

<b>Prüfbericht-Nr.:</b> <i>Test report no.:</i>	<b>NN23C2NI 001</b>	<b>Auftrags-Nr.:</b> <i>Order no.:</i>	<b>168439281</b>	<b>Seite 1 von 21</b> <i>Page 1 of 21</i>
<b>Kunden-Referenz-Nr.:</b> <i>Client reference no.:</i>	N/A	<b>Auftragsdatum:</b> <i>Order date:</i>	2023-08-05	
<b>Auftraggeber:</b> <i>Client:</i>	<b>IKEA of Sweden AB</b> Box 702, SE-343 81 Älmhult, Sweden			
<b>Prüfgegenstand:</b> <i>Test item:</i>	Plug Smart			
<b>Bezeichnung / Typ-Nr.:</b> <i>Identification / Type no.:</i>	E2220 (Trademark: IKEA)			
<b>Auftrags-Inhalt:</b> <i>Order content:</i>	Test Report			
<b>Prüfgrundlage:</b> <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 15: Subpart C Section 15.207	RSS-247 Issue 3 August 2023 RSS-Gen Issue 5 February 2021 ANSI C63.10:2013		
<b>Wareneingangsdatum:</b> <i>Date of sample receipt:</i>	2023-08-15	Please refer to Photo Document		
<b>Prüfmuster-Nr.:</b> <i>Test sample no.:</i>	A003538734-001-004			
<b>Prüfzeitraum:</b> <i>Testing period:</i>	2023-08-05 – 2023-08-25			
<b>Ort der Prüfung:</b> <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
<b>Prüflaboratorium:</b> <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
<b>Prüfergebnis*:</b> <i>Test result*:</i>	Pass			
<b>geprüft von:</b> <i>tested by:</i>	<input checked="" type="checkbox"/> <u>Breeze Jiang</u>	<b>genehmigt von:</b> <i>authorized by:</i>	<input checked="" type="checkbox"/> <u>Bell Hu</u>	
<b>Datum:</b> <i>Date:</i>	2023-11-15 <small>Signed by: Breeze Jiang</small>	<b>Ausstellungsdatum:</b> <i>Issue date:</i>	2023-11-15 <small>Signed by: Bell Hu</small>	
<b>Stellung / Position:</b>	Sachverständige(r)/Expert	<b>Stellung / Position:</b>	Sachverständige(r)/Expert	
<b>Sonstiges /</b> <i>Other:</i>	FCC ID: FHO-E2220 IC: 10912A-E2220      HVIN: E2220			
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
<small>* Legende:</small>	<small>P(ass) = entspricht o.g. Prüfgrundlage(n)</small>	<small>F(ail) = entspricht nicht o.g. Prüfgrundlage(n)</small>	<small>N/A = nicht anwendbar</small>	<small>N/T = nicht getestet</small>
<small>* Legend:</small>	<small>P(ass) = passed a.m. test specification(s)</small>	<small>F(ail) = failed a.m. test specification(s)</small>	<small>N/A = not applicable</small>	<small>N/T = not tested</small>
<b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b> <i>This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

v05

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Test report no.:

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**Anmerkungen**  
*Remarks*

1	<p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>
2	<p>Wie vertraglich vereinbart, wurde dieses Dokument nur digital unterzeichnet. Der TÜV Rheinland hat nicht überprüft, welche rechtlichen oder sonstigen diesbezüglichen Anforderungen für dieses Dokument gelten. Diese Überprüfung liegt in der Verantwortung des Benutzers dieses Dokuments. Auf Verlangen des Kunden kann der TÜV Rheinland die Gültigkeit der digitalen Signatur durch ein gesondertes Dokument bestätigen. Diese Anfrage ist an unseren Vertrieb zu richten. Eine Umweltgebühr für einen solchen zusätzlichen Service wird erhoben.</p> <p><i>As contractually agreed, this document has been signed digitally only. TUV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TUV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged.</i></p>
3	<p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>
4	<p>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</p> <p><i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i></p>

## Test Summary

**5.1.1 ANTENNA REQUIREMENT**

RESULT: Pass

**5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER**

RESULT: Pass

**5.1.3 CONDUCTED POWER SPECTRAL DENSITY**

RESULT: Pass

**5.1.4 99%dB BANDWIDTH**

RESULT: Pass

**5.1.5 6dB BANDWIDTH**

RESULT: Pass

**5.1.6 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHz BANDWIDTH**

RESULT: Pass

**5.1.7 RADIATED SPURIOUS EMISSION**

RESULT: Pass

**5.1.8 CONDUCTED EMISSION ON AC MAINS**

RESULT: Pass

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## 1 General Remarks

### 1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Test Results of Conducted & Radiated Testing

Appendix B: Photographs of the Test Set-up

## 2 Test Sites

### 2.1 Test Facilities

**TÜV Rheinland (Shenzhen) Co., Ltd.**

No. 362 Huanguan Road Middle, Longhua District, Shenzhen 518110, People's Republic of China

FCC Registration No.: 694916

IC Registration No.: 25069 and the CAB identifier is CN0078.

## 2.2 List of Test and Measurement Instruments

**Table 1: List of Test and Measurement Equipment**

<b>Radio Spectrum Testing (SRD-Tonscend)</b>				
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model</b>	<b>Serial No.</b>	<b>Cal. until</b>
Wireless Connectivity Tester	R&S	CMW270	101375	2024-07-25
Signal Analyzer	R&S	FSV 40	101441	2024-07-25
Vector Signal Generator	R&S	SMBV100A	263301	2024-07-25
Signal Generator	R&S	SMB100A	115186	2024-07-25
OSP	R&S	OSP 150	101017	2023-11-21
Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A
Test Software	R&S	WMS32(V11.00.00 )	N/A	N/A
Power Meter	R&S	NRP2	107105	2023-11-21
Power Sensor	R&S	NRP-Z81	105677	2024-07-25
<b>Unwanted Emission Testing (TS9975)</b>				
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model</b>	<b>Serial No.</b>	<b>Cal. until</b>
EMI Test Receiver	R&S	ESR 7	102021	2024-07-25
Signal Analyzer	R&S	FSV 40	101439	2024-07-25
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2024-07-25
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2024-07-25
Amplifier	R&S	SCU-18F	180070	2024-07-25
Amplifier	R&S	SCU40A	100475	2024-07-25
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2024-06-08
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2024-06-08
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2024-08-27
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2024-06-08
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2024-06-22

<b>Conducted Emissions</b>				
<b>Equipment</b>	<b>Manufacturer</b>	<b>M/N</b>	<b>S/N</b>	<b>Calibrated until</b>
EMI Test Receiver	R&S	ESR3	102680	2024-07-30
Artificial Mains Network	R&S	ENV216	101445	2024-08-01
EMC32 test software	R&S	EMC32(Ver.10.50.00)	N/A	N/A

## 2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

## 2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

## 2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Parameter	Uncertainty (k=2)
Occupied Channel Bandwidth	± 2.08 %
RF output power, conducted	± 0.99 dB
RF power density, conducted	± 0.99 dB
Unwanted Emissions, conducted	± 0.89 dB
All emissions, radiated	± 4.17 dB
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	± 3.70 dB / ± 3.30 dB

## 2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) file for certification follow-up purposes.

## 2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at No. 362 Huanguan Road Middle, Longhua District, Shenzhen 518110, People's Republic of China. is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

### 3 General Product Information

#### 3.1 Product Function and Intended Use

The EUT is Plug Smart which supports 2.4GHz ZigBee wireless technology.

For details refer to the User Manual and Circuit Diagram.

#### 3.2 Ratings and System Details

**Table 2: Technical Specification of EUT**

General Information of EUT	Value
Kind of Equipment	Plug Smart
Type Designation	E2220
Trademark	IKEA
FCC ID	FHO-E2220
IC	10912A-E2220
HVIN	E2220
Operating Voltage	AC 120V 50/60Hz
Testing Voltage	DC 3.3V From USB debugging board AC 120V 60Hz
Technical Specification of ZigBee	
Characteristic	Description
Frequency Range	2405.0 - 2480.0 MHz
Type of Modulation	DSSS(OQPSK)
Channel Number	16 channels
Channel Separation	5 MHz
Receiver Categories	Receiver category 2
Antenna Type	Internal Antenna
Antenna Gain	0 dBi

**Table 3: RF Channel and Frequency of ZigBee**

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
<b>11</b>	<b>2405.0</b>	15	2425.0	<b>19</b>	<b>2445.0</b>	23	2465.0
12	2410.0	16	2430.0	20	2450.0	24	2470.0
13	2415.0	17	2435.0	21	2455.0	25	2475.0
14	2420.0	18	2440.0	22	2460.0	<b>26</b>	<b>2480.0</b>

Test frequencies are lowest channel: 2405.0 MHz, middle channel: 2445.0 MHz and highest channel: 2480.0 MHz.



### 3.3 Independent Operation Modes

The basic operation modes are:

- A. On, ZigBee transmitting mode
  - 1. Low channel
  - 2. Middle channel
  - 3. High channel
- B. On, normal operating
- C. Off

### 3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

### 3.5 Submitted Documents

- Application Form
- Block Diagram
- FCC/IC Label and Location Info
- Operation Description
- Photo Document
- Schematics
- User Manual

## 4 Test Set-up and Operation Modes

### 4.1 Principle of Configuration Selection

**Radio Spectrum:** The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

**Emission:** The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

### 4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All testing were performed according to the procedures in ANSI C63.10: 2013.

**Table 4: List of Power Level setting under Test**

Test Mode	Power Level setting in software
ZigBee	10

### 4.3 Special Accessories and Auxiliary Equipment

**Table 5: List of Accessories and Auxiliary Equipment**

Description	Manufacturer	Model	S/N
Personnal Computer	Lenovo	ThinkCenter M910t	M70760G2
Zigbee Modular	LEEDARSON LIGHTING CO., LTD.	LDS73B000A	N/A
Bulb	LEEDARSON LIGHTING CO., LTD.	N/A	N/A

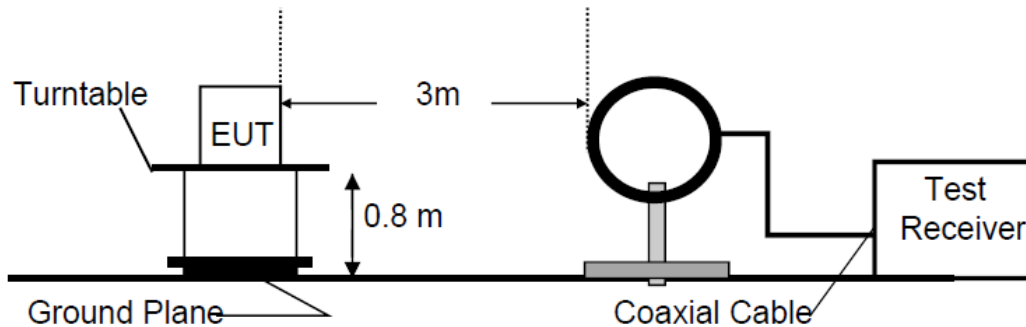
### 4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

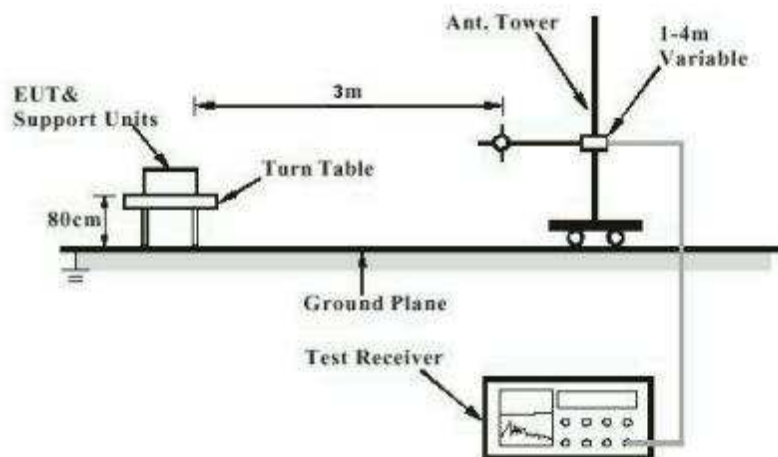
No additional measures were employed to achieve compliance.

