Washington Laboratories, Ltd.
www.wll.com
7560 Lindbergh Drive . Gaithersburg, MD 20879
301.216.1500 . info@wll.com

FCC and Industry Canada Certification Test Report
For the
SkyBitz, Inc.
MTXP L-Band Mobile Terminal
FCC ID: SAE-000MTXP
IC ID: 5375A-000MTXP

WLL REPORT# 11373-01 Rev 1

April 30, 2010

Prepared for:

SkyBitz, Inc.
22455 Davis Drive Suite 100
Sterling, Virginia 20164

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ACCREDITED
Testing Cert. 2675.01

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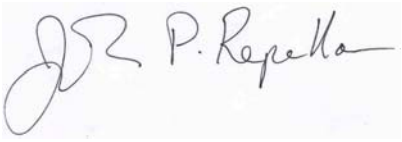

John P. Repella
Compliance Engineer

Reviewed by:

Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of SkyBitz, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Satellite Terminal under Part 25 of the FCC Rules and Regulations and under the Regulations and Spectrum Management and Telecommunications Policy RSS-170 of Industry Canada. This Certification Test Report documents the test configuration and test results for a SkyBitz, Inc. MTXP L-Band Mobile Terminal.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

Additionally WLL, recently received accreditation from ACLASS under Certificate AT-1448, the retest completed in April is covered under this accreditation.

The SkyBitz, Inc. MTXP L-Band Mobile Terminal complies with the technical requirements under FCC Part 25 and Industry Canada RSS-170.

Revision History	Reason	Date
Rev 0	Initial Release	April 9, 2010
Rev 1	Updated Information for TX Power and Frequency Tolerance	April 30,2010

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1 Introduction

1.1 Compliance Statement

The SkyBitz, Inc. MTXP L-Band Mobile Satellite Terminal complies with the limits for a Mobile Earth Station under FCC Part 25 and Industry Canada RSS-170.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	SkyBitz, Inc. 22455 Davis Drive Suite 100 Sterling, Virginia 20164
Purchase Order Number:	0004774
Quotation Number:	65392

1.4 Test Dates

Testing was performed on the following date(s):	3/8/2010 - 3/26/10, 4/6/10

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell, John P. Repella
Client Representative	Dana Johnson

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**C**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**Decibel**
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**M**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The SkyBitz, Inc. MTXP L-Band Mobile Terminal transmits and receives messages through the SkyBitz network. Its integrated design includes a software-based radio, antennas, and lithium battery pack in one package.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	SkyBitz, Inc.
FCC ID Number	SAE-000MTXP
IC ID Number	5375A-000MTXP
EUT Name:	Mobile Terminal
Model:	MTXP
FCC Rule Parts:	§25
IC Rule Parts	RSS-170 Annex B
Frequency Range:	TX: 1626.5-1660.5MHz RX: 1525-1559MHz & 1575.42MHz
Maximum Output Power:	0.398 watts EIRP (-4.0dBW)
Modulation:	MSK
Necessary Bandwidth	4.248 kHz
Occupied Bandwidth (20dB):	4.3707 kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	Variable- determined by satellite provider
Antenna Type	Integral
Frequency Tolerance Limits:	0.001% (FCC) , +/-320 Hz (IC)
Frequency Tolerance Meas:	(FCC) 0.000014, (IC) +230Hz
Emission Type(s):	G1D
Emissions Designator	4K37G1D
Interface Cables:	RS485 Interface
Power Source & Voltage:	6Vdc from batteries
Final RF Amp Voltage	4.9 VDC
Final RF Amp Current	275 mA
Receiver Spurious	48.7 dBµV/m @ 3m
Transmitter Spurious	-40.7 dBc @ 1626.51508MHz (TX@ 1626.505MHz)

2.2 Test Configuration

The EUT was configured with a support laptop and an RS485 adapter. The laptop used SkyBitz software, SkyPort, to configure the system for continuous transmit. A separate DC power supply was used to provide a constant 6Vdc to the EUT so as not to drain the batteries.

The EUT firmware/software was set up to simulate normal transmission to a satellite

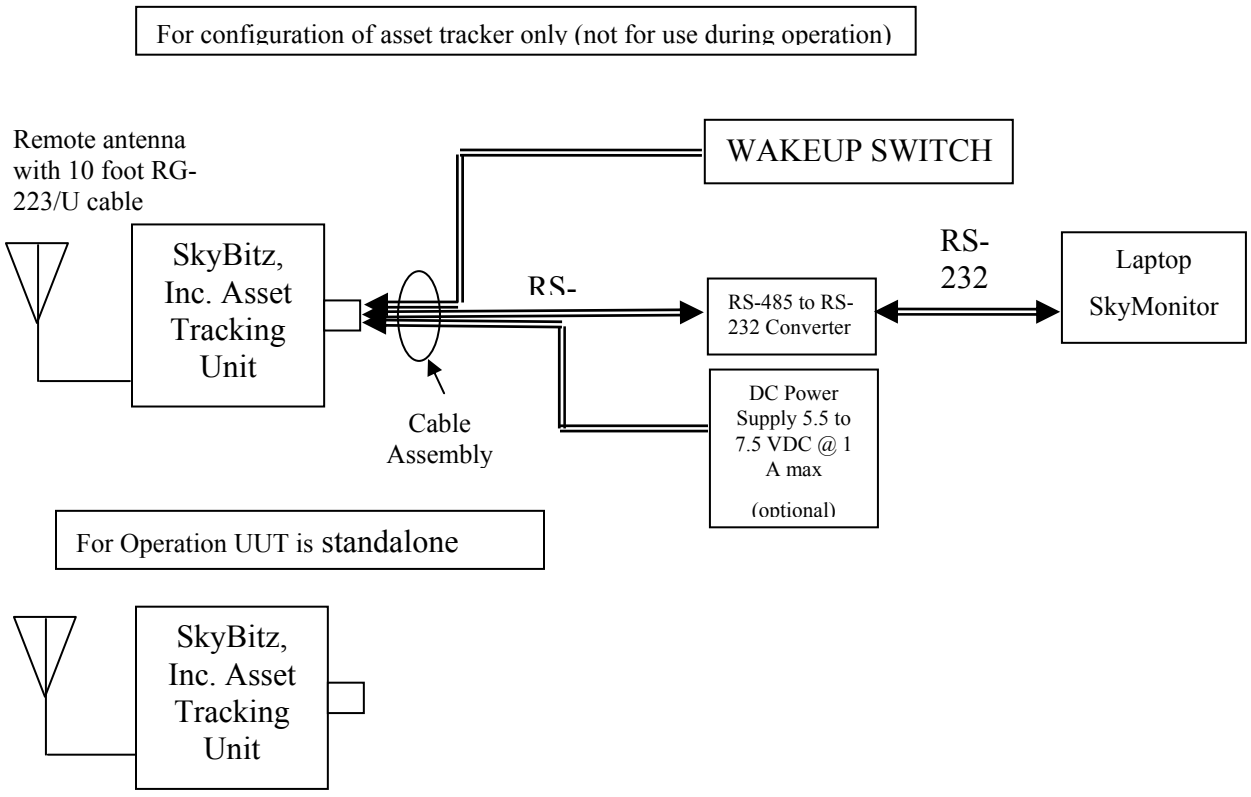

Figure 1: Test Setup Diagram

2.3 Testing Algorithm

The MTXP L-Band Mobile Terminal was configured by SkyBitz software on the support laptop to continually transmit on the following channels:

- Low channel: 1626.505 MHz –limited testing (Power, Bandwidth and Emission Masks)
- Center channel: 1643.5 MHz- full testing
- High channel: 1660.495 MHz- limited testing (Power, Bandwidth and Emission Masks)

Worst case emission levels are provided in the test results data.

2.4 Test Location

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879.

Testing that was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

RSS170 Issue 1, Rev. 1 Satellite Mobile Earth Stations

47 CFR Part 25

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values radiated emissions is 4.55dB.

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3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Test Name:	**Radiated Emissions**	Test Date:	**03/16/2010**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
4	ARA, DRG-118/A	Antenna, DRG, 1-18GHz	02/06/2011
521	MegaPhase, LLC F230-S1S1-246	Cable, Coaxial	12/29/2010
528	Agilent, E4446A	Analyzer, Spectrum	09/04/2010
7	ARA, LPB-2520	Antenna, Biconilog Antenna	06/17/2010
559	HP, 8447D	Amplifier	12/17/2010
428	EMCO, 3109	Antenna, Biconical	03/06/2010
556	EMCO, 3146	Antenna, Log Periodic	CNR 0:00:00
1	A.H., Systems, SAS-200/518	Antenna, LP, 1-18GHz	04/29/2010
478	Rhode & Schwarz, SMT 06	Signal Generator	04/15/2010

4 Test Results

4.1 RF Power Output (FCC 25.204, RSS-170 Section 6.2)

FCC 25.204 specifies the limits for Satellite Earth Stations.

In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits:

+40 dBW in any 4 KHz band for θ: 0°

+40+3 θ dBW in any 4 KHz band for θ <0°≤05°

Where, θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

IC RSS-170 Section 6.2 and Annex B specify the following requirements:

The output power shall be measured when the transmitter is operating at the manufacturer's rated power and modulated with signals representative (i.e. typical) of those encountered in a real system operation. This measurement shall be carried out before the other tests.

If the power is in bursts, the power shall be averaged over any 100 millisecond interval, or over the burst interval if the burst is shorter than 100 milliseconds, during which its value is at its maximum.

4.1.1 Power measurement test procedure – Signal Substitution Method

No direct connection to the antenna is available for making the power measurement as the antenna is integrated with the unit.

To measure the EIRP the EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components of the EUT were measured.

The received level of the detected emission was recorded in the data sheet. The EUT is then replaced with a transmit antenna and signal generator. Output power of the signal generator was increased until the same received level was indicated on the spectrum analyzer for the emission under investigation. Radiated power of the emission was then determined by adding the forward power supplied to the substitution antenna with the gain of the substitution antenna and comparing the result to the limit.

