

Date : 2018-03-02 No. : HM18010010	100(1)		Page 1 of 63
Applicant:		ng Electron Technology Co., Lto ilin Town, Zhongkai Hi-tech De angdong, China	
Manufacturer:		ng Electron Technology Co., Lto ilin Town, Zhongkai Hi-tech De angdong, China	
Description of Sample(s):	Product: Brand Name: Model Number: FCC ID:	Bluetooth Speaker Sakar SP2-17714 2AAWNSP217714BTS	
Date Sample(s) Received:	2018-01-03		
Date Tested:	2018-02-07 to 201	18-02-14	
Investigation Requested:	with FCC 47 CF	Iagnetic Interference measuremR [Codes of Federal Regulatio: 2013 for FCC Certification.	
Conclusion(s):	Federal Commu Regulations Part	product <u>COMPLIED</u> with the unications Commission [FC 15. The tests were performed in scribed above and on Section	CC] Rules and n accordance with
Remark(s):	Bluetooth FHSS (GFSK/ π/4-DQPSK)	G KONG STAL

CHEUNG Chi, Kenneth Authorized Signatory ElectroMagnetic Compatibility Department For and on behalf of The Hong Kong Standards and Testing Centre Ltd.



Date : 2018-03-02 No. : HM18010010

Page 2 of 63

CONT	'ENT:	
	Cover Content	Page 1 of 63 Page 2 of 63
<u>1.0</u>	General Details	
1.1	Test Laboratory	Page 3 of 63
1.2	Equipment Under Test [EUT] Description of EUT operation	Page 3 of 63
1.3	Date of Order	Page 3 of 63
1.4	Submitted Sample	Page 3 of 63
1.5	Test Duration	Page 3 of 63
1.6	Country of Origin	Page 4 of 63
1.7	Antenna Details	Page 4 of 63
1.8	Channel List	Page 4 of 63
<u>2.0</u>	Technical Details	
2.1	Investigations Requested	Page 5 of 63
2.2	Test Standards and Results Summary	Page 5 of 63
2.3	Table for Test Modes	Page 6 of 63
<u>3.0</u>	Test Results	
3.1	Emission	Page 7 - 58 of 63
	<u>Appendix A</u>	
	List of Measurement Equipment	Page 59 of 63
	Appendix B	
	Photographs	Page 60- 63 of 63



Date : 2018-03-02

No. : HM18010010

<u>1.0</u> General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd. EMC Laboratory 10 Dai Wang Street, Taipo Industrial Estate

Telephone:(852) 26661888Fax:(852) 26644353

1.2 Equipment Under Test [EUT] Description of Sample(s)

Product:	Bluetooth Speaker
Manufacturer:	Huizhou Qing Teng Electron Technology Co., Ltd He-Bei Village, Lilin Town, Zhongkai Hi-tech Development
	Zone, Huizhou City, Guangdong, China
Brand Name:	Sakar
Model Number:	SP2-17714
Additional Model Number:	SP2-17717, SP2-17718
Rating:	Input: Li-ion Rechargeable battery x1: 3.7Vd.c / 110Va.c,
	5Vd.c (USB Micro B), (Adaptor was not provided by
	manufacturer, universal adaptor was used for tests. Adaptor
	info: Model no., SP-12-UK, Input: 100-240Va.c, Output:
	5V, 14.4VA)

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is Bluetooth Speaker. The transmission signal is digital modulated with channel frequency range 2402-2480MHz. The R.F. signal was modulated by IC; the type of modulation used was frequency hopping spread spectrum Modulation.

1.3 Date of Order

2018-01-03

1.4 Submitted Sample(s):

2 Samples

1.5 Test Duration

2018-02-07 to 2018-02-14

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Page 3 of 63



Date : 2018-03-02 No. : HM18010010

Page 4 of 63

1.6 Country of Origin

China

1.7 Antenna Details

Antenna Type (Bluetooth):Circuit board printed meander line antennaAntenna Gain (Bluetooth):-0.58dBi

1.8 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	42	2444
1	2403	43	2445
2	2404	44	2446
3	2405	45	2447
4	2406	46	2448
5	2407	47	2449
6	2408	48	2450
7	2409	•••	
8	2410	67	2469
9	2411	68	2470
		69	2471
33	2435	70	2472
34	2436	71	2473
35	2437	72	2474
36	2438	73	2475
37	2439	74	2476
38	2440	75	2477
39	2441	76	2478
40	2442	77	2479
41	2443	78	2480



Date : 2018-03-02

No. : HM18010010

2.0 <u>Technical Details</u>

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations. ANSI C63.10:2013 for FCC Certification.

2.2 Test Standards and Results Summary Tables

EMISSION (BLUETOOTH) Results Summary							
Test Condition	Test Requirement	Test Method	Class /	Class / Test Result			
	Severity Pass Fail M					N/A	
Maximum Peak Conducted Output Power	FCC 47CFR 15.247(b)(1)	ANSI C63.10:2013	N/A	\boxtimes			
Radiated Spurious Emissions	FCC 47CFR 15.209	ANSI C63.10:2013	N/A	\boxtimes			
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10:2013	N/A				
Number of Hopping Frequency	FCC 47CFR 15.247 (b)(1)	ANSI C63.10:2013	N/A	\boxtimes			
20dB Bandwidth	FCC 47CFR 15.247(a)(2)	ANSI C63.10: 2013	N/A	\boxtimes			
Hopping Channel Separation	FCC 47CFR 15.247(a)(1)	ANSI C63.10: 2013	N/A	\boxtimes			
Band-edge measurement (Radiated)	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	\boxtimes			
Pseudorandom Hopping Algorithm	FCC 47CFR 15.247(a)(1)	N/A	N/A	\boxtimes			
Time of Occupancy (Dwell Time)	FCC 47CFR 15.247(a)(1)(iii)	ANSI C63.10: 2013	N/A	\boxtimes			
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	\boxtimes			
RF Exposure	FCC 47CFR 15.247(i)	N/A	N/A			\boxtimes	

Note: N/A – Not Applicable

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Page 5 of 63



Page 6 of 63

Date : 2018-03-02 No. : HM18010010

2.3 Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate in the table below is the worst case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items		
Maximum Peak Conducted Output Power	GFSK / π/4-DQPSK	
Hopping Channel Separation	GFSK / π/4-DQPSK	
Number of Hopping Frequency	GFSK / π/4-DQPSK	
Time of Occupancy(Dwell Time)	π/4-DQPSK (DH1 / DH3 / DH5)	
Radiated Spurious Emissions	GFSK / π/4-DQPSK	



Date : 2018-03-02

No. : HM18010010

- <u>3.0</u> <u>Test Results</u>
- 3.1 Emission

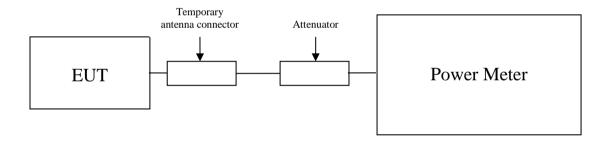
3.1.1 Maximum Peak Conducted Output Power

Test Requirement:	FCC 47CFR 15.247(b)(2)
Test Method:	ANSI C63.10:2013
Test Date:	2018-02-14
Mode of Operation:	Tx mode :GFSK/π/4-DQPSK

Test Method:

The RF output of the EUT was connected to the Power Meter. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in dBm.

Test Setup:



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Page 7 of 63



Date : 2018-03-02 No. : HM18010010

Limits for Maximum Peak Conducted Output Power [FCC 47CFR 15.247]:

2400-2483.5 MHz band:

The maximum peak output power shall not exceeded the following limits: For frequency hopping systems employing at least 75 hopping channels: 1 Watt For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt

Results of Bluetooth Communication mode (GFSK) (Fundamental Power): Pass Maximum conducted output power

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.000208
39	2441	0.000147
78	2480	0.000164

Results of Bluetooth Communication mode (π /4-DQPSK) (Fundamental Power): Pass Maximum conducted output power

Channel	Frequency(MHz)	Output Power(Watt)
0	2402	0.000138
39	2441	0.000098
78	2480	0.000105

Calculated measurement uncertainty

 30MHz to 1GHz
 1.7dB

 1GHz to 18GHz
 1.7dB

Remark:

1. All test data for each data rate were verified, but only the worst case was reported.

2. The EUT is programmed to transmit signals continuously for all testing.

Page 8 of 63

:



Date : 2018-03-02 No. : HM18010010

Page 9 of 63

3.1.2 Conducted Emissions (0.15MHz to 30MHz)

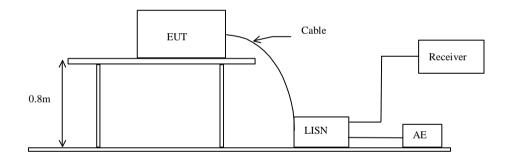
Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.10:2013
Test Date:	2018-02-07

Mode of Operation: Tx mode

Test Method:

The test was performed in accordance with ANSI C63.10:2013, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

Test Setup:





Page 10 of 63

Date : 2018-03-02 No. : HM18010010

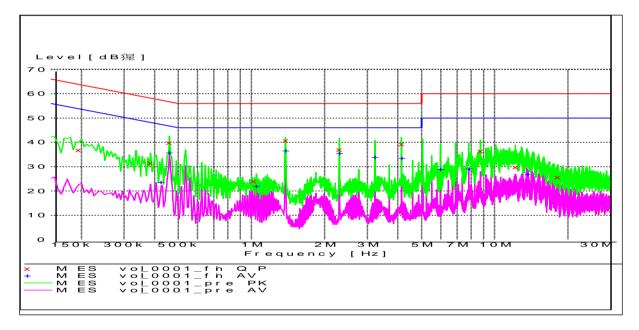
Limit for Conducted Emissions (FCC 47CFR 15.207):

Frequency Range [MHz]	Quasi-Peak Limits [dBµV]	Average [dBµV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

Results of Tx mode – Live: PASS





Date : 2018-03-02 No. : HM18010010

Page 11 of 63

MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.195000 0.385000 1.025000 1.385000 2.305000 4.155000	36.80 31.50 39.90 24.10 40.80 37.00 39.30	9.9 10.0 10.0 9.8 9.9 10.2 10.5	64 58 57 56 56 56	27.0 26.7 16.8 31.9 15.2 19.0 16.7	L1 L1 L1 L1 L1 L1 L1	GND GND GND GND GND GND GND
8.770000 12.215000 18.200000	36.30 29.80 25.70	10.4 10.6 10.7	60 60 60	23.7 30.2 34.3	L1 L1 L1	GND GND GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.425000 0.460000 1.050000 2.310000 3.230000 4.155000 6.000000 7.850000	23.50 35.70 21.90 36.60 35.50 34.00 33.50 29.00 29.10	10.0 10.0 9.8 9.9 10.2 10.4 10.5 10.6 10.5	47 46 46 46 46 46 50 50	23.8 11.0 24.1 9.4 10.5 12.0 12.5 21.0 20.9	L1 L1 L1 L1 L1 L1 L1 L1 L1	GND GND GND GND GND GND GND GND
13.695000	26.80	10.7	50	23.2	L1	GND



Page 12 of 63

Date : 2018-03-02 No. : HM18010010

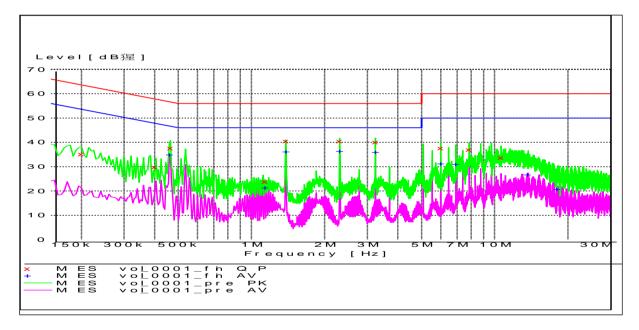
Limit for Conducted Emissions (FCC 47CFR 15.207):

Frequency Range [MHz]	Quasi-Peak Limits [dBµV]	Average [dBµV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

Results of Tx mode –Neutral: PASS





Page 13 of 63

Date : 2018-03-02 No. : HM18010010 MEASUREMENT RESULT: "vol 0001 fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.200000	35.20	9.9	64	28.4	Ν	GND
0.400000	29.70	10.0	58	28.2	Ν	GND
0.465000	37.60	10.0	57	19.0	Ν	GND
1.135000	23.80	9.8	56	32.2	Ν	GND
1.385000	40.50	9.9	56	15.5	Ν	GND
2.310000	40.60	10.2	56	15.4	Ν	GND
3.235000	40.10	10.4	56	15.9	Ν	GND
6.005000	37.60	10.6	60	22.4	Ν	GND
7.855000	37.00	10.5	60	23.0	Ν	GND
10.625000	33.70	10.4	60	26.3	N	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.460000	35.00	10.0	47	11.7	Ν	GND
1.135000	21.30	9.8	46	24.7	Ν	GND
1.385000	36.10	9.9	46	9.9	Ν	GND
2.310000	36.40	10.2	46	9.6	Ν	GND
3.235000	36.00	10.4	46	10.0	Ν	GND
6.005000	31.20	10.6	50	18.8	Ν	GND
6.930000	31.10	10.6	50	18.9	Ν	GND
13.630000	26.70	10.7	50	23.3	Ν	GND
18.040000	20.80	10.7	50	29.2	Ν	GND

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Date : 2018-03-02 No. : HM18010010

Page 14 of 63

3.1.3 Radiated Spurious Emissions

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2018-02-14
Mode of Operation:	Tx mode :GFSK/ π /4-DQPSK

Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semianechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

* Semi-anechoic chamber located on the G/F of "The Hong Kong Standards and Testing Centre Ltd." with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Designation Number: HK0001.

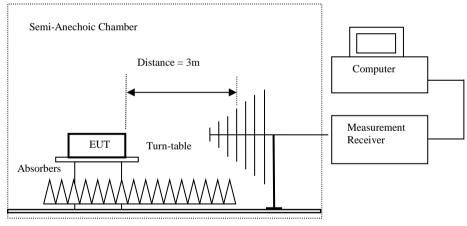


Page 15 of 63

Date : 2018-03-02 No. : HM18010010 Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)	RBW: VBW: Sweep: Span: Trace:	10kHz 30kHz Auto Fully capture the emissions being measured Max. hold
30MHz – 1GHz (QP)	RBW: VBW: Sweep: Span: Trace:	120kHz 120kHz Auto Fully capture the emissions being measured Max. hold
Above 1GHz (Pk & Av)	RBW: VBW: Sweep: Span: Trace:	1MHz 3MHz Auto Fully capture the emissions being measured Max. hold

Test Setup:



Ground Plane

- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.

- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used,

9kHz to 30MHz loop antennas are used.

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Page 16 of 63

Date : 2018-03-02 No. : HM18010010

Limits for Radiated Emissions [FCC 47 CFR 15.209 Class B]:

Eraguanay Danga	Quasi-Peak Limits
Frequency Range	Quasi-Feak Linnis
[MHz]	[µV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.



Page 17 of 63

Date : 2018-03-02 No. : HM18010010

Result of Tx mode (GFSK: 2402.0 MHz) (9kHz - 30MHz): Pass

Field Strength of Spurious Emissions								
	Peak Value							
Frequency	Measured	Correction	Field	Field	Limit	E-Field		
	Level	Factor	Strength	Strength		Polarity		
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m			
	Emissions detected are more than 20 dB below the FCC Limits							

Result of Tx mode (GFSK: 2402.0 MHz) (30MHz - 1GHz): Pass

Field Strength of Spurious Emissions								
Quasi-Peak Value								
Frequency	Measured	Correction	Field	Field	Limit	E-Field		
	Level	Factor	Strength	Strength		Polarity		
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m			
	Emissions detected are more than 20 dB below the FCC Limits							

Result of Tx mode (GFSK: 2402.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions							
			Peak Value				
Frequency	Measured	Correction	Field	Limit	Margin	E-Field	
	Level @3m	Factor	Strength	@3m		Polarity	
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
2402.0	59.7	27.8	87.5	N/A	N/A	Vertical	
4804.0	3.1	42.4	45.5	74.0	28.5	Vertical	
7206.0	2.3	46.7	49.0	74.0	25.0	Vertical	
9608.0	1.8	48.4	50.2	74.0	23.8	Vertical	
12010.0	0.5	53.1	53.6	74.0	20.4	Vertical	

Result of Tx mode (GFSK: 2402.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions							
		A	verage Valu	e			
Frequency	Measured	Correction	Field	Limit	Margin	E-Field	
	Level @3m	Factor	Strength	@3m		Polarity	
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
2402.0	48.7	27.8	76.5	N/A	N/A	Vertical	
4804.0	-7.3	42.4	35.1	54.0	18.9	Vertical	
7206.0	-10.7	46.7	36.0	54.0	18.0	Vertical	
9608.0	-11.3	48.4	37.1	54.0	16.9	Vertical	
12010.0	-11.9	53.1	41.2	54.0	12.8	Vertical	

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Page 18 of 63

Date : 2018-03-02 No. : HM18010010 Described of The mode (CES)

Result of Tx mode (GFSK: 2441.0 MHz) (9kHz - 30MHz): Pass

Field Strength of Spurious Emissions								
Peak Value								
Frequency	Measured	Correction	Field	Field	Limit	E-Field		
	Level	Factor	Strength	Strength		Polarity		
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m			
	Emissions detected are more than 20 dB below the FCC Limits							

Results of Tx mode (GFSK: 2441.0 MHz) (30MHz - 1000MHz): PASS

Field Strength of Spurious Emissions Quasi-Peak Value						
Frequency	Measured	Correction	Field	Field	Limit	E-Field
	Level	Factor	Strength	Strength		Polarity
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m	
	Emissions	detected are r	nore than 20	dB below the	FCC Limits	

Result of Tx mode (GFSK: 2441.0 MHz) (Above 1GHz): Pass

	Field Strength of Spurious Emissions							
			Peak Value					
Frequency	Measured	Correction	Field	Limit	Margin	E-Field		
	Level @3m	Factor	Strength	@3m		Polarity		
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB			
2441.0	58.1	27.8	85.9	N/A	N/A	Vertical		
4882.0	2.6	42.5	45.1	74.0	28.9	Vertical		
7323.0	1.5	47.1	48.6	74.0	25.4	Vertical		
9764.0	1.4	49.3	50.7	74.0	23.3	Vertical		
12205.0	0.9	53.1	54.0	74.0	20.0	Vertical		

