Electromagnetic Compatibility Test Report

Tests Performed on a Horizon Hobby

2.4 GHz Transmitter Transciever, Model DX2E

Radiometrics Document RP-7632

Product Detail: FCC ID: BRWDSTX1 IC: 6157A-STX1 Equipment type: DTS
Test Standards: US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2012 Industry Canada RSS-210, Issue 8: 2010 as required for Category I Equipment This report concerns: Class II Permissive Change FCC Part 15.247

Tests Performed For:	*Test Facility:*
Horizon Hobby 4105 Fieldstone Rd. Champaign, IL 61822	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 (815) 293-0772

Test Date(s): (Month-Day-Year)
July 9 to September 17, 2013

Document RP-7632 Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	September 17, 2013		
1	May 2, 2014	6	Joseph Strzelecki

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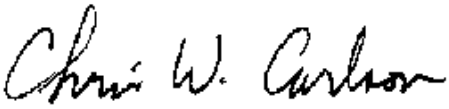
1 ADMINISTRATIVE DATA

Equipment Under Test: A Horizon Hobby, 2.4 GHz Transmitter Model: DX2E Serial Number: none This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) July 8, 2013	*Test Date(s): (Month-Day-Year)* July 9 to September 17, 2013
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* Jeff Walker Horizon Hobby
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a 2.4 GHz Transmitter, Model DX2E, manufactured by Horizon Hobby. The detailed test results are presented in a separate section. The following is a summary of the test results.

Spread Spectrum Transmitter Requirements

Environmental Phenomena	Frequency Range	FCC Section	RSS- Section	Test Result
RF AC Mains Conducted Emissions	0.15 - 30 MHz	15.207	GEN; 7.2.2	N/A Note 1
RF Radiated Emissions (Unintential Radiation Receive mode)	30-25,000 MHz	15.209	GEN; 7.2.5	Pass
6 dB Bandwidth Test	2400 to 2483 MHz	15.247 a	210; A8.1 (4)	Pass
20 dB Bandwidth Test	2400 to 2483 MHz	15.247 a	210; A8.1 (4)	Pass
Peak Output Power	2400 to 2483 MHz	15.247 b	210; A8.1 (1)	Pass
Band-edge Compliance of RF Conducted Emissions	2400 to 2483 MHz	15.247 d	210; A8.4 (2)	Pass
Spurious Radiated Emissions	30 MHz to 25 GHz	15.247 d	210; A8.5	Pass
Power Spectral Density	2400 to 2483 MHz	15.247 e	210; A8.2 (1)	Pass

Note 1: AC conducted emissions were not done since the EUT is battery powered.

The RSS-210 specification is not currently covered in Radiometrics' Scope of Accreditation. This is technically very similar to FCC, CFR 47 Part 15 which is on Radiometrics scope.

The middle channel was not tested since that channel was not changed.

2.1 RF Exposure Compliance Requirements

Since the EUT is less than 20 mW average, it is exempt from RSS-102 102 SAR and RF exposure evaluations. There are no power level adjustments and the antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a 2.4 GHz Transmitter, Model DX2E, manufactured by Horizon Hobby. The EUT was in good working condition during the tests, with no known defects.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is a half wave monopole. The antenna has a reverse polarity connector type that is not readily available to the general public. Therefore it meets the 15.203 Requirements.

The antenna is permanently attached to the printed circuit board. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore, it meets the 15.203 Requirements.

3.2 Description of Permissive Change

In the original version the transmitting frequency range is from 2418MHz to 2460MHz. In the new version, the range changed from 2402MHz to 2478MHz.

The middle channel was not tested since that channel was not changed.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations.

Since the EUT is wall mounted, it was placed in an upright configuration during the tests. The EUT was tested as a stand-alone device. Power was supplied with a new battery.

The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	2.4 GHz Transmitter	E	Horizon Hobby	DX2E	none

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2012	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2009	2009	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2009	2009	American National Standard for Testing Unlicensed Wireless Devices
IC RSS-210 Issue 8	2010	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 3	2010	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)
FCC 558074	2005	Measurement of Digital Transmission Systems Operating under Section 15.247

The test procedures used are in accordance with the FCC 558074, Industry Canada RSS-GEN and ANSI document C63.4, "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber. The floor has a 9' x 9' section of microwave absorber for testing above 1 GHz.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC8727A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	01/24/13
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo	01/15/13
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	01/16/13
AMP-29	HP / Agilent	Amplifier	11975A	2304A00158	2-8 GHz	12 Mo.	11/06/12
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	12/05/12
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	12/14/11
ANT-48	RMC	Std Gain Horn	HW2020	1001	18-26 GHz	12 Mo.	04/05/13
ANT-53	EMCO	Loop Antenna	6507	1453	1 kHz-30 MHz	24 Mo	10/26/11
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	01/24/12
HPF-06	Mini-Circuits	High Pass Filter	VHF-3800+	31035	4-11 GHz	12 Mo.	08/06/12
MXR-02	HP / Agilent	Harmonic Mixer	11970K	2332A00489	18-26.5GHz	12 Mo.	11/06/12
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	04/08/13
REC-08	Hewlett Packard	Spectrum Analyzer	8566B	2648A13481 2209A01436	30Hz-22GHz	24 Mo.	10/28/11
REC-11	Hewlett Packard	Spectrum Analyzer	E7405A	US39110103	9Hz-26.5GHz	12 Mo.	06/13/13
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	12 Mo.	05/25/12

