Report No. REP008732

Test Report

Product	Electronic Control Unit for vehicle Integration
Name and address of the applicant	CPAC Systems AB Bergskroken 3, 431 37 Mölndal, Sweden
Name and address of the manufacturer	CPAC Systems AB Bergskroken 3, 431 37 Mölndal, Sweden
Model	SID 2.0
Rating	24VDC
Trademark	CPAC Systems AB
Serial number	See page 3
Additional information	This report covers 2.4 GHz WiFi. (Alps module UGCZ1 containing Qualcomm QCA6175A)
Tested according to	**ETSI EN 300 328 V2.2.2 (2019-07)** Wideband transmission systems; Data transmission equipment operating in the 2.4 GHz band; Harmonised Standard for access to radio spectrum
Order number	PRJ0024292
Tested in period	2023-02-25 to 2023-04-27
Issue date	2023-05-15
Name and address of the testing laboratory	Nemko Scandinavia AS Instituttveien 6, 2007 Kjeller, Norway

An accredited technical test executed under the Norwegian accreditation scheme

Prepared by [G.Suhanthakumar]	Approved by [Jan G Eriksen]

Revision history

Revision #	Date	sign	Order #	Description
A	2023-05-15	gns	PRJ0024292	First issued

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1 Test Information

1.1 Tested Item

Name	CPAC Systems AB
Model/version	SID 2.0
Serial number	23040034
Hardware identity and/or version	P-01
Software identity and/or version	Hydra_BTSW_1.0
Frequency Range	**2412 – 2472 MHz**
Number of Channels	**13**
Channel Spacing	**/**
Operating Mode	**802.11 b/g/ , n HT20 and HT40**
Type of Modulation	**DSSS and OFDM**
Rated Output Power	**<100 mW**
Power Source	**24V DC**
Antenna Connector	FAKRA 50 ohm
Number of Antennas	See cl.1.3 of this report
Antenna gain	See cl.1.3 of this report
Antenna Diversity Supported	**Yes**
Smart Antenna System	**no**
Receiver Category	**1**
Geo-Location Capability	**Not implemented**

Description of Tested Device(s)

Electronic Control Unit for vehicle Integration

1.2 Model Variants

According to the manufacturer the following models have same RF parts and RF modules.

Model/type	LTE Module mounted	Superseal 26	Tested
SID 2.0 (tested at Nemko)	Yes	version 1	☒
SID 2.0M	No (Marine commercial)	version 2	
SID 2.0MLTE	Yes (Marine leisure)	version 2	
SID 2.0X (EU only)	Yes	version 1	

1.3 Antenna types

Declared by the manufacturer.

Name	P/N	Max gain (dBi)	Function
2J 2× 4G/3G/2G MIMO, 2× 2.4/5.0 GHz MIMO and GNSS	2J #2J4A50PCFa	3.7	2.4GHz Wifi+BT
2J 2× 4G/3G/2G MIMO, 2× 2.4/5.0 GHz MIMO and GNSS	2J #2J4A50PCFa	4	2G+3G+4G
TE ANTENNA BASE FULL FEAT	Volvo #23311779	7	2.4GHz Wifi+BT
TE ANTENNA BASE FULL FEAT	Volvo #23311779	7	2G+3G+4G
TE ANTENNA INTERIOR PHONE	Volvo #23311714	3	2G+3G+4G
TE ANTENNA INTERIOR WLAN	Volvo #23311706	3.5	2.4GHz Wifi+BT

1.4 Receiver Categories

Receiver Category 1	- **Adaptive equipment with maximum RF Output Power greater that 10 mW e.i.r.p.**
Receiver Category 2	- **Non-adaptive equipment with MU Factor greater than 1% and less than or equal to 10%, or** - **Any equipment with a maximum RF output power greater than 0 dBm e.i.r.p and less than or equal to 10 dBm e.i.r.p.**
Receiver Category 3	- **Non-adaptive equipment with a maximum MU factor of 1%, or** - **Any equipment with a maximum RF output power of 0 dBm e.i.r.p.**

NOTE: Non-adaptive equipment is categorized as receiver category 2 or receiver category 3.

1.5 Normal test condition

Temperature	20 – 23 °C
Relative humidity	20 – 45 %
Normal test voltage	24 VDC

The values are the limit registered during the test period.

1.6 Extreme test conditions

	Voltage	Temperature
Minimum	**8 VDC**	**-40 °C**
Maximum	**32 VDC**	**+85 °C**

1.7 Test Engineer

G.Suhanthakumar

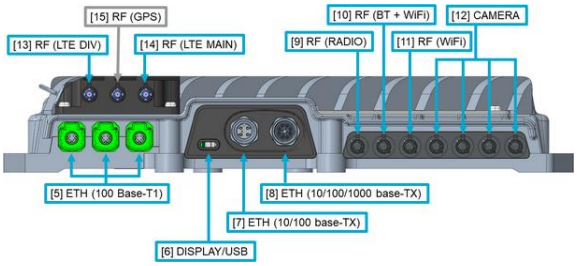
1.8 Test Equipment

See list of test equipment in clause 9.

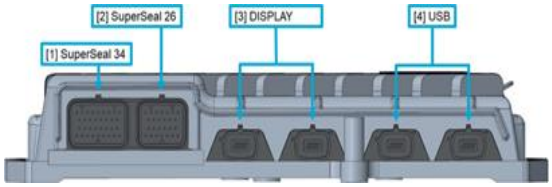
1.9 Test Configuration

Channel nr	Frequency (MHz)	Modulation	BW
01	**2412**	**b/g/n**	**HT20**
06	**2442**	**b/g/n**	**HT20**
13	**2472**	**b/g/n**	**HT20**
3,6,9	**2422,2437,2452**	**n**	**HT40**

		Power setting
b	1Mbps	10
b	11Mbps	10
g	6M-2.4G	12
g	54-2.4G	12
HT	mcs0-2.4G	13
HT	mcs7-2.4G	13



Connectors – rear side



1.10 Worst Case Mode

Operation Mode	Worst Case Bit Rate
802.11b	1 Mbit/s
802.11g	6 Mbit/s
802.11n HT20	MCS0
802.11n HT40	MCS0

All tests were performed at the worst case bit rate noted above.

1.11 Other Comments

The EUT have been tested to ETSI EN 300 328 V2.2.2 and all tests are Passed.
All radiated and conducted RF measurements are done with DC power supply.

2 TEST REPORT SUMMARY

2.1 General

The tests were conducted on a sample of the equipment for demonstrating compliance with the following standards:

Standard	Description
EN 300 328 V2.2.2 (2019-07)	Wideband Transmission systems; Data transmission equipment operating in the 2,4GHz band; Harmonized Standard for access to radio spectrum

The test methods have been in accordance with TM-NO-WLS-500, TM-NO-WLS-204A and EN 300 328 where applicable. Radiated tests were performed is accordance with TM-NO-WLS-500, TM-NO-WLS-204A and EN 300 328.

Radiated emissions are made in a 3m fully anechoic chamber.

☐ **Production Unit**
☒ **Pre-production Unit**

3 Test Report Summary

3.1 Abbreviations

N/A Not applicable. The testcase is not applicable for the tested equipment.
N/T Not tested. The testcase is not covered by this test report.
U Unconditional (test is mandatory)
C Conditional (test is only mandatory if certain conditions are met)

3.2 Test Summary

Harmonized Standard EN 300 328					
Technical Reqirement reference		**Technical Requirement Conditionality**		**Test Specification**	
Description	**Reference Clause No**	**U/C**	**Condition**	**Reference Clause No**	**Verdict**
RF Output Power	4.3.1.2 or 4.3.2.2	U		5.4.2	**Pass**
Power Spectral Density	4.3.2.3	C		5.4.3	**Pass**
Duty cycle, Tx-Sequence, Tx-gap	4.3.1.3 or 4.3.2.4	C	Only for non-adaptive equipment	5.4.2	**N/A**
Accumulated Transmit time, Frequency Occupation and Hopping Sequence	4.3.1.4	C	Only for FHSS	5.4.4	**N/A**
Hopping Frequency Separation	4.3.1.5	C	Only for FHSS	5.4.5	**N/A**
Medium Utilisation Factor	4.3.1.6 or 4.3.2.5	C	Only for non-adaptive equipment	5.4.2	**N/A**
Adaptivity	4.3.1.7 or 4.3.2.6	C	Only for adaptive equipment	5.4.6	**Pass**
Occupied Channel Bandwidth	4.3.1.8 or 4.3.2.7	U		5.4.7	**Pass**
Transmitter unwanted emissions in the Out-of-Band domain	4.3.1.9 or 4.3.2.8	U		5.4.8	**Pass**
Transmitter unwanted emissions in the spurious domain	4.3.1.10 or 4.3.2.9	U		5.4.9	**Pass**
Receiver spurious emissions	4.3.1.11 or 4.3.2.10	U		5.4.10	**Pass**
Receiver Blocking	4.3.1.12 or 4.3.2.11	U		5.4.11	**Pass**
Geo-location capability	4.3.1.13 or 4.3.2.12	C	Optional feature	N/A	**N/A[2]**

[1] Not required for Adaptive equipment
[2] Not implemented

4 Test Results

4.1 RF Output Power, Radiated

ETSI EN 300 328 Clause 4.3.2.2

Conducted RF measurements done with maximum antenna gain to get eirp. Standard FAKRA RF connector is provided for 2 types of detachable antenna.

Channel Frequency (MHz)	Measured values (dBm)				
	802.11b 1M	802.11g 6M	802.11n MCS0 HT20 SISO	802.11n MCS0 HT20 MIMO	802.11n MCS0 HT40 SISO
2412	17.1	17.2	19.4	19.5	/
2442	17.3	17.1	19.6	19.7	/
2472	17.1	18.4	19.6	19.8	/
2422	/	/	/	/	11.2
2437	/	/	/	/	11.1
2452	/	/	/	/	11.2

Detector rms

Nominal conditions - RF output power

The maximum antenna gain declared by the manufacturer is 7.0 dBi. (base antenna)

Limits:

Maximum Effective Radiated Power shall be less than or equal to 100 mW (20 dBm) e.i.r.p.

Test Equipment Used: 2, 3, 4, 5, 6

4.2 RF output power, Conducted

ETSI EN 300 328 Clause 4.3.2.2

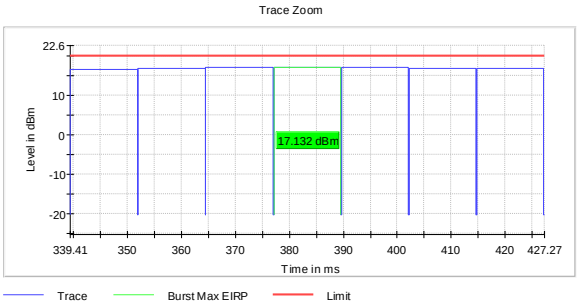
Channel Frequency (MHz)	Temp.	Voltage	Measured values (dBm)			
			802.11b 1M	802.11g 6M	802.11n MCS0 HT20 SISO	802.11n MCS0 HT20 MIMO
2412	**-40 °C**	**8 VDC**	16.7	16.9	19.1	19.2
2442			17.0	16.8	19.3	19.4
2472			16.2	17.5	18.7	18.9
2412	**-40 °C**	**32 VDC**	16.8	17.0	19.2	19.3
2442			17.0	16.8	19.3	19.4
2472			16.2	17.5	18.7	18.9
2412	**85 °C**	**8 VDC**	16.0	16.2	18.4	18.5
2442			17.1	16.9	19.4	19.5
2472			15.0	16.3	17.5	17.7
2412	**85 °C**	**32 VDC**	16.2	16.4	18.6	18.7
2442			17.2	17.0	19.5	19.6
2472			15.2	16.5	17.7	17.9

Declared maximum antenna gain of 7 dBi used above.