Result of Tx mode (GFSK: 2441.0 MHz) (Above 1GHz): Pass

	Field Strength of Spurious Emissions							
		A	verage Valu	e				
Frequency	Measured	Correction	Field	Limit	Margin	E-Field		
	Level @3m	Factor	Strength	@3m		Polarity		
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB			
2441.0	46.3	27.8	74.1	N/A	N/A	Vertical		
4882.0	-8.3	42.5	34.2	54.0	19.8	Vertical		
7323.0	-9.1	47.1	38.0	54.0	16.0	Vertical		
9764.0	-11.4	49.3	37.9	54.0	16.1	Vertical		
12205.0	-12.0	53.1	41.1	54.0	12.9	Vertical		

The Hong Kong Standards and Testing Centre Limited



Page 19 of 63

Date : 2018-03-02 No. : HM18010010

Result of Tx mode (GFSK: 2480.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions							
Peak Value							
Frequency	Measured	Correction	Field	Field	Limit	E-Field	
	Level	Factor	Strength	Strength		Polarity	
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m		
	Emissions	detected are 1	nore than 20	dB below the	FCC Limits		

Results of Tx mode (GFSK: 2480.0 MHz) (30MHz - 1000MHz): Pass

Field Strength of Spurious Emissions Quasi-Peak Value						
Frequency	Measured	Correction	Field	Field	Limit	E-Field
	Level	Factor	Strength	Strength		Polarity
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m	
	Emissions	detected are r	nore than 20	dB below the	FCC Limits	

Result of Tx mode (GFSK: 2480.0 MHz) (Above 1GHz): Pass

	Field Strength of Spurious Emissions							
			Peak Value					
Frequency	Measured	Correction	Field	Limit	Margin	E-Field		
	Level @3m	Factor	Strength	@3m		Polarity		
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB			
2480.0	58.4	27.8	86.2	N/A	N/A	Vertical		
4960.0	2.3	43.2	45.5	74.0	28.5	Vertical		
7440.0	1.3	46.2	47.5	74.0	26.5	Vertical		
9920.0	1.1	50.9	52.0	74.0	22.0	Vertical		
12400.0	0.9	54.3	55.2	74.0	18.8	Vertical		

Result of Tx mode (GFSK: 2480.0 MHz) (Above 1GHz): Pass

	Field Strength of Spurious Emissions							
		A	verage Valu	e				
Frequency	Measured	Correction	Field	Limit	Margin	E-Field		
	Level @3m	Factor	Strength	@3m		Polarity		
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB			
2480.0	45.3	27.8	73.1	N/A	N/A	Vertical		
4960.0	-9.3	43.2	33.9	54.0	20.1	Vertical		
7440.0	-11.7	46.2	34.5	54.0	19.5	Vertical		
9920.0	-11.8	50.9	39.1	54.0	14.9	Vertical		
12400.0	-12.5	54.3	41.8	54.0	12.2	Vertical		

The Hong Kong Standards and Testing Centre Limited



Page 20 of 63

Date : 2018-03-02 No. : HM18010010

Result of Tx mode (π /4-DQPSK: 2402.0 MHz) (9kHz – 30MHz): Pass

	Field Strength of Spurious Emissions							
	Peak Value							
Frequency	Measured	Correction	Field	Field	Limit	E-Field		
	Level	Factor	Strength	Strength		Polarity		
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m			
	Emissions detected are more than 20 dB below the FCC Limits							

Result of Tx mode (π/4-DQPSK: 2402.0 MHz) (30MHz – 1GHz): Pass

	Field Strength of Spurious Emissions							
Quasi-Peak Value								
Frequency	Measured	Correction	Field	Field	Limit	E-Field		
	Level	Factor	Strength	Strength		Polarity		
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m			
	Emissions detected are more than 20 dB below the FCC Limits							

Result of Tx mode (π /4-DQPSK: 2402.0 MHz) (Above 1GHz): Pass

	Field Strength of Spurious Emissions							
			Peak Value					
Frequency	Measured	Correction	Field	Limit	Margin	E-Field		
	Level @3m	Factor	Strength	@3m		Polarity		
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB			
2402.0	57.4	27.8	85.2	N/A	N/A	Vertical		
4804.0	2.1	42.4	44.5	74.0	29.5	Vertical		
7206.0	1.4	46.7	48.1	74.0	25.9	Vertical		
9608.0	1.6	48.4	50.0	74.0	24.0	Vertical		
12010.0	0.6	53.1	53.7	74.0	20.3	Vertical		

Result of Tx mode (π /4-DQPSK: 2402.0 MHz) (Above 1GHz): Pass

	Field Strength of Spurious Emissions							
		A	verage Valu	e				
Frequency	Measured	Correction	Field	Limit	Margin	E-Field		
	Level @3m	Factor	Strength	@3m		Polarity		
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB			
2402.0	43.7	27.8	71.5	N/A	N/A	Vertical		
4804.0	-8.9	42.4	33.5	54.0	20.5	Vertical		
7206.0	-10.4	46.7	36.3	54.0	17.7	Vertical		
9608.0	-11.3	48.4	37.1	54.0	16.9	Vertical		
12010.0	-12.1	53.1	41.0	54.0	13.0	Vertical		

The Hong Kong Standards and Testing Centre Limited



Page 21 of 63

Date : 2018-03-02 No. : HM18010010

Result of Tx mode (π /4-DQPSK: 2441.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions							
Peak Value							
Frequency	Measured	Correction	Field	Field	Limit	E-Field	
	Level	Factor	Strength	Strength		Polarity	
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m		
	Emissions	detected are r	nore than 20	dB below the	FCC Limits		

Results of Tx mode (π/4-DQPSK: 2441.0 MHz) (30MHz – 1000MHz): Pass

		Field Streng Qu	th of Spuriou asi-Peak Val			
Frequency	Measured	Correction	Field	Field	Limit	E-Field
	Level	Factor	Strength	Strength		Polarity
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m	
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (π/4-DQPSK: 2441.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions							
			Peak Value				
Frequency	Measured	Correction	Field	Limit	Margin	E-Field	
	Level @3m	Factor	Strength	@3m		Polarity	
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
2441.0	57.1	27.8	84.9	N/A	N/A	Vertical	
4882.0	2.2	42.5	44.7	74.0	29.3	Vertical	
7323.0	1.7	47.1	48.8	74.0	25.2	Vertical	
9764.0	0.9	49.3	50.2	74.0	23.8	Vertical	
12205.0	0.8	53.1	53.9	74.0	20.1	Vertical	

Result of Tx mode (π/4-DQPSK: 2441.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions							
		A	verage Valu	e			
Frequency	Measured	Correction	Field	Limit	Margin	E-Field	
	Level @3m	Factor	Strength	@3m		Polarity	
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
2441.0	42.1	27.8	69.9	N/A	N/A	Vertical	
4882.0	-8.5	42.5	34.0	54.0	20.0	Vertical	
7323.0	-10.3	47.1	36.8	54.0	17.2	Vertical	
9764.0	-11.3	49.3	38.0	54.0	16.0	Vertical	
12205.0	-12.2	53.1	40.9	54.0	13.1	Vertical	

The Hong Kong Standards and Testing Centre Limited



Page 22 of 63

Date : 2018-03-02 No. : HM18010010

Result of Tx mode (π /4-DQPSK: 2480.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions								
	Peak Value							
Frequency	Measured	Correction	Field	Field	Limit	E-Field		
	Level	Factor	Strength	Strength		Polarity		
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m			
Emissions detected are more than 20 dB below the FCC Limits								

Results of Tx mode (π/4-DQPSK: 2480.0 MHz) (30MHz – 1000MHz): Pass

		Field Streng Qu	th of Spuriou asi-Peak Val			
Frequency	Measured	Correction	Field	Field	Limit	E-Field
	Level	Factor	Strength	Strength		Polarity
MHz	dBuV	dB/m	dBuV/m	uV/m	uV/m	
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (π /4-DQPSK: 2480.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions							
			Peak Value				
Frequency	Measured	Correction	Field	Limit	Margin	E-Field	
	Level @3m	Factor	Strength	@3m		Polarity	
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
2480.0	58.4	27.8	86.2	N/A	N/A	Vertical	
4960.0	3.4	43.2	46.6	74.0	27.4	Vertical	
7440.0	2.1	46.2	48.3	74.0	25.7	Vertical	
9920.0	1.3	50.9	52.2	74.0	21.8	Vertical	
12400.0	0.8	54.3	55.1	74.0	18.9	Vertical	

Result of Tx mode (π/4-DQPSK: 2480.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions							
		A	verage Valu	e			
Frequency	Measured	Correction	Field	Limit	Margin	E-Field	
	Level @3m	Factor	Strength	@3m		Polarity	
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
2480.0	43.2	27.8	71.0	54.0	-17.0	Vertical	
4960.0	-8.7	43.2	34.5	54.0	19.5	Vertical	
7440.0	-10.8	46.2	35.4	54.0	18.6	Vertical	
9920.0	-11.9	50.9	39.0	54.0	15.0	Vertical	
12400.0	-12.1	54.3	42.2	54.0	11.8	Vertical	

The Hong Kong Standards and Testing Centre Limited



Date : 2018-03-02 No. : HM18010010

Page 23 of 63

Limits for Radiated Emissions [FCC 47 CFR 15.209 Class B]:

Frequency Range [MHz]	Quasi-Peak Limits [µV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Field Strength of Fundamental and Harmonics Emissions							
		Qı	asi-Peak Va	lue			
Frequency	Measured	Correction	Field	Field	Limit @3m	E-Field	
	Level @3m	Factor	Strength	Strength		Polarity	
MHz	dBµV/m	dBµV/m	dBµV/m	$\mu V/m$	$\mu V/m$		
60.1	16.7	6.8	23.5	15.0	100	Vertical	
300.0	19.3	13.3	32.6	42.7	150	Vertical	
360.0	3.1	16.1	19.2	9.1	150	Vertical	
540.0	8.4	20.0	28.4	26.3	200	Horizontal	
600.0	8.6	21.0	29.6	30.2	200	Horizontal	
780.0	6.9	24.5	31.4	37.2	200	Horizontal	

Result of Bluetooth communication mode, (30MHz - 1GHz): PASS

Result of Bluetooth communication mode, (9kHz – 30MHz): PASS

Emissions detected are more than 20 dB below the FCC Limits

Result of Bluetooth communication mode, (1GHz – 26GHz): PASS

Emissions detected are more than 20 dB below the FCC Limits

Remarks:

Denotes restricted band of operation.

