

FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2

CERTIFICATION TEST REPORT

For

Communication Module

MODEL NUMBER: 1CQ

PROJECT NUMBER: 4788296310

REPORT NUMBER: 4788296310-2

FCC ID: VPYLB1CQ

IC ID: 772C-LB1CQ

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Prepared for

Murata Manufacturing Co.,Ltd.

Prepared by

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Revision History

Rev.	Issue Date	Revisions	Revised By
	1/31/2019	Initial Issue	

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Summary of Test Results						
Clause	Test Items	FCC/IC Rules	Test Results			
1	20dB Bandwidth And 99% Bandwidth	FCC 15.247 (a) (1) RSS-247 Clause 5.1 (a)	Complied			
2	Peak Conducted Output Power	FCC 15.247 (b) (1) RSS-247 Clause 5.1 (b)	Complied			
3	Carrier Hopping Channel Separation	FCC 15.247 (a) (1) RSS-247 Clause 5.1 (b)	Complied			
4	Number of Hopping Frequency	15.247 (a) (1) III RSS-247 Clause 5.1 (d)	Complied			
5	Time of Occupancy (Dwell Time)	15.247 (a) (1) III RSS-247 Clause 5.1 (d)	Complied			
6	Conducted Bandedge	FCC 15.247 (d) RSS-247 Clause 5.5	Complied			
7	Radiated Bandedge and Spurious	FCC 15.247 (d) FCC 15.209 FCC 15.205 RSS-247 Clause 5.5 RSS-GEN Clause 8.9 RSS-GEN Clause 8.10	Complied			
8	Conducted Emission Test for AC Power Port	FCC 15.207 RSS-GEN Clause 8.8	Complied			
9	Antenna Requirement	FCC 15.203 RSS-GEN Clause 8.3	Complied			

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1. ATTESTATION OF TESCT RESULTS

Applicant Information

Company Name: Address: Murata Manufacturing Co.,Ltd. 10-1,Higashikotari 1-chome,Nagaokakyo-shi,Kyoto 617-8555,Japan

Manufacturer Information

Company Name:Murata Manufacturing Co.,Ltd.Address:10-1,Higashikotari 1-chome,Nagaokakyo-shi,Kyoto617-8555,Japan

EUT Description

Product Name Model Name Sample ID Sample Status Sample Received date Date Tested Communication Module 1CQ 1468264 Good March 8, 2018 March 8, 2018~Jan 31, 2019

APPLICABLE STANDARDS					
STANDARD	TEST RESULTS				
CFR 47 Part 15 Subpart C	PASS				
ISED RSS-247 Issue 2	PASS				
ISED RSS-GEN Issue 5	PASS				

Tested By:

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Checked By:

Shawn Wen

Laboratory Leader

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ephentus

Stephen Guo Laboratory Manager

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TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB 558074 D01 15.247 Meas Guidance v05, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

Test Location	UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch.
Address	Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
Accreditation Certificate	UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing. The Certificate Registration Number is 4102.01. UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The Designation Number is CN1187. UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. EMC Laboratory has been registered and fully described in a report filed with the FCC (Sederal Communications Commission).

Note:

- 1. All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
- 2. The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.
- 3. For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30MHz had been correlated to measurements performed on an OATS.

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4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty			
Uncertainty for Conduction emission test	2.90dB			
Uncertainty for Radiation Emission test (include Fundamental emission) (9KHz-30MHz)	2.2dB			
Uncertainty for Radiation Emission test (include Fundamental emission) (30MHz-1GHz)	4.52dB			
Uncertainty for Radiation Emission test	5.04dB(1-6GHz)			
(1GHz to 26GHz) (include Fundamental	5.30dB (6GHz-18Gz)			
emission)	5.23dB (18GHz-26Gz)			
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.				

