

Prüfbericht-Nr.: <i>Test report no.:</i>	CN239SP6 002	Auftrags-Nr.: <i>Order no.:</i>	168424086	Seite 1 von 26 Page 1 of 26
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2023-04-25	
Auftraggeber: <i>Client:</i>	Shenzhen HAC Telecom Technology Co., LTD Floor 9, Block A, Building 1, Shenzhen International Innovation Valley, Xingke 1st Street, Nanshan District, Shenzhen, China			
Prüfgegenstand: <i>Test item:</i>	LoRaWAN Gateway			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	HAC-GWW1-U (Trademark: HAC)			
Auftrags-Inhalt: <i>Order content:</i>	Type Test			
Prüfgrundlage: <i>Test specification:</i>	*CFR47 FCC Part 15: Subpart C Section 15.247 *RSS-247 Issue 2 *CFR47 FCC Part 22 *RSS-130 Issue 2 *CFR47 FCC Part 24 *RSS-132 Issue 3 *CFR47 FCC Part 27 *RSS-133 Issue 6 *RSS-139 Issue 3			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2022-02-21	Refer to photos documents		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003214225, A003214379			
Prüfzeitraum: <i>Testing period:</i>	2022-02-22 – 2022-03-31			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	genehmigt von: <i>authorized by:</i>			
Datum: <i>Date:</i> 2023-05-09	 Signed by: Alex Lan		 Signed by: Hardy Suo	
Stellung / Position	Senior Project Engineer	Ausstellungsdatum: <i>Issue date:</i> 2023-05-10	Reviewer	
Sonstiges / Other:	* The LTE module, Wi-Fi module and Lora module are combination in a new host, the co-located radiated spurious emission is arrange re-assessment. * * This product contains transmitter module, refer to clause 3.1 for details.			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend N/A = nicht anwendbar	4 = ausreichend N/T = nicht
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient 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. <i>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.</i>				

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Test Summary

5.1 Co-Located Radiated Spurious Emissions

RESULT: Pass

5.2 Conducted emissions

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:
None.

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

No.362, Huanguan Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District,
Shenzhen, Guangdong, China/518110

FCC Registration No.: 694916

IC Registration No.: 25069, CAB identifier: CN0078

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2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Unwanted Emission Testing (TS9975)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
EMI Test Receiver	R&S	ESR 7	102021	2024-08-02
Signal Analyzer	R&S	FSV 40	101439	2024-08-01
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2024-08-01
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2024-08-02
Amplifier	R&S	SCU-18F	180070	2024-08-02
Amplifier	R&S	SCU40A	100475	2024-08-02
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2024-08-06
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2024-08-06
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2024-08-27
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2024-08-06
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

Conducted Emissions testing				
Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
EMI Test Receiver	R&S	ESR3	102428	2023-07-31
Artificial Mains Network	R&S	ENV216	102333	2023-08-01
Impedance Stabilisation Network	R&S	ENY81	100323	2023-08-01
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

Test	Parameters	uncertainty
Conducted Emission	Conducted emission 150kHz-30MHz (AMN)	± 3.70 dB ± 3.30 dB
Radiated Emission	Radiated emission 30MHz-1GHz	± 4.52 dB
	Radiated emission 1GHz-18GHz	± 4.37 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were at 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 Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District, Shenzhen, Guangdong, China/518110 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 WisGate, which supports 2.4GHz Wi-Fi, Lora and LTE functions.

Note: This product contains transmitter modules.

LTE module Model: EG95NA	Contains FCC ID: XMR201807EG95NA
2.4GHz Wi-Fi module Model: RAK634	Contains FCC ID: WMUHAC-WF
Lora module Model: RAK5146	Contains FCC ID: WMUHAC-MLWR

Note: The test standard for frequency Bands 698-756 MHz and 777-787 MHz in LTE module test report is RSS-130 issue 1 and the essential requirements remain unchanged in the updated version RSS-130 issue 2, hence it has been updated in current test report without additional test.

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	LoRaWAN Gateway
Type Designation	HAC-GWW1-U
Trade Mark	HAC
Input Voltage	DC 12V via AC/DC Adapter or DC 37 ~57V via POE adapter
Testing Voltage	AC 120V, 60Hz or DC 48V
AC/DC Adapter information	Model #1: AD-0241200200US-1 Model #2: PSYC1202000US Model #3: PSYC1202000 Rating for all models: Input: AC 100-240V, 50/60Hz, 0.6A Max Output: DC 12.0V, 2A 24.0W Note: Model #2 is identical with model # 3 except the type of plug.