## 4.5 Test Setup Diagram

**Diagram of Measurement Configuration for Radiation Test (Below 30MHz)**



**Diagram of Measurement Configuration for Radiation Test (Below 1GHz)**



**Diagram of Measurement Configuration for Radiation Test (Above 1GHz)**

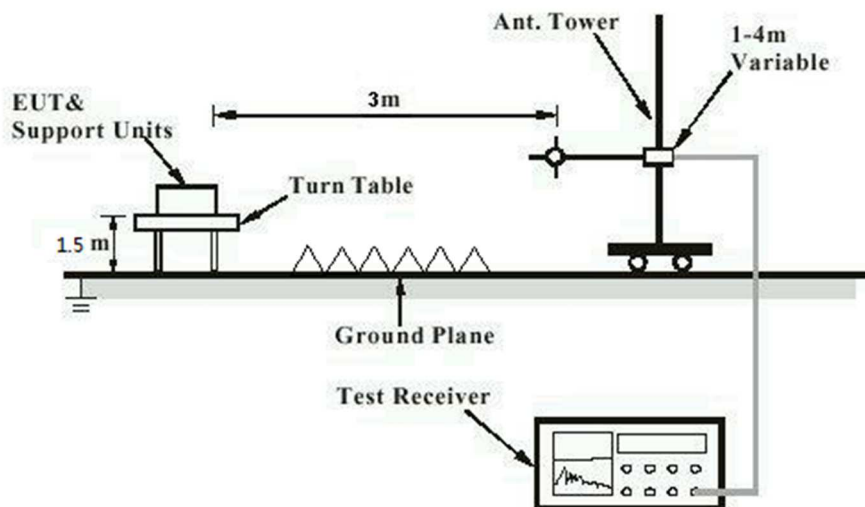


Diagram of Measurement Configuration for Mains Conduction Measurement

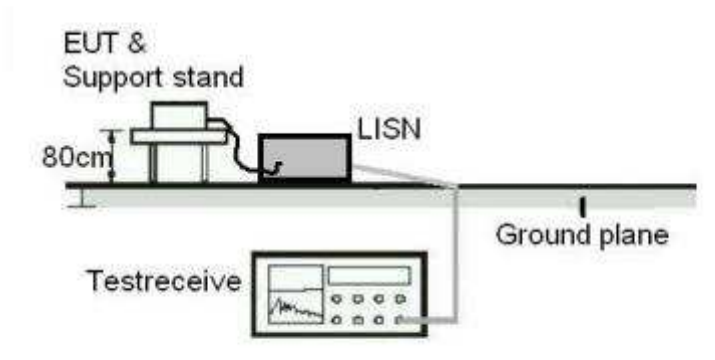
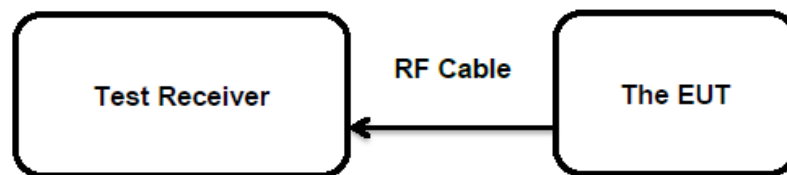


Diagram of Measurement Configuration for Conducted Transmitter Measurement



## 5 Test Results

### 5.1 Transmitter Requirement & Test Suites

#### 5.1.1 Antenna Requirement

**RESULT:****Pass****Test Specification**

Test standard	:	FCC Part 15.247(b)(4) and Part 15.203
	:	RSS-Gen Clause 6.8
Limit	:	the use of antennas with directional gains that do not exceed 6 dBi

According to the manufacturer declared, the EUT has one Internal antenna, the directional gain of antennas are 0 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

### 5.1.2 Maximum Peak Conducted Output Power

**RESULT:**
**Pass**
**Test Specification**

Test standard : FCC Part 15.247(b)(3)  
 : RSS-247 Clause 5.4(a)&(d)  
 Basic standard : ANSI C63.10: 2013  
 Limits : < 1 Watt (Maximum Conducted Peak Power)  
 : e.i.r.p. <4W  
 Kind of test site : Shielded Room

**Test Setup**

Date of testing : 2023-08-22  
 Input voltage : DC 3.3V From USB debugging board  
 Operation mode : A  
 Test channel : Low / Middle / High  
 Ambient temperature : 25.2 °C  
 Relative humidity : 42 %  
 Atmospheric pressure : 101 kPa

For details refer to following test result.

**Table 6: Test Result of Maximum Peak Conducted Output Power**

Test Mode	Antenna	Test Channel (MHz)	Measured Peak Power		Limit (W)
			(dBm)	(W)	
ZigBee	Ant1	2405	11.88	0.0154	< 1.0
		2445	11.83	0.0152	
		2480	11.90	0.0155	
<b>Maximum Measured Value</b>			11.90	0.0155	

Note:

- 1) The cable loss is taken into account in results.
- 2) Antenna gain(G): 0 dBi

### 5.1.3 Conducted Power Spectral Density

**RESULT:****Pass****Test Specification**

Test standard	:	FCC Part 15.247(e) RSS-247 Clause 5.2(b), RSS-247 Clause 5.3
Basic standard	:	ANSI C63.10: 2013
Limits	:	8 dBm / 3kHz
Kind of test site	:	Shielded Room

**Test Setup**

Date of testing	:	2023-08-22
Input voltage	:	DC 3.3V From USB debugging board
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	25.2 °C
Relative humidity	:	42 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix A.

### 5.1.4 99%dB Bandwidth

**RESULT:****Pass****Test Specification**

Test standard : RSS-Gen clause 6.7  
Basic standard : ANSI C63.10: 2013  
Kind of test site : Shielded Room

**Test Setup**

Date of testing : 2023-08-22  
Input voltage : DC 3.3V From USB debugging board  
Operation mode : A  
Test channel : Low / Middle / High  
Ambient temperature : 25.2 °C  
Relative humidity : 42 %  
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix A.



### 5.1.5 6dB Bandwidth

**RESULT:****Pass****Test Specification**

Test standard	:	FCC Part 15.247(a)(2) RSS-247 Clause 5.2(a)
Basic standard	:	ANSI C63.10: 2013
Kind of test site	:	Shielded Room

**Test Setup**

Date of testing	:	2023-08-22
Input voltage	:	DC 3.3V From USB debugging board
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	25.2 °C
Relative humidity	:	42 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix A.

## 5.1.6 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

**RESULT:****Pass****Test Specification**

Test standard	:	FCC Part 15.247(d) RSS-247 Clause 5.5
Basic standard	:	ANSI C63.10: 2013
Limits	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	:	Shielded Room

**Test Setup**

Date of testing	:	2023-08-22
Input voltage	:	DC 3.3V From USB debugging board
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	25.2 °C
Relative humidity	:	42 %
Atmospheric pressure	:	101 kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to test plots, and compliance is achieved as well.

For the measurement records, refer to the appendix A.

## 5.1.7 Radiated Spurious Emission

**RESULT:****Pass****Test Specification**

Test standard	:	FCC Part 15.247(d) & FCC Part 15.205 RSS-247 Clause 3.3 & 5.5
Basic standard	:	ANSI C63.10: 2013
Limits	:	Refer to 15.209(a) of FCC part 15.247(d) RSS-Gen Table 4 & Table 5
Kind of test site	:	3m Semi-anechoic Chamber

**Test Setup**

Date of testing	:	2023-08-20 to 2023-08-23
Input voltage	:	AC 120V 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	Refer to test result
Relative humidity	:	Refer to test result
Atmospheric pressure	:	101 kPa

**Remark:**

Testing was carried out within frequency range 9kHz to the tenth harmonics. Only the worst case spurious emissions configuration of the each mode were reported.

For the measurement records, refer to the appendix A.

## 5.1.8 Conducted Emission on AC Mains

**RESULT:****Pass****Test Specification**

Test standard	:	FCC Part 15.207(a) RSS-Gen Clause 8.8
Basic standard	:	ANSI C63.10: 2013
Frequency range	:	0.15 – 30MHz
Limits	:	FCC Part 15.207(a) RSS-Gen Table 4
Kind of test site	:	Shielded Room
Date of testing	:	2023-08-20 to 2023-08-23
Input voltage	:	AC 120V 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	Refer to test result
Relative humidity	:	Refer to test result
Atmospheric pressure	:	101 kPa

**Remark:**

Testing was carried out within frequency range 9kHz to the tenth harmonics. Only the worst case spurious emissions configuration of the each mode were reported.

For the measurement records, refer to the appendix A.

## 6 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix B.

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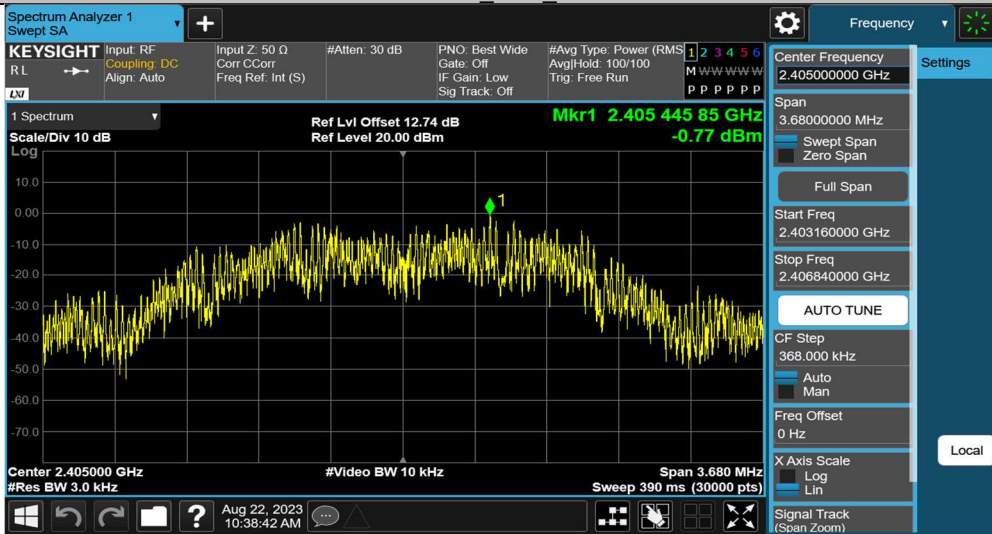
## Appendix A: Test Results

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### Appendix A.1: Test Results of Conducted Power Spectral Density

TestMode	Antenna	Frequency[MHz]	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
Zigbee	Ant1	2405	-0.77	≤8.00	PASS
		2445	-1.23	≤8.00	PASS
		2480	-1.22	≤8.00	PASS

