

FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS-247 ISSUE 1

CERTIFICATION TEST REPORT

FOR

TABLET DEVICE

MODEL NUMBER: A1674, A1675

FCC ID: BCGA1674 IC: 579C-A1674

REPORT NUMBER: 15U22428-E1V2

ISSUE DATE: FEBRUARY 09, 2016

Prepared for APPLE, INC. 1 INFINITE LOOP CUPERTINO, CA 95014, U.S.A.

Prepared by UL VERIFICATION SERVICES INC. 47173 BENICIA STREET FREMONT, CA 94538, U.S.A. TEL: (510) 771-1000 FAX: (510) 661-0888

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NVLAP LAB CODE 200065-0

Revision History

Rev.	lssue Date	Revisions	Revised By
V1	02/03/2016	Initial Review	C. Pang
V2	02/09/2016	Addressed TCB's Questions	E. Yu

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1. ATTESTATION OF TEST RESULTS

DATE TESTED:	DECEMBER 14, 2015 – JANUARY 14, 2015
SERIAL NUMBER:	DLXQ00ZH0JF (Conducted); DLXQL01HH0JF (Radiated)
MODEL:	A1674, A1675
EUT DESCRIPTION:	TABLET DEVICE
COMPANY NAME:	APPLE, INC. 1 INFINITE LOOP CUPERTINO, CA 95014, U.S.A.

APPLICABLE STANDARDS					
STANDARD	TEST RESULTS				
CFR 47 Part 15 Subpart C	Pass				
INDUSTRY CANADA RSS-247 Issue 1	Pass				
INDUSTRY CANADA RSS-GEN Issue 4	Pass				

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL Verification Services Inc. By:

Chin Pang

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Tested By:

ERIC YU EMC ENGINEER UL VERIFICATION SERVICES INC.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 1.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
Chamber A	Chamber D
Chamber B	Chamber E
Chamber C	Chamber F
	Chamber G
	🛛 Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <u>http://ts.nist.gov/standards/scopes/2000650.htm</u>.

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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. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB) 36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	±3.52 dB
Radiated Disturbance, 30 to 1000 MHz	±4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a tablet with multimedia functions (music, application support, and video), Cellular GSM/GPRS/EGPRS/CDMA2000 1xRTT/1xAdvanced/EVDO Rev.A/WCDMA/HSPA+/DC-HSDPA/LTE FDD & Carrier Aggregation/TDD/TD-SCDMA radio, IEEE 802.11a/b/g/n/ac radio, and Bluetooth radio. The rechargeable battery is not user accessible.

5.2. DESCRIPTION OF MODELS DIFFERENCES

Model tested: A1674.The Models A1674 & A1675 have one FCC ID: BCGA1674 and IC ID: 579C-A1674

Both Model A1674 and A1675 have identical PCB layout, design and functionality, except that A1674 supports second electronic-UICC based SIM or "soft SIM" (called eSIM) beside the regular UICC based SIM and A1675 will come with eSIM removed.

RF and electromagnetic characteristic are independent of the eSIM element. Both models have exactly same technology and band support.

5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
	Basic GFSK Antenna B High Power Mode	17.18	52.24
	Enhanced 8PSK Antenna B High Power Mode	14.52	28.31
	Basic GFSK Antenna B Low Power Mode	9.60	9.12
2402 - 2480	Enhanced 8PSK Antenna B Low Power Mode	8.08	6.43
2402 - 2400	Basic GFSK Antenna D High Power Mode	12.16	16.44
	Enhanced 8PSK Antenna D High Power Mode	13.19	20.84
	Basic GFSK Antenna D Low Power Mode	5.16	3.28
	Enhanced 8PSK Antenna D Low Power Mode	6.88	4.88

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band	Antenna Gain (dBi)		
(GHz)	Antenna B	Antenna D	
2.4	-1.75	0.96	

5.5. SOFTWARE AND FIRMWARE

The software installed in the EUT during testing was 13E31820k.

