FCC CFR47 PART 90, SUBPART I
INDUSTRY CANADA RSS-119
INDUSTRY CANADA RSS-310 ISSUE 2

CERTIFICATION TEST REPORT

FOR

GNSS RECEIVER

TOPCON MODEL NUMBER: HiPerII/U
SOKKIA MODEL: GRX1/U
FCC ID: LCB-090521
IC: 6050B-090521

REPORT NUMBER: 09J12695-3, REVISION A

ISSUE DATE: AUGUST 26, 2009

Prepared for
TOPCON POSITIONING SYSTEMS, INC
7400 NATIONAL DRIVE
LIVERMORE, CA 94551 USA

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
---	07/27/09	Initial Issue	T. Chan
A	08/26/09	Added MPE Section	T. Chan

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: TOPCON POSITIONING SYSTEMS, INC
7400 NATIONAL DRIVE
LIVERMORE, CA 94551 USA

EUT DESCRIPTION: GNSS RECEIVER

TOPCON MODEL: HiPerII/U
SOKKIA MODEL: GRX1/U

SERIAL NUMBER: 25

DATE TESTED: JULY 21-24, 2009

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 90 SUBPART I	Pass
IC RSS-119 ISSUE 9	Pass
IC RSS-310 ISSUE 2	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

THU CHAN
EMC MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

CHIN PANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with RSS-GEN, RSS119, RSS-310, TIA/EIA 603C (2004), FCC CFR 47 Part 2, and FCC CFR 47 Part 90.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.
CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is equipped with GPS, UHF and Bluetooth transceivers. The UHF transceiver operates at the frequency of 410-470MHz.

The radio module is manufactured by ArWest Comminications.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Modulation	Conducted Output Power (dBm)	Conducted Output Power (W)
410-470	CW	30.00	1.000

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a dipole antenna, with a maximum gain of 2.4 dBi.

5.4. WORST-CASE CONFIGURATION AND MODE

The EUT with antenna at upright position is determined to be the worst case.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	Manufacturer	Model	Serial Number
Oscilloscope, Digital	Tektronix	11403	B052990
Power Splitter, 5 ~ 500 MHz	MCL	ZFRSC-2-1	NA
Spectrum Analyzer, 40 GHz	Agilent / HP	8564E	3943A01643
AC Adapter	HP	DC359A	F3-06072698200B
Laptop 1	HP	Pavilion dv1000	CNF62007RV
Signal Generator	Agilent / HP	83732B	C00774

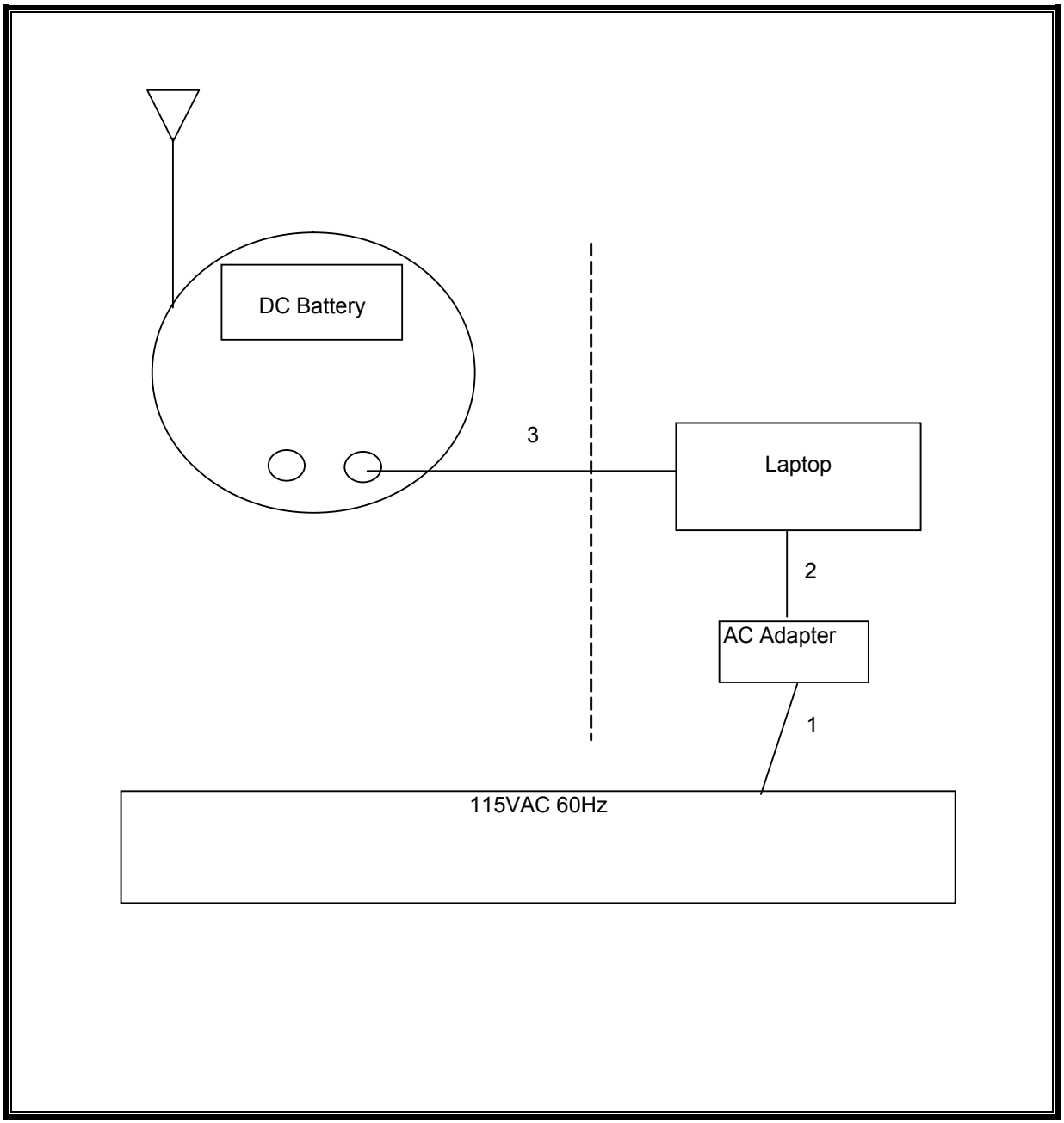
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	US 115V	Un-shielded	2m	NA
2	DC	2	DC	Un-shielded	2m	NA
3	USB	1	DB9 to USB Adapter	Un-shielded	2m	NA

TEST SETUP

The EUT is connected to a Laptop via a USB to RS232 connector. Test software exercised the EUT.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	12/16/09
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	02/03/10
Temperature / Humidity	Thermotron	SE 600-10-10	C00930	04/06/10
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	01/14/10
Antenna, Horn, 18 GHz	EMCO	3115	C00783	01/29/10
Oscilloscope, Digital	Tektronix	11403	N02469	11/02/09
Power Splitter, 5 ~ 500 MHz	MCL	ZFRSC-2-1	N01550	CNR
Signal Generator, 20 GHz	Agilent / HP	83732B	C00774	07/03/10
Directional Coupler, 40 dB, 0.01 ~ 1000 MHz	Werlatone	C6021	C00907	CNR

7. LIMITS AND RESULTS

7.1. RF POWER OUTPUT

LIMIT

FCC part 90.205 (g) & (h): The Maximum ERP transmitter power will be considered and authorized on a case-by-case basis. Please also refer to the limitations on power and antenna heights are specified as Table 2 below.

Table 2—450–470 MHz—Maximum ERP/Reference HAAT for a Specific Service Area Radius

	Service area radius (km)									
	3	**8**	**13**	**16**	**24**	**32**	**40[4]**	**48[4]**	**64[4]**	**80[4]**
Maximum ERP (w)[1]	2	100	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500
Up to reference HAAT (m)[3]	15	15	15	27	63	125	250	410	950	2700

[1]Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R–6602, Fig. 29 (See §73.699, Fig. 10 b).

[2]Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.

[3]When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow}=ERP_{max}\times (HAAT_{ref}/HAAT_{actual})^2$.

[4]Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

at the signal strength at the edge of the service area does not exceed 37 dBu.

RSS-119 § 5.4: The output power shall be within ±1.0 dB of the manufacturer's rated power.

TEST PROCEDURE

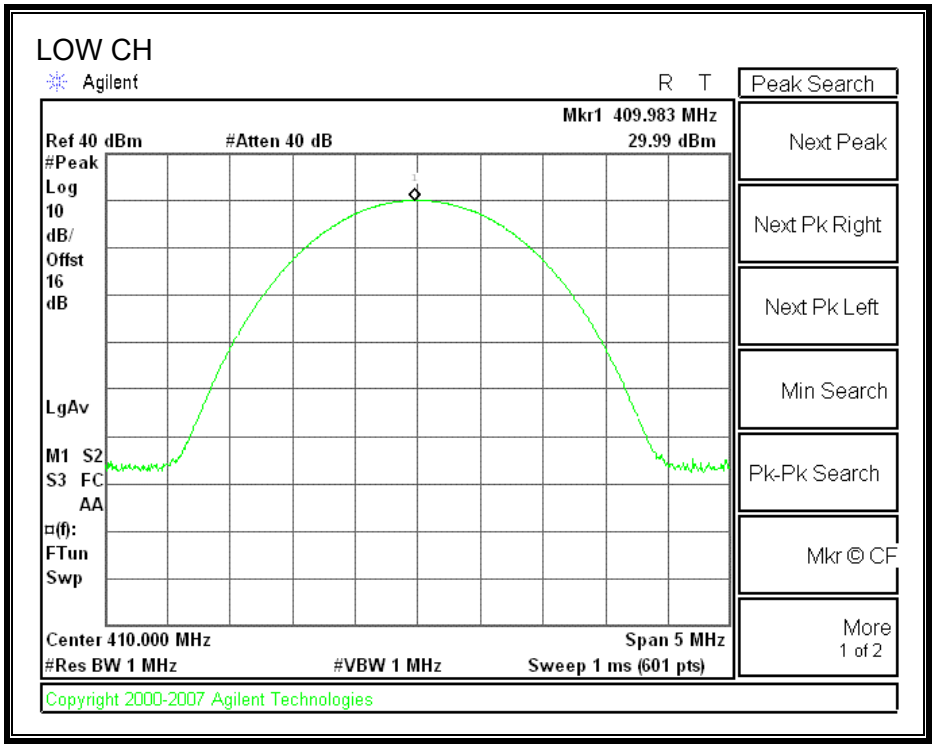
RSS-119 & ANSI / TIA / EIA 603 Clause 3.2.1

