

Prüfbericht-Nr.: <i>Test Report No.:</i>	50287839 001	Auftrags-Nr.: <i>Order No.:</i>	238107999	Seite 1 von 47 <i>Page 1 of 47</i>
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	22-Jul-2019	
Auftraggeber: <i>Client:</i>	Zeroplus Technology Corporation 3rd Floor, No. 121, Jianba Road, Zhonghe District, New Taipei City, Taiwan (R.O.C)			
Prüfgegenstand: <i>Test item:</i>	C17068-P4 Battery Pack			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	ZPMN02C			
Auftrags-Inhalt: <i>Order content:</i>	FCC Part15C Test report (BT)			
Prüfgrundlage: <i>Test specification:</i>	FCC 47 CFR Part 15: Subpart C Section 15.247(FHSS) FCC 47CFR Part 2: Subpart J section 2 .1091			
Wareneingangsdatum: <i>Date of receipt:</i>	16-Aug-2019			
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000976081-004 to 005			
Prüfzeitraum: <i>Testing period:</i>	23-Sep-2019 – 27-Sep-2019			
Ort der Prüfung: <i>Place of testing:</i>	EMC/RF Laboratory Taipei			
Prüflaboratorium: <i>Testing laboratory:</i>	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von / tested by: 04-Oct-2019	 Jack Chang/Project Manager		kontrolliert von / reviewed by: 04-Oct-2019	
Datum <i>Date/Report Date</i>	Name / Stellung <i>Name / Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name / Stellung <i>Name / Position</i>
Sonstiges / Other:				
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>	
<p>* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(pass) = entspricht o.g. Prüfgrundlage(n) F(fail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet</p> <p>Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(pass) = passed a.m. test specification(s) F(fail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested</p>				
<p>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.</p> <p><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></p>				

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TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

5.1.2 MAXIMUM CONDUCTED OUTPUT POWER

RESULT: Passed

5.1.3 20dB BANDWIDTH

RESULT: N/A

5.1.4 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH

RESULT: Passed

5.1.5 SPURIOUS EMISSION

RESULT: Passed

5.1.6 FREQUENCY SEPARATION

RESULT: Passed

5.1.7 NUMBER OF HOPPING FREQUENCY

RESULT: Passed

5.1.8 TIME OF OCCUPANCY

RESULT: Passed

5.2.1 MAINS CONDUCTED EMISSIONS

RESULT: Passed

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Passed

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1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation
(File Name: 50287839 001 APPENDIX P)
Appendix D: Test Result of Radiated Emissions
(File Name: 50287839 001 APPENDIX D)

Test Specifications

The following standards were applied.

Table 1: Applied Standard and Test Levels

Radio
FCC 47CFR Part 15: Subpart C Section 15.247
FCC 47CFR Part 2: Subpart J Section 2.1091
ANSI C63.10:2013
KDB558074 D01 DTS Meas Guidance v05r02
KDB447498 D01 General RF Exposure Guidance v06

1.2 Decision Rule of conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

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2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.
Taipei Testing Laboratories

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

FCC Registration No.: 180491
IC Canada Registration No.: 9465A
TAF Accredited NCC Test Lab. No.:3567
TAF ISO17025 Certification effective period: 6th-May-2019 to 05th-May-2022



Testing Laboratory
3567

2.3 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Type	S/N	Last Calibration	Next Calibration
Spectrum Analyzer	Agilent	N9010A	MY53470241	2019/06/17	2020/06/17
Power Meter	Anritu	ML2495A	1901008	2019/04/29	2020/04/29
Spectrum Analyzer	Rohde & Schwarz	FSV-40	101112	2018/10/01	2019/10/01
Pre-Amplifier	EMC Instruments	EMC9135	980628	2019/02/23	2020/02/23
Pre-Amplifier	EM Electronics	EM01G18G	060649	2019/09/11	2020/09/11
Pre-Amplifier	EMC Instruments	EMC184045SE	980408	2019/06/12	2020/06/14
Bilog Antenna	TESEQ	CBL 6111D	40101	2018/10/03	2019/10/03
Horn Antenna	ETS-Lindgren	3117	00218931	2018/12/27	2019/12/27
Horn Antenna	Com-Power	AH-840	101029	2018/12/22	2019/12/22
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2019/07/11	2020/07/11
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100797	2019/01/16	2020/01/16
Two-Line V-Network	Rohde & Schwarz	ENV216	101243	2019/06/23	2020/06/23
Test Software	Audix	e3	Ver. 9	N/A	N/A

2.4 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.5 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.

2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements are $\pm 3\text{dB}$.

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
RF power, conducted	$\pm 1.5\text{ dB}$
Adjacent channel power	$\pm 3\text{ dB}$
Radiated emission of transmitter, valid up to 26 GHz	$\pm 6\text{ dB}$
Radiated emission of receiver, valid up to 26 GHz	$\pm 6\text{ dB}$
Temperature	$\pm 2\text{ }^{\circ}\text{C}$
Humidity	$\pm 10\text{ \%}$

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Battery Pack with Bluetooth function. It contains a Bluetooth compatible module enabling the user to communicate data through a Wireless interface.

For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	C17068-P4 Battery Pack
Type Identification	ZPMN02C
FCC ID	2ADKMN009

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequency	2402 MHz ~ 2480 MHz
Channel Spacing	1 MHz
Channel number	79
Operation Voltage	5Vdc
Modulation	GFSK, $\pi/4$ DQPSK, 8 DPSK
Antenna gain	-6.72032dB

Table 6: Frequency hopping information

Technical Specification	Description
Hopping Range	Hereby we declare that the maximum frequency of this device is: 2402-2480MHz. This is according the Bluetooth Core Specification v5.0 for devices which will be operated in the USA. This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04).
Hopping Sequence	Example of a 79 hopping sequence in data mode: 33,04,21,44,23,42,53,46,55,48,40,59,72,29,76,31,08,73, 07,75,09,45,60,39,58,13,47,11,77,52,35,50,65,54,67,56, 69,62,71,64,7,25,27,66,57,70,74,61,78,63,10,41,05,43, 15,44,64,68,02,70,06,01,51,03,55,05,03,66,53,49,36,47,
Receiver input bandwidth	The input bandwidth of the receiver is 1MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings. Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

3.3 Independent Operation Modes

The basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Hopping

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- | | |
|-------------------------|-------------------|
| - Photo Document | - Circuit Diagram |
| - Technical Description | - Block Diagram |
| - Rating Label | |

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Setup for testing: The Test samples are provided with a USB interface which makes it possible to control the module through the test software installed on a notebook computer.

This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:

Conducted sample: A000976081-004

Radiation sample: A000976081-005

Full test was applied on all test modes, but only worst case was shown.

Power Setting for 1-DH5	10
Power Setting for 3-DH5	7

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

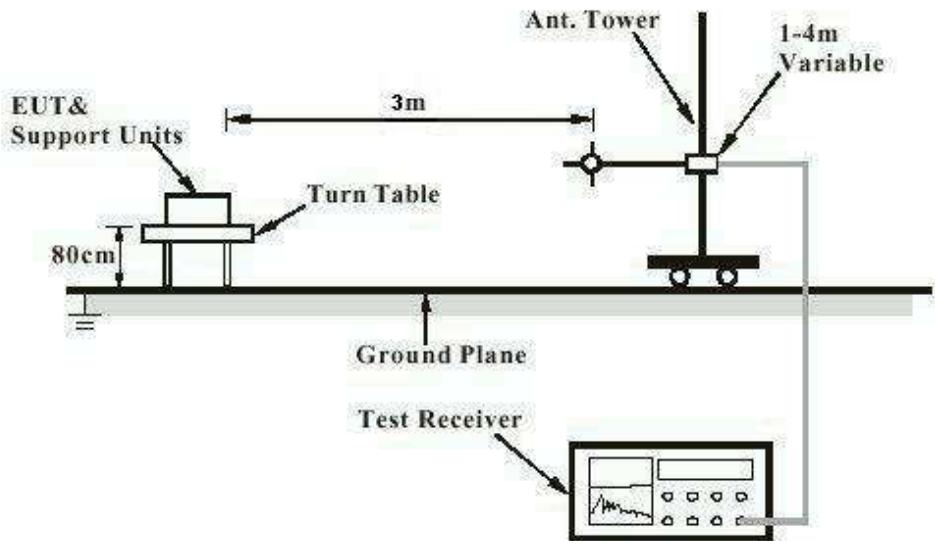
Description	Manufacturer	Model No.	Serial No.
Notebook(EMC-09)	Lenovo	G580	-
Test tool	銳迪科微電子 (上海)有限公司	HC_Data_Test.exe	3.2.0
Adapter for AC mains	Lenovo	E480	-

