ETSI EN 300 328 V2.2.2

TEST REPORT

For

WIFI+BT Module

MODEL NUMBER: WXT52M2511

REPORT NUMBER: 4791023025-1-RF-2

ISSUE DATE: October 26, 2023

Prepared for

Hui Zhou Gaoshengda Technology Co.,LTD
No.2,Jin-da Road,Huinan High-tech Industrial Park,Hui-ao Avenue,Huizhou City,Guangdong,China

Prepared by

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	October 26, 2023	Initial Issue	

Summary of Test Results

Test Item	Clause	Limit/Requirement	Result
NORMAL AND EXTREME CONDITIONS	N/A	Clause 5.1.2	Pass
RF output power	Clause 5.4.2.2.1.2	Clause 4.3.1.2	Pass
Duty Cycle, Tx-sequence, Tx-gap	Clause 5.4.2.2.1.3	Clause 4.3.1.3	N/A
Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	Clause 5.4.4.2.1	Clause 4.3.1.4	Pass
Hopping Frequency Separation	Clause 5.4.5.2.1	Clause 4.3.1.5	Pass
Medium Utilization (MU) factor	Clause 5.4.2.2.1.4	Clause 4.3.1.6	N/A
Adaptivity (Adaptive FHSS)	Clause 5.4.6.2.1	Clause 4.3.1.7	N/A
Occupied Channel Bandwidth	Clause 5.4.7.2.1	Clause 4.3.1.8	Pass
Transmitter unwanted emissions in the out-of-band domain	Clause 5.4.8.2.1	Clause 4.3.1.9	Pass
Transmitter unwanted emissions in the spurious domain	Clause 5.4.9.2.1& Clause 5.4.9.2.2	Clause 4.3.1.10	Pass
Receiver spurious emissions	Clause 5.4.10.2.1& Clause 5.4.10.2.2	Clause 4.3.1.11	Pass
Receiver Blocking	Clause 5.4.11.2.1	Clause 4.3.1.12	Pass
Geo-location capability	N/A	Clause 4.3.1.13	N/A

Note:
1. N/A: In this whole report not applicable.

*This test report is only published to and used by the applicant, and it is not for evidence purpose in China.
*The measurement result for the sample received is <Pass> according to <ETSI EN 300 328 V2.2.2> when <Simple Acceptance> decision rule is applied.

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1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name:	Hui Zhou Gaoshengda Technology Co.,LTD
Address:	No.2,Jin-da Road,Huinan High-tech Industrial Park,Hui-ao Avenue,Huizhou City,Guangdong,China

Manufacturer Information

Company Name:	Hui Zhou Gaoshengda Technology Co.,LTD
Address:	No.2,Jin-da Road,Huinan High-tech Industrial Park,Hui-ao Avenue,Huizhou City,Guangdong,China

EUT Information

EUT Name:	WIFI+BT Module
Model:	WXT52M2511
Brand:	GSD
Sample Received Date:	October 8, 2023
Sample Status:	Normal
Sample ID:	6522183
Date of Tested:	October 11, 2023 to October 26, 2023

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
ETSI EN 300 328 V2.2.2	**Pass**

Prepared By:

Fanny Huang

Engineer Project Associate

Checked By:

Denny Huang

Senior Project Engineer

Approved By:

Stephen Guo

Operations Manager

2. TEST METHODOLOGY

All tests were performed in accordance with the standard ETSI EN 300 328 V2.2.2

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	**A2LA (Certificate No.: 4102.01)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA. **FCC (FCC Designation No.: CN1187)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules **ISED (Company No.: 21320)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with ISED. The Company Number is 21320 and the test lab Conformity Assessment Body Identifier (CABID) is CN0046. **VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B , the VCCI registration No. is C-20012 and T-20011

Note 1:
All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, No. 1, Li Bin Road, Song Shan Lake Hi-Tech Development Zone Dongguan, 523808, People's Republic of China.

Note 2:
The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd.
Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.

Note 3:
For below 30 MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30 MHz had been correlated to measurements performed on an OFS.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Case	Description	Limit	Uncertainties
5.3.2.2.1.1	RF Output Power	±1.5 dB	1.15
5.3.2.2.1.2	Duty Cycle	±5 %	0.03
	Tx Sequence	±5 %	0.03
	Tx Gap	±5 %	0.03
5.3.2.2.1.3	Medium Utilisation	±5 %	0.10
5.3.3.2.1	Power Spectral Density	±3 dB	1.21
5.3.4.2.1	Accumulated Dwell Time	±5 %	0.05
	Minimum Frequency Occupation Time	±5 %	0.15
5.3.5.2.1	Hopping Frequency Separation	-	0.24
5.3.8.2.1	Occupied Channel Bandwidth	±5 %	1.71
5.3.9..2.1	Out-of-band emissions	±3 dB	1.39
5.3.10.2.1	Transmitter unwanted emissions in the spurious domain		
	30 MHz to 1 GHz	±3 dB	0.64
	1 GHz to 12.75GHz	±3 dB	1.68
5.3.11.2.1	Receiver Spurious emission		
	30 MHz to 1 GHz	±3 dB	0.64
	1 GHz to 12.75GHz	±3 dB	1.68

Test Item	Uncertainty
Uncertainty for Radiation Emission test	4.62 dB (30 MHz-1 GHz)
	3.50 dB (1 GHz-18 GHz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k=2.	

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT Name	WIFI+BT Module
Model	WXT52M2511

Frequency Range:	2402 MHz to 2480 MHz
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Type of Modulation:	GFSK, Π/4DQPSK, 8DPSK
Normal Test Voltage:	DC 5 V

5.2. DESCRIPTION OF EQUIPMENT CATEGORY

EUT belong to	Receiver categories	Relevant receiver clauses
☐	1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p.
☒	2	Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or equipment (adaptive or non-adaptive) 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.
☐	3	non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % (irrespective of the maximum RF output power); or equipment (adaptive or non-adaptive) with a maximum RF output power of 0 dBm e.i.r.p.

5.3. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	/	/

5.4. MAXIMUM POWER

Test Mode	Frequency (MHz)	Channel Number	Max AVG EIRP (dBm)
GFSK	2402 ~ 2480	0-78[79]	4.14
8DPSK	2402 ~ 2480	0-78[79]	4.30

5.5. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
GFSK-DH5	CH 00(Low Channel), CH 39(MID Channel), CH 78(High Channel)	2402 MHz, 2441 MHz, 2480 MHz
8DPSK-3DH5	CH 00(Low Channel), CH 39(MID Channel), CH 78(High Channel)	2402 MHz, 2441 MHz, 2480 MHz
GFSK-DH5	Hopping	
8DPSK-3DH5	Hopping	

PACKET TYPE CONFIGURATION

Test Mode	Packet Type	Setting (Packet Length)
GFSK	DH1	27
	DH3	183
	DH5	339
∏/4-DQPSK	2-DH1	54
	2-DH3	367
	2-DH5	679
8DPSK	3-DH1	83
	3-DH3	552
	3-DH5	1021

5.6. THE WORSE CASE POWER SETTING PARAMETER

WORST-CASE CONFIGURATIONS

Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BR	FHSS	GFSK	1Mbit/s
EDR	FHSS	8DPSK	3Mbit/s

Note: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Test Software		WCN_Combo_Tool		
Modulation Type	Transmit Antenna Number	Test Software setting value		
		CH 00	CH 39	CH 78
GFSK	1	Default	Default	Default
8DPSK	1	Default	Default	Default

5.7. DESCRIPTION OF AVAILABLE ANTENNAS

Antenna	Frequency (MHz)	Antenna Type	MAX Antenna Gain (dBi)
1	2402-2480	PCB Antenna	-1.77

Test Mode	Transmit and Receive Mode	Description
GFSK	☒1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.
∏/4-DQPSK	☒1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.
8DPSK	☒1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.

Note: The value of the antenna gain was declared by customer.

5.8. SUPPORT UNITS FOR SYSTEM TEST

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	Remarks
1	Laptop	Lenovo	E42-80	R303U5AG

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	USB	/	/	1.0	/

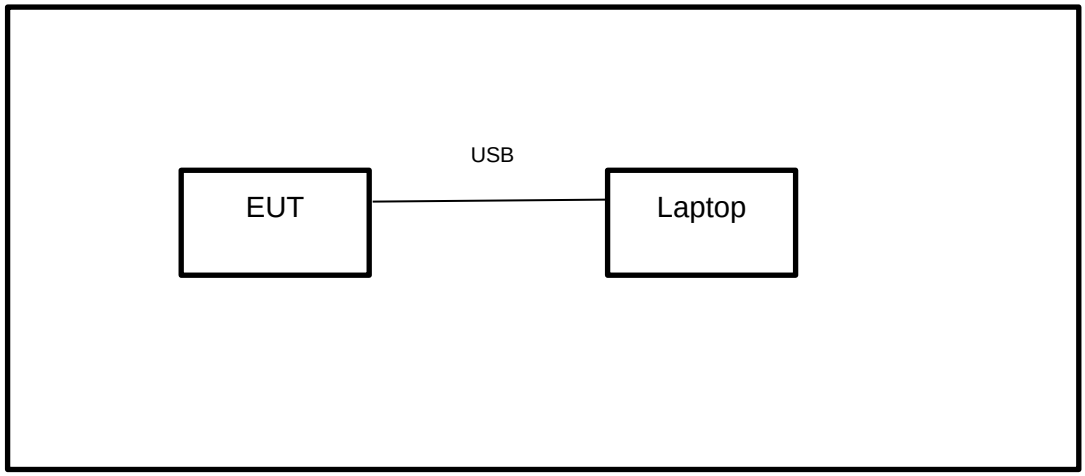
ACCESSORIES

Item	Accessory	Brand Name	Model Name	Description
/	/	/	/	/

TEST SETUP

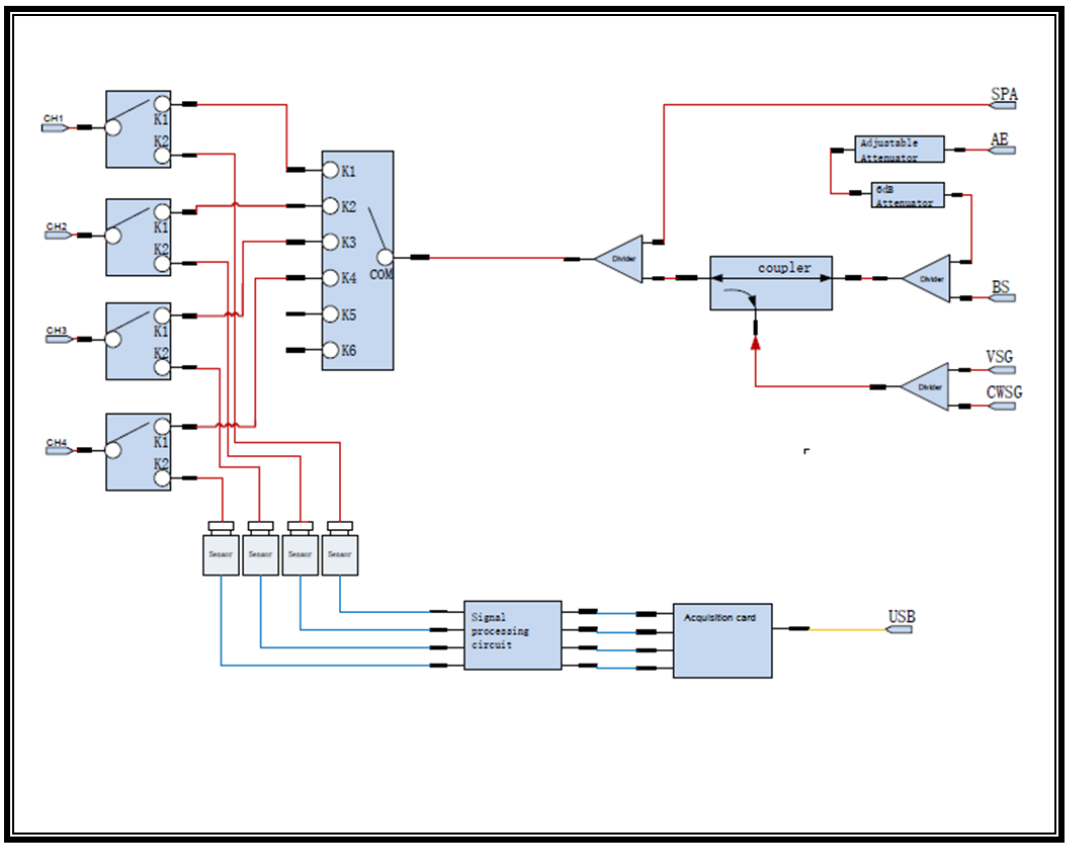
The EUT can work in engineering mode with a software through a Laptop.