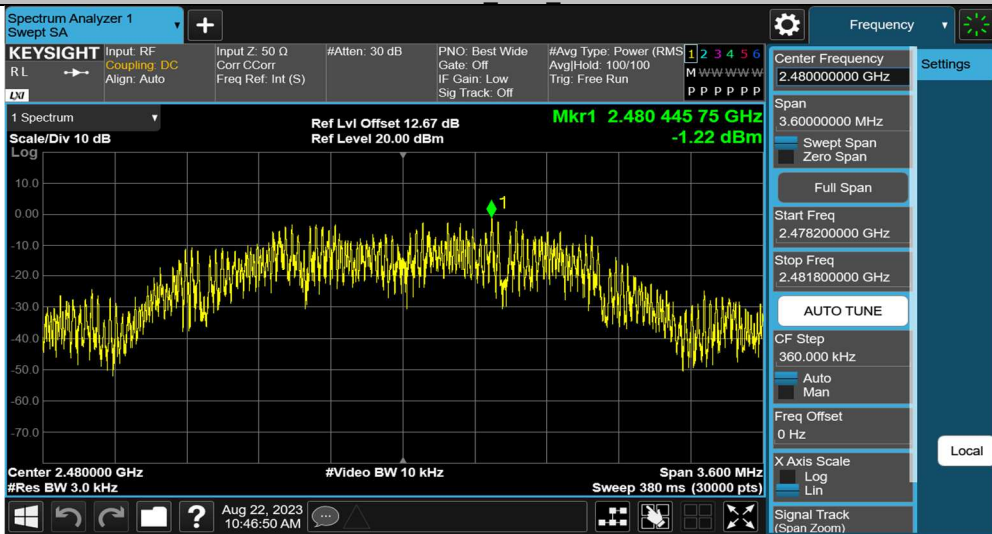
ZIGBEE Ant1 2405



ZIGBEE Ant1 2445



ZIGBEE Ant1 2480

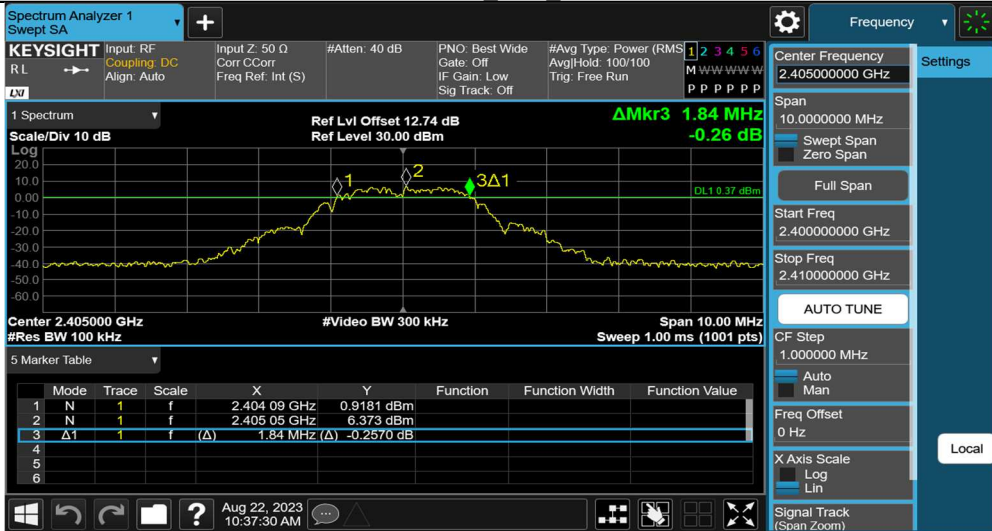




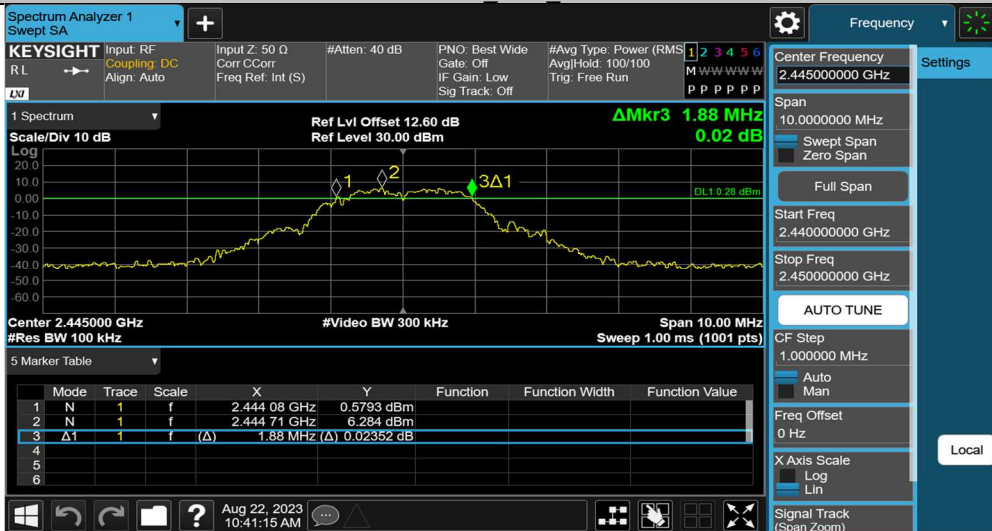
### Appendix A.2: Test Results of 6dB Bandwidth

TestMode	Antenna	Frequency[MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
Zigbee	Ant1	2405	1.840	2404.090	2405.930	>0.5	PASS
		2445	1.880	2444.080	2445.960	>0.5	PASS
		2480	1.800	2479.120	2480.920	>0.5	PASS

ZIGBEE Ant1 2405



ZIGBEE Ant1 2445



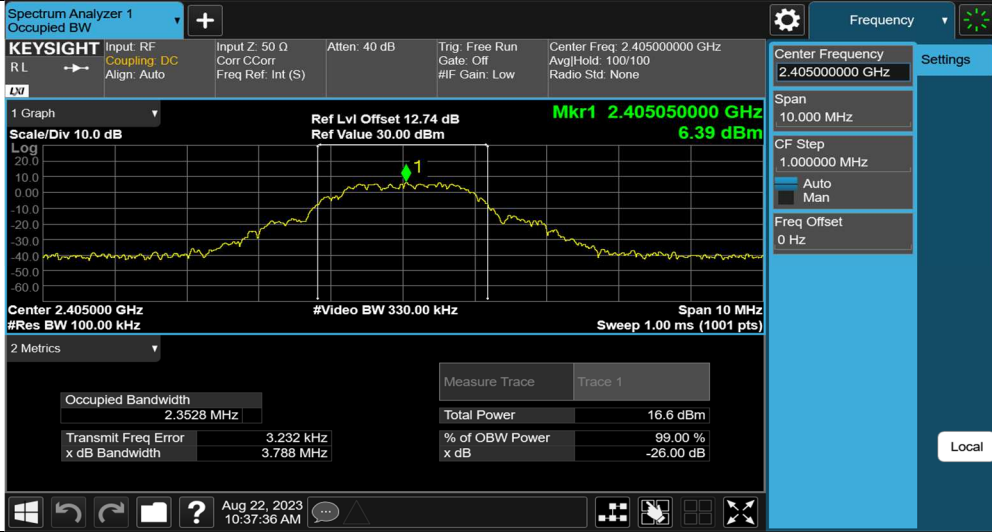
ZIGBEE Ant1 2480



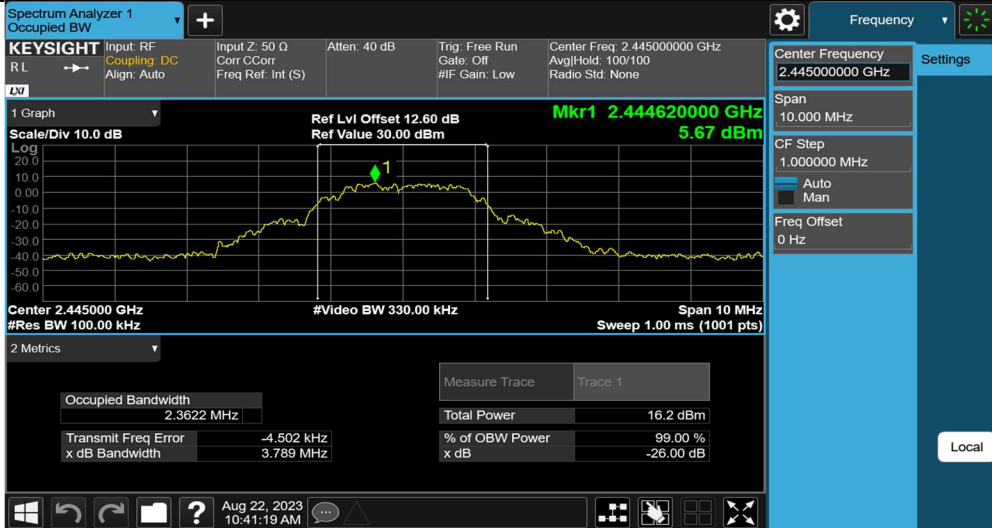
### Appendix A.3: Test Results of 99% Bandwidth

TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
Zigbee	Ant1	2405	2.3528	2403.8268	2406.1796	---	PASS
		2445	2.3622	2443.8144	2446.1766	---	PASS
		2480	2.3670	2478.8161	2481.1831	---	PASS

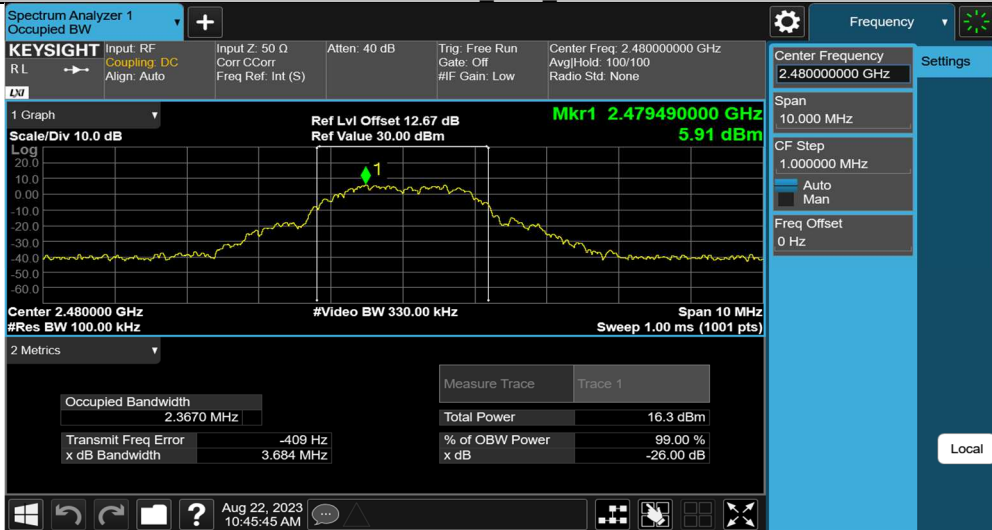
ZIGBEE Ant1 2405



ZIGBEE Ant1 2445



ZIGBEE Ant1 2480



### Appendix A.4: Test Results of Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Conducted Spurious Emission

TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	Ant1	2405	Reference	6.63	6.63	---	PASS
			30~1000	6.63	-47.15	≤-13.37	PASS
			1000~26500	6.63	-37.97	≤-13.37	PASS
		2445	Reference	5.92	5.92	---	PASS
			30~1000	5.92	-47.58	≤-14.08	PASS
			1000~26500	5.92	-37.92	≤-14.08	PASS
		2480	Reference	4.88	4.88	---	PASS
			30~1000	4.88	-47.49	≤-15.12	PASS
			1000~26500	4.88	-38.82	≤-15.12	PASS