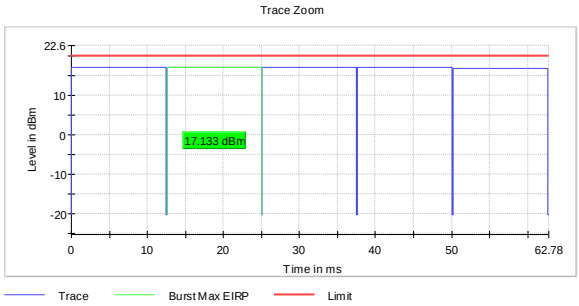
Limits: Clause 4.3.2.1

Maximum Equivalent Isotropic Radiated Power shall be less than or equal to 100 mW (20 dBm)

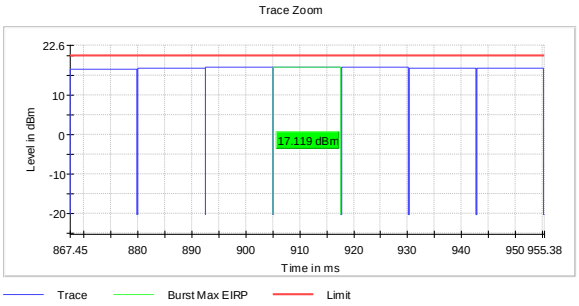
Test Equipment Used: 1, 8, 9



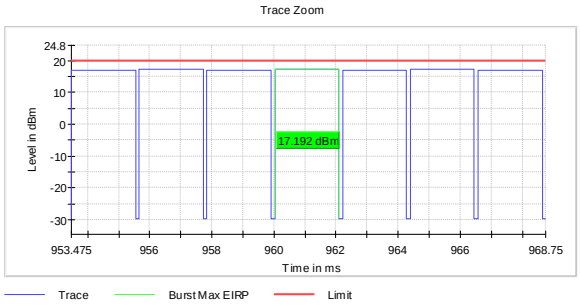
Output Power 2412 MHz, 802.11b 1M, Normal Conditions



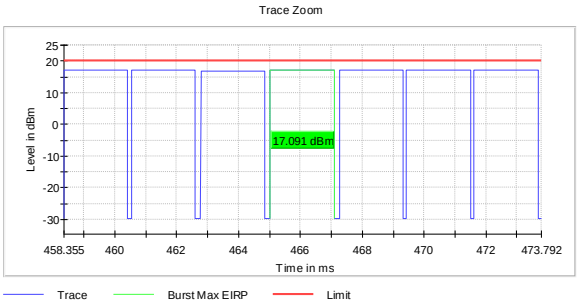
Output Power 2442 MHz, 802.11b 1M, Normal Conditions



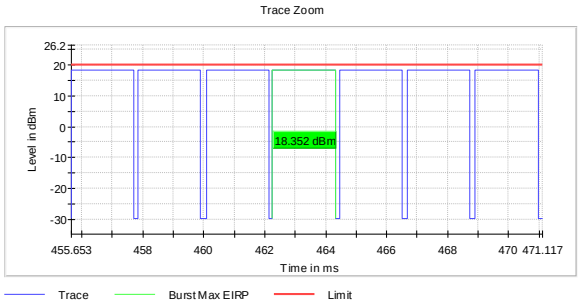
Output Power 2472 MHz, 802.11b 1M, Normal Conditions



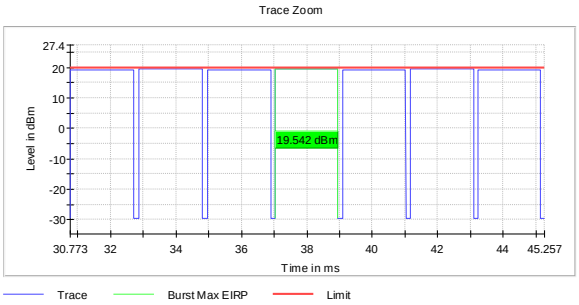
Output Power 2412 MHz, 802.11g 6M, Normal Conditions



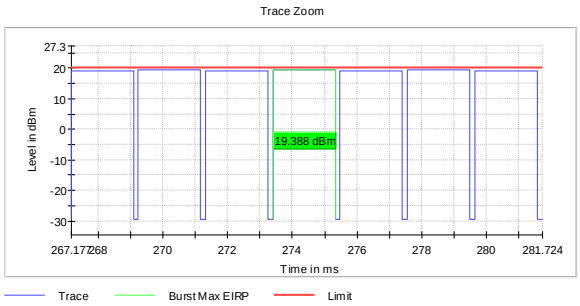
Output Power 2442 MHz, 802.11g 6M, Normal Conditions



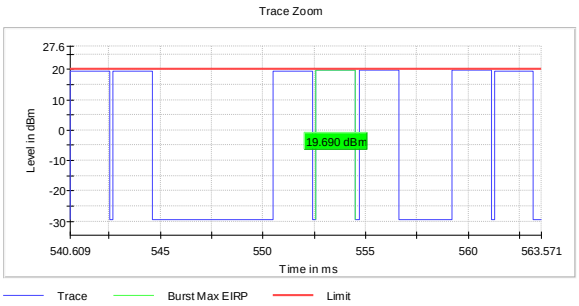
Output Power 2472 MHz, 802.11g 6M, Normal Conditions



Output Power 2412 MHz, 802.11n MCS0 HT20, SISO, Normal Conditions



Output Power 2442 MHz, 802.11n MCS0 HT20, SISO, Normal Conditions

	
Output Power 2472 MHz, 802.11n MCS0 HT20, SISO, Normal Conditions	

4.3 Power Spectral Density

ETSI EN 300 328 Clause 4.3.2.3

Channel Frequency (MHz)	Measured values (dBm)			
	802.11b 1M	802.11g 6M	802.11n MCS0 HT20 SISO	802.11n MCS0 HT20 MIMO
2412	9.0	8.3	8.1	8.0
2442	9.1	8.5	8.3	8.5
2472	8.1	8.5	8.2	8.4

Limits:

The maximum power spectral density is limited to 10 dBm per MHz

Test Equipment Used: 1, 8, 9

4.4 Duty Cycle, TX-Sequence, TX-Gap

ETSI EN 300 328 subclause 4.3.2.4

Please refer to the cl.4.6 adaptivity.

This requirement is not applicable for using FHSS and using DSSS with RF output power less than 10 dBm e.i.r.p., and to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode.

Limits:

The Duty cycle shall be equal to or less than the maximum value declared by the supplier. The TX- sequence time shall be equal to or less than 10ms. The minimum Tx-gap time following a Tx-sequence shall be equal to the duration of that proceeding Tx-sequence with minimum of 3.5ms.

4.5 Medium Utilisation (MU) factor

ETSI EN 300 328 Clause 4.3.2.5

This requirement is not applicable for Adaptive Equipments.

Limits:

For non-adaptive equipment using wide band modulations other than FHSS, the maximum Medium Utilisation factor shall be 10 %.

Test Equipment Used: N/A

4.6 Adaptivity

ETSI EN 300 328 Clause 4.3.2.6

Cl.4.3.2.5.1 – Non-LBT based Detect and Avoid : N/A

Cl.4.3.2.5.2 – LBT based Detect and Avoid (ch2437):

Normal Operation

DutyCycle DUT (all ports) (%)	Monitoring Length (ms)	COT Max (ms)	Limit Max (ms)	COT Max Start (ms)	COT Min (ms)	Number of COTs	CCA Time Min (ms)	CCA Time Max (ms)
10.575	10000.000	4.106	13.000	8883.382	0.002	4555	0.021	35.253

(continuation of the "Normal Operation" table from column 9 ...)

DutyCycle DUT (all ports) (%)	CCA Time Limit Min (ms)	Result
10.575	0.020	PASS

Reaction on Interferer and Blocker

DC in max DC Evaluation Window (%)	Limit Max (%)	Result	Length of max DC Evaluation Window (ms)
3.156	10.000	PASS	50.000

(continuation of the "Reaction on Interferer and Blocker" table from column 4 ...)

DC in max DC Evaluation Window (%)	Start of max DC Evaluation Window (ms)	Stop of max DC Evaluation Window (ms)	Interferer On (ms)
3.156	22153.951	22203.951	1000.000

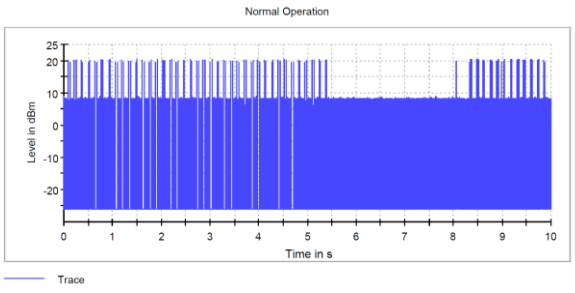
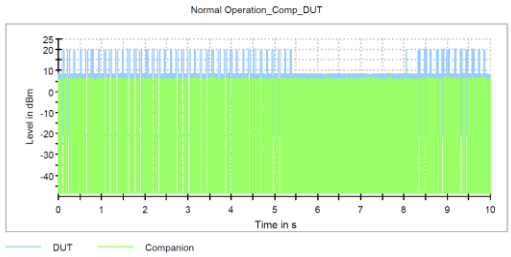
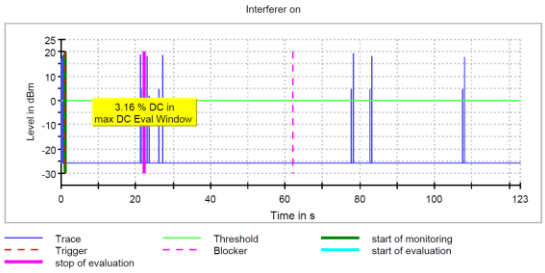
(continuation of the "Reaction on Interferer and Blocker" table from column 7 ...)

DC in max DC Evaluation Window (%)	Blocker On (ms)	Monitoring Offset (ms)	Monitoring Start (ms)	Monitoring Length (ms)
3.156	62000.000	13.000	1013.000	121987.000

Cl.4.3.2.5.3 – Short Control Signalling Transmissions: N/A

Limits:

Test Equipment Used: 1

	
Normal operation	**DuT and Companion device**
	
Interference On	

4.7 Occupied Channel Bandwidth

ETSI EN 300 328 Clause 4.3.2.7

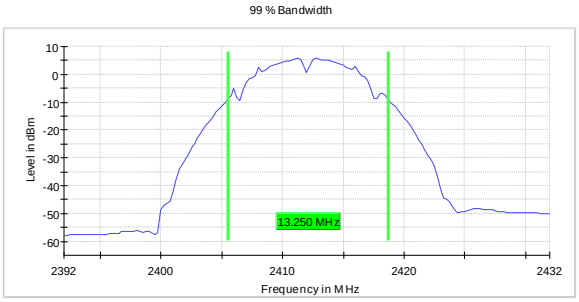
Channel Frequency (MHz)	Occupied Channel Bandwidth (MHz)			
	802.11b 1M	802.11g 6M	802.11n MCS0 HT20 SISO	802.11n MCS0 HT20 MIMO
2412	13.2	16.5	17.5	17.5
2442	13.0	16.5	17.5	17.5
2472	13.0	16.5	17.5	17.5

Comment: Measured conducted with a spectrum analyzer with OBW function and RMS Detector.

