

Electromagnetic Emission

FCC MEASUREMENT REPORT

CERTIFICATION OF COMPLIANCE

FCC Part 15 Certification Measurement

PRODUCT	:	SkyPro GPS Receiver
MODEL/Serial No.	:	XGPS160 / Proto type
MULTIPLE MODEL	:	-
FCC ID	:	GJW-XGPS160
IC	:	4038A-XGPS160
APPLICANT	:	Namsung Corporation. ACE Techno Tower 13th Fl, 197-22, Guro-dong, Guro-gu, Seoul, Korea 152-050 Attn.: Byungjae Ahn / Director
MANUFACTURER	:	Namsung Electronics(SHENZHEN) LTD. 34 Industrial District, Xian Town, Baoan, Shenzhen China
FCC CLASSIFICATION	:	DSS (Part 15 Spread Spectrum Transmitter)
TYPE OF MODULATION	:	FHSS (GFSK (Normal), 8DPSK (EDR))
FREQUENCY CHANNEL	:	2 402 MHz to 2 480 MHz and Channel Spacing 1 MHz (79 Ch)
AIR DATE RATE	:	Normal (1 Mbps), EDR (3 Mbps)
ANTENNA TYPE	:	Chip Antenna (Integral)
ANTENNA GAIN	:	3.50 dBi max
RF POWER	:	0.770 mW
RULE PART(S)	:	FCC Part 15 Subpart C RSS-210 Issue 8
FCC PROCEDURE	:	ANSI C63.4-2003
TEST REPORT No.	:	ETLE130611.0610
DATES OF TEST	:	June 12, 2013 to June 14, 2013
REPORT ISSUE DATE	:	June 24, 2013
TEST LABORATORY	:	ETL Inc. (FCC Designation Number : KR0022)

The SkyPro GPS Receiver, Model XGPS160 has been tested in accordance with the measurement procedures specified in ANSI C63.4-2003 at the ETL Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart C section 15.247 and RSS-210 Issue 8 - Category I Equipment, Annex 8.

I attest to the accuracy of data. All measurement herein was performed by me or was made under my supervision and is correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Prepared by:

Hoon Pyo, Lee (Test Engineer)

June 24, 2013

Reviewed by:

Kug Kyoung, Yoon (Chief Engineer)

June 24, 2013

ETL Inc.
#371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea
Tel: 82-2-858-0786 Fax: 82-2-858-0788

The test report merely corresponds to the test sample(s).

This report shall not be reproduced, in whole or in part without the written approval of ETL Inc.

Table of Contents

FCC Measurement Report

- 1. Introduction**
- 2. Product Information**
- 3. Description of Tests**
- 4. Test Condition**
- 5. Test Results**
 - 5.1 Summary of Test Results**
 - 5.2 Channel Bandwidth and Frequency Separation**
 - 5.3 Maximum Peak Output Power**
 - 5.4 Bandwidth of Frequency Band Edges**
 - 5.5 Number of Hopping Channels**
 - 5.6 Time of Occupancy (Dwell time)**
 - 5.7 Spurious Emissions**
 - 5.8 Radio Frequency Exposure**
- 6. Sample Calculation**
- 7. List of test Equipment used for Measurement**

- Appendix A. FCC ID Label and Location**
- Appendix B. Test Setup Photographs**
- Appendix C. External Photographs**
- Appendix D. Internal Photographs**
- Appendix E. Block Diagram**
- Appendix F. Circuit Diagram**
- Appendix G. User Manual**
- Appendix H. Operational Description**
- Appendix I. Antenna Requirement**
- Appendix J. Radio Frequency Exposure**

FCC MEASUREMENT REPORT

Scope – *Measurement and determination of electromagnetic emission (EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)*

General Information

Applicant Name	: Namsung Corporation.
Address	: ACE Techno Tower 13th Fl, 197-22, Guro-dong, Guro-gu, Seoul, Korea 152-050
Attention	: Byungjae Ahn / Director

- EUT Type** : SkyPro GPS Receiver
- Model Number** : XGPS160
- S/N** : Proto type
- Freq. Range** : 2 402 MHz - 2 480 MHz
- Number of Channels** : 79
- Modulation Technique** : FHSS (GFSK (Normal), 8DPSK (EDR))
- Frequency Channel** : 2 402 MHz to 2 480 MHz and Channel Spacing 1 MHz (79 Ch)
- Air Data Rate** : Normal (1 Mbps), EDR (3 Mbps)
- Antenna Type** : Chip Antenna (Integral)
- Antenna Gain** : 3.50 dBi max
- RF Power** : 0.770 mW
- FCC Rule Part(s)** : FCC Part 15 Subpart C
RSS-210 Issue 8
- Test Procedure** : ANSI C63.4-2003
- FCC Classification** : DSS (Part 15 Spread Spectrum Transmitter)
- IC Equipment Category** : RSS-210 Issue 8 - Category I Equipment, Annex 8
- Place of Tests** : ETL Inc. Testing Lab.
Radiated Emission test;
#499-1, Sagot-ri, Seosin-myeon, Hwaseong-si, Gyeonggi-do,
445-882, Korea

Conducted Emission test;
ETL Inc. Testing Lab.
371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea

1. INTRODUCTION

The measurement test for radiated and conducted emission test was conducted at the ETL Inc. The site is constructed in conformance with the requirements of the ANSI C63.4-2003 and CISPR Publication 16. The ETL has site descriptions on file with the FCC for 3 m and 10 m site configurations. Detailed description of test facility was found to be in compliance with FCC Rules according to the ANSI C63.4-2003 and registered to the Federal Communications Commission (FCC Designation Number : KR0022).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) was used in determining radiated and conducted emissions from the Namsung Corporation. Model: XGPS160

2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the SkyPro GPS Receiver (model: XGPS160).

2.2 General Specification

Item	Specification	
Frequency Channel	2 402 MHz to 2 480 MHz and Channel Spacing 1 MHz (79 Ch)	
Dimensions (W x H x D)	55 mm x 70 mm x 22 mm Non-slip pad: 107 mm x 122 mm x 25 mm	
Charging Voltage	Input	5 V DC
Cigarette Lighter Power Adapter Voltage	Input	12 V DC ~ 30 V DC
	Output	5 V DC, 2.1 A
GPS/GLONASS	GPS and GLONASS supported simultaneously.	
	SBAS (WASS, MSAS, EGNOS and GAGAN) supported.	
	GPS: L1 1575.42 MHz	
	GLONASS: L1 1598.0625 MHz ~ 1605.3750 MHz	
	Cold start	< 29 sec typ. (open sky)
	Warm start	< 25 sec typ. (open sky)
Bluetooth	CSR engine	
	Version	2.1 + EDR
	Range	~ 10 m (~ 33 ft.) (open space)
Internal Battery	Capacity	1 400 mAh
	Operating time	~ 10 hours (based on good GPS receiving and one device connection)
	Charging time	~ 3 hours
Environment Requirements	Operating Temp.	(77 ± 63) °F ((25 ± 35) °C)
	Storage Temp.	(86 ± 90) °F ((30 ± 50) °C)
	Relative Humidity	(50 ± 45) % R.H. non condensing

3. DESCRIPTION OF TESTS

The tests documented in this report were performed in accordance with ANSI C63.4-2003 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

IC Equipment Category: RSS-210 Issue 8 - Category I Equipment, Annex 8

3.1 Radiated Emission Measurement

Radiated emission measurements were made in accordance with § 13 in ANSI C63.4-2003 "Measurement of Intentional radiators". The measurements were performed over the frequency range of 30 MHz to 40 GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak, Quasi-peak, Average" within a bandwidth of 120 kHz and above 1 GHz is 1 MHz.

Preliminary measurements were made at 3 m using broadband antennas, and spectrum analyzer to determine the frequency producing the maximum emission in shielded room. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1 000 MHz using Log-Bicon antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made open site at 3 m. The test equipment was placed on a wooden turn-table. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The detector function was set to CISPR Quasi-peak mode and the bandwidth of the receiver was set to 120 kHz or 1 MHz depending on the frequency of type of signal. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8 m high nonmetallic 1.0 m x 1.5 m table. The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 m to 4 m and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade) as per section 15.31(f).

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

3.2 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section § 13 in ANSI C63.4-2003 "measurement of intentional radiators". The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a $50\ \Omega/50\ \mu\text{H}$ LISN as the input transducer to a Spectrum Analyzer or a Test Receiver. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 9 kHz or for "quasi-peak" within a bandwidth of 9 kHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1 m x 1.5 m x 0.8 m wooden table which is placed 0.4 m away from the vertical wall and 1.5 m away from the side wall of the chamber room. Two LISN are bonded to the shielded room. The EUT is powered from the LISN and the support equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2 cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the LISN. Non-inductive bundling to a 1 m length shortened all interconnecting cables more than 1 m. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the EMI Test Receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using to set Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.15 MHz to 30 MHz. The bandwidth of the spectrum analyzer was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission.

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

3.3 FCC Part 15.205 Restricted Bands of Operations

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 - 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 - 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 - 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 - 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 - 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 - 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 - 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 - 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 - 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 - 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 - 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 - 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 - 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 - 4 400	(²)
13.36 - 13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490 MHz - 0.510 MHz.

² Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

4. TEST CONDITION

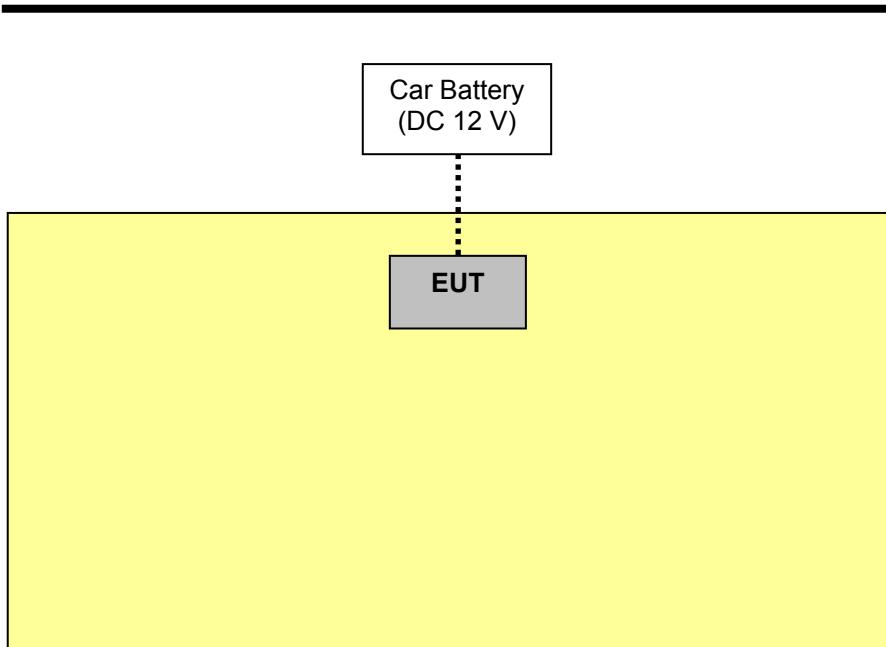
4.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

4.2 Description of Test modes

CSR BlueCore that has the control software.

4.3 The setup drawing(s)



—— : Signal line
— : AC Power line
····· : DC Power line
█ : Adapter

5. TEST RESULTS

5.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

47 CFR Part 15, Subpart C	RSS Standards	Measurement Required	Result
15.247(a)(1)	RSS-210 A8.2(a)	Channel Bandwidth, Frequency Separation	Pass
15.247(b)(3)	RSS-210 A8.4(2)	Maximum Peak Output Power	Pass
15.247(d)	RSS-210 A8.5	Bandwidth of Frequency Band Edges	Pass
15.247(a)(1)(iii)	RSS-210 A8.1(d)	Number of Hopping Channels	Pass
15.247(a)(1)(iii)	RSS-210 A8.1(d)	Time of Occupancy (Dwell time)	Pass
15.209 15.247(d)	RSS-Gen 7.2.5	Spurious Emissions	Pass
-	RSS-Gen 6.1	Receiver Spurious Emissions	Pass
15.207	RSS-Gen 7.2.4	Conducted Emissions	N/A *
15.247(i) 1.1307(b)(1)	RSS-102 2.5	RF Exposure	Pass

* This test was not applied. Because, EUT power supplies from battery type.

The data collected shows that the **Namsung Corporation. / SkyPro GPS Receiver / XGPS160** complied with technical requirements of above rules RSS-210, part 15.207, 209 and 15.247 Limits.

The equipment is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

5.2 Channel Bandwidth and Frequency Separation

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	FCC Part 15.247(a)(1), RSS-210 A8.2(a)
Test Date	June 12, 2013
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

5.2.1 Channel (20 dB) Bandwidth

Type of Modulation	Frequency [MHz]	20 dB Bandwidth [MHz]	Limit
GFSK	2 402	0.940	2/3 of the 20 dB Bandwidth < Carrier frequency separation
	2 441	0.943	
	2 480	0.943	
8DPSK	2 402	1.260	2/3 of the 20 dB Bandwidth < Carrier frequency separation
	2 441	1.260	
	2 480	1.260	

NOTES:

1. Measure frequency separation of relevant channel using spectrum analyzer.
2. Please see the measured plot in next page.

5.2.2 Frequency Separation

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

Type of Modulation	EUT Channel Separation [MHz]	20 dB bandwidth [MHz]	Limit
GFSK	1.000 (Worst)	0.943 (Worst)	> 25 kHz or > 2/3 of the 20 dB Bandwidth
8DPSK	1.000 (Worst)	1.167 (Worst)	

NOTES:

1. Measure frequency separation of relevant channel using spectrum analyzer.
2. Please see the measured plot in next page.

5.2.3 Channel (99 %) Bandwidth

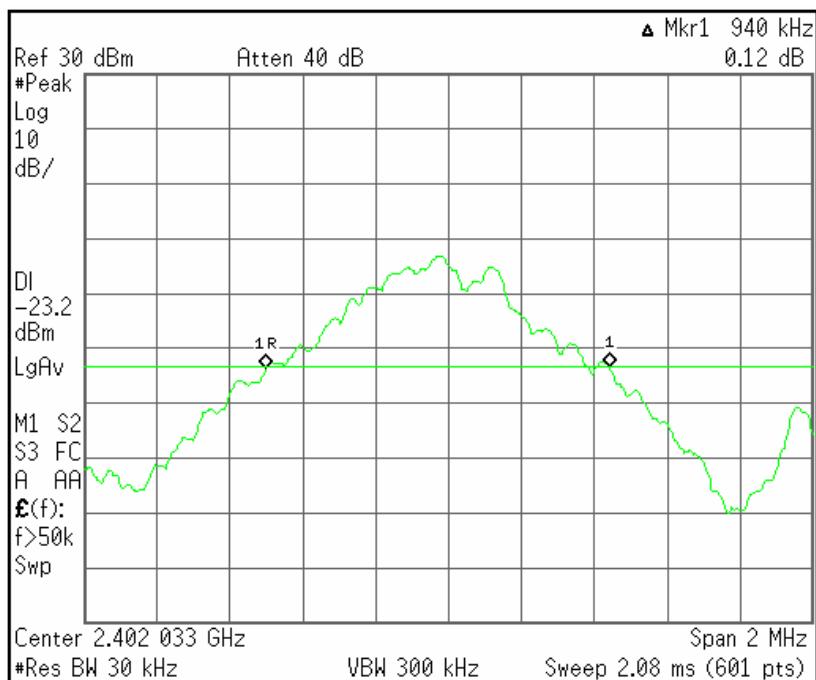
Type of Modulation	Frequency [MHz]	99 % Bandwidth [MHz]	Limit
GFSK	2 402	0.871	2/3 of the 20 dB Bandwidth < Carrier frequency separation
	2 441	0.855	
	2 480	0.861	
8DPSK	2 402	1.158	2/3 of the 20 dB Bandwidth < Carrier frequency separation
	2 441	1.165	
	2 480	1.167	

NOTES:

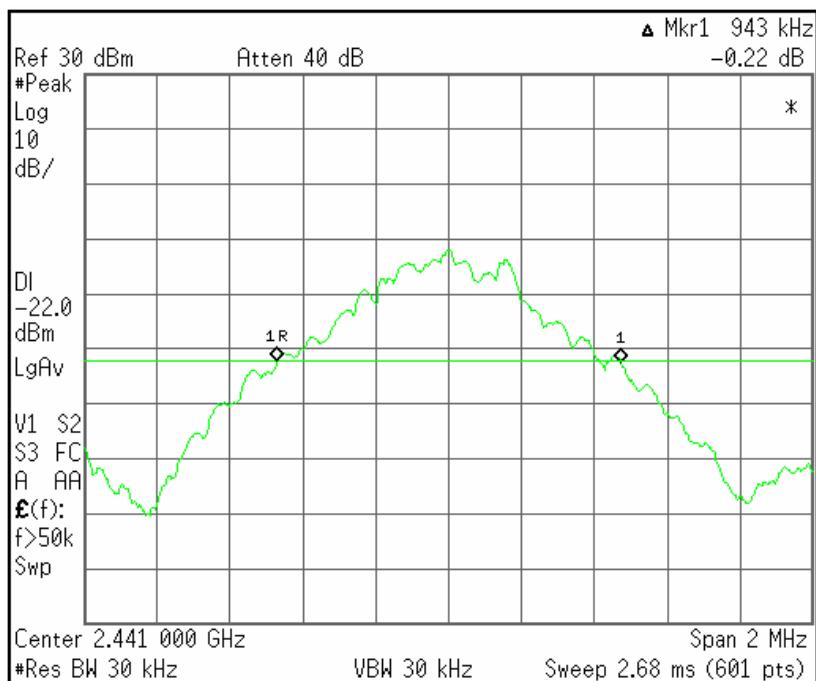
1. Measure frequency separation of relevant channel using spectrum analyzer.
2. Please see the measured plot in next page.

