CE Radio Test Report

Project No.	:	2405G097
Equipment	:	Projector
Brand Name	:	XGIMI
Test Model	:	XN13A
Series Model	:	N/A
Applicant	:	XGIMI Technology Co., Ltd.
Address	:	Building No.4, Zone A, No.1129, Shijicheng Road, Chengdu High-tech Zone, Sichuan Pilot Free Trade Zone, China
Manufacturer	:	XGIMI Technology Co., Ltd.
Address	:	Building No.4, Zone A, No.1129, Shijicheng Road, Chengdu High-tech Zone, Sichuan Pilot Free Trade Zone, China
Factory	:	Yibin XGIMI Optoelectronic Co., Ltd.
Address	:	No. 2, West Section 4, Changjiang North Road, Lingang Economic Development Zone, Yibin City, Sichuan P.R. China
Date of Receipt	:	May 31, 2024
Date of Test	:	Jun. 06, 2024 ~ Jul. 05, 2024
Issued Date	:	Jul. 19, 2024
Report Version	:	R00
Test Sample	:	Engineering Sample No.: SSL2024053139 for radiated, SSL2024053136 for conducted.
Standard(s)	:	ETSI EN 300 328 V2.2.2 (2019-07)

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

Prepared by : Sheldon Ou

Approved by : Chay Cai

Room 108, Building 2, No.1, Yile Road, Songshan Lake Zone, Dongguan City, Guangdong, People's Republic of China.
Tel: +86-769-8318-3000 Web: www.newbtl.com Service mail: btl_qa@newbtl.com

Declaration

BTL represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

BTL's reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. BTL assumes no responsibility for the data provided by the customer, any statements, inferences or generalizations drawn by the customer or others from the reports issued by BTL.

The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any agency of the U.S. Government.

This report is the confidential property of the client. As a mutual protection to the clients, the public and ourselves, the test report shall not be reproduced, except in full, without our written approval.

BTL's laboratory quality assurance procedures are in compliance with the ISO/IEC 17025: 2017 requirements, and accredited by the conformity assessment authorities listed in this test report.

BTL is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.
Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

Table of Contents Page

Table of Contents Page

Table of Contents Page

REPORT ISSUED HISTORY

Report No.	Version	Description	Issued Date	Note
BTL-ETSP-1-2405G097	R00	Original Report.	Jul. 19, 2024	Valid

1. RF EMISSIONS MEASUREMENT

1.1 TEST FACILITY

The test facilities used to collect the test data in this report is **DG-CB15/TR15/TR17** at the location of No.3, Jinshagang 1st Road, Dalang, Dongguan City, Guangdong People's Republic of China.

1.2 MEASUREMENT UNCERTAINTY

The measurement uncertainty figures shall be calculated according the methods described in the ETSI TR 100 028 and shall correspond to an expansion factor (coverage factor) k=1.96 or k=2(which provide confidence levels of respectively 95% and 95.45% in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).
Measurement Uncertainty for a Level of Confidence of 95.45%, $U=2\times u_c(y)$.

The BTL measurement uncertainty as below table:

Parameter	**Uncertainty**
Output Power	1.3 dB
Occupied Channel Bandwidth	0.90 %
Power Spectral Density	1.4 dB
Conducted Spurious Emission	1.9 dB
Spurious Emissions, Radiated f ≤ 1GHz	3.50 dB
Spurious Emissions, Radiated 1GHz < f ≤ 12.75GHz	3.54 dB
Temperature	0.8 °C
Supply voltages	3 %
Time	5 %

1.3 TEST ENVIRONMENT CONDITIONS

Test Item	Temperature	Humidity	Test Voltage	Tested By	Test Date
RF Output Power	Normal & Extreme	51%	DC 12V	Alex Yin	Jun. 26, 2024
Accumulated Transmit time, Frequency Occupation & Hopping Sequence	21°C	53%	DC 12V	Jaden Kong	Jul. 01, 2024
Hopping Frequency Separation	21°C	53%	DC 12V	Jaden Kong	Jul. 01, 2024
Occupied Channel Bandwidth	21°C	53%	DC 12V	Jaden Kong	Jul. 01, 2024
Transmitter unwanted emissions in the OOB domain	21°C	53%	DC 12V	Jaden Kong	Jul. 01, 2024
Transmitter unwanted emissions in the spurious domain	25°C	45%	AC 230V/50Hz	Meers Zhang	Jul. 01, 2024-Jul. 02, 2024
Receiver spurious emissions	25°C	45%	AC 230V/50Hz	Meers Zhang	Jul. 01, 2024-Jul. 02, 2024
Receiver Blocking	23°C	49%	DC 12V	Complex Qin	Jul. 04, 2024

1.4 TEST CHANNEL

Test Channel	EUT Channel	Test Frequency
low	CH00	2402 MHz
middle	CH39	2441 MHz
high	CH78	2480 MHz

1.5 TEST METHODOLOGY AND RESULT

Harmonised Standard ETSI EN 300 328					
Essential Requirement			Requirement Conditionality		Result
No	Description	Reference: Clause No	U/C	Condition	
1	RF Output Power	4.3.1.2 or 4.3.2 2	U	-	Pass
2	Power Spectral Density	4.3.2.3	C	Only for non-FHSS equipment	N/A
3	Duty cycle, Tx-Sequence, Tx-gap	4.3.1.3 or 4.3.2.4	C	Only for non-Adaptive equipment	N/A
4	Accumulated Transmit time, Frequency Occupation & Hopping Sequence	4.3.1.4	C	Only for FHSS equipment	Pass
5	Hopping Frequency Separation	4.3.1.5	C	Only for FHSS equipment	Pass
6	Medium Utilization	4.3.1.6 or 4.3.2.5	C	Only for non-Adaptive equipment	N/A
7	Adaptivity	4.3.1.7 or 4.3.2.6	C	Only for Adaptive equipment	N/A
8	Occupied Channel Bandwidth	4.3.1.8 or 4.3.2.7	U	-	Pass
9	Transmitter unwanted emissions in the OOB domain	4.3.1.9 or 4.3.2.8	U	-	Pass
10	Transmitter unwanted emissions in the spurious domain	4.3.1.10 or 4.3.2.9	U	-	Pass
11	Receiver spurious emissions	4.3.1.11 or 4.3.2.10	U	-	Pass
12	Receiver Blocking	4.3.1.12 or 4.3.2.11	U	-	Pass
13	Geo-location capability	4.3.1.13 or 4.3.2.12	C	Only for equipment with geo-location capability	N/A

Note:

(1) “U/C”: Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	Projector
Brand Name	XGIMI
Test Model	XN13A
Series Model	N/A
Model Difference(s)	N/A
Hardware Version	V06
Software Version	V0.0.75
Power Source	DC voltage supplied from AC adapter. Model: S065ARV2000325
Power Rating	I/P: 100-240V~ 50/60Hz 1.8A Max O/P: 5.0V⎓3.0A 15.0W or 9.0V⎓3.0A 27.0W or 12.0V⎓3.0A 36.0W or 15.0V⎓3.0A 45.0W or 20.0V⎓3.25A 65.0W
Operation Frequency	2402 MHz ~ 2480 MHz
Modulation Type	GFSK,π/4-DQPSK,8-DPSK
Modulation Technology	FHSS
Transfer Rate	1Mbps, 2Mbps, 3Mbps
Max. e.i.r.p.	1Mbps: 7.16 dBm (5.20 mW) 2Mbps: 7.05 dBm (5.07 mW) 3Mbps: 7.61 dBm (5.77 mW)
Categorization	☐Receiver category 1 ☒Receiver category 2 ☐Receiver category 3

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. Channel List:

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

3. Table for Filed Antenna:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	ZTX	N/A	FPC	N/A	2.77

2.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Test Items	Modulation Type	Data Rate	Operating Mode	Channel
RF Output Power	GFSK π/4-DQPSK 8-DPSK	1Mbps 2Mbps 3Mbps	Hopping	00~78
Accumulated Transmit time, Frequency Occupation & Hopping Sequence	GFSK 8-DPSK	1Mbps 3Mbps	Hopping	00~78
Hopping Frequency Separation	GFSK 8-DPSK	1Mbps 3Mbps	Hopping	00~78
Occupied Channel Bandwidth	GFSK 8-DPSK	1Mbps 3Mbps	Fixed	00/78
Transmitter unwanted emissions in the OOB domain	GFSK 8-DPSK	1Mbps 3Mbps	Hopping	00~78
Transmitter unwanted emissions in the spurious domain (30 MHz ~ 1 GHz)	8-DPSK	3Mbps	Fixed	00/78
Transmitter unwanted emissions in the spurious domain (1 GHz ~ 12.75 GHz)	GFSK 8-DPSK	1Mbps 3Mbps	Fixed	00/78
Receiver spurious emissions (30 MHz ~ 1 GHz)	8-DPSK	3Mbps	Fixed	00/78
Receiver spurious emissions (1 GHz ~ 12.75 GHz)	8-DPSK	3Mbps	Fixed	00/78
Receiver Blocking	GFSK	1Mbps	Hopping	00~78

Note:

(1) The measurements for RF Output Power were tested with DH1/3/5 during 1Mbps, 2Mbps and 3Mbps, the worst case were 1Mbps (DH5) and 3Mbps (3DH5), only worst case were documented for other test items except Accumulated Transmit time.

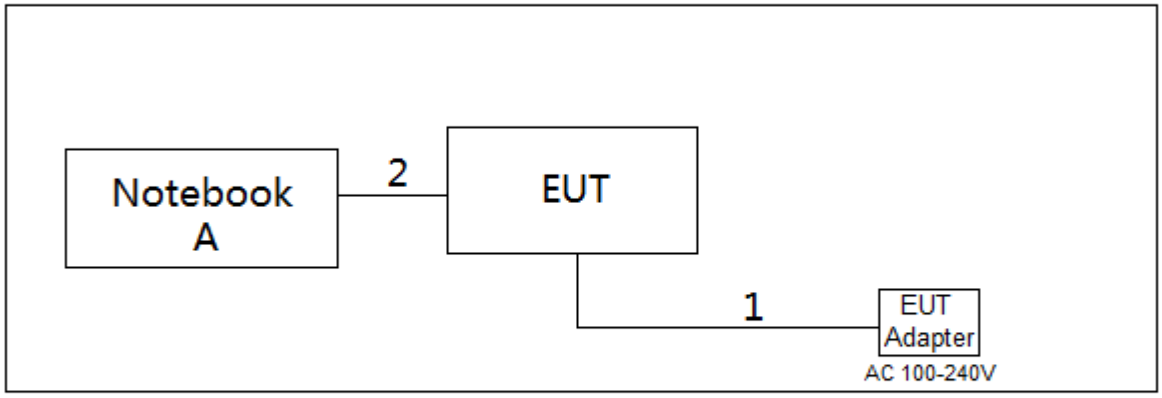
(2) For radiated spurious emissions below 1 GHz and receiver spurious emissions above 1 GHz test, the 3Mbps channel 00/78 are found to be the worst case and recorded.

2.3 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

Test Software Version	WCN Combo Tool_V1.0
Frequency (MHz)	2402~2480
1Mbps	6
2Mbps	6
3Mbps	6

2.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



2.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Brand	Model No.	Series No.
A	Notebook	Huawei	NbDE-WFH9	N/A

Item	Cable Type	Shielded Type	Ferrite Core	Length
1	DC Cable	NO	NO	1.5m
2	USB Cable	NO	NO	0.5m

2.6 CUSTOMER INFORMATION DESCRIPTION

1) The antenna gain is provided by the manufacturer.
2) Except for radiated spurious emissions, the results of all test items include cable losses. Part of the cable losses (0.5dB) are provided by the manufacturer, while the other parts of the cable losses are provided by the testing laboratory.

3. RF OUTPUT POWER

3.1 APPLIED PROCEDURES / LIMIT

Clause	4.3.1.2
Test Item	RF output power
Limit	The RF output power for FHSS equipment shall be equal to or less than 20 dBm. Note: For Non-adaptive FHSS equipment, the manufacturer may have declared a reduced RF Output Power (see clause 5.4.1 m) and associated Duty Cycle (see clause 5.4.1 e) that will ensure that the equipment meets the requirement for the Medium Utilization (MU) factor further described in clause 4.3.1.6. This is verified by the conformance test referred to in clause 4.3.1.6.4. For non-adaptive FHSS equipment, where the manufacturer has declared an RF output power lower than 20 dBm e.i.r.p., the RF output power shall be equal to or less than that declared value. This limit shall apply for any combination of power level and intended antenna assembly.

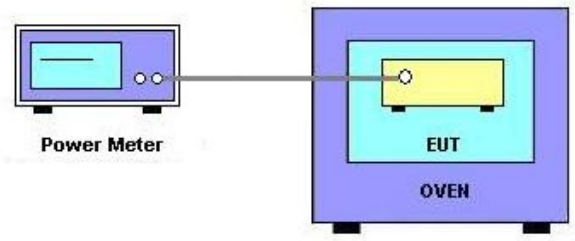
3.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.2.2.1.

3.3 TEST SETUP LAYOUT

Normal Condition

Extreme Condition



3.4 TEST DEVIATION

There is no deviation with the original standard.

3.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

3.6 TEST RESULTS

Please refer to the Appendix A.

4. DUTY CYCLE, TX-SEQUENCE, TX-GAP

4.1 APPLIED PROCEDURES / LIMIT

Clause	4.3.1.3
Test Item	Duty Cycle, Tx-sequence, Tx-gap
Limit	For non-adaptive FHSS equipment, The Duty Cycle shall be equal to or less than the maximum value declared by the manufacturer. The maximum Tx-sequence time shall be 5 ms. The minimum Tx-gap time shall be 5 ms. NOTE: For Non-adaptive FHSS equipment, the manufacturer may have declared a reduced RF Output Power (see clause 5.4.1 m) and associated Duty Cycle (see clause 5.4.1 e) that will ensure that the equipment meets the requirements for the Medium Utilization (MU) factors further described in clause 4.3.1.6. This is verified by the conformance test referred to in clause 4.3.1.6.4.

4.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.2.2.1.

4.3 TEST SETUP LAYOUT

4.4 TEST DEVIATION

There is no deviation with the original standard.

4.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

4.6 TEST RESULTS

Please refer to the Appendix B.

5. ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

5.1 APPLIED PROCEDURES / LIMIT

Clause	4.3.1.4
Test Item	Accumulated Transmit Time, Frequency Occupation and Hopping Sequence
Limit	**Non-adaptive FHSS equipment** The Accumulated Transmit Time on any hopping frequency 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. In order for the FHSS equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options: 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. Option 2: The probability that each hopping frequency is occupied shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use. The Hopping Sequence(s) 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. NOTE: See also clause 4.3.1.5.3.1 for the Hopping Frequency Separation applicable to non-adaptive FHSS equipment. Non-Adaptive FHSS equipment, may blacklist some but not all hopping frequencies. From the N hopping frequencies defined above, the equipment shall transmit on at least one hopping frequency. For the blacklisted frequencies, the equipment has to occupy these frequencies for the duration of the average dwell time (see also definition for blacklisted frequency in clause 3.1). **Adaptive FHSS equipment** Adaptive FHSS equipment shall be capable of operating over a minimum of 70 % of the band specified in table 1. The Accumulated Transmit Time on any hopping frequency 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. In order for the FHSS equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options: 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. 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. The Hopping Sequence(s) 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. NOTE: See also clause 4.3.1.5.3.2 for the Hopping Frequency Separation applicable to adaptive FHSS equipment. For Adaptive FHSS equipment, from the N hopping frequencies defined above, the equipment shall consider at least one hopping frequency for its transmissions. Providing that there is no interference present on this hopping frequency with a level above the detection threshold defined in clause 4.3.1.7.2.2, point 5 or clause 4.3.1.7.3.2, point 5, then the equipment shall have transmissions on this hopping frequency. For Adaptive FHSS equipment using LBT, if a signal is detected during the CCA, the equipment may jump immediately to the next hopping frequency in the Hopping Sequence (see clause 4.3.1.7.2.2, point 2) provided the limit for Accumulated Transmit Time on the new hopping frequency is respected.

5.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.4.2.1.

5.3 TEST SETUP LAYOUT

5.4 TEST DEVIATION

There is no deviation with the original standard.

5.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

5.6 TEST RESULTS

Please refer to the Appendix C.

6. HOPPING FREQUENCY SEPARATION

6.1 APPLIED PROCEDURES / LIMIT

Clause	4.3.1.5
Test Item	Hopping Frequency Separation
Limit	**Non-adaptive FHSS equipment** For non-adaptive FHSS equipment, the Hopping Frequency Separation shall be equal to or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz. For FHSS equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive FHSS equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p., the Hopping Frequency Separation shall be equal to or greater than 100 kHz. **Adaptive FHSS equipment** For adaptive FHSS equipment, the minimum Hopping Frequency Separation shall be 100 kHz. Adaptive FHSS equipment that switched to a non-adaptive mode for one or more hopping frequencies because interference was detected on each of these hopping frequencies with a level above the threshold level defined in clause 4.3.1.7.2.2, point 5 or clause 4.3.1.7.3.2, point 5, does not have to comply with the Hopping Frequency Separation provided in clause 4.3.1.5.3.1 for non-adaptive FHSS equipment. If the Hopping Frequency Separation is below the Occupied Channel Bandwidth but greater than 100 kHz, the equipment is allowed to continue to operate with this Hopping Frequency Separation as long as the interference remains present on these hopping frequencies. As this relaxed Hopping Frequency Separation only applies to adaptive FHSS equipment, the FHSS equipment shall continue to operate in an adaptive mode on all other hopping frequencies. Adaptive FHSS equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit for Hopping Frequency Separation for non-adaptive FHSS equipment defined in clause 4.3.1.5.3.1 (first paragraph) for these hopping frequencies.

6.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.5.2.1.

6.3 TEST SETUP LAYOUT

6.4 TEST DEVIATION

There is no deviation with the original standard.

6.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

6.6 TEST RESULTS

Please refer to the Appendix D.

7. MEDIUM UTILIZATION (MU) FACTOR

7.1 APPLIED PROCEDURES / LIMIT

Clause	4.3.1.6
Test Item	Medium Utilization (MU) factor
Limit	The maximum Medium Utilization factor for non-adaptive FHSS equipment shall be 10 %.

7.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.2.2.1.

7.3 TEST SETUP LAYOUT

7.4 TEST DEVIATION

There is no deviation with the original standard.

7.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

7.6 TEST RESULTS

Please refer to the Appendix E.