SETUP DIAGRAM FOR TESTS



5.9. TEST SYSTEM CONFIGURATION

Tonsend SRD Test System



5.10. DESCRIPTION OF THE EQUIPMENT UNDER TESTED

(INFORMATION AS REQUIRED BY EN 300 328 V2.2.2, CLAUSE 5.4.1)

a)	**Modulation Type**		
	☒ FHSS		
	☐ non-FHSS		
b)	FHSS Equipment Description		
	The Number of Hopping Frequencies	The Maximum	79
		The Minimum	20
	The (average) dwell time	343.315ms	
c)	**Adaptive / Non-adaptive Equipment**		
	☐ Non-adaptive Equipment		
	☒ Adaptive Equipment Without the Possibility to Switch to A Non-adaptive Mode		
	☐ Adaptive Equipment Which can also operate in A Non-adaptive Mode		
d)	**Adaptive Equipment Description**		
	The maximum Channel Occupancy Time implemented by the equipment	/	
	☒ The equipment has implemented an LBT mechanism		
	☐ The equipment has implemented a DAA mechanism		
	☐ The equipment can operate in more than one adaptive mode		
e)	**The different transmit operating modes**		
	☒ Operating mode 1 (single antenna)	☒ Equipment with only one antenna	
		☐ Equipment with two diversity antennas but only one antenna active at any moment in time	
		☐ Smart Antenna Systems with two or more antennas, but operating in a (legacy) mode where only one antenna is used (e.g. IEEE 802.11™ legacy mode in smart antenna systems)	
	☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming	☐ Single spatial stream/Standard throughput/(e.g. IEEE 802.11™ legacy mode)	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2	
	☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming	☐ Single spatial stream/Standard throughput (e.g. IEEE 802.11™ legacy mode)	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1	
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2	
f)	**In case of Smart Antenna Systems**		
	The number of Receive chains		1
	The number of Transmit chains		1
	In case of beam forming, the maximum (additional) beam forming gain:		/
g)	**Operating Frequency Range(s) of the equipment**		
	Operating Frequency Range	2402 MHz to 2480 MHz	
h)	**Nominal Channel Bandwidth(s)**		
	Occupied Channel Bandwidth	1.193 MHz	

i)	**Type of Equipment**						
	☒ Stand-Alone						
	☐ Plug-in radio Equipment						
	☐ Combined Equipment						
j)	**The extreme operating conditions that apply to the equipment**						
	Operating temperature range	-10 °C to 70 °C					
k)	**The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels**						
	Antenna Type	☒ Integral Antenna	Antenna Gain	-1.77 dBi			
		☐ Dedicated Antennas (equipment with antenna connector)	☐ Single power level with corresponding antenna(s)	Gain			
			☐ Multiple power settings and corresponding antenna(s)	Power Level 1			
				Power Level 2			
				Power Level 3			
l)	**The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:**						
	Details provided are for the	☒ Testing of stand-alone equipment					
		☐ Combined equipment					
		☐ Test jig					
	Supply Voltage	☐ AC mains	State AC voltage				
		☒ DC	State DC voltage	☐ Internal Power Supply			
				☐ External Power Supply or AC/DC adapter			
				☐ Battery			
				☒ Other	DC 5 V		
m)	**The equipment type**						
	☒ Bluetooth®						
	☐ IEEE 802.11™ [i.3]						
	☐ Proprietary						
n)	**Geo-location capability supported by the equipment**	☐ Yes ☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.					
		☒ No					

6. MEASURING EQUIPMENT AND SOFTWARE USED

R&S TS 8997 Test System						
Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Due. Date
Power sensor, Power Meter	R&S	OSP120	100921	/	Mar.31, 2023	Mar.30, 2024
Vector Signal Generator	R&S	SMBV100A	261637	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Signal Generator	R&S	SMB100A	178553	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Signal Analyzer	R&S	FSV40	101118	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Software						
Description	Manufacturer	Name	Version			
For R&S TS 8997 Test System	Rohde & Schwarz	EMC 32	10.60.10			

Tonsend RF Test System						
Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Due. Date
Wideband Radio Communication Tester	R&S	CMW500	155523	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Wireless Connectivity Tester	R&S	CMW270	1201.0002N75-102	Sep.28, 2022	Sep.27, 2023	Sep.26, 2024
PXA Signal Analyzer	Keysight	N9030A	MY55410512	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
MXG Vector Signal Generator	Keysight	N5182B	MY56200284	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
MXG Vector Signal Generator	Keysight	N5172B	MY56200301	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
DC power supply	Keysight	E3642A	MY55159130	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Temperature & Humidity Chamber	SANMOOD	SG-80-CC-2	2088	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Attenuator	Aglient	8495B	2814a12853	Oct.18, 2022	Oct.12, 2023	Oct.11, 2024
RF Control Unit	Tonscend	JS0806-2	23B80620666	/	April 18,2023	April 17,2024
Software						
Description	Manufacturer	Name	Version			
Tonsend SRD Test System	Tonsend	JS1120-3 RF Test System	V3.2.22			

RSE Test System						
Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Due. Date
Spectrum Analyzer	R&S	FSW	1312.8000K26-103950-sj	Oct. 18, 2022	Oct.12, 2023	Oct.11, 2024
Trilog broadband antenna	Schwarzbeck	VULB9163	01061	/	Feb.7,2023	Feb.6,2026
Horn Antenna	ETS-Lindgren	3117	00213191	/	Feb.7,2023	Feb.6,2026
Preamplifier	TDK	PA-02-0118	TRS-305-00067	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Preamplifier	TDK	PA-02-0118	TRS-305-00066	Jun.19,2023	Oct.12, 2023	Oct.11, 2024
High Gain Horn Antenna	Schwarzbeck	BBHA-9170	697	/	July 20, 2021	July 19, 2024
Preamplifier	TDK	PA-02-2	TRS-307-00002	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Preamplifier	TDK	PA-02-3	TRS-308-00002	Oct.17, 2022	Oct.12, 2023	Oct.11, 2024
Band Reject Filter	Wainwright	WRCJV12-5695-5725-5850-5880-40SS	4	/	Dec.01,2022	Nov.30,2023
Band Reject Filter	Wainwright	WRCJV20-5120-5150-5350-5380-60SS	2	/	Dec.01,2022	Nov.30,2023
Band Reject Filter	Wainwright	WRCJV20-5440-5470-5725-5755-60SS	1	/	Dec.01,2022	Nov.30,2023
Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	4	/	Dec.01,2022	Nov.30,2023
Notch Filter	Wainwright	WRCT5-901.6-902.3-902.5-903.2-40SS	1	/	Dec.01,2022	Nov.30,2023
Band Reject Filter	Wainwright	WRCD5-1746.4-174725-1747.55-1748.4-40SS	1	/	Dec.01,2022	Nov.30,2023
Highpass Filter	Wainwright	WHKX10-5850-6500-1800-40SS	4	/	Dec.01,2022	Nov.30,2023
Highpass Filter	Wainwright	WHKX10-2700-3000-1800-40SS	24	/	Dec.01,2022	Nov.30,2023

Software			
Description	Manufacturer	Name	Version
For TDK RSE Test System	TDK	TDK Emission lab	V10.81

Other Instrument						
Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Due. Date
Temperature humidity probe	OMEGA	ITHX-SD-5	18470007	Oct.22, 2022	Oct.19, 2023	Oct.18, 2024
Barometer	Yiyi	Baro	N/A	Oct.24, 2022	Oct.19, 2023	Oct.18, 2024
Attenuator	Agilent	8495B	2814a12853	Oct.18, 2022	Oct.12, 2023	Oct.11, 2024

7. TEST PROCEDURES AND RESULTS

7.1. NORMAL AND EXTREME CONDITIONS

REQUIREMENT

None; for reporting purposes only.

RESULTS

	Normal Test Conditions	Extreme Test Conditions
Relative Humidity	45 % ~ 70 %	/
Atmospheric Pressure	100 kPa ~ 102 kPa	/
Temperature	NT (Normal Temperature): 22 °C ~ 28 °C	/
		LT (Low Temperature): -10 °C
Supply Voltage	NV (Normal Voltage): DC 5 V	HT (High Temperature): 70 °C
		/

DESCRIPTION

Pass

7.2. RF OUTPUT POWER

LIMITS

RF OUTPUT POWER	
Condition	Limit
☐ Non-adaptive non-FHSS Equipment	For non-adaptive non-FHSS equipment, where the manufacturer has declared an RF output power of less than 20 dBm e.i.r.p., the RF output power shall be equal to or less than that declared value.
☒ Adaptive non-FHSS Equipment	non-FHSS equipment shall be equal to or less than 20 dBm.

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.2

The power sensor was used for power measurement, and it use a fast power sensor with a minimum sensitivity of -40 dBm and capable of minimum 1 MS/s.

The test software was used to control the power detector and the sampling unit.

For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.

Measurement	
☒Conducted measurement	☐Radiated measurement

CALCULATIONS

Add the (stated) antenna assembly gain G in dBi of the individual antenna.
• In case of smart antenna systems operating in mode with beamforming (see clause 5.3.2.2.4), add the additional beamforming gain Y in dB.
• If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
• The RF Output Power (Pout) shall be calculated using the formula below:

$$P_{out} = A + G + Y$$

TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix H

7.3. ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

LIMITS

DWELL TIME		
Condition	Limit	
☐ Non-adaptive frequency hopping systems	Shall not be greater than 15 ms within any observation period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.	
☒ Adaptive frequency hopping systems	Shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.	
MINIMUM FREQUENCY OCCUPATION TIME		
Condition	Limit	
☐ Non-adaptive frequency hopping systems	Option 1	Each hopping frequency of the Hopping Sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.
☒ Adaptive frequency hopping system	Option 2	The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.
HOPPING SEQUENCE (S)		
Condition	Limit	
☐ Non-adaptive frequency hopping systems	Shall contain at least N hopping frequencies where N is either 5 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.	
☒ Adaptive frequency hopping systems	shall be capable of operating over a minimum of 70 % of the 2.4 GHz to 2.4835 GHz band	
	Shall contain at least N hopping frequencies at all times, where N is either 15 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.	

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.4

Connect the UUT to the spectrum analyzer and use the following settings:

Frequency Center	Equal to the hopping frequency being investigated
Frequency Span	0 Hz
Trance Mode	Clear / Write
Trigger Mode	Free Run
Detector	RMS
Sweep Point	30000
Sweep Time	Equal to the applicable observation period (see clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2)
RBW	~ 50 % of the Occupied Channel Bandwidth
VBW	≥ RBW

TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix A&B&C&I

7.4. HOPPING FREQUENCY SEPARATION

LIMITS

HOPPING FREQUENCY SEPARATION	
Condition	Limit
☐ Non-adaptive frequency hopping systems	Shall be equal to or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz.
☒ Adaptive frequency hopping systems	The minimum Hopping Frequency Separation shall be 100 kHz.

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.5

Measurement	
☒Conducted measurement	☐Radiated measurement

Connect the UUT to the spectrum analyzer and use the following settings:

Center Frequency	Centre of the two adjacent hopping frequencies
Frequency Span	Sufficient to see the complete power envelope of both hopping frequencies
Detector Mode	Max Peak
RBW	1 % of the span
VBW	3 × RBW
Trace	Max hold
Sweep Time	Auto

TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix J

7.5. OCCUPIED CHANNEL BANDWIDTH

LIMITS

OCCUPIED CHANNEL BANDWIDTH		
Condition		Limit
All types of equipment		Each hopping frequency shall be within the 2400 to 2483.5 MHz band
Additional requirement	For non-adaptive non-FHSS equipment with e.i.r.p. greater than 10 dBm	Each hopping frequency shall be equal to or less than 20 MHz

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.7

Measurement	
☒Conducted measurement	☐Radiated measurement

Connect the UUT to the spectrum analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test
Frequency Span	2 × Nominal Channel Bandwidth
Detector	RMS
RBW	~ 1 % of the span without going below 1 %
VBW	3 × RBW
Trace	Max hold
Sweep Time	1s

TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix D

7.6. TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN

LIMITS

Transmitter Unwanted Emissions in The Out-Of-Band Domain	
Condition	Limit
Under Normal Test Condition	The transmitter unwanted emissions in the out-of-band domain shall not exceed the values provided by the mask in figure 3.

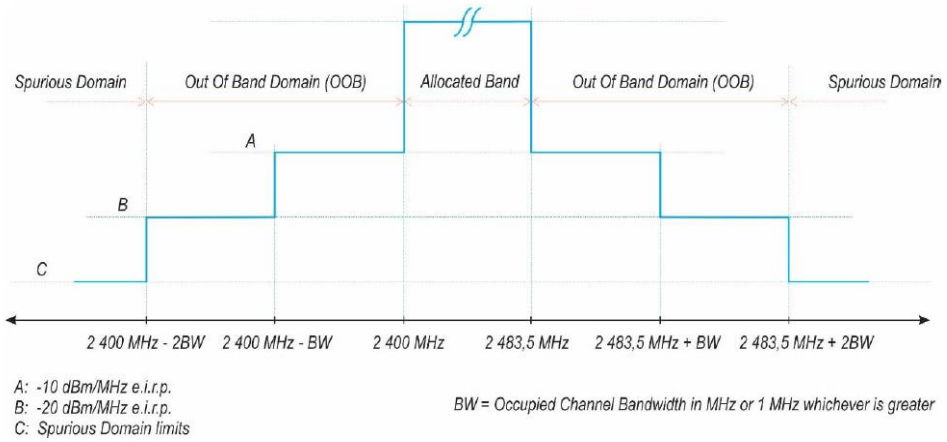


Figure 3: Transmit mask

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.8

Measurement	
☒Conducted measurement	☐Radiated measurement

Connect the UUT to the spectrum analyzer and use the following settings:

Span	Zero Span
Filter Mode	Channel Filter
Trace Mode	Max Hold
Trigger Mode	Video
Detector	RMS
Sweep Points	Sweep time [µs] / (1 µs) with a maximum of 30 000
RBW / VBW	1 MHz / 3 MHz
Measurement Mode	Time Domain Power
Sweep Time	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix E

7.7. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

LIMITS

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). 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.

Table 12: Transmitter limits for spurious emissions

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 PROCEDURE

Refer to Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.9

Measurement	
☒Conducted measurement	☒Radiated measurement

Spectrum analyser settings for pre-scan:

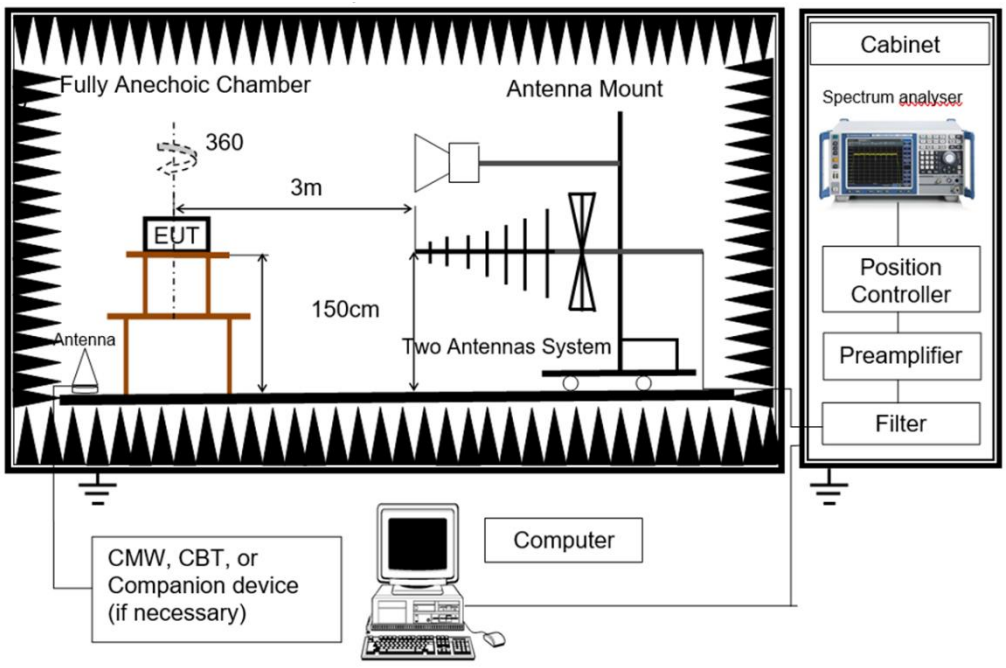
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak
Filter type	3 dB (Gaussian)
Trace Mode	Max hold
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analyzers not supporting this high number of sweep points, the frequency band may be segmented.

