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Shenzhen CTL Testing Technology Co., Ltd.
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TEST REPORT

ETSI EN 300 328 V2.2.2 (2019-07)

Report Reference No. **CTL2312127041-WR02**

Compiled by: (position+printed name+signature)	Happy Guo (File administrators)	Happy Guo
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Product Name	: ROBOTIC POOL SKIMMER
Model/Type reference	: Aiper Surfer S1
List Model(s)..............................	: Aiper Surfer M1
Trade Mark.................................	: Aiper
Applicant's name	: **Shenzhen Aiper Intelligent Co.,Ltd.**
Address of applicant	: Units 3201,3203A and 3205, 32nd floor, Block C, Phase 2 Galaxy World, Minle community, Minzhi street, Longhua district, Shenzhen, China
Test Firm....................................	: **Shenzhen CTL Testing Technology Co., Ltd.**
Address of Test Firm	: Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055
Test specification.......................	:
Standard	: **ETSI EN 300 328 V2.2.2 (2019-07)**
TRF Originator	: Shenzhen CTL Testing Technology Co., Ltd.
Master TRF....................................	: Dated 2011-01
Date of receipt of test item	: Mar. 04, 2024
Date of Test Date........................	: Mar. 04, 2024-Apr. 25, 2024
Date of Issue	: Apr. 26, 2024
Result...	: **Pass**

TEST REPORT

Test Report No. :	CTL2312127041-WR02	Apr. 26, 2024
		Date of issue

Equipment under Test : ROBOTIC POOL SKIMMER

Sample No. CTL2312127041

Model /Type : Aiper Surfer S1

Listed Models : N/A

Applicant : **Shenzhen Aiper Intelligent Co.,Ltd.**

Address : Units 3201,3203A and 3205, 32nd floor, Block C, Phase 2 Galaxy World, Minle community, Minzhi street, Longhua district, Shenzhen, China

Manufacturer : **Shenzhen Aiper Intelligent Co.,Ltd.**

Address : 3 Units 3201,3203A and 3205, 32nd floor, Block C, Phase 2 Galaxy World, Minle community, Minzhi street, Longhua district, Shenzhen, China

Test result	**Pass ***

∗ In the configuration tested, the EUT complied with the standards specified page 5.

** Modified History **

Revision	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2024-04-26	CTL2312127041-WR02	Tracy Qi

Contents

1 TEST SUMMARY

1.1 Test Standards

The tests were performed according to following standards:

ETSI EN 300 328 V2.2.2 (2019-07)–Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard for access to radio spectrum

1.2 Test Description

Item	Reference	Result
Maximum transmit power	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.2	PASS
Power Spectral Density	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.3	PASS
Duty Cycle, Tx-sequence, Tx-gap	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.4	N/A note1
Medium Utilisation (MU) factor	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.5	N/A note1
Adaptively	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.6	N/A note2
Occupied Channel Bandwidth	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.7	PASS
Transmitter unwanted emissions in the out-of-band domain	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.8	PASS
Transmitter unwanted emissions in the spurious domain	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.9	PASS
Receiver spurious emissions	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.10	PASS
Receiver Blocking	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.11	PASS
Geo-location capability	EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.12	N/A note3

Note1: This requirement does not apply to adaptive equipment.
Note2: Which is not applicable to device with a maximum RF Output power level is less than 10 dBm e.i.r.p.
Note3: This equipment without geo-location capability function.

1.3 Test Facility

1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.
Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 32/EN 55032 requirements.

1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L7497

Shenzhen CTL Testing Technology Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2017 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No. 4343.01

Shenzhen CTL Testing Technology Co., Ltd, EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

IC Registration No.: 9618B

CAB identifier: CN0041

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements with Registration No.: 9618B.

FCC-Registration No.: 399832

Designation No.: CN1216

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 399832.

1.4 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test Items	Measurement Uncertainty	Notes
Transmitter power Radiated	±2.20 dB	(1)
Radiated spurious emission	±2.20 dB	(1)
Temperature	±1℃	(1)
Humidity	±3%	(1)
DC and low frequency voltages	±1.5%	(1)

RF output power	± 1.18 dB	(1)
Power Spectral Density	±1.51 dB	(1)
Duty Cycle	±0.11%	(1)
Tx-sequence	±0.11%	(1)
Tx-gap	±0.11%	(1)
Medium Utilization (MU) factor	±1.18%	(1)
Dwell time	±0.11%	(1)
Minimum Frequency Occupation	±1.9%	(1)
Hopping Sequence	±1.9%	(1)
Hopping Frequency Separation	±1.9%	(1)
Occupied Channel Bandwidth	±1.9%	(1)
Transmitter unwanted emissions in the out-of-band domain	±1.21dB	(1)
Transmitter unwanted emissions in the spurious domain	9kHz-7GHz:±1.09dB 7GHz-26.5GHz: ±3.27dB	(1)
Receiver spurious emissions	9kHz-7GHz:±1.09dB 7GHz-26.5GHz: ±3.27dB	(1)
Adaptivity	±1.17%	(1)
Receiver Blocking	±2.69%	(1)

Note 1: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

2 GENERAL INFORMATION

2.1 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature	Normal Temperature:	25°C
	High Temperature:	55°C
	Low Temperature:	-20°C
Voltage	Normal Voltage	DC 10.80V
Other	Relative Humidity	55 %
	Air Pressure	101 kPa

2.2 General Description of EUT

Product Name:	ROBOTIC POOL SKIMMER
Model/Type reference:	Aiper Surfer S1
Power supply:	AC100-240V~ 50/60Hz 0.8A from adapter or DC 10.8V from battery
Adapter 1	Model:DZ024EHL126180V Input:100-240V~50/60Hz 0.8A Outputi:12.6V ⎓ 1.8A 22.68W
Adapter 2	Model:GQ24-126180-AG Input:100-240V~50/60Hz 1.0A Outputi:12.6V ⎓ 1.8A 22.68W
Bluetooth LE	
Supported type:	Bluetooth Low Energy
Modulation:	GFSK
Operation frequency:	2402MHz to 2480MHz
Channel number:	40
Channel separation:	2 MHz
Antenna type:	PCB Antenna
Antenna gain:	4.81dBi

Note 1: For more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
Note 2: Antenna gain provided by the applicant.

2.3 Receiver categories

This device belongs to the receiver categories as the choice box selected:

	Categorization	Note
☐	Receiver category 1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p.
☒	Receiver category 2	Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p.
☐	Receiver category 3	Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p.

2.4 Description of Test Modes and Test Frequency

The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing.

Test Modes	LE 1M Continuous Transmitting	LE 2M Continuous Transmitting
1	■	
2		■

Operation Frequency List：

Channel	Frequency (MHz)
00	**2402**
01	2404
02	2406
⋮	⋮
19	**2440**
⋮	⋮
37	2476
38	2478
39	**2480**

Note: The line display in grey were the channel selected for testing

2.5 Measurement Instruments List

RF output power & PSD & OOB & OBW & Hoping & Duty Cycle, Tx-sequence, Tx-gap & Adaptively, Blocking						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	Spectrum Analyzer	Agilent	N9020A	US46220290	2023/05/05	2024/05/04
2	Spectrum Analyzer	Keysight	N9020A	MY53420874	2023/05/05	2024/05/04
3	Signal Generator	Agilent	N5182A	MY50142850	2023/05/05	2024/05/04
4	Signal Generator	Agilent	N5182A	MY52420355	2023/05/05	2024/05/04
5	Signal Generator	Wiltron	68347B	657001	2023/05/05	2024/05/04
6	Power measurement module	TSTPASS	TSPS2023R	TSCB220016	2023/05/05	2024/05/04

7	Power Sensor	Agilent	U2021XA	MY53340004	2023/05/06	2024/05/05
8	Power Sensor	Agilent	U2021XA	MY54080012	2023/05/05	2024/05/04
9	WIDEBAND RADIO COMMUNICATION TESTER	RS	CMW500	1201.0002K50-107930-CD	2023/05/09	2024/05/08
10	Temperature/Humidity Meter	Ji Yu	MC501	/	2023/05/05	2024/05/04
11	Temperature Humidity chamber	Kingbo	TLHW-64B	/	2023/05/06	2024/05/05

Test Software

Name of Software	Version
TST-PASS	V2.0

Transmitter spurious emissions & Receiver spurious emissions

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	Double cone logarithmic antenna	Schwarzbeck	VULB 9168	824	2023/02/13	2026/02/12
2	Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2021/12/23	2024/12/22
3	Amplifier	Agilent	8449B	3008A02306	2023/05/04	2024/05/03
4	Amplifier	Brief&Smart	LNA-4018	2104197	2023/05/05	2024/05/04
5	Amplifier	MRT-AP01M06	MRT	S-001	2023/05/04	2024/05/03
6	Spectrum Analyzer	RS	FSP	1164.4391.38	2023/05/05	2024/05/04

Test software

Name of Software	Version
EZ_EMC(Below 1GHz)	V1.1.4.2
EZ_EMC(Above 1GHz)	V1.1.4.2

2.6 TEST ITEM AND RESULTS

2.7 RF Output Power

Limit

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.2.3

The maximum RF output power for adaptive FHSS equipment shall be equal to or less than 20 dBm. The maximum RF output power for non-adaptive FHSS equipment shall be declared by the manufacturer. See clause 5.4.1 m). The maximum RF output power for this equipment shall be equal to or less than the value declared by the manufacturer. This declared value shall be equal to or less than 20 dBm. This limit shall apply for any combination of power level and intended antenna assembly.

Test Procedure

The test procedure shall be as follows:

Step 1:
• Use a fast power sensor suitable for 2,4 GHz and capable of minimum 1 MS/s.
• Use the following settings:
- Sample speed 1 MS/s or faster.
- The samples shall represent the RMS power of the signal.
- Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) is captured.
For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.

Step 2:
• For conducted measurements on devices with one transmit chain:
- Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.
• For conducted measurements on devices with multiple transmit chains:
- Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
- Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
- For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples as the new stored data set.

Step 3:
• Find the start and stop times of each burst in the stored measurement samples.
The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2.
In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

Step 4:
• Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. The start and stop points shall be included. Save these Pburst values, as well as the start and stop times for each burst.

$$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n)$$

with k being the total number of samples and n the actual sample number.

Step 5:
• The highest of all Pburst values (value A in dBm) will be used for maximum e.i.r.p. calculations.

Step 6:
• Add the (stated) antenna assembly gain G in dBi of the individual antenna.
• If applicable, 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 (P) shall be calculated using the formula below:
P = A + G + Y
•This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

Test Results

Raw data reference to Section 2 of Appendix of BLE.

2.8 Power Spectral Density

Limit

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.3.3

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

Test Procedure

Option 1: For equipment with continuous and non-continuous transmissions

The transmitter shall be connected to a spectrum analyser and the Power Spectral Density (PSD) as defined in clause 4.3.2.3 shall be measured and recorded.

The test procedure shall be as follows:
Step 1:
Connect the UUT to the spectrum analyser and use the following settings:
• Start Frequency: 2 400 MHz
• Stop Frequency: 2 483,5 MHz
• Resolution BW: 10 kHz
• Video BW: 30 kHz
• Sweep Points: > 8 350; for spectrum analysers not supporting this number of sweep points, the frequency band may be segmented
• Detector: RMS
• Trace Mode: Max Hold
• Sweep time: For non-continuous transmissions: 2 × Channel Occupancy Time × number of sweep points For continuous transmissions: 10 s; the sweep time may be increased further until a value where the sweep time has no further impact anymore on the RMS value of the signal.
For non-continuous signals, wait for the trace to stabilize. Save the data (trace data) set to a file.

Step 2:
For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.3.2.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:
Add up the values for power for all the samples in the file using the formula below.

$$P_{Sum} = \sum_{n=1}^{k} P_{sample}(n)$$

with k being the total number of samples and n the actual sample number

Step 4:
Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.4.2 and save the corrected data. The following formulas can be used:

$$C_{Corr} = P_{Sum} - P_{e.i.r.p.}$$

$$P_{Samplecorr}(n) = P_{Sample}(n) - C_{Corr}$$

with n being the actual sample number

Step 5:
Starting from the first sample $P_{Samplecorr}(n)$ (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.

Step 6:
Shift the start point of the samples added up in step 5 by one sample and repeat the procedure in step 5 (i.e. sample #2 to sample #101).

