Test Certificate

A sample of the following product received on January 25, 2006 and tested on January 25, January 26 and February 2, 2006 complied with the requirements of the following standard(s), given the measurement uncertainties as detailed in Elliott report R72140:

- **EN 300 328 V1.7.1 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive"**

Horizon Hobby, Inc.
Model(s) DX7, DX6, DX5

Mark E. Hill
Staff Engineer

Horizon Hobby, Inc.

Printed Name

ACCREDITED

Testing Cert #2016-01

Elliott Laboratories
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94086-3518
408-245-7800 Phone
408-245-3499 Fax

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www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94085-3518
408-245-7800 Phone
408-245-3499 Fax

Electromagnetic Compatibility Test Report

EN 300 328 V1.7.1
ElectroMagnetic Compatibility and Radio spectrum Matters (ERM);
Wideband Transmission Systems;
Data transmission equipment operating in the 2,4 GHz ISM band and
using spread spectrum modulation techniques;

Horizon Hobby, Inc.
Model: DX7, DX6, DX5

MANUFACTURER:	Horizon Hobby, Inc. 4105 Fieldstone Road Champaign, IL 61822
TEST SITE:	Elliott Laboratories 684 W. Maude Ave Sunnyvale, CA 94086
REPORT DATE:	June 26, 2008
FINAL TEST DATE:	January 25, January 26 and February 2, 2006
AUTHORIZED SIGNATORY:	Mark E. Hill Staff Engineer

ACCREDITED

Testing Cert #2016-01

REVISION HISTORY

Rev #	Date	Comments	Modified By
1	July 9, 2008	Initial Release	Gary Izard

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SCOPE

The European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI) publish standards regarding ElectroMagnetic Compatibility and Radio spectrum Matters for radio-communications devices. Tests have been performed on the Horizon Hobby, Inc. model DX6 in accordance with these standards.

Electromagnetic compatibility test data has been taken pursuant to the relevant requirements of the following harmonized EN standard(s) covering essential requirements under article 3.2 of the R&TTE Directive:

- EN 300 328 V1.7.1 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques"

Tests were performed in accordance with these standards together with the current published versions of the basic standards referenced therein as outlined in Elliott Laboratories test procedures. The test data has been provided as an appendix to this report for reference.

The test results recorded herein are based on a single type test of the Horizon Hobby, Inc. model DX6 and therefore apply only to the tested sample. The sample was selected and prepared by Paul Beard of Horizon Hobby, Inc.

Testing on the DX6 was considered representative of testing on the DX7 and DX5 versions of the product. The hardware is identical for all three systems. Differences in the models is achieved thru software changes.

OBJECTIVE

The objective of the manufacturer is to comply with the harmonized standards identified in the previous section. In the case of most equipment, this document requires testing to other EN specifications.

In order to demonstrate compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards.

STATEMENT OF COMPLIANCE

The tested sample of Horizon Hobby, Inc. model DX6 complied with the relevant requirements of:

EN 300 328 V1.7.1

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.

DEVIATIONS FROM THE STANDARD

No deviations were made from the test methods and requirements detailed in the standards listed in this report.

PERFORMANCE ASSESSMENT

The Horizon Hobby, Inc. model DX6 primary function is to remotely control model aircraft and helicopters. All other characteristics of the product tested are detailed in the remainder of this report.

TEST RESULTS

EN 300 328 V1.7.1 – Frequency Hopping Modulation

Section	Description	Measured	Limit	Result
4.3.1.2	Average Effective Radiated Power (over normal and extreme conditions)	19.1 dBm	100mw (20dBm)	Complies
4.3.3	Frequency Range (over normal and extreme conditions)	2400.8 - 2478.75 MHz	2400 MHz – 2483.5 MHz	Complies
4.3.4	Number of hopping channels	40	>15 channels	Complies
4.3.4	Channel separation	2 MHz	The greater of >1 MHz or >20dB bandwidth	Complies
4.3.4	Maximum time of occupancy	0.43 ms	0.4 s	Complies
4.3.5	Medium Access Protocol	See operational description		Complies
4.3.6	Transmit Mode Spurious Emissions (radiated)	45.3dBµV/m @ 4959.6MHz (-20.0dB)	EN 300 328 v1.4.1 Tables 2 and 3	Complies
4.3.7	Stand-By/Receive Mode Spurious Emissions (radiated)	33.7dBµV/m @ 798.828MHz (-12.3dB)	EN 300 328 v1.4.1 Tables 4 and 5	Complies

EXTREME CONDITIONS

Voltage extremes used during testing were for equipment intended to operate from a mercury or nickel-cadmium type of battery, 0.9 times and 1.15 times the nominal voltage (9.6Vdc) of the battery.

Temperature extremes used during testing were those for unrestricted use, -20°C to +55°C.

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 (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF frequency	Hz	25 to 7000 MHz	1.7×10^{-7}
RF power, conducted	dBm	25 to 7000 MHz	± 0.52 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission of transmitter	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission of receiver	dBm	25 to 26500 MHz	± 2.5 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Horizon Hobby, Inc. model DX6 is a 2.4GHz Spread Spectrum transceiver module which is designed for model aircraft control and telemetry. The RF Module inside is named as X1TXN. Normally, the EUT would be hand-held during operation. The EUT was treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the RF module is 9.6V DC 300mA.

The sample was received on January 25, 2006 and tested on January 25, January 26 and February 2, 2006. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number
Horizon Hobby	DX6 w/X1TXN FHSS radio module	Remote Control	-

OTHER EUT DETAILS

The EUT antenna is a 2dBi Folded dipole.

The RF Module does not have an enclosure as it is designed to be installed within the enclosure of a host device.

The DX6 enclosure is primarily constructed of fabricated plastic. It measures approximately 20 cm wide by 35 cm deep by 10 cm high.

