

Prüfbericht-Nr.: <i>Test report no.:</i>	60443732 001	Auftrags-Nr.: <i>Order no.:</i>	168266574	Seite 1 von 22 <i>Page 1 of 22</i>
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2020-05-15	
Auftraggeber: <i>Client:</i>	Sensitech Inc. 800 Cummings Center Suite 258X, Beverly MA 01915-6197 USA			
Prüfgegenstand: <i>Test item:</i>	Quarterback Gateway			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	T11012860			
Auftrags-Inhalt: <i>Order content:</i>	FCC Test Report			
Prüfgrundlage: <i>Test specification:</i>	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: Section 2.1091			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2020-05-15	Please refer to photo documents		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A002920612-001			
Prüfzeitraum: <i>Testing period:</i>	2020-11-02 - 2021-07-01			
Ort der Prüfung: <i>Place of testing:</i>	Refer to clause 2.1			
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> 2022-06-29	Ausstellungsdatum: <i>Issue date:</i> 2022-06-29			
Stellung / Position	Project Manager	Stellung / Position	Review er	
Sonstiges / Other:	FCC ID: SRMT11012860			
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 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft 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. <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>				

Test Summary

5.1.1 ANTENNA REQUIREMENT

RESULT: Pass

5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER

RESULT: Pass

5.1.3 20dB BANDWIDTH

RESULT: Pass

5.1.4 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 kHz BANDWIDTH

RESULT: Pass

5.1.5 RADIATED SPURIOUS EMISSION

RESULT: Pass

5.1.6 CARRIER FREQUENCY SEPARATION

RESULT: Pass

5.1.7 NUMBER OF HOPPING FREQUENCY

RESULT: Pass

5.1.8 TIME OF OCCUPANCY

RESULT: Pass

5.1.9 CONDUCTED EMISSION ON AC MAINS

RESULT: Pass

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Pass

Contents

1	GENERAL REMARKS.....	4
1.1	COMPLEMENTARY MATERIALS	4
2	TEST SITES	4
2.1	TEST FACILITIES	4
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS	5
2.3	TRACEABILITY	6
2.4	CALIBRATION.....	6
2.5	MEASUREMENT UNCERTAINTY	6
2.6	LOCATION OF ORIGINAL DATA	6
2.7	STATUS OF FACILITY USED FOR TESTING	6
3	GENERAL PRODUCT INFORMATION.....	7
3.1	PRODUCT FUNCTION AND INTENDED USE.....	7
3.2	RATINGS AND SYSTEM DETAILS	7
3.3	INDEPENDENT OPERATION MODES.....	8
3.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS.....	8
3.5	SUBMITTED DOCUMENTS	8
4	TEST SET-UP AND OPERATION MODES.....	9
4.1	PRINCIPLE OF CONFIGURATION SELECTION.....	9
4.2	TEST OPERATION AND TEST SOFTWARE.....	9
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT.....	9
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE	9
4.5	TEST SETUP DIAGRAM	10
5	TEST RESULTS.....	12
5.1	TRANSMITTER REQUIREMENT & TEST SUITES.....	12
5.1.1	Antenna Requirement.....	12
5.1.2	Maximum Peak Conducted Output Power	13
5.1.3	20dB Bandwidth.....	14
5.1.4	Conducted Spurious Emissions Measured in 100 kHz Bandwidth	15
5.1.5	Radiated Spurious Emission	16
5.1.6	Carrier Frequency Separation	17
5.1.7	Number of Hopping Frequency.....	18
5.1.8	Time of Occupancy.....	19
5.1.9	Conducted Emission on AC Mains	20
6	SAFETY HUMAN EXPOSURE.....	21
6.1	RADIO FREQUENCY EXPOSURE COMPLIANCE.....	21
6.1.1	Electromagnetic Fields	21
7	PHOTOGRAPHS OF THE TEST SET-UP	22
8	LIST OF TABLES	22

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.

2 Test Sites

2.1 Test Facilities

Test Location 1:

TÜV Rheinland (Shenzhen) Co., Ltd

362 Huanguan Road Middle Longhua District, Shenzhen 518110 People's Republic of China

FCC Registration No.: 694916

Test Location 2:

Shenzhen UnionTrust Quality and Technology Co., Ltd.

16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1,
Longhua New District, Shenzhen, China

Note: The Conducted Emission on AC Mains was tested on test location 2, all others items were tested on location 1.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Radio Spectrum Testing (TS8997) (TÜVR)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
Signal Analyzer	R&S	FSV 40	101441	10.08.2021
OSP	R&S	OSP 150	101017	10.12.2021
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	10.12.2021
Power Sensor	R&S	NRP-Z81	105677	10.09.2021
Shielding Room 8#	Albatross	SR8	APC17151-SR8	23.07.2021
Unwanted Emission Testing (TS9975) (TÜVR)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
EMI Test Receiver	R&S	ESR 7	102021	11.08.2021
Signal Analyzer	R&S	FSV 40	101439	10.08.2021
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	10.08.2021
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	10.08.2021
Amplifier	R&S	SCU-18F	180070	10.08.2021
Amplifier	R&S	SCU40A	100475	10.09.2021
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	08.08.2022
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	08.08.2022
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	08.08.2022
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	13.09.2022
Wideband Ridged Horn Antenna (12-18 GHz)	Steatite	QMS-00208	18313	02.09.2021
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	06.07.2021
Conducted Emission on AC Mains (UTTL)				
Equipment	Manufacturer	Model No.	Serial No.	Cal. until
EMI Test Receiver	R&S	ESR7	1316.3003K07-101181-K3	21.11.2021
Artificial Mains Network	R&S	3816/2SH	00201088	21.11.2021
Artificial Mains Network	ETS-Lindgren	ESH2-Z5	860014/024	21.11.2021

Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	21.11.2021
Test Software	Audix	e3	9.160323	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
Radio Frequency	$\pm 1 \times 10^{-7}$
RF Power (conducted)	± 2.5 dB
Radiated Emission of Transmitter, valid up to 26.5 GHz	± 6 dB
Radiated Emission of Receiver, valid up to 26.5 GHz	± 6 dB
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	± 3.2 dB / ± 2.7 dB
Radiated Emission (3m SAC), 30MHz to 1000MHz	± 4.52 dB
Radiated Emission (3m SAC), above 1000MHz	± 4.37 dB
Temperature	± 1 °C
Humidity	± 5 %
Voltage (DC)	± 1 %
Voltage (AC, <10kHz)	± 2 %

2.6 Location of Original Data

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

2.7 Status of Facility Used for Testing

The Refer to clause 2.1 Test facility located at 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. The Shenzhen UnionTrust Quality and Technology Co., Ltd. Test facility located at 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 T11012860 is a LTE-M/NB-IoT/2G GSM Quad band tracking device, it also support the 915MHz wireless technology to communicate with the sensors.

This report is only for 915MHz 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	Quarterback Gateway
Type Designation	T11012860
FCC ID	SRMT11012860
Operating Voltage	12 / 24V DC Charger AC/DC Adapter Rechargeable Battery (4.2V)
Testing Voltage	AC/DC Adapter Rechargeable Battery (4.2V)
Antenna Type	Integral Antenna
Antenna Gain	0 dBi

Technical Specification of FHSS	
Frequency Range	902.306 - 922.396MHz
Type of Modulation	GFSK
Data Rate	Up to 250Kbps
Channel Number	50 channels
Channel Separation	410 KHz

Table 3: RF Channel and Frequency of Lora FHSS

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
1	902.306	17	908.866	33	915.426	49	921.986
2	902.716	18	909.276	34	915.836	50	922.396
3	903.126	19	909.686	35	916.246		
4	903.536	20	910.096	36	916.656		
5	903.946	21	910.506	37	917.066		
6	904.356	22	910.916	38	917.476		
7	904.766	23	911.326	39	917.886		
8	905.176	24	911.736	40	918.296		
9	905.586	25	912.146	41	918.706		
10	905.996	26	912.556	42	919.116		
11	906.406	27	912.966	43	919.526		
12	906.816	28	913.376	44	919.936		
13	907.226	29	913.786	45	920.346		
14	907.636	30	914.196	46	920.756		
15	908.046	31	914.606	47	921.166		
16	908.456	32	915.016	48	921.576		

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, transmitting mode (FHSS)
 - 1) Low Channel
 - 2) Middle Channel
 - 3) High Channel
- B. On, Transmitting on Hopping channel
- C. On, Normal Operation (Radio Link)
- D. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- ID Label and Location Info
- Block Diagram
- Operation Description
- User Manual
- Schematics

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: 2013 and ANSI C63.4: 2014.

4.3 Special Accessories and Auxiliary Equipment

Table 4: Auxiliary Equipment Used during Test

Description	Manufacturer	Model	S/N	Rating
Sensor	Sensitech Inc.	T11012860	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)

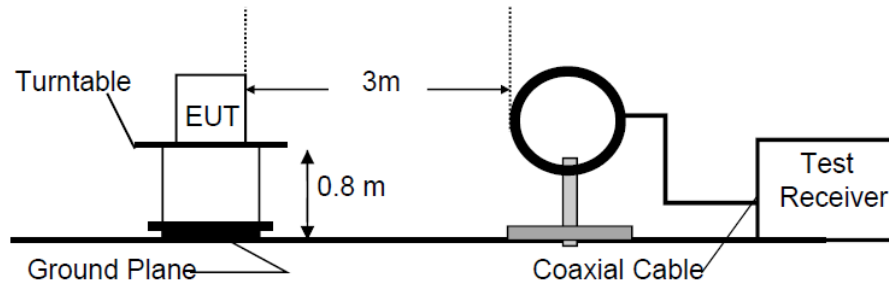


Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

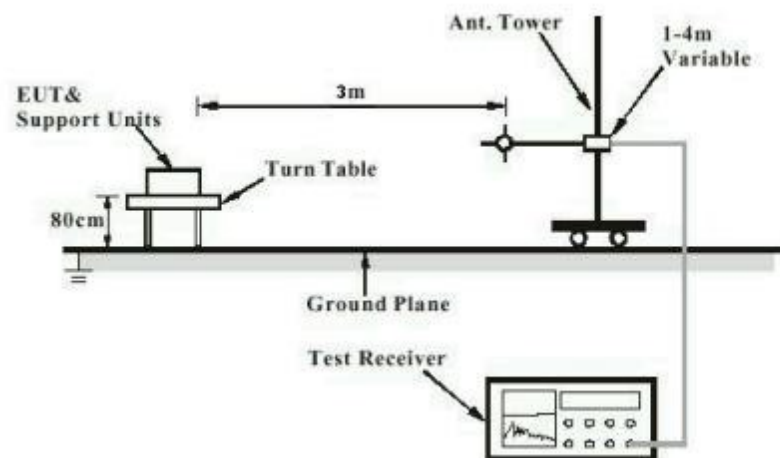


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

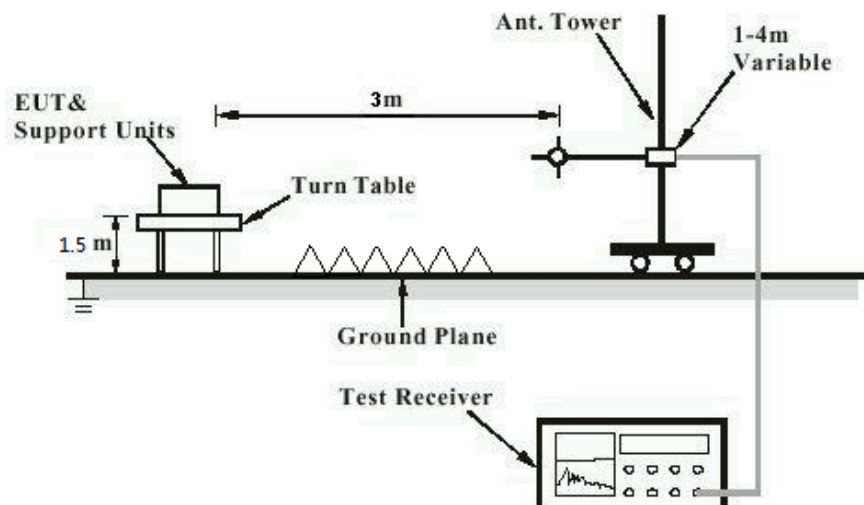


Diagram of Measurement Configuration for Mains Conduction Measurement

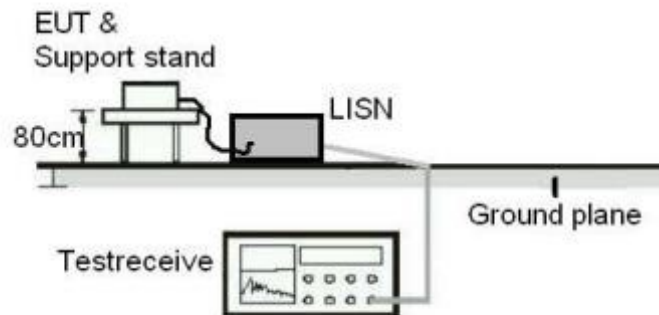
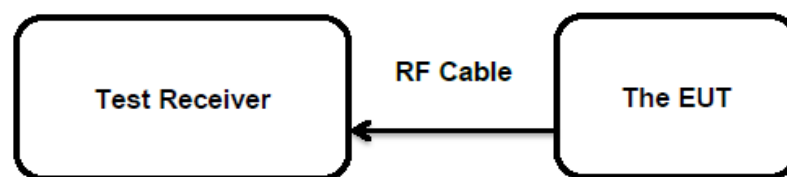


Diagram of Measurement Configuration for Conducted Transmitter Measurement



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

According to the manufacturer declared, the EUT has a integral antenna, the directional gain of antenna is 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.