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

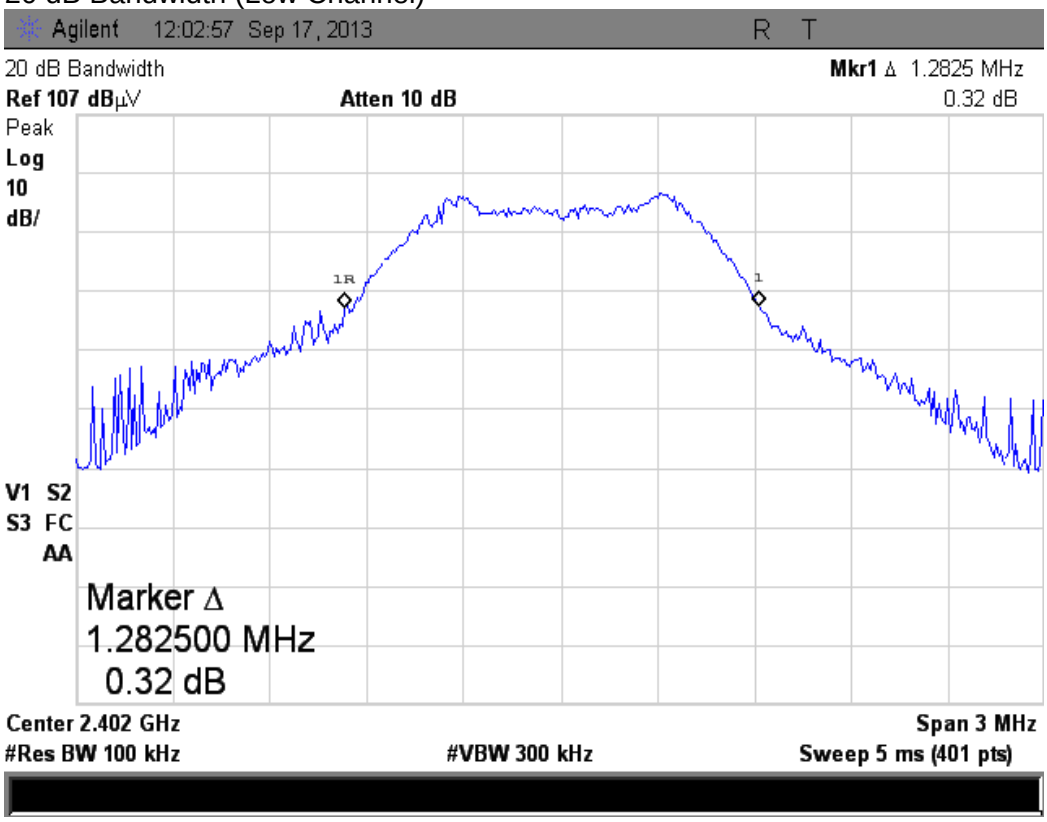
10.1 Occupied Bandwidth

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

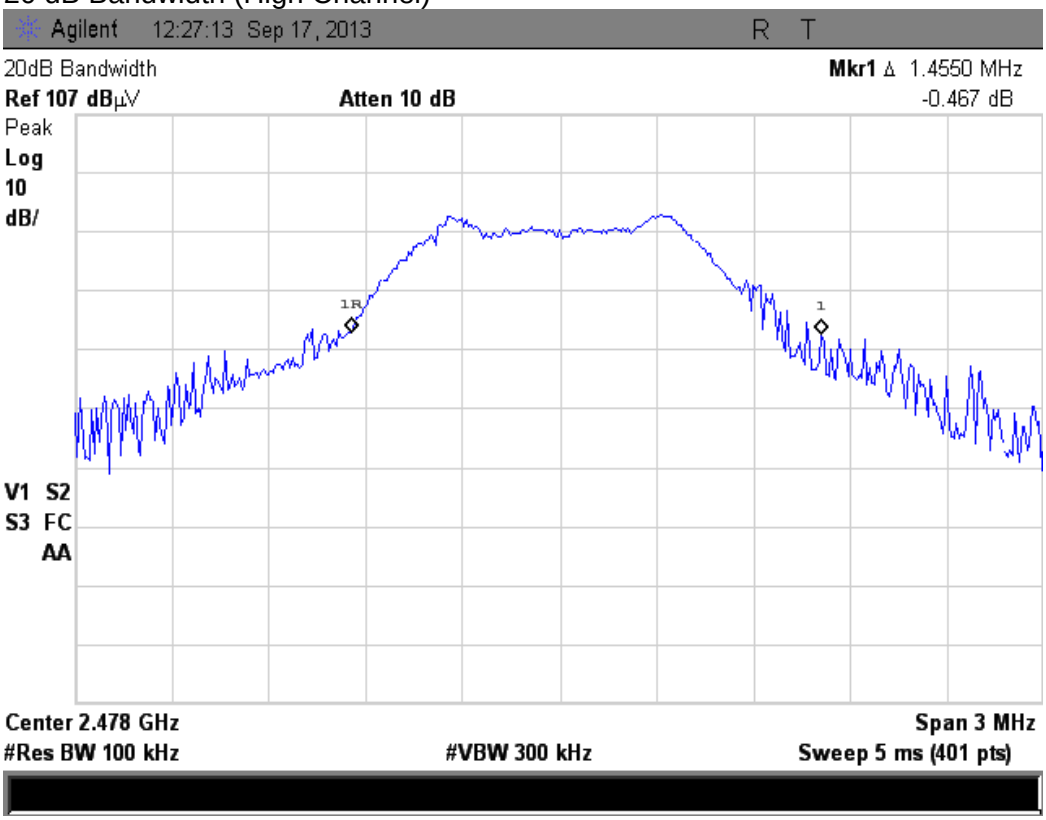
The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 6 or 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the bandwidth of the emission.

Channel	20 dB EBW MHz	6 dB EBW MHz
2402	1.282	0.892
2478	1.455	0.922

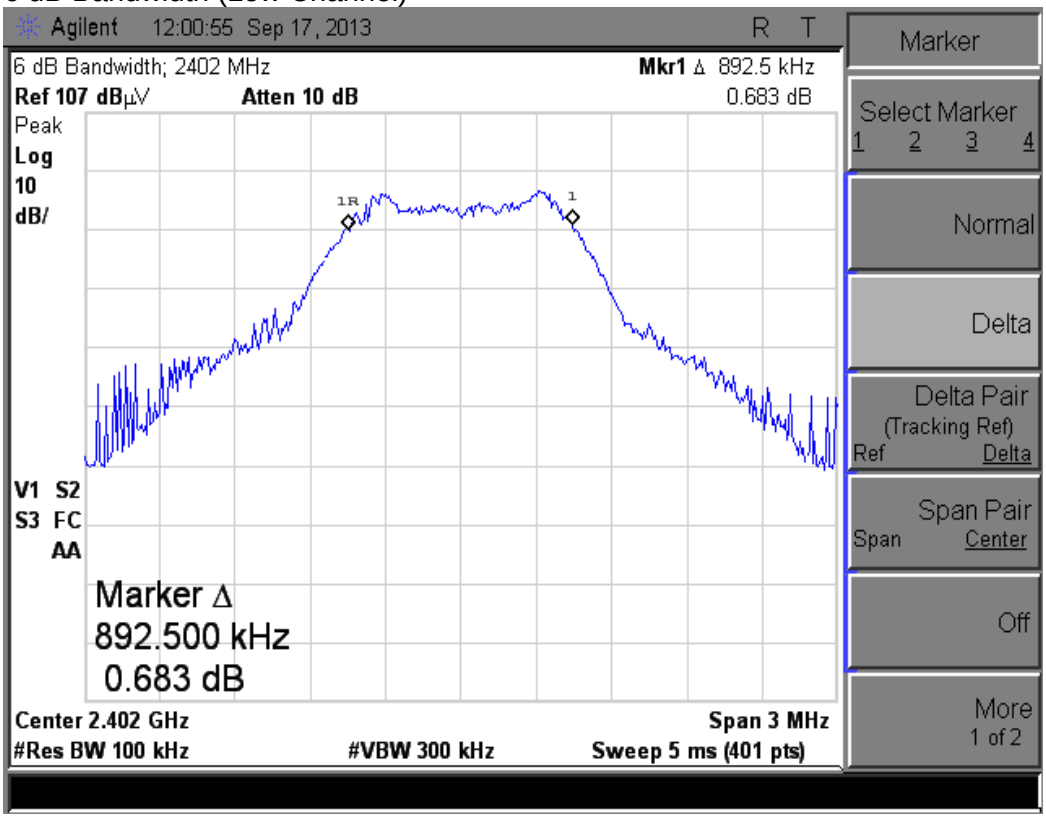
20 dB Bandwidth (Low Channel)



