

FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

HANDHELD COMPUTING DEVICE

MODEL NUMBER: 1573

FCC ID: C3K1573 IC: 3048A-1573

REPORT NUMBER: 13U15414-15A

ISSUE DATE: FEBRUARY 11, 2014

Prepared for MICROSOFT CORPORATION ONE MICROSOFT WAY REDMOND, WA 98052, U.S.A.

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NVLAP LAB CODE 200065-0

Revision History

Rev.	lssue Date	Revisions	Revised By
-	11/10/13	Initial Issue	T. LEE
А	02/11/14	Update sections 8.1.4 and 8.2.4 with AFH calculation tables.	D. Garcia

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Pass

1. ATTESTATION OF TEST RESULTS

INDUSTRY CANADA RSS-GEN Issue 3

COMPANY NAME:	MICROSOFT CORPORATION ONE MICROSOFT WAY REDMOND, WA 98052, U.S.A.	
EUT DESCRIPTION:	HANDHELD COMPUTING DEV AND BLUETOOTH RADIOS	ICE WITH 802.11 A/B/G/N WLAN
MODEL:	1573	
SERIAL NUMBER:	001925433252	
DATE TESTED: OCTOBER 23, 2013 – OCTOBER 29, 2013		
	APPLICABLE STANDARDS	
:	STANDARD	TEST RESULTS
CFR 47	' Part 15 Subpart C	Pass
INDUSTRY CANA	DA RSS-210 Issue 8 Annex 8	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:

TIMOTHY LEE WISE PROGRAM MANAGER UL Verification Services Inc.

Tested By:

Joe Vang EMC ENGINEER UL Verification Services Inc.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <u>http://www.ccsemc.com</u>.

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 hand held computing device with 802.11 a/b/g/n WLAN and Bluetooth radios.

The unit supports AFH mode. The manufacturer attested the following.

- It is in compliance with Bluetooth Specification 1.2 or later specification.
- The number of hopping channels in AFH mode is 20 channels
- The output power does not transmit over 125 mW
- The channel separation is based upon 2/3 of 20 dB channel bandwidth

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range	Juency Range Mode		Output Power
(MHz)		(dBm)	(mW)
2402 - 2480	Basic GFSK	8.93	7.82
2402 - 2480	Enhanced 8PSK	7.36	5.45

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of 3.1 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Window RT 8.1 Preview Build 943

The test utility software used during testing was Laptool 189.1.0.9.0\ WIFI Tool.exe

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5.5. 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 Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

Conducted measurement was conducted on Model 1572 under FCC ID C3K1572. Model 1572 are identical to Model 1573 except Model 1573 includes the WWAN radio.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List							
Description Manufacturer Model Serial Number FCC ID							
USB Ethernet Adaptor	CISCO	USB 300M	CU90MC02233	DoC			
Laptop	Lenovo	L420	7854CT0	DoC			
AC Adaptor (laptop)	Lenovo	92P1156	111S92P1156ZDXN272091	N/A			

I/O CABLES

	I/O Cable List								
Cable	Cable Port # of identical		Connector	Cable Type	Cable	Remarks			
No		ports	Туре		Length (m)				
1	AC	1	AC	Unshielded	1.8	AC adapter			
2	USB	1	USB	Unshielded	0.1	USB to Ethernet adapter			
3	DC	1	DC	Unshielded	1.8				
4	Ethernet	1	RJ 45	Unshielded	7.62	Connects to USB adapter			

TEST SETUP

The EUT is a standalone wireless handheld computing device. Test software exercised the wireless module installed within the device under test.