4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m

Diagram of Measurement Equipment Configuration for Mains Conduction Measurement

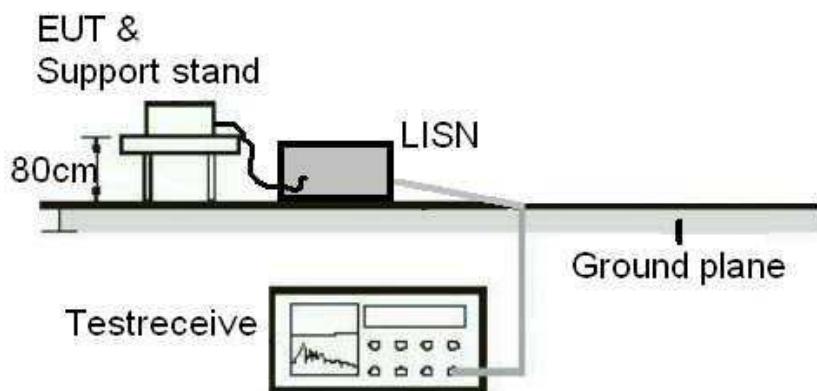
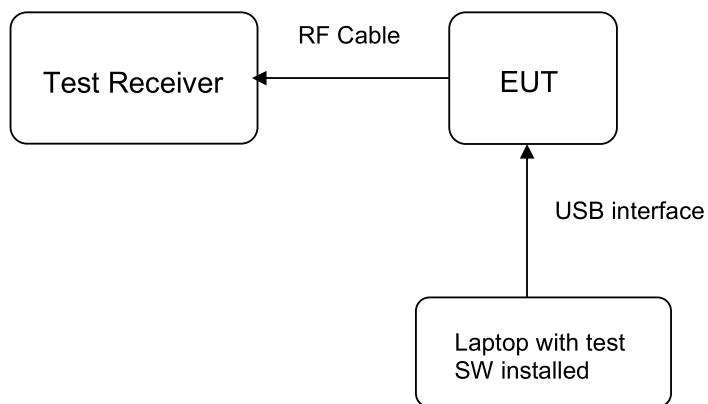


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT: **Passed**

Test standard : FCC Part 15.247(b)(4), Part 15.203

Requirement : use of approved antennas only with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with Max directional gain of -6.72032dBi. The antenna is a printed PCB trace with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

5.1.2 Maximum conducted output power

RESULT:

Passed

Test standard : FCC Part 15.247(b)(1)
 Basic standard : ANSI C63.10:2013
 Kind of test site : Conducted room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A
 Ambient temperature : 18-25 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103kPa

Table 7: Test result of Maximum conducted output power, 1DH5

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	
Low Channel	2402	-15.72	0.00003	0.125
Middle Channel	2441	-15.83	0.00003	0.125
High Channel	2480	-16.32	0.00002	0.125

Table 8: Test result of Maximum conducted output power, 3DH5

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	
Low Channel	2402	-7.39	0.00018	0.125
Middle Channel	2441	-7.57	0.00017	0.125
High Channel	2480	-7.66	0.00017	0.125

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*Test Report No.*Seite 18 von 47
Page 18 of 47**5.1.3 20dB Bandwidth****RESULT:****N/A**

Test standard	:	FCC Part 15.247(a)(1)
Basic standard	:	ANSI C63.10:2013
Kind of test site	:	Shielded room

Test setup

Test Channel	:	Low/ Middle/ High
Operation Mode	:	A
Ambient temperature	:	18-25°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103kPa

Table 9: Test result of 20dB Bandwidth, 1DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
Low Channel	2402	1.029
Mid Channel	2441	1.026
High Channel	2480	1.029

Note: For reporting purposes only.

Table 10: Test result of 20dB Bandwidth, 3DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
Low Channel	2402	1.342
Mid Channel	2441	1.339
High Channel	2480	1.339

Note: For reporting purposes only.

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Test Plot of 20dB Bandwidth, 1DH5 Low Channel



Middle Channel



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High Channel



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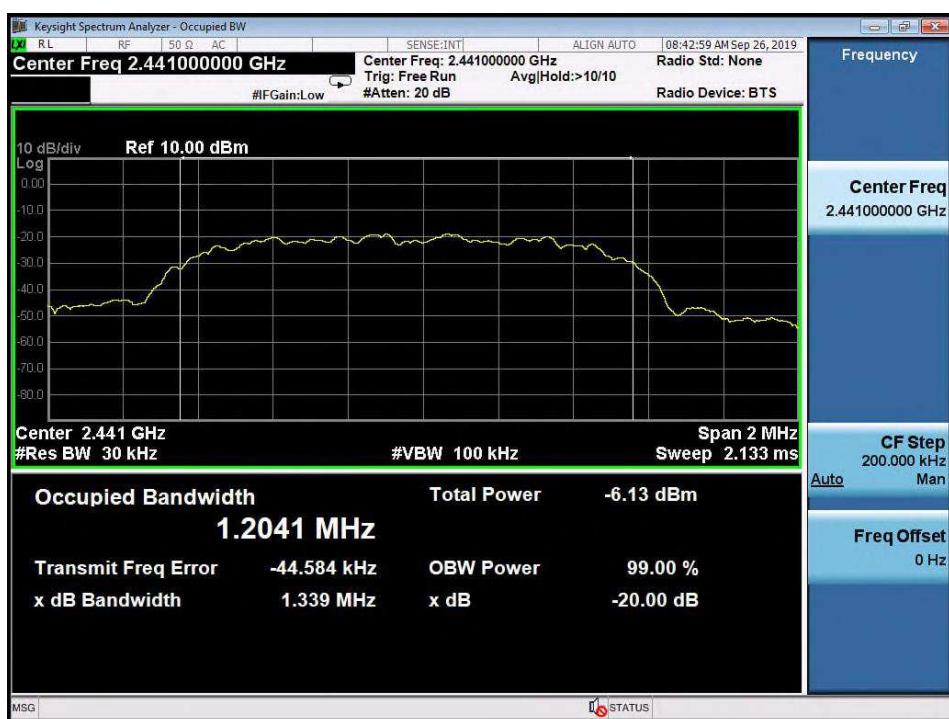
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Test Plot of 20dB Bandwidth, 3DH5

Low Channel



Middle Channel



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High Channel



5.1.4 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

RESULT:**Passed**

Test standard	:	FCC part 15.247(d)
Basic standard	:	ANSI C63.10:2013, KDB558074
Limit	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power)
Kind of test site	:	Conducted room

Test setup

Test Channel	:	Low/ Mid/ High for spurious, Low/ High for Band Edge
Operation Mode	:	A
Ambient temperature	:	18-25°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103kPa

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.

Due to the small size of the product and that there are no inductive components of significant size 9kHz to 30MHz frequency range is not tested based on technical judgment.

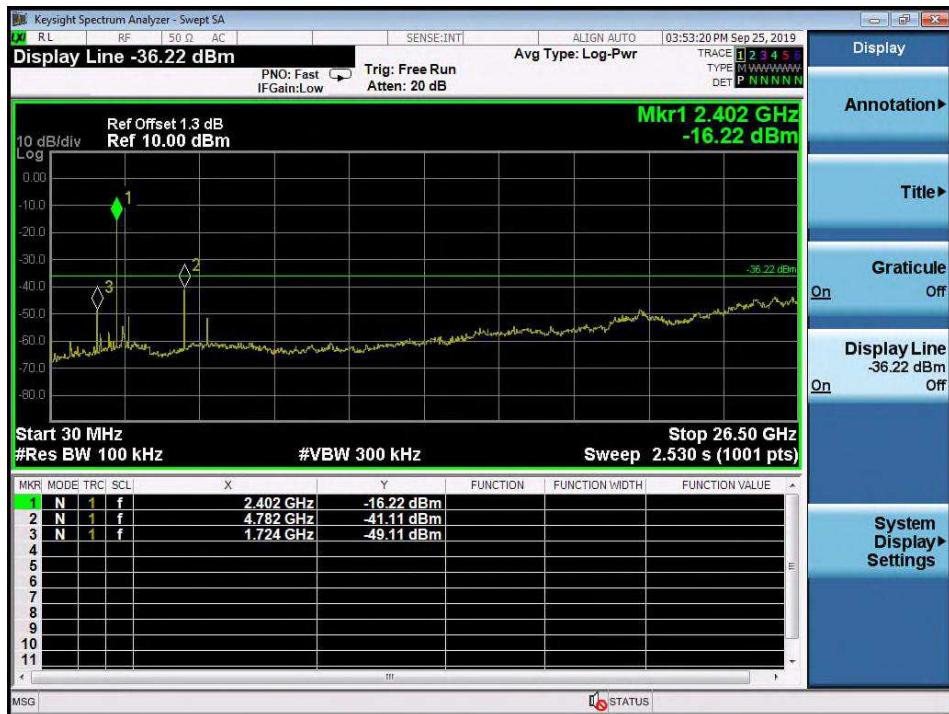
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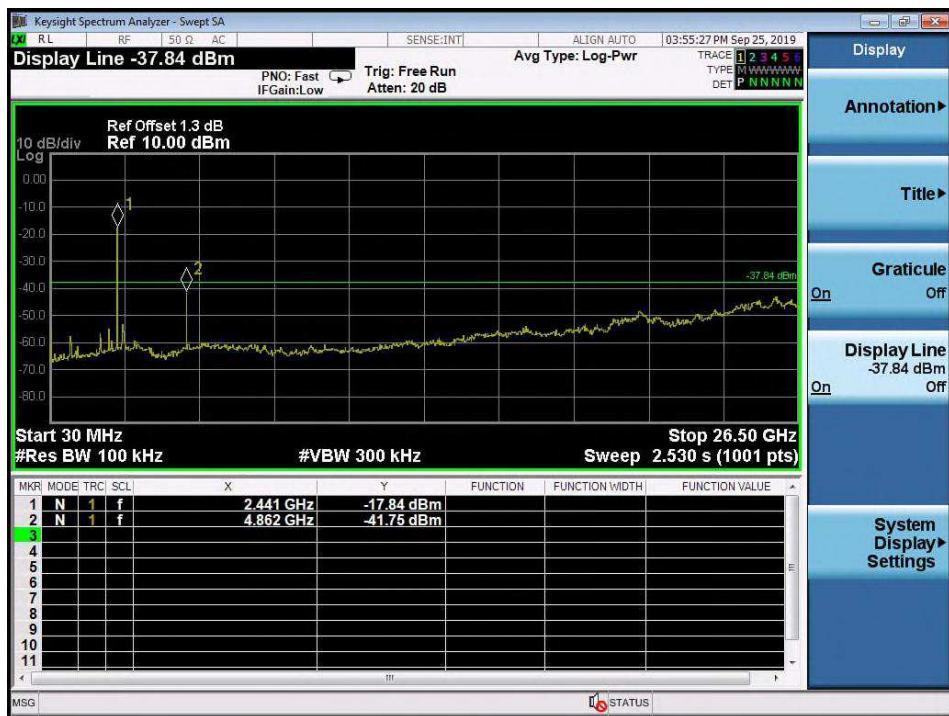
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Test Plot of 100kHz Conducted Emissions, 1DH5