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Technical Specification of Wi-Fi

Operating Frequency	2412 - 2462 MHz for 802.11b/g/n(HT20) 2422 - 2452 MHz for 802.11n(HT40)
Type of Modulation	DSSS(DBPSK/DQPSK/CCK) OFDM(BPSK/QPSK/16QAM/64QAM)
Data Rate	1/2/5.5/11 Mbps for 802.11b 6/9/12/18/24/36/48/54 Mbps for 802.11g MCS0 ~ MCS7 for 802.11n
Channel Number	11 channels for 802.11b/g/n(HT20) 7 channels for 802.11n(HT40)
Channel Separation	5 MHz
Number of Antenna:	2
Antenna Gain:	5.4dBi for Ant0 5.0dBi for Ant1

Technical Specification of Lora DTS

Operating Frequency	923.3 - 927.5MHz
Type of Modulation	Lora
Data Rate	SF7 – SF12 / DR8 – DR13
Channel Number	8 channels
Channel Separation	600 KHz
Occupied Bandwidth	500 KHz
Number of Antenna:	1
Antenna Gain:	2.3dBi (Dipole Antenna)

Technical Specification of Lora Hybrid

Frequency Range	903.9MHz - 905.3MHz
Type of Modulation	Lora
Data Rate	SF7 – SF10 / DR0 –DR3
Channel Number	8 channels
Channel Separation	200 KHz
Occupied Bandwidth	125 KHz
Number of Antenna:	1
Antenna Gain:	2.3dBi (Dipole Antenna)

Technical Specification of LTE

Wireless Technology:	LTE & WCDMA
Operation Frequency band(s)	WCDMA Band: II, IV, V LTE Band: 2, 4, 5, 12, 13
Power Class:	Class 4
Type of Modulation:	BPSK, QPSK
Type of Antenna:	Internal Antenna
Antenna number:	2
Antenna Gain:	4.4dBi for Ant 0 2.9dBi@780MHz,3.5dBi@2300MHz for Ant1

3.3 Independent Operation Modes

The basic operation modes are:

A, On, WIFI link + LTE link + Lora DTS link

B, On, WIFI link + LTE link + Lora DSS (Hybrid) link

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- | | |
|-----------------|------------------|
| - Block Diagram | - 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 tests were performed according to the procedures in ANSI C63.10 and ANSI C63.26.

According to clause 3.1, Co-location Radiated Spurious Emissions test were applied on model HAC-GWW1-U with AC/DC Adapter #1 and Conducted Emissions test were applied on model HAC-GWW1-U with AC/DC Adapter #1 & # 2.

4.3 Special Accessories and Auxiliary Equipment

Table 3: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model No.	Serial Number or Rating
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	166305
Portable Laptop	Lenovo	ThinkPad T480	10Q67059
POE Adapter	HAC	R012-4800500	Input: AC 100-240V, 50/60Hz, 0.6A Max Output: DC 48.0V, 0.5A 24.0W

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)

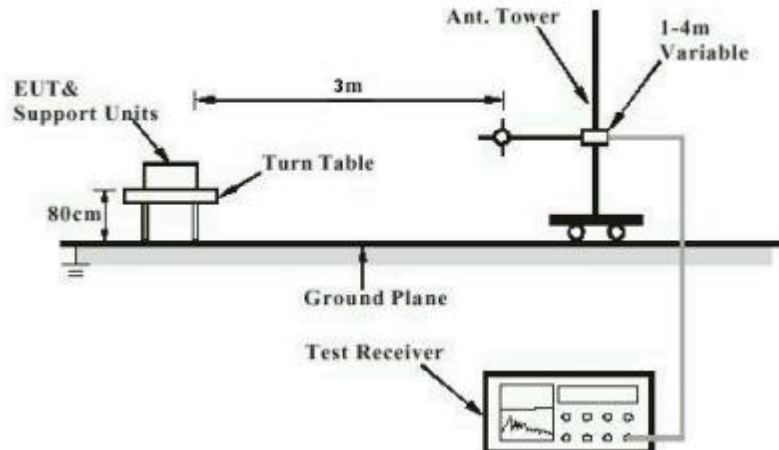


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

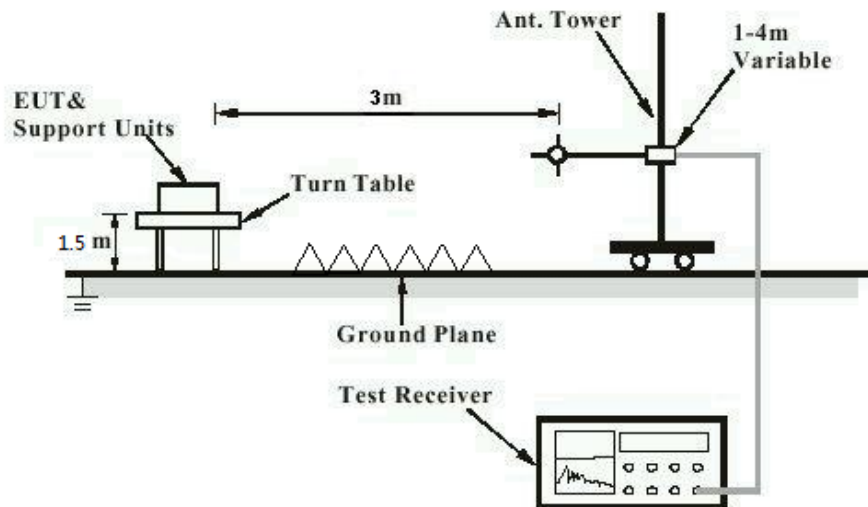
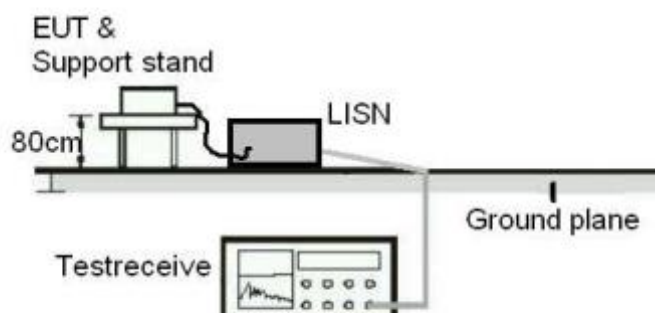