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SETUP DIAGRAM FOR TESTS



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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	Asset	Cal Date	Cal Due			
Bilog 30-1000MHz	Sunol	JB1	C01011	02/07/12	03/28/14			
LISN, 30 MHz	FCC	LISN-50/250-25-	N02625	01/14/13	01/14/14			
Power meter	Agilent	N119A	T198	06/25/12	12/13/13			
Power Sensor	Agilent	E9323A	T397	06/26/12	04/02/14			
Spectrum Analyzer, 26 GHz	Agilent / HP	E4440A	C01176	10/21/12	12/13/13			
Spectrum Analyzer	Agilent	N9030A	F00128	2/22/2013	2/22/2014			
Horn Antenna, 1-18GHz	ETS Lindgren	3117	F00133	2/19/2013	2/19/2014			
Antenna, Biconolog, 30MHz-1	Sunol Sciences	JB3	F00168	3/7/2013	3/7/2014			
High Pass Filter, fc: 3.0GHz, 50	Micro-Tronics	HPM17543	F00180	8/24/2013	8/24/2014			
Low Pass Filter, fc: 5GHz, 50 O	Micro-Tronics	LPS17541	F00174	8/24/2013	8/24/2014			
RF PreAmplifier, 1-18GHz	Miteq	To Be Determine	F00353	8/24/2013	8/24/2014			
Amplifier	Sonoma	310	F00008	11/6/2012	11/6/2013			

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7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

7.1.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time	Period	Duty Cycle	Duty	Duty Cycle	1/T
	В		x	Cycle	Correction Factor	Minimum VBW
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)
GFSK	2.884	3.751	0.769	76.9%	1.14	0.347
8PSK	2.869	3.751	0.765	76.5%	1.16	0.349

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8. ANTENNA PORT TEST RESULTS

8.1. BASIC DATA RATE GFSK MODULATION

8.1.1. 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	1.018	826.1347
Middle	2441	1.018	847.7085
High	2480	1.017	826.4963

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20 dB BANDWIDTH





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99% BANDWIDTH





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8.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

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 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

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HOPPING FREQUENCY SEPARATION



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8.1.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 nonoverlapping 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.

<u>RESULTS</u>

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS



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8.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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.

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)			
GFSK Norma	GFSK Normal Mode							
DH1	0.3833	32	0.123	0.4	-0.277			
DH3	1.617	16	0.259	0.4	-0.141			
DH5	2.833	10	0.283	0.4	-0.117			

RESULTS

AFH Calculations

DH Packet	Pulse Width (msec)	Number of Pulses in 8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.3833	8	0.031	0.8	-0.769
DH3	1.617	4	0.065	0.8	-0.735
DH5	2.833	3	0.072	0.8	-0.728

AFH # of pulses calculation formula: (8*(# of pulses in normal hopping/3.16)/10)

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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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8.1.5. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency	Output Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	2402	8.93	30	-21.07
Middle	2441	8.71	30	-21.29
High	2480	8.45	30	-21.55

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OUTPUT POWER



🔆 Agilent 20:1	7:46 Aug 20, 2013		R T	Peak Search
Ref 20 dBm #Peak	#Atten 20 dB		Mkr1 2.440 850 GHz 8.71 dBm	Next Peak
H eak Log 10 dB/		1		Next Pk Right
dB				Next Pk Left
#PAvg				Min Search
V1 S2 S3 FC				Pk-Pk Search
¤(f): FTun Swp				Mkr © C
Center 2.441 000 #Res BW 3 MHz) GHz	VBW 3 MHz	Span 5 MHz #Sweep 100 ms (601 pts)	More 1 of 2

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K Aglient 20	:16:52 Aug 2	.0, 2013	R I	Peak Search
tef 20 dBm	#Atte	n 20 dB	Mkr1 2.479 850 GHz 8.45 dBn	Next Peak
Peak .og		1		
0 B/				Next Pk Right
0.8 B				Next Pk Left
PAvg				Min Search
/1 S2 i3 FC				Pk-Pk Search
(f): Tun				Mkr © C
Center 2.480 0	00 GHz		Span 5 Mi	Iz More

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8.1.6. 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 10.75dB (including 10 dB pad and .75dB 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	7.62
Middle	2441	7.45
High	2480	7.18

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8.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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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8.2. ENHANCED DATA RATE 8PSK MODULATION

8.2.1. 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.

