



EMC Test Report

*Application for Grant of Equipment Authorization
pursuant to*

FCC Part 15 Subpart C

Model: X1TXO

FCC ID: BRWDAMTX11

APPLICANT: Horizon Hobby, Inc.
4105 Fieldstone Road
Champaign, IL 61822

TEST SITE(S): Elliott Laboratories
41039 Boyce Road.
Fremont, CA. 94538-2435

IC SITE REGISTRATION #: 2845B-5

REPORT DATE: July 27, 2009

FINAL TEST DATES: March 10, 2009

AUTHORIZED SIGNATORY:

A handwritten signature in blue ink, appearing to read "Mark E. Hill", written over a horizontal line.

Mark E. Hill
Staff Engineer
Elliott Laboratories.



Testing Cert #2016-01

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REVISION HISTORY

Rev#	Date	Comments	Modified By
1	August 7, 2009	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Horizon Hobby, Inc. model X1TXO, pursuant to the following rules:

FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003

FCC DTS Measurement Procedure KDB558074, March 2005

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

Testing was performed only on model X1TXO. This model was considered representative of the following models.

STATEMENT OF COMPLIANCE

The tested sample of Horizon Hobby, Inc. model X1TXO complied with the requirements of the following regulations:

FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Horizon Hobby, Inc. model X1TXO and therefore apply only to the tested sample. The sample was selected and prepared by Paul Beard of Horizon Hobby, Inc.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY**DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)**

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 210 A8.2	Digital Modulation	Systems uses DSSS techniques	-	Complies
15.247 (a) (2)	RSS 210 A8.2 (1)	6dB Bandwidth	0.85 MHz	>500kHz	Complies
15.247 (b) (3)	RSS 210 A8.2 (4)	Output Power (multipoint systems)	24.8 dBm (0.302 Watts) EIRP = 0.479 W ^{Note 1}	1 Watt, EIRP limited to 4 Watts.	Complies
15.247(d)	RSS 210 A8.2 (2)	Power Spectral Density	2.1 dBm/3kHz	8dBm/3kHz	Complies
15.247(c)	RSS 210 A8.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	All signal below the limit	< -20dBc	Complies
15.247(c) / 15.209	RSS 210 A8.5	Radiated Spurious Emissions 30MHz – 25 GHz	50.8dB μ V/m (346.7 μ V/m) @ 2352.0MHz (-3.2dB)	15.207 in restricted bands, all others < -20dBc	Complies

Note 1: EIRP calculated using antenna gain of 2 dBi for the highest EIRP multi-point system.

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	EUT uses non-standard micro coax connector	-	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	-	Refer to Standard	N/A – Receiver tunes above 960 MHz
15.207	RSS GEN Table 2	AC Conducted Emissions	-	Refer to standard	N/A – EUT is powered from battery powered host device
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in Exhibit 11, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	0.015 to 30	± 3.0
Radiated Emissions	30 to 1000	± 3.6
Radiated Emissions	1000 to 40000	± 6.0

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The Horizon Hobby, Inc. model X1TXO is a 2.4GHz Spread Spectrum transceiver module which is designed for model aircraft control and telemetry. Normally, the EUT would be mounted in a handheld remote control system. The EUT was mounted in a typical remote control system. The host system was battery powered. The electrical rating of the module is 5.0V DC 300mA.

The sample was received on March 10, 2009 and tested on March 10, 2009. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Horizon Hobby	X1TXO	2.4GHz SS Transceiver Module	-	BRWDAMTX11

ANTENNA SYSTEM

The EUT antenna is a 2dBi Folded dipole. The antenna connects to the EUT via a non-standard micro-coax, thereby meeting the requirements of FCC 15.203.

ENCLOSURE

The EUT does not have an enclosure as it is designed to be installed within the enclosure of a host system.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment:

Manufacturer	Model	Description	Serial Number	FCC ID
Spektrum	DX7	Remote Control	-	-

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Description	Cable(s)	
			Shielded or Unshielded	Length(m)
None	-	-	-	-

EUT OPERATION

The X1TXM module was configured to continuously transmit on a single channel (top, center or bottom) for transmit-mode tests. For receive mode tests the device was configured to continuously receive on the center channel.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken on March 10, 2009 at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 5	211948	2845B-5	41039 Boyce Road Fremont, CA 94538-2435