Diagram of Measurement Configuration for Mains Conduction Measurement



5 Test Results

5.1 Co-Located Radiated Spurious Emissions

RESULT:

Pass

Test Specification

Test standard	:	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 22 CFR47 FCC Part 24 CFR47 FCC Part 27 RSS-247 Issue 2 RSS-130 Issue 2 RSS-132 Issue 3 RSS-133 Issue 6 RSS-139 Issue 3
Basic standard	:	ANSI C63.10 & ANSI C63.26
Limit	:	KDB 996369 D04 The emissions not exceed the highest limit.
Kind of test site	:	3m Semi-anechoic Chamber

Test Setup

Date of testing	:	2022-02-22 – 2022-03-24
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A B
Earthing	:	Not Connected
Ambient temperature	:	22. °C
Relative humidity	:	55 %
Atmospheric pressure	:	101 kPa

Note: The test plots of Co-located radiated spurious emissions beyond the limit are the fundamental radio frequency of Lora, Wi-Fi and LTE.

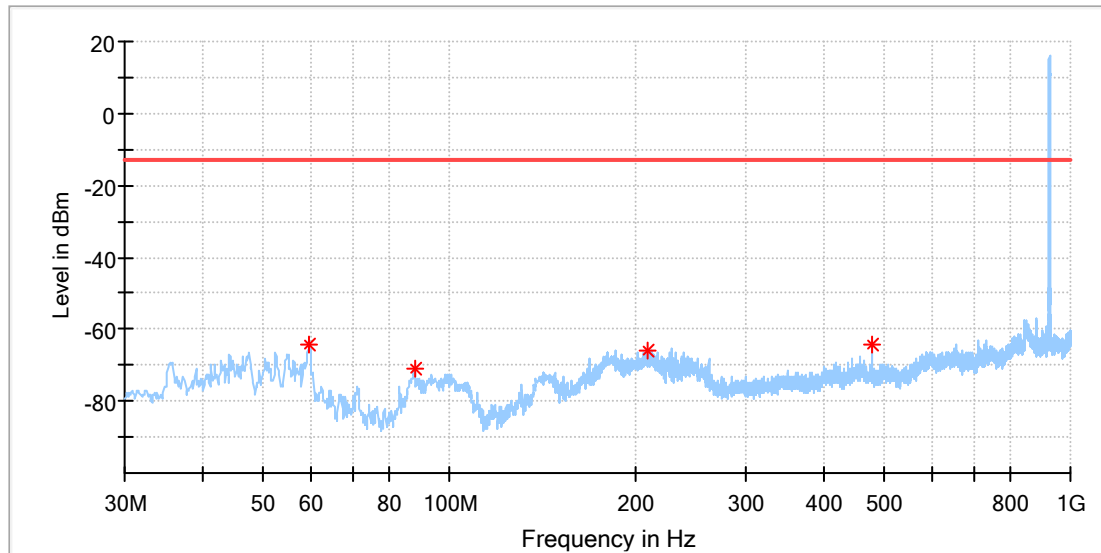
For the measurement records, refer to the following plots, only the worst case mode are shown in this report.

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EUT Information

EUT Name:	LoRaWAN Gateway
Model:	HAC-GWW1-U
Test Mode:	Lora DTS 500K+WIFI 2.4G+LTE B5
Order No/Sample No:	168359594/A003214225-008
Test Voltage::	Adaptor
Remark:	Temp 22 Humi:55%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

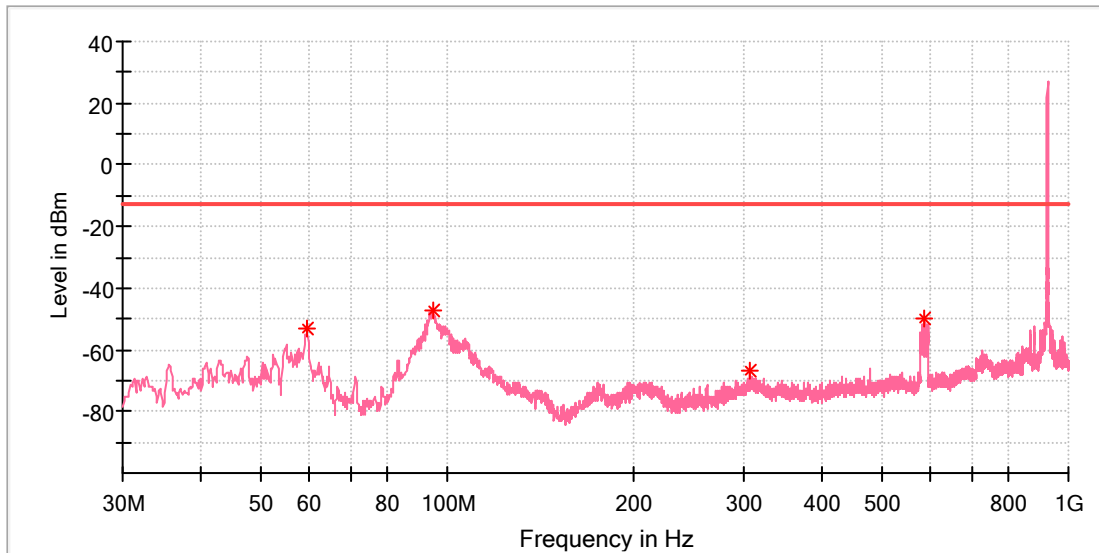
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
59.342500	-64.24	-13.00	51.24	100.0	H	339.0	-116.5
87.836250	-71.20	-13.00	58.20	100.0	H	357.0	-123.0
209.086250	-65.77	-13.00	52.77	100.0	H	53.0	-115.1
479.958750	-64.18	-13.00	51.18	100.0	H	173.0	-109.9