Prüfbericht - Nr.: 60443732 001
Test Report No.

Seite 13 von 22
Page 13 of 22

5.1.2 Maximum Peak Conducted Output Power

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.247(b)(2)
 Basic standard : ANSI C63.10: 2013
 Limits : Not more than 1Watt(30dBm) for FHSS with at least 50 hopping channels in the band 902-928MHz
 Kind of test site : Shielded Room

Test Setup

Date of testing : 2020-11-02 -2021-07-01
 Input voltage : Fully charged battery
 Operation mode : A
 Test channel : Low / Middle / High
 Ambient temperature : 25 °C
 Relative humidity : 56 %
 Atmospheric pressure : 101 kPa

Table 5: Test Result of Maximum Peak Conducted Output Power

Test Mode	Test Channel (MHz)	Measured Peak Power		Limit (W)
		(dBm)	(W)	
Lora FHSS	902.306	16.52	0.0449	< 1W
	912.146	16.37	0.0434	
	922.396	16.30	0.0427	
Max. Measured Value		16.52	0.0449	

Note:

1) The cable loss is taken into account in results.

5.1.3 20dB Bandwidth

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

Test standard : FCC Part 15.247(a)(1) (i)
Basic standard : ANSI C63.10: 2013
Limits : < 250KHz for at least 50 hopping frequencies
 : >=250KHz for at least 25 hopping frequencies
Kind of test site : Shielded Room

Test Setup

Date of testing : 2020-11-02 -2021-07-01
Input voltage : Fully charged battery
Operation mode : A
Test channel : Low / Middle / High
Ambient temperature : 25 °C
Relative humidity : 56 %
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Table 6: Test Result of 20dB Bandwidth

Test Mode	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (MHz)
Lora FHSS	902.306	71.64	<250KHz
	912.146	72.36	
	922.396	71.64	

Prüfbericht - Nr.: 60443732 001
Test Report No.Seite 15 von 22
Page 15 of 22**5.1.4 Conducted Spurious Emissions Measured in 100 kHz Bandwidth****RESULT:****Pass****Test Specification**

Test standard	: FCC Part 15.247(d)
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	: 2020-11-02 -2021-07-01
Input voltage	: Fully charged battery
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 25 °C
Relative humidity	: 56 %
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. Only the worst case plots were reported.

For the measurement records, refer to the appendix B.

Prüfbericht - Nr.: 60443732 001
Test Report No.Seite 16 von 22
Page 16 of 22

5.1.5 Radiated Spurious Emission

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

Test standard	: FCC Part 15.247(d) & FCC Part 15.205
Basic standard	: ANSI C63.10: 2013
Limits	: Refer to 15.209(a) of FCC part 15.247(d)
Kind of test site	: 3m Semi-anechoic Chamber

Test Setup

Date of testing	: 2020-11-02 -2021-07-01
Input voltage	: Fully charged battery
Operation mode	: A, B
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 B.

Prüfbericht - Nr.: 60443732 001
Test Report No.

Seite 17 von 22
Page 17 of 22

5.1.6 Carrier Frequency Separation

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.247(a)(1)
 Basic standard : ANSI C63.10: 2013
 Limits : $\geq 25\text{kHz}$ or 20dB bandwidth, whichever is greater
 Kind of test site : Shielded Room

Test Setup

Date of testing : 2020-11-02 -2021-07-01
 Input voltage : Fully charged battery
 Operation mode : B
 Test channel : Low / Middle / High
 Ambient temperature : 25 °C
 Relative humidity : 56 %
 Atmospheric pressure : 101 kPa

Note: This test was carried out on right earphone only.

Table 7: Test Result of Carrier Frequency Separation

Test Mode	Channel	Channel Frequency (MHz)	Measured Channel Separation (KHz)	Limit (kHz)	Result
Hopping	Low Channel	902.306	411	≥ 20dB bandwidth	Pass
	Adjacency Channel	902.716			
	Middle Channel	912.146	411		Pass
	Adjacency Channel	912.556			
	High Channel	921.986	411		Pass
	Adjacency Channel	922.396			

Note:

The limit is maximum of the 20 dB bandwidth: 72.36 KHz.

Prüfbericht - Nr.: 60443732 001
Test Report No.Seite 18 von 22
Page 18 of 22

5.1.7 Number of Hopping Frequency

RESULT:

Pass

Test Specification

Test standard : FCC part 15.247(a)(1)(iii)
Basic standard : ANSI C63.10: 2013
Limits : ≥ 50 non-overlapping channels
Kind of test site : Shielded Room

Test Setup

Date of testing : 2020-11-02 -2021-07-01
Input voltage : Fully charged battery
Operation mode : B
Ambient temperature : 25 °C
Relative humidity : 56 %
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Table 8: Test result of hopping channel number

Test Mode	20dB Bandwidth(kHz)	Hopping frequencies	Limit
Hopping	20dB Bandwidth < 250	50	≥ 50

5.1.8 Time of Occupancy

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

Test standard : FCC part 15.247(a)(1)(iii)
Basic standard : ANSI C63.10: 2013
Limits : < 0.4s
Kind of test site : Shielded Room

Test Setup

Date of testing : 2020-11-02 -2021-07-01
Input voltage : Fully charged battery
Operation mode : B
Test channel : Low / Middle / High
Ambient temperature : 25 °C
Relative humidity : 56 %
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Table 9: Test result of Channel Occupancy

Test Mode	20dB Bandwidth(kHz)	Period (s)	Channel Occupancy Time (ms)	Limit (ms)
Hopping	20dB Bandwidth < 250	20	15	400

Prüfbericht - Nr.: 60443732 001
Test Report No.Seite 20 von 22
Page 20 of 22

5.1.9 Conducted Emission on AC Mains

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

Test standard	: FCC Part 15.207(a) & FCC Part 15.107(a)
Basic standard	: ANSI C63.10: 2013 & ANSI C63.4: 2014
Frequency range	: 0.15 – 30MHz
Limits	: FCC Part 15.207(a) & FCC Part 15.107(a)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2020-11-02 -2021-07-01
Input voltage	: Battery charged by AC/DC adapter with 120V/60Hz input
Operation mode	: C
Earthing	: Not connected
Ambient temperature	: 24.8 °C
Relative humidity	: 64 %
Atmospheric pressure	: 99.43 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)

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/cm²)

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:

18.00 dBm

From the peak RF output power, the minimum mobile separation distance, d=20 cm, as well as the antenna gain (0.0 dBi), the RF power density can be calculated as below:

For **Error! Reference source not found.**: $S_{(mW/cm^2)} = PG/4\pi R^2 = 0.013 \text{ mW/cm}^2$

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

“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.

8 List of Tables

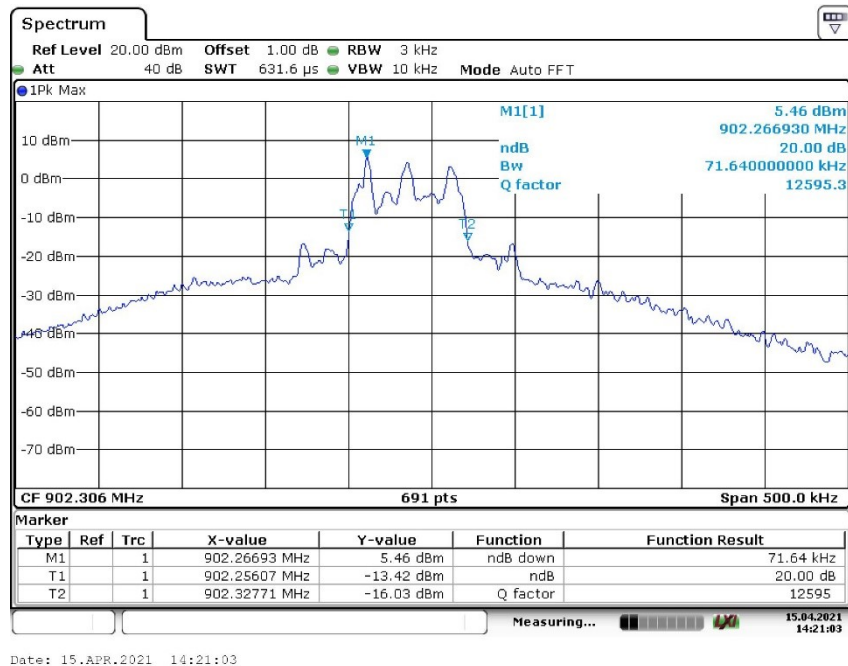
Table 1: List of Test and Measurement Equipment	5
Table 2: Technical Specification of EUT	7
Table 3: RF Channel and Frequency of Lora FHSS	8
Table 4: Auxiliary Equipment Used during Test.....	9
Table 5: Test Result of Maximum Peak Conducted Output Power, Lora FHSS	13
Table 6: Test Result of 20dB Bandwidth.....	14
Table 7: Test Result of Carrier Frequency Separation.....	17
Table 8: Test result of hopping channel number.....	18
Table 9: Test result of Channel Occupancy	19

Appendix B: Test Results

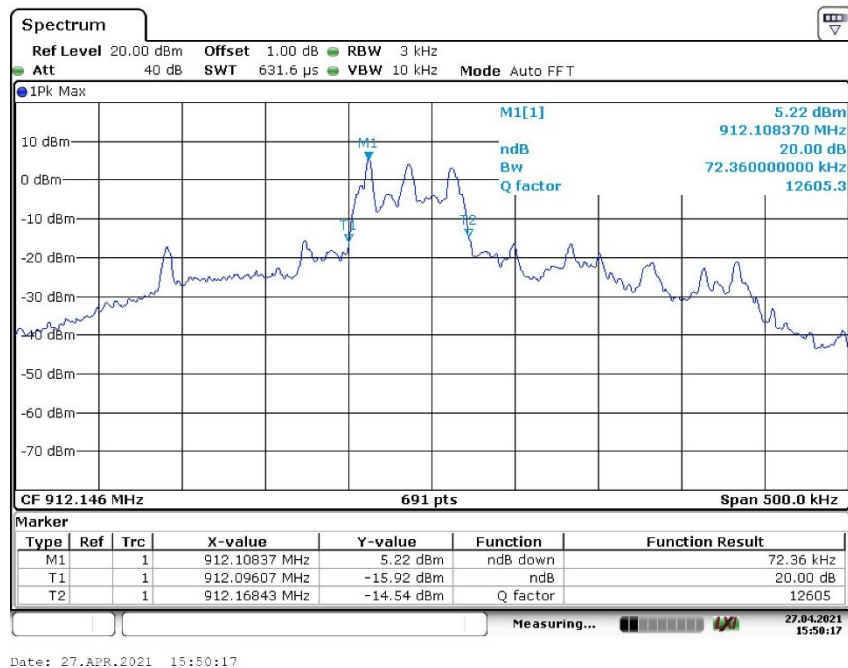
APPENDIX B: TEST RESULTS.....	1
APPENDIX B.1: 20dB BANDWIDTH.....	2
APPENDIX B.2: CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 kHz BANDWIDTH	4
APPENDIX B.3: CARRIER FREQUENCY SEPARATION.....	8
APPENDIX B.4: NUMBER OF HOPPING FREQUENCY.....	10
APPENDIX B.5: TIME OF OCCUPANCY.....	11
APPENDIX B.6: TEST RESULTS OF RADIATED SPURIOUS EMISSIONS	12
APPENDIX B.6: TEST RESULTS OF CONDUCTED EMISSION ON AC MAINS.....	28