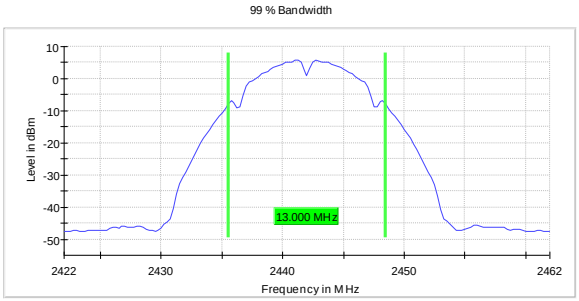
Limits:

The Occupied Channel Bandwidth shall fall completely within the 2400 – 2483.5 MHz band. In addition, for non-adaptive systems 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

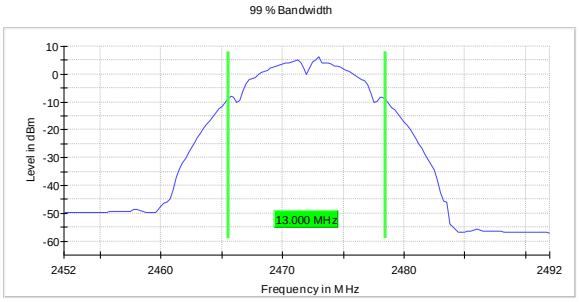
Test Equipment Used: 1, 9



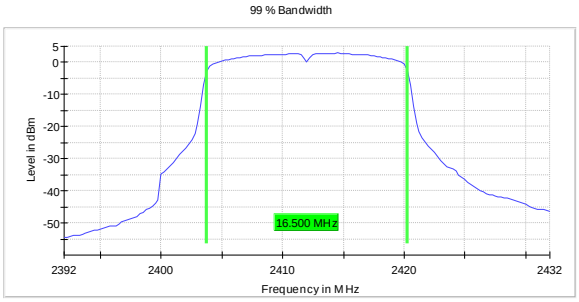
Occupied Bandwidth 2412 MHz, 802.11b 1M



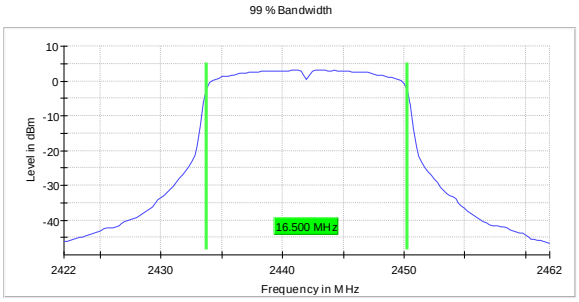
Occupied Bandwidth 2442 MHz, 802.11b 1M



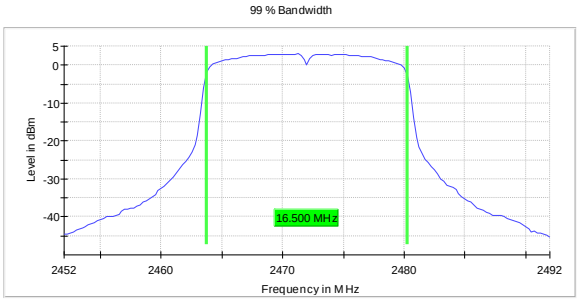
Occupied Bandwidth 2472 MHz, 802.11b 1M



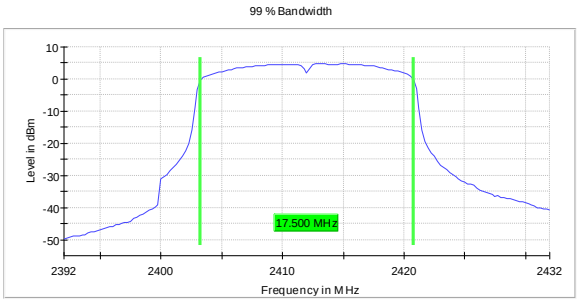
Occupied Bandwidth 2412 MHz, 802.11g 6M



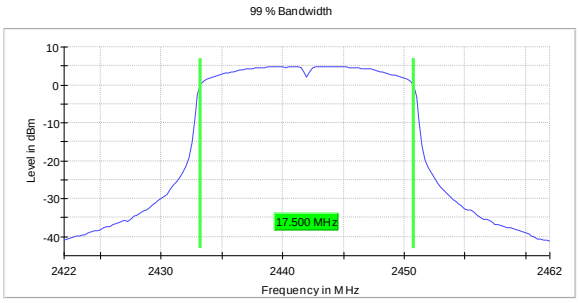
Occupied Bandwidth 2442 MHz, 802.11g 6M



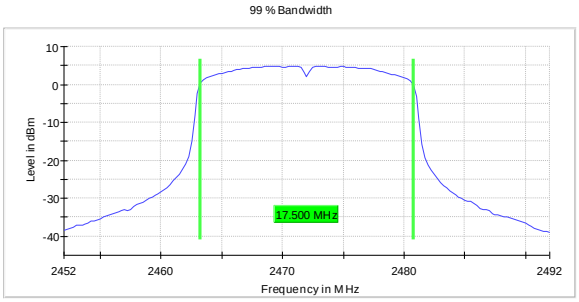
Occupied Bandwidth 2472 MHz, 802.11g 6M



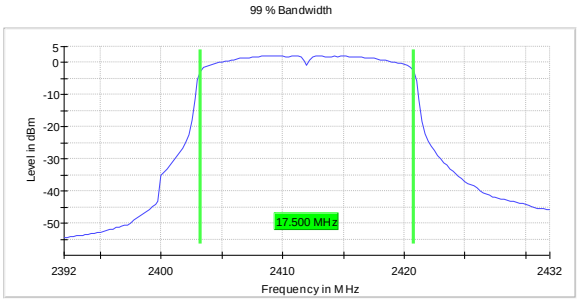
Occupied Bandwidth 2412 MHz, 802.11n MCS0 HT20, SISO



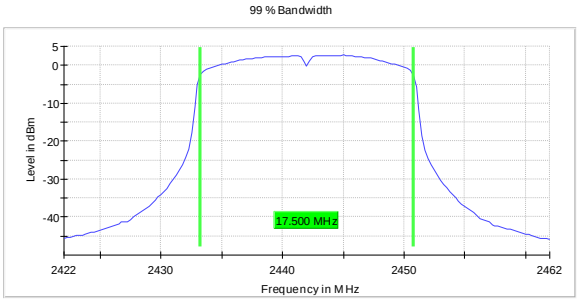
Occupied Bandwidth 2442 MHz, 802.11n MCS0 HT20, SISO



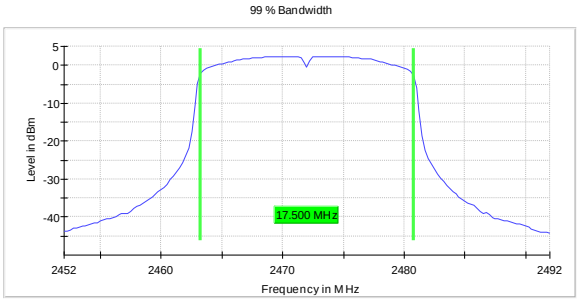
Occupied Bandwidth 2472 MHz, 802.11n MCS0 HT20, SISO



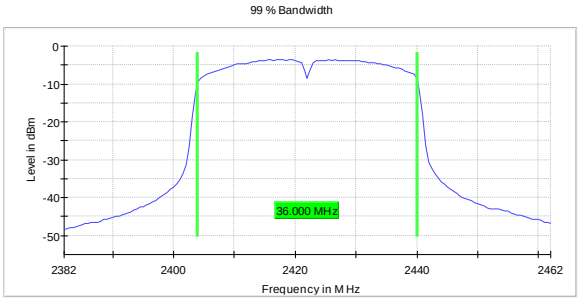
Occupied Bandwidth 2412 MHz, 802.11n MCS0 HT20, MIMO



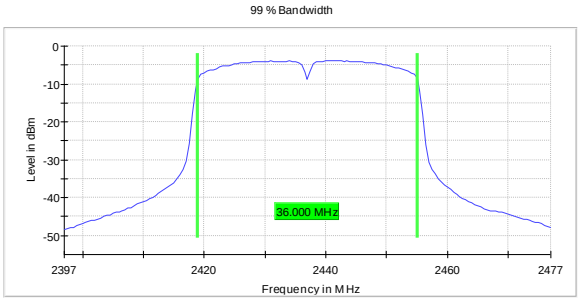
Occupied Bandwidth 2442 MHz, 802.11n MCS0 HT20, MIMO



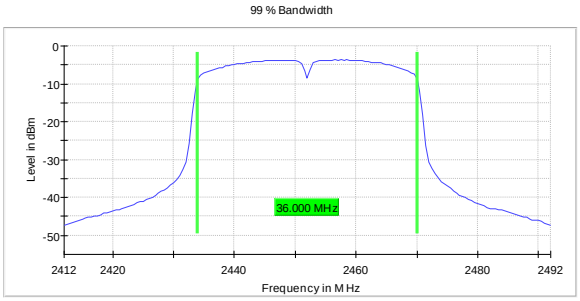
Occupied Bandwidth 2472 MHz, 802.11n MCS0 HT20, MIMO



Occupied Bandwidth 2422 MHz, 802.11n MCS0 HT40, SISO



Occupied Bandwidth 2437 MHz, 802.11n MCS0 HT40, SISO



Occupied Bandwidth 2452 MHz, 802.11n MCS0 HT40, SISO

4.8 Transmitter unwanted emissions in the Out-of-band domain

ETSI EN 300 328 Clause 4.3.2.8

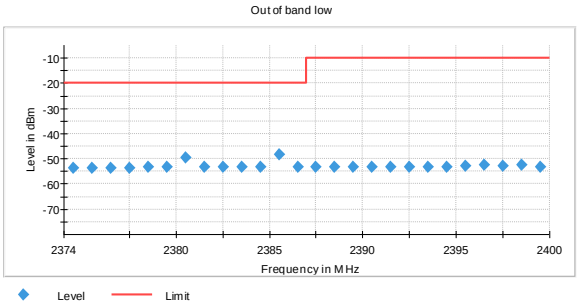
Out of Band Domain	Emission Level (dBm/MHz)			
	802.11b 1M	802.11g 6M	802.11n HT20	802.11n HT40
A: 2400MHz -2BW to 2400MHz -BW	< -40	< -40	< -40	< -40
B: 2400MHz -BW to 2400MHz	< -30	< -30	< -30	< -30
B: 2400MHz to 2400MHz +BW	< -30	< -30	< -30	< -30
A: 2400MHz +BW to 2400MHz +2BW	< -40	< -40	< -40	< -40
Measurement Uncertainty	± 2.0 dB			

Comment: Measured conducted with a spectrum analyzer with rms Detector.
Conducted value is then corrected for antenna gain.

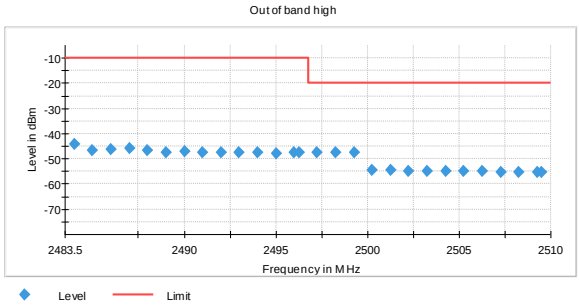
Limits:

Out of Band Domain	Limit (dBm/MHz)
A	-20 dBm/MHz e.i.r.p.
B	-10 dBm/MHz e.i.r.p.