Calculated measurement uncertainty:

Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included Antenna Factor and Cable Attenuation.

(9kHz - 30MHz): 2.4dB

(30MHz - 18GHz): 5.0dB

(18GHz - 26GHz): 5.24dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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Date : 2018-03-02 No. : HM18010010

Page 24 of 63

3.1.4 Number of Hopping Frequency

Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels

Test Method:

The RF output of the EUT was connected to the spectrum analyzer by a low loss cable.

Spectrum Analyzer Setting:

RBW = 100kHz, $VBW \ge RBW$, Sweep = Auto, Span = the frequency band of operation Detector = Peak, Trace = Max. hold

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

Measurement Data: GFSK: 79 of 79 Channel

10 dE Log r	3/div	Ref	0.00 dBm									
-10.0												
-10.0												
-20.0												
-30.0	ሲስስ	ሳሲበስ	ሽለስከፍከለ	ሰስስለለስሰ	HAANNAAA		ኒሱክሌስክለሱነ	NAAAAAAA	ሽከአለኪሲሲኩ	ן המתמה מתחיים	ለብለለለ	
-40.0												
<i>c</i> o o	╎	ĬĬĬ	U U Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y	KANAAAAA	aaajiiahi	ואהותימו	ייייייי	UTARTAR	18000010000000000000000000000000000000	TATA A A A A A A A A A A A A A A A A A	VYYY Y	
-50.0	ſ											
-60.0	ĥ											
-70.0	(-
-80.0												ļγ,
-90.0												
	t 2.400 s BW 7				#VB	W 300 kHz			Sweet	Stop 2. 5 8.000 ms	48350 C (1001	GHz pts)

The Hong Kong Standards and Testing Centre Limited



Date : 2018-03-02 No. : HM18010010 π/4-DOPSK: 79 of 79 Channel Page 25 of 63

10 dE		0.00 dBm								
-10.0										
-20.0	։	A. 11514	ի իսկիսկո	∎A.t.1.6	งฝีเป็กกกิเ	ነበለበኪበ የ				44144
-30.0	\ <u>\</u> \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	ጞ፟፟ቑ፝፝፝ኯዀኯኯጚጚጚ፞፞፞፞ጞ፟፟፟፟፟፟	ᡐᢦ᠋ᡗᡰᢦ᠊ᢦᡪᠮᢦ	ላ ትትላላላላላላ	₽₩₽₽₽₽₽₩₩	aa damad	የዋት የሚያት የ	ᡥᠶᡃᢉᡃᢦᡥᡗᡃᡧᠯᡪᢍᡃᡁ	$\gamma \gamma $	NW I
-40.0										
-50.0										
-60.0	<u>j</u> i									
-70.0										1
-80.0										
-90.0										
	t 2.40000 (s BW 100		1	#VB	W 300 kHz	1	1	#Swee	Stop 2 p 10.00 ms	48350 GHz (1001 pts)



Date : 2018-03-02 No. : HM18010010

Page 26 of 63

3.1.5 20dB Bandwidth

Test Requirement:
Test Method:
Test Date:
Mode of Operation:

FCC 47CFR 15.247(a)(1) ANSI C63.10:2013 2018-02-14 Tx mode :GFSK/π/4-DQPSK

Remark:

The result has been done on all the possible configurations for searching the worst cases.

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

Spectrum Analyzer Setting:

RBW = 30kHz, $VBW \ge RBW$, Sweep = Auto, Span = two times and five times the OBW Detector = Peak, Trace = Max. hold

Test Setup:

As Test Setup of clause 3.1.1 in this test report.



Page 27 of 63

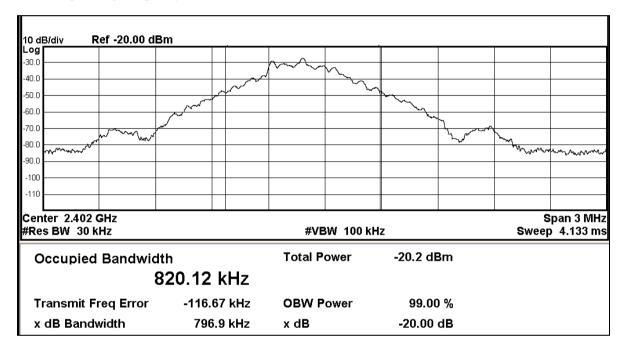
NO. : HIVI18010010		
Fundamental Frequency	20dB Bandwidth	FCC Limits
[MHz]	[MHz]	[MHz]
2402	0.80	Within 2400-2483.5

(Lowest Operating Frequency) - (GFSK)

Date : 2018-03-02

ът

TTN #10010010



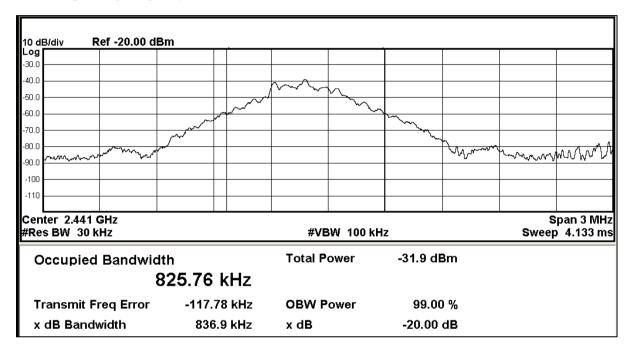


Page 28 of 63

Date	e : 2018-03-02
No.	: HM18010010

Fundamental Frequency	20dB Bandwidth	FCC Limits
[MHz]	[MHz]	[MHz]
2441	0.84	Within 2400-2483.5

(Middle Operating Frequency) - (GFSK)



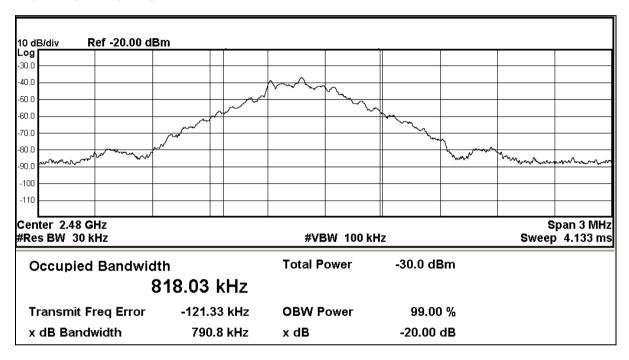


Page 29 of 63

No. : HM18010010		
Fundamental Frequency	20dB Bandwidth	FCC Limits
[MHz]	[MHz]	[MHz]
2480	0.79	Within 2400-2483.5

(Highest Operating Frequency) - (GFSK)

Date : 2018-03-02

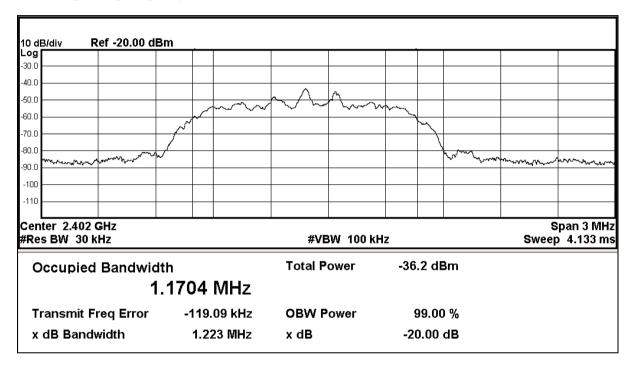




Date : 2018-03-02

Fundamental Frequency	20dB Bandwidth	FCC Limits	
[MHz]	[MHz]	[MHz]	
2402	1.22	Within 2400-2483.5	

(Lowest Operating Frequency) - ($\pi/4$ DQPSK)



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Within 2400 240

Page 30 of 63



1.22

Page 31 of 63

No. : HM18010010		
	Fundamental Frequency	20dB Bandwidth
	[MHz]	[MHz]