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5.6. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X/Y/Z, it was determined that Y orientation was the worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y orientation.

Worst-case data rates were:

GFSK mode: DH5 8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

For simultaneous transmission of multiple channels from the same antenna in the 2.4 GHz and Cellular bands, tests were conducted for various configurations having the highest power, least separation in frequencies and widest operation bandwidths. No noticeable new emission was found. Simultaneous transmission does not support BT/BLE High Power Mode.

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5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Latitude 3540	6LNG802	N/A
Laptop AC/DC adapter	Dell	FA90PE1-00	CN-0CM889-73245-95L-4954-A00	N/A
Earphone	Apple	NA	NA	N/A
EUT AC/DC adapter	Apple	A1385	D293062F3WVDHLHCF	N/A

I/O CABLES (CONDUCTED TEST)

I/O Cable List							
Cable	Port	Remarks					
No		ports	Туре		Length (m)		
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer	
2	USB	1	USB	Shielded	1	N/A	
3	AC	1	AC	Un-shielded	3	N/A	

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None Used						

I/O CABLES (RADAITED BELOW 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Headphones Jack	1	3.5mm Audio	Shielded	0.9	N/A
2	AC	1	AC	Un-shielded	3	N/A

I/O CABLES (AC LINE CONDUCTED: AC/DC ADAPTER)

	I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks	
1	Headphones Jack	1	3.5mm Audio	Shielded	0.9	N/A	
2	AC	1	AC	Un-shielded	3	N/A	

I/O CABLES (AC LINE CONDUCTED: LAPTOP CONFIGUARTION)

	I/O Cable List							
Cable	Port	# of	Connector	Cable Type	Cable	Remarks		
No		identical	Туре		Length (m)			
1	Headphones Jack	1	3.5mm Audio	Shielded	0.9	N/A		
2	USB	1	USB	Shielded	1	N/A		
3	AC	1	AC	Un-shielded	3	N/A		

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TEST SETUP - CONDUCTED TESTS

The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

SETUP DIAGRAM



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TEST SETUP- RADIATED-ABOVE 1 GHZ

The EUT was tested battery powered. Test software exercised the EUT.

SETUP DIAGRAM



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TEST SETUP- BELOW 1GHz

The EUT was tested with earphone connected and powered by AC adapter. Test software exercised the EUT.

SETUP DIAGRAM



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TEST SETUP- AC LINE CONDUCTED: AC/DC ADAPTER

The EUT was tested with earphone connected and powered by AC/DC adapter via USB cable. Test software exercised the EUT.

SETUP DIAGRAM



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TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION

The EUT was tested with earphone connected and powered by host PC via USB cable. Test software exercised the EUT.

SETUP DIAGRAM



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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List						
Description	Manufacturer	Model	Cal Date	Cal Due		
Antenna, Horn 1-18GHz	ETS Lindgren	3117	2/10/2015	2/10/2016		
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB1	9/25/2015	9/25/2016		
Amplifier, 1 - 18GHz	Miteq	AFS42- 00101800-25-S- 42	8/12/2015	8/12/2016		
Amplifier, 1 - 18GHz	Miteq	AMF-4D- 01000800-30- 29P	8/12/2015	8/12/2016		
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	6/9/2015	6/9/2016		
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	3/31/2015	3/31/2016		
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	11/19/2015	11/19/2016		
Power Meter, P-series single channel	Agilent	N1911A	4/7/2015	4/7/2016		
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	2/27/2015	2/27/2016		
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	5/12/2015	5/12/2016		
Spectrum Analyzer, 40 GHz	Agilent	8564E	8/14/2015	8/14/2016		
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Agilent	8449B	6/29/2015	6/29/2016		
	AC Line Cor	nducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ECSI7	08/07/15	08/07/16		
LISN for Conducted Emissions CISPR-16	FCC	50/250-25-2	01/16/15	01/16/16		
LISN for Conducted Emissions CISPR-16	Fisher	50/250-2-01	09/16/15	09/16/16		
Power Cable, Line Conducted Emissions	UL	PG1	7/28/2015	7/28/2016		
	UL SOFT\	NARE				
* Radiated Software	UL	UL EMC	Ver 9.5, Ju	uly 22, 2014		
* Conducted Software	UL	UL EMC	Ver 2.2, Ma	arch 31, 2015		
* AC Line Conducted Software	UL	UL EMC	Ver 9.5, A	pril 3, 2015		

