Prüfbericht - Produkte
Test Report - Products

TÜVRheinland®

Prüfbericht-Nr.: *Test report no.:*	**CN20L0JK 001**	**Auftrags-Nr.:** *Order no.:*	168291077	Seite 1 von 22 *Page 1 of 22*
Kunden-Referenz-Nr.: *Client reference no.:*	N/A	**Auftragsdatum:** *Order date:*	2020-11-16	
Auftraggeber: *Client:*	**LEEDARSON LIGHTING CO., LTD.** Xingtai Industrial Zone, Economic Development Zone, Changtai County, Zhangzhou City, Fujian Province, P.R. China			
Prüfgegenstand: *Test item:*	Smart Plug			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	HPPA21SZ			
Auftrags-Inhalt: *Order content:*	FCC and IC approval			
Prüfgrundlage: *Test specification:*	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 15: Subpart C Section 15.207 CFR47 FCC Part 15: Subpart C Section 15.209 CFR47 FCC Part 2.1091	RSS-247 Issue 2 February 2017 RSS-Gen Issue 5 March 2019 RSS-102 Issue 5 March 2015		

Wareneingangsdatum: *Date of sample receipt:*	2020-11-19	Please refer to photo documents
Prüfmuster-Nr.: *Test sample no.:*	A002952000-001 to 003	
Prüfzeitraum: *Testing period:*	2020-11-30 – 2020-12-22	
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüfergebnis*: *Test result*:*	Pass	

geprüft von: *tested by:*	X Alex Lan	**genehmigt von:** *authorized by:*	X Winnie Hou
Datum: *Date:* 2021-01-21	Signed by: Alex Lan	**Ausstellungsdatum:** *Issue date:* 2021-01-21	Signed by: Winnie Hou
Stellung / Position	Senior Project Engineer	**Stellung** / Position	Department Manager

Sonstiges / *Other:*

FCC ID: 2AB2Q-HPPA21SZ
IC: 10256A-HPPA21SZ HVIN: HPPA21SZ

Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:* Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged:*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhalt
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
Legend:	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specifications(s)		*F(ail) = failed a.m. test specifications(s)*	*N/A = not applicable*	*N/T = not tested*

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.

This test report only relates to the a. m. 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.

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

6.1.1 ELECTROMAGNETIC FIELDS
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: Photographs of the Test Set-up

Appendix B: Test Results of Conducted & Radiated Testing

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

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Radio Spectrum Testing				
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Until**
Wireless Connectivity Tester	Rohde & Schwarz	CMW270	101375	2021-08-30
Signal Analyzer	Rohde & Schwarz	FSV 40	101441	2021-08-30
Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A
Test Software	Rohde & Schwarz	WMS32 (V10.40.10)	N/A	N/A
Power Meter	Rohde & Schwarz	NRP2	107105	2021-12-20
Wideband Power Sensor	Rohde & Schwarz	NRP-Z81	105350	2021-12-20
Unwanted Emission Testing				
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Until**
EMI Test Receiver	R&S	ESR 7	102021	2021-08-11
Signal Analyzer	R&S	FSV 40	101439	2021-08-10
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2021-08-10
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2021-08-10
Amplifier	R&S	SCU-18F	180070	2021-08-10
Amplifier	R&S	SCU40A	100475	2021-09-10
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2021-08-08
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2021-08-08
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2021-08-08
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2021-09-13
Wideband Ridged Horn Antenna (12-18 GHz)	Steatite	QMS-00208	18313	2021-09-02
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	2021-06-07
Unwanted Emission Testing				
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Until**
EMI Test Receiver	R&S	ESR3	102428	2021-09-03
Artificial Mains Network	R&S	ENV216	102333	2021-08-19

Artificial Mains Network	R&S	ENV432	101411	2021-08-19
Current Probe	R&S	EZ-17	101247	2021-08-19
Voltage Probe	R&S	ESH2-Z3	100557	2021-08-19
Attenuator	R&S	ESH2Z31	100300	2021-08-19
EMC32 test software	R&S	EMC32(Ver.10.50.01)	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 basics 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.

Item		Extended Uncertainty
Conducted Emission		± 2.74 dB
Radiated Emission (30-1000MHz)	Field strength (dBµV/m)	4.27dB
Radiated Emission (above 1000MHz)	Field strength (dBµV/m)	4.46dB
Radio Spectrum		± 1.5 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B 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 a Smart Plug, it supports ZigBee wireless technology.

For details refer to the User Manual, Technical Description and Circuit Diagram.

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment	Smart Plug
Type Designation	HPPA21SZ
FCC ID	2AB2Q-HPPA21SZ
IC	10256A-HPPA21SZ
HVIN	HPPA21SZ
Operating Voltage	AC 120V, 60Hz, 15A Max 1800W
Testing Voltage	AC 120V, 60Hz
Technical Specification of ZigBee	
Operating Frequency	2405-2480 MHz
Channel Number	16 channels
Channel separation	5MHz
Modulation	OQPSK
Antenna Type	Internal Antenna
Smart Antenna Systems:	Not Applicable
Number of Antenna	1
Antenna Gain	-4.18 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)
11	2405.00	15	2425.00	19	2445.00	23	2465.00
12	2410.00	16	2430.00	20	2450.00	24	2470.00
13	2415.00	17	2435.00	21	2455.00	25	2475.00
14	2420.00	18	2440.00	22	2460.00	26	2480.00

3.3 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.4 Independent Operation Modes

The basic operation modes are:

A. On, transmitting mode
   1. Low channel
   2. Middle channel
   3. High channel

B. Off

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.

4.3 Special Accessories and Auxiliary Equipment

Table 4: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N
Notebook	Lenovo	ThinkPad X260	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 1GHz)

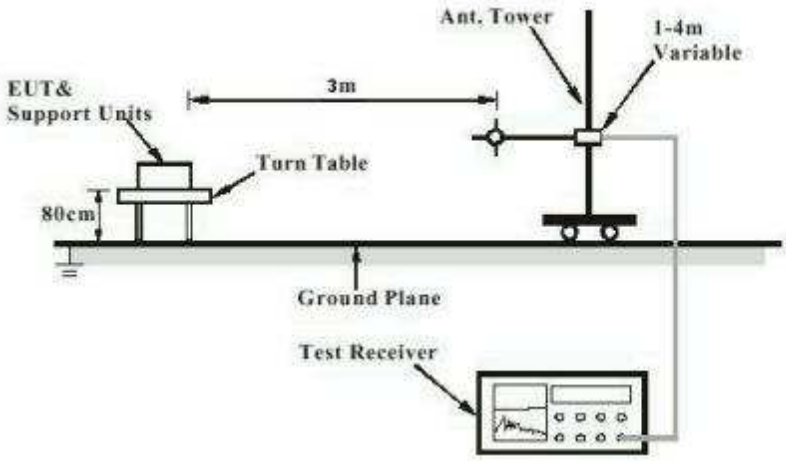


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

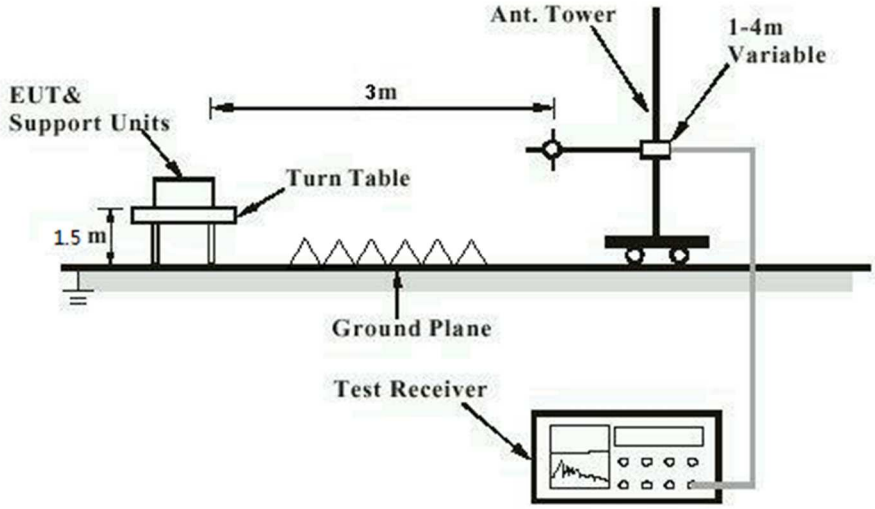
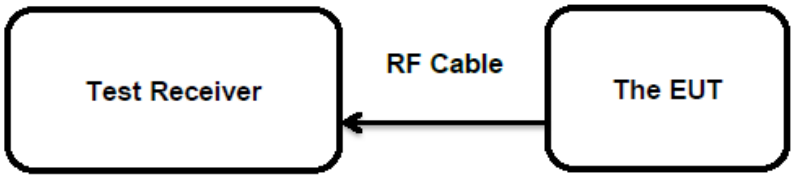


Diagram of Measurement Configuration for Conducted Transmitter Measurement



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 6.7
Limit	:	the use of antennas with directional gains that do not exceed 6 dBi

According to the manufacturer declared, the EUT has an internal antenna, the directional gain of antenna is -4.18 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(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	:	2020-12-08
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	22.5 ℃
Relative humidity	:	48 %
Atmospheric pressure	:	101 kPa

For details refer to following test result.

Table 5: Test Result of Maximum Peak Conducted Output Power,

Channel	Channel Frequency (MHz)	Peak Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2405	11.5	0.01413	1
Middle Channel	2445	11.5	0.01413	1
High Channel	2480	11.0	0.01259	1

Note: The cable loss is taken into account in results and the e.i.r.p. is 7.32 dBm less than 4W (36 dBm).

5.1.3 Conducted Power Spectral Density

RESULT: **Pass**

Test Specification

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

Test Setup

Date of testing	:	2020-12-08
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	22.5 ℃
Relative humidity	:	48 %
Atmospheric pressure	:	101 kPa

For details refer to following test result.

Table 6: Test Result of Power Spectral Density

Channel	Channel Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
Low Channel	2405	-1.53	8
Middle Channel	2445	-1.70	8
High Channel	2480	-1.86	8

Note: The cable loss is taken into account in results.

For the measurement records, refer to the appendix B.

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	:	2020-12-08
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	22.5 ℃
Relative humidity	:	48 %
Atmospheric pressure	:	101 kPa

Table 7: Test Result of 99% Bandwidth

Channel	Channel Frequency (MHz)	99% Bandwidth (kHz)	Limit (MHz)	Result
Low Channel	2405	2250	/	Pass
Mid Channel	2445	2250	/	Pass
High Channel	2480	2250	/	Pass

For the measurement records, refer to the appendix B.

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	:	2020-12-08
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	22.5 ℃
Relative humidity	:	48 %
Atmospheric pressure	:	101 kPa

Table 8: Test Result of 99% Bandwidth

Channel	Channel Frequency (MHz)	-6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2405	1700	500	Pass
Mid Channel	2445	1700	500	Pass
High Channel	2480	1700	500	Pass

For the measurement records, refer to the appendix B.

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	:	2020-12-08
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	22.5 ℃
Relative humidity	:	48 %
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 B.

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	:	2020-11-30
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	23℃
Relative humidity	:	49 %
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 B.

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

Test Setup

Date of testing	:	2020-12-22
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Earthing	:	Connected
Ambient temperature	:	24 ℃
Relative humidity	:	53 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

6 Safety Human Exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT: **Pass**

Test Specification

Test standard	:	CFR47 FCC Part 2: Section 2.1091
		CFR47 FCC Part 1: Section 1.1310
		FCC KDB Publication 447498 v06
		FCC KDB Publication 865664 D02 v01r02
		OET Bulletin 65 (Edition 97-01)
		RSS-102 Issue 5 March 2019

FCC requirement: Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20cm normally can be maintained between the user and the device.