8. ADAPTIVITY (ADAPTIVE FREQUENCY HOPPING)

8.1 APPLIED PROCEDURES / LIMIT

Clause	4.3.1.7
Test Item	Adaptivity (Adaptive Frequency Hopping)
Limit	**Adaptive FHSS using LBT** Adaptive FHSS equipment using LBT shall comply with the following minimum set of requirements: 1) At the start of every dwell time, before transmission on a hopping frequency, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The CCA observation time shall be not less than 0,2 % of the Channel Occupancy Time with a minimum of 18 µs. If the equipment finds the hopping frequency to be clear, it may transmit immediately. 2) If it is determined that a signal is present with a level above the detection threshold defined in step 5 the hopping frequency shall be marked as 'unavailable'. Then the equipment may jump to the next frequency in the hopping scheme even before the end of the dwell time, but in that case the 'unavailable' channel cannot be considered as being 'occupied' and shall be disregarded with respect to the requirement of the minimum number of hopping frequencies as defined in clause 4.3.1.4.3.2. Alternatively, the equipment can remain on the frequency during the remainder of the dwell time. However, if the equipment remains on the frequency with the intention to transmit, it shall perform an Extended CCA check in which the (unavailable) channel is observed for a random duration between the value defined for the CCA observation time in step 1 and 5 % of the Channel Occupancy Time defined in step 3. If the Extended CCA check has determined the frequency to be no longer occupied, the hopping frequency becomes available again. If the Extended CCA time has determined the channel still to be occupied, it shall perform new Extended CCA checks until the channel is no longer occupied. 3) The total time during which an equipment has transmissions on a given hopping frequency without reevaluating the availability of that frequency is defined as the Channel Occupancy Time. The Channel Occupancy Time for a given hopping frequency, which starts immediately after a successful CCA, shall be less than 60 ms followed by an Idle Period of minimum 5 % of the Channel Occupancy Time with a minimum of 100 µs. After the Idle Period has expired, the procedure as in step 1 shall be repeated before having new transmissions on this hopping frequency during the same dwell time. For LBT based adaptive FHSS equipment with a dwell time < 60 ms, the maximum Channel Occupancy Time is limited by the dwell time. 4) 'Unavailable' channels may be removed from or may remain in the Hopping Sequence, but in any case: - apart from Short Control Signalling Transmissions referred to in clause 4.3.1.7.4, there shall be no transmissions on 'unavailable' channels; - a minimum of N hopping frequencies as defined in clause 4.3.1.4.3.2 shall always be maintained. 5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power levels less than 20 dBm e.i.r.p., the detection threshold level may be relaxed to: TL = -70 dBm/MHz + 10 x $\log_{10}$ (100 mW/P_{out}) (P_{out} in mW e.i.r.p.)

<table>
<tr><td>Limit</td><td>6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in table 2.
Table 2: Unwanted Signal parameters
<table>
<tr><th>Wanted signal mean power from companion device</th><th>Unwanted CW signal frequency (MHz)</th><th>Unwanted CW signal power (dBm)</th></tr>
<tr><td>sufficient to maintain the link (see note 2)</td><td>2 395 or 2 488,5 (see note 1)</td><td>-35 (see note 3)</td></tr>
<tr><td colspan="3">NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1.
NOTE 2: A typical conducted value which can be used in most cases is -50 dBm/MHz.
NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna.</td></tr>
</table></td></tr>
<tr><td>Limit</td><td><u>Adaptive FHSS using DAA</u>
Adaptive FHSS equipment using DAA, shall comply with the following minimum set of requirements:
1) During normal operation, the equipment shall evaluate the presence of a signal for each of its hopping frequencies. If it is determined that a signal is present with a level above the detection threshold defined in step 5 the hopping frequency shall be marked as 'unavailable'.
2) The hopping frequency shall remain unavailable for a minimum time equal to 1 second or 5 times the actual number of hopping frequencies in the current (adapted) channel map used by the equipment, multiplied with the Channel Occupancy Time whichever is greater. There shall be no transmissions during this silent period on this hopping frequency. After this, the hopping frequency may be considered again as an 'available' frequency.
3) The total time during which an equipment has transmissions on a given hopping frequency without re-evaluating the availability of that hopping frequency is defined as the Channel Occupancy Time.
The Channel Occupancy Time for a given hopping frequency shall be less than 40 ms. For equipment using a dwell time > 40 ms that wants to have other transmissions during the same hop (dwell time) an Idle Period (no transmissions) of minimum 5 % of the Channel Occupancy Period with a minimum of 100 µs shall be implemented.
After the Idle Period has expired, the equipment may continue its normal operation as explained in step 1.
For FHSS equipment using DAA with a dwell time < 40 ms, the maximum Channel Occupancy Time may be non-contiguous, i.e. spread over a number of Hopping Sequences (equal to 40 ms divided by the dwell time [ms]).
4) In case the 'unavailable' channels remain in the Hopping Sequence, apart from the Short Control Signalling Transmissions referred to in clause 4.3.1.7.4, there shall be no transmissions on these 'unavailable' channels. In case the 'unavailable channels' are removed from the Hopping Sequence, a minimum of N hopping frequencies as defined in clause 4.3.1.4.3.2 shall always be maintained.
5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power levels below 20 dBm e.i.r.p., the detection threshold level may be relaxed to:
TL = -70 dBm/MHz + 10 x $\log_{10}$ (100 mW/P_{out}) (P_{out} in mW e.i.r.p.)</td></tr>
</table>

<table>
<tr>
<td>Limit</td>
<td>
6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in table 3.

Table 3: Unwanted Signal parameters

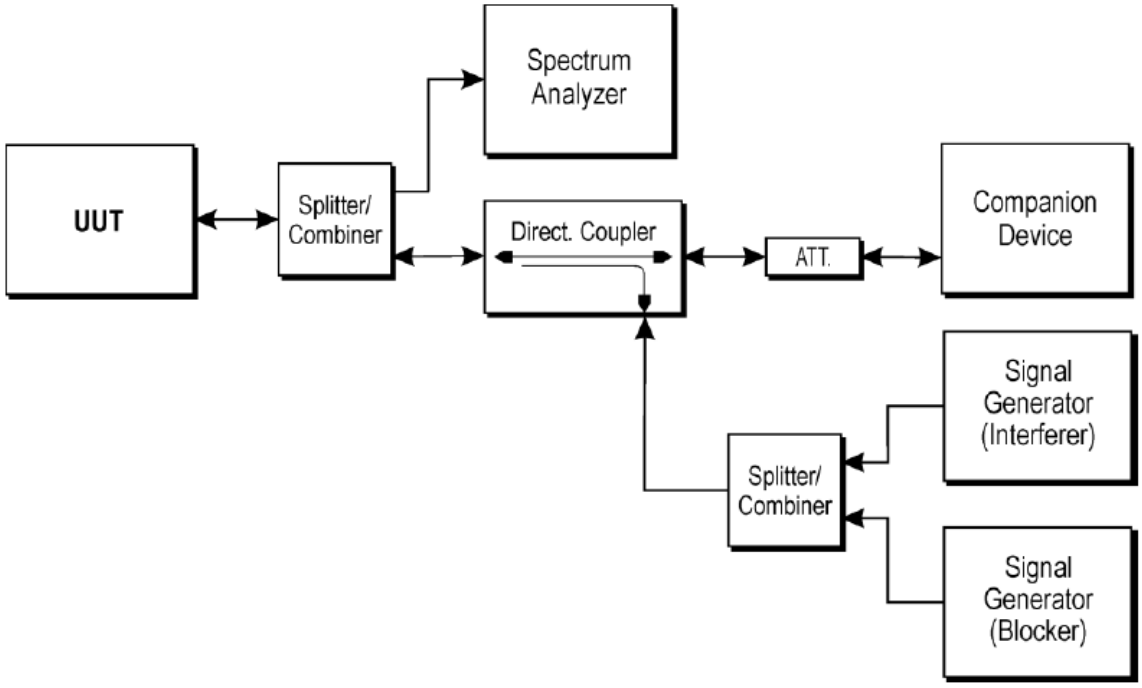
<table>
<tr><th>Wanted signal mean power from companion device (dBm)</th><th>Unwanted signal frequency (MHz)</th><th>Unwanted CW signal power (dBm)</th></tr>
<tr><td>-30
(see note 2)</td><td>2 395 or 2 488,5
(see note 1)</td><td>-35
(see note 2)</td></tr>
<tr><td colspan="3">NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1.
NOTE 2: 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 in front of the UUT antenna (see example below).</td></tr>
</table>

<u>Short Control Signalling Transmissions</u>
If implemented, Short Control Signalling Transmissions shall have a maximum TxOn / (TxOn + TxOff) ratio of 10 % within any observation period of 50 ms or within an observation period equal to the dwell time, whichever is less.
</td>
</tr>
</table>

8.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.6.2.1.

8.3 TEST SETUP LAYOUT



8.4 TEST DEVIATION

There is no deviation with the original standard.

8.5 EUT OPERATION DURING TEST

The measurements shall be performed during normal operation.

8.6 TEST RESULTS

Please refer to the Appendix F.

9. OCCUPIED CHANNEL BANDWIDTH

9.1 APPLIED PROCEDURES / LIMIT

<table>
<tr><td>Clause</td><td>4.3.1.8</td></tr>
<tr><td>Test Item</td><td>Occupied Channel Bandwidth</td></tr>
<tr><td>Limit</td><td>The Occupied Channel Bandwidth for each hopping frequency shall be within the band given in table 1.
Table 1: Service frequency bands
<table><tr><th></th><th>Service frequency bands</th></tr><tr><td>Transmit</td><td>2 400 MHz to 2 483,5 MHz</td></tr><tr><td>Receive</td><td>2 400 MHz to 2 483,5 MHz</td></tr></table>In addition, for non-adaptive FHSS equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than 5 MHz.</td></tr>
</table>

9.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.7.2.1.

9.3 TEST SETUP LAYOUT

9.4 TEST DEVIATION

There is no deviation with the original standard.

9.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

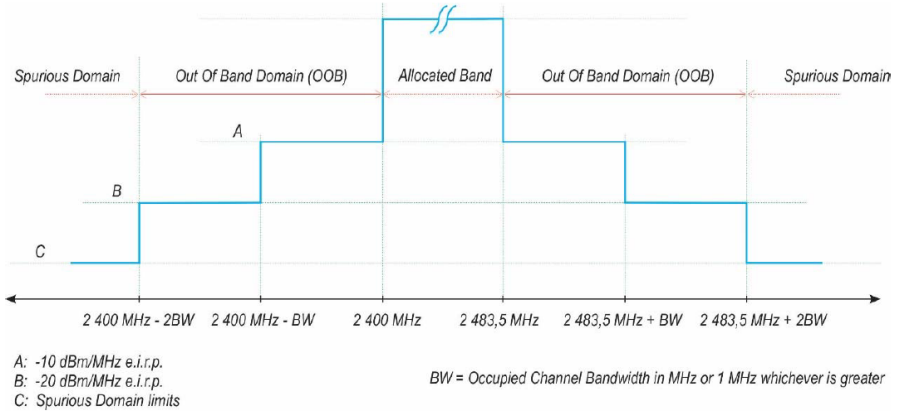
9.6 TEST RESULTS

Please refer to the Appendix G.

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

10.1 APPLIED PROCEDURES / LIMIT

Clause	4.3.1.9
Test Item	Transmitter unwanted emissions in the out-of-band domain
Limit	The transmitter unwanted emissions in the out-of-band domain shall not exceed the values provided by the mask in figure.



10.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.8.2.1.

10.3 TEST SETUP LAYOUT

10.4 TEST DEVIATION

There is no deviation with the original standard.

10.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

10.6 TEST RESULTS

Please refer to the Appendix H.

11. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

11.1 APPLIED PROCEDURES / LIMIT

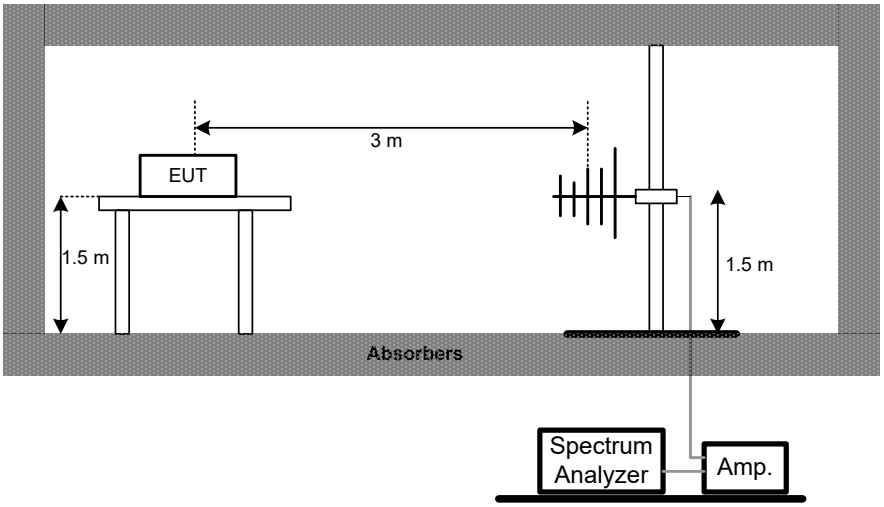
<table>
<tr><td>Clause</td><td>4.3.1.10</td></tr>
<tr><td>Test Item</td><td>Transmitter unwanted emissions in the spurious domain</td></tr>
<tr><td>Limit</td><td>The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 4.
In case of equipment with antenna connectors, 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 e.i.r.p. for emissions above 1 GHz.
Table 4: Transmitter limits for spurious emissions
<table>
<tr><th>Frequency range</th><th>Maximum power</th><th>Bandwidth</th></tr>
<tr><td>30 MHz to 47 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr>
<tr><td>47 MHz to 74 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr>
<tr><td>74 MHz to 87,5 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr>
<tr><td>87,5 MHz to 118 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr>
<tr><td>118 MHz to 174 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr>
<tr><td>174 MHz to 230 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr>
<tr><td>230 MHz to 470 MHz</td><td>-36 dBm</td><td>100 kHz</td></tr>
<tr><td>470 MHz to 694 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr>
<tr><td>694 MHz to 1 GHz</td><td>-36 dBm</td><td>100 kHz</td></tr>
<tr><td>1 GHz to 12,75 GHz</td><td>-30 dBm</td><td>1 MHz</td></tr>
</table></td></tr>
</table>

11.2 TEST PROCEDURES

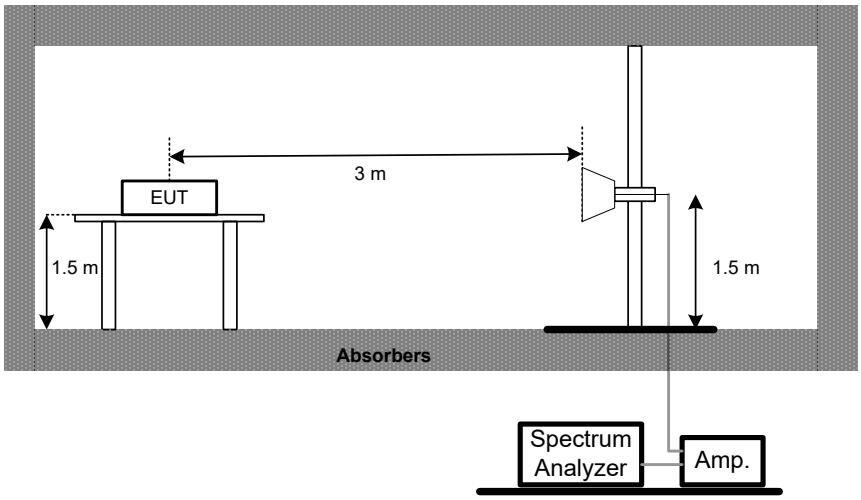
Refer to ETSI EN 300 328, chapter 5.4.9.2.2.

11.3 TEST SETUP LAYOUT

Radiated Measurement Test Set-Up Frequency Below 1 GHz



Radiated Measurement Test Set-Up Frequency Above 1 GHz



11.4 TEST DEVIATION

There is no deviation with the original standard.

11.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously transmitting.

11.6 TEST RESULTS

Please refer to the Appendix I.

12. RECEIVER SPURIOUS EMISSIONS

12.1 APPLIED PROCEDURES / LIMIT

<table>
<tr><td>Clause</td><td>4.3.1.11</td></tr>
<tr><td>Test Item</td><td>Receiver spurious emissions</td></tr>
<tr><td>Limit</td><td>The receiver spurious emissions shall not exceed the values given in table 5.
In case of FHSS 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 e.i.r.p. for emissions above 1 GHz.
Table 5: Spurious emission limits for receivers
<table>
<tr><th>Frequency range</th><th>Maximum power</th><th>Bandwidth</th></tr>
<tr><td>30 MHz to 1 GHz</td><td>-57 dBm</td><td>100 kHz</td></tr>
<tr><td>1 GHz to 12,75 GHz</td><td>-47 dBm</td><td>1 MHz</td></tr>
</table>
</td></tr>
</table>

12.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.10.2.2.

12.3 TEST SETUP LAYOUT

Refer to clause 11.3.

12.4 TEST DEVIATION

There is no deviation with the original standard.

12.5 EUT OPERATION DURING TEST

The measurements shall be performed during continuously receiving.

12.6 TEST RESULTS

Please refer to the Appendix J.

13. RECEIVER BLOCKING

13.1 APPLIED PROCEDURES / LIMIT

<table>
<tr><td>Clause</td><td>4.3.1.12</td></tr>
<tr><td>Test Item</td><td>Receiver Blocking</td></tr>
<tr><td>Limit</td><td>
While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, 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 6, table 7 or table 8.

Receiver Category 1
Table 6 contains the Receiver Blocking parameters for Receiver Category 1 equipment.
Table 6: Receiver Blocking parameters for Receiver Category 1 equipment
<table>
<tr><th>Wanted signal mean power from companion device (dBm) (see notes 1 and 4)</th><th>Blocking signal frequency (MHz)</th><th>Blocking signal power (dBm) (see note 4)</th><th>Type of blocking signal</th></tr>
<tr><td>(-133 dBm + 10 × log₁₀(OCBW)) or -68 dBm whichever is less (see note 2)</td><td>2 380
2 504</td><td rowspan="2">-34</td><td rowspan="2">CW</td></tr>
<tr><td>(-139 dBm + 10 × log₁₀(OCBW)) or -74 dBm whichever is less (see note 3)</td><td>2 300
2 330
2 360
2 524
2 584
2 674</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>
</td></tr>
</table>

Limit

Receiver Category 2

Table 7 contains the Receiver Blocking parameters for Receiver Category 2 equipment.

Table 7: 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 8 contains the Receiver Blocking parameters for Receiver Category 3 equipment.