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

MEASUREMENT INSTRUMENTATION**RECEIVER SYSTEM**

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

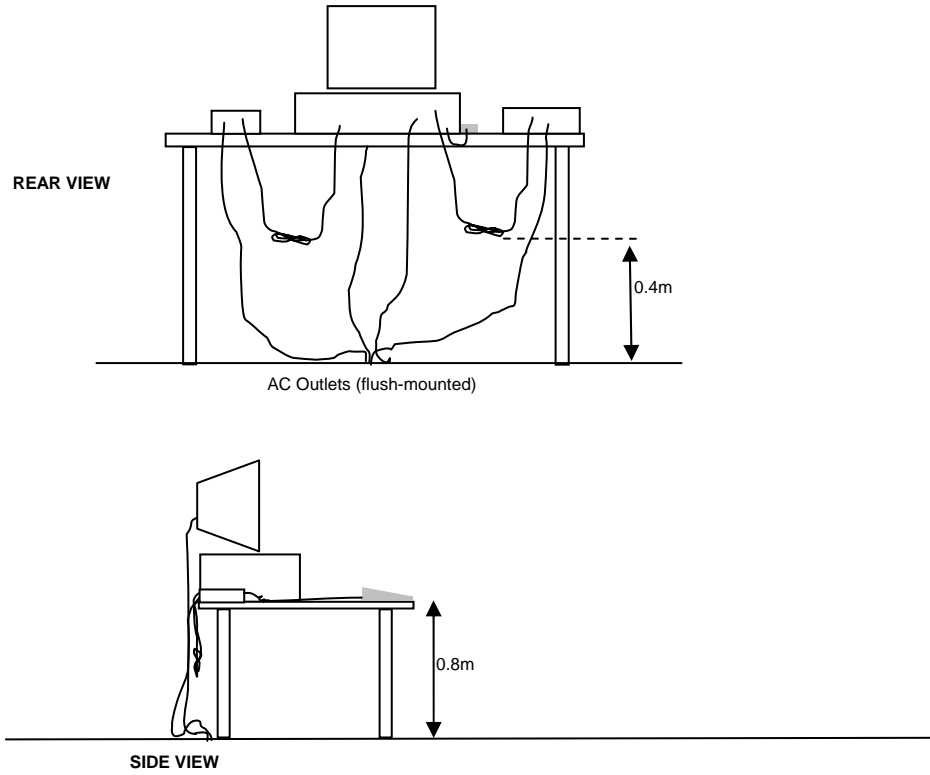
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

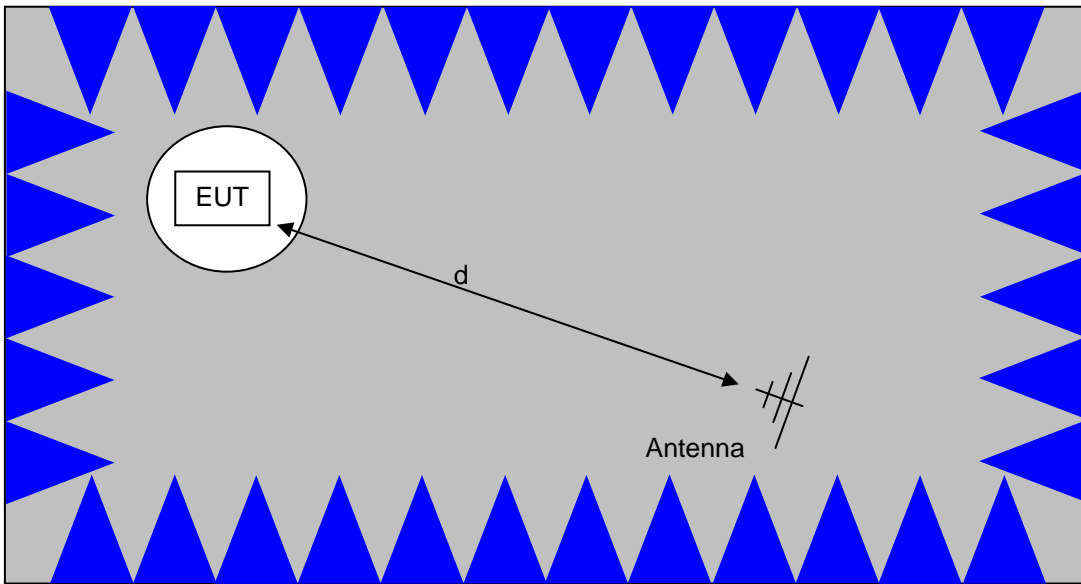
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

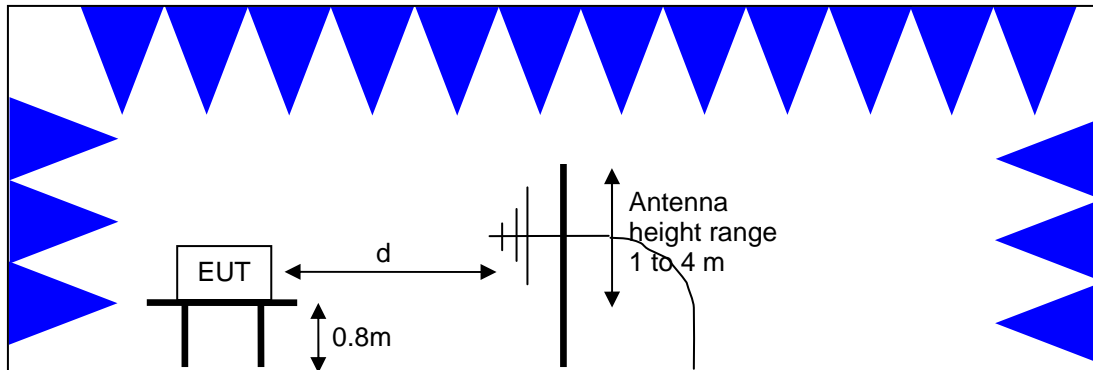


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands¹ (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	2400/F _{KHz} @ 300m	67.6-20*log ₁₀ (F _{KHz}) @ 300m
0.490-1.705	24000/F _{KHz} @ 30m	87.6-20*log ₁₀ (F _{KHz}) @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain

¹ The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_T - S = M$$

where:

R_T = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

$$R_r = \text{Receiver Reading in dBuV/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_c = \text{Corrected Reading in dBuV/m}$$

$$L_s = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{3} \text{ microvolts per meter}$$

where P is the eirp (Watts)