As specified above, the limit is +40 dBW in any 4 kHz band. The analyzer used for testing was set to a 4 kHz measurement bandwidth. The following calculations were used for determining the EIRP level:

Pout (dBW) = SL (dBm) + G (dBi) + -30(dB)

Where: SL is the substitution level in dBm

G is the substitution antenna gain in dBi

-30dB is the conversion factor for dBm to dBW

Table 3: RF Power Output

Frequency (MHz)	Polarity	Azimuth	Ant. Height (m)	Spurious Level (dBuV)	Sub. Sig. Gen. Level (dBm)	Sub. Power Level (dBm)	Sub. Ant. Factor (dB)	Sub. Ant. Gain (dB)	EIRPLevel dBW/4kHz	Limit (dBW/4kHz)	Margin (dB)
1626.51	V	0.0	1.0	92.9	22.1	19.7	28.8	5.7	-4.6	40	-44.6
1643.50	V	0.0	1.0	92.8	22.3	19.9	28.9	5.7	-4.5	40	-44.5
1660.50	V	0.0	1.0	92.5	22.5	20.2	29.0	5.7	-4.1	40	-44.1
1626.51	H	10.0	1.0	94.8	22.1	19.7	28.8	5.7	-4.6	40	-44.6
1643.50	H	10.0	1.0	92.9	22.8	20.4	28.9	5.7	-4.0	40	-44.0
1660.50	H	10.0	1.0	91.9	22.2	19.9	29.0	5.7	-4.4	40	-44.4

4.2 Occupied Bandwidth

The occupied bandwidth of the MTXP Mobile Terminal was measured. This measurement was performed by coupling the output of the EUT via an antenna to the input of a spectrum analyzer. The 20dB occupied bandwidth was measured for the Low, High and Middle channels and the test results are listed in the following table. Figure 2 thru Figure 4 show plots of the occupied bandwidth.

Table 4: Occupied Bandwidth Results

Frequency (MHz)	Occupied Bandwidth (kHz)	Standard Reference
Low Channel: 1626.505	4.3193 kHz	RSS-170
Middle Channel: 1643.5	4.3424 kHz	FCC Part 25
High Channel: 1660.495	4.3707 kHz	RSS-170

The necessary BW for a 2-ary MSK (Minimum Shift Keying) signal is calculated as follows:

Number of states = 2

Bit Rate R = 3.6 kbps

Factor K' = 1.18 for a 2-ary MSK signal {NOTE: K' = (1/Log2(number of States) + 0.18) = (1/(Ln(2)/Ln(2) + 0.18) = 1 + 0.18 = 1.18} {also note that this is for unfiltered MSK, where any filtering is sufficiently wide that it has no or little effect on the occupied BW}.

Necessary BW Bn = R X K' for an MSK signal

Bn = 3.6 kbps X 1.18 = 4.248 kHz

MSK is considered phase modulation ("G"), we utilize a single channel ("1"), and we transmit data ("D"). This is consistent with Part 2.201 Subpart C-Emissions.

Therefore the emission designator based on FCC part 2.202 is something like 4K25G1D. The actual emission designator is based on the 99% occupied BW measurement.

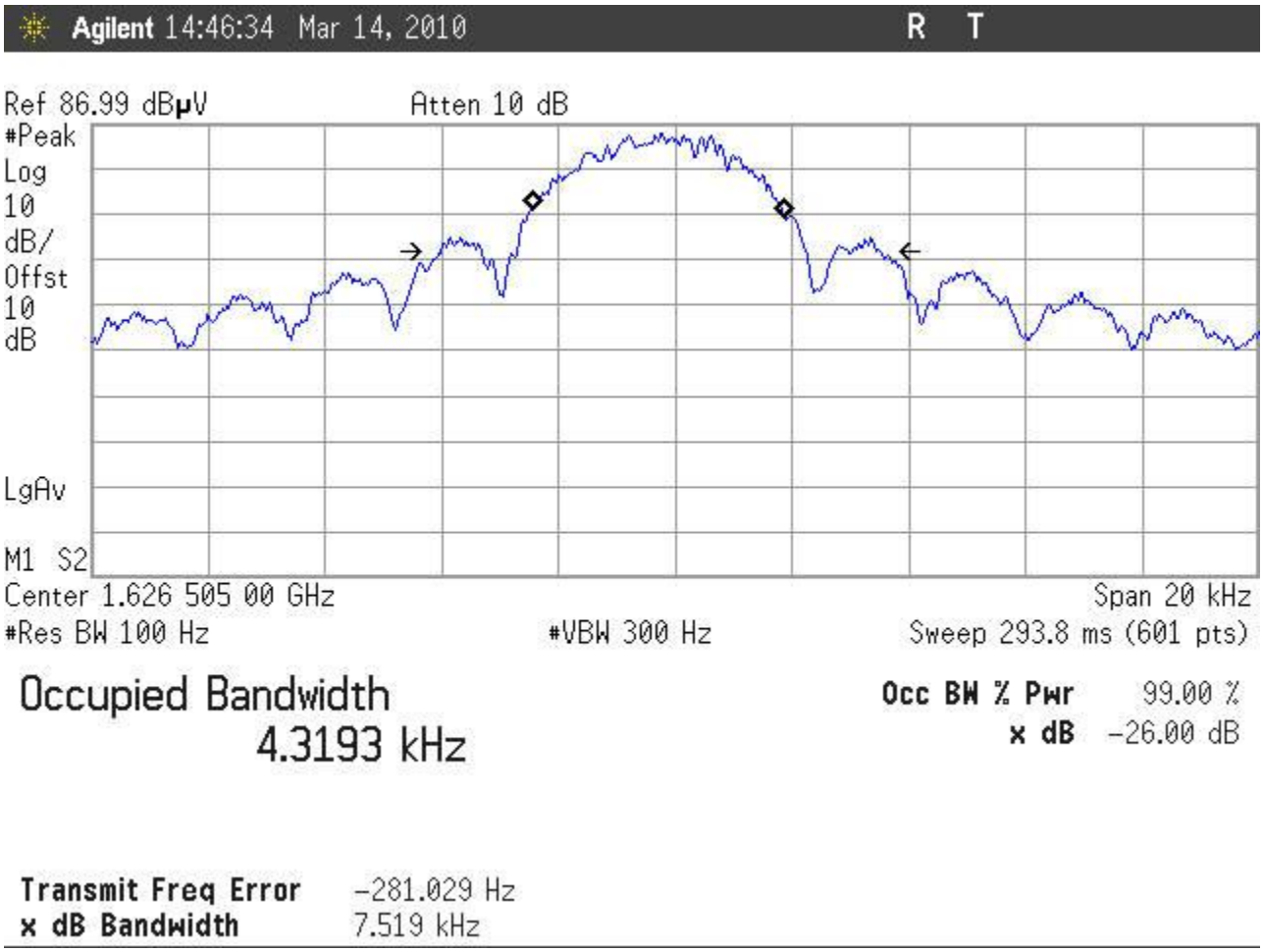


Figure 2: Occupied Bandwidth, Low Channel, TX @ 1626.505MHz

Figure 3: Occupied Bandwidth, Mid Channel, TX @ 1643.5MHz

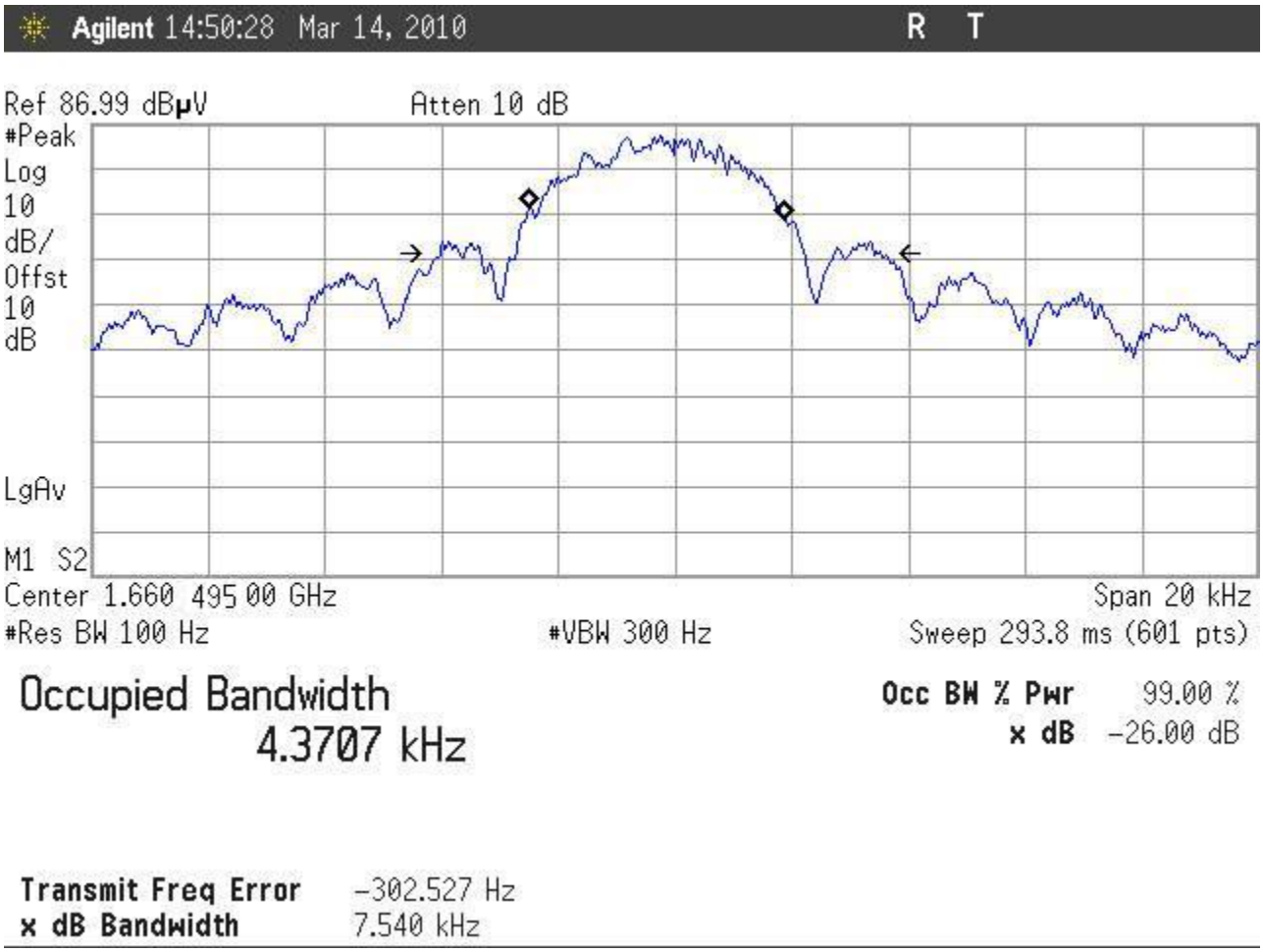


Figure 4: Occupied Bandwidth, High Channel, TX @ 1660.495MHz

4.3 Emission Limitations per FCC Part 25.202(f); RSS-170 Section 6.3 (Emission Masks)

Radiated spurious emissions must comply with the requirements of §25.202 (f) of FCC and Table B1 column (a) of RSS-170. The limits for the spurious emissions for RSS-170 and FCC Part 25 are as follows:

FCC Part 25.202(f):

Radiated spurious emissions must comply with the requirements of §25.202(f). The limits for the spurious emissions are as follows:

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts.