MPE Calculation Method according to OET Bulletin 65

Power Density: $S_{(mW/cm^2)} = PG/4\pi R^2$ or $EIRP/4\pi R^2$

Where:

S = power density (mW/cm^2)

P = power input to the antenna (mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (cm)

The nominal maximum conducted output power specified:

ZigBee: 11.50 dBm

From the peak RF output power, the minimum mobile separation distance, d=20 cm, as well as the antenna gain (-4.18 dBi ZigBee), the RF power density can be calculated as below:

For ZigBee: $\mathbf{S_{(mW/cm^2)} = PG/4\pi R^2 =}$ 0.001 mW/cm^2

Limits for Maximum Permissible Exposure (MPE) according to FCC Part 1.1310: 1.0 mW/cm2

- **IC requirements:** The EUT shall comply with the requirement of RSS-102 section 2.5.2.

Exemption from Routine Evaluation Limits – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

- RF exposure evaluation exempted power for 2.4G DTS: 2.676 W

The nominal maximum conducted output power specified:

ZigBee: 11.50 dBm

Antenna Gain: -4.18 dBi ZigBee

The Max. e.i.r.p. for ZigBee: 7.32dBm = 0.005 W

The e.i.r.p. for the ZigBee is less than the RF exposure evaluation exempted power. So RF exposure evaluation is not required.

"RF Radiation Exposure Statement Caution: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons."

7 Photographs of the Test Set-Up

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

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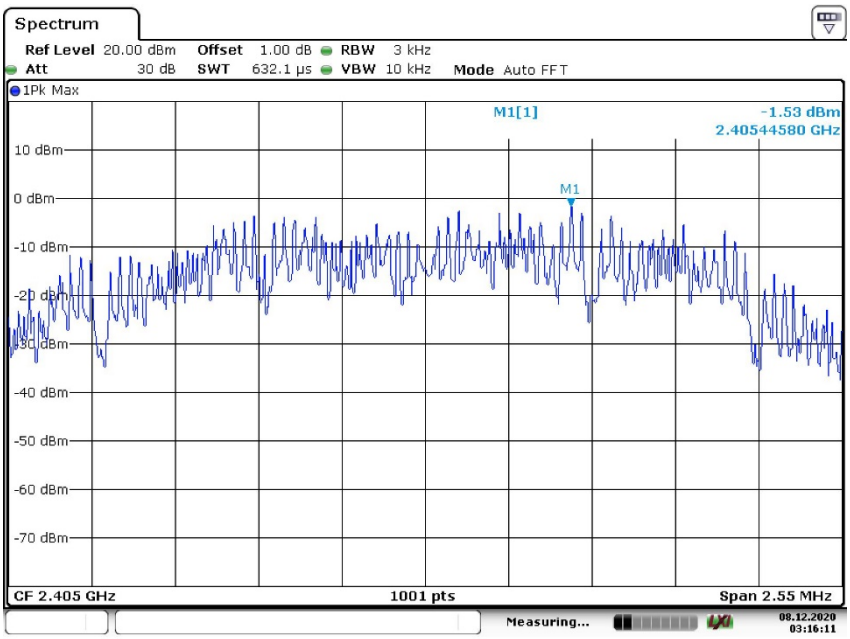
Appendix B.1: Conducted Power Spectral Density

Low Channel



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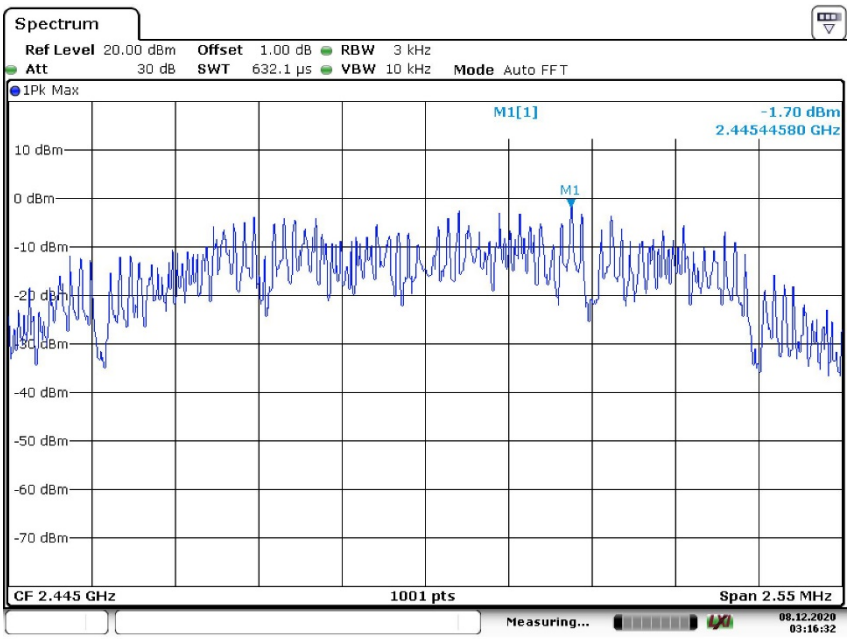
Middle Channel



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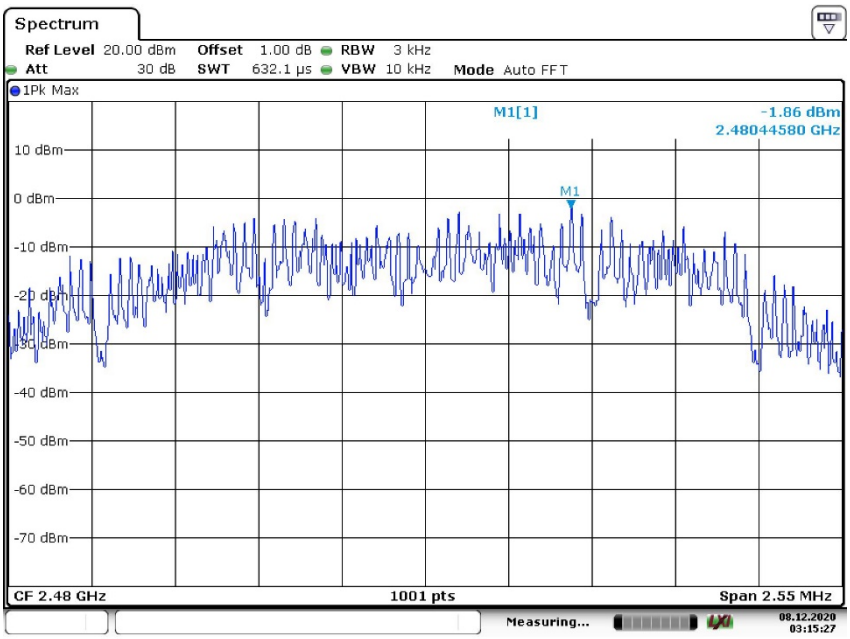
High Channel