Appendix B.1: 20dB Bandwidth

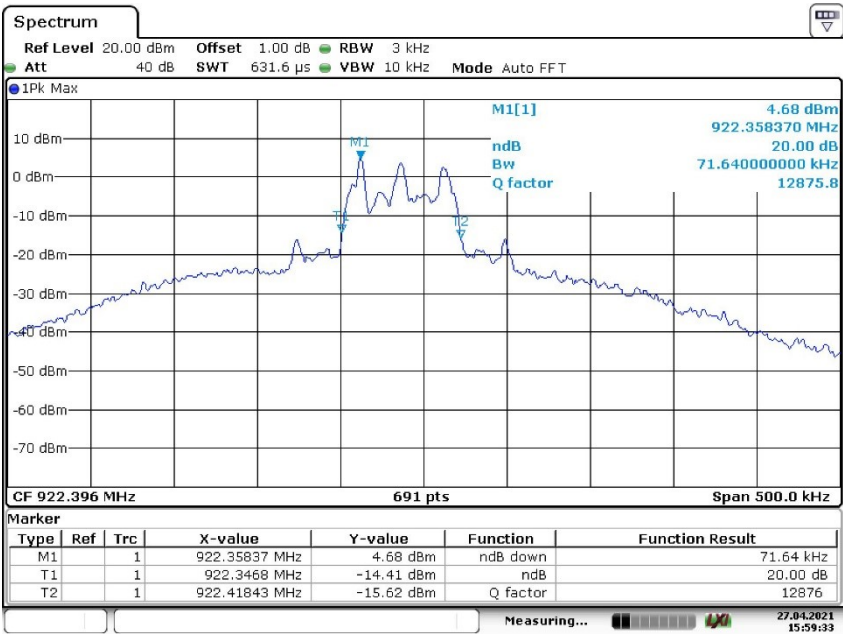
Low Channel



Middle Channel



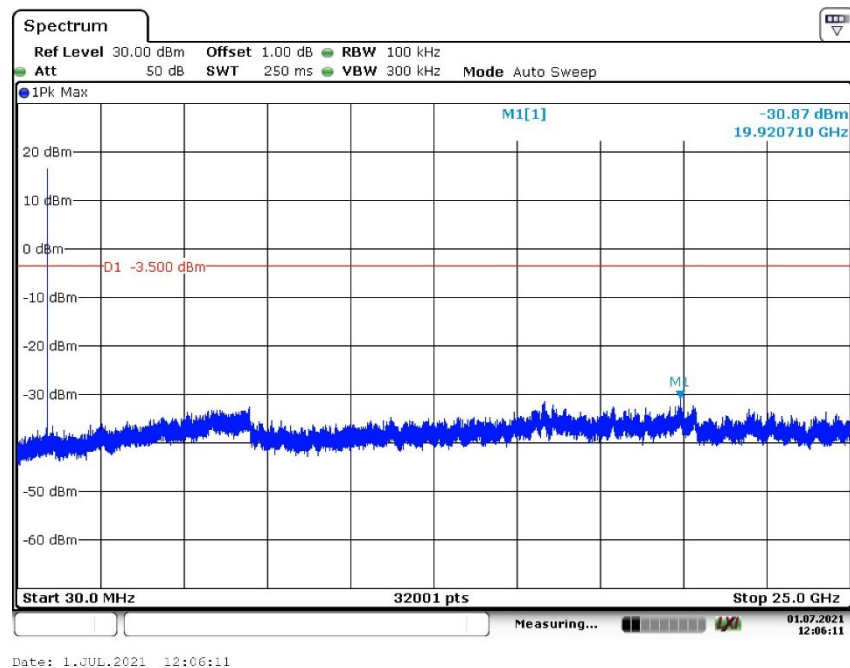
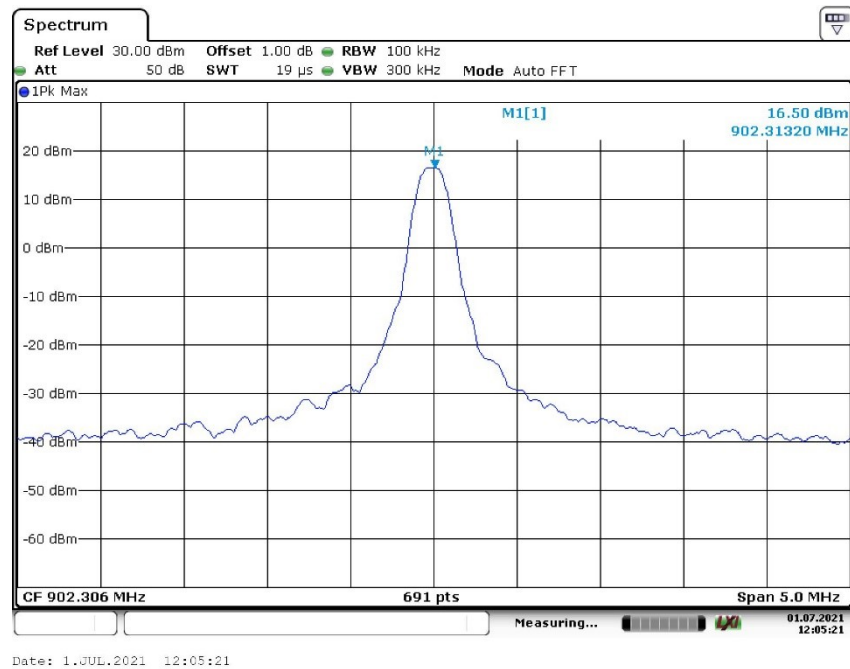
High Channel