Appendix A Test Equipment Calibration Data

1 Page

Radiated Emissions, 30 - 25,000 MHz, 10-Mar-09

Engineer: Mehran Birgani

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263	09-Oct-09
EMCO	Antenna, Horn, 1-18GHz	3115	868	10-Jun-10
Hewlett Packard	SpectAn 9 kHz - 40 GHz, FT (SA40) Blue	8564E (84125C)	1393	15-Mar-09
Rohde & Schwarz	Power Sensor 100 uW - 2 Watts	NRV-Z32	1423	07-Nov-09
Rohde & Schwarz	Power Meter, Dual Channel	NRVD	1539	12-Sep-09
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1731	02-Dec-09

Appendix B Test Data

T74282 13 Pages



EMC Test Data

Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	Test-Log Number:	T74282
		Project Manager:	Sheareen Washington
Contact:	Paul Beard	Project Engineer:	
Emissions Spec:	FCC 15.247, EN 300-328, EN 300-440	Class:	B
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Horizon Hobby, Inc.

Model

X1TXO

Date of Last Test: 8/31/2009



EMC Test Data

Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	Test-Log Number:	T74282
Contact:	Paul Beard	Project Manager:	Sheareen Washington
Emissions Spec:	FCC 15.247, EN 300-328, EN 300-440	Class:	B
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a 2.4GHz Spread Spectrum transceiver module which is designed for model aircraft control and telemetry. Normally, the EUT would be mounted in a handheld remote control system. The EUT was mounted in a typical remote control system. The host system was battery powered. The electrical rating of the module is 5.0V DC 300mA.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Horizon Hobby	X1TXO	2.4GHz SS Transceiver	-	BRWDAMTX11

EUT Antenna (Intentional Radiators Only)

The EUT antenna is a 2dBi Folded dipole. The antenna connects to the EUT via a non-standard micro-coax, thereby meeting the requirements of FCC 15.203.

EUT Enclosure

The EUT does not have an enclosure as it is designed to be installed within the enclosure of a host system.



EMC Test Data

Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	T-Log Number:	T74282
Contact:	Paul Beard	Project Manager:	Sheareen Washington
Emissions Spec:	FCC 15.247, EN 300-328, EN 300-440	Class:	B
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Spektrum	DX7	Remote Control	-	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None	-	-	-	-

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
None	-	-	-	-

EUT Operation During Emissions Tests

The X1TXM module was configured to continuously transmit on a single channel (top, center or bottom) for transmit-mode tests. For receive mode tests the device was configured to continuously receive on the center channel.

Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	T-Log Number:	T74282
		Account Manager:	Sheareen Washington
Contact:	Paul Beard		
Standard:	FCC 15.247, EN 300-328, EN 300-440	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/10/2009
 Test Engineer: Mehran Birgani
 Test Location: Fremont Chamber #5

Config. Used: 1
 Config Change: None
 EUT Voltage: Battery

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions: Temperature: 22 °C
 Rel. Humidity: 43 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Channel	Measured Power	Test Performed	Limit	Result / Margin
1a	Low	-	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	50.8dBµV/m (346.7µV/m) @ 2352.0MHz (-3.2dB)
		-	Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	35.2dBµV/m (57.5µV/m) @ 7205.2MHz (-18.8dB)
1b	Center	-	Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	33.2dBµV/m (45.7µV/m) @ 7325.2MHz (-20.8dB)
1c	High	-	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	47.7dBµV/m (242.7µV/m) @ 2483.5MHz (-6.3dB)
		-	Radiated Emissions 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	30.9dBµV/m (35.1µV/m) @ 4951.5MHz (-23.1dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	T-Log Number:	T74282
		Account Manager:	Sheareen Washington
Contact:	Paul Beard		
Standard:	FCC 15.247, EN 300-328, EN 300-440	Class:	N/A

Note: Near field scan showed that at low and middle channels the only signals were 3rd harmonics of the fundamental. Near field scan showed that at high channel the only signal was 2nd harmonic; therefore only those signals were measured. Also there were no measurable differences between 3 orientations. The EUT was measured at vertical orientation only.

Run #1: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: 802.11b

Run #1a: Low Channel @ 2402 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2401.960	106.0	V	-	-	AVG	9	1.0	RB 1 MHz; VB: 10 Hz
2401.710	107.9	V	-	-	PK	9	1.0	RB 1 MHz; VB: 1 MHz
2401.960	98.3	H	-	-	AVG	60	1.8	RB 1 MHz; VB: 10 Hz
2401.700	100.2	H	-	-	PK	60	1.8	RB 1 MHz; VB: 1 MHz
2402.360	107.1	V	-	-	-	9	1.0	RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	107.1 dB μ V/m	
Limit for emissions outside of restricted bands:	87.1 dB μ V/m	Limit is -20dBc (Peak power measurement)