Plots of 20 dB Bandwidth (GFSK)

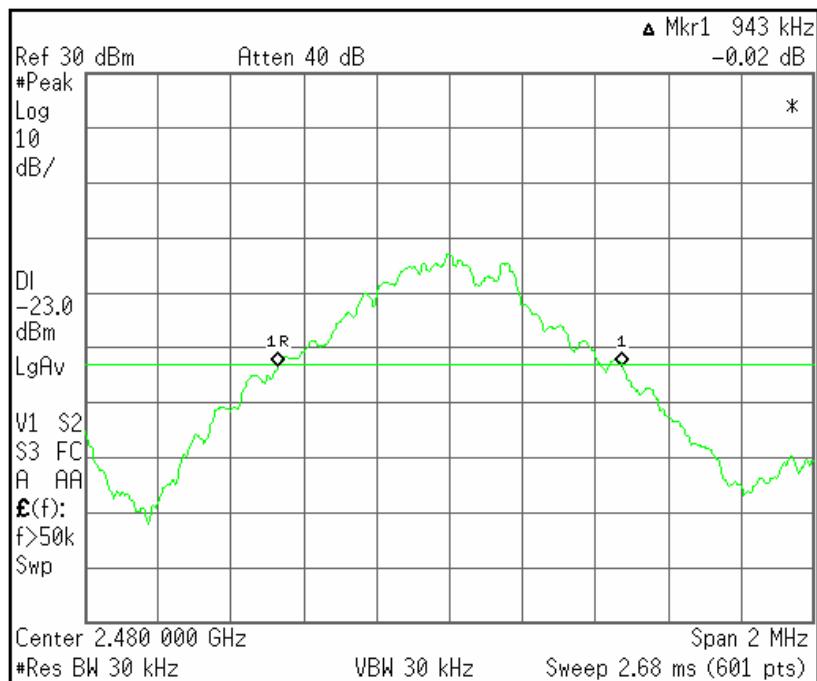
[2 402 MHz]



[2 441 MHz]

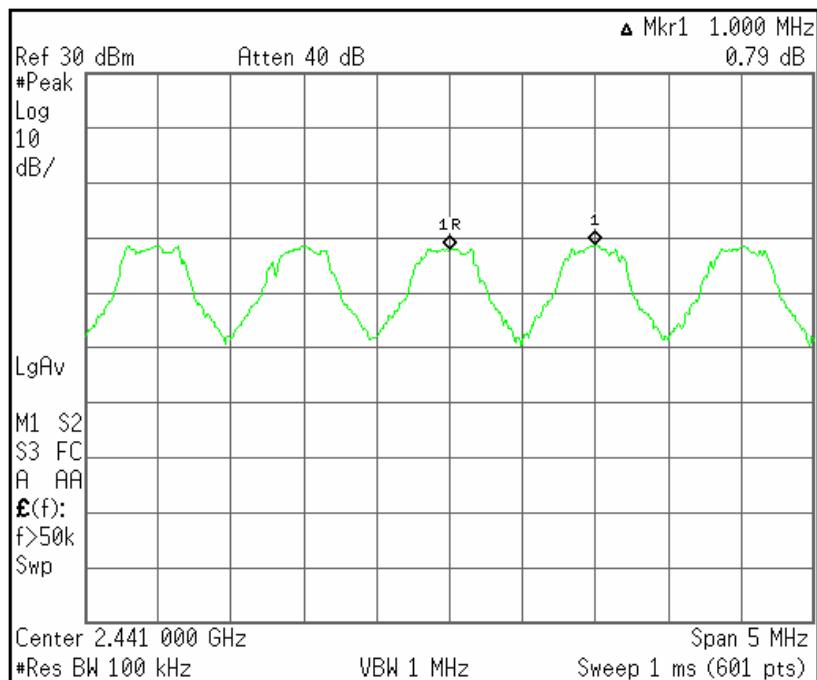


[2 480 MHz]



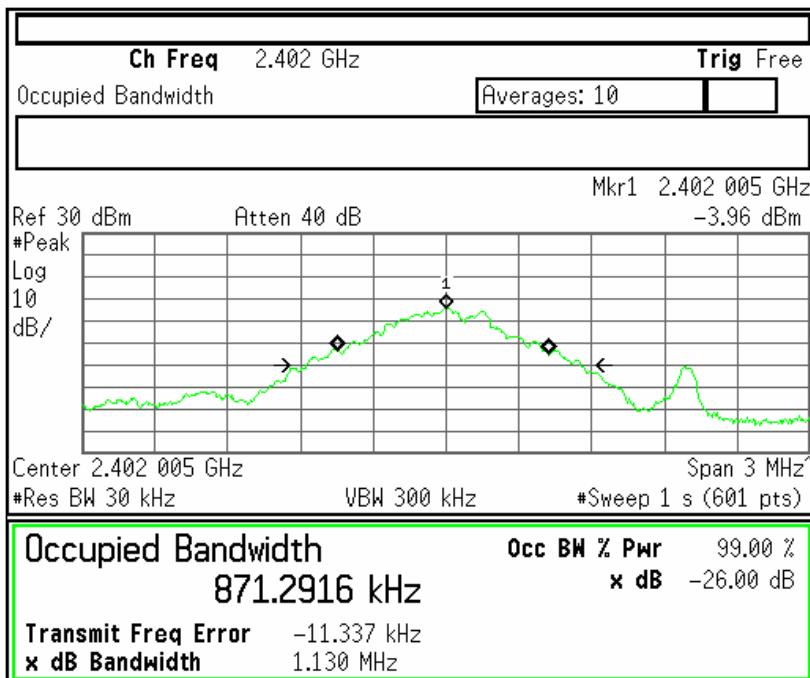
Plots of Frequency Separation (GFSK)

[Channel Separation]

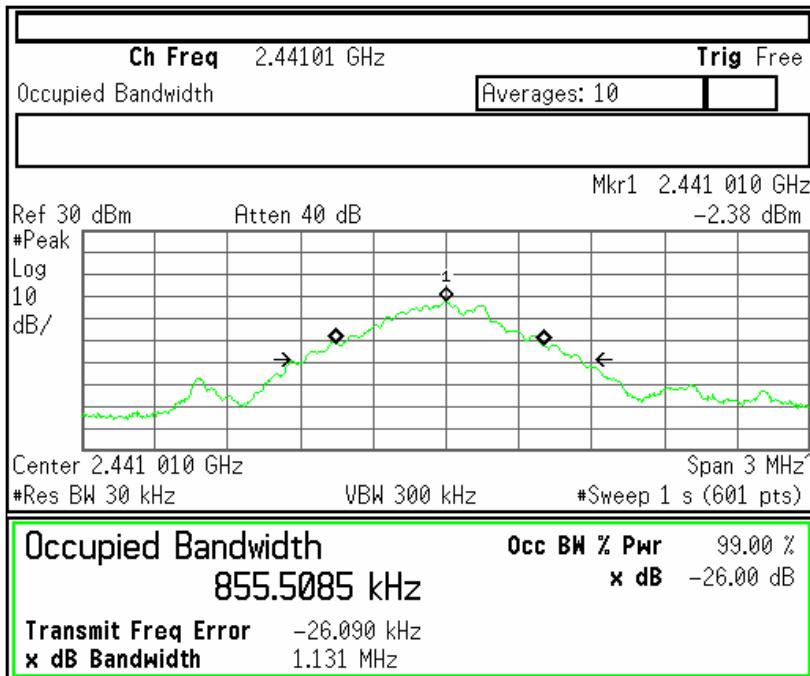


Plots of 99 % Bandwidth (GFSK)

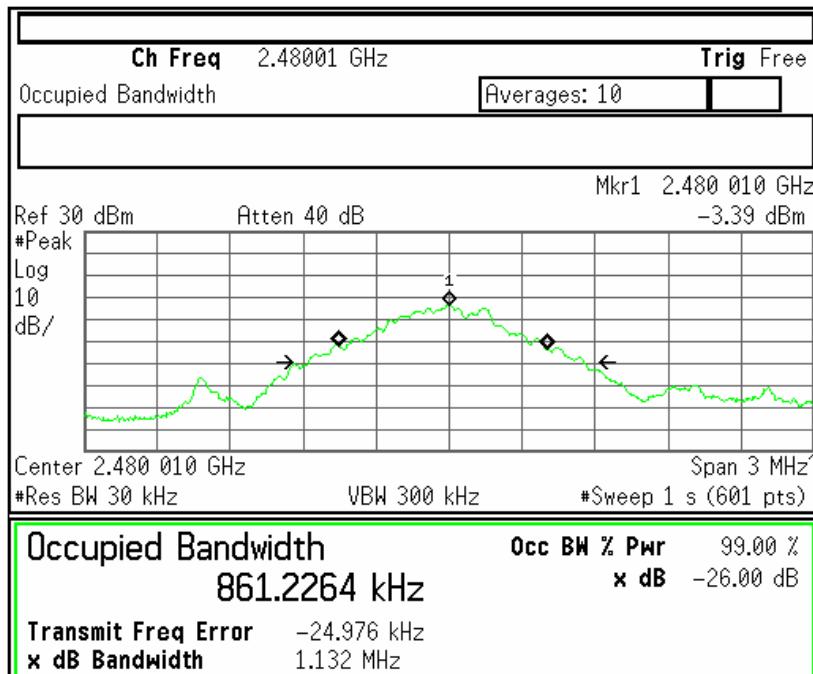
[2 402 MHz]



[2 441 MHz]

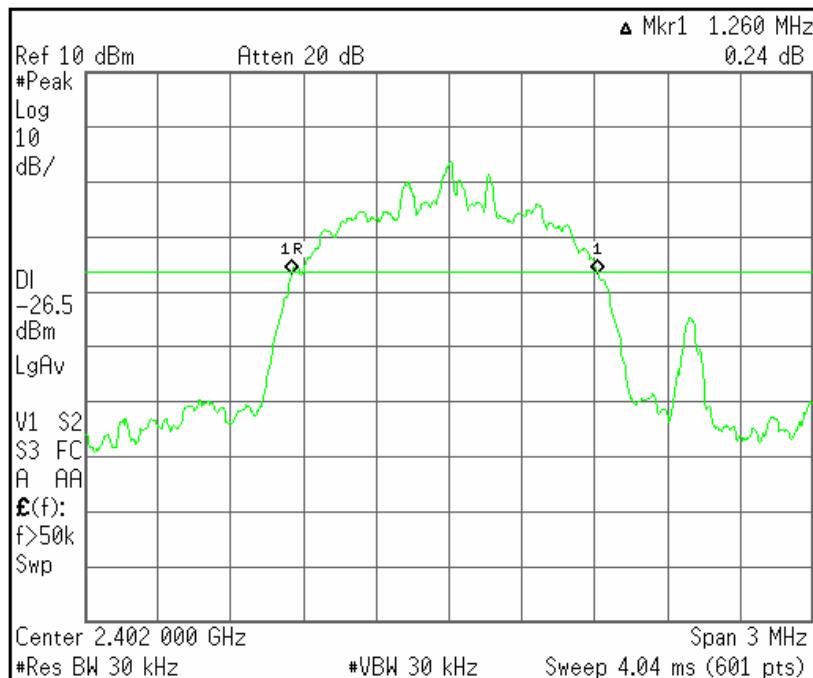


[2 480 MHz]

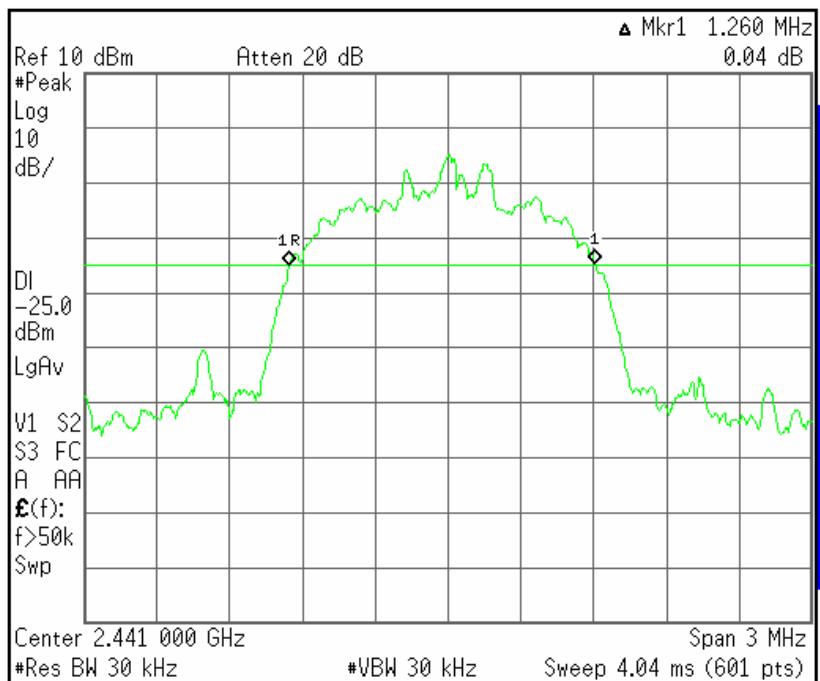


Plots of 20 dB Bandwidth (8DPSK)

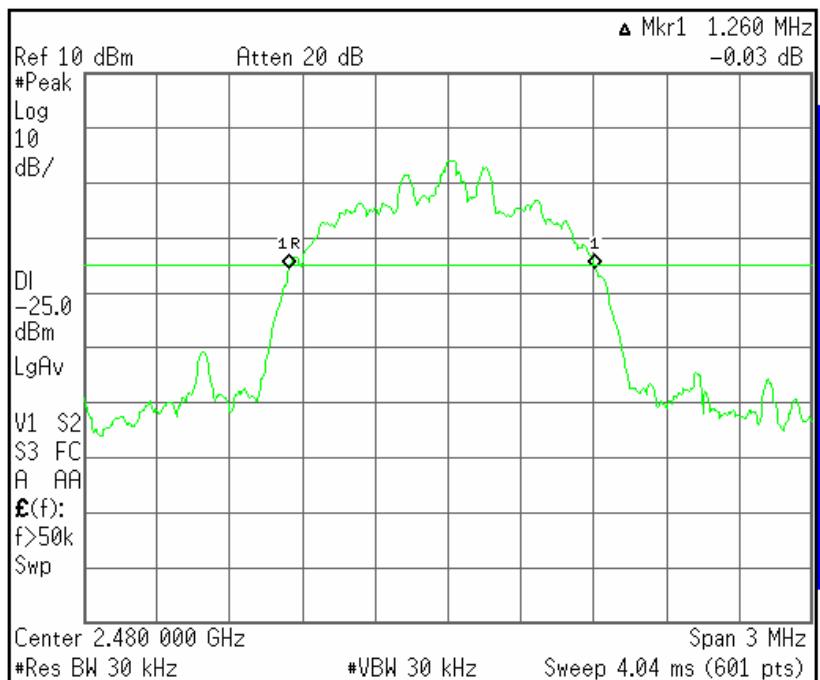
[2 402 MHz]



[2 441 MHz]

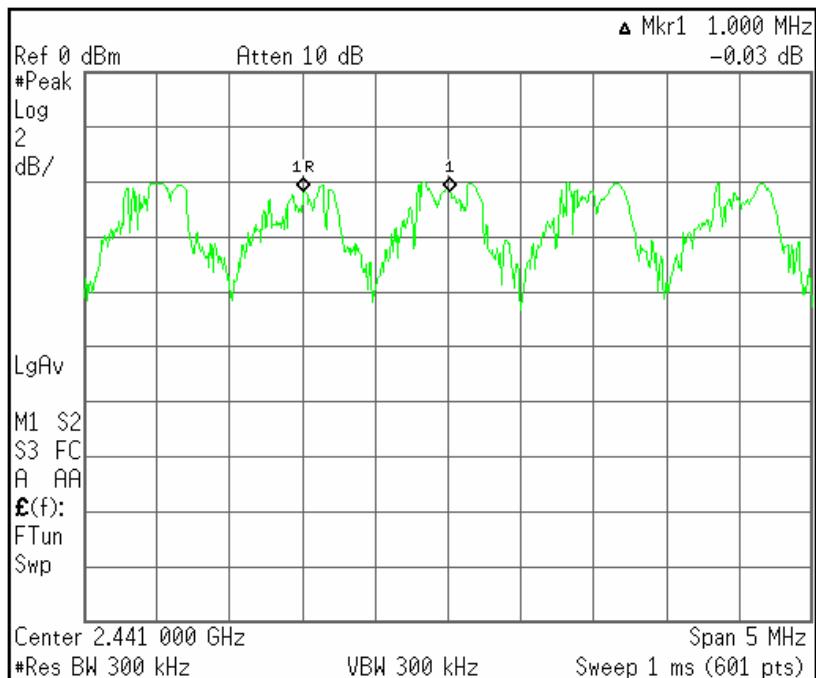


[2 480 MHz]



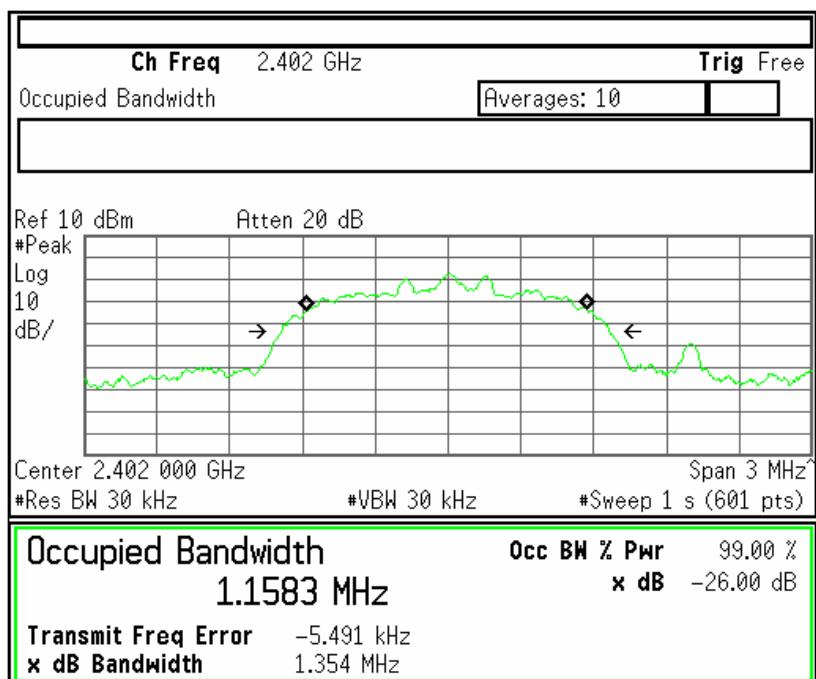
Plots of Frequency Separation (8DPSK)

[Channel Separation]