ENCLOSURE

The DX6 enclosure is primarily constructed of fabricated plastic. It measures approximately 20 cm wide by 35 cm deep by 10 cm high.

MODIFICATIONS

No modifications were made to the EUT during testing.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for testing:

Manufacturer	Model	Description	Serial Number	FCC ID
JR	XP9303	9# RC Unit	1953706	N/A
SPEKTRUM	SPM7101	AC-DC Adapter	-	N/A

No equipment was used as remote support equipment for testing.

EUT INTERFACE PORTS

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

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

EUT OPERATION

The X1 TXM 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.

EMISSIONS TEST SITE

GENERAL INFORMATION

Final test measurements were taken on January 25, January 26 and February 2, 2006 at the Elliott Laboratories Test Site(s) listed below. The test sites contain separate areas for radiated and conducted emissions testing. The sites conform to the requirements of CISPR 16-1:1999. They are registered with the VCCI and are on file with the FCC and Industry Canada. Ambient levels are at least 6 dB below the specification limits with the exception of predictable local TV, radio, and mobile communications traffic. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

	Site	VCCI Registration #	Location
	SVOATS #1	R458	684 West Maude Avenue,
	SVOATS #2	R709	Sunnyvale CA 94086-3518

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions measurements are performed with the EUT's rf input/output connected to the input of a spectrum analyzer. When required an attenuator or dc block is placed between the EUT and the spectrum analyzer.

RADIATED EMISSIONS CONSIDERATIONS

CISPR has determined that radiated measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an Open Area Test Site or anechoic chamber, as defined in CISPR 16-1 and Annex A of EN 300 328 / EN 301 893 / EN 300 440-1. The test site is maintained free of conductive objects within the CISPR defined elliptical area.

EMISSIONS MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 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.

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.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

INSTRUMENT CONTROL COMPUTER

Software control is used to convert the receiver measurements to the field strength at an antenna, 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 exported in a graphic and/or tabular format, as appropriate.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer runs automated data collection programs that 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 EUT antenna port or receiving antenna and the test receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 25 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements.

Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

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.

The test height above ground for non-body worn devices shall be 150 centimeters. Floor mounted equipment will 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.

RADIO STANDARD TEST PROCEDURES

OUTPUT POWER

Output power is measured using an average sensor head. If the device is operating with a duty cycle during the measurement the measurement time is set to exceed the on/off duty cycle and the measured value is then corrected by adding a factor of 10 log(1/duty cycle) to the measured value.

Peak power measurements as required by EN 300 328 are measured using a diode detector as detailed in EN 300 328 section 5.7.2.2.

Power density is initially measured as a peak bandwidth (RBW=VBW=1MHz). If the power density is within 3dB of the limit it is re-measured via the IF output of the spectrum analyzer using an average sensor.

Power measurements made directly on the rf power port are, when appropriate, converted to an EIRP by adding the gain of the highest gain antenna that can be used with the device under test, as specified by the manufacturer.

FREQUENCY RANGE (EN 300 328, 2.4 GHz Band)

Frequency range is measured in accordance with EN 300 328 section 5.7.4.. Typically a bandwidth of 100kHz is used and the lower and upper frequencies at which the transmitted signal exceeds the spurious emission limit, adjusted for the measurement bandwidth, define the frequency range.

CONDUCTED SPURIOUS EMISSIONS

Conducted emissions are measured at the output of the device using a RF cable and attenuator if required. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

RADIATED SPURIOUS EMISSIONS

Radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration.

At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. The limit is a field strength limit derived from the ERP limit specified in the standard(s).

All signals within 10dB of this calculated limit are re-measured on an OATS or Semi-anechoic chamber. The field strength is recorded and the EUT is then replaced with a substitution antenna of known gain (typically a dipole antenna or a double-ridged horn antenna). The erp of the substitution antenna is measured and used to calculate the erp of the EUT as outlined in section C3 of EN 300 328 and EN 301 893.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS

Measurements are compared directly to the conducted emissions specification limit (decibel form). The calculation is as follows:

$$R_r - S = M$$

where:

R_r = Measured value in dBm
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED SPURIOUS EMISSIONS

Receiver readings are compared directly to a converted specification limit (decibel form).

The conversion uses the effective radiated power limit specified in the standard to calculate the expected field strength in free space using the following formula:

$$E = \frac{\sqrt{30\ P\ G}}{d}$$

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of antenna in numeric gain[1]
D = distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated as follows:

$$M = R_C - L_S$$

where:

R_C = Corrected Receiver Reading in dBuV/m
L_S = Calculated specification Limit in dBuV/m
M = Margin in dB Relative to Spec

When substitution measurements are required (all signals with less than 6dB of margin relative the field strength limit) the margin of the emissions relative to the effective radiated power limit is calculated from:

$$P_S - S = M$$

where:

P_S = effective radiated power determined from antenna substitution (dBm)
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

[1] Although the gain relative to a dipole should be used for limits expressed as an erp, the isotropic gain is used as this produces a more conservative limit.