Low Channel



Middle Channel



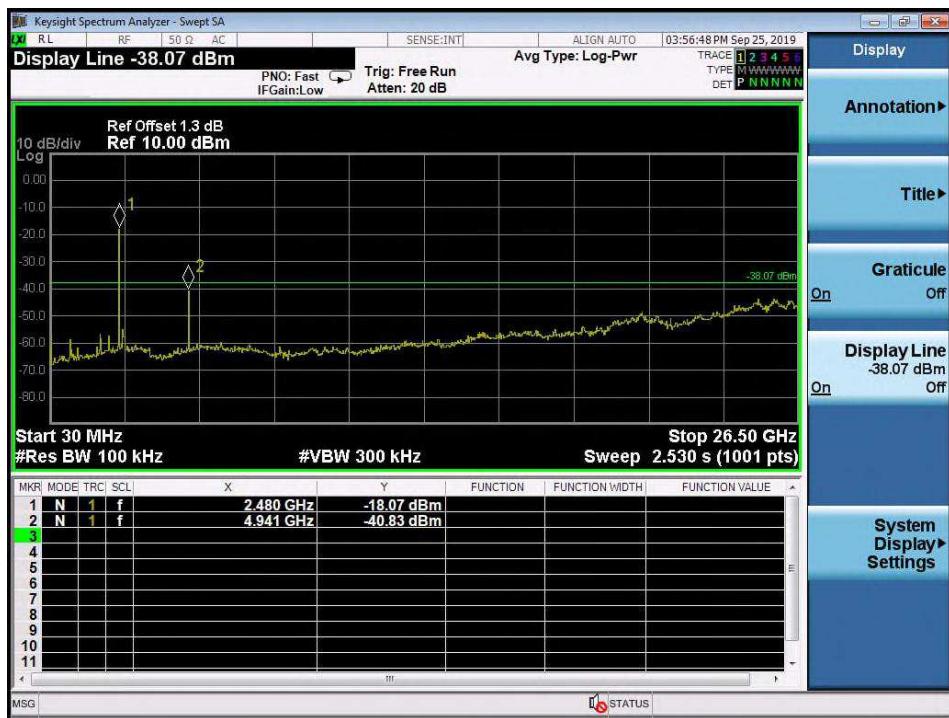
Produkte

Products

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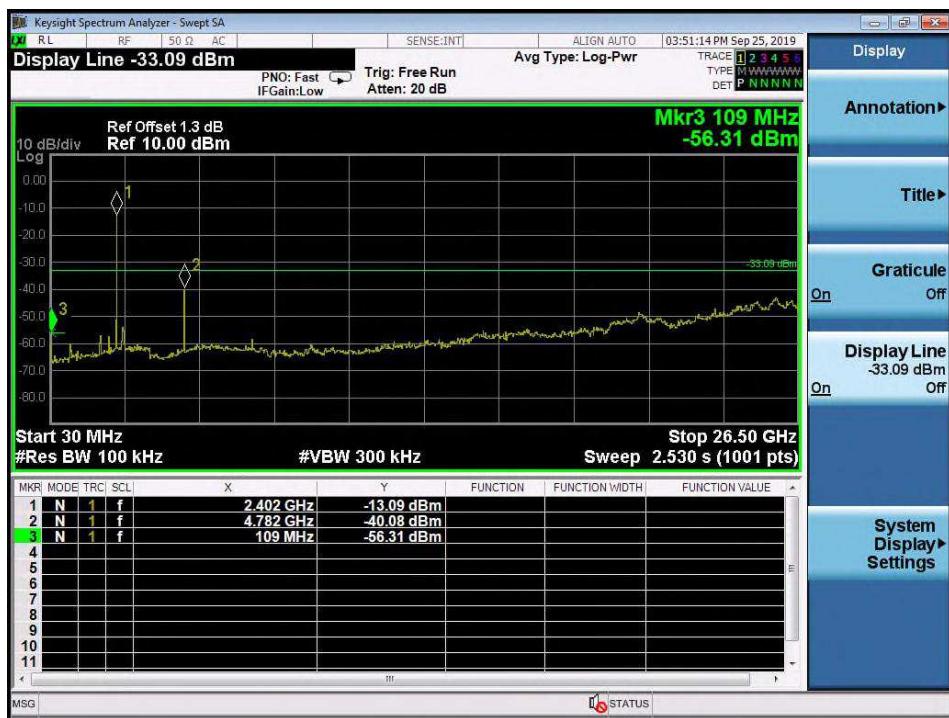
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High Channel



Test Plot of 100kHz Conducted Emissions, 3DH5

Low Channel

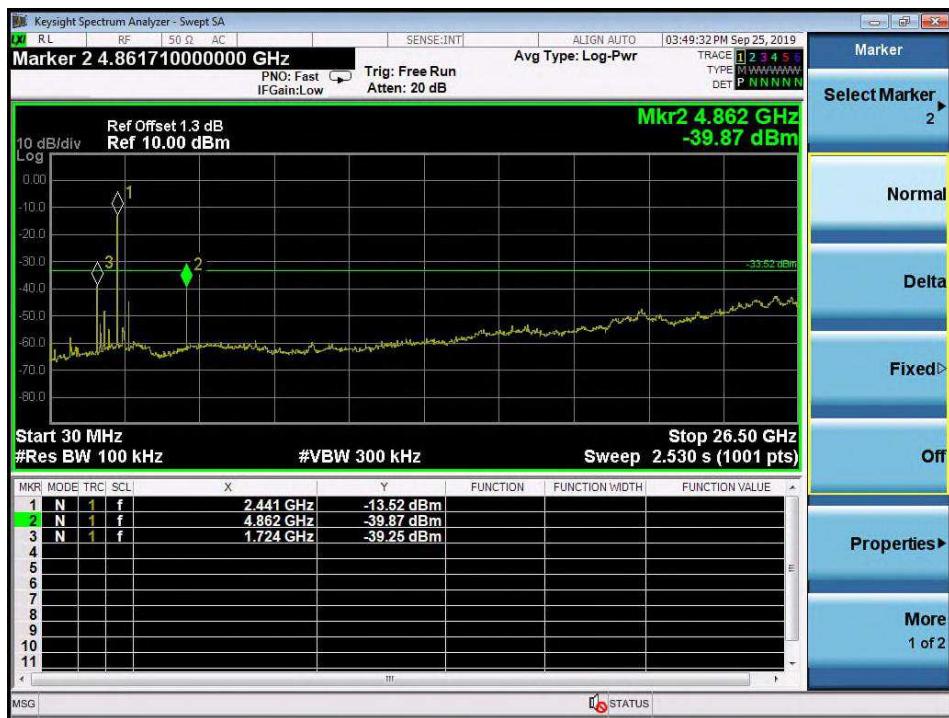


Produkte

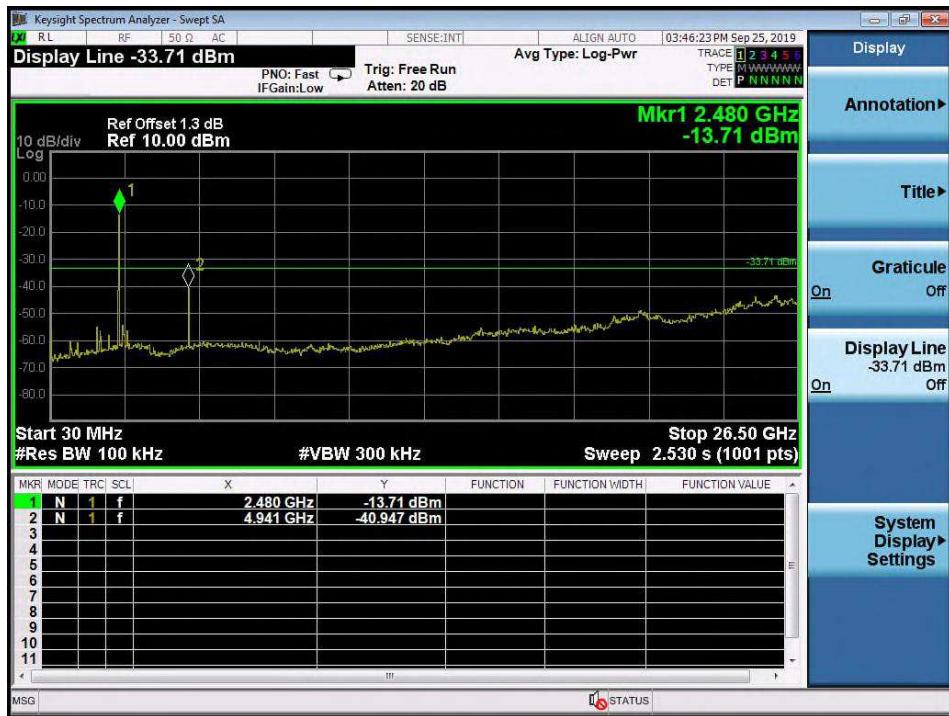
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Middle Channel