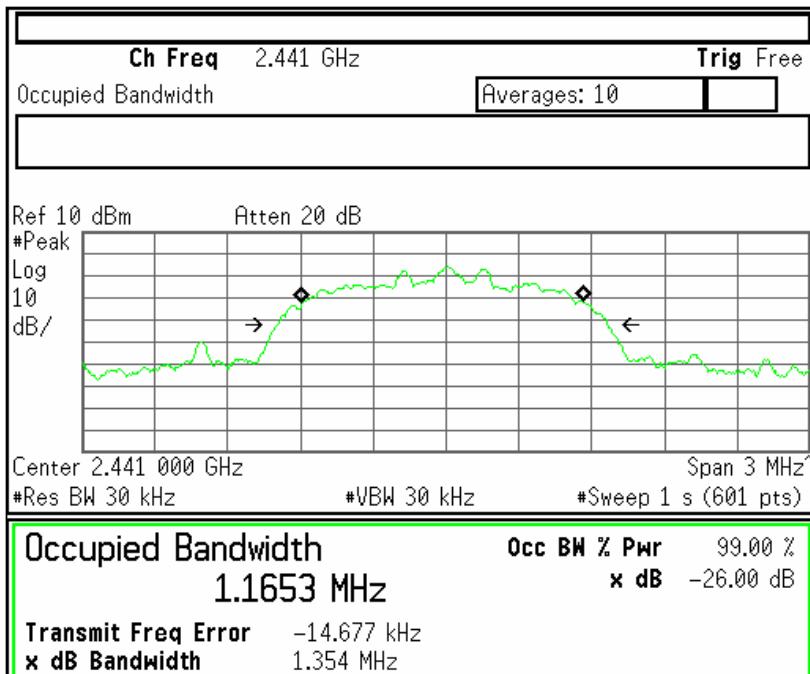


Plots of 99 % Bandwidth (8DPSK)

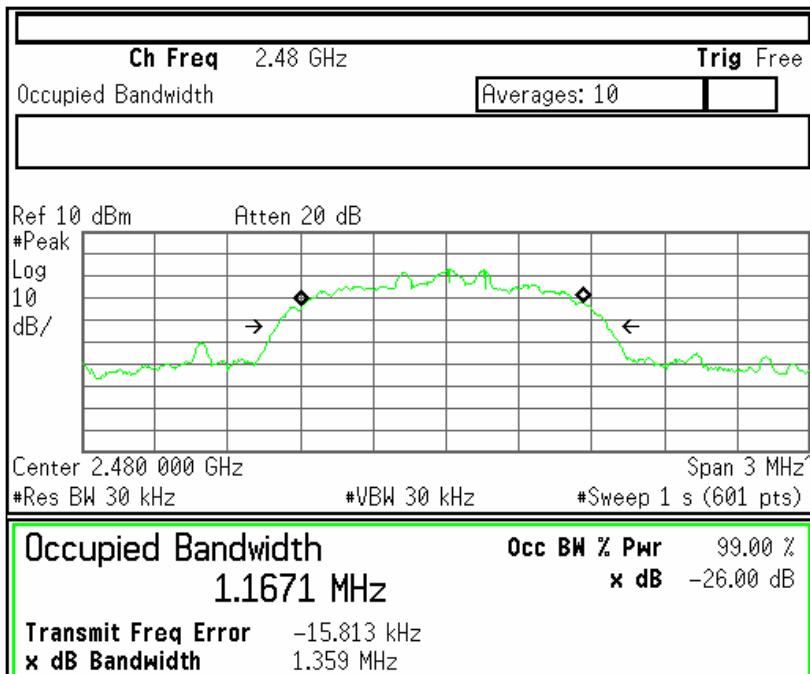
[2.402 MHz]



[2 441 MHz]



[2 480 MHz]



5.3 Maximum Peak Conducted Output Power

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	FCC Part 15.247(b)(3), RSS-210 A8.4(2)
Test Date	June 12, 2013
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

Limit

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 2 400.0 MHz - 2 483.5 MHz band employing at least 75 non-overlapping hopping channels: 125 mW

Test Data

Type of Modulation	Channel	Frequency [MHz]	Output Power [dBm]	Limit
GFSK	Low	2 402	-3.05	< 21 dBm (125 mW)
	Mid	2 441	-1.13	
	High	2 480	-1.99	
8DPSK	Low	2 402	-4.57	< 21 dBm (125 mW)
	Mid	2 441	-2.66	
	High	2 480	-3.54	

Maximum measured transmitter power (for RF Exposure):

Type of Modulation	Output Power		Max Antenna Gain [dBi]	EIRP [mW]
	[dBm]	[mW]		
GFSK	-1.13	0.770	4.120	1.990
8DPSK	-2.66	0.540	4.120	1.400

- Theory value for RF Exposure

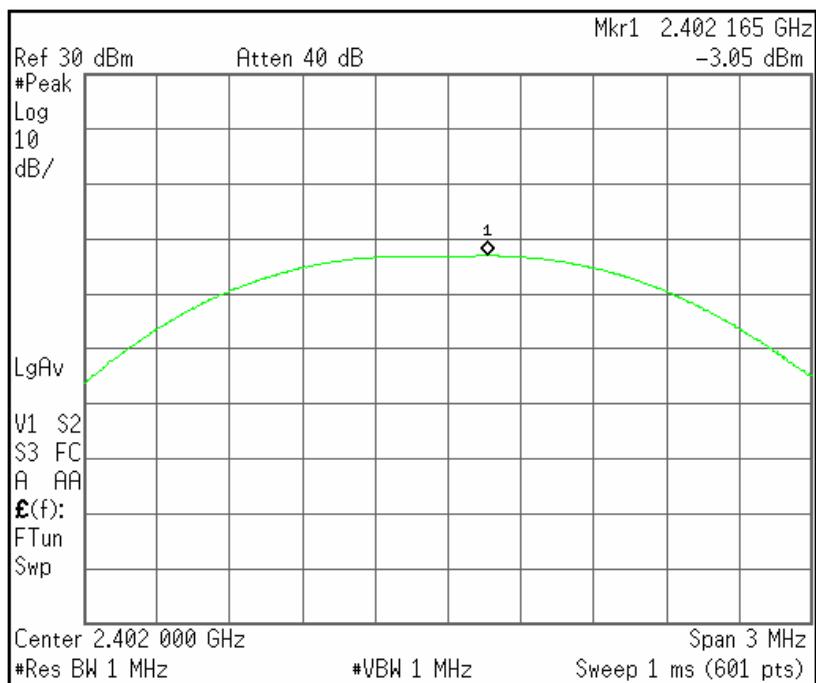
$$P_{e.i.r.p.}(mW) = A_{cond}(dBm) + G_{assembly\ antenna\ gain}(dBi)$$

NOTES:

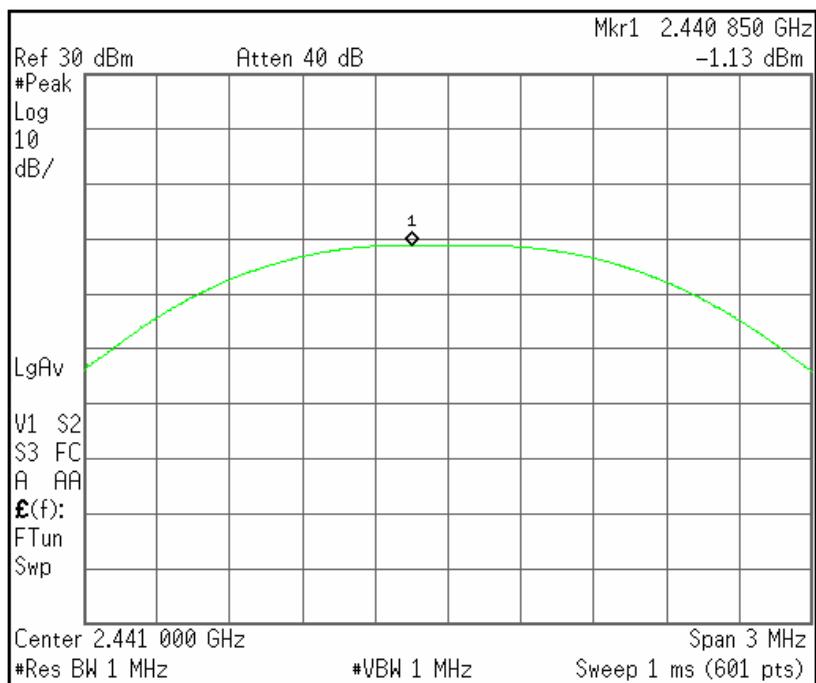
1. Measure conducted Channel power of relevant channel using Spectrum analyzer
2. RBW 1 MHz, VBW 1 MHz
3. Please see the measured plot in next page.

Plots of Maximum Peak Output Power (GFSK)

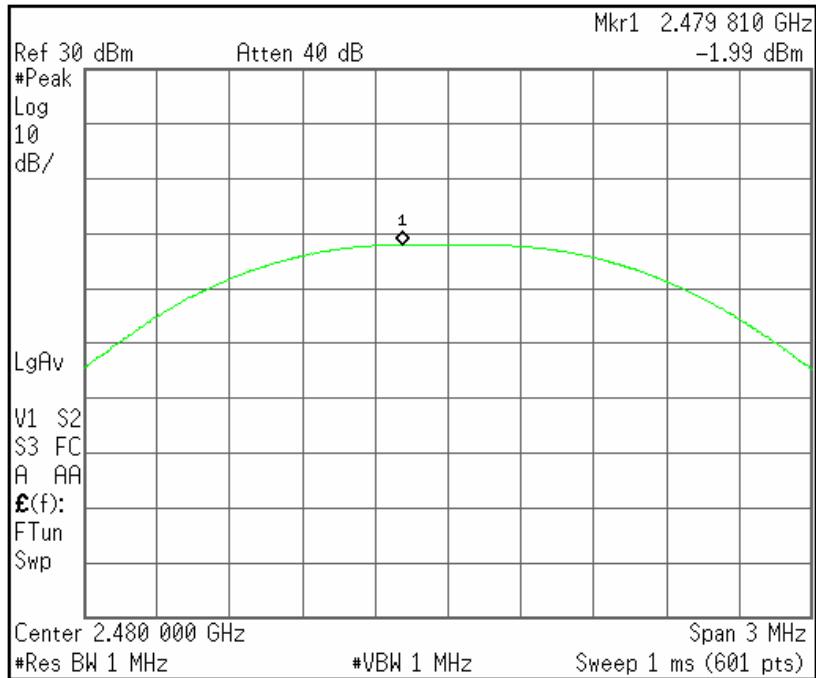
[2 402 MHz]



[2 441 MHz]

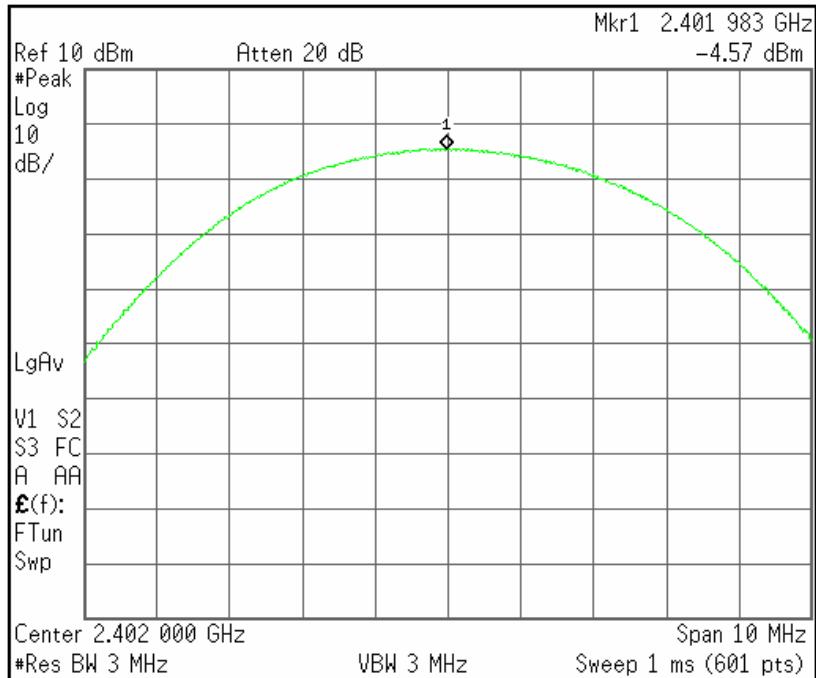


[2 480 MHz]

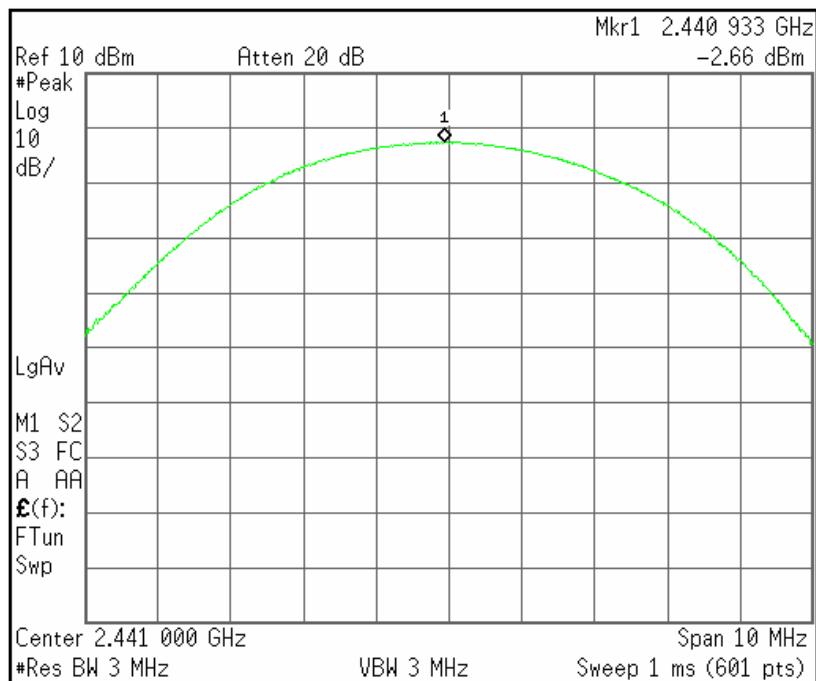


Plots of Maximum Peak Output Power (8DPSK)

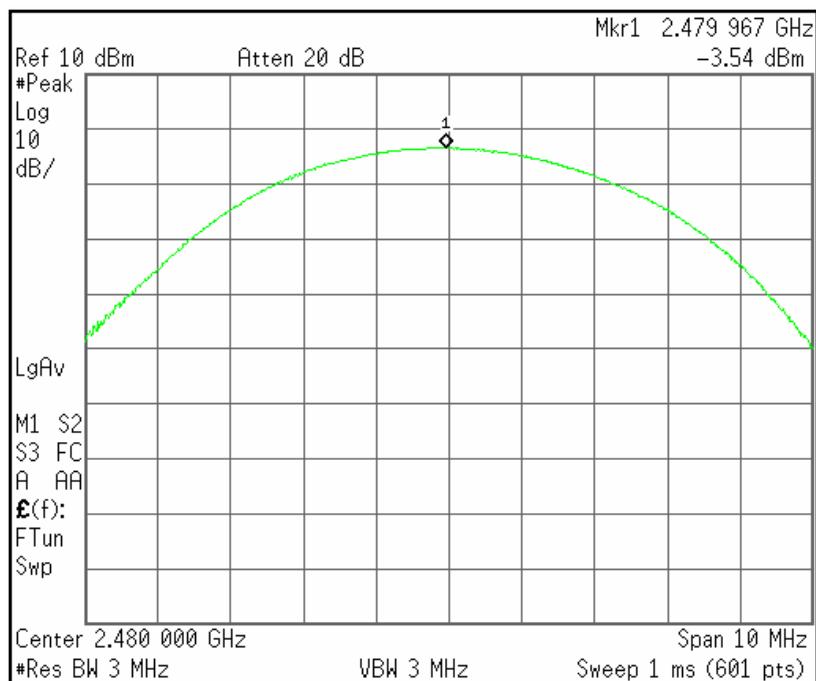
[2 402 MHz]



[2 441 MHz]



[2 480 MHz]



5.4 Bandwidth of Frequency Band Edges

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	FCC Part 15.247(d), RSS-210 A8.5
Test Date	June 12, 2013 to June 13, 2013
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Test Results

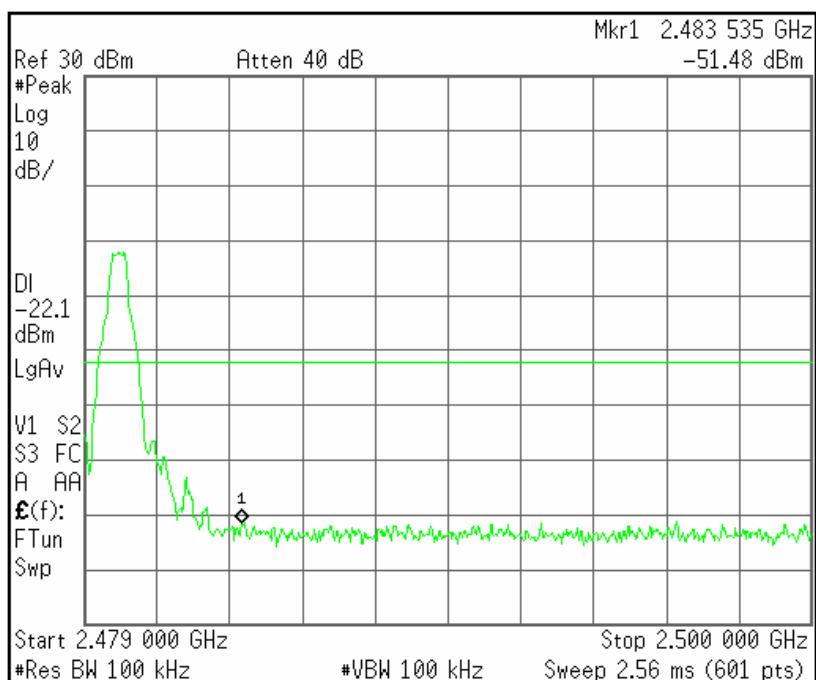
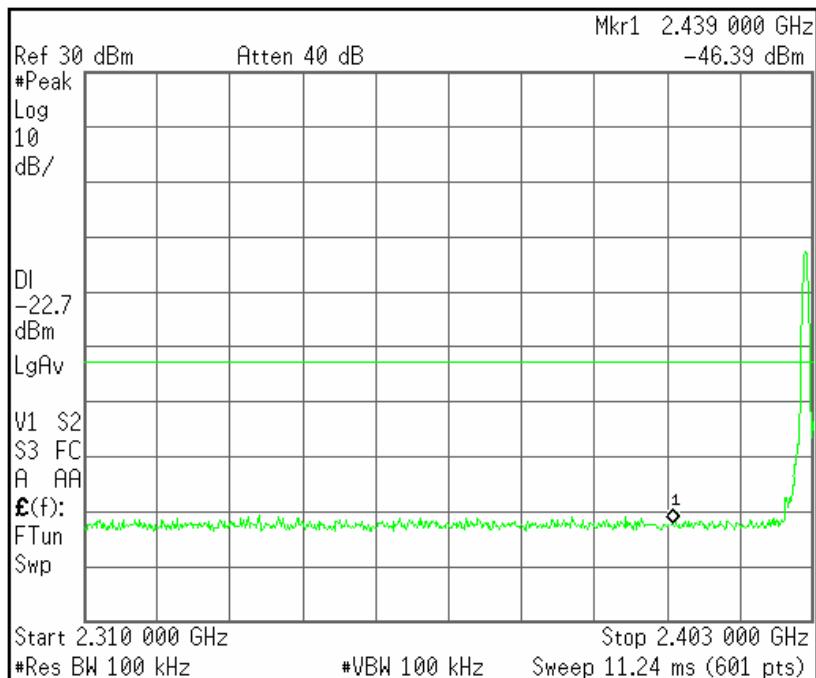
- Refer to see the measured plot in next page.