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5. EQUIPMENT UNDER TEST 5.1. DESCRIPTION OF EUT

Equipment	Communication Module			
Model Name	1CQ			
	Operation Frequency 2402 MH:		z ~ 2480 MHz	
Product	Modulation Type		Data Rate	
Description	GFSK		1Mbps	
(Bluetooth)	∏/4-DQPSK		2Mbps	
	8DPSK		3Mbps	
Dowor Supply	VDD_3P3/SWREG_IN/VDD_FEM: Typ. DC3.3V, Max. DC3.5V, Min. DC3.1V			
Fower Suppry	VDDIO_GPIO0/1/VDDIO_Xtal: Typ_DC1 8V or DC3 3V_Max_DC3 46V_Min_DC1 71V			
Bluetooth Version	BR/EDR			
Hardware Version	V1.0			

5.2. MAXIMUM OUTPUT POWER

Bluetooth Mode	Frequency (MHz)	Channel Number	Max Output Power	EIRP (dBm)
GFSK	2402-2480	0-78[79]	8.72	8.72
8DPSK	2402-2480	0-78[79]	7.88	7.88

5.3. PACKET TYPE CONFIGURATION

Test Mode	Packet Type	Setting(Packet Length)
	DH1	27
GFSK	DH3	183
	DH5	339
	2-DH1	54
∏/4-DQPSK	2-DH3	367
	2-DH5	679
	3-DH1	83
8DPSK	3-DH3	552
	3-DH5	1021

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5.4. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

5.5. TEST CHANNEL CONFIGURATION

Test Mode Test Channel Number		Test Channel	
GFSK	CH 00, CH 39, CH 78	Low, Middle, High	
8DPSK	CH 00, CH 39, CH 78	Low, Middle, High	

5.6. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band						
Test So	oftware	Tera Term & QRCT				
Modulation Type Transmit Antenna		Test Channel				
modulation Type	Number	CH 00	CH 39	CH 78		
GFSK	1	9 9		9		
8DPSK	1	9 9 9				

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5.7. **DESCRIPTION OF AVAILABLE ANTENNAS**

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
1	2402-2480	PCB Antenna	0

Note: There are two antennas in the EUT, only antenna 1 support BT mode.

Test Mode	Transmit and Receive Mode	Description
GFSK	1TX, 1RX	Chain 1 can be used as transmitting/receiving antenna.
8DPSK	1TX, 1RX	Chain 1 can be used as transmitting/receiving antenna.



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Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BR	FHSS	GFSK	1Mbit/s
EDR	FHSS	8DPSK	3Mbit/s

Note: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

5.9. TEST ENVIRONMENT

Environment Parameter	Selected Values During Tests			
Relative Humidity		55 ~ 65%		
Atmospheric Pressure:	1005Pa			
Temperature	TN -20 ~ 70°C			
	VL	N/A		
Voltage	VN	VDD_3P3/SWREG_IN/VDD_FEM:DC3.3V VDDIO_GPIO0/1/VDDIO_Xtal:DC1.8V		
	VH N/A			

Note: VL= Lower Extreme Test Voltage

VN= Nominal Voltage.

VH= Upper Extreme Test Voltage

TN= Normal Temperature

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5.10. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	Remarks
1	Laptop	ThinkPad	E450	N/A

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	LAN	LAN	N/A	0.2	N/A
2	USB	USB	Unshielded	0.5	N/A

ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
1	N/A	N/A	N/A	N/A

TEST SETUP

The EUT can work in an engineer mode with a software through a PC.

SETUP DIAGRAM FOR TESTS



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5.11. MEASURING INSTRUMENT AND SOFTWARE USED