Note: * indicates automation software version used in the compliance certification testing

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7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time	Period	Duty Cycle	Duty	Duty Cycle	1/B
	В		x	Cycle	Correction Factor	Minimum VBW
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)
GFSK Ant. B High Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010
GFSK Ant. B Low Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010
8PSK Ant. B High Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010
8PSK Ant. B Low Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010
GFSK Ant. D High Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010
GFSK Ant. D Low Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010
8PSK Ant. D High Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010
8PSK Ant. D Low Power Mode	100.000	100.000	1.000	100.00%	0.00	0.010

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DUTY CYCLE PLOTS

HOPPING OFF

RL RF 50Ω	DC PN	0: Fast ↔	SENSE:IN	#Avg Ty	ALIGNAUTO	09:28:55 AM Jan 05, 2016 TRACE 1 2 3 4 5 6 TYPE WWWWWWW DET P. N N N N	Frequency
Ref Offset 11 0 dB/div Ref 25.00 d	dB d B m	ain:Low 🖡	Atten: 30 dB				Auto Tune
15.0							Center Freq 2.441000000 GHz
5.00							Start Freq 2.441000000 GHz
5.0							Stop Freq 2.441000000 GHz
5.0							CF Step 8.000000 MHz <u>Auto</u> Man
5.0							Freq Offset 0 Hz
enter 2.441000000 G	Hz					Span 0 Hz	



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7.2. ANTENNA B HIGH POWER BASIC DATA RATE GFSK MODULATION

7.2.1. 20 dB AND 99% BANDWIDTH

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to \geq 1% of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(KHz)	(KHz)
Low	2402	872.6	864.07
Middle	2441	916.6	875.68
High	2480	843.9	863.35

20 dB AND 99% BANDWIDTH



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7.2.2. HOPPING FREQUENCY SEPARATION

<u>LIMIT</u>

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



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7.2.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS





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7.2.4. AVERAGE TIME OF OCCUPANCY

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

<u>RESULTS</u>

DH Packet	Pulse	Number of	Average Time	Limit	Margin		
	Width (msec)	Pulses in 3.16 seconds	of Occupancy (sec)	(sec)	(sec)		
GFSK Norma	GFSK Normal Mode						
DH1	0.386	32	0.124	0.4	-0.276		
DH3	1.640	18	0.295	0.4	-0.105		
DH5	2.888	12	0.347	0.4	-0.053		

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PULSE WIDTH - DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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PULSE WIDTH – DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH3



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PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



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7.2.5. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	16.95	30	-13.05
Middle	2441	16.93	30	-13.07
High	2480	17.18	30	-12.82

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7.2.6. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	16.73
Middle	2441	16.69
High	2480	16.94

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7.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

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SPURIOUS EMISSIONS, LOW CHANNEL





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SPURIOUS EMISSIONS, MID CHANNEL





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SPURIOUS EMISSIONS, HIGH CHANNEL





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SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





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7.3. ANTENNA B HIGH POWER ENHANCED DATA RATE QPSK MODULATION

7.3.1. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	14.25	21	-6.72
Middle	2441	14.50	21	-6.47
High	2480	14.46	21	-6.51

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7.3.2. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	11.21
Middle	2441	11.49
High	2480	11.23

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7.4. ANTENNA B HIGH POWER ENHANCED DATA RATE 8PSK MODULATION

7.4.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to \geq 1% of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(MHz)	(MHz)
Low	2402	1.3390	1.2040
Middle	2441	1.3040	1.2201
High	2480	1.3150	1.2148