<u>RESULTS</u>

Channel	Frequency	20 dB Bandwidth	99% Bandwidth
	(MHz)	(kHz)	(kHz)
Low	2402	1325	1186.8
Middle	2441	1321	1189.8
High	2480	1304	1216.2

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20 dB BANDWIDTH





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BANDWIDTH HIG	GH CH 20, 2013		RТ	Measure
Ch Freq 2. Occupied Bandwidth	48 GHz		Trig Free	Meas Off
				Channel Power
Ref 20 dBm #Atte #Peak	en 20 dB			Occupied BW
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			A	ACF
dB			Span 3 MHz	Multi Carrier Power
#Res BW 20 kHz	VBW 62 kHz	Sweep 7.16	ms (601 pts)	Power Stat
Occupied Bandv 1.20	vidth 013 MHz	Occ BW % Pwr x dB	99.00 % -20.00 dB	CCD
Transmit Freq Error x dB Bandwidth	-2.331 kHz 1.304 MHz			More 1 of 2
Neg.Trig Delay unavailable ir	n Swept Mode, zero dela	ay used.		

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99% BANDWIDTH





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	Meacure
Ch Freq 2.48 GHz Trig Free	Meas Off
Occupied Bandwidth Averages: 100	Channel Power
Ref 20 dBm #Atten 20 dB #Samp	Occupied BW
Log 10 dB/ offst 	ACF
10.8 dB Center 2.480 000 GHz Span 2 MHz	Multi Carrier Power
#Res BW 20 kHz VBW 62 kHz #Sweep 100 ms (601 pts) Occupied Bandwidth Occ BW % Pwr 99.00 %	Power Stat CCD
1.2162 MHz × dB -26.00 dB Transmit Freq Error -482.098 Hz -28.00 dB x dB Bandwidth 1.384 MHz* -26.00 dB	More 1 of 2
Neg.Trig Delay unavailable in Swept Mode, zero delay used.	<u>u</u> r

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8.2.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

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 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

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HOPPING FREQUENCY SEPARATION



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8.2.3. NUMBER OF HOPPING CHANNELS

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 nonoverlapping 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.

<u>RESULTS</u>

Normal Mode: 79 Channels observed.

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NUMBER OF HOPPING CHANNELS





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Agilent 22	09:58 Aug 20	0, 2013					R	Т	Freq/Channel
Ref 20 dBm ≇Peak	#Atte	n 20 dB							Center Freq 2.44500000 GHz
Log 10 dB/									Start Freq 2.43000000 GHz
ID.8 IB	<u>.</u>			Y V Y	V V	· · · · · ·		· · · · ·	Stop Freq 2.46000000 GHz
éPA∨g									CF Step 3.0000000 MHz <u>Auto Ma</u>
/1 S2 53 FC									Freq Offset 0.00000000 Hz
i(f): Tun Swp									Signal Track On <u>Off</u>
Start 2.430 00	GHz Hz		/BW/1 M	147	#6	Stop	2.460 00	GHz	



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8.2.4. AVERAGE TIME OF OCCUPANCY

<u>LIMIT</u>

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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>

Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

DH Packet	Pulse	Number of	Average	Limit	Margin
	(msec)	3.16	(sec)	(sec)	(sec)
		seconds			
DH1	0.40	33	0.132	0.4	-0.268
DH3	1.63	14	0.229	0.4	-0.171
DH5	2.86	10	0.286	0.4	-0.114

8PSK (EDR) Mode

AFH Calculations

DH Packet	Packet Pulse Number of Width (msec) Seconds		Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
8PSK Norma	I Mode				
DH1	0.3833	8	0.032	0.8	-0.768
DH3	1.617	4	0.057	0.8	-0.743
DH5	2.833 3		0.072	0.8	-0.728

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AFH # of pulses calculation formula: (8*(# of pulses in normal hopping/3.16)/10)

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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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8.2.5. OUTPUT POWER