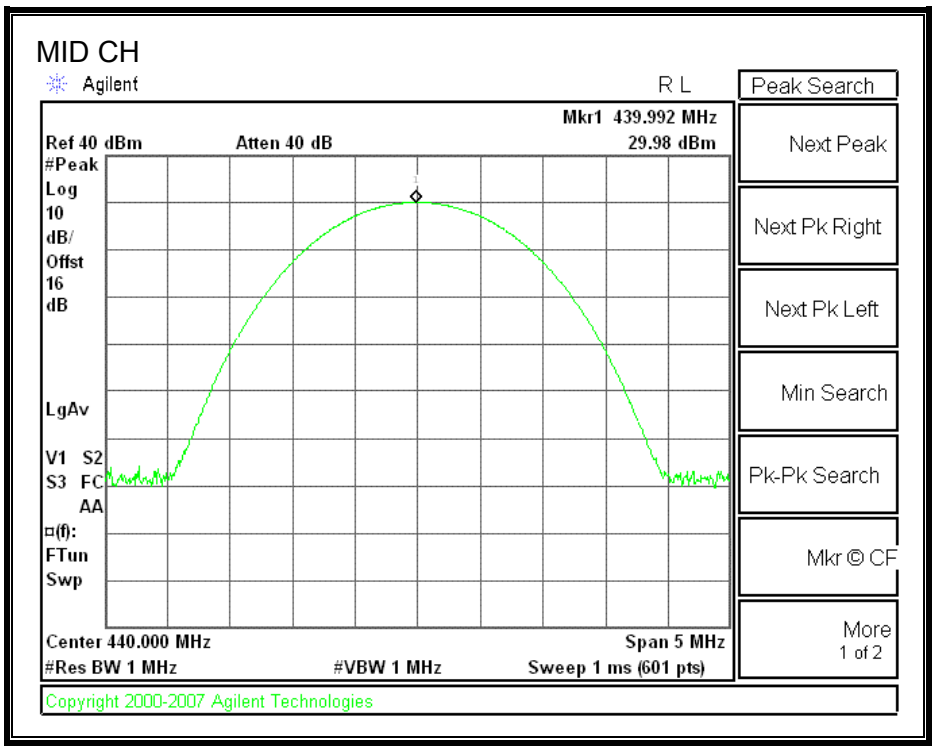
RESULTS

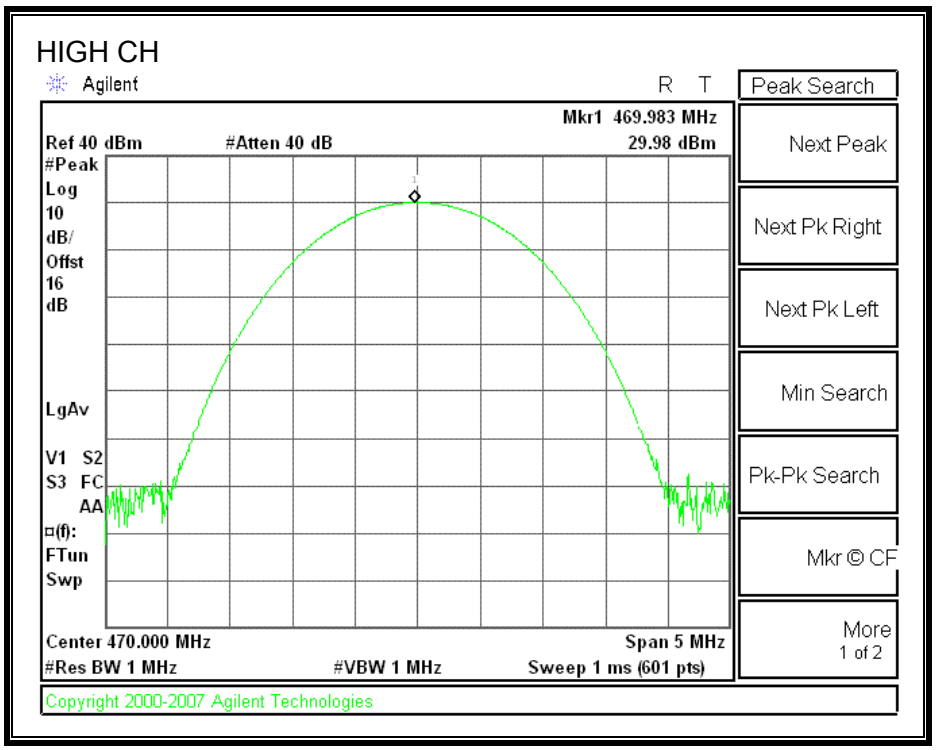
Conducted Output Power

Channel	Frequency	Conducted Output Power (dBm)	Conducted Output Power (W)	ERP Output Power	ERP Output Power (W)
12.5KHz					
Low	410	29.99	0.998	28.50	0.708
Mid	440	29.98	0.995	29.40	0.871
High	470	29.98	0.995	27.90	0.617
25KHz					
Low	410	29.48	0.887	28.40	0.692
Mid	440	29.82	0.959	29.90	0.977
High	470	30.00	1.000	27.40	0.550

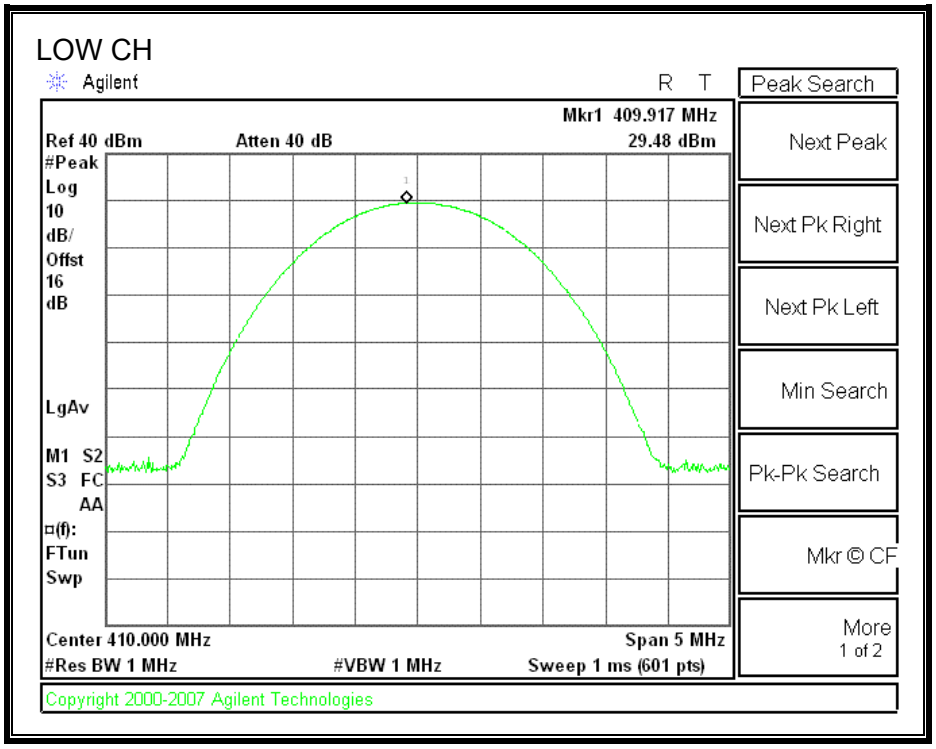
PEAK OUTPUT, 12.5KHZ

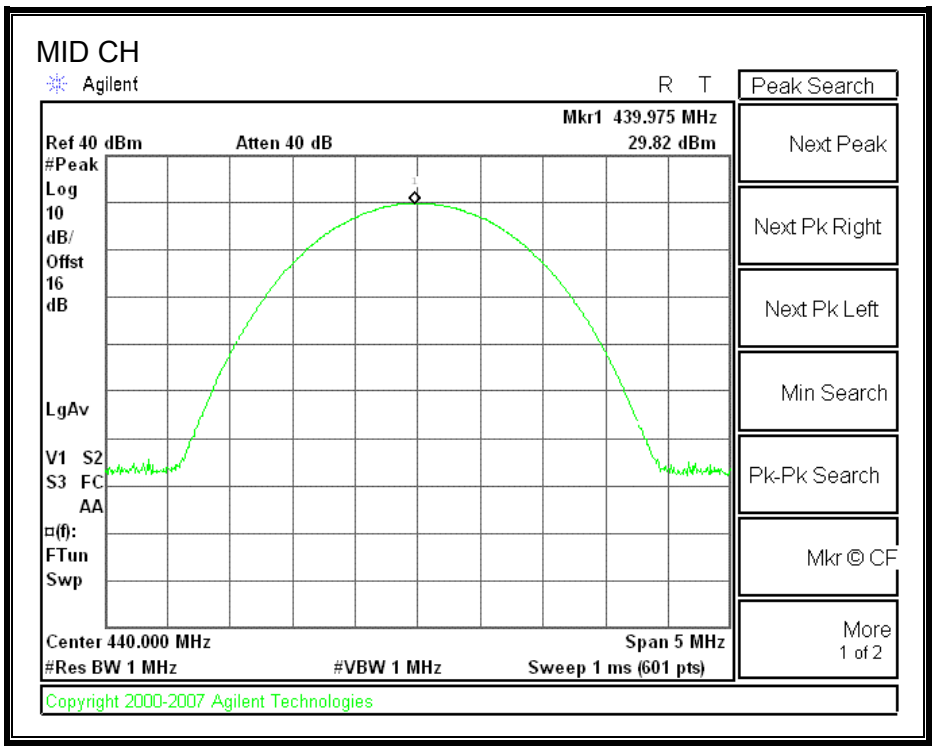


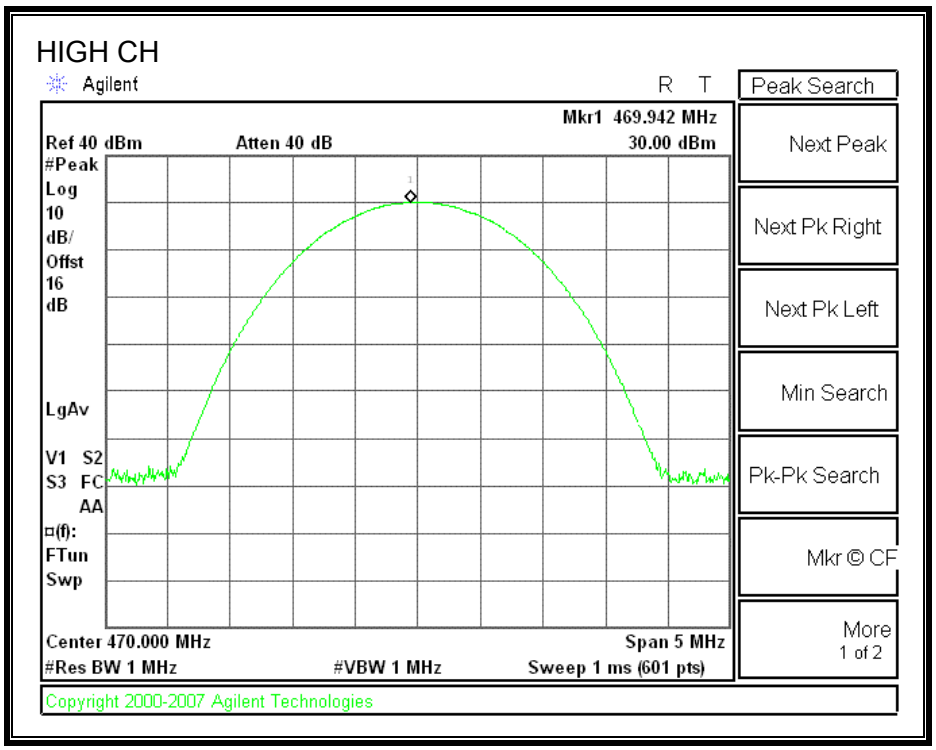




PEAK OUTPUT, 25KHZ







ERP Output Power

30 - 1000MHz Substitution Measurement
Compliance Certification Services, Fremont 5m B-Chamber

Company: Topcon
Project #:09J12695
Date: 7/21/2009
Test Engineer: Chin Pang
Configuration: EUT Only
Mode: TX, GMSK

Test Equipment:

Bilog Antenna	Cable	Pre-amplifer 8447D	Limit
5m Chamber Sunol Bilog	5m Chamber Cable		ERP

f MHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	ERP (dBm)			Notes
25KHz										
410.00	113.0	V	30.6	2.2	-2.1	0.0	28.5			
410.00	103.3	H	22.0	2.2	-2.1	0.0	19.8			
440.00	113.3	V	31.7	2.3	-2.1	0.0	29.4			
440.00	103.5	H	22.3	2.3	-2.1	0.0	20.0			
470.00	111.9	V	30.3	2.4	-2.1	0.0	27.9			
470.00	104.6	H	23.5	2.4	-2.1	0.0	21.1			
12.5KHz										
410.00	113.0	V	30.6	2.2	-2.1	0.0	28.4			
410.00	103.0	H	21.9	2.2	-2.1	0.0	19.7			
440.00	113.9	V	32.2	2.3	-2.1	0.0	29.9			
440.00	103.5	H	22.3	2.3	-2.1	0.0	20.0			
470.00	111.0	V	29.8	2.4	-2.1	0.0	27.4			
470.00	103.3	H	22.0	2.4	-2.1	0.0	19.6			

Rev. 4.29.7

7.2. OCCUPIED BANDWIDTH

LIMITS

§ FCC 90.209 & RSS-119 § 5.5 Bandwidth limitations.
(5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table.

Standard Channel Spacing/Bandwidth

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
Below 25[2]		
25–50	20	20
72–76	20	20
150–174	[1]7.5	[1,3]20/11.25/6
216–220[5]	6.25	20/11.25/6
220–222	5	4
406–512[2]	[1]6.25	[1,3]20/11.25/6
806–809/851–854	12.5	20
809–824/854–869	25	20
896–901/935–940	12.5	13.6
902–928[4]		
929–930	25	20
1427–1432[5]	12.5	12.5
[3]2450–2483.5[2]		
Above 2500[2]		

[1]For stations authorized on or after August 18, 1995.

[2]Bandwidths for radiolocation stations in the 420–450 MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by-case basis.

[3]Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth.

[4]The maximum authorized bandwidth shall be 12 MHz for non-multilateration LMS operations in the band 909.75–921.75 MHz and 2 MHz in the band 902.00–904.00 MHz. The maximum authorized bandwidth for multilateration LMS operations shall be 5.75 MHz in the 904.00–909.75 MHz band; 2 MHz in the 919.75–921.75 MHz band; 5.75 MHz in the 921.75–927.25 MHz band and its associated 927.25–927.50 MHz narrowband forward link; and 8.00 MHz if the 919.75–921.75 MHz and 921.75–927.25 MHz bands and their associated 927.25–927.50 MHz and 927.50–927.75 MHz narrowband forward links are aggregated.