APPENDIX A: Test Equipment Calibration Data

1 Page

Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	30-Mar-07
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 40 GHz, Fremont (SA40)	8564E (84125C)	1393	26-Oct-05
EMCO	Horn antenna, D. Ridge 1-18GHz (SA40 system antenna)30Hz sunnyvale	3115	1142	11-Jun-06
Hewlett Packard	Microwave EMI test system head (includes W1 - W4, Asset 1143 and 1144)	84125C	1145	07-Sep-06
EMCO	Horn antenna, 18-26.5 GHz (SA40 30Hz)	3160-09 (84125C)	1150	12-Sep-06
Hewlett Packard	High Pass filter, 3.5GHz	P/N 84300-80038	1157	28-Apr-06

Radiated Emissions, 23-Nov-05
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Narda West	High Pass Filter 4.0 GHz,	HXF370	247	16-May-06
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	26-Apr-06
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	1242	19-Oct-06
Hewlett Packard	EMC Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	28-Mar-06

Conducted Emissions - AC Power Ports, 23-Nov-05
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	812	11-Feb-06
Fischer Custom Comm.	LISN, Freq. 0.9 -30 MHz,16 Amp	FCC-LISN-50/250-16-2	1079	07-Jul-06
Rohde & Schwarz	Test Receiver, 9kHz-2750MHz	ESCS 30	1337	12-Jan-06

Radiated Emissions, 1000 - 26,500 MHz, 26-Jan-06
Engineer: Chris Byleckie

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	26-Apr-06
Hewlett Packard	High Pass filter, 3.5GHz	P/N 84300-80038	1157	28-Apr-06
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 40 GHz, Fremont (SA40) Blue	8564E (84125C)	1393	10-Nov-06
EMCO	Horn antenna, D. Ridge 1-18GHz (SA40 system antenna)30Hz sunnyvale	3115	1142	11-Jun-06

, 02-Feb-06
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	26-Apr-06
Filtek	High Pass Filter, 1GHz	HP12/1000-5BA	957	18-Apr-06
EMCO	Horn antenna, D. Ridge 1-18GHz (SA40 system antenna)30Hz sunnyvale	3115	1142	11-Jun-06
Hewlett Packard	EMC Spectrum Analyzer 30Hz - 40GHz, Sunnyvale (SA40) Red	8564E (84125C)	1148	09-Sep-06
EMCO	Biconical Antenna, 30-300 MHz	3110B	1320	05-Oct-06
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	30-Mar-07
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	23-May-06

APPENDIX B: Test Data Log Sheets

ELECTROMAGNETIC COMPATABILITY

TEST LOGS

T61985 16 Pages

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	Test-Log Number:	T61985
		Project Manager:	Ezther Zhu
Contact:	Paul Beard		
Emissions Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	-
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Horizon Hobby, Inc.

Model

X1TXN Spektrum DSM X1 module

Date of Last Test: 3/12/2007

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	Test-Log Number:	T61985
		Project Manager:	Ezther Zhu
Contact:	Paul Beard		
Emissions Spec:	EN 300 440 V1.3.1, EN 300-328 V	Class:	-
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. The RF Module inside is named as X1TXN. Normally, the EUT would be hand-held during operation. The EUT was treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the RF module is 9.6V DC 300mA.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Horizon Hobby	DX7	2.4GHz SS Transceiver	PFB101005	BRWDAMTX10

EUT Antenna (Intentional Radiators Only)

The EUT antenna is a 2dBi Folded dipole.
The antenna connects to the RF module via a non-standard micro-coax, thereby meeting the requirements of EN 300 328.

EUT Enclosure

The RF Module does not have an enclosure as it is designed to be installed within the enclosure of a host device.

Modification History

Mod. #	Test	Date	Modification
1	-	-	None

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Project Manager:	Ezther Zhu
Contact:	Paul Beard		
Emissions Spec:	EN 300 440 V1.3.1, EN 300-328 V	Class:	-
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
JR	XP9303	9# RC Unit	1953706	N/A
SPEKTRUM	SPM7101	AC-DC Adapter	-	N/A

The JR RC unit was used as a test fixture to provide the module with power and control signals during testing.
AC adapter used for conducted emissions measurements. An external battery pack was used for radiated emissions.

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:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Temperature and Voltage Extremes - EN 300 440

Test Specifics

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: 1/25/2006
Test Engineer: Mehran Birgani
Test Location: Environment Chamber
Config. Used: 1
Config Change: None
EUT Voltage: 9.6 Vdc

General Test Configuration

The EUT's RF port was connected to the measurement instrument's RF port, via an attenuator or dc-block if necessary.

Summary of Results

Run #	Test Performed	Limit	Result	Value / Margin
1	Permitted Frequency Range of the Modulation Bandwidth (EN 300 220)	Allocated band is 2400 - 2483.5 MHz	Pass	2400.8 - 2478.75 MHz
2	Frequency stability under low voltage conditions	signal shall remain in-band / on-channel	Pass	EUT cease to operate below 7.2Vdc
2	Power under normal and extreme operating conditions	Peak / Avg	Pass	19.1 dBm
3	20dB Bandwidth	15.247(a)	Pass	1.3MHz
3	Channel Occupancy	15.247(a)	Pass	21.99mS
3	Number of Channels	15.247(a)	Pass	40

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

The following modifications were made to the EUT during testing in order to comply with the requirements of the standard:
Peak power sensor was used instead of diode peak detctor measured peak.

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Test Notes

Voltage extremes:

Mercury or nickel-cadmium type of battery: 0.9 times and 1.15 times the nominal voltage of the battery;

Temperature extremes:

Unrestricted use: -20°C to +55°C

The transmitter was tested at temperature extremes of -20 and +55 degrees C and at voltage extremes based on a 9.6V operating voltage with +0%,-85% extremes as detailed in EN 300 440-1.

Run# 1: Frequency range of modulation (permitted range of operating frequency)

Direct measurements were taken from the EUT. The fundamental must stay within the frequency of operation. Drift of the fundamental is determined by using the -30dBm spurious emissions limit. Fl is frequency low and Fh is frequency high.

Signal monitored with direct connection.

Temp	-20°C		20°C	25°C		55°C		
Voltage	8.2	9.6	9.6	8.2	10.0	8.2	9.6	
F_L (MHz)	2400.8	2400.8	2400.91			2400.91	2400.91	RBW=100kHz
F_H (MHz)	2478.75	2478.75	2478.75			2478.75	2478.75	RBW=100kHz

FL min: 2400.800

FH max: 2478.750

Permitted range is 2400 - 2483.5 MHz, device complies.