RSS-170(B2):

The attenuation of the spectrum shall be in accordance with the schedule of column (a), or alternatively of column (b) of Table B1, whichever is less stringent.

Table 5: Table B1 of RSS-170

Frequency Offset Normalized to SR (symbol rate)	(a) Minimum attenuation relative to in-band spectral density, (dB)	(b) Minimum attenuation relative to transmitter output power (dB), in any 4 kHz
+0.75 SR	0	0
+1.40 SR	20	30
+2.80 SR	40	50
+4.00 SR	55 or (37 + 10 Log10TP) whichever is less stringent	65 or (47 + 10 Log10TP) whichever is less stringent

4.3.1 Test Procedure

For the FCC Part 25 requirements the unit was set to transmit at 1643MHz and the emissions were scanned to +/-250% of the authorized bandwidth and compared to the emission mask specified in FCC Part 25.202(f). The authorized bandwidth used in the calculations for the limit was 7 kHz.

For complying with the RSS-170 emission mask, the unit was first set to transmit at the lowest authorized frequency of 1626.505MHz. The emission mask of Table B1 column "a" was then entered into the spreadsheet based on a baud rate of 3600. Discrete measurements of the channel power in a 4 kHz bandwidth were then measured and plotted against the limit curve. The unit was then set to the highest authorized frequency of 1660.495MHz and the test was repeated.

Spectrum plots of the emissions +/-250% as measured with a 100Hz RBW were also obtained at the low and high channel settings.

4.3.2 Test Results

The EUT complies with the emissions mask requirements of FCC Part 25.202(f) and RSS-170 Annex B. Figure 5 and Figure 6 contain the plots of the emissions mask for FCC Part 25.202(f). Figure 7, Figure 8 and Figure 9 contain the plots of the emissions mask per RSS-170.

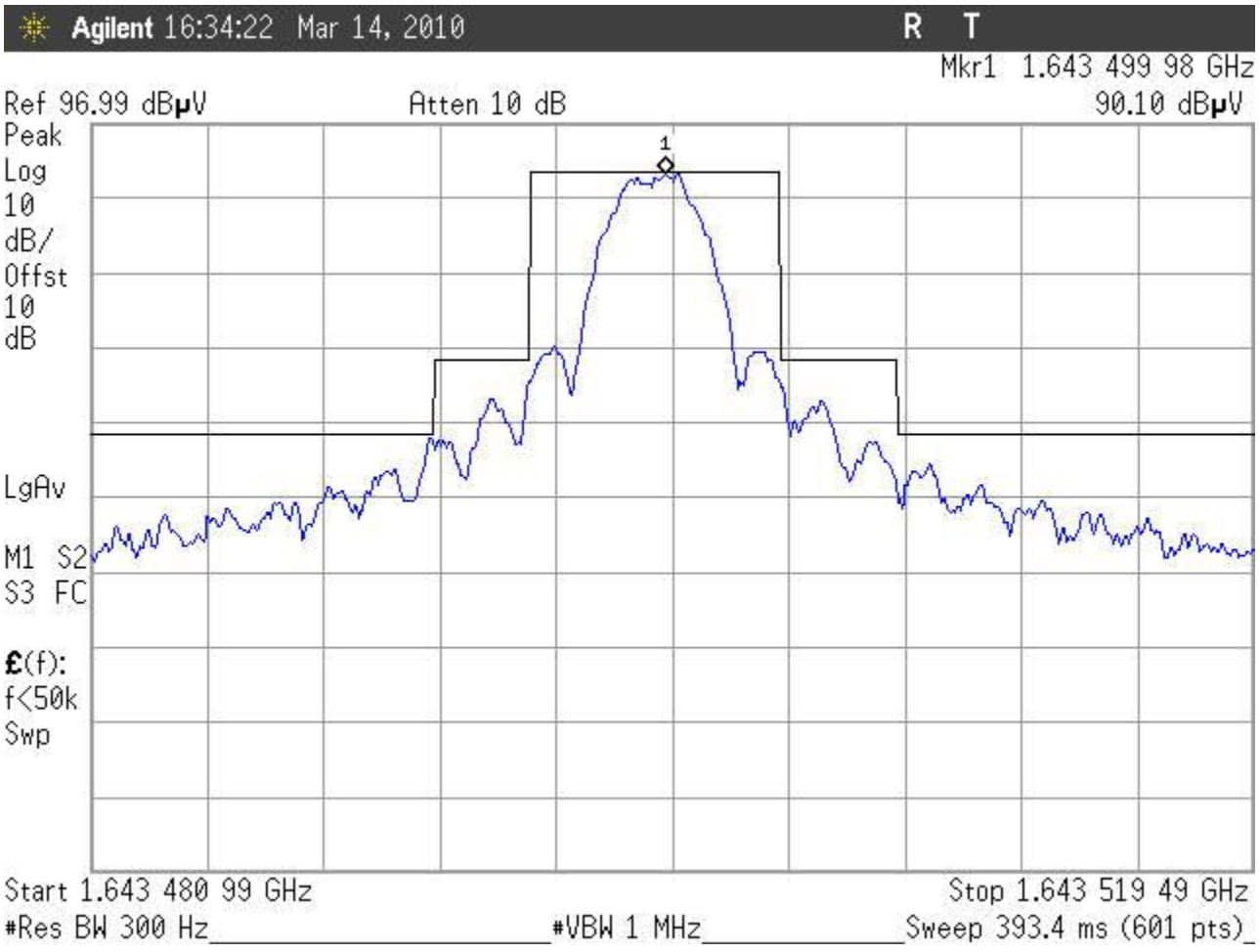


Figure 5: FCC Part 25.202(f) Emissions Mask, Vertical Polarity

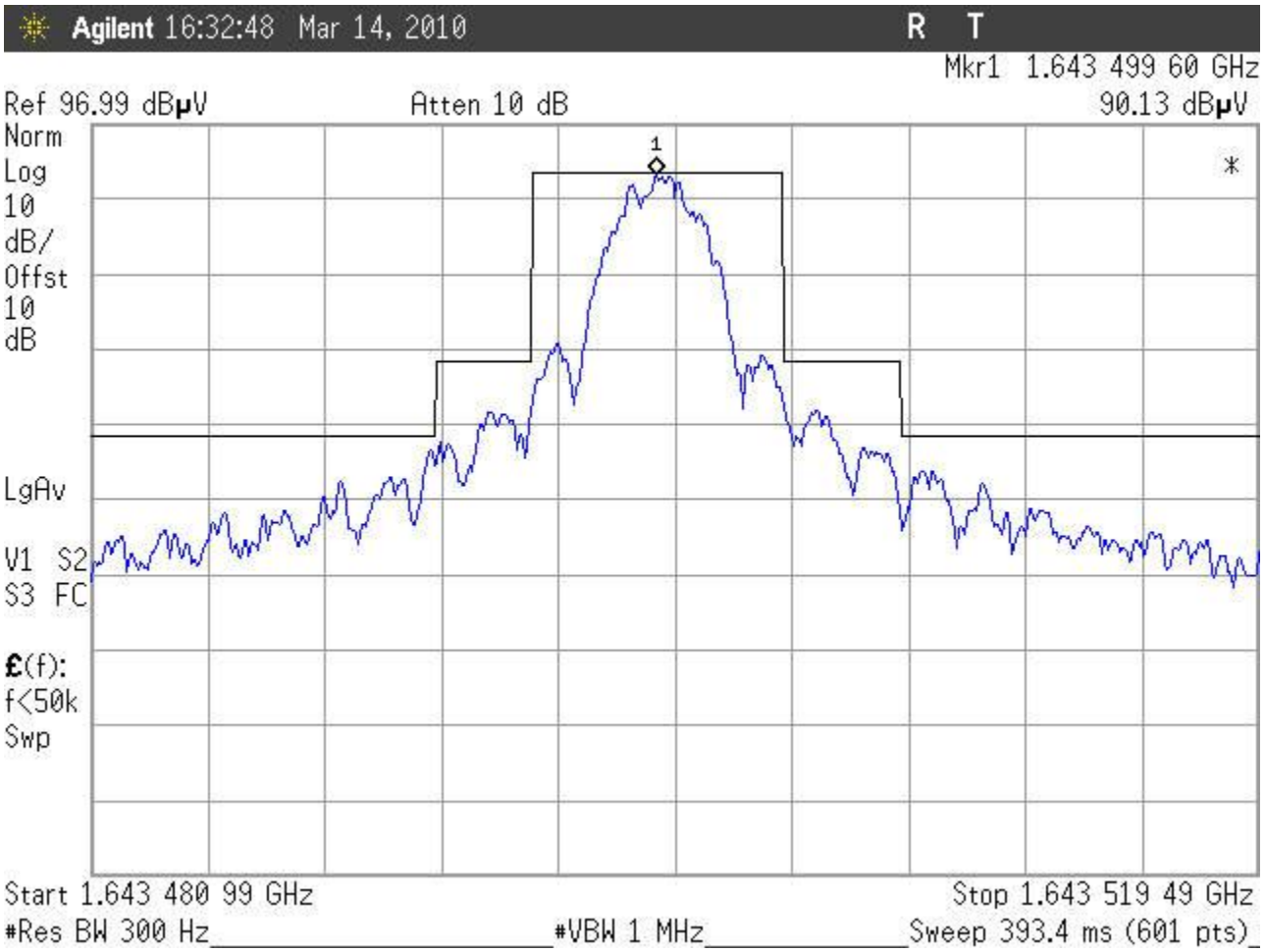
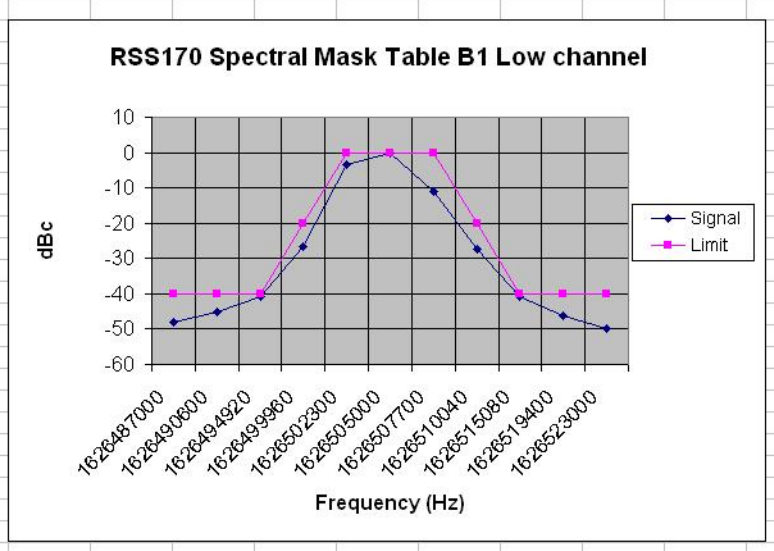


