

Prüfbericht-Nr.: Test Report No.:	50271748 001	Auftrags-Nr.: Order No.:	114083434	Seite 1 von 48 Page 1 of 48
Kunden-Referenz-Nr.: Client Reference No.:	N/A	Auftragsdatum: Order date:	24-Oct-2018	
Auftraggeber: Client:	安儀精密儀器有限公司 臺北市大同區天水路 46 號 1 樓			
Prüfgegenstand: Test item:	GIS 資料蒐集器			
Bezeichnung / Typ-Nr.: Identification / Type No.:	Zeno 20			
Auftrags-Inhalt: Order content:	NCC LP0002 Test report (BR/EDR)			
Prüfgrundlage: Test specification:	NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2018) Section 3.10.1			
Wareneingangsdatum: Date of receipt:	30-Oct-2018			
Prüfmuster-Nr.: Test sample No.:	A000830237-006(Conducted) A000830237-007(Radiated)			
Prüfzeitraum: Testing period:	03-Jul-2019 – 16-Jul-2019			
Ort der Prüfung: Place of testing:	EMC/RF Laboratory Taipei			
Prüflaboratorium: Testing laboratory:	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von / tested by: 22-Jul-2019 Brenda Chen/Senior Project Manager Datum Name / Stellung Unterschrift Date(Report Date) Name / Position Signature		kontrolliert von / reviewed by: 22-Jul-2019 Arvin Ho/Vice General Manager Datum Name / Stellung Unterschrift Date Name / Position Signature		
Sonstiges / Other:				
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 = 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 specification(s) F(ail) = failed a.m. test specification(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: 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: 50271748 001 APPENDIXP)

Appendix D: Test Result of Radiated Emissions

(File Name: 50271748 001 APPENDIXD)

Test Specifications

The following standards were applied

Table 1: Applied Standard and Test Levels

Radio
NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2018)(107 年 1 月 10 日)

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.

2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.
Taichung Branch Office

No.9, Lane 36, Minsheng Rd., Sec. 3, Daya District,
Taichung City 428
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.)

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	Manu-facturer	Type	S/N	Last Calibration	Next Calibration
Test Software	Audix	e3	Ver. 9	N/A	N/A
Spectrum Analyzer	R&S	FSV 40	101514	2019/02/07	2020/02/07
EXA Signal Analyzer	KEYSIGHT	N9010A	MY53470241	2019/02/15	2020/02/15
Preamplifier (30MHz -1GHz)	HP	8447D	2944A09270	2018/08/31	2019/08/31
Preamplifier (18 GHz -40 GHz)	EMC Instruments	EMC184045SE	980652	2019/02/25	2020/02/25
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	060649	2018/08/24	2019/08/24
Bilog Antenna	TESEQ	CBL 6111D	29802	2018/08/22	2019/08/22
Horn Antenna	ETS-Lindgren	3117	00201918	2018/08/23	2019/08/23
Horn Antenna (18GHz~40GHz)	COM-POWER	AH-840	101029	2018/12/22	2019/12/22
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2019/07/11	2020/07/11
Two-Line V-Network	R&S	ENV216	101243	2019/06/23	2020/06/23
EMI Test Receiver	R&S	ESCI 7	100797	2019/01/16	2020/01/16

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 GIS collector. 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	GIS 資料蒐集器
Type Identification	Zeno 20
Brand Name	Leica

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequency	2402 MHz ~ 2480 MHz
Channel Spacing	1 MHz
Channel number	79
Operation Voltage	3.7Vdc
Modulation	GFSK, $\pi/4$ DQPSK, 8DPSK
Antenna gain	1.57dBi

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 packer 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. Receiver
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- C. Hopping

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

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

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 an application and test scripts used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:
Conducted sample: A000830237-006
Radiation sample: A000830237-007

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

4.3 Special Accessories and Auxiliary Equipment

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

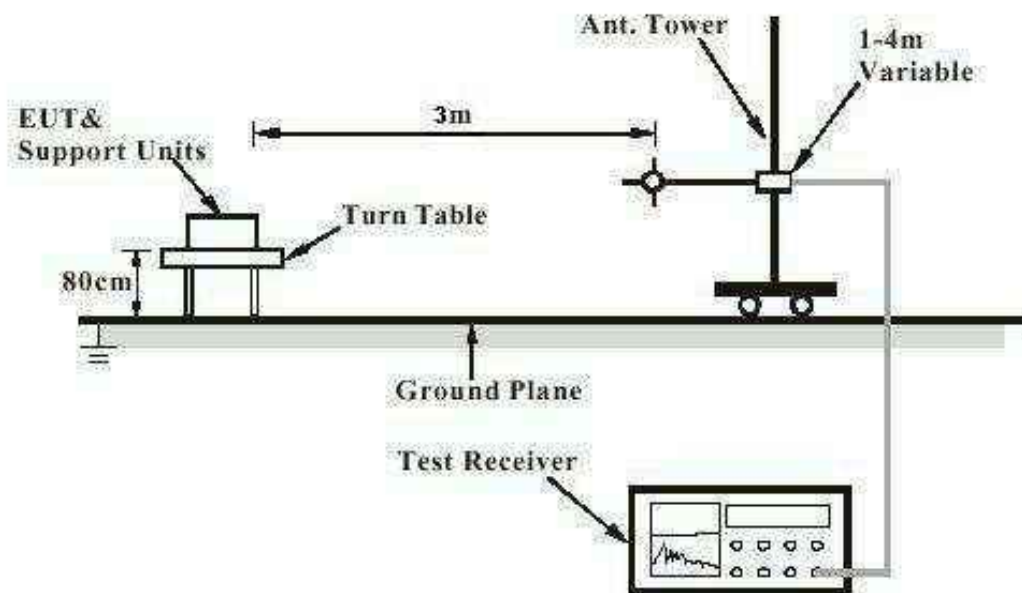
Description	Manufacturer	Model No.	Serial No.
Test application	-	PM_BT_MANUAL_DRIVER.cab	-
Test application	-	ZENO20_BT_TEST	-
Test tool to edit scripts	TI	HCITester	-
Adapter for AC mains	Apple	A1401	-

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

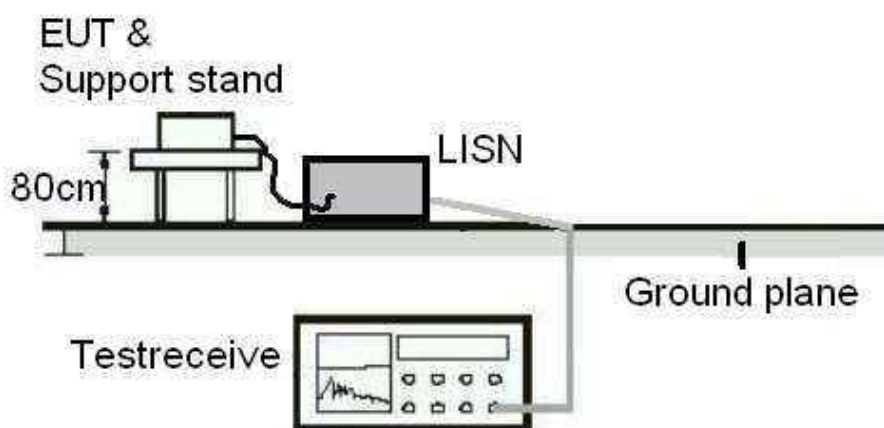
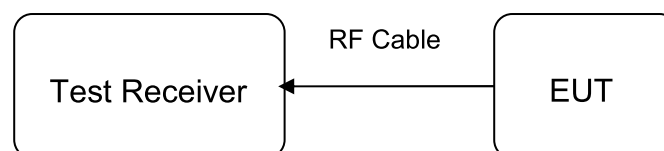