Sweep Time	For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel. For FHSS equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies. The above sweep time setting may result in long measuring times in case of FHSS equipment. To avoid such long measuring times, an FFT analyzer may be used.

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep
Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	Sweep time [µs] / (1 µs) with a maximum of 30 000
Sweep Time	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

TEST SETUP



TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix F

7.8. RECEIVER SPURIOUS EMISSIONS

LIMITS

The spurious emissions of the receiver shall not exceed the values given in table 13.
In case of non-FHSS equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). 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

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

TEST PROCEDURE

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

Measurement	
☒Conducted measurement	☒Radiated measurement

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

Spectrum analyser settings for pre-scan:

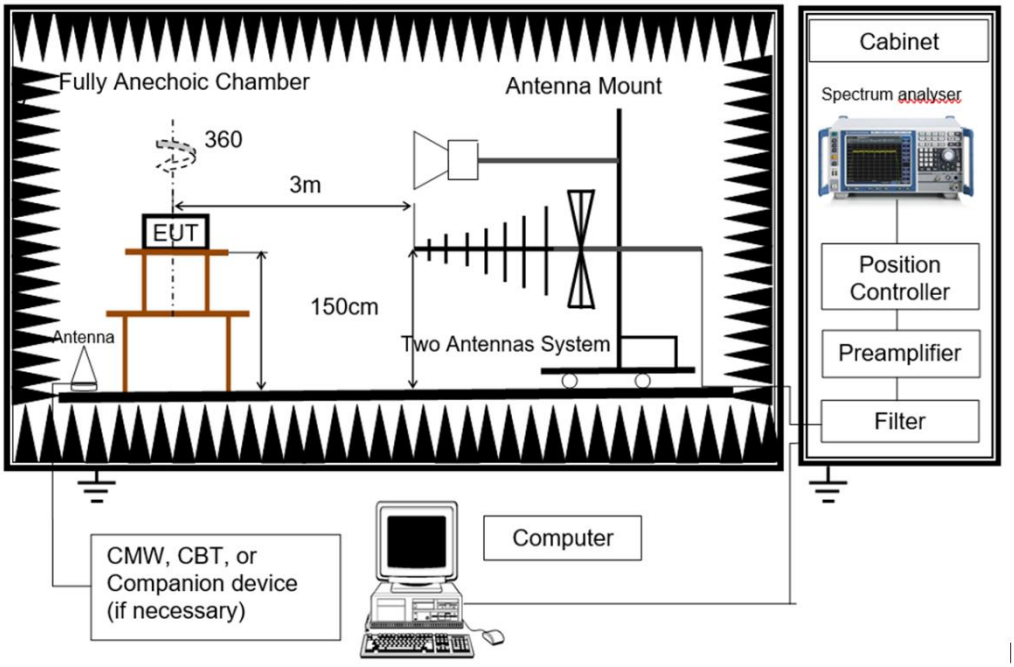
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak
Filter type	3 dB (Gaussian)
Trace Mode	Max hold
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analyzers not supporting this high number of sweep points, the frequency band may be segmented.
Sweep Time	Auto

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep

Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	≥ 30 000
Sweep Time	30 ms

TEST SETUP



TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix G

7.9. RECEIVER BLOCKING

LIMITS

Performance Criteria

For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER less than or equal to 10 %.
For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall be no loss of the wireless transmission function needed for the intended use of the equipment.

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 14, table 15 or table 16.

☐ Receiver Category 1

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

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)	2 380 2 504	-34	CW
(-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 2 674		

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 P_{min} + 26 dB where P_{min} 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 P_{min} + 20 dB where P_{min} 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.

☒ Receiver Category 2

Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
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 P_{min} + 26 dB where P_{min} 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: 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.			

☐ Receiver Category 3

Table 16: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
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 P_{min} + 30 dB where P_{min} 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: 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.			

TEST PROCEDURE

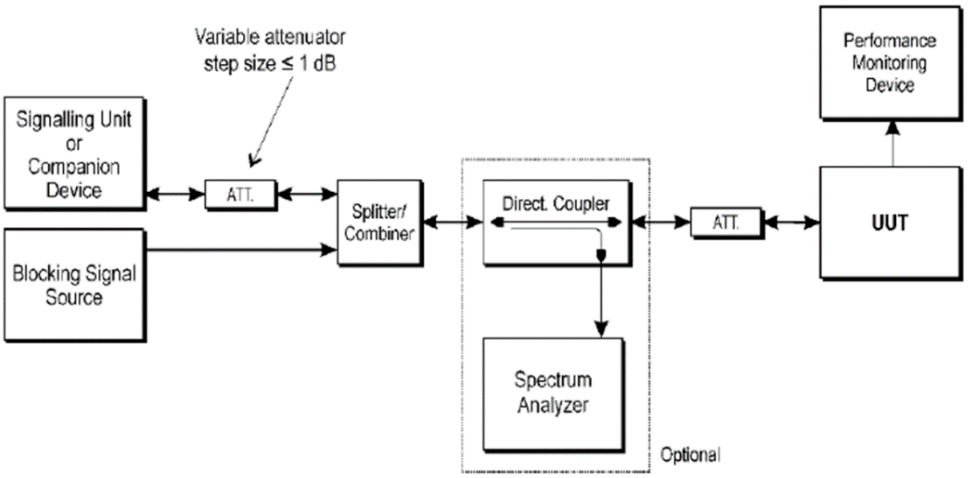
Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.11

Measurement	
☒Conducted measurement	☐Radiated measurement

Step 1:
• For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).
Step 2:
• The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.
Step 3:
• With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6.
• Unless the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the level of the wanted signal shall be set to the value provided in the table corresponding to the receiver category and type of equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be used to measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain of the companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at the output of the companion device and a correction is made for the coupling loss into the UUT. The actual level for the wanted signal shall be recorded in the test report.
• When the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is Pmin. This signal level (Pmin) is increased by the value provided in note 2 of the applicable table corresponding to the receiver category and type of equipment.
Step 4:
• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 are met then proceed to step 6.
Step 5:
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been increased with a value equal to the Occupied Channel Bandwidth except:
- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been decreased with a value equal to the Occupied Channel Bandwidth except:
- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.

• It shall be recorded in the test report whether the shift of blocking frequencies as described in the present step was used.
Step 6:
• Repeat step 4 and step 5 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.
Step 7:
• For non-FHSS equipment, repeat step 2 to step 6 with the UUT operating at the highest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).
Step 8:
• It shall be assessed and recorded in the test report whether the UUT complies with the Receiver Blocking requirement.

TEST SETUP



TEST ENVIRONMENT

Temperature	24.2℃	Relative Humidity	68.0%
Atmosphere Pressure	101kPa	Test Voltage	DC 5 V

TEST DATE / ENGINEER

Test Date	October 11, 2023	Test By	Johnson Liu

TEST RESULTS

Please refer to section "Test Data" - Appendix K

8. TEST DATA

Appendix A: Accumulated Transmit Time

Mode	Frequency (MHz)	Antenna	Accumulated Transmit Time (ms)	Limit (ms)	Sweep Time (ms)	Burst Number	Verdict
1-DH5	2402	Ant1	290.779	400	31600	101	Pass
	2480		293.454	400	31600	102	Pass
3-DH5	2402		343.315	400	31600	119	Pass
	2480		265.42	400	31600	92	Pass

Test Graphs

Dwell NVNT 1-DH5 2402MHz Ant1

Dwell NVNT 1-DH5 2480MHz Ant1

Dwell NVNT 3-DH5 2402MHz Ant1

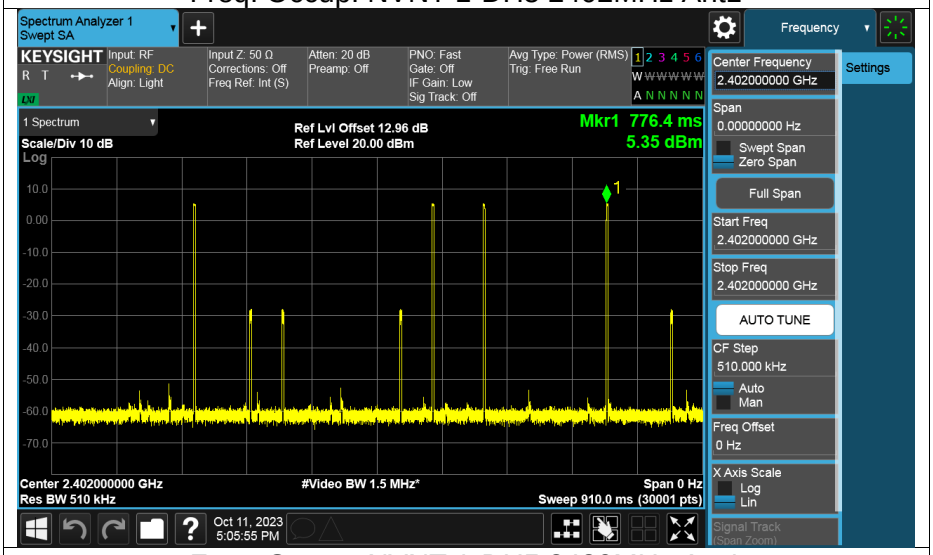
Dwell NVNT 3-DH5 2480MHz Ant1

Appendix B: Frequency Occupation

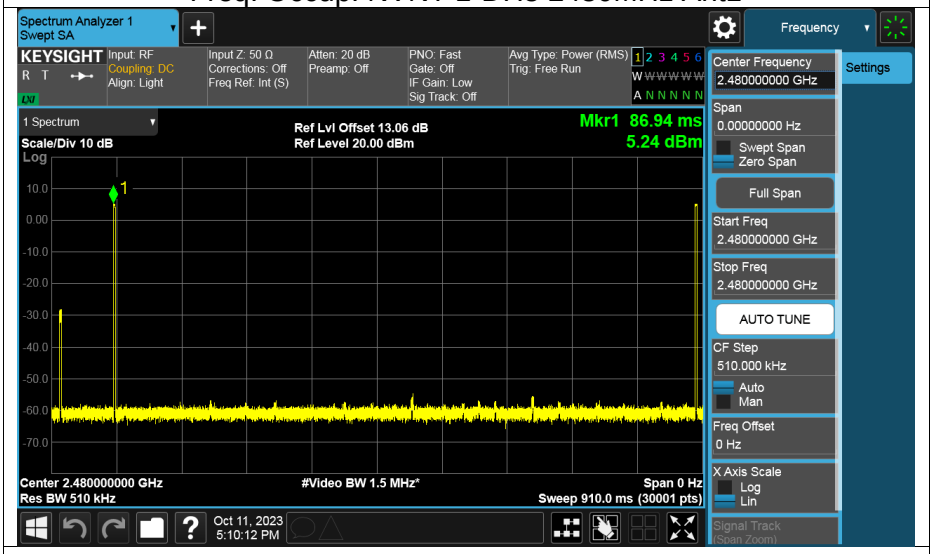
Mode	Frequency (MHz)	Antenna	Burst Number	Limit	Sweep Time (ms)	Verdict
1-DH5	2402	Ant1	4	1	909.764	Pass
	2480		2	1	909.132	Pass
3-DH5	2402		3	1	911.66	Pass
	2480		8	1	911.66	Pass