[5]See §90.259.

TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99% bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

12.5KHz

99% BANDWIDTH

Channel	Frequency (MHz)	Bandwidth (kHz)
LOW	410	6.1510
MIDDLE	440	6.1112
HIGH	470	6.1755

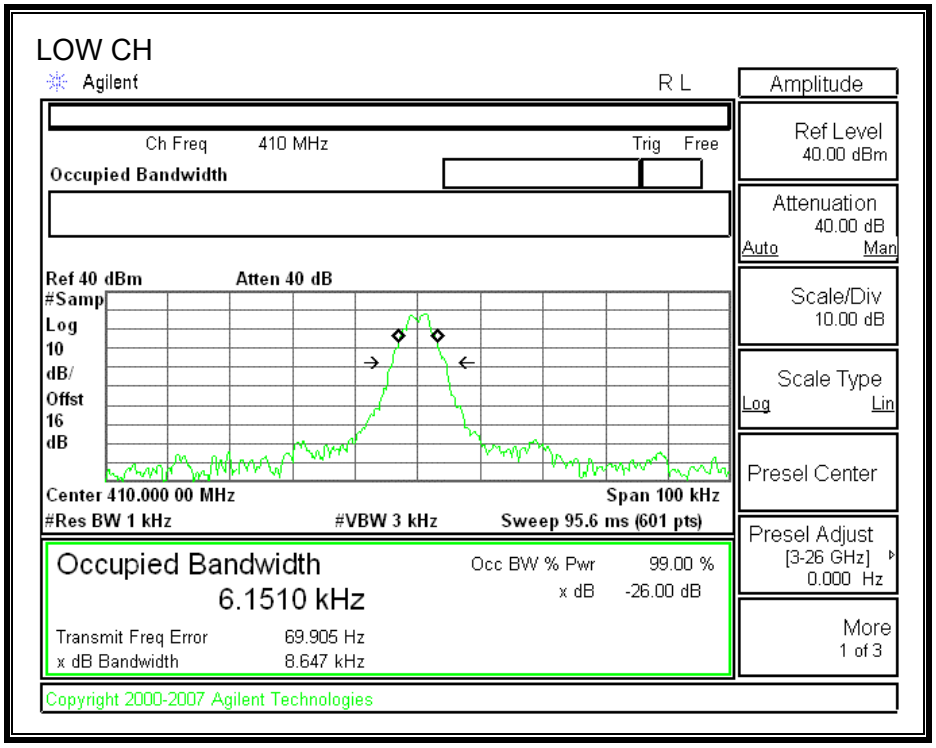
25KHz

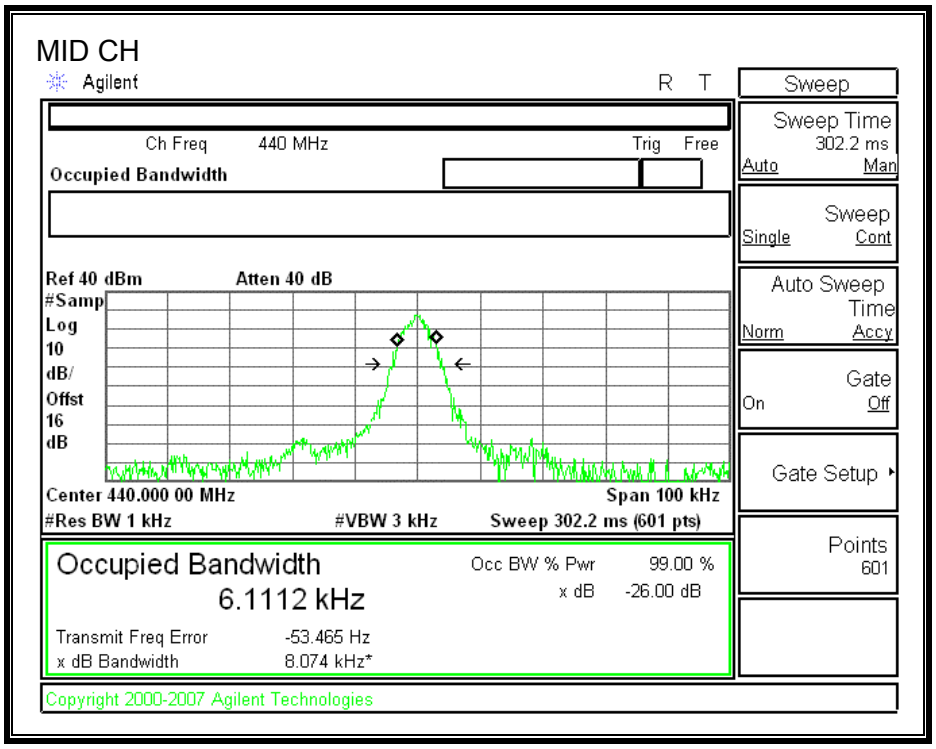
99% BANDWIDTH

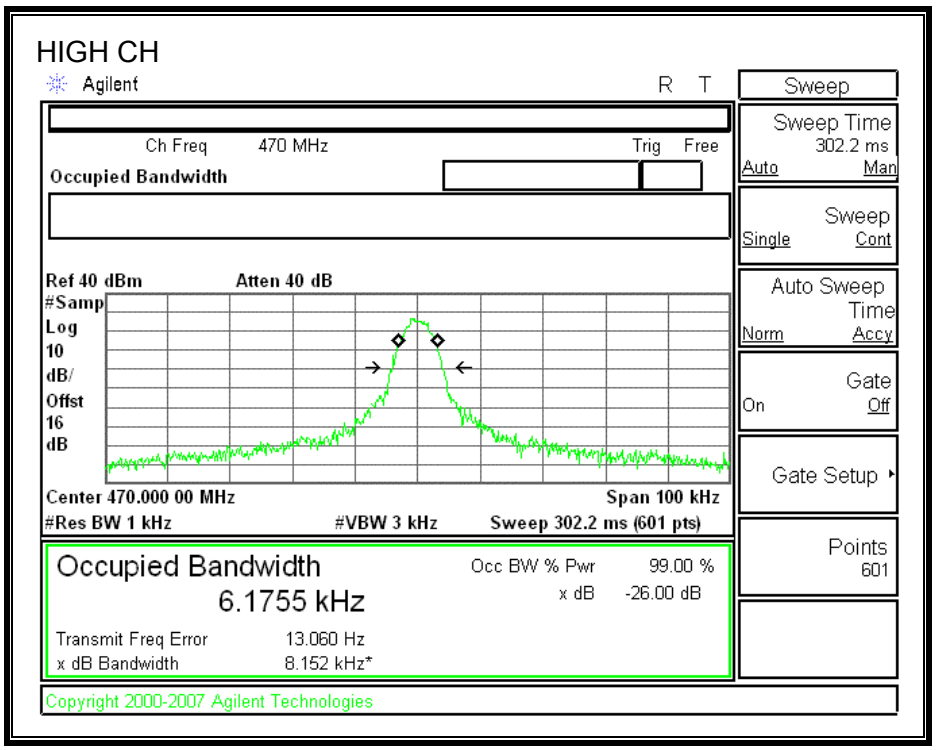
Channel	Frequency (MHz)	Bandwidth (kHz)
LOW	410	11.333
MIDDLE	440	11.4981
HIGH	470	11.6351

99% BANDWIDTH

12.5KHZ

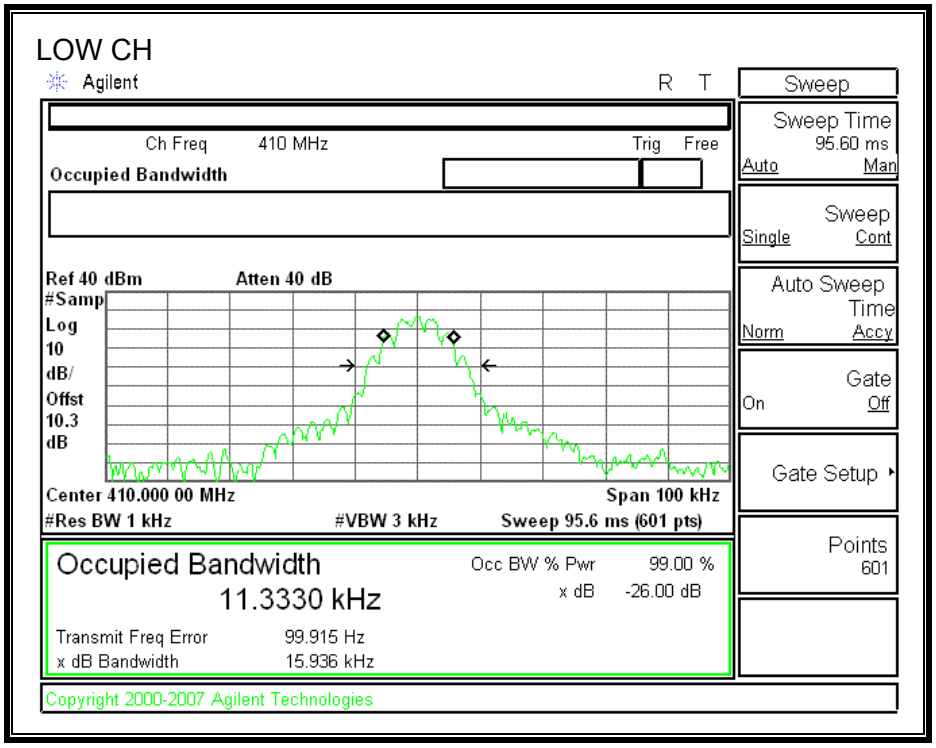


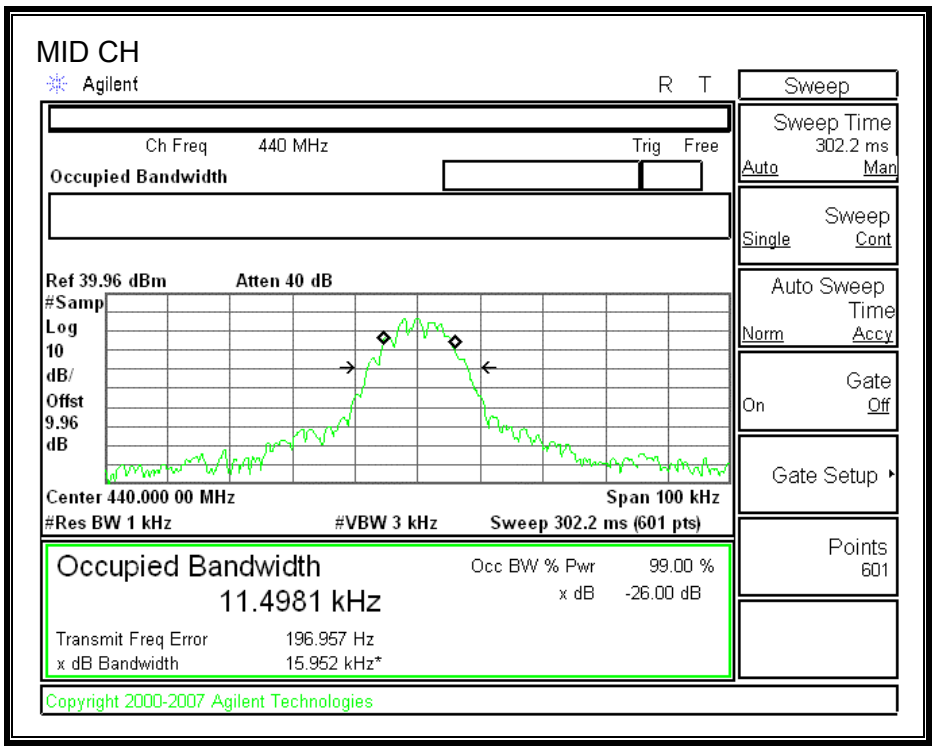


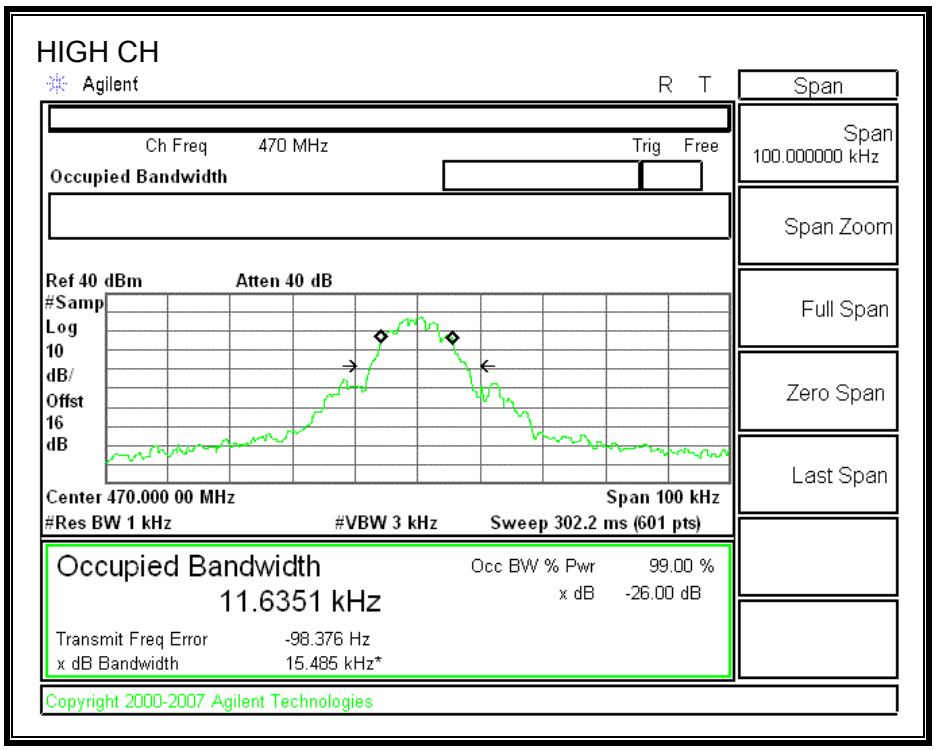


99% BANDWIDTH

25 KHz







7.3. EMISSION MASK

LIMIT

§ FCC 90.210 & RSS-119 § 5.5 Emission masks
(c) Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd 2/11) dB or 50 dB, whichever is the lesser attenuation;
(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

