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Radio Test Report

FCC Part 90
(410 MHz to 470 MHz)

Model: HiPeR GA (01-860805-01)

FCC ID:	LCB-860805
COMPANY:	Topcon Positioning Systems 7400 National Drive Livermore, CA 94550
TEST SITE(S):	NTS Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
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SCOPE

Tests have been performed on the Topcon Positioning Systems model HiPeR GA (01-860805-01), pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Industry Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 90 (Private Land Mobile Radio Service)

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

ANSI C63.4:2003
ANSI TIA-603-C August 17, 2004
FCC Public Notice, DA-02-1097, May 10, 2002 *Guidance on Certification of Linear Power Amplifiers used with Cellular and PCS Transmitters*

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

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

The test results recorded herein are based on a single type test of the Topcon Positioning Systems model HiPeR GA (01-860805-01) and therefore apply only to the tested sample. The sample was selected and prepared by Ferdinand Riodique of Topcon Positioning Systems.

OBJECTIVE

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

Prior to marketing in the USA, the device requires certification. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

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

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

Testing was performed only on model HiPeR GA (01-860805-01).

STATEMENT OF COMPLIANCE

The tested sample of Topcon Positioning Systems model HiPeR GA (01-860805-01) complied with the requirements of the standards and frequency bands declared in the scope of this test report.

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

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS

FCC Part 90

FCC	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics				
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 90.279 & 90.205	RF power output at the antenna terminals	28.40dBm to 28.74dBm	5 watts e.r.p.	Pass
§2.1033 (c) (4) §2.1047 90.210	Emission types			
	Emission mask	Pass	Mask D Ch spacing:12.5	Pass
§2.1049 § 90.212	Occupied Bandwidth	6.1 kHz	< 11.25 kHz	Pass
§ 90.214	Transient frequency behavior	Transient behavior	Refer to plots	Pass
Transmitter spurious emissions				
§2.1051 §2.1057	At the antenna terminals	-20.3 dBm	-20 dBm	-0.3 dB
§2.1053 §2.1057	Field strength	-35.9 dBm	-20 dBm	-15.9 dB
Receiver spurious emissions				
15.109	At the antenna terminals	-73.6 dBm	See limit table on page 18	Pass
15.109	Field strength	35.3 dBuV/m	See limit table on page 18	-4.7 dB
Other details				
§2.1055 § 90.213	Frequency stability	1.3 ppm (528 Hz)	1.5 ppm	Pass
§2.1093	RF Exposure	See separate exhibit		
§2.1033 (c) (8)	Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	-	-	-
-	Antenna Gain	2.5 dBi 1/2 wave flexible cable antenna		
Notes				

EXTREME CONDITIONS

Frequency stability is determined over extremes of temperature and voltage. As the device is hand carried, battery powered equipment, the supply voltage was reduced to the battery operating end point of 5.2 Vdc as specified by the manufacturer.

The extremes of temperature were -30°C to +50°C as specified in FCC §2.1055(a)(1).

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF frequency	Hz	25 to 7,000 MHz	1.7×10^{-7}
RF power, conducted	dBm	25 to 7,000 MHz	± 0.52 dB
Conducted emission of transmitter	dBm	25 to 40,000 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 40,000 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 40,000 MHz	± 2.5 dB
Radiated emission (field strength)	dBμV/m	25 to 1,000 MHz 1 to 40 GHz	± 3.6 dB ± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Topcon Positioning Systems model HiPeR GA (01-860805-01) is a GPS receiver with UHF, Bluetooth radio that is designed for land surveying. Since the EUT would be placed on a pole during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The EUT is internal battery operated. It has an external battery charging power supply which give 12 VDC 2.5 Amps. The electrical rating of the charger is 120 Volts, 60 Hz, 0.8 Amps.

The sample was received on August 7, 2012 and tested on August 7, 8, 9, 17, 22 and 23, 2012. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Topcon	HiPer Ga	GPS receiver	457-04601	FCC ID: LCB-860805
Phihong	PSC30U-120V	Power supply	PO3109830A1	N/A

OTHER EUT DETAILS

The EUT antenna is 2.5 dBi 1/2 wave flexible cable antenna.

The antenna connects to the EUT via BNC connector

ENCLOSURE

The EUT enclosure is primarily constructed of manganese zinc alloy. It measures approximately 16 cm wide by 16 cm deep by 10 cm high.

MODIFICATIONS

The following modification was made during testing to comply with the requirements:

1. Power was reduced from the maximum setting to 29 dBm for the 12.5 kHz BW operation in order to comply with conducted spurious.

SUPPORT EQUIPMENT

A Notebook computer was used to configure the EUT. The computer was not connected during testing.