Step 7:
Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments. From all the recorded results, the highest value is the maximum Power Spectral Density (PSD) for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.

Option 2: For equipment with continuous transmission capability or for equipment operating (or with the capability to operate) with a constant duty cycle (e.g. Frame Based equipment)

This option is for equipment that can be configured to operate in a continuous transmit mode (100 % DC) or with a constant Duty Cycle (DC).

Step 1:
• Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: The centre frequency of the channel under test
- RBW: 1 MHz
- VBW: 3 MHz
- Frequency Span: 2 × Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: Peak
- Trace Mode: Max Hold

Step 2:
• When the trace is complete, find the peak value of the power envelope and record the frequency.

Step 3:
• Make the following changes to the settings of the spectrum analyser:
- Centre Frequency: Equal to the frequency recorded in step 2
- Frequency Span: 3 MHz
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 minute
- Detector Mode: RMS
- Trace Mode: Max Hold

Step 4:
• Wait until the trace has stabilized, the trace shall be captured using the "Hold" or "View" option on the spectrum analyser.
• Find the peak value of the trace and place the analyser marker on this peak. This level is recorded as the highest mean power (power spectral density) D in a 1 MHz band.
• Alternatively, where a spectrum analyser is equipped with a function to measure power spectral density, this function may be used to display the power spectral density D in dBm / MHz.
• In case of conducted measurements on smart antenna systems operating in a mode with multiple transmit chains active simultaneously, the power spectral density of each transmit chain shall be measured separately to calculate the total power spectral density (value D in dBm / MHz) for the UUT.

Step 5:
• The maximum Power Spectral Density (PSD) e.i.r.p. is calculated from the above measured power spectral density D, the observed Duty Cycle (DC), the applicable antenna assembly gain G in dBi and if applicable the beamforming gain Y in dB, according to the formula below. The Duty Cycle (DC) can be determined using the procedure defined in clause 5.4.2.2.1.3). This value shall be recorded in the test report. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the highest gain shall be used.
PSD = D + G + Y + 10 × log (1 / DC) (dBm / MHz)

Test Result

Raw data reference to Section 3 of Appendix of BLE.

2.9 Duty Cycle, Tx-sequence, Tx-gap

Limit

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.4.3

The Duty Cycle shall be equal to or less than the maximum value declared by the manufacturer. The

Tx-sequence time shall be equal to or less than 10 ms. The minimum Tx-gap time following a Tx-sequence shall be equal to the duration of that proceeding Tx-sequence with a minimum of 3,5 ms.

Test Procedure

The test procedure, which shall only be performed for non-adaptive equipment, shall be as follows:

Step 1:
• Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.
• The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples. In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

Step 2:
• Between the saved start and stop times of each individual burst, calculate the TxOn time. Save these TxOn values.

Step 3:
• Duty Cycle (DC) is the sum of all TxOn times between the end of the first gap (which is the start of the first burst within the observation period) and the start of the last burst (within this observation period) divided by the observation period. The observation period is defined in clause 4.3.1.3.2 or clause 4.3.2.4.2.

Step 4:
• For FHSS equipment using blacklisting, the TxOn time measured for a single (and active) hopping frequency shall be multiplied by the number of blacklisted frequencies. This value shall be added to the sum calculated in step 3 above. If the number of blacklisted frequencies cannot be determined, the minimum number of hopping frequencies (N) as defined in clause 4.3.1.4.3 shall be assumed.
• The calculated value for Duty Cycle (DC) shall be recorded in the test report. This value shall be equal to or less than the maximum value declared by the manufacturer.

Step 5:
• Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.
• Identify any TxOff time that is equal to or greater than the minimum Tx-gap time as defined in clause 4.3.1.3.3 or clause 4.3.2.4.3. These are the potential valid gap times to be further considered in this procedure.
• Starting from the second identified gap, calculate the time from the start of this gap to the end of the preceding gap. This time is the Tx-sequence time for this transmission. Repeat this procedure until the last identified gap within the observation period is reached.
• A combination of consecutive Tx-sequence times and Tx-gap times followed by a Tx-gap time, which is at least as long as the duration of this combination, may be considered as a single Tx-sequence time and in which case it shall comply with the limits defined in clause 4.3.1.3.3 or clause 4.3.2.4.3.
• It shall be noted in the test report whether the UUT complies with the limits for the maximum Tx-sequence time and minimum Tx-gap time as defined in clause 4.3.1.3.3 or clause 4.3.2.4.3.

Test Results

Not applicable to this device which was adaptive equipment and cannot operate in a non-adaptive mode.

2.10 Medium Utilization (MU) factor

Limit

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.5.3

The maximum Medium Utilization factor for non-adaptive non-FHSS equipment shall be 10 %.

Definition

The Medium Utilisation (MU) factor is a measure to quantify the amount of resources (Power and Time) used by non-adaptive equipment. The Medium Utilisation factor is defined by the formula:

MU = (P/100 mW) × DC

Where: MU is Medium Utilisation factor in %.

P is the RF output power as defined in clause 4.3.1.2.2 expressed in mW.

DC is the Duty Cycle as defined in clause 4.3.1.3.2 expressed in %.

The equipment may have a dynamic behaviour with regard to duty cycle and corresponding power level. See clause 5.4.1 e).

Test Procedure

Step 1:

• Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.

Step 2:

• For each burst calculate the product of (Pburst / 100 mW) and the TxOn time. Pburst is expressed in mW. TxOn time is expressed in ms.

Step 3:

• Medium Utilization is the sum of all these products divided by the observation period (expressed in ms) which is defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. This value, which shall comply with the limit given in clause 4.3.1.6.3 or clause 4.3.2.5.3, shall be recorded in the test report.

If, in case of FHSS equipment, operation without blacklisted frequencies is not possible, the power of the bursts on blacklisted hopping frequencies (for the calculation of the Medium Utilization) is assumed to be equal to the average value of the RMS power of the bursts on all active hopping frequencies.

Test Results

Not applicable to this device which cannot operation in a non-adaptive mode.

2.11 Occupied Channel Bandwidth

Limit

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.7.3

The Occupied Channel Bandwidth shall fall completely within the band given in table 1.

In addition, for non-adaptive non-FHSS equipment with e.i.r.p. greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

Test Procedure

Step 1:
Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: ~ 1 % of the span without going below 1 %
- Video BW: 3 × RBW
- Frequency Span: 2 × Nominal Channel Bandwidth
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep time: 1 s

Step 2:
Wait for the trace to stabilize.
Find the peak value of the trace and place the analyser marker on this peak.

Step 3:
Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded.
Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.

Test Result

Raw data reference to Section 4 of Appendix of BLE.

2.12 Transmitter unwanted emissions in the out-of-band domain

Limit

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.8.3

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 3.

Within the band specified in table 1, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.2.7.

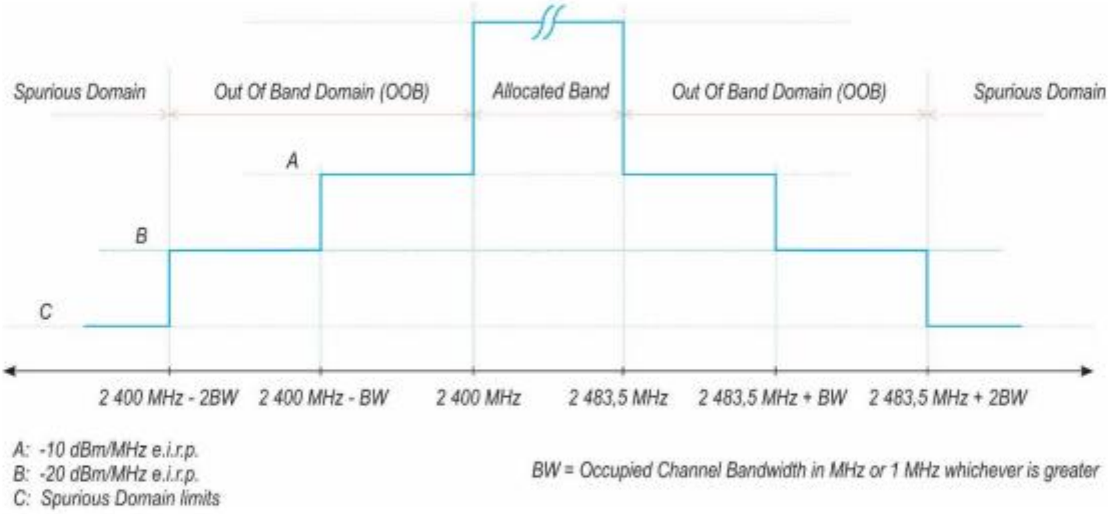


Figure 3: Transmit mask

Test Procedure

The applicable mask is defined by the measurement results from the tests performed under clause 5.4.7 (Occupied Channel Bandwidth).

The Out-of-band emissions within the different horizontal segments of the mask provided in figure 1 and figure 3 shall be measured using the procedure in step 1 to step 6 below. This method assumes the spectrum analyser is equipped with the Time Domain Power option.

Step 1:
• Connect the UUT to the spectrum analyser and use the following settings:
- Measurement Mode: Time Domain Power
- Centre Frequency: 2 484 MHz
- Span: Zero Span
- Resolution BW: 1 MHz
- Filter mode: Channel filter
- Video BW: 3 MHz
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep Mode: Single Sweep
- Sweep Points: Sweep time [µs] / (1 µs) with a maximum of 30 000
- Trigger Mode: Video (burst signals) or Manual (continuous signals)
- Sweep Time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

Step 2 (segment 2 483,5 MHz to 2 483,5 MHz + BW):
• Adjust the trigger level to select the transmissions with the highest power level.
• For FHSS equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.
• Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS

power shall be measured using the Time Domain Power function.
• Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.
• Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3 (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2 BW):
• Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2 BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 4 (segment 2 400 MHz - BW to 2 400 MHz):
• Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 5 (segment 2 400 MHz - 2 BW to 2 400 MHz - BW):
• Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2 BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2 BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 6:
• In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain G in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figure 1 or figure 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.
• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain G in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:
- Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain Y in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figure 1 or figure 3.
- Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by 10 × log10(Ach) and the additional beamforming gain Y in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.
NOTE: Ach refers to the number of active transmit chains.
It shall be recorded whether the equipment complies with the mask provided in figure 1 or figure 3.

Test Result

Raw data reference to Section 5 of Appendix of BLE.

2.13 Transmitter unwanted emissions in the spurious domain

Limit

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.9.3

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 as e.i.r.p. for emissions above 1 GHz.