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test standard : LP0002(2018): 2.2, 3.10.1.3, 3.10.1.4

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 1.57 dBi. The antenna is a Carrier Antenna 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 : LP0002(2018): 3.10.1.2(1)(B)
 Basic standard : ANSI C63.10:2013, LP0002(2018) Appendix II
 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 : 100-103 kPa

Table 7: Test result of Maximum conducted output power, GFSK modulation

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2402	3.72	0.00236	0.125
Middle Channel	2441	3.47	0.00222	0.125
High Channel	2480	3.12	0.00205	0.125

Table 8: Test result of Maximum conducted output power, 8DPSK modulation

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2402	0.10	0.00102	0.125
Middle Channel	2441	-0.12	0.00097	0.125
High Channel	2480	-0.49	0.00089	0.125

Maximum Output power: 2.355mW

5.1.3 20dB Bandwidth

RESULT:
N/A

Test standard : LP0002(2018): 3.10.1.6 (1) (A)
 Basic standard : ANSI C63.10:2013
 Kind of test site : LP0002(2018) Appendix II
 : Shielded room

Test setup

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

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

Table 9: Test result of 20dB Bandwidth, GFSK modulation

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
Low Channel	2402	0.954
Mid Channel	2441	0.9576
High Channel	2480	0.9532

Note: For reporting purposes only.

Table 10: Test result of 20dB Bandwidth, 8DPSK modulation

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
Low Channel	2402	1.362
Mid Channel	2441	1.361
High Channel	2480	1.365

Note: For reporting purposes only.

Test Plot of 20dB Bandwidth, GFSK modulation

Low Channel



Middle Channel



High Channel

Test Plot of 20dB Bandwidth, 8DPSK modulation
Low Channel


Middle Channel



High Channel



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

RESULT:**Passed**

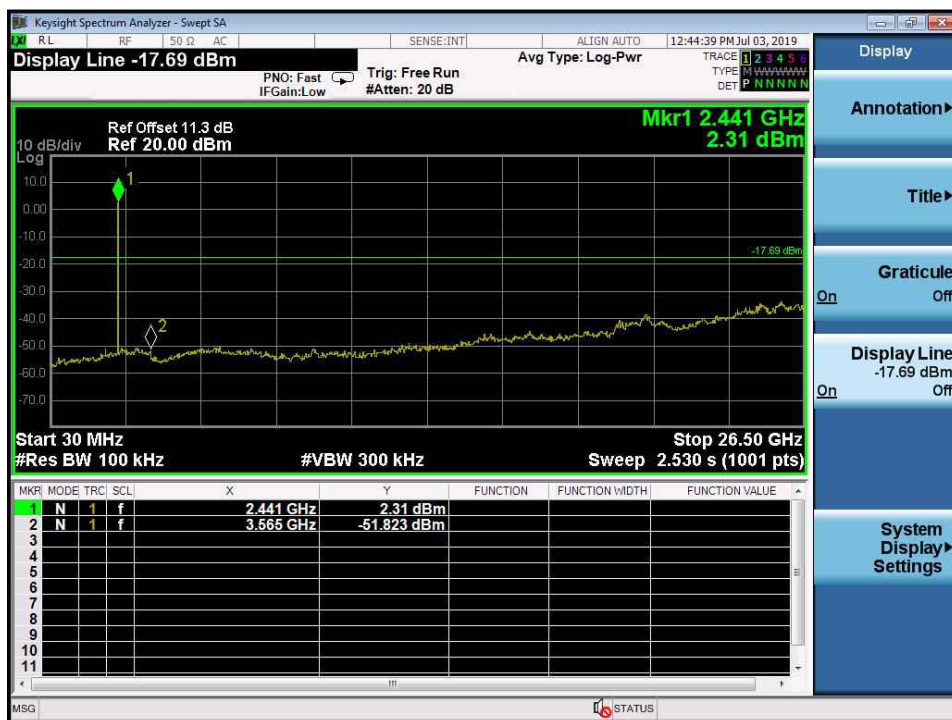
Test standard	:	LP0002(2018): 3.10.1.5
Basic standard	:	ANSI C63.10:2013, KDB558074 LP0002(2018) Appendix II
Limit	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power)
Kind of test site	:	Conducted room

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 30dB 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.