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
AC Power	AC Mains	Three wire	Unshielded	2
DC Power	EUT	Two wire	Unshielded	1.7

Note: The USB and serial ports (A and D) were not connected during testing. The manufacturer stated that these are for configuration purposes and therefore would not normally be connected.

EUT OPERATION

During emissions testing the UHF radio was configured to transmit at rated power with frequencies and modulations indicated in each run.

TESTING

GENERAL INFORMATION

Antenna port measurements were taken at the NTS Silicon Valley test site located at 41039 Boyce Road, Fremont, CA 94538-2435.

Radiated spurious emissions measurements were taken at the NTS Silicon Valley Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4: 2003 *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* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are on file with the FCC and industry Canada.

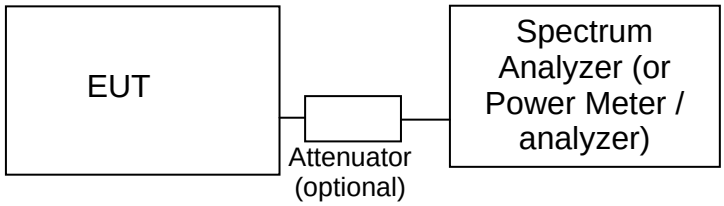
Site	Registration Numbers		Location
	FCC	Canada	
Chamber 3	769238	IC 2845B-3	41039 Boyce Road Fremont, CA 94538-2435

In the case of Open Area Test Sites, ambient levels are at least 6 dB below the specification limits with the exception of predictable local TV, radio, and mobile communications traffic.

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

RF PORT MEASUREMENT PROCEDURES

Conducted measurements are performed with the EUT's rf input/output connected to the input of a spectrum analyzer, power meter or modulation analyzer. When required an attenuator, filter and/or dc block is placed between the EUT and the spectrum analyzer to avoid overloading the front end of the measurement device. Measurements are corrected for the insertion loss of the attenuators and cables inserted between the rf port of the EUT and the measurement equipment.



Test Configuration for Antenna Port Measurements

For devices with an integral antenna the output power and spurious emissions are measured as a field strength at a test distance of (typically) 3m and then converted to an eirp using a substitution measurement (refer to RADIATED EMISSIONS MEASUREMENTS). All other measurements are made as detailed below but with the test equipment connected to a measurement antenna directed at the EUT.

OUTPUT POWER

Output power is measured using a power meter and an average sensor head, a spectrum analyzer or a power meter and peak power sensor head as required by the relevant rule part(s). Where necessary measurements are gated to ensure power is only measured over periods that the device is transmitting.

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

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN. The measurement bandwidth is set to be at least 1% of the instrument's frequency span.

CONDUCTED SPURIOUS EMISSIONS

Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode measurements). Where the limits are expressed as an average power the spectrum analyzer is tunes to that frequency with a narrow span (wide enough to capture the emission and its sidebands) and the resolution and video bandwidths are adjusted as required by the reference measurement standards. For transmitter measurements the appropriate detector (average, peak, normal ,sample, quasi-peak) is used when making measurements for licensed devices. For receiver conducted spurious measurements the detector is set to peak.

TRANSMITTER MASK MEASUREMENTS

The transmitter mask measurements are made using resolution bandwidths as specified in the pertinent rule part(s). Where narrower bandwidths are used the measurement is corrected to account for the reduced bandwidth by either using the adjacent channel power function of the spectrum analyzer to sum the power across the required measurement bandwidth. The frequency span of the analyzer is set to ensure the fundamental signal and all significant sidebands are displayed.

The top of the mask may be set by the total output power of the signal, the power of the unmodulated signal or the peak value of the signal in the reference bandwidth being used for the mask measurement.

FREQUENCY STABILITY

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The temperature is varied across the specified frequency range in 10 degree increments with frequency measurements made at each temperature step. The EUT is allowed enough time to stabilize at each temperature variation.

The spectrum analyzer is configured to give a 5- or 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. Where possible the device is set to transmit an unmodulated signal. Where this is not possible the frequency drift is determined by finding a stable point on the signal (e.g. the null at the centre of an OFDM signal) or by calculating a centre frequency based on the upper and lower XdB points (where X is typically 6dB or 10dB) on the signal's skirts.

TRANSIENT FREQUENCY BEHAVIOR:

The TIA/EIA 603 procedure is used to determine compliance with transient frequency timing requirements as the radio is keyed on and off.

The EUTs rf output is connected via a combiner/splitter to the test receiver/spectrum analyzer and to a diode detector. The test receiver or spectrum analyzer video output is connected to an oscilloscope, which is triggered by the output from the diode detector.

Plots showing Ton, T1, and T2 are made when turning on the transmitter and showing T3 when turning off the transmitter.