Table 8: Receiver Blocking parameters receiver Category 3 equipment

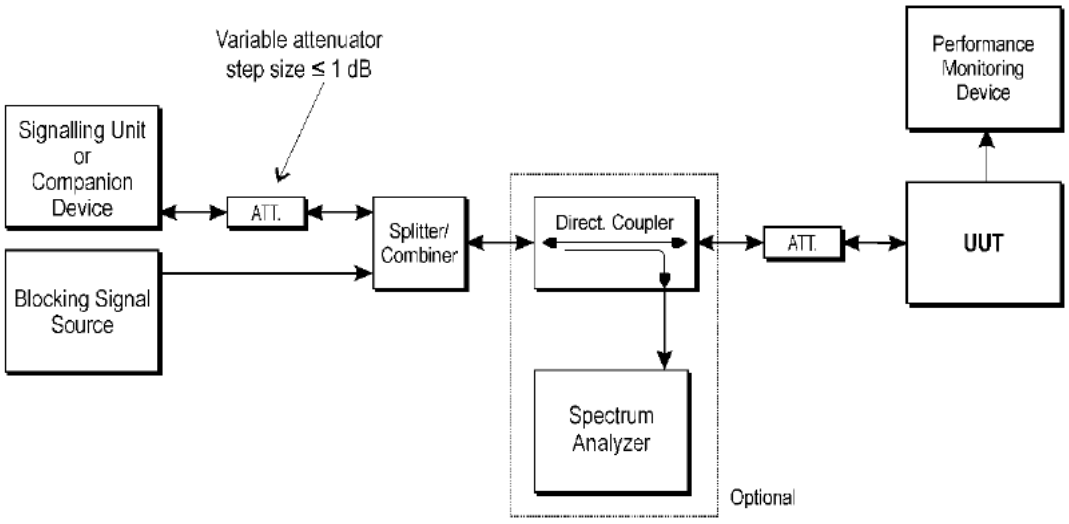
Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW

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 the 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.

13.2 TEST PROCEDURES

Refer to ETSI EN 300 328, chapter 5.4.11.2.1.

13.3 TEST SETUP LAYOUT



13.4 TEST DEVIATION

There is no deviation with the original standard.

13.5 EUT OPERATION DURING TEST

The measurements shall be performed during normal receiving.

13.6 TEST RESULTS

Please refer to the Appendix K.

14. MEASUREMENT INSTRUMENTS LIST

RF Output Power					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Table top type high and low temperature test chamber	CEPREI	CEEC-M64T-40	15-008	Dec. 22, 2024
2	Power Sensor	Agilent	U2021XA	MY53320006	May 31, 2025
3	Cable	Woke	20210802 001	RWP50-402-SM SM-1M	N/A
4	BTL TestSystem	BTL	TestSoftware	N/A	N/A
5	Attenuator	Talent Microwave	TA10A2-S-18	N/A	N/A

Accumulated Transmit time, Frequency Occupation and Hopping Sequence & Hopping Frequency Separation & Occupied Channel Bandwidth & Transmitter unwanted emissions in the out-of-band domain					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	MXA Signal Analyzer	KEYSIGHT	N9020B	MY63380204	Nov. 17, 2024
2	Attenuator	Talent Microwave	TA10A0-S-26.5	N/A	N/A
3	DC Block	N/A	N/A	N/A	N/A
4	BTL TestSystem	BTL	TestSoftware	N/A	N/A

Receiver Blocking					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Cable	RegalWay	20210802 013	RWP50-402-SM SM-1M	N/A
2	Cable	RegalWay	S02-1081212-050	RWP50-402-SM SM-1M	N/A
3	DC Block	N/A	N/A	N/A	N/A
4	DC Block	N/A	N/A	N/A	N/A
5	MXG Vector Signal Generator	Agilent	N5182A	MY47420312	Jul. 07, 2025
6	Power Splitter	N/A	N/A	SZ201504789	Dec. 22, 2024
7	wideband radio communication tester	R&S	CMW500	153083	Dec. 22, 2024

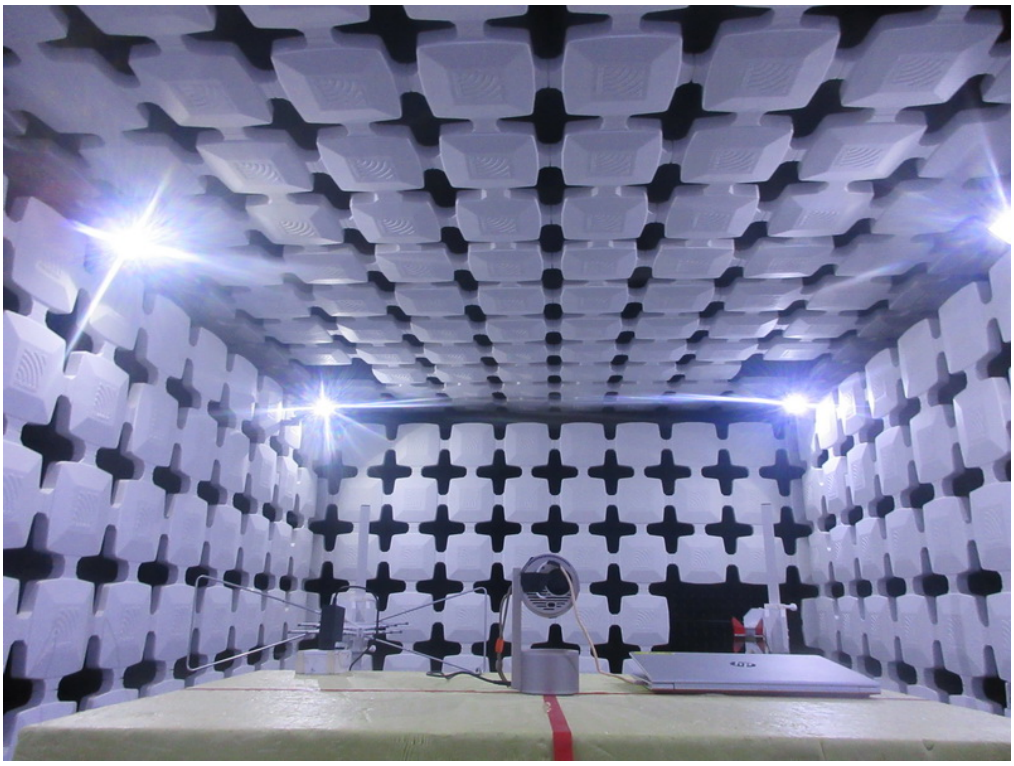
Transmitter and Receiver Spurious Emission (Radiated Measurement)_Below 1GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Preamplifier	EMC INSTRUMENT	EMC001330	980986	May 31, 2025
2	EXA Signal Analyzer	Keysight	N9010A	MY56480488	Dec. 22, 2024
3	Antenna	Schwarzbeck	VULB9160	9160-3231	Apr. 14, 2025
4	Attenuator	SHX	TS2-6dB-6G-A	16101103	Apr. 14, 2025
5	Cable	Talent microwave	L6-NMNM-10M	N/A	N/A
6	Cable	RegalWay	LMR400-NMRANM-0.8M	N/A	N/A
7	Controller	Innco Systems Gmbh	CO3000-4port	CO3000/1155/45430119/P	N/A
8	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A

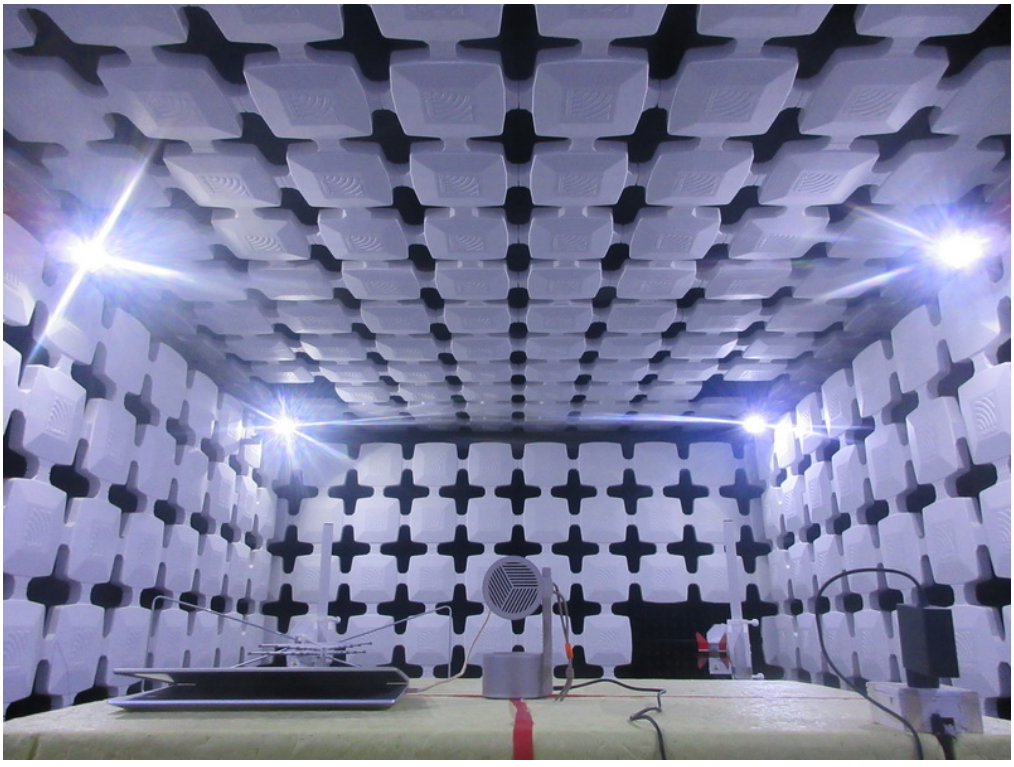
Transmitter and Receiver Spurious Emission (Radiated Measurement)_Above 1GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	EXA Signal Analyzer	Keysight	N9010A	MY56480488	Dec. 22, 2024
2	Cable	RegalWay	RWLP50-4.0A-SMRANMRA-2M	N/A	N/A
3	DRG Horn Antenna	ETS	3117-PA	221576	Jul. 07, 2024
4	Preamplifier	ETS	3117-PA	221576	May 31, 2025
5	Cable	Talent microwave	A81-SMAMSMAM-12.5M	N/A	N/A
6	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
7	Controller	Innco Systems Gmbh	CO3000-4port	CO3000/1155/45430119/P	N/A
8	Filter	STI	STI15-9912	N/A	May 31, 2025
9	Attenuator	Talent Microwave	TA10A0-S-26.5	N/A	N/A

Remark: “N/A” denotes no model name, serial no. or calibration specified.
All calibration period of equipment list is one year.

15. EUT TEST PHOTO

Radiated Emissions Test Photos





APPENDIX A - RF OUTPUT POWER

Test Mode:	TX Mode_1Mbps

Test Conditions		e.i.r.p. (dBm)
T nom (°C)	22	6.93
T min (°C)	0	7.16
T max (°C)	40	6.82
Max. e.i.r.p.		7.16
Limits		20dBm
Result		Pass
Burst Number		6

Test Mode:	TX Mode_2Mbps

Test Conditions		e.i.r.p. (dBm)
T nom (°C)	22	6.73
T min (°C)	0	7.05
T max (°C)	40	6.58
Max. e.i.r.p.		7.05
Limits		20dBm
Result		Pass
Burst Number		6

Test Mode:	TX Mode_3Mbps

Test Conditions		e.i.r.p. (dBm)
T nom (°C)	22	7.44
T min (°C)	0	7.61
T max (°C)	40	7.34
Max. e.i.r.p.		7.61
Limits		20dBm
Result		Pass
Burst Number		6

Note:
1) e.i.r.p. = Conducted output power + G (Ant Gain)
2) Conducted output power = Measure result + Cable loss

APPENDIX B - DUTY CYCLE, TX-SEQUENCE, TX-GAP

Test Mode: N/A

Note: “N/A” denotes test is not applicable to this device.

APPENDIX C - ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

Test Mode:	TX Mode_1Mbps

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (3.16s Pluse N)	Dwell Time (s)	Limits (s)
DH1	2402	0.378	32	0.1210	0.4000
DH3	2402	1.640	18	0.2952	0.4000
DH5	2402	2.880	7	0.2016	0.4000
DH1	2480	0.378	32	0.1210	0.4000
DH3	2480	1.640	14	0.2296	0.4000
DH5	2480	2.880	9	0.2592	0.4000

NOTE:

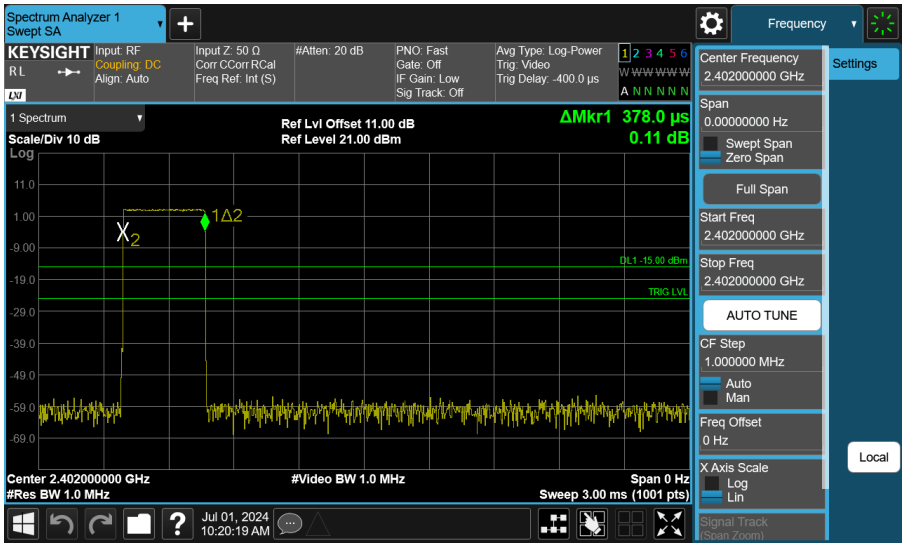
DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.

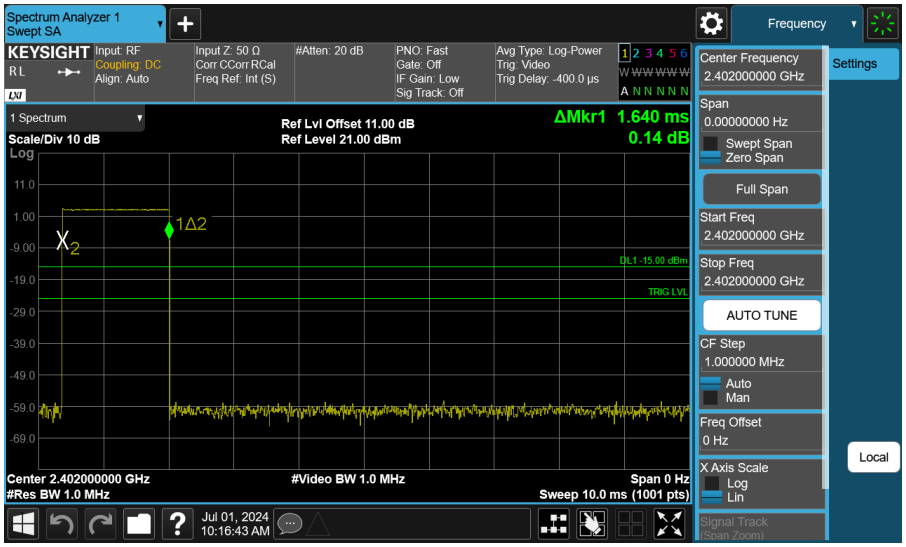
DH5 Packet permit maximum 1600 / 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.

Mode	Frequency (MHz)	Number of Hopping Channel	Time (ms) of 4*dwell time* (ms)*Actual number of hopping frequencies in use	Number of transmission in a period of 4*dwell time*Actual number of hopping frequencies in use	4*dwell time* 79 (ms) Minimum Frequency Occupation (ms)	Minimum Limit (ms)	Result
DH1	2402	79	119.4480	2	0.7560	0.378	Pass
DH3	2402	79	518.2400	3	4.9200	1.640	Pass
DH5	2402	79	910.0800	2	5.7600	2.880	Pass
DH1	2480	79	119.4480	2	0.7560	0.378	Pass
DH3	2480	79	518.2400	4	6.5600	1.640	Pass
DH5	2480	79	910.0800	2	5.7600	2.880	Pass