Band Edge Signal Field Strength - Direct measurement of field strength

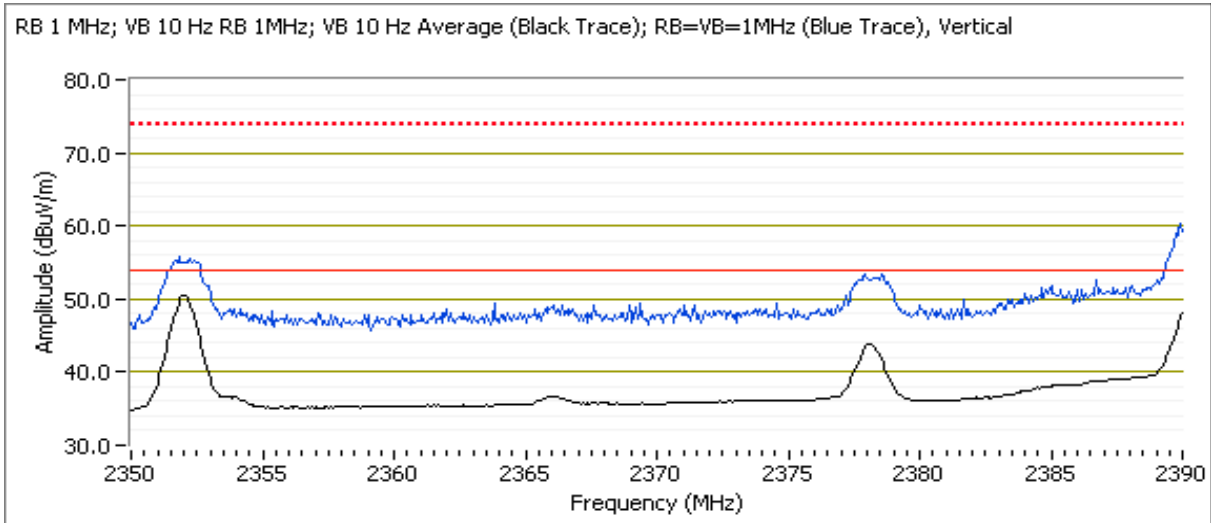
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2352.000	50.8	V	54.0	-3.2	AVG	9	1.0	RB 1 MHz; VB: 10 Hz
2390.000	59.4	V	74.0	-14.6	PK	9	1.0	RB 1 MHz; VB: 1 MHz

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
7205.230	35.2	H	54.0	-18.8	AVG	105	1.0	RB 1 MHz; VB: 10 Hz
7205.470	34.7	V	54.0	-19.3	AVG	0	2.2	RB 1 MHz; VB: 10 Hz
7205.030	44.9	H	74.0	-29.1	PK	105	1.0	RB 1 MHz; VB: 1 MHz
7207.480	46.1	V	74.0	-27.9	PK	0	2.2	RB 1 MHz; VB: 1 MHz

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental and measured in 100kHz.

Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	T-Log Number:	T74282
Contact:	Paul Beard	Account Manager:	Sheareen Washington
Standard:	FCC 15.247, EN 300-328, EN 300-440	Class:	N/A



Run #1b: Center Channel @ 2442 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
7317.270	31.6	V	54.0	-22.4	AVG	139	1.0	RB 1 MHz; VB: 10 Hz
7325.200	33.2	H	54.0	-20.8	AVG	98	1.0	RB 1 MHz; VB: 10 Hz
7318.100	42.9	V	74.0	-31.1	PK	139	1.0	RB 1 MHz; VB: 1 MHz
7318.800	43.0	H	74.0	-31.0	PK	98	1.0	RB 1 MHz; VB: 1 MHz

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental and measured in 100kHz.

Run #1c: High Channel @ 2476 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2475.940	113.6	V	-	-	AVG	317	1.0	RB 1 MHz; VB: 10 Hz
2475.700	115.3	V	-	-	PK	317	1.0	RB 1 MHz; VB: 1 MHz
2475.980	101.2	H	-	-	AVG	165	1.3	RB 1 MHz; VB: 10 Hz
2476.390	103.0	H	-	-	PK	165	1.3	RB 1 MHz; VB: 1 MHz
2475.700	114.7	V	-	-	-	317	1.0	RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW: 114.7 dB μ V/m

Limit for emissions outside of restricted bands: 94.7 dB μ V/m Limit is -20dBc (Peak power measurement)

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Model:	X1TXO	T-Log Number:	T74282
Contact:	Paul Beard	Account Manager:	Sheareen Washington
Standard:	FCC 15.247, EN 300-328, EN 300-440	Class:	N/A

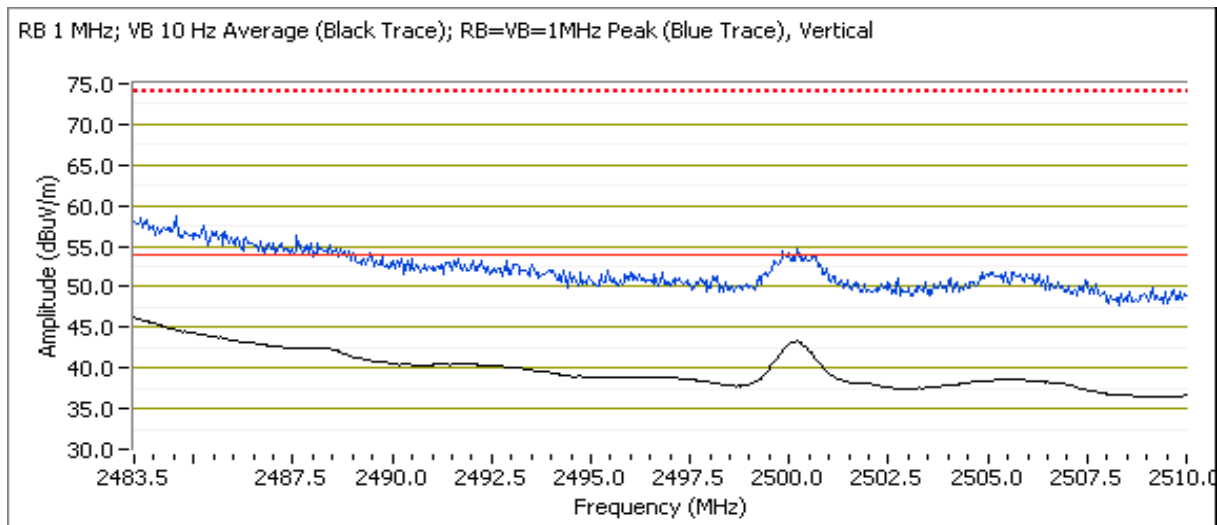
Band Edge Signal Field Strength - Direct measurement of field strength

