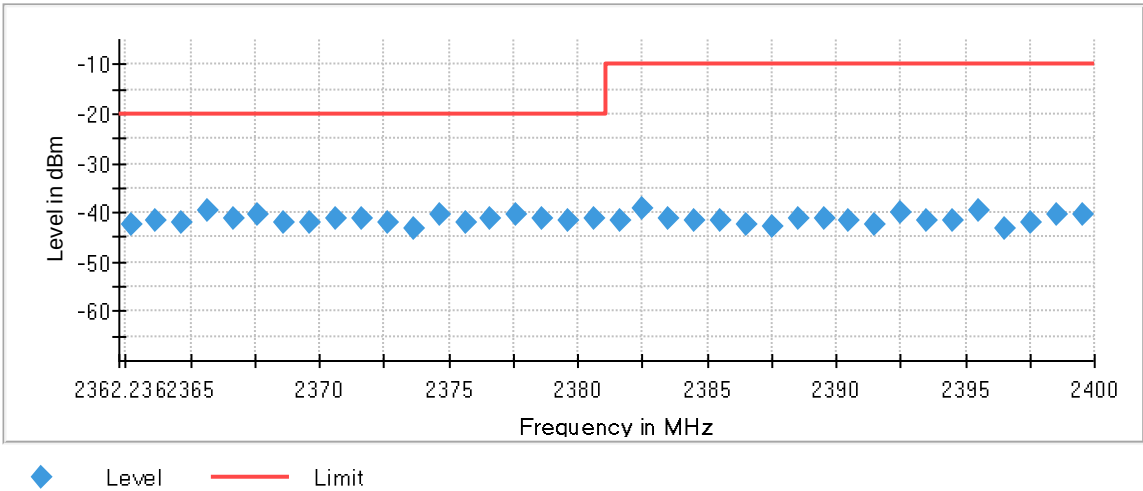


UNWANTED OOB High Freq Section, Channel 1



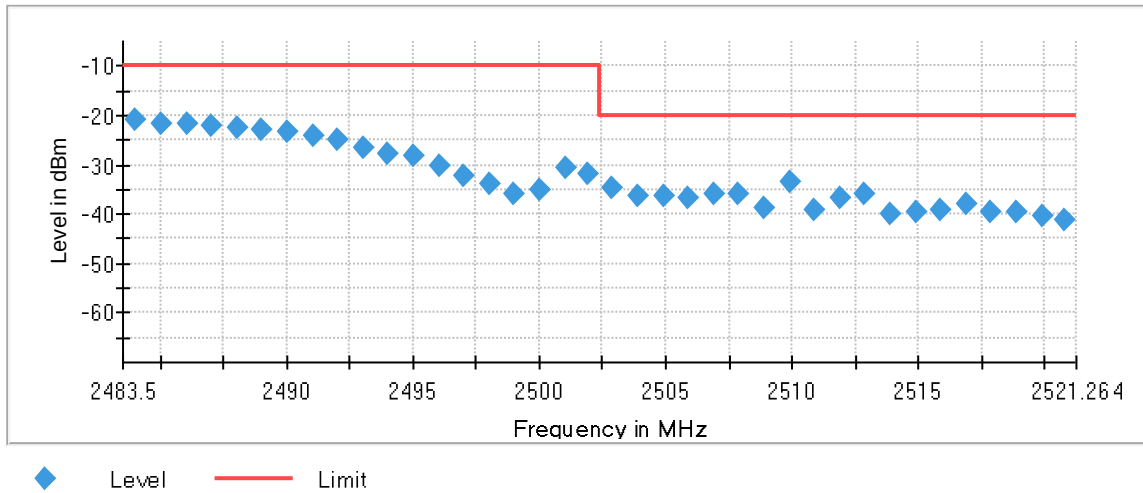
UNWANTED OOB Low Freq Section, Channel 13

Out of band low



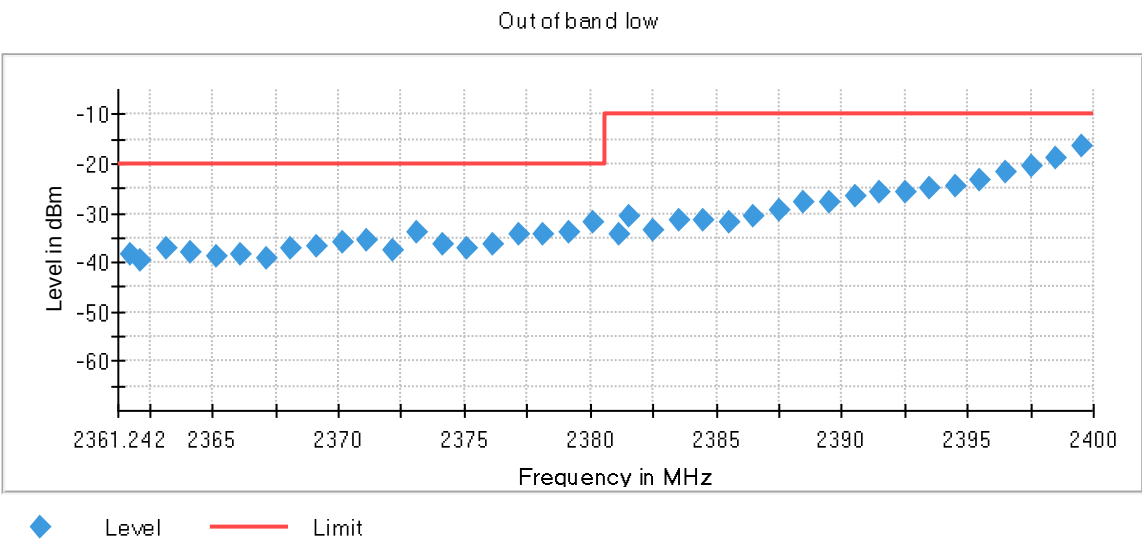
UNWANTED OOB High Freq Section, Channel 13