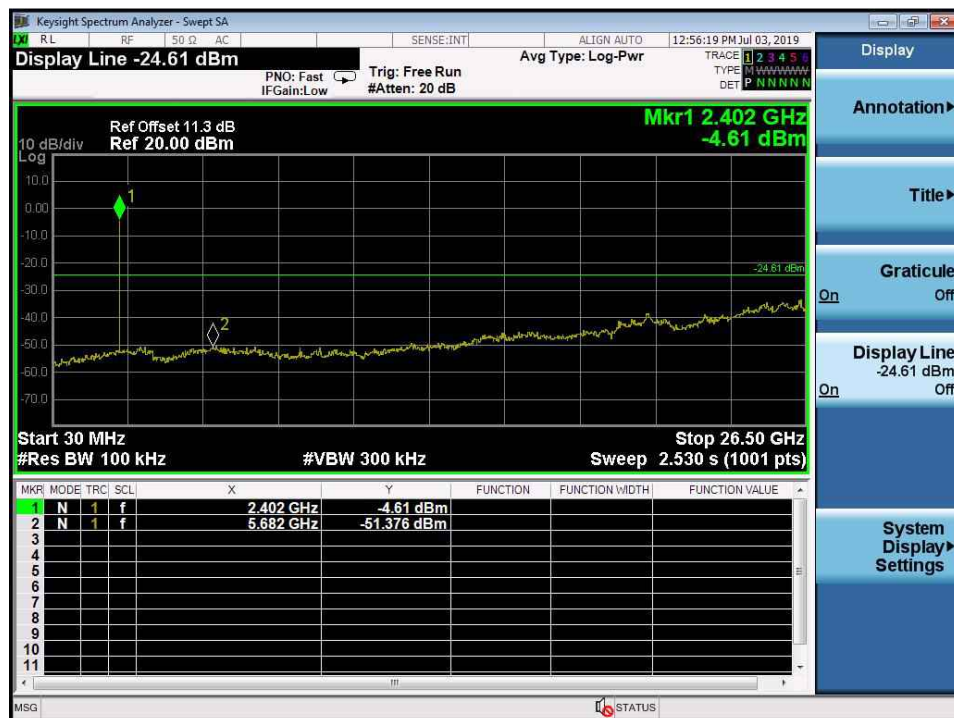


High Channel

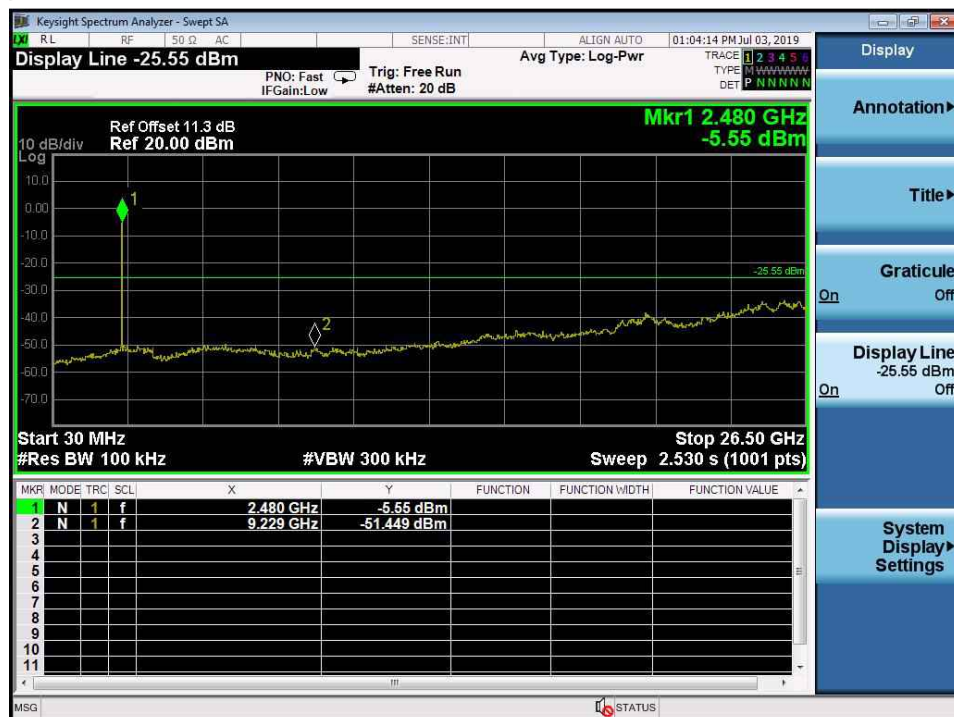


Test Plot of 100kHz Conducted Emissions, 8DPSK modulation

Low Channel

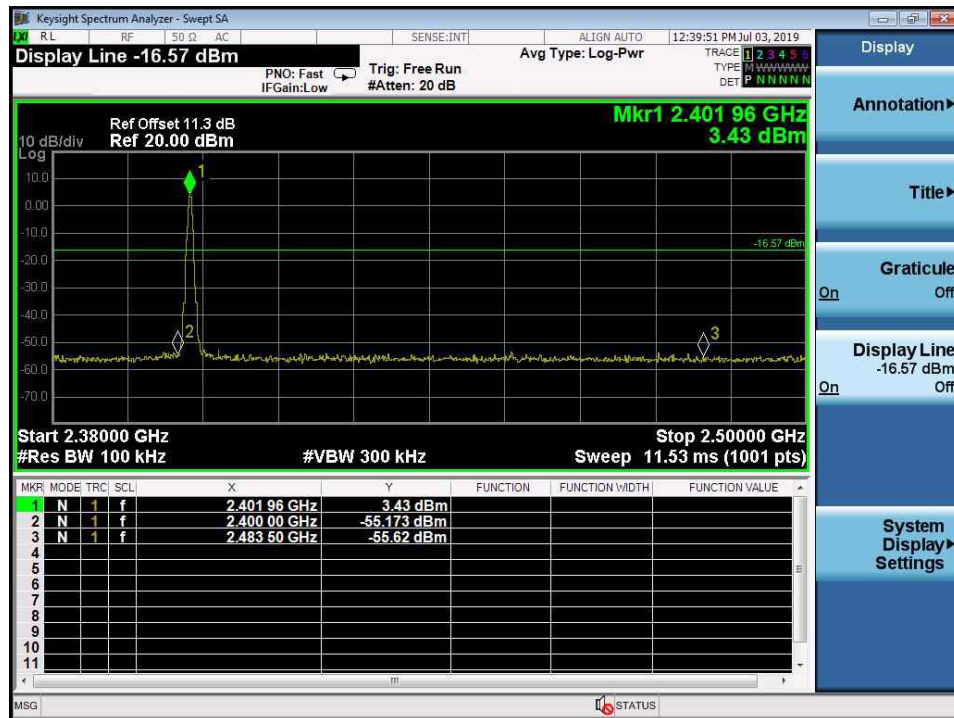


Middle Channel

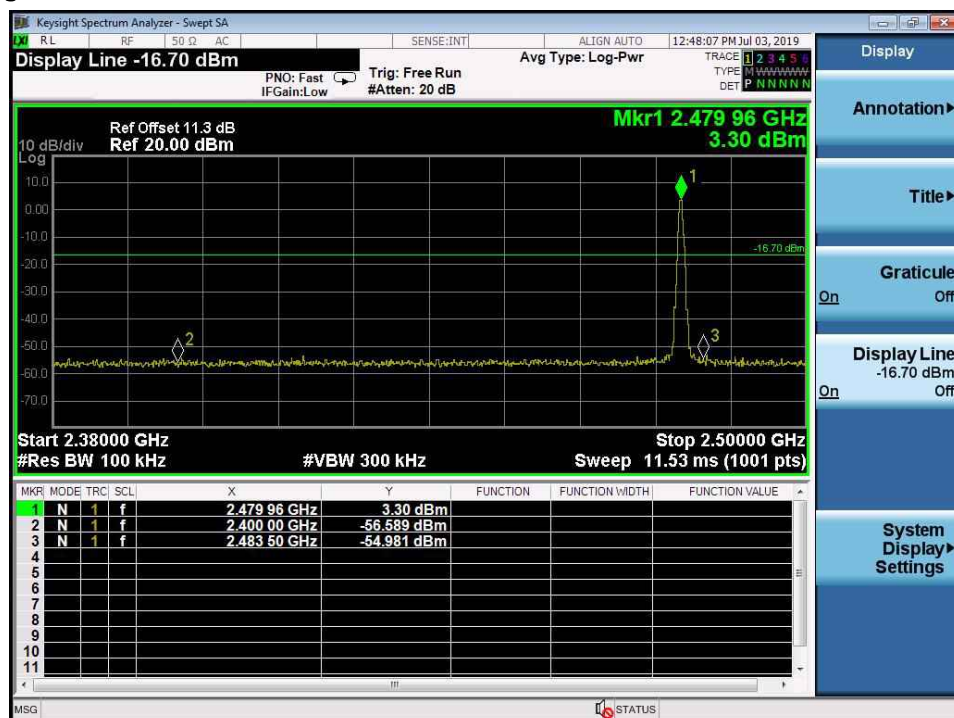
High Channel


Test Plot of 100kHz Bandwidth of Frequency Band Edge, GFSK modulation

Low Channel

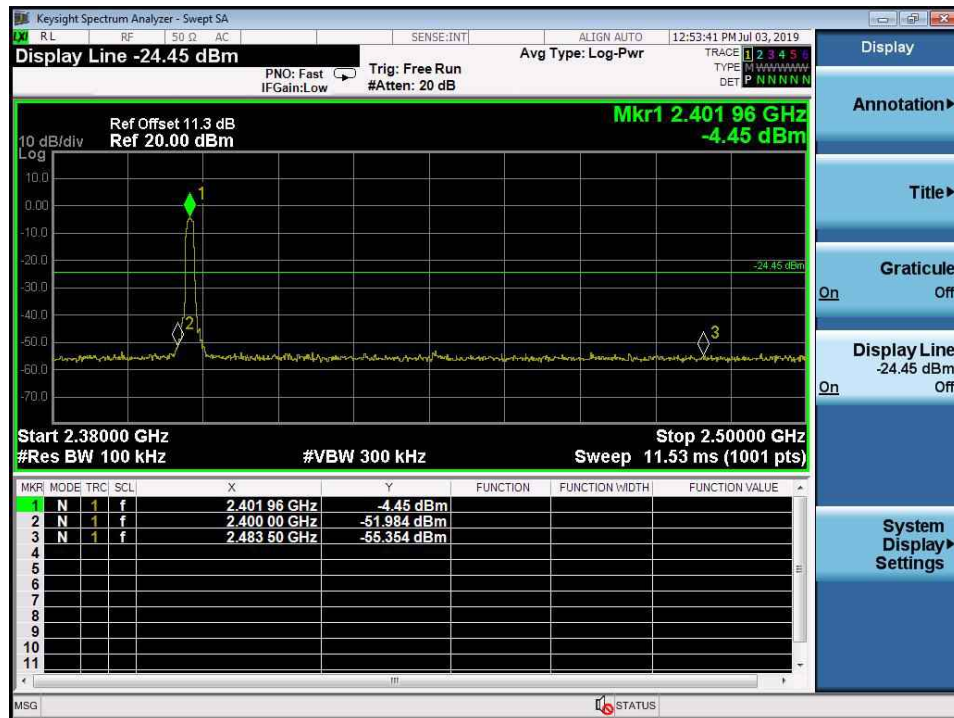


High Channel

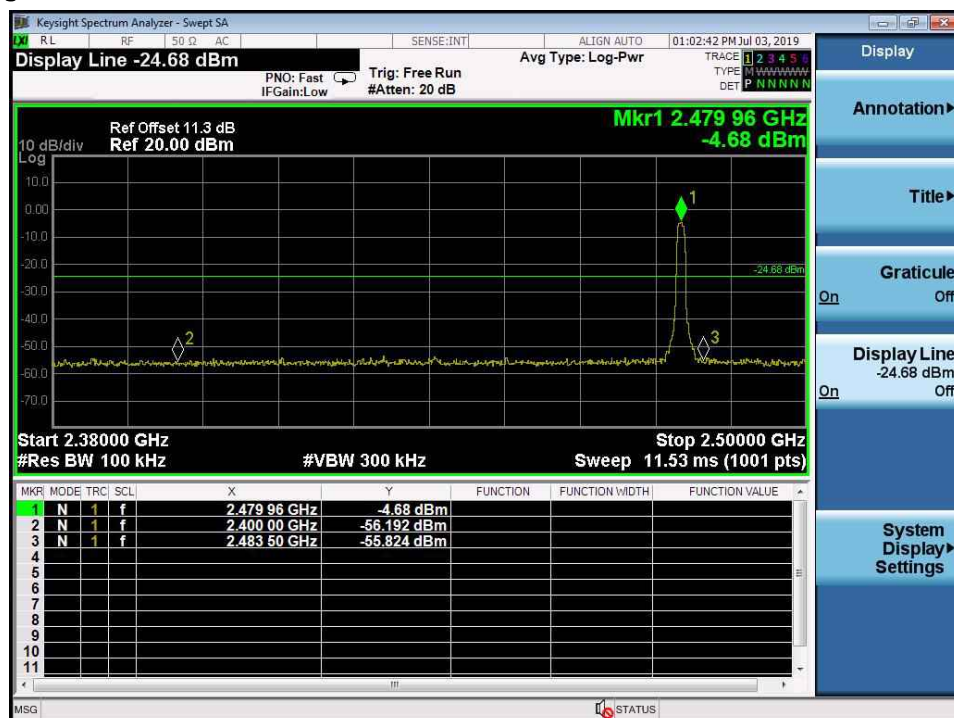


Test Plot of 100kHz Bandwidth of Frequency Band Edge, 8DPSK modulation