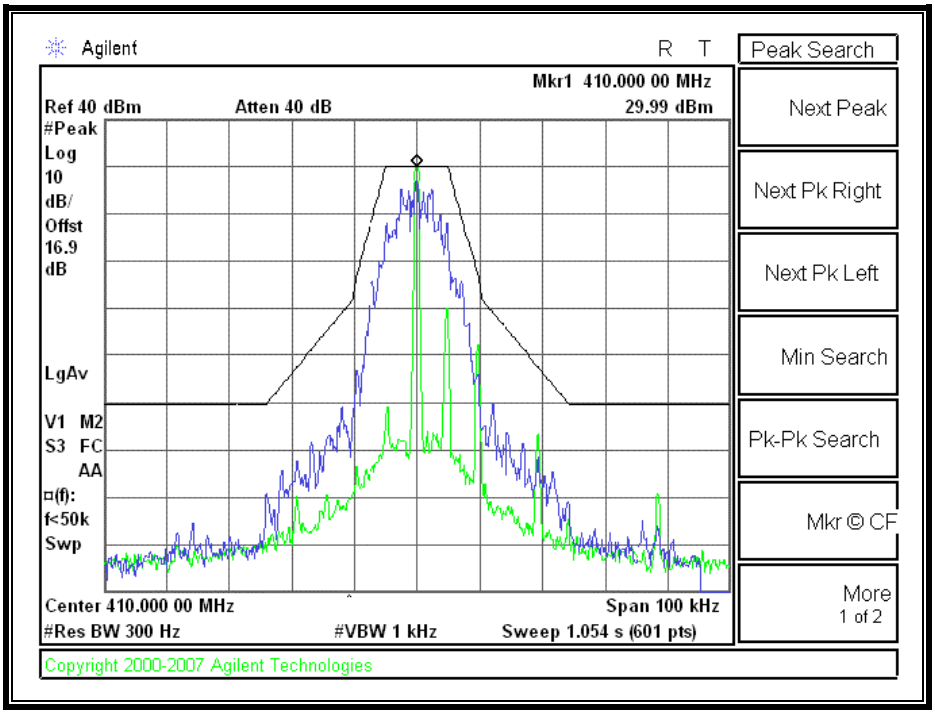
(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd¥2.88 kHz) dB.
(3) On any frequency removed fromthe center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

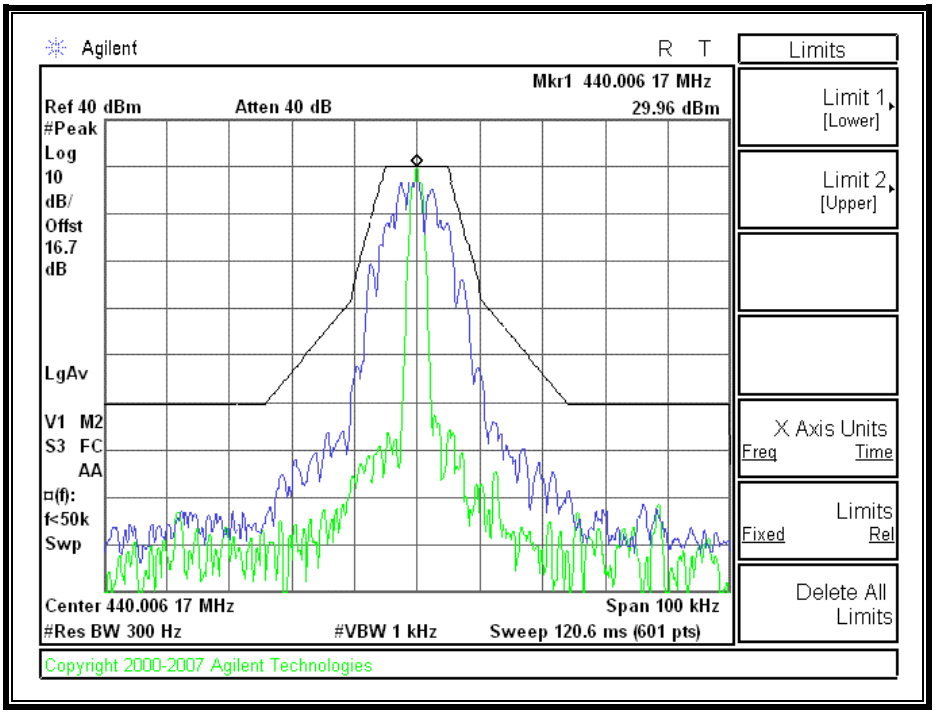
TEST PROCEDURE

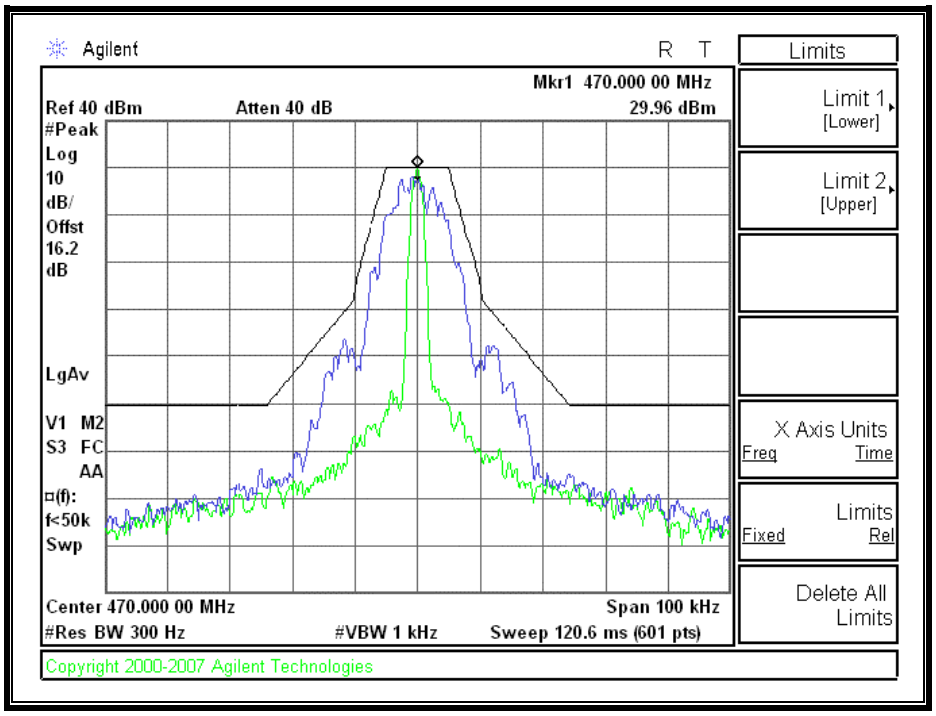
RSS-119, ANSI / TIA / EIA 603 Clause 3.2.13, & FCC 90.210