Test Graphs

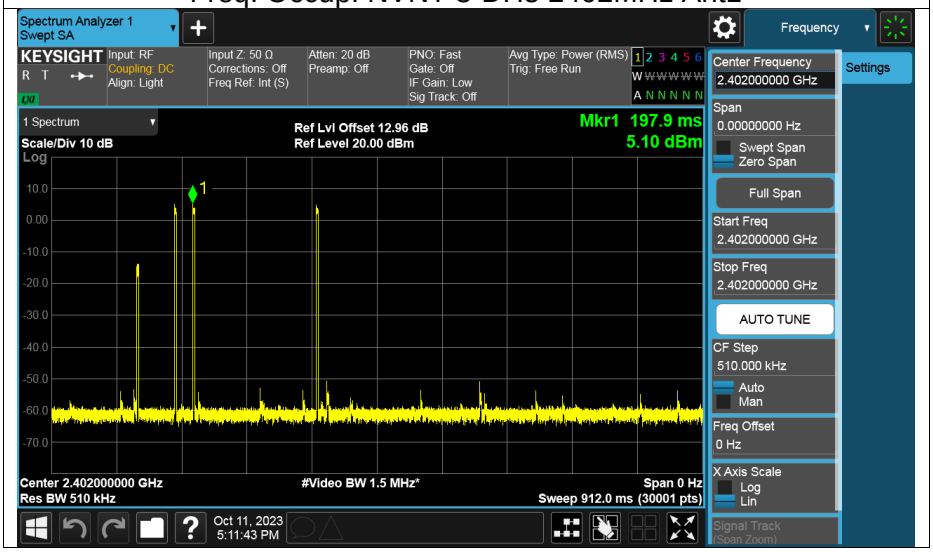
Freq. Occup. NVNT 1-DH5 2402MHz Ant1



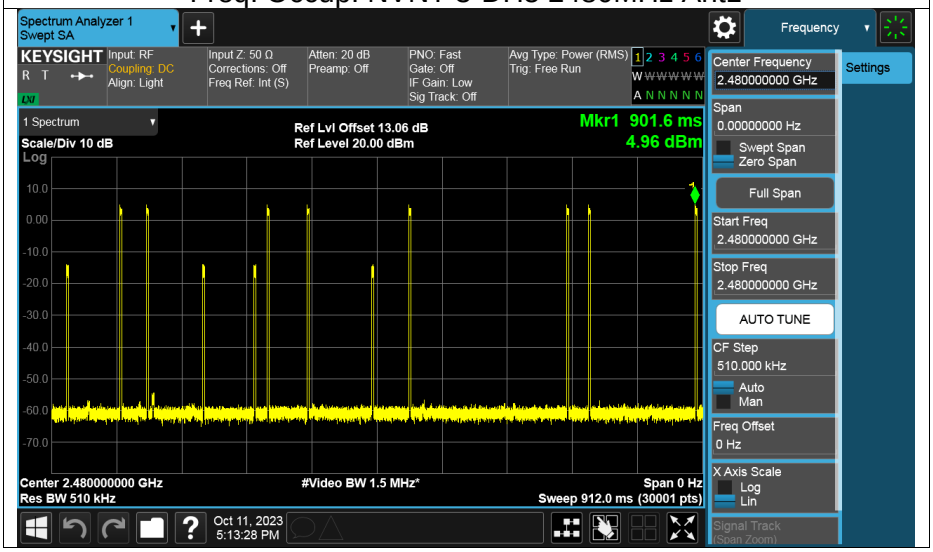
Freq. Occup. NVNT 1-DH5 2480MHz Ant1



Freq. Occup. NVNT 3-DH5 2402MHz Ant1



Freq. Occup. NVNT 3-DH5 2480MHz Ant1

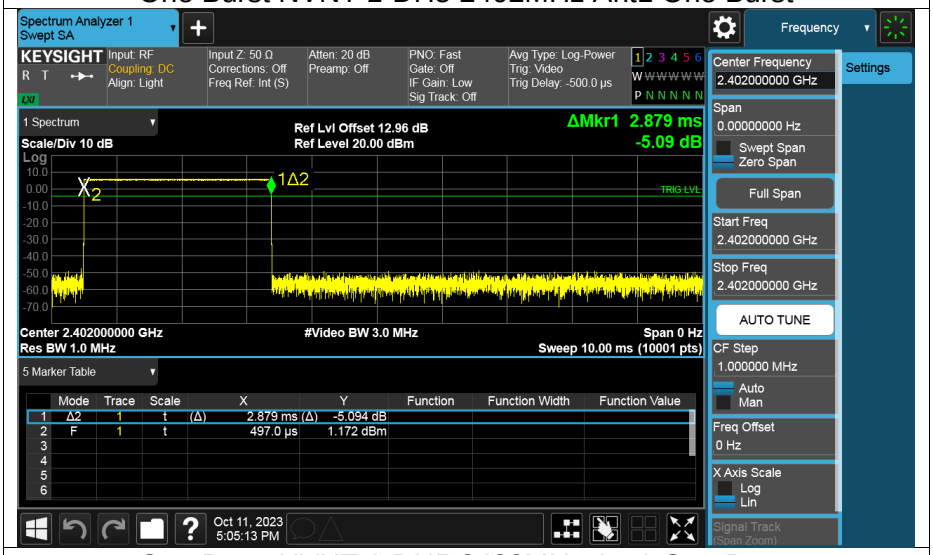


Appendix C: Dwell Time One Burst

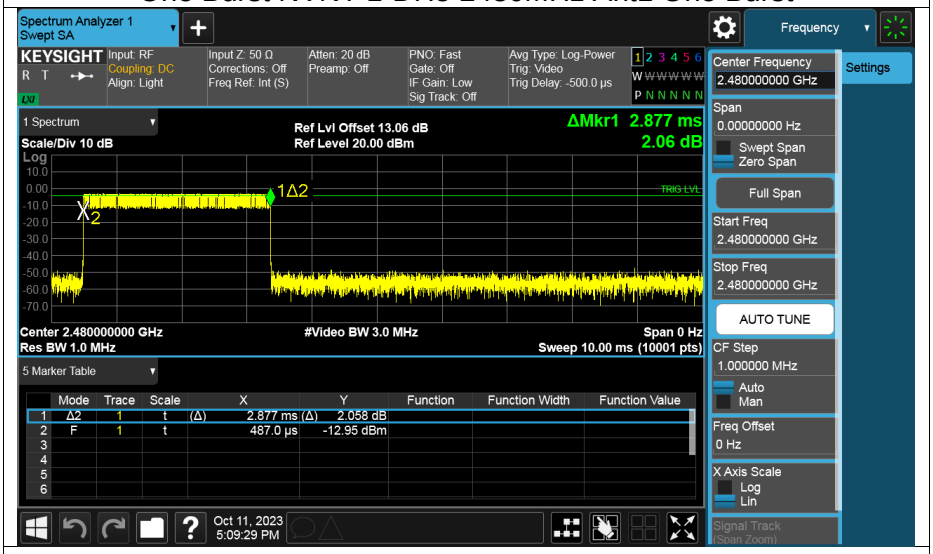
Mode	Frequency (MHz)	Antenna	Pulse Time (ms)
1-DH5	2402	Ant1	2.879
	2480		2.877
3-DH5	2402		2.885
	2480		

Test Graphs

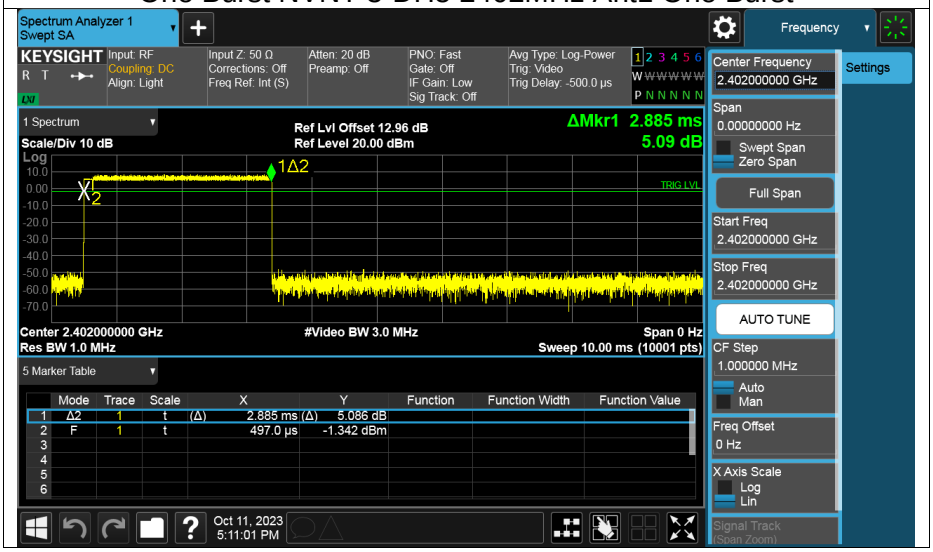
One Burst NVNT 1-DH5 2402MHz Ant1 One Burst



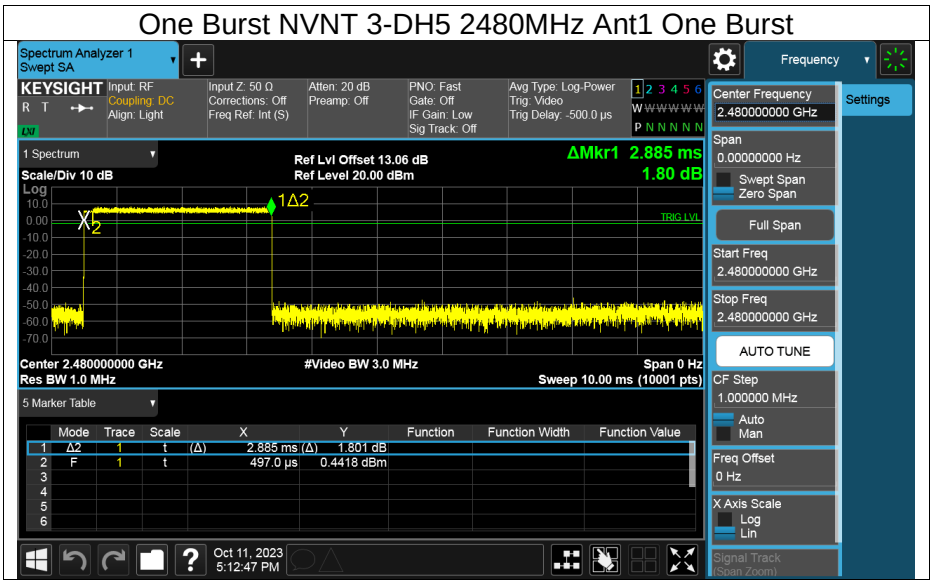
One Burst NVNT 1-DH5 2480MHz Ant1 One Burst



One Burst NVNT 3-DH5 2402MHz Ant1 One Burst



One Burst NVNT 3-DH5 2480MHz Ant1 One Burst

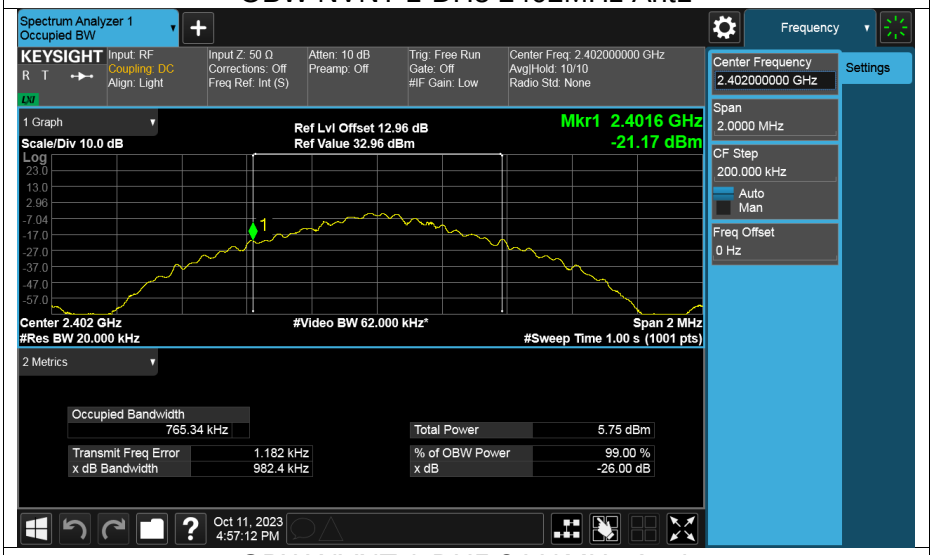


Appendix D: Occupied Channel Bandwidth

Mode	Frequency (MHz)	Antenna	Center Frequency (MHz)	OBW (MHz)	Lower Edge (MHz)	Upper Edge (MHz)	Limit OBW (MHz)	Verdict
1-DH5	2402	Ant1	2402.001	0.765	2401.619	2402.384	2400 - 2483.5MHz	Pass
	2441		2441.001	0.765	2440.618	2441.383	2400 - 2483.5MHz	Pass
	2480		2480.001	0.765	2479.618	2480.384	2400 - 2483.5MHz	Pass
3-DH5	2402		2402	1.193	2401.404	2402.597	2400 - 2483.5MHz	Pass
	2441		2441	1.193	2440.404	2441.597	2400 - 2483.5MHz	Pass
	2480		2480	1.193	2479.403	2480.597	2400 - 2483.5MHz	Pass