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Run #2: Output Power

Average Power[1] under normal and extreme operating conditions

	Channel / Mode	Average Power (dBm)[1] For Operating Condition					Max Antenna Gain[3]	Duty Cycle[4]	Max Average Power (EIRP)[5]	Maximum permitted EIRP (dBm)
		Normal	Extreme							
		20°C	-20°C		55°C					
		9.6Vdc	8.2Vdc	9.6Vdc	8.2Vdc	9.6Vdc				
	2402.00	15.8	16.8	17.0	12.9	12.9	2.0	1.0	19.0	20.0
	2441.00	16.4	17.0	17.1	13.2	13.2	2.0	1.0	19.1	20.0
	2476.00	16.0	16.8	16.9	12.9	12.9	2.0	1.0	18.9	20.0

Peak Power[2] under normal and extreme operating conditions

	Channel / Mode	Peak Power (dBm)[2] For Operating Condition					Max Antenna Gain[3]	Duty Cycle[4]	Max Average Power (EIRP)[5]	Maximum permitted EIRP (dBm)
		Normal	Extreme							
		20°C	-20°C		55°C					
		9.6Vdc	8.2Vdc	9.6Vdc	8.2Vdc	9.6Vdc				
	2402.00	16.0	16.9	17.0	13.1	13.1	2.0	1.0	19.0	23.0
	2441.00	16.3	17.1	17.1	13.3	13.3	2.0	1.0	19.1	23.0
	2476.00	16.1	16.9	16.9	13.3	13.3	2.0	1.0	18.9	23.0

Note 1:	Output power measured using Average Sensor. Maximum permitted based on information provided by Horizon Hobby for average power plus 3dB.
Note 2:	Output power measured using Peak Power Sensor (specifications refers to use of a diode detctor, however the peak power sesnor was used). Maximum permitted based on information provided by Horizon Hobby for average power plus 3dB.
Note 3:	Gain is the maximum gain of the antenna assembly that can be used with the EUT at this power level.
Note 4:	Duty Cycle - the duty cycle of the transmitter during the power measurement [time on /(time off + time on)]. Measured using the spectrum analyzer to verify continuous transmission (duty cycle = 1.0).
Note 5:	EIRP levels are the measured levels corrected for duty cycle [10log(duty cycle)] and EUT antenna gain.

As the device is battery powered the frequency stability under low voltage conditions was verified. The transmitter switched off when the voltage dropped below the lower extreme (7.2 V) with no variation in the freqency.

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Run #3: Bandwidth, Channel Occupancy, Spacing and Number of Channels

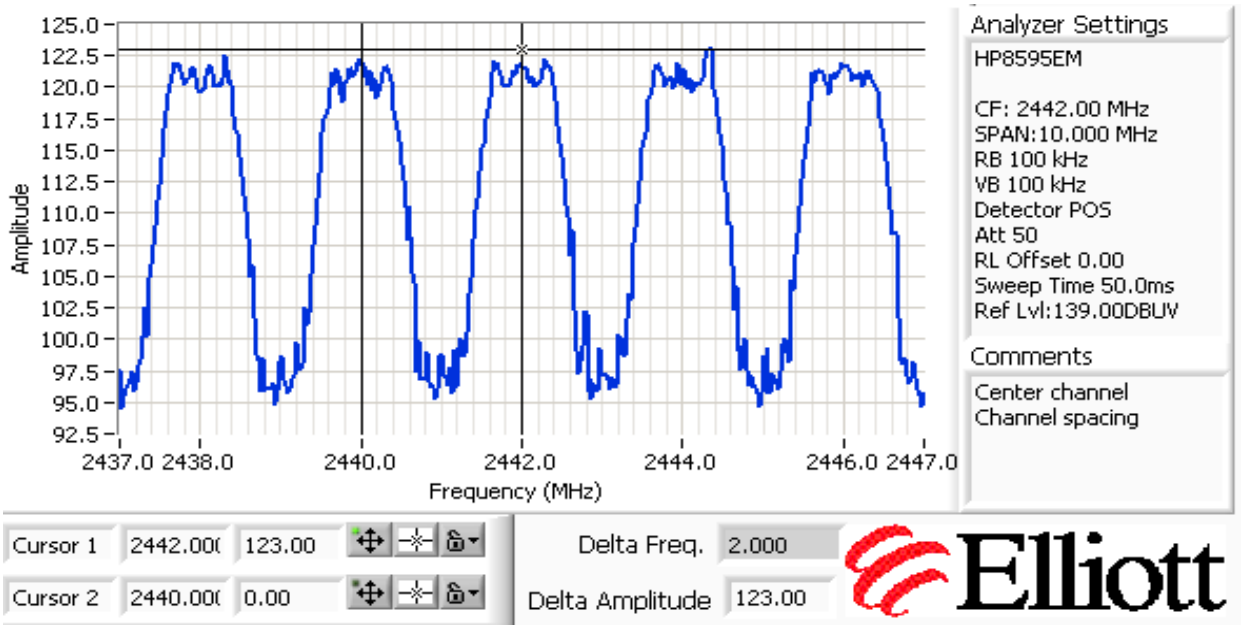
Channel	Frequency (MHz)	Resolution Bandwidth	20dB Bandwidth (kHz)	Resolution Bandwidth	99% Bandwidth (kHz)
Low	2402	100	1250	100	1200
Mid	2442	100	1270	100	1200
High	2478	100	1300	100	1200