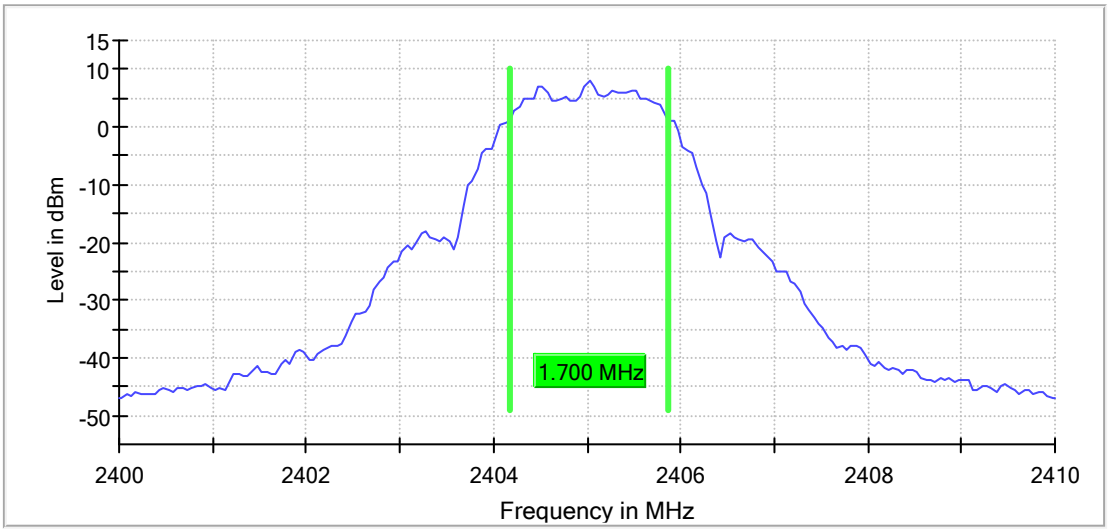


Appendix B.2: 6dB Bandwidth

Low Channel

RBW=100KHz, VBW=300KHz

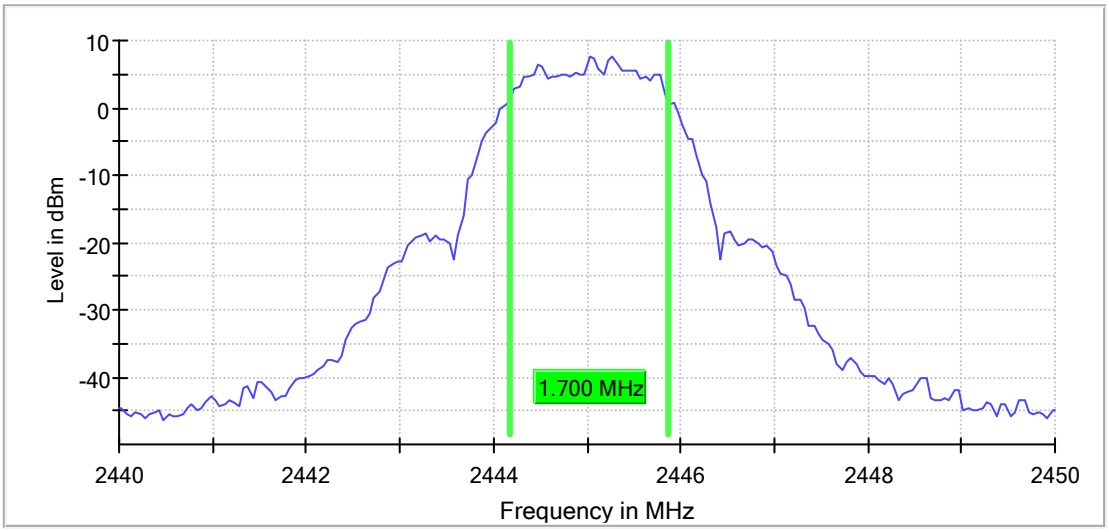
6 dB Bandwidth



Middle Channel

RBW=100KHz, VBW=300KHz

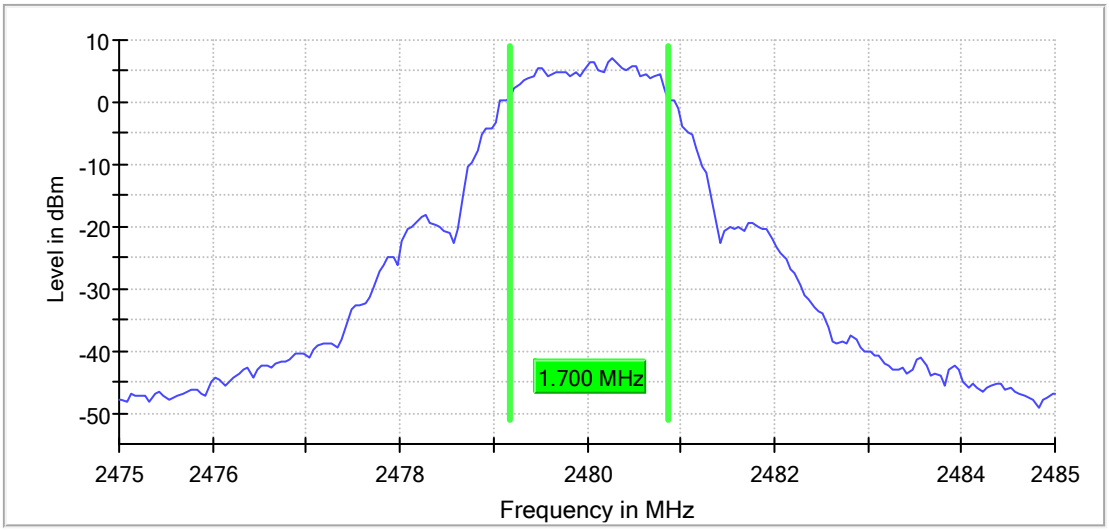
6 dB Bandwidth



High Channel

RBW=100KHz, VBW=300KHz

6 dB Bandwidth

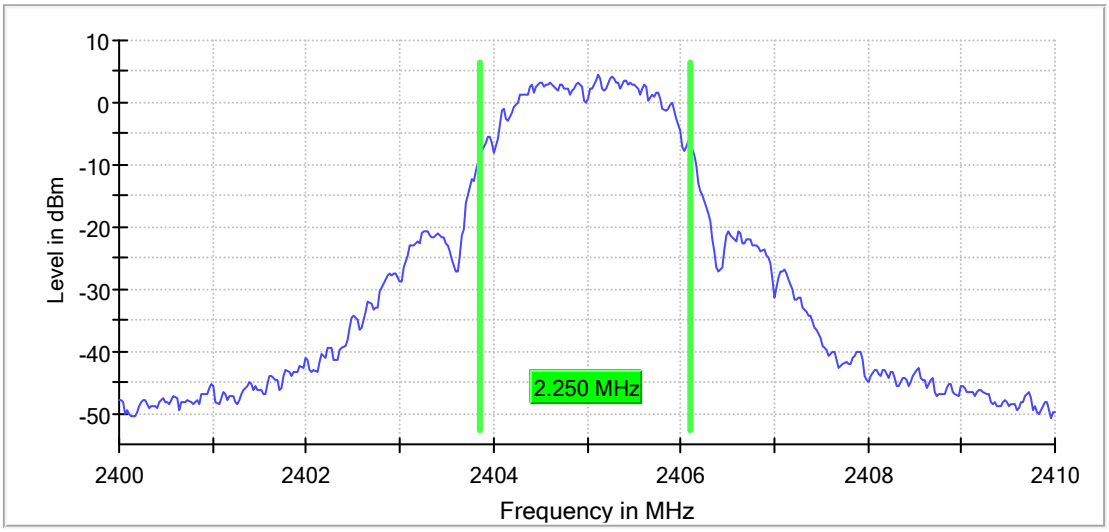


Appendix B.3: 99% Bandwidth

Low Channel

RBW=50KHz, VBW=200KHz

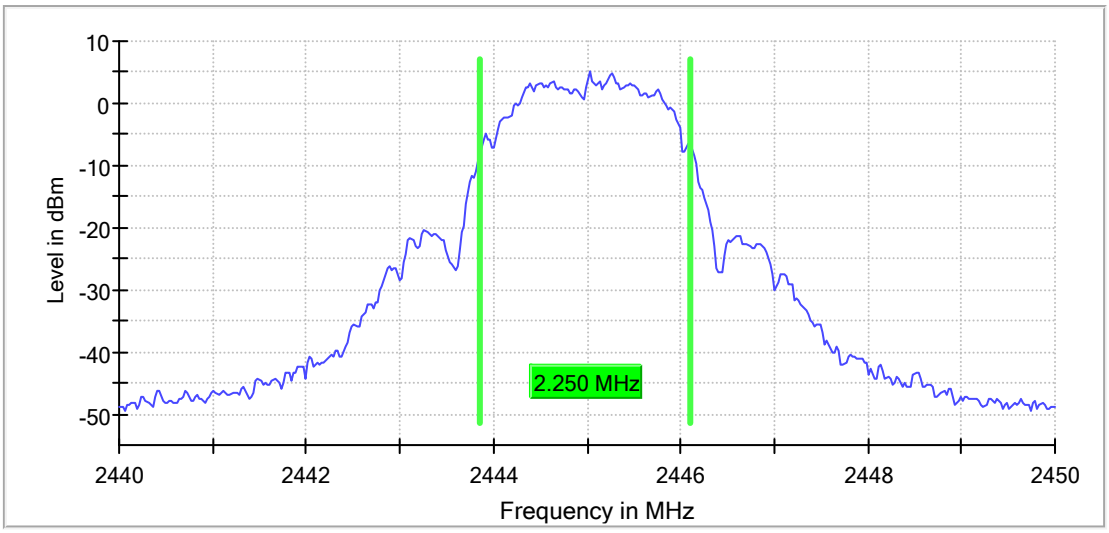
99 % Bandwidth



Middle Channel

RBW=50KHz, VBW=200KHz

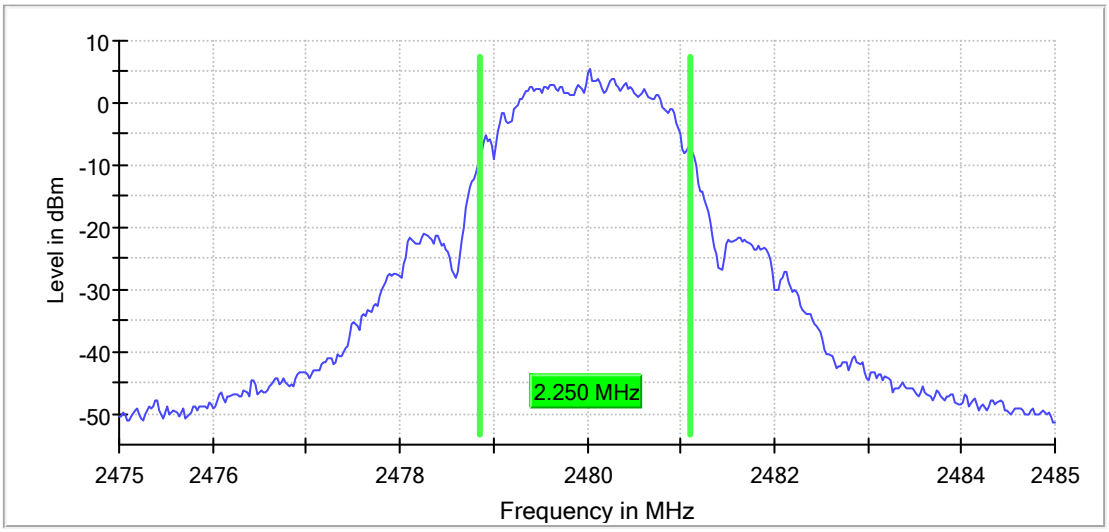
99 % Bandwidth



High Channel

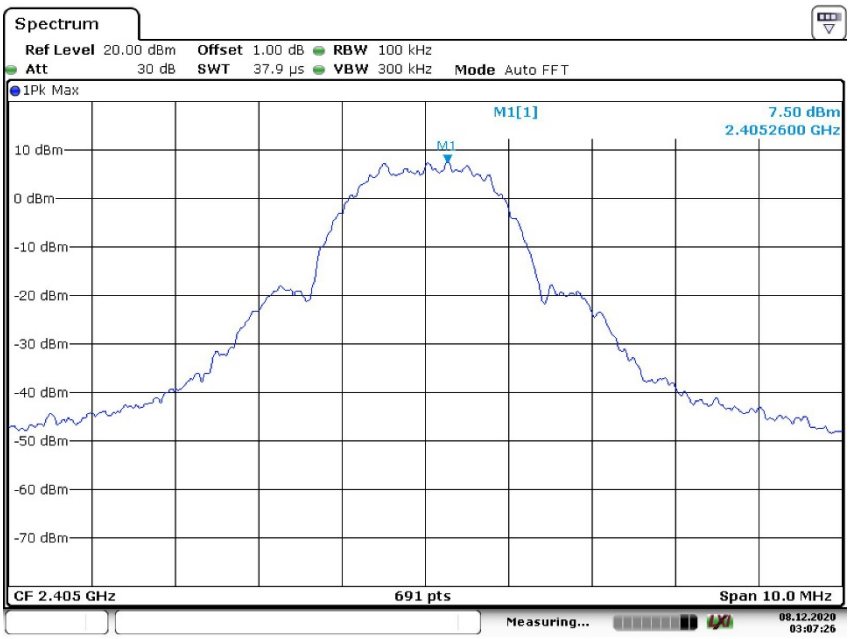
RBW=50KHz, VBW=200KHz

99 % Bandwidth

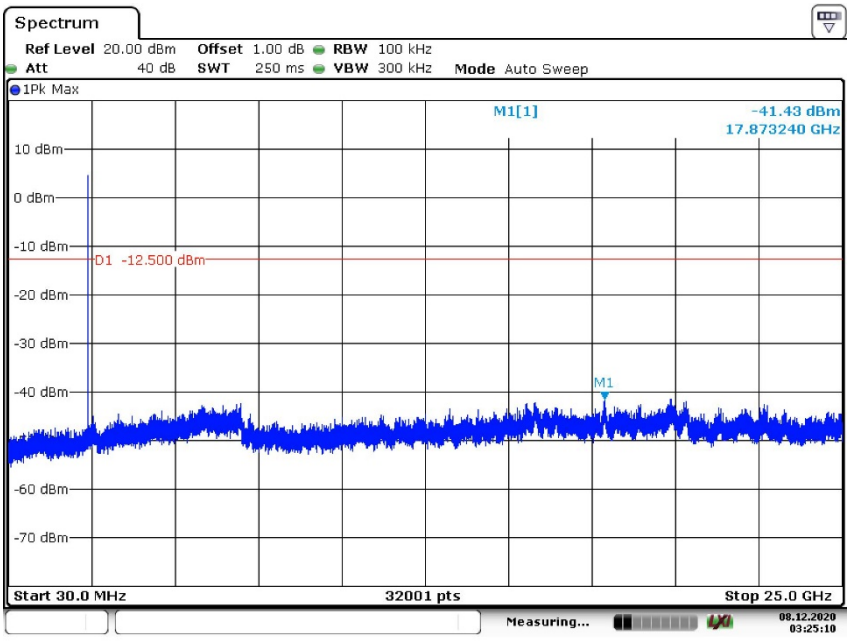


Appendix B.4: Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Low Channel



Date: 8.DEC.2020 03:07:26



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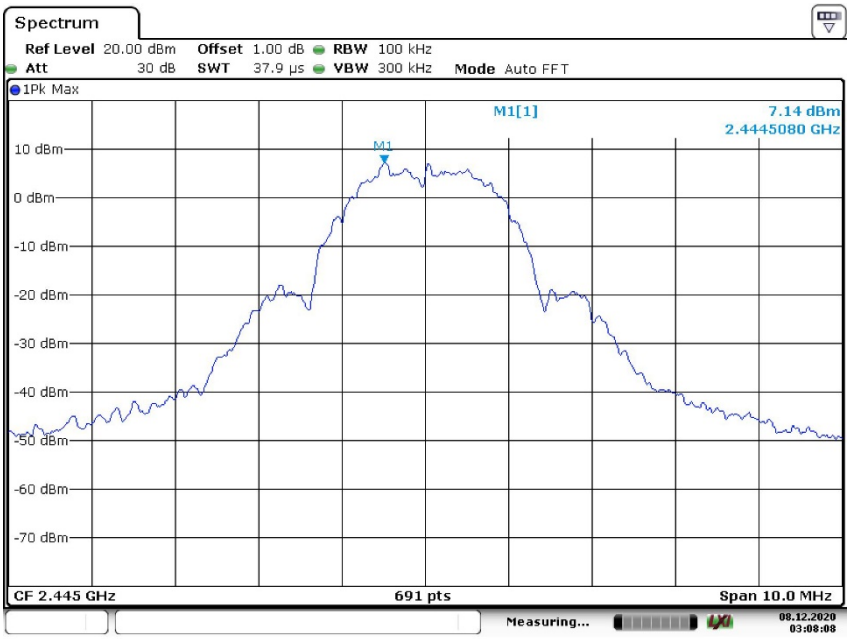