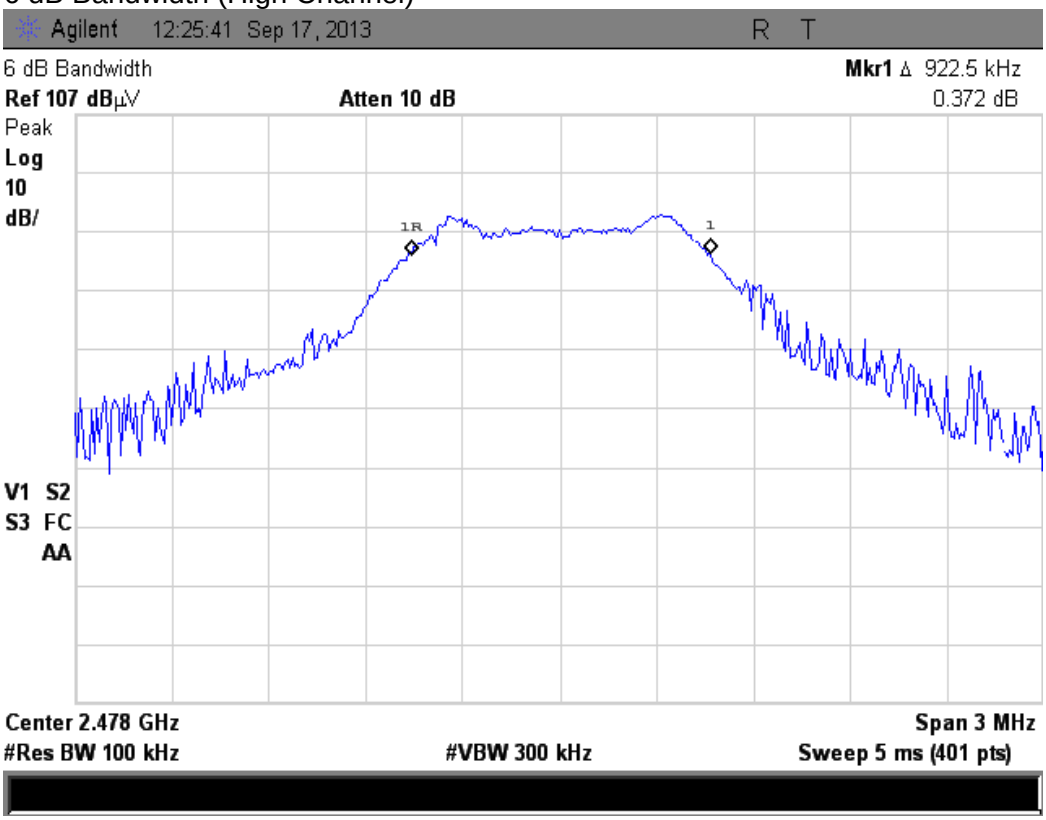
20 dB Bandwidth (High Channel)



6 dB Bandwidth (Low Channel)



6 dB Bandwidth (High Channel)



10.2 Peak Output Power

Since antenna conducted tests cannot be performed on the EUT, radiated tests were performed to show compliance with this requirement. The FCC procedures from power output option 2, Method #3 were used.

The transmitter's peak power was calculated using the following equation:
P = (E x d)^2 / (30)
Where: E = the measured maximum peak field strength in V/m.
d = Distance in meters from which the field strength was measured. (3 meters)
P = The EUT power in watts

The Field Strength was measured using the procedures described in section 10.9, with the exception of the resolution and video bandwidths. The spectrum analyzer was set to the following settings:

Span = 3 MHz ; RBW = 1 MHz (> the 20 dB bandwidth of the emission being measured)
VBW = 3 MHz; Sweep = auto; Detector function = peak; Trace = max hold

Since the gain of the antenna is always less than 6dB, the limit is not reduced.

MHz	dBuV/m peak	V/m	Test Dist meters	Power Watts	Peak EUT dBm	Limit dBm
2402	109.8	0.309	3	0.0286	14.6	30
2478	112.1	0.403	3	0.0487	16.9	30

Overall Test result: Pass by 13.1 dB

10.3 Power Spectral Density

Since antenna conducted tests cannot be performed on the EUT, radiated tests were performed to show compliance with this requirement. The FCC procedures from PSD option 1 was used. The power spectral density was measured as follows.

The field strength was measured using the procedures described in section 10.9, with the following exceptions: The analyzer was tuned to the highest point of the maximized fundamental emission. The analyzer was set to RBW = 3 kHz, VBW > RBW, span = 300 kHz and a sweep = 100 Sec. Using this peak level, the transmitter's power spectral density was calculated using the following equation:

P = (E x d)^2 / (30)

Where: E = the measured maximum peak field strength in V/m, using the bandwiths in this section.
d = Distance in meters from which the field strength was measured. (3 meters)
P = The EUT power in watts

Freq	3kHz PSD Field Strength		Test Distance	3 kHz Spectral Density from EUT		Limit
MHz	dBuV/m	V/m	Meters	Watts	dBm	dBm
2402	100.7	0.108	3	0.0035	5.5	8
2478	100.9	0.111	3	0.0037	5.7	8

Overall Test result: Pass by 2.3 dB

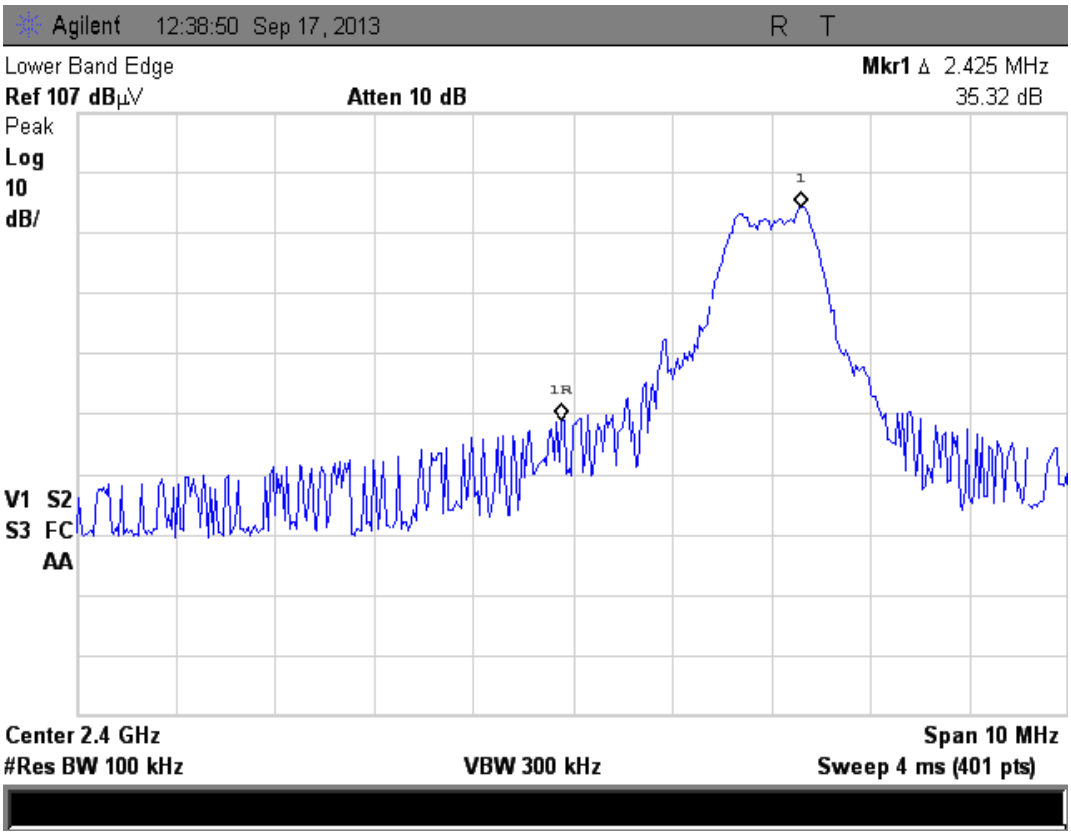
10.4 Band-edge Compliance of RF Conducted Emissions