Frequency MHz	Level dB μ V/m	Pol V/H	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2483.500	47.7	V	54.0	-6.3	AVG	317	1.0	RB 1 MHz; VB: 10 Hz
2483.500	38.3	H	54.0	-15.7	AVG	165	1.3	RB 1 MHz; VB: 10 Hz
2483.500	57.5	V	74.0	-16.5	PK	317	1.0	RB 1 MHz; VB: 1 MHz
2497.360	48.7	H	74.0	-25.3	PK	165	1.3	RB 1 MHz; VB: 1 MHz

Other Spurious Emissions

Frequency MHz	Level dB μ V/m	Pol V/H	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
4951.430	30.7	H	54.0	-23.3	AVG	245	1.0	RB 1 MHz; VB: 10 Hz
4951.500	30.9	V	54.0	-23.1	AVG	264	1.0	RB 1 MHz; VB: 10 Hz
4945.000	40.6	V	74.0	-33.4	PK	264	1.0	RB 1 MHz; VB: 1 MHz
4951.500	40.6	H	74.0	-33.4	PK	245	1.0	RB 1 MHz; VB: 1 MHz

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental and measured in 100kHz.



Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	T-Log Number:	T74282
		Account Manager:	Sheareen Washington
Contact:	Paul Beard		
Standard:	FCC 15.247, EN 300-328, EN 300-440	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/10/2009
 Test Engineer: Mehran Birgani
 Test Location: Fremont Chamber #5

Config. Used: 1
 Config Change: None
 EUT Voltage: Battery

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions: Temperature: 23 °C
 Rel. Humidity: 42 %

Summary of Results

Run #	Rate	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	64		Output Power	15.247(b)	Pass	24.8 dBm
2	64		Power spectral Density (PSD)	15.247(d)	Pass	2.1 dBm/3kHz
3	64		Minimum 6dB Bandwidth	15.247(a)	Pass	0.85 MHz
3	64		99% Bandwidth	RSS GEN	-	1.1 MHz
4	64		Spurious emissions	15.247(b)	Pass	All signal below the limit

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client: Horizon Hobby, Inc.	Job Number: J74242
Model: X1TXO	T-Log Number: T74282
Contact: Paul Beard	Account Manager: Sheareen Washington
Standard: FCC 15.247, EN 300-328, EN 300-440	Class: N/A

Run #1: Output Power

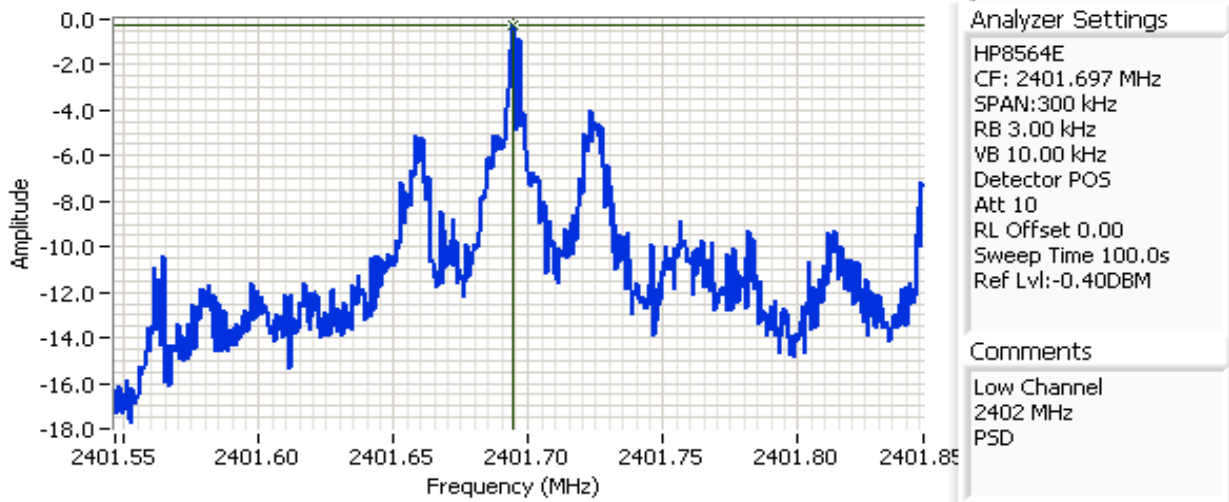
Rate ²	Frequency (MHz)	Output Power		Antenna Gain (dBi)	Result	EIRP	
		(dBm) ¹	mW			dBm	W
64	2402	24.7	295.1	2.0	Pass	26.7	0.468
64	2442	24.8	302.0	2.0	Pass	26.8	0.479
64	2476	24.5	281.8	2.0	Pass	26.5	0.447

- Note 1: Output power measured using a peak power meter
 Note 2: The Rate = 64 represented the maximum output power setting.