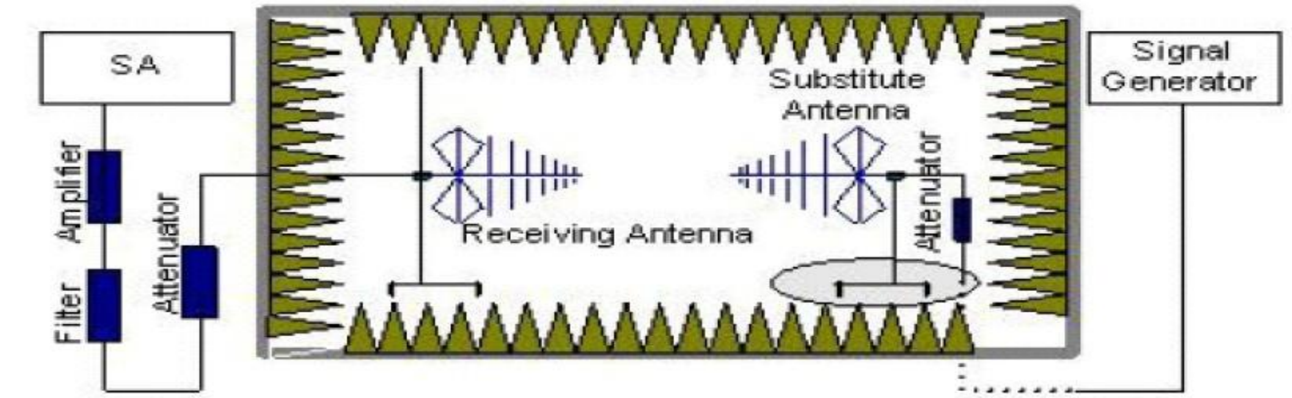
Table 4: Transmitter limits for spurious emissions

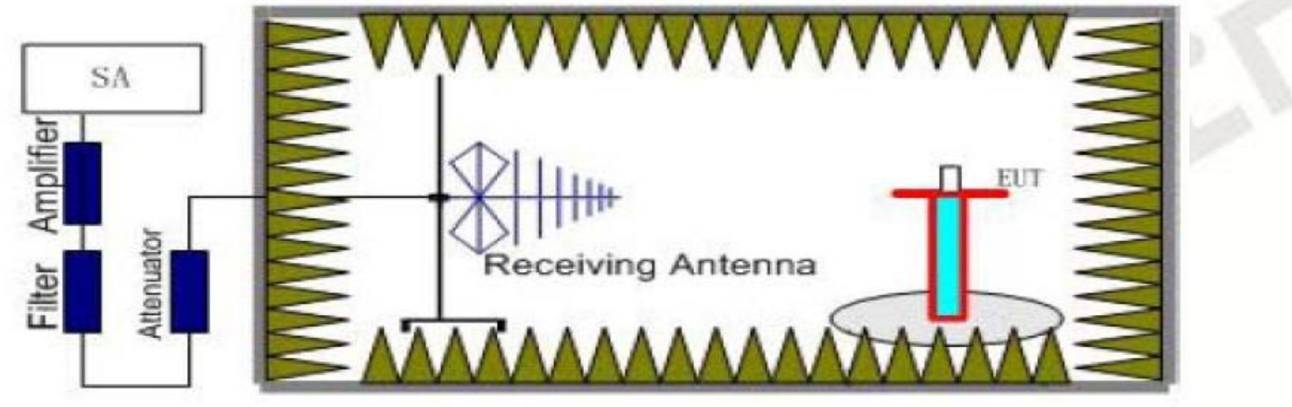
Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-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

1. The measurement performed at the lowest and the highest channel on which the equipment can operate.
2. The EUT was placed on a turntable with 1.5m height.
3. The test distance between the receiving antenna and the EUT is 3 meter, while the receiving (test) antenna is kept at 1.5 meter height.
4. Set EUT in continuous transmitting with maximum output power.
5. The table was rotated from 0 to 360 degree to search the highest radiated emission.
6. Repeat step 3 to 5 for each polarization and channel to find the worst emission level.
7. The results obtained are compared to the limits in order to prove compliance with the requirement.

Test Configuration





Test Results

All modes were tested, with only the following worst mode being captured (Test Mode 2)

BLE			
Channel:	*CH00*	*Polarity:*	*Horizontal*

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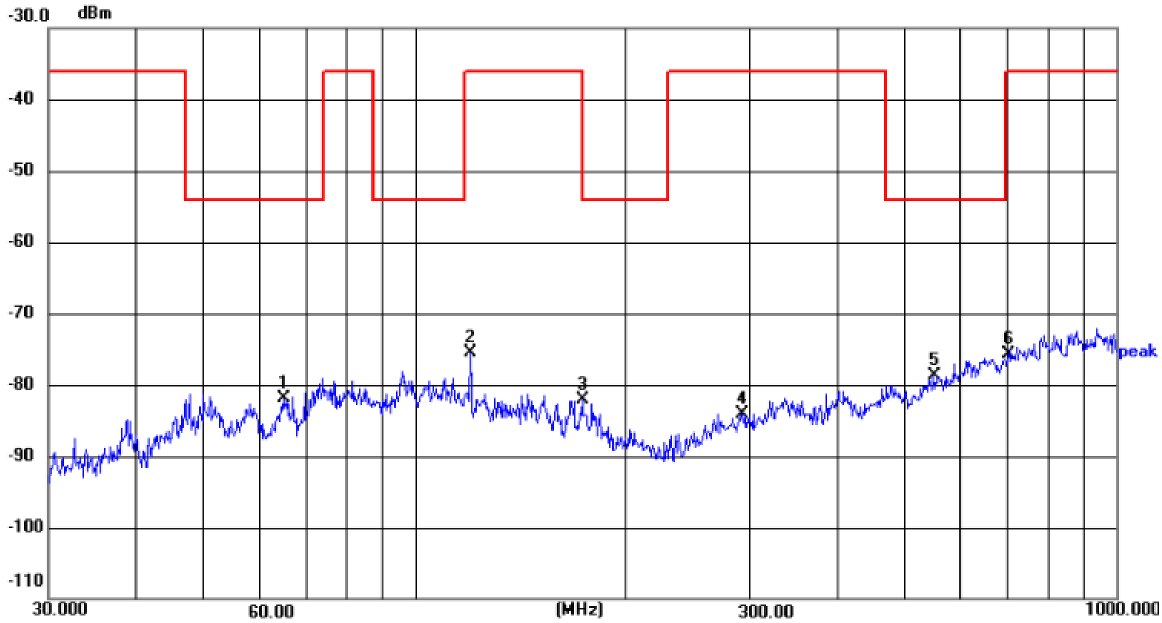
Radiated Emission Measurement

File :RF-RSE 4 Data :#6151 Date: 2024/04/24 Time: 2:37:02



Site LAB Chamber 2 Polarization: *Horizontal* Temperature: 25(C)
Limit: ETSI EN300328TX(RF) Power: Humidity: 50 %
EUT: Distance: 3m
M/N: Aiper Surfer S1
Mode: BLE2M 2402MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	65.0574	-69.33	-12.65	-81.98	-54.00	27.98	peak	150	0	P	
2	120.0133	-64.69	-10.73	-75.42	-36.00	39.42	peak	150	0	P	
3	173.4330	-68.39	-13.80	-82.19	-36.00	46.19	peak	150	0	P	
4	293.7272	-69.45	-14.58	-84.03	-36.00	48.03	peak	150	0	P	
5	549.9829	-69.44	-9.23	-78.67	-54.00	24.67	peak	150	0	P	
6	703.6090	-69.65	-6.01	-75.66	-36.00	39.66	peak	150	0	P	

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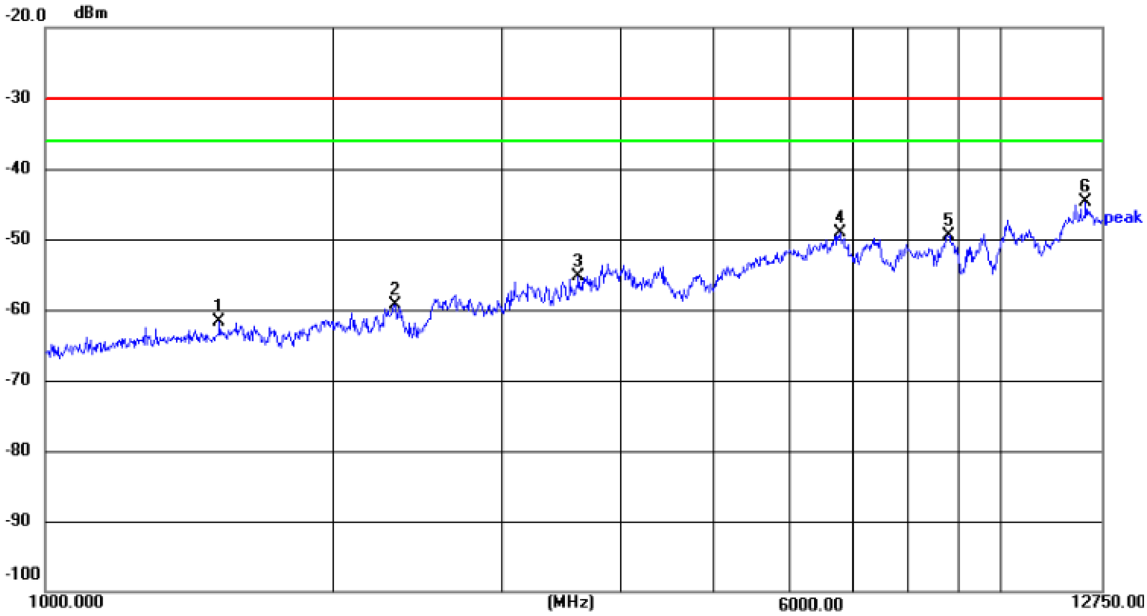
Radiated Emission Measurement

File :RF-RSE 4 Data :#6210 Date: 2024/04/24 Time: 3:59:52



Site LAB Chamber 2 Polarization: *Horizontal* Temperature: 25(C)
Limit: ETSI EN300328TX(RF) Power: Humidity: 50 %
EUT: Distance: 3m
M/N: Aiper Surfer S1
Mode: BLE2M 2402MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1523.434	-51.97	-9.64	-61.61	-30.00	31.61	peak	150	151	P	
2	2318.638	-54.31	-4.92	-59.23	-30.00	29.23	peak	150	2	P	
3	3624.515	-56.43	1.17	-55.26	-30.00	25.26	peak	150	342	P	
4	6786.096	-58.86	9.78	-49.08	-30.00	19.08	peak	150	65	P	
5	8800.762	-59.27	9.85	-49.42	-30.00	19.42	peak	150	162	P	
6	12295.796	-58.63	13.96	-44.67	-30.00	14.67	peak	150	224	P	

Channel:	CH00	Polarity:	Vertical

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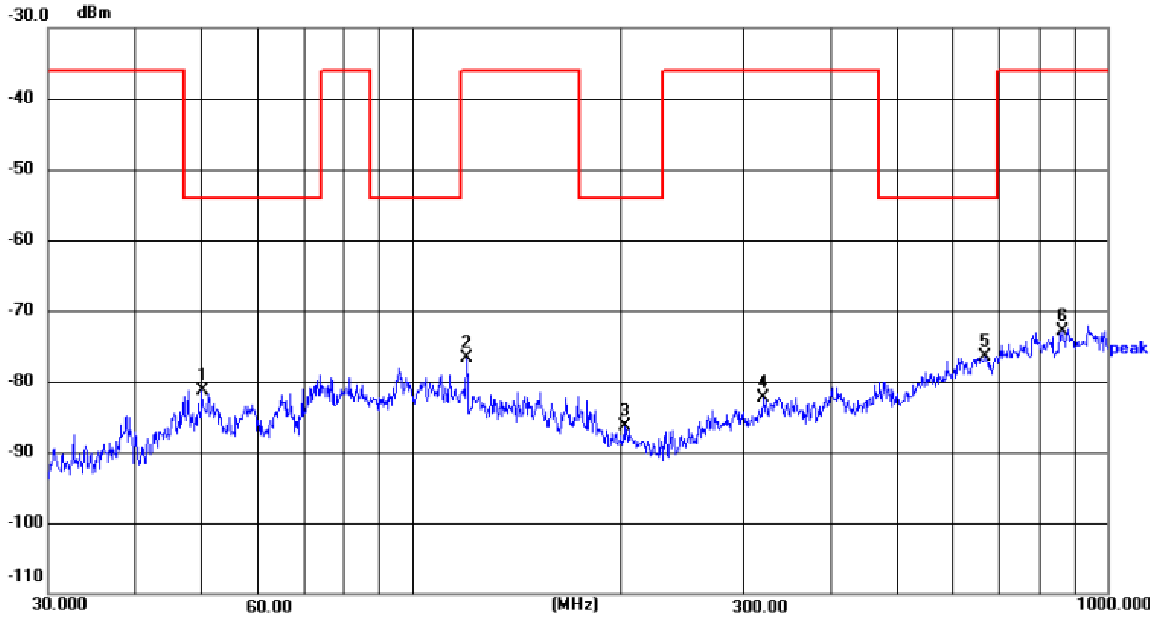
Radiated Emission Measurement

File :RF-RSE 4 Data :#6150 Date: 2024/04/24 Time: 2:36:52



Site LAB Chamber 2
Limit: ETSI EN300328TX(RF)
EUT:
M/N: Aiper Surfer S1
Mode: BLE2M 2402MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	50.0128	-69.20	-12.12	-81.32	-54.00	27.32	peak	150	0	P	
2	120.0133	-65.91	-10.73	-76.64	-36.00	40.64	peak	150	0	P	
3	202.1891	-69.34	-17.04	-86.38	-54.00	32.38	peak	150	0	P	
4	320.2175	-68.97	-13.33	-82.30	-36.00	46.30	peak	150	0	P	
5	668.7282	-70.08	-6.43	-76.51	-54.00	22.51	peak	150	0	P	
6	866.0879	-68.79	-4.12	-72.91	-36.00	36.91	peak	150	0	P	