	Conducted Emissions							
Used	Equipment	Manufactur	Model No	Seria	al No.	Upper Cal.	Last Cal.	Next Cal.
	EMI Test Receiver	R&S	ESR3	101	1961	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
	Two-Line V-Network	R&S	ENV216	101	1983	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
			S	oftware	;			
Used	Descri	ption	Μ	anufact	urer	Name	Version	
\checkmark	Test Software for Cor	nducted distu	rbance	UL		Antenna port	Ver. 7.2	
			Radiat	ed Emis	ssions			
Used	Equipment	Manufactur	Model No	Seria	al No.	Upper Cal.	Last Cal.	Next Cal.
\checkmark	MXE EMI Receiver	KESIGHT	N9038A	MY5	64000	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
\checkmark	Hybrid Log Periodic Antenna	TDK	HLP-3003	130	0960	Jan.09, 2016	Sept. 17, 2018	Sept.17, 2021
\checkmark	Preamplifier	HP	8447D	2944	A0909	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
V	EMI Measurement Receiver	R&S	ESR26	101	1377	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
\checkmark	Horn Antenna	TDK	HRN-0118	3 130)939	Jan. 09, 2016	Sept. 17, 2018	Sept.17, 2021
\checkmark	High Gain Horn	Schwarzbe	BBHA-917	0 6	91	Jan.06, 2016	Aug.11, 2018	Aug.11, 2019
\checkmark	Preamplifier	TDK	PA-02-011	8 TRS 00	-305- 066	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
V	Preamplifier	TDK	PA-02-2	TRS 00	-307- 003	Dec.12,2017	Dec.10, 2018	Dec.10, 2019
\checkmark	Loop antenna	Schwarzbe	1519B	00	800	Mar. 26,	Mar. 26, 2016	Mar. 26, 2019
			S	oftware	;			
Used	Descript	ion	Manu	acturer		Name	Version	
\checkmark	Test Software for Rad	iated disturba	ance Fa	rad		EZ-EMC	Ver. UL-3A1	
			Other	instrun	nents			
Used	Equipment	Manufactur er	Model No	Seria	al No.	Upper Cal.	Last Cal.	Next Cal.
\mathbf{N}	Spectrum Analyzer	Keysight	N9030A	MY5	54105 12	Dec.12,2017	Dec.10,2018	Dec.10,2019
V	Power Sensor	Keysight	U2021XA	MY5 (70300)4	Dec.12,2017	Dec.10,2018	Dec.10,2019
V	Power Meter	Keysight	N1911A	MY5	54160 24	Dec.12,2017	Dec.11,2018	Dec.10,2019
V	High Pass Filter	Wainwright	WHKX10 5850-6500 1800-40S	-	4	Dec.12,2017	Dec.11,2018	Dec.10,2019
V	Band Reject Filter	Wainwright	WRCJV20 5440-5470 5725-5755 60SS	-	1	Dec.12,2017	Dec.11,2018	Dec.10,2019

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6. ANTENNA PORT TEST RESULTS

6.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP



RESULTS

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (db)	1/T Minimum VBW (KHz)
GFSK	2.867	3.725	0.770	77.0	1.13	3.488
8DPSK	2.883	3.725	0.774	77.4	1.11	3.469

Note: Duty Cycle Correction Factor=10log(1/x). Where: x is Duty Cycle (Linear) Where: T is On Time (transmit duration)

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6.2. 20 dB BANDWIDTH AND 99% BANDWIDTH

LIMITS

FCC Part15 (15.247) Subpart C RSS-247 ISSUE 2						
Section Test Item Limit Frequency Range (MHz)						
FCC 15.247 (a) (1) RSS-247 Clause 5.1 (a) 20dB Bandwidth		NA	2400-2483.5			
RSS-Gen Clause 6.6	99% Bandwidth	N/A	2400-2483.5			

TEST PROCEDURE

Connect the UUT to the spectrum Analyzer and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 20dB Bandwidth:1% of the 20 dB bandwidth
	For 99% Bandwidth: 1% to 5% of the occupied bandwidth For 20dB Bandwidth: ≥ RBW
VBW	For 99% Bandwidth: approximately 3×RBW
Span	approximately 2 to 3 times the 20 dB bandwidth
Trace	Max hold
Sweep	Auto couple

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

TEST SETUP



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RESULTS

6.2.1. GFSK MODE

Channel	Frequency (MHz)	20dB bandwidth (MHz)	99% bandwidth (MHz)	Result
Low	2402	1.095	0.970	PASS
Middle	2441	1.100	0.973	PASS
High	2480	1.105	0.973	PASS

Test Graph



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KEYSIG RL +	HT Input: RF Coupling: DC Align: Auto/No RF	Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)	Atten: 40 dB Preamp: Off	Trig: Free Run Gate: Off #IF Gain: Low	Center Fr Avg Hold: Radio Sto	eq: 2.44100000 >10/10 I: None	0 GHz	Center Frequency 2.441000000 GHz	Setting
1 Graph Scale/Div	ب 10.0 dB	F	Ref LvI Offset 9. Ref Value 30.00 (10 dB dBm		Mkr1 2.4 8	410 GHz .32 dBm	Span 2.0000 MHz CF Step	
20.0 10.0 0.00			1					200.000 kHz Auto Man	
-20.0 -30.0 -40.0								Freq Offset 0 Hz	
-50.0 -60.0 Center 2.4	141 GHz	#	Video BW 300.0	0 kHz	Sweer	Time 1 07 m	Span 2 MHz s (8001 pts)		
2 Metrics	•								
C	Occupied Bandwidth 972.92	2 kHz		Total Power		13.6 dl	Bm		
T X	ransmit Freq Error dB Bandwidth	3.491 kH 1.100 MH	z z	% of OBW Pow x dB	/er	99.00 -20.00) % dB		