20 dB AND 99% BANDWIDTH



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7.4.2. HOPPING FREQUENCY SEPARATION

<u>LIMIT</u>

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



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7.4.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS

ente	r Freq	F 50 Ω 2.44000	0000 GI	−IZ NO: Fast G) Trig: Free	Run	Avg Type Avg Hold:	ALIGN AUTO : Log-Pwr >100/100	04:14:10 PMD TRACE TYPE DET	BC 14, 2015	Frequency
) dB/di	Re iv Re	f Offset 11 f 20.00 d	dB IBm	Gain:Low	Atten. 20	40			,		Auto Tune
		mm	~~~~~	www	******	•••••••••••	www.	·····	mm		Center Fred 2.440000000 GHz
.00										-3.02 dBm	Start Fred
D.O											2.390000000 GHz
0.0											Stop Fred 2.490000000 GH
0.0											CF Step 10.000000 MH
0.0 🏎	N. Carlow									Myre	<u>Auto</u> Mar
D.0 -											Freq Offse 0 H;
3.0											
tart 2	.39000	GHz		#\/D\M	10 MU-			Pwoon 3	Stop 2.490	00 GHz	



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7.4.4. AVERAGE TIME OF OCCUPANCY

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

RESULTS

8PSK (EDR) Mode

DH Packet	Pulse	Number of	Average	Limit	Margin
	Width	Pulses in	Time of		-
	(msec)	3.16	(sec)	(sec)	(sec)
		seconds			
3DH1	0.392	33	0.129	0.4	-0.271
3DH3	1.644	19	0.312	0.4	-0.088
3DH5	2.892	13	0.376	0.4	-0.024

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PULSE WIDTH - 3DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - 3DH1



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PULSE WIDTH – 3DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - 3DH3



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PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5



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7.4.5. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	14.28	21	-6.69
Middle	2441	14.52	21	-6.45
High	2480	14.50	21	-6.47

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7.4.6. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	11.23
Middle	2441	11.50
High	2480	11.26

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7.4.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

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SPURIOUS EMISSIONS, LOW CHANNEL





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SPURIOUS EMISSIONS, MID CHANNEL





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SPURIOUS EMISSIONS, HIGH CHANNEL





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SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





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7.5. ANTENNA B LOW POWER BASIC DATA RATE GFSK MODULATION

7.5.1. 20 dB AND 99% BANDWIDTH

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to \geq 1% of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth		
	(MHz)	(KHz)	(KHz)		
Low	2402	920.8	890.13		
Middle	2441	920.1	880.46		
High	2480	873.3	885.89		

20 dB AND 99% BANDWIDTH



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7.5.2. HOPPING FREQUENCY SEPARATION

<u>LIMIT</u>

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



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7.5.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS

enter Free	RF 50 Ω] 2.44000	DC	Hz PNO: Fast 🕞	SEN	Run	Avg Type Avg Hold:	ALIGNAUTO 3: Log-Pwr :>100/100	11:21:56 AM TRACE TYPE	Dec 14, 2015	Frequency
dB/div F	tef Offset 11 tef 20.00 c	dB 1Bm	Gain:Low	Atten: 20	dБ				p	Auto Tune
0.0		mm		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		mmm	*******	www		Center Freq 2.440000000 GHz
0.0									-9.71 dBm	Start Fred 2.390000000 GHz
0.0										Stop Frec 2.49000000 GH;
										CF Step 10.000000 MH Auto Mar
0.0										Freq Offse 0 H
1.0 tart 2.3900	0 GHz							Stop 2.49	000 GHz	



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7.5.4. AVERAGE TIME OF OCCUPANCY