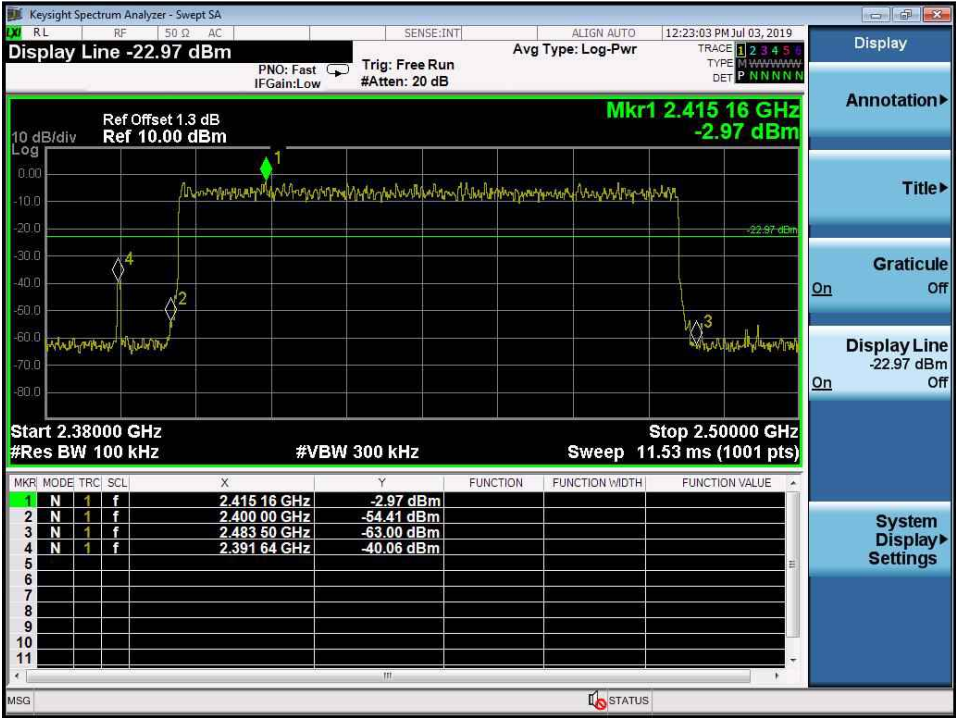
Low Channel



High Channel



Hopping ON



5.1.5 Spurious Emission

RESULT:**Passed**

Test standard	:	LP0002(2018): 3.10.1.5
Basic standard	:	ANSI C63.10, LP0002(2018) Appendix II
Limits	:	Radiated emissions which fall in the restricted bands, as defined in LP0002(2018): 2.7 , must comply with the radiated emission limits specified in LP0002(2018): 2.8 Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in LP0002(2018): 2.8
Kind of test site	:	3m Semi-Anechoic Chamber