_			99% BA		HIGH C	СН		
Spectrum Anal Occupied BW	lyzer 1 🔹 🕇	-					Frequenc	y ▼ <mark>×12</mark>
KEYSIGH1 RL ↔	Input: RF Coupling: DC Align: Auto/No RF	Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)	Atten: 40 dB Preamp: Off	Trig: Free Run Gate: Off #IF Gain: Low	Center Freq: 2.4 Avg Hold: 10/10 Radio Std: None	80000000 GHz	Center Frequency 2.480000000 GHz	Settings
1 Graph Scale/Div 10.0	▼ 0 dB		Ref LvI Offset 9. Ref Value 30.00 (10 dB dBm	Mkr	1 2.4800 GHz 8.77 dBm	2.0000 MHz	
20.0			1				200.000 kHz	
10.0							Auto Man	
-10.0							Freq Offset	1
-40.0							0.112	
-60.0								
Center 2.48 G #Res BW 100	Hz .00 kHz		#Video BW 300.0	0 kHz	Sweep Time	Span 2 MHz 1.07 ms (8001 pts		
2 Metrics								
Occu	upied Bandwidth 973.19	ı kHz		Total Power		14.1 dBm		
Tran: x dB	smit Freq Error Bandwidth	4.038 kl	HZ HZ	% of OBW Pow x dB	er	99.00 % -20.00 dB		
, ab								
<u>+</u> า	? ٦ ٢	Mar 10, 2018 3:22:23 PM						

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6.2.2. 8DPSK MODE

Channel	Frequency (MHz)	20dB bandwidth (MHz)	99% bandwidth (MHz)	Result
Low	2402	1.357	1.2067	Pass
Middle	2441	1.357	1.2073	Pass
High	2480	1.356	1.2081	Pass



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	99% E	BANDWIDTH	HIGH CH	
Spectrum Analyzer 1				🔅 Frequency v 🔆
KEYSIGHT Input: RF I RL ↔ Coupling: DC C Align: Auto/No RF F	nput Z: 50 Ω Atten: 40 dB Corrections: Off Preamp: Off Freq Ref: Int (S)	Trig: Free Run Gate: Off #IF Gain: Low	Center Freq: 2.480000000 GHz Avg Hold: 10/10 Radio Std: None	Center Frequency Settings 2.480000000 GHz
1 Graph ▼ Scale/Div 10.0 dB	Ref LvI Offset Ref Value 30.0	9.10 dB 00 dBm	Mkr1 2.4800 GHz 6.35 dBm	2.0000 MHz
Log 20.0 10.0 0.00 -10.0	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	1		200.000 kHz Auto Man
-20.0 -30.0 -40.0 -50.0				Freq Offset 0 Hz
-60.0 Center 2.48 GHz #Res BW 100.00 kHz	#Video BW 30	0.00 kHz	Span 2 MHz Sweep Time 1.07 ms (8001 pts)	
2 Metrics Cccupied Bandwidth 1 2081 M		Total Power	12.5 dPm	
Transmit Freq Error x dB Bandwidth	1.959 kHz 1.356 MHz	% of OBW Pow x dB	er 99.00 % -20.00 dB	
ミッペー?	Mar 10, 2018 3:36:23 PM			

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6.3. PEAK CONDUCTED OUTPUT POWER

LIMITS

FCC Part15 (15.247) , Subpart C RSS-247 ISSUE 2				
Section	Test Item	Limit	Frequency Range (MHz)	
FCC 15.247 (b) (1) RSS-247 Clause 5.4 (b)	Peak Conducted Output Power	1 watt or 30dBm	2400-2483.5	

TEST PROCEDURE

Connect the UUT to the spectrum Analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	≥ 20 dB bandwidth
VBW	≥RBW
Span	Approximately five times the 20 dB bandwidth
Trace	Max hold
Sweep time	Auto couple

Allow trace to fully stabilize and use peak marker function to determine the peak amplitude level.