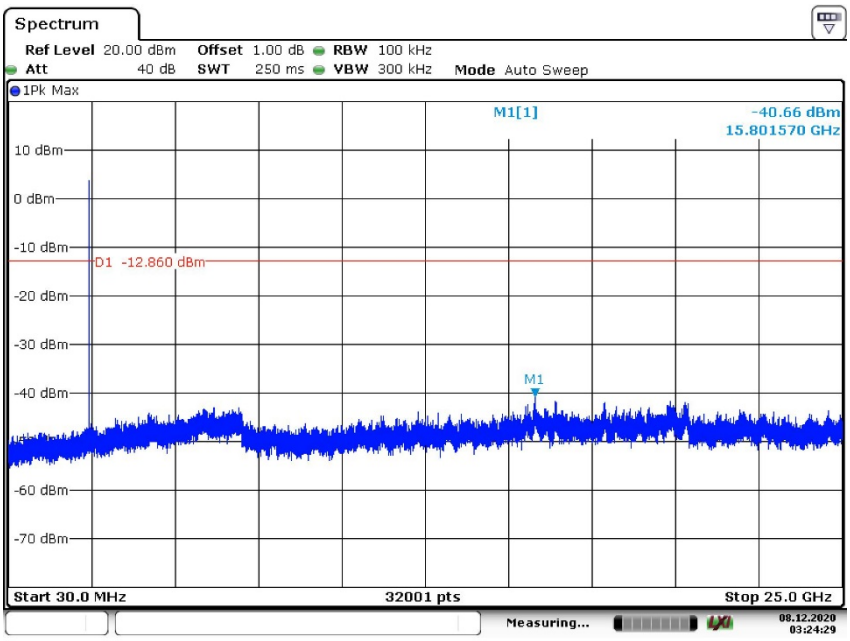
Middle Channel

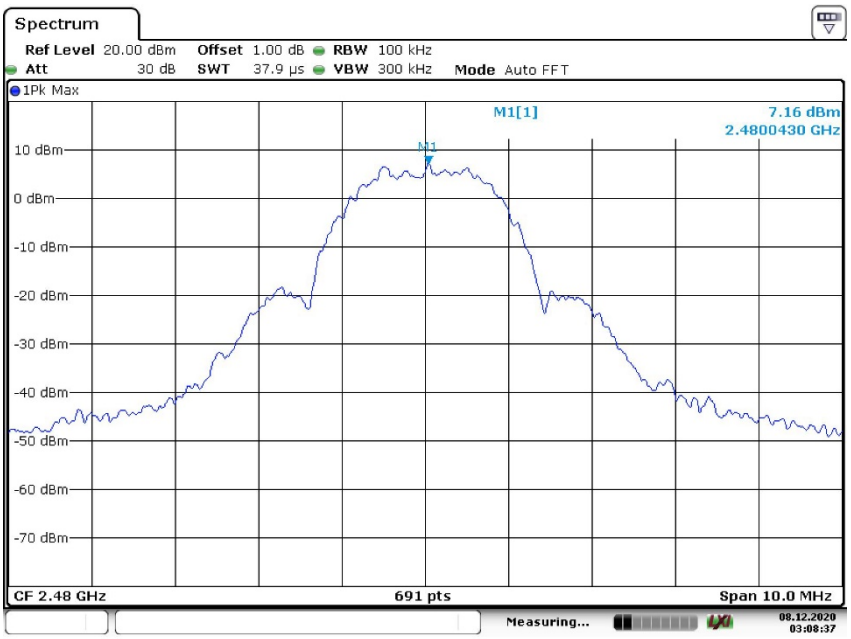


Date: 8.DEC.2020 03:08:08



Date: 8.DEC.2020 03:24:30

High Channel



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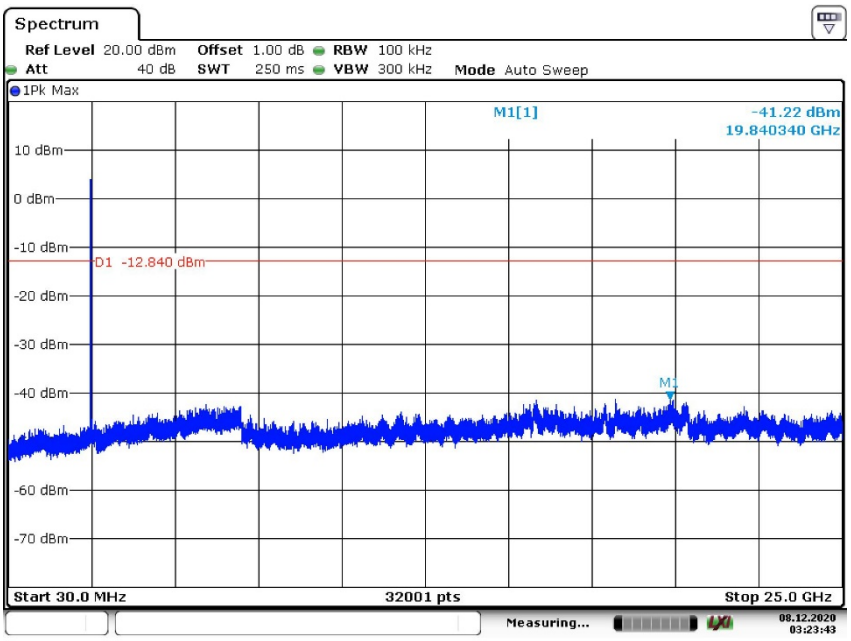
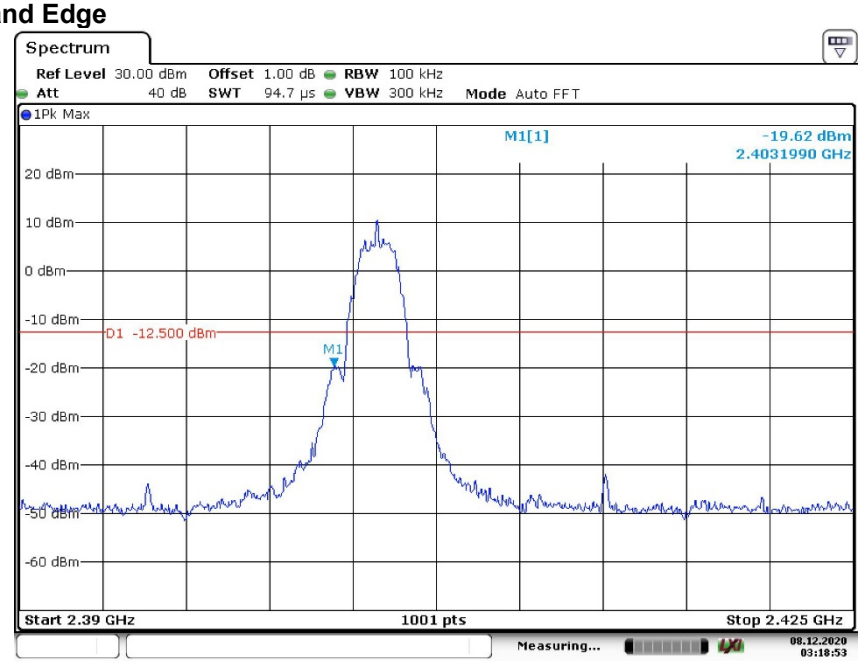


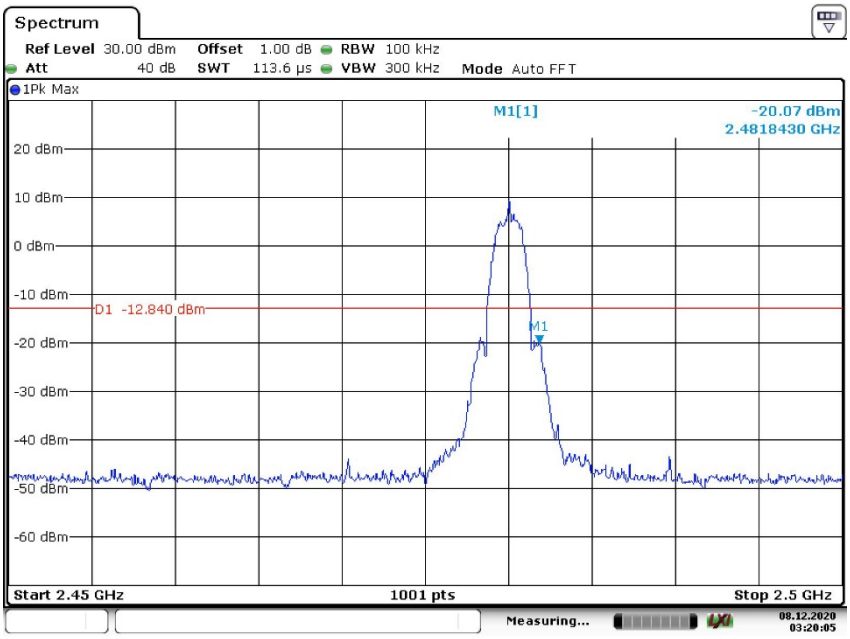
Date: 8.DEC.2020 03:23:43

Low Channel_Band Edge



Date: 8.DEC.2020 03:18:53

High Channel_Band Edge



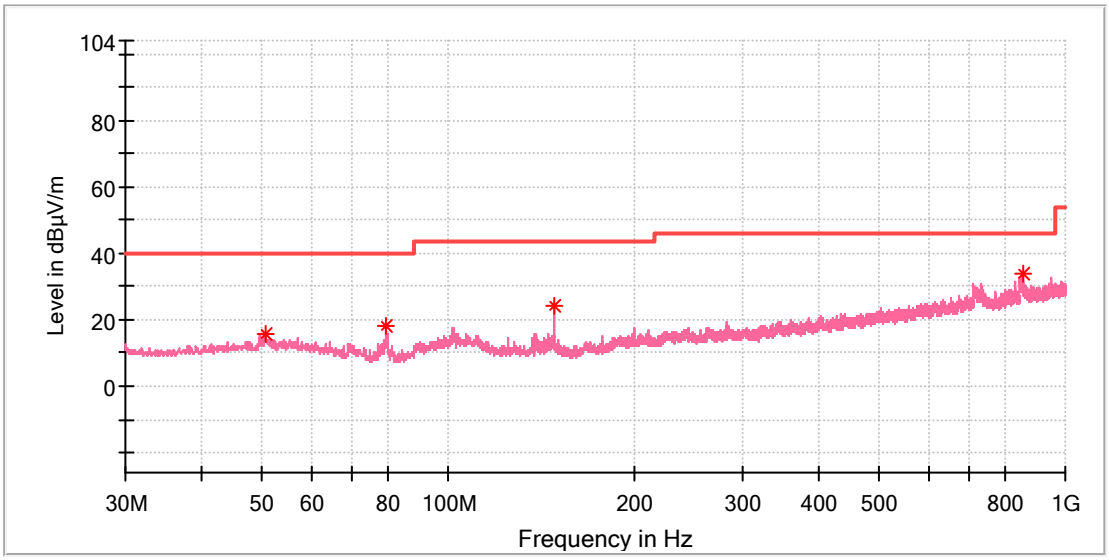
Date: 8.DEC.2020 03:20:06

Appendix B.5: Test Results of Radiated Spurious Emissions

Note 1: Testing was carried out within frequency range 9 kHz to the tenth harmonics. The measurement results below 30MHz and above 18GHz were greater than 20dB below the limit, so only the radiated spurious emissions from 30MHz to 18GHz were reported.