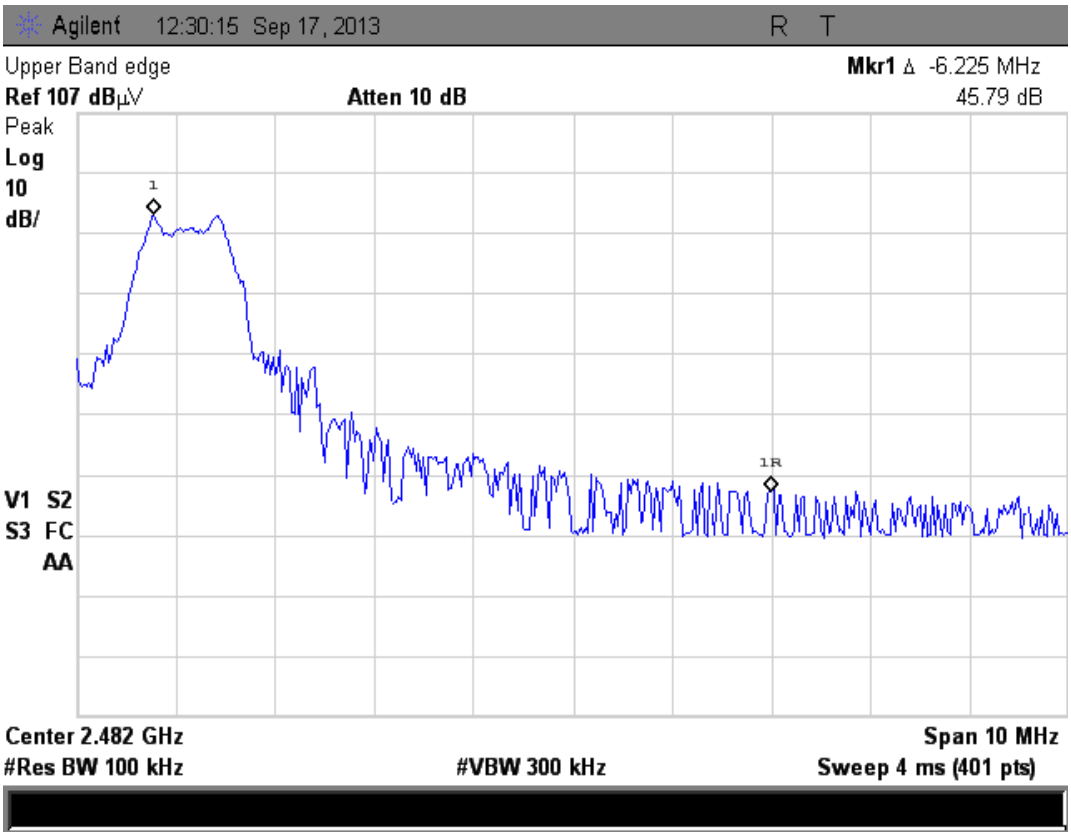
The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation at the band-edge, with the EUT set to the lowest frequency. The trace was allowed to stabilize.

Span = 30 MHz
RBW = 100 kHz
VBW = 1 MHz
Sweep = auto
Detector function = peak
Trace = max hold

Channel	Reading at Band Edge		Minimum Allowed
	Freq. (MHz)	Delta (dB)	dBc
2402 Lower Band edge	2400	35.3	20
2474 Upper Band edge	2483.5	45.8	20

Judgment: Passed by 15.2 dB

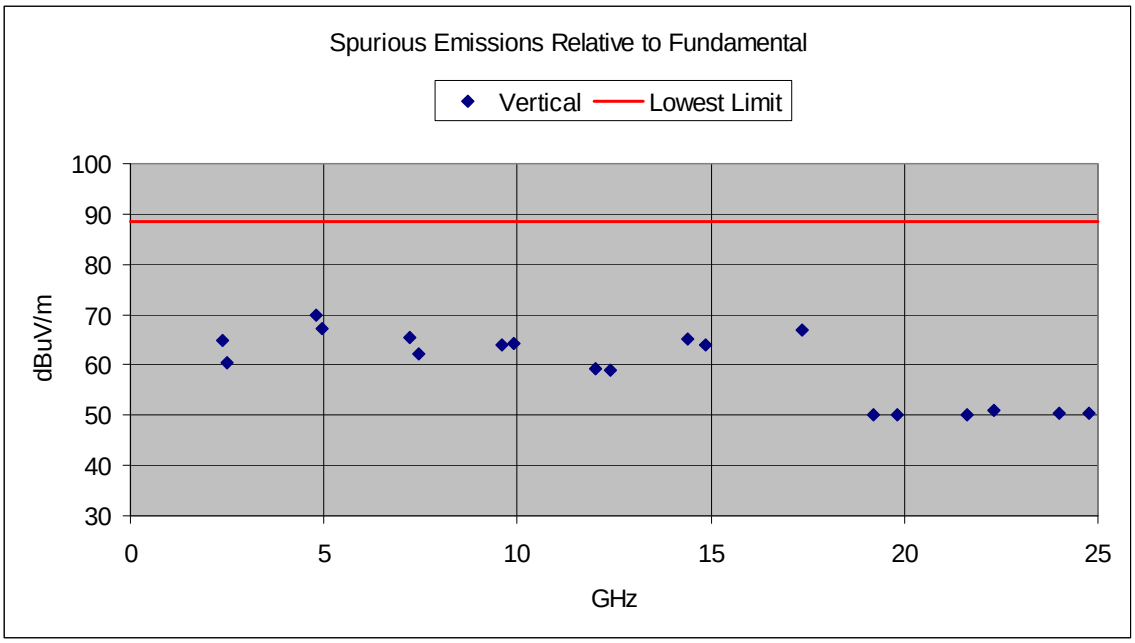

Agilent 12:38:50 Sep 17, 2013
R T
Lower Band Edge
Mkr1 Δ 2.425 MHz
Ref 107 dBµV
Atten 10 dB
35.32 dB
Peak
Log
10
dB/
1
1R
V1 S2
S3 FC
AA
Center 2.4 GHz
Span 10 MHz
#Res BW 100 kHz
VBW 300 kHz
Sweep 4 ms (401 pts)