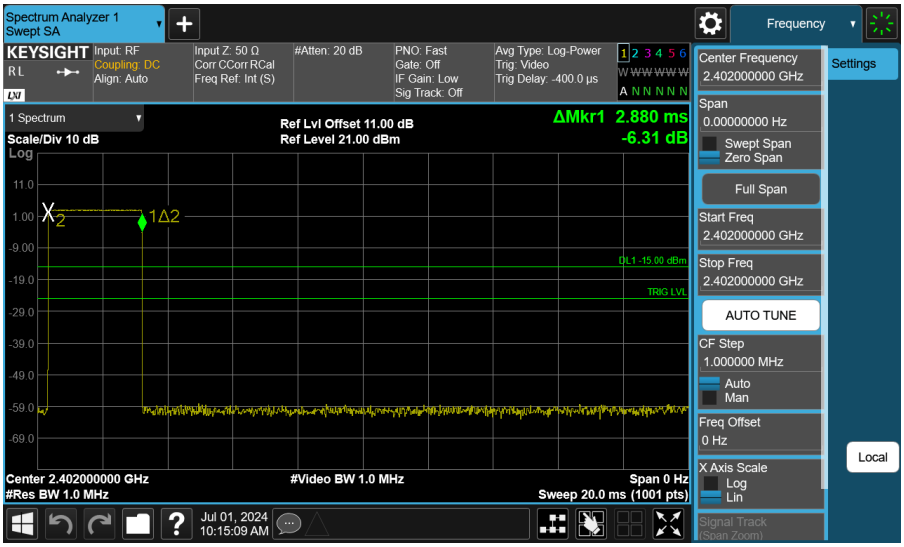
2402 MHz-DH1



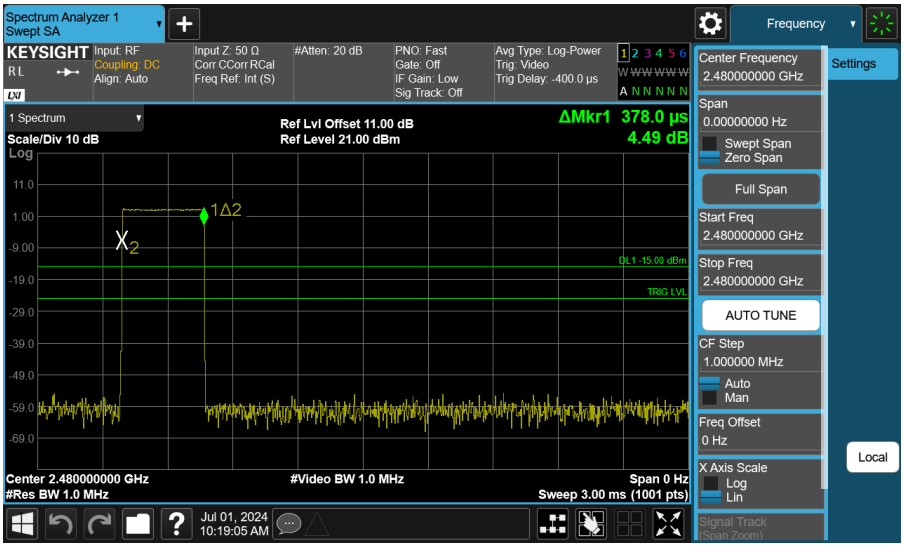
2402 MHz-DH3



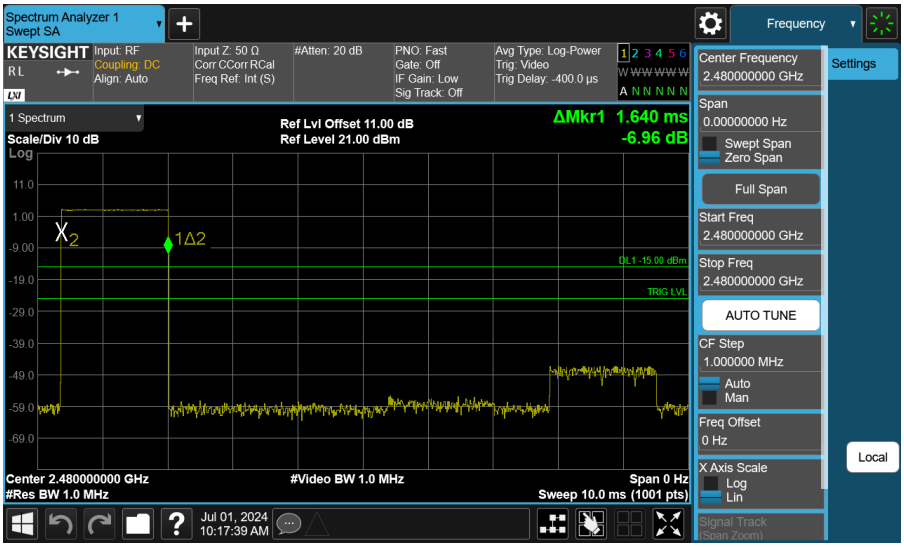
2402 MHz-DH5



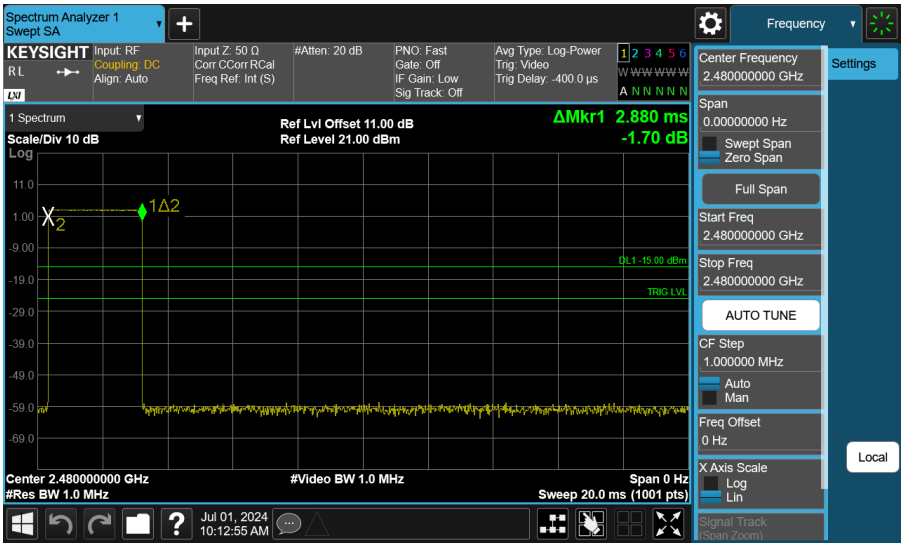
2480 MHz-DH1



2480 MHz-DH3



2480 MHz-DH5

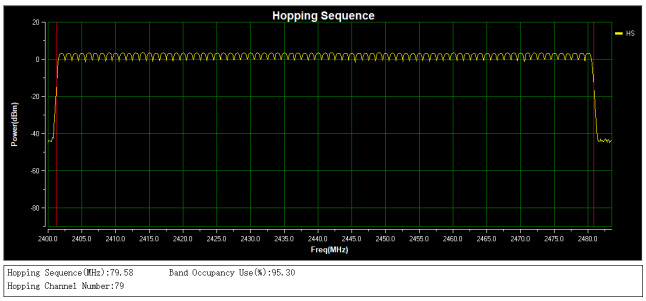


Test Mode:	TX Mode_1Mbps

Frequency Band (MHz)	Number of Hopping Frequencies	Limit	Result
2400-2483.5	79	≥ 15	PASS

Frequency Band (MHz)	20dB Points Occupied Bandwidth (MHz)	Limit (MHz)	Result
2400-2483.5	79.58	≥ 58.45	PASS

Number of Hopping Frequencies & 20dB Points Occupied Bandwidth



Test Mode:	TX Mode_3Mbps

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (3.16s Pluse N)	Dwell Time (s)	Limits (s)
3DH1	2402	0.384	32	0.1229	0.4000
3DH3	2402	1.630	17	0.2771	0.4000
3DH5	2402	2.860	5	0.1430	0.4000
3DH1	2480	0.384	32	0.1229	0.4000
3DH3	2480	1.630	17	0.2771	0.4000
3DH5	2480	2.880	10	0.2880	0.4000

NOTE:

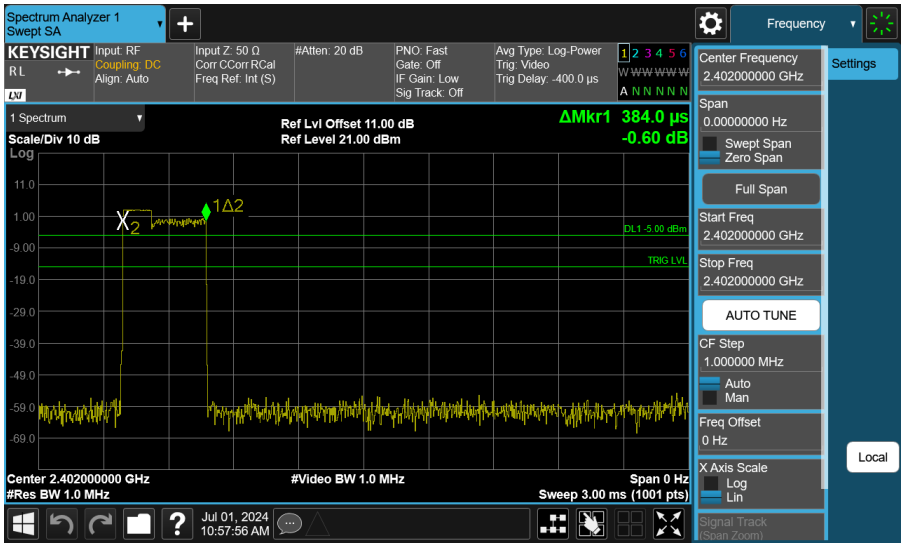
3DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

3DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.

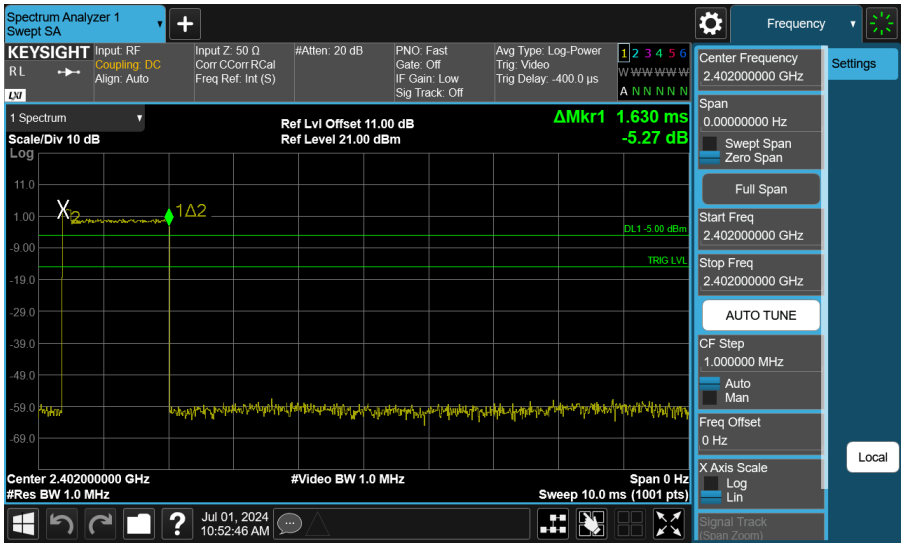
3DH5 Packet permit maximum 1600 / 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.

Mode	Frequency (MHz)	Number of Hopping Channel	Time (ms) of 4*dwell time* (ms)*Actual number of hopping frequencies in use	Number of transmission in a period of 4*dwell time*Actual number of hopping frequencies in use	4*dwell time* 79 (ms) Minimum Frequency Occupation (ms)	Minimum Limit (ms)	Result
3DH1	2402	79	121.3440	2	0.7680	0.384	Pass
3DH3	2402	79	515.0800	2	3.2600	1.630	Pass
3DH5	2402	79	903.7600	2	5.7200	2.860	Pass
3DH1	2480	79	121.3440	2	0.7680	0.384	Pass
3DH3	2480	79	515.0800	1	1.6300	1.630	Pass
3DH5	2480	79	910.0800	3	8.6400	2.880	Pass

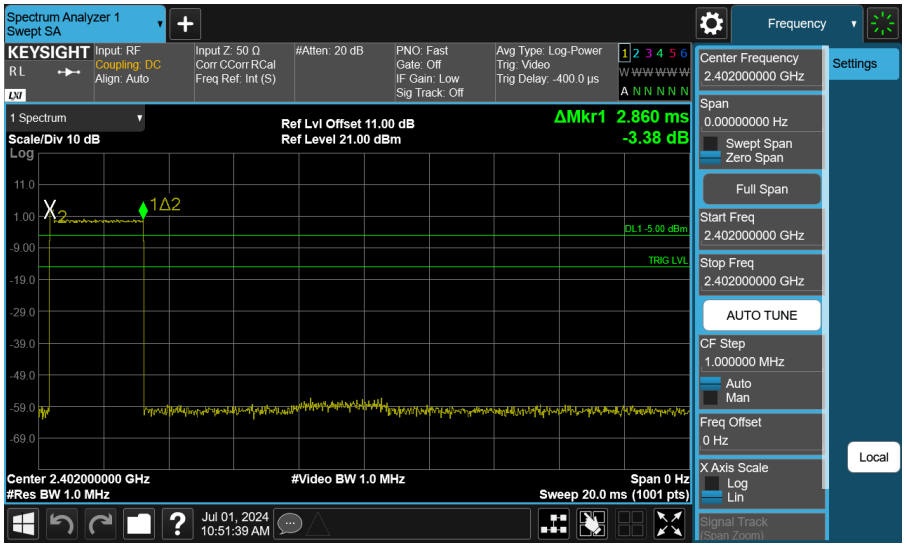
2402 MHz-3DH1



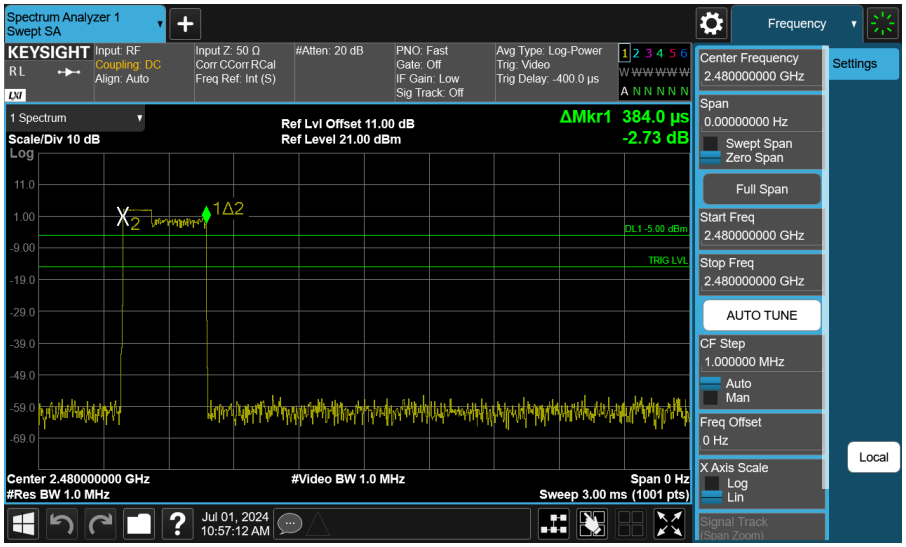
2402 MHz-3DH3



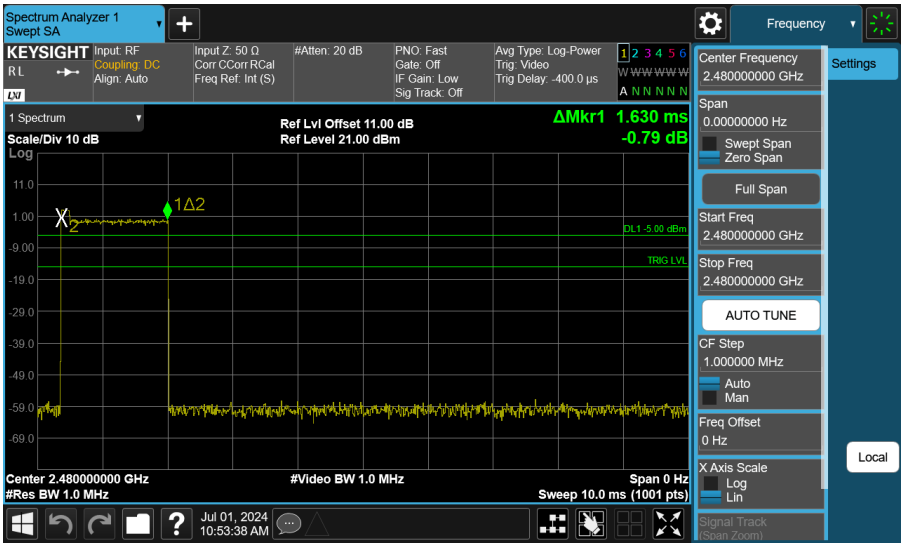
2402 MHz-3DH5



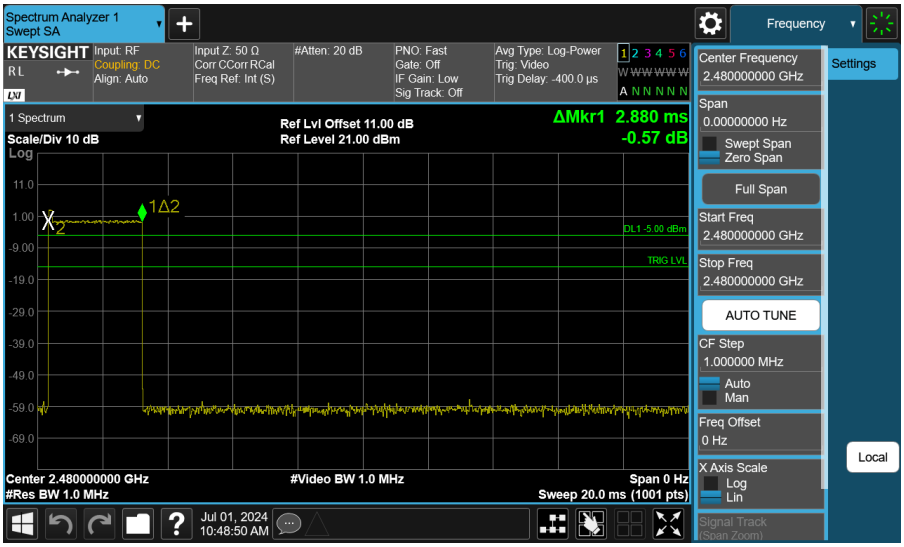
2480 MHz-3DH1



2480 MHz-3DH3



2480 MHz-3DH5

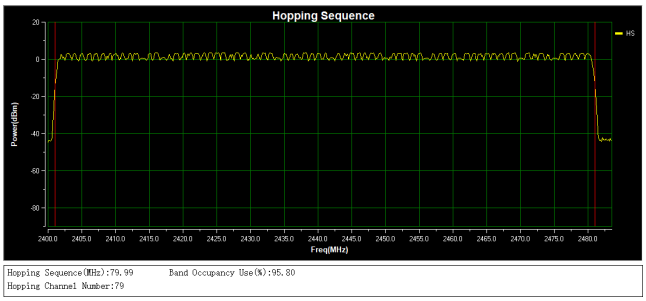


Test Mode:	TX Mode_3Mbps

Frequency Band (MHz)	Number of Hopping Frequencies	Limit	Result
2400-2483.5	79	≥ 15	PASS

Frequency Band (MHz)	20dB Points Occupied Bandwidth (MHz)	Limit (MHz)	Result
2400-2483.5	79.99	≥ 58.45	PASS

Number of Hopping Frequencies & 20dB Points Occupied Bandwidth

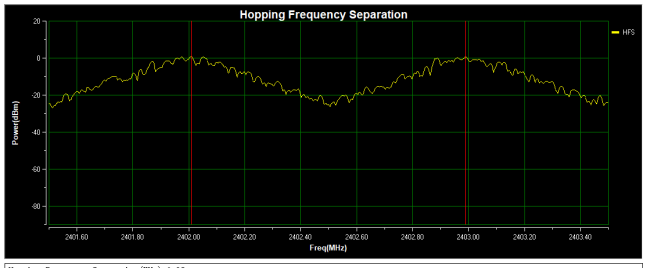


APPENDIX D - HOPPING FREQUENCY SEPARATION

Test Mode:	TX Mode_1Mbps

Frequency Band (MHz)	Channel Separation (MHz)	Channel Separation Limit (kHz)	Result
2400-2483.5	0.98	100	Pass

1Mbps

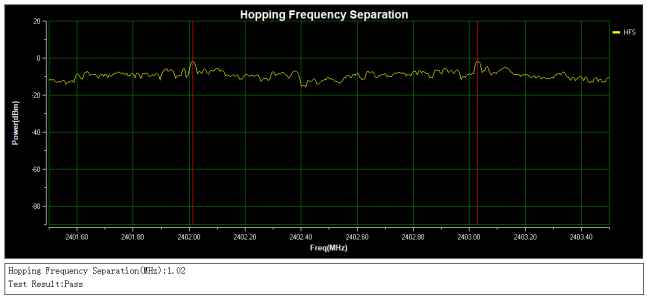


Hopping Frequency Separation(MHz):0.98
Test Result:Pass

Test Mode:	TX Mode_3Mbps

Frequency Band (MHz)	Channel Separation (MHz)	Channel Separation Limit (kHz)	Result
2400-2483.5	1.02	100	Pass

3Mbps



APPENDIX E - MEDIUM UTILIZATION (MU) FACTOR

Test Mode: N/A

Note: “N/A” denotes test is not applicable to this device.