Figure 6: FCC Part 25.202(f) Emissions Mask, Horizontal Polarity

Low Chan Freq(Hz)	Power	dBc	limit
1626487000	-61.8	-48.1	-40
1626490600	-58.8	-45.1	-40
1626494920	-54.5	-40.8	-40
1626499960	-40.2	-26.5	-20
1626502300	-17.2	-3.5	0
1626505000	-13.7	0	0
1626507700	-24.6	-10.9	0
1626510040	-41.2	-27.5	-20
1626515080	-54.4	-40.7	-40
1626519400	-59.8	-46.1	-40
1626523000	-63.4	-49.7	-40

Baud: 3600



Hi Chan Freq(Hz)	Power	dBc	limit
1660477000	-60.9	-46.7	-40
1660480600	-59.7	-45.5	-40
1660484920	-55	-40.8	-40
1660489960	-41	-26.8	-20
1660492300	-18.8	-4.6	0
1660495000	-14.2	0	0
1660497700	-25.3	-11.1	0
1660500040	-42.2	-28	-20
1660505080	-56.7	-42.5	-40
1660509400	-59.8	-45.6	-40
1660513000	-60.7	-46.5	-40

Method: Using DRG118/A Antenna. a spectrum analyzer was utilized to measure Channel power in a 4 kHz Bandwidth a Resolution 300Hz and Video BW of 3 kHz was used with video averaging (10Hz w/30 readings/measurment. A signal reading wa specified in RSS170 table B1 Column 1