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

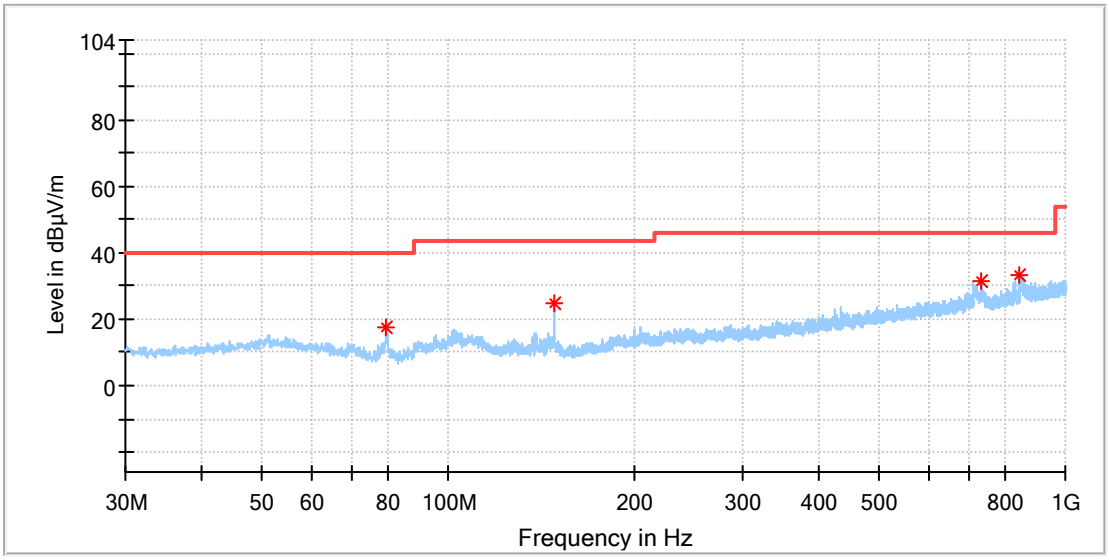


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
50.564000	15.65	---	40.00	24.35	100.0	V	301.0	-18.3
79.227500	17.90	---	40.00	22.10	100.0	V	216.0	-23.5
148.437000	24.21	---	43.50	19.29	100.0	V	0.0	-22.1
851.590000	33.74	---	46.00	12.26	100.0	V	359.0	-5.5

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

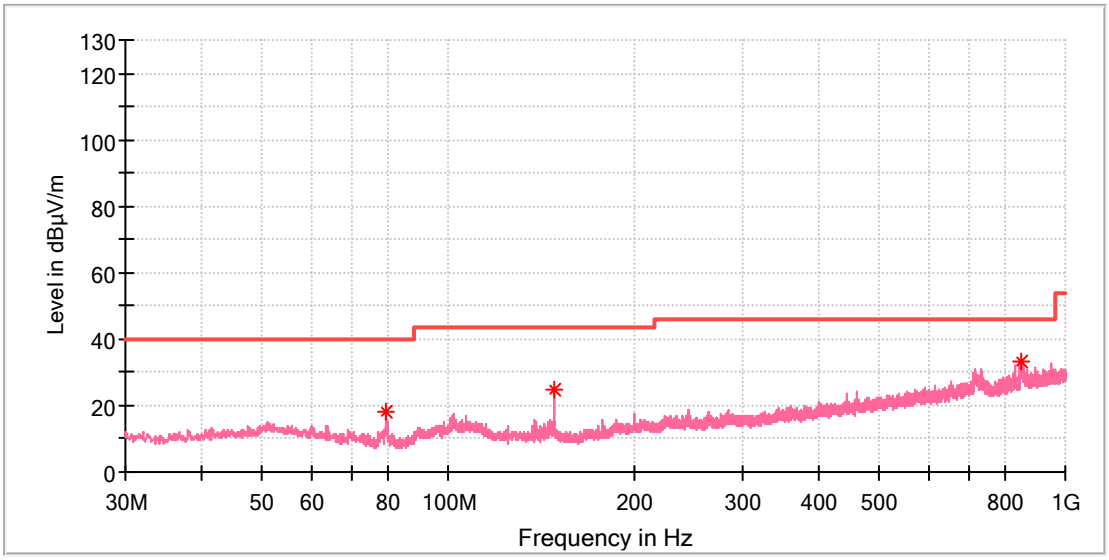


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.227500	17.77	---	40.00	22.23	100.0	H	183.0	-23.5
148.485500	24.83	---	43.50	18.67	100.0	H	284.0	-22.1
728.739500	31.40	---	46.00	14.60	100.0	H	257.0	-7.5
844.800000	33.32	---	46.00	12.68	100.0	H	56.0	-5.6

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

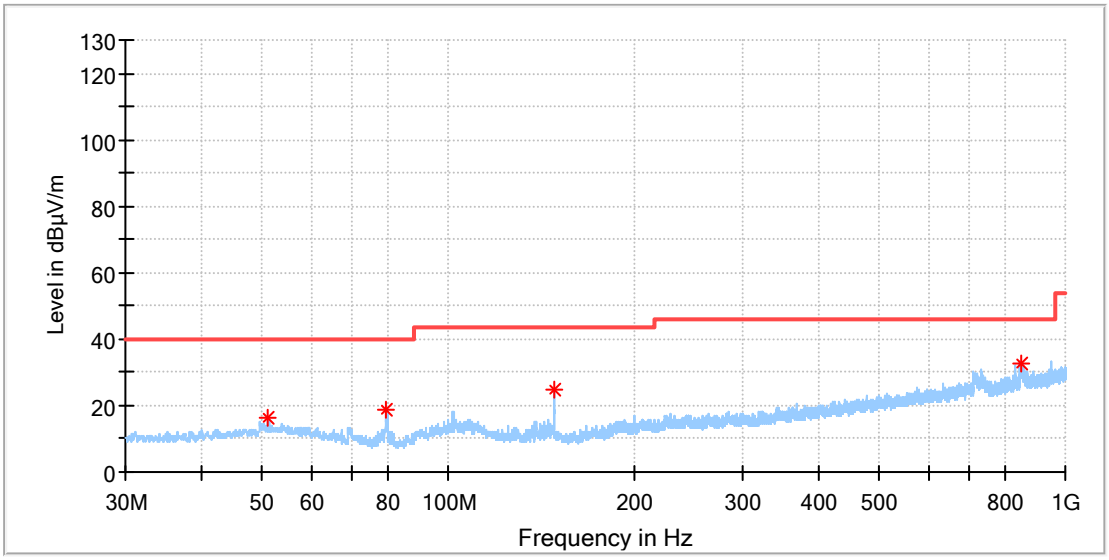


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.179000	17.99	---	40.00	22.01	100.0	V	57.0	-23.5
148.485500	24.87	---	43.50	18.63	100.0	V	65.0	-22.1
845.382000	33.46	---	46.00	12.54	100.0	V	217.0	-5.6

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

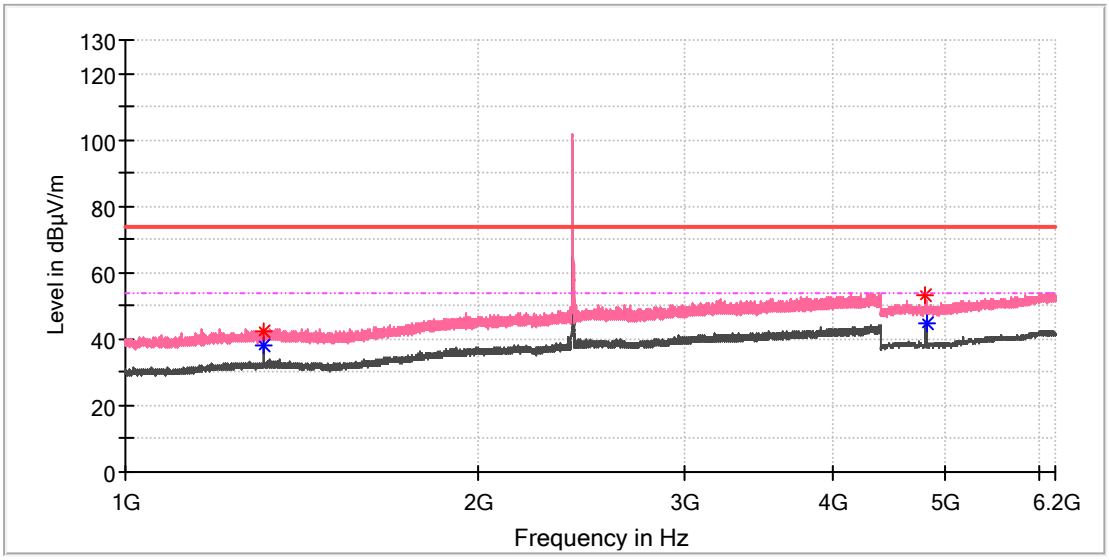


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.194500	16.05	---	40.00	23.95	100.0	H	64.0	-18.3
79.227500	18.78	---	40.00	21.22	100.0	H	228.0	-23.5
148.485500	24.88	---	43.50	18.62	100.0	H	101.0	-22.1
849.019500	32.93	---	46.00	13.07	100.0	H	255.0	-5.5

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

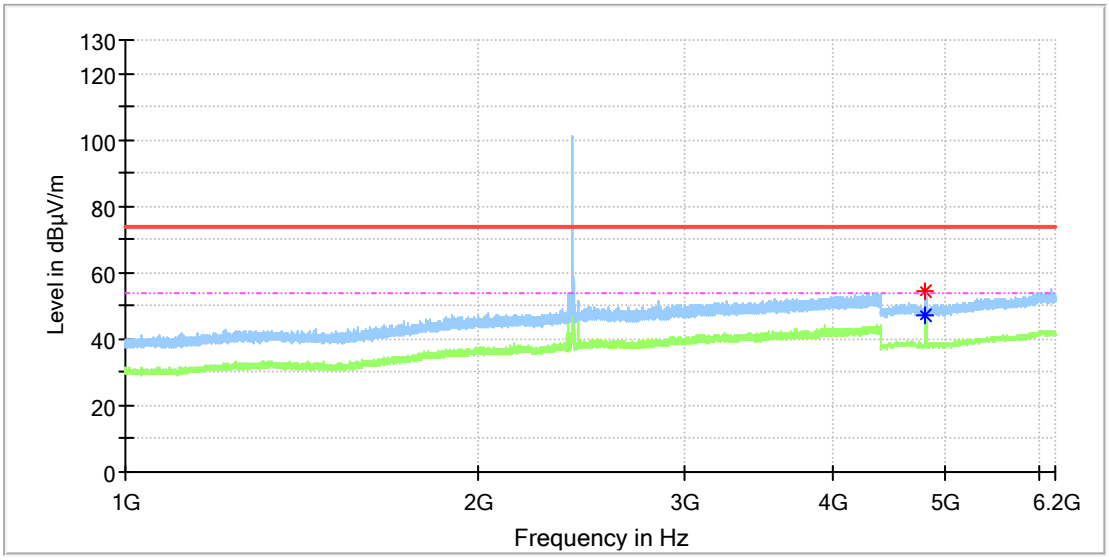


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1312.587500	42.53	---	74.00	31.47	100.0	V	281.0	2.0
1312.587500	---	37.91	54.00	16.09	100.0	V	281.0	2.0
4810.500000	53.21	---	74.00	20.79	100.0	V	0.0	11.8
4812.500000	---	44.51	54.00	9.49	100.0	V	175.0	11.8