Date: 27.APR.2021 15:59:33

Appendix B.2: Conducted Spurious Emissions Measured in 100 kHz Bandwidth

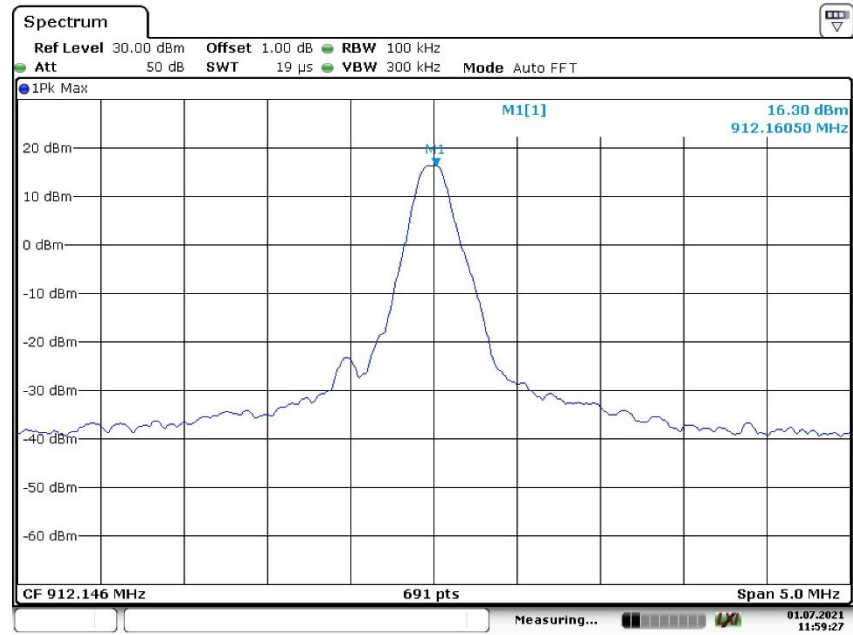
Low Channel



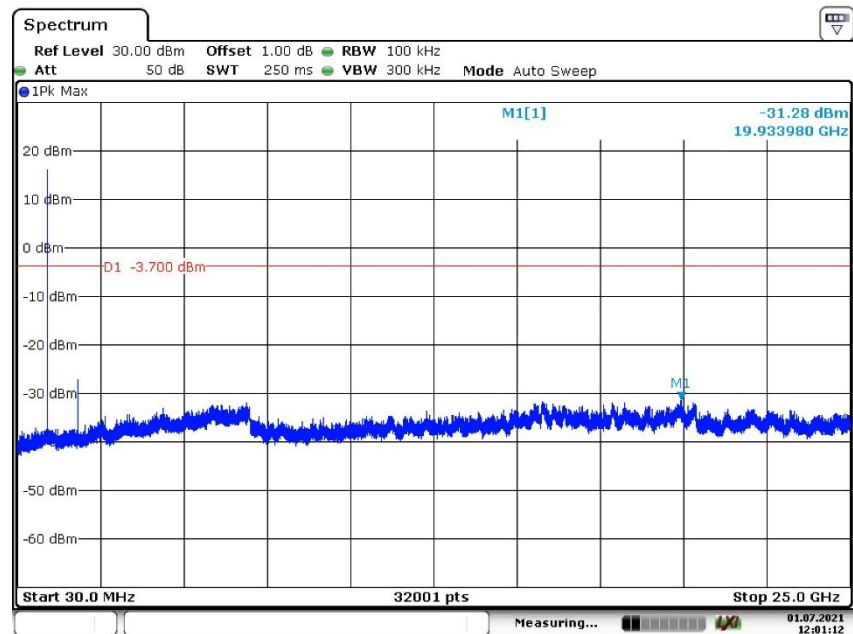
Prüfbericht - Produkte

Test Report - Products

Middle Channel

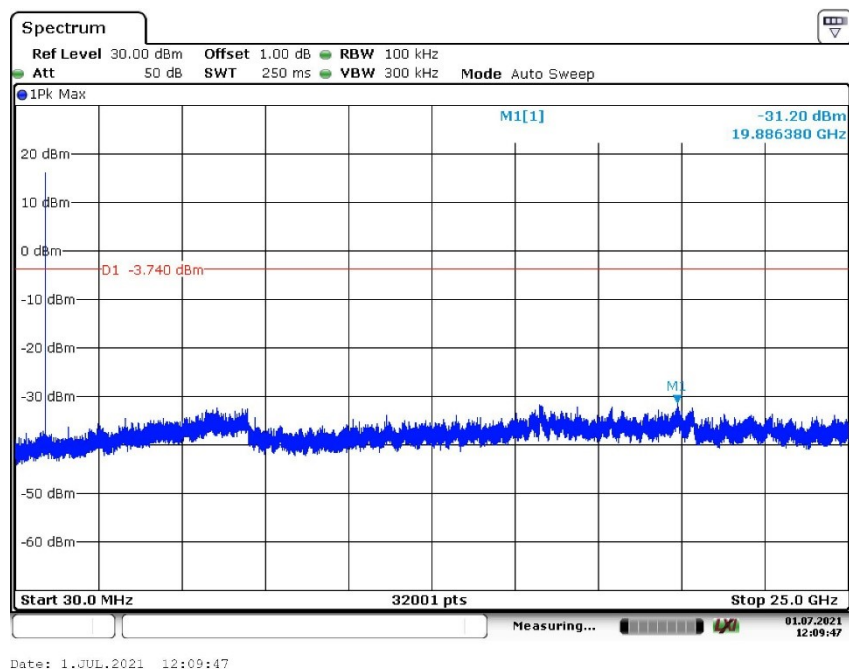
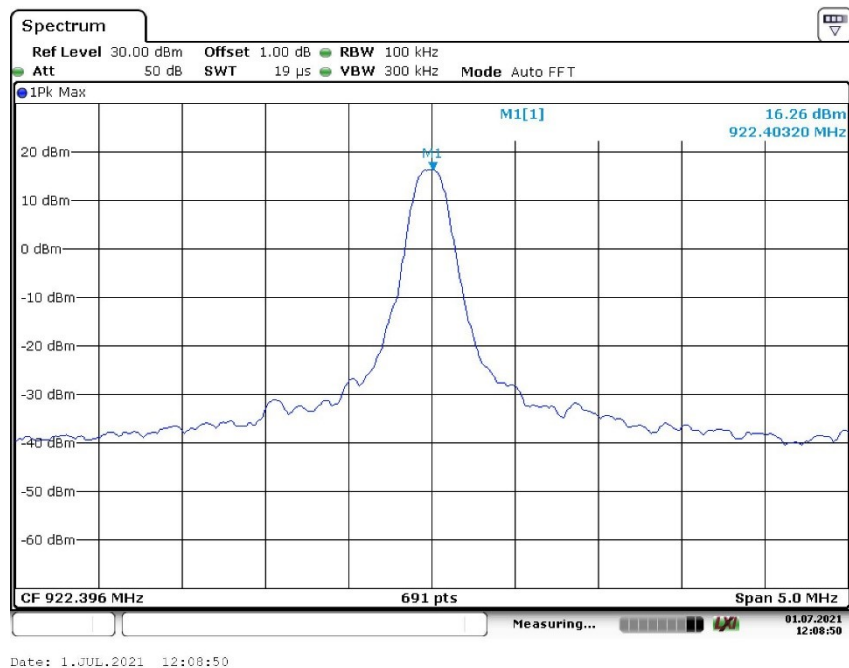