Out of band high

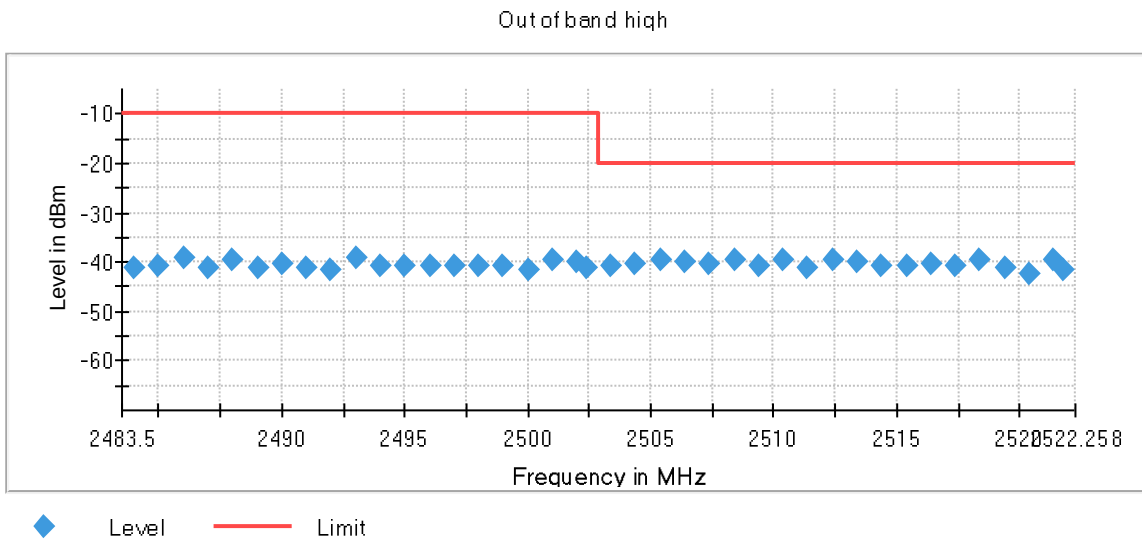


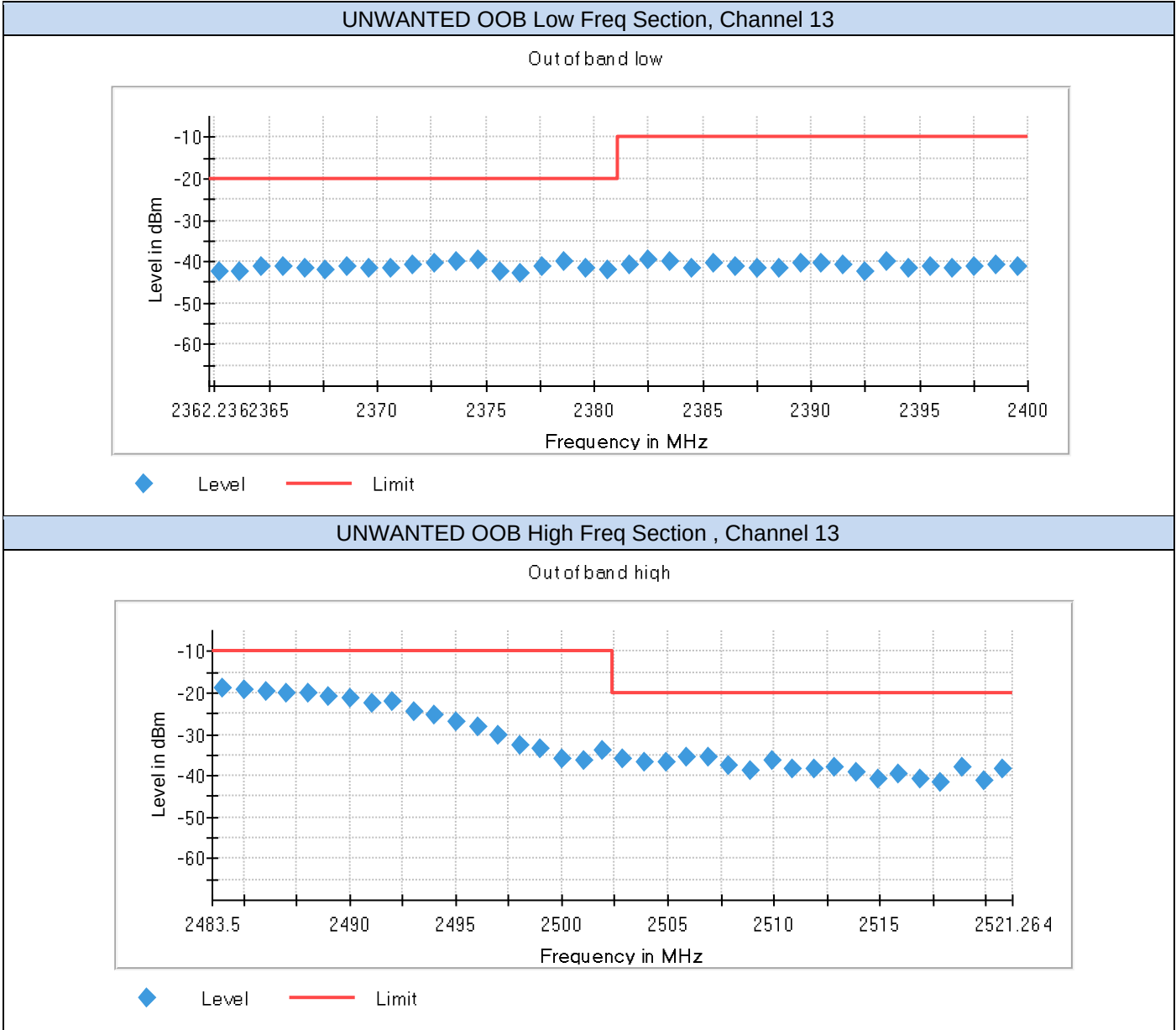
802.11ax20, HE0 (SISO) – Chain B

UNWANTED OOB Low Freq Section, Channel 1



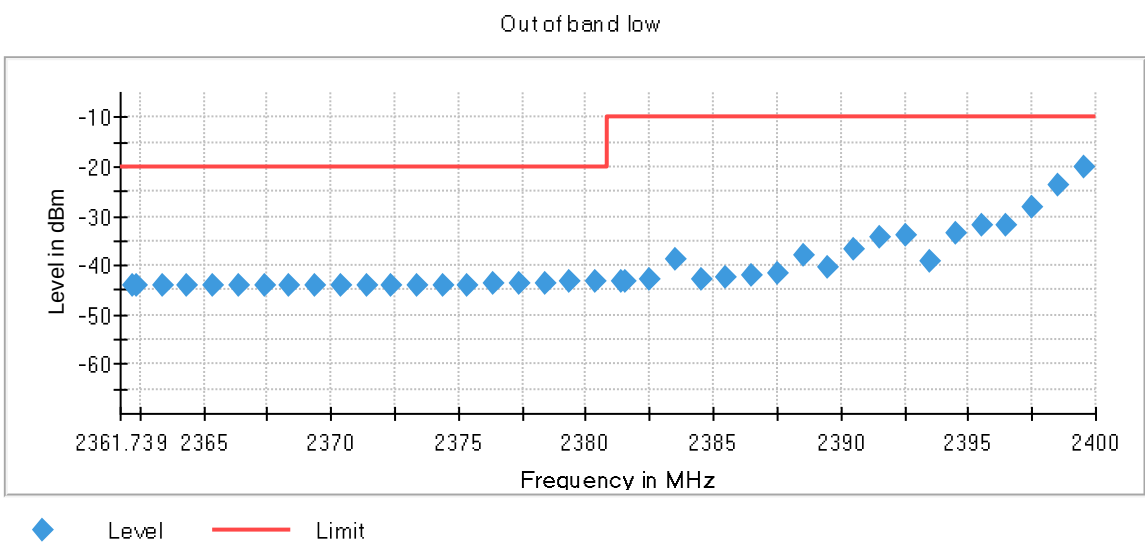
UNWANTED OOB High Freq Section, Channel 1



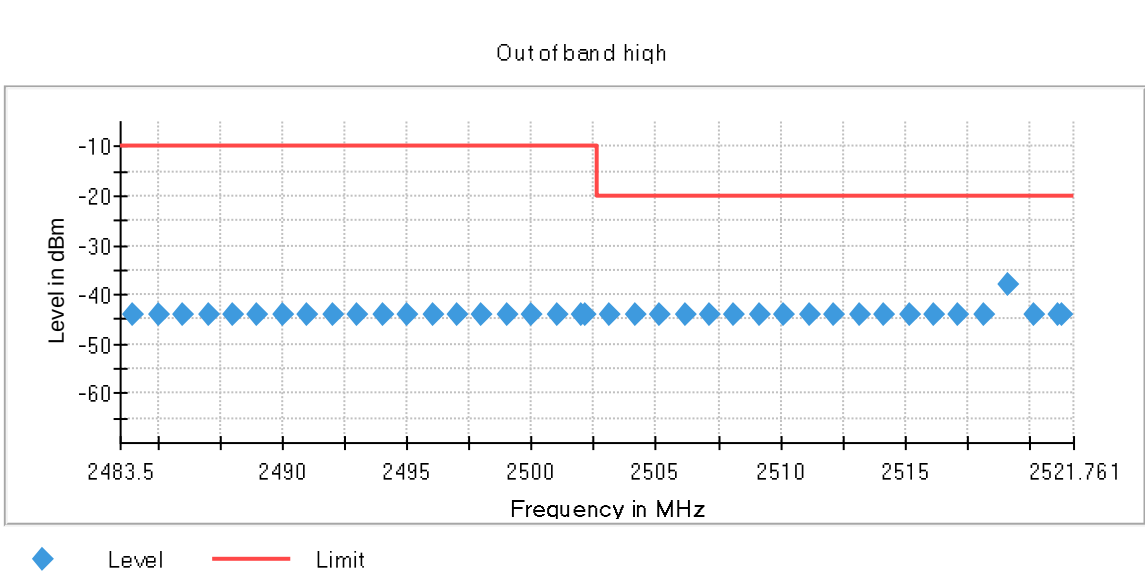


802.11ax20, HE0 (MIMO)