RADIATED EMISSIONS MEASUREMENTS

Receiver radiated spurious emissions measurements are made in accordance with ANSI ANSI C63.4:2003 by measuring the field strength of the emissions from the device at a specific test distance and comparing them to a field strength limit. Where the field strength limit is specified at a longer distance than the measurement distance the measurement is extrapolated to the limit distance.

Transmitter radiated spurious emissions are initially measured as a field strength. The eirp or erp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Emissions within 20dB of this limit are the subjected to a substitution measurement.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. For transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made on an OATS or in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission. The field strength is recorded and, for receiver spurious emissions, compared to the field strength limit. For the final measurement the appropriate detectors (average, peak, normal, sample, quasi-peak) are used. For receiver measurements below 1GHz the detector is a Quasi-Peak detector, above 1GHz a peak detector is used and the peak value (RB=VB=1MHz) and average value (RB=1MHz, VB=10Hz) are recorded.

For transmitter spurious emissions, the radiated power of all emissions within 20dB of the calculated field strength limit are determined using a substitution measurement. The substitution measurement is made by replacing the EUT with an antenna of known gain (typically a dipole antenna or a double-ridged horn antenna), connected to a signal source. The output power of the signal generator is adjusted until the maximum field strength from the substitution antenna is similar to the field strength recorded from the EUT. The erp of the EUT is then calculated.

INSTRUMENTATION

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

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

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

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

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements.

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

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

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

Table mounted devices are placed on a non-conductive table at a height of 80 centimeters above the floor. Floor mounted equipment is placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angel with the highest level of emissions.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS

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

$$R_r - S = M$$

where:

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

SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH

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

A distance factor is sued when measurements are made at a test distance that is different to the specified limit distance by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB
D_m = Measurement Distance in meters
D_s = Specification Distance in meters

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

$$F_d = 40*LOG_{10} (D_m/D_s)$$

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

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_S = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS –RADIATED POWER

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

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

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of isotropic antenna (numeric gain) = 1
D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

P_S = effective isotropic radiated power of the substitution antenna (dBm)
P_{in} = power input to the substitution antenna (dBm)
G = gain of the substitution antenna (dBi)
E_S = field strength the substitution antenna (dBm) at eirp P_S
E_{EUT} = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2dBi) from the eirp value.

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset #	Cal Due
Conducted RF Measurements, 07-Aug-12				
Filtek	Filter, 1 GHz High Pass	HP12/1000-5BA	957	5/18/2013
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	12/13/2012
Rohde & Schwarz	Power Sensor 100 uW - 2 Watts (w/ 20 dB pad, SN BJ5155)	NRV-Z32	1536	12/8/2012
Anritsu	Anritsu 68347C Signal Generator, 10MHz-20GHz	68347C	1785	6/29/2013
Agilent	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	2/23/2013
Conducted RF Measurements, 08-Aug-12				
Rohde & Schwarz	Test Receiver, 20-1300 MHz	ESVP	213	7/3/2013
Tektronix	1 GHz, 4 CH, 5GS/s Oscilloscope	TDS5104	1435	7/16/2013
Rohde & Schwarz	Power Sensor 100 uW - 2 Watts (w/ 20 dB pad, SN BJ5155)	NRV-Z32	1536	12/8/2012
Anritsu	Anritsu 68347C Signal Generator, 10MHz-20GHz	68347C	1785	6/29/2013
Rohde & Schwarz	Power Meter, Dual Channel, DC to 40 GHz, 100 pW to 30 W, 9 kHz to 3 GHz, 200µV to 1000V	NRVD	1786	2/24/2013
Agilent	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	2/23/2013
Frequency stability, 09-Aug-12				
Rohde & Schwarz	Signal Analyzer 20-26.5GHz	FSQ26	2327	4/20/2013
Thermotron	Temperature & humidity chamber, air cooled	SM-32C Mini Max	877	8/9/2013
Thermotron	Temperature & humidity chamber controller	SM-32C Mini Max	2422	8/9/2013
Radiated Emissions, 30 - 1,000 MHz, 17-Aug-12				
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2197	2/7/2014
Com-Power Corp.	Preamplifier, 30-1000 MHz	PA-103A	2359	2/14/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	12/9/2012
Radiated Emissions - Substitution, 30 - 5,000 MHz, 22-Aug-12				
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/19/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/15/2012
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	8/9/2014
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	7/12/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	5/31/2013
Com-Power Corp.	Preamplifier, 30-1000 MHz	PA-103	1632	7/6/2013
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	11/22/2012
Anritsu	Anritsu 68347C Signal Generator, 10MHz-20GHz	68347C	1785	6/29/2013