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

<u>RESULTS</u>

DH Packet	Pulse	Number of	Average Time	Limit	Margin
	Width (msec)	Pulses in 3.16 seconds	of Occupancy (sec)	(sec)	(sec)
GFSK Norma	al Mode				
DH1	0.385	33	0.127	0.4	-0.273
DH3	1.640	19	0.312	0.4	-0.088
DH5	2.892	12	0.347	0.4	-0.053

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PULSE WIDTH - DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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PULSE WIDTH – DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH3



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PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



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7.5.5. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	9.60	30	-20.40
Middle	2441	9.05	30	-20.95
High	2480	8.58	30	-21.42

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7.5.6. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	9.49
Middle	2441	8.96
High	2480	8.47

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7.5.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

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SPURIOUS EMISSIONS, LOW CHANNEL





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SPURIOUS EMISSIONS, MID CHANNEL





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SPURIOUS EMISSIONS, HIGH CHANNEL





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SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





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7.6. ANTENNA B LOW POWER ENHANCED DATA RATE QPSK MODULATION

7.6.1. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	8.05	21	-12.92
Middle	2441	7.99	21	-12.98
High	2480	7.62	21	-13.35

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7.6.2. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	5.48
Middle	2441	5.46
High	2480	5.15

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7.7. ANTENNA B LOW POWER ENHANCED DATA RATE 8PSK MODULATION

7.7.1. 20 dB AND 99% BANDWIDTH

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to \geq 1% of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(MHz)	(MHz)
Low	2402	1.3690	1.2097
Middle	2441	1.3570	1.2335
High	2480	1.3280	1.2218

20 dB AND 99% BANDWIDTH



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7.7.2. HOPPING FREQUENCY SEPARATION

<u>LIMIT</u>

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



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7.7.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS

enter Fre	rf 50 Ω 0 q 2.440000	C 000 GHz PN0	:Fast 🕞	SEN	Run	Avg Type Avg Hold:	ALIGN AUTO : Log-Pwr >100/100	02:05:06 PMD TRACE TYPE	ec 14, 2015	Frequency
D dB/div	Ref Offset 11 dE Ref 20.00 dB	IFGai 3 m	n:Low	Atten: 20	dB			Denj		Auto Tune
og 10.0		www	******	wwww	~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	vmmm	mmy		Center Fred 2.440000000 GHz
0.0									-10.19 dBm	Start Fred 2.390000000 GHz
0.0										Stop Frec 2.490000000 GH;
									Unatan	CF Step 10.000000 MH: <u>Auto</u> Mar
).0										Freq Offse 0 H:
^{3.0}	0 GHz							Stop 2.490)00 GHz	



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7.7.4. AVERAGE TIME OF OCCUPANCY

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

RESULTS

8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
3DH1	0.399	33	0.132	0.4	-0.268
3DH3	1.644	19	0.312	0.4	-0.088
3DH5	2.888	13	0.375	0.4	-0.025

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NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - 3DH1



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PULSE WIDTH – 3DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - 3DH3



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PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5



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7.7.5. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	8.08	21	-12.89
Middle	2441	8.02	21	-12.95
High	2480	7.62	21	-13.35

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7.7.6. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	5.50
Middle	2441	5.48
High	2480	5.18

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7.7.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

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SPURIOUS EMISSIONS, LOW CHANNEL





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SPURIOUS EMISSIONS, MID CHANNEL





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SPURIOUS EMISSIONS, HIGH CHANNEL