Test setup

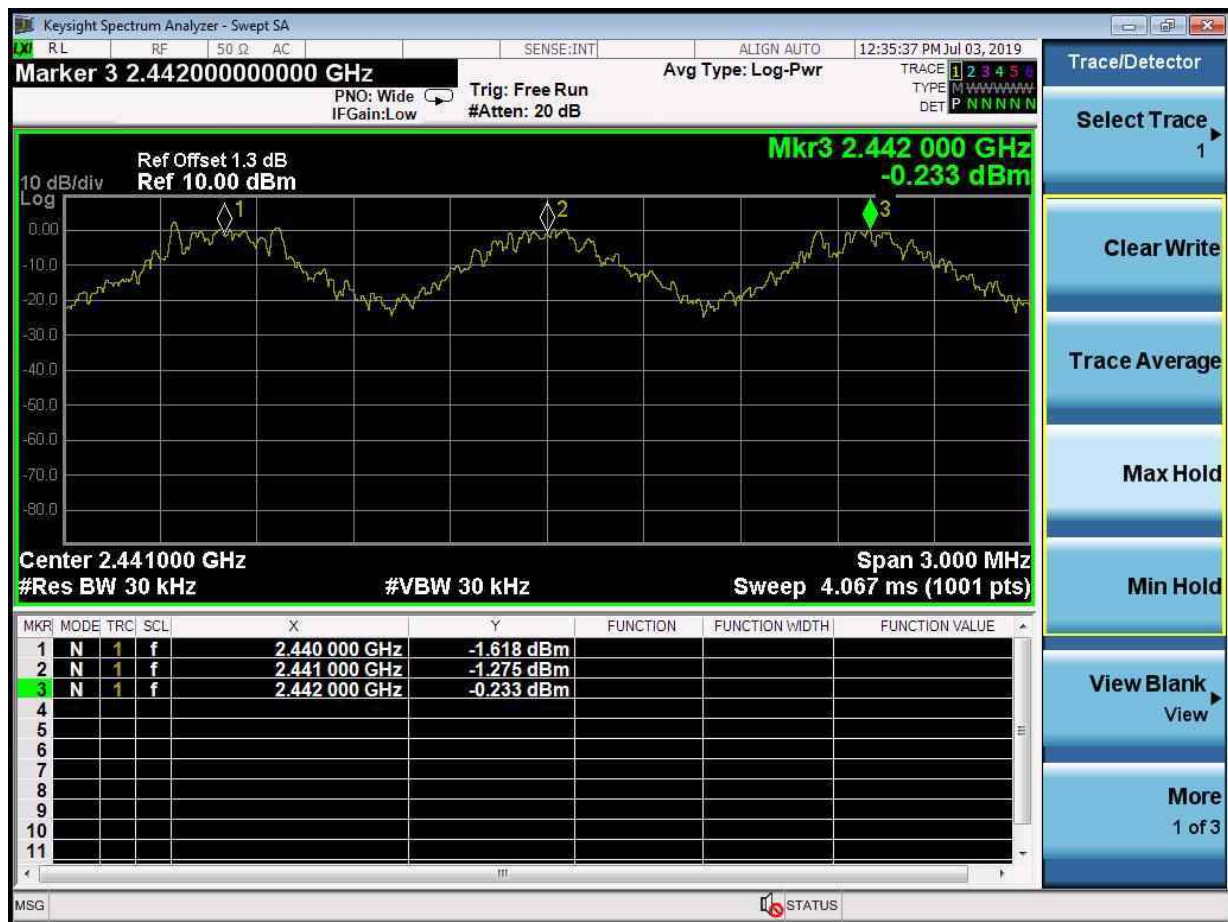
Test Channel	:	Low/ Middle/ High
Operation Mode	:	A, B

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 : LP0002(2018): 3.10.1.6 (1) (A)
 Basic standard : ANSI C63.10:2013
 LP0002(2018) Appendix II
 Limit : $\geq 25\text{kHz}$ or $2/3$ of 20dB bandwidth, whichever is greater

Test setup

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

Table 11: Test result of Frequency Separation (GFSK)

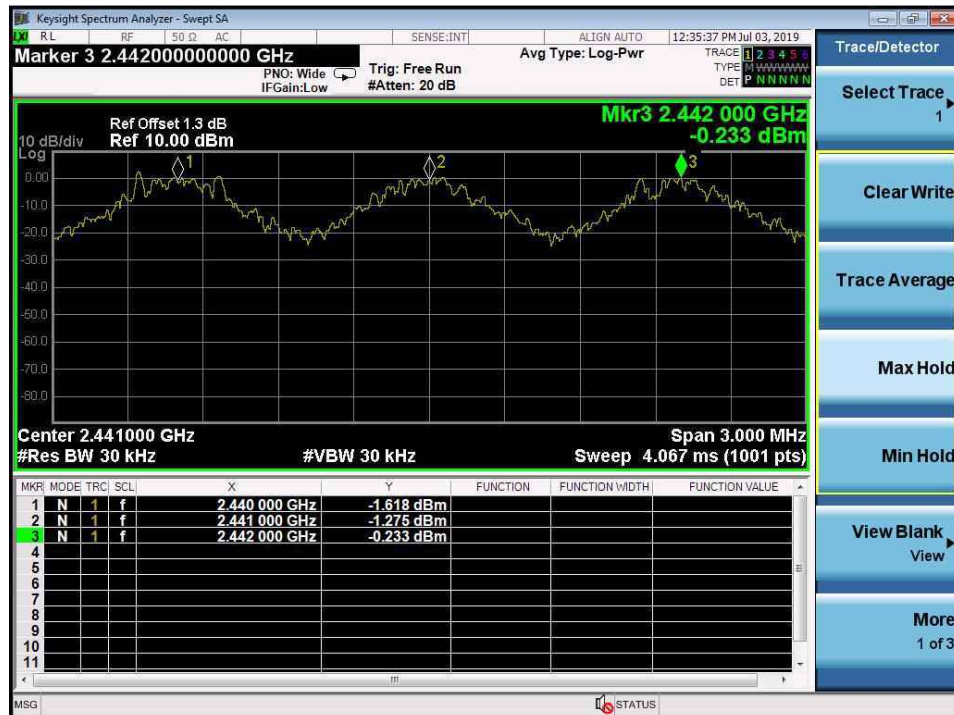
Channel	Channel Frequency (MHz)	Measured Channel Separation (MHz)	Limit (kHz)	Result
Record Channel	2440	1	$\geq 25\text{kHz}$ or 2/3 of 20dB bandwidth	Pass
Record Channel adj 1	2441			
Record Channel adj 2	2442			