Conducted Emissions - AC Power Ports, 23-Aug-12

Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1594	5/22/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	5/31/2013
Com-Power	9KHz-30MHz, 50uH, 15Aac, 10Adc, max	LI-215A	2672	5/25/2013

Appendix B Test Data

T88703 Pages 22 - 54

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		-
Emissions Standard(s):	FCC Part 90	Class:	B
Immunity Standard(s):	-	Environment:	

EMC Test Data

For The

Topcon Positioning Systems

Model

HiPer GA

Date of Last Test: 8/23/2012

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

FCC Part 90

Power, Occupied Bandwidth, Frequency Stability and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above. Frequency range of operation is 410 - 470 MHz

General Test Configuration

With the exception of the radiated spurious emissions tests, all measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was place inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

Ambient Conditions:

Temperature: 23 °C

Rel. Humidity: 37 %

Summary of Results

Run #	Spacing	Data Rate	Test Performed	Limit	Pass / Fail	Result / Margin
1	12.5 kHz	-	Output Power	5 Watts	Pass	Pass
2	12.5 kHz	-	Spectral Mask	Mask D (For ch spacing:12.5 kHz)	Pass	Pass
3	12.5 kHz	-	Channel spacing, Occupied Bandwidth, Authorized bandwidth	< 11.25 kHz (For ch spacing:12.5 kHz)	Pass	6.1 kHz
4	12.5 kHz	-	Tx Unwanted Emissions (conducted)	-20 dBm, (D)	Pass	-20.3 dBm @ 1350 MHz (-0.3 dB)
5	12.5 kHz	-	Tx Unwanted Emissions (radiated)	-20 dBm, (D)	Pass	73.7 dBuV/m @ 1406.67 MHz (-15.9 dB)
6	12.5 kHz	-	Rx Spurious Emissions (conducted)	-57 dBm <1 GHz -53 dBm >1 GHz	Pass	-73.6 dBm @ 840 MHz (-16.6 dB)
7	12.5 kHz	-	Rx Spurious emissions (radiated)	Part 15	Pass	35.3 dBµV/m @ 61.42 MHz (-4.7 dB)
8	12.5 kHz	-	Transient Frequency Behaviour	See table	Pass	Pass
9	12.5 kHz	-	Frequency Stability	1.5 ppm	Pass	1.3 ppm

Modifications Made During Testing

Power was reduced from the maximum setting to 29dBm for the 12.5 kHz BW operation in order to comply with conducted spurious.

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #1: Output Power

Date: 8/7/2012 Engineer: Deniz Demirci Location: FT Lab# 4

Cable Loss: 0.4 dB Attenuator: 20.0 dB Total Loss: 20.4 dB

Cable ID(s): 492 Attenuator IDs: 1878

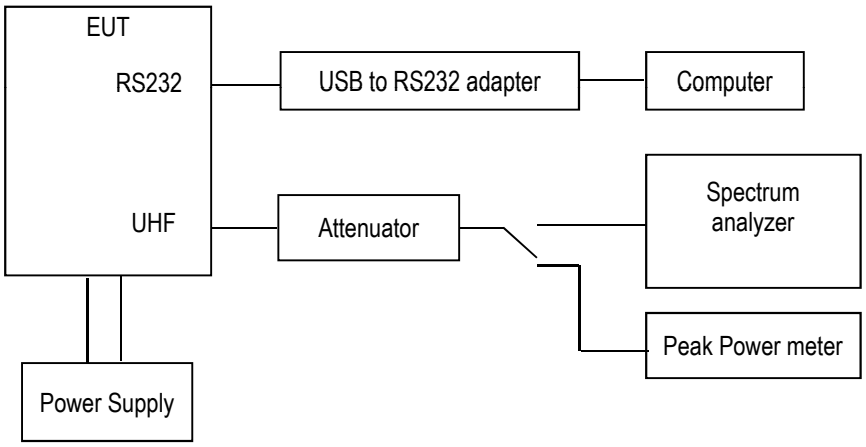
Power setting for channel spacing of 12.5 kHz

Power setting	Frequency (MHz)	Modulation	Output Power (dBm) [1]	Output Power mW	Duty Cycle %	Result
29 dBm	410.0000	CW	28.40	691.8	None	Pass
29 dBm	450.0125	CW	28.74	748.2	None	Pass
29 dBm	469.9875	CW	28.72	744.7	None	Pass

Note 1: Output power measured using a peak power meter

Note 2: Power setting - the power setting of 29 dBm was set with the control software during testing