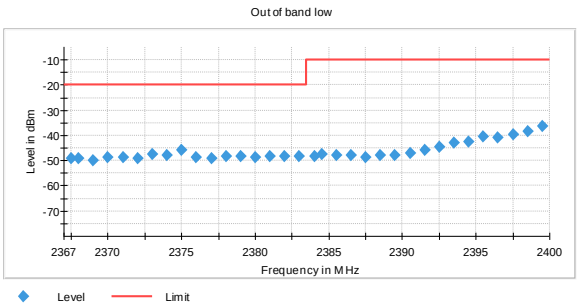
Test Equipment Used: 1, 9



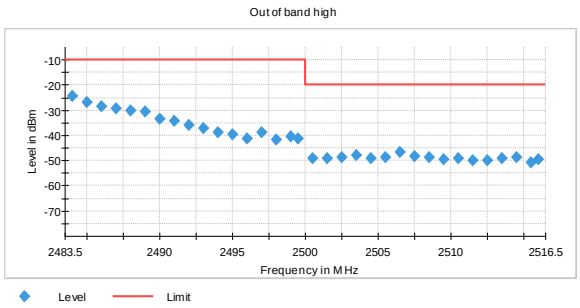
Out of Band Emissions 2412 MHz, 802.11b 1M



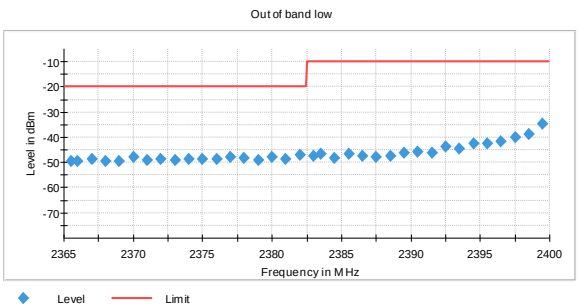
Out of Band Emissions 2472 MHz, 802.11b 1M



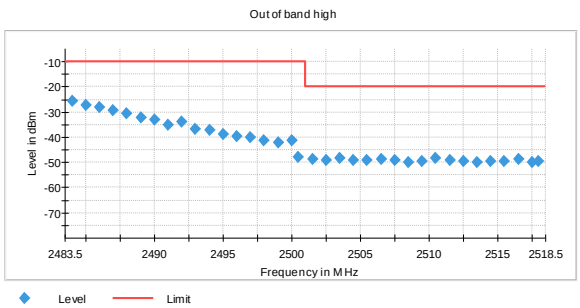
Out of Band Emissions 2412 MHz, 802.11g 6M



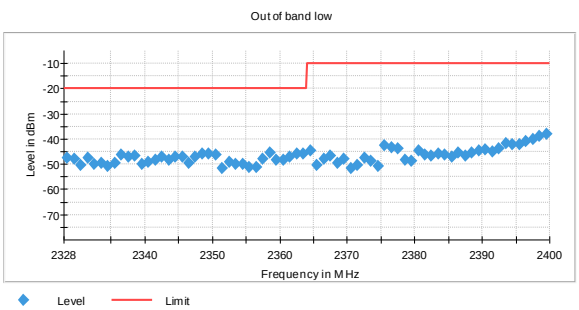
Out of Band Emissions 2472 MHz, 802.11g 6M



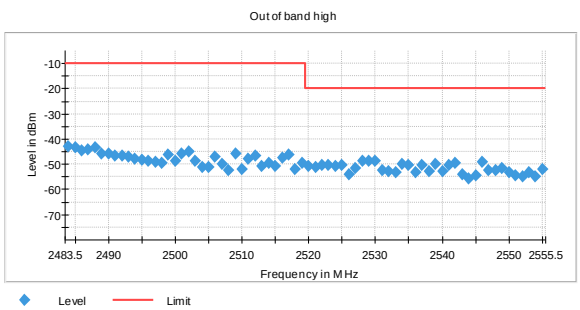
Out of Band Emissions 2412 MHz, 802.11n MCS0 HT20, SISO



Out of Band Emissions 2472 MHz, 802.11n MCS0 HT20, SISO



Out of Band Emissions 2412 MHz, 802.11n MCS0 HT40, SISO



Out of Band Emissions 2472 MHz, 802.11n MCS0 HT40, SISO

4.9 Transmitter spurious emissions - Radiated and conducted (Operating)

ETSI EN 300 328 Clause 4.3.2.9

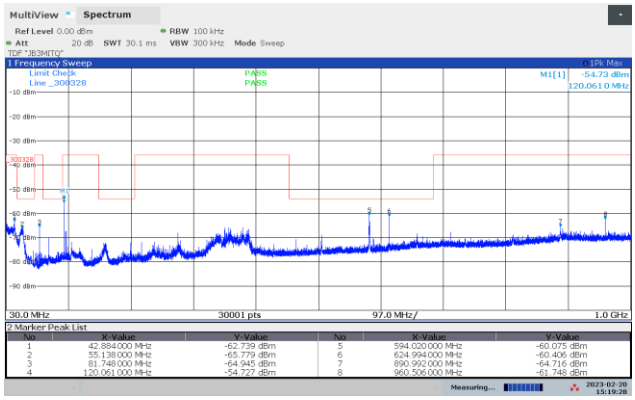
Frequency (MHz)	Spurious Emission Level (dBm)			
	802.11b 1M	802.11g 6M	802.11n HT20 SISO	802.11n HT20 MIMO
30 - 1000 (all limit: -54 dBm)	<-54	<-54	<-54	/
30 - 1000 (all limit: -36 dBm)	<-36	<-36	<-36	/
1000 - 12750	<-40	<-40	<-40	/

Measured with 50 ohm termination at antenna port 10, according to the cl. 5.4.9.1 a) in EN300 328 v2.2.2. Below 1 GHz measured with base antenna.

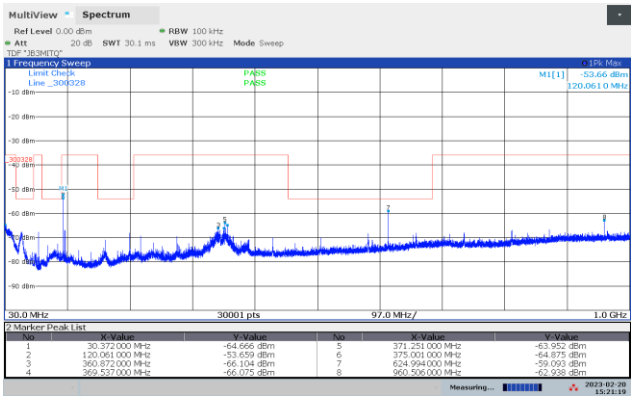
Limits:

Frequency Range	Maximum power e.r.p. (≤ 1 GHz) e.i.r.p (> 1 GHz)	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

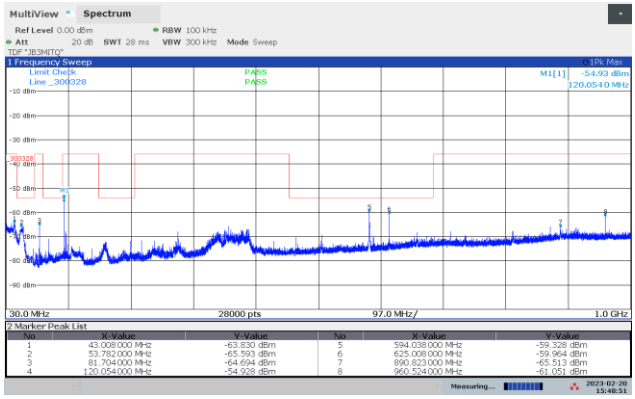
Test Equipment Used: 2, 4, 5, 6, 7



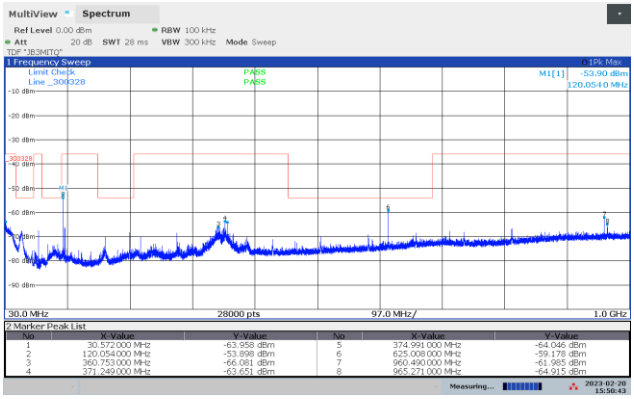
Radiated Emissions 30-1000 MHz, 2412 MHz, VP



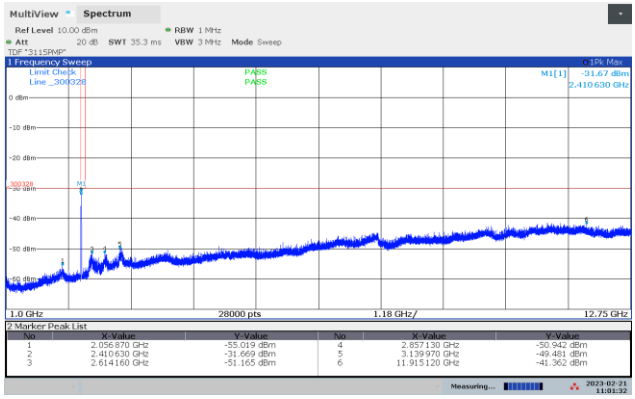
Radiated Emissions 30-1000 MHz, 2412 MHz, HP



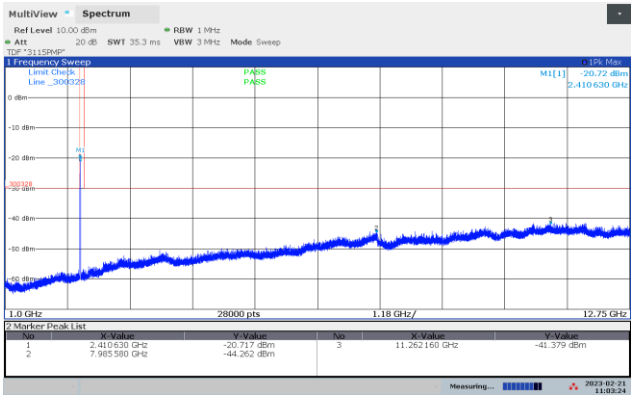
Radiated Emissions 30-1000 MHz, 2472 MHz, VP



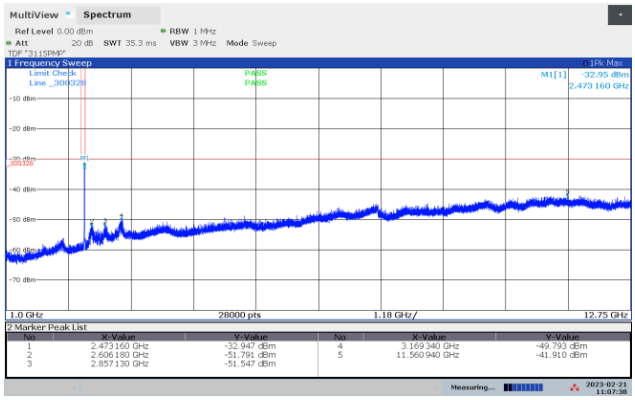
Radiated Emissions 30-1000 MHz, 2472 MHz, HP

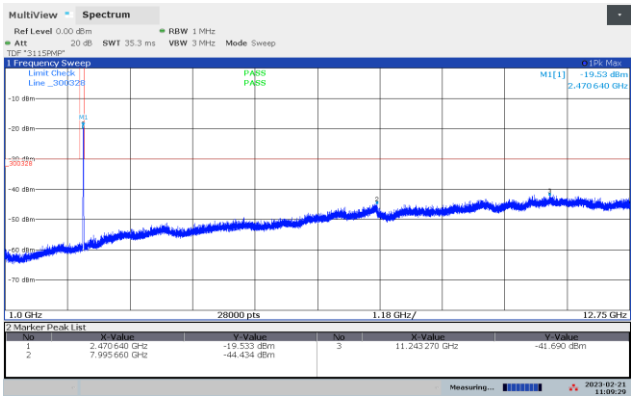


Radiated Emissions 1.0-12.75 GHz, 2412 MHz, 11b 1M, VP



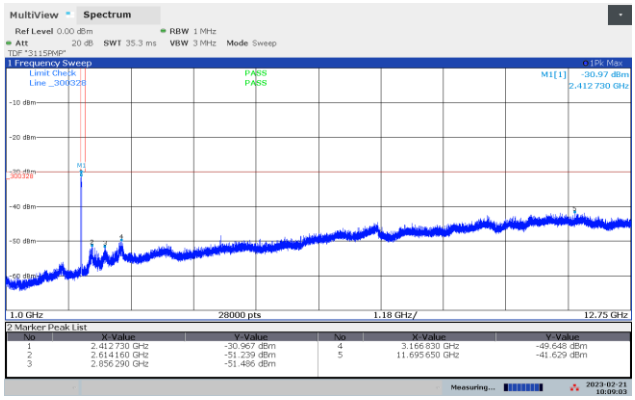
Radiated Emissions 1.0-12.75 GHz, 2412 MHz, 11b 1M, HP