APPENDIX F - ADAPTIVITY

Test Mode: N/A

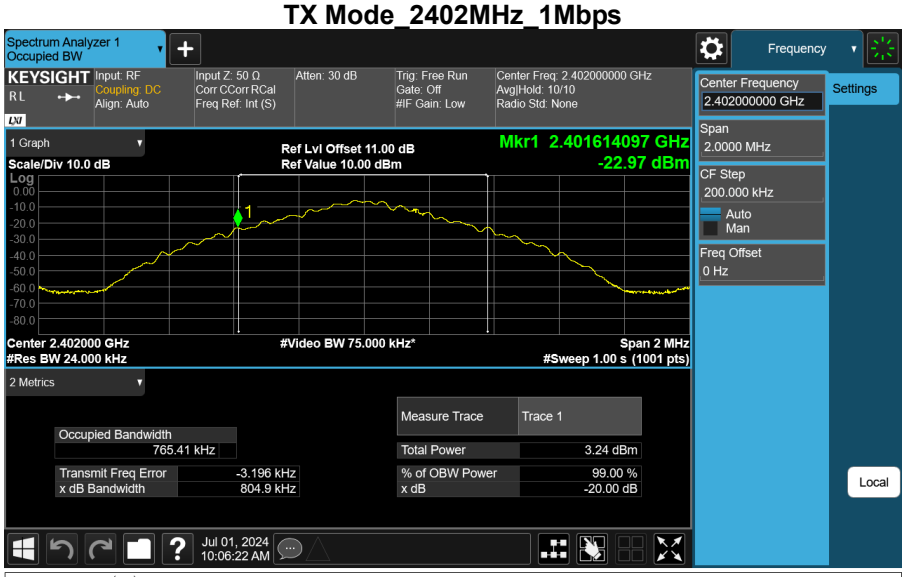
Note: “N/A” denotes test is not applicable to this device.

APPENDIX G - OCCUPIED CHANNEL BANDWIDTH

Test Mode:	TX Mode_1Mbps

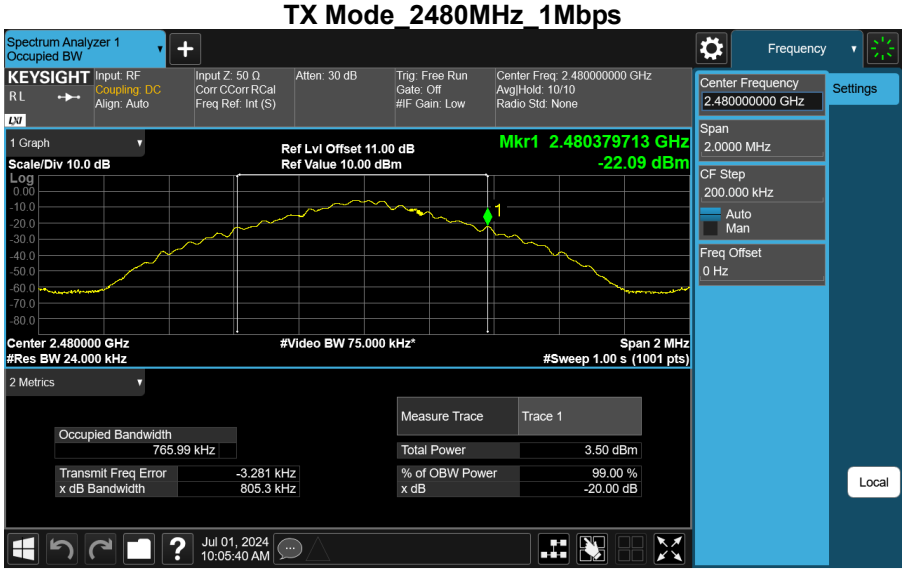
Frequency (MHz)	Occupied Channel Bandwidth (MHz)	F_L at 99% BW (MHz)	F_H at 99% BW (MHz)	Result
2402	0.765	2401.61	-	Pass
2480	0.766	-	2480.38	
N/A		F_L > 2400	F_H < 2483.5	

TX Mode_2402MHz_1Mbps



Occupied Bandwidth(MHz):0.765
Left Frequency(MHz):2401.61 Right Frequency(MHz):2402.38
Limit:>2400MHz Test Result:Pass

TX Mode_2480MHz_1Mbps

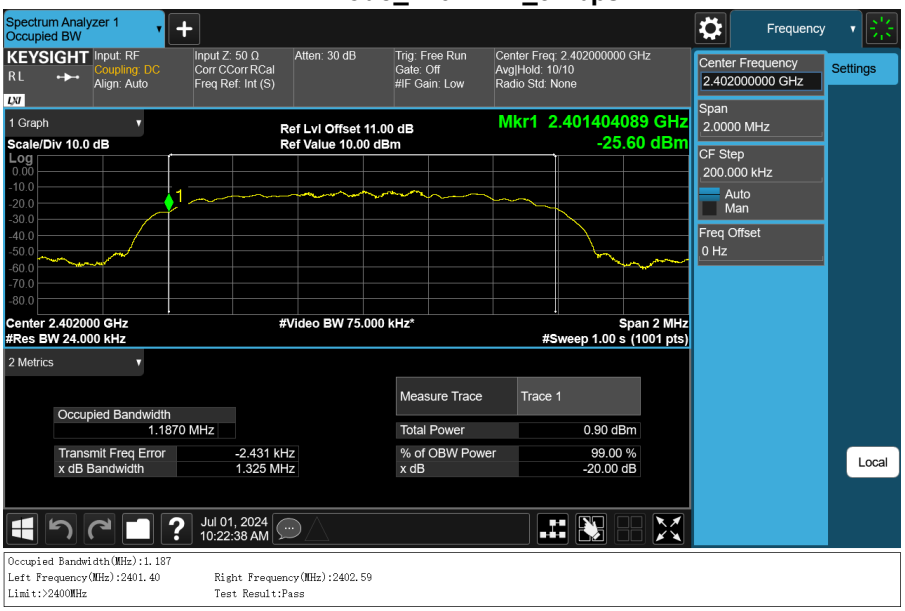


Occupied Bandwidth(MHz):0.766
Left Frequency(MHz):2479.61 Right Frequency(MHz):2480.38
Limit: <2483.5MHz Test Result:Pass

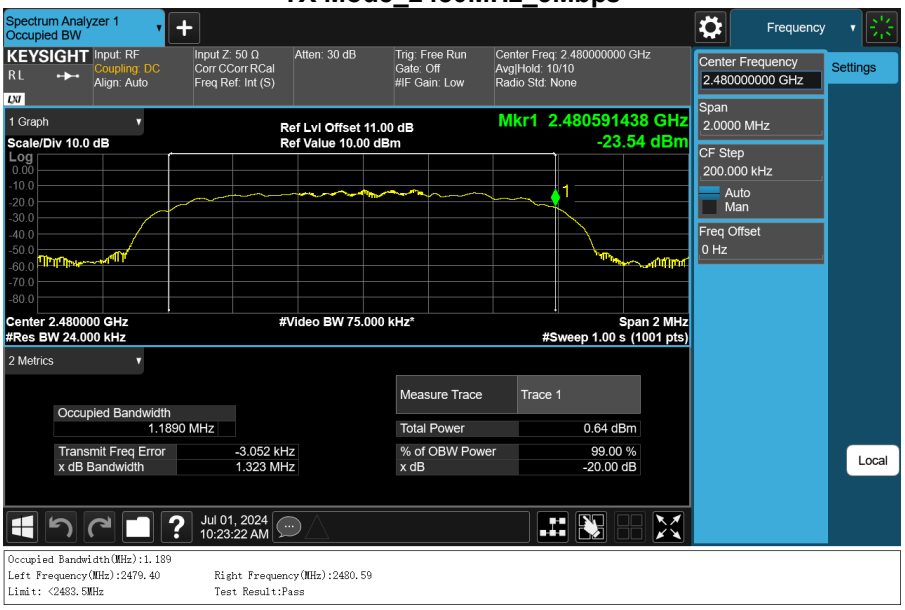
Test Mode:	TX Mode_3Mbps

Frequency (MHz)	Occupied Channel Bandwidth (MHz)	F_L at 99% BW (MHz)	F_H at 99% BW (MHz)	Result
2402	1.187	2401.40	-	Pass
2480	1.189	-	2480.59	
N/A		F_L > 2400	F_H < 2483.5	

TX Mode_2402MHz_3Mbps



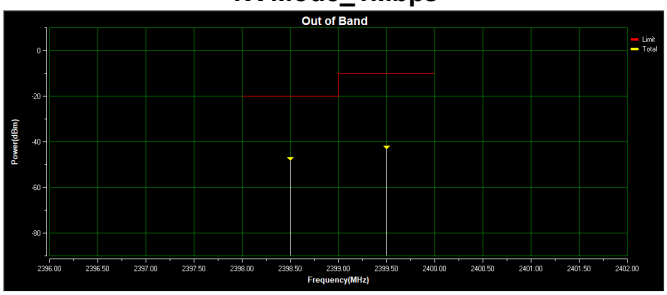
TX Mode_2480MHz_3Mbps



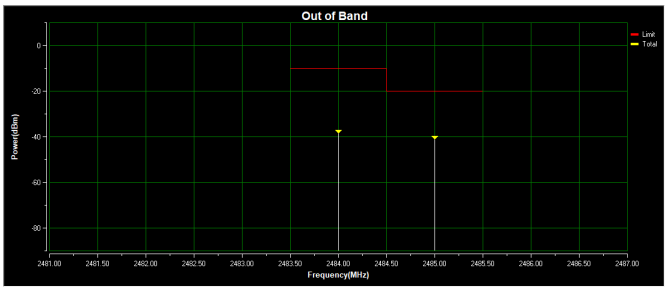
APPENDIX H - TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN

Test Mode:	TX Mode_1Mbps

TX Mode_1Mbps



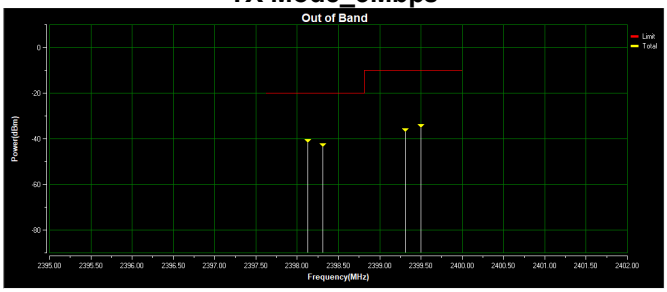
Test Result:Pass



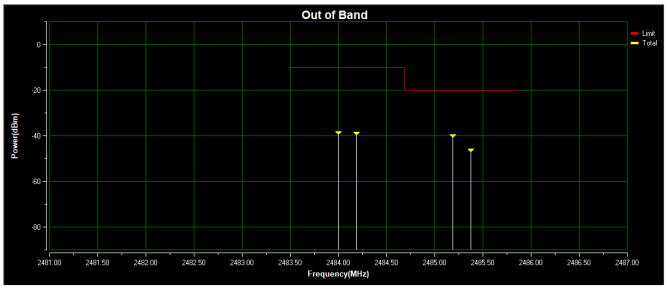
Test Result:Pass

Test Mode:	TX Mode_3Mbps

TX Mode_3Mbps



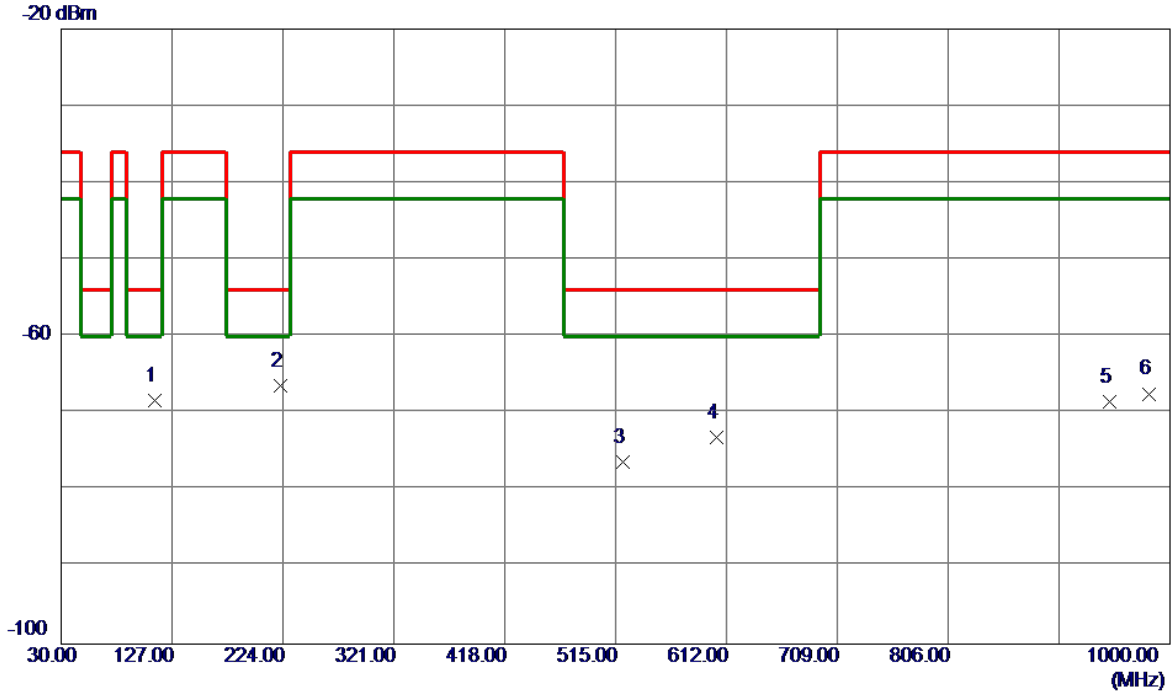
Test Result:Pass



Test Result:Pass

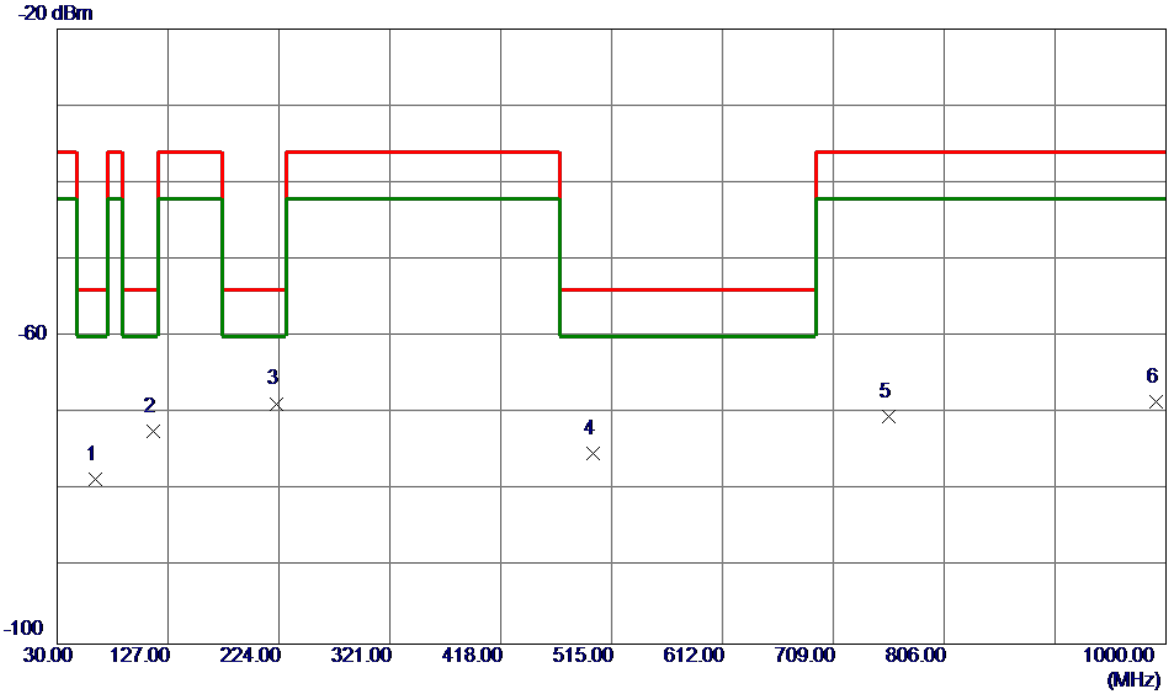
APPENDIX I - TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

Test Mode	TX Mode 2402 MHz_3Mbps	Polarization	Vertical



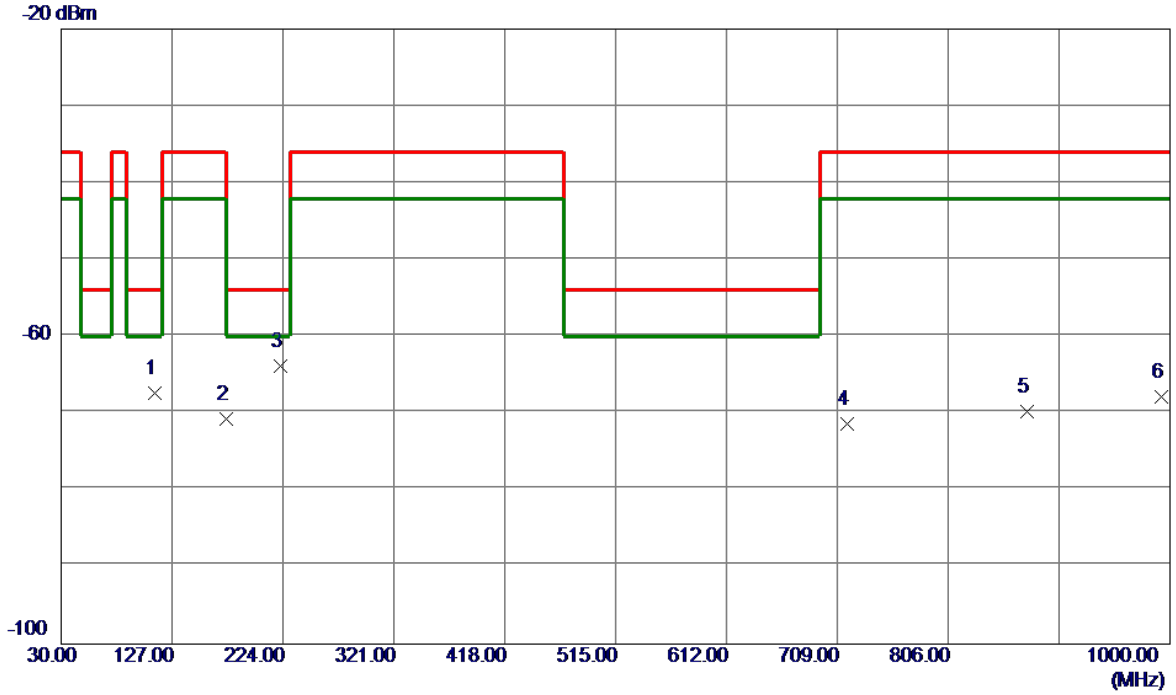
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	111.9650	-64.81	-3.52	-68.33	-54.00	-14.33	RMS	
2 *	221.8660	-63.60	-2.82	-66.42	-54.00	-12.42	RMS	
3	521.4020	-79.57	3.28	-76.29	-54.00	-22.29	RMS	
4	603.7550	-78.13	4.96	-73.17	-54.00	-19.17	RMS	
5	947.0380	-77.93	9.44	-68.49	-36.00	-32.49	RMS	
6	981.6670	-77.05	9.61	-67.44	-36.00	-31.44	RMS	