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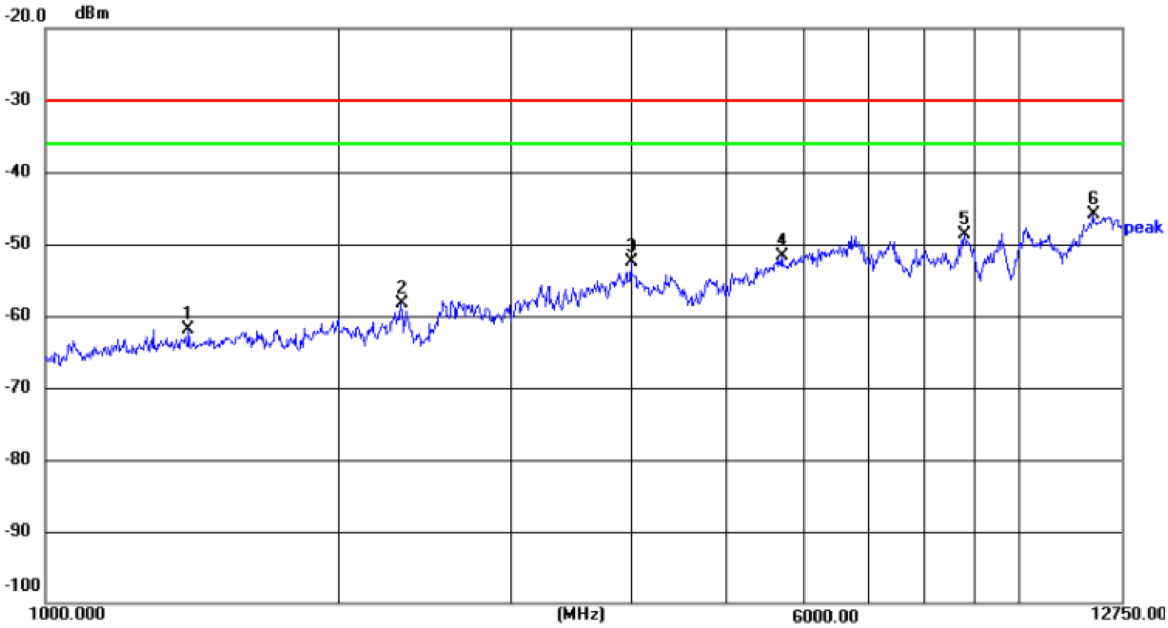
Radiated Emission Measurement

File :RF-RSE 4 Data :#6211 Date: 2024/04/24 Time: 4:01:05



Site LAB Chamber 2 Polarization: *Vertical* Temperature: 25(C)
Limit: ETSI EN300328TX(RF) Power: Humidity: 50 %
EUT: Distance: 3m
M/N:Aiper Surfer S1
Mode: BLE2M 2402MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1403.366	-51.44	-10.45	-61.89	-30.00	31.89	peak	150	97	P	
2	2316.426	-53.40	-4.95	-58.35	-30.00	28.35	peak	150	12	P	
3	3997.718	-55.61	3.14	-52.47	-30.00	22.47	peak	150	256	P	
4	5711.126	-57.34	5.65	-51.69	-30.00	21.69	peak	150	123	P	
5	8806.364	-58.52	9.85	-48.67	-30.00	18.67	peak	150	42	P	
6	11910.714	-58.71	12.81	-45.90	-30.00	15.90	peak	150	242	P	

BLE			
Channel:	CH39	Polarity:	Horizontal

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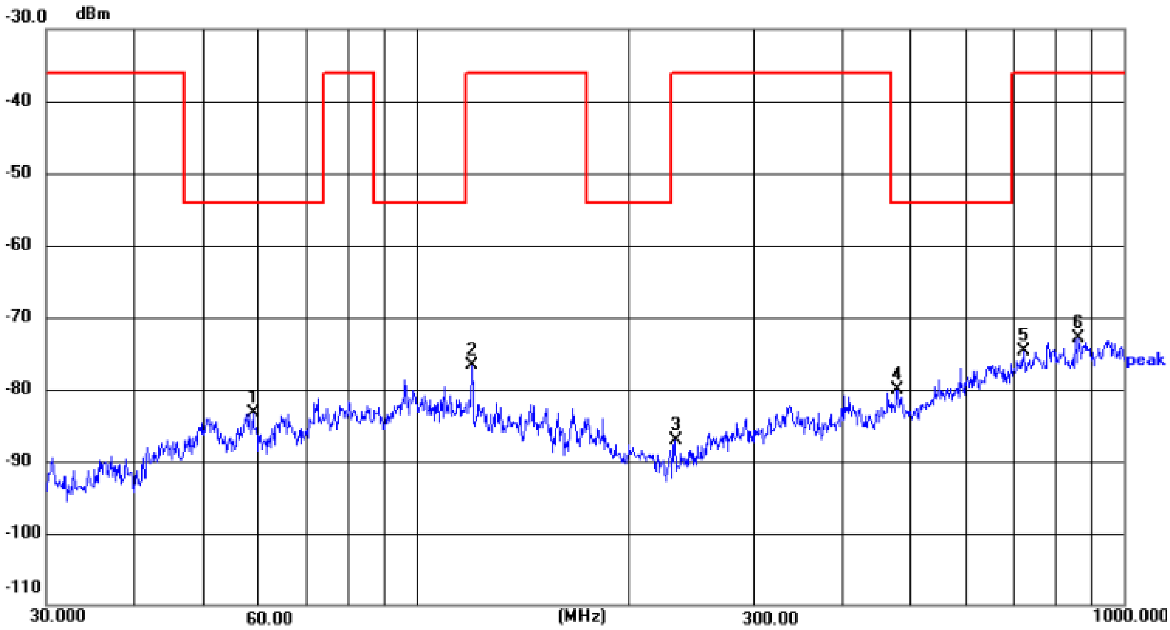
Radiated Emission Measurement

File :RF-RSE 4   Data :#6148   Date: 2024/04/24   Time: 2:36:27



Site LAB Chamber 2   Polarization: *Horizontal*   Temperature: 25(C)
Limit: ETSI EN300328TX(RF)   Power: Humidity: 50 %
EUT: Distance: 3m
M/N:Aiper Surfer S1
Mode: BLE2M 2480MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	58.8701	-70.59	-12.70	-83.29	-54.00	29.29	peak	150	0	P	
2	120.0133	-65.91	-10.73	-76.64	-36.00	40.64	peak	150	0	P	
3	232.0228	-68.33	-18.77	-87.10	-36.00	51.10	peak	150	0	P	
4	479.2655	-69.52	-10.63	-80.15	-54.00	26.15	peak	150	0	P	
5	723.9437	-69.22	-5.54	-74.76	-36.00	38.76	peak	150	0	P	
6	866.0879	-68.79	-4.12	-72.91	-36.00	36.91	peak	150	0	P	

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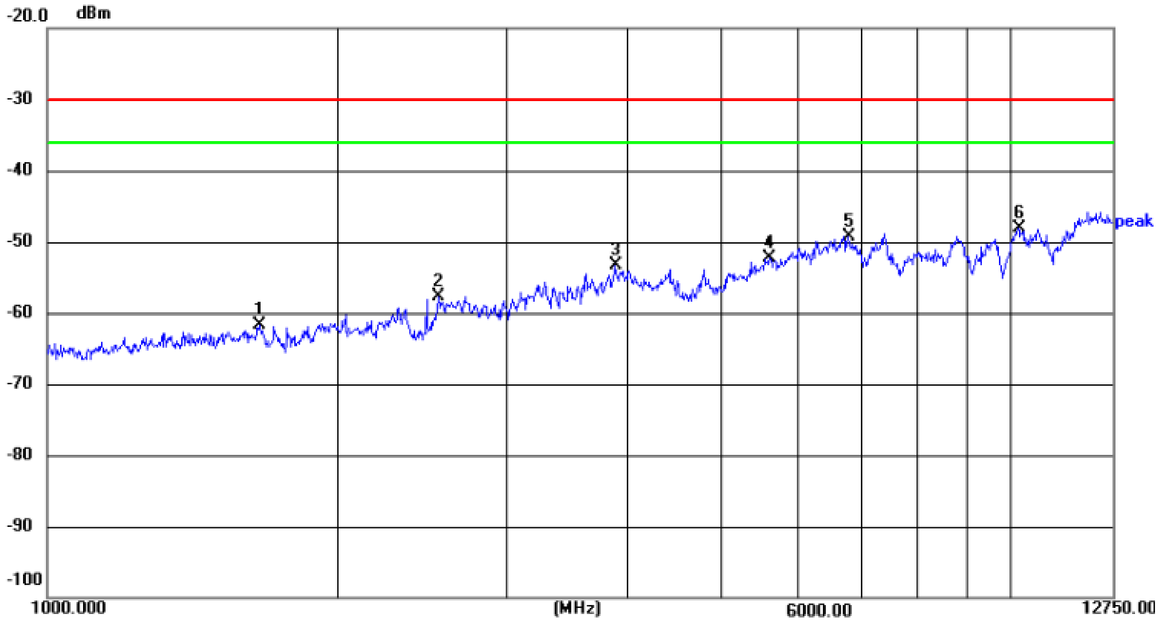
Radiated Emission Measurement

File :RF-RSE 4 Data :#6196 Date: 2024/04/24 Time: 3:36:17



Site LAB Chamber 2 Polarization: ***Horizontal*** Temperature: 25(C)
Limit: ETSI EN300328TX(RF) Power: Humidity: 50 %
EUT: Distance: 3m
M/N:Aiper Surfer S1
Mode: BLE2M 2480MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1660.630	-53.14	-8.63	-61.77	-30.00	31.77	peak	150	280	P	
2	2550.877	-54.44	-3.34	-57.78	-30.00	27.78	peak	150	161	P	
3	3887.331	-56.48	3.25	-53.23	-30.00	23.23	peak	150	360	P	
4	5620.983	-57.92	5.64	-52.28	-30.00	22.28	peak	150	327	P	
5	6775.309	-59.08	9.70	-49.38	-30.00	19.38	peak	150	261	P	
6	10184.716	-59.82	11.64	-48.18	-30.00	18.18	peak	150	231	P	

Channel:	CH39	Polarity:	Vertical

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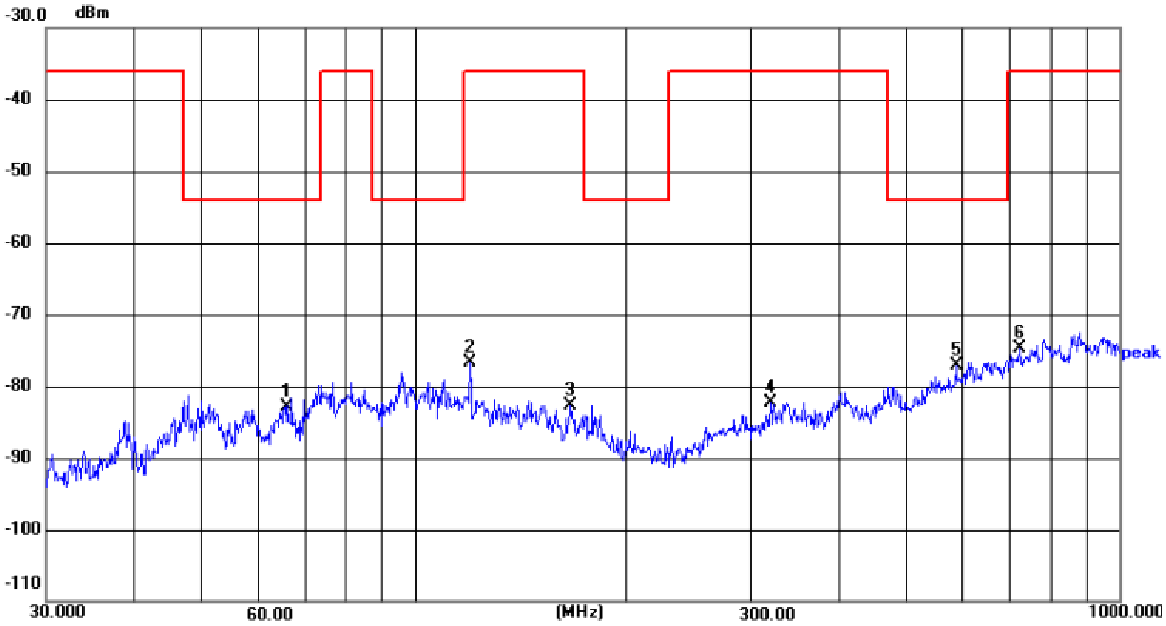
Radiated Emission Measurement