Run #2: Power spectral Density

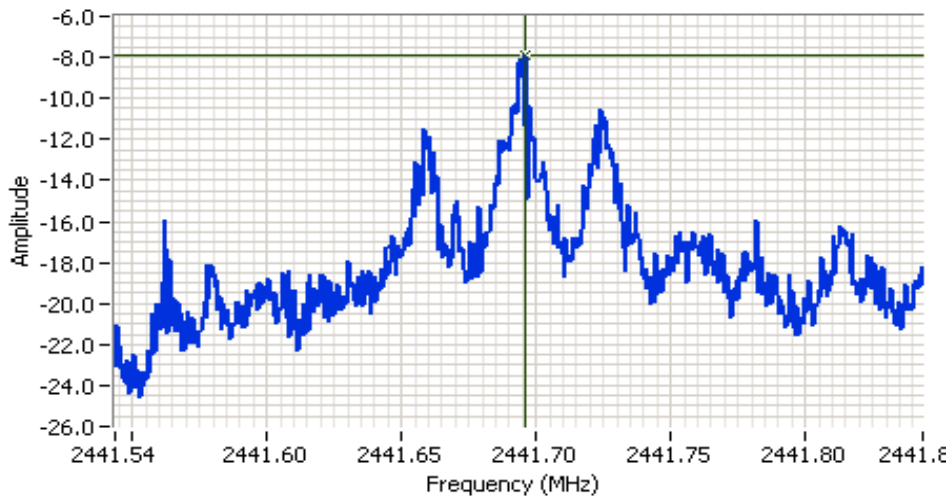
Rate	Frequency (MHz)	PSD	Limit dBm/3kHz	Result
		(dBm/3kHz) ^{Note 1}		
64	2401.695	-0.2	8.0	Pass
64	2441.696	-7.9	8.0	Pass
64	2475.697	2.1	8.0	Pass

- Note 1: Power spectral density measured using RB=3 kHz, VB=10kHz, analyzer with peak detector and with a sweep time set to ensure a dwell time of at least 1 second per 3kHz. The measurement is made at the frequency of PPSD determined from preliminary scans using RB=3kHz using multiple sweeps at a faster rate over the 6dB bandwidth of the signal.



Cursor 1	2401.6945	-0.23	
	0.0000	0.00	

Client: Horizon Hobby, Inc.	Job Number: J74242
Model: X1TXO	T-Log Number: T74282
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Standard: FCC 15.247, EN 300-328, EN 300-440	Class: N/A



Analyzer Settings

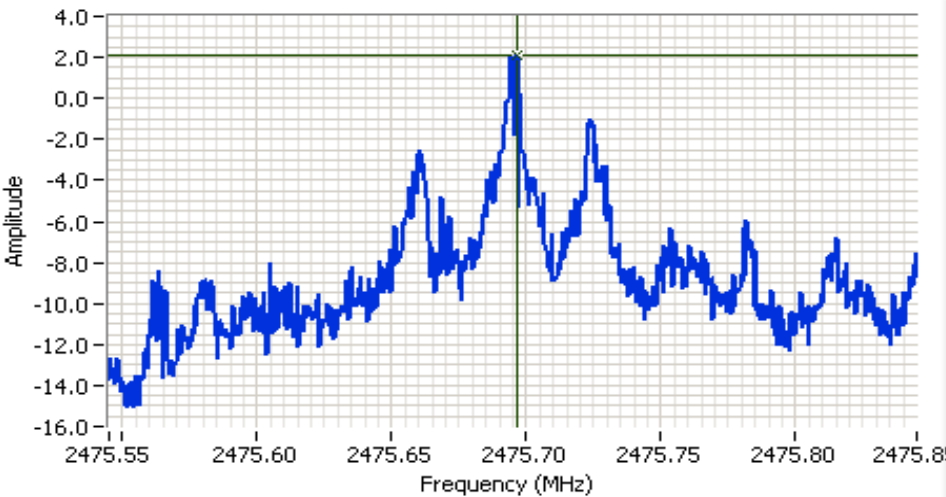
HP8564E
 CF: 2441.694 MHz
 SPAN: 300 kHz
 RB 3.00 kHz
 VB 10.00 kHz
 Detector POS
 Att 10
 RL Offset 0.00
 Sweep Time 100.0s
 Ref Lvl: -6.90DBM

Comments

Center Channel
 2442 MHz
 PSD

Cursor 1 2441.6961 -7.90

0.0000 0.00



Analyzer Settings

HP8564E
 CF: 2475.695 MHz
 SPAN: 300 kHz
 RB 3.00 kHz
 VB 10.00 kHz
 Detector POS
 Att 20
 RL Offset 0.00
 Sweep Time 100.0s
 Ref Lvl: 3.00DBM