RESULTS

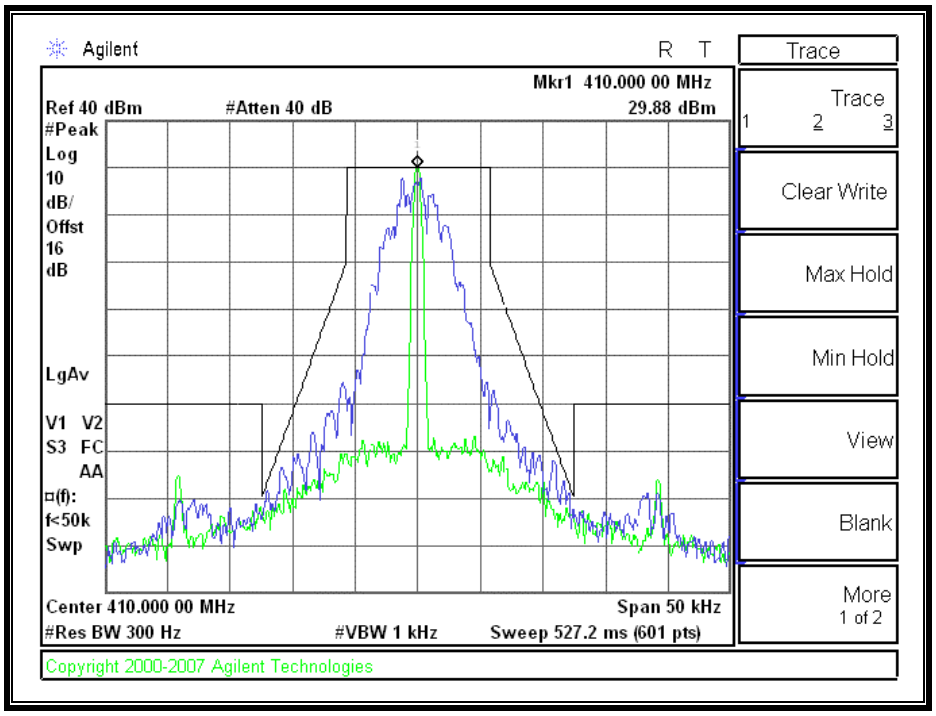
C MASK

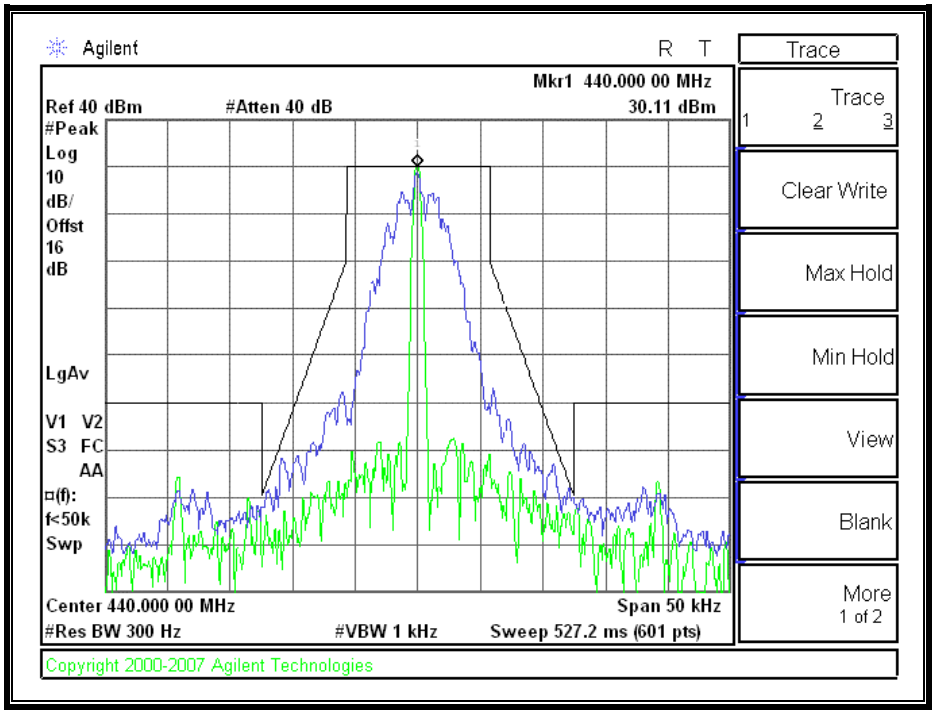


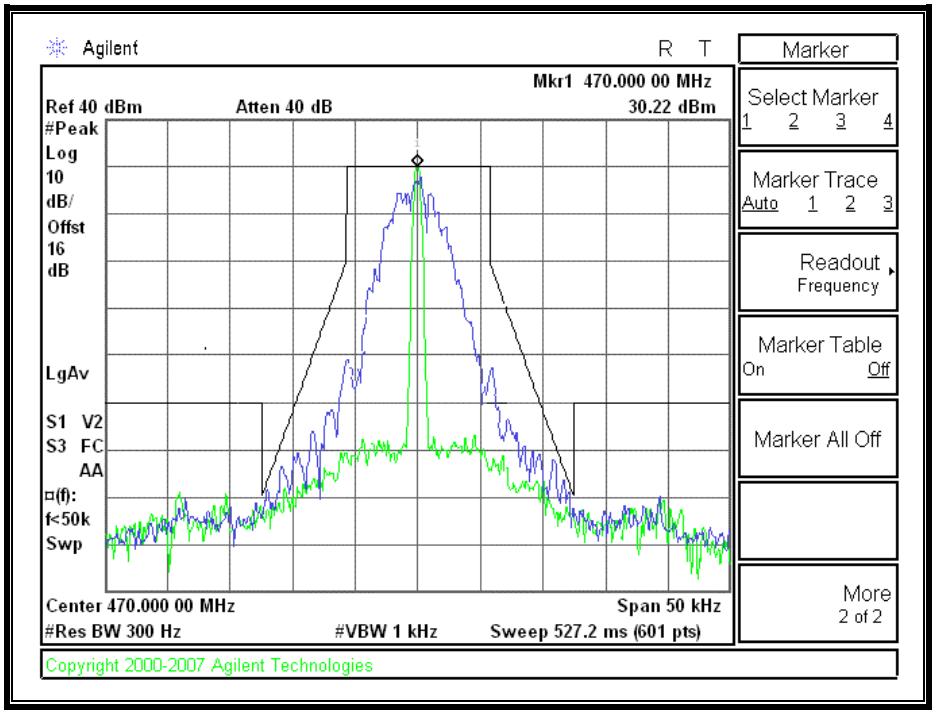




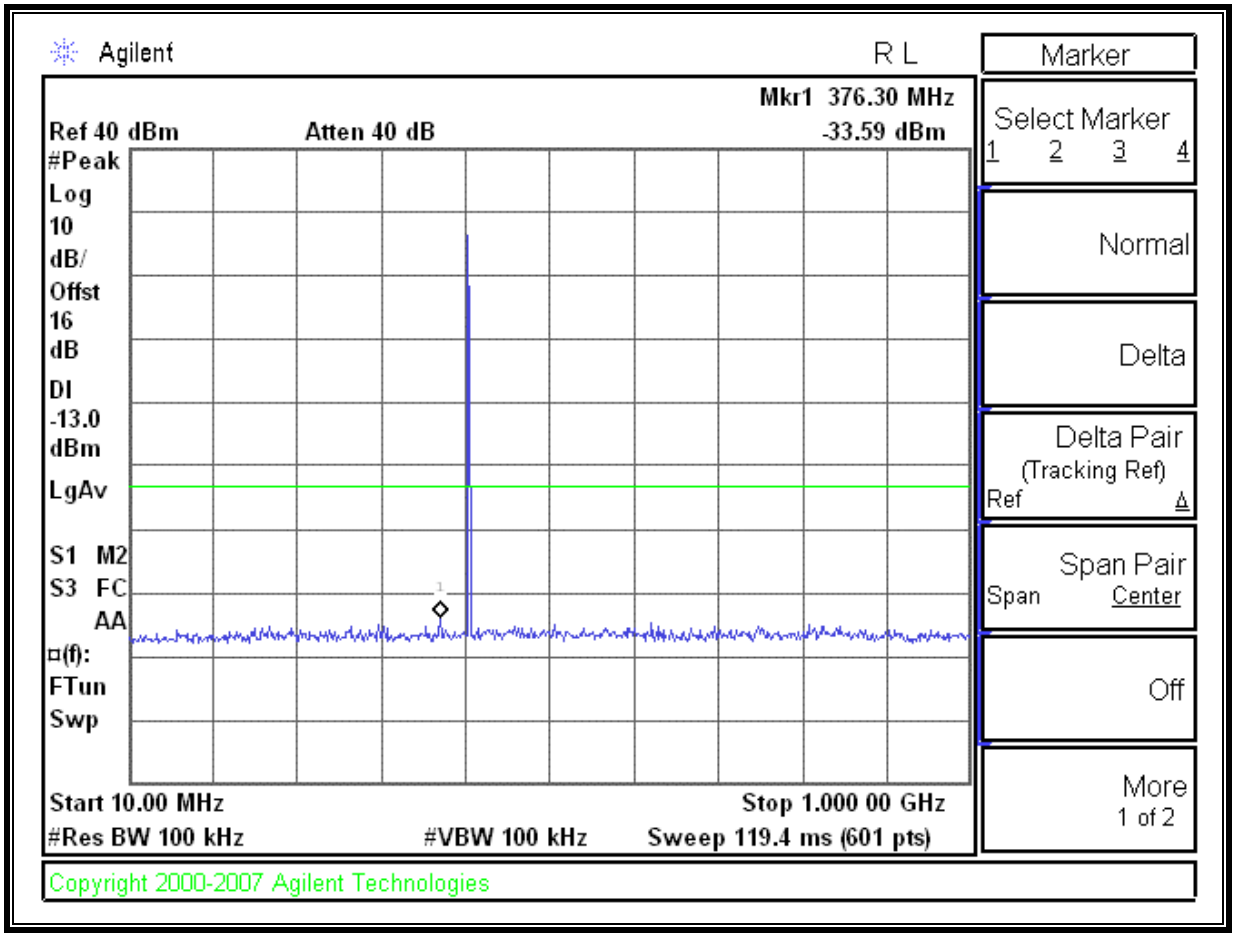
D MASK



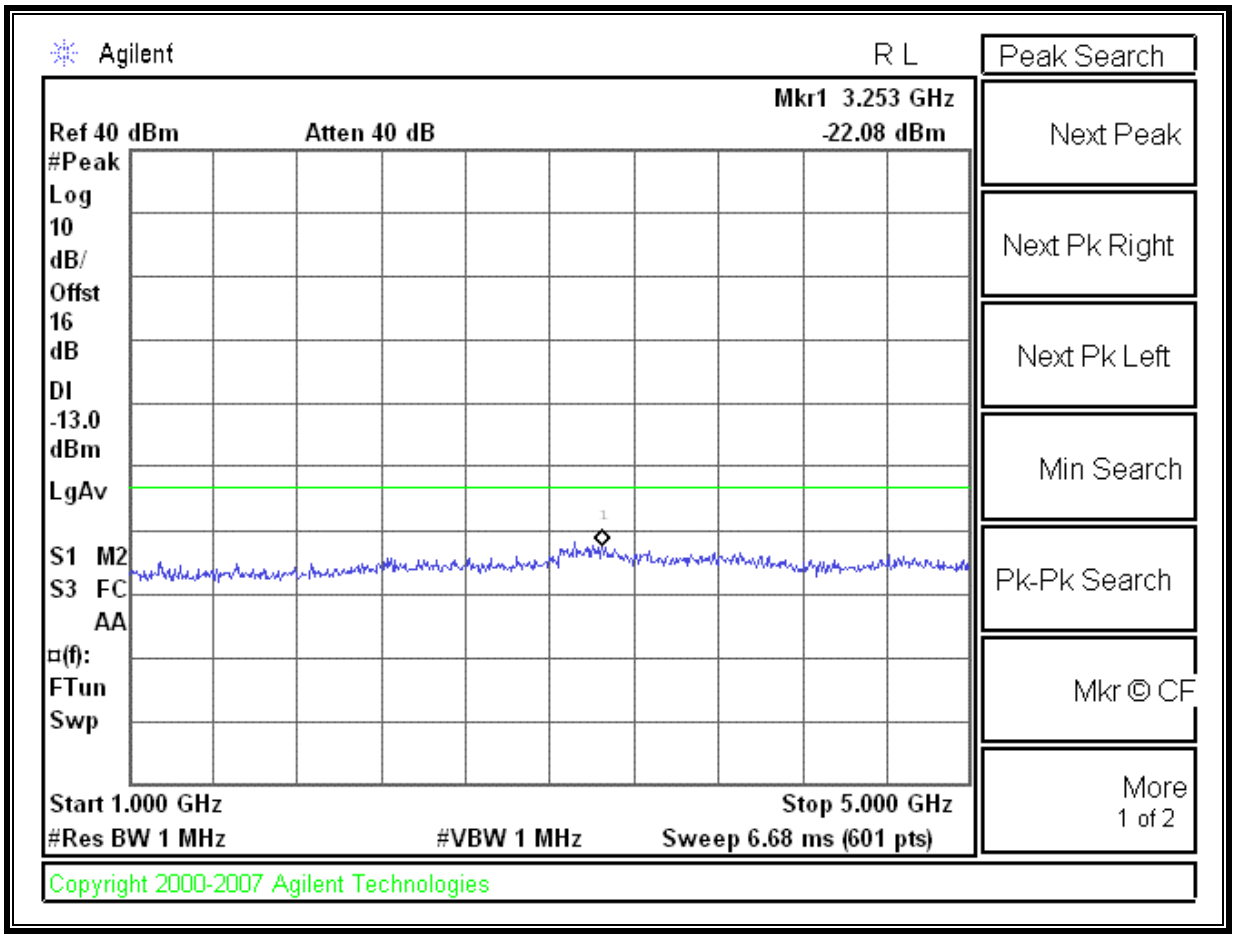




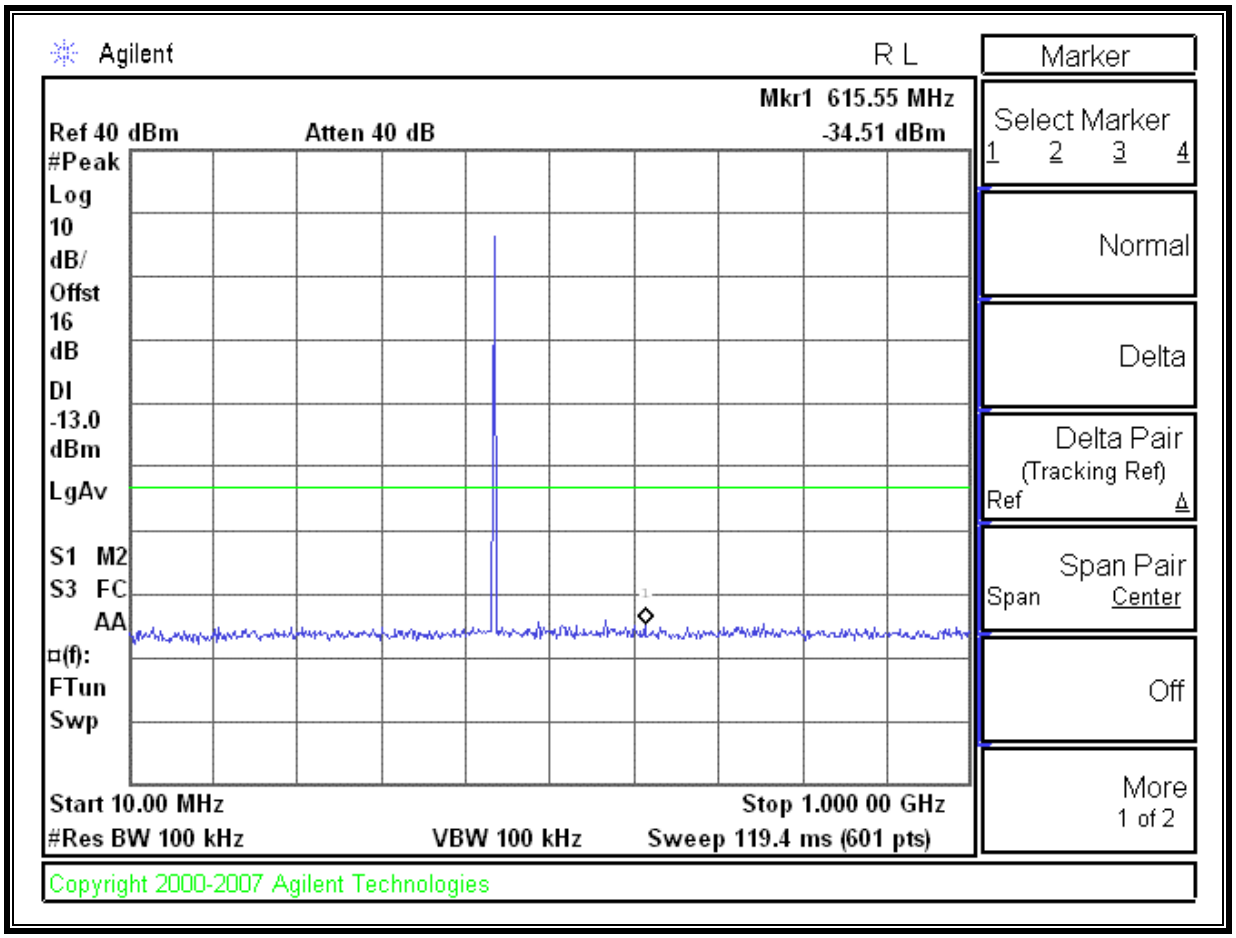
CONDUCTED SPURIOUS, LOW CHANNEL 10MHz to 1000MHz