Date: 1.JUL.2021 11:59:27

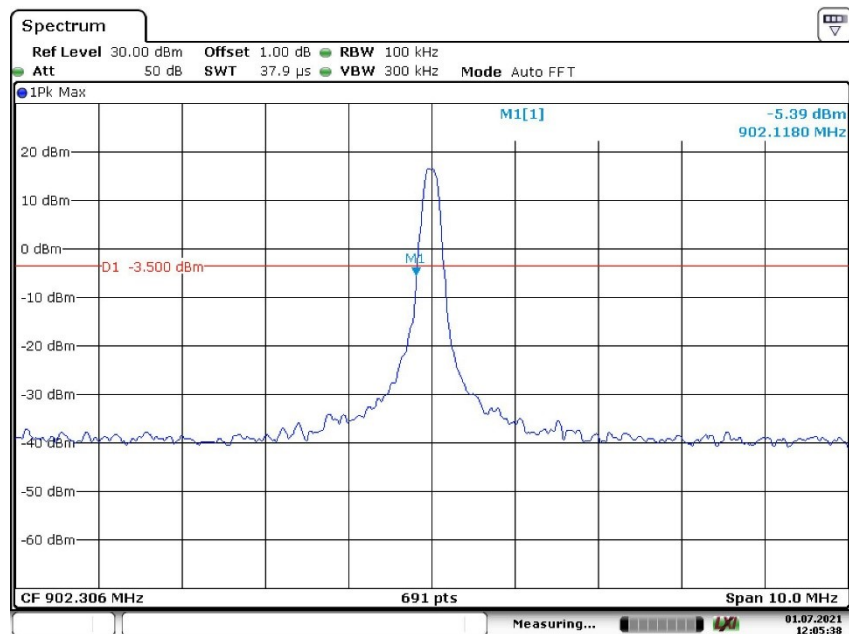


Date: 1.JUL.2021 12:01:12

High Channel

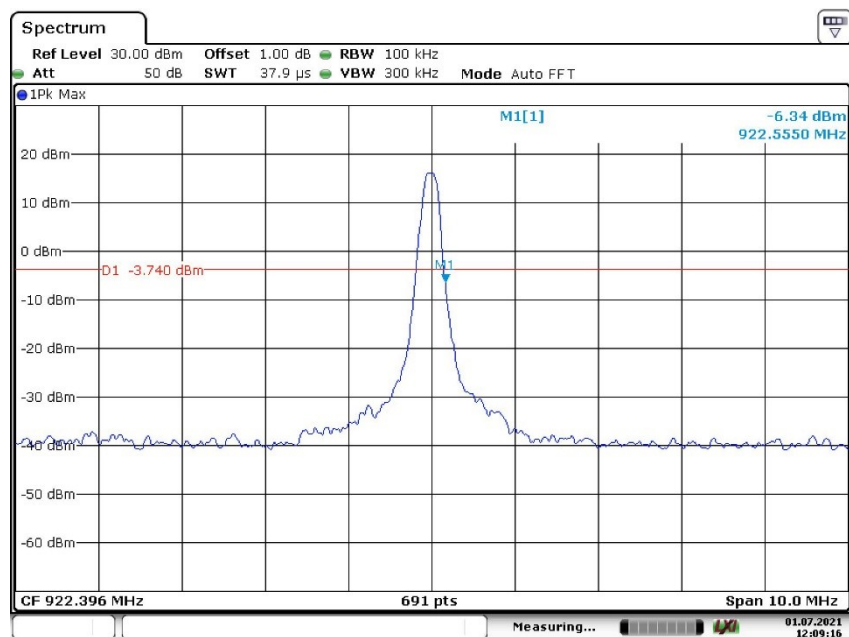


Band Edge Low Channel



Date: 1.JUL.2021 12:05:38

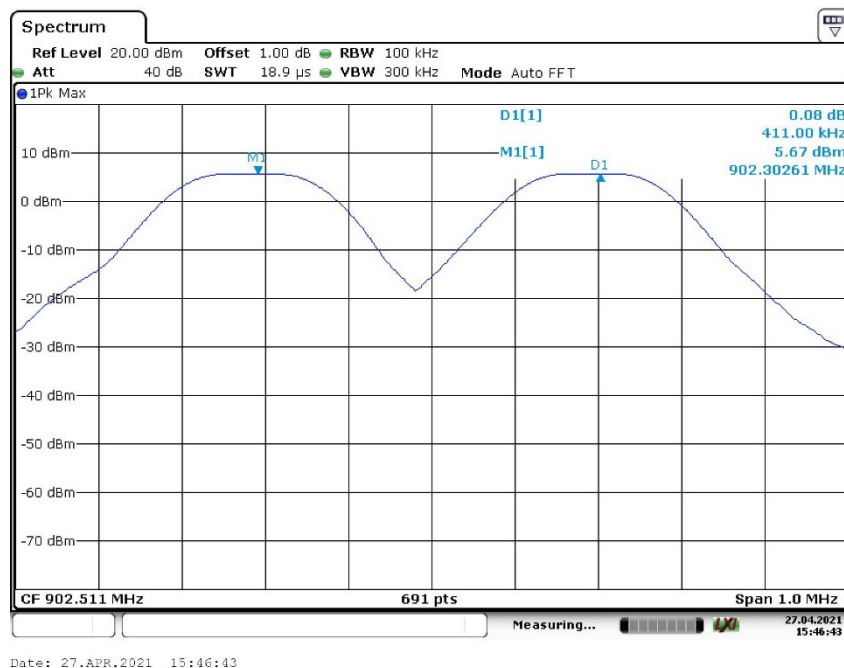
High Channel



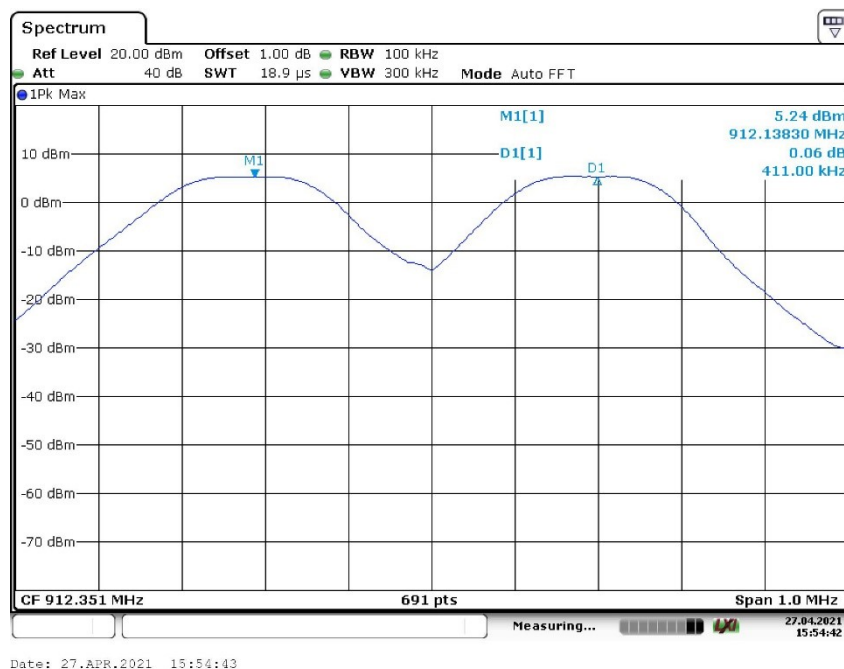
Date: 1.JUL.2021 12:09:16

Appendix B.3: Carrier Frequency Separation

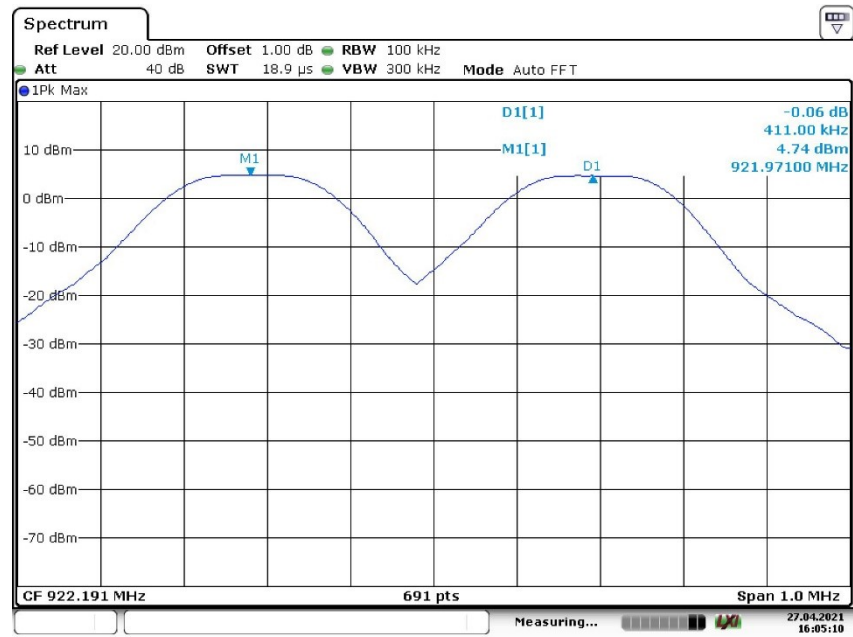
Low Channel



Middle Channel

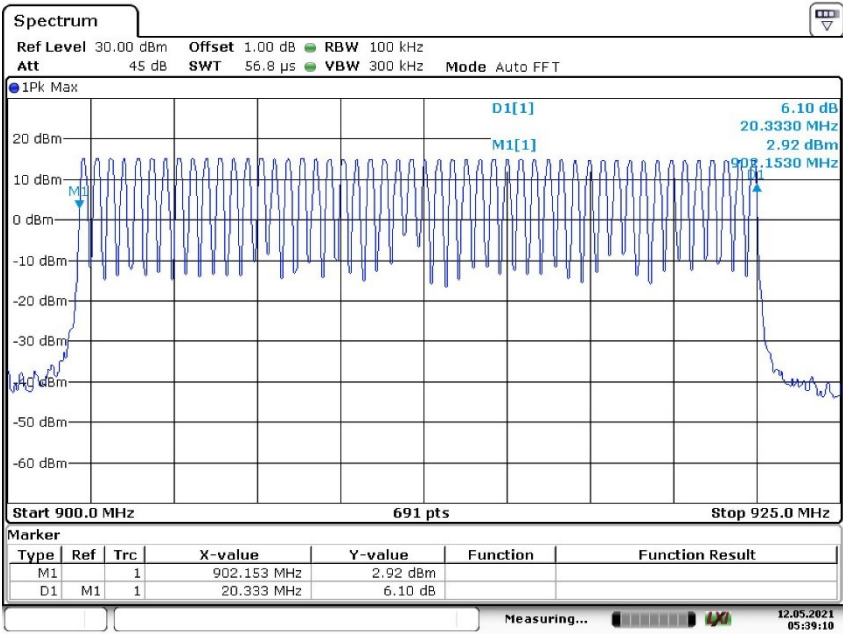


High Channel



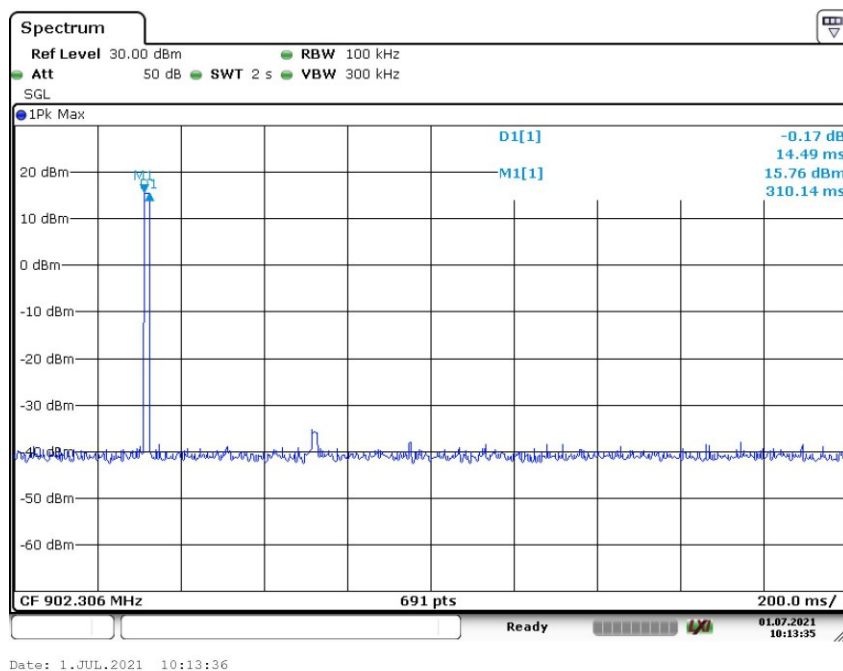
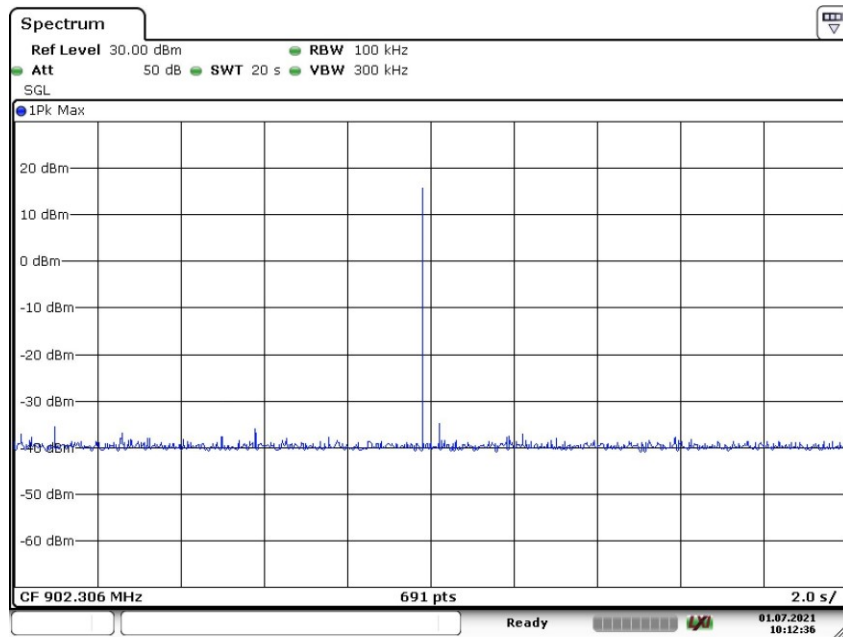
Date: 27.APR.2021 16:05:11

Appendix B.4: Number of Hopping Frequency



Date: 12.MAY.2021 05:39:10

Appendix B.5: Time of Occupancy



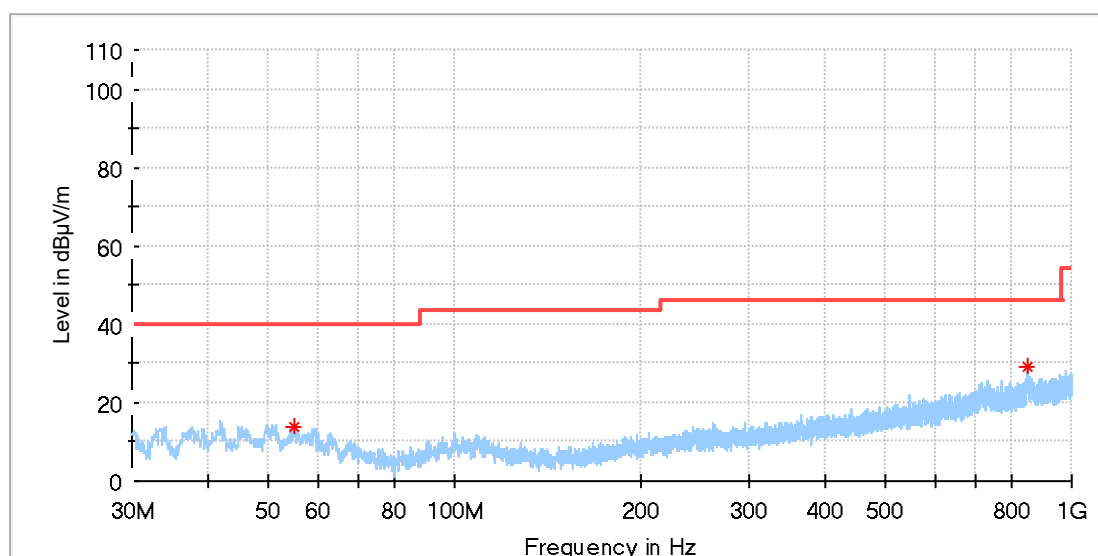
Note 1: Testing was carried out within frequency range 9 kHz to the tenth harmonics. The measurement results below 30MHz were greater than 20dB below the limit, so only the radiated spurious emissions from 30MHz to 10GHz were reported.

Appendix B.6: Test Results of Radiated Spurious Emissions

30MHz - 1GHz

EUT Information

EUT Name:	Gateway
Model:	T11012860
Test Mode:	TX_Low CH
Test Voltage::	Battery
Remark:	Temp 23 Humi:47%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical Freqs

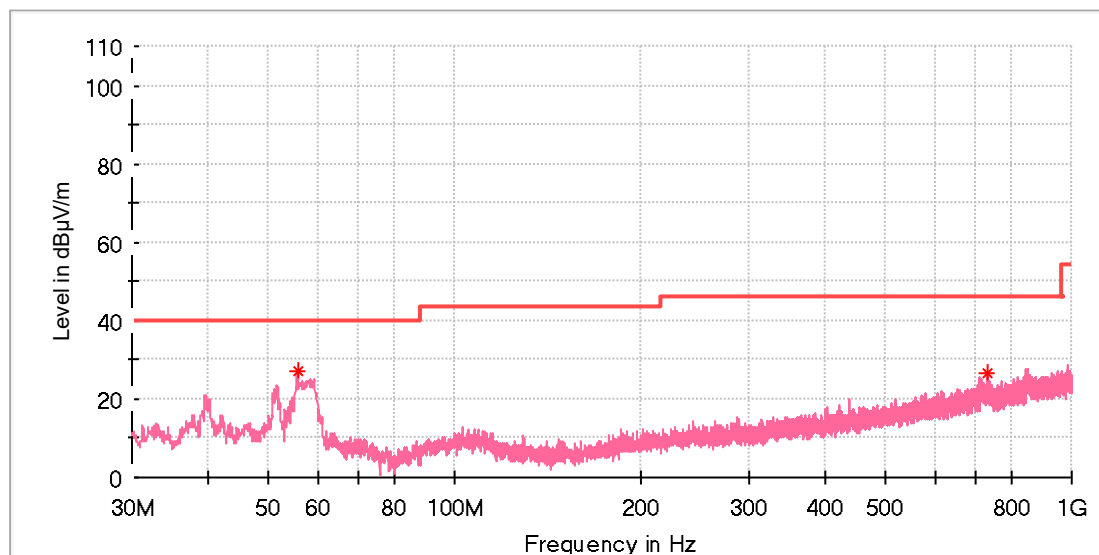
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
54.832000	13.92	---	40.00	26.08	100.0	H	3.0	-18.7
846.109500	29.00	---	46.00	17.00	100.0	H	121.0	-6.0

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name:	Gateway
Model:	T11012860
TestMode:	TX_Low CH
Test Voltage::	Battery
Remark:	Temp 23 Humi:47%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

**Critical Freqs**

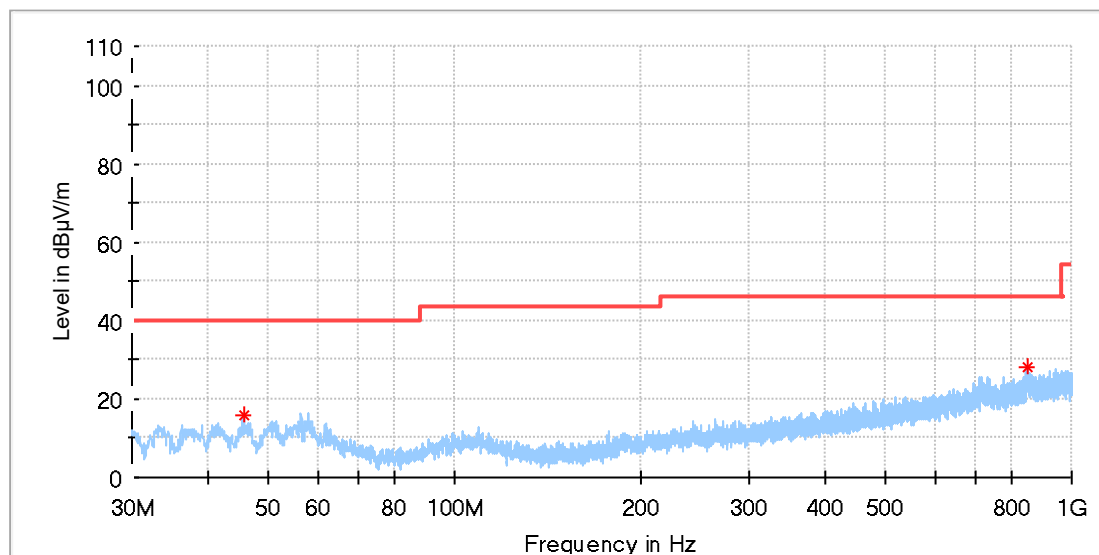
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
55.608000	26.93	---	40.00	13.07	100.0	V	4.0	-18.8
729.273000	26.81	---	46.00	19.19	100.0	V	200.0	-7.9