Table 12: Test result of Frequency Separation (8DPSK)

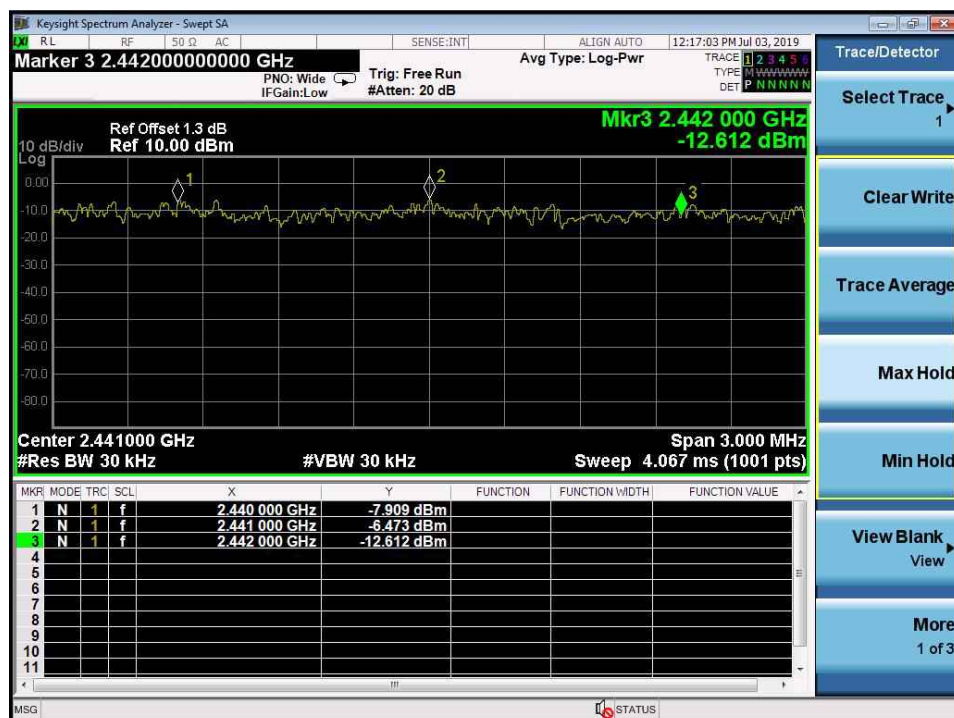
Channel	Channel Frequency (MHz)	Measured Channel Separation (MHz)	Limit (kHz)	Result
Record Channel	2440	1	$\geq 25\text{kHz}$ or 2/3 of 20dB bandwidth	Pass
Record Channel adj 1	2441			
Record Channel adj 2	2442			

Test Plot of Frequency Separation

GFSK



8DPSK



5.1.7 Number of hopping frequency

RESULT:**Passed**

Test standard : LP0002(2018): 3.10.1.6 (1) (A)(a)
Basic standard : ANSI C63.10:2013
LP0002(2018) Appendix II
Limits : ≥ 15 non-overlapping channels
Kind of test site : Shield room

Test setup

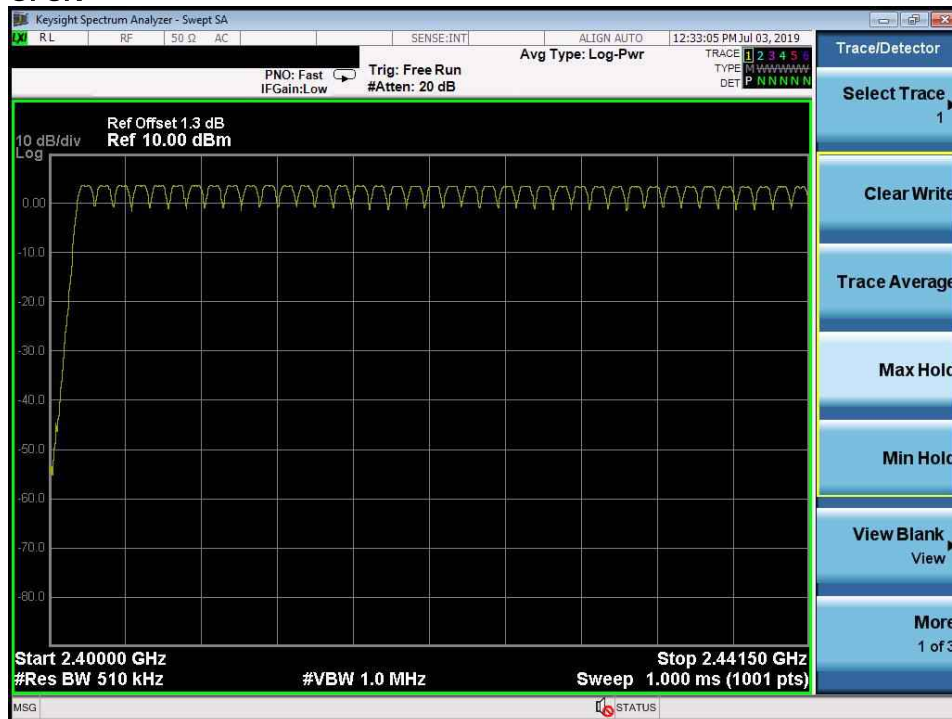
Test Channel : Hopping On

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

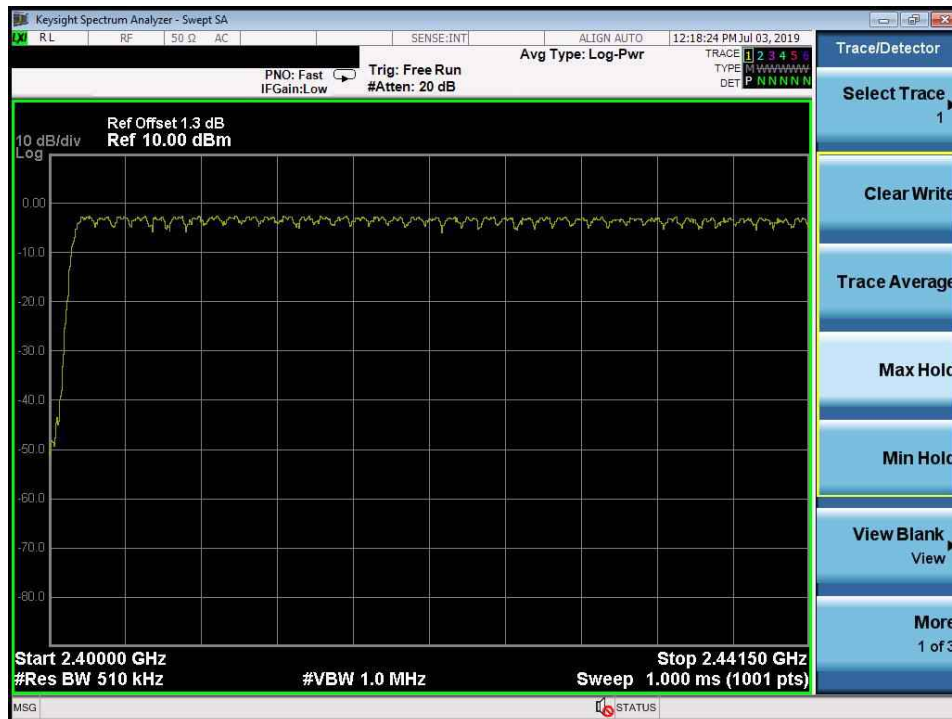
Table 13: Test result of Number of hopping frequency