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EUT Information

EUT Name: LoRaWAN Gateway
Model: HAC-GWW1-U
Test Mode: Lora DTS 500K+WIFI 2.4G+LTE B5
Order No/Sample No: 168359594/A003214225-008
Test Voltage:: Adaptor
Remark: Temp 22 Humi:55%
Test Standard: FCC Part 22
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical_Freqs

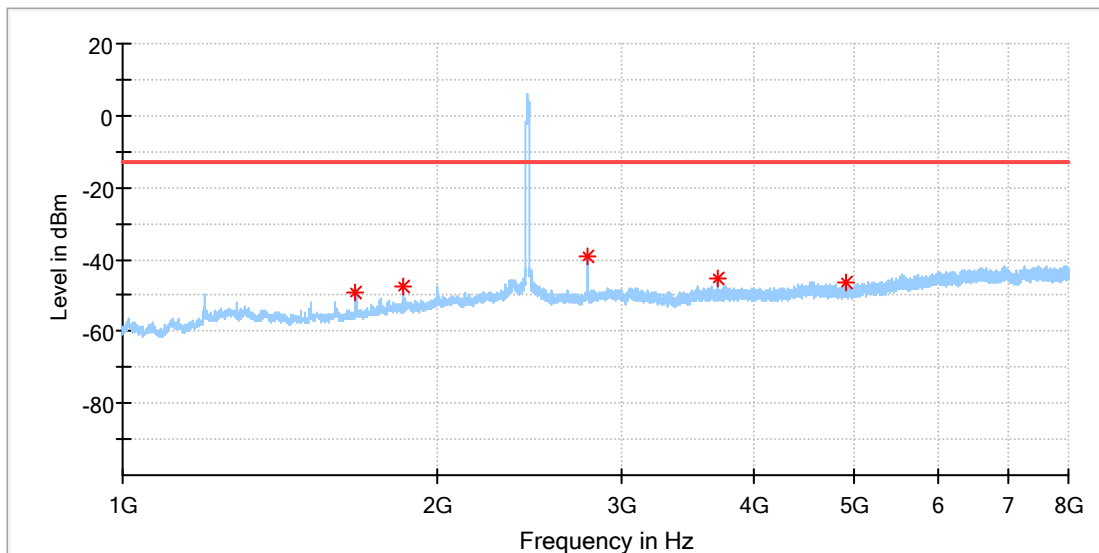
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
59.342500	-53.08	-13.00	40.09	100.0	V	286.0	-120.6
94.990000	-47.44	-13.00	34.44	100.0	V	0.0	-99.8
306.813750	-66.81	-13.00	53.81	100.0	V	44.0	-111.1
587.022500	-49.63	-13.00	36.63	100.0	V	331.0	-106.5

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EUT Information

EUT Name:	LoRaWAN Gateway
Model:	HAC-GWW1-U
Test Mode:	Lora DTS 500K+WIFI 2.4G+LTE B5
Order No/Sample No:	168359594/A003214225-008
Test Voltage::	Adaptor
Remark:	Temp 22 Humi:55%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical Freqs