UNWANTED OOB Low Freq Section, Channel 1

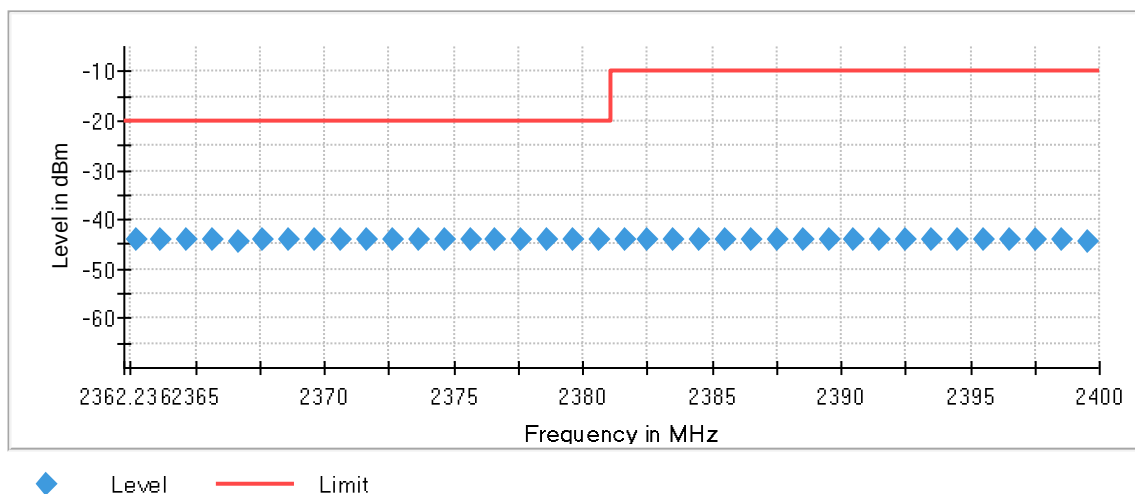


UNWANTED OOB High Freq Section , Channel 1



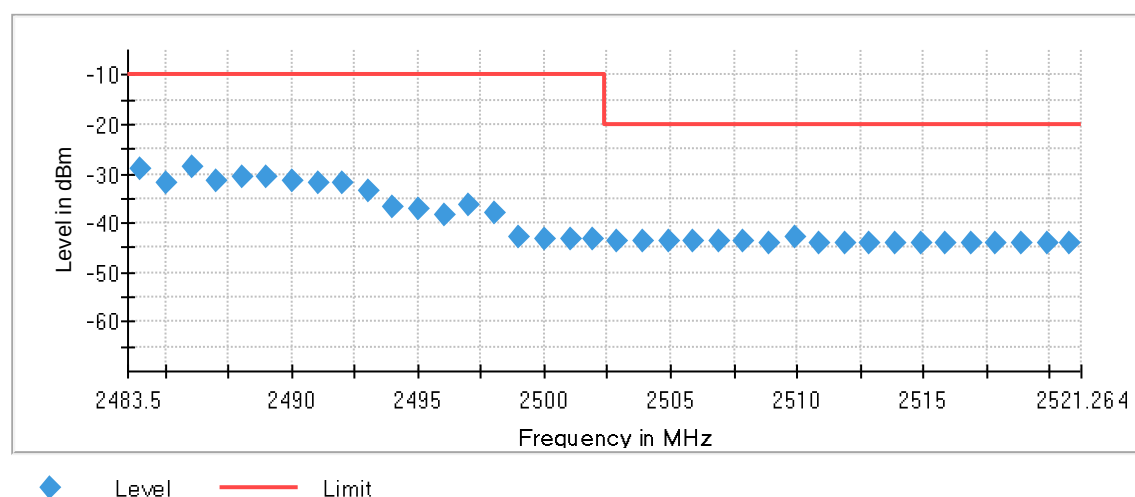
UNWANTED OOB Low Freq Section, Channel 13

Out of band low



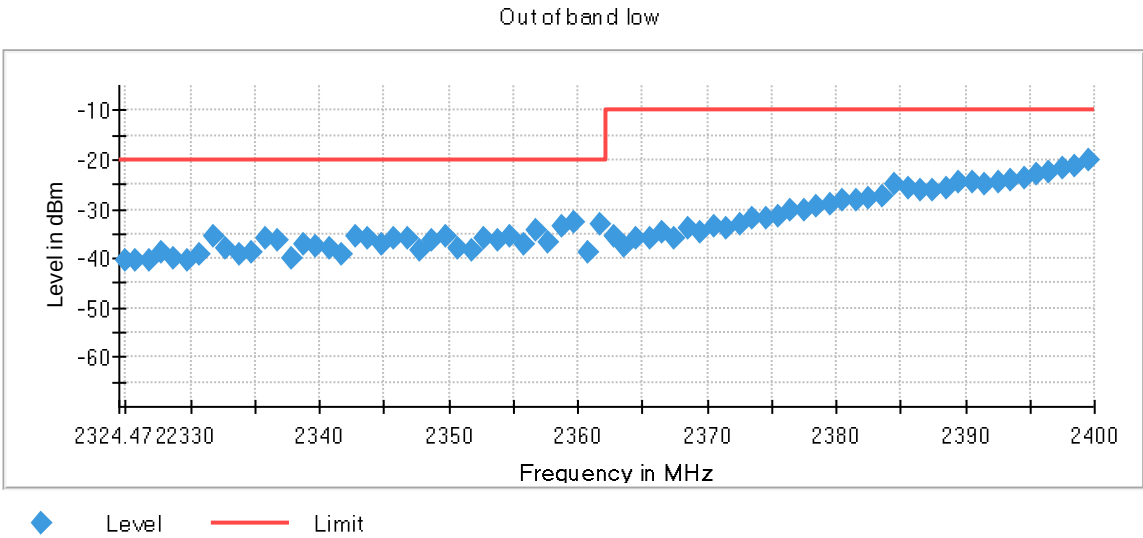
UNWANTED OOB High Freq Section, Channel 13