Frequency Range	Measured Quantity of Hopping Channel	Limit	Result
<u>2400</u> to <u>2483.5</u> MHz	79	≥ 15	Pass

Test Plot of Number of hopping frequencies GFSK



8DPSK



5.1.8 Time of Occupancy

RESULT:

Passed

Test standard : LP0002(2018): 3.10.1.6 (1) (A)(a)
 Basic standard : ANSI C63.10:2013
 LP0002(2018) Appendix II
 Limits : 0.4s
 Kind of test site : Conducted room

Test setup

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

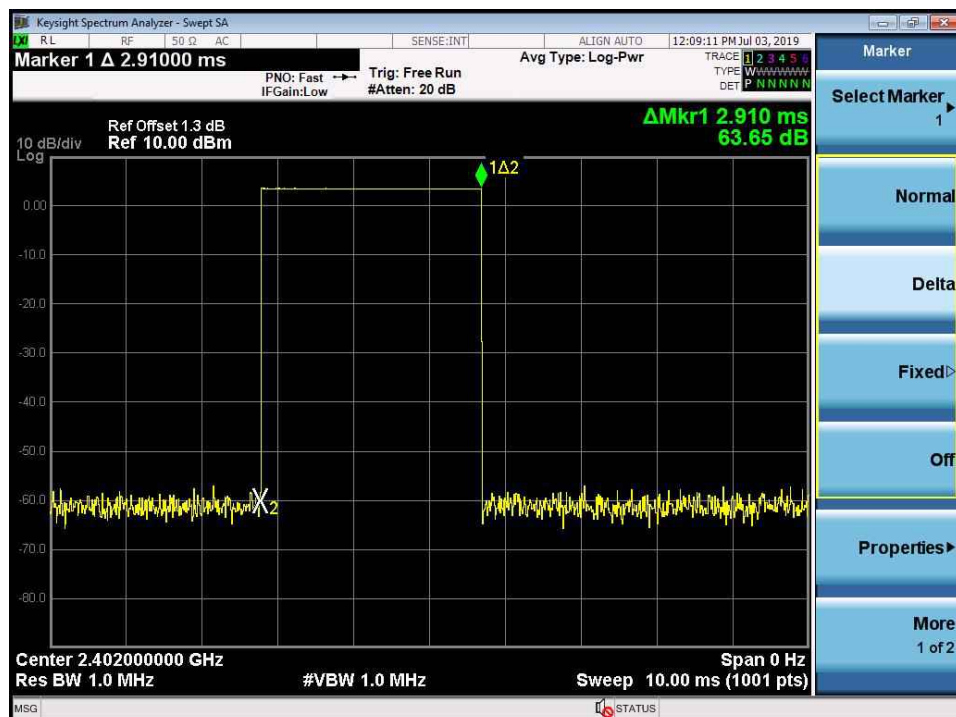
Table 14: Test result of Time of Occupancy

Data Mode	Captured Burst (s)	Number of bursts	Dwell time (s)	Limit (s)	Result
DH5	0.00291	13	0.03783	0.4	Pass
3DH5	0.00193	14	0.02702	0.4	Pass

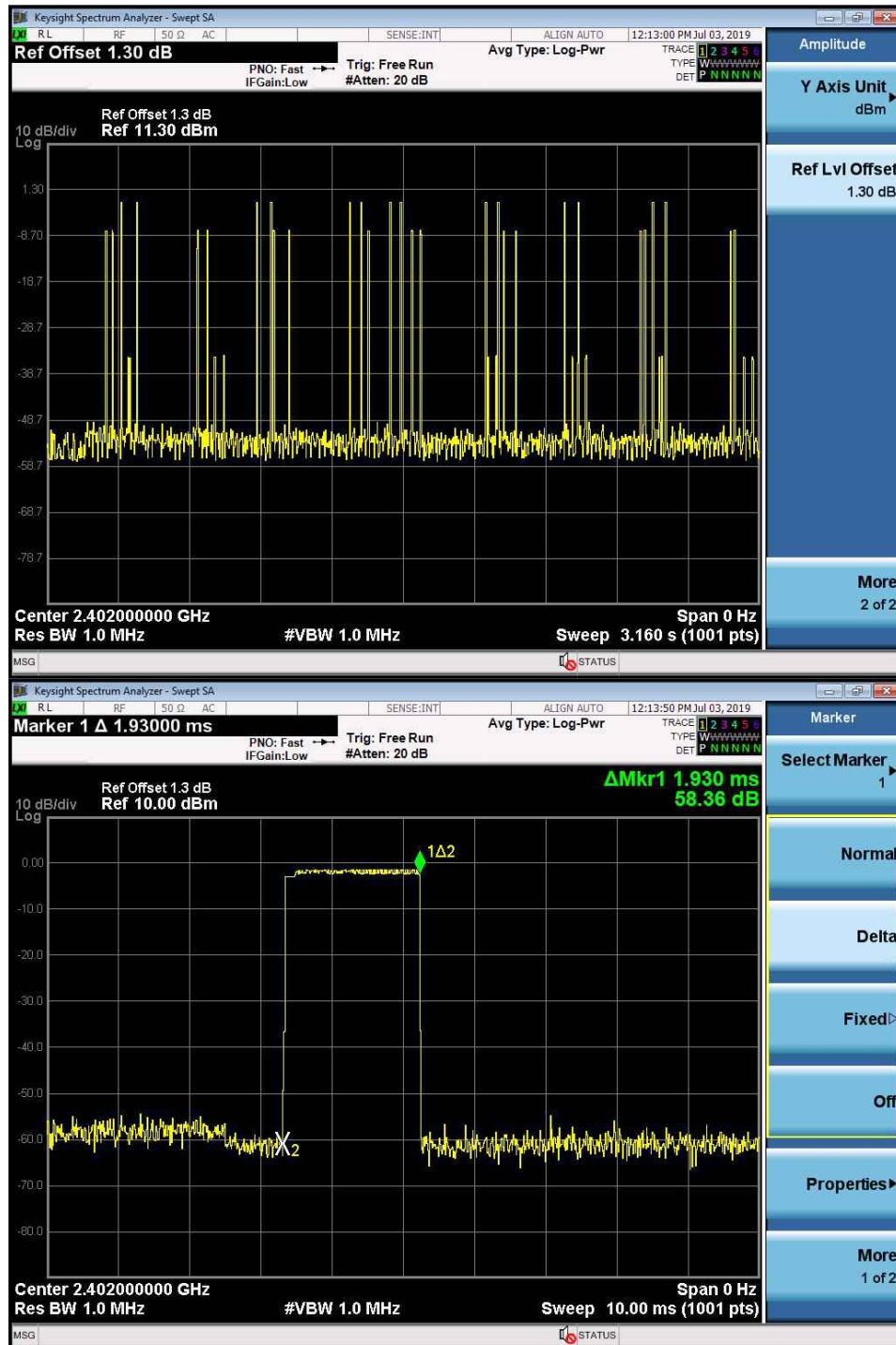
Note:

Dwell time = Captured Burst x Number of bursts

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



Test Plot of Time of Occupancy, 8DPSK modulation



5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

RESULT:**Passed**

Test standard : LP0002 (2018): 2.3
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 : LP0002(2018) 5.20.2.2

Separation distance is more than 20 cm, thus mobile device exposure limits can be applied

Maximum Exposure :

Power to Antenna (mW)	2.355 mW
Power to Antenna (dBm)	3.7 dBm
Antenna Gain	1.57 dBi
Power+Ant Gain	3.4 mW
Distance	20 cm
S=	0.001 mW/cm ²

NCC Limit:

0.3-1.34 MHz	(100) mW/cm ²
1.34-30 MHz	(180/f ²) mW/cm ²
30-300 MHz	0.2 mW/cm ²
300-1500 MHz f/1500	mW/cm ²
1500-100,000 MHz	1.0 mW/cm ²

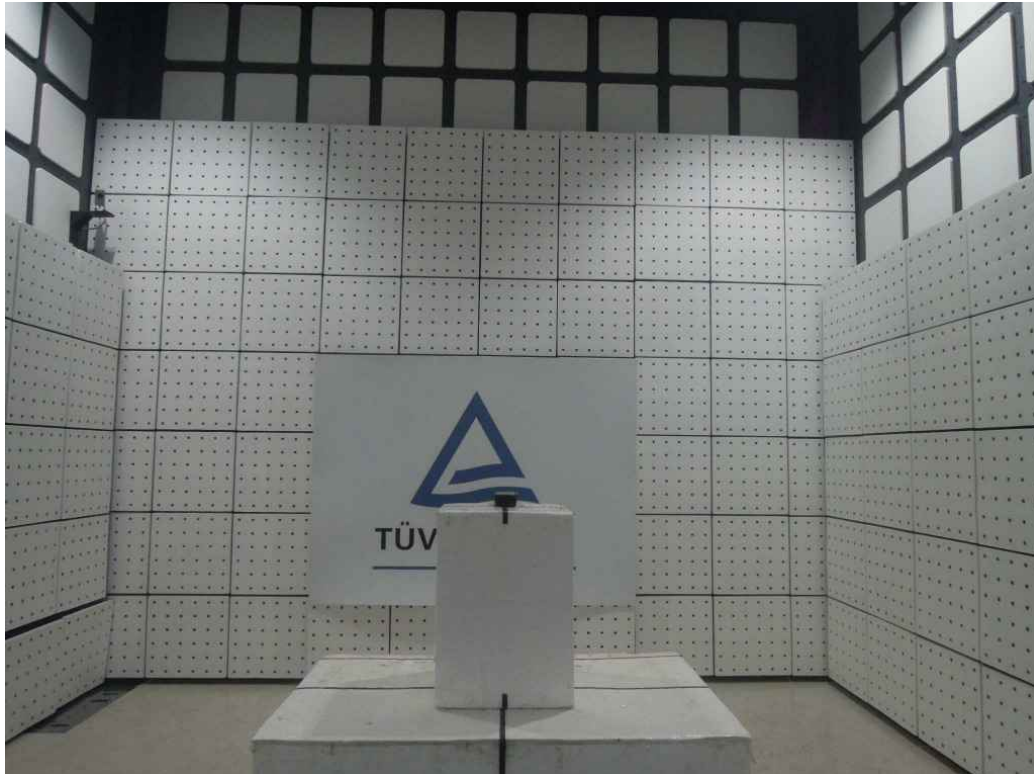
---End---

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)



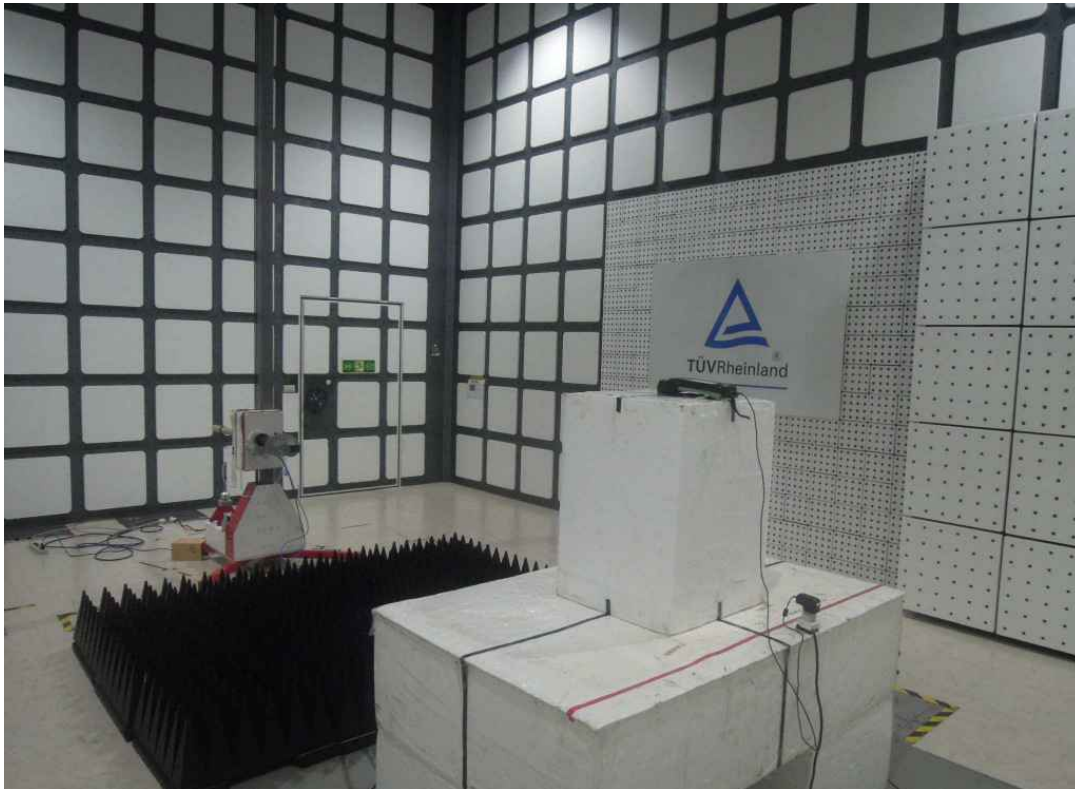
Photograph 4: Set-up for Spurious Emissions (Back View 2)



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



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



Photograph 7: Set-up for Conducted testing



Photograph 8: Set-up for Conducted testing



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



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



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