Conducted RF measurements setup

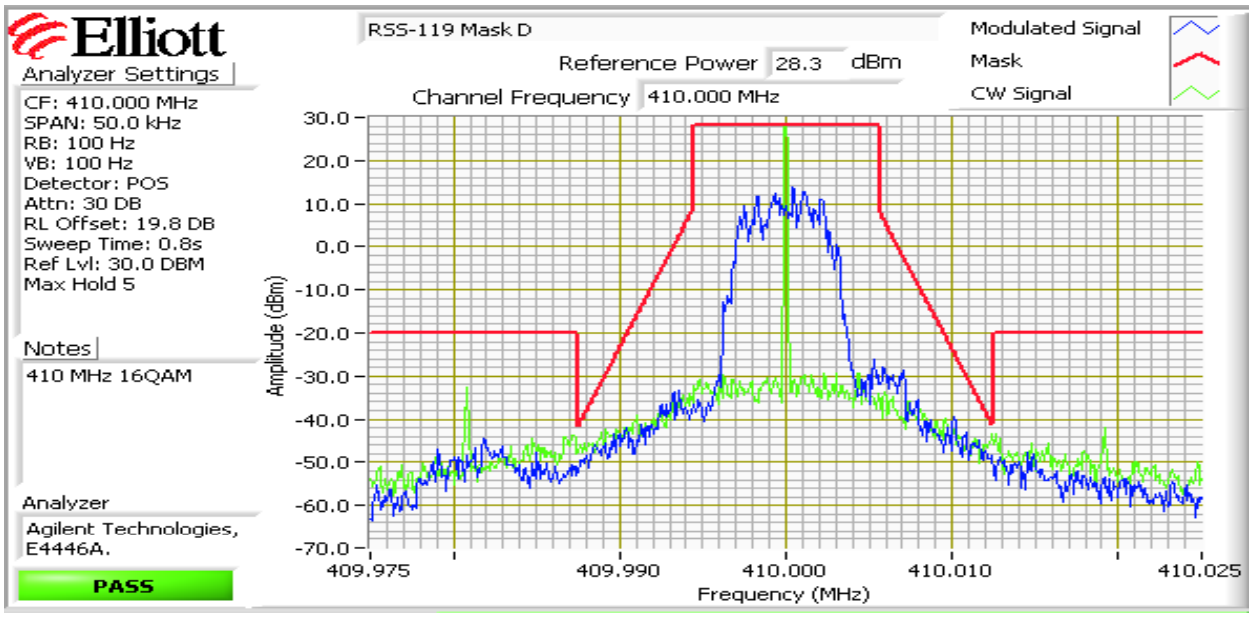


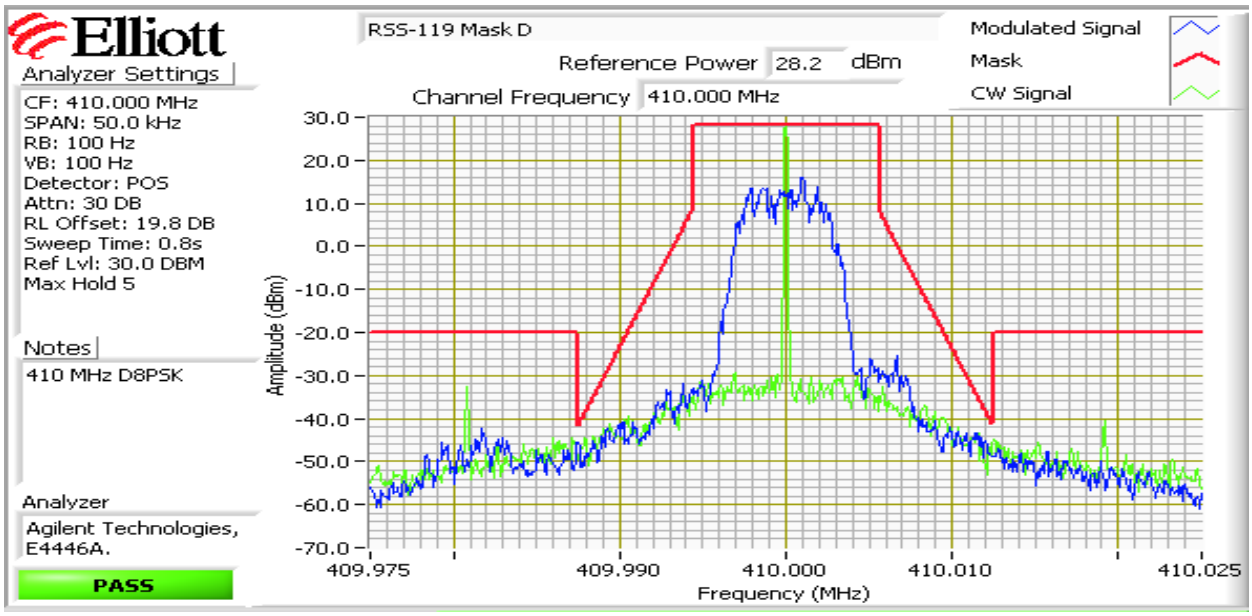
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #2a: Spectral Mask, Mask D (Channel spacing 12.5 kHz)