Out of band high

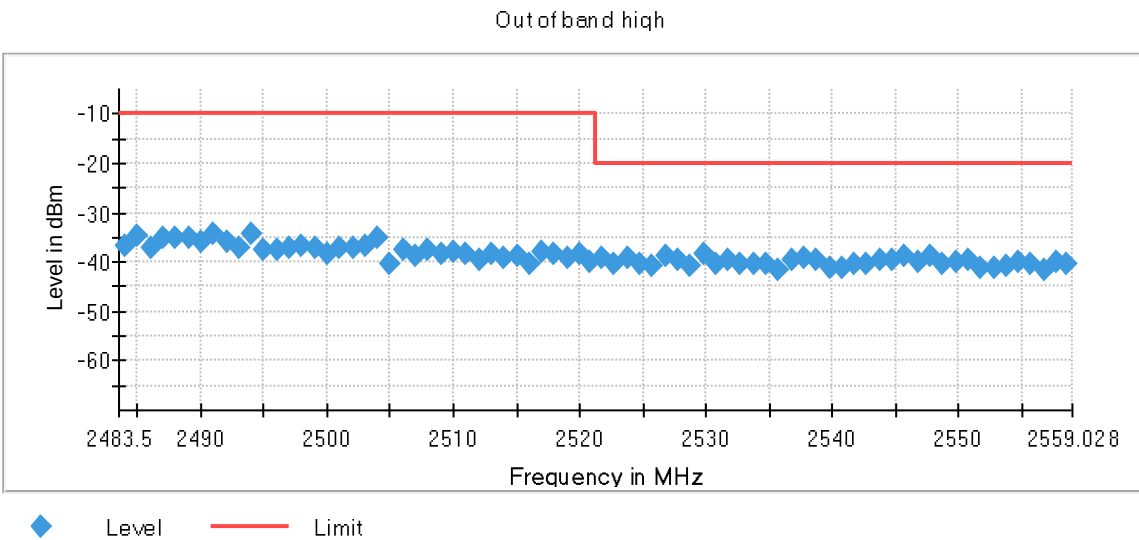


802.11ax40, HE0 (SISO) – Chain A

UNWANTED OOB Low Freq Section, Channel 3

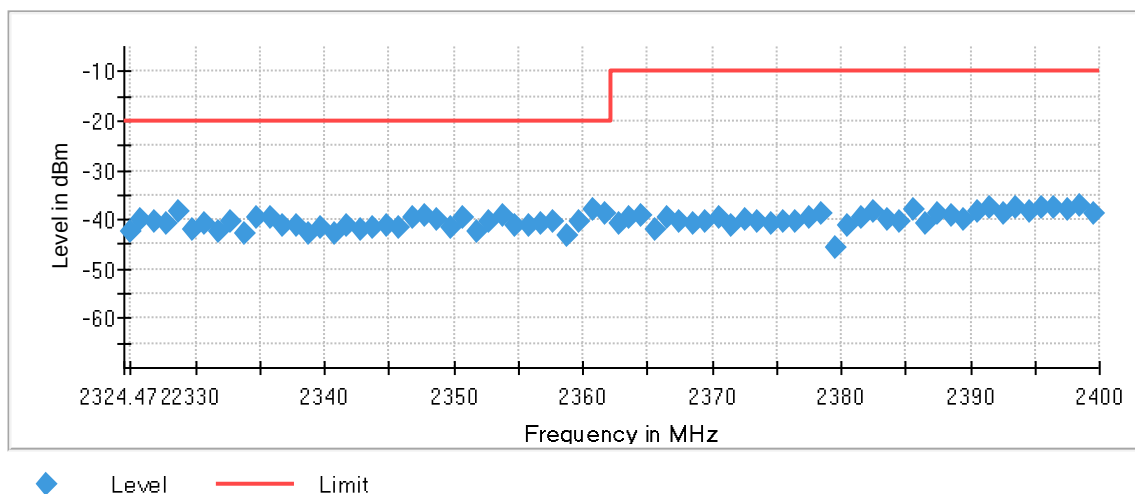


UNWANTED OOB High Freq Section, Channel 3



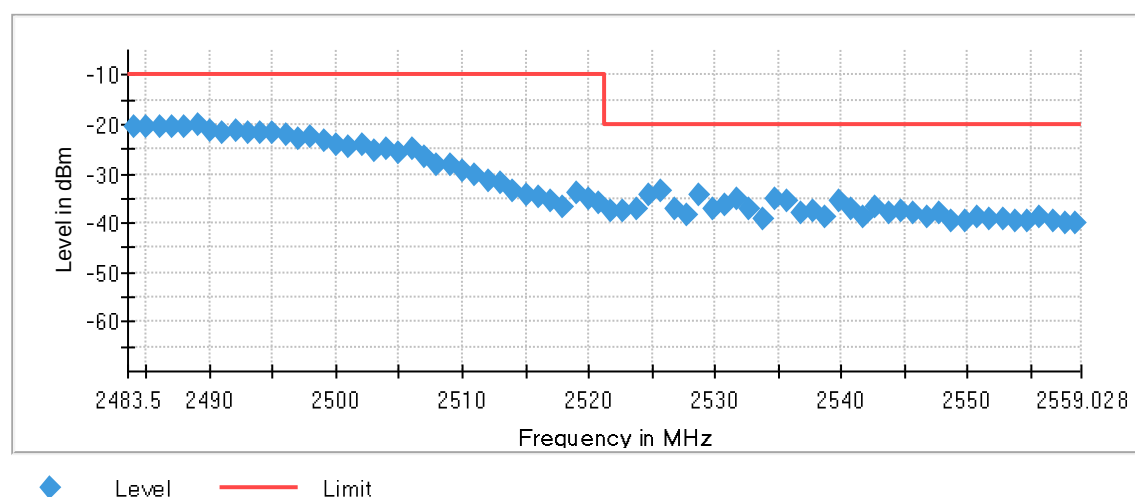
UNWANTED OOB Low Freq Section, Channel 11

Out of band low



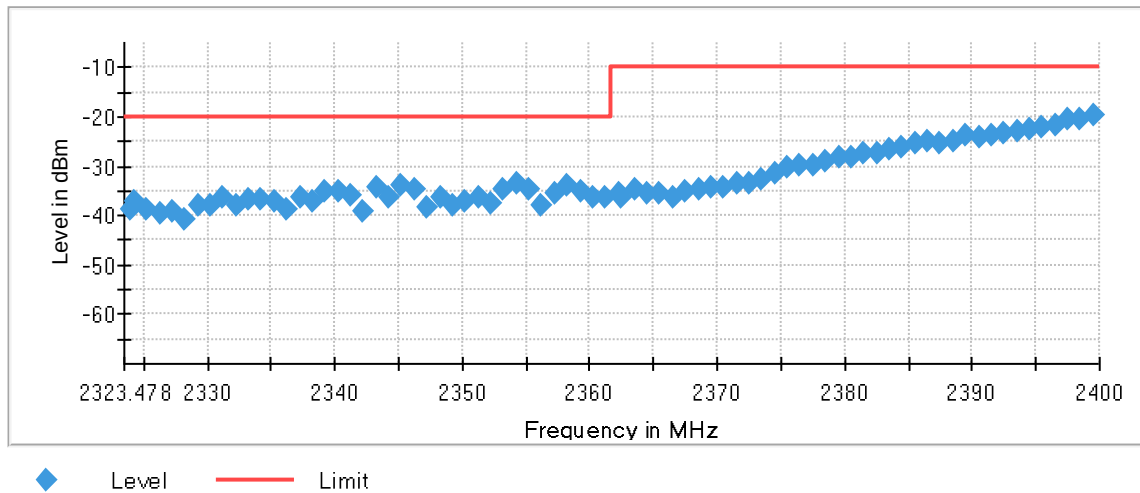
UNWANTED OOB High Freq Section, Channel 11

Out of band high

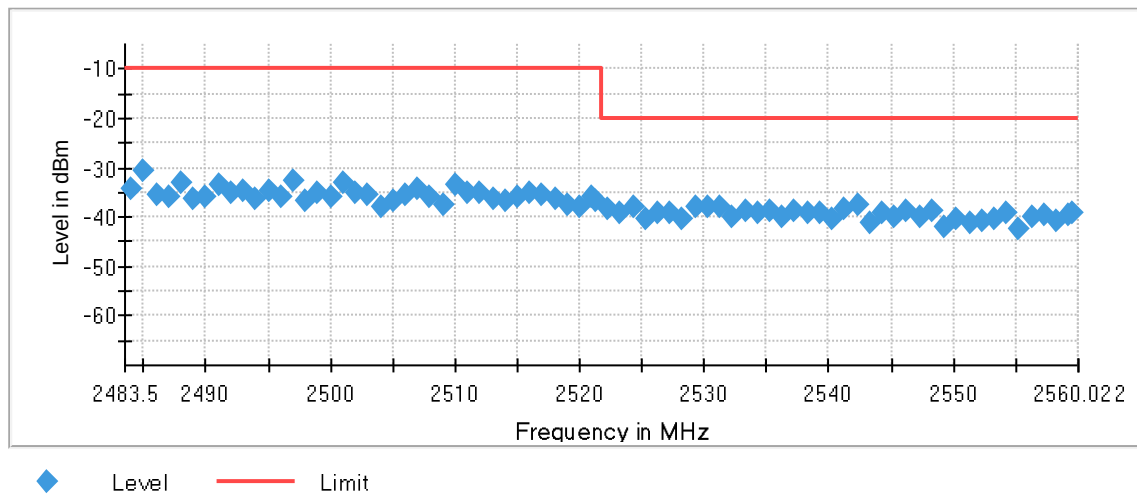


802.11ax40, HE0 (SISO) – Chain B**UNWANTED OOB Low Freq Section, Channel 3**

Out of band low

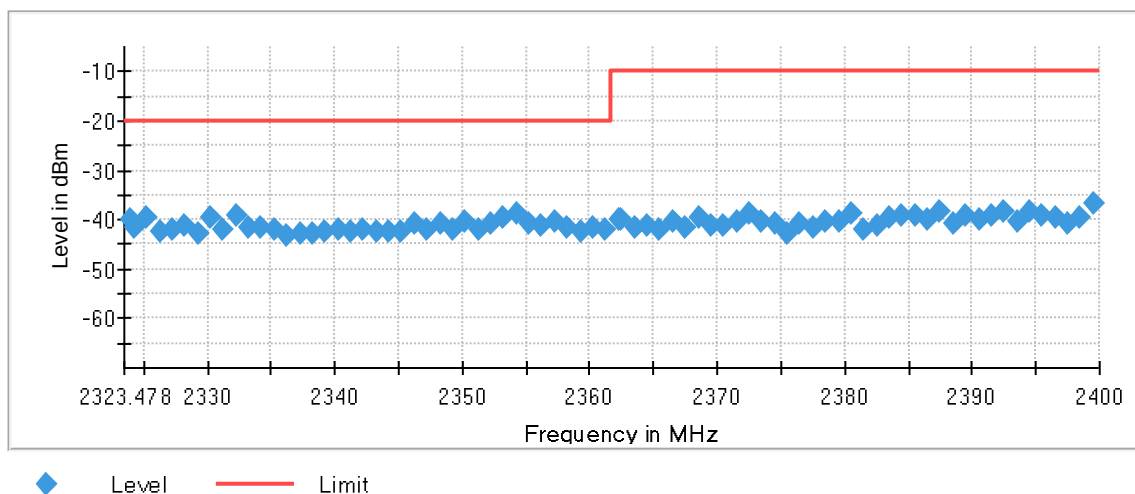
**UNWANTED OOB High Freq Section, Channel 3**