High Channel



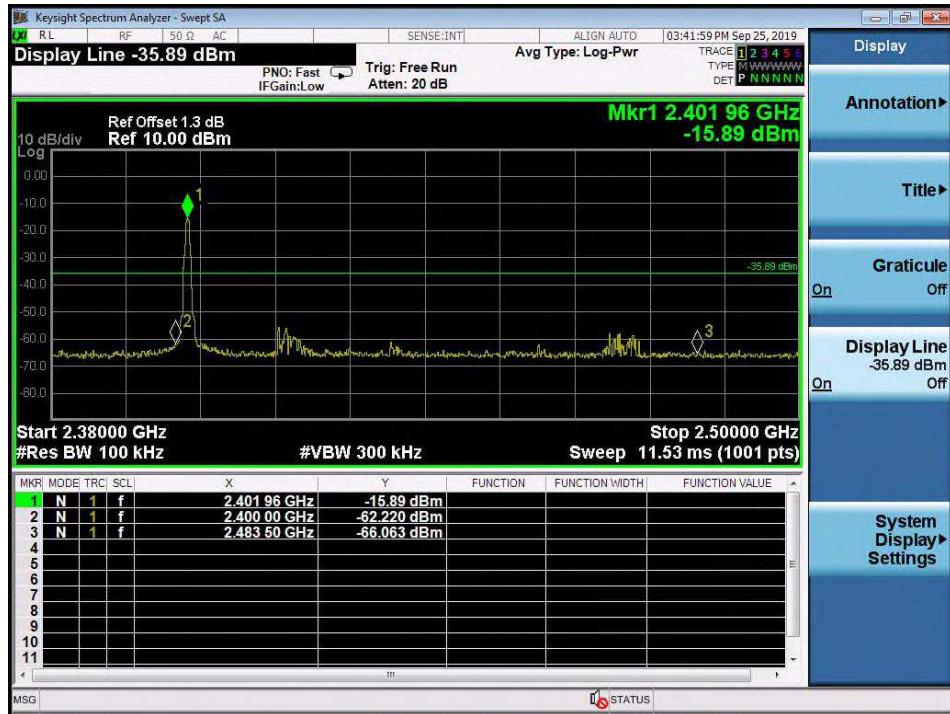
Produkte *Products*

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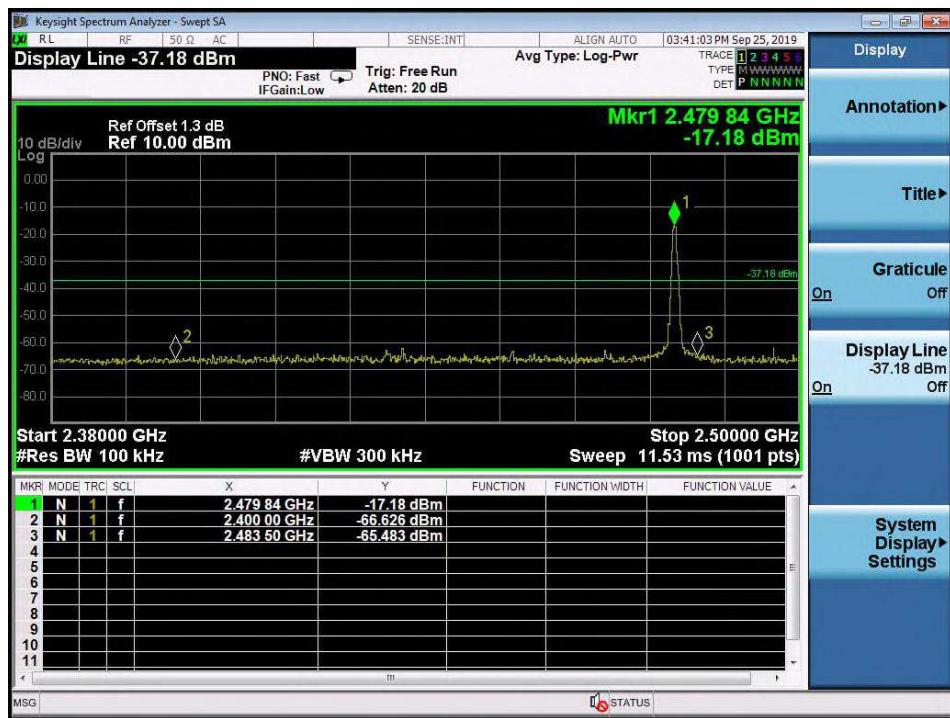
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Test Plot of 100kHz Bandwidth of Frequency Band Edge, 1DH5

Low Channel



High Channel



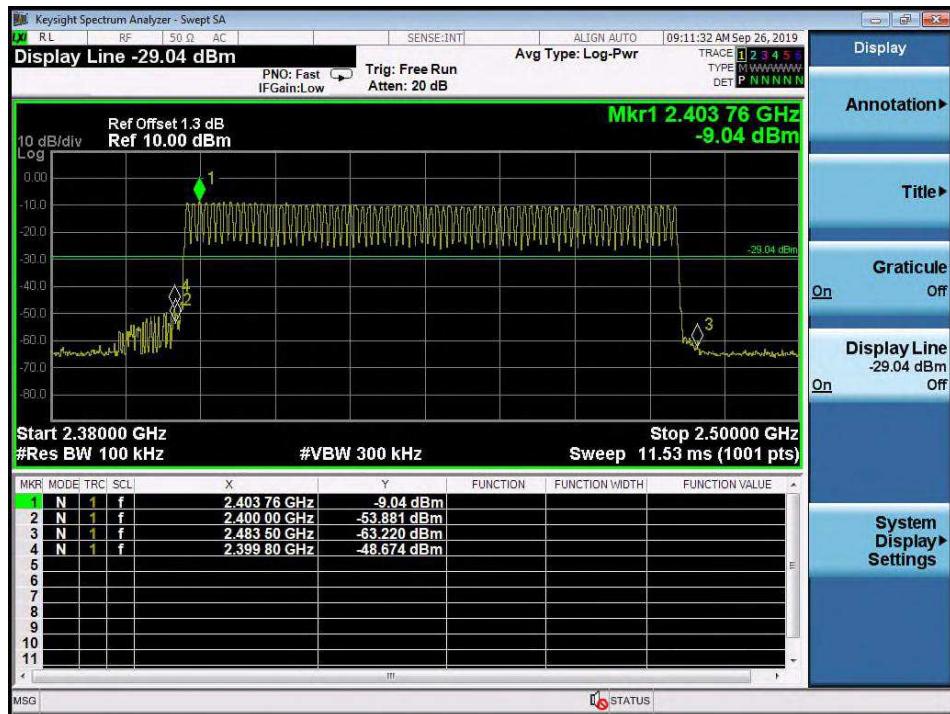
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Products

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Hopping ON



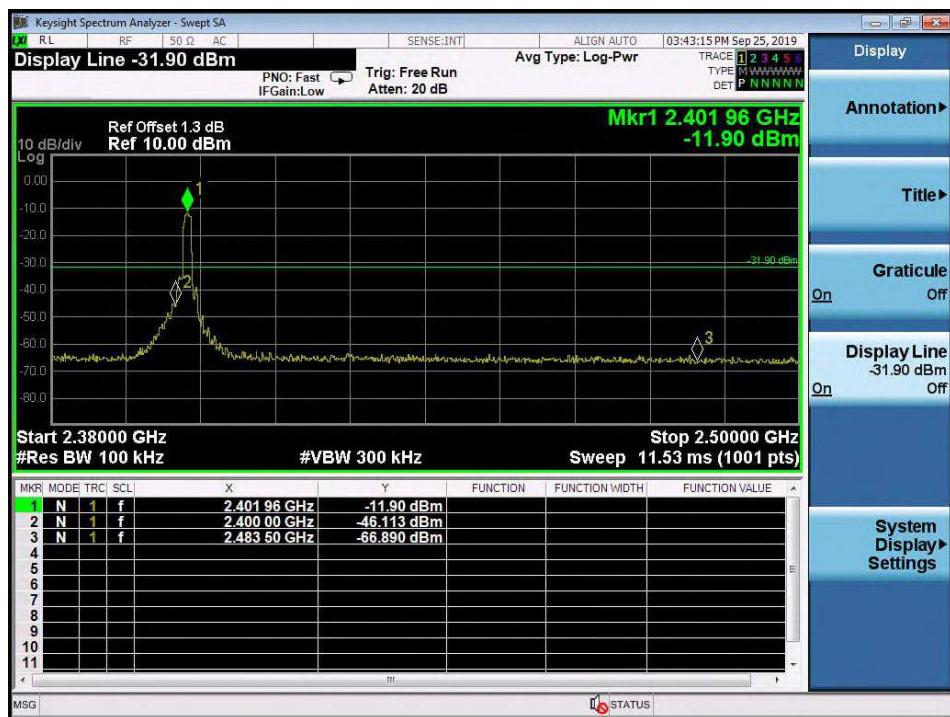
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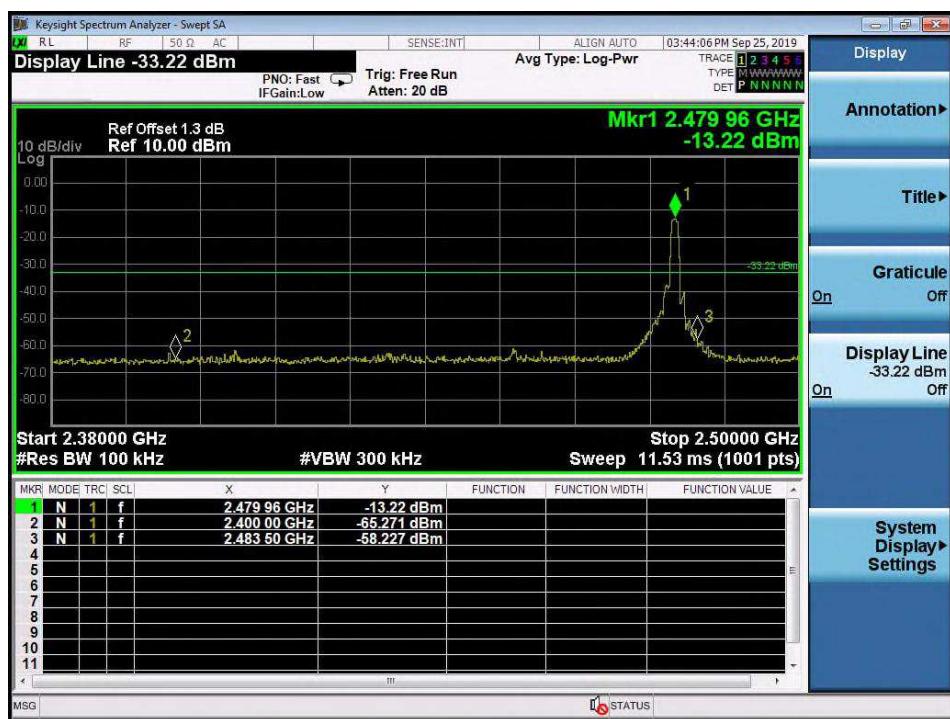
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Test Plot of 100kHz Bandwidth of Frequency Band Edge, 3DH5