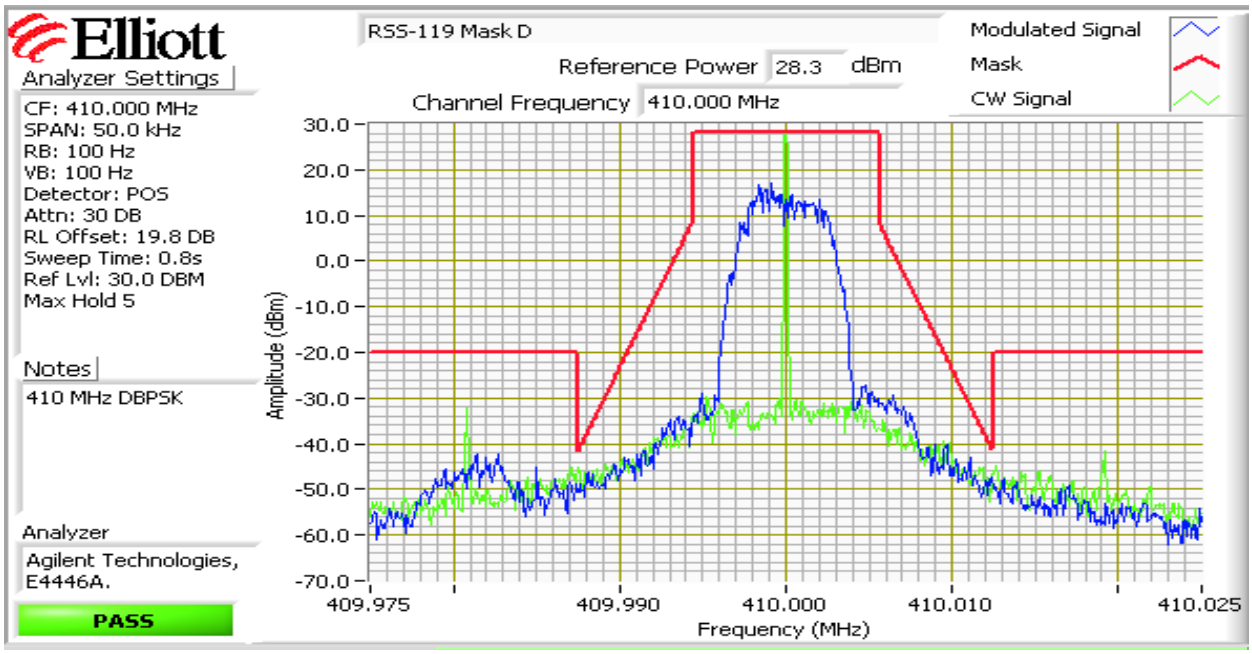
Date: 8/8/2012 Engineer: Deniz Demirci Location: FT Lab# 4

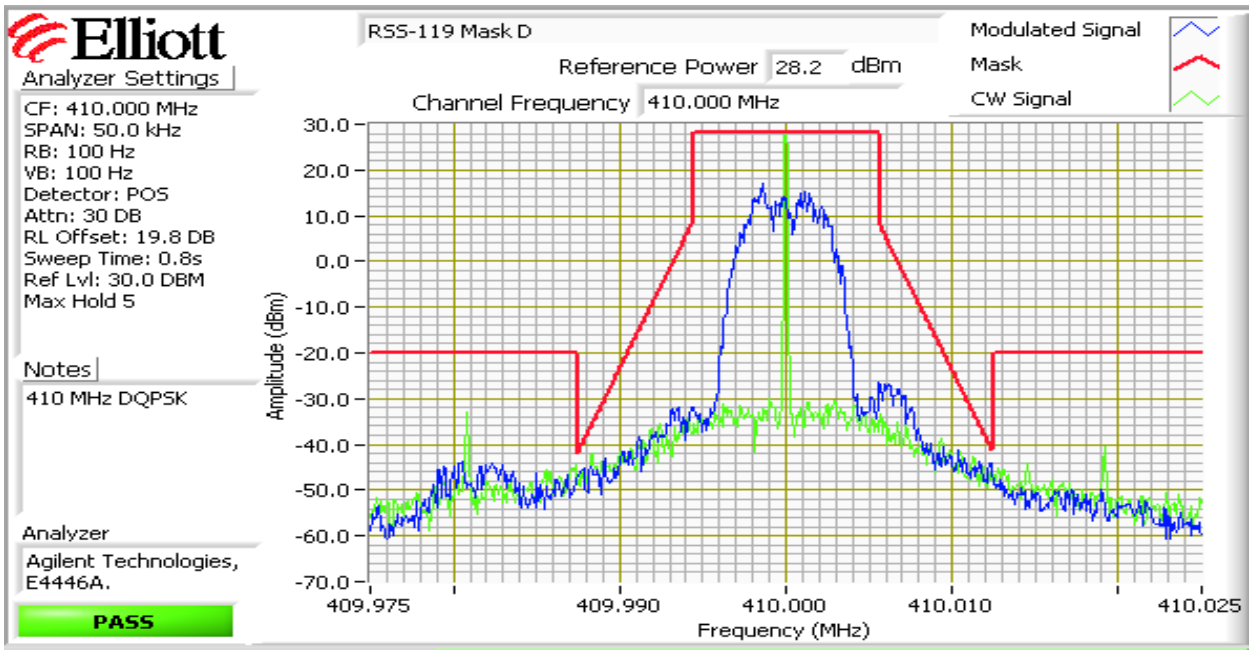
Note 1:	RBW 100 Hz, VBW 100 Hz, Span 50 kHz, Detector Positive peak
Note 3:	Power setting: 29 dBm, Modulations: DBPSK, DQPSK, D8PSK and 16QAM