L RF 5	50 Ω DC	SENSE:INT	ALIGN AUTO	09:24:42 AM Jan 14, 2016	_
nter Freq 2.483	3500000 GHz PNO: Wide IEGain:Low	Trig: Free Run Atten: 20 dB	#Avg Type: RMS Avg Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE M WWWWWW DET P N N N N N	Frequency
Ref Offse dB/div Ref 20.0	t 11 dB 00 dBm		Mkr3	2.480 050 GHz 4.495 dBm	Auto Tune
9 0.0	3				Center Free
.00					2.483500000 GH
0.0				-15.50 dBm	
1.0	m m				Start Free 2.476000000 GH:
1.0 .0		han 132			04 F
).0		mather	an and a strength and a st	anna an anna an an an an an an an an an	2.491000000 GH:
enter 2.483500 G Res BW 100 kHz	Hz #VI	300 kHz	Sweep 1	Span 15.00 MHz .000 ms (1001 pts)	CF Stej 1.500000 MH
KR MODE TRC SCL	X 2.493.500 CH-	Y F	UNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Ma
1 N 1 F 2 N 1 F 3 N 1 F	2.483 500 GHz 2.483 695 GHz 2.480 050 GHz	-57.092 dBm 4.495 dBm			Freq Offse
5 6				=	UH
7 8 9					
9					



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SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





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7.8. ANTENNA D HIGH POWER BASIC DATA RATE GFSK MODULATION

7.8.1. 20 dB AND 99% BANDWIDTH

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to \geq 1% of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(KHz)	(KHz)
Low	2402	896.50	880.23
Middle	2441	920.30	888.52
High	2480	920.70	871.08

20 dB AND 99% BANDWIDTH



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7.8.2. HOPPING FREQUENCY SEPARATION

<u>LIMIT</u>

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



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7.8.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS





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7.8.4. AVERAGE TIME OF OCCUPANCY

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

<u>RESULTS</u>

DH Packet	Pulse	Number of	Average Time	Limit	Margin
	Width (msec)	Pulses in 3.16 seconds	of Occupancy (sec)	(sec)	(sec)
GFSK Norma	al Mode	-	-		_
DH1	0.383	32	0.123	0.4	-0.277
DH3	1.640	16	0.262	0.4	-0.138
DH5	2.886	12	0.346	0.4	-0.054

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PULSE WIDTH - DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



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PULSE WIDTH – DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH3



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PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH5



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7.8.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	12.16	30	-17.84
Middle	2441	12.02	30	-17.98
High	2480	12.08	30	-17.92

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7.8.6. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power
	(MHz)	(dBm)
Low	2402	11.85
Middle	2441	11.73
High	2480	11.79

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7.8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

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SPURIOUS EMISSIONS, LOW CHANNEL





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SPURIOUS EMISSIONS, MID CHANNEL





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SPURIOUS EMISSIONS, HIGH CHANNEL





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SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





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7.9. ANTENNA D HIGH POWER ENHANCED DATA RATE QPSK MODULATION

7.9.1. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	13.02	21	-7.95
Middle	2441	13.16	21	-7.81
High	2480	13.13	21	-7.84

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7.9.2. AVERAGE POWER

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency	Average Power	
	(MHz)	(dBm)	
Low	2402	10.23	
Middle	2441	10.48	
High	2480	10.47	

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7.10. ANTENNA D HIGH POWER ENHANCED DATA RATE 8PSK MODULATION

7.10.1. 20 dB AND 99% BANDWIDTH

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to \geq 1% of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(MHz)	(MHz)
Low	2402	1.3140	1.1958
Middle	2441	1.3290	1.1077
High	2480	1.3440	1.2084

20 dB AND 99% BANDWIDTH



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7.10.2. HOPPING FREQUENCY SEPARATION

<u>LIMIT</u>

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, 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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION

RL RF 50 Ω DC	PNO: Wide	SENSE:INT	ALIGN AUTO #Avg Type: RMS	09:58:06 PMDec 14, 2015 TRACE 1 2 3 4 5 6 TYPE MWWWW	Frequency
Ref Offset 11 dB 10 dB/div Ref 30.00 dBm			۵N	Auto Tune	
20.0	13-Best for free free free free free free free		1Δ2	What was a series of the	Center Fred 2.441000000 GHz
0.00					Start Fred 2.438500000 GHz
20.0					Stop Fred 2.443500000 GHz
10.0					CF Step 500.000 kHz <u>Auto</u> Mar
0.0					Freq Offset 0 Hz
20.0				Spap 5 000 MHz	

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7.10.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS





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