Low Channel



High Channel

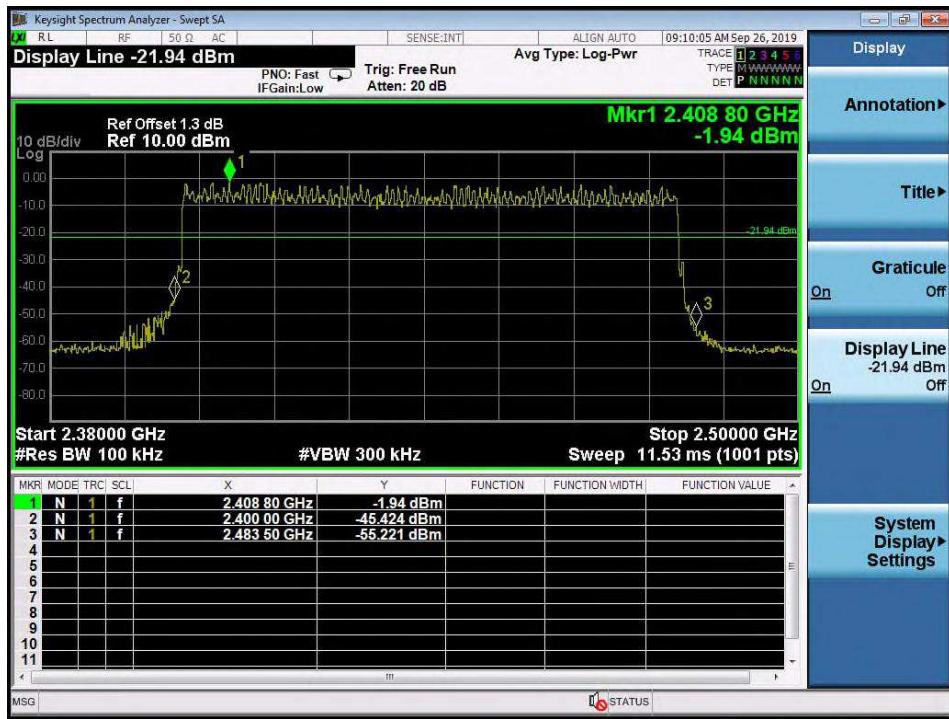


Produkte *Products*

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Hopping ON



5.1.5 Spurious Emission

RESULT:

Passed

Test standard	:	FCC part 15.247(d), FCC 15.205, FCC 15.209
Basic standard	:	ANSI C63.10
Limits	:	Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the radiated emission limits specified in FCC 15.209(a). Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a).
Kind of test site	:	3m Semi-Anechoic Chamber

Test setup

Test Channel	:	Low/ Middle/ High
Operation Mode	:	A

For details refer to Appendix D.

The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The worst-case Axis orientation is recorded in this test report.

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)

Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

5.1.6 Frequency Separation

RESULT:

Passed

Test standard : FCC part 15.247(a)(1)
 Basic standard : ANSI C63.10:2013
 Limit : ≥ 25kHz or 2/3 of 20dB bandwidth, whichever is greater

Test setup

Operation Mode : B
 Ambient temperature : 18-25°C
 Relative humidity : 50-65%

Table 11: Test result of Frequency Separation (1DH5)

Channel	Channel Frequency (MHz)	Measured Channel Separation (MHz)	Limit (kHz)	Result
Record Channel	2441	1	≥ 25kHz or 2/3 of 20dB bandwidth	Pass
Record Channel adj 1	2440			
Record Channel adj 2	2442			

Table 12: Test result of Frequency Separation (3DH5)

Channel	Channel Frequency (MHz)	Measured Channel Separation (MHz)	Limit (kHz)	Result
Record Channel	2441	1	≥ 25kHz or 2/3 of 20dB bandwidth	Pass
Record Channel adj 1	2440			
Record Channel adj 2	2442			

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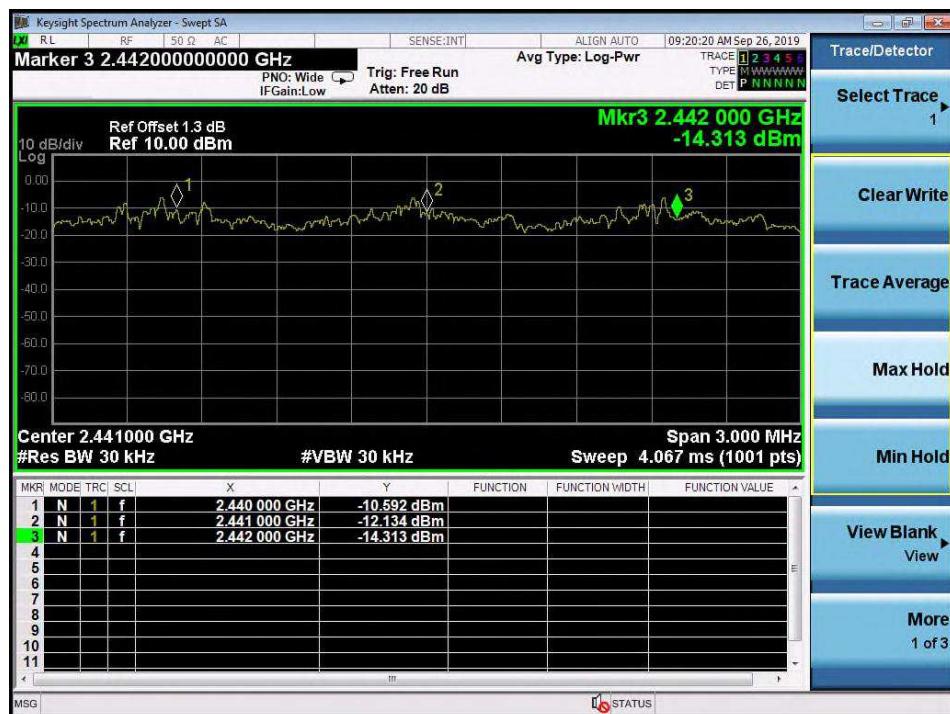
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Test Plot of Frequency Separation

1DH5



3DH5



5.1.7 Number of hopping frequency

RESULT:**Passed**

Test standard	:	FCC part 15.247(a)(1)(iii)
Basic standard	:	ANSI C63.10:2013
Limits	:	≥ 15 non-overlapping channels
Kind of test site	:	Shield room

Test setup

Test Channel	:	Hopping On
Ambient temperature	:	18-25°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103kPa

Table 13: Test result of Number of hopping frequency – 1DH5

Frequency Range	Measured Quantity of Hopping Channel	Limit	Result
<u>2400</u> to <u>2441</u> MHz	79	≥ 15	Pass