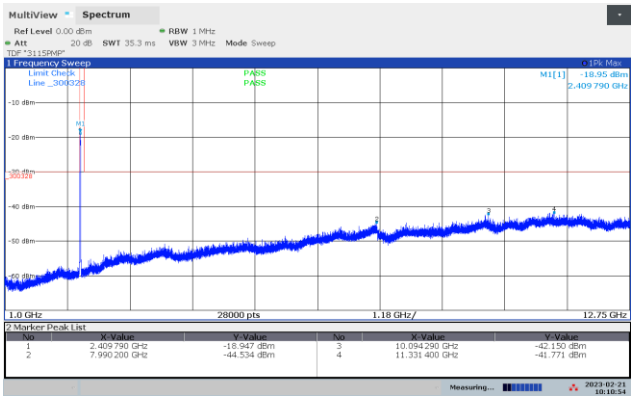


Radiated Emissions 1.0-12.75 GHz, 2472 MHz, 11b 1M, VP

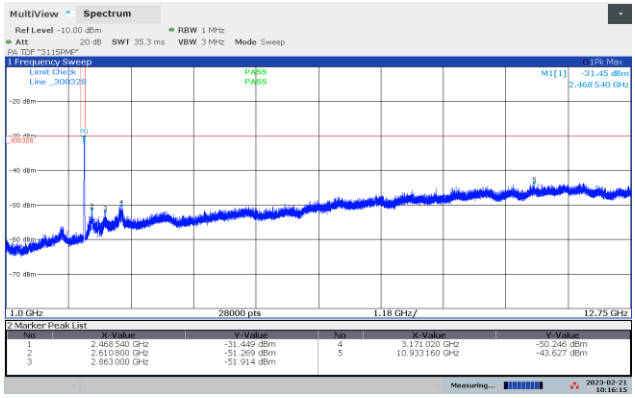
Radiated Emissions 1.0-12.75 GHz, 2472 MHz, 11b 1M, HP



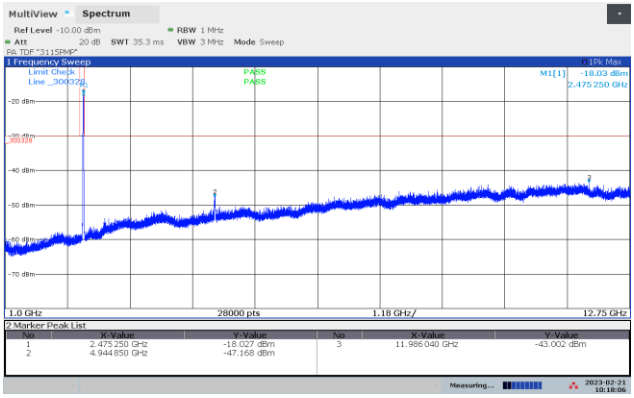
Radiated Emissions 1.0-12.75 GHz, 2412 MHz, 11g 6M, VP



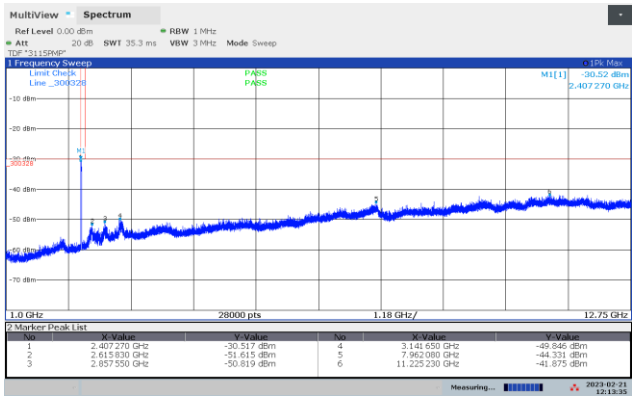
Radiated Emissions 1.0-12.75 GHz, 2412 MHz, 11g 6M, HP



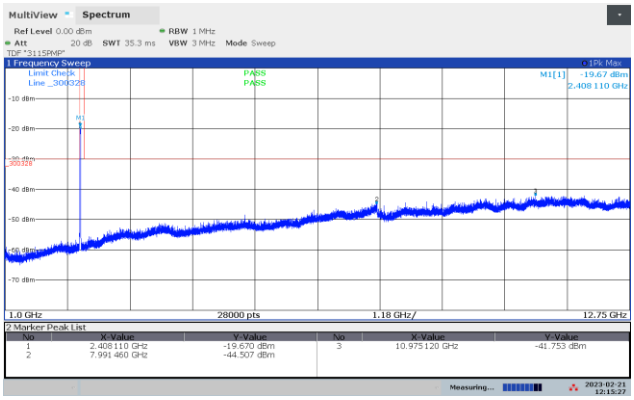
Radiated Emissions 1.0-12.75 GHz, 2472 MHz, 11g 6M, VP



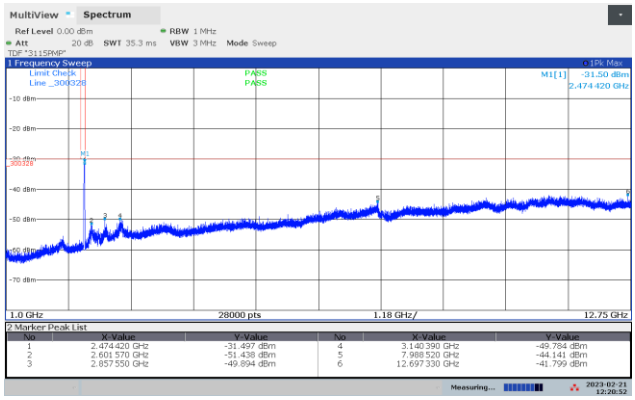
Radiated Emissions 1.0-12.75 GHz, 2472 MHz, 11g 6M, HP,



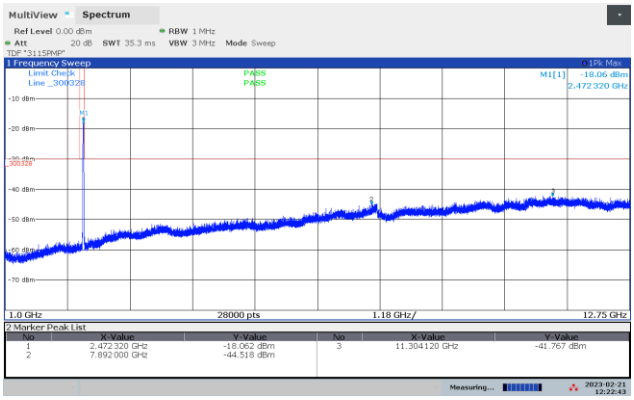
Radiated Emissions 1.0-12.75 GHz, 2412 MHz, 11n HT20, SISO, VP



Radiated Emissions 1.0-12.75 GHz, 2412 MHz, 11n HT20, SISO, HP



Radiated Emissions 1.0-12.75 GHz, 2472 MHz, 11n HT20, SISO, VP



Radiated Emissions 1.0-12.75 GHz, 2472 MHz, 11n HT20, SISO, HP

Conducted TX spurious emissions Measurements

Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
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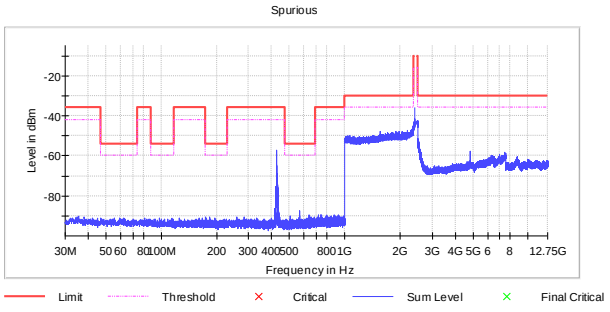
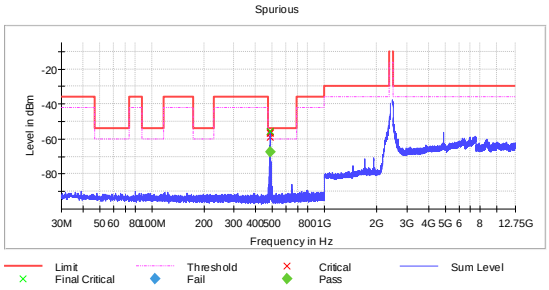
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
486.000000	-55.8	-67.6	-54.0	13.6	PASS



Conducted TX Emissions,ch2412MHz



Conducted TX Emissions,ch2472MHz

4.10 Receiver spurious emissions -Radiated and conducted

ETSI EN 300328 Clause 4.3.2.10

Frequency (MHz)	Detector	Polarization	Spurious Emission Level (dBm)
120	rms	HP	-57.1
3170	rms	VP	-55.9
30 – 1000 (all others)	PK	VP/HP	< -63
1000 – 12750 (all others)	PK	VP/HP	< -53

Measured with 50 ohm termination at antenna port 10, according to the cl. 5.4.9.1 a) in EN300 328 v2.2.2.

Below 1 GHz measured with base antenna.

The detected spurious emissions below 1 GHz is not from the radio chip. These emissions are undependent of radio chip whether in standby, RX or TX mode.

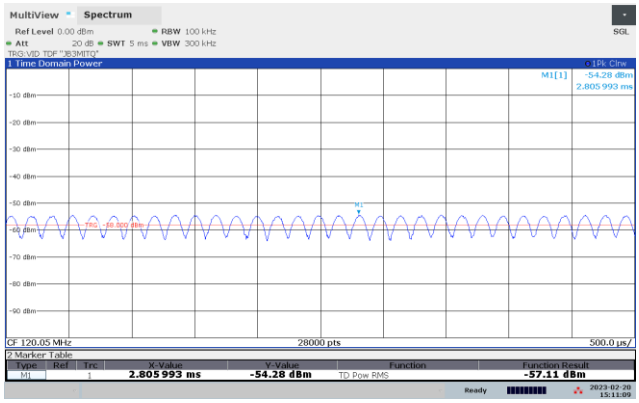
The 869 MHz emission is not from the EUT.

RBW of 100 kHz is used above 6 GHz to reduce the noise level. None detected above 6 GHz.