TEST SETUP

for peak power measurement:



for average power measurement:



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RESULTS

6.3.1. GFSK MODE

Channel	Frequency	Maximum Conducted Output Power(PK)	EIRP	Result
	(MHz)	(dBm)	(dBm)	
Low	2402	8.72	8.72	Pass
Middle	2441	8.27	8.27	Pass
High	2480	8.70	8.70	Pass

Channel	Frequency	Maximum Average Conducted Output Power(dBm)	EIRP	Result
	(MHz)	(dBm)	(dBm)	
Low	2402	7.47	7.47	Pass
Middle	2441	6.76	6.76	Pass
High	2480	7.05	7.05	Pass

Note:

1. The average conducted output power is measured by power meter for calculating the tune-up power.

2. Average conducted output power = power meter reading level + duty cycle correction factor.

3. For duty cycle correction factor please refer to clause 6.1. ON TIME AND DUTY CYCLE.



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6.3.2. 8DPSK MODE

Channel	Frequency	Maximum Conducted Output Power(PK)	EIRP	Result
	(MHz)	(dBm)	(dBm)	
Low	2402	7.88	7.88	Pass
Middle	2441	7.41	7.41	Pass
High	2480	7.84	7.84	Pass

Channel	Frequency	Maximum Average Conducted Output Power(dBm)	EIRP	Result
	(MHz)	(dBm)	(dBm)	
Low	2402	3.80	3.80	Pass
Middle	2441	3.15	3.15	Pass
High	2480	3.54	3.54	Pass

Note:

1. The average conducted output power is measured by power meter for calculating the tune-up power.

2. Average conducted output power = power meter reading level + duty cycle correction factor.

3. For duty cycle correction factor please refer to clause 6.1. ON TIME AND DUTY CYCLE.



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6.4. CARRIER HOPPING CHANNEL SEPARATION

LIMITS

FCC Part15 (15.247) , Subpart C RSS-247 ISSUE 2				
Section	Test Item	Limit	Frequency Range (MHz)	
FCC 15.247 (a) (1) RSS-247 Clause 5.1 (b)	Carrier Hopping Channel Separation	25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.	2400-2483.5	

TEST PROCEDURE

Connect the UUT to the spectrum Analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test			
Span	wide enough to capture the peaks of two adjacent channels			
Detector	Peak			
RBW	≥ 1% of the span			
VBW	≥RBW			
Trace	Max hold			
Sweep time	Auto couple			

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

TEST SETUP



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RESULTS

6.4.1. GFSK MODE

Channel	Carrier Hopping Channel Separation (MHz)	Limit (MHz)	Result
Middle	1.043	≥ two-thirds of the 20 dB Bandwidth Of The Hopping Channel	PASS



Note: For 20 dB Bandwidth of The Hopping Channel, please refer to clause 6.2.1.



6.4.2. 8DPSK MODE

Channel	Carrier Hopping Channel Separation (MHz)	Limit (MHz)	Result
Middle	1.007	≥ two-thirds of the 20 dB Bandwidth Of The Hopping Channel	PASS

	Channe	el Separatio	n MID CH			
Spectrum Analyzer 1 Swept SA	• +			Frequency V		
RL Coupling: Align: Auto	Input Z: 50 Ω #Atten: 40 dB DC Corrections: Off Preamp: Off o(No RF Freq Ref: Int (S)	PNO: Best Wide # Gate: Off # IF Gain: Low 7 Sig Track: Off	#Avg Type: Power (RMS 1 2 3 Avg Hold:>100/100 Trig: Free Run P P P	4 5 6 Center Frequency 2.441500000 GHz Settings		
1 Spectrum	Ref Lvi Offset 9.1 Ref Level 30.00 d	I0 dB IBm	ΔMkr1 1.007 250 0.41	MHz 3.00000000 MHz dB Swept Span		
20.0 10.0 0.00	X_2^	12	12	Full Span		
-10.0 -20.0 -30.0				Start Freq 2.440000000 GHz		
-40.0 -50.0 -60.0				2.443000000 GHz		
Start 2.440000 GHz #Res BW 100 kHz	Start 2.440000 GHz #Video BW 300 kHz Stop 2.443000 GHz AUTO TUNE #Res BW 100 kHz Sweep 1.07 ms (8001 pts) CF Step					
5 Marker Table V Mode Trace S	Scale X Y	Function Func	tion Width Function Valu	Auto Man		
2 F 1 3 4	f 2.441 017 375 GHz 5.280 dBm			Freq Offset 0 Hz		
5				X Axis Scale Log Lin		
1 7 7	Mar 10, 2018 💬 🛆			Signal Track (Span Zoom)		