Out of band high



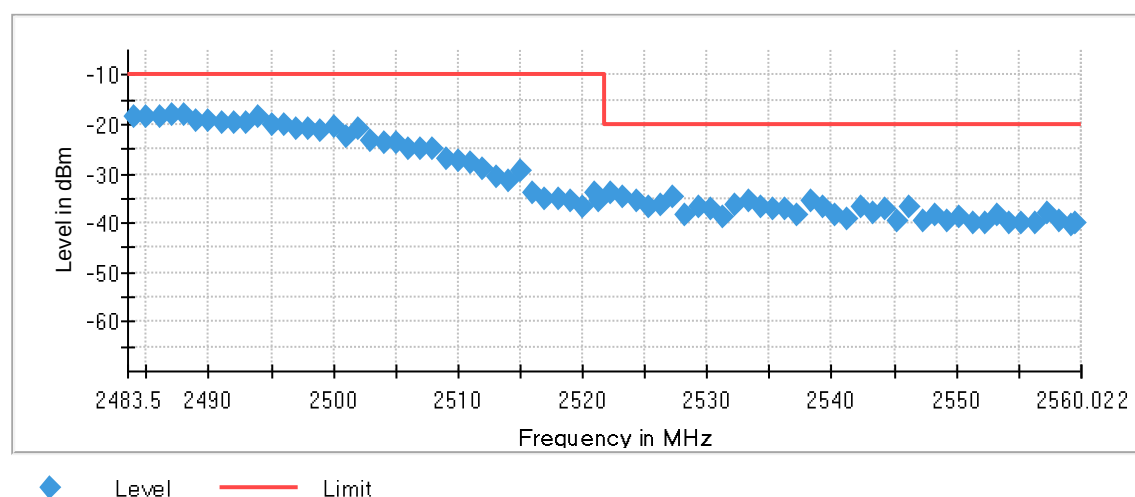
UNWANTED OOB Low Freq Section, Channel 11

Out of band low



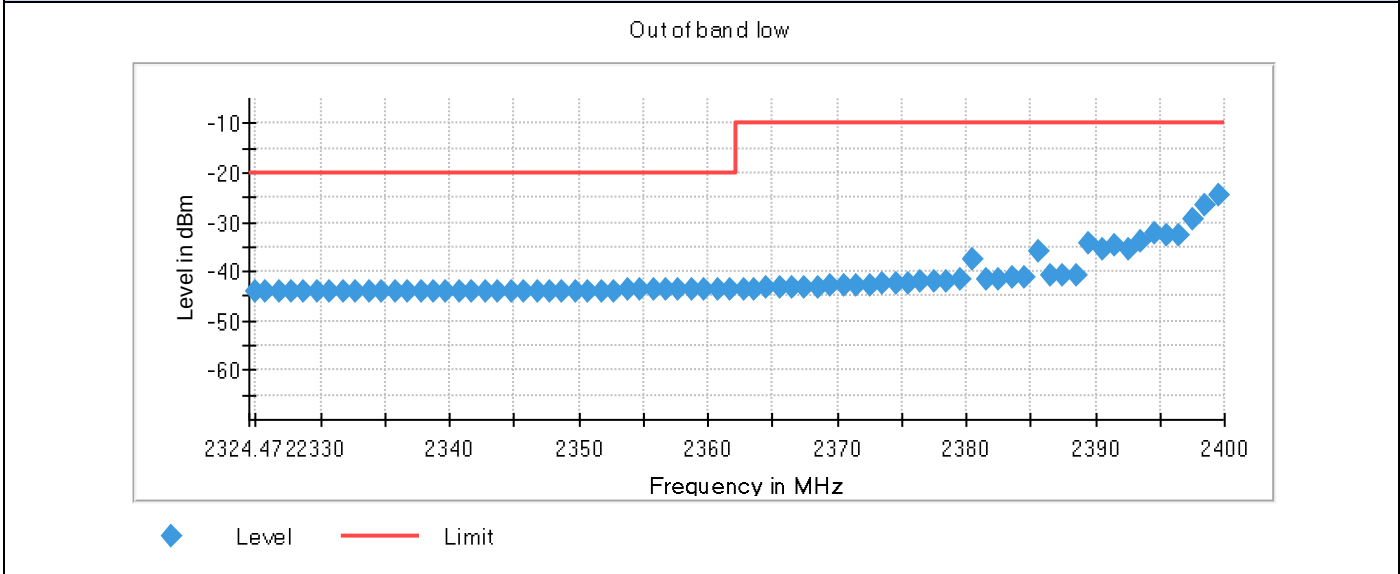
UNWANTED OOB High Freq Section, Channel 11

Out of band high

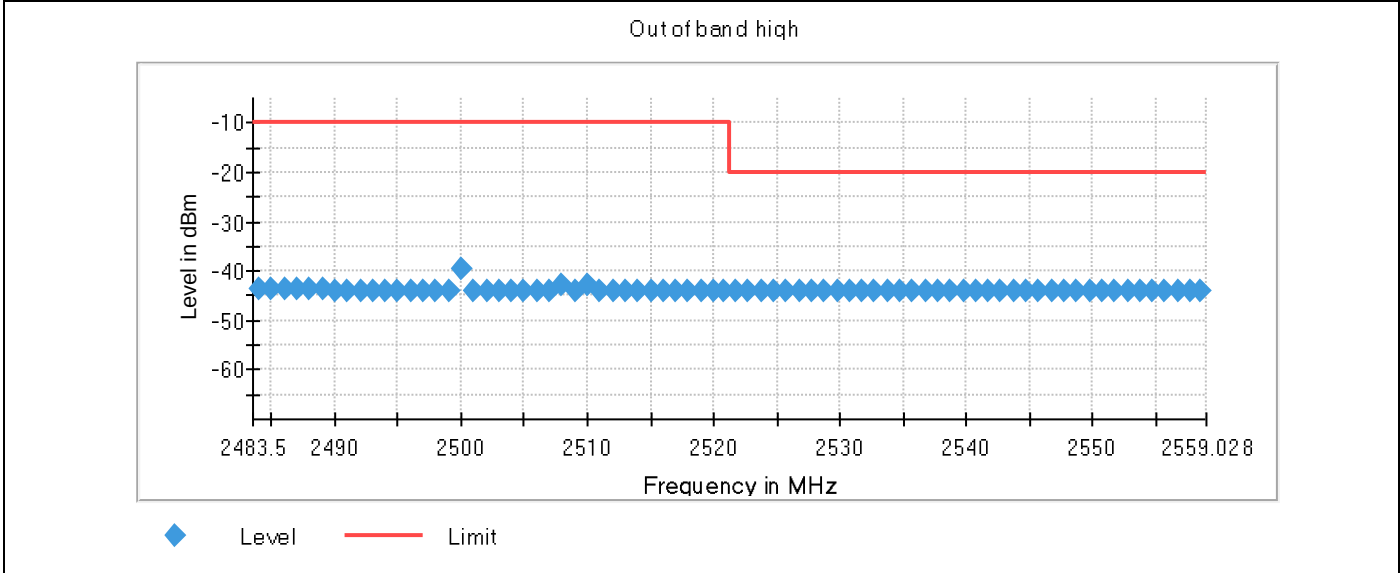


802.11ax40, HE0 (MIMO)