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name:	Gateway
Model:	T11012860
TestMode:	TX_High CH
Test Voltage::	Battery
Remark:	Temp 23 Humi:47%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

**Critical Freqs**

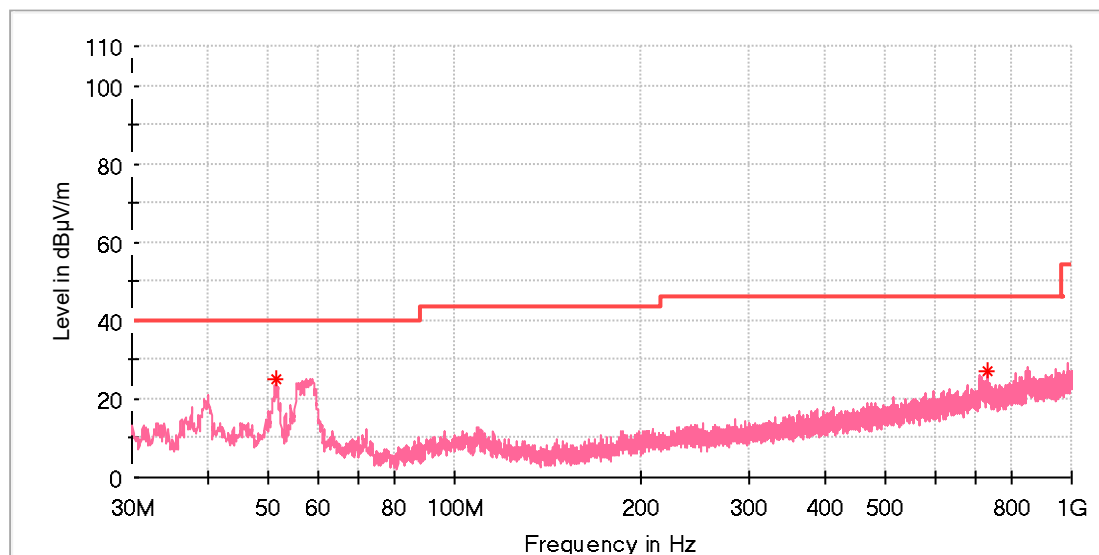
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
45.617000	15.75	---	40.00	24.25	100.0	H	170.0	-19.0
845.624500	28.30	---	46.00	17.70	100.0	H	307.0	-6.0

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name:	Gateway
Model:	T11012860
TestMode:	TX_High CH
Test Voltage::	Battery
Remark:	Temp 23 Humi:47%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

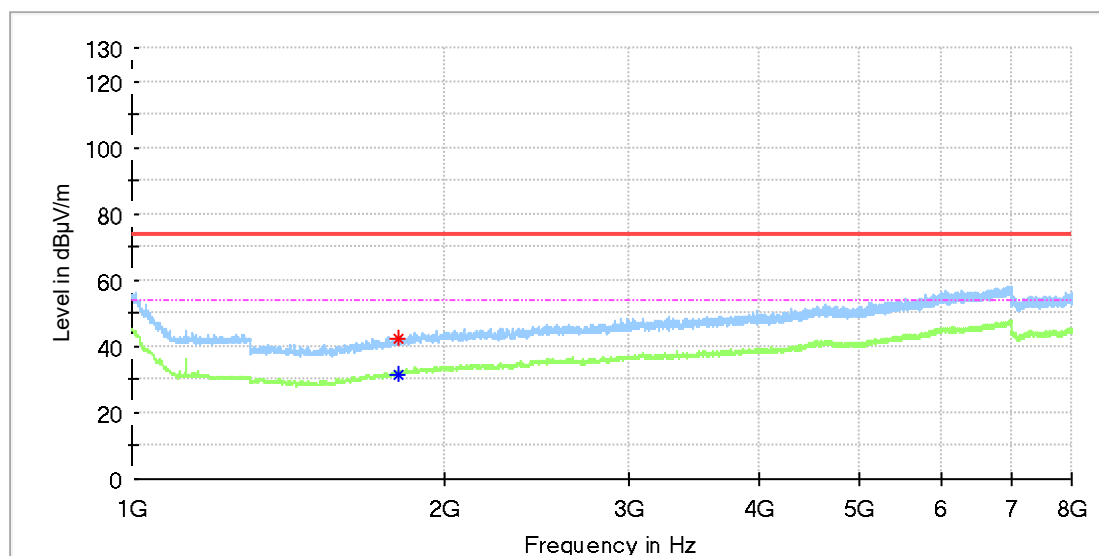
**Critical Freqs**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.485500	25.01	---	40.00	14.99	100.0	V	152.0	-18.6
729.176000	27.29	---	46.00	18.71	100.0	V	103.0	-7.9

1GHz - 10GHz

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 902.306MHz
 Test Voltage:: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

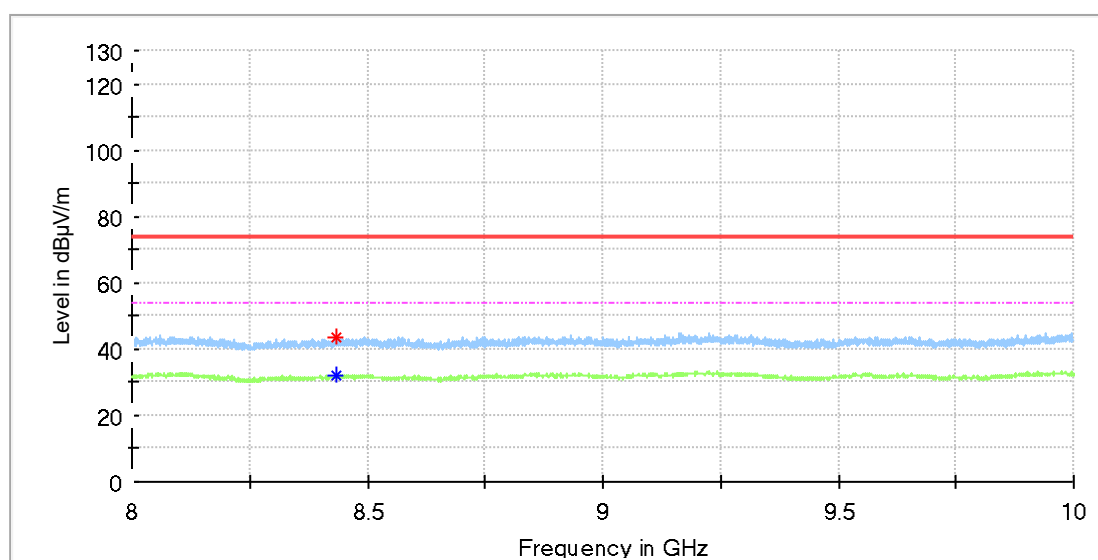


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1803.337500	---	31.74	54.00	22.26	100.0	H	106.0	4.7
1803.337500	42.23	---	74.00	31.77	100.0	H	106.0	4.7

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 902.306MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical Freqs

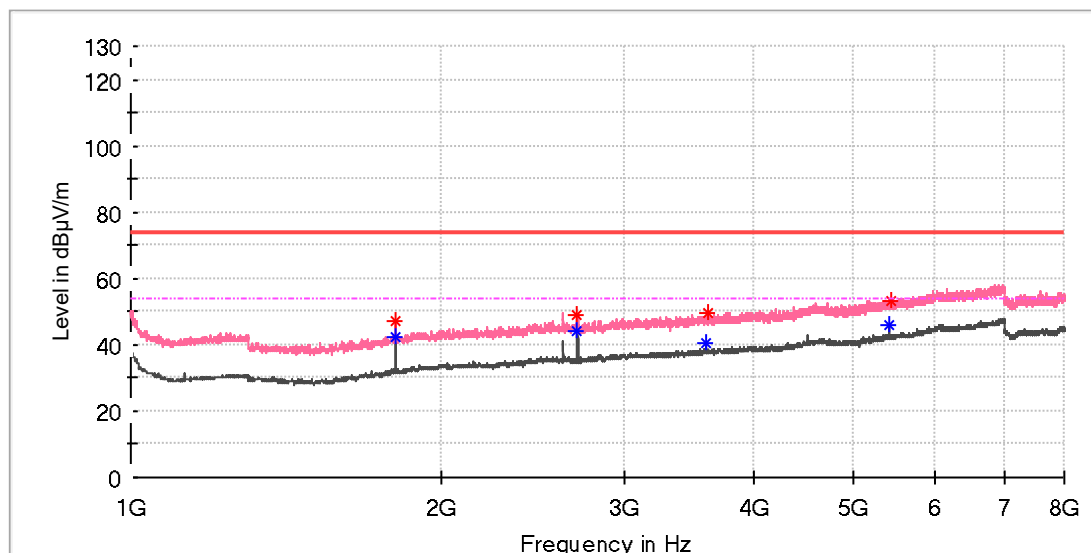
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8432.500000	---	32.24	54.00	21.76	100.0	H	90.0	8.7
8434.500000	43.40	---	74.00	30.60	100.0	H	49.0	8.7

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 902.306MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

**Critical Freqs**

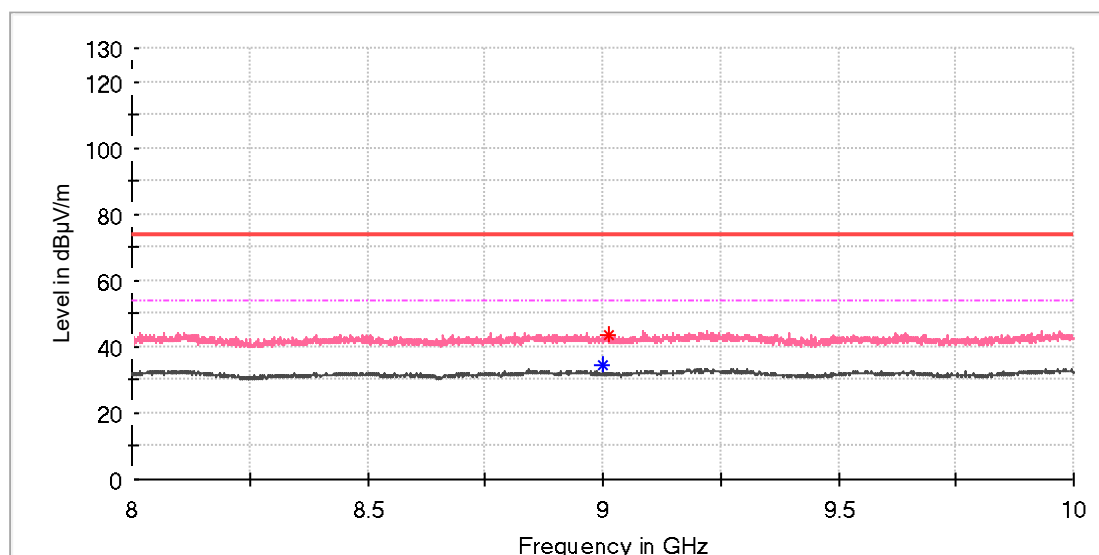
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1803.337500	47.08	---	74.00	26.92	100.0	V	246.0	4.7
1803.337500	---	42.10	54.00	11.91	100.0	V	246.0	4.7
2705.325000	---	44.35	54.00	9.65	100.0	V	127.0	7.5
2705.325000	49.07	---	74.00	24.93	100.0	V	127.0	7.5
3607.312500	---	40.31	54.00	13.69	100.0	V	159.0	9.4
3616.525000	49.38	---	74.00	24.62	100.0	V	235.0	9.4
5412.125000	---	46.03	54.00	7.97	100.0	V	235.0	13.5
5441.437500	53.23	---	74.00	20.77	100.0	V	246.0	13.5