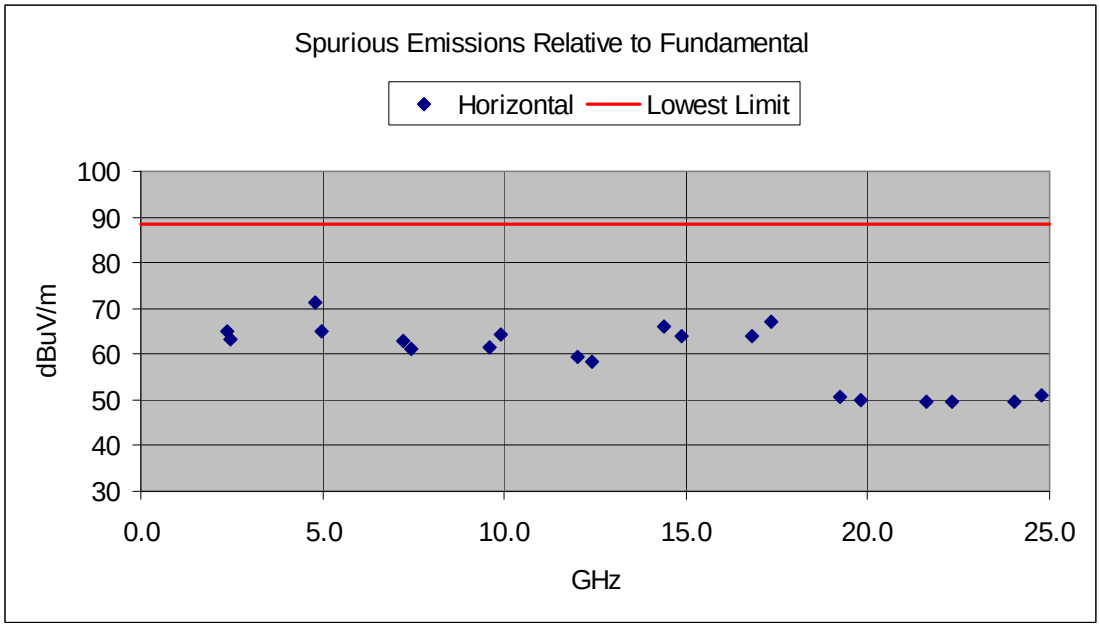

Agilent 12:30:15 Sep 17, 2013
R T
Upper Band edge
Mkr1 Δ -6.225 MHz
Ref 107 dBµV
Atten 10 dB
45.79 dB
Peak
Log
10
dB/
1
1R
V1 S2
S3 FC
AA
Center 2.482 GHz
Span 10 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 4 ms (401 pts)

10.5 Spurious RF Conducted Emissions

Since antenna conducted tests cannot be performed on the EUT, radiated tests were performed to show compliance with this requirement.

The EUT was tested in continous mode and peak readings were made from the lowest frequency generated in the EUT up through the 10th harmonic. The limit is 20 dB lower than the peak of the lowest fundamental. The data is shown graphically.





Judgement: Pass by 19 dB

10.6 Spurious Radiated Emissions (Restricted Band)

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu spectrum analyzer was used. For tests from 1 to 25 GHz, an HP 8566 spectrum analyzer was used. For tests from 1 to 10 GHz, a high pass filter was used to reduce the fundamental emission. A harmonic mixer was used from 18 to 25 GHz. Figure 4 herein lists the details of the test equipment used during radiated emissions tests. In addition, a high pass filter was used to reduce the fundamental emission.

The was device was rotated through three orthogonal axis as per 13.1.4.1 of ANSI C63.4 during the radiated tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 25000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

10.6.1 Radiated Emissions Field Strength Sample Calculation

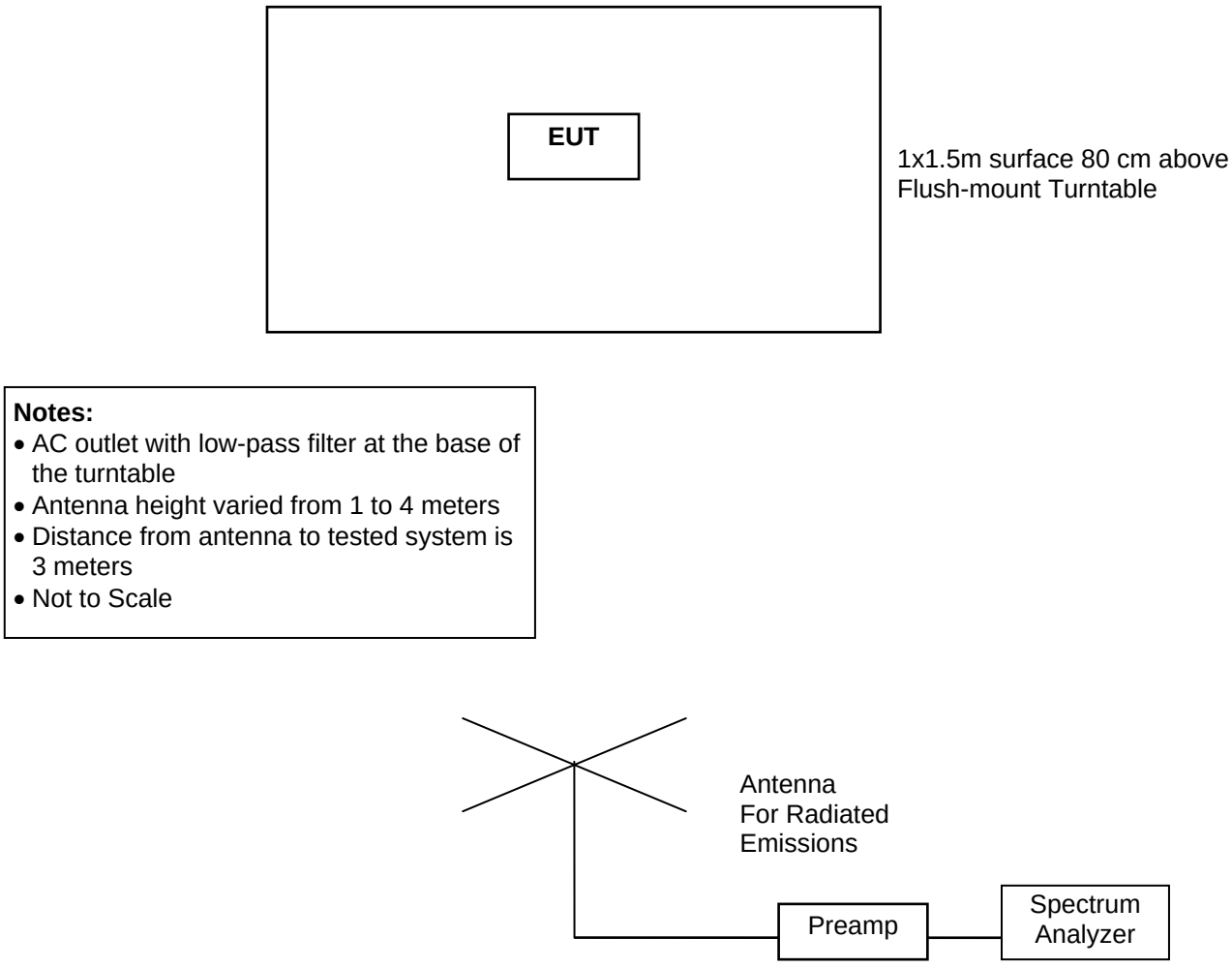
The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
HPF = High pass Filter Loss
PKA = Peak to Average Factor (This is zero for non-average measurements)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

Figure 1. Drawing of Radiated Emissions Setup



10.6.2 Spurious Radiated Emissions Test Results

The following spectrum analyzer settings were used.