UNWANTED OOB Low Freq Section, Channel 3

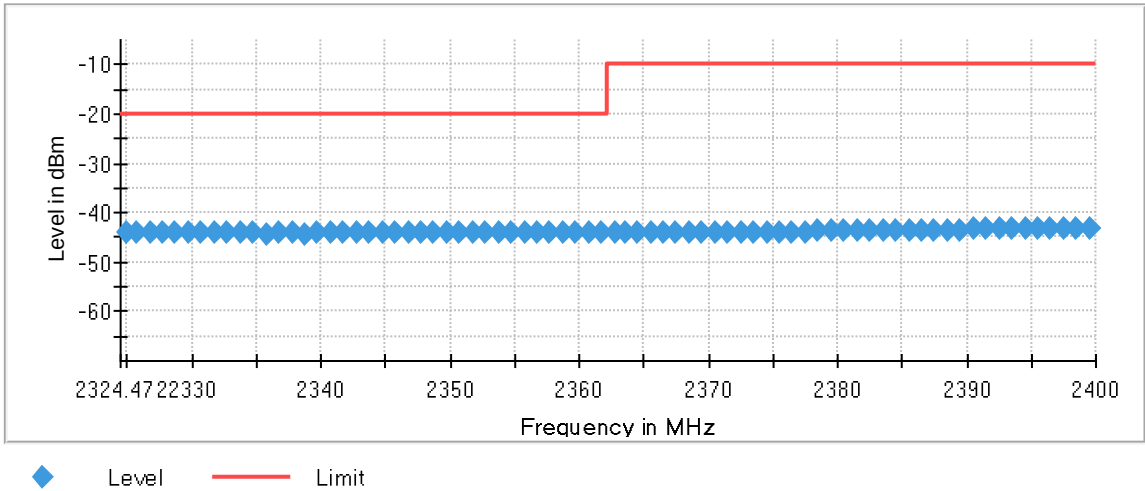


UNWANTED OOB High Freq Section , Channel 3



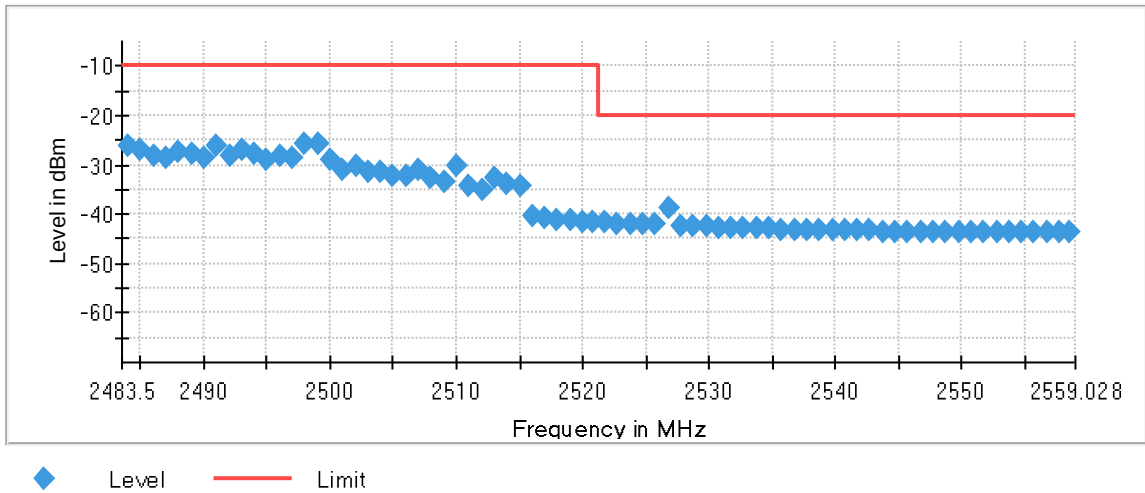
UNWANTED OOB Low Freq Section, Channel 11

Out of band low



UNWANTED OOB High Freq Section, Channel 11

Out of band high



B.7 Transmitter unwanted emissions in the spurious domain

Test limits

ETSI clause	Limits																																	
4.3.2.9.3	The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12. For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz. Table12: Transmitter limits for spurious emissions <table><tr><th>Frequency range</th><th>Maximum power</th><th>Bandwidth</th></tr><tr><td>30 MHz to 47 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr><tr><td>47 MHz to 74 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr><tr><td>74 MHz to 87.5 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr><tr><td>87.5 MHz to 118 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr><tr><td>118 MHz to 174 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr><tr><td>174 MHz to 230 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr><tr><td>230 MHz to 470 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr><tr><td>470 MHz to 694 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr><tr><td>694 MHz to 1 GHz</td><td>-36 dBm</td><td>100 kHz</td></tr><tr><td>1 GHz to 12.75 GHz</td><td>-30 dBm</td><td>1 MHz</td></tr></table>	Frequency range	Maximum power	Bandwidth	30 MHz to 47 MHz	-36 dBm	100 kHz	47 MHz to 74 MHz	-54 dBm	100 kHz	74 MHz to 87.5 MHz	-36 dBm	100 kHz	87.5 MHz to 118 MHz	-54 dBm	100 kHz	118 MHz to 174 MHz	-36 dBm	100 kHz	174 MHz to 230 MHz	-54 dBm	100 kHz	230 MHz to 470 MHz	-36 dBm	100 kHz	470 MHz to 694 MHz	-54 dBm	100 kHz	694 MHz to 1 GHz	-36 dBm	100 kHz	1 GHz to 12.75 GHz	-30 dBm	1 MHz
	Frequency range	Maximum power	Bandwidth																															
	30 MHz to 47 MHz	-36 dBm	100 kHz																															
	47 MHz to 74 MHz	-54 dBm	100 kHz																															
	74 MHz to 87.5 MHz	-36 dBm	100 kHz																															
	87.5 MHz to 118 MHz	-54 dBm	100 kHz																															
	118 MHz to 174 MHz	-36 dBm	100 kHz																															
	174 MHz to 230 MHz	-54 dBm	100 kHz																															
	230 MHz to 470 MHz	-36 dBm	100 kHz																															
	470 MHz to 694 MHz	-54 dBm	100 kHz																															
	694 MHz to 1 GHz	-36 dBm	100 kHz																															
	1 GHz to 12.75 GHz	-30 dBm	1 MHz																															

Test conditions

ETSI clause	Conditions
5.4.9.1	These measurements shall only be performed at normal test conditions. For non-FHSS equipment, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. The equipment shall be configured to operate under its worst case situation with respect to output power. If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then the equipment shall be configured to operate under its worst case situation with respect to spurious emissions.

Test procedure

The radiated setups (transmitter) shown in section *Test & System Description* were used to measure the transmission spurious emissions accordingly with ETSI EN 300 328 V2.2.2§ 5.4.9.2.2. Depending of the frequency range and bands being tested, different antennas and filters were used; in consequence different setups are employed.

The final measurement is done by varying the antenna height from 1 to 4 meters, the EUT azimuth over 360° and for both Vertical and Horizontal polarizations.

The radiated spurious emission was measured on the worst case configuration on the low and high channel for each transmission mode.

Test Results**Tx Spurious Emissions – 30MHz to 1GHz****Tx Spurious Emissions – All modes**

Frequency	RMS	Limit (e.i.r.p)	Margin	Polarization
MHz	dBm	dBm	dB	---
70.7	-62.2	-51.9	10.4	V

Note 1: The spurious signals detected do not depend on either the operating channel or the modulation mode.

Tx Spurious Emissions – 1GHz to 12.75GHz**Tx Spurious Emissions – 802.11b (SISO), Chain A – Channel 1**

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
4823.9	-52.2	-30.0	22.2	V
7236.6	-57.5	-30.0	27.5	V
9648.0	-56.3	-30.0	26.3	H

Tx Spurious Emissions – 802.11b (SISO), Chain A – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
4944.2	-51.0	-30.0	21.0	V
12089.4	-56.3	-30.0	26.3	H

Tx Spurious Emissions – 802.11b (SISO), Chain B – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
4823.9	-54.3	-30.0	24.3	V
7234.7	-59.5	-30.0	29.5	H

Tx Spurious Emissions – 802.11b (SISO), Chain B – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
4943.7	-51.2	-30.0	21.2	V
9965.0	-56.6	-30.0	26.6	H

Tx Spurious Emissions – 802.11g (SISO), Chain A – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2995.5	-48.5	-30.0	18.5	H
11346.4	-58.2	-30.0	28.2	V

Tx Spurious Emissions – 802.11g (SISO), Chain A – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2995.7	-46.4	-30.0	16.4	V
12360.9	-56.8	-30.0	26.8	H

Tx Spurious Emissions – 802.11g (SISO), Chain B – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2982.0	-48.8	-30.0	18.8	V
11334.4	-57.8	-30.0	27.8	H

Tx Spurious Emissions – 802.11g (SISO), Chain B – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2999.5	-47.0	-30.0	17.0	H
11757.2	-57.4	-30.0	27.4	V

Tx Spurious Emissions – 802.11n20 (SISO), Chain A – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2969.0	-48.7	-30.0	18.7	V
11235.3	-57.9	-30.0	27.9	H

Tx Spurious Emissions – 802.11n20 (SISO), Chain A – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2972.6	-47.1	-30.0	17.1	V
11799.9	-56.0	-30.0	26.0	H

Tx Spurious Emissions – 802.11n20 (SISO), Chain B – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2997.5	-48.3	-30.0	18.3	V
11407.8	-57.8	-30.0	27.8	H

Tx Spurious Emissions – 802.11n20 (SISO), Chain B – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2995.5	-46.9	-30.0	16.9	V
11277.0	-56.6	-30.0	26.6	H