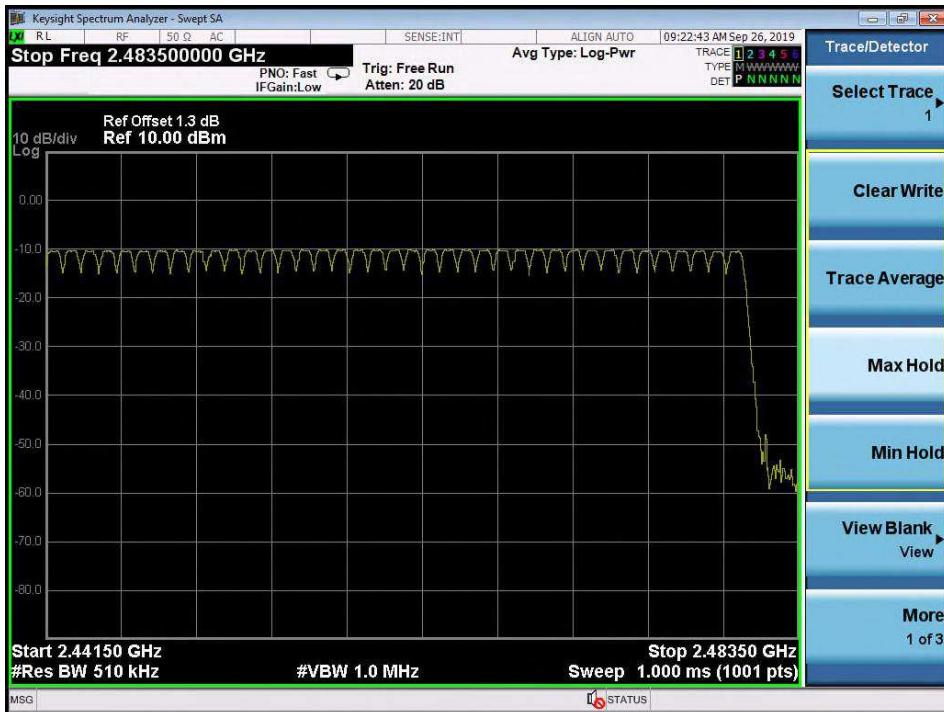
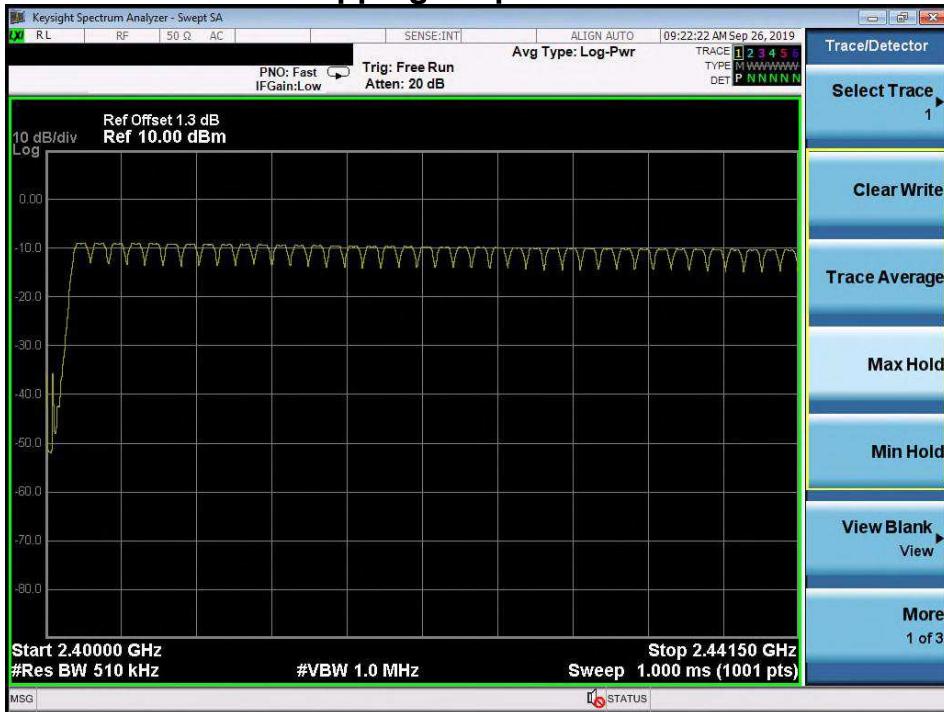
Table 14: Test result of Number of hopping frequency – 3DH5

Frequency Range	Measured Quantity of Hopping Channel	Limit	Result
<u>2400</u> to <u>2441</u> MHz	79	≥ 15	Pass

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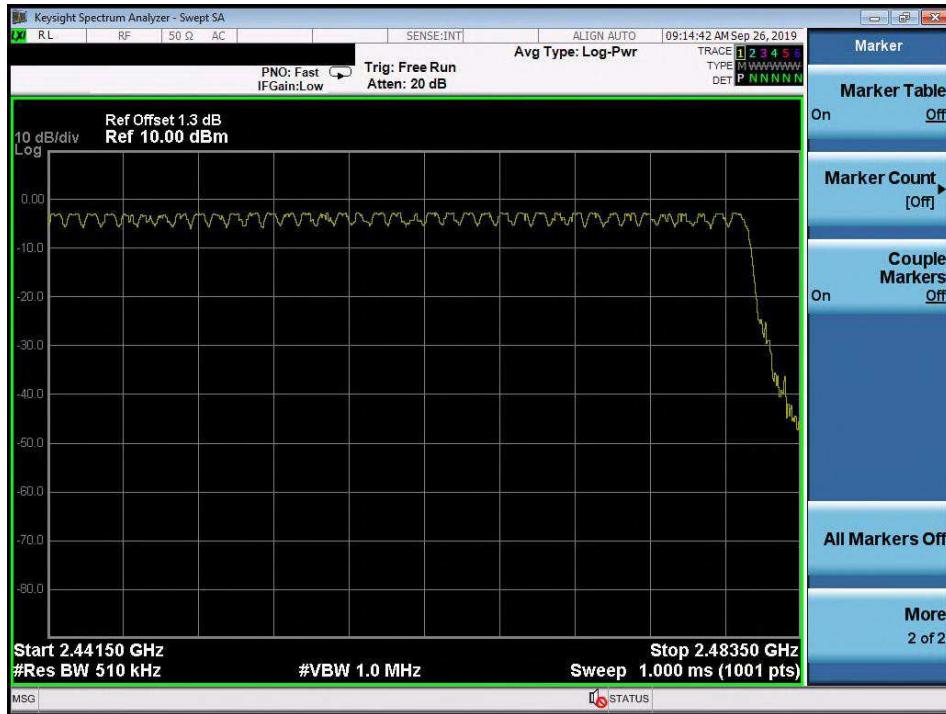
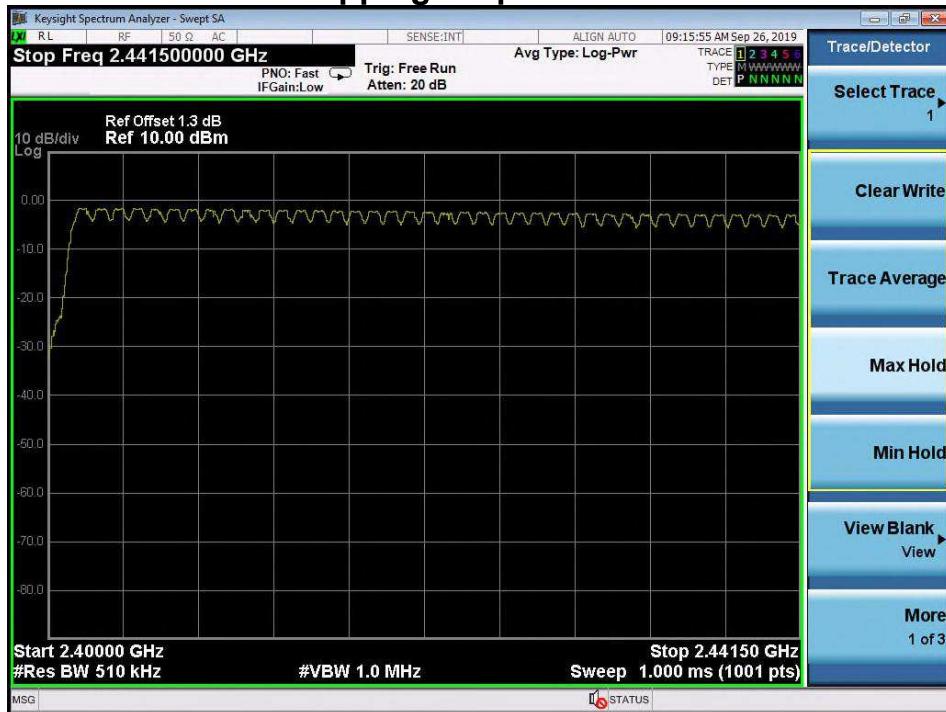
Test Plot of Number of hopping frequencies – 1DH5



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Test Plot of Number of hopping frequencies – 3DH5



5.1.8 Time of Occupancy

RESULT:
Passed

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

Test setup

Test Channel	:	Low
Operation Mode	:	A
Ambient temperature	:	18-25°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103kP

Table 15: Test result of Time of Occupancy

Data Mode	Captured Burst (s)	Dwell time (s)	On+Off time (s)	Limit (s)	Result
1DH5	0.00295	0.3147	0.00375	0.4	Pass
3DH5	0.00288	0.3072	0.00375	0.4	Pass

Note:

Dwell time = Pulse width x (Hopping rate / Number of channels) x Period

Period = 0.4 (seconds/ channel) x 79 (channel) = 31.6 seconds.