<u>LIMIT</u>

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency	Output Power	Limit	Margin		
	(MHz)	(dBm)	(dBm)	(dB)		
Low	2402	7.36	30	-22.64		
Middle	2441	7.16	30	-22.84		
High	2480	6.89	30	-23.11		

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OUTPUT POWER





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	10.20 1 109 20, 20				
Ref 20 dBm	#Atten 20	dB	Mkr1 2	2.479 908 GHz 6.89 dBm	Next Peak
Peak					
10 IB/			+		Next Pk Right
Offst 0.8 B					Next Pk Left
PA∨g					Min Search
/1 S2 53 FC					Pk-Pk Search
1(f):					Mkr © C
Swp					
Center 2.480 00	DO GHZ		#C 100	Span 5 MHz	More 1 of 2

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8.2.6. 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 10.8dB (including 10 dB pad and .75dB 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	4.11
Middle	2441	3.92
High	2480	3.68

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8.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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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9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

<u>LIMITS</u>

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and reduced video bandwidth technique for average measurements. The analyzer is set to power averaging mode for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





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RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





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RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





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HARMONICS AND SPURIOUS EMISSIONS

GFSK, LOW CHANNEL, 2402 MHz





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HORIZONTAL AND VERTICAL DATA

Radiated Emissions

Mark er	Freque ncy (GHz)	Meter Readin g (dBuV)	Det	AF T346 (dB/m)	Amp/C bl/10d B Pad	Correc ted Readin g (dBuV/ m)	Avg Limit (dBuV/ m)	Margi n (dB)	Peak Limit (dBuV/ m)	Margi n (dB)	Azimut h (Degs)	Heigh t (cm)	Polarit y
1	1.187	45.46	РК	28.9	-27.7	46.66	53.97	-7.31	74	-27.34	0-360	199	Н
2	1.535	45.47	РК	29	-26.5	47.97	53.97	-6	74	-26.03	0-360	100	V
7	1.183	37.98	Avg	28.9	-27.8	39.08	53.97	-14.89	-	-	0-360	199	Н
8	1.525	37.15	Avg	29	-26.5	39.65	53.97	-14.32	-	-	0-360	199	V

Mark	Freque	Meter	Det	AF	Amp/C	Correc	Avg	Margi	Peak	Margi	Azimut	Heigh	Polarit
er	ncy			T346	bl/3GH	ted	Limit	n	Limit	n	h	t	у
		Readin		(dB/m)	z HPF		(dBuV/		(dBuV/				
	(GHz)	g				Readin	m)	(dB)	m)	(dB)	(Degs)	(cm)	
						g							
		(dBuV)											
						(dBuV/							
						m)							
3	6.429	41.16	РК	35.8	-29.3	47.66	53.97	-6.31	74	-26.34	0-360	199	н
4	6.596	40.65	РК	35.8	-28.7	47.75	53.97	-6.22	74	-26.25	0-360	199	н
5	5.802	41.74	РК	35.5	-30	47.24	53.97	-6.73	74	-26.76	0-360	100	V
6	8.336	38.82	РК	36.2	-26.7	48.32	53.97	-5.65	74	-25.68	0-360	100	V

PK - Peak detector

Av - average detection

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GFSK, MID CHANNEL, 2441 MHz





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HORIZONTAL AND VERTICAL DATA

Radiated Emissions

Mark er	Freque ncy (GHz)	Meter Readin g (dBuV)	Det	AF T346 (dB/m)	Amp/C bl/10d B Pad	Correc ted Readin g (dBuV/	Avg Limit (dBuV/ m)	Margi n (dB)	Peak Limit (dBuV/ m)	Margi n (dB)	Azimut h (Degs)	Heigh t (cm)	Polarit y
						,							
1	1.513	44.57	РК	28.9	-26.5	46.97	53.97	-7	74	-27.03	0-360	199	Н
7	1.512	36.72	Avg	28.9	-26.5	39.12	53.97	-14.85	-	-	0-360	199	Н