Prüfbericht - Produkte

Test Report - Products

EUT Information

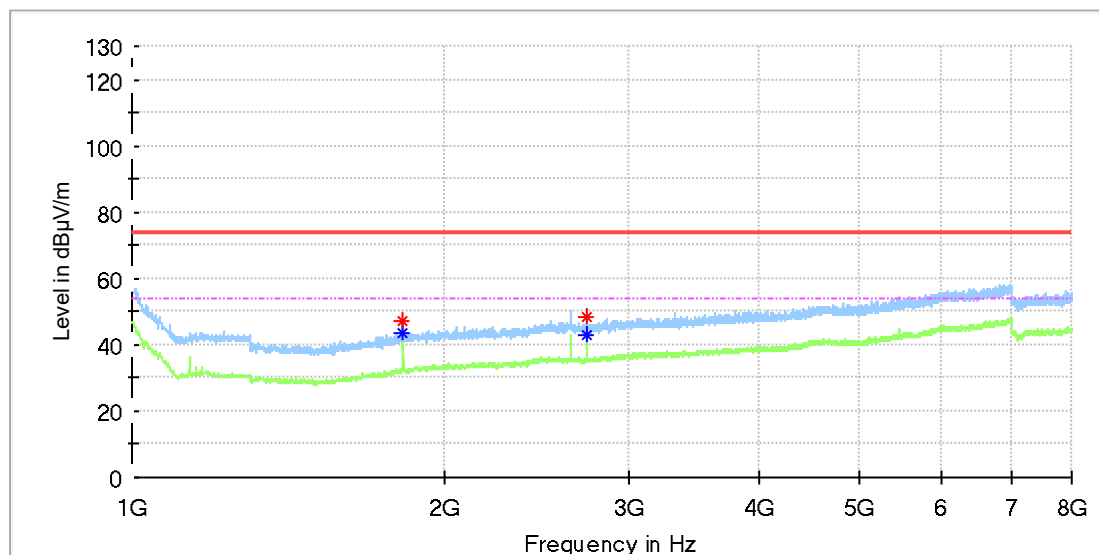
EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 902.306MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

**Critical Freqs**

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9000.000000	---	34.59	54.00	19.41	100.0	V	0.0	8.8
9013.000000	43.43	---	74.00	30.57	100.0	V	281.0	8.8

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 912.146MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical Freqs

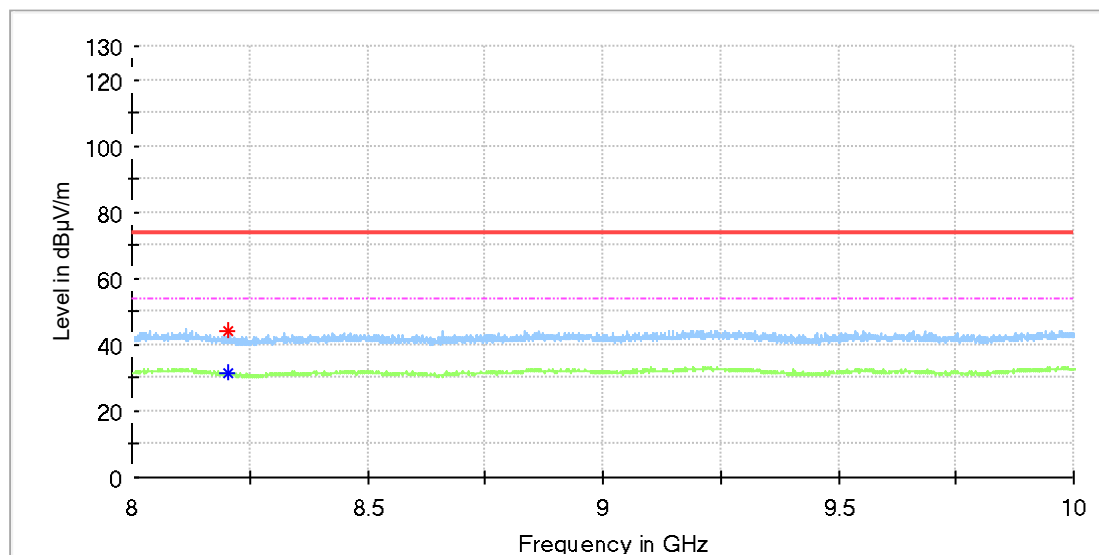
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1822.600000	47.05	—	74.00	26.95	100.0	H	315.0	4.8
1822.600000	—	43.33	54.00	10.67	100.0	H	315.0	4.8
2734.637500	48.32	—	74.00	25.68	100.0	H	292.0	7.7
2734.637500	—	43.16	54.00	10.84	100.0	H	292.0	7.7

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 912.146MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

**Critical Freqs**

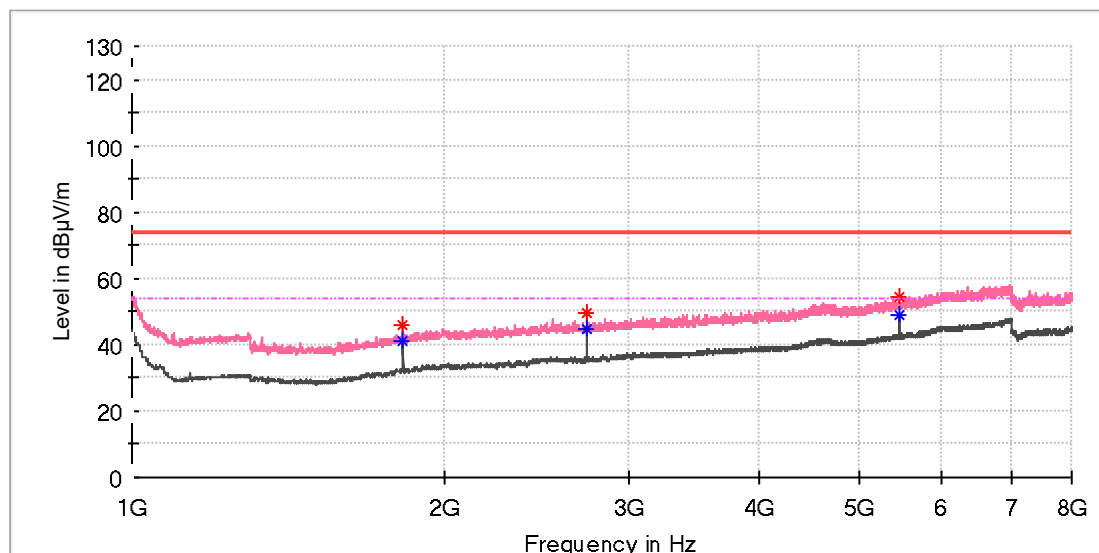
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8204.000000	---	31.60	54.00	22.40	100.0	H	302.0	8.5
8205.000000	44.20	---	74.00	29.80	100.0	H	259.0	8.5

Prüfbericht - Produkte

Test Report - Products

EUT Information

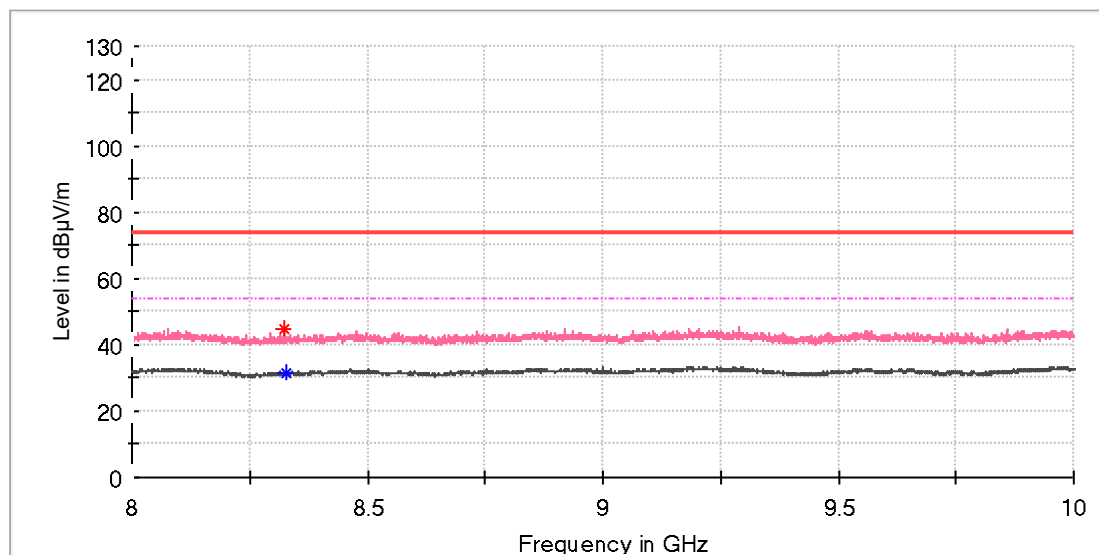
EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 912.146MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

**Critical Freqs**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1822.600000	46.06	---	74.00	27.94	100.0	V	353.0	4.8
1822.600000	---	41.00	54.00	13.00	100.0	V	353.0	4.8
2734.637500	49.58	---	74.00	24.42	100.0	V	345.0	7.7
2734.637500	---	44.76	54.00	9.24	100.0	V	345.0	7.7
5469.075000	54.61	---	74.00	19.39	100.0	V	292.0	13.6
5469.075000	---	49.07	54.00	4.93	100.0	V	292.0	13.6

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 912.146MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical Freqs

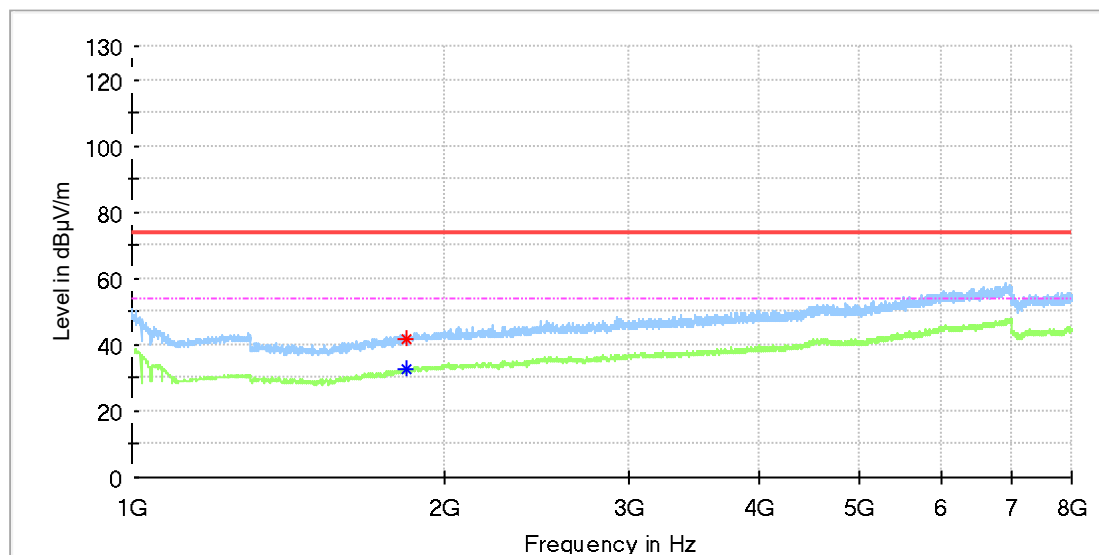
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8324.500000	44.98	---	74.00	29.02	100.0	V	80.0	8.3
8329.500000	---	31.44	54.00	22.56	100.0	V	60.0	8.4

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 922.396MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