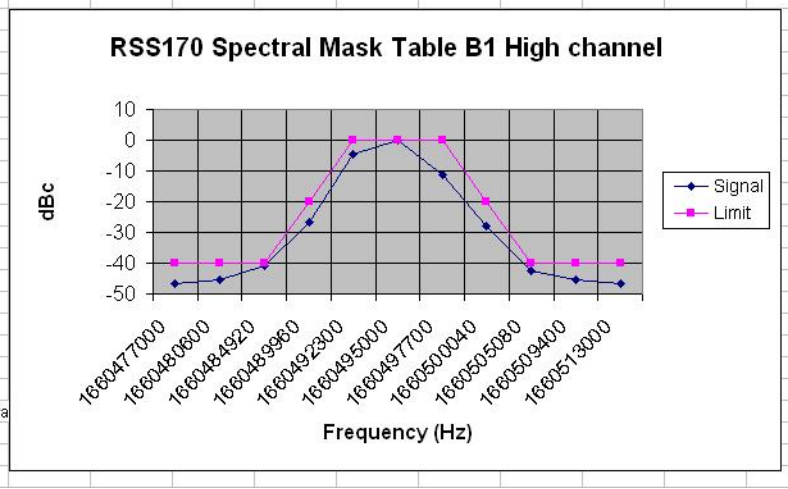


Figure 7: Out-of-Band Emissions to Table B1

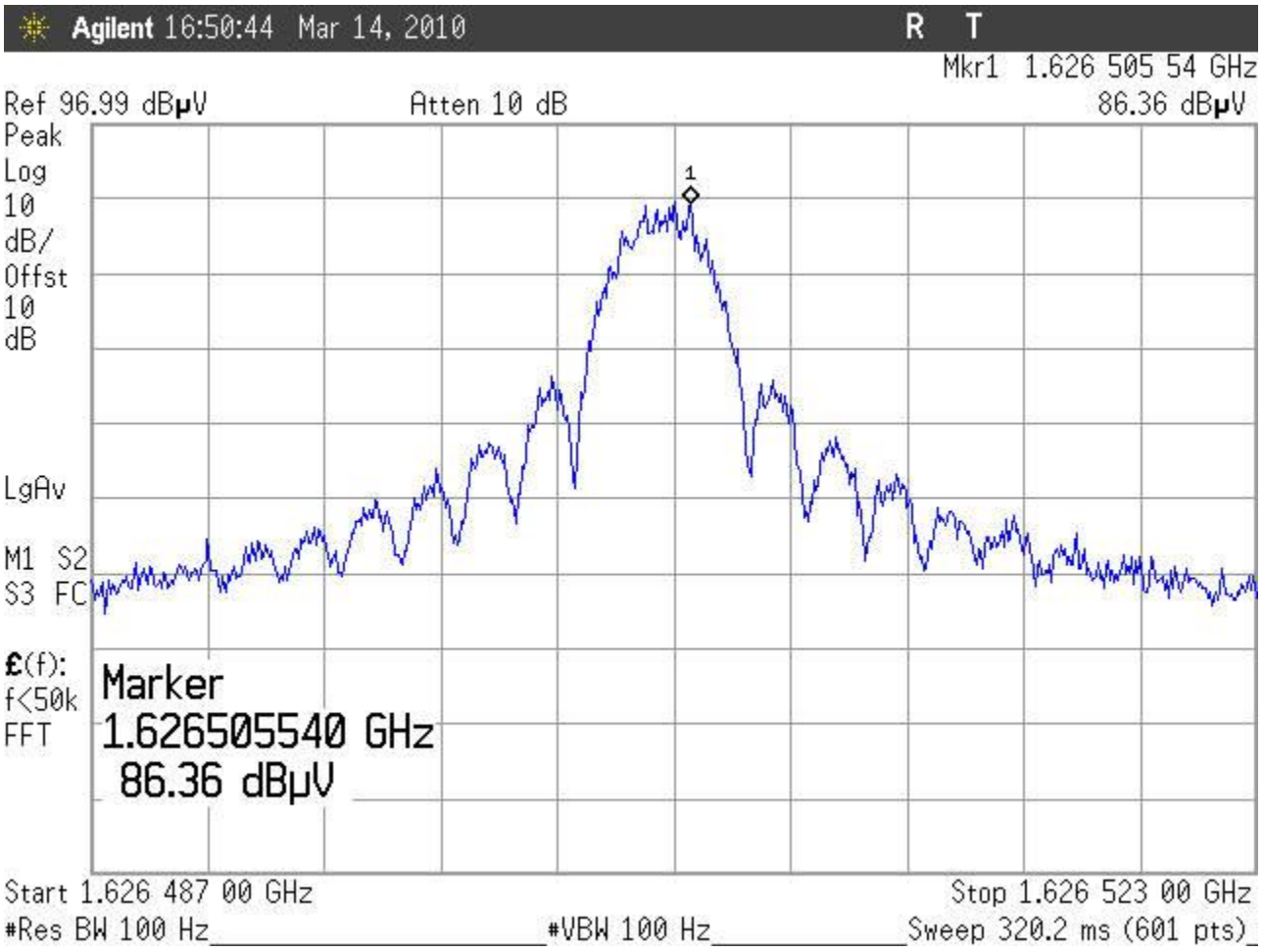


Figure 8: Spectrum Plot, Low Channel @ +/-250% of BW

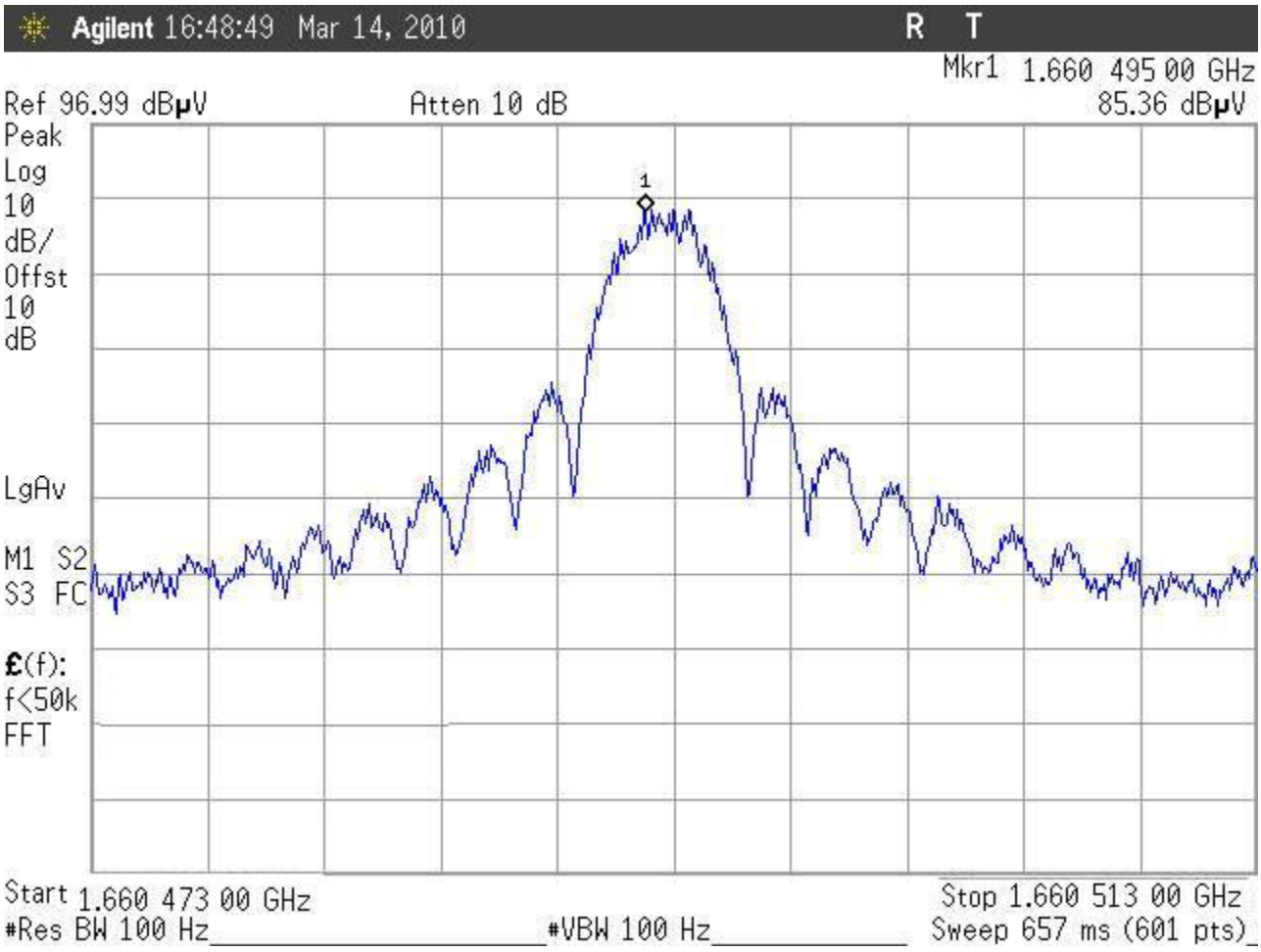


Figure 9: Spectrum Plot, High Channel @ +/-250% of BW

4.4 Radiated Spurious Emissions: EIRP Data (FCC §25.202(f) and RSS-170, Annex B3)

Radiated spurious emissions must comply with the requirements of §25.202 (f) of FCC and RSS-170 Annex B3. The limits for the spurious emissions are as follows:

FCC Part 25.202(f):

Radiated spurious emissions must comply with the requirements of §25.202(f). The limits for the spurious emissions are as follows:

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

Based on the power measured, the limit for emissions removed from the center frequency by more than 250% of the authorized bandwidth will be:

$$\text{Limit (dBm)} = 21.7(\text{dBm}) - (43 + 10\text{Log}(0.148)) = -13\text{dBm}$$

RSS-170:

Spurious and harmonic emissions, excluding the frequency band of ±4 SR about the carrier frequency (see Section 4.3) shall be attenuated below the transmitter output power TP in accordance with the following Table from RSS-170 Annex B, when measured with a spectrum analyzer of 4 kHz resolution bandwidth.

Frequency (MHz)	Minimum Attenuation Relative to Tx Power in any 4 kHz
30-1559	83 dB or (65 + 10 Log_{10}TP) dB whichever is less stringent
above 1559	55 dB or (37 + 10 Log_{10}TP) dB whichever is less stringent

The limit for RSS-170 is therefore calculated as:

For 30-1559 MHz: 21.7dBm – (65+10Log(0.148W)) = -35dBm

Above 1559MHz: 21.7dBm – (37+10Log(0.148W)) = -7dBm

This section covers emissions detected at more than 250% removed from the authorized bandwidth.

4.4.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Where emissions were detected, the EIRP levels were determined using the method of signal substitution. The measurement bandwidth used was set to 4kHz. A 1.3dB correction was added to the spectrum analyzer signal level for referencing to the specification bandwidth of 4kHz. The actual EIRP level was calculated as follows.

EIRP (dBm) = Signal generator substitution level (dBm) + Antenna Gain (dBi)

4.4.2 Test Results

The frequency range of 30 MHz to 16.5 GHz was measured and the data presented below.

Table 6: Radiated Emissions

Frequency (MHz)	Polarity	Azimuth	Ant. Height (m)	Spurious Level (dBuV)	Sub. Sig. Gen. Level (dBm)	Sub. Power Level (dBm)	Sub. Ant. Factor (dB)	Sub. Ant. Gain (dB)	EIRP Level (dBm)	Limit (dBW/4kHz)	Margin (dB)
42.99	V	270.0	1.0	32.8	-68.7	-68.9	11.0	-8.1	-75.7	-35	-40.7
57.35	V	270.0	1.0	29.6	-74.0	-74.3	9.7	-4.4	-77.4	-35	-42.4
71.68	V	270.0	1.0	34.2	-73.0	-73.4	9.5	-2.2	-75.5	-35	-40.5
114.69	V	300.0	1.0	28.0	-75.0	-75.6	11.2	0.2	-75.4	-35	-40.4
129.02	V	270.0	1.0	23.8	-67.0	-67.6	12.2	0.2	-67.4	-35	-32.4
301.00	V	200.0	1.0	19.8	-77.0	-78.0	15.1	4.7	-73.3	-35	-38.3
515.97	V	345.0	1.0	20.4	-87.1	-88.3	18.1	6.3	-82.0	-35	-47.0
42.99	H	300.0	1.0	33.4	-60.0	-60.2	11.0	-8.1	-68.3	-35	-33.3
57.35	H	300.0	1.0	35.6	-68.1	-68.4	9.7	-4.4	-72.7	-35	-37.7
71.68	H	300.0	1.0	39.2	-70.2	-70.6	9.5	-2.2	-72.7	-35	-37.7
114.69	H	355.0	1.0	24.8	-75.4	-76.0	11.2	0.2	-75.8	-35	-40.8
129.02	H	290.0	1.0	27.4	-79.0	-79.6	12.2	0.2	-79.4	-35	-44.4
515.97	H	290.0	1.0	22.5	-84.5	-85.7	18.1	6.3	-79.4	-35	-44.4

Frequency (MHz)	Polarity	Azimuth	Ant. Height (m)	Spurious Level (dBuV)	Sub. Sig. Gen. Level (dBm)	Sub. Power Level (dBm)	Sub. Ant. Factor (dB)	Sub. Ant. Gain (dB)	EIRP Level (dBm)	Limit (dBW/4kHz)	Margin (dB)
1330.33	V	0.0	1.0	22.9	-46.7	-48.4	26.9	5.8	-41.4	-13	-28.4
1621.90	V	0.0	1.0	27.5	-38.0	-39.9	28.7	5.7	-33.0	-13	-20.0
1661.67	V	0.0	1.0	20.0	-50.2	-52.1	29.0	5.7	-46.5	-13	-33.5
3253.01	V	355.0	1.0	34.9	-30.4	-32.6	35.5	4.9	-27.7	-13	-14.7
4879.5162	V	0.0	1.0	30.8	-31.0	-33.7	36.7	7.2	-26.5	-13	-13.5
3287.	V	5.0	1.0	36.3	-30.6	-32.8	35.4	5.1	-27.7	-13	-14.7
4930.5	V	10.0	1.0	27.7	-33.8	-36.6	36.8	7.3	-29.3	-13	-16.3
3320.99	V	5.0	1.0	33.0	-33.6	-35.8	35.3	5.3	-30.5	-13	-17.5
4981.5	V	0.0	1.0	27.0	-32.7	-35.5	36.8	7.3	-28.2	-13	-15.2
5649.74	V	0.0	1.0	18.5	-43.5	-46.6	38.5	6.7	-39.8	-13	-26.8
1330.33	V	350.0	1.0	27.9	-40.3	-42.0	26.9	5.8	-36.3	-13	-23.3
1626.32	H	0.0	1.0	12.9	-54.0	-55.9	28.8	5.7	-50.3	-13	-37.3
1661.67	V	0.0	1.0	29.2	-40.0	-41.9	29.0	5.7	-36.3	-13	-23.3
3253.01	H	25.0	1.0	38.0	-26.2	-28.4	35.5	4.9	-23.5	-13	-10.5
4879.5162	H	45.0	1.0	26.2	-35.0	-37.7	36.7	7.2	-30.5	-13	-17.5
3287.00	H	20.0	1.0	36.5	-30.0	-32.2	35.4	5.1	-27.1	-13	-14.1
4930.5	H	5.0	1.0	27.6	-34.6	-37.4	36.8	7.3	-30.1	-13	-17.1
3320.99	H	355.0	1.0	35.9	-30.2	-32.4	35.3	5.3	-27.1	-13	-14.1
4981.5	H	355.0	1.0	31.2	-30.3	-33.1	36.8	7.3	-25.8	-13	-12.8
5657.	H	45.0	1.0	19.3	-42.0	-45.1	38.5	6.7	-38.3	-13	-25.3

4.5 Receiver Spurious Emissions, RSS-170 Section 9.0

Spurious emissions related to the receiver were measured in accordance with RSS-170 Section 9.0. Testing was performed at 3m test distance on an OATS. The emission scan was performed from 30MHz up to 5577MHz (3 times the highest Local Oscillator).