Mark	Freque	Meter	Det	AF	Amp/C	Correc	Avg	Margi	Peak	Margi	Azimut	Heigh	Polarit
er	ncy			Т346	bl/3GH	ted	Limit	n	Limit	n	h	t	У
		Readin		(dB/m)	z HPF		(dBuV/		(dBuV/				
	(GHz)	g				Readin	m)	(dB)	m)	(dB)	(Degs)	(cm)	
		() -				g							
		(dBuV)				· · - · · ·							
						(dBuV/							
						m)							
2	7 2 2 2	40.08	Dν	26	20.1	10 00	E2 07	E 00	74	25 12	0.260	100	ц
2	7.525	40.98	PK	50	-20.1	40.00	55.97	-5.09	74	-25.12	0-500	199	п
3	9 305	37 37	РК	37.2	-25.3	49 27	53 97	-4 7	74	-24 73	0-360	199	н
5	5.505	57.57	· · ·	57.2	23.5	13.27	55.57	,	<i>,</i> ,	21.75	0 500	155	
4	3.112	42.18	РК	33.3	-31.3	44.18	53.97	-9.79	74	-29.82	0-360	100	V
5	7.324	43.73	РК	36	-28.1	51.63	53.97	-2.34	74	-22.37	0-360	200	V
6	8.984	37.78	РК	36.8	-25.5	49.08	53.97	-4.89	74	-24.92	0-360	100	V

Avg - Video bandwidth < Resolution bandwidth

PK - Peak detector

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Frequen cy (GHz)	Meter Readin g (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl /3GHz HPF	Correct ed Reading (dBuV/	Avg Limit (dBuV/ m)	Margi n (dB)	Peak Limit (dBuV/ m)	Margi n (dB)	Azimut h (Degs)	Heigh t (cm)	Polarit Y
7.323	28.82	Av	36	-28.1	36.72	53.97	-17.25	-	-	335	384	Н
9.302	22.28	Av	37.2	-25.3	34.18	53.97	-19.79	-	-	0	301	Н
7.323	25.93	Av	36	-28.1	33.83	53.97	-20.14	-	-	79	247	V
8.983	22.76	Av	36.8	-25.5	34.06	53.97	-19.91	-	-	345	367	V

Av - average detection

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GFSK, HIGH CHANNEL, 2480 MHz





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HORIZONTAL AND VERTICAL DATA

Radiated Emissions

Mark	Freque	Meter	Det	AF	Amp/C	Correc	Avg	Margi	Peak	Margi	Azimut	Heigh	Polarit
er	ncy			T346	bl/10d	ted	Limit	n	Limit	n	h	t	У
		Readin		(dB/m)	B Pad		(dBuV/		(dBuV/				
	(GHz)	g				Readin	m)	(dB)	m)	(dB)	(Degs)	(cm)	
						g							
		(dBuV)											
						(dBuV/							
						m)							
1	2.197	44.95	PK	32.3	-25.3	51.95	53.97	-2.02	74	-22.05	0-360	199	Н
2	2.645	44.98	PK	33	-24.2	53.78	53.97	19	74	-20.22	0-360	199	V
7	2.202	37.17	Avg	32.3	-25.3	44.17	53.97	-9.8	-	-	0-360	199	Н
8	2.663	37.25	Avg	33	-24.2	46.05	53.97	-7.92	-	-	0-360	199	V

Mark	Freque	Meter	Det	AF	Amp/C	Correc	Avg	Margi	Peak	Margi	Azimut	Heigh	Polarit
er	ncy			T346	bl/3GH	ted	Limit	n	Limit	n	h	t	У
		Readin		(dB/m)	z HPF		(dBuV/		(dBuV/				
	(GHz)	g				Readin	m)	(dB)	m)	(dB)	(Degs)	(cm)	
						g							
		(dBuV)											
						(dBuV/							
						m)							
3	3.308	42.18	РК	33.3	-31.8	43.68	53.97	-10.29	74	-30.32	0-360	100	н
4	7.441	40.15	РК	36.1	-28.8	47.45	53.97	-6.52	74	-26.55	0-360	100	н
5	3.256	42.46	РК	33.4	-32.1	43.76	53.97	-10.21	74	-30.24	0-360	200	V
6	7.441	46.11	РК	36.1	-28.8	53.41	53.97	56	74	-20.59	0-360	100	V