Note: For 20 dB Bandwidth of The Hopping Channel, please refer to clause 6.2.1.



6.5. NUMBER OF HOPPING FREQUENCY

<u>LIMITS</u>

FCC Part15 (15.247) , Subpart C RSS-247 ISSUE 2				
Section Test Item Limit				
15.247 (a) (1) III Number of Hopping RSS-247 Clause 5.1 (d) Frequency		at least 15 hopping channels		

TEST PROCEDURE

Connect the EUT to the spectrum Analyzer and use the following settings:

Detector	Peak
RBW	1% of the span
VBW	≥RBW
Span	The frequency band of operation
Trace	Max hold
Sweep time	Auto couple

Set EUT to transmit maximum output power and switch on frequency hopping function. then set enough count time (larger than 5000 times) to get all the hopping frequency channel displayed on the screen of spectrum analyzer.

Count the quantity of peaks to get the number of hopping channels.

Normal Mode: 79 Channels observed.

AFH Mode: 20 Channels declared.

TEST SETUP



RESULTS

6.5.1. GFSK MODE

Hopping numbers	Limit	Results
79	>15	Pass

RL + Coupling: DC Corrections: Off I Align: Auto/No RF Freq Ref: Int (S)		N∩ Fast	#Ava Type: Power			
LVI	Preamp: Off G	Sate: Off F Gain: Low Sig Track: Off	Avg Hold: 100/100 Trig: Free Run	<u>М</u> М РРРРРР 77 947 МНz	Center Frequency 2.441750000 GHz Span	Settings
Scale/Div 10 dB Re Log	f Lvl Offset 9.10 d f Level 30.00 dBm	IB 1		-0.49 dB	83.5000000 MHz Swept Span Zero Span	
		ANN	MANA MANA MANA MANA MANA MANA MANA MANA		Full Span Start Freq 2.400000000 GHz	
-40.0					Stop Freq 2.483500000 GHz AUTO TUNE	
Start 2.40000 GHz # #Res BW 100 kHz 5 Marker Table •	Video BW 300 kHz	2	Sweep 8	Stop 2.48350 GHz 8.00 ms (8001 pts)	CF Step 8.350000 MHz Auto	
Mode Trace Scale X 1 Δ2 1 f (Δ) 77.947 MHz (Δ) 2 F 1 f 2.402 046 GHz 3 4	Y F -0.4913 dB 9.251 dBm	unction Fun	iction Width	Function Value	Man Freq Offset 0 Hz	
5 6 9 Mar 10, 2018					X Axis Scale Log Lin Signal Track	

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6.5.2. 8DPSK MODE

Hopping numbers	Limit	Results
79	>15	Pass

EYSIGHT Input: RF L + Coupling: DC Align: Auto/No RF	Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)	#Atten: 40 dB Preamp: Off	PNO: Fast Gate: Off IF Gain: Low Sig Track: Off	#Avg Type: Pov Avg Hold:>100/ Trig: Free Run	wer (RMS 1 2 3 4 5 100 M WWW W P P P P P	Center Frequency 2.441750000 GHz	tings
Spectrum v cale/Div 10 dB og	F	ef LvI Offset 9.1 ef Level 30.00 d	0 dB IBm	ΔMk	r1 78.031 MH 1.14 dl	span 83.5000000 MHz Swept Span Zero Span	
0.0 .00 - Xyzlinin/m/m/m/m/m/m/m/m/m/m/m/m/m/m/m/m/m/m	www.	MANAN	uhahhhhhhhhh	Nowin	antidayatian	Full Span Start Freq 2.400000000 GHz	
0.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0					\	Stop Freq 2.483500000 GHz	
art 2.40000 GHz Res BW 100 kHz Marker Table v Mode Trace Scale	x	#Video BW 300	KHz Function F	Swee	Stop 2.48350 GH p 8.00 ms (8001 pts Function Value	Z CF Step 8.350000 MHz Auto Man	
1 <u>A2</u> 1 <u>f</u> (<u>/</u> 2 <u>F</u> 1 <u>f</u> 3 4 5 <u>6</u>	A) 78.031 MHz (2.401 983 GHz	Δ) 1.136 dB 3.369 dBm				Freq Offset 0 Hz X Axis Scale Log	