Test Graphs

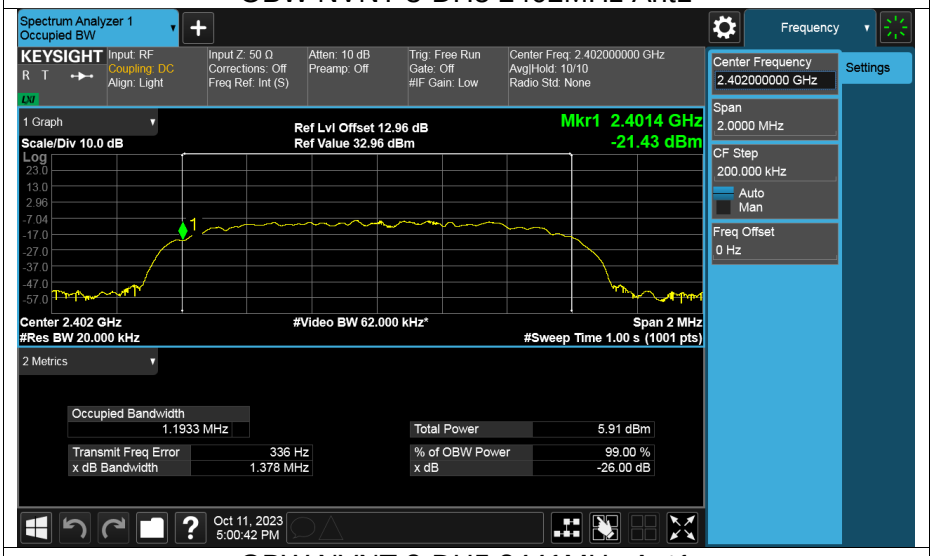
OBW NVNT 1-DH5 2402MHz Ant1



OBW NVNT 1-DH5 2441MHz Ant1

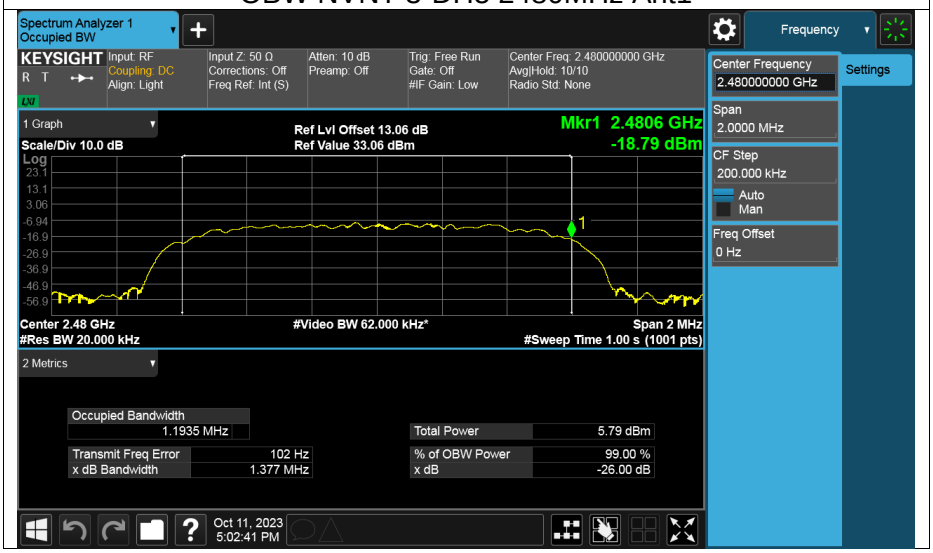
OBW NVNT 1-DH5 2480MHz Ant1

OBW NVNT 3-DH5 2402MHz Ant1



OBW NVNT 3-DH5 2441MHz Ant1

OBW NVNT 3-DH5 2480MHz Ant1

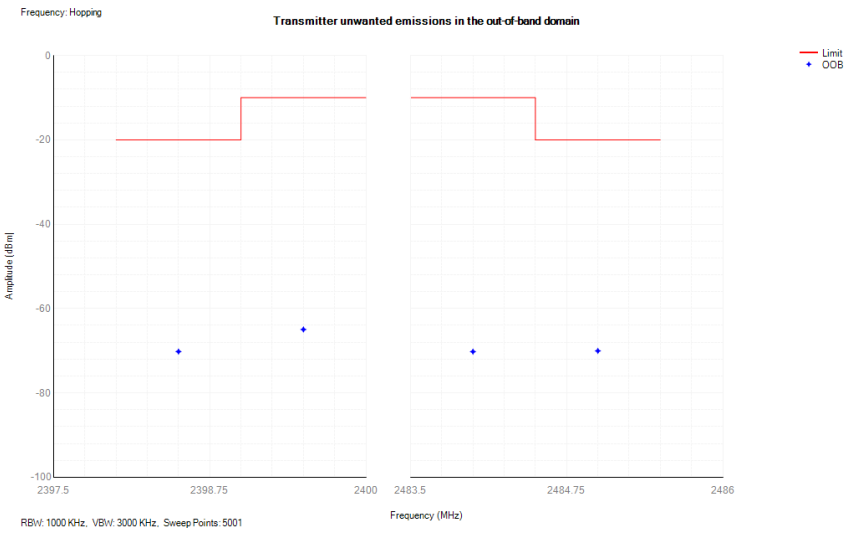


Appendix E: Transmitter unwanted emissions in the out-of-band domain

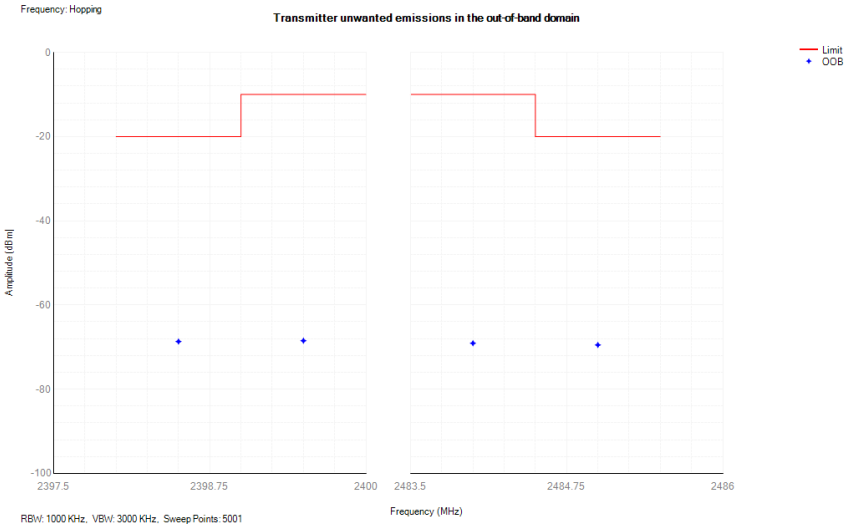
Mode	Frequency (MHz)	Antenna	OOB Frequency (MHz)	Level (dBm/MHz)	Limit (dBm/MHz)	Verdict
1-DH5	Hopping	Ant1	2399.5	-64.95	-10	Pass
			2398.5	-70.19	-20	Pass
			2484	-70.21	-10	Pass
			2485	-70.03	-20	Pass
			2399.5	-68.48	-10	Pass
			2398.5	-68.67	-20	Pass
			2484	-69.08	-10	Pass
			2485	-69.49	-20	Pass
3-DH5			2399.5	-69.66	-10	Pass
			2399.307	-70.11	-10	Pass
			2398.307	-69.23	-20	Pass
			2398.114	-69.56	-20	Pass
			2484	-69.96	-10	Pass
			2484.193	-69.71	-10	Pass
			2485.193	-69.24	-20	Pass
			2485.386	-66.76	-20	Pass
			2399.5	-70	-10	Pass
			2399.307	-65.85	-10	Pass
			2398.307	-70.1	-20	Pass
			2398.114	-70.11	-20	Pass
			2484	-67.41	-10	Pass
			2484.193	-69.69	-10	Pass
			2485.193	-69.56	-20	Pass
			2485.386	-69.1	-20	Pass

Test Graphs

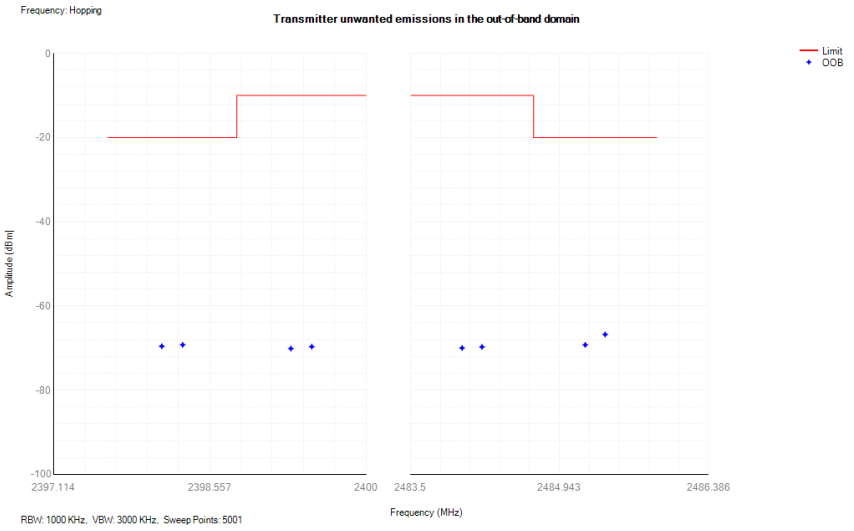
Tx. Emissions OOB NVNT 1-DH5 2402MHz Ant1



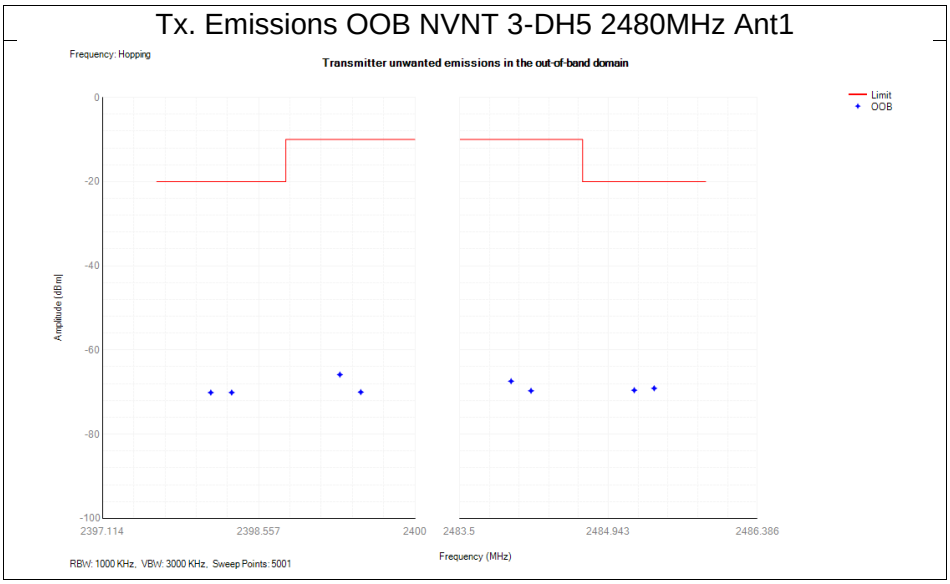
Tx. Emissions OOB NVNT 1-DH5 2480MHz Ant1



Tx. Emissions OOB NVNT 3-DH5 2402MHz Ant1



Tx. Emissions OOB NVNT 3-DH5 2480MHz Ant1



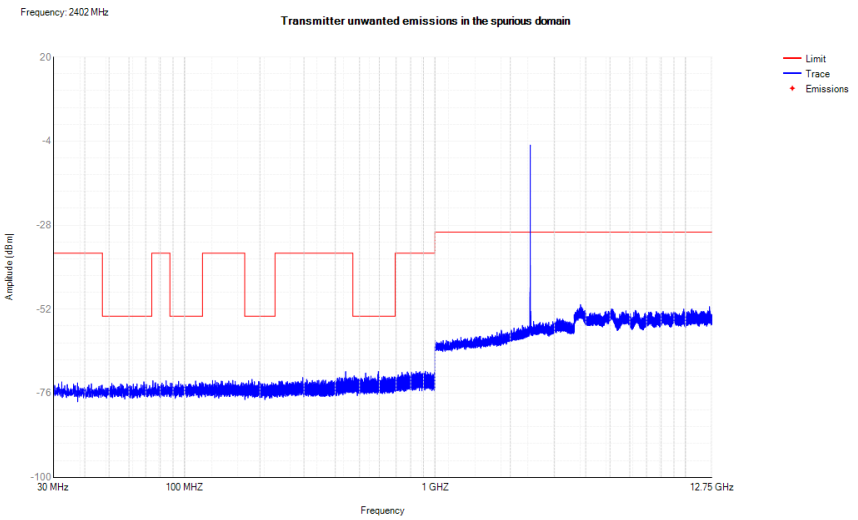
Appendix F: Transmitter unwanted emissions in the spurious domain

Mode	Frequency (MHz)	Antenna	Range (MHz)	Spur Freq (MHz)	Peak (dBm)	RMS (dBm)	Limit (dBm)	Verdict
1-DH5	2402	Ant1	30 -47	32.35	-72.76	NA	-36	Pass
			47 -74	68.85	-72.73	NA	-54	Pass
			74 -87.5	74.80	-72.41	NA	-36	Pass
			87.5 - 118	110.80	-72.49	NA	-54	Pass
			118 - 174	155.95	-72.32	NA	-36	Pass
			174 - 230	186.05	-72.03	NA	-54	Pass
			230 - 470	440.25	-69.80	NA	-36	Pass
			470 - 694	594.50	-69.77	NA	-54	Pass
			694 - 1000	916.45	-69.71	NA	-36	Pass
			1000 - 2398	2397.50	-47.05	NA	-30	Pass
			2485.5 - 12750	3811.00	-50.67	NA	-30	Pass
	2480		30 -47	32.05	-72.81	NA	-36	Pass
			47 -74	69.70	-73.24	NA	-54	Pass
			74 -87.5	80.00	-73.05	NA	-36	Pass
			87.5 - 118	116.25	-72.32	NA	-54	Pass
			118 - 174	144.95	-71.98	NA	-36	Pass
			174 - 230	204.45	-71.65	NA	-54	Pass
			230 - 470	461.65	-70.68	NA	-36	Pass
			470 - 694	601.65	-70.30	NA	-54	Pass
			694 - 1000	947.00	-69.02	NA	-36	Pass
			1000 - 2398	2301.00	-55.55	NA	-30	Pass
			2485.5 - 12750	6394.00	-50.65	NA	-30	Pass
3-DH5	2402		30 -47	34.25	-72.94	NA	-36	Pass
			47 -74	66.60	-72.34	NA	-54	Pass
			74 -87.5	83.45	-72.99	NA	-36	Pass
			87.5 - 118	90.65	-72.75	NA	-54	Pass
			118 - 174	133.45	-72.17	NA	-36	Pass
			174 - 230	186.95	-71.22	NA	-54	Pass
			230 - 470	306.60	-71.21	NA	-36	Pass

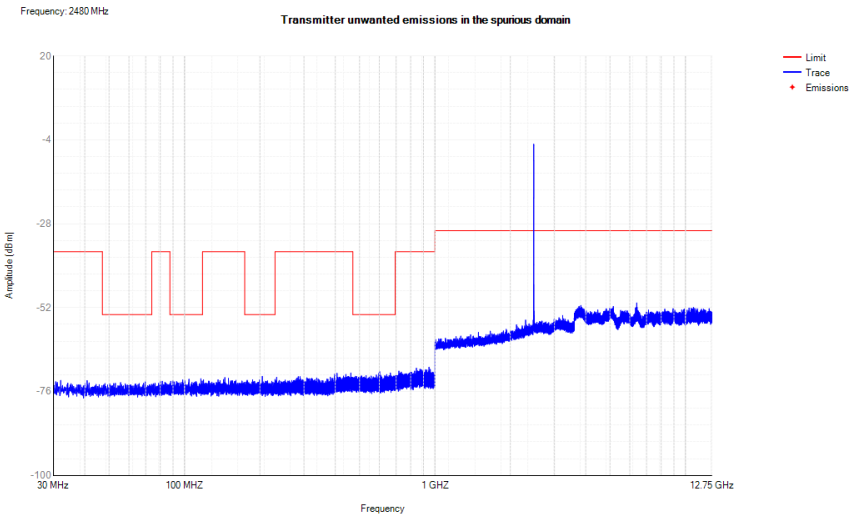
			470 - 694	677.85	-69.70	NA	-54	Pass
			694 - 1000	887.70	-69.23	NA	-36	Pass
			1000 - 2398	2397.50	-47.82	NA	-30	Pass
			2485.5 - 12750	3785.50	-51.31	NA	-30	Pass
	2480		30 -47	42.50	-73.16	NA	-36	Pass
			47 -74	60.00	-73.10	NA	-54	Pass
			74 -87.5	86.95	-72.43	NA	-36	Pass
			87.5 - 118	117.90	-72.18	NA	-54	Pass
			118 - 174	164.00	-71.90	NA	-36	Pass
			174 - 230	211.55	-72.29	NA	-54	Pass
			230 - 470	465.60	-70.85	NA	-36	Pass
			470 - 694	636.05	-70.05	NA	-54	Pass
			694 - 1000	896.80	-68.58	NA	-36	Pass
			1000 - 2398	2391.00	-56.32	NA	-30	Pass
			2485.5 - 12750	3830.50	-50.99	NA	-30	Pass