Comments

High Channel
 2476 MHz
 PSD

Cursor 1 2475.6966 2.08

0.0000 0.00



Client: Horizon Hobby, Inc.	Job Number: J74242
Model: X1TXO	T-Log Number: T74282
Contact: Paul Beard	Account Manager: Sheareen Washington
Standard: FCC 15.247, EN 300-328, EN 300-440	Class: N/A

Run #3: Signal Bandwidth

Rate	Frequency (MHz)	Resolution Bandwidth	Bandwidth (MHz)	
			6dB	99%
64	2402	100 kHz	0.85	1.11
64	2442	100 kHz	0.87	1.11
64	2476	100 kHz	0.85	1.11

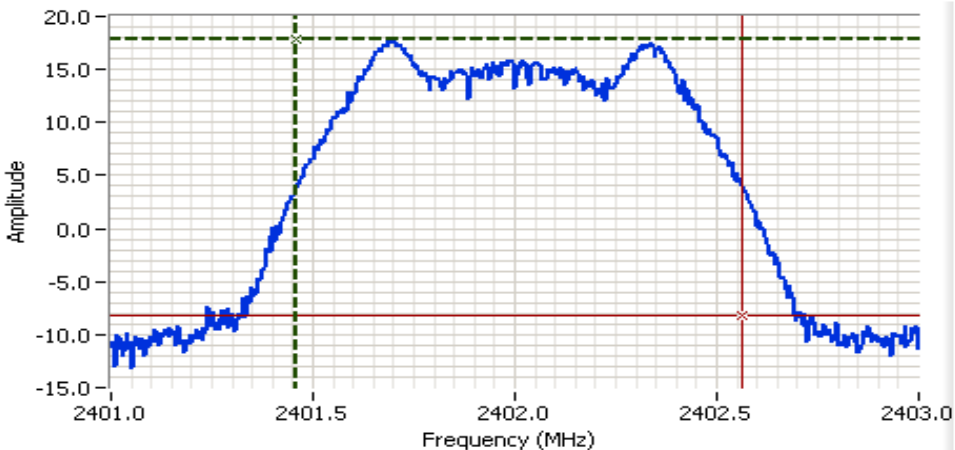
Note 1: 99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB



Analyzer Settings
 HP8564E
 CF: 2402.000 MHz
 SPAN: 2.000 MHz
 RB 100 kHz
 VB 100 kHz
 Detector POS
 Att 40
 RL Offset 0.00
 Sweep Time 50.0ms
 Ref Lvl: 20.80DBM

Comments
 6dB BW: 853 kHz

Cursor 1 2402.4333 17.55 
 Cursor 2 2401.5800 11.55 
 Delta Freq. 853 kHz
 Delta Amplitude 6.00



Analyzer Settings
 HP8564E
 CF: 2402.000 MHz
 SPAN: 2.000 MHz
 RB 100 kHz
 VB 300 kHz
 Detector POS
 Att 40
 RL Offset 0.00
 Sweep Time 50.0ms
 Ref Lvl: 20.80DBM

Comments
 99% BW: 1.105 MHz

Cursor 1 2401.4592 17.80 
 Cursor 2 2402.5641 -8.20 
 Delta Freq. 1.105
 Delta Amplitude 26.00

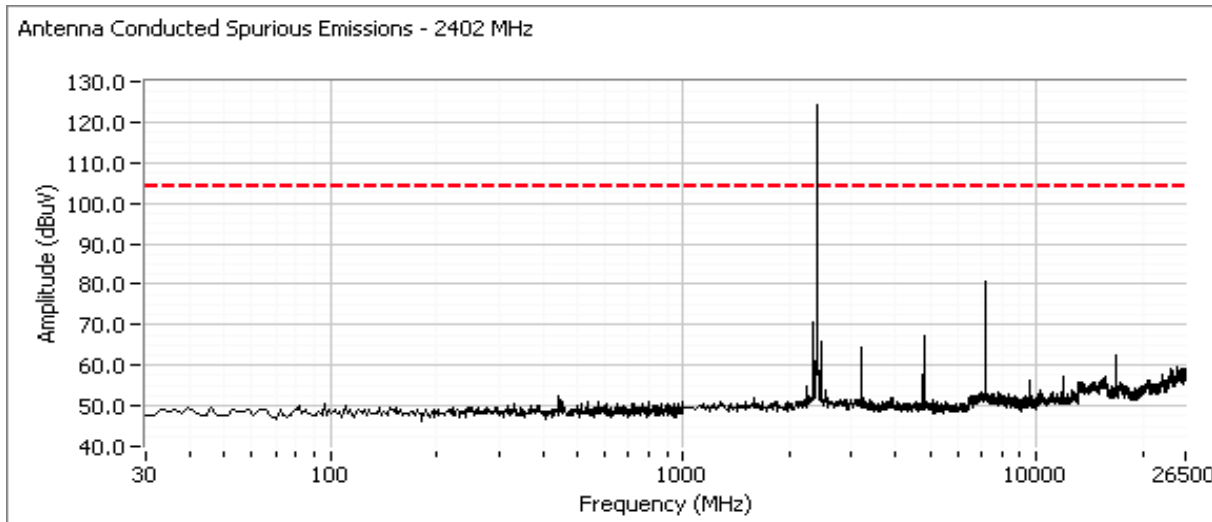


Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	T-Log Number:	T74282
		Account Manager:	Sheareen Washington
Contact:	Paul Beard		
Standard:	FCC 15.247, EN 300-328, EN 300-440	Class:	N/A