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

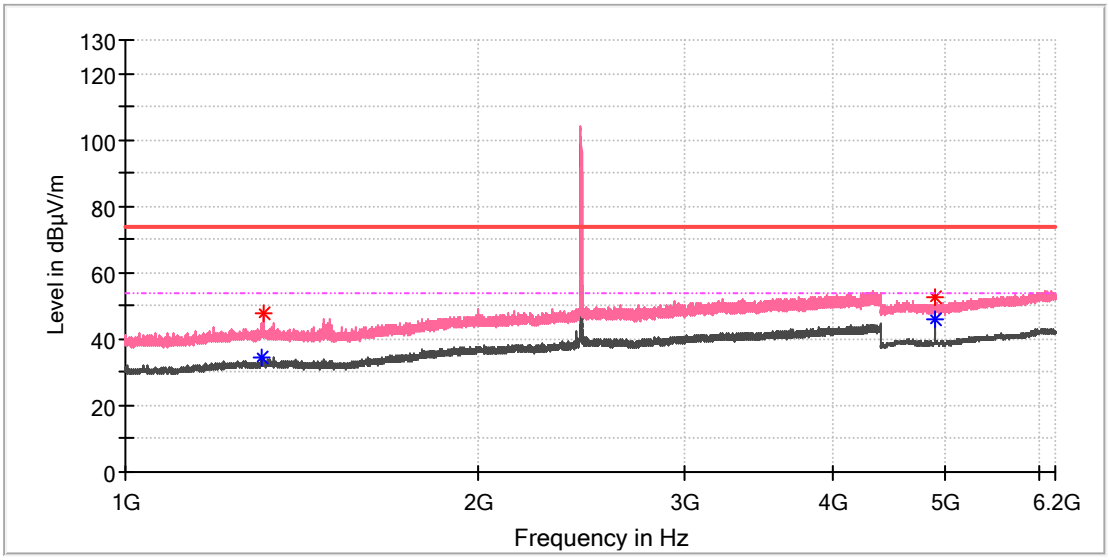


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4811.000000	---	46.89	54.00	7.11	100.0	H	43.0	11.8
4811.000000	54.32	---	74.00	19.68	100.0	H	43.0	11.8

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Mid CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

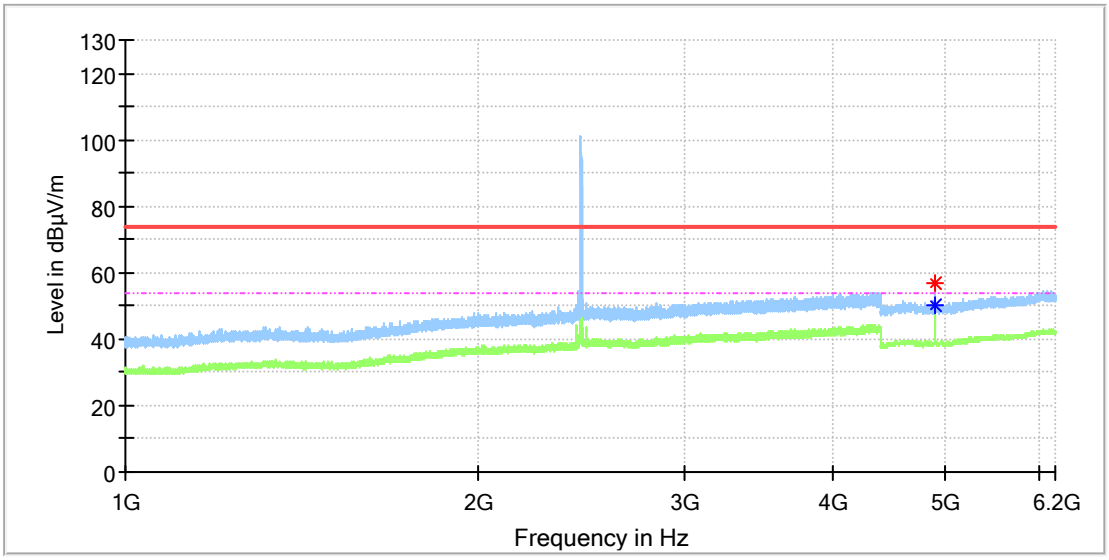


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1308.762500	---	34.54	54.00	19.46	100.0	V	121.0	2.0
1309.825000	47.89	---	74.00	26.11	100.0	V	121.0	2.0
4891.500000	52.58	---	74.00	21.42	100.0	V	197.0	11.8
4893.000000	---	45.72	54.00	8.28	100.0	V	162.0	11.8

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Mid CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

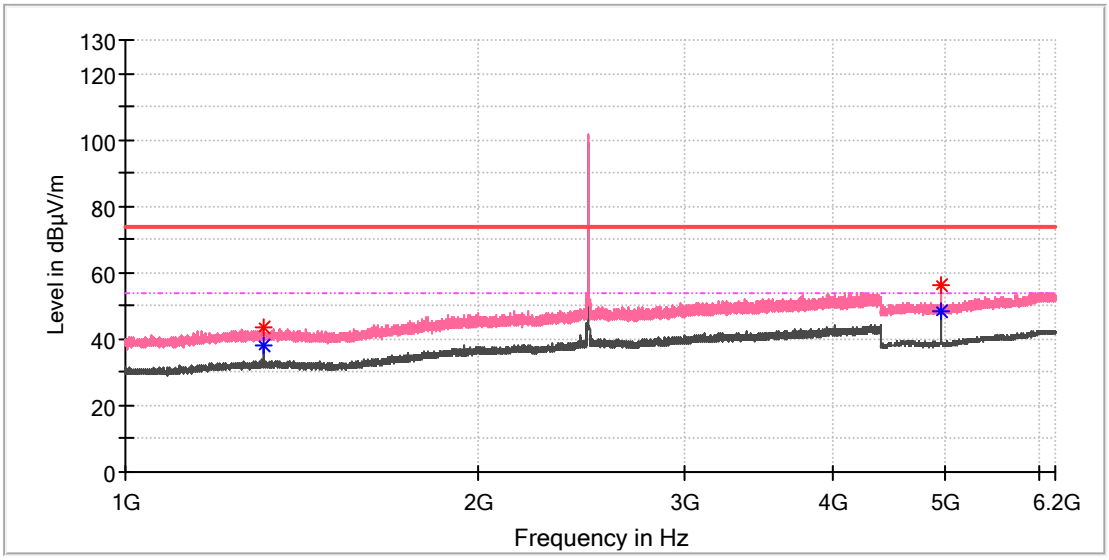


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4891.000000	---	50.17	54.00	3.83	100.0	H	358.0	11.8
4891.000000	56.92	---	74.00	17.08	100.0	H	358.0	11.8

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

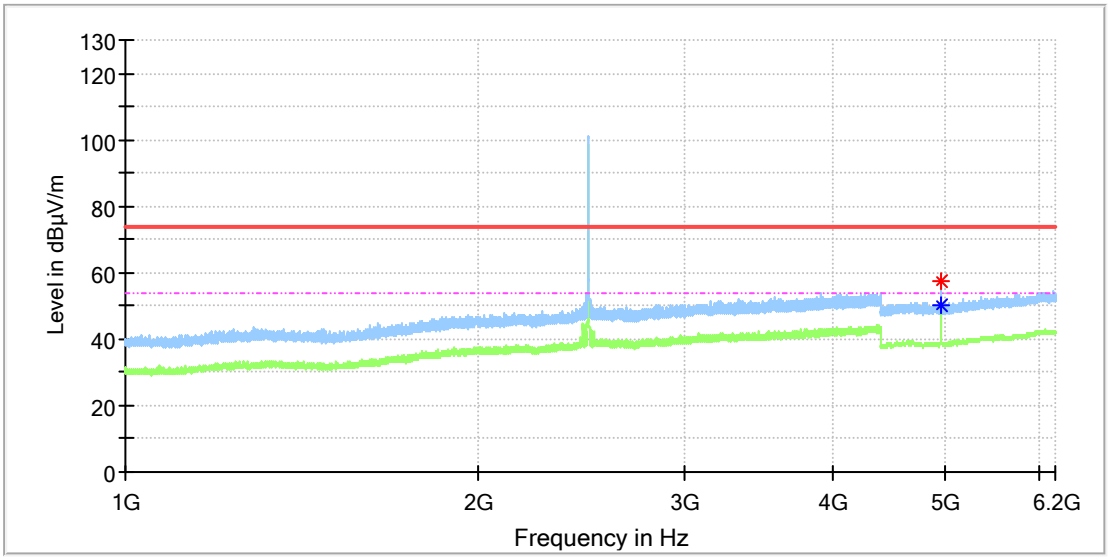


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1312.375000	---	38.15	54.00	15.85	100.0	V	276.0	2.0
1312.587500	43.60	---	74.00	30.40	100.0	V	276.0	2.0
4959.000000	55.98	---	74.00	18.02	100.0	V	161.0	11.8
4961.000000	---	48.60	54.00	5.40	100.0	V	161.0	11.8

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

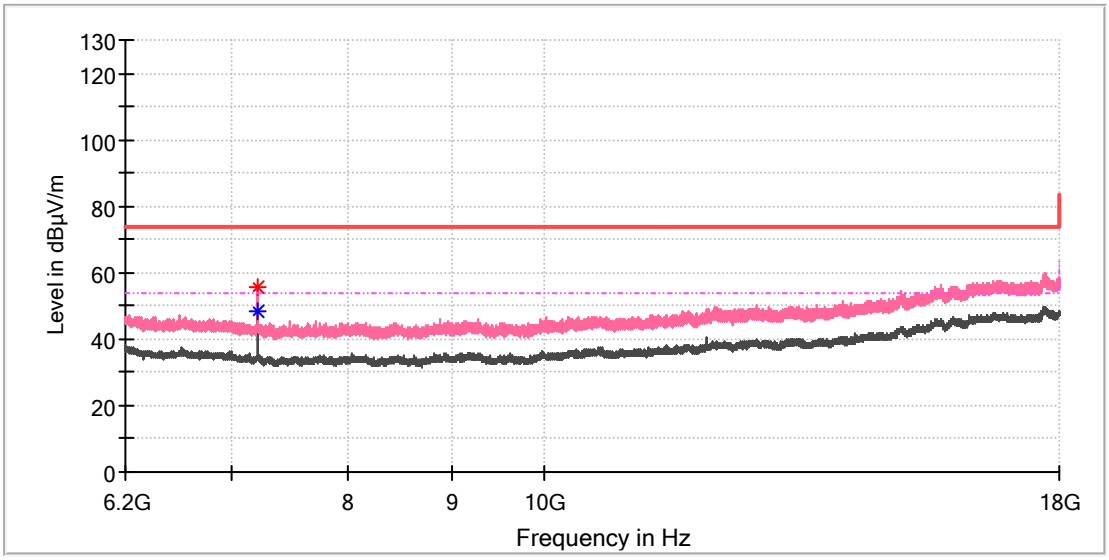


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4961.000000	---	50.06	54.00	3.94	100.0	H	22.0	11.8
4961.000000	57.15	---	74.00	16.85	100.0	H	22.0	11.8

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_ Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

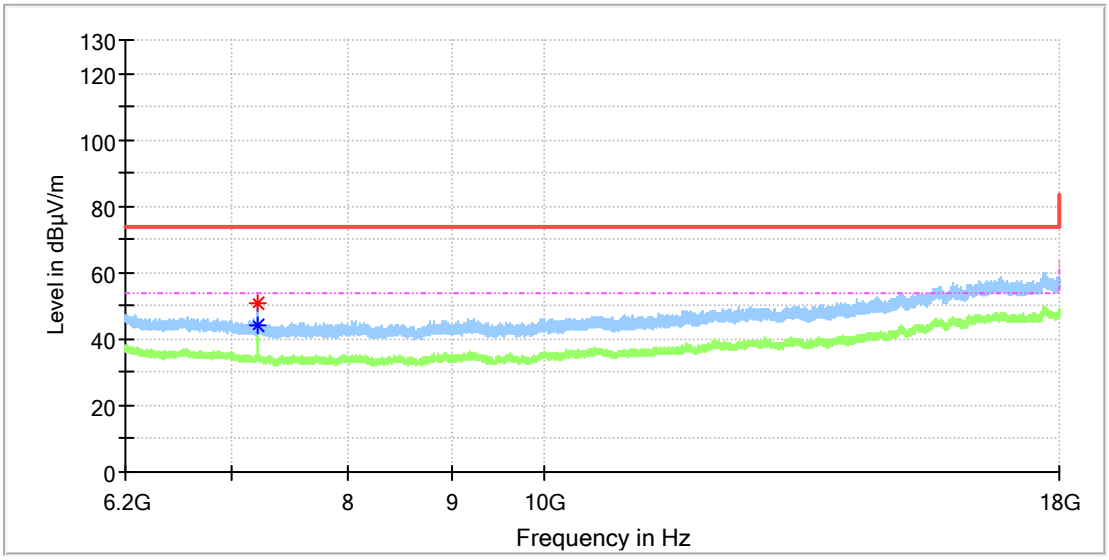


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7212.833333	55.33	---	74.00	18.67	100.0	V	193.0	8.7
7216.275000	---	48.43	54.00	5.57	100.0	V	193.0	8.7