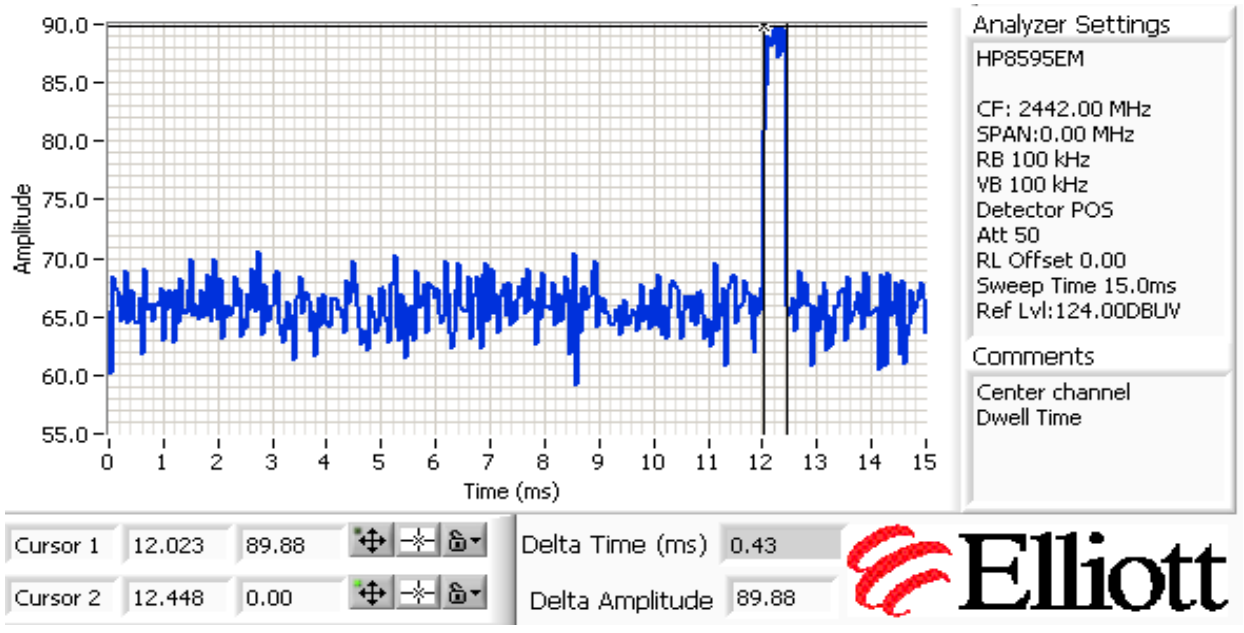
Note 1:	20dB bandwidth measured using RB = 100, VB = 300 (VB > RB)
Note 2:	99% bandwidth measured using RB = 100, VB = 300 (VB >=3RB)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
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. (Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.)
The channel dwell time is calculated from the transmit time on a channel mulitplied by the number of times a channel could be used in a period of 0.4 times the number of channels, N (i.e. 0.4N divided by the time between successive hops, rounded up to the closest integer), unless the time between successive hops exceeds 0.4N, in which case the channel dwell time is the transmit time on a channel.

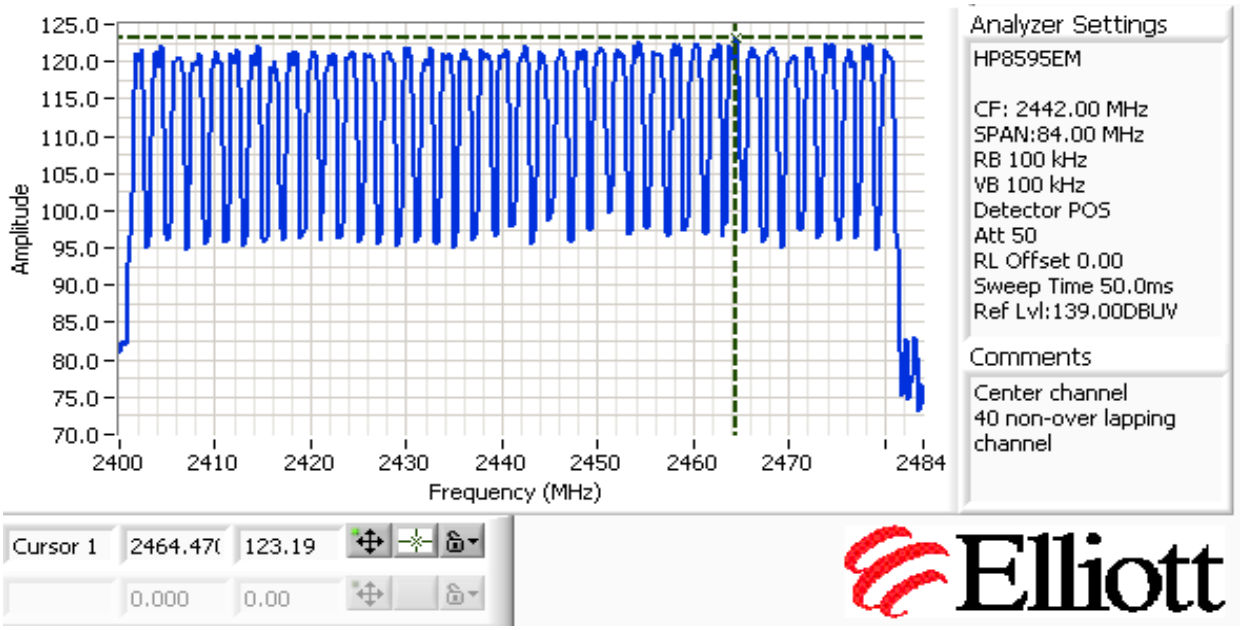
Maximum 20dB bandwidth:	1270	kHz	Pass
Channel spacing:	2000	kHz	Pass
Transmission time per hop:	0.43	ms	
The time between successive hops on a channel:	22	ms	
Number of channels (N):	40		Pass
Channel dwell time in 16.0 seconds:	0.43	ms	Pass