NOTES:

1. The test was performed to make a direct field strength measurement at the band edge frequencies.
2. The band edges test was applied to two types of test mode (hopping mode & non-hopping mode). (Worst case: Hopping mode)

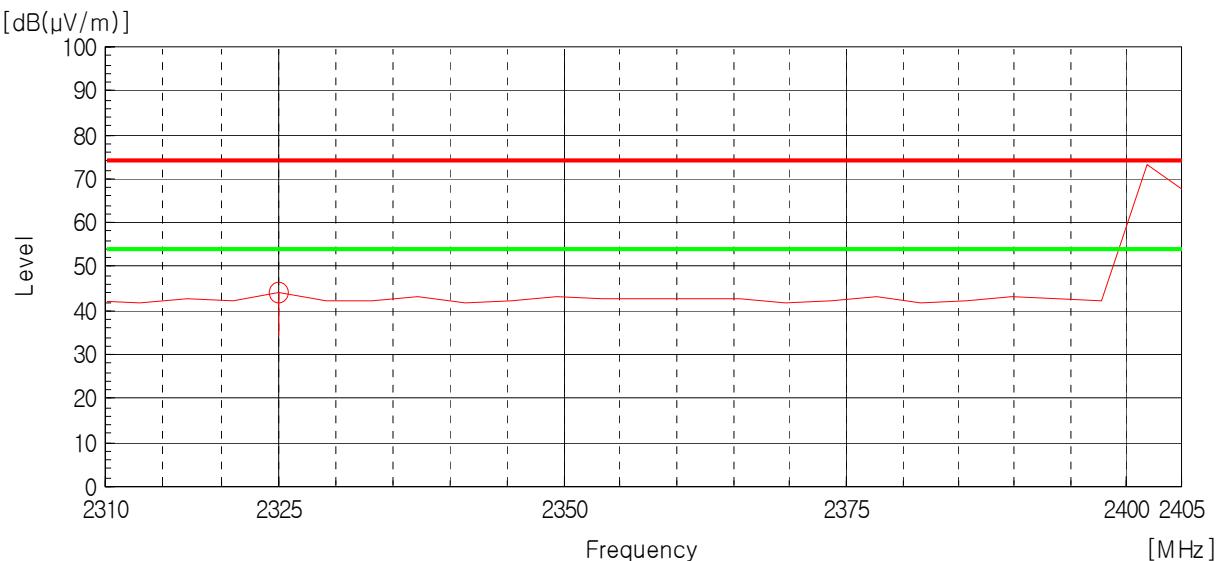
Plots of Bandwidth of Frequency Band Edges (GFSK, Worst case: Hopping mode)

Conducted

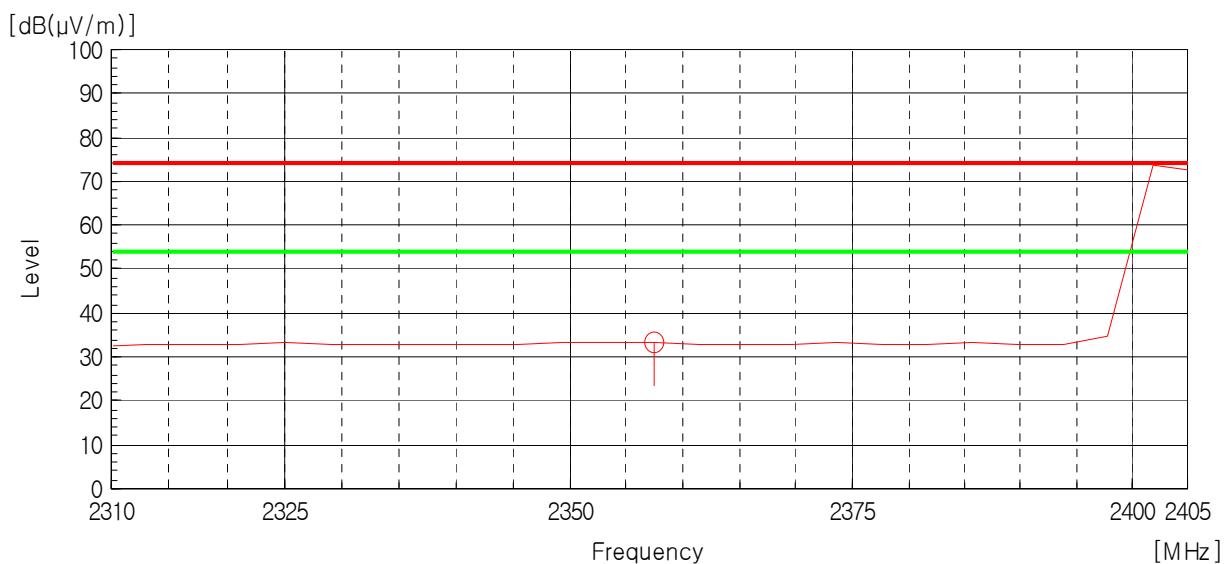


Radiated

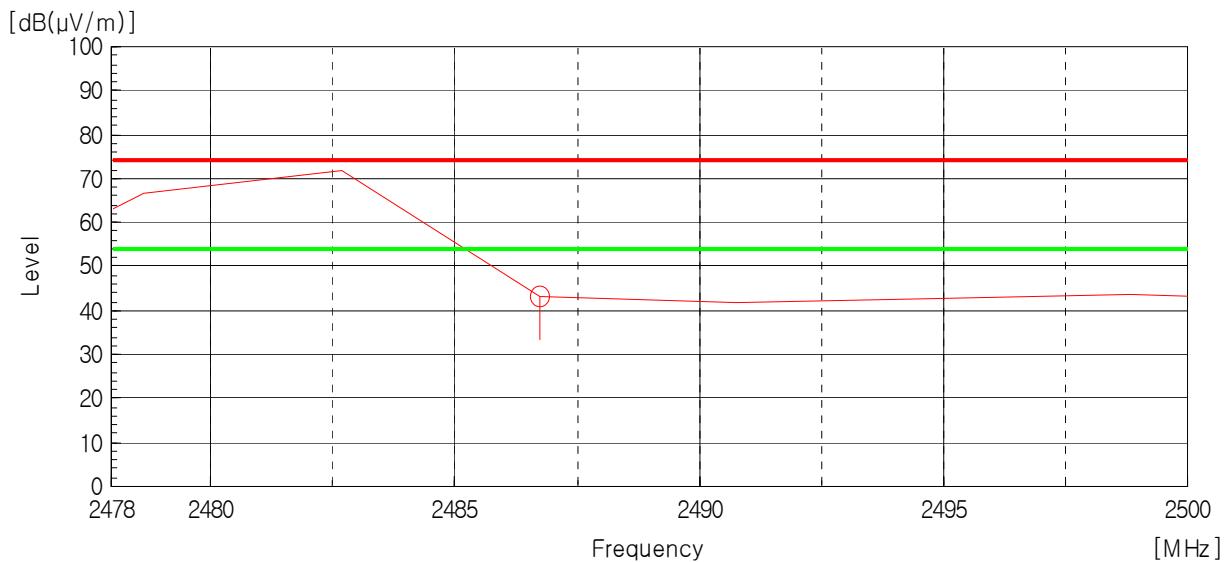
Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 310 MHz - 2 405 MHz), Worst case (Low, Horizontal)



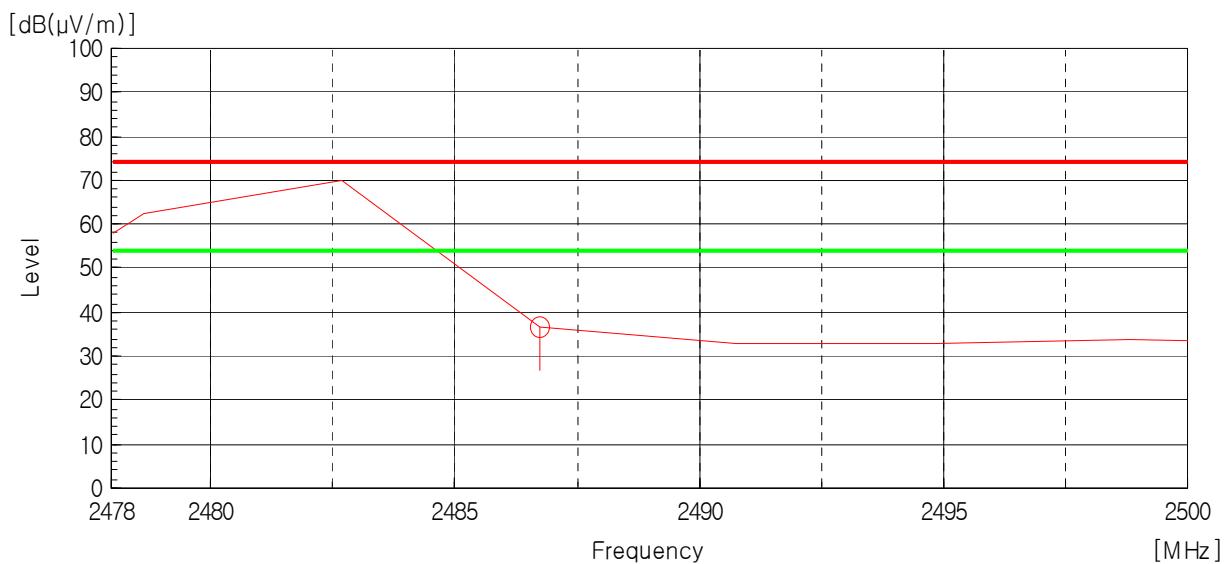
AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 310 MHz - 2 405 MHz), Worst case (Low, Horizontal)



Peak Detector: RBW: 1MHz, VBW: 1 MHz (2 475 MHz - 2 500 MHz), Worst case (High, Horizontal)

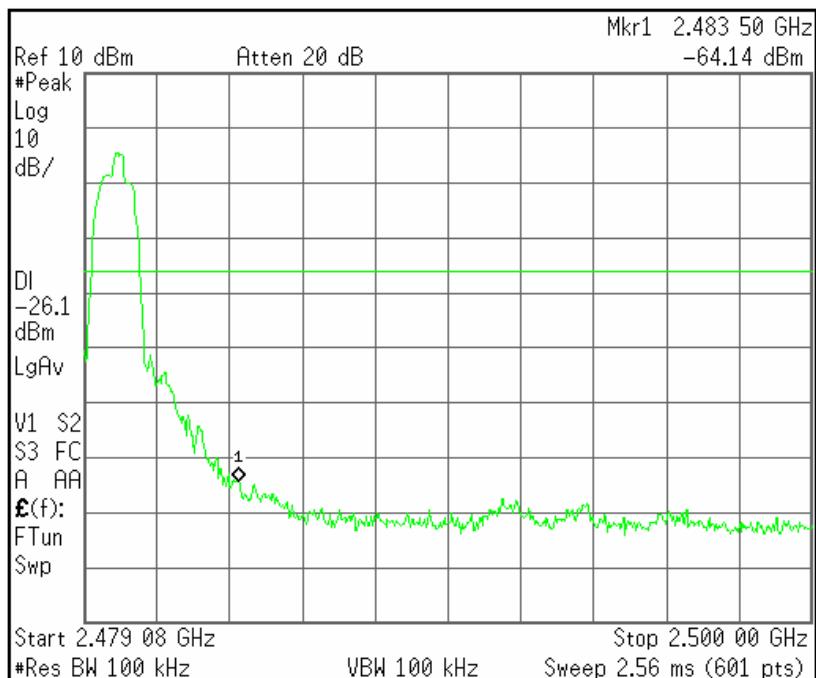
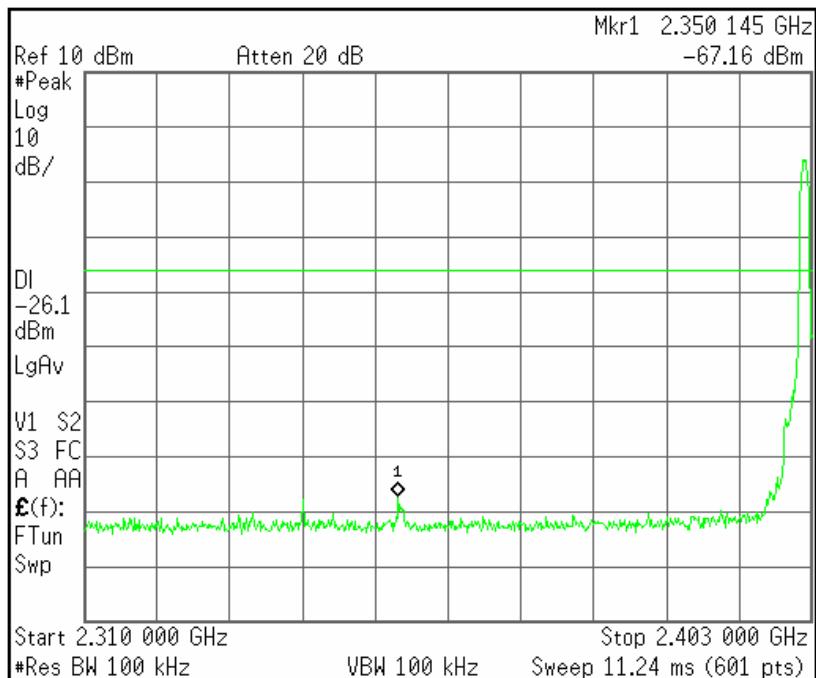


AV Detector: RBW: 1MHz, VBW: 10 Hz (2 475 MHz - 2 500 MHz), Worst case (High, Horizontal)



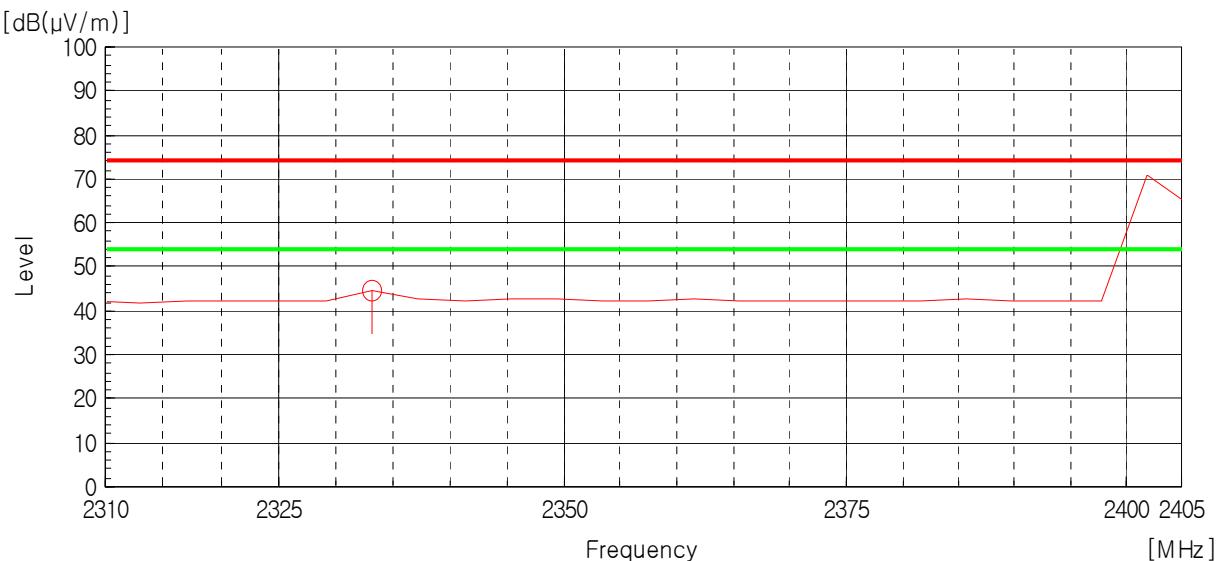
Plots of Bandwidth of Frequency Band Edges (8DPSK, Worst case: Hopping mode)