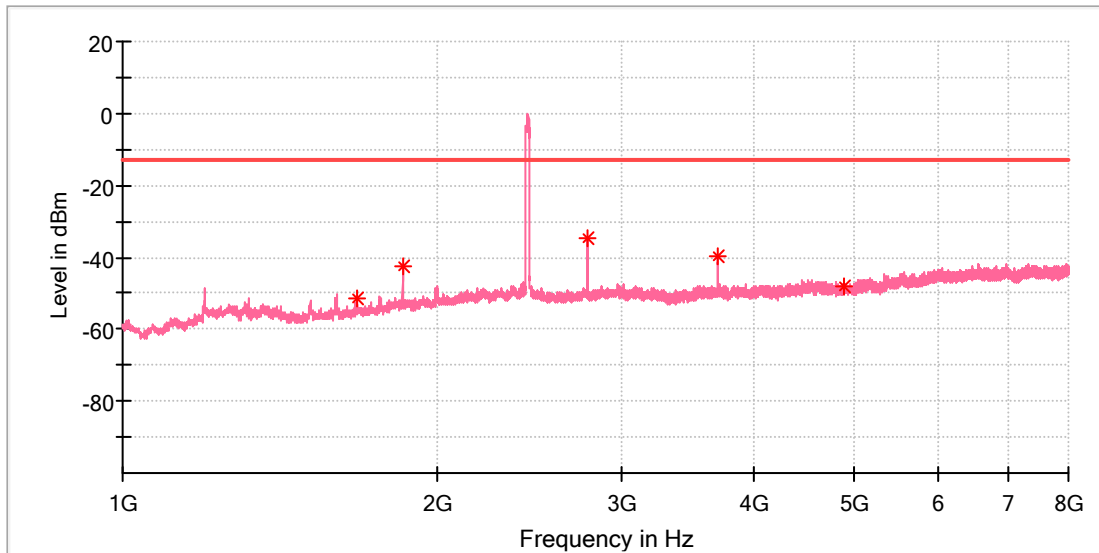
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1670.000000	-49.12	-13.00	36.12	100.0	H	278.0	-92.6
1850.500000	-47.38	-13.00	34.38	100.0	H	126.0	-90.5
2776.000000	-39.19	-13.00	26.19	100.0	H	56.0	-87.6
3700.000000	-45.03	-13.00	32.03	100.0	H	303.0	-86.7
4895.500000	-46.64	-13.00	33.64	100.0	H	0.0	-85.7

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EUT Information

EUT Name: LoRaWAN Gateway
Model: HAC-GWW1-U
Test Mode: Lora DTS 500K+WIFI 2.4G+LTE B5
Order No/Sample No: 168359594/A003214225-008
Test Voltage:: Adaptor
Remark: Temp 22 Humi:55%
Test Standard: FCC Part 22
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical_Freqs

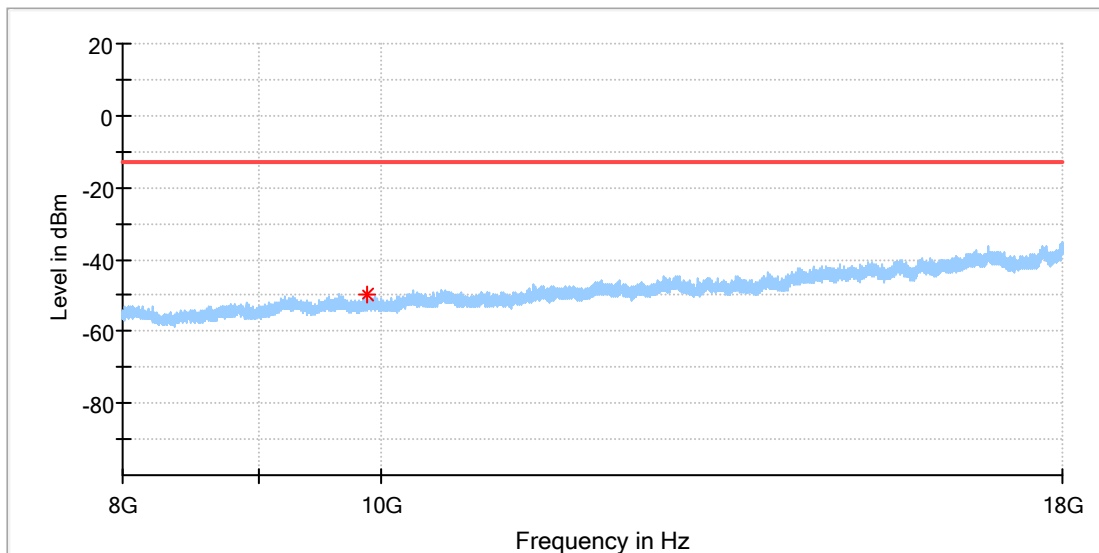
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1673.000000	-51.24	-13.00	38.24	100.0	V	239.0	-92.2
1850.500000	-42.56	-13.00	29.56	100.0	V	117.0	-90.2
2775.500000	-34.51	-13.00	21.51	100.0	V	37.0	-87.3
3699.000000	-39.86	-13.00	26.86	100.0	V	48.0	-86.7
4879.500000	-48.32	-13.00	35.32	100.0	V	0.0	-85.8

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EUT Information

EUT Name:	LoRaWAN Gateway
Model:	HAC-GWW1-U
Test Mode:	Lora DTS 500K+WIFI 2.4G+LTE B5
Order No/Sample No:	168359594/A003214225-008
Test Voltage::	Adaptor
Remark:	Temp 22 Humi:55%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical Freqs