Test Mode	TX Mode 2402 MHz_3Mbps	Polarization	Horizontal



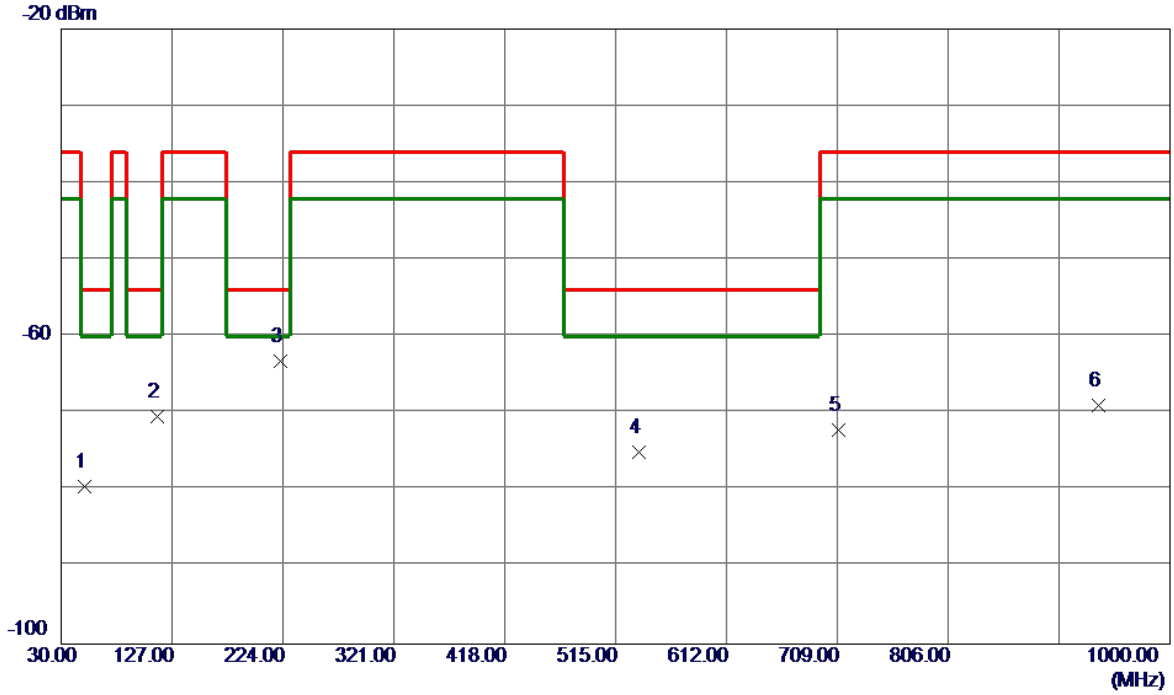
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	63.3680	-74.55	-4.07	-78.62	-54.00	-24.62	RMS	
2	114.4870	-68.52	-3.76	-72.28	-54.00	-18.28	RMS	
3 *	221.8660	-66.51	-2.21	-68.72	-54.00	-14.72	RMS	
4	498.6070	-77.94	2.81	-75.13	-54.00	-21.13	RMS	
5	757.9850	-77.12	6.68	-70.44	-36.00	-34.44	RMS	
6	991.6580	-78.63	10.09	-68.54	-36.00	-32.54	RMS	

Test Mode	TX Mode 2480 MHz_3Mbps	Polarization	Vertical



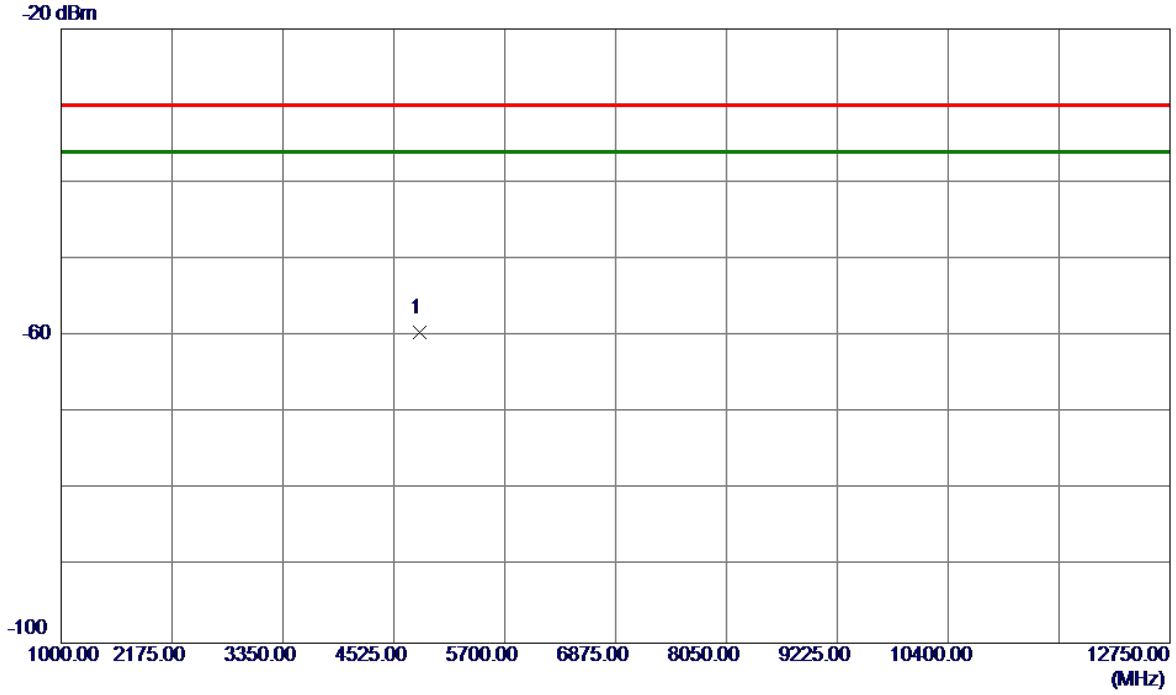
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	112.3530	-63.86	-3.48	-67.34	-54.00	-13.34	RMS	
2	174.2390	-69.49	-1.22	-70.71	-54.00	-16.71	RMS	
3 *	221.8660	-61.06	-2.82	-63.88	-54.00	-9.88	RMS	
4	717.6330	-77.86	6.45	-71.41	-36.00	-35.41	RMS	
5	875.0640	-77.53	7.75	-69.78	-36.00	-33.78	RMS	
6	992.4340	-77.53	9.64	-67.89	-36.00	-31.89	RMS	

Test Mode	TX Mode 2480 MHz_3Mbps	Polarization	Horizontal



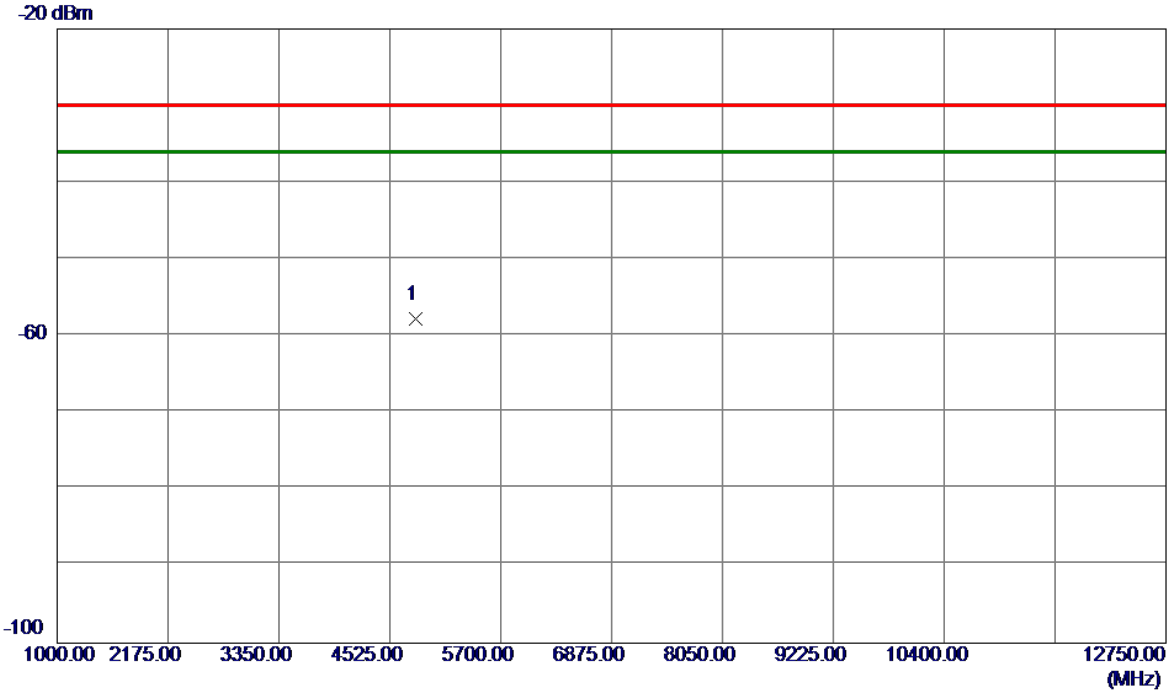
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	50.7580	-78.20	-1.39	-79.59	-54.00	-25.59	RMS	
2	114.0020	-66.50	-3.84	-70.34	-54.00	-16.34	RMS	
3 *	221.8660	-61.00	-2.21	-63.21	-54.00	-9.21	RMS	
4	535.8550	-78.68	3.64	-75.04	-54.00	-21.04	RMS	
5	710.3580	-78.29	6.19	-72.10	-36.00	-36.10	RMS	
6	937.8230	-78.16	9.22	-68.94	-36.00	-32.94	RMS	

Test Mode	TX Mode 2402 MHz_1Mbps	Polarization	Vertical



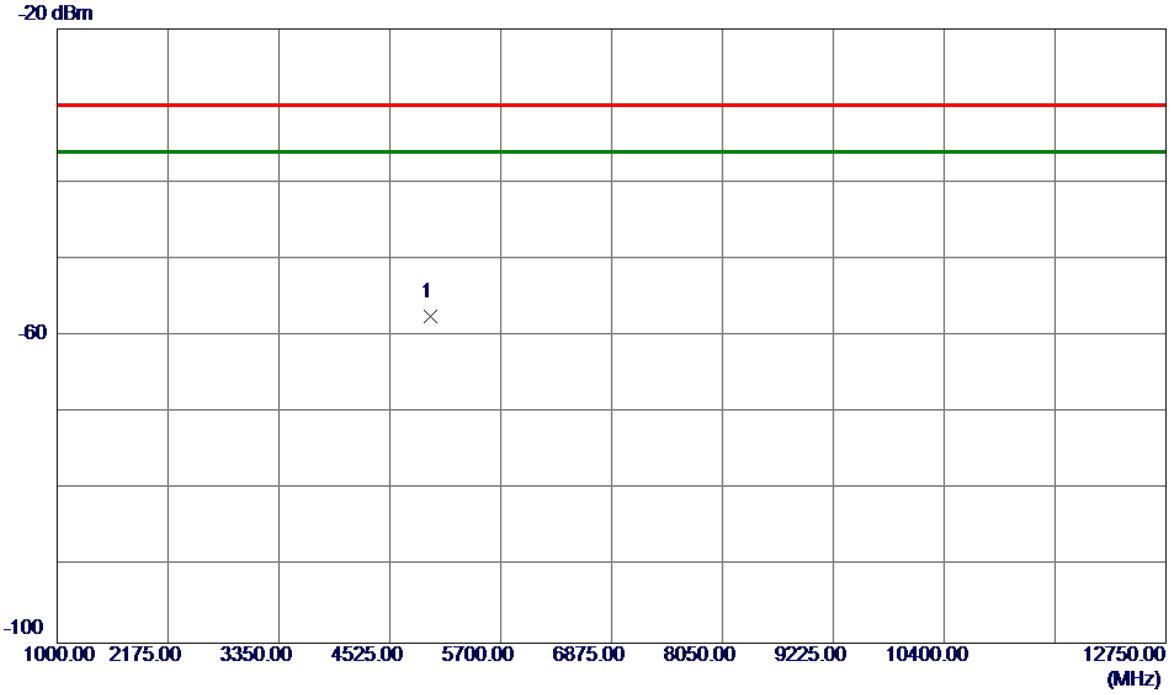
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4804.0630	-60.43	0.90	-59.53	-30.00	-29.53	RMS	

Test Mode	TX Mode 2402 MHz_1Mbps	Polarization	Horizontal



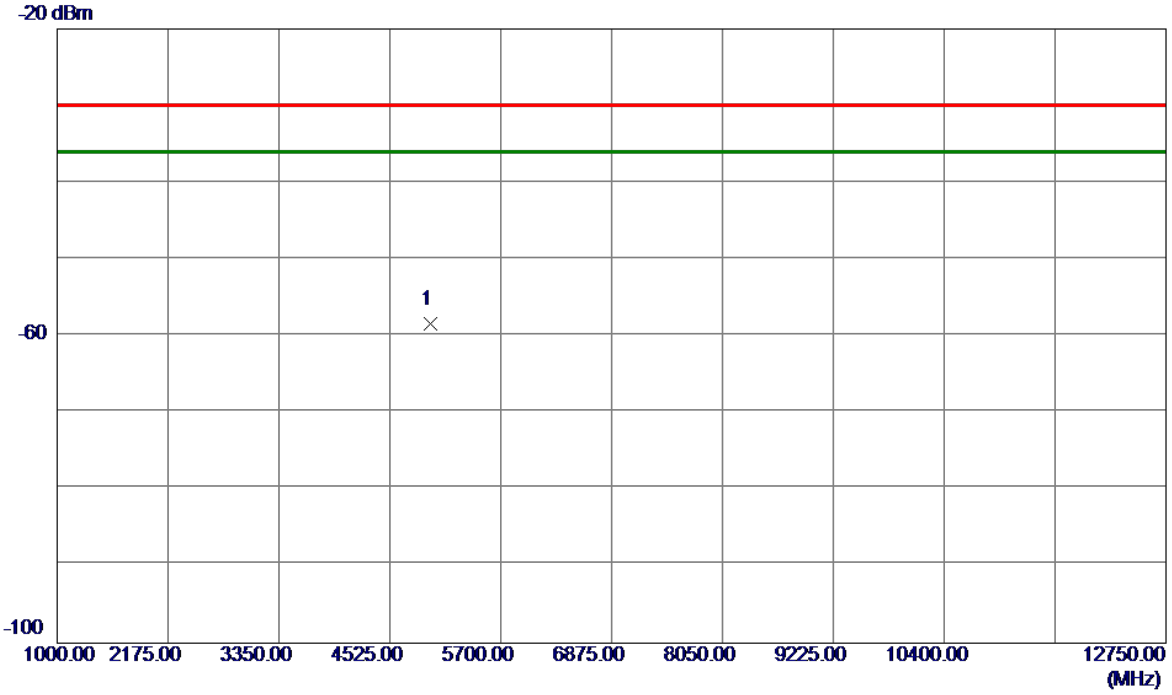
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4804.0630	-58.99	1.30	-57.69	-30.00	-27.69	RMS	

Test Mode	TX Mode 2480 MHz_1Mbps	Polarization	Vertical



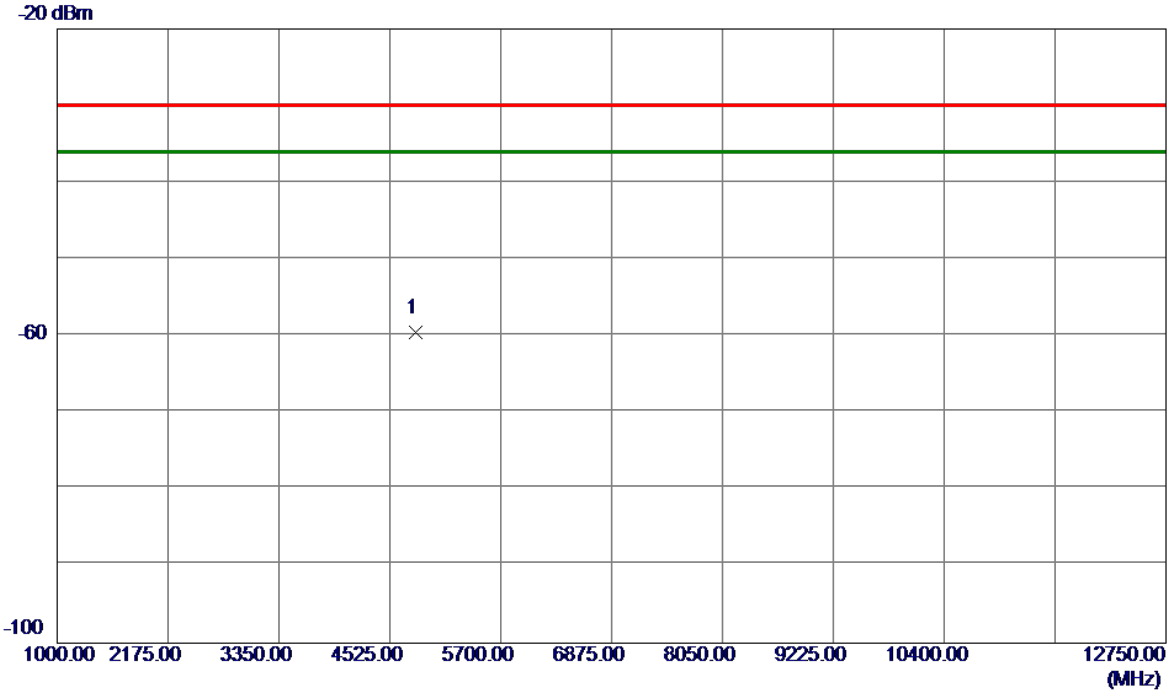
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4959.7500	-58.44	1.00	-57.44	-30.00	-27.44	RMS	