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_ Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

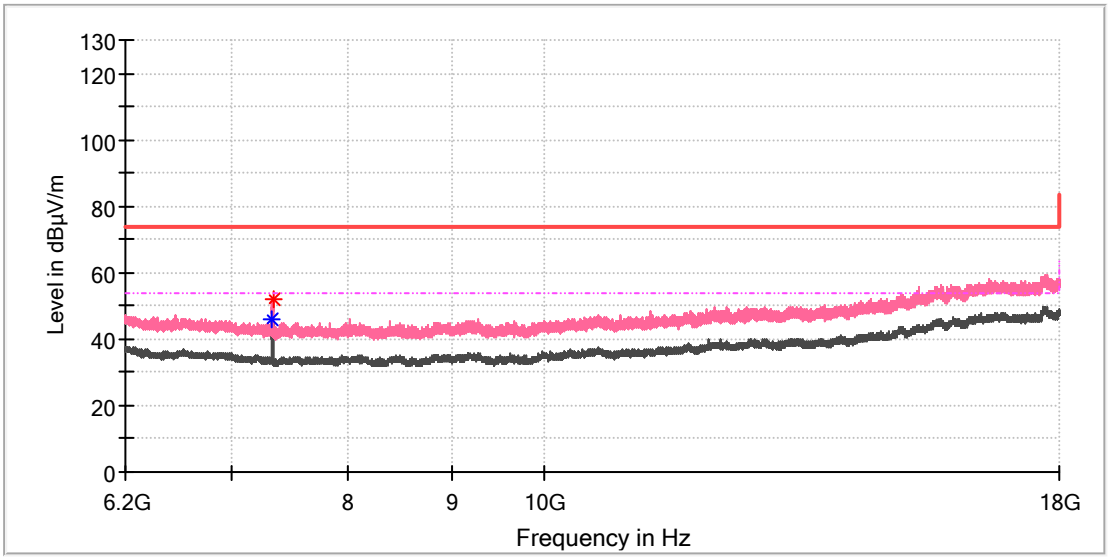


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7216.275000	---	44.38	54.00	9.62	100.0	H	41.0	8.7
7216.766667	50.94	---	74.00	23.06	100.0	H	41.0	8.7

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Mid CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

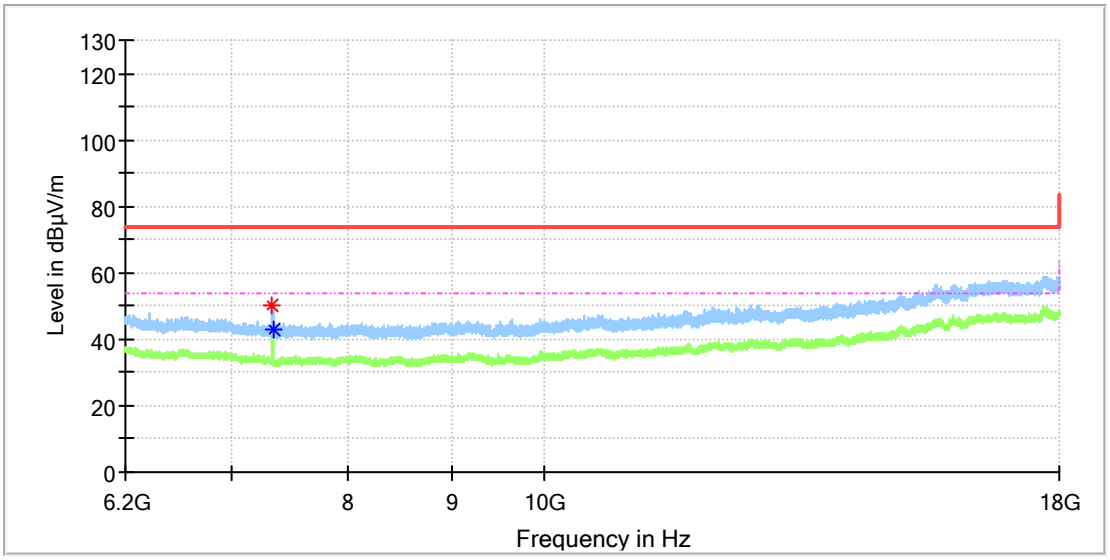


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7333.291667	---	45.85	54.00	8.15	100.0	V	35.0	8.1
7336.733333	51.74	---	74.00	22.26	100.0	V	35.0	8.1

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Mid CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

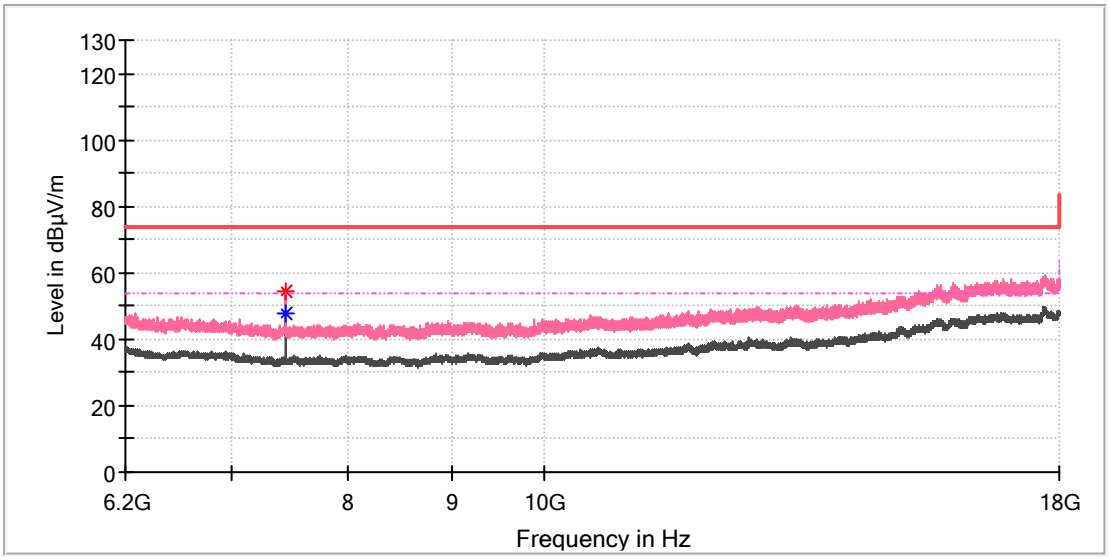


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7333.291667	50.41	---	74.00	23.59	100.0	H	50.0	8.1
7336.241667	---	43.12	54.00	10.88	100.0	H	280.0	8.1

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

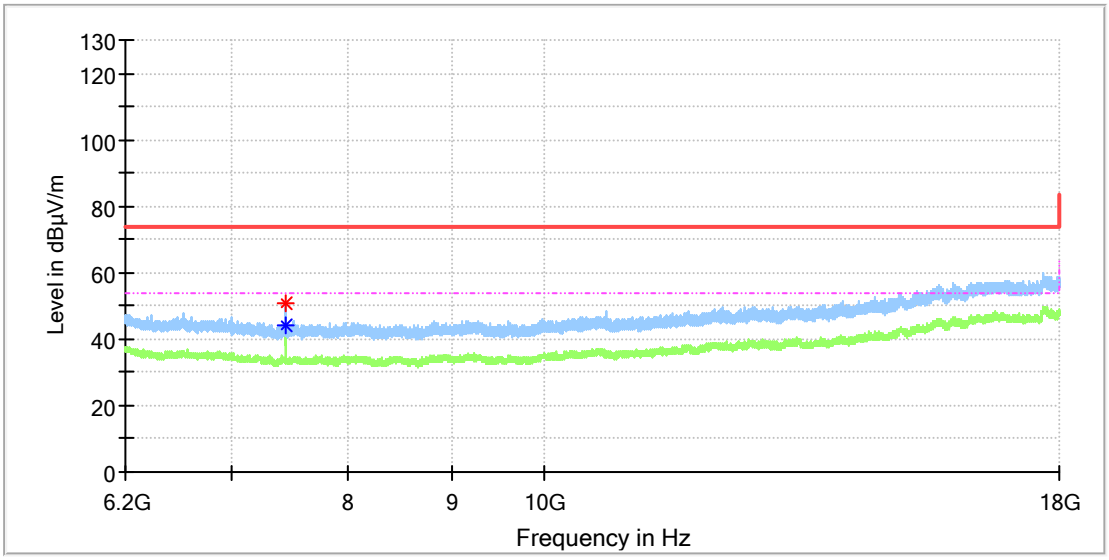


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7441.458333	54.61	---	74.00	19.39	100.0	V	270.0	8.4
7441.458333	---	47.48	54.00	6.52	100.0	V	270.0	8.4

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin



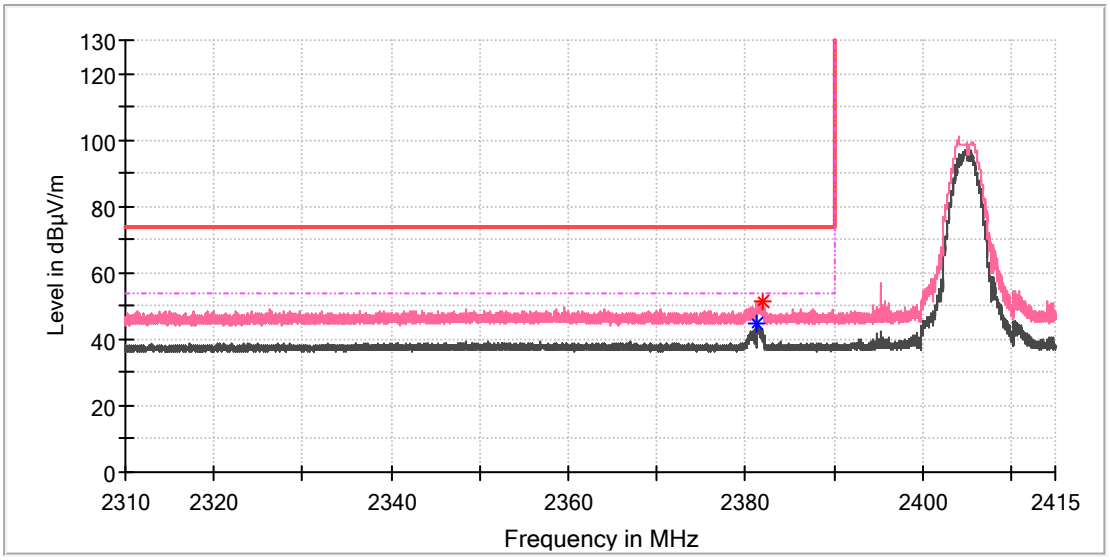
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7440.966667	---	44.08	54.00	9.92	100.0	H	275.0	8.4
7441.458333	50.56	---	74.00	23.44	100.0	H	275.0	8.4

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

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_ Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