Tx Spurious Emissions – 802.11n20 (MIMO), Chain A+B – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
3105.6	-55.6	-30.0	25.6	H
4823.4	-54.1	-30.0	24.1	V
11308.2	-57.2	-30.0	27.2	V

Tx Spurious Emissions – 802.11n20 (MIMO), Chain A+B – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2995.2	-46.9	-30.0	16.9	V
11529.3	-56.5	-30.0	26.5	H

Tx Spurious Emissions – 802.11n40 (SISO), Chain A – Channel 3

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2970.0	-48.9	-30.0	18.9	H
7571.1	-59.3	-30.0	29.3	H

Tx Spurious Emissions – 802.11n40 (SISO), Chain A – Channel 11

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2954.5	-47.5	-30.0	17.5	V
11218.9	-56.4	-30.0	26.4	V

Tx Spurious Emissions – 802.11n40 (SISO), Chain B – Channel 3

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
3184.6	-55.5	-30.0	25.5	H
11245.4	-57.5	-30.0	27.5	H

Tx Spurious Emissions – 802.11n40 (SISO), Chain B – Channel 11

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2912.4	-46.8	-30.0	16.8	H
11100.2	-56.6	-30.0	26.6	H

Tx Spurious Emissions – 802.11n40 (MIMO), Chain A+B – Channel 3

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2983.0	-48.4	-30.0	18.4	H
11225.6	-57.5	-30.0	27.5	H

Tx Spurious Emissions – 802.11n40 (MIMO), Chain A+B – Channel 11

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
3087.8	-52.6	-30.0	22.6	H
11325.4	-55.3	-30.0	25.3	V

Tx Spurious Emissions – 802.11ax20 (SISO), Chain A – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2956.0	-48.4	-30.0	18.4	V
7210.6	-57.6	-30.0	27.6	V

Tx Spurious Emissions – 802.11ax20 (SISO), Chain A – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2982.9	-46.9	-30.0	16.9	H
7390.8	-56.1	-30.0	26.1	H

Tx Spurious Emissions – 802.11ax20 (SISO), Chain B – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2940.0	-48.4	-30.0	18.4	H
7211.0	-59.2	-30.0	29.2	H

Tx Spurious Emissions – 802.11ax20 (SISO), Chain B – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
3093.9	-53.0	-30.0	23.1	H
7499.8	-57.4	-30.0	27.4	H

Tx Spurious Emissions – 802.11ax20 (MIMO), Chain A+B – Channel 1

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2993.0	-48.4	-30.0	18.4	V
7210.1	-57.0	-30.0	27.0	H

Tx Spurious Emissions – 802.11ax20 (MIMO), Chain A+B – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
4927.2	-50.5	-30.0	20.5	V
7391.3	-55.9	-30.0	25.9	H

Tx Spurious Emissions – 802.11ax40 (SISO), Chain A – Channel 3

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2983.5	-48.3	-30.0	18.3	H
7212.0	-57.0	-30.0	27.0	H

Tx Spurious Emissions – 802.11ax40 (SISO), Chain A – Channel 11

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2968.3	-46.8	-30.0	16.8	V
7331.7	-55.3	-30.0	25.3	H

Tx Spurious Emissions – 802.11ax40 (SISO), Chain B – Channel 3

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2985.5	-48.7	-30.0	18.7	V
7212.0	-58.3	-30.0	28.3	H

Tx Spurious Emissions – 802.11ax40 (SISO), Chain B – Channel 11

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2926.4	-47.3	-30.0	17.3	H
7332.5	-56.8	-30.0	26.8	H

Tx Spurious Emissions – 802.11ax40 (MIMO), Chain A+B – Channel 3

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2979.0	-48.0	-30.0	18.0	V
7211.5	-56.4	-30.0	26.4	H

Tx Spurious Emissions – 802.11ax40 (MIMO), Chain A+B – Channel 11

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
2926.0	-46.8	-30.0	16.8	H
7331.0	-55.4	-30.0	25.4	H

B.8 Receiver spurious emissions

Test limits

ETSI clause	Limits								
4.3.2.10.3	The spurious emissions of the receiver shall not exceed the values given in table 13.								
	For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.								
	Table 13: Spurious emission limits for receivers								
	<table><tr><th>Frequency range</th><th>Maximum power</th><th>Bandwidth</th></tr><tr><td>30 MHz to 1GHz</td><td>-57 dBm</td><td>100 kHz</td></tr><tr><td>1GHz to 12.75 GHz</td><td>-47 dBm</td><td>1 MHz</td></tr></table>	Frequency range	Maximum power	Bandwidth	30 MHz to 1GHz	-57 dBm	100 kHz	1GHz to 12.75 GHz	-47 dBm
Frequency range	Maximum power	Bandwidth							
30 MHz to 1GHz	-57 dBm	100 kHz							
1GHz to 12.75 GHz	-47 dBm	1 MHz							

Test conditions

ETSI clause	Conditions
5.3.10.1	These measurements shall only be performed at normal test conditions. Testing shall be performed when the equipment is in a receive-only mode. For non-FHSS equipment, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate

Test procedure

The radiated setups (receiver) shown in section *Test & System Description* were used to measure receiver spurious emissions accordingly with ETSI EN 300 328 V2.2.2§ 5.4.10.2.2. Depending of the frequency range and bands being tested, different antennas and filters were used.

The final measurement is done by varying the antenna height from 1 to 4 meters, the EUT azimuth over 360° and for both Vertical and Horizontal polarizations.

The radiated spurious emission was measured on the worst case configuration and on the low and high channel for each transmission mode.

Test Results**Rx Spurious Emissions – 30MHz to 1GHz****Rx Spurious Emissions – All modes**

Frequency	RMS	Limit (e.i.r.p)	Margin	Polarization
MHz	dBm	dBm	dB	---
72.0	-64.4	-54.9	9.5	V

Note 1: The spurious signals detected do not depend on either the operating channel or the modulation mode.

Rx Spurious Emissions – 1 GHz to 12.75 GHz**Rx Spurious Emissions – b/g/n20/ax20 (MIMO), Chain A+B – Channel 1**

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
12327.0	-58.3	-47.0	11.3	V

Rx Spurious Emissions – b/g/n20/ax20 (MIMO), Chain A+B – Channel 13

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
12329.1	-58.7	-47.0	11.7	V

Rx Spurious Emissions – 802.11n40/ax40 (MIMO), Chain A+B, CH3

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
12746.9	-58.5	-47.0	11.5	V

Rx Spurious Emissions – 802.11n40/ax40 (MIMO), Chain A+B, CH11

Frequency	RMS	Limit	Margin	Polar
MHz	dBm	dBm	dB	---
12340.1	-58.1	-47.0	11.2	V

B.9 Receiver Blocking

Test limits

ETSI clause	Limits																		
4.3.2.11.3 4.3.2.11.4	The minimum performance criterion shall be a PER less than or equal to 10 %. While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table below. Receiver blocking parameters for Receiver Category 1 equipment <table><tr><th>Wanted signal mean power from companion device (dBm) (see notes 1 and 4)</th><th>Blocking signal frequency (MHz)</th><th>Blocking signal power (dBm) (see note 4)</th><th>Type of blocking signal</th></tr><tr><td rowspan="4">(-133 dBm + 10 × log₁₀(OCBW)) or -68 dBm whichever is less (see note 2)</td><td>2380</td><td rowspan="8">-34</td><td rowspan="8">CW</td></tr><tr><td>2504</td></tr><tr><td>2300</td></tr><tr><td>2584</td></tr><tr><td rowspan="5">(-139 dBm + 10 × log₁₀(OCBW)) or -74 dBm whichever is less (see note 3)</td><td>2300</td></tr><tr><td>2330</td></tr><tr><td>2360</td></tr><tr><td>2524</td></tr><tr><td>2584</td></tr><tr><td>2674</td></tr></table> NOTE 1: OCBW is in Hz NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to Pmin + 26 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to Pmin + 20 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.	Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal	(-133 dBm + 10 × log ₁₀ (OCBW)) or -68 dBm whichever is less (see note 2)	2380	-34	CW	2504	2300	2584	(-139 dBm + 10 × log ₁₀ (OCBW)) or -74 dBm whichever is less (see note 3)	2300	2330	2360	2524	2584	2674
Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal																
(-133 dBm + 10 × log ₁₀ (OCBW)) or -68 dBm whichever is less (see note 2)	2380	-34	CW																
	2504																		
	2300																		
	2584																		
(-139 dBm + 10 × log ₁₀ (OCBW)) or -74 dBm whichever is less (see note 3)	2300																		
	2330																		
	2360																		
	2524																		
	2584																		
2674																			

Test conditions

ETSI clause	Conditions
5.4.11.1	These measurements shall only be performed at normal test conditions. For non-FHSS equipment, having more than one operating channel, the operating channels on which the testing has to be performed shall be selected as follows: • For testing blocking frequencies less than 2400 MHz, the equipment shall operate on the lowest operating channel. • For testing blocking frequencies greater than 2500 MHz, the equipment shall operate on the highest operating channel. Equipment which can change their operating channel automatically (adaptive channel allocation), and where this function cannot be disabled, shall be tested as a FHSS equipment. If the equipment can be configured to operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz) and different data rates, then the combination of the smallest channel bandwidth and the lowest data rate for this channel bandwidth which still allows the equipment to operate as intended shall be used. This mode of operation shall be aligned with the performance criteria defined in clause 4.3.1.12.3 or clause 4.3.2.11.3 and shall be described in the test report..