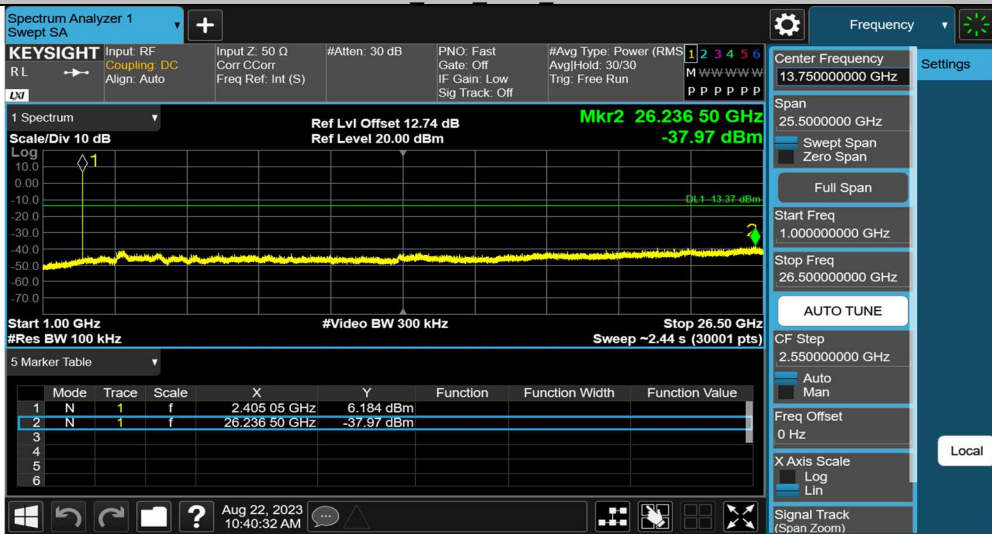
ZIGBEE\_Ant1\_2405\_0~Reference



ZIGBEE\_Ant1\_2405\_30~1000



ZIGBEE\_Ant1\_2405\_1000~26500



ZIGBEE\_Ant1\_2445\_0~Reference



ZIGBEE Ant1 2445 30~1000



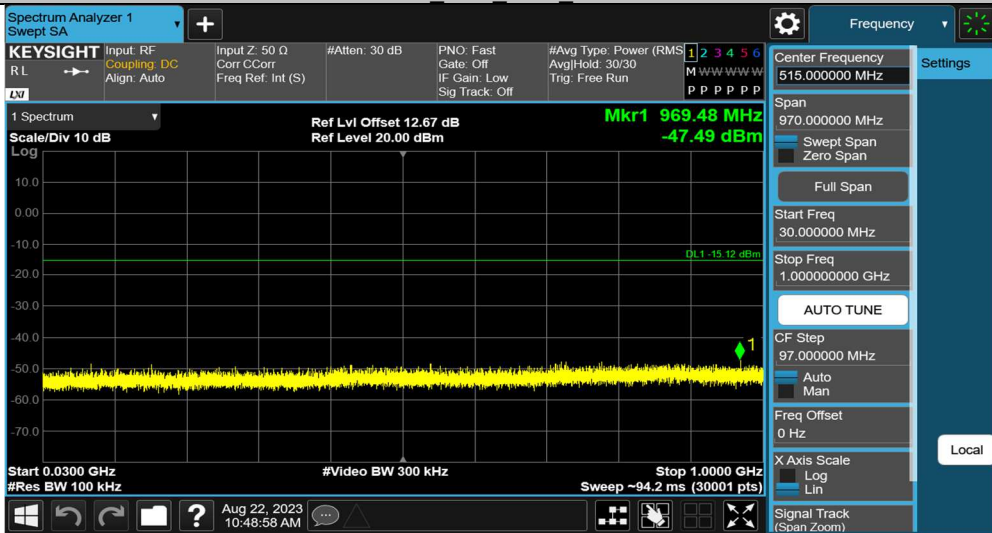
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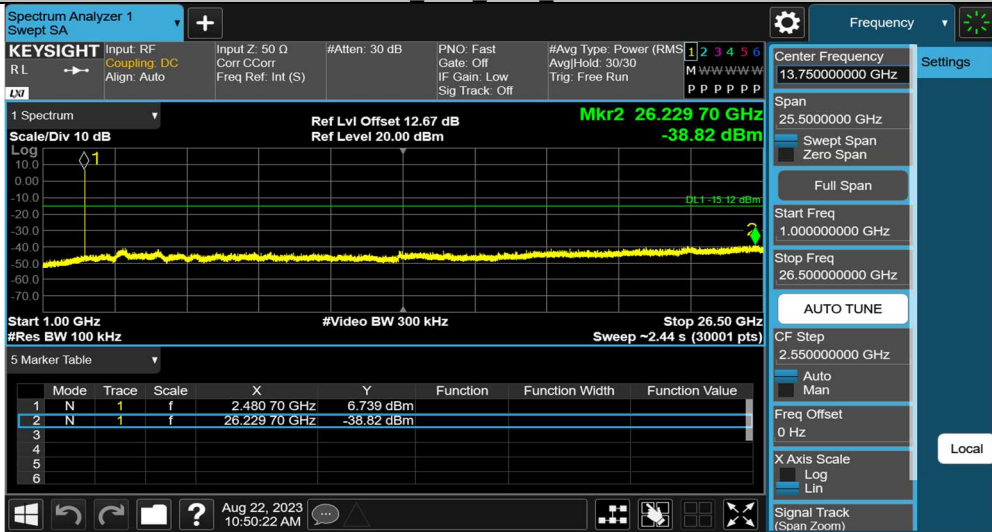
ZIGBEE OPERATING Ant1 2480 0~Reference



ZIGBEE Ant1 2480 30~1000



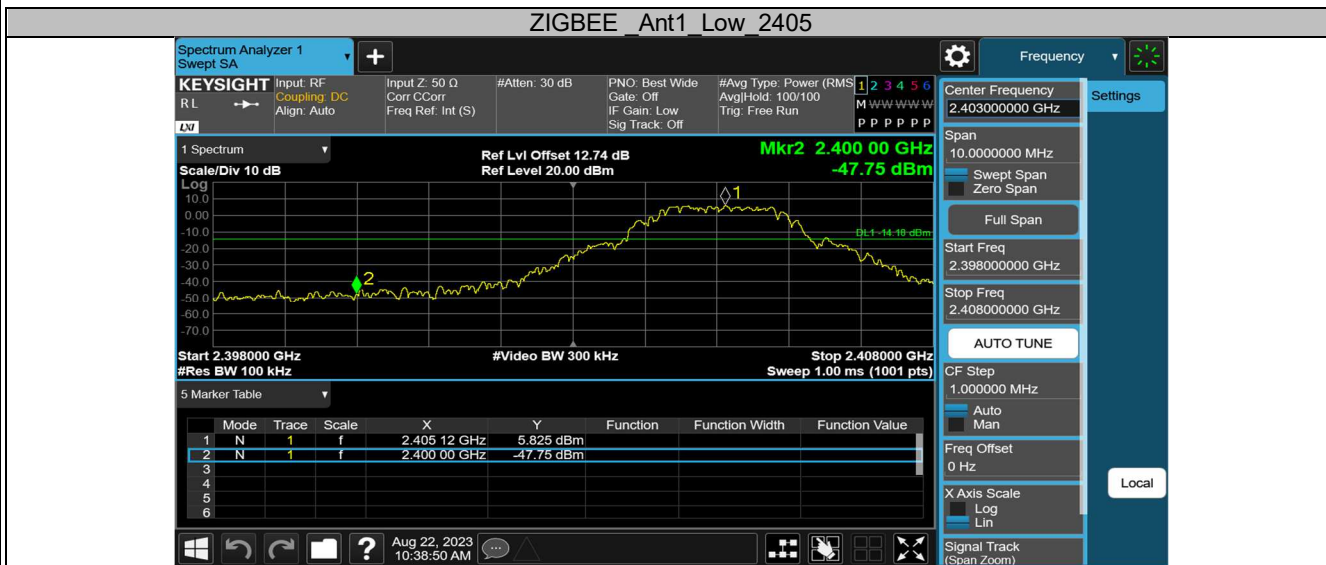
ZIGBEE Ant1 2480 1000~26500





Band Edge

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	Ant1	Low	2405	5.81	-47.9	≤-14.18	PASS
		High	2480	10.98	-44.2	≤-13.77	PASS



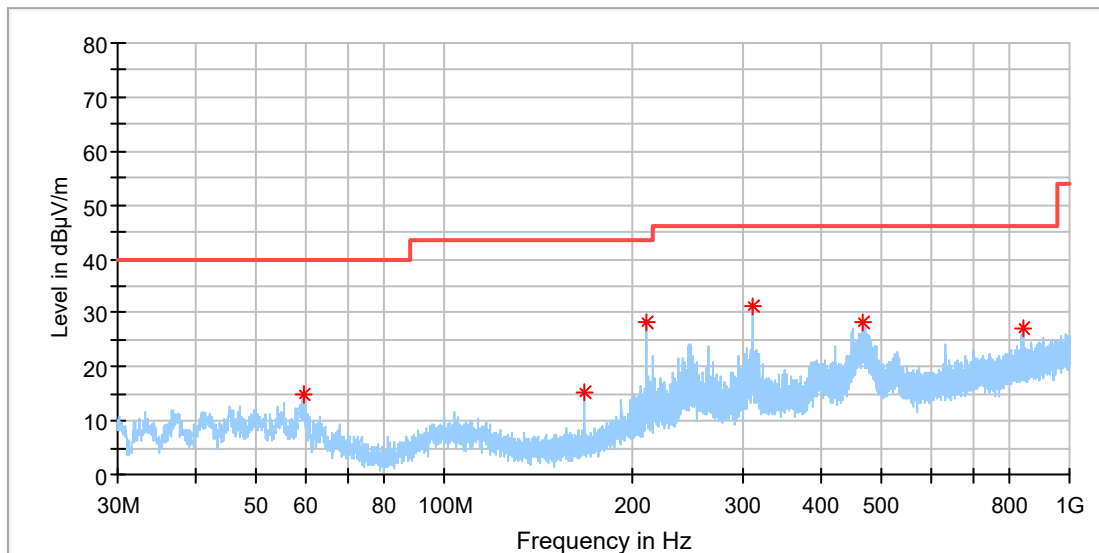
## Appendix A.5: Test Results of Radiated Spurious Emissions

Note:

- 1) This testing was carried out on different modulations, but only the worst case was presented in this report.
- 2) Testing was carried out within frequency range 9kHz to the tenth harmonics. The measurement results below 30MHz and 18GHz - 26.5GHz were greater than 20dB below the limit, so only the radiated spurious emissions from 30MHz to 18GHz were reported.