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

A Video Bandwidth of 10 Hz was used for Average measurements above 1 GHz.

Testing of the Horizon Hobby, Model DX2E, 2.4 GHz Transmitter

Manufacturer	Horizon Hobby	Specification	FCC Part 15 Subpart B & RSS-210
Model	DX2E	Test Date	July 17, 2013
Serial Number	none	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Biconical (ANT-3); LP = Log-Periodic (ANT-6); HN = Horn (ANT-13) P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		
Configuration	EUT is transmitting at 2440 MHz ; in the X position		

Freq. MHz	Meter Reading dBuV	Det. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
33.2	26.6	P	16.3	H/44	-28.4	14.5	40.0	25.5
105.6	38.3	P	11.7	H/44	-27.5	22.5	43.5	21.0
143.6	32.2	P	10.3	H/44	-27.1	15.5	43.5	28.0
191.2	41.2	P	9.9	H/44	-26.6	24.5	43.5	19.0
215.2	47.7	P	11.1	H/44	-26.3	32.5	43.5	11.0
226.8	53.3	P	11.7	H/44	-26.2	38.7	46.0	7.3
227.8	53.1	P	11.6	H/44	-26.2	38.4	46.0	7.6
240.1	49.9	P	11.8	H/44	-26.3	35.4	46.0	10.6
252.4	48.0	P	12.8	H/44	-27.6	33.2	46.0	12.8
276.5	44.0	P	13.1	H/44	-27.5	29.6	46.0	16.4
312.4	52.2	P	13.4	H/44	-27.5	38.1	46.0	7.9
336.4	42.3	P	14.0	H/44	-27.6	28.7	46.0	17.3
360.0	40.9	P	14.6	H/44	-27.4	28.1	46.0	17.9
384.0	47.6	P	15.5	H/44	-27.5	35.6	46.0	10.4
408.1	43.1	P	15.6	H/44	-27.4	31.3	46.0	14.7
455.7	36.0	P	16.1	H/44	-27.0	25.0	46.0	21.0
612.0	39.9	P	19.2	H/44	-26.8	32.3	46.0	13.7
732.0	39.2	P	20.4	H/44	-26.2	33.4	46.0	12.6
852.0	32.6	P	21.4	H/44	-25.6	28.4	46.0	17.6
226.8	42.4	P	11.7	V/44	-26.2	27.8	46.0	18.2
227.8	42.5	P	11.6	V/44	-26.2	27.9	46.0	18.1
312.4	48.9	P	13.4	V/44	-27.5	34.8	46.0	11.2
360.0	48.7	P	14.6	V/44	-27.4	35.8	46.0	10.2
384.0	54.0	Q	15.5	V/44	-27.5	42.0	46.0	4.0
395.8	51.9	P	15.4	V/44	-27.4	39.8	46.0	6.2
408.1	50.5	P	15.6	V/44	-27.4	38.7	46.0	7.3
431.6	44.8	P	16.5	V/44	-27.4	33.8	46.0	12.2
455.7	50.2	P	16.1	V/44	-27.0	39.3	46.0	6.7
491.6	36.3	P	17.2	V/44	-26.9	26.6	46.0	19.4
504.0	32.7	P	17.6	V/44	-26.9	23.5	46.0	22.5
612.0	39.7	P	19.2	V/44	-26.8	32.1	46.0	13.9
708.0	42.2	P	20.1	V/44	-26.5	35.8	46.0	10.2
780.0	45.2	P	20.6	V/44	-26.1	39.7	46.0	6.3
852.0	39.8	P	21.4	V/44	-25.6	35.6	46.0	10.4
924.0	38.6	P	21.8	V/44	-25.3	35.1	46.0	10.9
996.0	31.2	P	22.7	V/44	-24.4	29.5	54.0	24.5
Notes: Y position								
36.8	34.9	P	16.0	H/44	-28.4	22.5	40.0	17.5
103.2	39.3	P	10.5	H/44	-27.6	22.3	43.5	21.2

Freq. MHz	Meter Reading dBuV	Det. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
215.2	38.6	P	11.1	H/44	-26.3	23.4	43.5	20.1
227.2	41.9	P	11.7	H/44	-26.2	27.4	46.0	18.6
336.4	41.4	P	14.0	H/44	-27.6	27.8	46.0	18.2
360.0	45.5	P	14.6	H/44	-27.4	32.7	46.0	13.3
384.0	47.0	P	15.5	H/44	-27.5	35.0	46.0	11.0
408.1	40.2	P	15.6	H/44	-27.4	28.5	46.0	17.5
455.7	41.2	P	16.1	H/44	-27.0	30.2	46.0	15.8
636.0	42.3	P	20.1	H/44	-26.5	35.8	46.0	10.2
708.0	42.7	P	20.1	H/44	-26.5	36.2	46.0	9.8
732.0	42.2	P	20.4	H/44	-26.2	36.4	46.0	9.6
780.0	40.0	P	20.6	H/44	-26.1	34.5	46.0	11.5
828.0	34.3	P	21.0	H/44	-25.8	29.5	46.0	16.5
876.0	33.9	P	21.3	H/44	-25.6	29.6	46.0	16.4
936.0	38.0	P	22.3	H/44	-25.1	35.1	46.0	10.9
948.0	38.3	P	22.4	H/44	-25.0	35.6	46.0	10.4
984.0	37.2	P	23.0	H/44	-24.5	35.6	54.0	18.4
45.2	32.9	P	15.0	V/44	-28.2	19.7	40.0	20.3
113.2	46.6	P	12.7	V/44	-27.4	31.9	43.5	11.6
215.2	41.2	P	11.1	V/44	-26.3	25.9	43.5	17.6
226.8	43.8	P	11.7	V/44	-26.2	29.2	46.0	16.8
227.8	43.6	P	11.6	V/44	-26.2	28.9	46.0	17.1
312.4	50.8	P	13.4	V/44	-27.5	36.7	46.0	9.3
336.4	42.4	P	14.0	V/44	-27.6	28.8	46.0	17.2
360.0	47.2	P	14.6	V/44	-27.4	34.3	46.0	11.7
384.0	50.7	P	15.5	V/44	-27.5	38.7	46.0	7.3
407.6	47.6	P	15.6	V/44	-27.4	35.8	46.0	10.2
455.7	46.0	P	16.1	V/44	-27.0	35.0	46.0	11.0
612.0	40.2	P	19.2	V/44	-26.8	32.6	46.0	13.4
708.0	39.1	P	20.1	V/44	-26.5	32.7	46.0	13.3
732.0	39.1	P	20.4	V/44	-26.2	33.2	46.0	12.8
780.0	38.6	P	20.6	V/44	-26.1	33.1	46.0	12.9
852.0	34.0	P	21.4	V/44	-25.6	29.9	46.0	16.1
924.0	35.4	P	21.8	V/44	-25.3	31.9	46.0	14.1
Notes: Z position								
53.6	32.2	P	13.0	H/44	-28.1	17.1	40.0	22.9
191.2	41.0	P	9.9	H/44	-26.6	24.3	43.5	19.2
215.2	47.0	P	11.1	H/44	-26.3	31.8	43.5	11.7
226.8	52.9	P	11.7	H/44	-26.2	38.4	46.0	7.6
227.8	52.7	P	11.6	H/44	-26.2	38.1	46.0	7.9
252.4	47.9	P	12.8	H/44	-27.6	33.2	46.0	12.8
276.5	44.8	P	13.1	H/44	-27.5	30.4	46.0	15.6
312.4	54.9	P	13.4	H/44	-27.5	40.8	46.0	5.2
336.4	47.0	P	14.0	H/44	-27.6	33.4	46.0	12.6
360.0	49.8	P	14.6	H/44	-27.4	37.0	46.0	9.0
384.0	53.9	Q	15.5	H/44	-27.5	41.9	46.0	4.1
408.1	46.5	P	15.6	H/44	-27.4	34.8	46.0	11.2