Test procedure

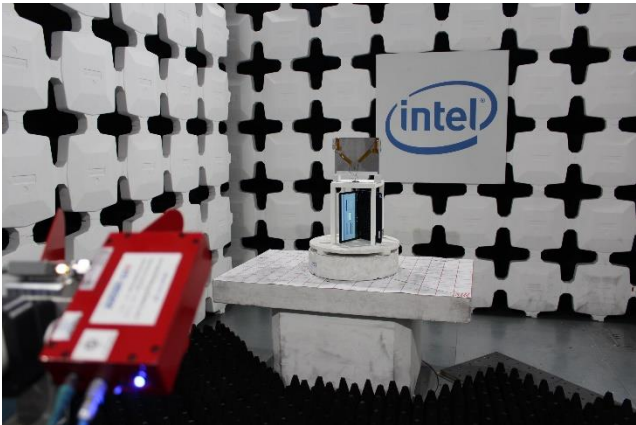
The receiver blocking setup (conducted) shown in section *Test & System Description* was used to measure receiver blocking signal. The signaling Unit is a CMW500. The packet error rate (PER) is measured with the CMW500. The blocking signal is emulated by the Signal generator SMB100A. Antenna gain and insertion loss are taken into account.

Test results

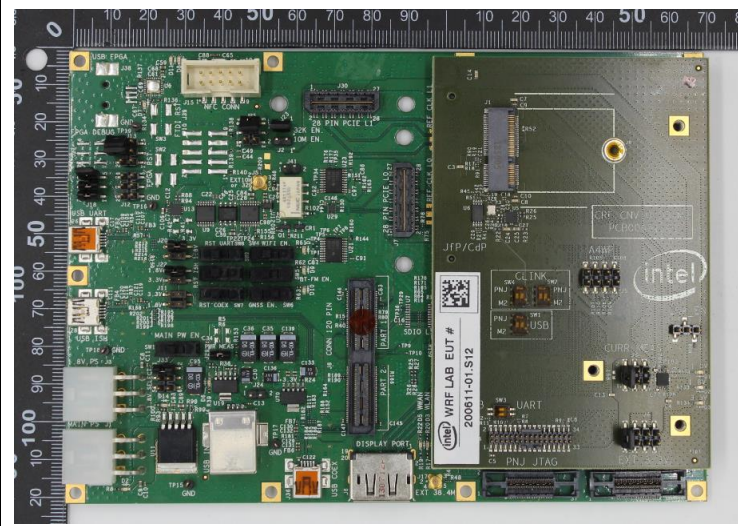
Configuration	99% Occupied bandwidth [MHz]	Wanted signal mean power from companion device (dBm)	PER [%] Without blocking signal	Blocking signal [MHz]	Blocking signal Power [dBm]	PER [%] With Blocking signal	Verdict
		Without blocking signal		With blocking signal			
802.11b Chain A Channel 1 2412MHz 1Mbps	13.42	-70.00	3.15	2380	-36	1.20	Pass
		-76.00	2.00	2300	-36	0.15	Pass
				2330	-36	0.15	Pass
				2360	-36	0.45	Pass
802.11b Chain A Channel 13 2472MHz 1Mbps	13.42	-70.00	1.50	2504	-36	0.75	Pass
		-76.00	0.80	2524	-36	0.10	Pass
				2584	-36	1.05	Pass
				2674	-36	0.25	Pass

Annex C. Photographs

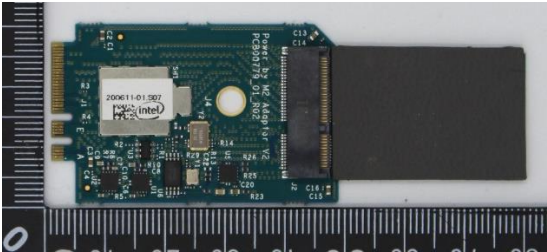
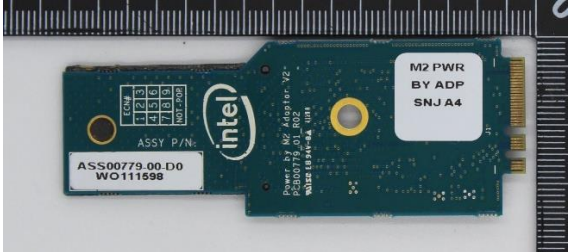
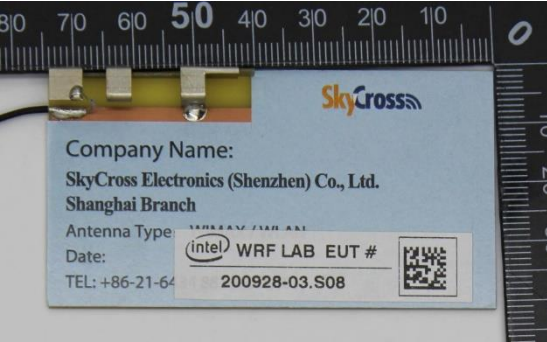
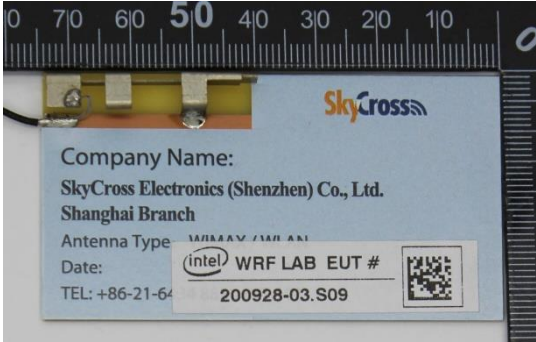
C.1 Test Setup

Radiated Setup 30 MHz – 1 GHz (Transmitter & Receiver tests) 	Radiated Setup 1 GHz – 6.4 GHz (Transmitter tests) 
Radiated Setup 6.4 GHz – 12.75 GHz (Transmitter tests) 1 GHz – 12.75 GHz (Receiver tests) 	

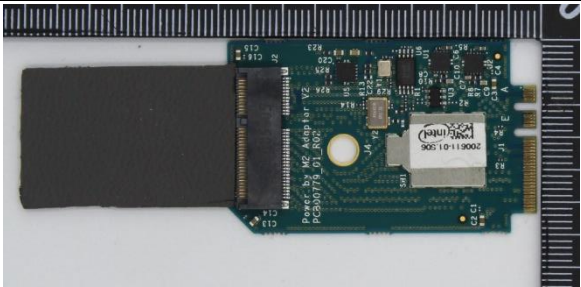
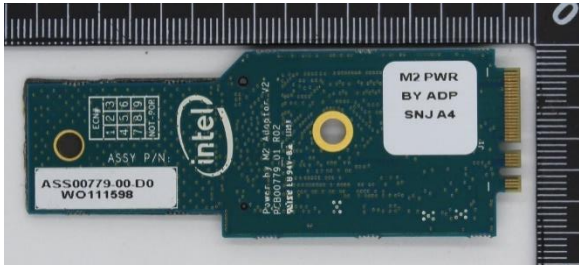
C.2 Test Sample

Sample #01	
Module Front	Module Back
	
Extender board	Laptop
	

Sample #02

Module Front 	Module Back 
Adaptor front (with absorber) 	Adaptor back 
Extender board 	Laptop 
Main Antenna 	Aux Antenna 

Sample #03

Module Front	Module Back
	
Adaptor front (with absorber)	Adaptor back
	
Laptop (Host)	
	

End of the report

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