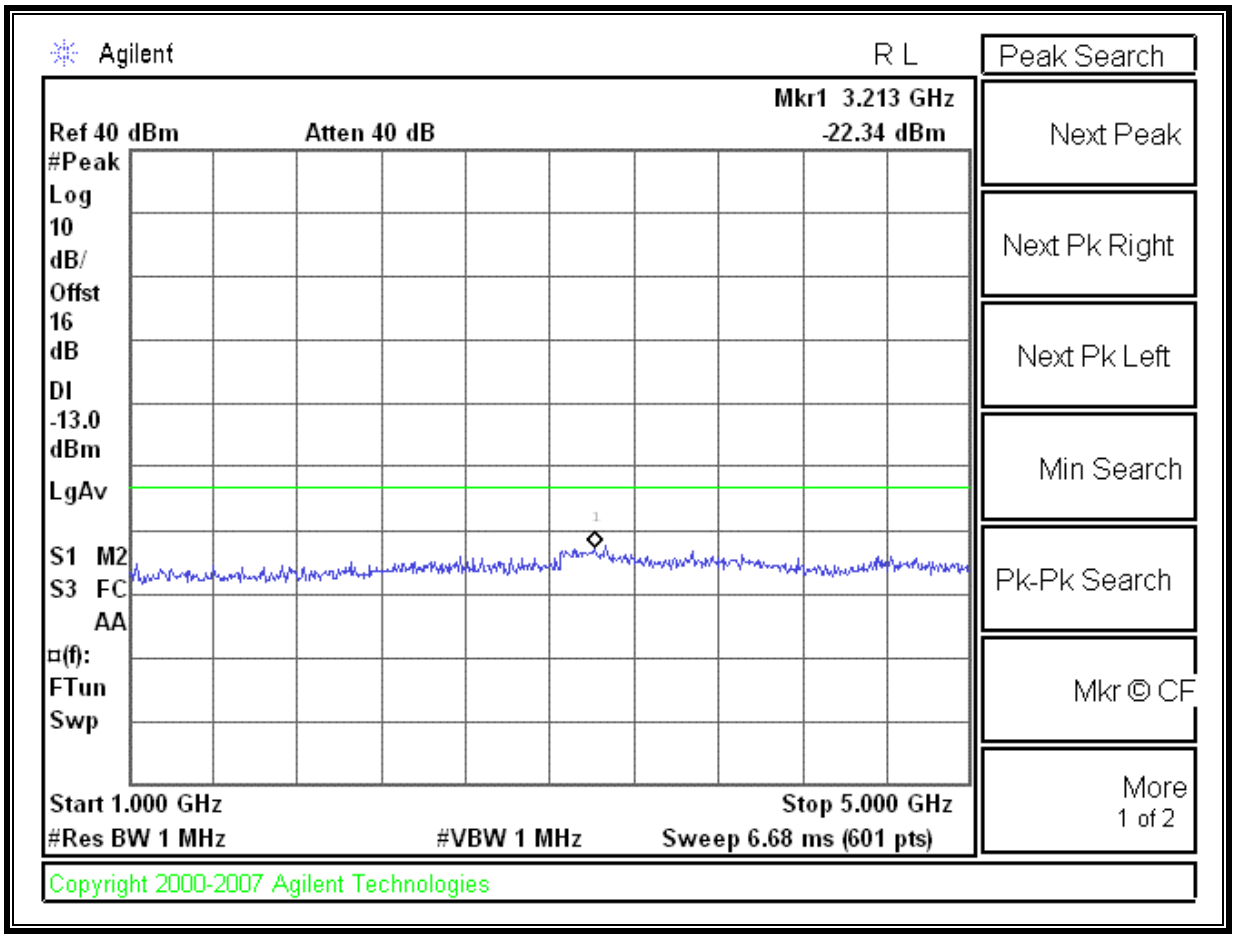
CONDUCTED SPURIOUS, LOW CHANNEL 1000-5000MHz



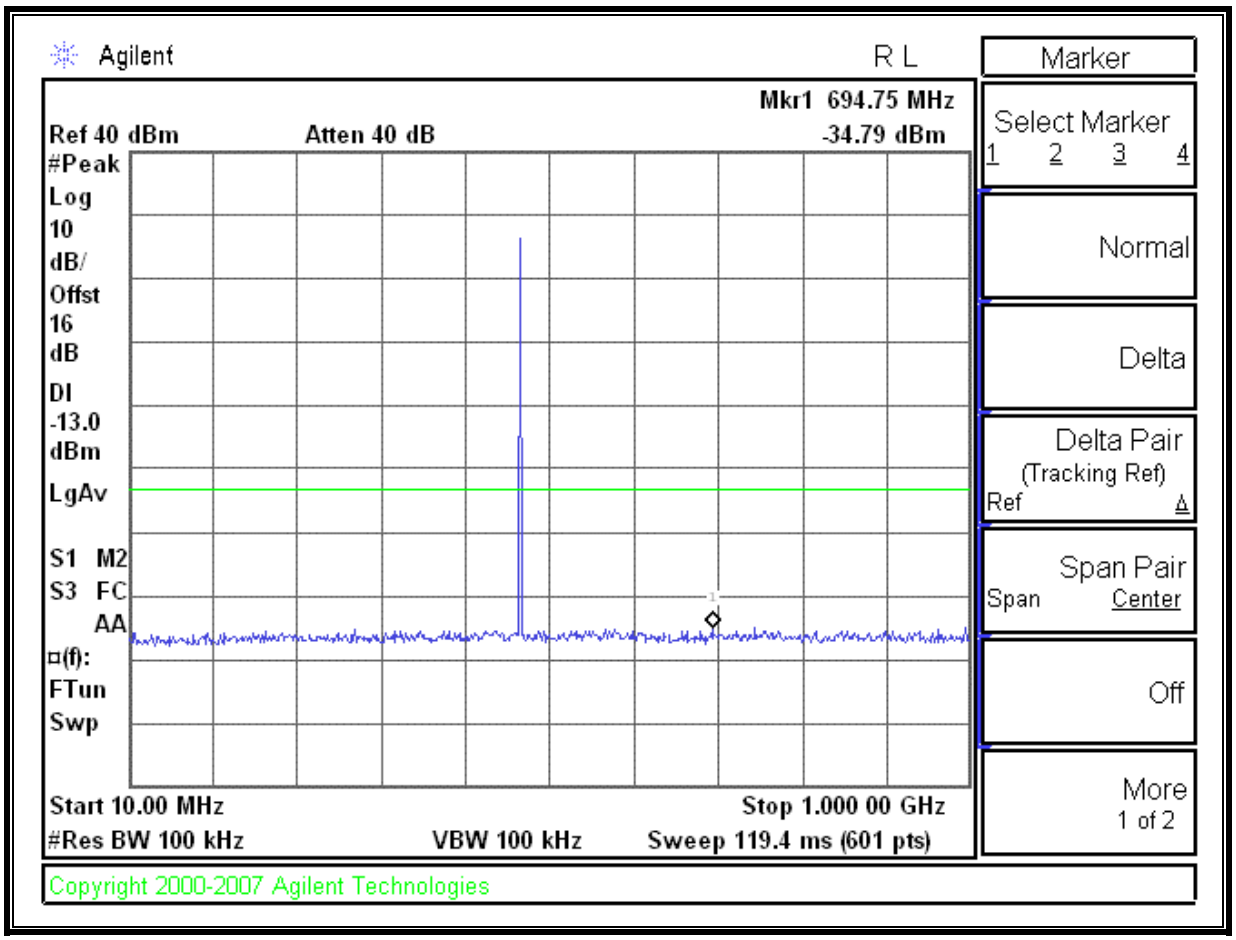
CONDUCTED SPURIOUS, MID CHANNEL 10MHz to 1000MHz



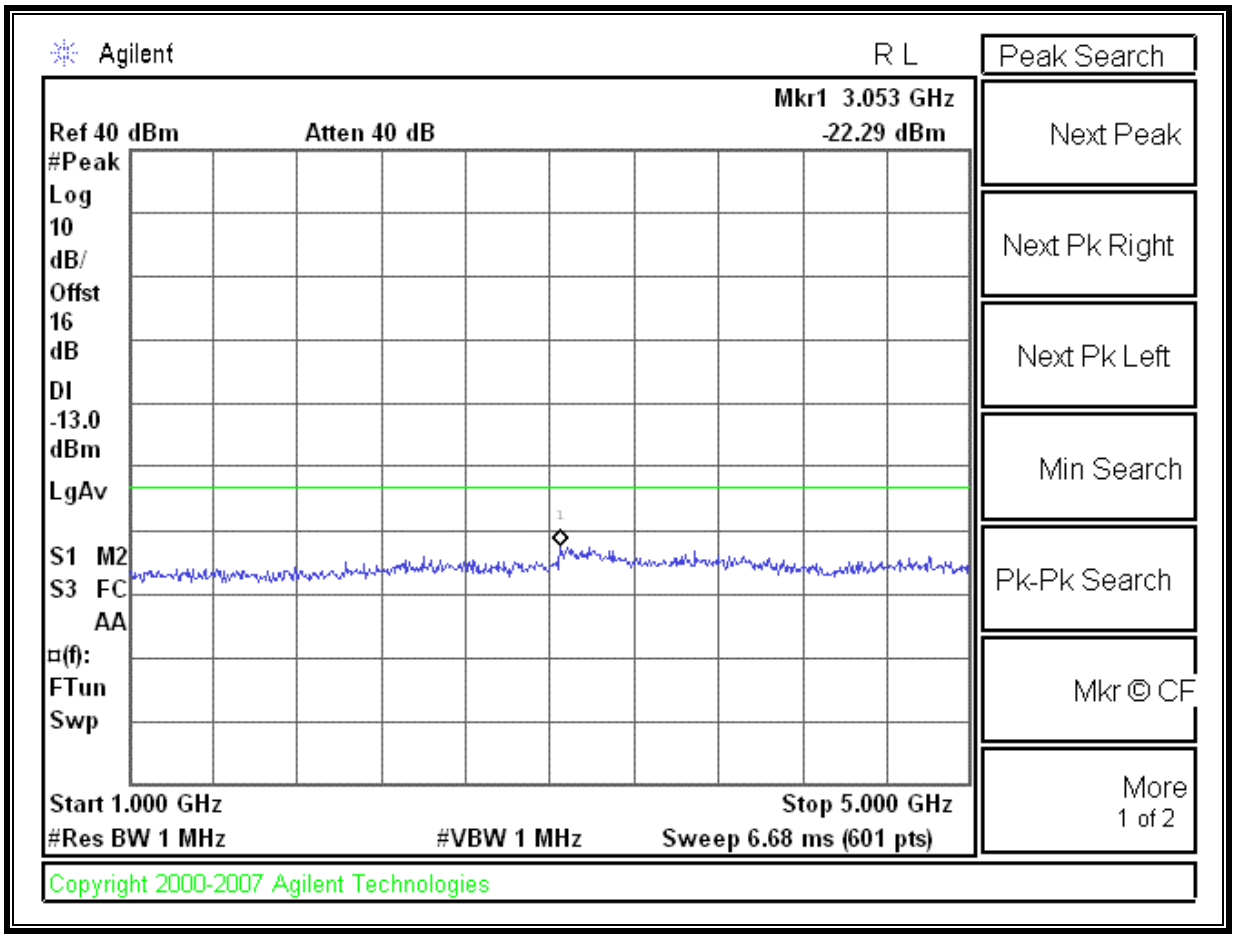
CONDUCTED SPURIOUS, MID CHANNEL 1000MHz to 5000MHz