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
41.06	V	180.00	1.00	7.80	14.3	12.7	100.0	-17.9
48.84	V	180.00	1.00	14.70	9.5	16.2	100.0	-15.8
111.09	V	0.00	1.00	14.30	13.6	24.7	150.0	-15.7
138.74	V	0.00	1.00	3.60	13.8	7.4	150.0	-26.1
228.87	V	0.00	1.00	5.40	12.4	7.8	200.0	-28.2
400.51	V	0.00	1.00	3.00	17.8	11.0	200.0	-25.2
569.24	V	0.00	1.00	6.20	20.3	21.1	200.0	-19.5
773.89	V	0.00	1.00	7.70	22.8	33.7	200.0	-15.5
928.92	V	0.00	1.00	6.00	26.0	39.6	200.0	-14.1
1647.24	V	180.00	1.00	38.20	-8.1	31.9	500.0	-23.9
1859.00	V	0.00	1.00	38.40	-6.5	39.3	500.0	-22.1
5577.00	V	0.00	1.00	32.60	0.6	45.5	500.0	-20.8
41.06	H	0.00	0.00	0.00	14.3	5.2	100.0	-25.7
48.84	H	180.00	3.00	3.80	9.5	4.6	100.0	-26.7
53.31	H	0.00	3.00	4.90	8.1	4.5	100.0	-27.0
111.09	H	0.00	3.00	7.80	13.6	11.7	150.0	-22.2
138.74	H	0.00	3.00	2.20	13.8	6.3	150.0	-27.5
228.87	H	0.00	3.00	5.70	12.4	8.1	200.0	-27.9
569.24	H	0.00	3.50	4.20	20.3	16.7	200.0	-21.5
773.89	H	0.00	3.50	3.90	22.8	21.7	200.0	-19.3
928.92	H	0.00	3.50	3.30	26.0	29.0	200.0	-16.8
1647.24	H	180.00	2.75	37.90	-8.1	30.8	500.0	-24.2
1859.00	H	0.00	3.00	36.80	-6.5	32.7	500.0	-23.7
5577.00	H	0.00	3.00	33.20	0.6	48.7	500.0	-20.2

4.6 Spurious Emissions per FCC §25.216

FCC Part 25 limits the emissions from mobile earth stations for the protection of aeronautical radionavigation-satellite service. The EIRP density of spurious emissions which fall within the frequency range of 1559M to 1610MHz were measured in accordance with §25.216.

In accordance with §25.216(c) the EIRP density of emissions from mobile earth stations operating between 1610MHz and 1660.5MHz shall not exceed -70dBW/MHz, averaged over any 2ms active transmission interval, in the band 1559M – 1605MHz. The EIRP of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed -80dBW/MHz, averaged over any 2ms active transmission interval, in the 1559M – 1605MHz band.

In accordance with §25.216(i) the peak e.i.r.p density of carrier-off state emissions from mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03–283 with assigned uplink frequencies between 1 and 3 GHz shall not exceed -80 dBW/MHz in the 1559– 1610 MHz band averaged over any 2 millisecond active transmission interval.

4.6.1 Test Procedure

The FCC was consulted on the measurement procedure of these emissions. Also, a measurement receiver with a RMS detector and the capability of performing the measurements as specified in §25.216 was obtained.

The EUT was setup at a test distance of 1 meter. The receiver was setup to scan the frequency range of 1559M – 1610MHz with a measurement bandwidth of 1MHz. Per the FCC guidance the EIRP limits were converted to field strength levels using the correction of 95.3. The following was used to calculate the limit and the corrected emissions levels.

For emissions from 1559M – 1605MHz:

Limit = -70dBW/MHz = -40dBm/MHz
-40dBm + 95.3 = 55.3dBuV/m @ 3m

To correct for the test distance of 1m:

55.3dBuV/m + 9.54 = 64.84dBuV/m @ 1m

For discrete emissions with bandwidths less than 700Hz from 1559M – 1605MHz

Limit = -80dBW = -50dBm
-50dBm + 95.3 = 45.3dBuV/m @ 3m

To correct for the test distance of 1m:

45.3dBuV/m + 9.54 = 54.84dBuV/m @ 1m

The limit for emissions appearing in the 1605M – 1610MHz is determined by the linear interpolation from -70dBW/MHz at 1605M to -10dBW/MHz at 1610MHz. Additionally, the emission levels were compared to the specification limit of §25.216(h). Under this section the limit is determined by linear interpolation from -70dBW/MHz at 1605MHz to -46dBW/MHz at 1610MHz

For emissions from 1605M – 1610MHz:

Limit = -70dBW/MHz (-40dBm/MHz) to -46dBW/MHz (-16dBm/MHz)
-40dBm @ 1m = 64.84dBuV/m
-16dBm @1m = 88.94dBuV/m

For discrete emissions with bandwidths less than 700Hz from 1605M – 1610MHz

Limit = -80dBW/MHz (-50dBm/MHz) to -56dBW/MHz (-26dBm/MHz)
-50dBm @ 1m = 54.94dBuV/m
-26dBm @1m = 78.94dBuV/m

For emissions in the Carrier –Off State from 1559M – 1610MHz

Limit = -80dBW/MHz (-50dBm/MHz)
-50dBm @ 1m = 54.94dBuV/m

The receiver emissions levels were adjusted for correction factors as follows:

Emission Level = RXL + ANTCORR + CABL - AMP

Where: RXL = Raw received level

ANTCORR = Antenna correction factor = 26dB

CABL = Cable loss = 3dB

Amp = Attenuator = 37 dB

These correction factors were entered into the receiver as an correction factors so the obtained plots would display corrected data for comparison to the limit.

4.6.2 Test Results

The following plots are the emissions detected with the band of 1559M – 1610MHz. Emissions were also measured in the standby mode from 1559M – 1610MHz.

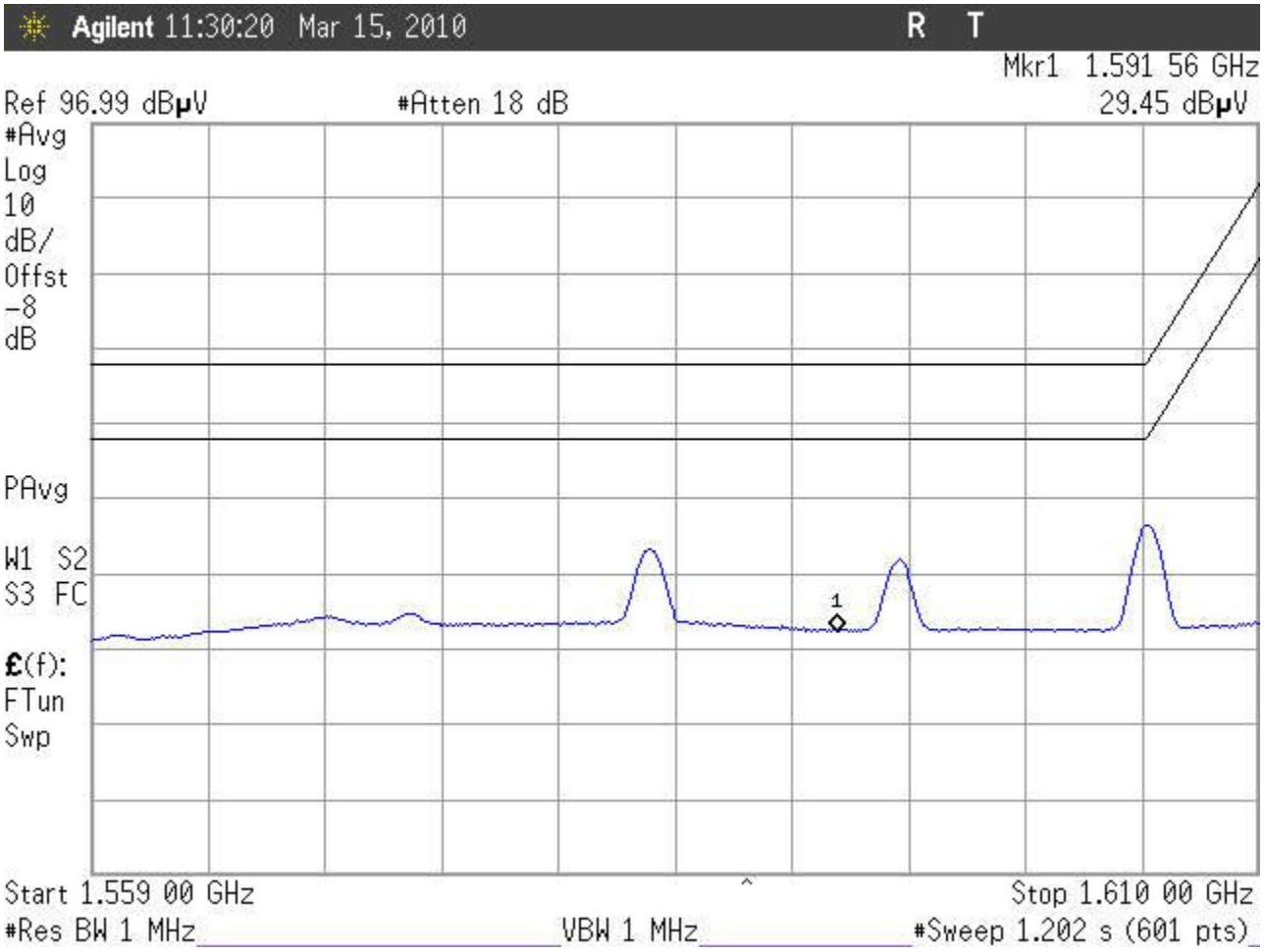


Figure 10: GPS Band Emissions Low Channel, 1559 – 1610MHz Vertical Antenna Polarity