Frequen	Meter	Det	AF T346	Amp/Cbl	Correct	Avg	Margi	Peak	Margi	Azimut	Heigh	Polarit
су			(dB/m)	/3GHz	ed	Limit	n	Limit	n	h	t	У
	Readin			HPF		(dBuV/		(dBuV/				
(GHz)	g				Reading	m)	(dB)	m)	(dB)	(Degs)	(cm)	
	(dBuV)				(dBuV/							
					m)							
7.44	32.7	Av	36.1	-28.8	40	53.97	-13.97	-	-	355	222	V

PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

Av - average detection

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9.2.2. ENHANCED DATA RATE 8PSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, PEAK, HORIZ lent Spectrum Anal 201 RL RF 150 0 C Start Freq 2.310000000 GHz PN0: Fast Freq 2.310000000 GHz IFGain:High #Atten: 0 dB 0 02:46:31 PM Oct 29, 2013 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P S N N N Frequency #Avg Type: RMS Auto Tune Mkr1 2.326 67 GHz 50.07 dBµV Ref Offset 9.64 dB Ref 96.63 dBµV I0 dB/div **Center Freq** 2.350000000 GHz Start Freq 2.310000000 GHz Stop Freq 2 39000000 GHz 46 CF Step 8.000000 MHz Man Auto 26 Freq Offset 0 Hz Start 2.31000 GHz Stop 2.39000 GHz #Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.00 ms (601 pts) STATUS



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RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





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RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





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HARMONICS AND SPURIOUS EMISSIONS

8PSK, LOW CHANNEL, 2402 MHz





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Radiated Emissions

Mark er	Freque ncy (GHz)	Meter Readin g (dBuV)	Det	AF T120 (dB/m)	Amp/C bl/3GH z HPF	Correc ted Readin g (dBuV/ m)	Avg Limit (dBuV/ m)	Margi n (dB)	Peak Limit (dBuV/ m)	Margi n (dB)	Azimut h (Degs)	Heigh t (cm)	Polarit Y
1	3.828	39.46	РК	33.6	-28.6	44.46	53.97	-9.51	74	-29.54	0-360	199	Н
2	5.039	39.88	РК	34.1	-27.6	46.38	53.97	-7.59	74	-27.62	0-360	100	Н
3	8.443	37.07	РК	36	-24.9	48.17	53.97	-5.8	74	-25.83	0-360	100	Н
4	4.81	39.71	РК	34.1	-27.3	46.51	53.97	-7.46	74	-27.49	0-360	101	V
5	5.452	38.71	РК	34.7	-27.6	45.81	53.97	-8.16	74	-28.19	0-360	101	V
6	7.626	37.3	РК	35.9	-25.7	47.5	53.97	-6.47	74	-26.5	0-360	101	V

Frequen	Meter	Det	AF T120	Amp/Cb	Correct	Avg	Margi	Peak	Margi	Azimut	Heigh	Polarit
су			(dB/m)	l/3GHz	ed	Limit	n	Limit	n	h	t	У
	Readin			HPF		(dBuV/		(dBuV/				
(GHz)	g				Reading	m)	(dB)	m)	(dB)	(Degs)	(cm)	
	(dBuV)				(dBuV/							
					m)							
8.448	23.92	VB1T	36	-24.9	35.02	53.97	-18.95	-	-38.98	-	125	н