CONDUCTED SPURIOUS, HIGH CHANNEL 10MHz to 1000MHz



CONDUCTED SPURIOUS, LOW CHANNEL 1000MHz to 5000MHz



7.4. FIELD STRENGTH OF SPURIOUS RADIATION

LIMIT

§FCC 90.210 & RSS-119 § 5.8 Out of band emissions, The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

TEST PROCEDURE

RSS-119, ANSI / TIA / EIA 603 Clause 3.2.13, & FCC 90.210

RESULTS

30MHz TO 1000MHz SPURIOUS & HARMONIC EMISSIONS (ERP)

Compliance Certification Services
30 - 1000MHz Substitution Measurement

Company:Topcon
Project #:09J12695
Date:7/21/2009
Test Engineer:Chin Pang
Configuration:EUT/Dipole Antenna
Mode:TX

Chamber	Pre-amplifer	Filter	Limit
5m Chamber B			TX, Part 90

f MHz	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, 410MHz										
820.00	-74.1	H	3.0	31.1			-43.0	-13.0	-30.0	
820.00	-54.0	V	3.0	33.5			-20.5	-13.0	-7.5	
Mid Ch, 440MHz										
880.00	-73.5	H	3.0	31.9			-41.6	-13.0	-28.6	
880.00	-54.0	V	3.0	33.5			-20.5	-13.0	-7.5	
High Ch, 470MHz										
200.00	-78.0	H	3.0	19.4			-58.6	-13.0	-45.6	
940.00	-82.0	H	3.0	32.8			-49.2	-13.0	-36.2	
200.00	-77.0	V	3.0	22.7			-54.4	-13.0	-41.4	
940.00	-55.0	V	3.0	34.2			-20.8	-13.0	-7.8	

Rev. 03.03.09
Note: No other emissions were detected above the system noise floor.

1000MHz TO 5000MHz SPURIOUS & HARMONIC EMISSIONS (ERP)

R

Compliance Certification Services
Above 1GHz High Frequency Substitution Measurement

Company:Topcon
Project #:09J12695
Date:7/21/2009
Test Engineer:Chin Pang
Configuration:EUT/Dipole Antenna
Mode:TX

Chamber	Pre-amplifer	Filter	Limit
5m Chamber B	T145 8449B		TX, Part 90

f GHz	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, 410MHz										
1.23	-47.6	H	3.0	33.7	36.0		-49.9	-13.0	-36.9	
1.64	-52.8	H	3.0	37.1	35.6		-51.2	-13.0	-38.2	
2.05	-51.7	H	3.0	40.5	35.4		-46.6	-13.0	-33.6	
1.23	-43.0	V	3.0	32.6	36.0		-46.4	-13.0	-33.4	
1.64	-44.6	V	3.0	36.7	35.6		-43.5	-13.0	-30.5	
2.05	-51.3	V	3.0	41.5	35.4		-45.1	-13.0	-32.1	
2.46	-48.5	V	3.0	41.6	35.4		-42.3	-13.0	-29.3	
2.87	-49.3	V	3.0	43.0	35.6		-41.9	-13.0	-28.9	
Mid Ch, 440MHz										
1.32	-48.1	H	3.0	34.4	35.9		-49.6	-13.0	-36.6	
1.76	-52.5	H	3.0	38.3	35.5		-49.7	-13.0	-36.7	
2.20	-50.0	H	3.0	40.2	35.4		-45.2	-13.0	-32.2	
1.32	-42.7	V	3.0	33.3	35.9		-45.3	-13.0	-32.3	
1.76	-46.2	V	3.0	38.3	35.5		-43.4	-13.0	-30.4	
2.20	-45.1	V	3.0	41.4	35.4		-39.1	-13.0	-26.1	
2.64	-45.0	V	3.0	42.3	35.5		-38.2	-13.0	-25.2	
3.08	-47.8	V	3.0	43.6	35.6		-39.8	-13.0	-26.8	
High Ch, 470MHz										
1.41	-47.3	H	3.0	35.1	35.8		-47.9	-13.0	-34.9	
1.88	-53.5	H	3.0	39.4	35.4		-49.5	-13.0	-36.5	
2.35	-55.0	H	3.0	39.9	35.4		-50.5	-13.0	-37.5	
1.41	-42.7	V	3.0	34.1	35.8		-44.4	-13.0	-31.4	
1.88	-55.0	V	3.0	39.9	35.4		-50.5	-13.0	-37.5	
2.35	-53.0	V	3.0	41.3	35.4		-47.1	-13.0	-34.1	
2.82	-57.2	V	3.0	42.8	35.6		-49.9	-13.0	-36.9	

Rev. 03.03.09

7.5. RECEIVER SPURIOUS EMISSIONS

LIMIT

RSS-Gen
Spurious Emission Limits for Receivers:

Spurious Frequency (MHz)	Field Strength (microvolts/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

TEST PROCEDURE

The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (local oscillator frequency, intermediate frequency or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable and local oscillator frequencies.

RESULTS

RECEIVER SPURIOUS EMISSIONS 30 TO 1000 MHz,

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

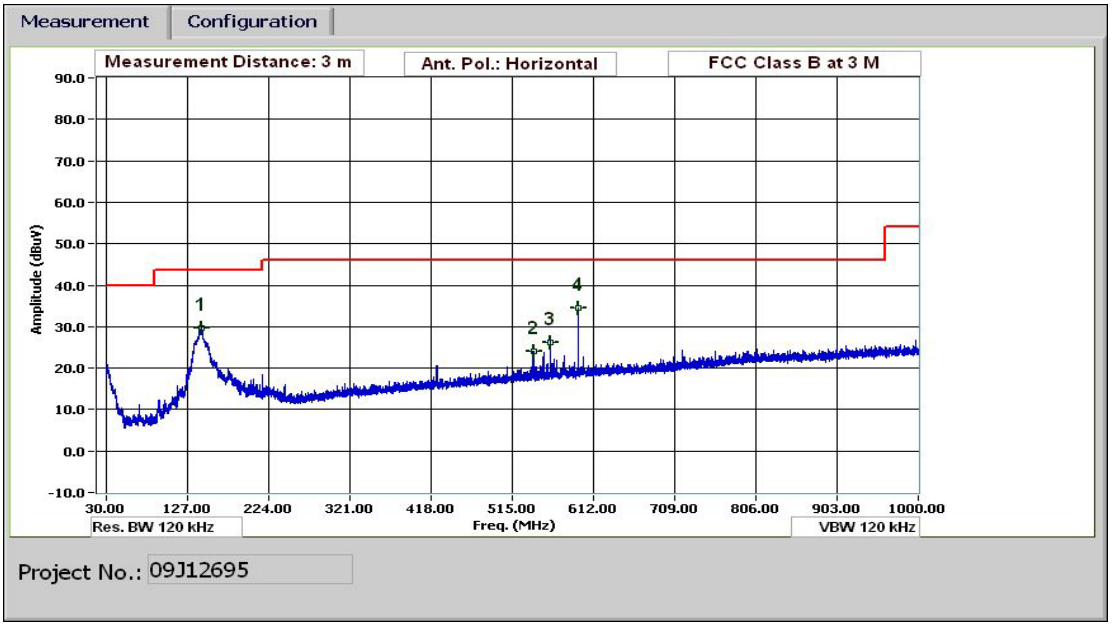
Test Engr: Chin Pang
Date: 07/21/09
Project #: 09J12695
Company: Topcon
EUT Description: GNSS Receiver
EUT M/N:
Test Target: FCC Class B
Mode Oper: RX

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

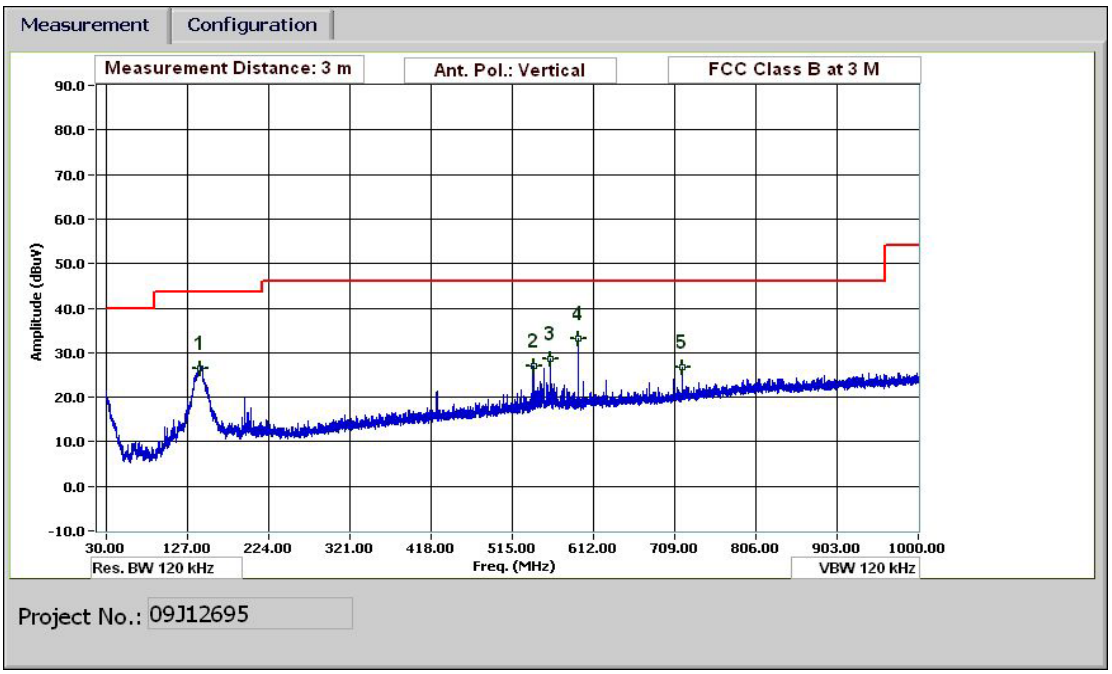
f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
horiz													
143.885	3.0	44.8	13.0	1.1	29.3	0.0	0.0	29.6	43.5	-13.9	H	EP	
540.021	3.0	34.2	17.4	2.2	29.7	0.0	0.0	24.2	46.0	-21.8	H	EP	
560.422	3.0	36.0	17.7	2.3	29.7	0.0	0.0	26.3	46.0	-19.7	H	EP	
594.023	3.0	43.5	18.2	2.4	29.6	0.0	0.0	34.4	46.0	-11.6	H	EP	
142.325	3.0	41.6	13.1	1.1	29.4	0.0	0.0	26.4	43.5	-17.1	V	EP	
540.021	3.0	37.2	17.4	2.2	29.7	0.0	0.0	27.1	46.0	-18.9	V	EP	
560.302	3.0	38.3	17.7	2.3	29.7	0.0	0.0	28.6	46.0	-17.4	V	EP	
594.023	3.0	42.4	18.2	2.4	29.6	0.0	0.0	33.3	46.0	-12.7	V	EP	
717.628	3.0	34.1	19.6	2.6	29.5	0.0	0.0	26.8	46.0	-19.2	V	EP	

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

HORIZONTAL PLOT



VERTICAL PLOT



RECEIVER SPURIOUS EMISSIONS FOR ABOVE 1GHz

Note: No emissions were found within above 1GHz of 20dB below the system noise floor.

7.6. FREQUENCY STABILITY

LIMIT

§FCC 90.213 Frequency stability

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Minimum Frequency Stability

[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1,2,3]100	100	200
25–50	20	20	50
72–76	5		50
150–174	[5,11]5	[6]5	[4,6]50
216–220	1.0		1.0
220–222[12]	0.1	1.5	1.5
421–512	[7,11,14]2.5	[8]5	[8]5
806–809	[14]1.0	1.5	1.5
809–824	[14]1.5	2.5	2.5
851–854	1.0	1.5	1.5
854–869	1.5	2.5	2.5
896–901	[14]0.1	1.5	1.5
902–928	2.5	2.5	2.5
902–928[13]	2.5	2.5	2.5
929–930	1.5		
935–940	0.1	1.5	1.5
1427–1435	[9]300	300	300
Above 2450[10]			

[1]Fixed and base stations with over 200 watts transmitter power must have a frequency stability of 50 ppm except for equipment used in the Public Safety Pool where the frequency stability is 100 ppm.

[2]For single sideband operations below 25 MHz, the carrier frequency must be maintained within 50 Hz of the authorized carrier frequency.