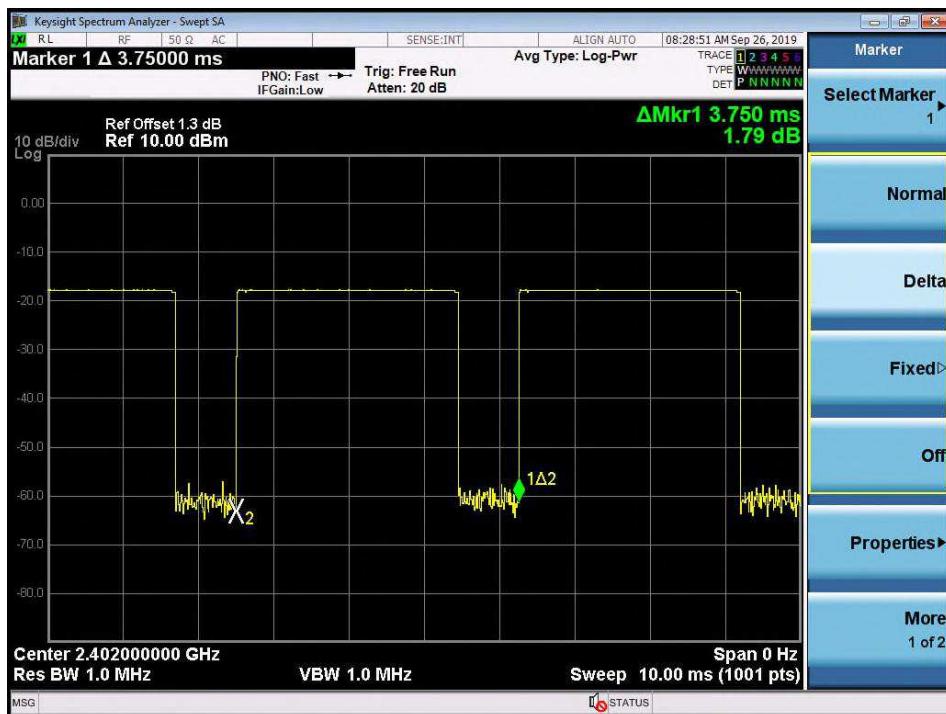
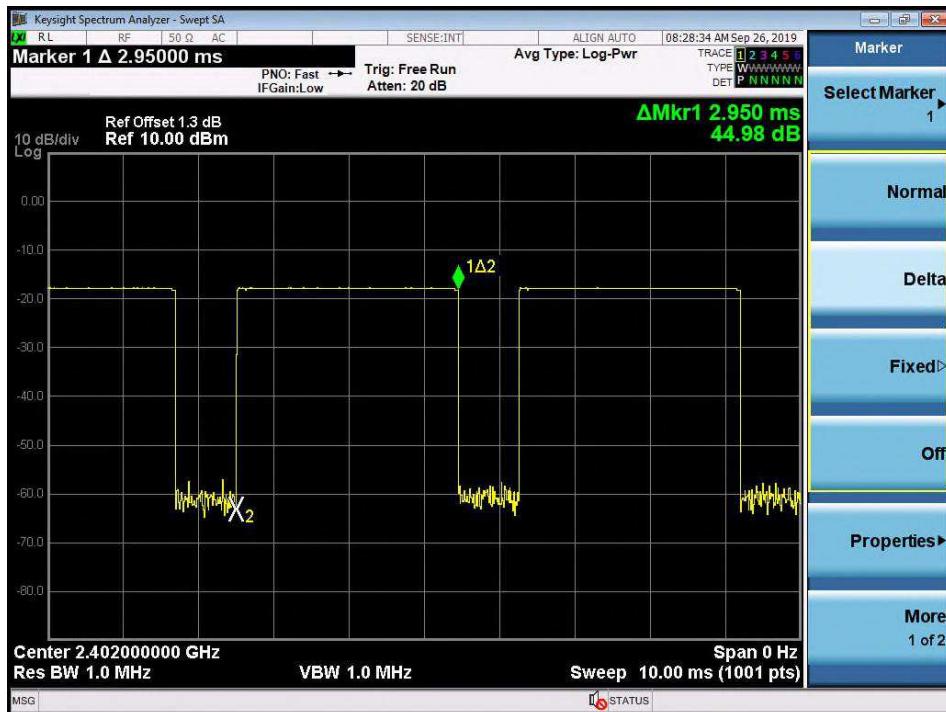
Hopping rate = 1 / (On+Off time)

Hopping Rate for DH5 = 267 Hz
 Hopping Rate for 3DH5 = 267 Hz

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Test Plot of Time of Occupancy, 1DH5

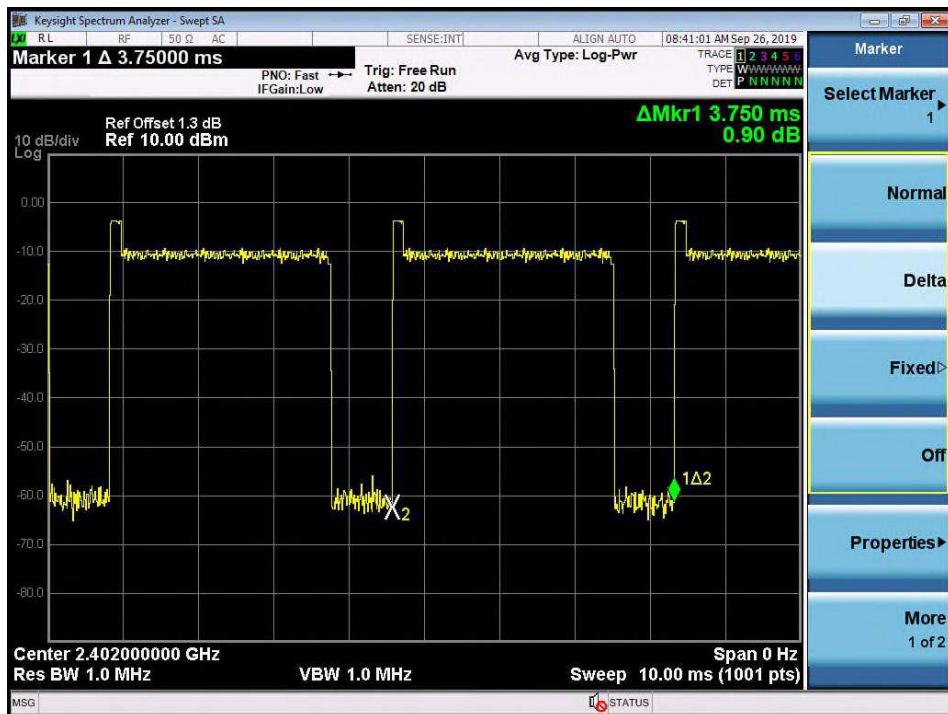
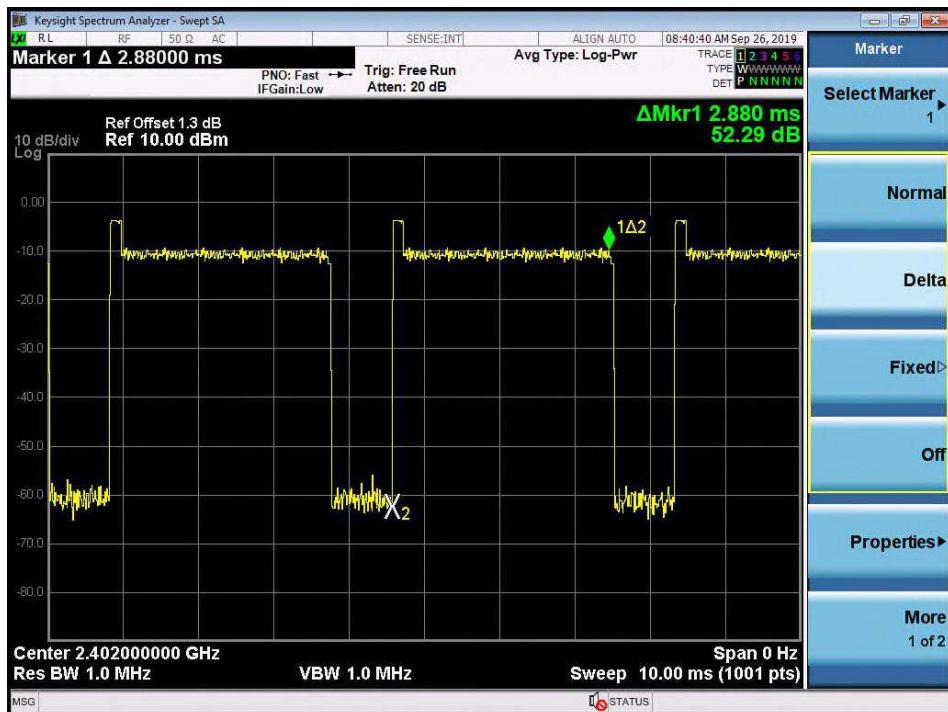


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Test Plot of Time of Occupancy, 3DH5



5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

RESULT:

Passed

Test standard	:	FCC Part 15.207 FCC Part 15.107
Limits	:	Mains Conducted emissions as defined in above test standards must comply with the mains conducted emission limits specified
Kind of test site	:	Shielded Room

Test setup

Test Channel	:	Middle
Operation mode	:	A

Remark: For details refer to Appendix D.

6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT: Passed

Test standard : FCC KDB Publication 447498 D01 v06
47CFR 1.1310
47CFR 2.1091

Since maximum peak output power of the transmitter is 0.18mW < 10mW, hence the EUT is excluded from SAR evaluation according FCC KDB publication 447498: Mobile Portable RF Exposure. Portable RF Exposure.