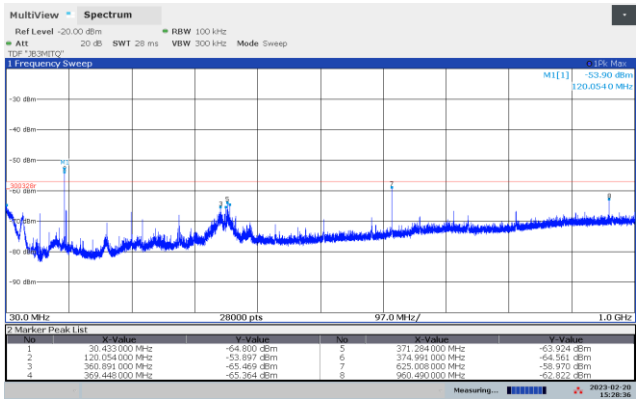
Limits: Clause 4.3.2.10.3

Frequency Range	Limit
30 MHz to 1 GHz	-57 dBm
above 1 GHz to 12,75 GHz	-47 dBm

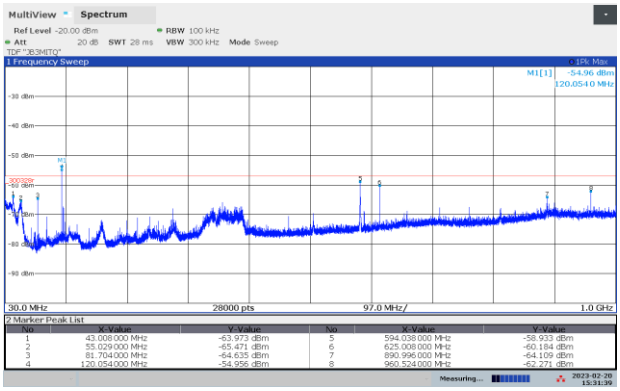
Test Equipment Used: 2, 4, 5, 6



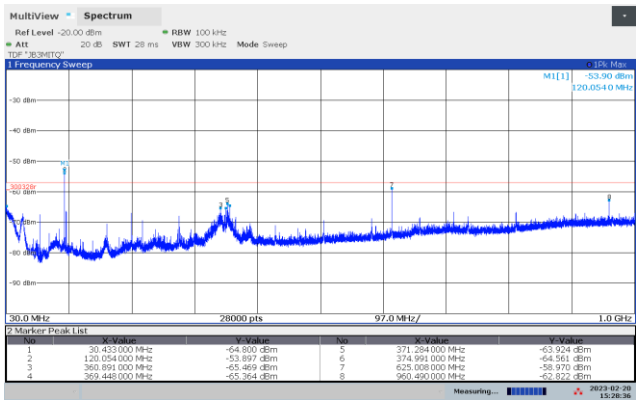
Radiated Emissions 120 MHz, HP, rms



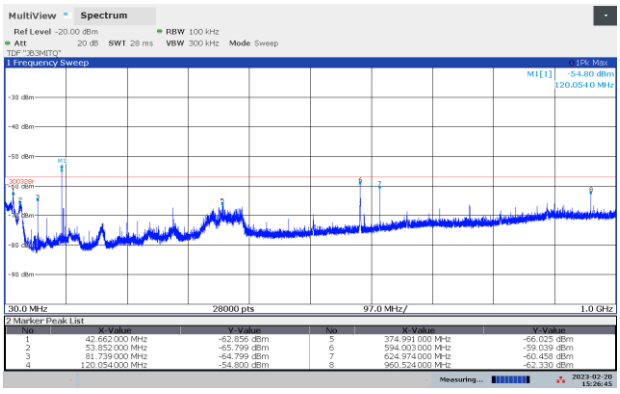
Radiated Emissions 30-1000 MHz, 2412 MHz, 11b 1M, HP



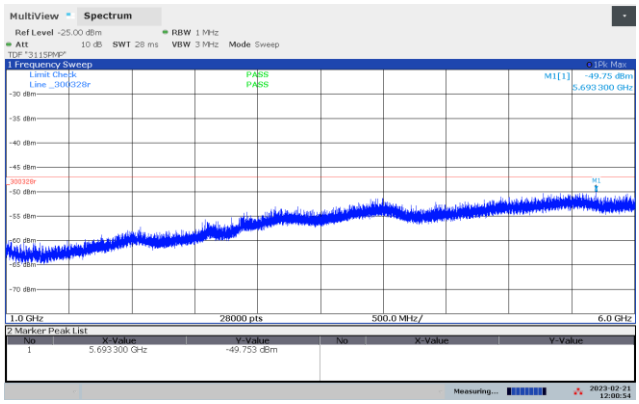
Radiated Emissions 30-1000 MHz, 2412 MHz, 11b 1M, VP



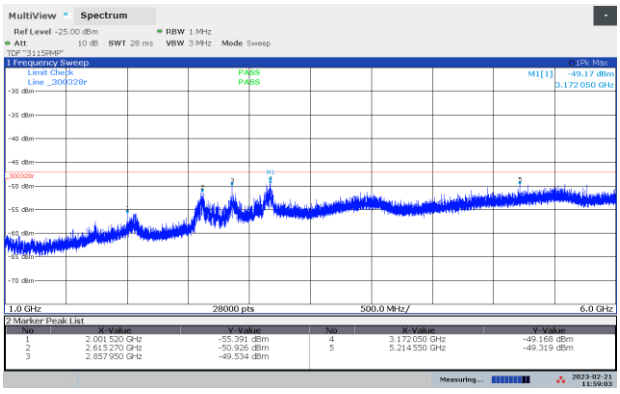
Radiated Emissions 30-1000 MHz, 2472 MHz, 11b 1M, HP



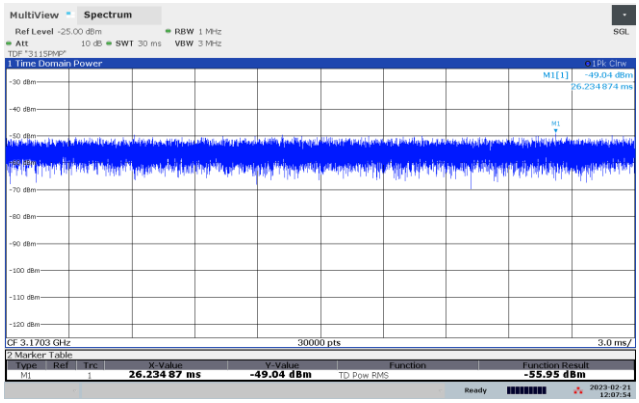
Radiated Emissions 30-1000 MHz, 2472 MHz, 11b 1M, VP



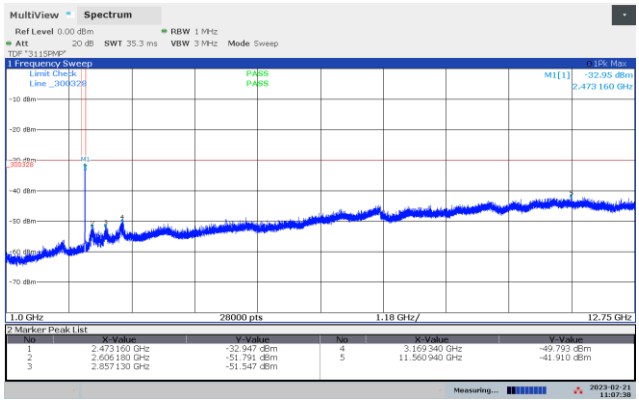
Radiated Emissions 1-12.75 GHz, 2412 MHz, 11b 1M, VP



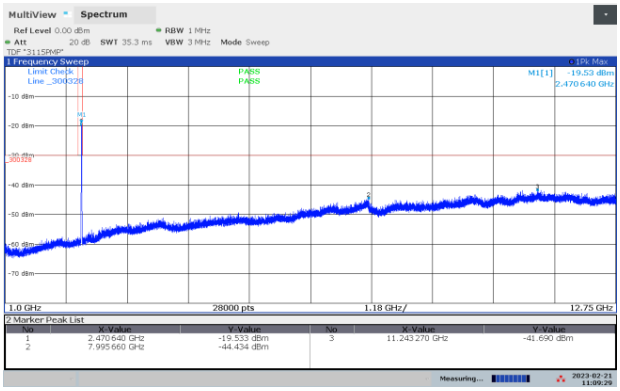
Radiated Emissions 1-12.75 GHz, 2412 MHz, 11b 1M, HP



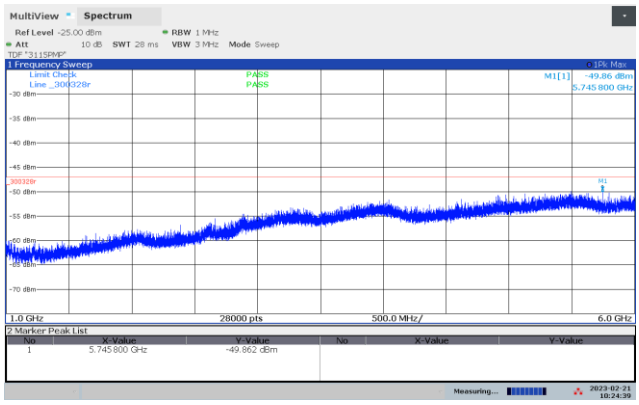
Radiated Emissions 3.17 GHz, 2412 MHz, 11b 1M, HP, rms



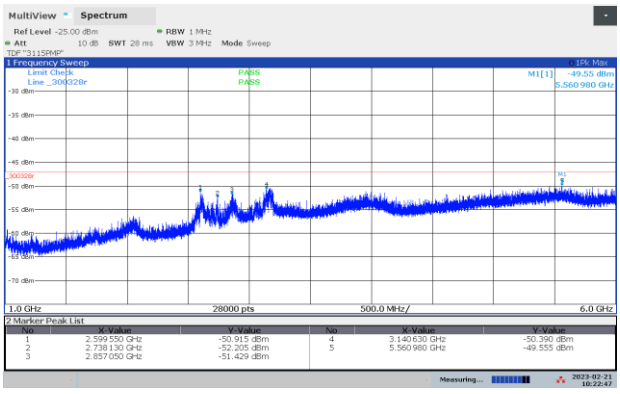
Radiated Emissions 1-12.75 GHz, 2472 MHz, 11b 1M, VP



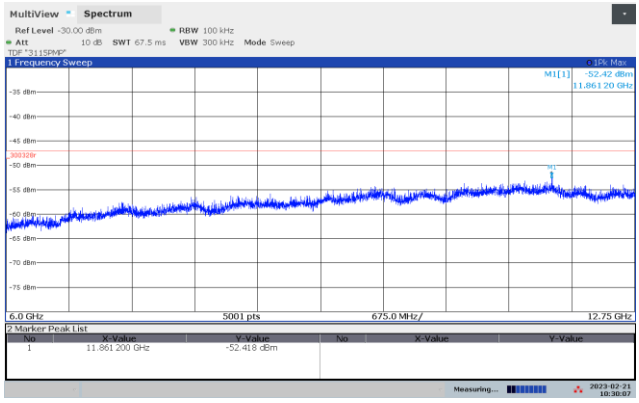
Radiated Emissions 1-12.75 GHz, 2472 MHz, 11b 1M, HP



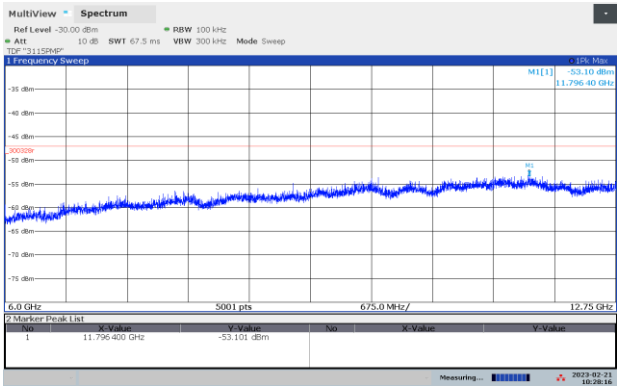
Radiated Emissions 1 - 6 GHz, 2412 MHz, 11g 6M, HP



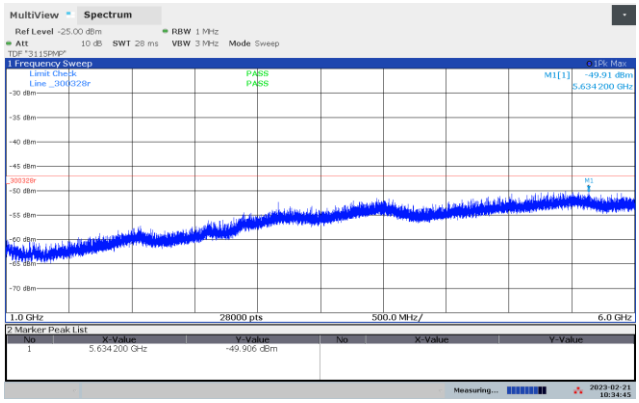
Radiated Emissions 1 - 6 GHz, 2412 MHz, 11g 6M, VP