Freq. MHz	Meter Reading dBuV	Det. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
443.4	37.3	P	17.2	H/44	-27.2	27.3	46.0	18.7
500.0	28.0	P	17.5	H/44	-26.9	18.7	46.0	27.3
503.3	29.9	P	17.6	H/44	-26.9	20.6	46.0	25.4
588.0	34.7	P	19.5	H/44	-26.7	27.5	46.0	18.5
612.0	43.9	P	19.2	H/44	-26.8	36.3	46.0	9.7
660.0	40.6	P	20.4	H/44	-26.6	34.3	46.0	11.7
684.0	42.2	P	20.3	H/44	-26.5	36.0	46.0	10.0
708.0	46.0	P	20.1	H/44	-26.5	39.6	46.0	6.4
732.0	47.4	Q	20.4	H/44	-26.2	41.6	46.0	4.4
756.0	48.9	Q	20.7	H/44	-26.1	43.4	46.0	2.6
780.0	48.1	Q	20.6	H/44	-26.1	42.6	46.0	3.4
804.0	44.6	P	20.7	H/44	-25.8	39.5	46.0	6.5
852.0	38.5	P	21.4	H/44	-25.6	34.3	46.0	11.7
900.0	32.6	P	21.8	H/44	-25.3	29.2	46.0	16.8
924.0	34.1	P	21.8	H/44	-25.3	30.5	46.0	15.5
43.6	35.4	P	15.4	V/44	-28.3	22.6	40.0	17.4
226.8	41.7	P	11.7	V/44	-26.2	27.1	46.0	18.9
360.0	42.9	P	14.6	V/44	-27.4	30.1	46.0	15.9
384.0	48.1	P	15.5	V/44	-27.5	36.1	46.0	9.9
408.1	50.1	P	15.6	V/44	-27.4	38.3	46.0	7.7
431.6	43.2	P	16.5	V/44	-27.4	32.3	46.0	13.7
455.7	46.3	P	16.1	V/44	-27.0	35.3	46.0	10.7
612.0	36.5	P	19.2	V/44	-26.8	28.8	46.0	17.2
708.0	36.9	P	20.1	V/44	-26.5	30.5	46.0	15.5
804.0	32.4	P	20.7	V/44	-25.8	27.3	46.0	18.7
876.0	34.2	P	21.3	V/44	-25.6	29.9	46.0	16.1

Judgment: Passed by 2.6 dB

Fundamental, Harmonic and Band edge emissions from 1 to 25 GHz

		Spectrum Analyzer Readings									EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx	Peak			Ave	Peak			Ave	Corr.	Emission	Tot. FS		Limit		Under
#	Freq	Vertical Polarization X	Y	Z	Max	Horizontal Polarization X	Y	Z	Max	Fact.	Freq MHz	dBuV/m		dBuV/m		Limit
1	2402	99.1	105.4	96.9	83.5	105.6	97.1	103.9	83.7	3.3	2402.0	108.9	87.0	125	115	16.1
be	2402	55.2	61.5	53.0	39.6	61.7	53.2	60.0	39.8	3.3	2390.0	65.0	43.1	74	54	9.0
2	2402	53.5	58.0	55.8	36.1	59.3	54.1	54.0	37.4	11.9	4804.0	71.2	49.3	74	54	2.8
3	2402	46.3	52.8	49.1	30.9	50.4	50.3	48.4	28.5	12.6	7206.0	65.4	43.5	74	54	8.6
4	2402	41.4	44.8	42.3	22.8	42.4	42.3	41.2	20.5	19.2	9608.0	64.0	42.0	74	54	10.1
1	2478	99.5	105.1	97.0	83.2	103.7	98.9	107.8	85.9	3.4	2478.0	111.2	89.3	125	115	13.8
BE	2478	53.7	59.3	51.2	37.4	57.9	53.1	62.0	40.1	3.4	2483.5	65.4	43.5	74	54	8.6
2	2478	52.8	53.9	55.2	33.3	52.6	53.0	51.0	31.1	11.9	4956.0	67.1	45.2	74	54	6.9
3	2478	46.6	49.2	47.0	27.3	48.1	45.6	46.9	26.2	13.1	7434.0	62.3	40.4	74	54	11.7
4	2478	41.6	41.4	41.1	19.7	41.8	41.7	41.4	19.9	22.6	9912.0	64.4	42.5	74	54	9.6
Column numbers (see below for explanations)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Judgment: Passed by 2.8 dB
No other emissions were detected from 10 to 25 GHz.

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #4. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.
Column #5. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cylce correction
Column #7. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #8. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.
Column #9. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.
Column #10. Average Reading based on peak reading reduced by the Duty cylce correction
Column #11. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #12. Frequency of Tested Emission
Column #13. Highest peak field strength at listed frequency.
Column #14. Highest Average field strength at listed frequency.
Column #15. Peak Limit.
Column #16. Average Limit.
Column #17. The margin (last column) is the worst case margin under the peak or average limits for that row.

10.7 Unintentional Emissions (Receive Mode)

Manufacturer	Horizon Hobby	Specification	FCC Part 15.209 & RSS-210
Model	DX2E	Test Date	07/24/2013
Serial Number	none	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		
Configuration	Receive mode, Z Position		