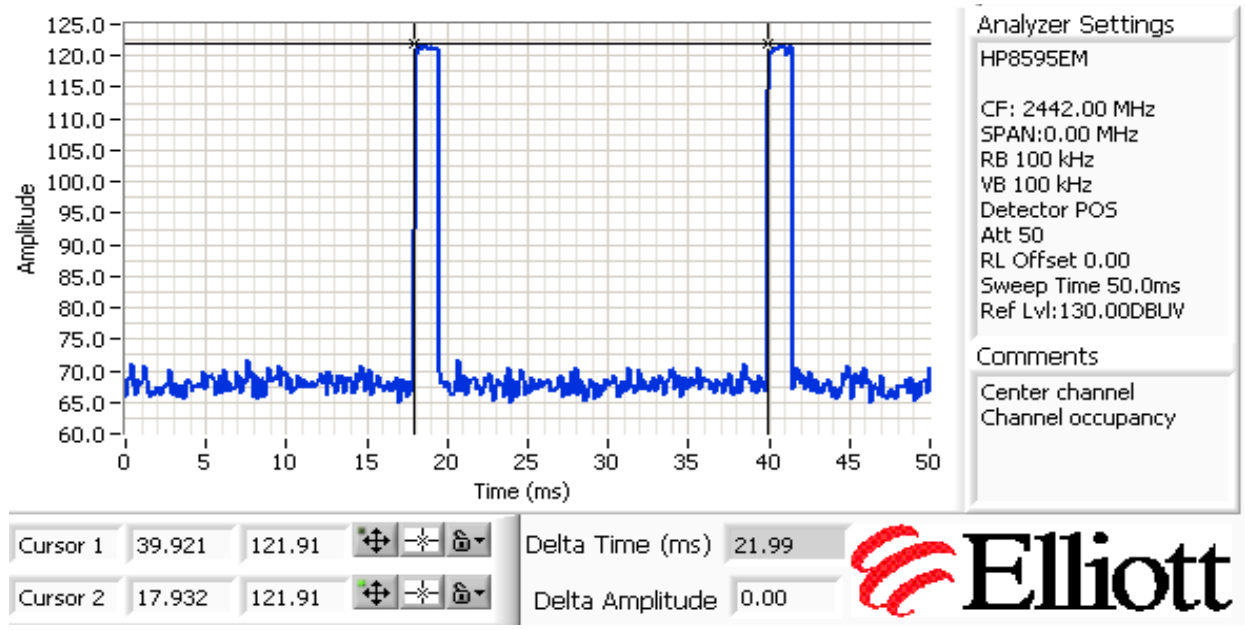
Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A