30 MHz to 1GHz

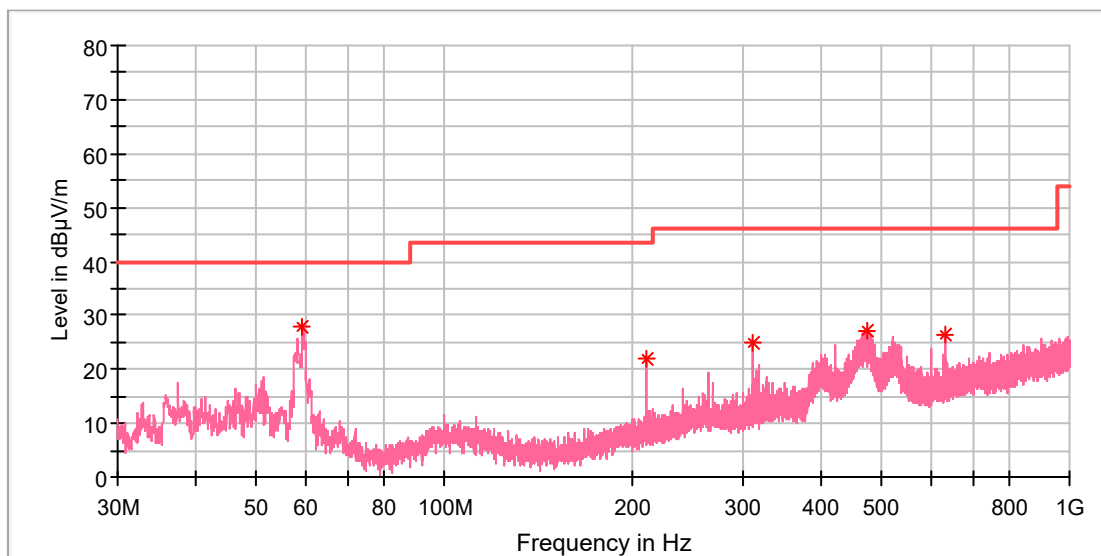
EUT Name:	Plug Smart
Model:	E2220
Test Mode:	Zigbee
Order No/Sample No:	168439281/A003538734-001
Test Voltage::	AC 120V 60Hz
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



### Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.547692	14.90	40.00	25.10	100.0	H	75.0	-19.2
168.001154	15.23	43.50	28.27	100.0	H	124.0	-21.7
210.345385	28.38	43.50	15.12	100.0	H	93.0	-19.2
312.008846	31.39	46.00	14.61	100.0	H	236.0	-16.3
466.164231	28.14	46.00	17.86	100.0	H	280.0	-12.9
841.479615	26.98	46.00	19.02	100.0	H	253.0	-6.0

EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



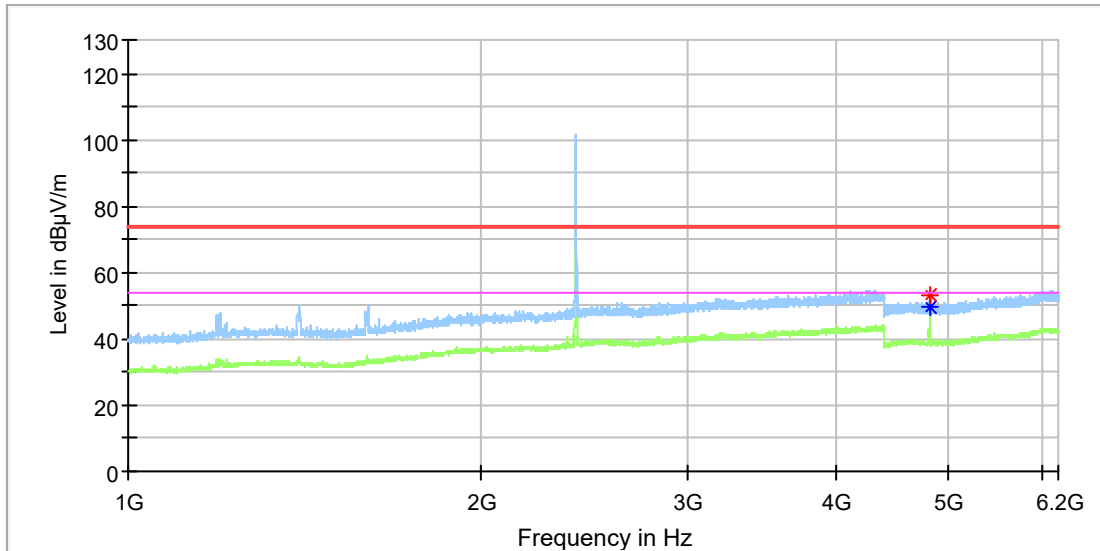
### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.361154	28.01	40.00	11.99	100.0	V	295.0	-19.2
210.345385	22.13	43.50	21.37	100.0	V	146.0	-19.2
312.008846	25.01	46.00	20.99	100.0	V	0.0	-16.3
473.103462	27.35	46.00	18.66	100.0	V	34.0	-12.7
631.101539	26.42	46.00	19.58	100.0	V	354.0	-9.7

1GHz-18GHz

Note: The highest waveform in the figure is Zigbee operating Fundamental.

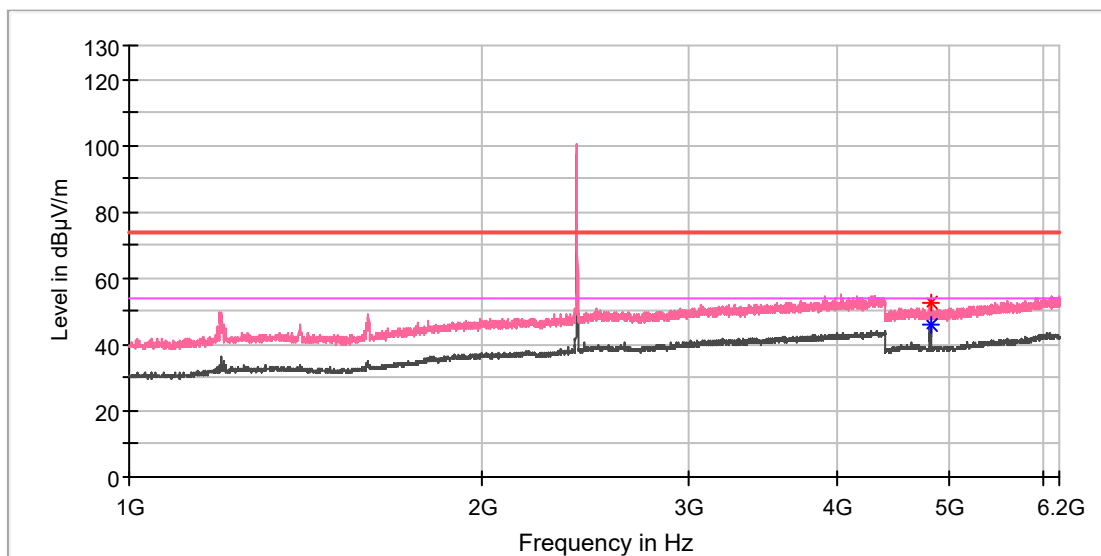
EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_Low channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



**Critical Freqs**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4812.500000	53.25	---	74.00	20.75	100.0	H	84.0	11.8
4812.500000	---	49.42	54.00	4.58	100.0	H	84.0	11.8

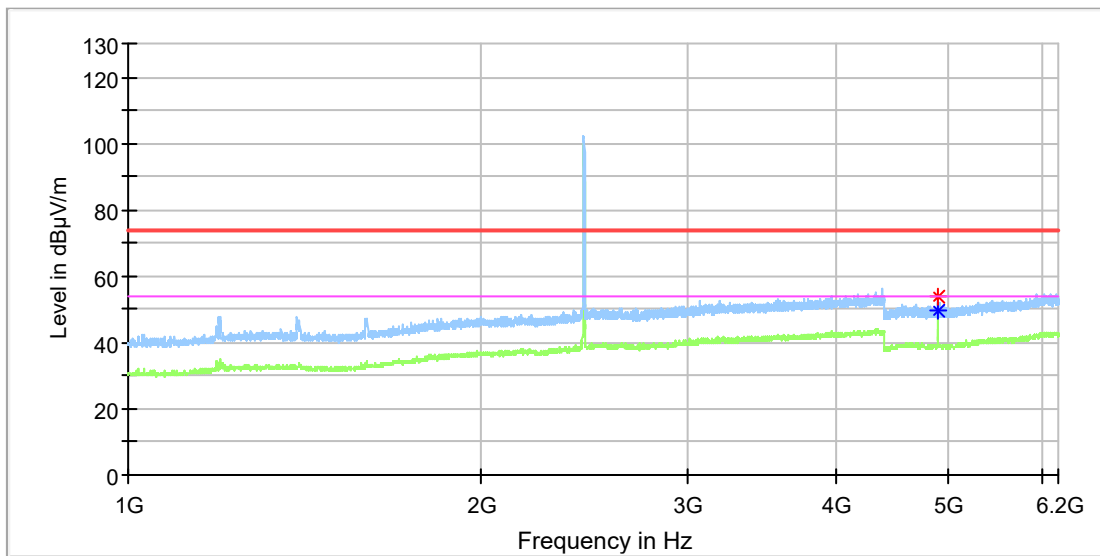
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 Model: E2220  
 Test Mode: Zigbee\_Low channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4812.500000	---	46.05	54.00	7.95	100.0	V	199.0	11.8
4813.000000	52.49	---	74.00	21.51	100.0	V	187.0	11.8

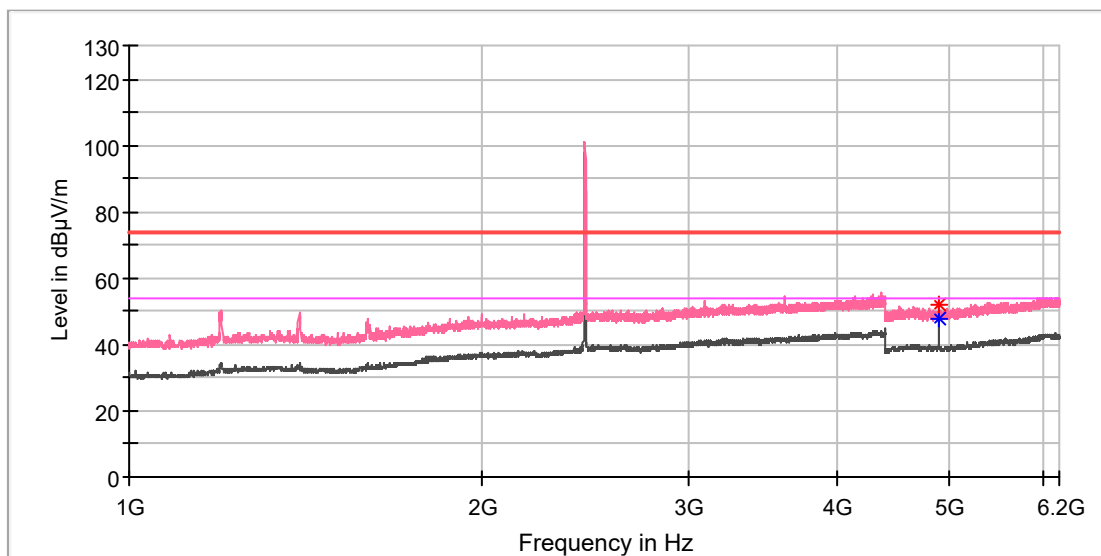
EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_Mid channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



**Critical\_Freqs**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4892.500000	53.52	---	74.00	20.48	100.0	H	88.0	11.8
4892.500000	---	49.29	54.00	4.71	100.0	H	88.0	11.8