Test Mode	TX Mode 2480 MHz_1Mbps	Polarization	Horizontal



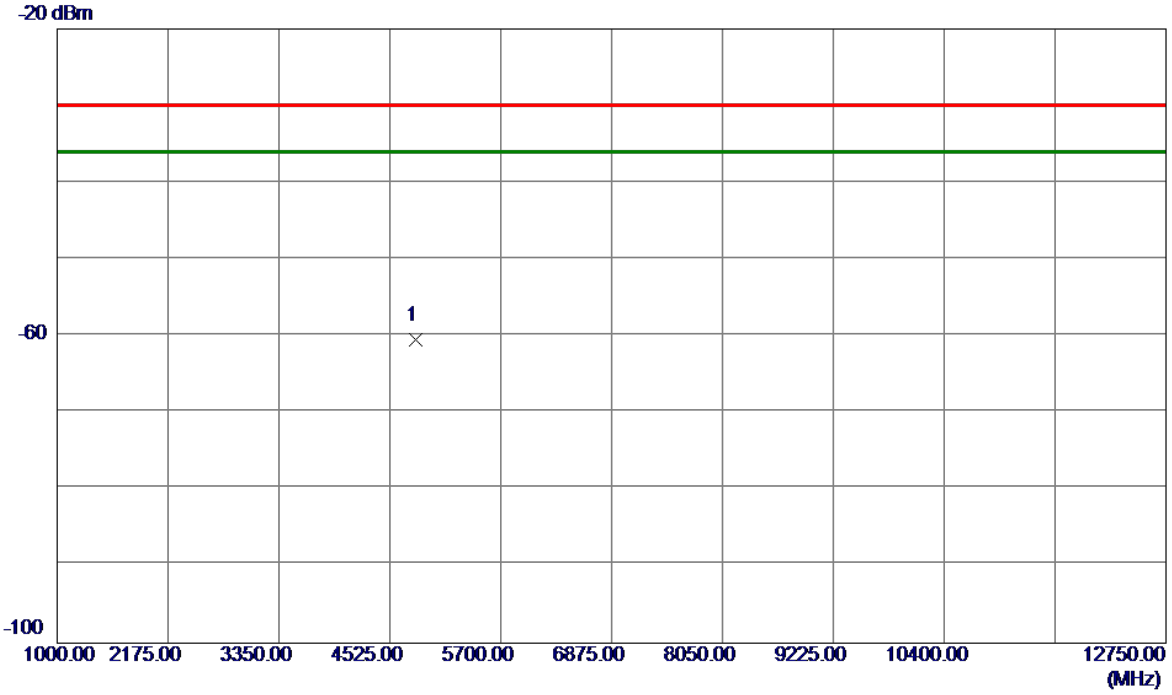
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4959.7500	-59.74	1.36	-58.38	-30.00	-28.38	RMS	

Test Mode	TX Mode 2402 MHz_3Mbps	Polarization	Vertical



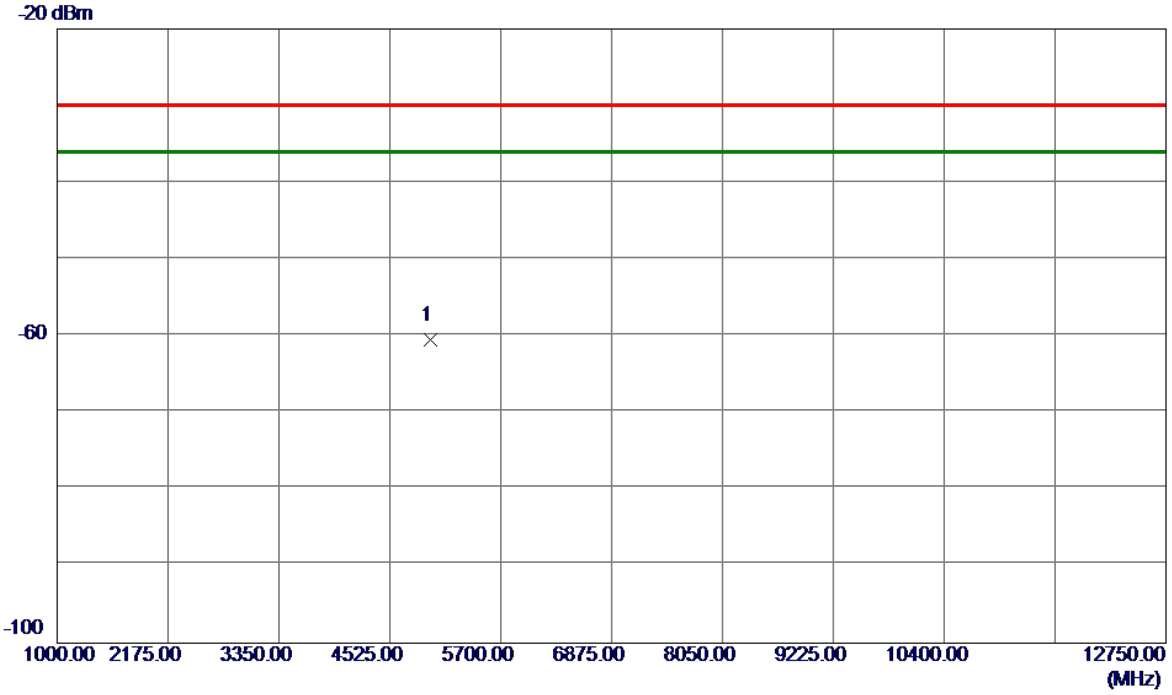
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4804.0630	-60.35	0.90	-59.45	-30.00	-29.45	RMS	

Test Mode	TX Mode 2402 MHz_3Mbps	Polarization	Horizontal



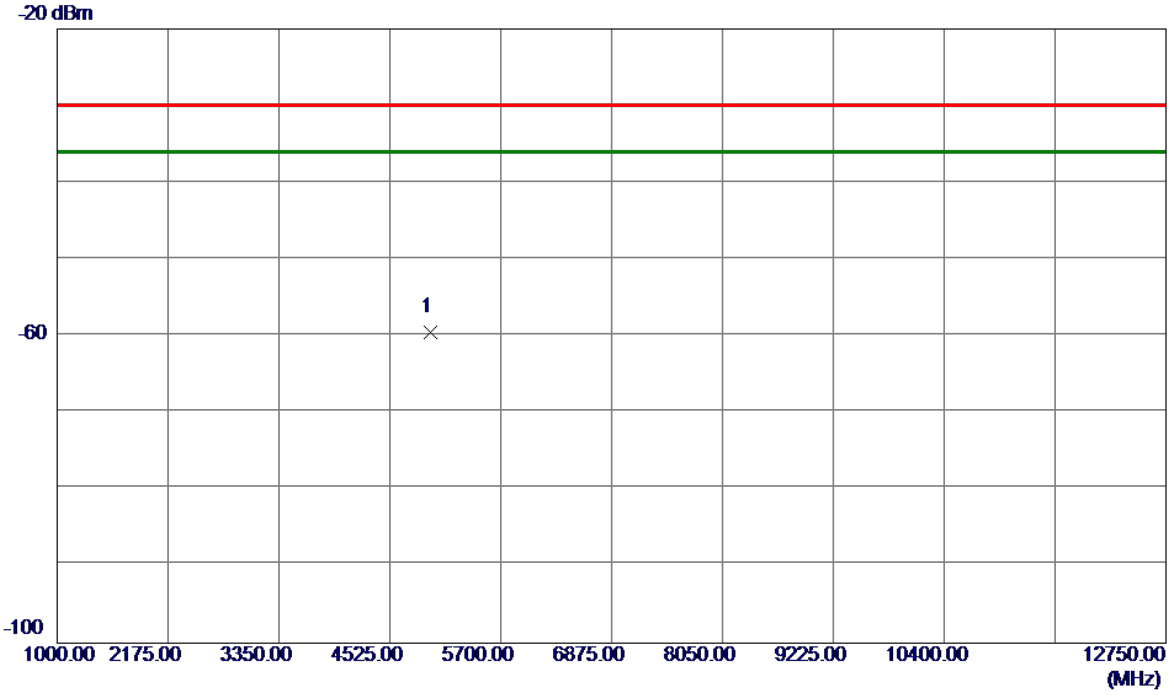
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4804.0630	-61.73	1.30	-60.43	-30.00	-30.43	RMS	

Test Mode	TX Mode 2480 MHz_3Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4960.3370	-61.45	1.00	-60.45	-30.00	-30.45	RMS	

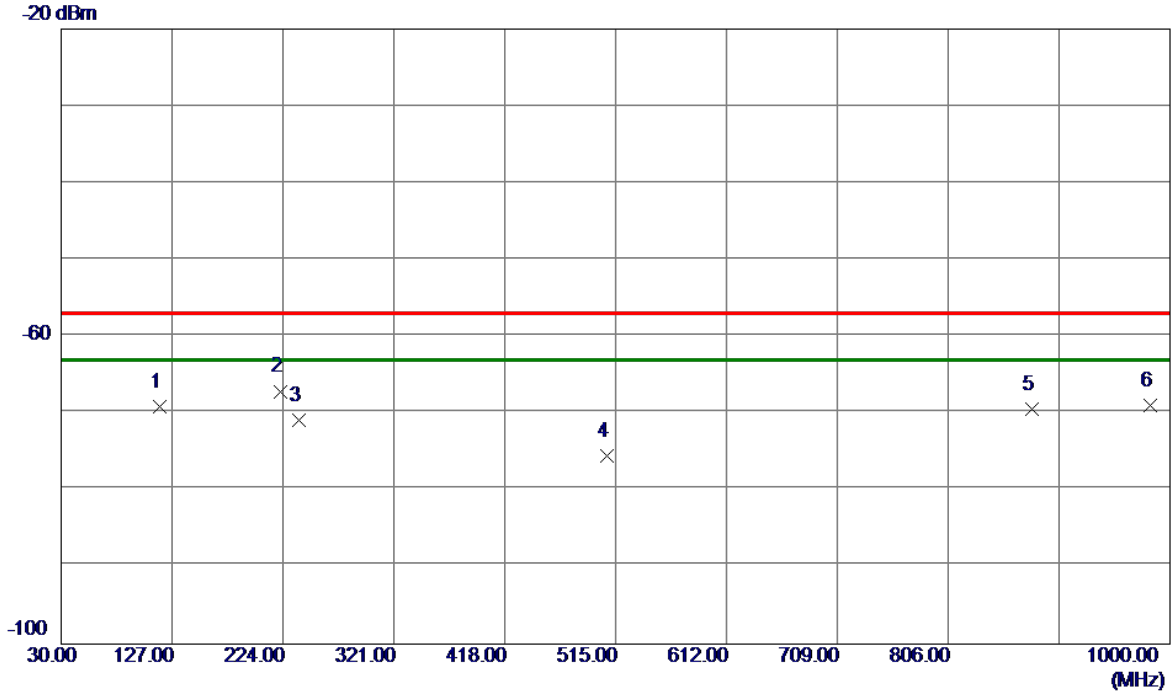
Test Mode	TX Mode 2480 MHz_3Mbps	Polarization	Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	4960.3370	-60.80	1.36	-59.44	-30.00	-29.44	RMS	

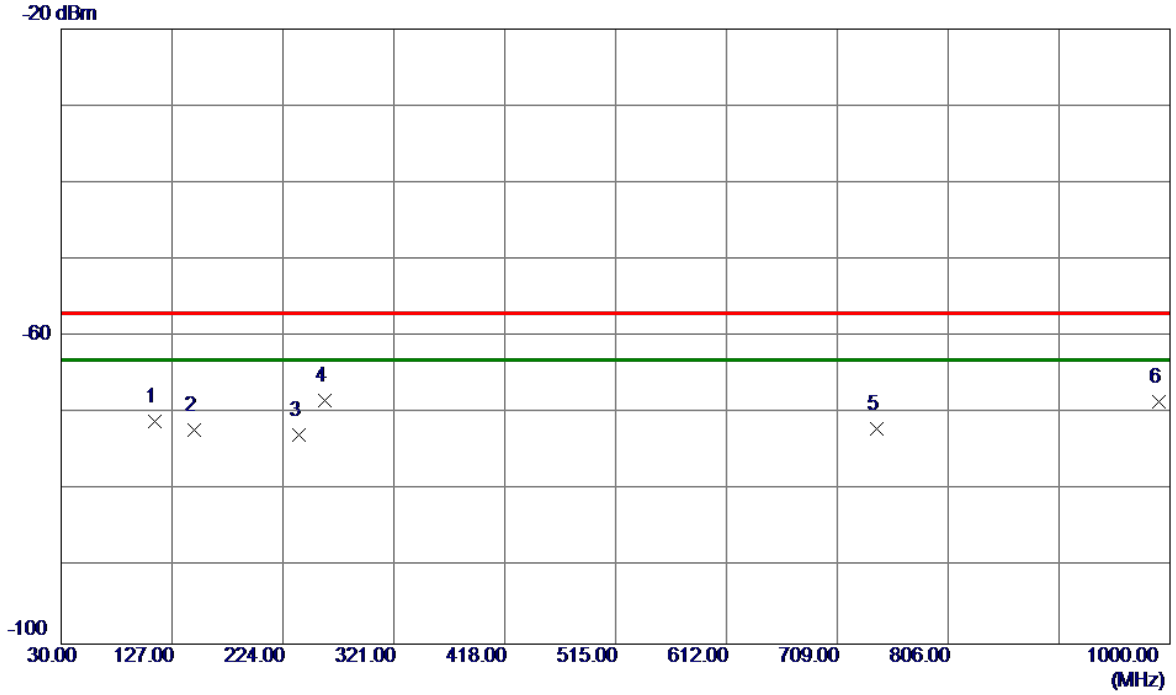
APPENDIX J - RECEIVER SPURIOUS EMISSIONS

Test Mode	RX Mode 2402 MHz_3Mbps	Polarization	Vertical



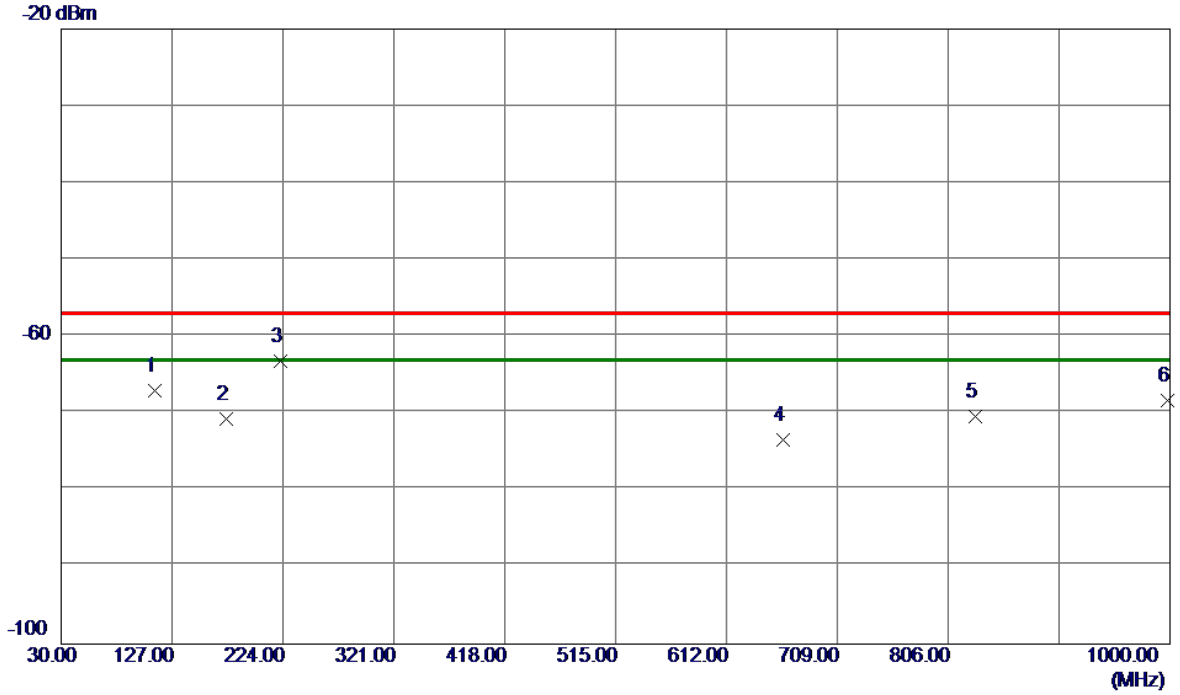
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	116.2330	-65.92	-3.14	-69.06	-57.00	-12.06	RMS	
2 *	221.7690	-64.29	-2.83	-67.12	-57.00	-10.12	RMS	
3	237.6770	-68.94	-1.93	-70.87	-57.00	-13.87	RMS	
4	506.9490	-78.60	3.04	-75.56	-57.00	-18.56	RMS	
5	879.3320	-77.32	7.82	-69.50	-57.00	-12.50	RMS	
6	982.7340	-78.61	9.61	-69.00	-57.00	-12.00	RMS	