Conducted

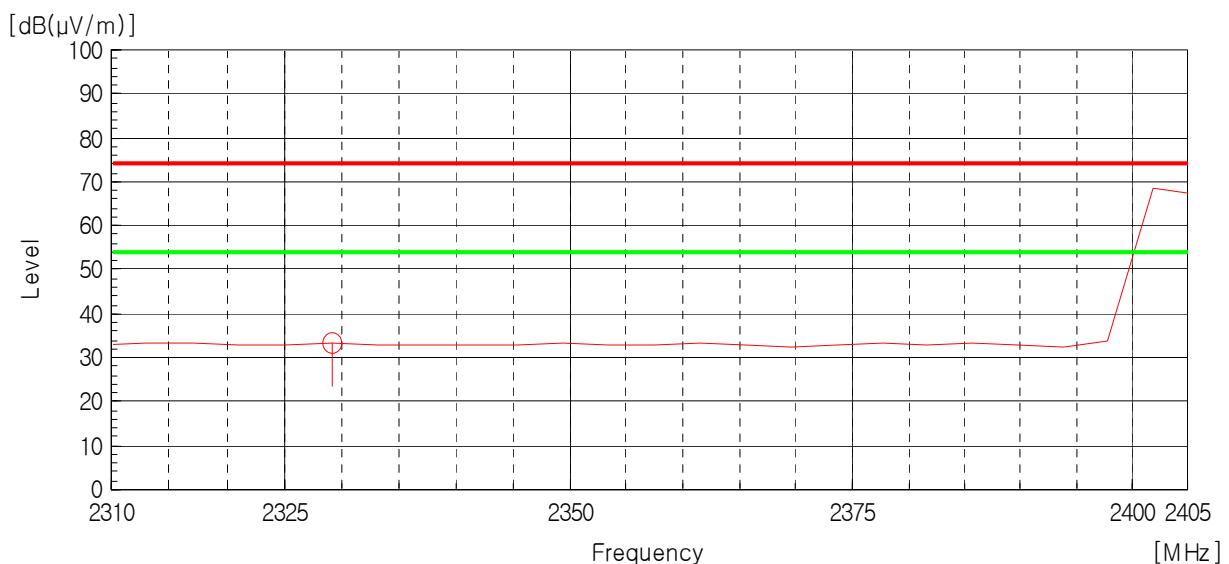


Radiated

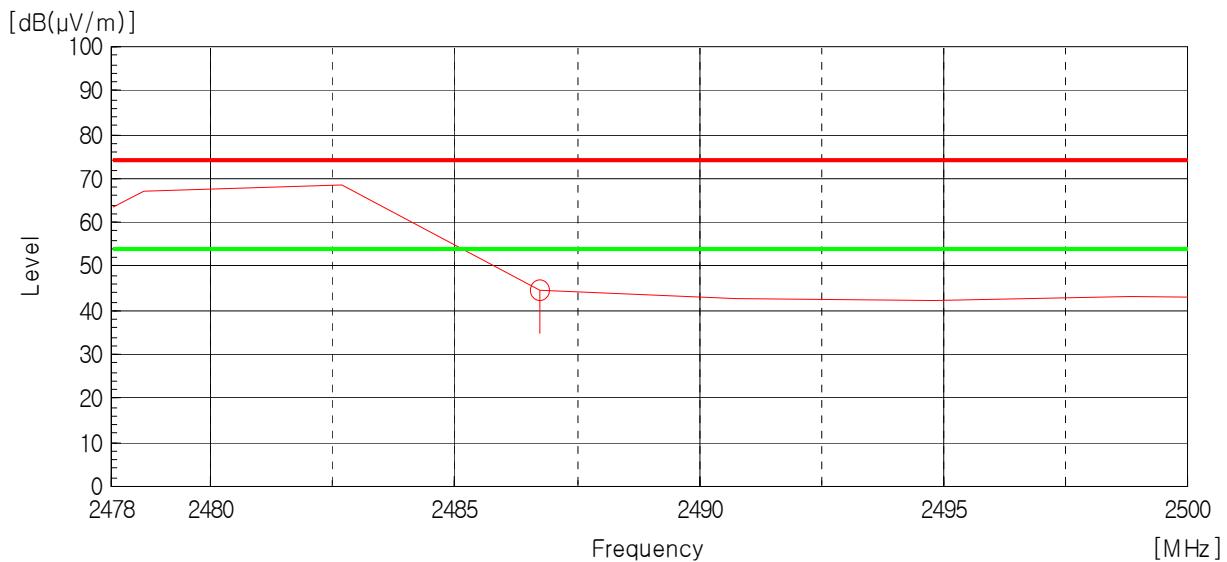
Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



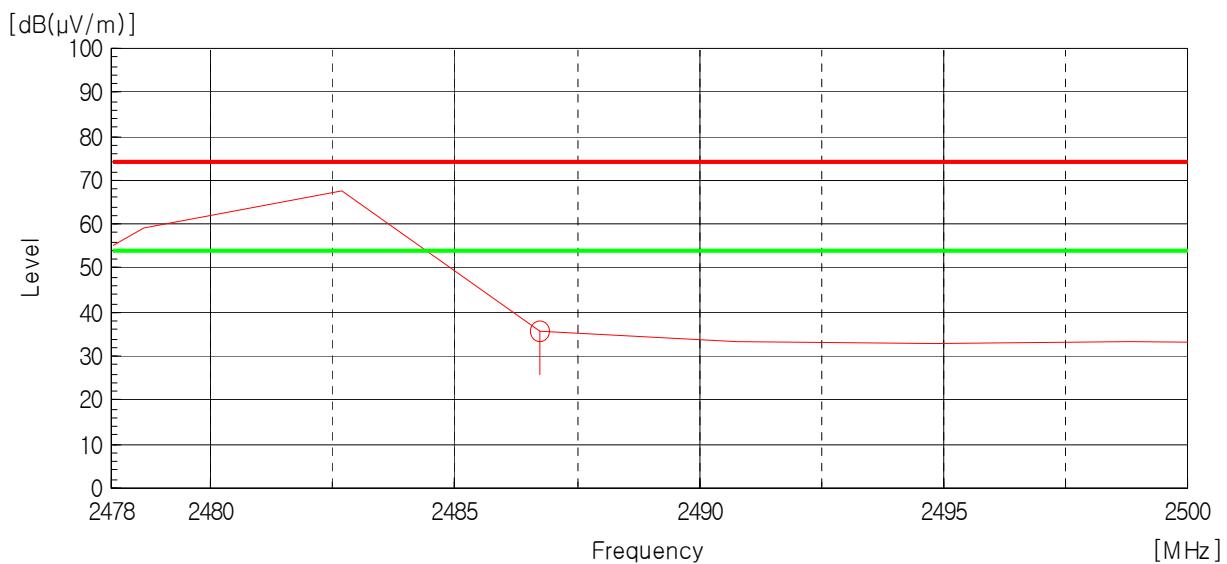
AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)



Peak Detector: RBW: 1MHz, VBW: 1 MHz (2 483.5 MHz - 2 500.0 MHz), Worst case (High, Horizontal)



AV Detector: RBW: 1MHz, VBW: 10 Hz (2 483.5 MHz - 2 500.0 MHz), Worst case (High, Horizontal)



5.5 Number of Hopping Channels

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	FCC Part 15.247(a)(1)(iii), RSS-210 A8.1(d)
Test Date	June 13, 2013
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

Limit

Frequency hopping systems in the 2 400.0 MHz - 2 483.5 MHz band shall use at least 15 channels.

Test Data

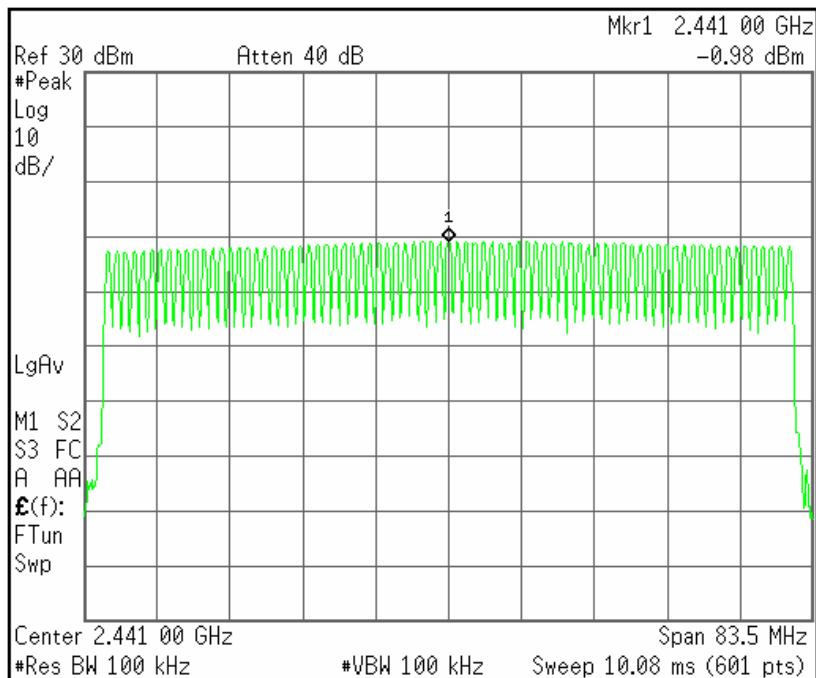
Type of Modulation	Result	Limit
GFSK	79	> 15 Channel
8DPSK	79	

NOTES:

1. Measure number of hopping channel of relevant channel using spectrum analyzer.
2. Please see the measured plot in next page.

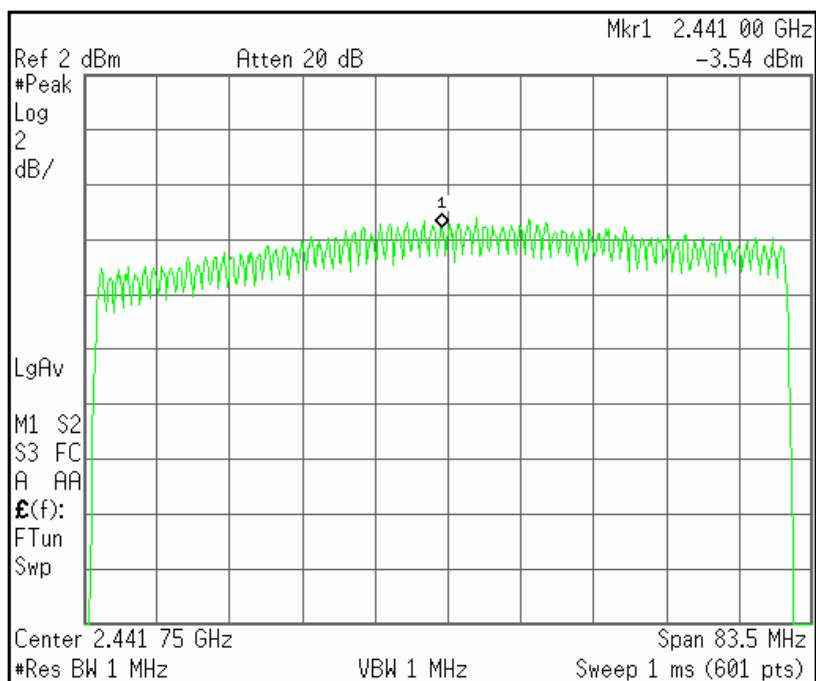
Plots of Number of Hopping Channels (GFSK)

[Hopping Channels]



Plots of Number of Hopping Channels (8DPSK)

[Hopping Channels]



5.6 Time of Occupancy

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	FCC Part 15.247(a)(1)(iii), RSS-210 A8.1(d)
Test Date	June 13, 2013
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

Limit

Frequency hopping systems in the 2 400.0 MHz - 2 483.5 MHz band. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Data

Time of Occupancy

Test period = 0.4 [seconds/channel] x 79 [channel]

Actual = Reading x (Hopping rate/Number of channels) x Test period

Hopping rate (DH5 Packet) = 1 600 [hopping/second] / 6 [time slot] = 266.667

- Type of Modulation: GFSK

0.4 s x 79 (CH) = 31.6 s

2.882 x (266.667/79) x 31.6 s = 307.413 ms

Pulse Time [ms]	Total of Dwell [ms]	Limit [ms]
2.882	307.413	400.000

- Type of Modulation: 8DPSK

0.4 s x 79 (CH) = 31.6 s

2.916 ms x (266.667/79) x 31.6 s = 311.040 ms

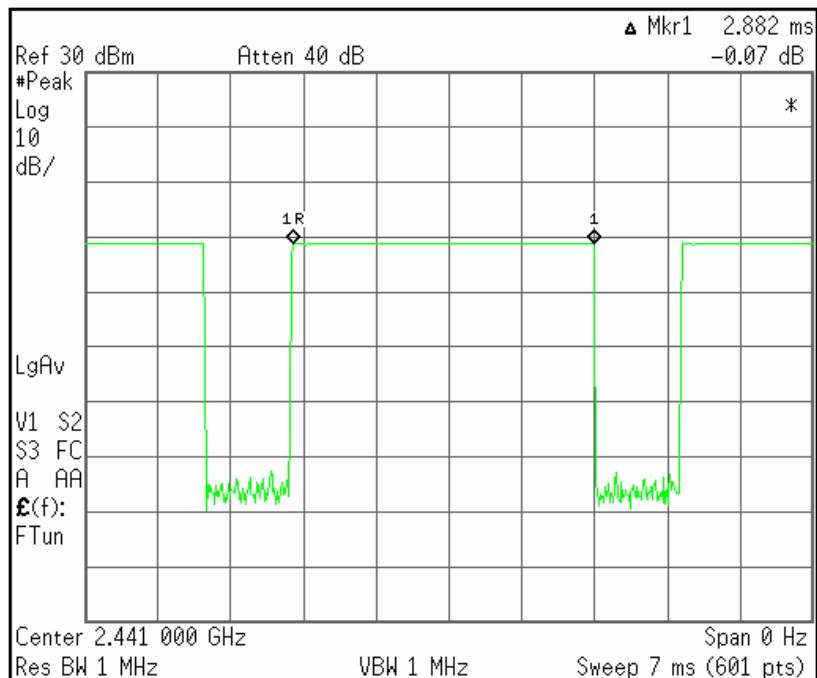
Pulse Time [ms]	Total of Dwell [ms]	Limit [ms]
2.916	311.040	400.000

NOTES:

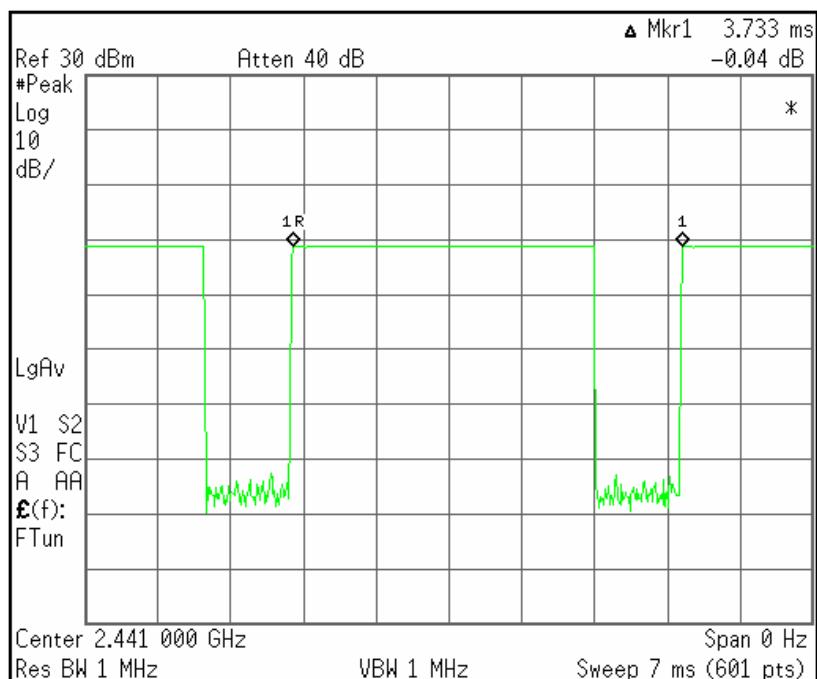
1. Measure time of occupancy of relevant channel using spectrum analyzer.
2. Please see the measured plot in next page.

Plots of Time of Occupancy (GFSK)

[Continuous Time]

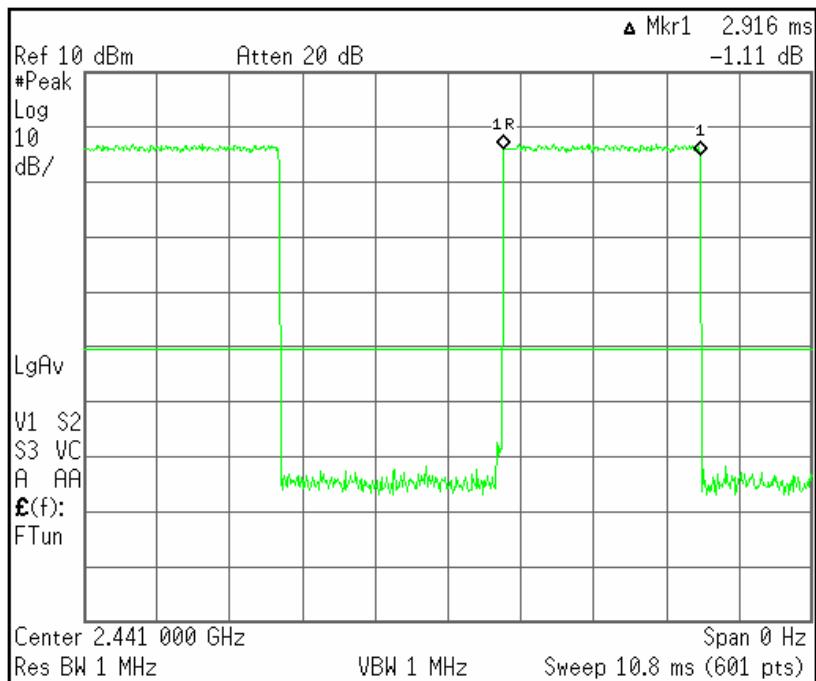


[Hopping Period]

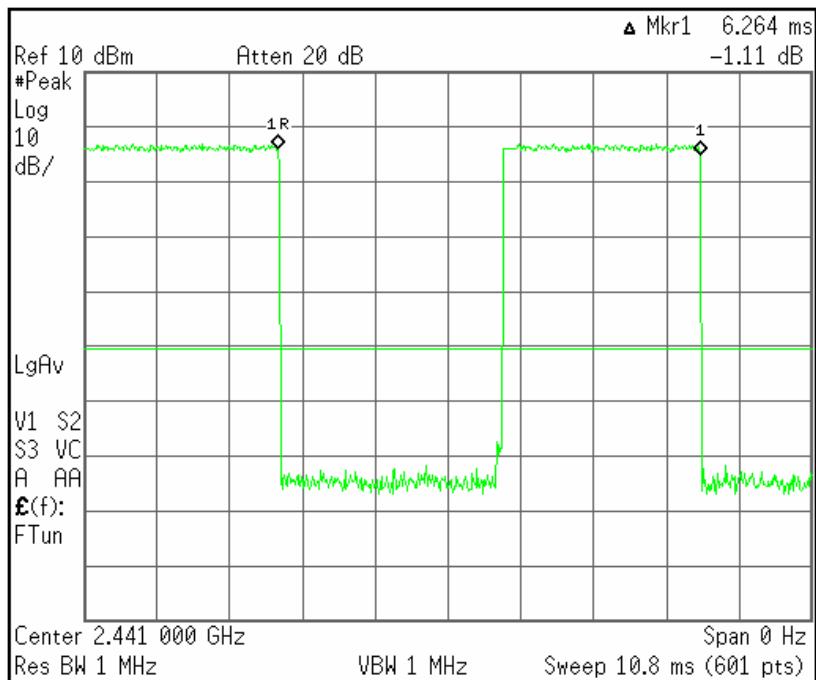


Plots of Time of Occupancy (8DPSK)

[Continuous Time]



[Hopping Period]



5.7 Spurious Emissions

5.7.1 Radiated Emissions (TX)

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	FCC Part 15.209, RSS-Gen 7.2.5
Test Date	June 13, 2013
Operating Condition	Low CH, Middle CH, High CH Transmission
Result	Passed

Limit

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequencies [MHz]	Field Strength [μ V/m]	Measurement Distance [m]
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 MHz - 72 MHz, 76 MHz - 88 MHz, 174 MHz - 216 MHz or 470 MHz - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

Test Results

- Refer to see the measured plot in next page.