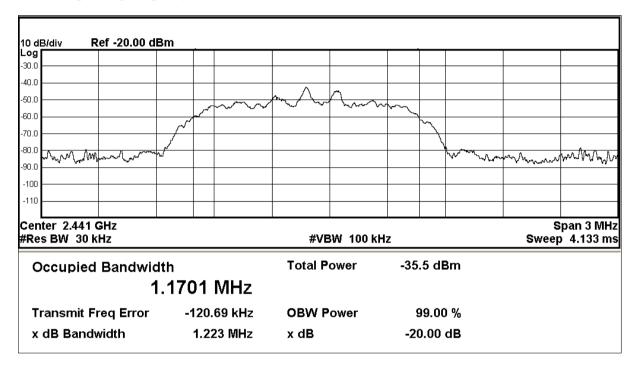
FCC Limits [MHz]

Within 2400-2483.5

(Middle Operating Frequency) - ($\pi/4$ DQPSK)

2441

Date : 2018-03-02



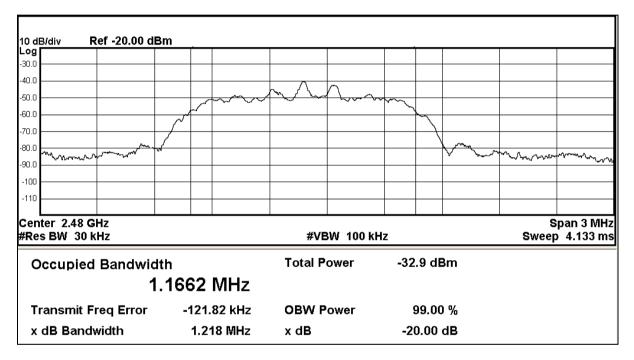


Date : 2018-03-02 No. : HM18010010

Page 32 of 63

Fundamental Frequency	20dB Bandwidth	FCC Limits
[MHz]	[MHz]	[MHz]
2480	1.22	Within 2400-2483.5

(Highest Operating Frequency) - ($\pi/4$ DQPSK)





Date : 2018-03-02 No. : HM18010010

Page 33 of 63

3.1.6 Hopping Channel Separation

Requirements:

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Spectrum Analyzer Setting:

RBW = 30kHz, $VBW \ge RBW$, Sweep = Auto, Span = Wide enough to captur the peaks of two adjacent channels Detector = Peak, Trace = Max. hold

Limit:

GFSK: The measured maximum bandwidth* 2/3 =0.84MHz * 2/3 = 560kHz

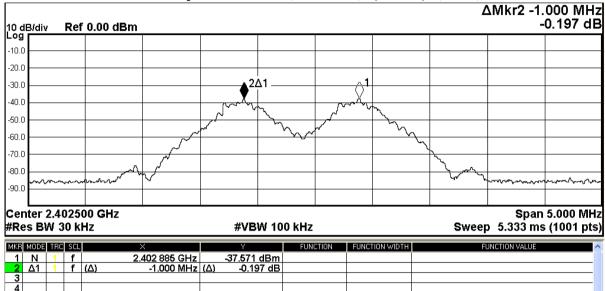
 $\pi/4$ DQPSK: The measured maximum bandwidth * 2/3 =1.22MHz * 2/3 = 780kHz



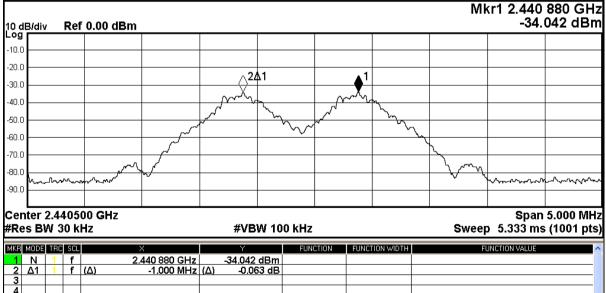
Page 34 of 63

Date : 2018-03-02 No. : HM18010010

Channel separation = 1MHz (>2/3 of BW) (Lowest) (GFSK)



Channel separation = 1MHz (>2/3 of BW) (Mid) (GFSK)



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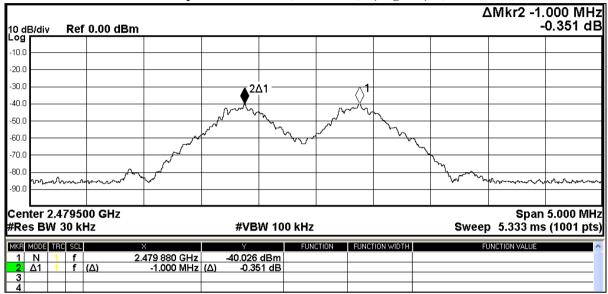


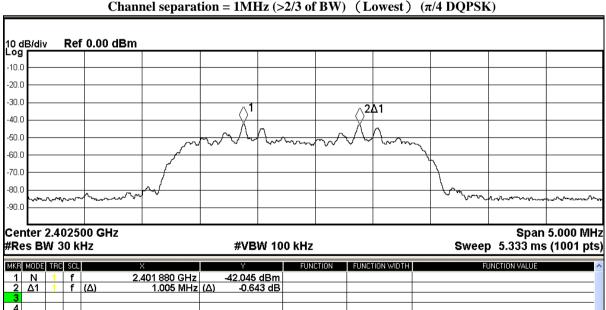
Page 35 of 63

No. : HM18010010

Date : 2018-03-02

Channel separation = 1MHz (>2/3 of BW) (Highest) (GFSK)





Channel separation = 1MHz (>2/3 of BW) (Lowest) ($\pi/4$ DQPSK)

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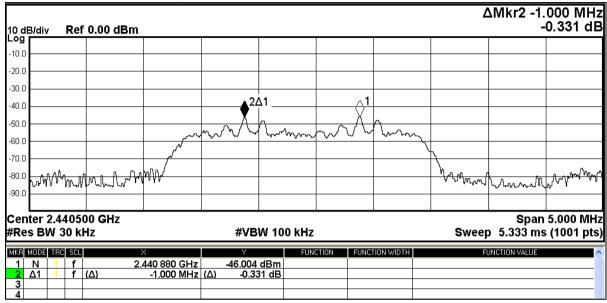


Page 36 of 63

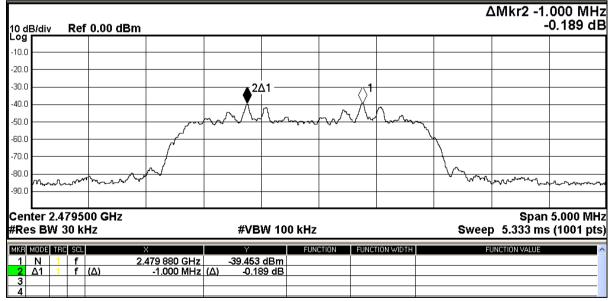
No. : HM18010010

Date : 2018-03-02

Channel separation = 1MHz (>2/3 of BW) (Mid) ($\pi/4$ DQPSK)



Channel separation = 1MHz (>2/3 of BW) (Highest) ($\pi/4$ DQPSK)



The Hong Kong Standards and Testing Centre Limited



Date : 2018-03-02 No. : HM18010010 Page 37 of 63

3.1.7 Band-edge Emissions Measurement:

Limit :

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.



Date : 2018-03-02 No. : HM18010010

Page 38 of 63

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	41.9

Band-edge Compliance of RF Emissions, GFSK (Hopping Off) – Lower Band Edge

0 dB/div	Ref Offset 6 Ref 112.99					MI	kr1 2.401 86.192	86 GH 2 dBµ`
og 103								
3.0								⊾ 1
3.0								X
3.0								<u> </u>
3.0								
3.0								2
3.0							 []	- I
3.0 	mar when and the	where a stand and the stand	Marine Contractor	water with	Anterna the share and the share	Mm. rolen los		L.
3.0								
							01	<u></u>
art 2.300 Res BW 1			#VBW 30	0 kHz		Sweep	Stop 2.41 10.53 ms (1	
R MODE TRO	C SCL	×	Y	FUNCTION	FUNCTION WIDTH	FUN	ICTION VALUE	
1 N 1	f	2.401 86 GHz	86.192 dBµV					
2 N 1 3 N 1	f	2.399 89 GHz 2.397 90 GHz	44.270 dBµV 53.195 dBµV					
4								



Date : 2018-03-02 No. : HM18010010 Page 39 of 63

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2400 – Lowest Fundamental (2402)	32.2

	Ba	und-edge C	Compliance	e of RF En	nissions, G	FSK (Hop	ping On)	- Lower B	and Edge	
)/div			Ψ					N		8 78 GHz 07 dBµV
										1
										32 //
									.n.Mada	
h		h- 4	، اسم ، م میل		በሲሊስ ለሲሊስ ሲ	ለስብሌስዲሲብሲሌ	լչերութ	V AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	ward	
tart 2.30000 GHz Stop 2.41000 GHz Res BW 100 kHz #VBW 300 kHz Sweep 10.53 ms (1001 pts)										
	SCL			Y		CTION FUNC	TION WIDTH	i	UNCTION VALUE	^
N 1 N 1	f									
<u>N 1</u>	f									
	2.300 BW 7 009 180 N 1	Ref (/div Ref 2.30000 (BW 100 k 000 ffC SCU	Ref Offset 6 dB /div Ref 112.99 dBj	Ref Offset 6 dB /div Ref 112.99 dBµV /div Ref 112.99 dBµV	Ref Offset 6 dB All Ref 112.99 dBµV /div Ref 112.99 dBµV Image: Constraint of the second sec	Ref Offset 6 dB /div Ref 112.99 dBµV Image: Set	Ref Offset 6 dB /div Ref 112.99 dBµV 2.30000 GHz #VBW 300 kHz /div Ref 112.99 dBµV /div Ref 112.99 dBµV	Ref Offset 6 dB Ref 112.99 dBµV /div Ref 112.99 dBµV Image: Set State	Ref Offset 6 dB M /div Ref 112.99 dBµV Image: Set State S	/div Ref 112.99 dBµV 52.2 /div Ref 112.99 dBµV 52.2 ////////////////////////////////////