**Critical Freqs**

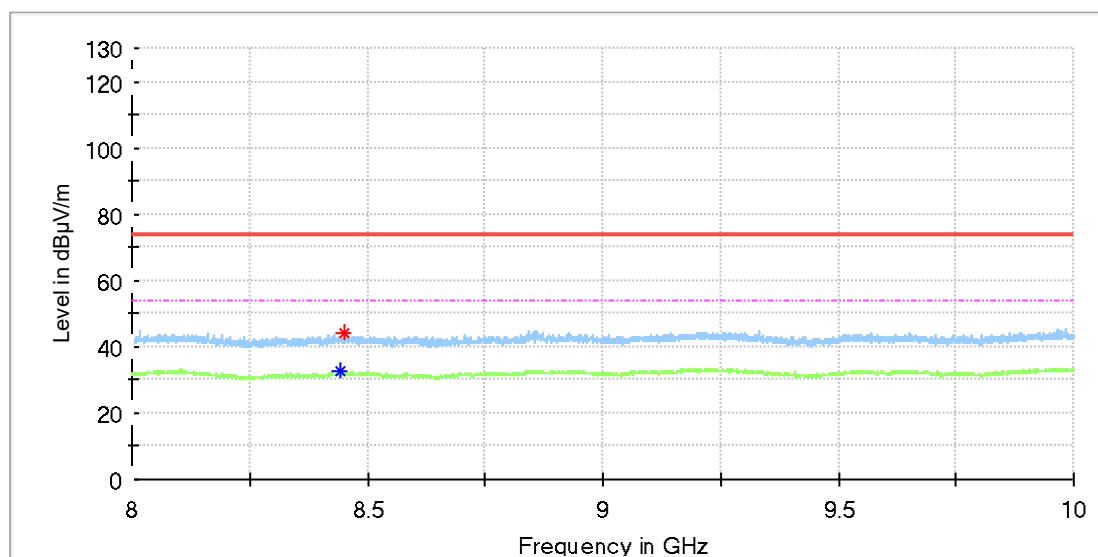
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1839.350000	41.80	---	74.00	32.20	100.0	H	101.0	4.9
1839.350000	---	32.74	54.00	21.26	100.0	H	101.0	4.9

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 922.396MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

**Critical Freqs**

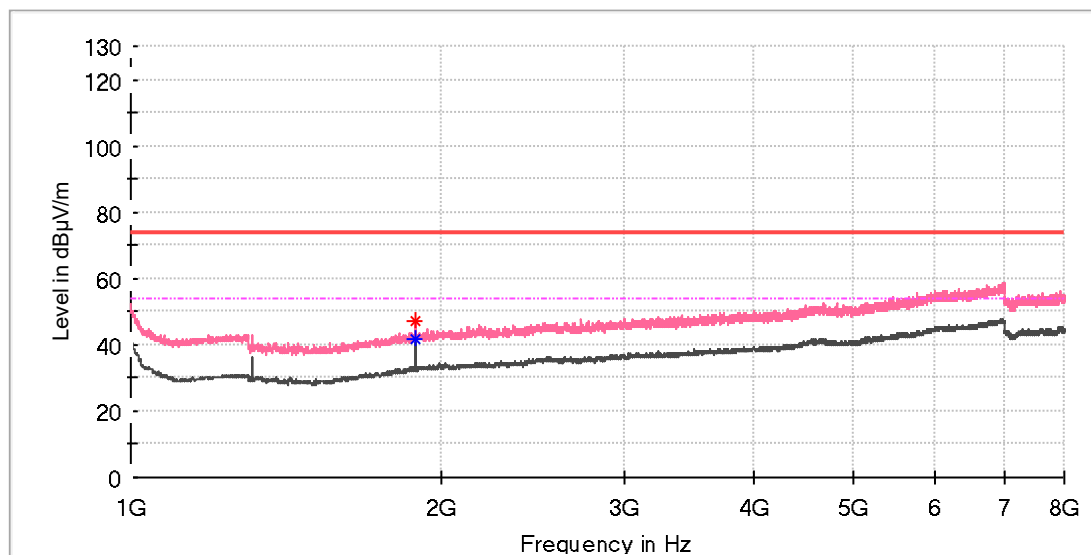
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8443.500000	---	32.38	54.00	21.62	100.0	H	96.0	8.8
8450.500000	44.07	---	74.00	29.93	100.0	H	12.0	8.8

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 922.396MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

**Critical Freqs**

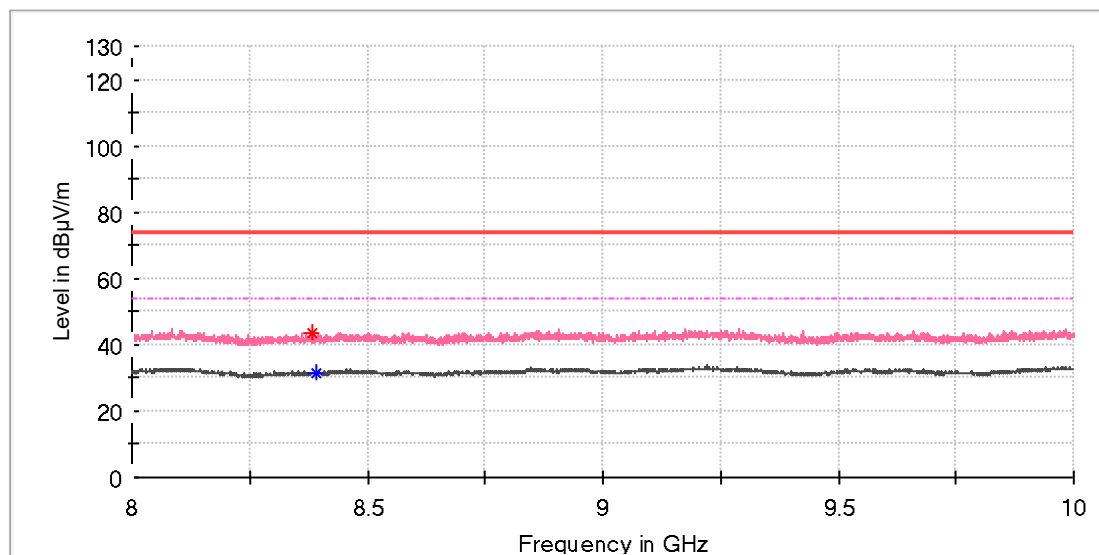
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1887.087500	---	41.61	54.00	12.39	100.0	V	315.0	5.4
1887.087500	46.87	---	74.00	27.13	100.0	V	315.0	5.4

Prüfbericht - Produkte

Test Report - Products

EUT Information

EUT Name: Quarterback Gateway
 Model: T11012860
 Test Mode: 922.396MHz
 Test Voltage: Battery
 Remark: Temp 23 Humi:49%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin

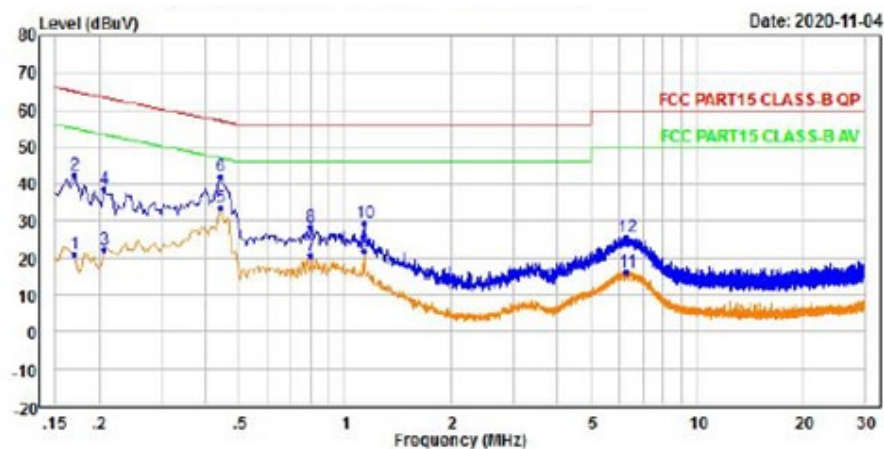


Critical Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8382.500000	43.29	---	74.00	30.71	100.0	V	295.0	8.5
8392.500000	---	31.68	54.00	22.32	100.0	V	219.0	8.5

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

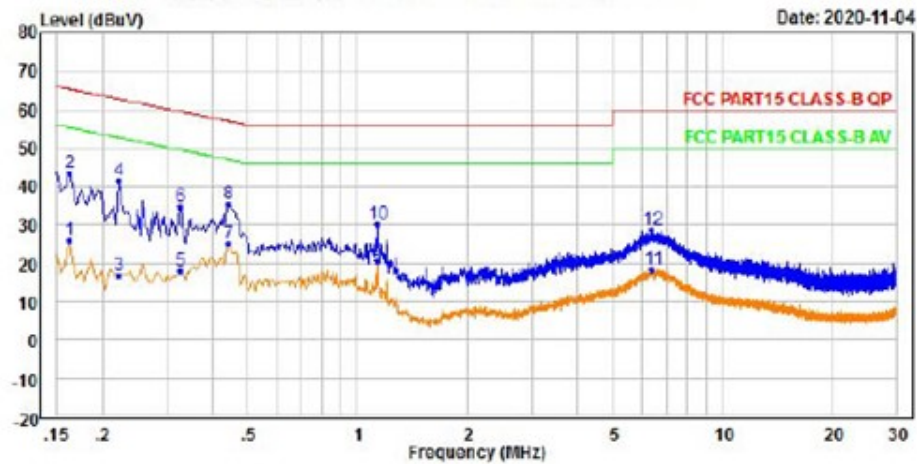
Charging with wireless link



Site : Shielding Room
 Condition : Line
 Temp.(C)/Hum.(%) : 24.8(C) /52%
 Press : 99.43kPa
 Product : Gateway
 Model No. : T11012860
 Power Rating : AC 120V/60Hz
 Test Engineer : Tripp
 Note :

	Freq	Read Level	LISN Factor	Cable Loss	Aux Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.1700	12.06	-0.90	0.01	9.94	21.11	54.96	-33.85	Average
2	0.1700	33.43	-0.90	0.01	9.94	42.48	64.96	-22.48	QP
3	0.2060	13.09	-0.86	0.01	9.93	22.17	53.37	-31.20	Average
4	0.2060	29.41	-0.86	0.01	9.93	38.49	63.37	-24.88	QP
5 PP	0.4420	24.23	-0.69	0.02	9.93	33.49	47.02	-13.53	Average
6 QP	0.4420	32.72	-0.69	0.02	9.93	41.98	57.02	-15.04	QP
7	0.8020	11.38	-0.53	0.02	9.93	20.80	46.00	-25.20	Average
8	0.8020	19.04	-0.53	0.02	9.93	28.46	56.00	-27.54	QP
9	1.1339	12.20	-0.50	0.02	9.93	21.65	46.00	-24.35	Average
10	1.1339	20.02	-0.50	0.02	9.93	29.47	56.00	-26.53	QP
11	6.3056	6.46	-0.21	0.07	9.76	16.08	50.00	-33.92	Average
12	6.3056	15.95	-0.21	0.07	9.76	25.57	60.00	-34.43	QP

Charging with wireless link



Site : Shielding Room
 Condition : Neutral
 Temp.(C)/Hum.(%) : 24.8(C) /52%
 Press : 99.43kPa
 Product : Gateway
 Model No. : T11012860
 Power Rating : AC 120V/60Hz
 Test Engineer : Tripp
 Note :

	Freq	Read Level	LISN Factor	Cable Loss	Aux Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.1620	16.82	-0.91	0.01	9.94	25.86	55.36	-29.50	Average
2	0.1620	34.45	-0.91	0.01	9.94	43.49	65.36	-21.87	QP
3	0.2220	7.75	-0.84	0.01	9.93	16.85	52.74	-35.89	Average
4 PP	0.2220	32.68	-0.84	0.01	9.93	41.78	62.74	-20.96	QP
5	0.3260	8.72	-0.76	0.01	9.93	17.90	49.55	-31.65	Average
6	0.3260	25.48	-0.76	0.01	9.93	34.66	59.55	-24.89	QP
7 AV	0.4420	16.16	-0.69	0.02	9.93	25.42	47.02	-21.60	Average
8	0.4420	26.41	-0.69	0.02	9.93	35.67	57.02	-21.35	QP
9	1.1339	11.29	-0.50	0.02	9.93	20.74	46.00	-25.26	Average
10	1.1339	20.73	-0.50	0.02	9.93	30.18	56.00	-25.82	QP
11	6.4296	8.69	-0.21	0.07	9.76	18.31	50.00	-31.69	Average
12	6.4296	18.97	-0.21	0.07	9.76	28.59	60.00	-31.41	QP