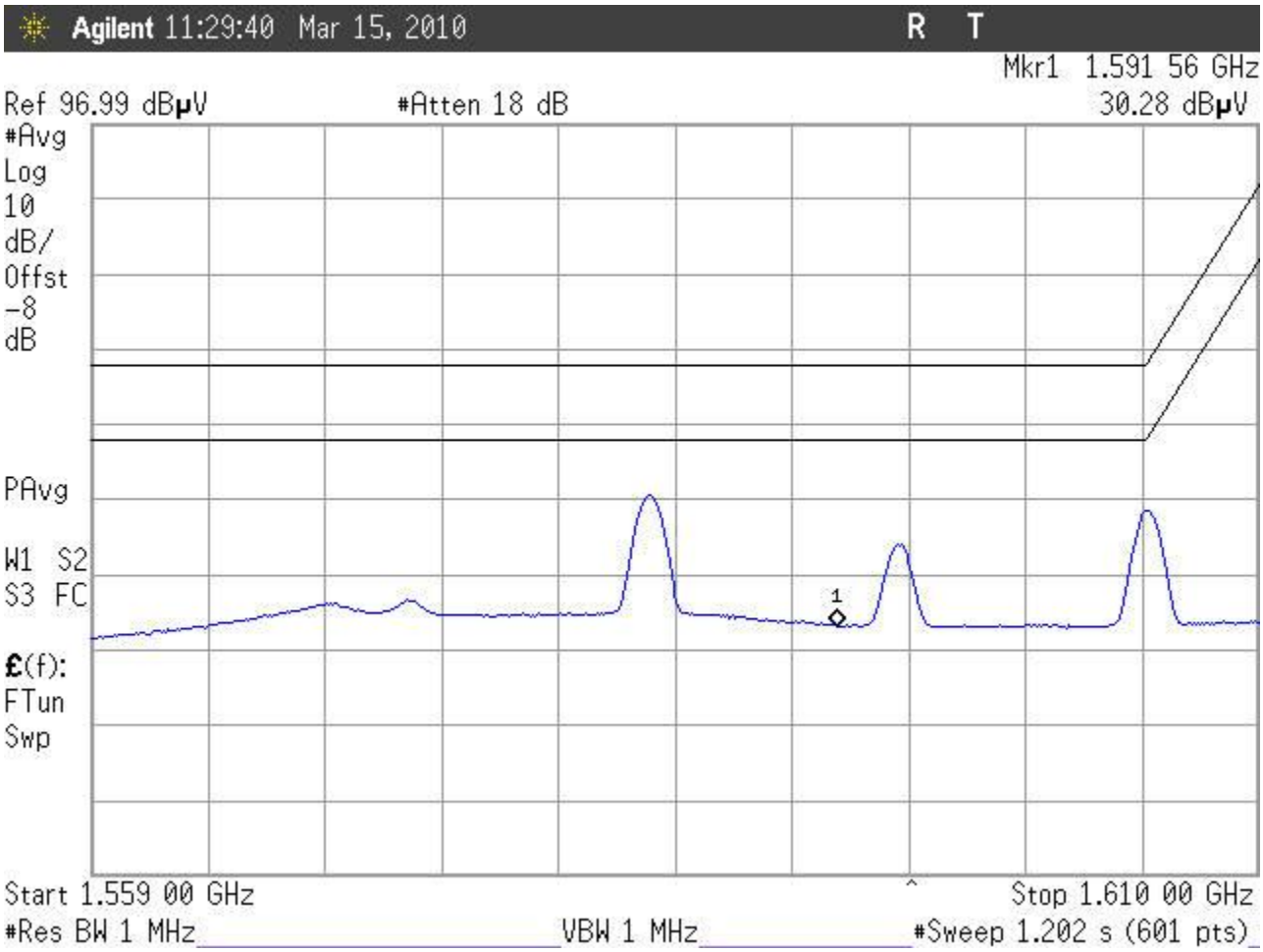


Figure 11: GPS Band Emissions Low Channel, 1559 – 1610MHz Horizontal Antenna Polarity

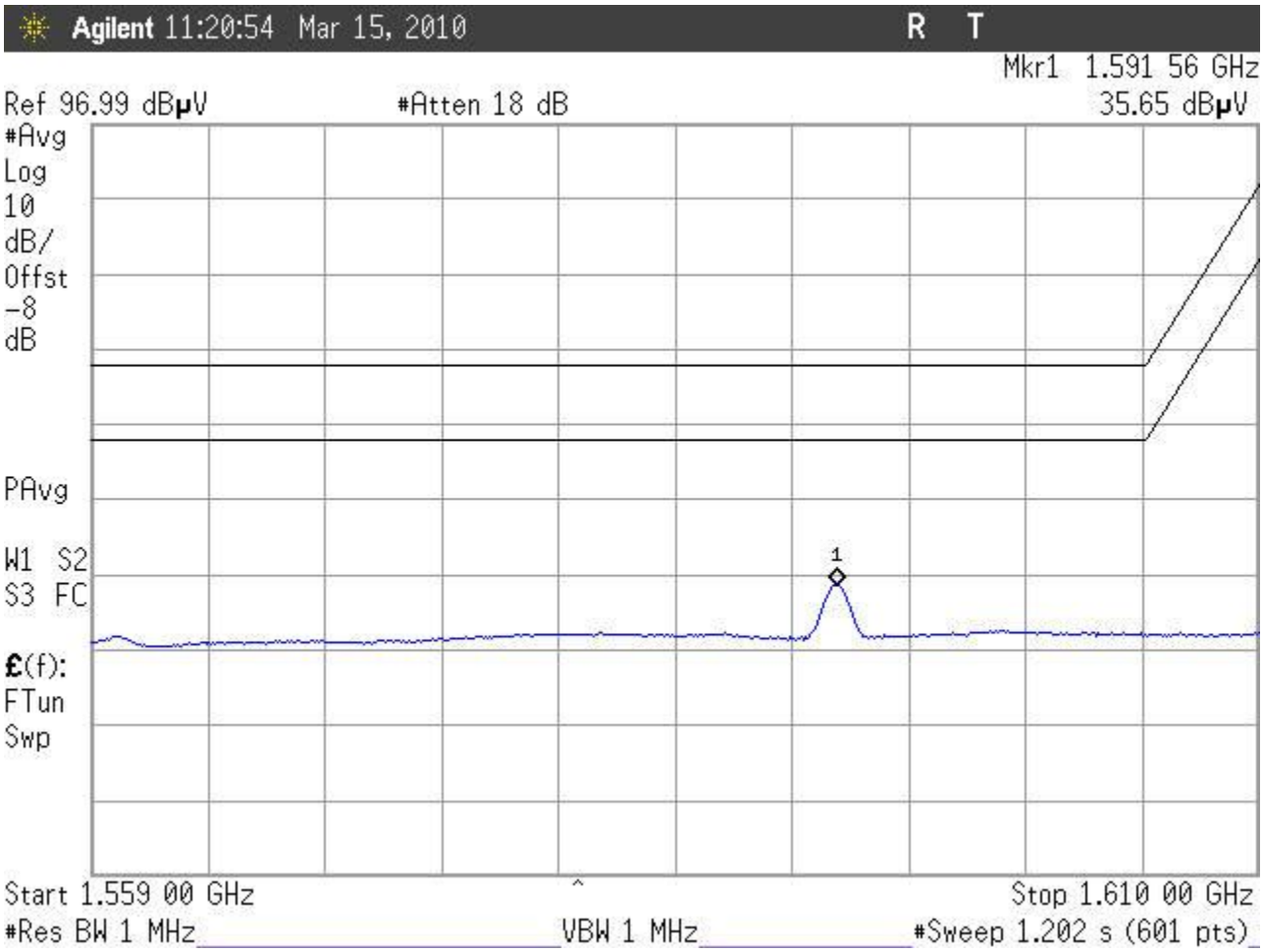


Figure 12: GPS Band Emissions Middle Channel, 1559 – 1610MHz, Vertical Antenna Polarity

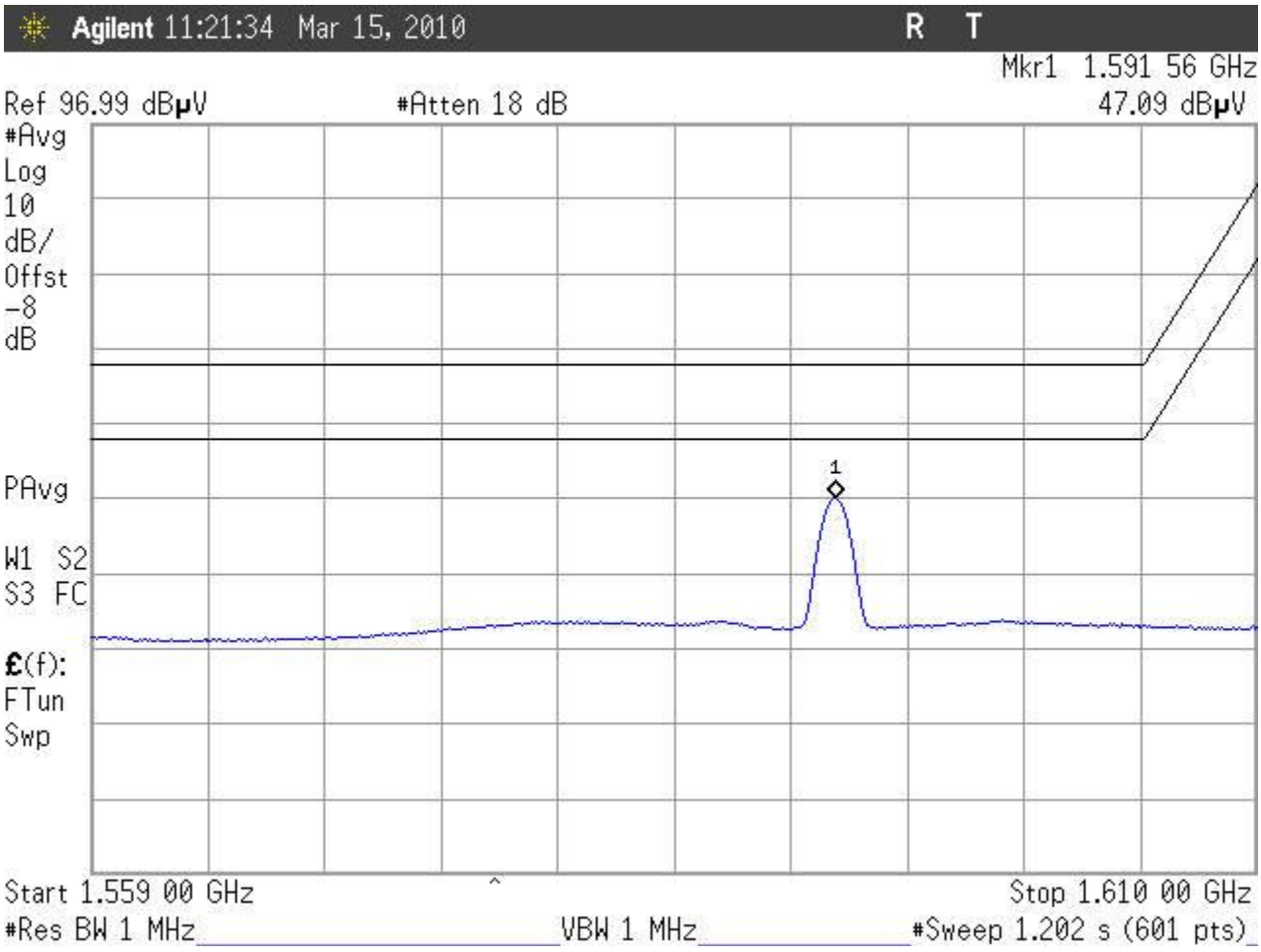


Figure 13: GPS Band Emissions Middle Channel, 1559 – 1610MHz, Horizontal Antenna Polarity