Date : 2018-03-02 No. : HM18010010

Page 40 of 63

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2483.5 - Highest Fundamental (2480)	48.6

		Ba	nd-edge C	Compliance	e of RF En	nissions, C	FSK	(Hop	ping O	ff) – I	U pper B	and Edg	ge
10 dBi			Dffset 6 dB 112.99 dB	μV							N		83 65 GHz .011 dBµV
103													
93.0 -					1								
83.0 -					- / \								
73.0													
63.0					$\langle \rangle$								
					/ \								
53.0 -	~		٣	ι _									
43.0 -	<u></u>	<u>√</u> {		Λf	<u> </u>	<mark></mark> ∮²્રે	l						
33.0 🛰	-Caller	- ⁽ ,	and the spect	There are a second second	โมงจิน	hannta	¥	al and the second s				๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛๛	hand the second s
23.0													
L													
	2.470												2.50000 GHz
#Res	BW 1	00 k	Hz		#VB	W 300 kHz					Sweep	o 2.933 n	ns (1001 pts)
MKR M	DDE TRC	SCL	;	~	Y	FUN	CTION	FUNCT	ION WIDTH		FL	JNCTION VALUE	~
<u> </u>	N 1	f		2.479 87 GHz	83.612								
	N 1 N 1	f		2.483 65 GHz 2.484 40 GHz	35.011 35.807			-					
4		-	4	2.404 40 GHZ	35.607								



Date : 2018-03-02 No. : HM18010010

Page 41 of 63

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	49.5

0 dB/div		fset 6 dB 12.99 dB	μV							Μ		′9 87 GH: 832 dBµ\
.og												
103												
93.0				1								
B3.0 73.0		\int		V.								
63.0	· · ·		• • •	Ý Ì								
53.0				1								
43.0				l l		2						
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33.0									~~~~~~		╺╾╴╌╏┉╏┱┑┠╼╍╲╾╩┍╣┝╌	All and the second s
23.0												
tart 2.470 Res BW 1				#VB	W 300 k	Hz				Sweep		.50000 GH s (1001 pt
IKR MODE TRO	C SCL	2	X	Y		FUNCTION	FUNC	TION WIDTH		FL	INCTION VALUE	
1 N 1	f		2.479 87 GHz	82.832								
2 N 1 3 N 1	f		2.483 50 GHz 2.483 92 GHz	<u>33.346 c</u> 34.109 c								
4												



Date : 2018-03-02 No. : HM18010010

Band-edge Emissions Measurement:

Result: RF Radiated Emissions - GFSK

	F	ield Strength	of Band-edg	ge Compliance							
	Peak Value										
Frequency	Measured	Correction	Field	Limit	Margin	E-Field					
	Level @3m	Factor	Strength	@3m		Polarity					
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB						
2397.9	27.4	27.8	55.2	74.0	18.8	Vertical					
2398.8	27.8	27.8	55.6	74.0	18.4	Vertical					
2484.0	8.5	27.9	36.4	74.0	37.6	Vertical					
2483.9	7.8	27.9	35.7	74.0	38.3	Vertical					

	Field Strength of Band-edge Compliance AverageValue										
Frequency	Measured	Correction	Field	Limit	Margin	E-Field					
1 2	Level @3m	Factor	Strength	@3m	U	Polarity					
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB						
2397.9	6.7	27.8	34.5	54.0	19.5	Vertical					
2398.8	7.3	27.8	35.1	54.0	18.9	Vertical					
2484.0	-2.1	27.9	25.8	54.0	28.2	Vertical					
2483.9	-2.3	27.9	25.6	54.0	28.4	Vertical					



Date : 2018-03-02 No. : HM18010010 Page 43 of 63

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	50.9

	Ba	nd-e	dge Con	npliance of	RF Emiss	ions, π	/4 DQI	PSK (H	lopping O	ff) – Lowe	r Band Ed	ge
10 dB/c			set 6 dB 12.99 dB	μV						Ν	/kr3 2.39 53.3	7 68 GHz 351 dBµ∖
103 —												
93.0 —												+ 01
83.0 —												<u>⊢ λ</u>
73.0												[]
63.0 —												3
53.0												Ĩ.b
43.0											NIA / (
								100	all the state of the state	wheeler had	June 1	UI Underson
	ին անգացություն պատճան անգացություն անգացություն անգացին անգացին անգացին անգացին անգացին անգացին անգացին անգաց Անգացություն անգացություն անգացություն անգացություն անգացին անգացին անգացին անգացություն անգացություն անգացությո	dayar 1.84	~~~~	معروبا إعجاز بومعزز بالمعشار المبر	Carlor and a second	a that a second s					1	1.1.4.4
23.0 —												
Start :	2.3000	0 GH	z								Stop 2	.41000 GHz
#Res	BW 10	0 kH	z		#VB	W 300 I	kHz			Swee	p 10.53 m	s (1001 pts)
MKR MO	DE TRC S	SCL		×	Y		FUNCTION	FUNC	TION WIDTH	ŀ	FUNCTION VALUE	~
1 N		f		2.401 86 GHz								
2 N 3 N		f		2.399 89 GHz 2.397 68 GHz	43.823 53.351							
4		-		2.031 00 002	33.351							



Date : 2018-03-02 No. : HM18010010 Page 44 of 63

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2402)	48.1

]	Band-e	dge Compliance	of RF Emiss	sions, $\pi/4$	DQPSF	K (Hopping	On) – Lower	r Band Edg	ge
10 dB/div		set6 dB I2.99 dBµV					Ν	/lkr1 2.40 [/] 83.9	1 86 GHz ∣57 dBµ∖
103									
93.0									 1
83.0									hulukh
73.0									/**¥****
63.0									
53.0			_					4	KŽÍ
43.0									why
33.0			whitere	กนในปลายเม	a march like	U.A. LARAN	un for the second	สมบุรม _ี ณภูมิไป	
	- A A CHAR AND A CHAR	and and a second se	200 m 10 040-1 10 - 11 - 11						
23.0									
Start 2.30	000 GH	Z						Stop 2.4	41000 GHz
#Res BW	100 kH:	z	#VB	W 300 kHz	:		Swee	p 10.53 ms	
MKR MODE TH	C SCL	X	Y	FUN	ICTION	FUNCTION WIDTH		UNCTION VALUE	^
1 N 1	f	2.401 86 GH							
2 N 1	f	2.399 78 GH							
3 N 1 4	T	2.398 78 GH	lz 52.188	αΒμν					



Date : 2018-03-02 No. : HM18010010 Page 45 of 63

Frequency Range	Radiated Emission Attenuated below the Fundamental
[MHz]	[dB]
2483.5 - Highest Fundamental (2480)	58.2

]			pliance of	RF Emis	sions, $\pi/4$	DQPS	K (H	lopping (dge 83 92 GHz
10 dB/div	Ref Offs Ref 112	et6dB 2.99dB	Vı								.534 dBµV
Log 103											
93.0				~1							
83.0				'						_	
73.0				r h							
63.0				\square							
53.0											
43.0		^							_	_	
33.0	har			<u>۲</u>	-		1	. เกาะการใบคร.	[[]]]	านแก้งการจาก	ᠮᢦᢧᡰᡡ᠆᠇ᡙᢇᡧᢦᡃᡐᠵ᠇᠊ᠬ
23.0					1 10 1 10 10		, mes- (l	0 1 1 0 0 4			
Start 2.47 #Res BW				#VB	W 300 kHz	:			Swee		2.50000 GHz ns (1001 pts)
MKR MODE T	RC SCL	×		Y		ICTION	FUNCT	ION WIDTH		FUNCTION VALUE	<u>^</u>
1 N 1 2 N 1	f	2	.479 93 GHz .483 50 GHz	82.513 31.489	dBµV						
3 N 1	f	2	.483 92 GHz	34.534	dBµV						



Date : 2018-03-02 No. : HM18010010

Page 46 of 63

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2480)	50.3

]	Band-edge C	Compliance of	RF Emissions	s, π/4 DQPS	SK (Hopping	On) – Upper	Band Edg	e
10 dB/div	Ref Offset 6 dl Ref 112.99 (M	kr1 2.479 83.43	87 GHz 35 dBµV
103								
93.0			• ¹					
	والهرما أمهرا المسرحات	marthan	wh					
73.0								•
63.0								
53.0								
43.0				~23				
33.0			- Windowson	w. Mannahan	vanderessen and procession	Mar Marines		<u>՟՟՟֎՟֎՟֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎֎</u>
23.0								
Start 2.47 #Res BW			#VBW 30	0 kHz		Sweep	Stop 2.5 2.933 ms (0000 GHz (1001 pts)
MKR MODE TR	C SCL	×	Y	FUNCTION	FUNCTION WIDTH	- Fl	INCTION VALUE	~
1 N 1	f	2.479 87 GHz	83.435 dBµV					
2 N 1 3 N 1 4	f	2.483 50 GHz 2.483 92 GHz	35.406 dBµV 35.314 dBµV					
4		2						