Run #4: Out of Band Spurious Emissions

Frequency (MHz)	Limit	Result
2402	-20dBc	Pass
2442	-20dBc	Pass
2476	-20dBc	Pass

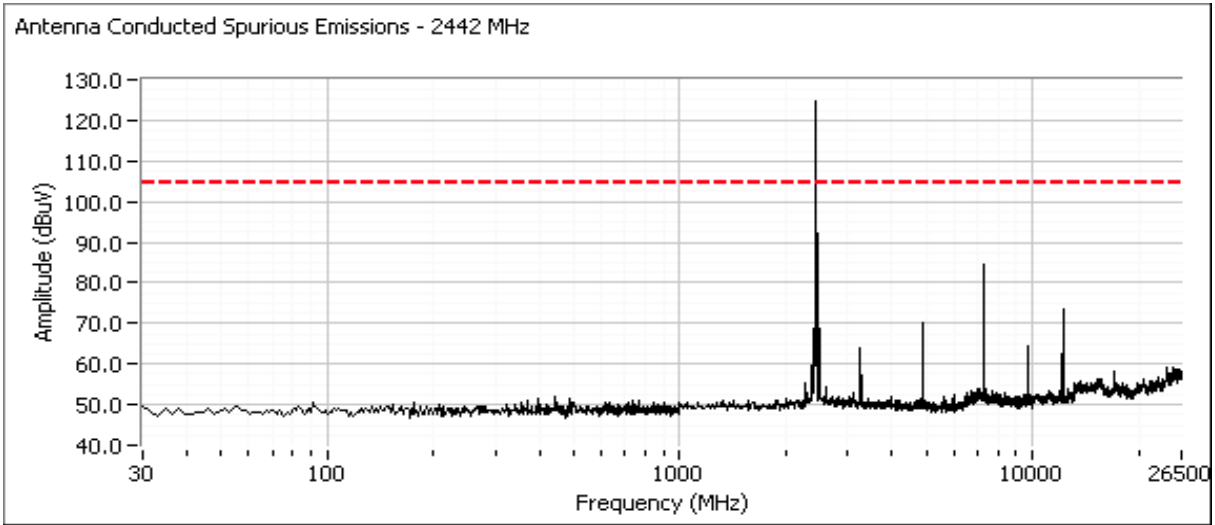
Plots for low channel



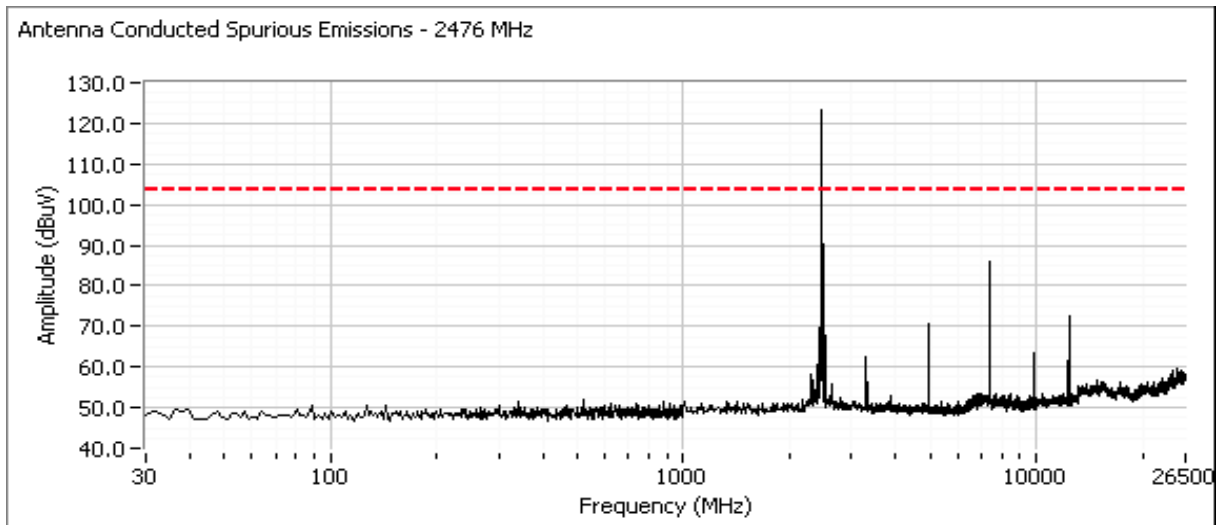
Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

Client:	Horizon Hobby, Inc.	Job Number:	J74242
Model:	X1TXO	T-Log Number:	T74282
Contact:	Paul Beard	Account Manager:	Sheareen Washington
Standard:	FCC 15.247, EN 300-328, EN 300-440	Class:	N/A

Plots for center channel



Plots for high channel



Appendix C Photographs of Test Configurations

Uploaded as a separate exhibit.

Appendix D Proposed FCC ID Label & Label Location

Uploaded as a separate exhibit.

Appendix E Detailed Photographs

Uploaded as a separate exhibit.

Appendix F Operator's Manual

Uploaded as a separate exhibit.

Appendix G Block Diagram

Uploaded as a separate exhibit.

Appendix H Schematic Diagrams

Uploaded as a separate exhibit.

Appendix I Theory of Operation

Uploaded as a separate exhibit.

Appendix J RF Exposure Information

Uploaded as a separate exhibit.