File :RF-RSE 4 Data :#6149 Date: 2024/04/24 Time: 2:36:38



Site LAB Chamber 2
Limit: ETSI EN300328TX(RF)
EUT:
M/N: Aiper Surfer S1
Mode: BLE2M 2480MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	65.7166	-70.26	-12.64	-82.90	-54.00	28.90	peak	150	0	P	
2	120.0133	-65.91	-10.73	-76.64	-36.00	40.64	peak	150	0	P	
3	167.0170	-69.17	-13.54	-82.71	-36.00	46.71	peak	150	0	P	
4	320.2175	-68.97	-13.33	-82.30	-36.00	46.30	peak	150	0	P	
5	588.3891	-68.73	-8.45	-77.18	-54.00	23.18	peak	150	0	P	
6	723.9437	-69.22	-5.54	-74.76	-36.00	38.76	peak	150	0	P	

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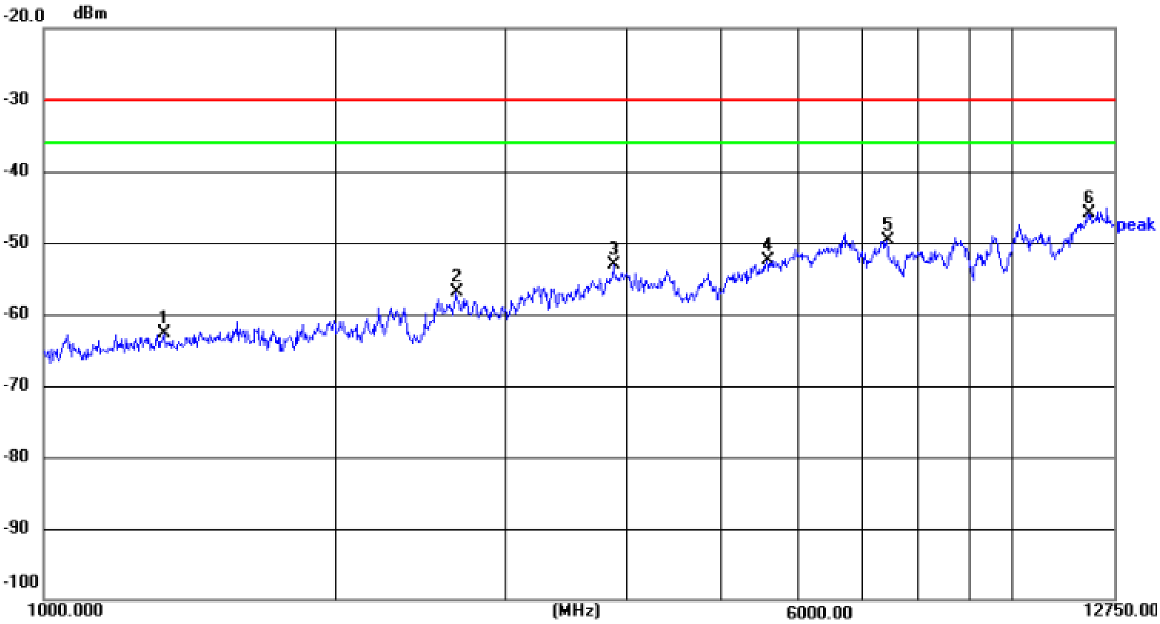
Radiated Emission Measurement

File :RF-RSE 4 Data :#6197 Date: 2024/04/24 Time: 3:37:29



Site LAB Chamber 2
Limit: ETSI EN300328TX(RF)
EUT:
M/N: Aiper Surfer S1
Mode: BLE2M 2480MHz TX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1333.284	-51.92	-10.77	-62.69	-30.00	32.69	peak	150	241	P	
2	2664.535	-53.70	-3.28	-56.98	-30.00	26.98	peak	150	241	P	
3	3876.214	-56.16	3.08	-53.08	-30.00	23.08	peak	150	64	P	
4	5579.997	-57.96	5.45	-52.51	-30.00	22.51	peak	150	343	P	
5	7413.726	-59.44	9.65	-49.79	-30.00	19.79	peak	150	35	P	
6	11971.507	-58.99	13.13	-45.86	-30.00	15.86	peak	150	71	P	

2.14 Receiver spurious emissions

LIMIT

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.10.3

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.

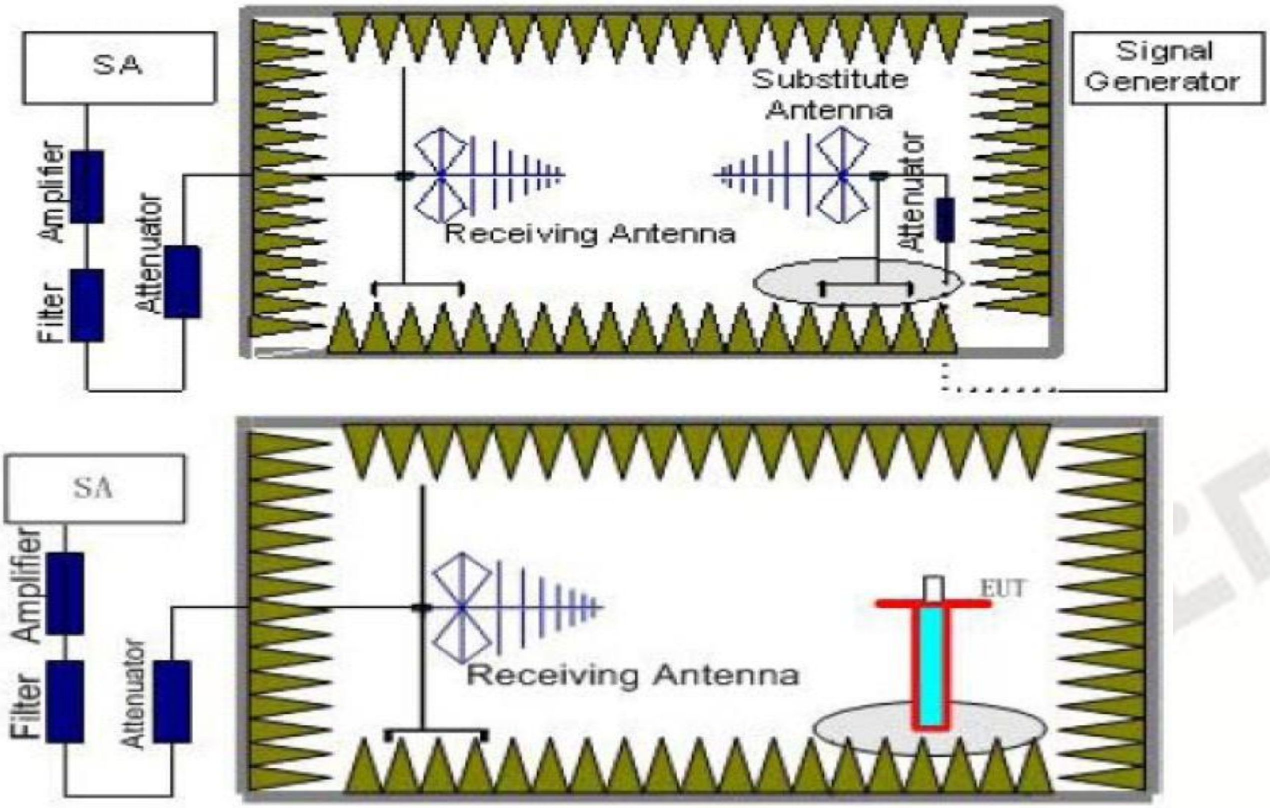
Table 13: Spurious emission limits for receivers

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

The same as clause 3.7

Test Configuration



Test Results

Note: All modes were tested, with only the following worst mode being captured (Test Mode 2)

BLE			
Channel:	*CH00*	*Polarity:*	*Horizontal*

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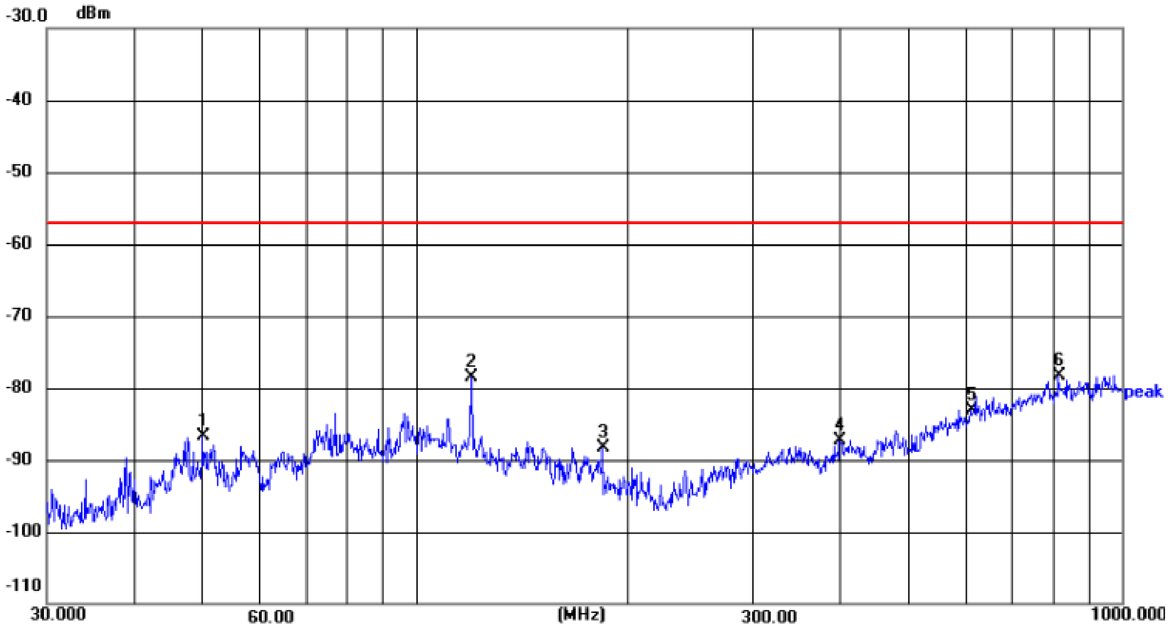
Radiated Emission Measurement

File :RF-RSE 4 Data :#6144 Date: 2024/04/24 Time: 2:35:23



Site LAB Chamber 2
Limit: ETSI EN300328RX(RF)
EUT:
M/N: Aiper Surfer S1
Mode: BLE2M 2402MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: ***Horizontal***
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	50.0128	-74.53	-12.12	-86.65	-57.00	29.65	peak	150	0	P	
2	120.0133	-67.72	-10.73	-78.45	-57.00	21.45	peak	150	0	P	
3	184.0053	-72.82	-15.41	-88.23	-57.00	31.23	peak	150	0	P	
4	398.6806	-75.12	-12.19	-87.31	-57.00	30.31	peak	150	0	P	
5	612.0642	-75.67	-7.33	-83.00	-57.00	26.00	peak	150	0	P	
6	814.5385	-74.42	-3.96	-78.38	-57.00	21.38	peak	150	0	P	