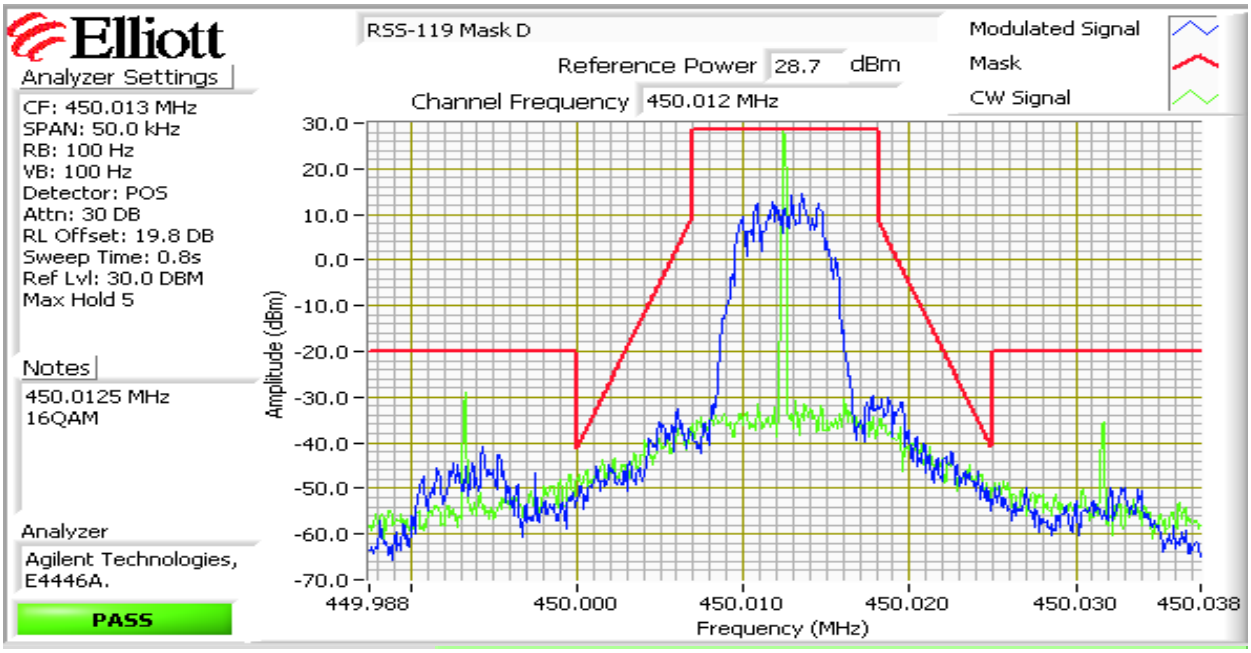


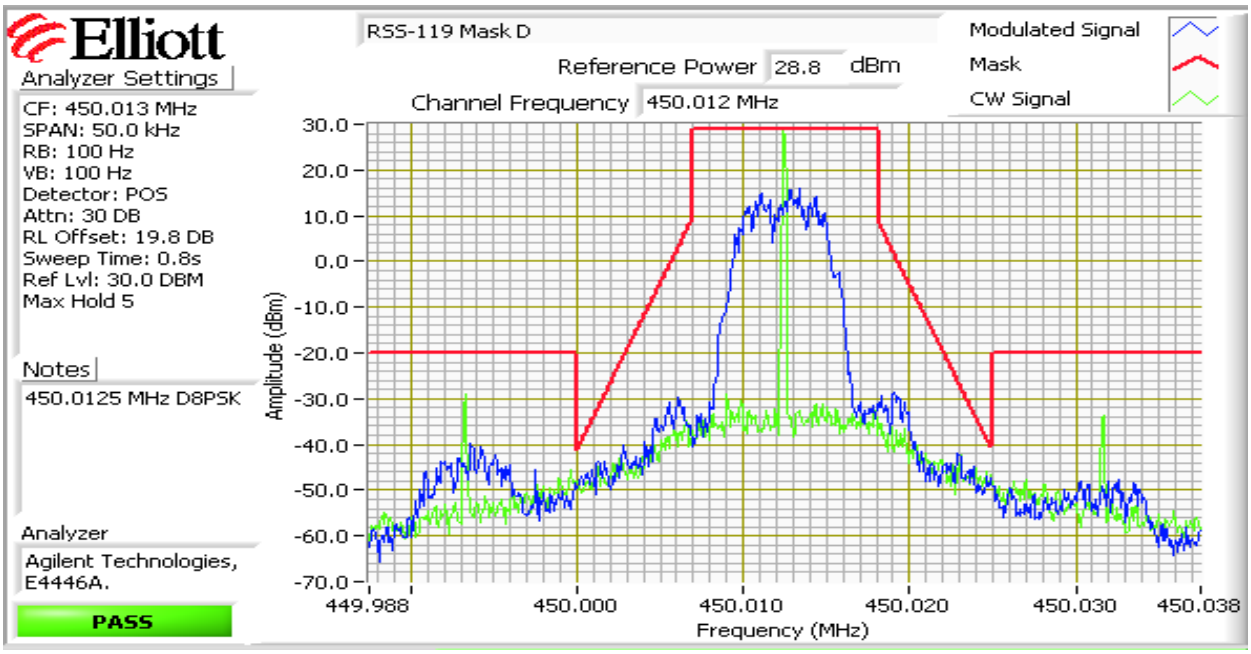