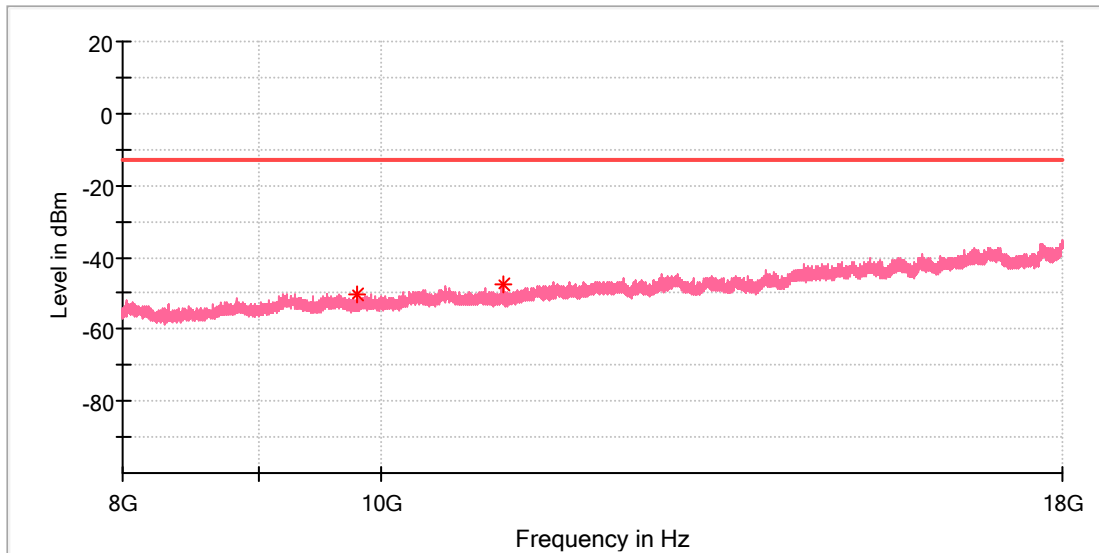
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
9876.000000	-49.66	-13.00	36.66	100.0	H	72.0	-83.7

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EUT Information

EUT Name: LoRaWAN Gateway
Model: HAC-GWW1-U
Test Mode: Lora DTS 500K+WIFI 2.4G+LTE B5
Order No/Sample No: 168359594/A003214225-008
Test Voltage:: Adaptor
Remark: Temp 22 Humi:55%
Test Standard: FCC Part 22
Tested By: Kei Zhang
Reviewed By: Terry Yin



Critical_Freqs

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
9789.500000	-50.57	-13.00	37.57	100.0	V	296.0	-84.3
11103.000000	-47.58	-13.00	34.58	100.0	V	0.0	-83.1

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5.2 Conducted emissions

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.207(a) RSS-Gen Clause 8.8
Basic standard	: ANSI C63.10: 2013
Frequency range	: 150KHz - 30MHz
Classification	: Class B
Limit	: FCC Part 15.207(a) RSS-Gen Table 4
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2022-03-31
Input voltage	: AC 120V, 60Hz
Operation mode	: A, B
Earthing	: Not Connected
Ambient temperature	: 24.5 °C
Relative humidity	: 57 %
Atmospheric pressure	: 101 kPa

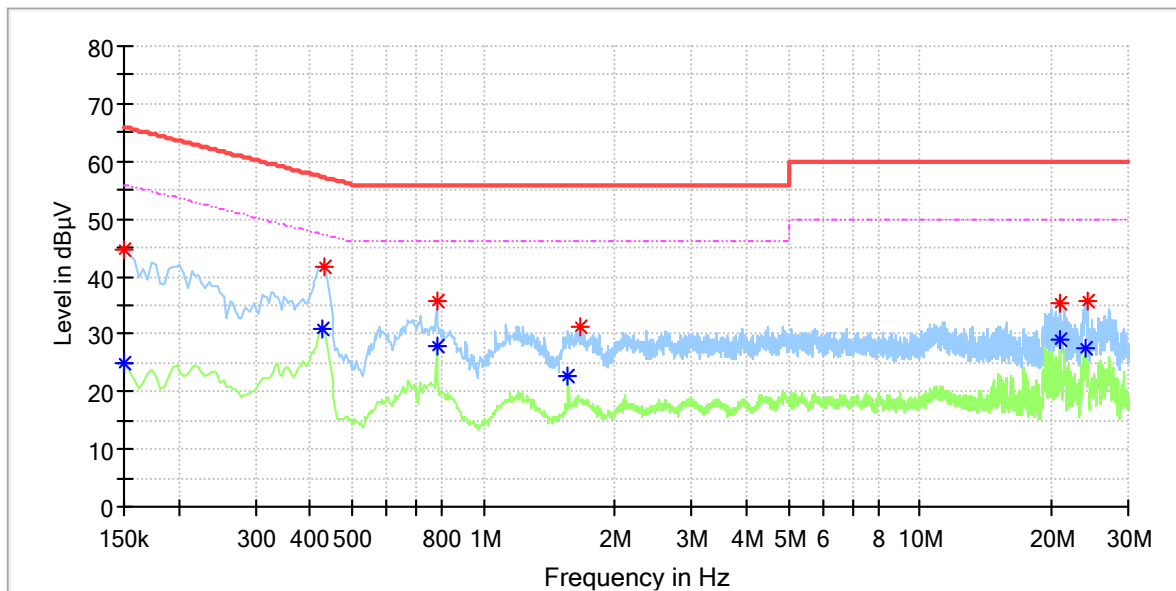
For the measurement records, refer to the following plots, only the worst case mode are shown in this report.