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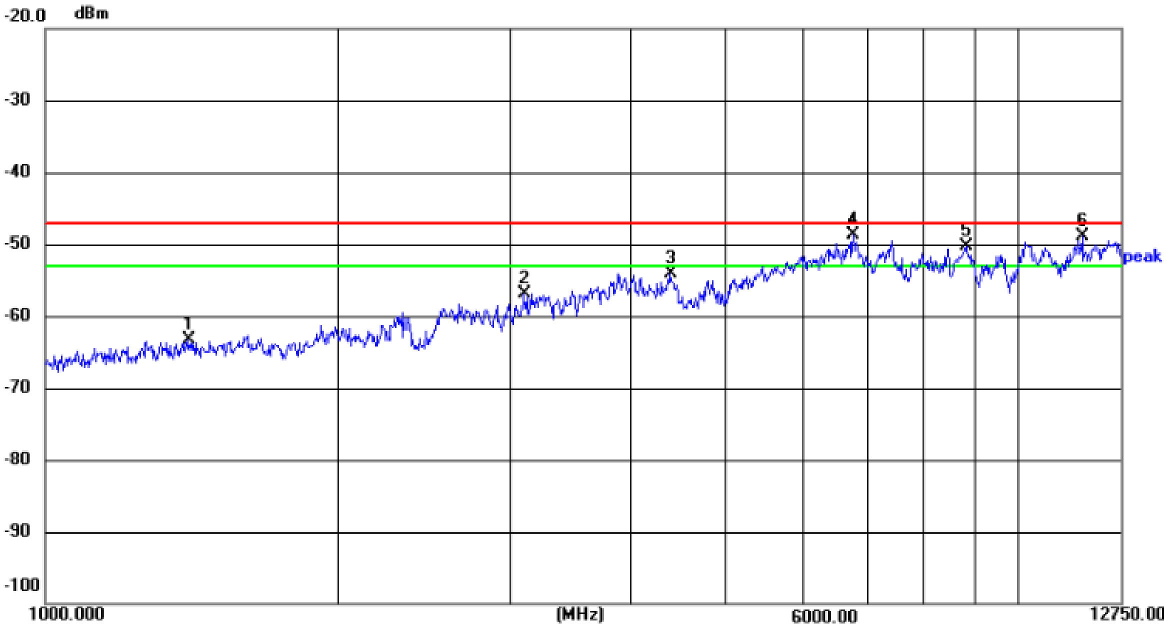
Radiated Emission Measurement

File :RF-RSE 4 Data :#6160 Date: 2024/04/24 Time: 2:48:29



Site LAB Chamber 2
Limit: ETSI EN300328RX(RF)
EUT:
M/N:Aiper Surfer S1
Mode: BLE2M 2402MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: *Horizontal*
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1404.260	-52.94	-10.45	-63.39	-47.00	16.39	peak	150	0	P	
2	3104.217	-55.50	-1.43	-56.93	-47.00	9.93	peak	150	0	P	
3	4392.543	-57.31	3.28	-54.03	-47.00	7.03	peak	150	0	P	
4	6764.538	-58.39	9.63	-48.76	-47.00	1.76	peak	150	0	P	
5	8840.054	-60.17	9.85	-50.32	-47.00	3.32	peak	150	0	P	
6	11633.538	-60.21	11.31	-48.90	-47.00	1.90	peak	150	0	P	

Channel:	CH00	Polarity:	Vertical

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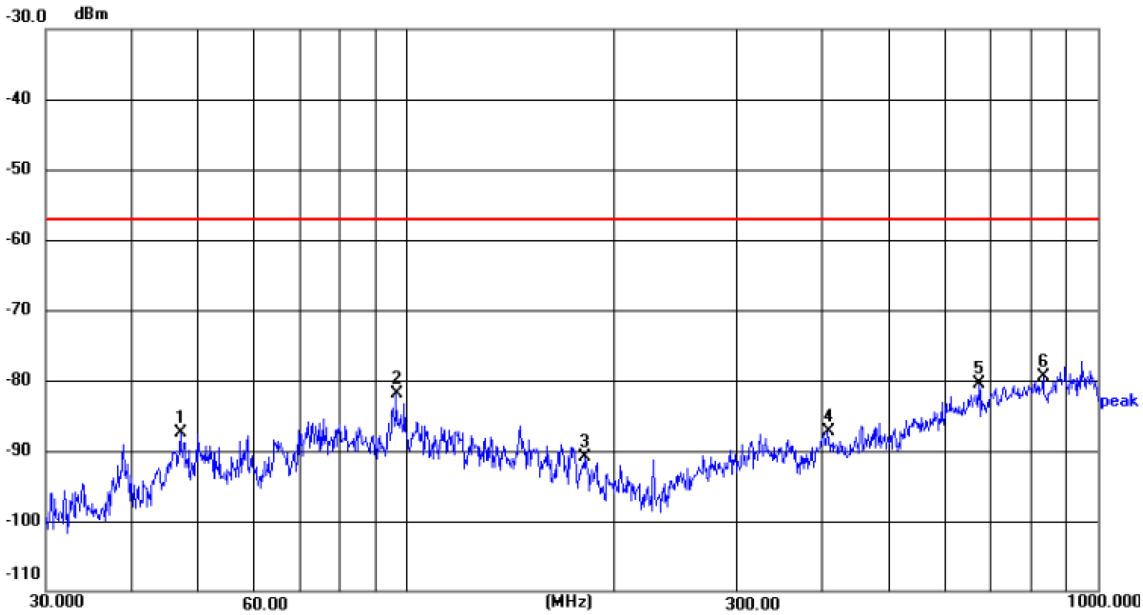
Radiated Emission Measurement

File :RF-RSE 4 Data :#6145 Date: 2024/04/24 Time: 2:35:35



Site LAB Chamber 2
Limit: ETSI EN300328RX(RF)
EUT:
M/N:Aiper Surfer S1
Mode: BLE2M 2402MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	47.0979	-74.14	-13.38	-87.52	-57.00	30.52	peak	150	0	P	
2	96.4362	-71.71	-10.26	-81.97	-57.00	24.97	peak	150	0	P	
3	180.8073	-76.21	-14.67	-90.88	-57.00	33.88	peak	150	0	P	
4	406.9790	-75.26	-12.07	-87.33	-57.00	30.33	peak	150	0	P	
5	672.8444	-74.07	-6.46	-80.53	-57.00	23.53	peak	150	0	P	
6	834.4136	-74.98	-4.52	-79.50	-57.00	22.50	peak	150	0	P	

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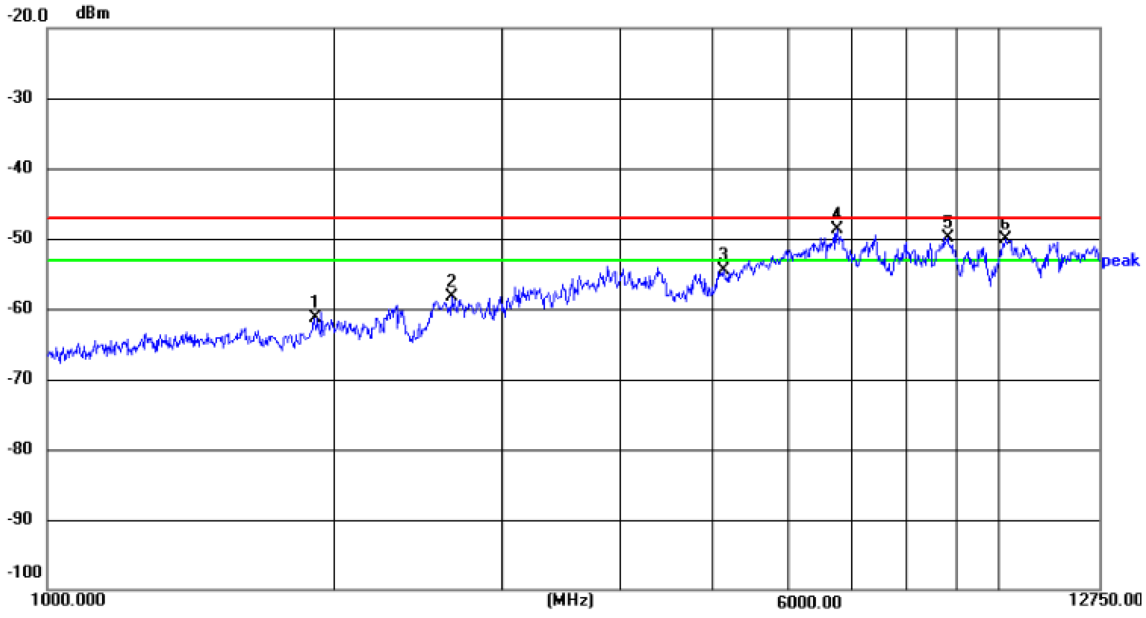
Radiated Emission Measurement

File :RF-RSE 4 Data :#6161 Date: 2024/04/24 Time: 2:48:48



Site LAB Chamber 2 Polarization: *Vertical* Temperature: 25(C)
Limit: ETSI EN300328RX(RF) Power: Humidity: 50 %
EUT: Distance: 3m
M/N: Aiper Surfer S1
Mode: BLE2M 2402MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1913.229	-54.96	-6.35	-61.31	-47.00	14.31	peak	150	0	P	
2	2657.761	-54.95	-3.30	-58.25	-47.00	11.25	peak	150	0	P	
3	5138.579	-57.99	3.49	-54.50	-47.00	7.50	peak	150	0	P	
4	6764.538	-58.39	9.63	-48.76	-47.00	1.76	peak	150	0	P	
5	8840.054	-59.67	9.85	-49.82	-47.00	2.82	peak	150	0	P	
6	10178.236	-61.78	11.67	-50.11	-47.00	3.11	peak	150	0	P	

BLE			
Channel:	CH39	Polarity:	Horizontal

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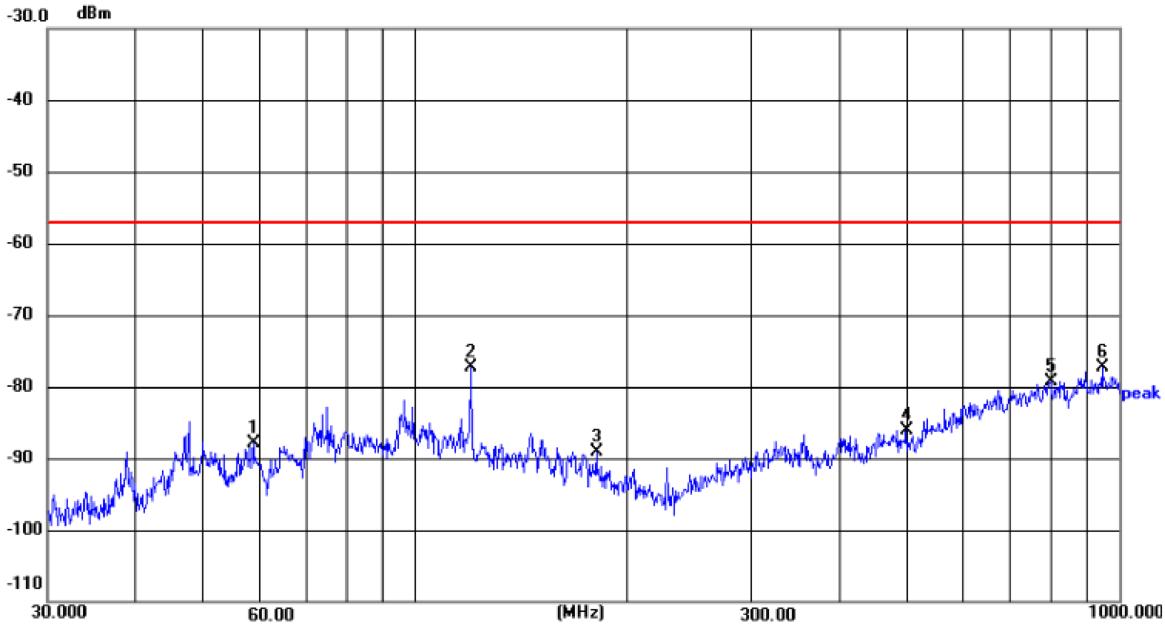
Radiated Emission Measurement

File :RF-RSE 4 Data :#6147 Date: 2024/04/24 Time: 2:36:00



Site LAB Chamber 2
Limit: ETSI EN300328RX(RF)
EUT:
M/N:Aiper Surfer S1
Mode: BLE2M 2480MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: Horizontal
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	58.8959	-75.18	-12.70	-87.88	-57.00	30.88	peak	150	0	P	
2	120.0133	-66.51	-10.73	-77.24	-57.00	20.24	peak	150	0	P	
3	180.8073	-74.35	-14.67	-89.02	-57.00	32.02	peak	150	0	P	
4	497.6765	-74.39	-11.74	-86.13	-57.00	29.13	peak	150	0	P	
5	798.9797	-74.93	-4.35	-79.28	-57.00	22.28	peak	150	0	P	
6	946.2691	-74.54	-2.76	-77.30	-57.00	20.30	peak	150	0	P	

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Radiated Emission Measurement