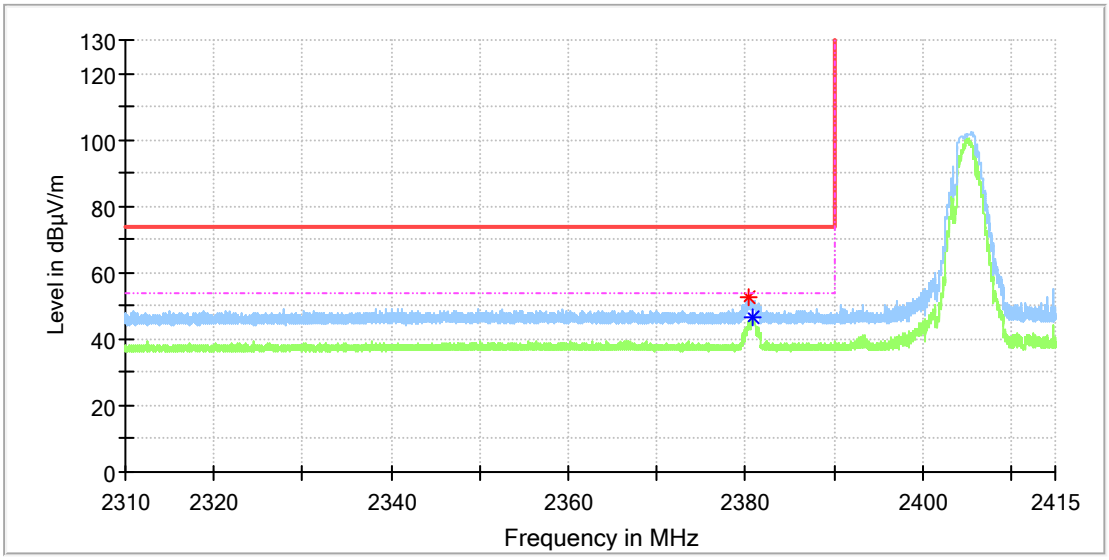


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2381.265563	---	44.70	54.00	9.30	100.0	V	52.0	7.0
2381.851438	51.62	---	74.00	22.38	100.0	V	52.0	7.0

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_Low CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

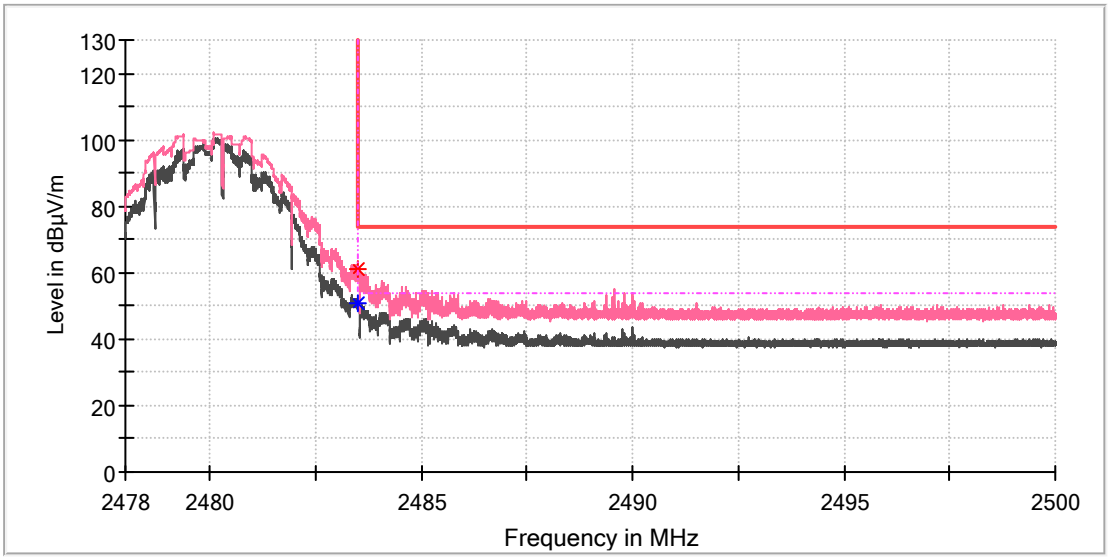


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2380.290938	52.79	---	74.00	21.21	100.0	H	133.0	7.0
2380.907813	---	46.84	54.00	7.16	100.0	H	145.0	7.0

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin

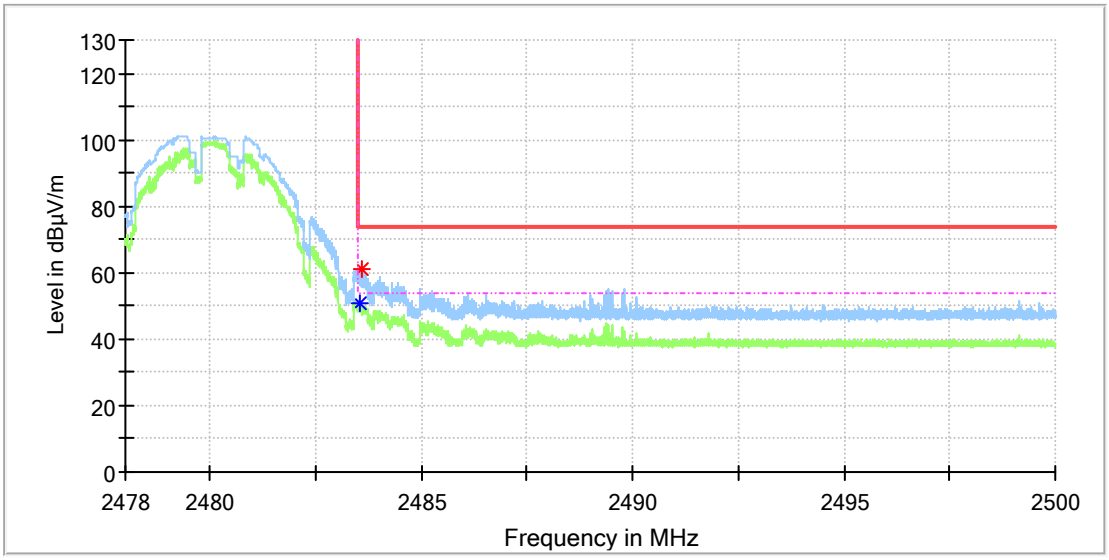


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.512375	61.32	---	74.00	12.68	100.0	V	267.0	7.4
2483.519250	---	50.97	54.00	3.03	100.0	V	267.0	7.4

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Mode:	TX_Zigbee_High CH
Test Voltage:	AC 120V, 60Hz
Remark:	Temp 23 Humi:49%
Test Standard:	FCC 15.247
Tested By:	Alano Qu
Reviewed By:	Terry Yin



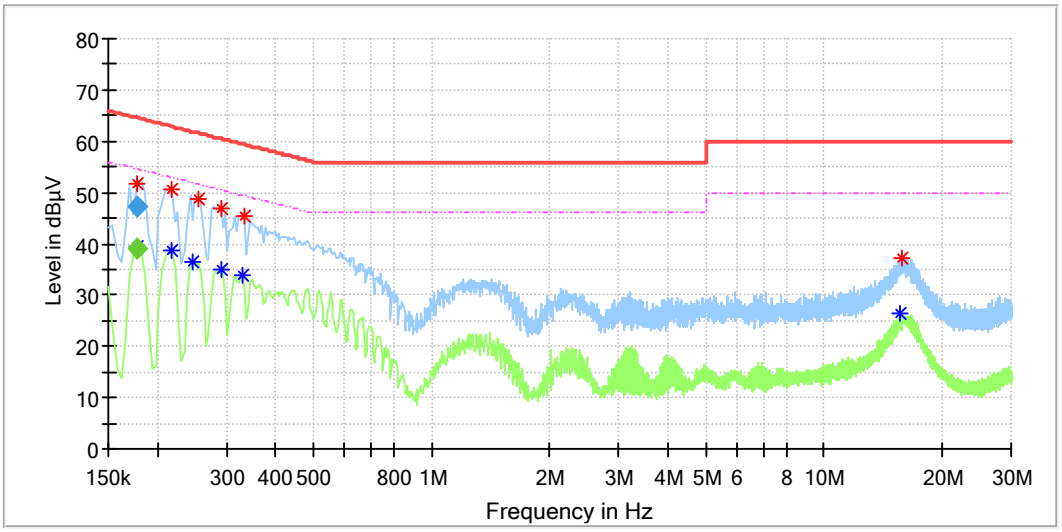
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.563125	---	50.75	54.00	3.25	100.0	H	358.0	7.4
2483.604688	60.89	---	74.00	13.11	100.0	H	358.0	7.4

Appendix B.7: Test Results of Conducted Emissions on AC Mains

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Model:	ON
Test Voltage:	AC120V/60Hz
Test By:	Ouyang Wang
Review By:	Gary Chen
Remark:	SR2



Critical_Freqs

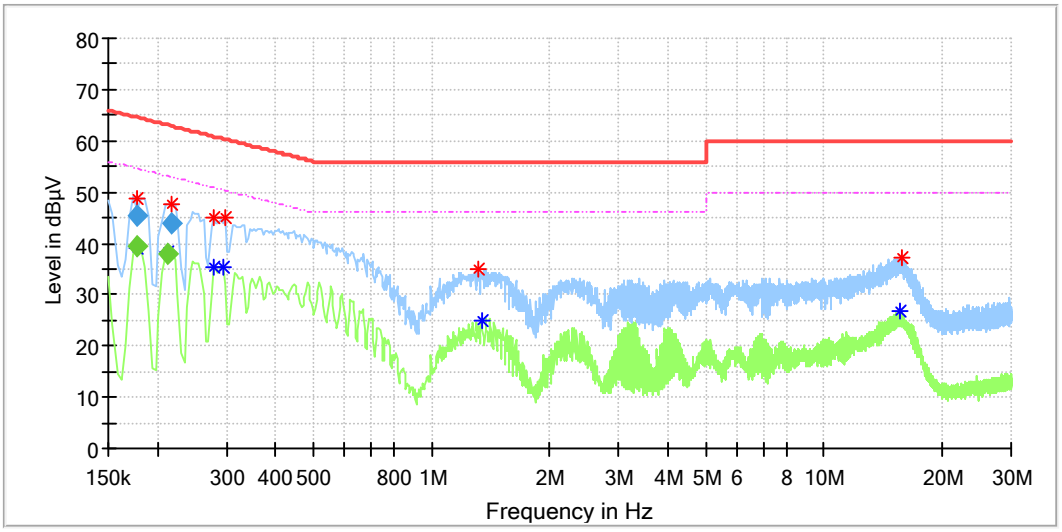
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line
0.218000	50.49	---	62.90	12.40	L1
0.218000	---	38.65	52.90	14.24	L1
0.246000	---	36.58	51.89	15.31	L1
0.254000	48.68	---	61.63	12.95	L1
0.290000	---	34.81	50.52	15.71	L1
0.290000	47.02	---	60.52	13.51	L1
0.330000	---	33.88	49.45	15.57	L1
0.334000	45.35	---	59.35	14.00	L1
15.694000	---	26.45	50.00	23.55	L1
15.742000	37.23	---	60.00	22.77	L1

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line
0.177500	---	39.24	54.60	15.36	1000.0	9.000	L1
0.177500	47.35	---	64.60	17.25	1000.0	9.000	L1

EUT Information

EUT Name:	Smart plug
Model:	HPPA21SZ
Test Model:	ON
Test Voltage:	AC120V/60Hz
Test By:	Ouyang Wang
Review By:	Gary Chen
Remark:	SR2



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line
0.278000	---	35.25	50.88	15.62	N
0.278000	45.04	---	60.88	15.83	N
0.294000	---	35.31	50.41	15.10	N
0.298000	44.86	---	60.30	15.44	N
1.310000	34.80	---	56.00	21.20	N
1.338000	---	24.94	46.00	21.06	N
15.682000	---	26.63	50.00	23.37	N
15.766000	37.31	---	60.00	22.69	N

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line
0.177500	---	39.32	54.60	15.28	1000.0	9.000	N
0.177500	45.39	---	64.60	19.21	1000.0	9.000	N
0.213500	---	38.02	53.07	15.05	1000.0	9.000	N
0.217500	44.07	---	62.91	18.84	1000.0	9.000	N