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EUT Information

EUT Name: LoRaWAN Gateway
Model: HAC-GWW1-U
Test Mode: operating
Test Voltage: AC 120V/60Hz
Test By: Jianhua Lu
Review By: Gary Chen
Remark: SR1
Adapter: AD-0241200200US-1



Critical_Freqs

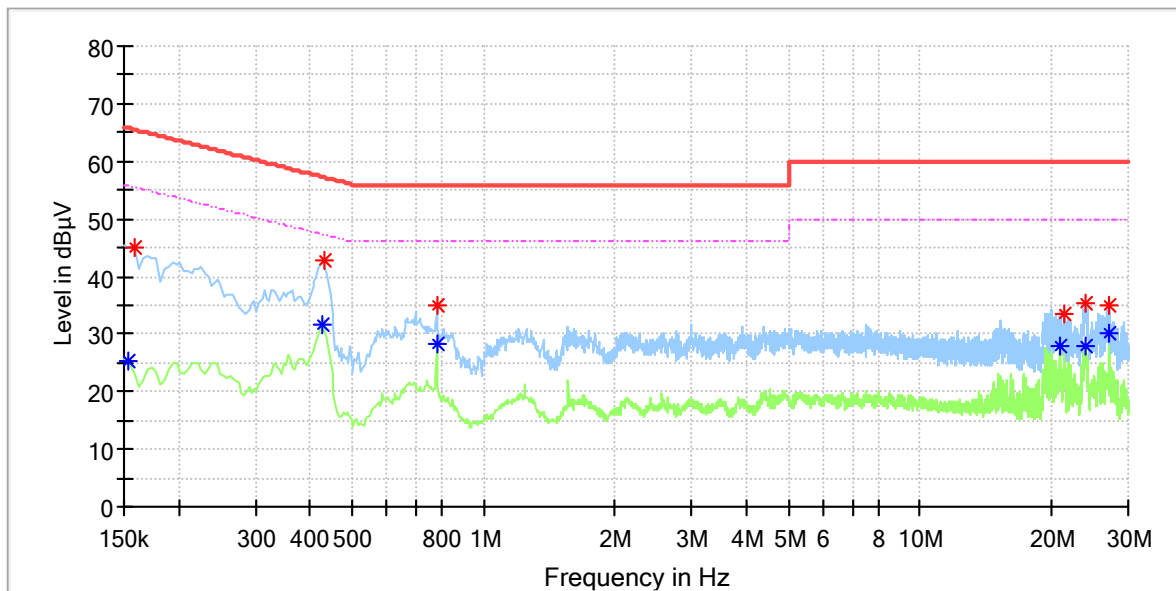
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.150000	---	25.07	56.00	30.93	L1	9.6
0.150000	44.57	---	66.00	21.43	L1	9.6
0.426000	---	30.99	47.33	16.34	L1	9.7
0.434000	41.78	---	57.18	15.40	L1	9.7
0.780000	35.54	---	56.00	20.46	L1	9.7
0.780000	---	28.03	46.00	17.97	L1	9.7
1.564000	---	22.74	46.00	23.26	L1	9.8
1.664000	31.35	---	56.00	24.65	L1	9.8
20.920000	35.19	---	60.00	24.81	L1	10.3
20.960000	---	29.15	50.00	20.85	L1	10.3
23.880000	---	27.68	50.00	22.32	L1	10.4
24.120000	35.72	---	60.00	24.28	L1	10.4

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EUT Information

EUT Name: LoRaWAN Gateway
Model: HAC-GWW1-U
Test Mode: operating
Test Voltage: AC 120V/60Hz
Test By: Jianhua Lu
Review By: Gary Chen
Remark: SR1
Adapter: AD-0241200200US-1



Critical_Freqs

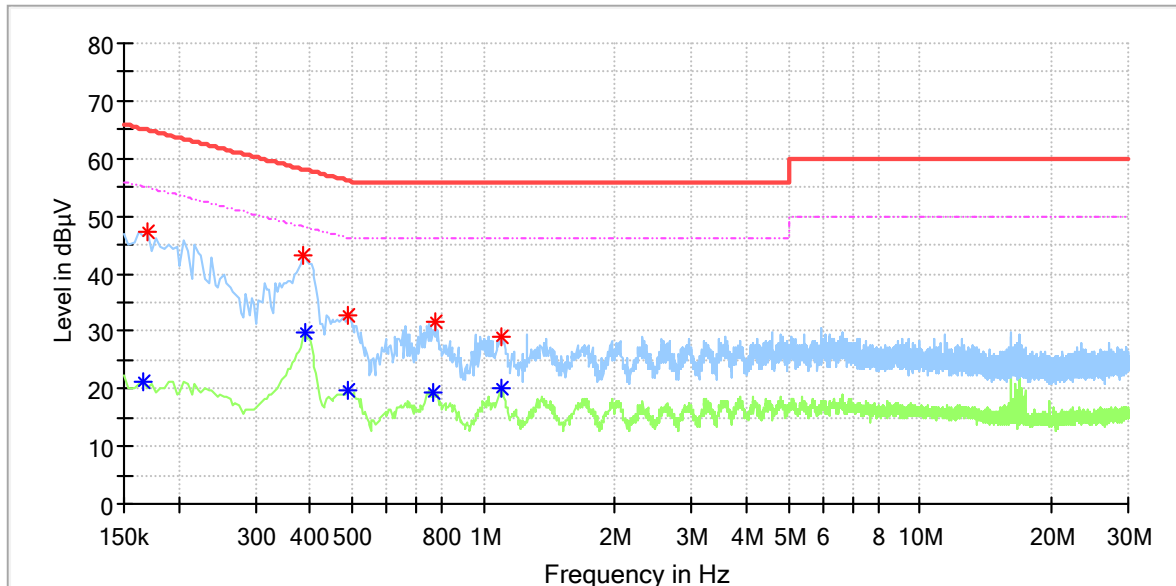
Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.154000	---	25.31	55.78	30.47	N	9.6
0.158000	45.15	---	65.57	20.42	N	9.6
0.426000	---	31.52	47.33	15.81	N	9.7
0.430000	42.90	---	57.25	14.35	N	9.7
0.780000	---	28.23	46.00	17.77	N	9.7
0.784000	34.96	---	56.00	21.04	N	9.7
20.920000	---	27.81	50.00	22.19	N	10.3
21.476000	33.61	---	60.00	26.39	N	10.3
23.840000	---	28.09	50.00	21.91	N	10.5
23.872000	35.46	---	60.00	24.54	N	10.5
27.076000	34.87	---	60.00	25.13	N	10.5
27.076000	---	30.18	50.00	19.82	N	10.5