File :RF-RSE 4 Data :#6163 Date: 2024/04/24 Time: 2:49:25

Site LAB Chamber 2 Polarization: *Horizontal* Temperature: 25(C)
Limit: ETSI EN300328RX(RF) Power: Humidity: 50 %
EUT: Distance: 3m
M/N:Aiper Surfer S1
Mode: BLE2M 2480MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1610.158	-53.93	-8.73	-62.66	-47.00	15.66	peak	150	0	P	
2	3104.217	-55.51	-1.42	-56.93	-47.00	9.93	peak	150	0	P	
3	4392.543	-57.31	3.28	-54.03	-47.00	7.03	peak	150	0	P	
4	6764.538	-58.39	9.63	-48.76	-47.00	1.76	peak	150	0	P	
5	10120.108	-61.77	11.96	-49.81	-47.00	2.81	peak	150	0	P	
6	11956.279	-63.40	13.05	-50.35	-47.00	3.35	peak	150	0	P	

Channel:	CH39	Polarity:	Vertical

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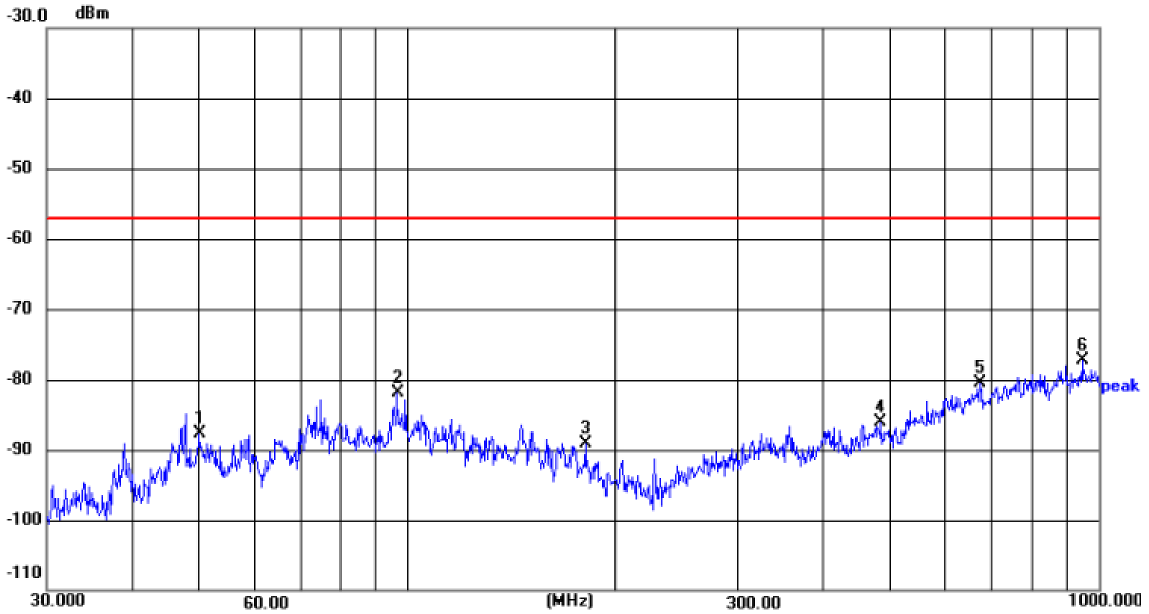
Radiated Emission Measurement

File :RF-RSE 4 Data :#6146 Date: 2024/04/24 Time: 2:35:49



Site LAB Chamber 2
Limit: ETSI EN300328RX(RF)
EUT:
M/N: Aiper Surfer S1
Mode: BLE2M 2480MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: *Vertical*
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	50.0128	-75.57	-12.12	-87.69	-57.00	30.69	peak	150	0	P	
2	96.4362	-71.71	-10.26	-81.97	-57.00	24.97	peak	150	0	P	
3	180.8073	-74.35	-14.67	-89.02	-57.00	32.02	peak	150	0	P	
4	484.7586	-75.08	-11.09	-86.17	-57.00	29.17	peak	150	0	P	
5	672.8444	-74.07	-6.46	-80.53	-57.00	23.53	peak	150	0	P	
6	946.2691	-74.54	-2.76	-77.30	-57.00	20.30	peak	150	0	P	

Shenzhen CTL Testing Technology Co., Ltd
Tel: +86-755-89486194

Radiated Emission Measurement

File :RF-RSE 4 Data :#6162 Date: 2024/04/24 Time: 2:49:10

Site LAB Chamber 2
Limit: ETSI EN300328RX(RF)
EUT:
M/N: Aiper Surfer S1
Mode: BLE2M 2480MHz RX
Note: Shenzhen Aiper Intelligent Co.,Ltd.

Polarization: ***Vertical***
Power:
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	1850.953	-55.55	-7.08	-62.63	-47.00	15.63	peak	150	0	P	
2	3104.217	-55.50	-1.43	-56.93	-47.00	9.93	peak	150	0	P	
3	3884.858	-57.03	3.22	-53.81	-47.00	6.81	peak	150	0	P	
4	6764.538	-58.39	9.63	-48.76	-47.00	1.76	peak	150	0	P	
5	7430.257	-58.80	9.22	-49.58	-47.00	2.58	peak	150	0	P	
6	10259.525	-61.02	11.27	-49.75	-47.00	2.75	peak	150	0	P	

2.15 Adaptivity(non-FHSS)

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.6.2.2

Requirements & Limits

Non-FHSS equipment using the non-LBT based Detect and Avoid mechanism, shall comply with the following minimum set of requirements:

1) During normal operation, the equipment shall evaluate the presence of a signal on its current operating channel. If it is determined that a signal is present with a level above the detection threshold defined in step 5 the channel shall be marked as 'unavailable'.

2) The channel shall remain unavailable for a minimum time equal to 1 s after which the channel may be considered again as an 'available' channel.

3) The total time during which an equipment has transmissions on a given channel without re-evaluating the availability of that channel, is defined as the Channel Occupancy Time.

4) The Channel Occupancy Time shall be less than 40 ms. Each such transmission sequence shall be followed by an Idle Period (no transmissions) of minimum 5 % of the Channel Occupancy Time with a minimum of 100 µs. After this, the procedure as in step 1 needs to be repeated.

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 × log10 (100 mW / Pout) (Pout in mW e.i.r.p.) 6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in table 9.

Table 9: Unwanted Signal parameters

Wanted signal mean power from companion device (dBm)	Unwanted signal frequency (MHz)	Unwanted CW signal power (dBm)
-30	2 395 or 2 488,5 (see note 1)	-35 (see note 2)
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 in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

Test Procedure

The different steps below define the procedure to verify the efficiency of the non-LBT based DAA adaptive mechanism of non-FHSS equipment.

For systems using multiple receive chains only one chain (antenna port) need to be tested. All other receiver inputs shall be terminated.

Step 1:

• The UUT shall connect to a companion device during the test. The interference signal generator, the unwanted signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5 although the interference and unwanted signal generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of both the UUT and the companion device and it should be possible to distinguish between either transmission. In addition, the spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals.

• Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 9 (clause 4.3.2.6.2.2). Testing of Unidirectional equipment does not require a link to be established with a companion device.

• The analyser shall be set as follows:

- RBW: ≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used)

- VBW: 3 × RBW (if the analyser does not support this setting, the highest available setting shall be used)

- Detector Mode: RMS

- Centre Frequency: Equal to the centre frequency of the operating channel

- Span: 0 Hz - Sweep time: > Channel Occupancy Time of the UUT

- Trace Mode: Clear/Write

- Trigger Mode: Video

Step 2:

• Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum transmitter activity ratio (TxOn / (TxOn + TxOff)) of 0,3. Where this is not possible, the UUT shall be configured to the maximum payload possible.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.2.2. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

Step 3: Adding the interference signal

• An interference signal as defined in clause B.7 is injected on the current operating channel of the UUT. The power spectral density level (at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clause 4.3.2.6.2.2, step 5.

Step 4: Verification of reaction to the interference signal

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall stop transmissions on the current operating channel being tested. The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.2.6.2.2, step 4.

ii) Apart from Short Control Signalling Transmissions (see iii) below), there shall be no subsequent transmissions on this operating channel for a (silent) period defined in clause 4.3.2.6.2.2, step 2. After that, the UUT may have normal transmissions again for the duration of a single Channel Occupancy Time period. Because the interference signal is still present, another silent period as defined in clause 4.3.2.6.2.2, step 2 needs to be included. This sequence is repeated as long as the interfering signal is present. To verify that the UUT is not resuming normal transmissions as long as the interference signal is present, the monitoring time may need to be 60 s or more.

iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interference signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2. The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

iv) Alternatively, the equipment may switch to a non-adaptive mode.

Step 5: Adding the unwanted signal

• With the interfering signal present, a 100 % duty cycle CW signal is inserted as the unwanted signal. The frequency and the level are provided in table 9 of clause 4.3.2.6.2.2.

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall not resume normal transmissions on the current operating channel as long as both the interference and unwanted signals remain present.

To verify that the UUT is not resuming normal transmissions as long as the interference and unwanted signals are present, the monitoring time may need to be 60 s or more.

ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interference and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.

The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

Step 6: Removing the interference and unwanted signal

• On removal of the interference and unwanted signal the UUT is allowed to start normal transmissions again on this channel however, it shall be verified that this shall only be done after the period defined in clause 4.3.2.6.2.2, step 2.

Step 7:

• Step 2 to step 6 shall be repeated for each of the frequencies to be tested.

LBT based non-FHSS equipment

Step 1 to step 7 below define the procedure to verify the efficiency of the LBT based adaptive mechanism of non-FHSS equipment. This method shall be applied to Load Based Equipment and Frame Based Equipment.

Step 1:

• The UUT shall connect to a companion device during the test. The interference signal generator, the unwanted signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5 although the interference and unwanted signal generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of both the UUT and the companion device and it should be possible to distinguish between either transmission. In addition, the spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals.

• Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 10 (clause 4.3.2.6.3.2.2) for Frame Based Equipment or in table 11 (clause 4.3.2.6.3.2.3) for Load Based Equipment. Testing of Unidirectional equipment does not require a link to be established with a companion device.

• The analyser shall be set as follows:

- RBW: ≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used)

- VBW: 3 × RBW (if the analyser does not support this setting, the highest available setting shall be used)

- Detector Mode: RMS

- Centre Frequency: Equal to the centre frequency of the operating channel

- Span: 0 Hz

- Sweep time: > maximum Channel Occupancy Time

- Trace Mode: Clear Write

- Trigger Mode: Video

Step 2:

• Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum transmitter activity ratio (TxOn / (TxOn + TxOff)) of 0,3. Where this is not possible, the UUT shall be configured to the maximum payload possible.

• For Frame Based Equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.3.2.2, step 3. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

• For Load Based equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.3.2.3, step 2 and step 3. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

For the purpose of testing Load Based Equipment referred to in the first paragraph of clause 4.3.2.6.3.2.3 (IEEE 802.11™ [i.3] or IEEE 802.15.4™ [i.4] equipment), the limits to be applied for the minimum Idle Period and the maximum Channel Occupancy Time are the same as defined for other types of Load Based Equipment (see clause 4.3.2.6.3.2.3, step 2 and step 3). The Idle Period is considered to be equal to the CCA or Extended CCA time defined in clause 4.3.2.6.3.2.3, step 1 and step 2.

Step 3: Adding the interference signal

• An interference signal as defined in clause B.7 is injected on the current operating channel of the UUT. The power spectral density level (at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clause 4.3.2.6.3.2.2, step 5 (frame based equipment) or clause 4.3.2.6.3.2.3, step 5 (load based equipment).

Step 4: Verification of reaction to the interference signal

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall stop transmissions on the current operating channel. The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.2.6.3.2.2 (frame based equipment) or clause 4.3.2.6.3.2.3 (load based equipment).

ii) Apart from Short Control Signalling Transmissions, there shall be no subsequent transmissions while the interfering signal is present. To verify that the UUT is not resuming normal transmissions as long as the interference signal is present, the monitoring time may need to be 60 s or more.

iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2. The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

iv) Alternatively, the equipment may switch to a non-adaptive mode.

Step 5: Adding the unwanted signal

• With the interfering signal present, a 100 % duty cycle CW signal is inserted as the unwanted signal. The frequency and the level are provided in table 10 (clause 4.3.2.6.3.2.2) for Frame Based Equipment or in table 11 (clause 4.3.2.6.3.2.3) for Load Based Equipment.