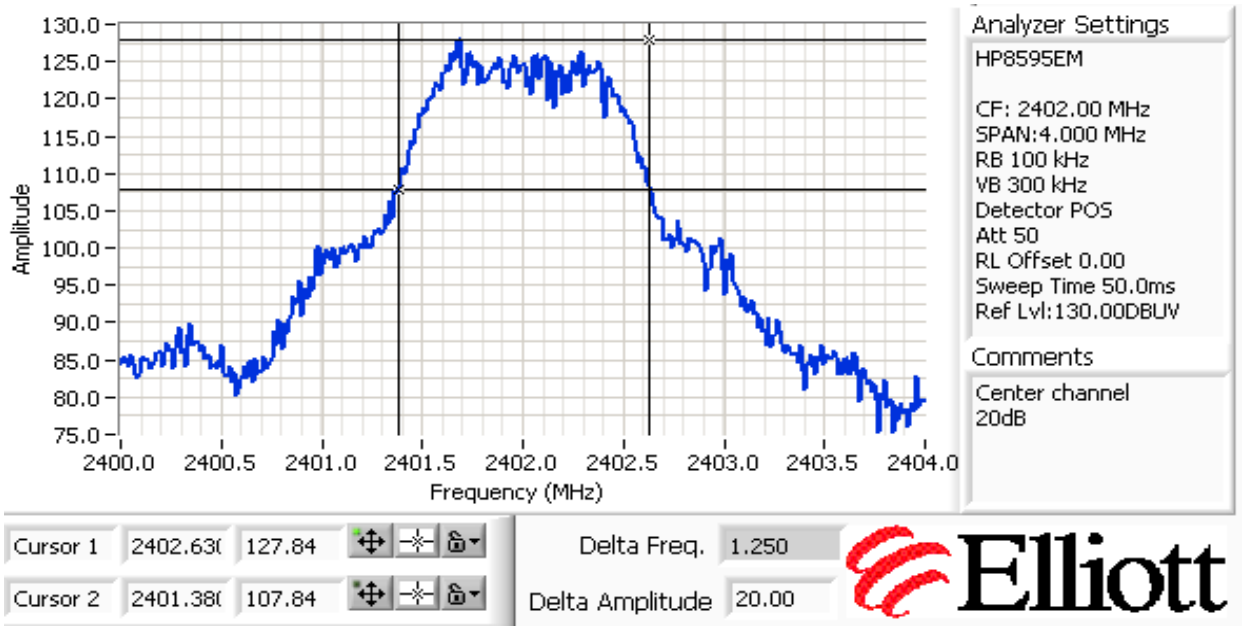


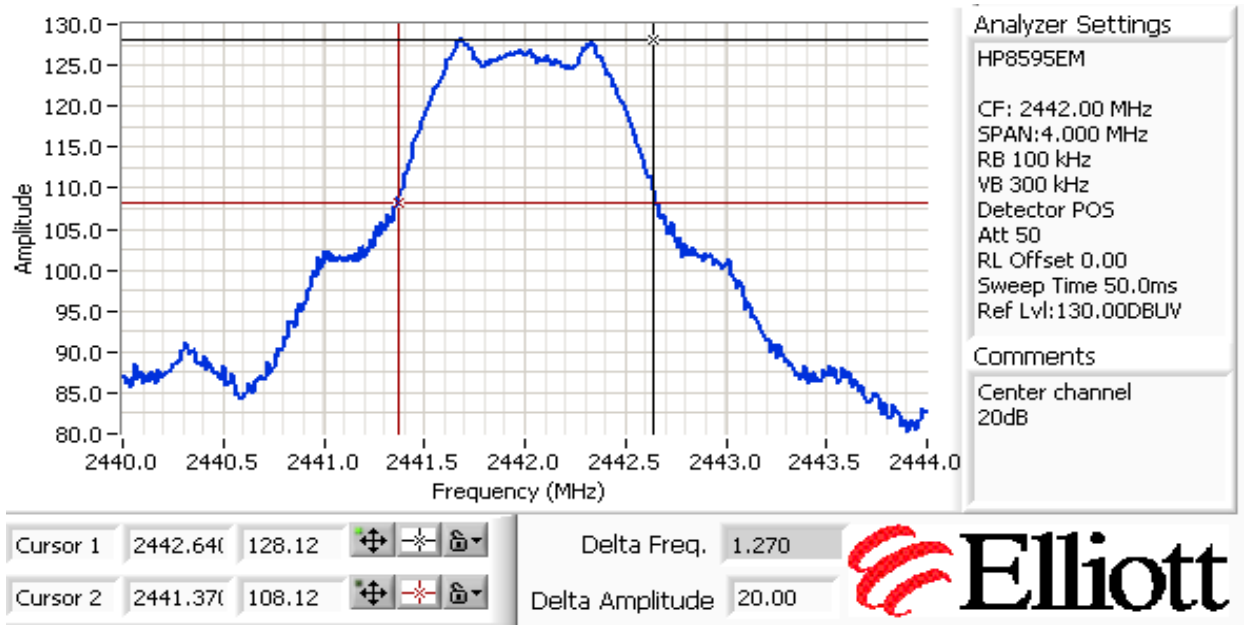
Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A



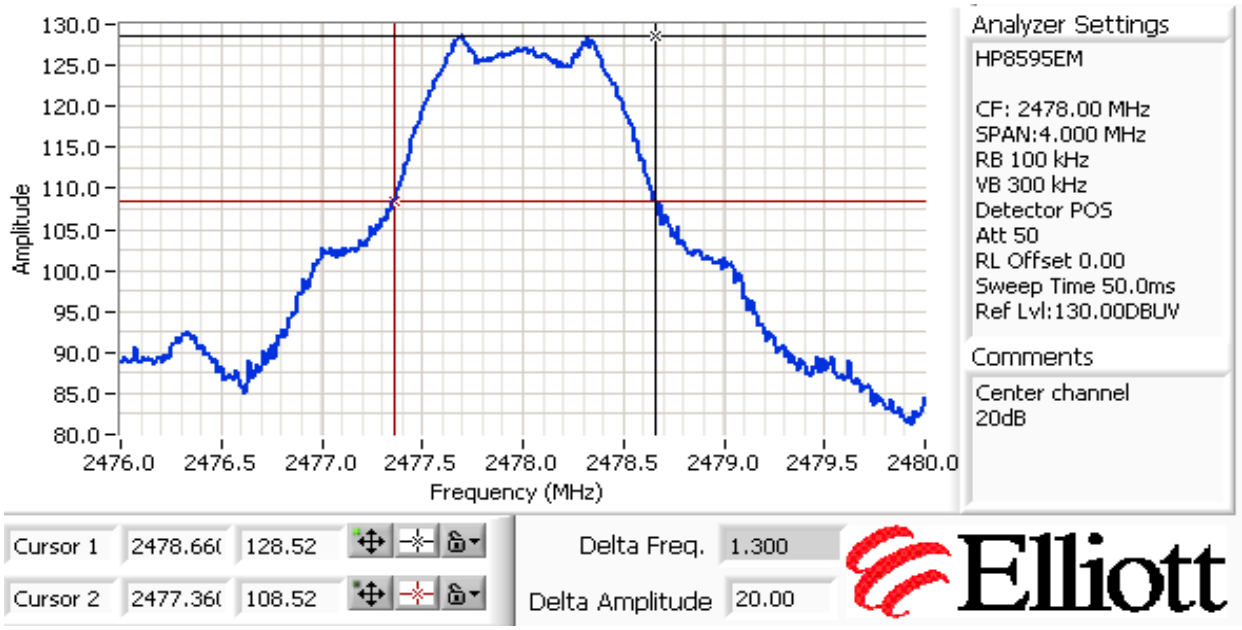


Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A





Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A



Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Radiated Spurious Emissions, EN 300 440 V1.3.1

Test Specifics

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: 1/26/2006
Test Engineer: Chris Byleckie
Test Location: SVOATS #2
Config. Used: 1 (Setup Photos Below)
Config Change: AC Adapter was not used
EUT Voltage: Battery

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.

The measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 13 °C
Rel. Humidity: 49 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	RE, Fundamental Level Transmit Mode	EN 300 440	Pass	117.5dBuV/m @ 2442MHz (+19.7dBm)
2	RE, 25 - 25000 MHz - Spurious Emissions Transmit Mode	EN 300 440	Pass	45.3dBµV/m @ 4959.6MHz (-20.0dB)

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:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Run #1: Radiated Spurious Emissions, Transmit Mode, Fundamental

Frequency	Level	Pol	EN 300 440 Note 1		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2402.000	116.1	v	115.3	0.8	Pk	183	1.8	EUT upright
2442.000	117.5	v	115.3	2.2	Pk	178	1.4	EUT upright
2480.000	116.9	v	115.3	1.6	Pk	23	1.4	EUT upright
2402.000	100.0	h	115.3	-15.3	Pk	54	1.0	EUT upright
2442.000	102.7	h	115.3	-12.6	Pk	226	1.3	EUT upright
2480.000	100.7	h	115.3	-14.7	Pk	315	1.1	EUT upright
2402.000	106.8	v	115.3	-8.5	Pk	349	1.0	EUT flat
2442.000	106.5	v	115.3	-8.8	Pk	334	1.3	EUT flat
2480.000	106.2	v	115.3	-9.1	Pk	328	1.0	EUT flat
2402.000	117.3	h	115.3	2.0	Pk	114	2.1	EUT flat
2442.000	117.3	h	115.3	2.0	Pk	132	1.3	EUT flat
2480.000	115.5	h	115.3	0.2	Pk	343	1.2	EUT flat

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 10dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	EUT sideways was not tested as the antenna would be in the same orientation as with the EUT flat

Horizontal

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
2480.000	8.2	9.3	115.3	97.8	115.3	17.5	15.3	20.0		-2.5
2442.000	8.4	9.3	117.3	99.6	117.3	17.7	15.5	20.0		-2.3
2402.000	8.4	9.3	117.3	99.6	117.3	17.7	15.5	20.0		-2.3

Vertical

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
2408.000	10.4	9.3	116.9	97.2	116.9	19.7	17.5	20.0		-0.3
2442.000	10.4	9.3	117.5	97.8	117.5	19.7	17.5	20.0		-0.3
2402.000	10.4	9.3	116.9	97.2	116.1	18.9	16.7	20.0		-1.1

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna. A dipole has a gain of 2.2dBi.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Run #2a: Radiated Spurious Emissions, Transmit Mode, 25 - 25000 MHz. EUT @ 2402 MHz

Frequency	Level	Pol	EN 300 440 Note 1		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4803.550	39.2	V	65.3	-26.1	PK	155	1.0	EUT upright
7205.040	42.7	V	65.3	-22.6	PK	171	1.0	EUT upright
4803.660	39.2	H	65.3	-26.2	PK	162	2.0	EUT upright
7207.445	42.7	H	65.3	-22.6	PK	182	1.0	EUT upright
4803.575	39.2	H	65.3	-26.2	PK	123	1.0	EUT Flat
7205.830	42.7	H	65.3	-22.6	PK	168	1.0	EUT Flat
4803.605	38.5	V	65.3	-26.8	PK	292	1.1	EUT Flat
7205.925	42.3	V	65.3	-23.0	PK	175	1.0	EUT Flat

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 10dB of margin relative to this field strength limit is determined using substitution measurements.

Run #2b: Radiated Spurious Emissions, Transmit Mode, 25 - 25000 MHz. EUT @ 2480 MHz

Frequency	Level	Pol	EN 300 440 Note 1		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4959.640	45.3	V	65.3	-20.0	PK	87	1.7	
7439.325	44.5	V	65.3	-20.8	PK	175	1.0	
4959.515	42.5	H	65.3	-22.9	PK	173	1.2	
7440.800	44.0	H	65.3	-21.3	PK	38	1.0	

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 10dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Only one EUT orientation scanned as there was little difference between orientation for 2402MHz

Run #3: Radiated Spurious Emissions, Transmit Mode: Final Field Strength and Substitution Measurements
No substitutions performed as all emissions were better than 20dB below the limit

Client:	Horizon Hobby, Inc.	Job Number:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Radiated Spurious Emissions, EN 300 440 V1.3.1

Test Specifics

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: 2/2/2006
Test Engineer: Mehran Birgani
Test Location: SVOATS #1
Config. Used: 1
Config Change: No AC/DC adapter
EUT Voltage: Battery

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.

The measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 17 °C
Rel. Humidity: 80 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	RE, 30 - 12750 MHz Spurious Emissions Receive	EN 300 440	Pass	33.7dBµV/m @ 798.828MHz (-12.3dB)

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:	J61984
Model:	X1TXN Spektrum DSM X1 module	T-Log Number:	T61985
		Account Manager:	Ezther Zhu
Contact:	Paul Beard		
Spec:	EN 300 440 V1.3.1, EN 300-328 V1.7	Class:	N/A

Run #1: Radiated Spurious Emissions, Receive Mode, 30 - 12750 MHz.

Frequency	Level	Pol	EN 300 440		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
798.828	33.7	H	46.0	-12.3	QP	340	2.2	LO, EUT Standing Up
798.828	31.5	H	46.0	-14.5	QP	14	2.1	LO, EUT Lay Down
798.828	29.4	V	46.0	-16.6	QP	350	1.0	LO, EUT Standing Up
798.828	26.4	V	46.0	-19.6	QP	310	1.0	LO, EUT Lay Down
1598.774	27.2	H	54.0	-26.9	AVG	197	1.0	EUT Standing Up
1602.989	26.7	V	54.0	-27.3	AVG	361	1.0	EUT Standing Up
1596.244	26.2	H	54.0	-27.8	AVG	338	1.0	EUT Lay Down
1602.989	38.7	V	74.0	-35.3	PK	361	1.0	EUT Standing Up
1598.774	38.4	H	74.0	-35.6	PK	197	1.0	EUT Standing Up
1596.244	38.1	H	74.0	-36.0	PK	338	1.0	EUT Lay Down

Note:	All harmonics of LO were measured and signal levels were more than 20dBuV/m under the limit. The measurement were performed in low, center and high channel in receive mode and there were no changes observed with change in channel.

Run #2: Radiated Spurious Emissions, Receive Mode: Final Field Strength and Substitution Measurements
No substitutions performed as all emissions were better than 10dB below the limit

APPENDIX C: Radiated Emissions Photographs

APPENDIX C: Radiated Emissions Photographs

APPENDIX D: Conducted Emissions Photographs