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6.6. TIME OF OCCUPANCY (DWELL TIME)

LIMITS

FCC Part15 (15.247) , Subpart C RSS-247 ISSUE 2				
Section	Test Item	Limit		
15.247 (a) (1) III RSS-247 Clause 5.1 (d)	Time of Occupancy (Dwell Time)	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 channels employed.		

TEST PROCEDURE

Connect the UUT to the spectrum Analyzer and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	1 MHz
VBW	≥RBW
Span	zero span
Trace	Max hold
Sweep time	As necessary to capture the entire dwell time per hopping channel

a. The transmitter output (antenna port) was connected to the spectrum analyzer

- b. Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz.
- c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
- d. Sweep Time is more than once pulse time.
- e. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- f. Measure the maximum time duration of one single pulse.
- g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
- h. Measure the maximum time duration of one single pulse.

A Period Time = (channel number)*0.4

For Normal Mode (79 Channel):

DH1 Time Slot: Reading * (1600/2)*31.6/(channel number) DH3 Time Slot: Reading * (1600/4)*31.6/(channel number) DH5 Time Slot: Reading * (1600/6)*31.6/(channel number)

For AFH Mode (20 Channel):

DH1 Time Slot: Reading * (1600/2)*8/(channel number) DH3 Time Slot: Reading * (1600/4)*8/(channel number) DH5 Time Slot: Reading * (1600/6)*8/(channel number)

TEST SETUP

EUT	Attenuator	Spectrum Analyzer
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RESULTS

6.6.1. GFSK MODE

Normal Mode				
Packet	Channel	Burst Width [ms/hop/ch]	Dwell Time [ms]	Results
DH1	MCH	0.384	0.123	PASS
DH3	MCH	1.638	0.524	PASS
DH5	MCH	2.888	0.924	PASS
AFH Mode				
DH1	MCH	0.384	0.123	PASS
DH3	MCH	1.638	0.524	PASS
DH5	MCH	2.888	0.924	PASS

Test Graph



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6.6.2. 8DPSK MODE

Normal Mode				
Packet	Channel	Burst Width [ms/hop/ch]	Dwell Time [ms]	Results
3DH1	MCH	0.391	0.125	PASS
3DH3	MCH	1.642	0.525	PASS
3DH5	MCH	2.883	0.923	PASS
AFH Mode				
3DH1	MCH	0.367	0.125	PASS
3DH3	MCH	1.633	0.525	PASS
3DH5	MCH	2.890	0.923	PASS

Test Graph



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6.7. CONDUCTED SPURIOUS EMISSION

LIMITS

FCC Part15 (15.247) , Subpart C RSS-247 ISSUE 2		
Section Test Item Limit		
FCC §15.247 (d) RSS-247 5.5	Conducted Spurious Emission	at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

TEST PROCEDURE

For Band-edge use the following settings:

Detector	Peak
RBW	RBW ≥ 1% of the span
VBW	≥RBW
Span	wide enough to fully capture the emission being measured
Trace	Max hold
Sweep time	Auto couple.

For Spurious Emission use the following settings:

Detector	Peak
RBW	100K
VBW	≥ RBW
Span	wide enough to fully capture the emission being measured
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum amplitude level.

TEST SETUP



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RESULTS

6.7.1. GFSK MODE

SPURIOUS EMISSIONS, LOW CHANNEL



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SPURIOUS EMISSIONS, MID CHANNEL



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SPURIOUS EMISSIONS, HIGH CHANNEL



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