Test Graphs

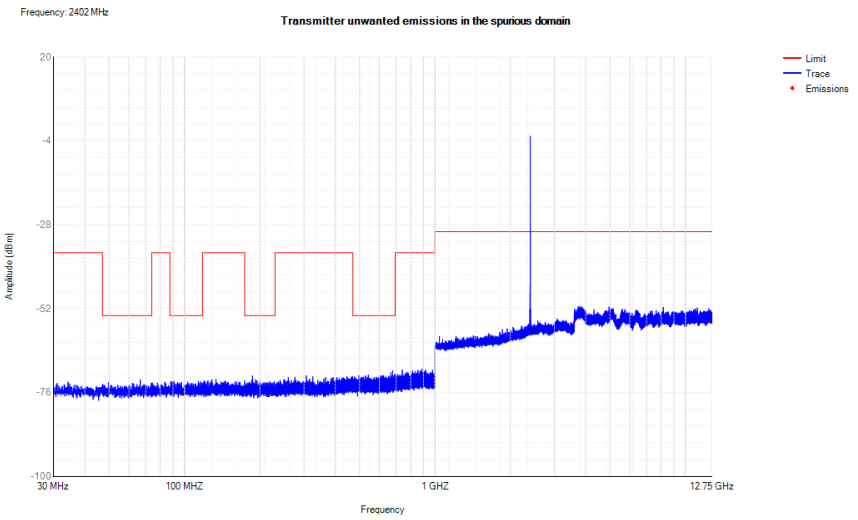
Tx. Spurious NVNT 1-DH5 2402MHz Ant1



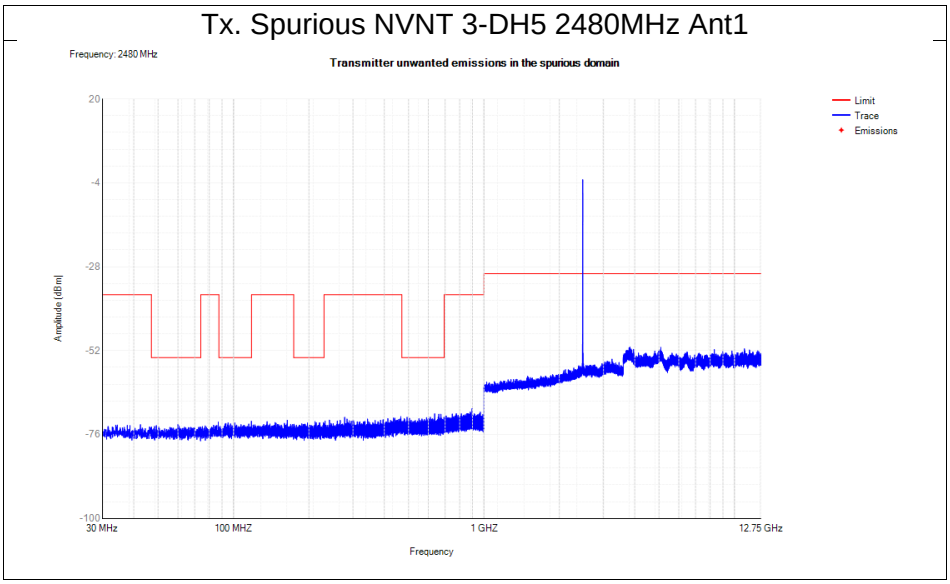
Tx. Spurious NVNT 1-DH5 2480MHz Ant1



Tx. Spurious NVNT 3-DH5 2402MHz Ant1

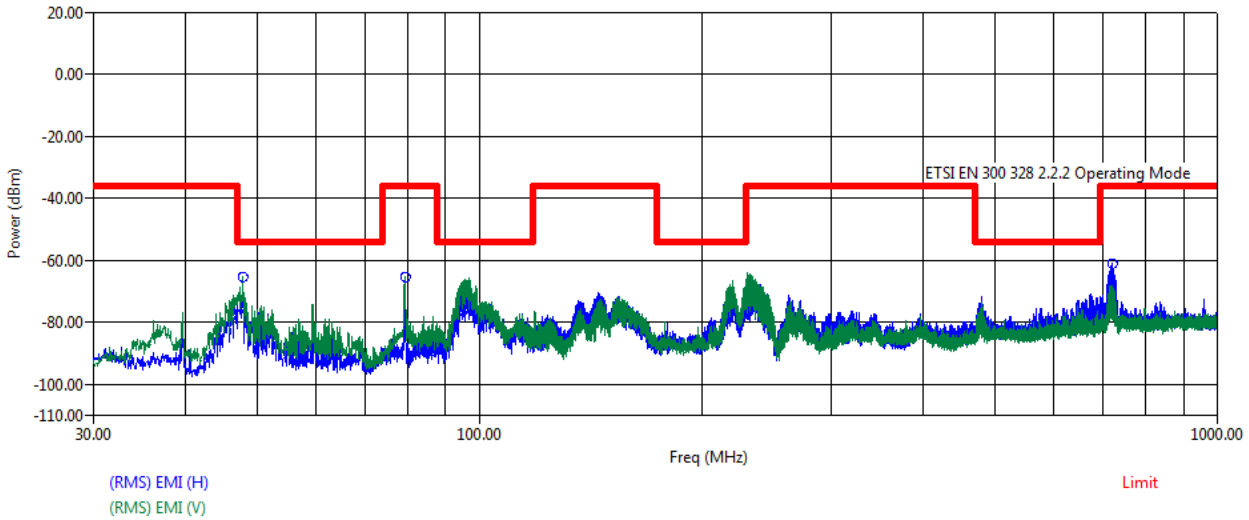


Tx. Spurious NVNT 3-DH5 2480MHz Ant1



TX Radiated Test Result

Transmitter unwanted emissions in the spurious domain 30MHz – 1GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	DH5	Test Channel:	CH 0

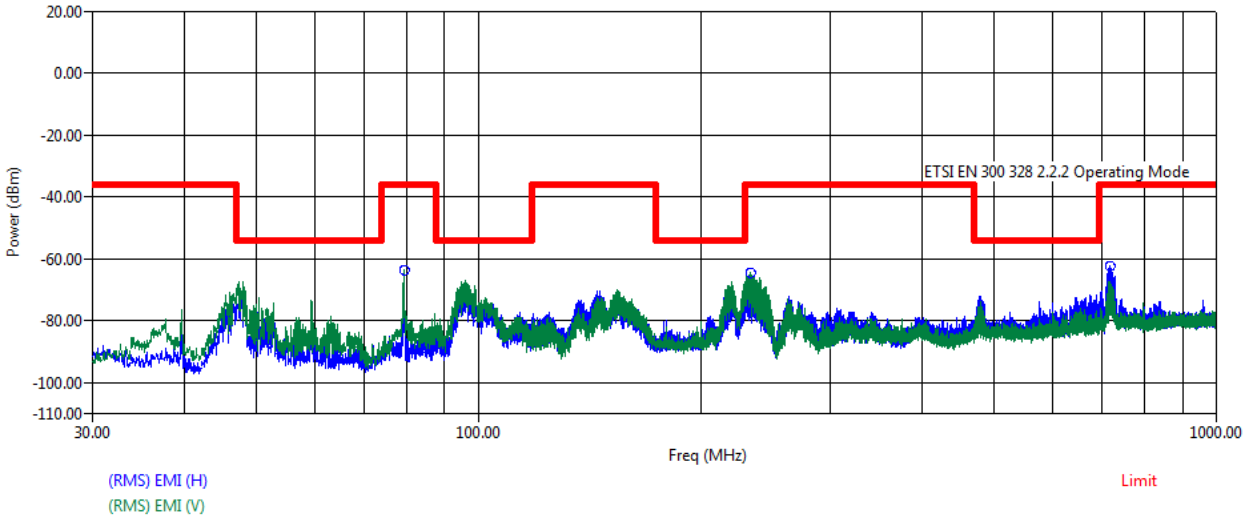


Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
47.80	52.61	-85.18	0.00	0.88	43.00	-74.69	-54.00	-20.69
79.25	59.35	-86.81	0.00	1.12	43.00	-69.33	-36.00	-33.33
720.00	55.29	-77.00	0.00	3.65	42.74	-60.81	-36.00	-24.81
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
47.80	59.39	-82.30	0.00	0.88	43.00	-65.04	-54.00	-11.04
79.25	64.14	-87.41	0.00	1.12	43.00	-65.15	-36.00	-29.15
720.00	46.86	-76.34	0.00	3.65	42.74	-68.57	-36.00	-32.57

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

Transmitter unwanted emissions in the spurious domain 30MHz – 1GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	DH5	Test Channel:	CH 78



Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
79.25	59.79	-86.81	0.00	1.12	43.00	-68.90	-36.00	-32.90
233.30	58.64	-86.65	0.00	2.05	43.07	-69.02	-36.00	-33.02
717.25	53.91	-77.11	0.00	3.63	42.75	-62.33	-36.00	-26.33

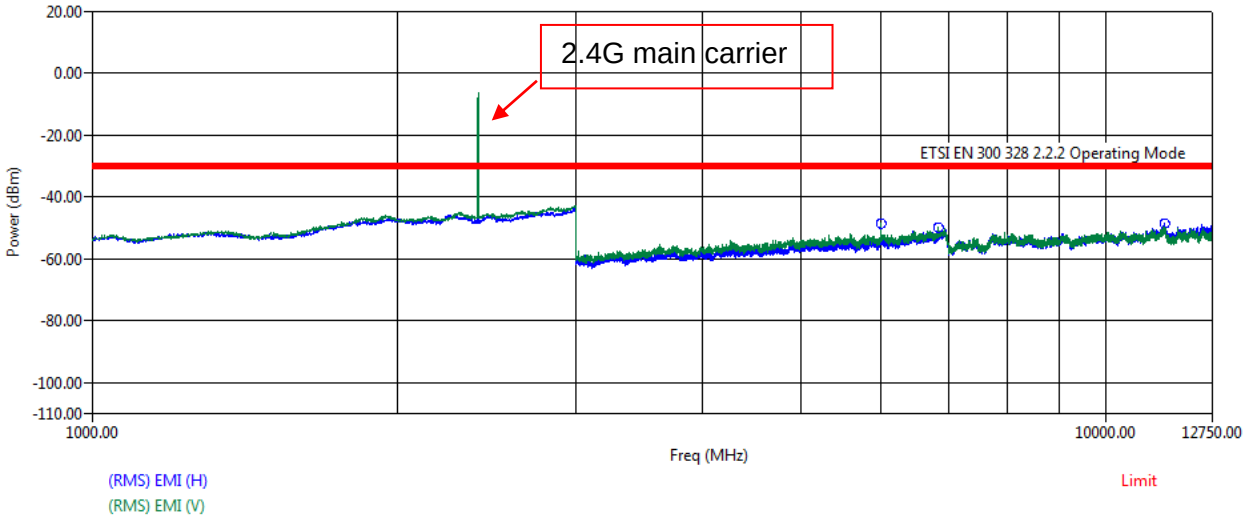
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
79.25	65.63	-87.41	0.00	1.12	43.00	-63.65	-36.00	-27.65
233.30	63.26	-86.65	0.00	2.05	43.07	-64.42	-36.00	-28.42
717.25	46.60	-76.50	0.00	3.63	42.75	-69.02	-36.00	-33.02

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

Note: All the modes had been tested, but only the worst data was recorded in the report.

Transmitter unwanted emissions in the spurious domain 1GHz – 12.75GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	DH5	Test Channel:	CH 0



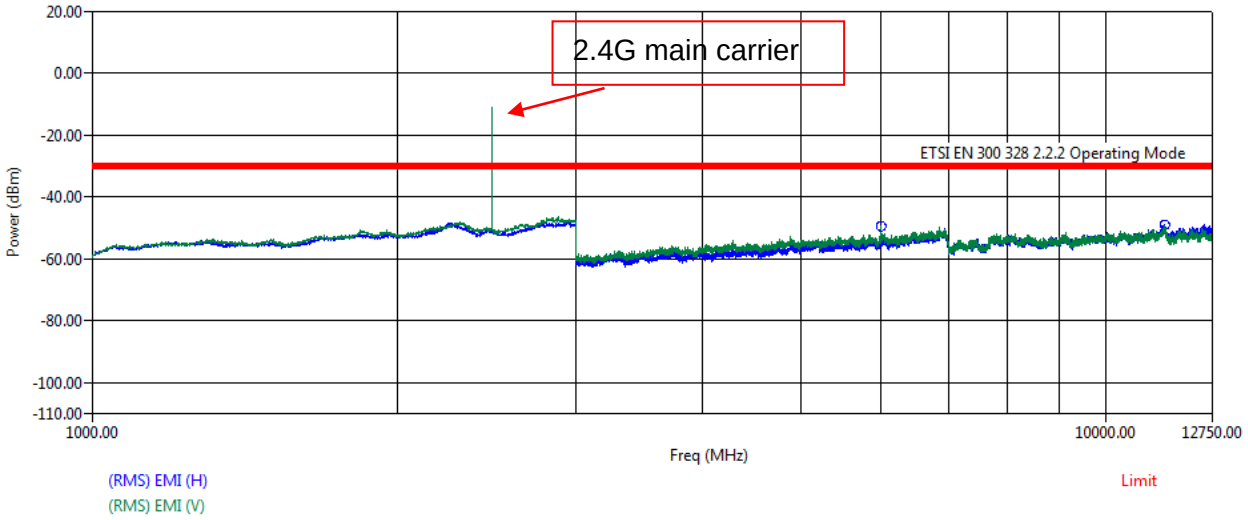
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
6000.00	39.91	-60.88	0.00	11.59	42.60	-51.98	-30.00	-21.98
6835.00	35.71	-59.34	0.00	12.33	41.75	-53.05	-30.00	-23.05
11444.00	33.05	-56.06	0.00	16.42	42.02	-48.60	-30.00	-18.60
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
6000.00	41.99	-59.45	0.00	11.59	42.60	-48.47	-30.00	-18.47
6835.00	38.05	-58.48	0.00	12.33	41.75	-49.86	-30.00	-19.86
11444.00	30.41	-56.57	0.00	16.42	42.02	-51.75	-30.00	-21.75

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

Note: 2.4G main carrier was recorded in the plot.