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
35.6	32.4	P	16.2	H/44	-28.4	20.2	40.0	19.8
191.2	40.5	P	9.9	H/44	-26.6	23.8	43.5	19.7
215.2	46.9	P	11.1	H/44	-26.3	31.7	43.5	11.8
227.8	52.7	P	11.6	H/44	-26.2	38.0	46.0	8.0
240.1	52.1	P	11.8	H/44	-26.3	37.6	46.0	8.4
252.4	48.0	P	12.8	H/44	-27.6	33.2	46.0	12.8
312.4	44.5	P	13.4	H/44	-27.5	30.4	46.0	15.6
336.4	43.3	P	14.0	H/44	-27.6	29.7	46.0	16.3
360.0	51.1	P	14.6	H/44	-27.4	38.2	46.0	7.8
384.0	53.8	Q	15.5	H/44	-27.5	41.8	46.0	4.2
443.4	45.3	P	17.2	H/44	-27.2	35.3	46.0	10.7
612.0	45.0	P	19.2	H/44	-26.8	37.3	46.0	8.7
636.0	44.5	P	20.1	H/44	-26.5	38.0	46.0	8.0
708.0	42.9	P	20.1	H/44	-26.5	36.5	46.0	9.5
744.0	45.7	P	20.1	H/44	-26.3	39.5	46.0	6.5
768.0	44.9	P	20.8	H/44	-26.1	39.7	46.0	6.3
816.0	38.7	P	21.4	H/44	-25.7	34.4	46.0	11.6
863.0	35.8	P	21.1	H/44	-25.7	31.2	46.0	14.8
935.0	35.3	P	22.3	H/44	-25.2	32.5	46.0	13.5
34.8	34.6	P	16.2	V/44	-28.4	22.4	40.0	17.6
227.8	40.9	P	11.6	V/44	-26.2	26.3	46.0	19.7
360.0	44.8	P	14.6	V/44	-27.4	31.9	46.0	14.1
384.0	51.0	P	15.5	V/44	-27.5	39.0	46.0	7.0
407.6	45.6	P	15.6	V/44	-27.4	33.8	46.0	12.2
431.6	44.2	P	16.5	V/44	-27.4	33.3	46.0	12.7
443.4	49.8	P	17.2	V/44	-27.2	39.7	46.0	6.3
636.0	34.1	P	20.1	V/44	-26.5	27.7	46.0	18.3
744.0	35.4	P	20.1	V/44	-26.3	29.2	46.0	16.8
887.0	33.3	P	20.9	V/44	-25.5	28.7	46.0	17.3
935.0	33.2	P	22.3	V/44	-25.2	30.4	46.0	15.6
Configuration	Y Position							
44.0	32.5	P	15.4	H/44	-28.3	19.6	40.0	20.4
104.0	42.3	P	11.0	H/44	-27.5	25.7	43.5	17.8
227.8	42.0	P	11.6	H/44	-26.2	27.3	46.0	18.7
229.2	41.0	P	11.6	H/44	-26.2	26.4	46.0	19.6
312.4	52.1	P	13.4	H/44	-27.5	38.0	46.0	8.0
336.4	40.4	P	14.0	H/44	-27.6	26.9	46.0	19.1
360.0	48.9	P	14.6	H/44	-27.4	36.0	46.0	10.0

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
372.3	45.4	P	15.0	H/44	-27.4	33.0	46.0	13.0
384.0	49.2	P	15.5	H/44	-27.5	37.2	46.0	8.8
407.6	38.8	P	15.6	H/44	-27.4	27.0	46.0	19.0
443.4	41.3	P	17.2	H/44	-27.2	31.3	46.0	14.7
588.0	40.1	P	19.5	H/44	-26.7	33.0	46.0	13.0
612.0	46.5	P	19.2	H/44	-26.8	38.8	46.0	7.2
636.0	43.7	Q	20.1	H/44	-26.5	37.3	46.0	8.7
660.0	43.9	P	20.4	H/44	-26.6	37.6	46.0	8.4
732.0	42.7	P	20.4	H/44	-26.2	36.9	46.0	9.1
768.0	42.6	P	20.8	H/44	-26.1	37.4	46.0	8.6
911.0	36.1	P	22.0	H/44	-25.3	32.8	46.0	13.2
959.0	40.7	P	21.9	H/44	-25.0	37.6	46.0	8.4
983.0	39.5	P	22.9	H/44	-24.5	37.8	54.0	16.2
33.6	38.1	P	16.3	V/44	-28.4	26.0	40.0	14.0
215.2	41.9	P	11.1	V/44	-26.3	26.7	43.5	16.8
227.2	43.6	P	11.7	V/44	-26.2	29.1	46.0	16.9
227.8	41.9	P	11.6	V/44	-26.2	27.3	46.0	18.7
240.1	42.2	P	11.8	V/44	-26.3	27.7	46.0	18.3
312.4	47.5	P	13.4	V/44	-27.5	33.4	46.0	12.6
360.0	46.5	P	14.6	V/44	-27.4	33.6	46.0	12.4
384.0	49.0	P	15.5	V/44	-27.5	37.1	46.0	8.9
407.6	45.6	P	15.6	V/44	-27.4	33.8	46.0	12.2
444.0	51.2	Q	17.2	V/44	-27.2	41.2	46.0	4.8
467.5	37.5	P	17.1	V/44	-27.0	27.5	46.0	18.5
588.0	39.0	P	19.5	V/44	-26.7	31.8	46.0	14.2
732.0	34.1	P	20.4	V/44	-26.2	28.2	46.0	17.8
911.0	39.1	P	22.0	V/44	-25.3	35.8	46.0	10.2
935.0	39.8	P	22.3	V/44	-25.2	36.9	46.0	9.1
Configuration	X Position							
34.0	34.7	P	16.3	H/44	-28.4	22.5	40.0	17.5
215.2	46.7	P	11.1	H/44	-26.3	31.5	43.5	12.0
227.2	52.8	P	11.7	H/44	-26.2	38.2	46.0	7.8
227.8	52.6	P	11.6	H/44	-26.2	37.9	46.0	8.1
240.1	52.1	P	11.8	H/44	-26.3	37.6	46.0	8.4
252.4	47.9	P	12.8	H/44	-27.6	33.2	46.0	12.8
276.5	43.9	P	13.1	H/44	-27.5	29.5	46.0	16.5
312.4	53.0	P	13.4	H/44	-27.5	38.9	46.0	7.1
336.4	40.0	P	14.0	H/44	-27.6	26.4	46.0	19.6
360.0	43.4	P	14.6	H/44	-27.4	30.6	46.0	15.4
384.0	51.7	P	15.5	H/44	-27.5	39.7	46.0	6.3
407.6	42.1	P	15.6	H/44	-27.4	30.3	46.0	15.7
443.4	43.1	P	17.2	H/44	-27.2	33.1	46.0	12.9
612.0	39.2	P	19.2	H/44	-26.8	31.5	46.0	14.5
684.0	34.7	P	20.3	H/44	-26.5	28.4	46.0	17.6
768.0	36.5	P	20.8	H/44	-26.1	31.2	46.0	14.8
935.0	33.3	P	22.3	H/44	-25.2	30.4	46.0	15.6

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
43.2	39.0	P	15.3	V/44	-28.3	26.1	40.0	13.9
227.8	42.6	P	11.6	V/44	-26.2	28.0	46.0	18.0
229.2	41.6	P	11.6	V/44	-26.2	26.9	46.0	19.1
240.1	41.4	P	11.8	V/44	-26.3	26.9	46.0	19.1
360.0	48.2	P	14.6	V/44	-27.4	35.4	46.0	10.6
384.0	52.0	P	15.5	V/44	-27.5	40.0	46.0	6.0
407.6	45.8	P	15.6	V/44	-27.4	34.1	46.0	11.9
431.6	48.6	P	16.5	V/44	-27.4	37.7	46.0	8.3
444.0	53.8	Q	17.2	V/44	-27.2	43.7	46.0	2.3
467.5	42.9	P	17.1	V/44	-27.0	33.0	46.0	13.0
612.0	42.6	P	19.2	V/44	-26.8	35.0	46.0	11.0
768.0	40.2	P	20.8	V/44	-26.1	34.9	46.0	11.1
839.0	38.1	P	21.4	V/44	-25.8	33.7	46.0	12.3
911.0	40.3	P	22.0	V/44	-25.3	37.1	46.0	8.9
935.0	41.4	P	22.3	V/44	-25.2	38.5	46.0	7.5
983.0	38.1	P	22.9	V/44	-24.5	36.5	54.0	17.5

Judgment: Passed by 2.3 dB