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EUT Information

EUT Name: LoRaWAN Gateway
Model: HAC-GWW1-U
Test Mode: operating
Test Voltage: AC 120V/60Hz
Test By: Jianhua Lu
Review By: Gary Chen
Remark: SR1
Adapter: PSYC1202000



Critical_Freqs

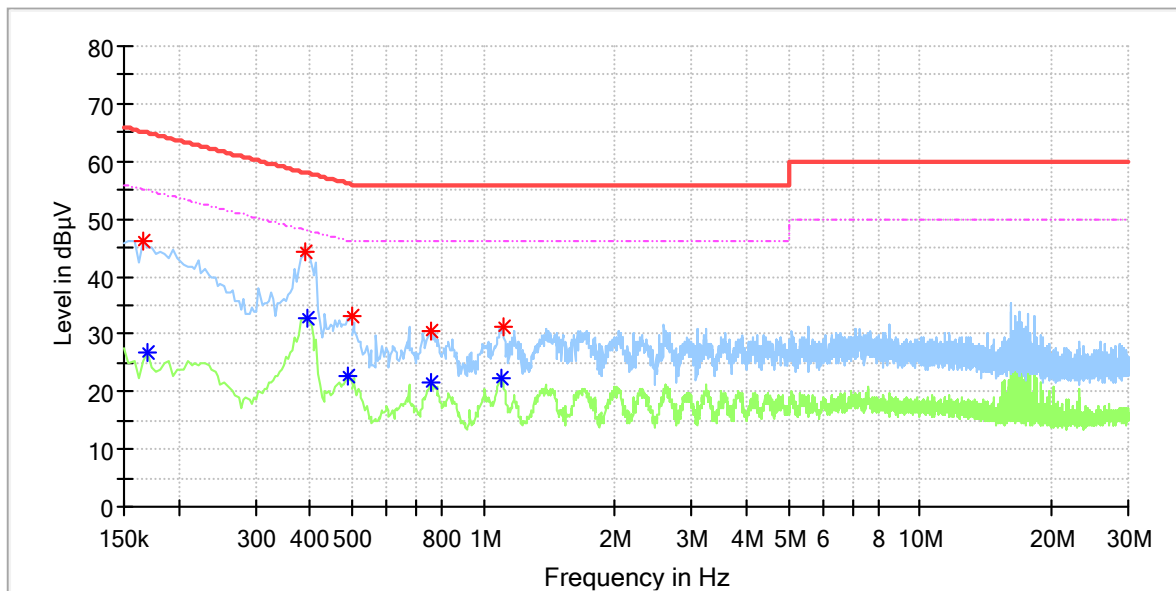
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.166000	---	21.30	55.16	33.86	L1	9.6
0.170000	47.30	---	64.96	17.66	L1	9.6
0.386000	43.26	---	58.15	14.89	L1	9.7
0.390000	---	29.73	48.06	18.34	L1	9.7
0.486000	---	19.79	46.24	26.45	L1	9.7
0.490000	32.76	---	56.17	23.41	L1	9.7
0.768000	---	19.48	46.00	26.52	L1	9.7
0.776000	31.52	---	56.00	24.48	L1	9.7
1.096000	---	19.94	46.00	26.06	L1	9.7
1.100000	29.19	---	56.00	26.81	L1	9.7

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EUT Information

EUT Name: LoRaWAN Gateway
Model: HAC-GWW1-U
Test Mode: operating
Test Voltage: AC 120V/60Hz
Test By: Jianhua Lu
Review By: Gary Chen
Remark: SR1
Adapter: PSYC1202000



Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.166000	46.02	---	65.16	19.14	N	9.6
0.170000	---	26.91	54.96	28.05	N	9.6
0.390000	44.28	---	58.06	13.78	N	9.7
0.394000	---	32.71	47.98	15.26	N	9.7
0.490000	---	22.71	46.17	23.45	N	9.7
0.498000	33.15	---	56.03	22.88	N	9.7
0.756000	---	21.45	46.00	24.55	N	9.7
0.756000	30.59	---	56.00	25.41	N	9.7
1.096000	---	22.49	46.00	23.51	N	9.7
1.112000	31.43	---	56.00	24.57	N	9.7

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