Date : 2018-03-02 No. : HM18010010

Band-edge Emissions Measurement:

Result: RF Radiated Emissions -π/4 **DQPSK**

	Field Strength of Band-edge Compliance											
	Peak Value											
Frequency	Frequency Measured Correction Field Limit Margin E-Field											
	Level @3m	Factor	Strength	@3m		Polarity						
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB							
2397.9	26.4	27.8	54.2	74.0	19.8	Vertical						
2398.8	26.3	27.8	54.1	74.0	19.9	Vertical						
2483.9	8.2	27.9	36.1	74.0	37.9	Vertical						
2483.9	7.5	27.9	35.4	74.0	38.6	Vertical						

	Field Strength of Band-edge Compliance AverageValue											
Frequency Measured Correction Field Limit Margin E-Field												
1 0	Level @3m	Factor	Strength	@3m	C	Polarity						
MHz	, , , , , , , , , , , , , , , , , , ,											
2397.9	6.3	27.8	34.1	54.0	19.9	Vertical						
2398.8	6.8	27.8	34.6	54.0	19.4	Vertical						
2483.9	-2.3	27.9	25.6	54.0	28.4	Vertical						
2483.9	-2.4	27.9	25.5	54.0	28.5	Vertical						

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Page 47 of 63



Date : 2018-03-02 No. : HM18010010

Page 48 of 63

3.1.8 Time of Occupancy (Dwell Time)

Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channel employed. No requirements for Digital Transmission System.

Spectrum Analyzer Setting:

RBW = 300kHz, $VBW \ge RBW$, Sweep = A longer sweep time to show two successive hops on a channel, Span = Zero, Detector = Peak, Trace = Max. hold

Dwell Time = Pulse Duration * hop rate / number of channel * observation duration Observed duration: $0.4s \times 79 = 31.6s$

Measurement Data: Channel Occupied in $\pi/4$ -DQPSK: 79 of 79 Channel

10 dE	3/div Ref	0.00 dBm								_
-10.0										
-20.0		a tukha	 		. Ma Na 1 N I I	1.000 1.000				
-30.0	_{~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	┙┿┉┽┽╱┶┤ᠶ	╈╋┟┿╲┿╲┞┉┥┥	╟╙┲┦╝┙╘╝╵┙╝	WWWW	₩₩₩₩₩₩₩₩	₦√৻৻৻৻৻৻৻৻৻	(WW	
-40.0										
-50.0										-
-60.0	<u>М</u>									_
-70.0										
-80.0										1.
-90.0										
	t 2.40000 (s BW 100		#VB	W 300 kHz			#Sweej	.Stop 2 م 10.00 ms		

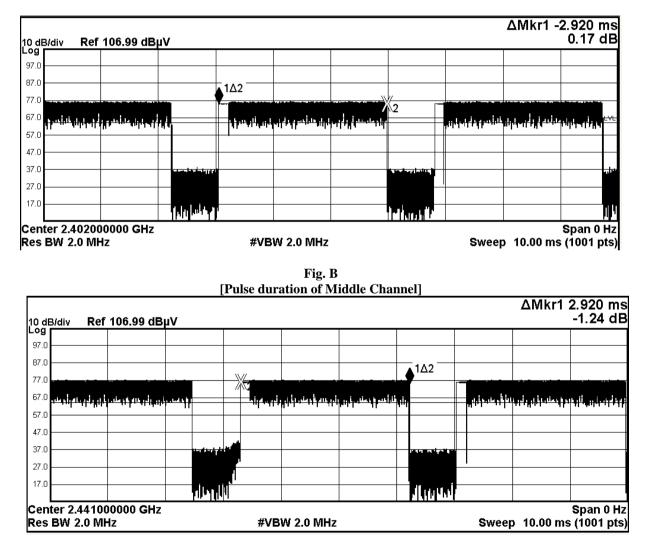
The Hong Kong Standards and Testing Centre Limited



Date : 2018-03-02 No. : HM18010010 DH5 Packet:

DH5 Packet permit maximum 1600/79/6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times $3.37 \times 31.6 = 106.6$ within 31.6 seconds

Fig. A [Pulse duration of Lowest Channel]



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Page 49 of 63



Date : 2018-03-02 No. : HM18010010 Page 50 of 63

Fig. C [Pulse duration of Highest Channel]

												∆Mkr1	2.920 m
10 dB/div Log	Ref 106.99 d	ΒμV											-1.19 dl
97.0													
87.0													
					v/ .				1Δ2				
77.0	والمتحكفة بالمتكول									Γ			
67.0 <mark>بىلەر</mark> 67. 0	والمريقة والمتشارية والمرواد					, ili i i i i i i i i i i i i i i i i i	اللعم ومعليان	ΠI				براديا والمتحدي	<u>պուլը հերկությո</u>
57.0													
47.0													
37.0			. انار دار	u i si					a a statistica da la				
27.0													
17.0		- P	וןיאי								-		
enter 2.4	80000000 GH		. 1			1	1						Span 0 H
les BW 2.					#VB	W 2.0 MHz					Sweep) 10.00 m	s (1001 pt



Date : 2018-03-02 No. : HM18010010 DH3 Packet:

DH3 Packet permit maximum 1600/79/4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times $5.06 \times 31.6 = 160$ within 31.6 seconds

Fig. D [Pulse duration of Lowest Channel]

10 dB/div Re	ef 106.99 dBj	Vı						∆Mkr1	1.670 ms -3.26 dB
97.0									
87.0									
77.0						1Δ2			
ا <u>نو قرب بند زارمت</u> 67.0	ļ	<u>~</u> 2	الأيقاني فريز والقار	<u>قىنىر ئىر. ھىرازى ئە</u>	ر قانوقىرىيەر ئارىخى			شەر <u>ئى مەر ئى مىڭ ب</u> ۇرىنار	غان ڈیں در اور
57.0	_		· · ·						
47.0									
37.0	line the damage is	i i riperi r							
27.0	-								
17.0	hereiten					i ^d in (1) ^d in (1) and (1)	╢ [₽] ╢┯──		
Center 2.402							-		Span 0 Hz
Res BW 2.0 N	/IHZ		#VB	W 2.0 MHz			Swee	p 5.000 ms	- (1001 pts)

Fig. E [Pulse duration of Middle Channel]

10 dB	3/div Re f	f 106.99 dE	μV						∆Mkr1	-1.670 ms -1.19 dB
Log 97.0										
87.0				 1∆2						
77.0				•				2		
67.0	ا محقق أن فريض يزز أنظ	منانية، ويقى واقتل	•		لمعين ريش والم	يتنقنه وروية بزراقة	ر ما <u>از اردر او باز ما</u>	~z		الم الم الم الم الم الم الم الم
57.0	•	· ·								
47.0										
37.0									a in T	
27.0										
17.0									n'inn	
	ter 2.4410 BW 2.0 M	00000 GHz Hz		#VB	W 2.0 MHz			Sweep	5.000 m	Span 0 Hz is (1001 pts)

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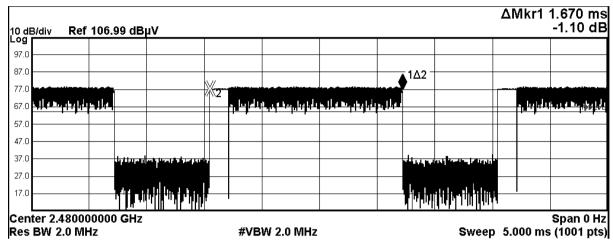
Page 51 of 63



Page 52 of 63

Date : 2018-03-02 No. : HM18010010

Fig. F [Pulse duration of Highest Channel]





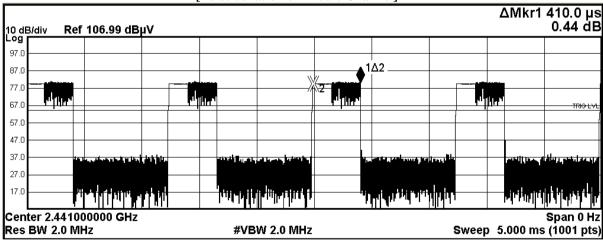
Date : 2018-03-02 No. : HM18010010 DH1 Packet:

DH1 Packet permit maximum 1600/79/2 = 10.12 hops per second in each channel (3 time slots RX, 1 time slot TX). The Dwell time is the time duration of the pulse times $10.12 \times 31.6 = 320$ within 31.6 seconds

	[Pulse duration of	Lowest Channel]	
10 dB/div Ref 106.99 dBµV			ΔMkr1 410.0 μs 0.44 dB
97.0			
87.0 77.0			
67.0 11 11 1 1 57.0 1			
47.0 37.0	· · · · · · · · · · · · · · · · · · ·		
27.0			
^{17.0} T Mattin Lini Center 2.402000000 GHz			۳۹۳٬۱۳٬۱۳٬۱۳٬۱۳٬۱۳٬۱۳٬۱۳٬۱۳٬۱۳ Span 0 Hz
Res BW 2.0 MHz	#VBW 2.0 MH:	z \$	Sweep 5.000 ms (1001 pts