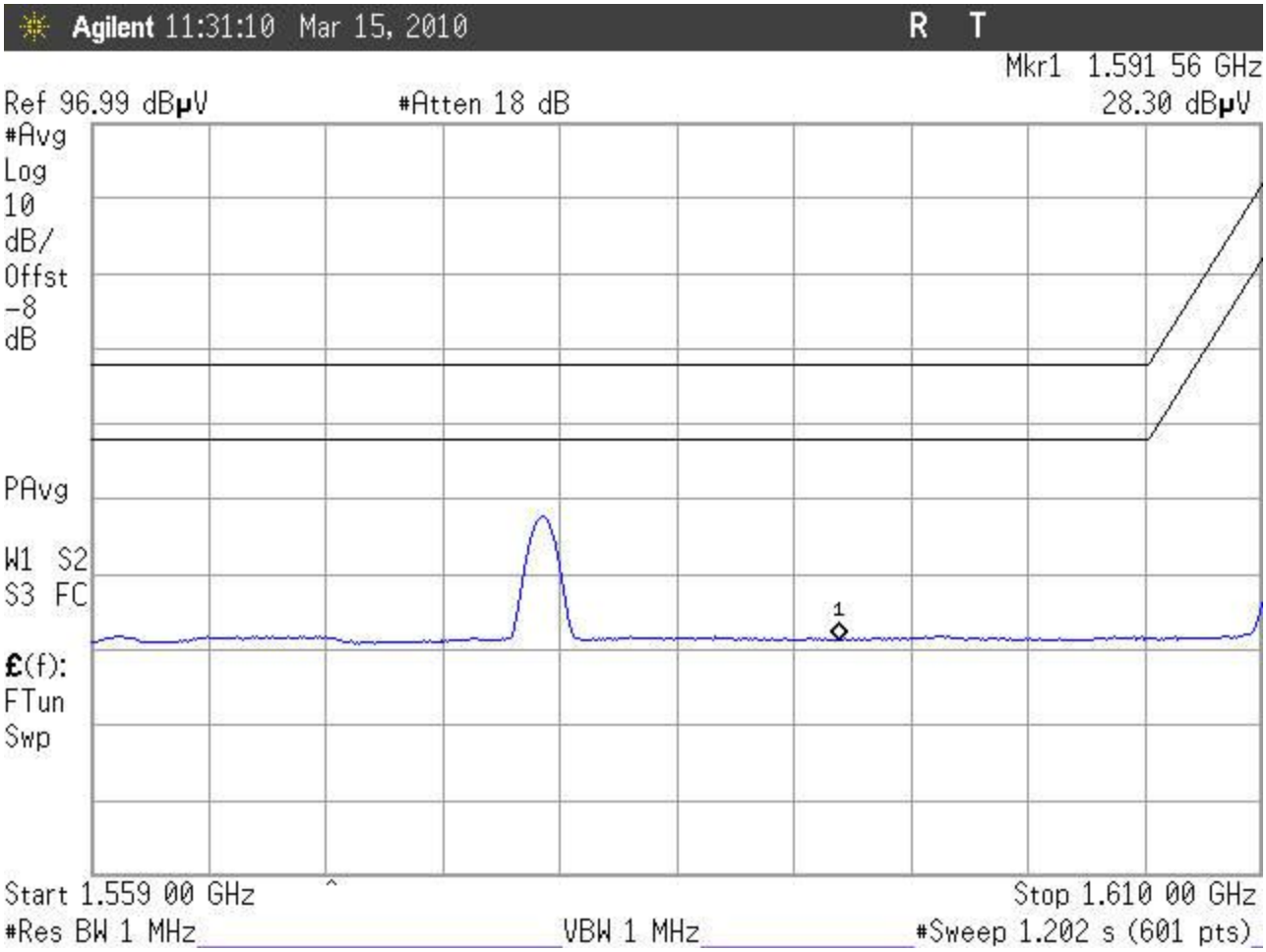


Figure 14: GPS Band Emissions High Channel, 1559 – 1610MHz Vertical Antenna Polarity

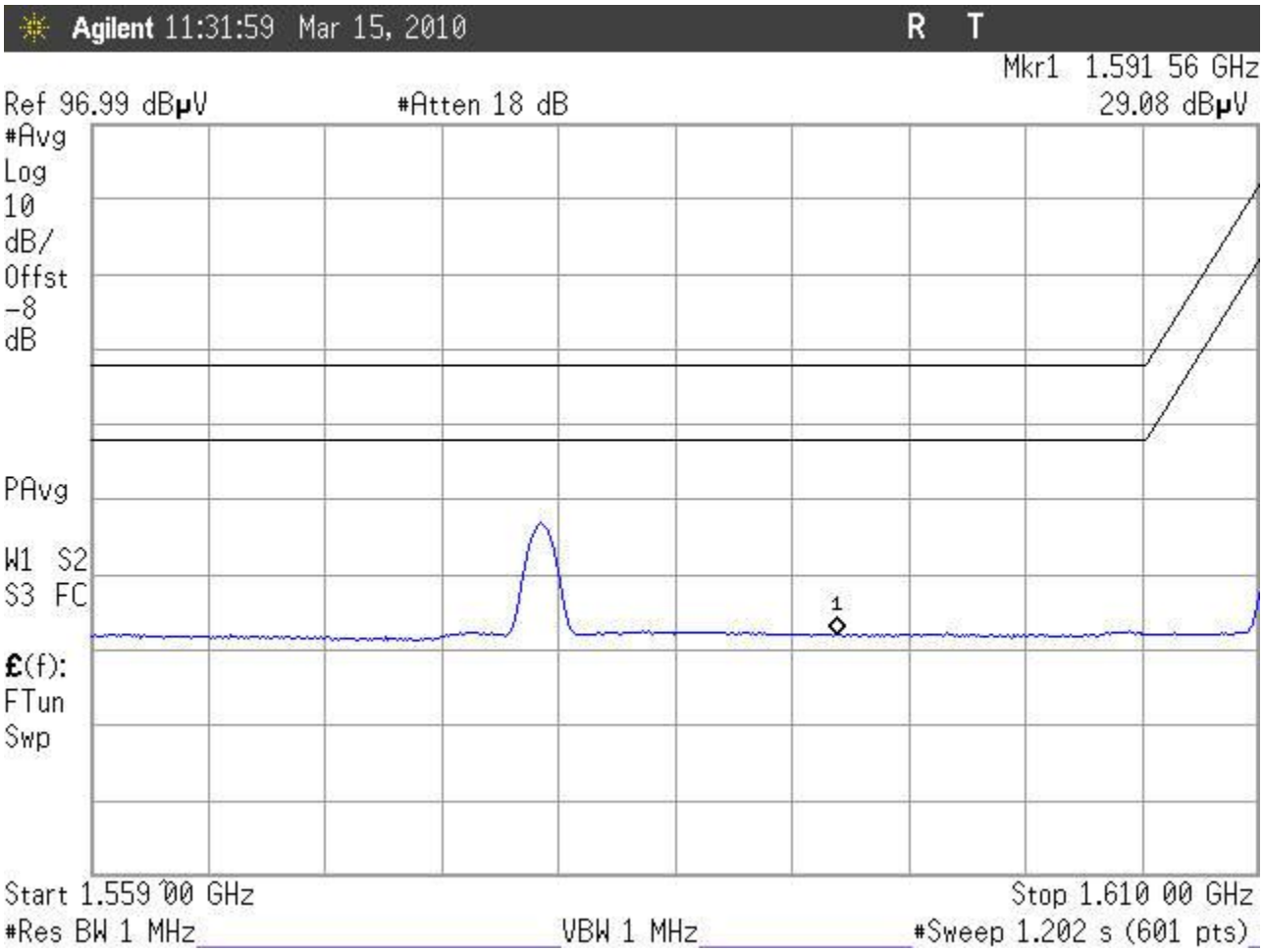


Figure 15: GPS Band Emissions High Channel, 1559 – 1610MHz Horizontal Antenna Polarity

Figure 16: GPS Band Emission, Carrier Off, Mid Channel, 1559 – 1610MHz

4.7 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances. Per §25.202(d) the frequency tolerance shall be maintained within 0.001% of the reference frequency.

4.7.1 Test Procedure

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter.

The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

The RF carrier frequency shall not depart from the reference frequency (reference frequency is the frequency at 20ºC and rated supply voltage) in excess of .001%.

The EUT is powered by a 6 VDC voltage supplied via an external DC power supply.

4.7.2 Test Results

The EUT complies with the temperature stability requirements of FCC §25.202 and RSS-170. Test results are given in Table 7.

Table 7: Frequency Stability Test Data - Temperature

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Difference +/- 320Hz RSS-170 Limit
Ambient	1643.500190	0	0	
-30	1643.50033	140.0	0.000009	Pass
-20	1643.500282	92.0	0.000006	Pass
-10	1643.500403	213.0	0.000013	Pass
0	1643.500334	144.0	0.000009	Pass
10	1643.500384	194.0	0.000012	Pass
20	1643.500190	0.0	0.000000	Pass
30	1643.500222	32.0	0.000002	Pass
40	1643.500227	37.0	0.000002	Pass
50	1643.500420	230.0	0.000014	Pass

Table 8: Frequency Stability Test Data - Voltage

Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Voltage (Volts)
Rated	1643.50019	0	0	6.2
85%	1643.500195	5.0	0.000000	5.27
115%	1643.50013	-60.0	-0.000004	7.13

The EUT cuts off below 5.2 VDC.