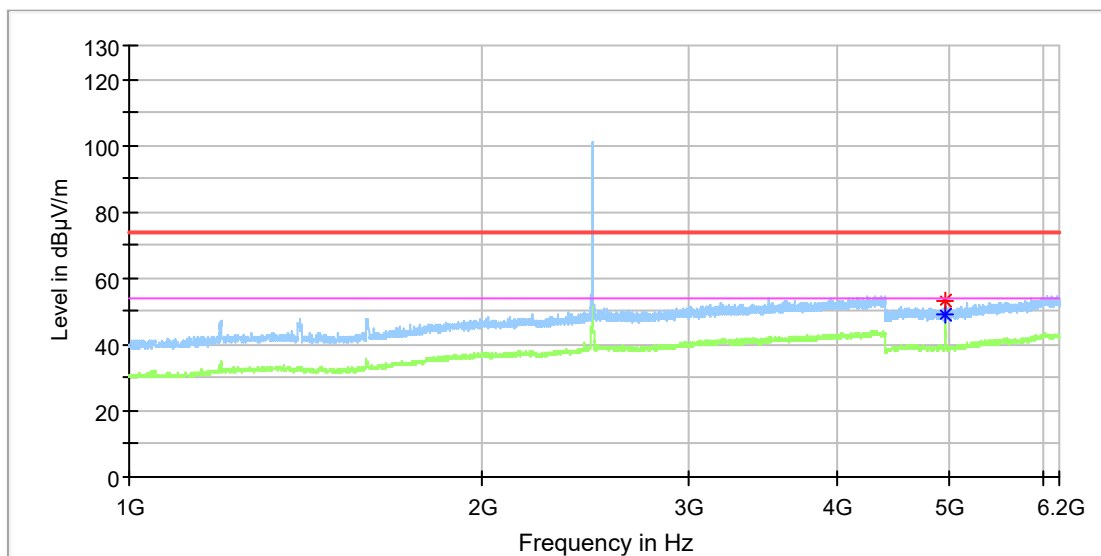
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 Model: E2220  
 Test Mode: Zigbee\_Mid channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



**Critical\_Freqs**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4892.500000	52.28	---	74.00	21.72	100.0	V	181.0	11.8
4892.500000	---	47.56	54.00	6.44	100.0	V	181.0	11.8

EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_High channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin

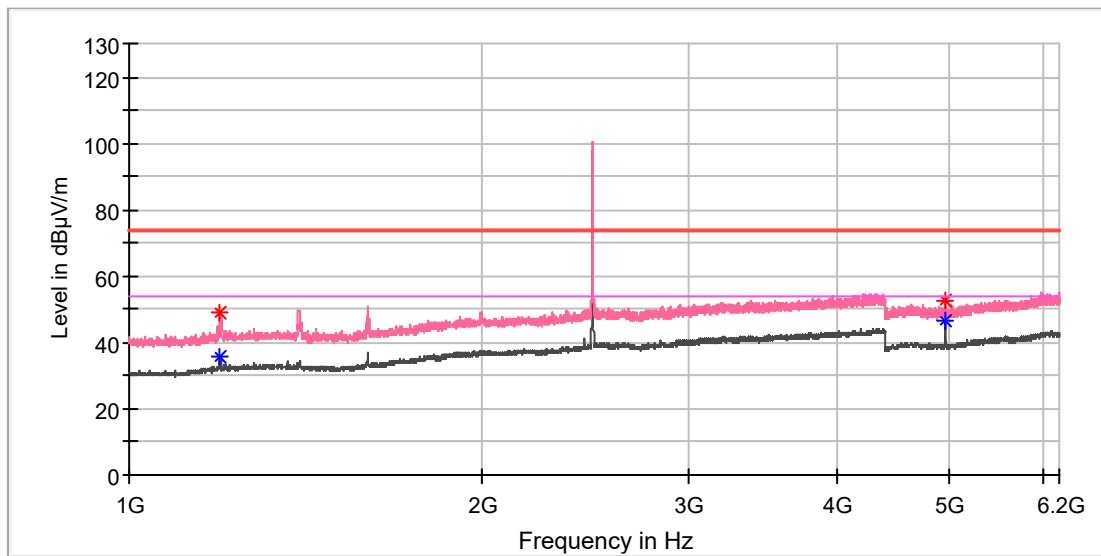


### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4961.000000	53.43	---	74.00	20.57	100.0	H	73.0	11.8
4962.500000	---	49.01	54.00	4.99	100.0	H	91.0	11.8



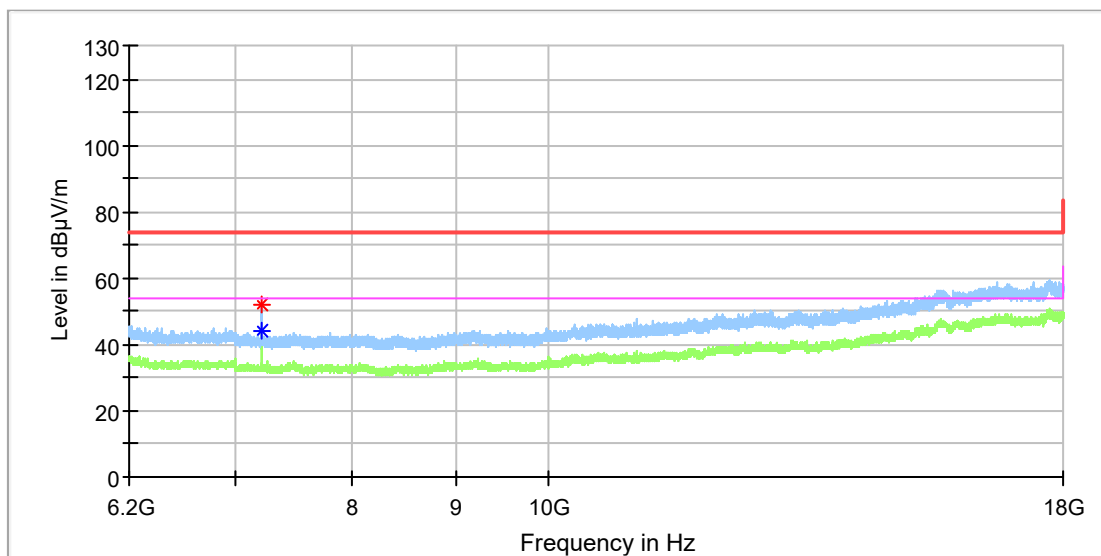
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 Model: E2220  
 Test Mode: Zigbee\_High channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



**Critical\_Freqs**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1195.500000	49.08	---	74.00	24.92	100.0	V	22.0	1.1
1195.500000	---	35.92	54.00	18.08	100.0	V	22.0	1.1
4962.500000	52.63	---	74.00	21.37	100.0	V	191.0	11.8
4962.500000	---	46.42	54.00	7.58	100.0	V	191.0	11.8

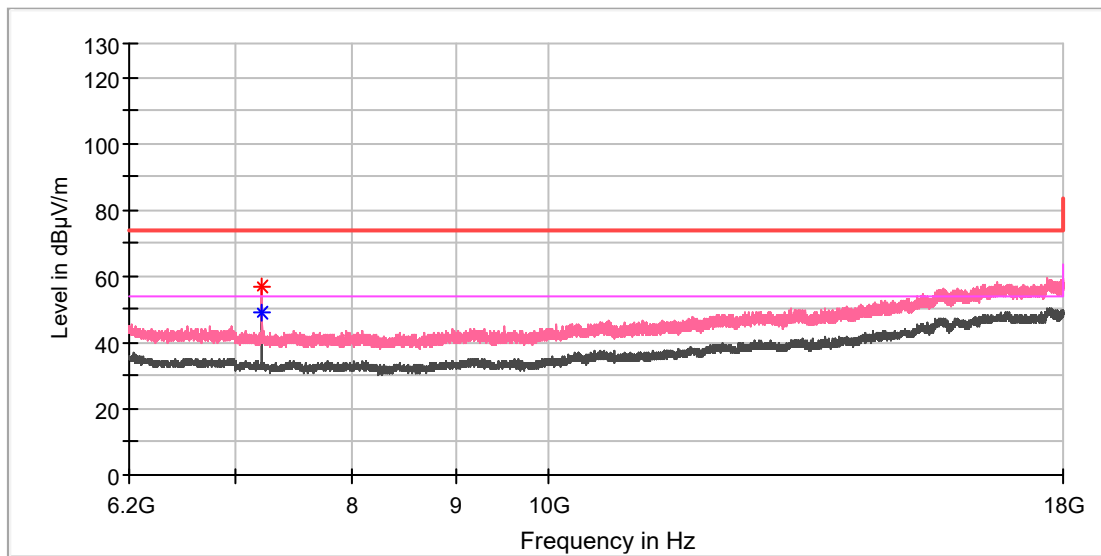
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 Model: E2220  
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 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7213.325000	52.28	---	74.00	21.72	100.0	H	104.0	8.7
7213.325000	---	44.25	54.00	9.75	100.0	H	104.0	8.7

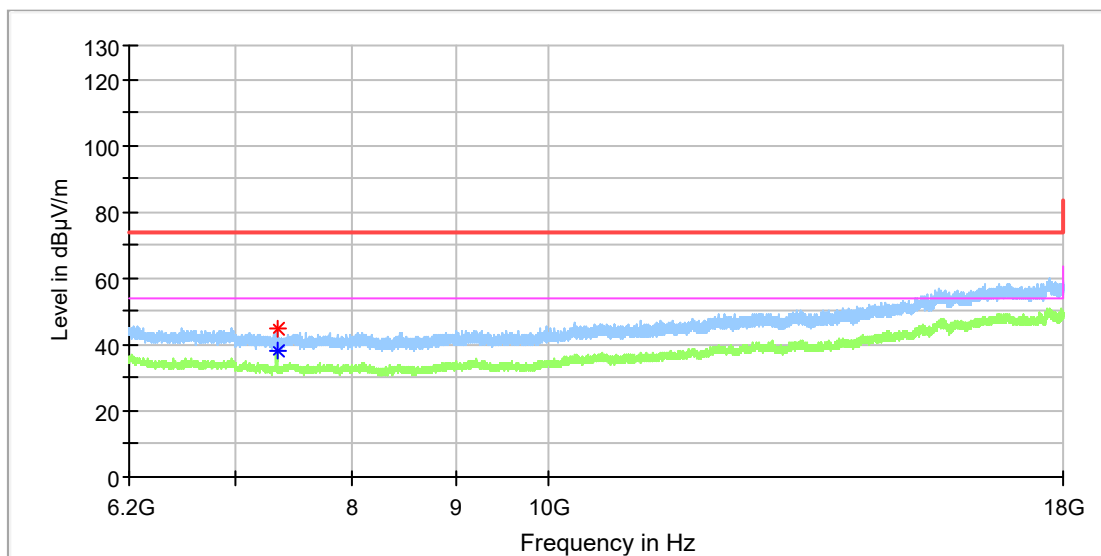
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 Model: E2220  
 Test Mode: Zigbee\_Low channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7215.783333	---	49.22	54.00	4.78	100.0	V	325.0	8.7
7216.275000	56.97	---	74.00	17.03	100.0	V	325.0	8.7