Radiated Emissions Test data

- 9 kHz to 30 MHz

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
 Detector mode: CISPR Quasi-Peak mode (100 Hz, 9 kHz)

- Type of Modulation: GFSK, 8DPSK

Frequency [MHz]	Reading [dB(μ V)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]
	Emission attenuated more than 20 dB below the limit are not reported.						

Result: All emissions below noise floor of 20 dB(μ V/m).

NOTES:

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Result = Reading + Antenna factor + Cable loss
3. Margin = Limit - Result
4. The measurement was performed for the frequency range 9 kHz to 30 MHz according to FCC Part 15.209.

- Below 1 GHz (30 MHz to 1 GHz)

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
 Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

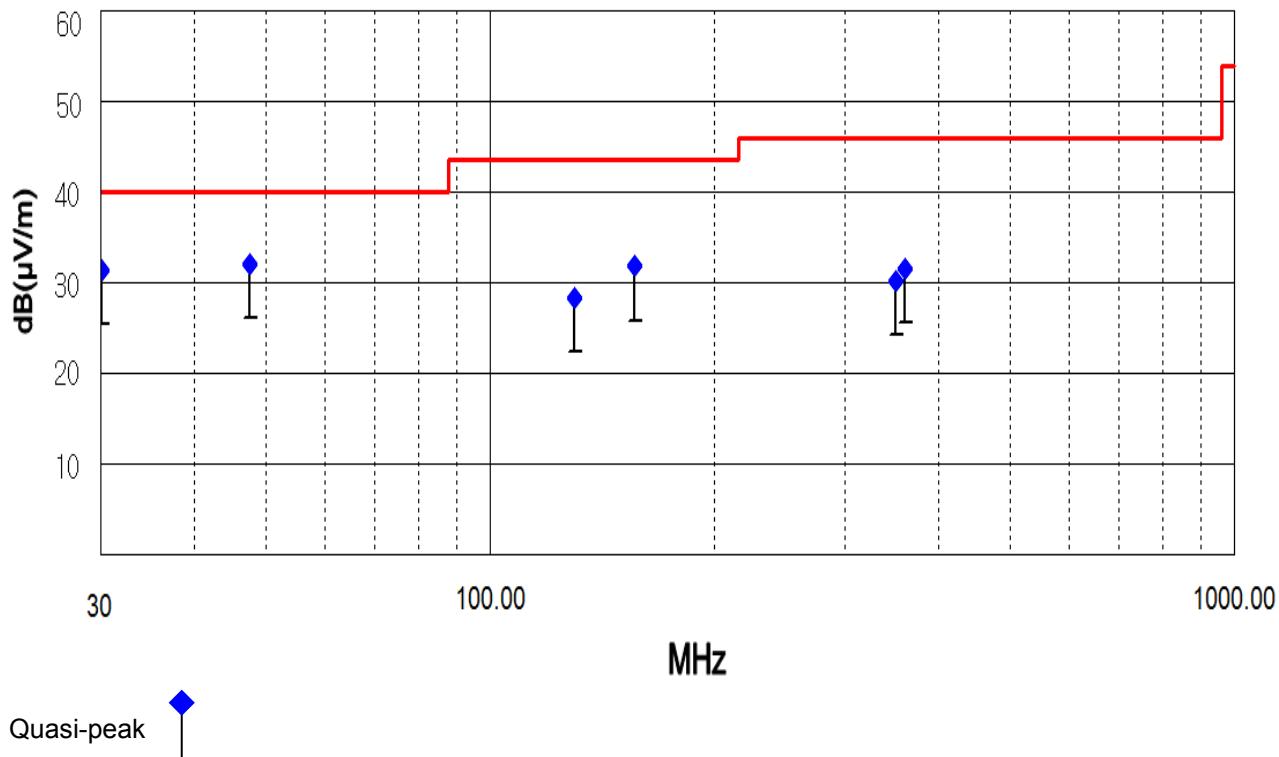
- Type of Modulation: GFSK (worst case)

Frequency [MHz]	Reading [dB(μ V)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]
30.05	18.73	V	11.26	1.41	31.40	40.00	8.60
47.55	18.43	V	12.29	1.38	32.10	40.00	7.90
129.90	14.52	V	11.87	1.91	28.30	43.50	15.20
156.22	16.68	H	13.07	2.05	31.80	43.50	11.70
350.75	12.84	H	14.51	2.85	30.20	46.00	15.80
361.25	13.96	H	14.76	2.88	31.60	46.00	14.40

NOTES:

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Result = Reading + Antenna factor + Cable loss
3. Margin value = Limit - Result
4. The measurement was performed for the frequency range above 30 MHz according to FCC Part 15.209.

— : Limit



- Above 1 GHz (1 GHz to 25 GHz)

- Type of Modulation: GFSK (worst case)

1. Low CH

Frequency [MHz]	Reading [dB(µV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(µV/m)]		Limit [dB(µV/m)]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
4 804.00	50.14	42.84	H	31.45	-31.49	50.10	42.80	74.00	54.00	23.90	11.20

2. Middle CH

Frequency [MHz]	Reading [dB(µV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(µV/m)]		Limit [dB(µV/m)]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
4 882.00	51.20	41.90	H	31.60	-31.50	51.30	42.00	74.00	54.00	22.70	12.00

3. High CH

Frequency [MHz]	Reading [dB(µV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(µV/m)]		Limit [dB(µV/m)]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
4 960.00	50.87	40.77	H	31.74	-31.51	51.10	41.00	74.00	54.00	22.90	13.00

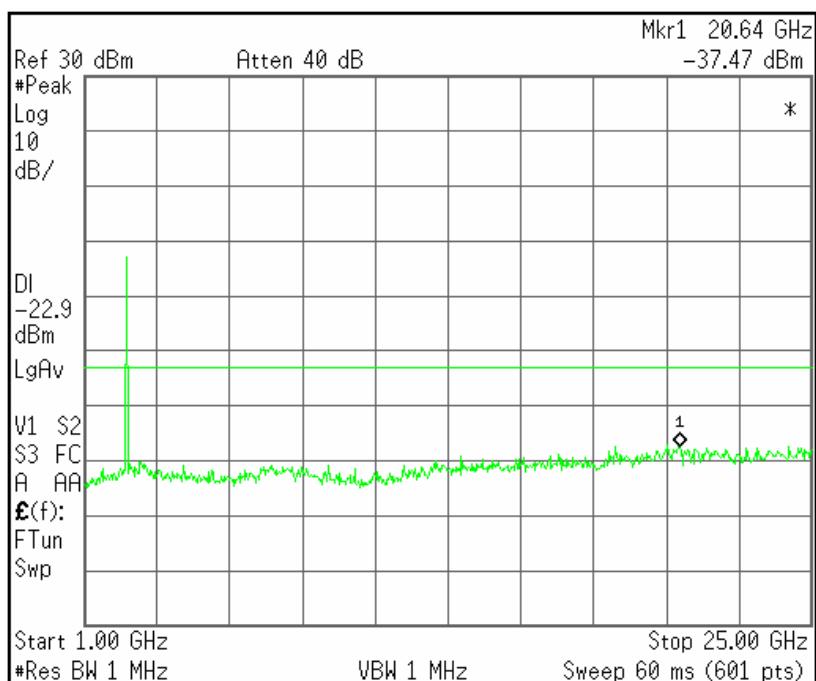
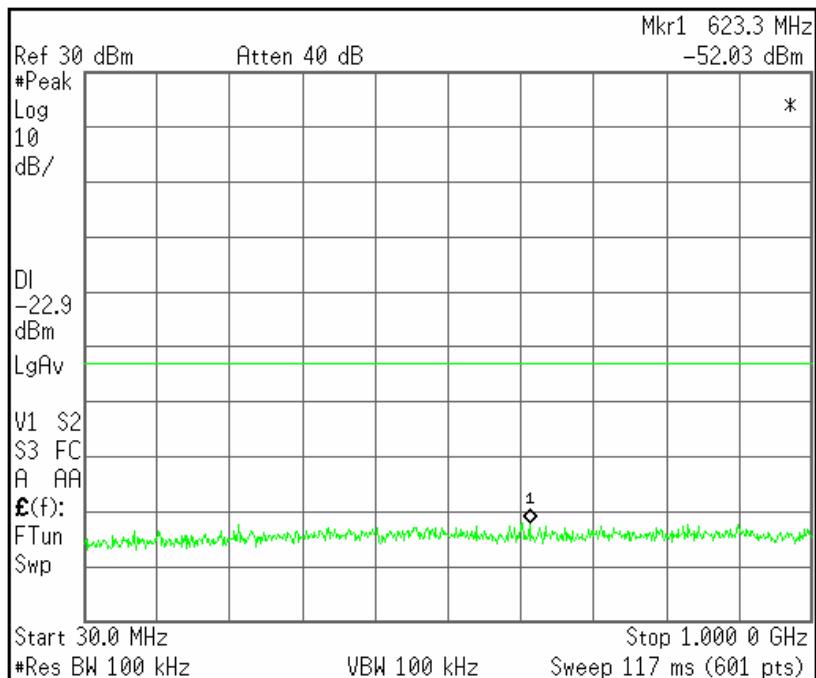
Result: No signal detect above second harmonic.

NOTES:

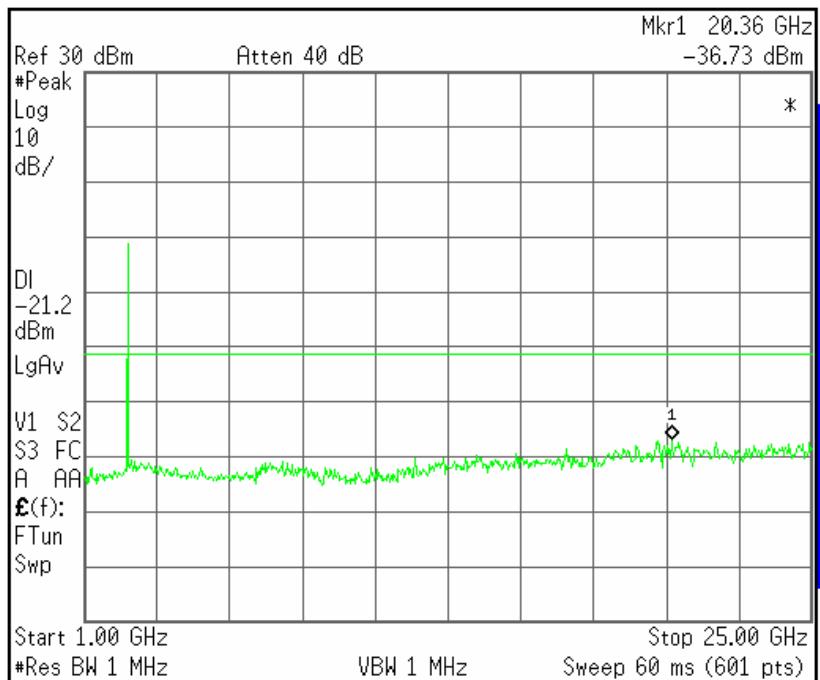
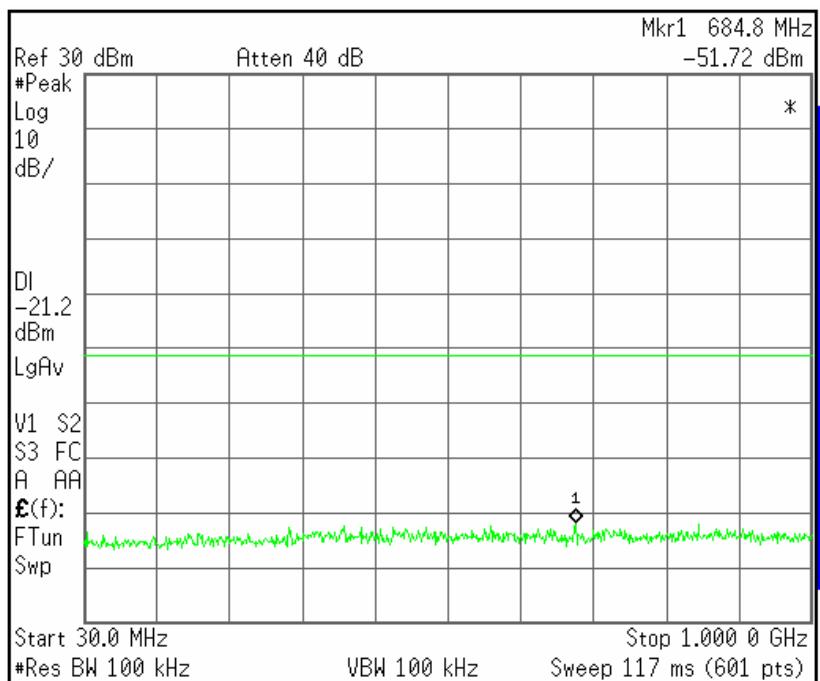
1. * H : Horizontal polarization , ** V : Vertical polarization
2. Cable loss = Cable loss + Amp. Gain
3. Result = Reading + Antenna factor + Cable loss
4. Margin value = Limit - Result
5. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
6. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded(ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
7. Spectrum setting:
 - a. Peak Setting 1 GHz to 10th harmonics of fundamental, RBW = 1 MHz, VBW = 1 MHz, Sweep = Auto
 - b. AV Setting 1 GHz to 10th harmonics of fundamental, RBW = 1 MHz, VBW = 10 Hz, Sweep = Auto

Plots of Spurious Emissions (Conducted Measurement) (GFSK)

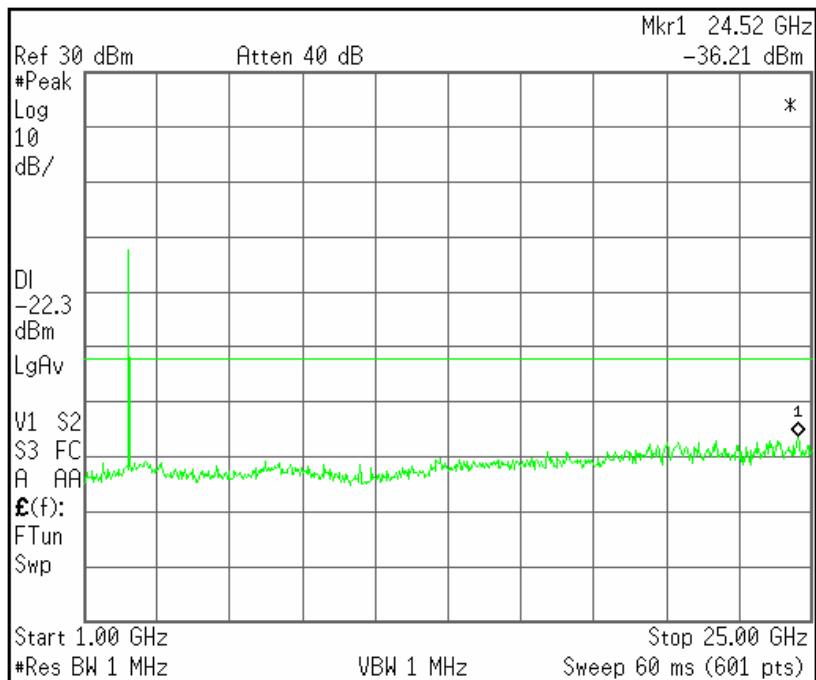
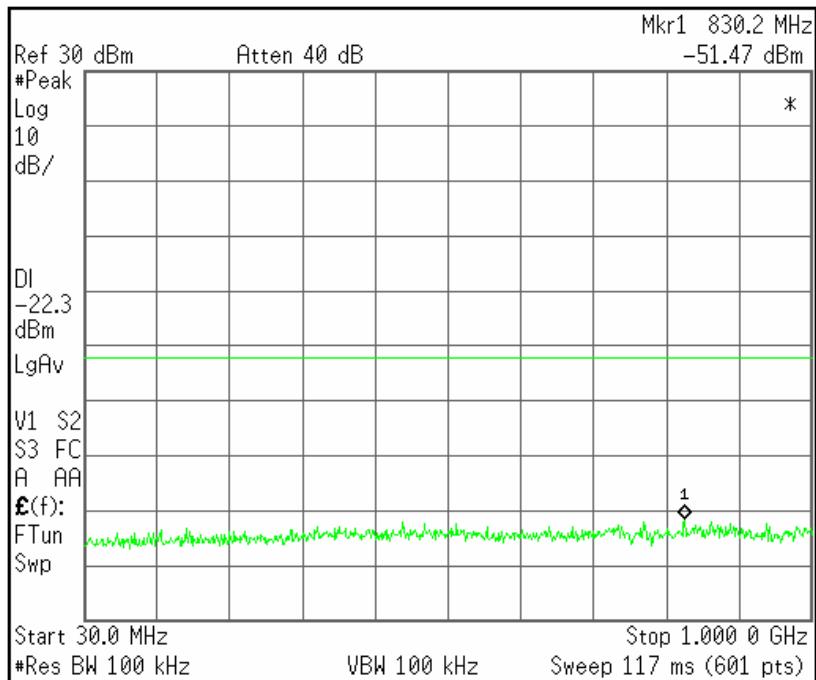
[CH Low]



[CH Mid]