Test Mode	RX Mode 2402 MHz_3Mbps	Polarization	Horizontal



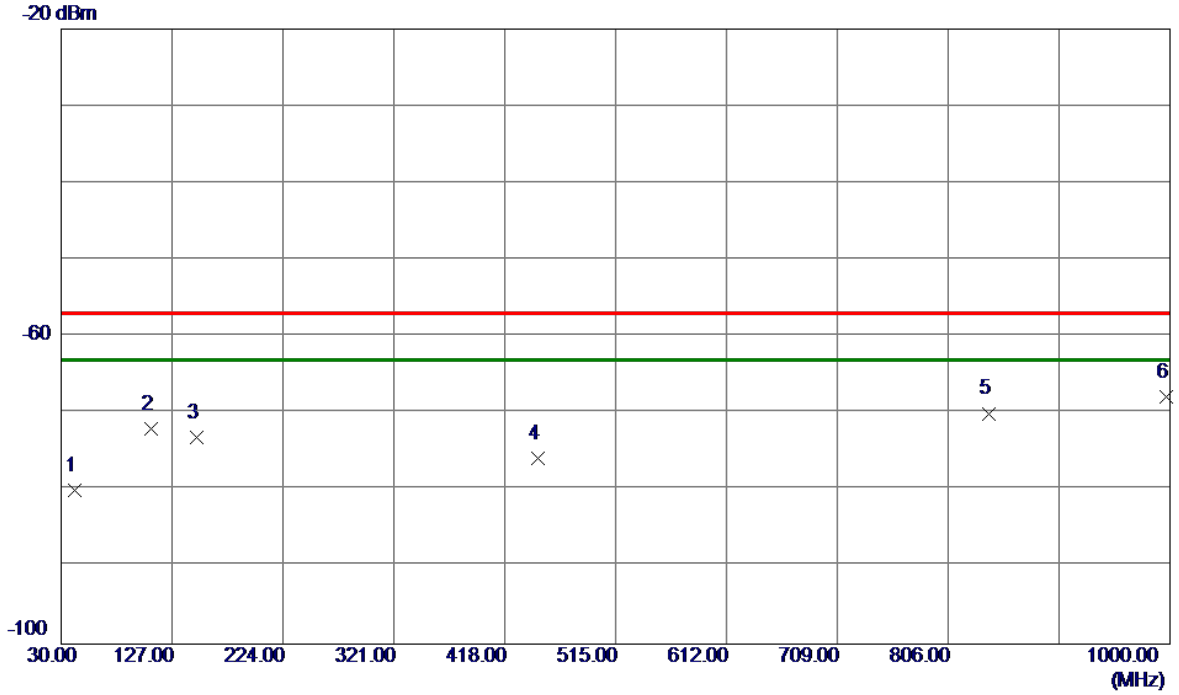
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	111.6740	-66.81	-4.22	-71.03	-57.00	-14.03	RMS	
2	146.4970	-73.23	1.03	-72.20	-57.00	-15.20	RMS	
3	237.6770	-71.16	-1.60	-72.76	-57.00	-15.76	RMS	
4 *	261.0540	-66.13	-2.13	-68.26	-57.00	-11.26	RMS	
5	743.8230	-78.41	6.42	-71.99	-57.00	-14.99	RMS	
6	990.3000	-78.58	10.07	-68.51	-57.00	-11.51	RMS	

Test Mode	RX Mode 2480 MHz_3Mbps	Polarization	Vertical



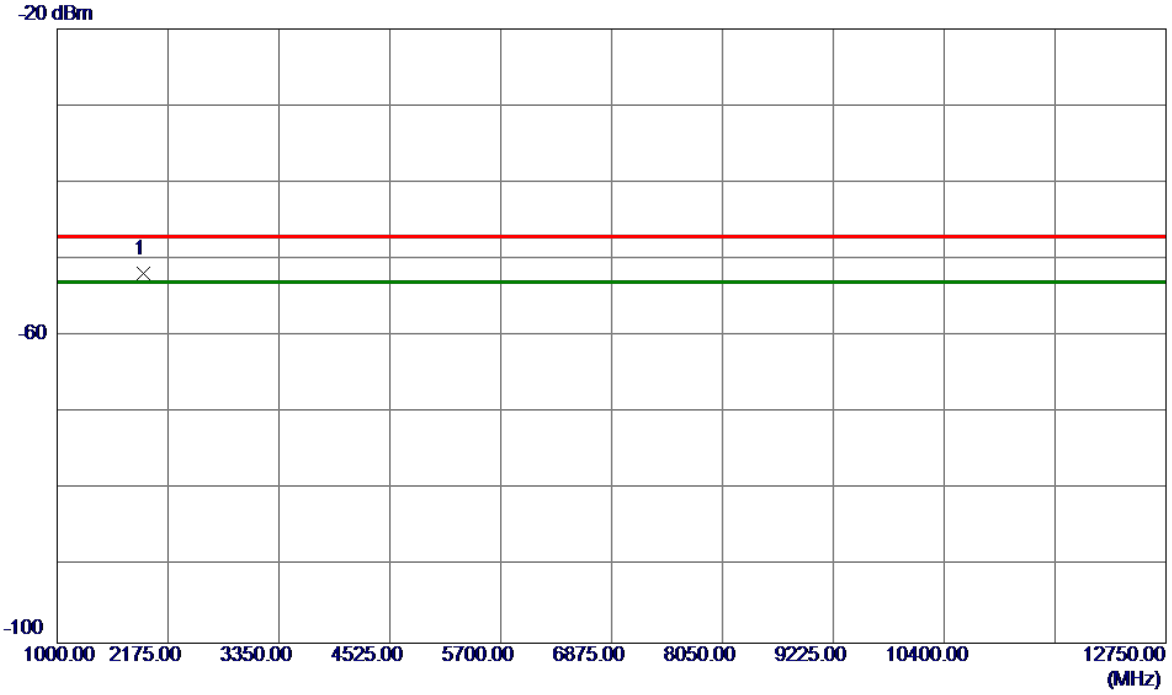
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	111.7710	-63.52	-3.53	-67.05	-57.00	-10.05	RMS	
2	174.3359	-69.45	-1.24	-70.69	-57.00	-13.69	RMS	
3 *	221.8660	-60.44	-2.82	-63.26	-57.00	-6.26	RMS	
4	662.0520	-79.00	5.51	-73.49	-57.00	-16.49	RMS	
5	829.8620	-78.03	7.58	-70.45	-57.00	-13.45	RMS	
6	998.0600	-77.99	9.65	-68.34	-57.00	-11.34	RMS	

Test Mode	RX Mode 2480 MHz_3Mbps	Polarization	Horizontal



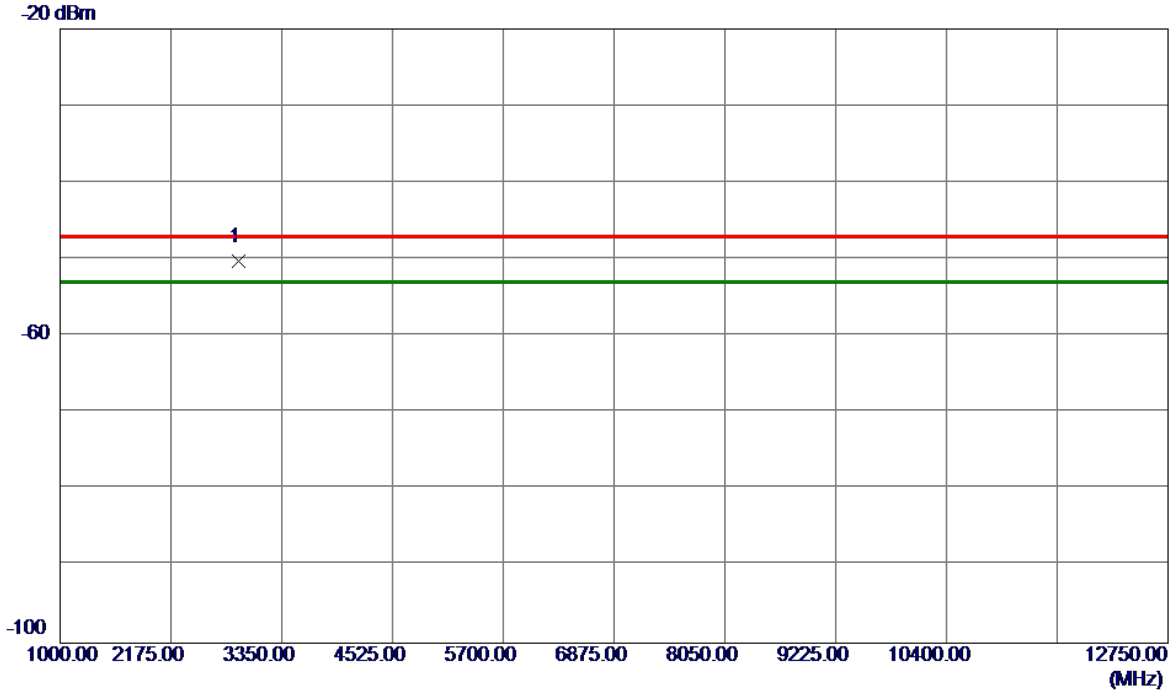
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1	41.9310	-79.39	-0.55	-79.94	-57.00	-22.94	RMS	
2	109.0550	-67.38	-4.59	-71.97	-57.00	-14.97	RMS	
3	148.8250	-74.31	1.12	-73.19	-57.00	-16.19	RMS	
4	447.2940	-78.23	2.42	-75.81	-57.00	-18.81	RMS	
5	841.8900	-77.68	7.68	-70.00	-57.00	-13.00	RMS	
6 *	996.8960	-77.96	10.15	-67.81	-57.00	-10.81	RMS	

Test Mode	RX Mode 2402 MHz_3Mbps	Polarization	Vertical



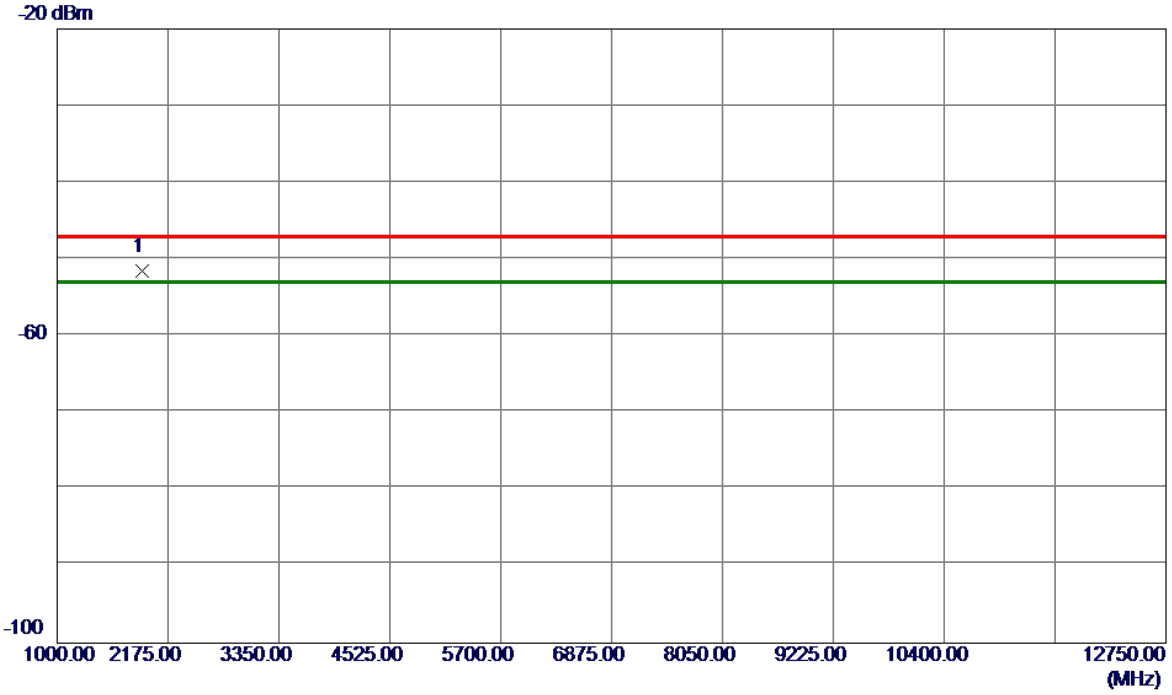
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	1909.4500	-47.38	-4.51	-51.89	-47.00	-4.89	RMS	

Test Mode	RX Mode 2402 MHz_3Mbps	Polarization	Horizontal



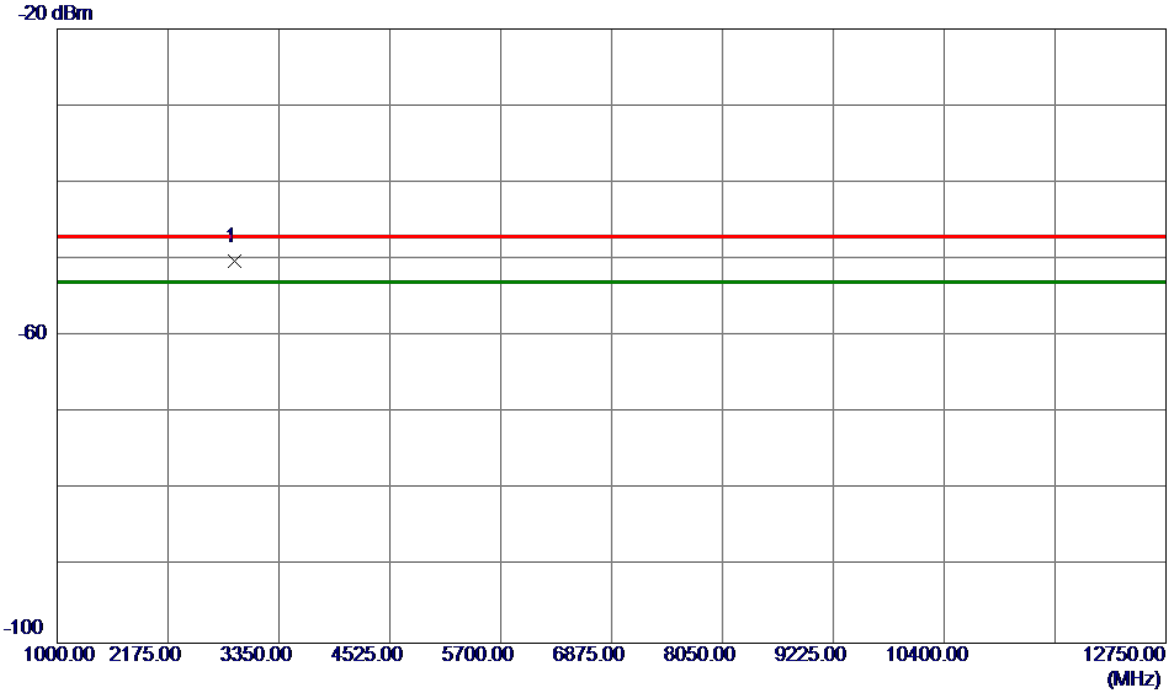
No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	2887.0500	-50.34	0.13	-50.21	-47.00	-3.21	RMS	

Test Mode	RX Mode 2480 MHz_3Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	1907.1000	-47.01	-4.54	-51.55	-47.00	-4.55	RMS	

Test Mode	RX Mode 2480 MHz_3Mbps	Polarization	Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBm	dB	dBm	dBm	dB	Detector	Comment
1 *	2880.5880	-50.34	0.12	-50.22	-47.00	-3.22	RMS	

APPENDIX K - RECEIVER BLOCKING

Receiver Blocking Result						
Modulation Mode	Operation Mode	Wanted Signal Mean Power from Companion Device (dBm) **(See Note 1)**	Blocking Signal Freq. (MHz) **(See Note 2)**	Blocking Signal Power (dBm) **(See Note 1)**	Blocking Signal Power + Max. Ant. Gain (dBm)	PER (%)
1 Mbps	hopping	-67.39	2380	-34	-31.23	1.00
			2300	-34	-31.23	0.60
		-67.39	2504	-34	-31.23	0.00
			2584	-34	-31.23	0.00
Limit	PER(Packet Error Rate) ≤ 10%					
Result	Pass					

Note:
1) The levels had been corrected by the actual antenna assembly gain.
2) The test report did not use the shift of blocking frequencies with the standard Clause 5.4.11.2.1 Step 5.

APPENDIX L - INFORMATION AS REQUIRED BY EN 300 328 V2.2.2, CLAUSE 5.4.1

In accordance with ETSI EN 300 328, clause 5.4.1, the following information is provided by the manufacturer.

a) The type of wideband data transmission equipment:

☒ FHSS

☐ non-FHSS

b) In case of FHSS:

(1) In case of non-Adaptive FHSS equipment:

The number of Hopping Frequencies: N/A

(2) In case of Adaptive FHSS equipment:

The maximum number of Hopping Frequencies: 79

The minimum number of Hopping Frequencies: 15

(3) The (average) dwell time: 0.2952 s

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) In case of adaptive equipment:

The maximum Channel Occupancy Time implemented by the equipment: N/A ms

☒ The equipment has implemented an LBT mechanism

* In case of non-FHSS equipment:

☐ The equipment is Frame Based equipment

☐ The equipment is Load Based equipment

☐ The equipment can switch dynamically between Frame Based and Load Based equipment

The CCA time implemented by the equipment: N/A µs

☐ The equipment has implemented a DAA mechanism

☐ The equipment can operate in more than one adaptive mode

f) The worst case operational mode for each of the following tests:

(1) RF Output Power: 7.61 dBm

(2) Power Spectral Density: N/A dBm/MHz

(3) Duty cycle, Tx-Sequence, Tx-gap: N/A

(4) Accumulated Transmit time, Frequency Occupation & Hopping Sequence (only for FHSS equipment): 0.2952 s, 1 , 79

(5) Hopping Frequency Separation (only for FHSS equipment): 0.98 MHz

(6) Medium Utilization: N/A

(7) Adaptivity: N/A ; Receiver Blocking: 1.00 %

(8) Nominal Channel Bandwidth: 1.189 MHz

(9) Transmitter unwanted emissions in the OOB domain: -40.70 dBm

(10) Transmitter unwanted emissions in the spurious domain: -63.21 dBm

(11) Receiver spurious emissions: -50.21 dBm

g) The different transmit operating modes (tick all that apply):

☒ Operating mode 1: Single Antenna Equipment

☒ 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

NOTE: Add more lines if more channel bandwidths are supported.

☐ 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

NOTE: Add more lines if more channel bandwidths are supported.

h) In case of Smart Antenna Systems: N/A

(1) The number of Receive chains: _____

(2) The number of Transmit chains: _____

☐ symmetrical power distribution

☐ asymmetrical power distribution

In case of beam forming, the maximum (additional) beam forming gain: _____dB

NOTE: The additional beam forming gain does not include the basic gain of a single antenna.

i) Operating Frequency Range(s) of the equipment:

(1) Operating Frequency Range 1: 2402 MHz to 2480 MHz

NOTE: Add more lines if more Frequency Ranges are supported.

j) Nominal Channel Bandwidth(s):

(1) Nominal Channel Bandwidth 1: 1.189 MHz

NOTE: Add more lines if more channel bandwidths are supported.

k) Type of Equipment (stand-alone, combined, plug-in radio device, etc.):

☒ Stand-alone

☐ Combined Equipment

☐ Plug-in radio device

☐ Other _____

l) The extreme operating conditions that apply to the equipment:

Operating temperature range: 0 ° C to 40 ° C

Details provided are for the: ☒ stand-alone equipment

☐ combined equipment

☐ test jig

n) The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined equipment or test jig in case of plug-in devices:

Details provided are for the: ☒ stand-alone equipment

☐ combined equipment

☐ test jig

Supply Voltage ☐ AC mains State AC voltage ____ V

☒ DC State DC voltage 12 V

In case of DC, indicate the type of power source

☐ Internal Power Supply

☒ External Power Supply or AC/DC adapter

☐ Battery

☐ Other: _____

o) Describe the test modes available which can facilitate testing:

The measurements shall be performed during continuously transmitting and normal operation.

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™, IEEE 802.15.4™, proprietary, etc.):

Bluetooth®

s) 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

End of Test Report