[3]Travelers information station transmitters operating from 530–1700 kHz and transmitters exceeding 200 watts peak envelope power used for disaster communications and long distance circuit operations pursuant to §§90.242 and 90.264 must maintain the carrier frequency to within 20 Hz of the authorized frequency.

[4]Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.

[5]In the 150–174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

[6]In the 150–174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.

[7]In the 421–512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

[8]In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

[9]Fixed stations with output powers above 120 watts and necessary bandwidth less than 3 kHz must operate with a frequency stability of 100 ppm. Fixed stations with output powers less than 120 watts and using time-division multiplex, must operate with a frequency stability of 500 ppm.

[10]Except for DSRCS equipment in the 5850–5925 MHz band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5850–5925 MHz band is specified in subpart M of this part.

[11]Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150–174 MHz band and 2.5 ppm in the 421–512 MHz band.

[12]Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.

[13]Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

[14]Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

RSS-119 §5.3 Frequency stability Table 1 below

Table 1 - Transmitter Frequency Stability

Frequency range (MHz)	Authorized Bandwidth (kHz)	Base / Fixed	Mobile stations	
			>2 watts	≤ 2 watts
406.1-430 and 450-470 (Note 5)	20	2.5	5	5
	11.25	1.5	2.5	2.5
	6.25	0.5	1	1

Note 5: Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

TEST PROCEDURE

RSS-119, ANSI / TIA / EIA 603 Clause 2.3.1 and 2.3.2

RESULTS

Reference Frequency: Mid Channel 439.99964Hz @ 25*C Limit: ± 2.5 ppm = 1099.999 Hz				
Power Supply (Vdc)	Environment Temperature (*C)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
12.00	50	439.99990	-0.591	± 2.5
12.00	40	439.99986	-0.500	± 2.5
12.00	30	439.99976	-0.273	± 2.5
12.00	***20***	***439.99964***	***0***	***± 2.5***
12.00	10	439.99996	-0.718	± 2.5
12.00	0	439.99999	-0.786	± 2.5
12.00	-10	440.00000	-0.814	± 2.5
12.00	-20	440.00025	-1.386	± 2.5
12.00	-30	440.00042	-1.773	± 2.5
10.8	20	439.99975	-0.250	± 2.5
13.8	20	439.99996	-0.727	± 2.5

Note: The unit only apply for 12.5 kHz & 25 kHz Channel Spacing.

7.7. TRANSIENT FREQUENCY BEHAVIOR

LIMIT

.

RSS-119 §5.9 Transmitters designed to operate in the 150–174 MHz and 421–512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals[1,2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz (FCC) 138 to 174 MHz (IC)	421 to 512 MHz (FCC) 406.1 to 512 MHz (IC)
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

[1] $_{on}$is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

$t_1$is the time period immediately following t_{on}.

$t_2$is the time period immediately following t_1.

$t_3$is the time period from the instant when the transmitter is turned off until t_{off}.

$t_{off}$is the instant when the 1 kHz test signal starts to rise.

[2]During the time from the end of $t_2$to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.

[3]Difference between the actual transmitter frequency and the assigned transmitter frequency.

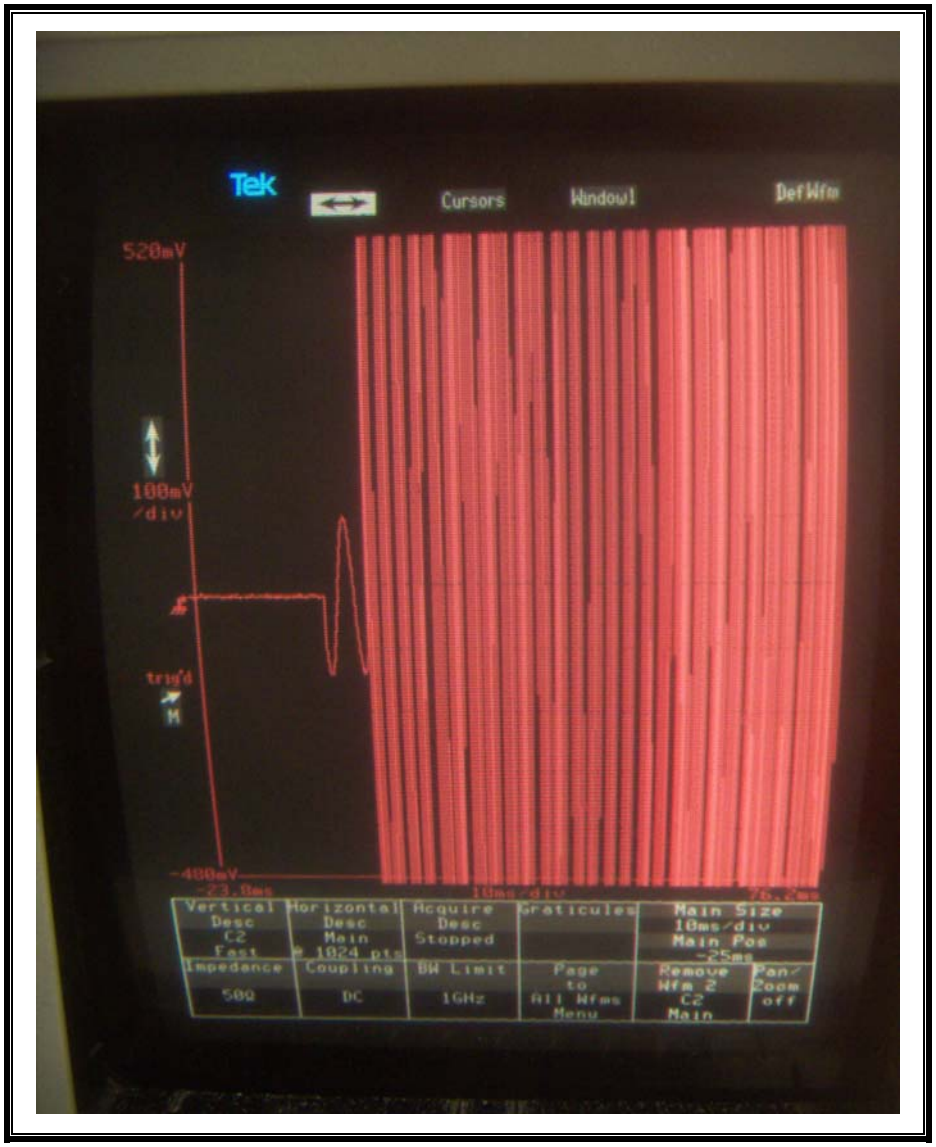
[4]If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

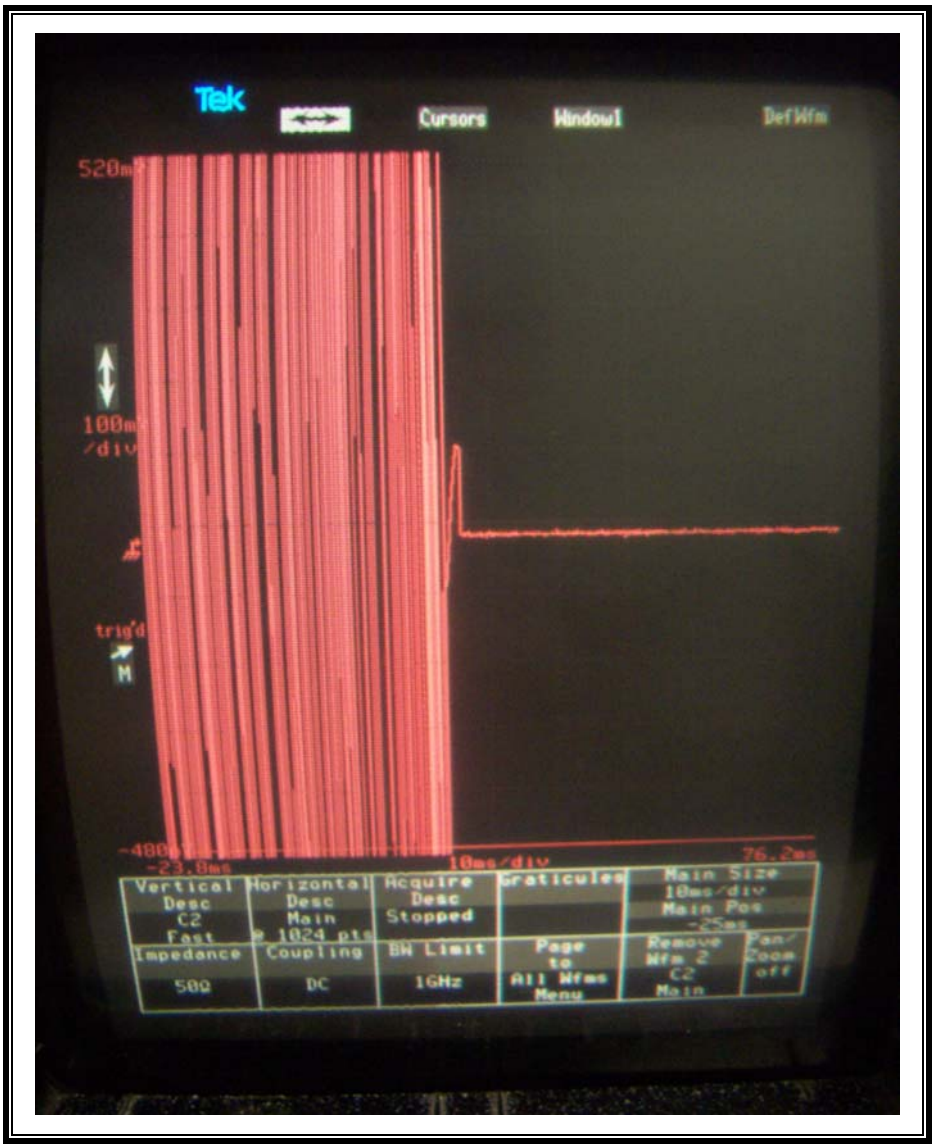
TEST PROCEDURE

RSS-119, ANSI / TIA / EIA 603 Clause 3.2.19

RESULTS

Please see pass results of TransientOn and TransientOff





8. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

CALCULATIONS

Given

E = √ (30 * P * G) / d

and

S = E ^ 2 / 3770

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

d = 0.282 * 10 ^ ((P + G) / 20) / √ S

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Rearranging terms to calculate the power density at a specific distance yields

S = 0.0795 * 10 ^ ((P + G) / 10) / (d^2)

The power density in units of mW/cm^2 is converted to units of W/m^2 by multiplying by a factor of 10.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 0.273 mW/cm^2

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 2.73 W/m^2

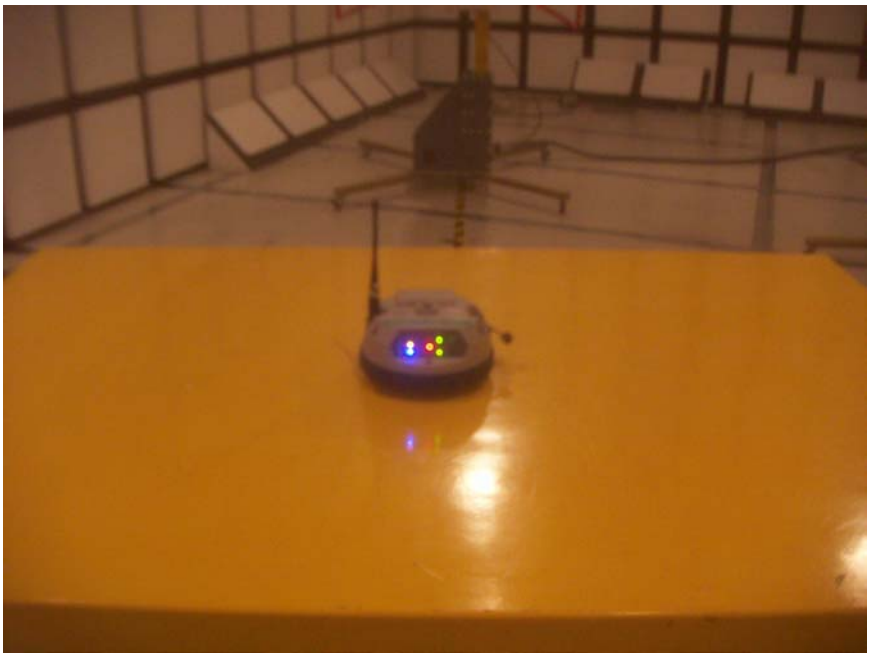
RESULTS

Frequency Range (MHz)	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
410-470	20.0	30.00	2.40	0.273	2.73

9. SETUP PHOTOS

RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO



RADIATED BACK PHOTO

END OF REPORT