PK - Peak detector

VB 1/T - FHSS Method: Reduced Video Bandwidth

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8PSK, MID CHANNEL, 2441 MHz





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Radiated Emissions

Mark	Freque	Meter	Det	AF	Amp/C	Correc	Avg	Margi	Peak	Margi	Azimut	Heigh	Polarit
er	ncy			T120	bl/3GH	ted	Limit	n	Limit	n	h	t	У
		Readin		(dB/m)	z HPF		(dBuV/		(dBuV/		<i>i</i>		
	(GHz)	g				Readin	m)	(dB)	m)	(dB)	(Degs)	(cm)	
		(dp)/)				g							
		(UBUV)											
						(UBUV) m)							
						,							
1	4.527	39.25	РК	34	-27.7	45.55	53.97	-8.42	74	-28.45	0-360	199	Н
2	5.062	38.58	PK	34.1	-27.1	45.58	53.97	-8.39	74	-28.42	0-360	199	Н
3	7.322	39.44	РК	35.7	-26.8	48.34	53.97	-5.63	74	-25.66	0-360	199	н
4	3.625	41.57	РК	33.7	-29.2	46.07	53.97	-7.9	74	-27.93	0-360	101	V
5	4.789	39.6	PK	34.1	-27.8	45.9	53.97	-8.07	74	-28.1	0-360	200	V
	7.000	40.70			26.0	40.00	50.07	4.05			0.000	101	
6	7.323	40.72	РК	35.7	-26.8	49.62	53.97	-4.35	74	-24.38	0-360	101	V

Frequen cy	Meter	Det	AF T120 (dB/m)	Amp/Cb l/3GHz	Correct ed	Avg Limit	Margi n	Peak Limit	Margi n	Azimut h	Heigh t	Polarit y
(GHz)	Readin g			HPF	Reading	(dBuV/ m)	(dB)	(dBuV/ m)	(dB)	(Degs)	(cm)	
	(dBuV)				(dBuV/ m)							
7.323	27.73	VB1T	35.7	-26.8	36.63	53.97	-17.34	-	-	329	160	Н
7.323	33.6	VB1T	35.7	-26.8	42.5	53.97	-11.47	-	-	0	305	V

PK - Peak detector

VB 1/T - FHSS Method: Reduced Video Bandwidth

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8PSK, HIGH CHANNEL, 2480 MHz





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Radiated Emissions

Mark	Freque	Meter	Det	AF 1120	Amp/C	Correc	Avg	Margi	Peak	Margi	Azimut	Heigh +	Polarit
er	ncy (GHz)	Readin g (dBuV)		(dB/m)	z HPF	ted Readin g	(dBuV/ m)	n (dB)	(dBuV/ m)	n (dB)	n (Degs)	t (cm)	У
						m)							
1	3.579	39.42	РК	33.6	-28.7	44.32	53.97	-9.65	74	-29.68	0-360	100	н
2	5.072	38.21	РК	34.1	-27.1	45.21	53.97	-8.76	74	-28.79	0-360	199	Н
3	8.124	37.76	РК	36	-25.6	48.16	53.97	-5.81	74	-25.84	0-360	199	Н
4	3.633	39.99	РК	33.7	-29.4	44.29	53.97	-9.68	74	-29.71	0-360	201	V
5	4.727	40.27	РК	34.1	-28.7	45.67	53.97	-8.3	74	-28.33	0-360	201	V
6	7.44	39.62	РК	35.8	-26.2	49.22	53.97	-4.75	74	-24.78	0-360	101	V

Frequen cy (GHz)	Meter Readin g	Det	AF T120 (dB/m)	Amp/Cb I/3GHz HPF	Correct ed Reading	Avg Limit (dBuV/ m)	Margi n (dB)	Peak Limit (dBuV/ m)	Margi n (dB)	Azimut h (Degs)	Heigh t (cm)	Polarit Y
	(dBuV)				(dBuV/ m)							
8.124	24.76	VB1T	36	-25.6	35.16	53.97	-18.81	-	-	152	230	Н
7.44	33.54	VB1T	35.8	-26.2	43.14	53.97	-10.83	-	-	21	284	V