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall not resume normal transmissions on the current operating channel as long as both the interference and unwanted signals remain present. To verify that the UUT is not resuming normal transmissions as long as the interference and unwanted signals are present, the monitoring time may need to be 60 s or more.

ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2. The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

Step 6: Removing the interference and unwanted signal

• On removal of the interference and unwanted signals the UUT is allowed to start transmissions again on this channel; however, this is not a requirement and, therefore, does not require testing.

Step 7:

• Step 2 to step 6 shall be repeated for each of the frequencies to be tested.

Generic test procedure for measuring channel/frequency usage

This is a generic test method to evaluate transmissions on the operating (hopping) frequency being investigated. This test is performed as part of the procedures described in clause 5.4.6.2.1.2 to clause 5.4.6.2.1.4. The test procedure shall be as follows:

Step 1:

• The analyser shall be set as follows:
- Centre Frequency: Equal to the hopping frequency or centre frequency of the channel being investigated.
- Frequency Span: 0 Hz.
- RBW: ~ 50 % of the Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used).
- VBW: ≥ RBW (if the analyser does not support this setting, the highest available setting shall be used).
- Detector Mode: RMS.
- Sweep time: > the Channel Occupancy Time. It shall be noted that if the Channel Occupancy Time is non-contiguous (for non-LBT based FHSSequipment), the sweep time shall be sufficient to cover the period over which the Channel Occupancy Time is spread out.
- Number of sweep points: The time resolution has to be sufficient to meet the maximum measurement uncertainty of 5 % for the period to be measured. In most cases, the Idle Period is the shortest period to be measured and thereby defining the time resolution. If the Channel Occupancy Time is non-contiguous (non-LBT based FHSS equipment), there is no Idle Period to be measured and therefore the time resolution can be increased (e.g. to 5 % of the dwell time) to cover the period over which the Channel Occupancy Time is spread out, without resulting in too high a number of sweep points for the analyser.

EXAMPLE 1: For a Channel Occupancy Time of 60 ms, the minimum Idle Period is 3 ms, hence the minimum time resolution should be < 150 µs.

EXAMPLE 2: For a Channel Occupancy Time of 2 ms, the minimum Idle Period is 100 µs, hence the minimum time resolution should be < 5 µs.

EXAMPLE 3: In case of a FHSS equipment using the non-contiguous Channel Occupancy Time approach (40 ms) and using 79 hopping frequencies with a dwell time of 3,75 ms, the total period over which the Channel Occupancy Time is spread out is 3,2 s. With a time resolution 0,1875 ms (5 % of the dwell time), the minimum number of sweep points is ~ 17 000.

- Trace mode: Clear/Write
- Trigger: Video

In case of FHSS equipment, the data points resulting from transmissions on the hopping frequency being investigated are assumed to have much higher levels compared to data points resulting from transmissions on adjacent hopping frequencies. If a clear determination between these transmissions is not possible, the RBW in step 1 shall be further reduced. In addition, a channel filter may be used.

Step 2:

• Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

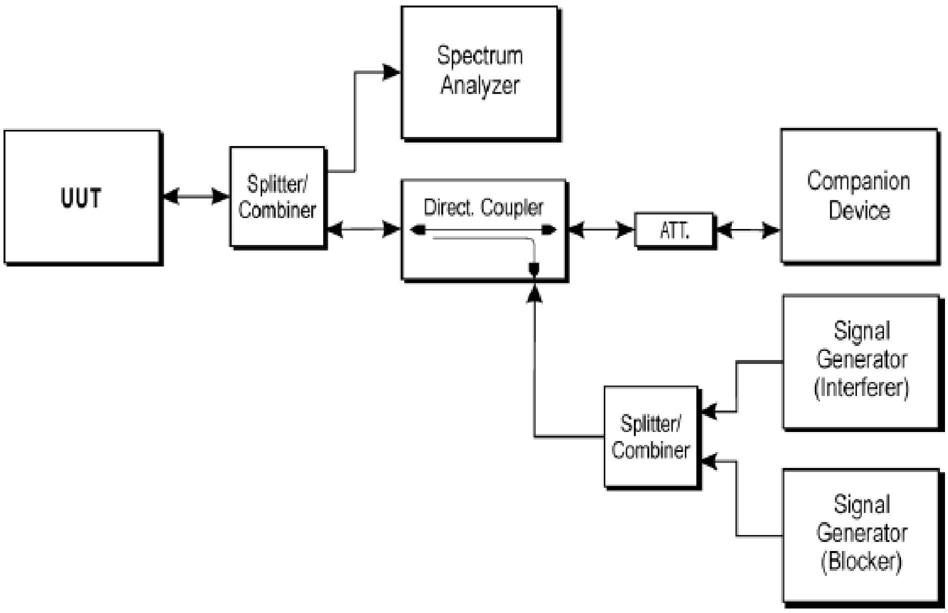
Step 3:

• Identify the data points related to the frequency being investigated by applying a threshold.

• Count the number of consecutive data points identified as resulting from a single transmission on the frequency being investigated and multiply this number by the time difference between two consecutive data points. Repeat this for all the transmissions within the measurement window.

• For measuring idle or silent periods, count the number of consecutive data points identified as resulting from a single transmitter off period on the frequency being investigated and multiply this number by the time difference between two consecutive data points. Repeat this for all the transmitter off periods within the measurement window.

Test Configuration



Test Results

Not applicable to this device which maximum RF Output power level is less than 10 dBm e.i.r.p.

2.16 Receiver Blocking

Limits

EN 300 328 V2.2.2 (2019-07) Sub-clause 4.3.2.11.4

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 6, table 7 or table 8.

Table 6: 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.

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

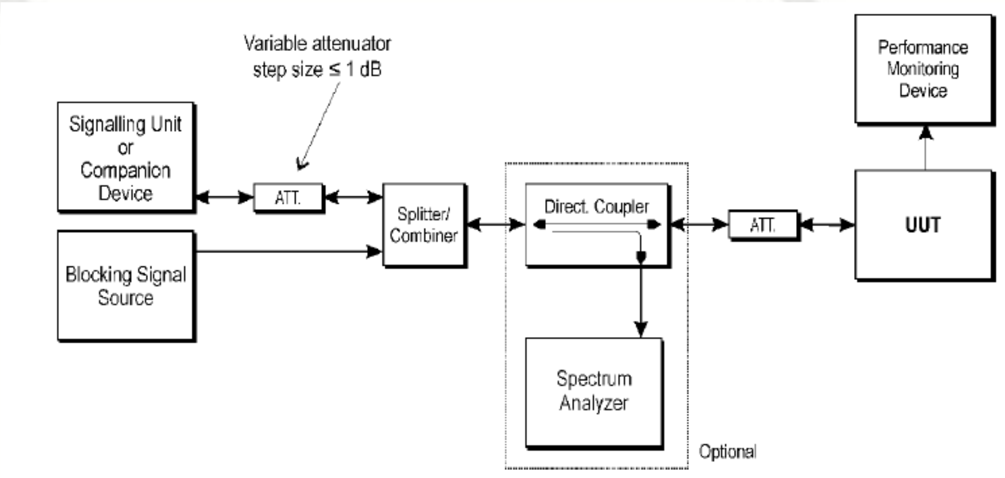
NOTE 1: OCBW is in Hz.
NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal 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.

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.

Test Configuration



Test Procedure

The procedure in step 1 to step 6 below shall be used to verify the receiver blocking requirement as described in clause 4.3.1.12 or clause 4.3.2.11.

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.

• 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. Where the manufacturer has declared the actual antenna gain for each of the applicable blocking frequencies (see clause 5.4.1 m) ii)) this blocking level shall be adjusted for the difference between the in-band antenna assembly gain (G) and the actual antenna gain for the blocking frequency being tested. See also note 5 in table 6, note 4 in table 7 and note 4 in table 8 or note 5 in table 14, note 4 in table 15 and note 4 in table 16. Where the actual antenna gains at the blocking frequencies have not been declared, then the antenna gain at the blocking frequencies shall be assumed identical to the in-band antenna gain.

• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is 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 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 result

Remark:

1. *According to the Power measurement the device belongs to Receiver category 2.*
2. *With the blocking signal generator switched off, adjust variable attenuator value by 1dB until to communication once cannot maintains. Then replace EUT by a power sensor, measure the power and recorded as P_{min}.*

Test Frequency (MHz)	Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	PER
2402	P_{min} + 26dB	2380	-34	6.9%
	P_{min} + 26dB	2504		4.2%
	P_{min} + 26dB	2300		5.4%
	P_{min} + 26dB	2584		7.6%
2480	P_{min} + 26dB	2380		4.8%
	P_{min} + 26dB	2504		2.2%
	P_{min} + 26dB	2300		4.6%
	P_{min} + 26dB	2584		7.4%

3. Note: P_{min}=-68dBm

3 Test Setup Photos of the EUT

4 External and Internal Photos of the EUT

Reference to the test report No. CTL2312127041-WE

************************* End of Report *************************

5 ANNEX E

Information as required by EN 300 328 V2.2.2, clause 5.4.1

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

a) The type of modulation used by the equipment:

☐FHSS
☒Other forms of modulation

b) In case of FHSS modulation:

- In case of non-Adaptive Frequency Hopping equipment:
  The number of Hopping Frequencies:
- In case of Adaptive Frequency Hopping Equipment:
  The maximum number of Hopping Frequencies:
  The minimum number of Hopping Frequencies:
- The (average) Dwell Time:

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 Channel Occupancy Time implemented by the equipment: ms
☒The equipment has implemented an LBT based DAA mechanism

- In case of equipment using modulation different from FHSS:
  ☐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:

☐The equipment has implemented an non-LBT based DAA mechanism
☐The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): dBm
The maximum (corresponding) Duty Cycle: %
Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared):

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

- RF Output Power
  LE1M,
- Power Spectral Density
  LE1M,
- Duty cycle, Tx-Sequence, Tx-gap
  N/A
- Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment)
  N/A
- Hopping Frequency Separation (only for FHSS equipment)
  N/A
- Medium Utilisation
  N/A
- Adaptivity
  N/A
- Occupied Channel Bandwidth

LE1M

- Transmitter unwanted emissions in the OOB domain
  LE1M
- Transmitter unwanted emissions in the spurious domain
  LE1M,
- Receiver spurious emissions
  LE1M,
- Receiver Blocking
  LE1M

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

☒Operating mode 1: Single Antenna Equipment
☒Equipment with only 1 antenna
☐Equipment with 2 diversity antennas but only 1 antenna active at any moment in time
☐Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] 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™ [i.3] legacy mode)
☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
☐Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming
☐Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)
☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
☐High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

h) In case of Smart Antenna Systems:

- The number of Receive chains:
- The number of Transmit chains:
  ☐Symmetrical power distribution
  ☐Asymmetrical power distribution

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

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

- Operating Frequency Range 1: 2402MHz to2480MHz

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

j) Occupied Channel Bandwidth(s):

- Occupied Channel Bandwidth 1: 2MHz

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

☒Stand-alone
☐Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)
☐Plug-in radio device (Equipment intended for a variety of host systems)
☐Other

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

Operating temperature range: -20° C to +55° C
Operating voltage range: 2.97V to 3.63V ☐AC ☒DC
Details provided are for the: ☒stand-alone equipment
☐Combined (or host) equipment
☐Test jig

m) 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:

☒PCB Antenna

Antenna Gain: 4.81dBi

If applicable, additional beamforming gain (excluding basic antenna gain): dB

☒Temporary RF connector provided

☐No temporary RF connector provided

☐Dedicated Antennas (equipment with antenna connector)

☐Single power level with corresponding antenna(s)

☐Multiple power settings and corresponding antenna(s)

Number of different Power Levels:

Power Level 1:	6.62	dBm
Power Level 2:		dBm
Power Level 3:		dBm

n) 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: ☒stand-alone equipment
☐combined (or host) equipment
☐test jig

Supply Voltage ☒AC mains State AC voltage 220V
☒DC State DC voltage 10.8V

In case of DC, indicate the type of power source
☐Internal Power Supply
☒External Power Supply or AC/DC adapter
☒Battery
☐Other: DC 5V from PC

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

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):
Bluetooth®

q) 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

r) Describe the minimum performance criteria that apply to the equipment (see clause 4.3.1.12.3 or clause 4.3.2.11.3):
N/A