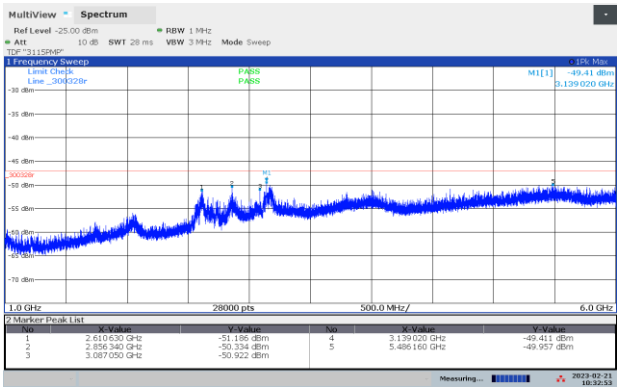
Radiated Emissions 6-12.75 GHz, 2412 MHz, 11g 6M, HP



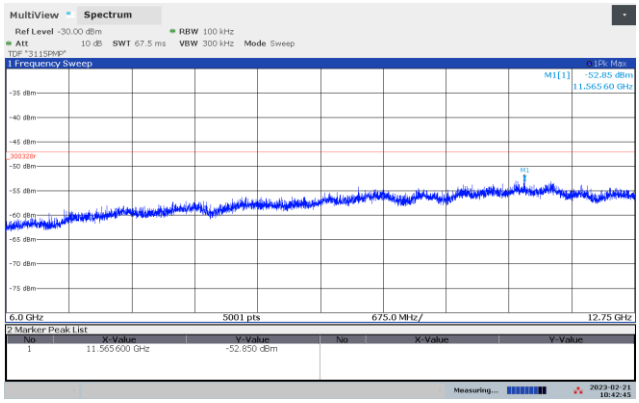
Radiated Emissions 6-12.75 GHz, 2412 MHz, 11g 6M, VP



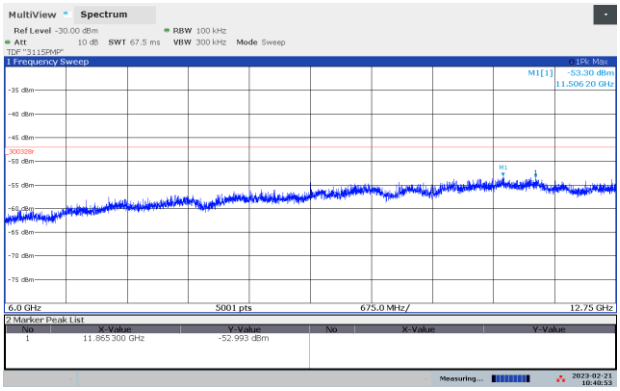
Radiated Emissions 1 - 6 GHz, 2472 MHz, 11g 6M, HP



Radiated Emissions 1 - 6 GHz, 2472 MHz, 11g 6M, VP

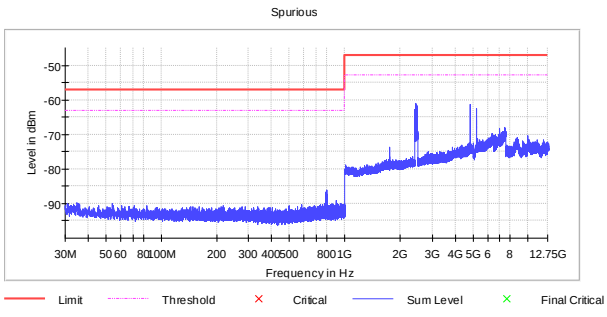


Radiated Emissions 6-12.75 GHz, 2472 MHz, 11g 6M, HP

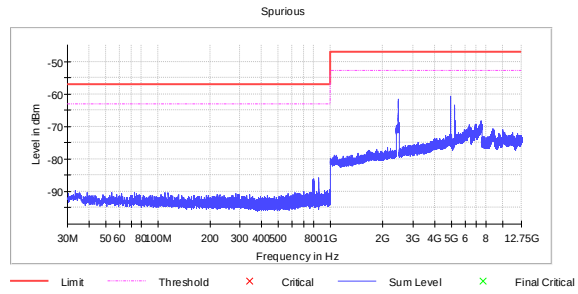


Radiated Emissions 6-12.75 GHz, 2472 MHz, 11g 6M, VP

Conducted RX spurious emissions Measurements



Conducted RX Emissions,ch2412MHz



Conducted RX Emissions,ch2472MHz

4.11 Receiver Blocking

ETSI EN 300328 Clause 4.3.2.11

Conducted measurements, Category 1 Receiver

Blocking Signal Frequency (MHz)	EUT Operating Frequency (MHz)	Wanted Signal Level (dBm)	Blocking Signal Level (dBm)	Limit (dBm)	Margin (dB)	Verdict
2300	**Lowest**	**-75.1**	**-31.1**	**-34**	**2.9**	**Pass**
2330	**Lowest**	**-75.1**	**-31.1**	**-34**	**2.9**	**Pass**
2360	**Lowest**	**-75.1**	**-31.1**	**-34**	**2.9**	**Pass**
2380	**Lowest**	-75.1	-31.1	**-34**	2.9	**Pass**
2504	**Highest**	-75.1	-31.1	**-34**	2.9	**Pass**
2524	**Highest**	-75.1	-31.1	**-34**	2.9	**Pass**
2584	**Highest**	-75.1	-31.1	**-34**	2.9	**Pass**
2674	**Highest**	-75.1	-31.1	**-34**	2.9	**Pass**
Measurement uncertainty		**+ 2.0/- 2.5 dB**				

1000 packets were sent for each test
Ch2412MHz and Ch2472 MHz, 11b_1M
OCBW = 13 MHz
§: -139 dBm + 10 x log10(OCBW) + 10 dB= -51.86 dBm

***Blocking signal power with antenna gain of 7 dBi is used for ch2402MHz and for ch2480MHz.**
The Packet Error Rate was < 1%.
Blocking Level was raised in 1 dB steps.

Limits, Receiver Category 1

Wanted signal mean power from companion device	Blocking signal frequency [MHz]	Blocking signal power [dBm]	Type of blocking signal
(-133 dBm + 10 × log10(OCBW)) or -68 dBm whichever is less	**2380**	**-34**	**CW**
	2504		
(-139 dBm + 10 × log10(OCBW)) or -74 dBm whichever is less	**2300**		
	2330		
	2360		
	2524		
	2584		
	2674		
OCBW is in Hz **Level above is assuming antenna gain of 0 dBi, the above level has to be corrected for antenna gain in case of conducted measurements**			

Test Equipment Used: 10, 11, 12, 13, 14

4.12 Geo-Location capability

ETSI EN 300 328 subclause 4.3.2.12

Description	Yes/NO
Geo-location capability implemented	NO
Accessible to user	NO

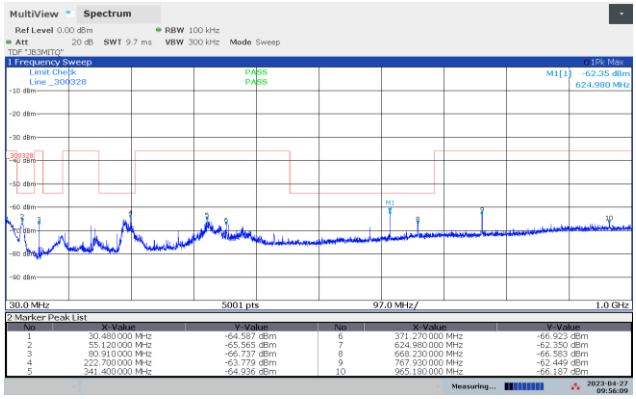
Requirements: Clause 4.3.2.12.3

The geographical location determined by the equipment as defined in cl. 4.3.2.12.2 shall not be accessible to the user.

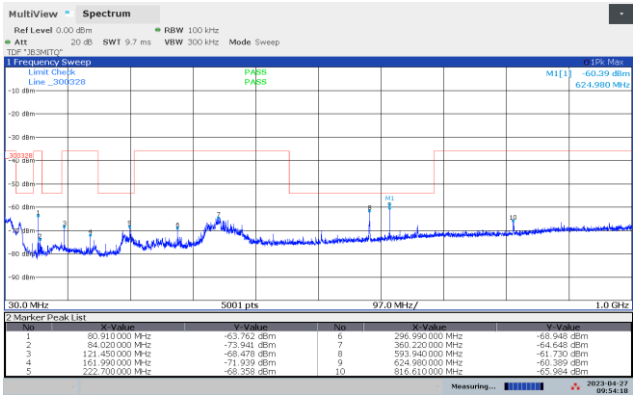
5 Simulataneous Transmission - Radiated 2.4GHz wifi with BT/BLE

Wifi channels	BLE channels	Intermodulation products
Ch2412 MHz	Ch2402 MHz	None produced
Ch2472 MHz	Ch2440 MHz	None produced
Ch2442 MHz	Ch2440 MHz	None produced
Ch2412 MHz	Ch2480 MHz	None produced
Ch2472 MHz	Ch2480 MHz	None produced

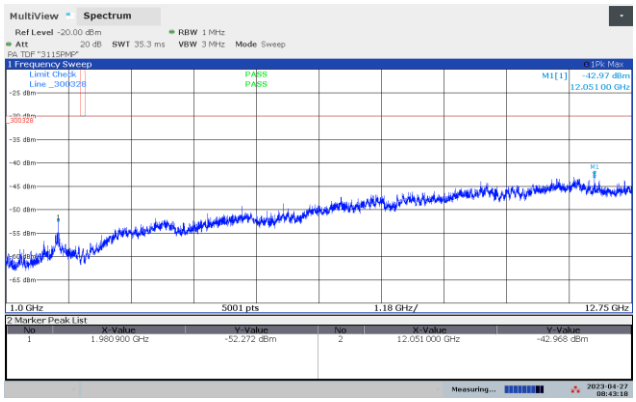
Test Equipment Used: 7,8,9,10,11,12,13,14



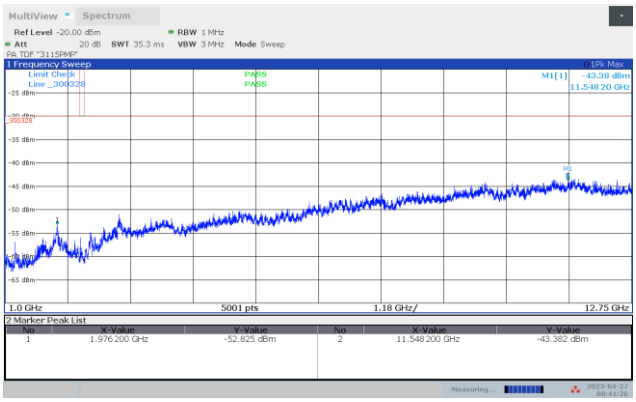
Radiated Emissions 30 - 1000MHz,ch2412 + ch2480 HP ,pk scan



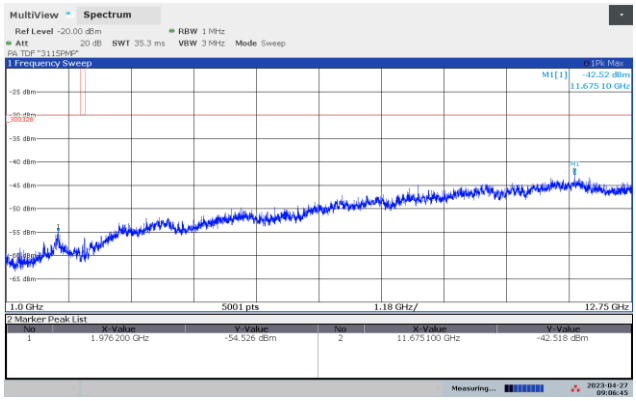
Radiated Emissions 30 - 1000MHz,ch2412 + ch2480 VP ,pk scan