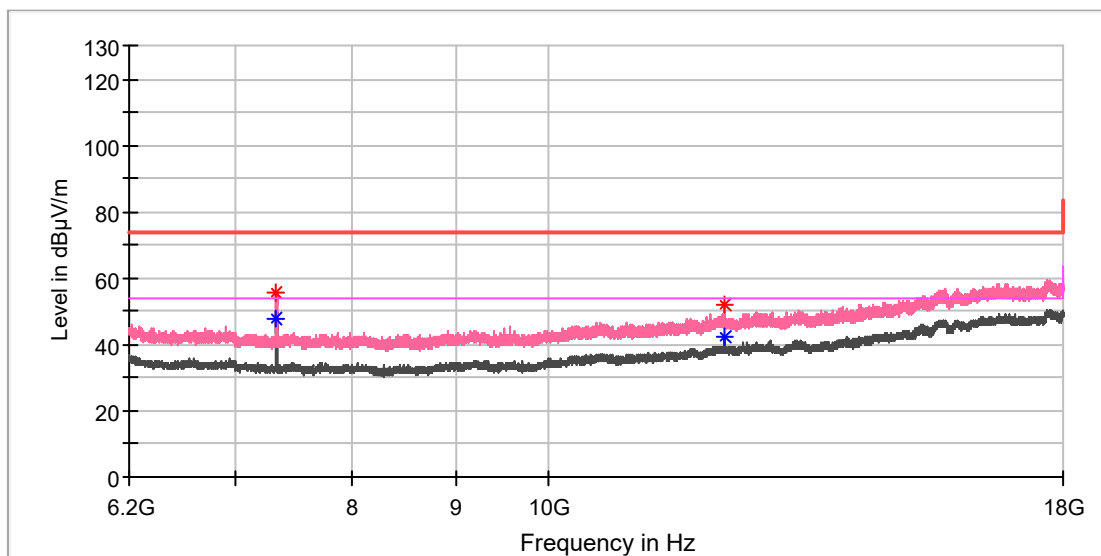
EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_Mid channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7336.241667	---	38.19	54.00	15.81	100.0	H	0.0	8.1
7336.733333	44.62	---	74.00	29.38	100.0	H	0.0	8.1

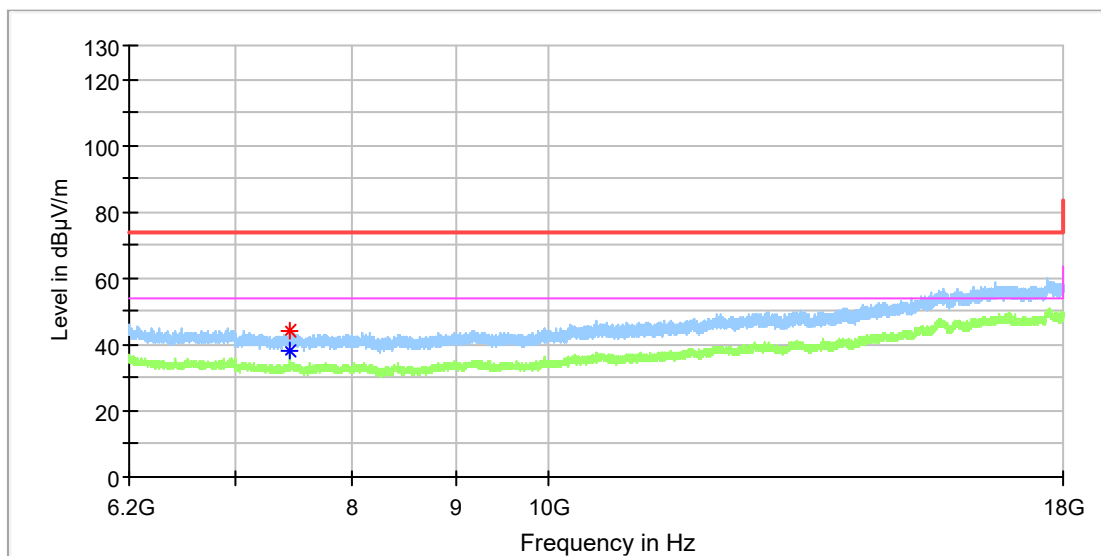
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 Model: E2220  
 Test Mode: Zigbee\_Mid channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7332.800000	---	47.57	54.00	6.43	100.0	V	5.0	8.1
7333.783333	55.58	---	74.00	18.42	100.0	V	5.0	8.1
12227.833333	51.79	---	74.00	22.21	100.0	V	5.0	14.7
12227.833333	---	42.58	54.00	11.42	100.0	V	5.0	14.7

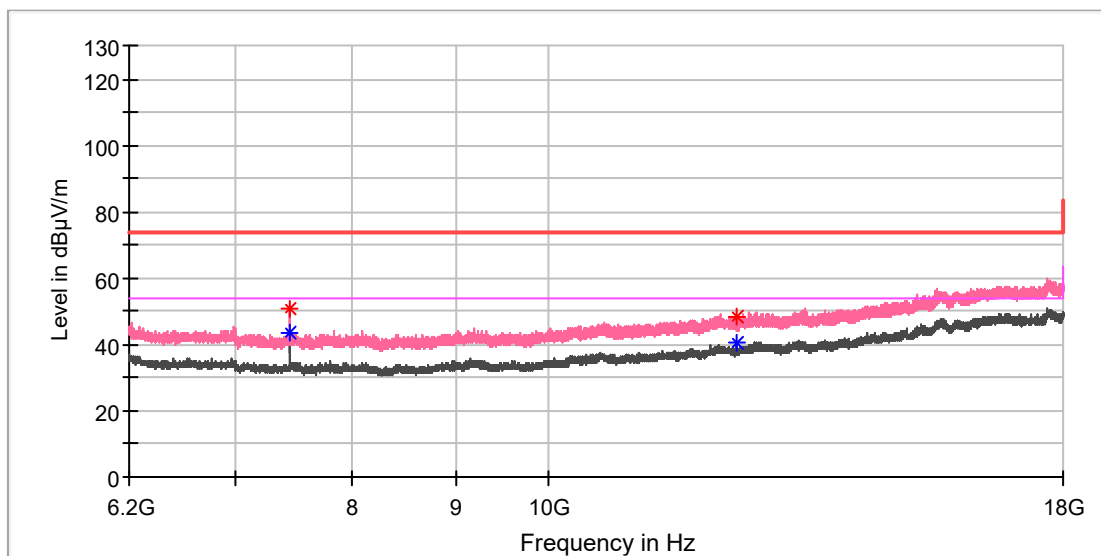
EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_High channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7438.508333	44.20	---	74.00	29.80	100.0	H	171.0	8.4
7438.508333	---	37.98	54.00	16.02	100.0	H	171.0	8.4

EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_High channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin

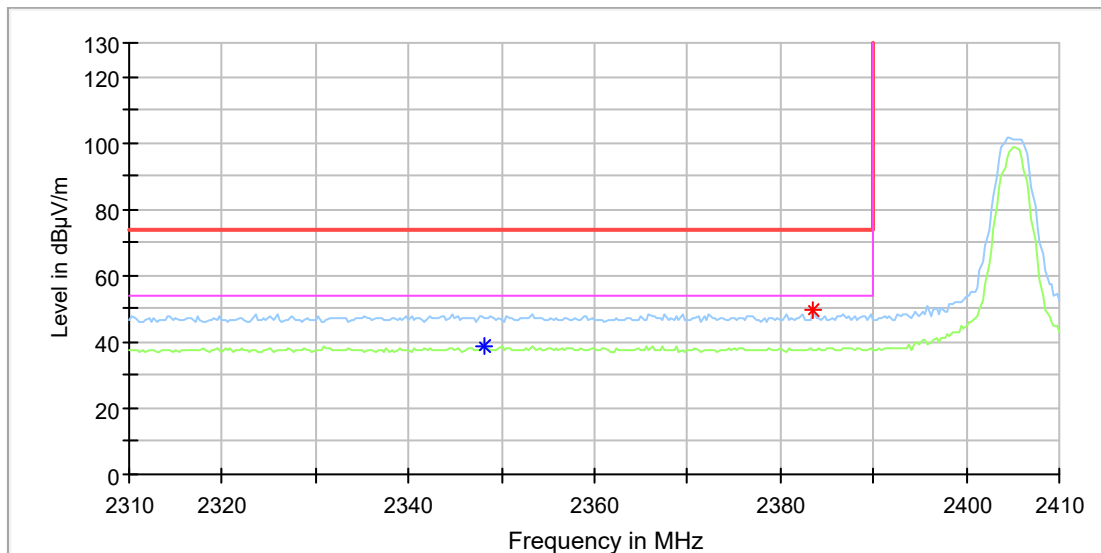


### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7438.508333	50.51	---	74.00	23.49	100.0	V	19.0	8.4
7441.458333	---	43.72	54.00	10.28	100.0	V	19.0	8.4
12397.458333	48.52	---	74.00	25.48	100.0	V	163.0	14.7
12397.458333	---	40.71	54.00	13.29	100.0	V	163.0	14.7

### Appendix A.6: Test Results of Radiated Emissions in Restricted Bands

EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_Low channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin

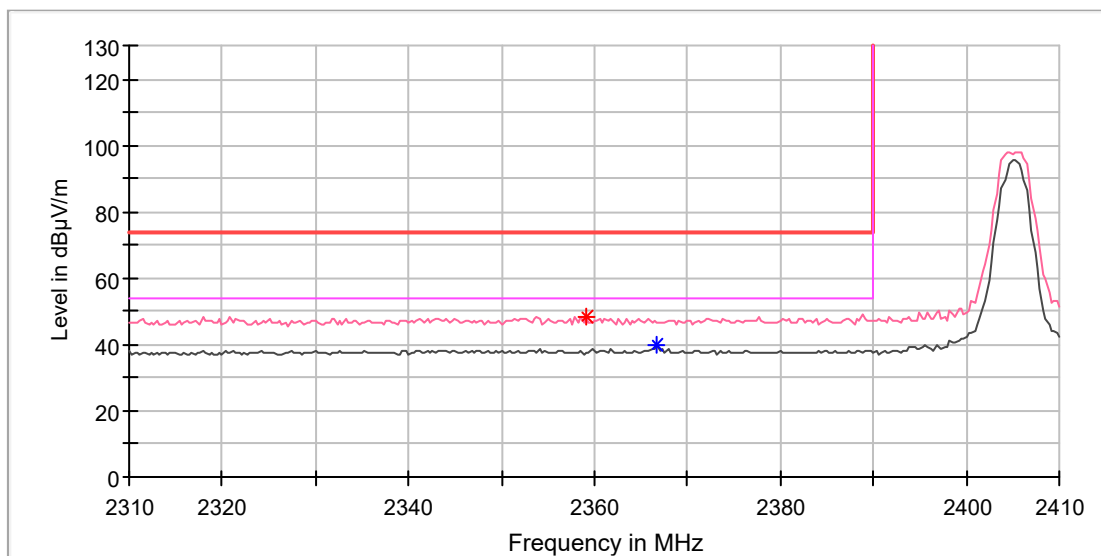


#### Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2348.235294	---	38.41	54.00	15.59	100.0	H	315.0	6.9
2383.529412	49.33	---	74.00	24.67	100.0	H	287.0	7.0