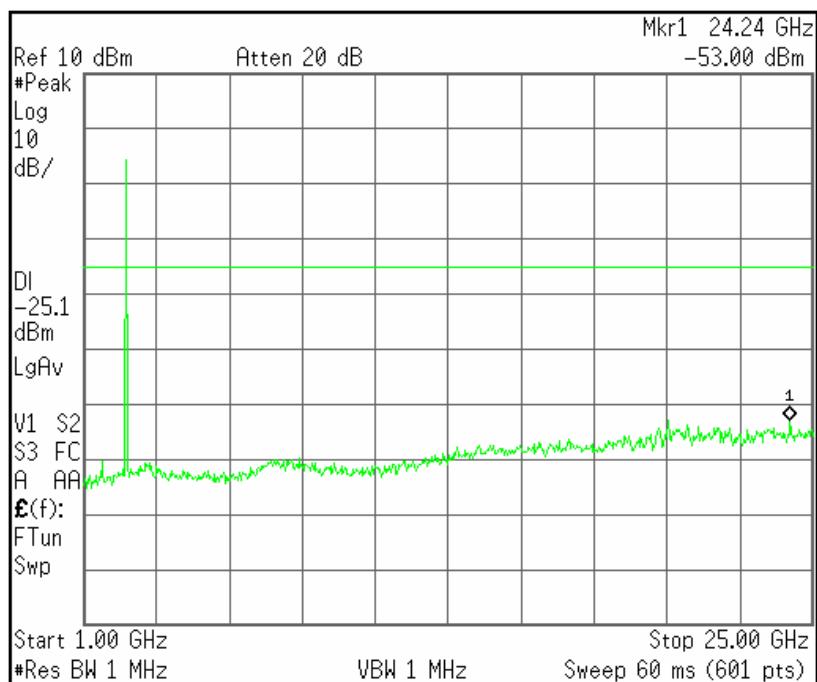
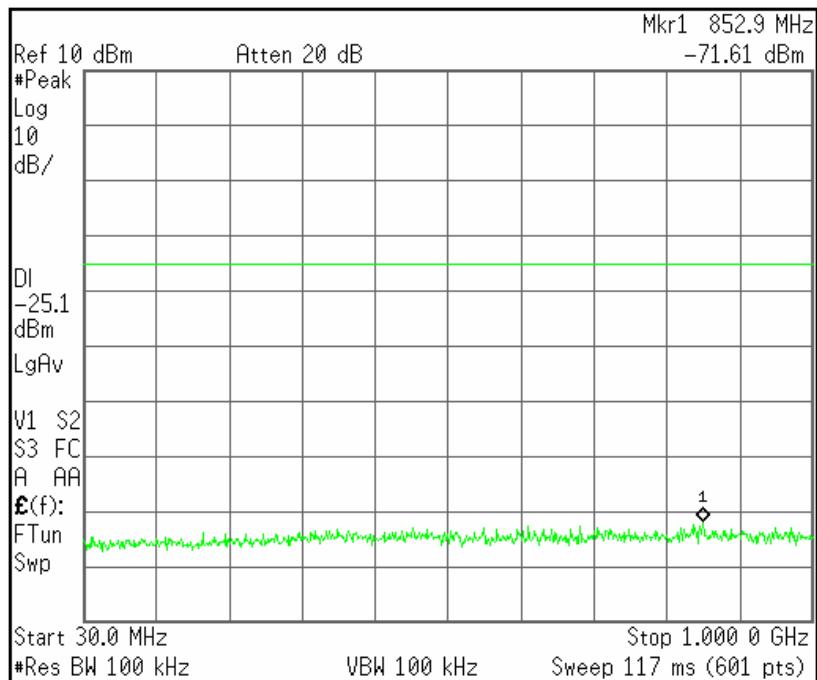


[CH High]

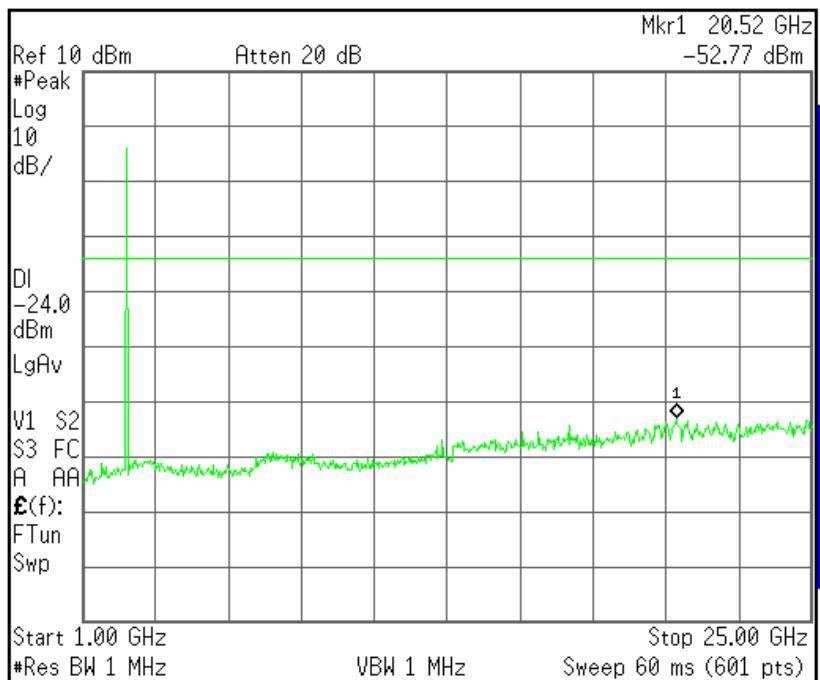
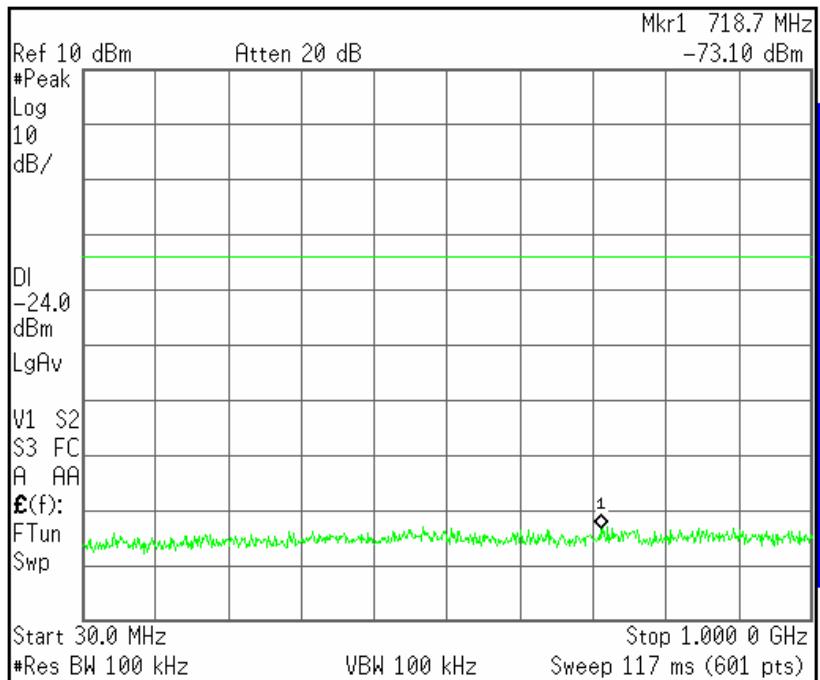


Plots of Spurious Emissions (Conducted Measurement) (8DPSK)

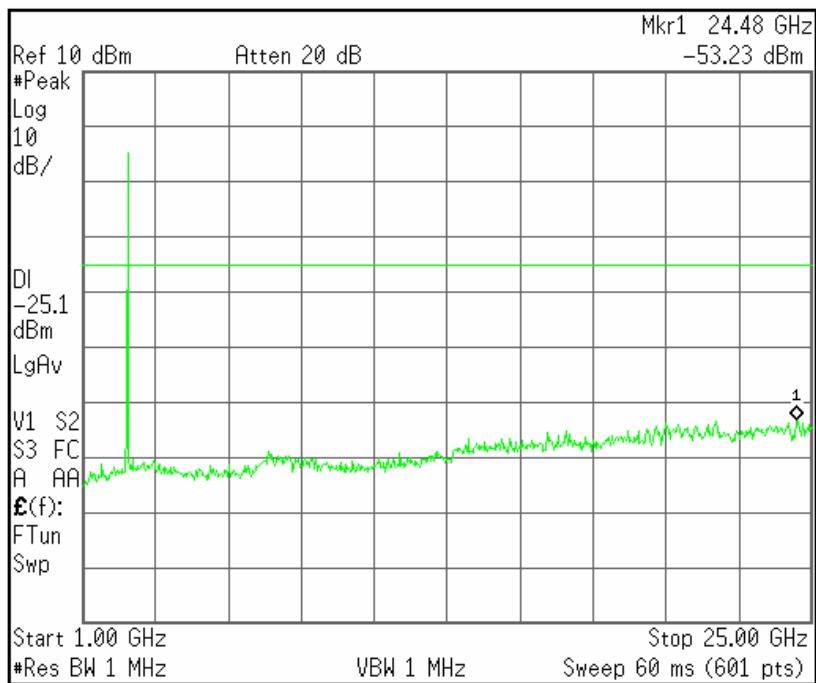
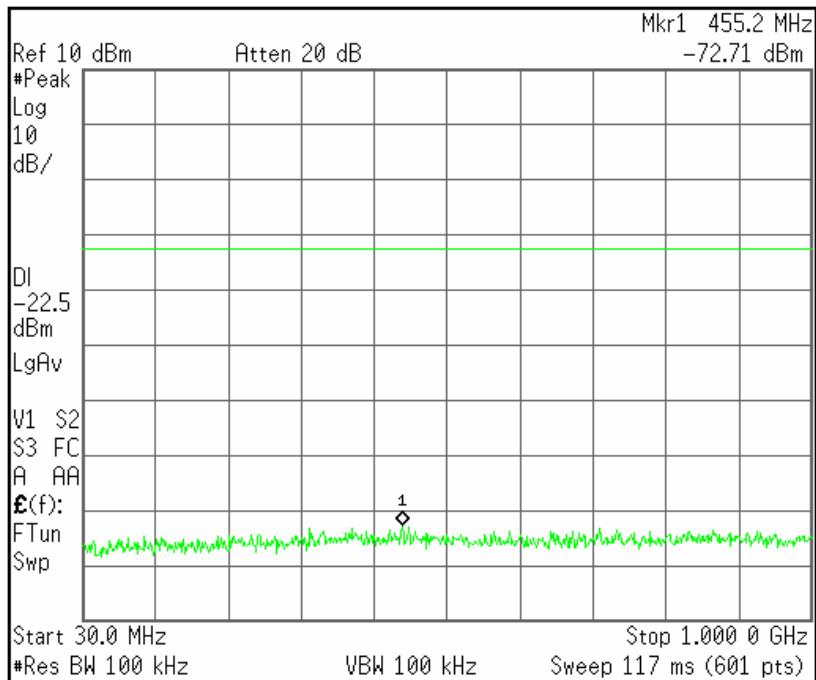
[CH Low]



[CH Mid]



[CH High]



5.7.2 Radiated Emissions (RX)

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	RSS-Gen 6.1
Test Date	June 13, 2013
Operating Condition	Low CH, Middle CH, High CH Transmission
Result	Passed

Limit

Receiver spurious emissions at any discrete frequency shall not exceed 2 nano watts in the band 30 MHz - 1 000 MHz, or 5 nano watts above 1 GHz.

Test Results

- Refer to see the measured plot in next page.

Radiated Emissions Test data

- Below 1 GHz (30 MHz to 1 GHz)

- Operating mode: RX / CH: Low, Mid, High

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
 Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

- Type of Modulation: GFSK, 8DPSK

Frequency [MHz]	Reading [dB(μ V)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]
	No Spurious Radiated Emissions Found						

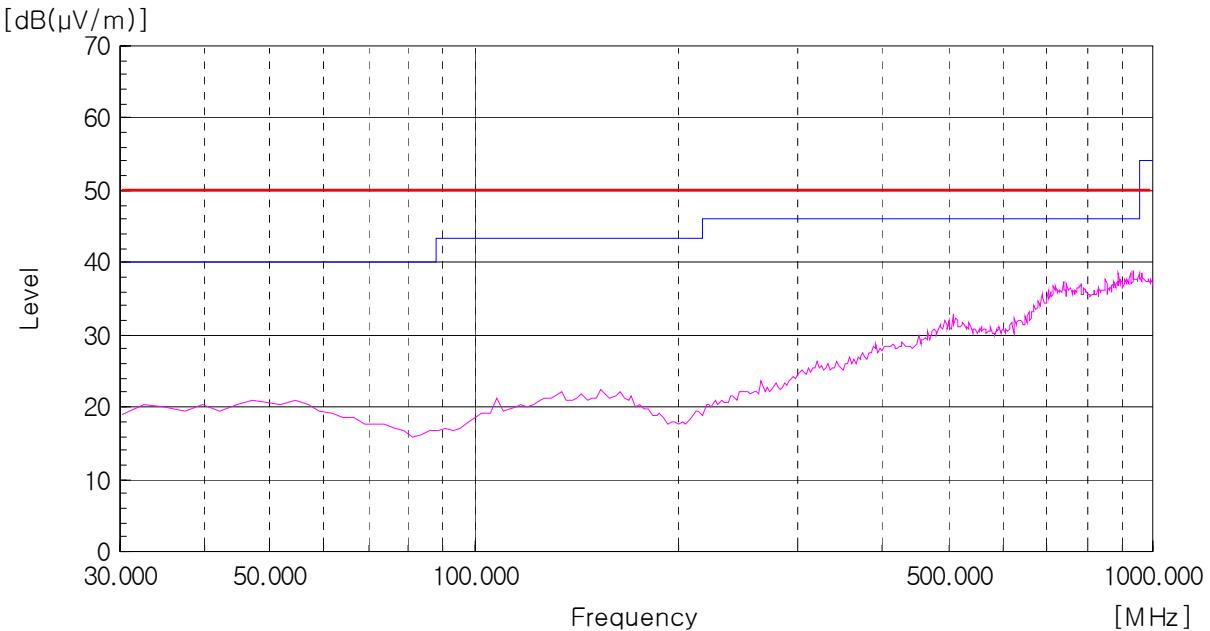
Result: No Spurious Radiated Emissions Found.

NOTES:

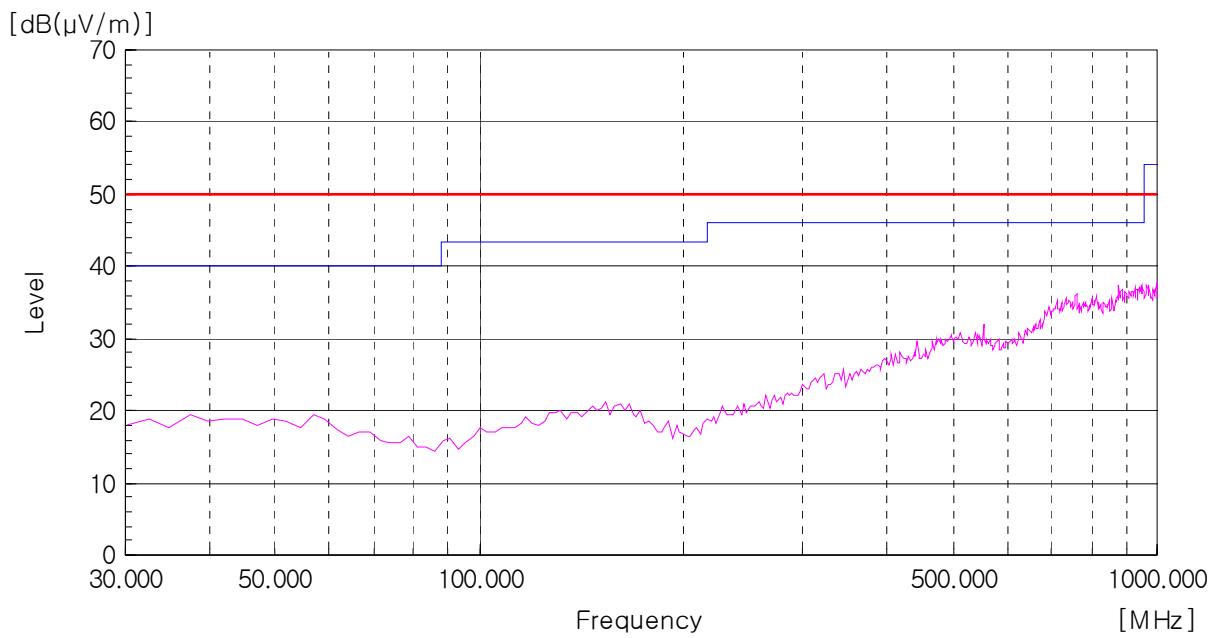
1. * H : Horizontal polarization , ** V : Vertical polarization
2. Result = Reading + Antenna factor + Cable loss
3. Margin value = Limit - Result

— : TX Limit
— : RX Limit

Horizontal



Vertical



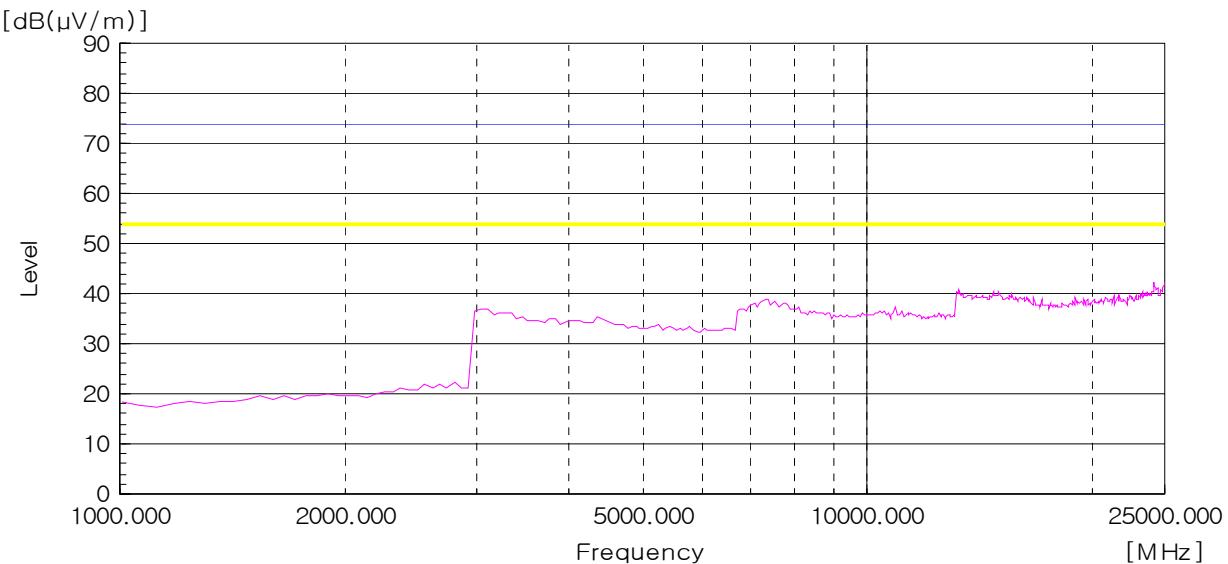
- Above 1 GHz (1 GHz to 25 GHz)