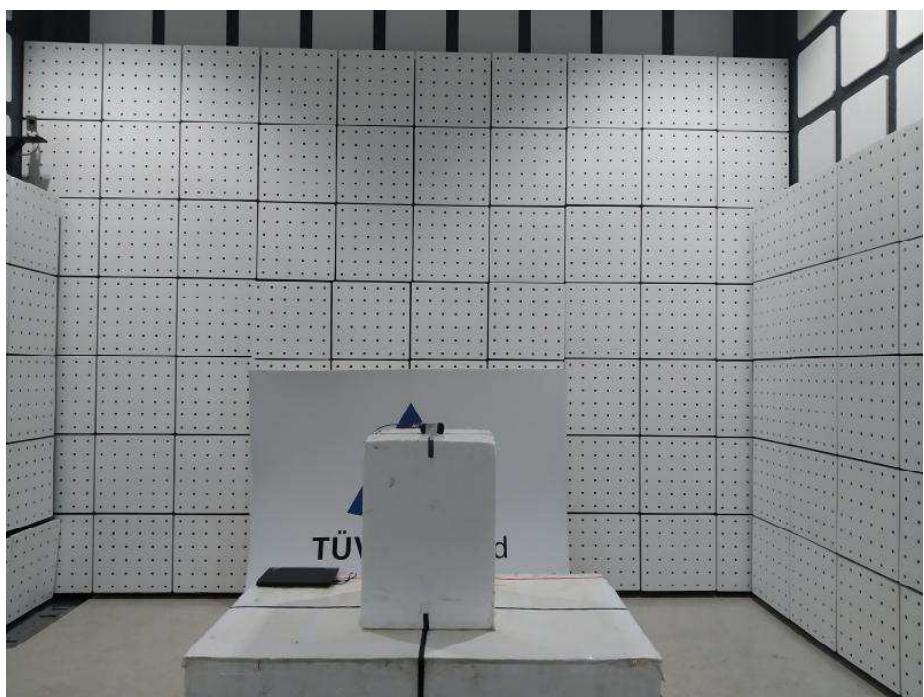
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7. Photographs of the Test Set-Up

Photograph 1: Set-up for Spurious Emissions (Front View 1)



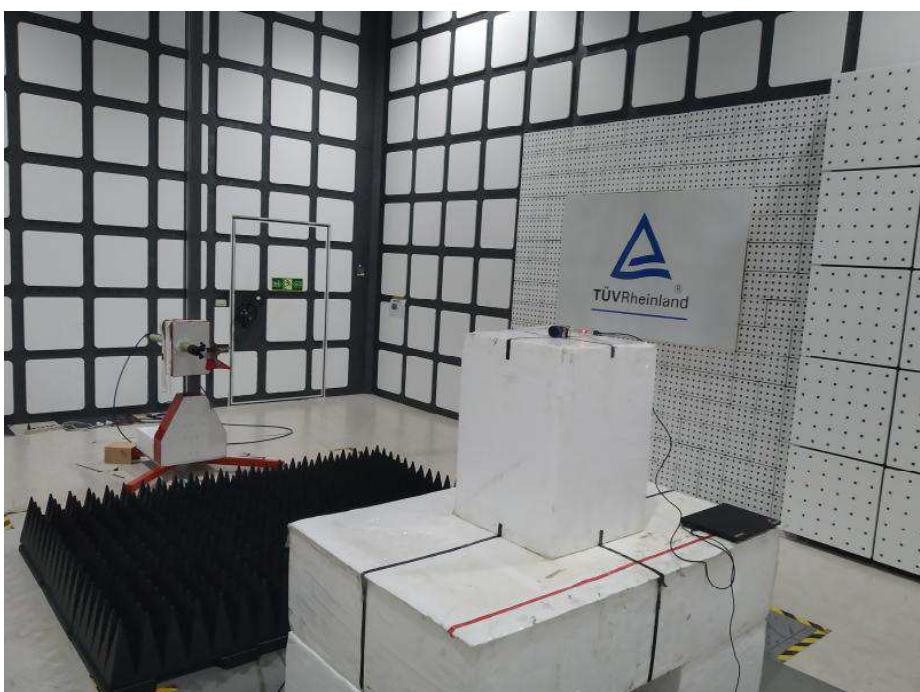
Photograph 2: Set-up for Spurious Emissions (Front View 2)



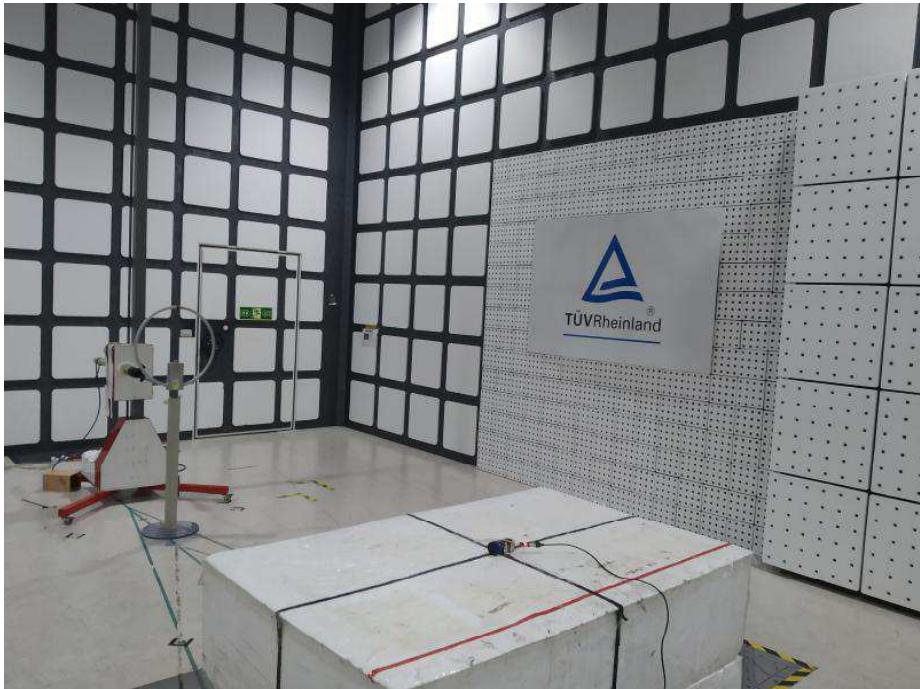
Photograph 3: Set-up for Spurious Emissions (Back View 1)



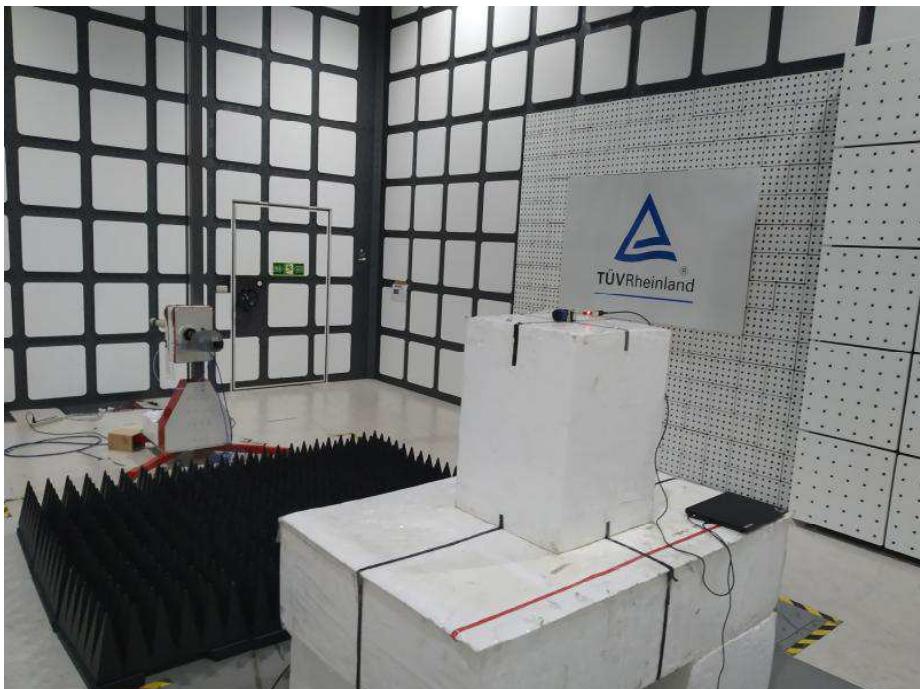
Photograph 4: Set-up for Spurious Emissions (Back View 2)



Photograph 5: Set-up for Spurious Emissions (Back View 3)



Photograph 6: Set-up for Spurious Emissions (Back View 4)



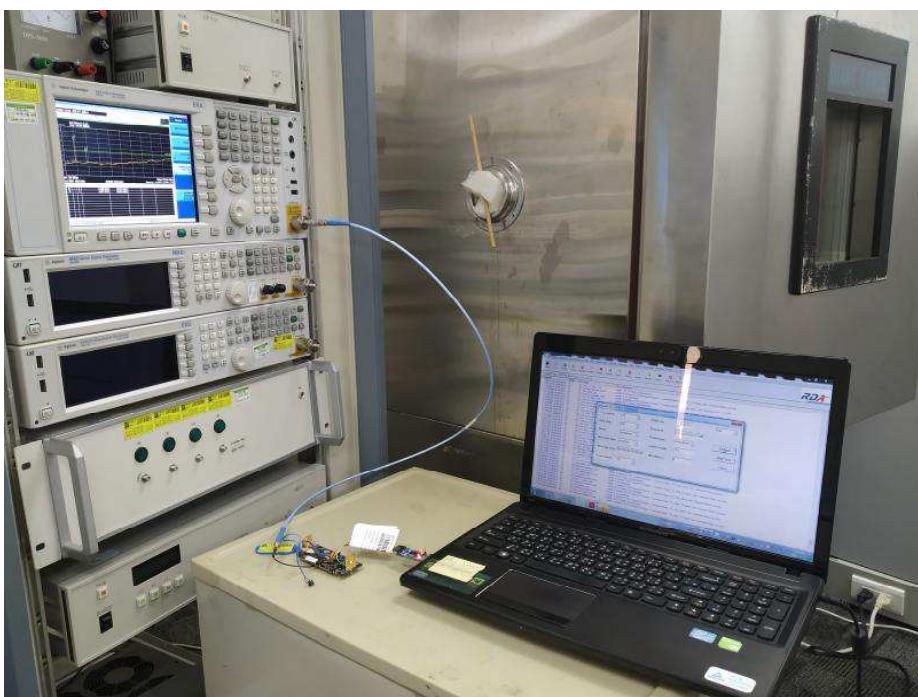
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Photograph 7: Set-up for Conducted testing (View 1)



Photograph 8: Set-up for Conducted testing (View 2)



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Photograph 9: Set-up for Mains Conducted testing (Back View)



Photograph 10: Set-up for Mains Conducted testing (Front View)



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