Fig. G [Pulse duration of Lowest Channel]

Fig. H [Pulse duration of Middle Channel]



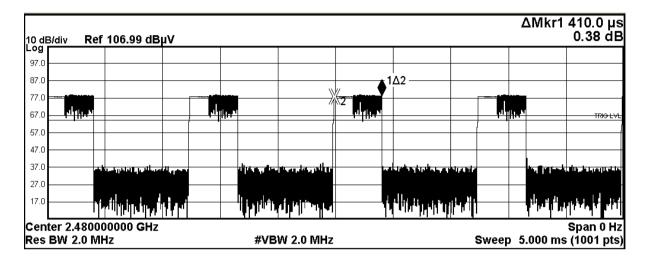
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Page 53 of 63



Date : 2018-03-02 No. : HM18010010 Page 54 of 63

Fig. I [Pulse duration of Highest Channel]



Time of occupancy (Dwell Time):

Data Packet	Frequency	Pulse Duration	Dwell Time	Limits	Test Results
	(MHz)	(ms)	(s)	(s)	
DH5	2402	2.920	0.312	0.400	Complies
DH5	2441	2.920	0.312	0.400	Complies
DH5	2480	2.920	0.312	0.400	Complies
DH3	2402	1.670	0.267	0.400	Complies
DH3	2441	1.670	0.267	0.400	Complies
DH3	2480	1.670	0.267	0.400	Complies
DH1	2402	0.410	0.131	0.400	Complies
DH1	2441	0.410	0.131	0.400	Complies
DH1	2480	0.410	0.131	0.400	Complies

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Page 55 of 63

Date : 2018-03-02 No. : HM18010010 3.1.9 Channel Centre Frequency

Requirements:

Frequency hopping system in the 2400-2483.5MHz band shall use at least 79 (Channel 1 to 79) non-overlapping channels.

The EUT operates in according with the Bluetooth system specification within the 2400 - 2483.5 MHz frequency band.

RF channels for Bluetooth systems are spaced 1 MHz and are ordered in channel number k. In order to comply with out-of-band regulations, a lower frequency guard band of 2.0 MHz and a higher frequency guard band of 3.5MHz is used.

The operating frequencies of each channel are as follows:

First RF channel start from 2400MHz + 2MHz guard band = 2402MHz Frequency of RF Channel = 2402+k MHz, k = 1,...,79 (Channel separation = 1MHz)



Page 56 of 63

Date : 2018-03-02 No. : HM18010010 3.1.10 Pseudorandom Hopping Algorithm

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

EUT Pseudorandom Hopping Algorithm

The EUT is a Bluetooth device, the Pseudo-random hopping pattern; hopping characteristics and algorithm are based on the Bluetooth specification.



Date : 2018-03-02 No. : HM18010010

Page 57 of 63

3.1.11 Antenna Requirement

Test Requirements: § 15.203

Test Specification:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Test Results:

This is Circuit printed meander line antenna. There is no external antenna, the antenna gain = -0.58dBi. User is unable to remove or changed the Antenna.



Page 58 of 63

Date : 2018-03-02 No. : HM18010010 3.1.12 RF Exposure

Test Requirement: Test Date: Mode of Operation: FCC 47CFR 15.247(i) 2018-02-14 On mode

Requirements:

In 15.247(i), an equipment shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the limits in §§ 1.1310 and 2.1093 of this chapter. Applications to the Commission for construction permits, licenses to transmit or renewals thereof,

equipment authorizations or modifications in existing facilities must contain a statement confirming compliance with the limits unless the facility, operation, or transmitter is categorically excluded, as discussed below. Technical information showing the basis for this statement must be submitted to the Commission upon request.

According to KDB447498 D01 General RF Exposure Guidance v06, unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition.

RF Exposure Evaluation

The Maximum tune-up power = -5.12dBm (0.308mW)

SAR Test Exclusion Thresholds= $0.1 \le 3.0$ for 1-g SAR,

The test separation distances is ≤5 mm The power tune up tolerance is -6.82±1.70dBm Max. duty factor is 100%



Date : 2018-03-02 No. : HM18010010

Page 59 of 63

Appendix A

LIST OF MEASUREMENT EQUIPMENT

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM299	DOUBLE-RIDGED WAVEGUIDE HORN ANTENNA	ETS-LINDGREN	3115	00114120	2016/04/27	2018/04/27
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3		2017/04/20	2018/04/20
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM355	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00094856	2016/03/03	2018/03/03
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2017/06/01	2018/06/01
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2016/03/16	2018/03/16
EM302	PRECISION OMNIDIRECTIONAL DIPOLE (1 – 6GHZ)	SEIBERSDORF LABORATORIES	POD 16	161806/L	2016/05/11	2018/05/11
EM303	PRECISION OMNIDIRECTIONAL DIPOLE (6 – 18GHZ)	SEIBERSDORF LABORATORIES	POD 618	6181908/L	2016/05/11	2018/05/11

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.5 2	2017/11/29	2018/11/29
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2017/06/01	2018/06/01
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357- 8810.52/54	2018/01/11	2019/01/11
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740- 057-99A	2017/02/02	2022/02/02
N/A	MEASUREMENT AND EVALUATION SOFTWARE	ROHDE & SCHWARZ	ESIB-K1	V1.20	N/A	N/A

Remarks:-

- CM Corrective Maintenance
- N/A Not Applicable or Not Available
- TBD To Be Determined

The Hong Kong Standards and Testing Centre Limited



Date : 2018-03-02 No. : HM18010010 Page 60 of 63

Appendix B

Photographs of EUT



Front View of the product (Additional)



Rear View of the product (Basic)

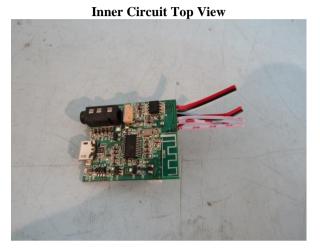


Rear View of the product (Additional)





Date : 2018-03-02 No. : HM18010010 Page 61 of 63

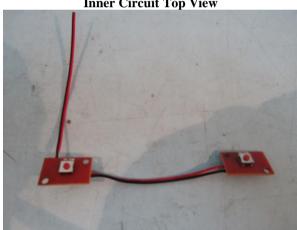


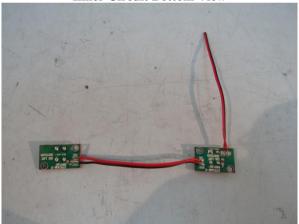
Inner Circuit Top View



Inner Circuit Bottom View

Inner Circuit Bottom View

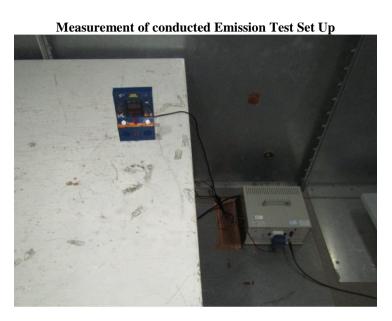






Page 62 of 63

Date : 2018-03-02 No. : HM18010010 Photographs of EUT



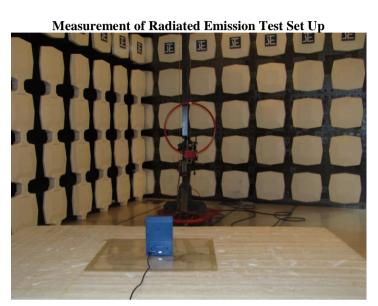
Measurement of Radiated Emission Test Set Up





Date : 2018-03-02 No. : HM18010010 Page 63 of 63

Photographs of EUT



Measurement of Radiated Emission Test Set Up



Conditions of Issuance of Test Reports

- 1. All samples and goods are accepted by The Hong Kong Standards & Testing Centre Limited (the "Company") solely for testing and reporting in accordance with the following terms and conditions. The Company provides its services on the basis that such terms and conditions constitute express agreement between the Company and any person, firm or company requesting its services (the "Clients").
- 2. Any report issued by the Company as a result of this application for testing service (the "Report") shall be issued in confidence to the Clients and the Report will be strictly treated as such by the Company. It may not be reproduced either in its entirety or in part and it may not be used for advertising or other unauthorized purposes without the written consent of the Company. The Clients to whom the Report is issued may, however, show or send it, or a certified copy thereof prepared by the Company to his customer, supplier or other persons directly concerned. The Company will not, without the consent of the Clients, enter into any discussion or correspondence with any third party concerning the contents of the Report, unless required by the relevant governmental authorities, laws or court orders.
- 3. The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.
- 4. The Report refers only to the sample tested and does not apply to the bulk, unless the sampling has been carried out by the Company and is stated as such in the Report.
- 5. In the event of the improper use the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.
- 6. Sample submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.
- 7. The Company will not be liable for or accept responsibility for any loss or damage howsoever arising from the use of information contained in any of its Reports or in any communication whatsoever about its said tests or investigations.
- 8. Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.
- 9. Subject to the variable length of retention time for test data and report stored hereinto as to otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of this test report for a period of three years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after the retention period. Under no circumstances shall we be liable for damages of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.
- 10. Issuance records of the Report are available on the internet at www.stc-group.org. Further enquiry of validity or verification of the Reports should be addressed to the Company.