PK - Peak detector

VB 1/T - FHSS Method: Reduced Video Bandwidth

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9.3. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL & VERTICAL)





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Radiated Emissions

Mark	Frequen	Meter	Det	AF T122	Amp/Cbl	Correct	QPk Limit	Margi	Azimut	Heigh	Polarit
er	су			(dB/m)	(dB)	ed	(dBuV/m)	n	h	t	У
		Readin									
	(MHz)	g				Reading		(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/					
						m)					
1	40.625	43.86	РК	13.4	-32	25.26	40	-14.74	0-360	300	н
2	117.167	47.51	РК	13.8	-31.5	29.81	43.52	-13.71	0-360	300	н
	5										
_											
3	40.9225	55.76	РК	13.2	-32	36.96	40	-3.04	0-360	100	V
4	665.1	34.7	РК	19.8	-30	24.5	46.02	-21.52	0-360	400	н
_										100	
5	713.3	37.46	РК	20.4	-29.8	28.06	46.02	-17.96	0-360	100	н
-											
6	665.1	39.29	РК	19.8	-30	29.09	46.02	-16.93	0-360	100	V
_											
7	710.2	42.78	РК	20.4	-29.9	33.28	46.02	-12.74	0-360	100	V

Frequen	Meter	Det	AF T122	Amp/Cbl	Correct	QPk Limit	Margi	Azimut	Heigh	Polarit
су			(dB/m)	(dB)	ed	(dBuV/m)	n	h	t	У
	Readin									
(MHz)	g				Reading		(dB)	(Degs)	(cm)	
	(dBuV)				(dBuV/					
					m)					
41.0121	50.75	QP	13.1	-32	31.85	40	-8.15	119	166	V

PK - Peak detector

QP - Quasi-Peak detector

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10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted I	.imit (dBuV)
	Quasi-peak	Average
0.15-0.5	66 to 56 "	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

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<u>6 WORST EMISSIONS</u>

Line-L1 .15 - 30MHz

Mark er	Frequenc y (MHz)	Meter Reading (dBuV)	De t	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Correcte d Reading dB(uVolt s)	CISPR 11/22 Class B Quasi- peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
1	.186	57.09	PK	.1	0	57.19	64.2	-7.01	-	-
2	.186	32.63	Av	.1	0	32.73	-	-	54.2	-21.47
3	.249	49.72	PK	.1	0	49.82	61.8	-11.98	-	-
4	.249	24.89	Av	.1	0	24.99	-	-	51.8	-26.81
5	4.623	42.61	PK	.1	.1	42.81	56	-13.19	-	-
6	4.623	24.77	Av	.1	.1	24.97	-	-	46	-21.03
7	14.0145	50.73	PK	.2	.2	51.13	60	-8.87	-	-
8	14.0145	31.43	Av	.2	.2	31.83	-	-	50	-18.17

Line-L2 .15 - 30MHz

Mark er	Frequenc y (MHz)	Meter Reading (dBuV)	De t	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Correcte d Reading dB(uVolt s)	CISPR 11/22 Class B Quasi- peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
9	.186	57.51	PK	.1	0	57.61	64.2	-6.59	-	-
10	.186	33.68	Av	.1	0	33.78	-	-	54.2	-20.42
11	.249	49.88	PK	.1	0	49.98	61.8	-11.82	-	-
12	.249	26.27	Av	.1	0	26.37	-	-	51.8	-25.43
13	4.6905	41.47	PK	.1	.1	41.67	56	-14.33	-	-
14	4.6905	22.75	Av	.1	.1	22.95	-	-	46	-23.05
15	14.0055	49.21	PK	.2	.2	49.61	60	-10.39	-	-
16	14.0055	30.18	Av	.2	.2	30.58	-	-	50	-19.42

PK - Peak detector

Av - average detection

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LINE 1 RESULTS



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LINE 2 RESULTS



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