Transmitter unwanted emissions in the spurious domain 1GHz – 12.75GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	DH5	Test Channel:	CH 78



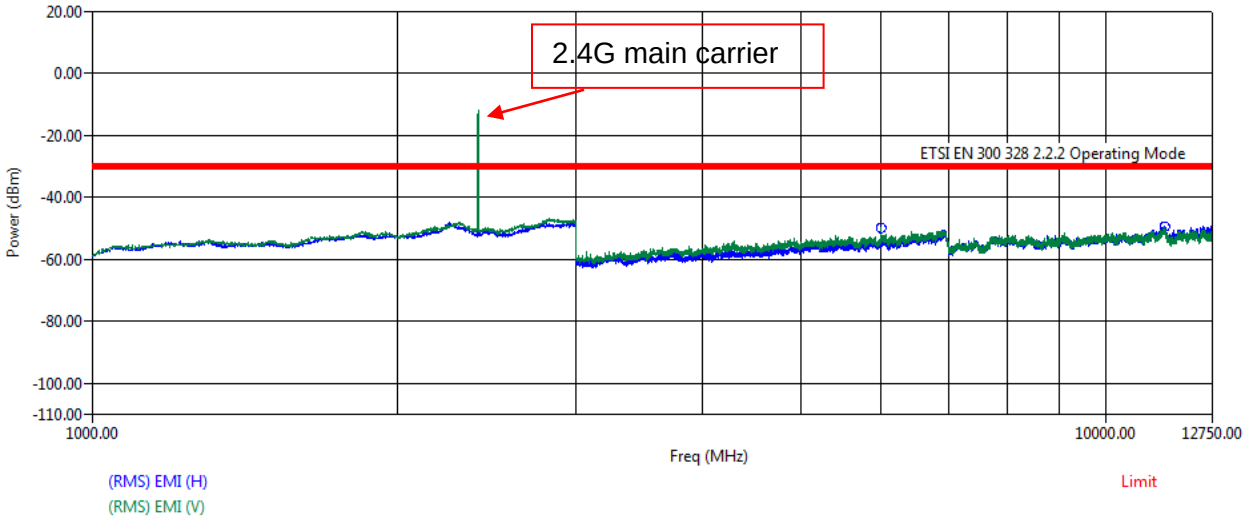
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
6000.00	39.65	-60.88	0.00	11.59	42.60	-52.24	-30.00	-22.24
11436.00	32.76	-56.23	0.00	16.44	42.02	-49.05	-30.00	-19.05
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
6000.00	41.15	-59.45	0.00	11.59	42.60	-49.31	-30.00	-19.31
11436.00	30.60	-56.75	0.00	16.44	42.02	-51.72	-30.00	-21.72

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

Note: 2.4G main carrier was recorded in the plot.

Transmitter unwanted emissions in the spurious domain 1GHz– 12.75GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	3DH5	Test Channel:	CH 0



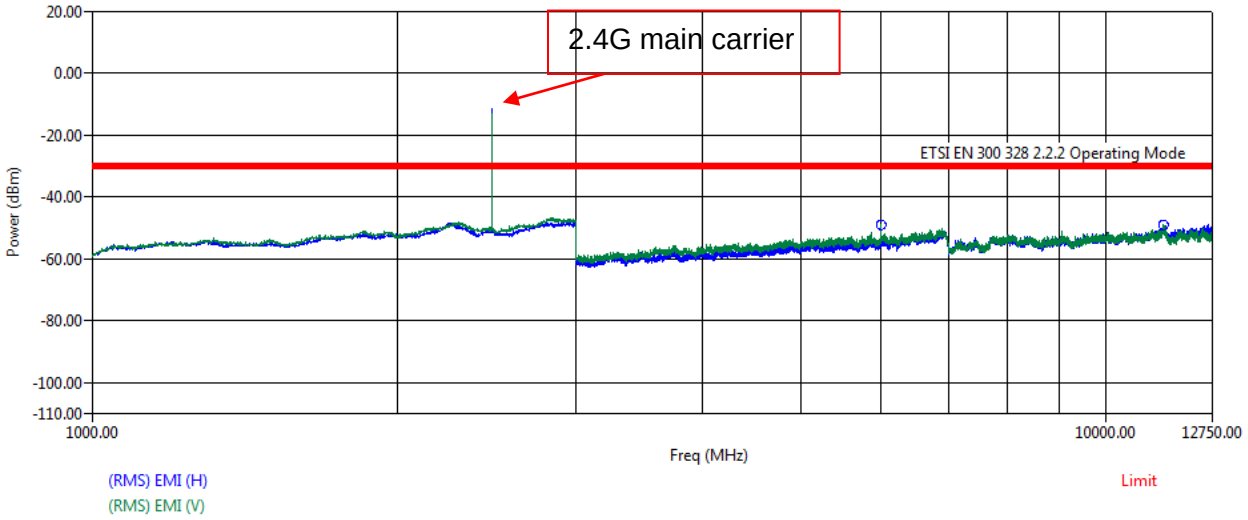
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
6000.00	39.29	-60.88	0.00	11.59	42.60	-52.60	-30.00	-22.60
11448.00	32.47	-55.97	0.00	16.41	42.02	-49.10	-30.00	-19.10
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
6000.00	40.89	-59.45	0.00	11.59	42.60	-49.57	-30.00	-19.57
11448.00	31.48	-56.48	0.00	16.41	42.02	-50.60	-30.00	-20.60

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

Note: 2.4G main carrier was recorded in the plot.

Transmitter unwanted emissions in the spurious domain 1GHz– 12.75GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	3DH5	Test Channel:	CH 78



Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
6000.00	40.07	-60.88	0.00	11.59	42.60	-51.82	-30.00	-21.82
11395.00	30.48	-57.04	0.00	16.55	42.04	-52.05	-30.00	-22.05
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
6000.00	41.61	-59.45	0.00	11.59	42.60	-48.85	-30.00	-18.85
11395.00	34.25	-57.61	0.00	16.55	42.04	-48.85	-30.00	-18.85

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

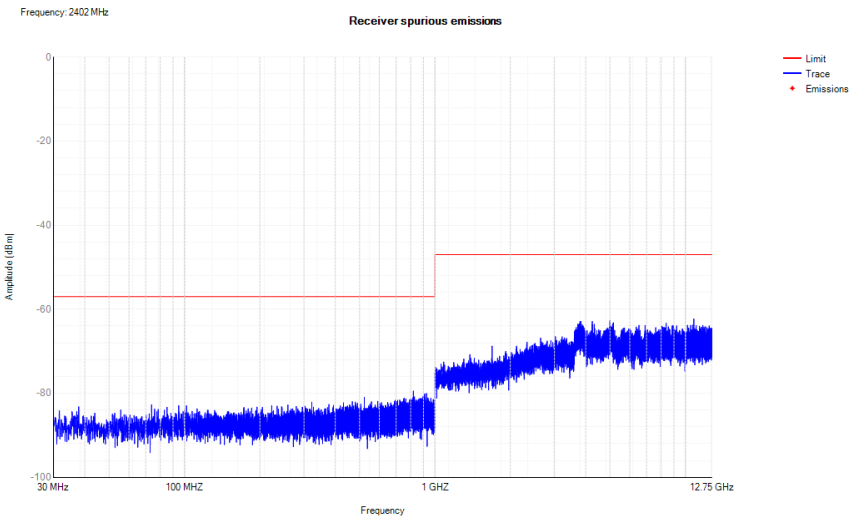
Note: 2.4G main carrier was recorded in the plot.

Appendix G: Receiver spurious emissions

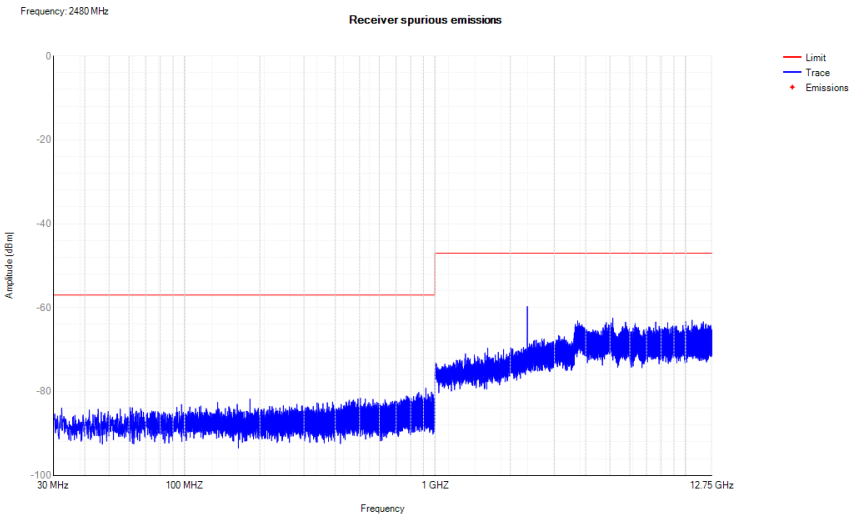
Mode	Frequency (MHz)	Antenna	Range (MHz)	Spur Freq (MHz)	Peak (dBm)	RMS (dBm)	Limit (dBm)	Verdict
1-DH5	2402	Ant1	30 - 1000	820.3	-79.47	NA	-57	Pass
			1000 - 12750	10814.5	-62.31	NA	-47	Pass
	2480		30 - 1000	920.35	-79.19	NA	-57	Pass
			1000 - 12750	2339	-59.74	NA	-47	Pass
3-DH5	2402		30 - 1000	901.25	-79.76	NA	-57	Pass
			1000 - 12750	3781.5	-63.15	NA	-47	Pass
	2480		30 - 1000	867.3	-79.55	NA	-57	Pass
			1000 - 12750	11795	-62.54	NA	-47	Pass