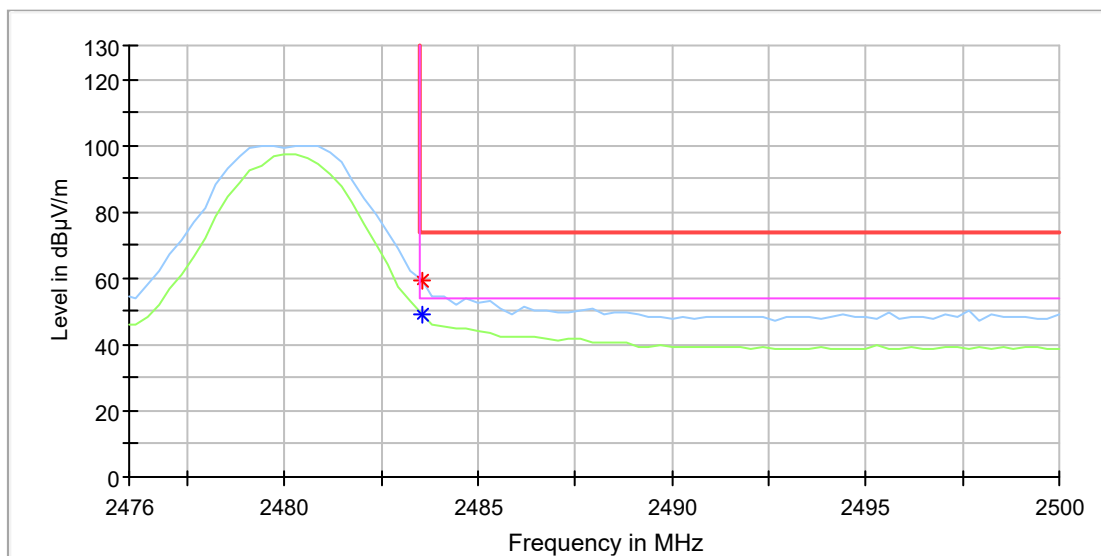
EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_Low channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2359.117647	48.56	---	74.00	25.44	100.0	V	23.0	6.9
2366.764706	---	39.87	54.00	14.13	100.0	V	65.0	6.9

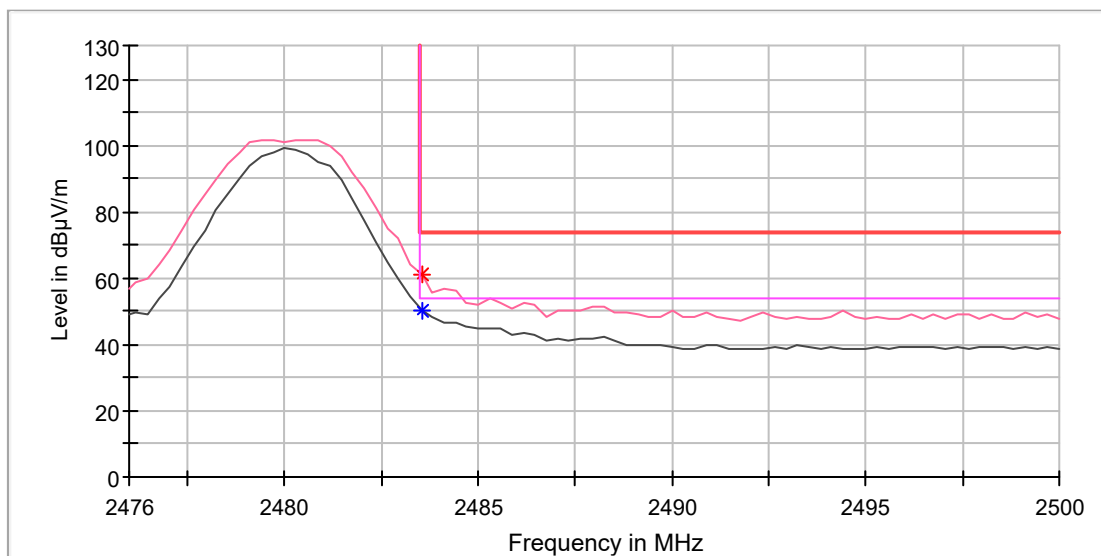
EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_High channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.529412	59.43	---	74.00	14.57	100.0	H	315.0	7.4
2483.529412	---	48.74	54.00	5.26	100.0	H	315.0	7.4

EUT Name: Plug Smart  
 Model: E2220  
 Test Mode: Zigbee\_High channel  
 Order No/Sample No: 168439281/A003538734-001  
 Test Voltage:: AC 120V 60Hz  
 Remark: Temp 24 Humi:50%  
 Test Standard: FCC 15.247  
 Tested By: Kei Zhang  
 Reviewed By: Terry Yin

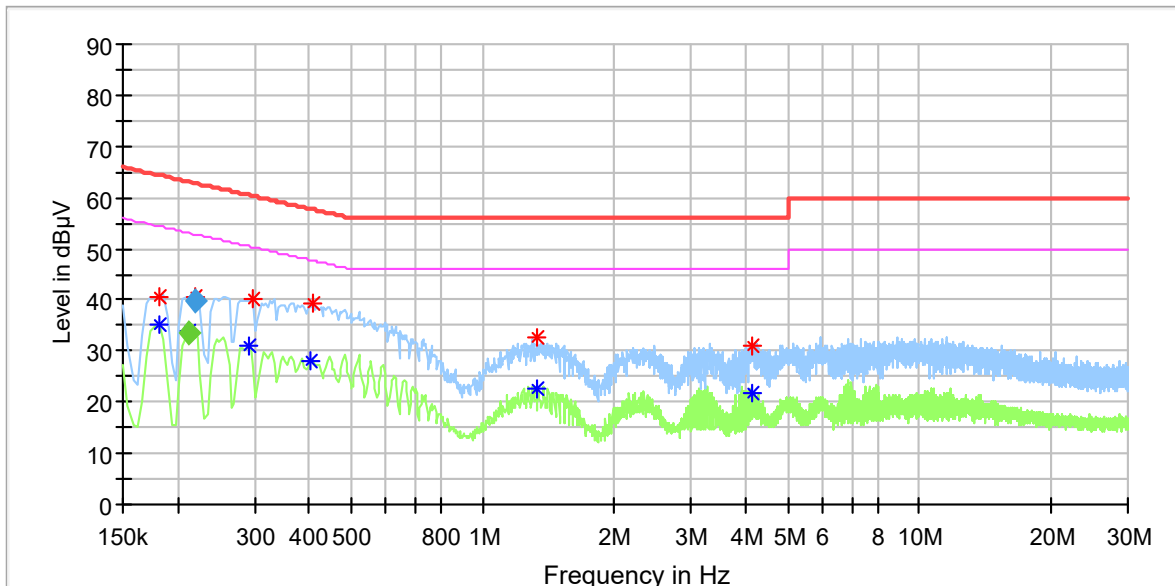


### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.529412	61.10	---	74.00	12.90	100.0	V	190.0	7.4
2483.529412	---	50.21	54.00	3.79	100.0	V	190.0	7.4

### Appendix A.7: Test Results of Conducted Emission

EUT Name: Plug Smart  
 Order Number: 168349281 40  
 Model: E2220  
 Test Mode: Zigbee mode  
 Test Voltage: AC 120V 60Hz  
 Test By./Review By: Soloman Wu/Gary Chen  
 Tem./Hum./Pressure: 24.3°C/51.8%/101kPa  
 Remark: SR1



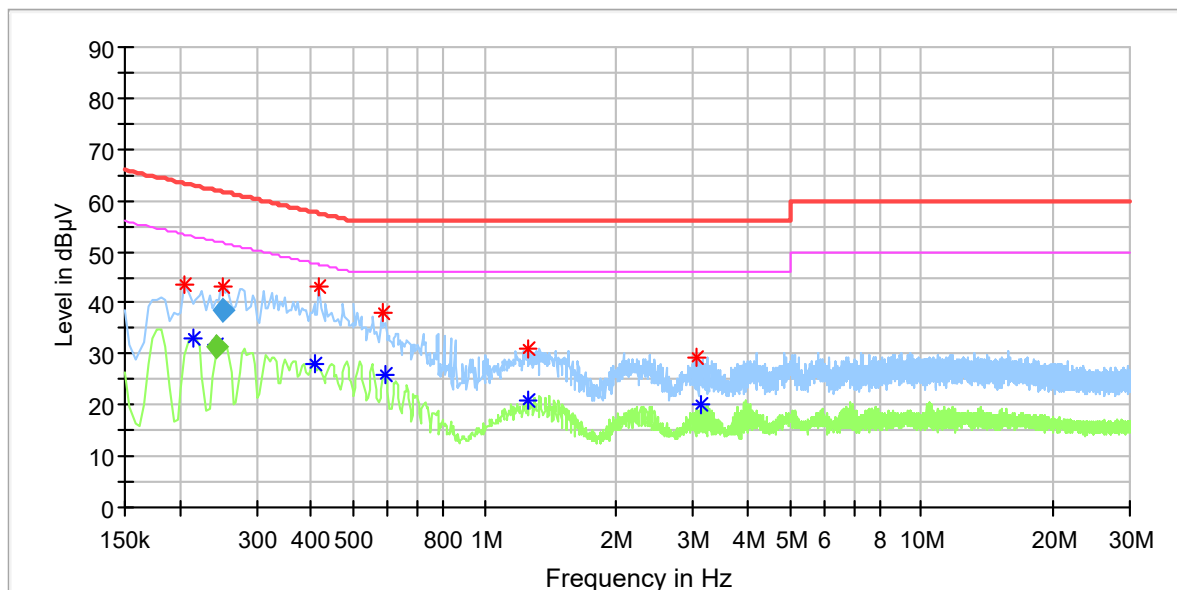
#### Critical Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.182000	---	35.06	54.39	19.34	L1	9.7
0.182000	40.63	---	64.39	23.76	L1	9.7
0.212500	---	34.05	52.90	18.85	L1	9.8
0.220500	40.68	---	62.90	22.21	L1	9.8
0.290000	---	30.77	50.52	19.75	L1	9.8
0.298000	40.22	---	60.30	20.07	L1	9.8
0.402000	---	28.14	47.81	19.67	L1	9.9
0.410000	39.34	---	57.65	18.31	L1	9.9
1.332000	32.86	---	56.00	23.14	L1	9.8
1.336000	---	22.48	46.00	23.52	L1	9.8
4.156000	---	21.68	46.00	24.32	L1	10.0
4.160000	30.89	---	56.00	25.11	L1	10.0

#### Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.212500	---	33.43	53.11	19.68	1000.0	9.000	L1	9.8
0.220500	39.65	---	62.80	23.15	1000.0	9.000	L1	9.8

EUT Name: Plug Smart  
 Order Number: 168349281 40  
 Model: E2220  
 Test Mode: Zigbee mode  
 Test Voltage: AC 120V 60Hz  
 Test By:/Review By: Soloman Wu/Gary Chen  
 Tem./Hum./Pressure: 24.3°C/51.8%/101kPa  
 Remark: SR1



### Critical\_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.206000	43.54	---	63.37	19.82	N	9.7
0.214000	---	33.01	53.05	20.04	N	9.7
0.244500	---	31.92	51.63	19.70	N	9.7
0.252500	43.00	---	61.76	18.75	N	9.7
0.406000	---	28.18	47.73	19.55	N	9.7
0.418000	43.14	---	57.49	14.35	N	9.7
0.584000	38.15	---	56.00	17.85	N	9.7
0.592000	---	25.77	46.00	20.23	N	9.8
1.252000	31.14	---	56.00	24.86	N	9.7
1.264000	---	20.84	46.00	25.16	N	9.7
3.068000	29.38	---	56.00	26.62	N	10.0
3.128000	---	19.98	46.00	26.02	N	10.0

### Final\_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.244500	---	31.42	51.94	20.52	1000.0	9.000	N	9.7
0.252500	38.52	---	61.68	23.16	1000.0	9.000	N	9.7