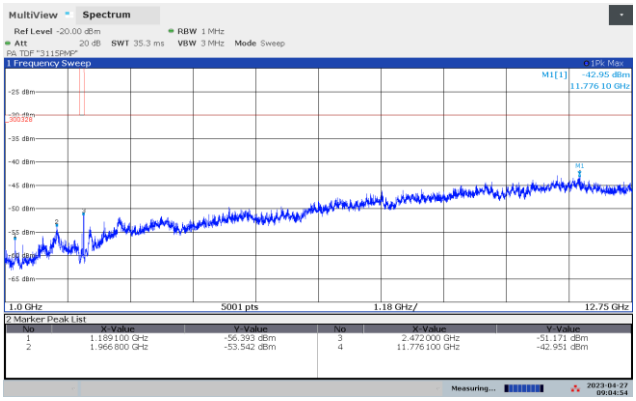
Radiated Emissions 1 – 12.75 GHz,ch2412 + ch2402 HP ,pk scan



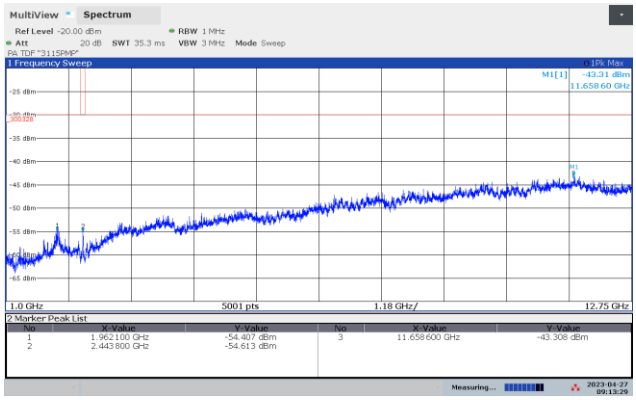
Radiated Emissions 1 – 12.75 GHz,ch2412 + ch2402 VP ,pk scan



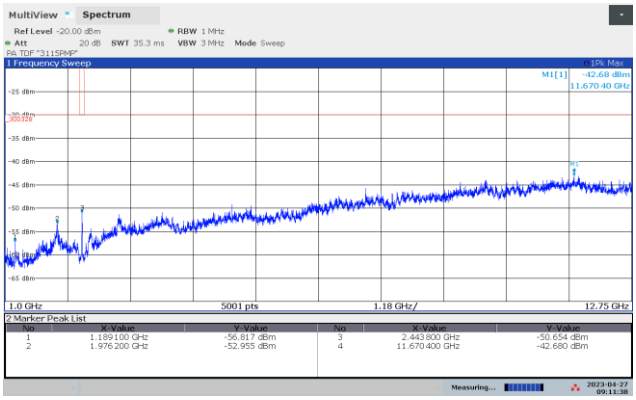
Radiated Emissions 1 – 12.75 GHz,ch2472 + ch2440 HP ,pk scan



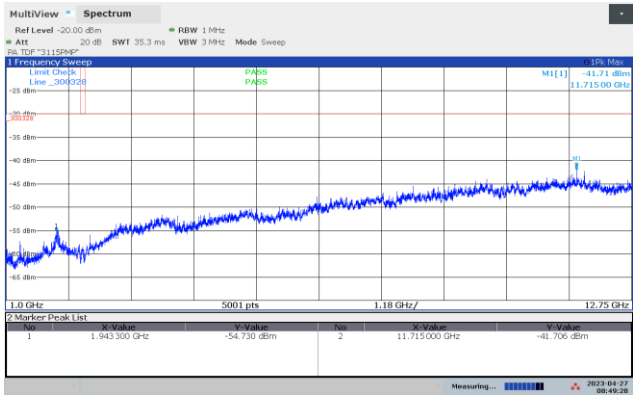
Radiated Emissions 1 – 12.75 GHz,ch2472 + ch2440 VP ,pk scan



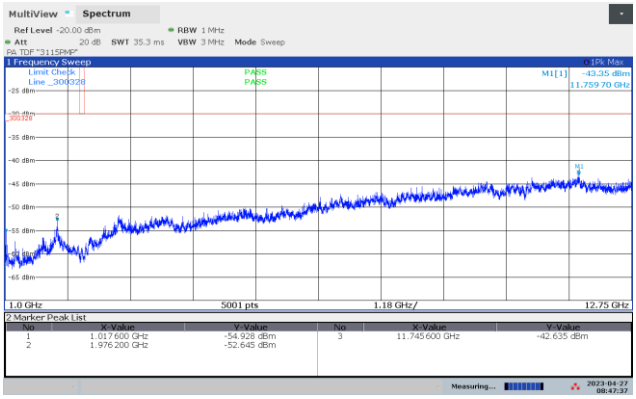
Radiated Emissions 1 – 12.75 GHz,ch2442 + ch2440 HP ,pk scan



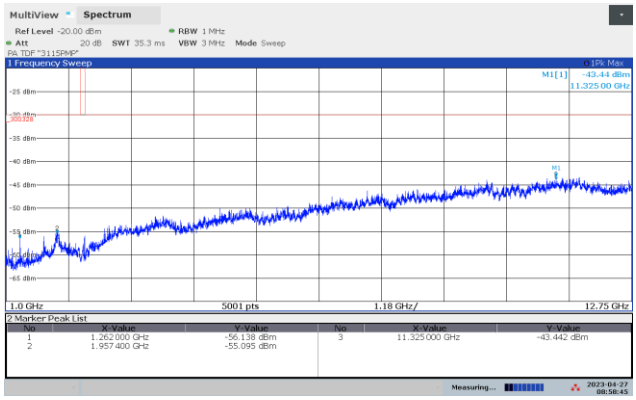
Radiated Emissions 1 – 12.75 GHz,ch2442 + ch2440 VP ,pk scan



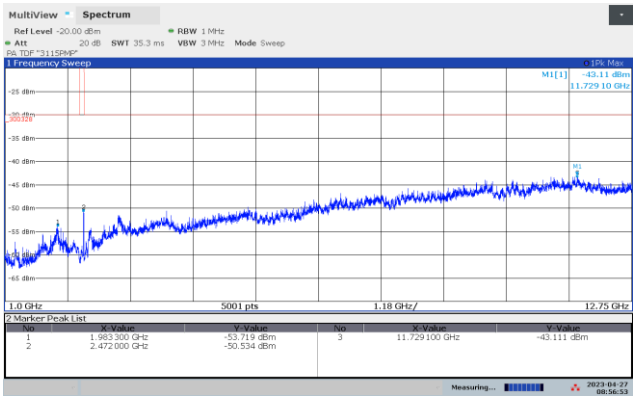
Radiated Emissions 1 – 12.75 GHz,ch2412 + ch2480 HP ,pk scan



Radiated Emissions 1 – 12.75 GHz,ch2480 + ch2402 VP ,pk scan



Radiated Emissions 1 – 12.75 GHz,ch2472 + ch2480 HP ,pk scan



Radiated Emissions 1 – 12.75 GHz,ch2472 + ch2480 VP ,pk scan

6 Measurement Uncertainty

Measurement Uncertainty Values U_{95}		
Test Item		**Uncertainty**
Conducted Output Power		< 1 dB
Power Spectral Density		< 1 dB
Out of Band Emissions, Conducted	< 1 GHz	< 1 dB
	> 1 GHz	< 1 dB
Spurious Emissions, Radiated	30 – 80MHz	±4.23 dB
	80 – 180 MHz	±2.80 dB
	180 – 1000 MHz	±2.54 dB
	1 – 18 GHz	±2.23 dB
Occupied Bandwidth		< 2%
Timing/Duty cycle		< 1%

Conducted measurements are given by the manufacturer (R&S TS8997)

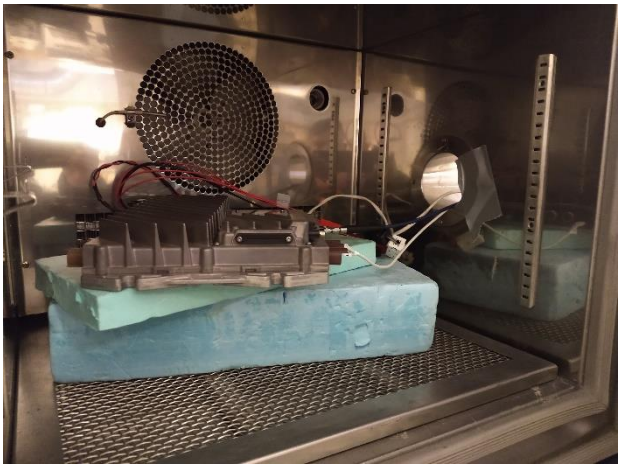
7 Test Setups

Radiated measurements with 50ohm termination

Radiated measurements with antenna type Base

Radiated measurements with antenna type 2J

Radiated measurements with antenna type Interior WLAN



Climatic tests

8 PHOTOGRAPHS OF THE EUT

External photos

View from above

View from rear

View of antenna ports

View of power port

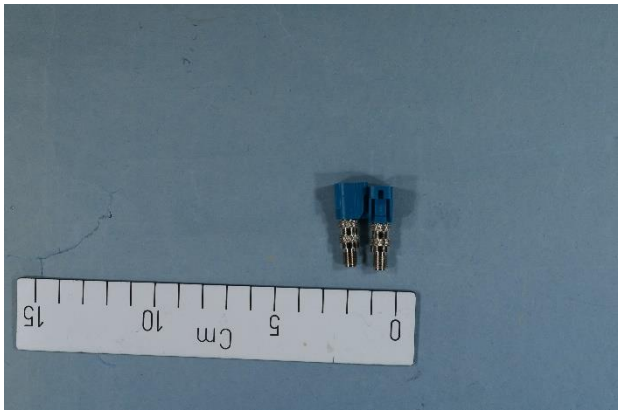
View of antenna type Interior WLAN

View of antenna type 2J

View of antenna type Base

Power connector

Audio connector



FAKRA to SMA RF connector for conducted test

Display- rear side

Display front side

Display cable

9 Test Equipment Used

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the testhouse.

No	Ref. No	Description	Manufacturer	Type	Cal. date	Cal. due
1.	LR 1808	Spectrum Analyzer	Rohde & Schwarz	FSVA3044	08.2022	08.2023
2.	LR 1806	Power meter	Rohde & Schwarz	OSP220	08.2022	08.2023
3.	LR 1793	Power Meter	Rohde & Schwarz	OSP-B157W8Plus	08.2022	08.2023
4.	LR 1807	Vector Signal generator	Rohde & Schwarz	SMW200A	08.2022	08.2023
5.	LR 1656	Signal generator	Rohde & Schwarz	SMB100A	01.2023	01.2024
6.	-	EMC 32, TS8997 (Soft ware)	Rohde & Schwarz	11.40.00	N/A	
7.	LR 1640	Spectrum Analyzer	Rohde & Schwarz	FSW26	01.2023	01.2024
8.	LR 1673	Attenuator	NARDA	4768-10	Cal b4 use	
9.	LR 1747	Pre-Amplifier	Miteg	JS4	08.2022	08.2023
10.	LR 1330	Double Ridged Horn Antenna	EMCO	3115	11.2022	11.2026
11.	LR 1614	Highpass Filter	Trilithic	6HC3000/18000	Cal b4 use	
12.	LR 1615	Highpass Filter	Trilithic	6HC2500/18000	Cal b4 use	
13.	LR 1785	Notch filter	Microwave circuits	NO324415	Cal b4 use	
14.	N-4525	Biconical-Log hybrid	Sunol Sciences	JB3	07.2022	07.2024
15.	LR 1083	Climatic Chamber	ACS	TY 80	03.2022	03.2023
16.	LR 1713	Power Supply	TTi	CPX400S	Cal b4 use	
17.	LR 1598	Multimeter, Digital	Fluke	87 V	04.2022	04.2024
18.	LR 1528	Hybrid	NARDA	4356B	Cal b4 use	
19.	LR1526	Directional coupler	Agilent	87300C	Cal b4 use	
20.	LR1627	Cable			Cal b4 use	
21.	LR1634	Cable			Cal b4 use	
22.	LR 1791	Communication analyser	Rohde & Schwarz	CMW 500	01.2022	01.2024