Test Graphs

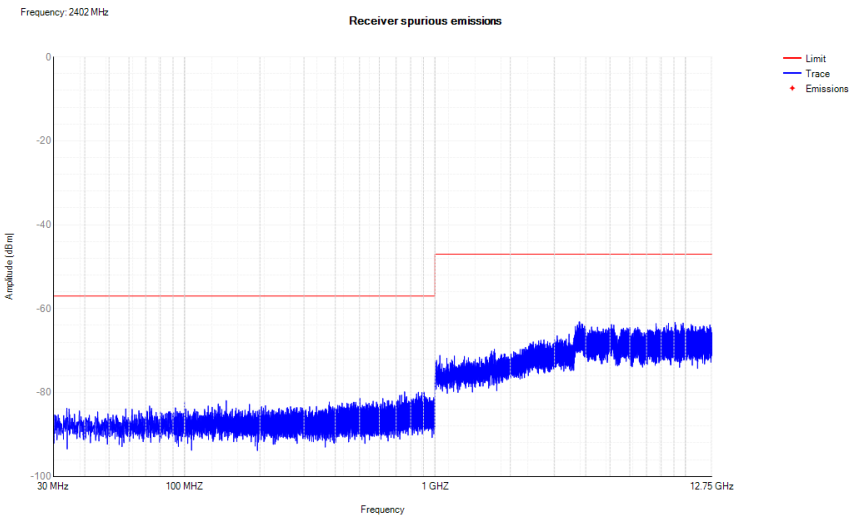
Rx. Spurious NVNT 1-DH5 2402MHz Ant1



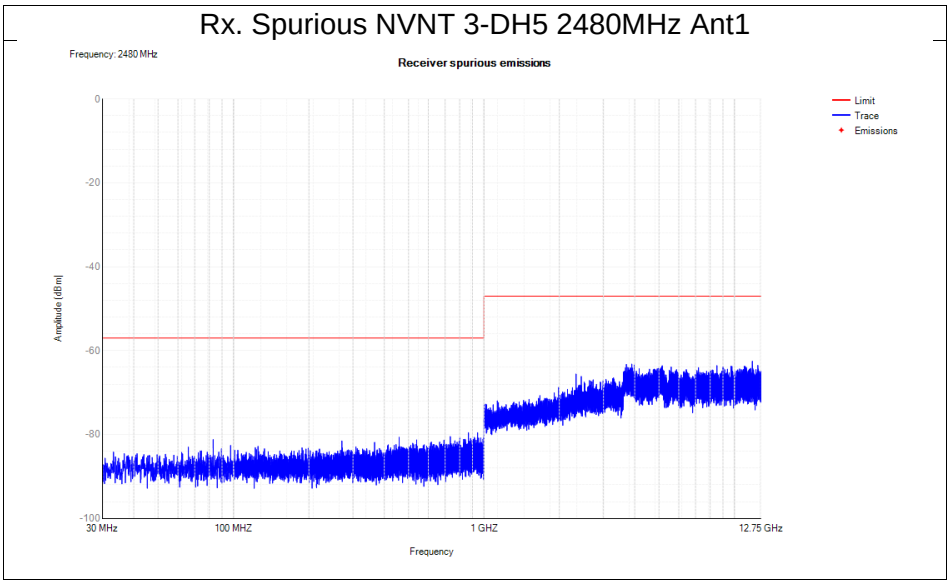
Rx. Spurious NVNT 1-DH5 2480MHz Ant1



Rx. Spurious NVNT 3-DH5 2402MHz Ant1

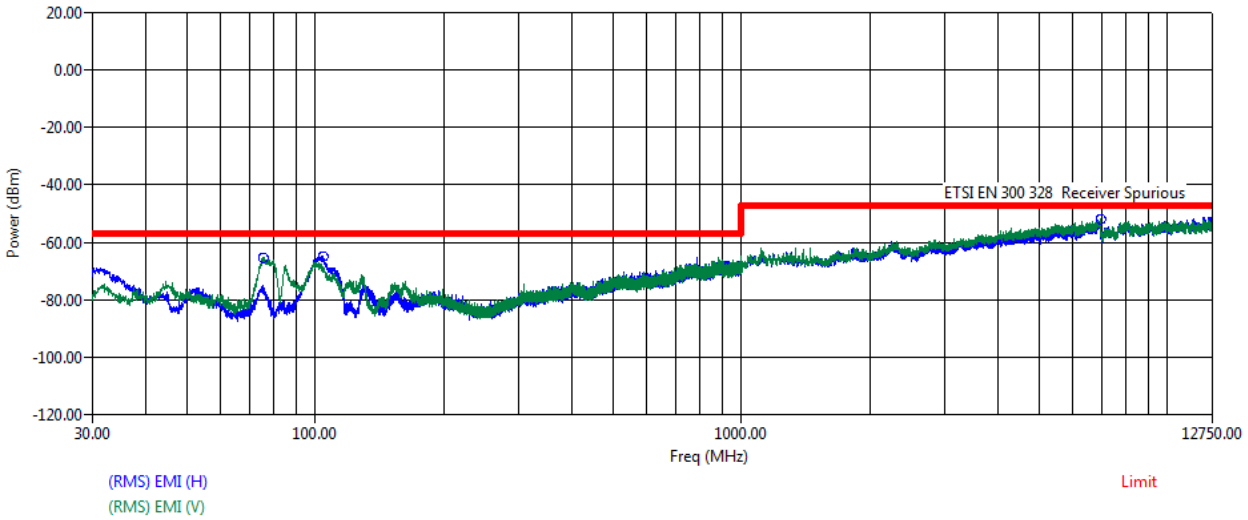


Rx. Spurious NVNT 3-DH5 2480MHz Ant1



RX Radiated Test Result

Receiver spurious emissions 30MHz– 12.75GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	DH5	Test Channel:	CH 0



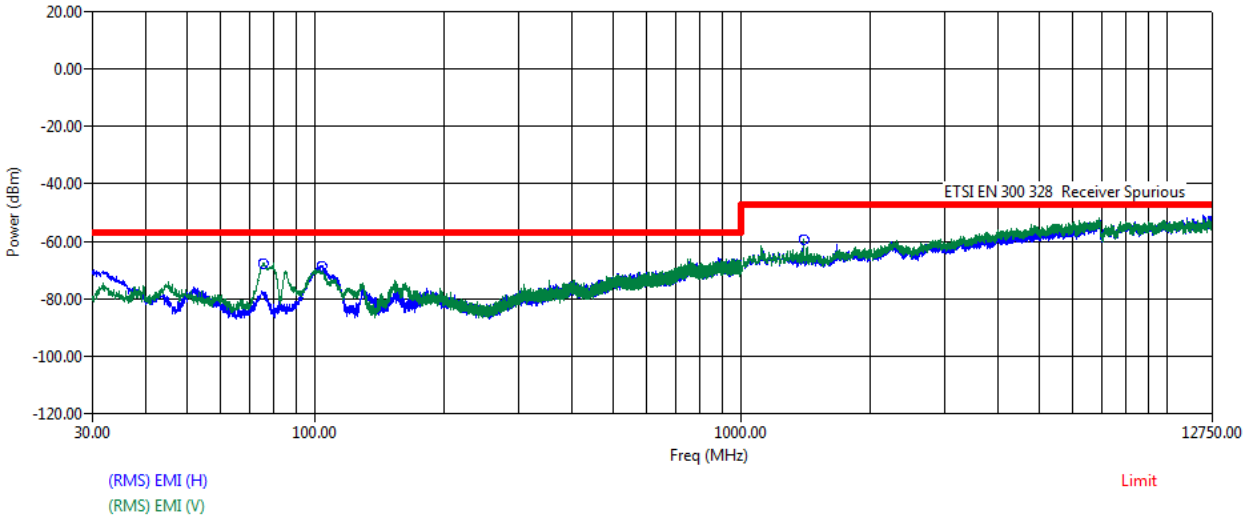
Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
75.20	52.33	-87.06	0.00	1.09	43.00	-76.64	-57.00	-19.64
104.20	62.92	-85.90	0.00	1.29	43.01	-64.70	-57.00	-7.70
6945.50	33.00	-58.21	0.00	11.62	41.65	-55.24	-47.00	-8.24

Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
75.20	64.06	-87.39	0.00	1.09	43.00	-65.24	-57.00	-8.24
104.20	57.96	-86.20	0.00	1.29	43.01	-69.95	-57.00	-12.95
6945.50	36.44	-58.04	0.00	11.62	41.65	-51.64	-47.00	-4.64

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

Receiver spurious emissions 30MHz– 12.75GHz			
Measurement Method	Radiated	Polar:	Horizontal/Vertical
Test Mode:	DH5	Test Channel:	CH 78



Freq (MHz)	(RMS) Trace (H) (dBuV)	ERP Factor (H) (dB)	Transducer (H) (dB)	Cable (H) (dB)	Preamp (H) (dB)	(RMS) EMI (H) (dBm)	Limit (dBm)	(RMS) Margin (H) (dB)
75.60	51.13	-87.04	0.00	1.10	43.00	-77.81	-57.00	-20.81
103.55	59.39	-86.01	0.00	1.29	43.01	-68.34	-57.00	-11.34
1403.00	40.80	-69.26	0.00	4.98	43.50	-66.98	-47.00	-19.98
Freq (MHz)	(RMS) Trace (V) (dBuV)	ERP Factor (V) (dB)	Transducer (V) (dB)	Cable (V) (dB)	Preamp (V) (dB)	(RMS) EMI (V) (dBm)	Limit (dBm)	(RMS) Margin (V) (dB)
75.60	61.52	-87.39	0.00	1.10	43.00	-67.77	-57.00	-10.77
103.55	56.96	-86.22	0.00	1.29	43.01	-70.98	-57.00	-13.98
1403.00	48.28	-68.97	0.00	4.98	43.50	-59.21	-47.00	-12.21

Note:

(RMS) EMI (H) = (RMS) Trace (H) + ERP Factor (H) + Transducer (H) + Cable (H) - Premp (H)
(RMS) EMI (V) = (RMS) Trace (V) + ERP Factor (V) + Transducer (V) + Cable (H) - Premp (V)
(RMS) Margin (H) = (RMS) EMI (H) – Limit
(RMS) Margin (V) = (RMS) EMI (V) - Limit

Note: All the modes had been tested, but only the worst data was recorded in the report.

Appendix H: RF Output Power

Condition	Mode	Frequency (MHz)	Antenna	Max EIRP (dBm)	Limit (dBm)	Verdict
NTNV	1-DH5	hopping	Ant1	4.14	20	Pass
	3-DH5	hopping	Ant1	4.30	20	Pass

Condition	Mode	Frequency (MHz)	Antenna	Max EIRP (dBm)	Limit (dBm)	Verdict
LTNV	1-DH5	hopping	Ant1	3.76	20	Pass
	3-DH5	hopping	Ant1	3.98	20	Pass

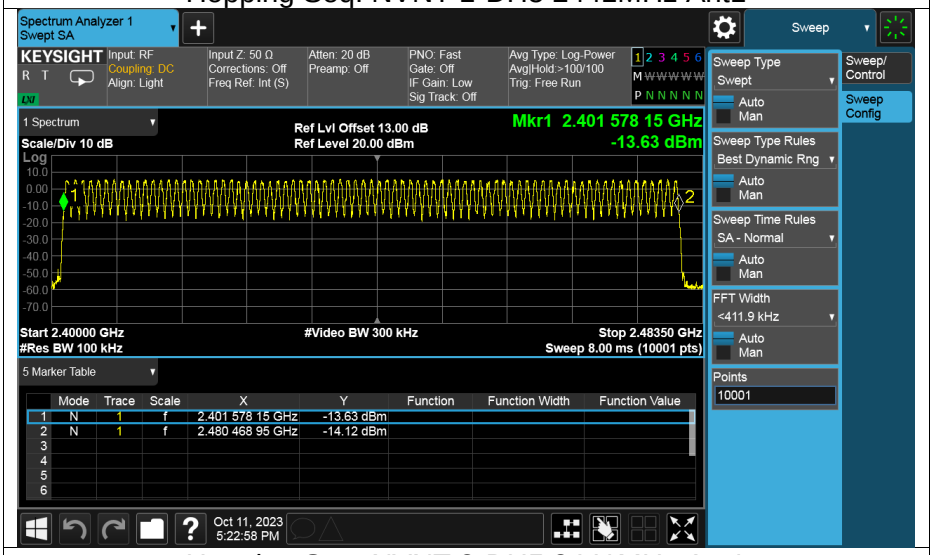
Condition	Mode	Frequency (MHz)	Antenna	Max EIRP (dBm)	Limit (dBm)	Verdict
HTNV	1-DH5	hopping	Ant1	3.89	20	Pass
	3-DH5	hopping	Ant1	3.91	20	Pass

Appendix I: Hopping Sequence

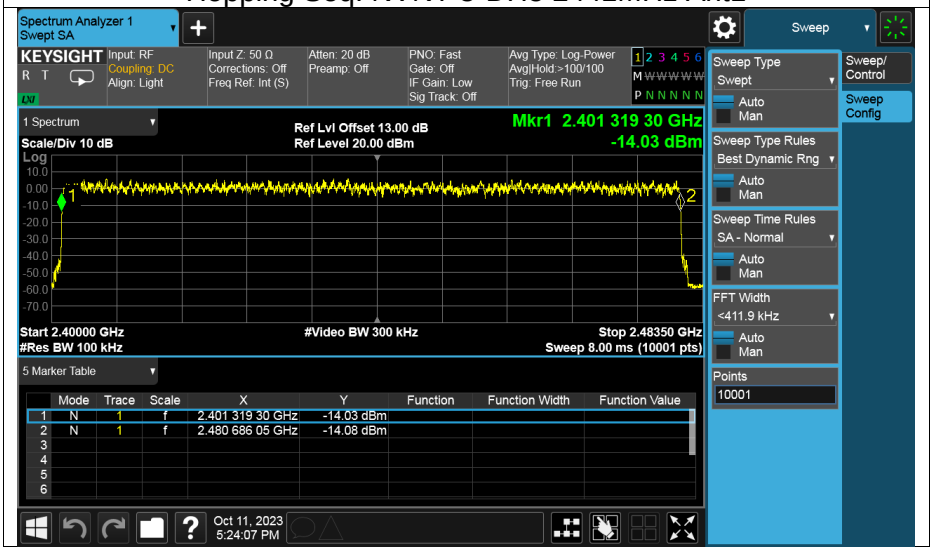
Mode	Antenna	Hopping Number	Limit	Band Allocation (%)	Limit Band Allocation (%)	Verdict
1-DH5	Ant1	79	15	94.48	70	Pass
3-DH5	Ant1	79	15	95.05	70	Pass

Test Graphs

Hopping Seq. NVNT 1-DH5 2441MHz Ant1



Hopping Seq. NVNT 3-DH5 2441MHz Ant1



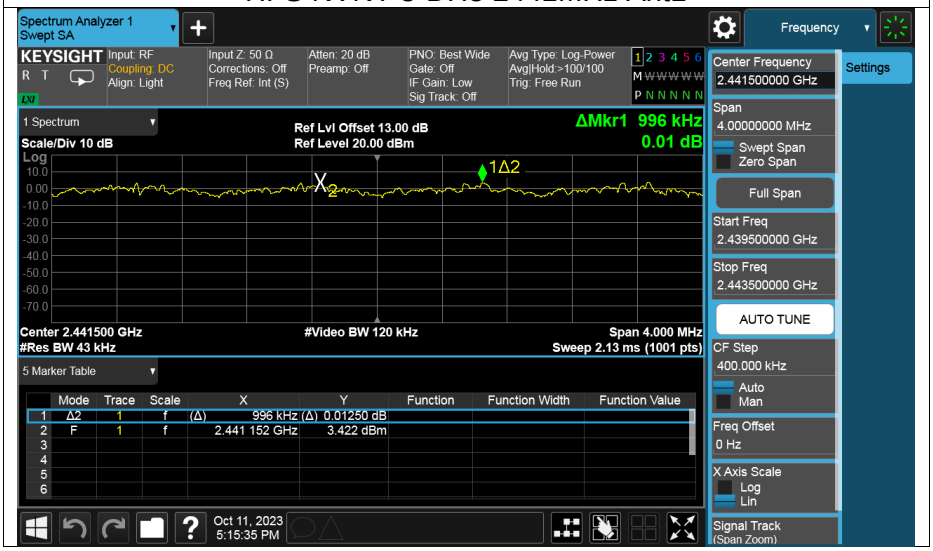
Appendix J: Hopping Frequency Separation

Mode	Antenna	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
1-DH5	Ant1	2440.988	2442.016	1.028	0.1	Pass
3-DH5	Ant1	2441.152	2442.148	0.996	0.1	Pass

Test Graphs

HFS NVNT 1-DH5 2441MHz Ant1

HFS NVNT 3-DH5 2441MHz Ant1



Appendix K: Receiver Blocking

Mode	Antenna	Channel	Wanted signal [dBm]	Freq. [MHz]	CW [dBm]	PER [%]	Limit [%]	Verdict
1-DH5	Ant1	Hop	-71.93	2300	-35.77	1.90	<=10	PASS
			-71.93	2380	-35.77	1.80	<=10	PASS
			-71.93	2504	-35.77	8.40	<=10	PASS
			-71.93	2584	-35.77	2.70	<=10	PASS

Note: All the modes had been tested, but only the worst data was recorded in the report.

APPENDIX: PHOTOGRAPHS OF TEST CONFIGURATION

Transmitter unwanted emissions in the spurious domain

END OF REPORT