- Operating mode: RX / CH: Low, Mid, High (Type of Modulation: GFSK, 8DPSK)

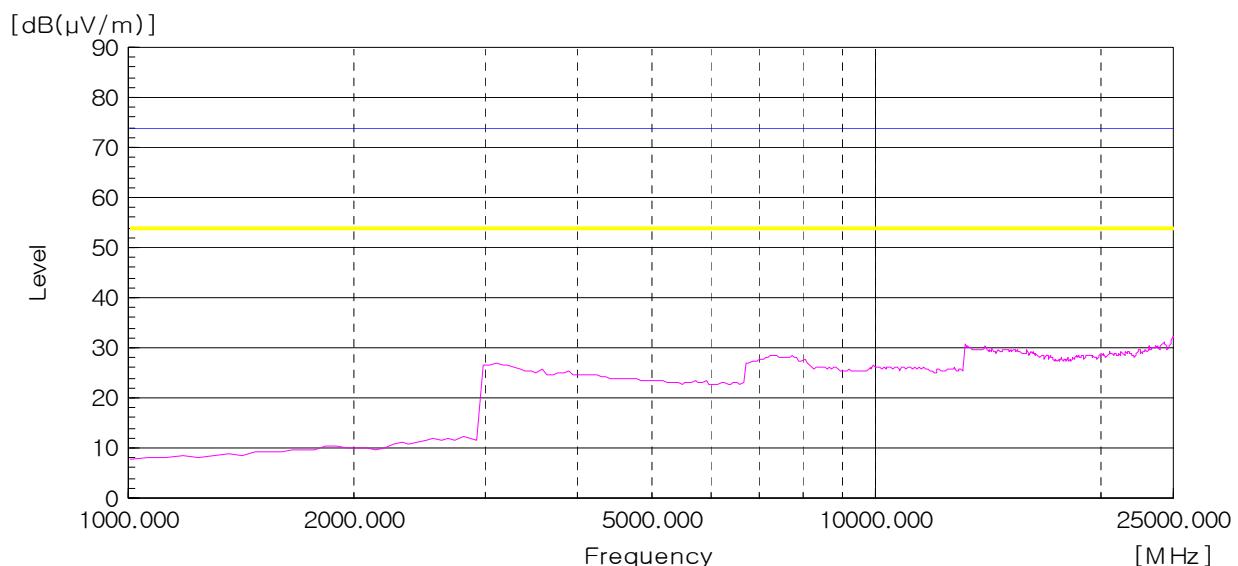
The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

 Peak Limit Line
 AV Limit Line

Final Data Peak



Final Data AV



5.7.3 Conducted Emissions

EUT	SkyPro GPS Receiver / XGPS160
Limit apply to	FCC Part 15.247(d)
Test Date	June 14, 2013
Operating Condition	RF transmitting continuously during the tested
Result	Passed

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Test Results

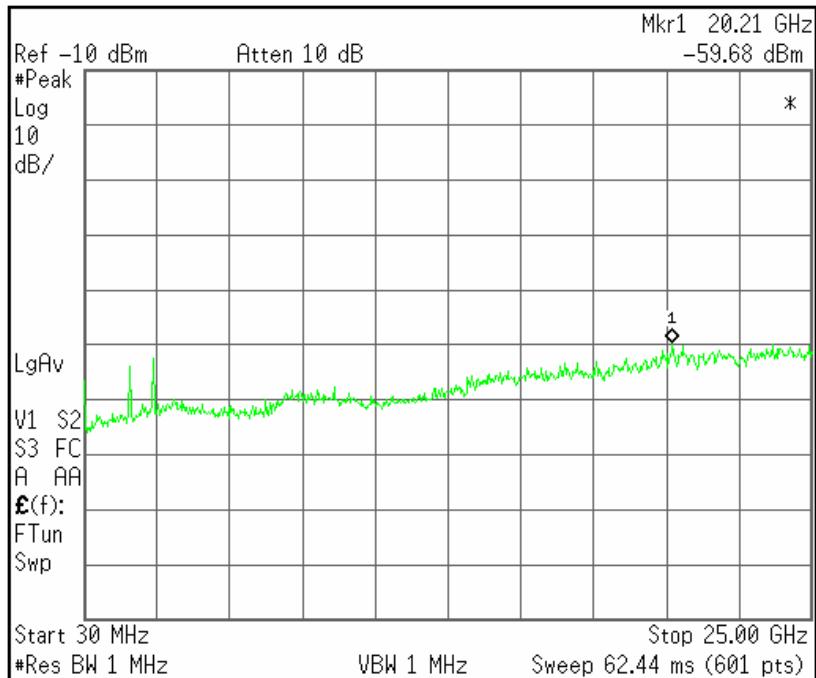
- Refer to see the measured plot in next page.

NOTES:

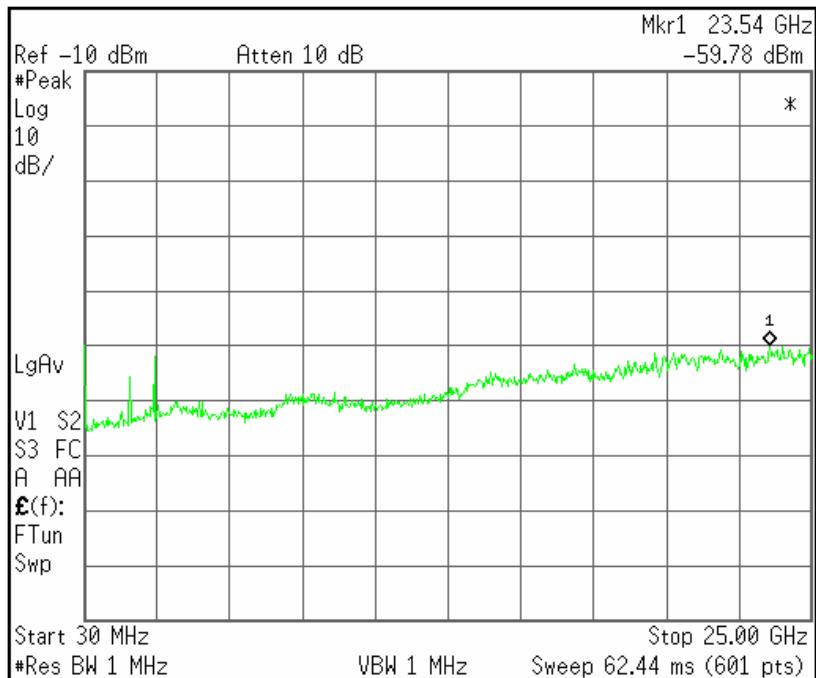
1. The test was performed to make a direct field strength measurement at the band edge frequencies.

Plots of Spurious Emissions (Conducted Measurement) (GFSK)

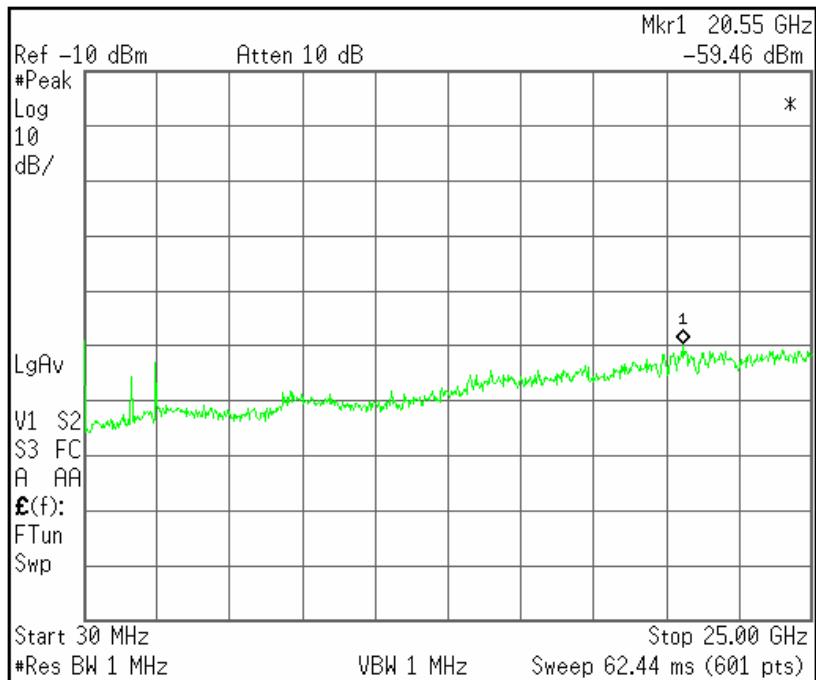
[CH Low]



[CH Mid]

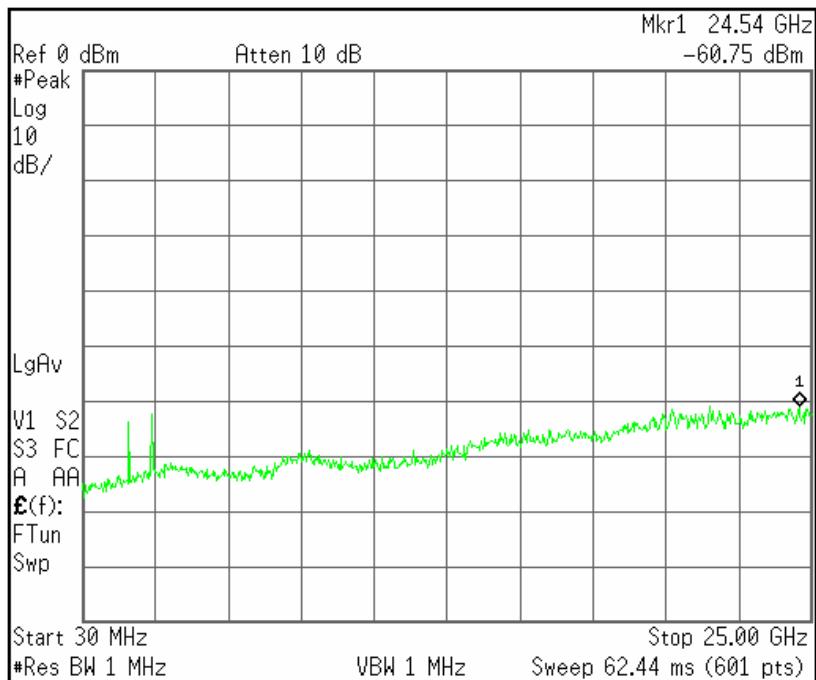


[CH High]

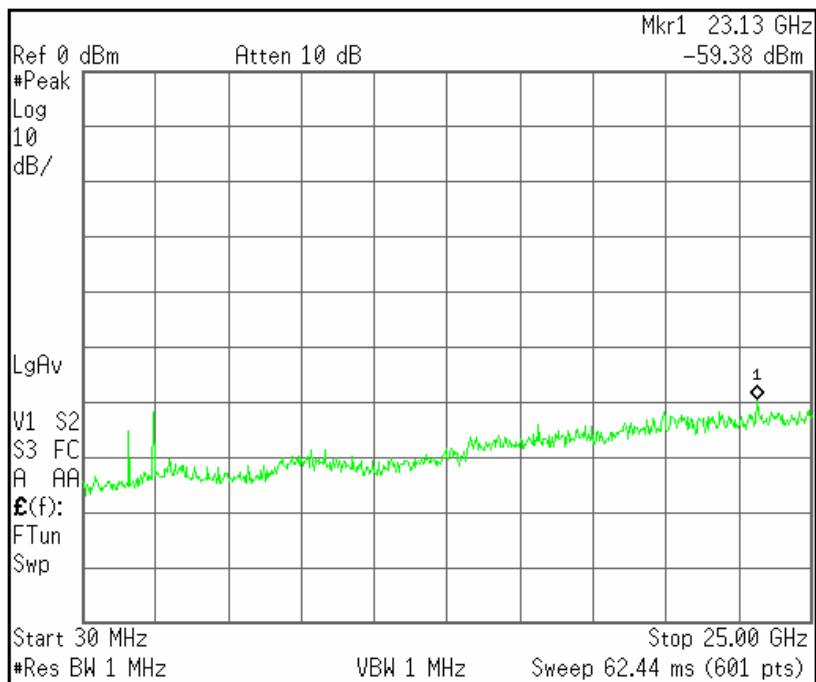


Plots of Spurious Emissions (Conducted Measurement) (8DPSK)

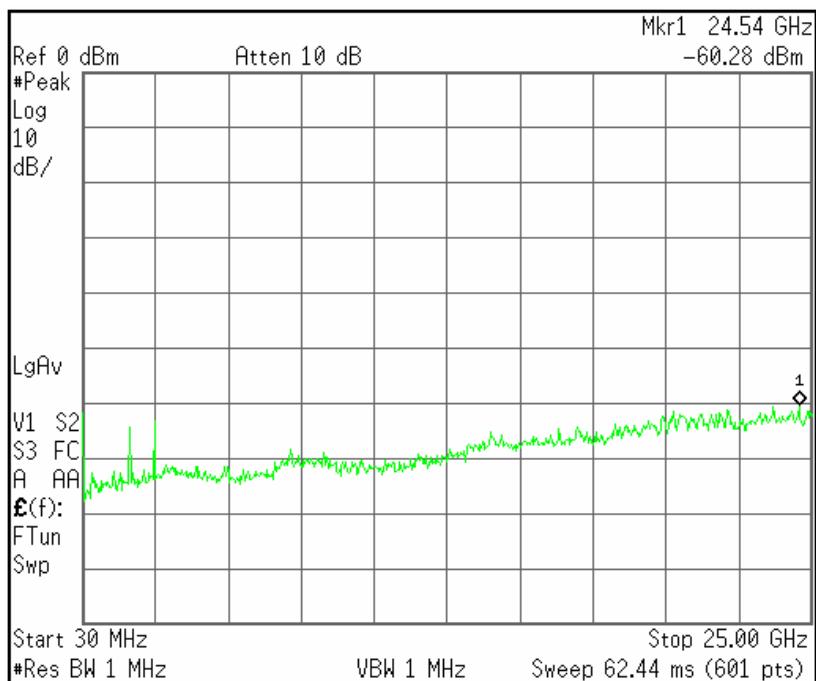
[CH Low]



[CH Mid]



[CH High]



5.8 Radio Frequency Exposure

Standard Applicable:

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Portable device with its physical nature to be used nearby, the distance between radiating structure and human is less than 20 cm.

As per KDB 447498 D01, The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances \leq 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * \sqrt{f(\text{GHz})} \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

f (GHz) is the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation

The result is rounded to one decimal place for comparison

Measurement Result:

This is a portable device and the Max peak output power is **(0.770 mW)** lower than the threshold given and derived as above, where

$$= 0.770 \text{ (mW)} / 5 \text{ (mm)} * \sqrt{2.441 \text{ (GHz)}} = 0.240 < 3.0$$

As the result of calculation result indicates, the RF exposure generating from given transmitter (transmitter employed digital modulation) can be excluded from SAR measurement, and is deemed compliant with RF exposure as per FCC.

6. SAMPLE CALCULATION

Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF$$

Where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

$$dB(\mu V) = 20 \log_{10} (\mu V) : \text{Equation}$$

$$dB(\mu V) = dBm + 107$$

Example : @ 47.55 MHz

$$\text{Class B Limit} = 40.00 \text{ dB}(\mu V/m)$$

$$\text{Reading} = 18.43 \text{ dB}(\mu V)$$

$$\text{Antenna Factor + Cable Loss} = 12.29 + 1.38 = 13.67 \text{ dB}(\mu V/m)$$

$$\text{Total} = 32.10 \text{ dB}(\mu V/m)$$

$$\text{Margin} = 40.00 - 32.10 = 7.90 \text{ dB}$$

$$= 7.90 \text{ dB below Limit}$$

7. List of test equipments used for measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Date	Cal. Due Date
<input checked="" type="checkbox"/>	EMI Test Receiver	ESVS 10	R&S	835165/001	13.03.18	14.03.18
<input checked="" type="checkbox"/>	Loop Antenna	AL-130	COM-POWER	121025	12.06.14	14.06.14
<input checked="" type="checkbox"/>	LogBicon Antenna	VULB9160	Schwarzbeck	3128	12.02.22	14.02.22
<input checked="" type="checkbox"/>	Horn Antenna	BBHA 9120D	Schwarzbeck	277	13.02.28	15.02.28
<input checked="" type="checkbox"/>	Spectrum Analyzer	E7405A	H.P.	US41160290	12.09.05	13.09.05
<input checked="" type="checkbox"/>	PSA Series Spectrum Analyzer	E4440A	Agilent	MY46185482	12.08.06	13.08.06
<input checked="" type="checkbox"/>	Amplifier	TK-PA18	TESTEK.	120020	12.12.15	13.12.15
<input checked="" type="checkbox"/>	Band Reject Filter	WRCGV 2402/2480-2382/2500-52/10SS	Wainwright Instruments GmbH	2	12.09.06	13.09.06
<input checked="" type="checkbox"/>	Power Meter	NRVS	R&S	834053/060	12.09.06	13.09.06
<input checked="" type="checkbox"/>	DC Power Supply	DP30-05A	Toyo Tech	0300266	12.09.06	13.09.06
<input checked="" type="checkbox"/>	Controller	HD2000	HD GmbH	C/125	N/A	N/A
<input checked="" type="checkbox"/>	Antenna Master	MA2400	HD GmbH	N/A	N/A	N/A
<input checked="" type="checkbox"/>	Turn-Table	TT 1.35 SI	SES	-	N/A	N/A
<input checked="" type="checkbox"/>	Antenna Master	AM 4.5	SES	-	N/A	N/A