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A



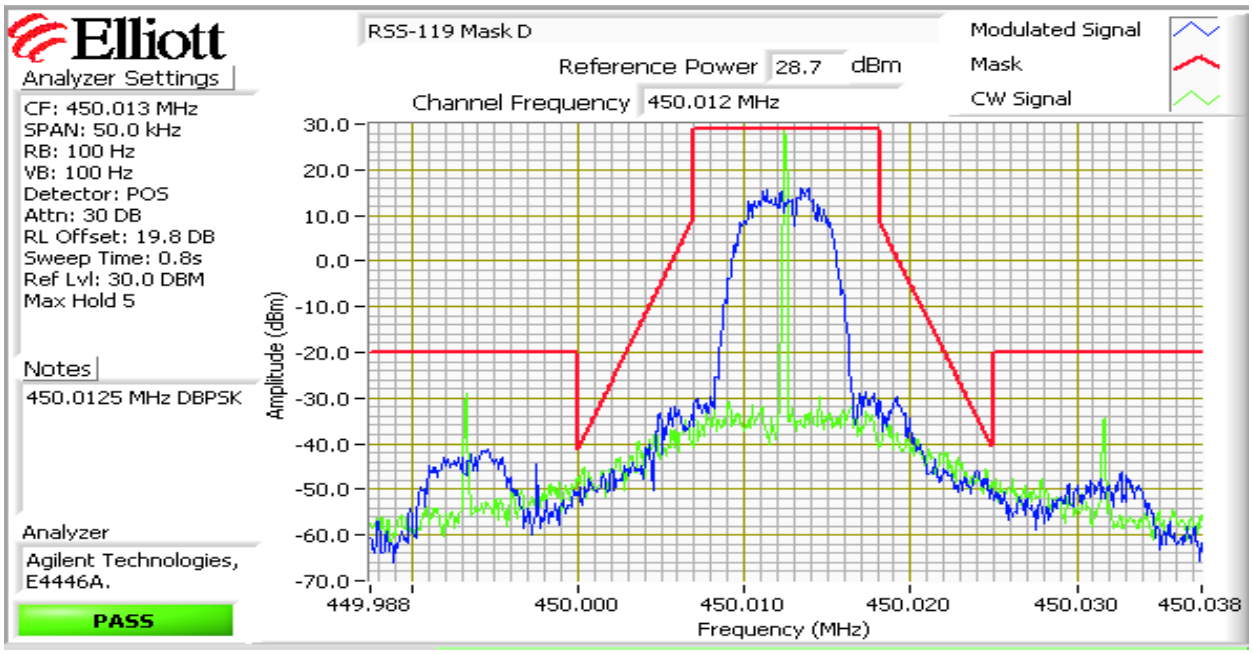


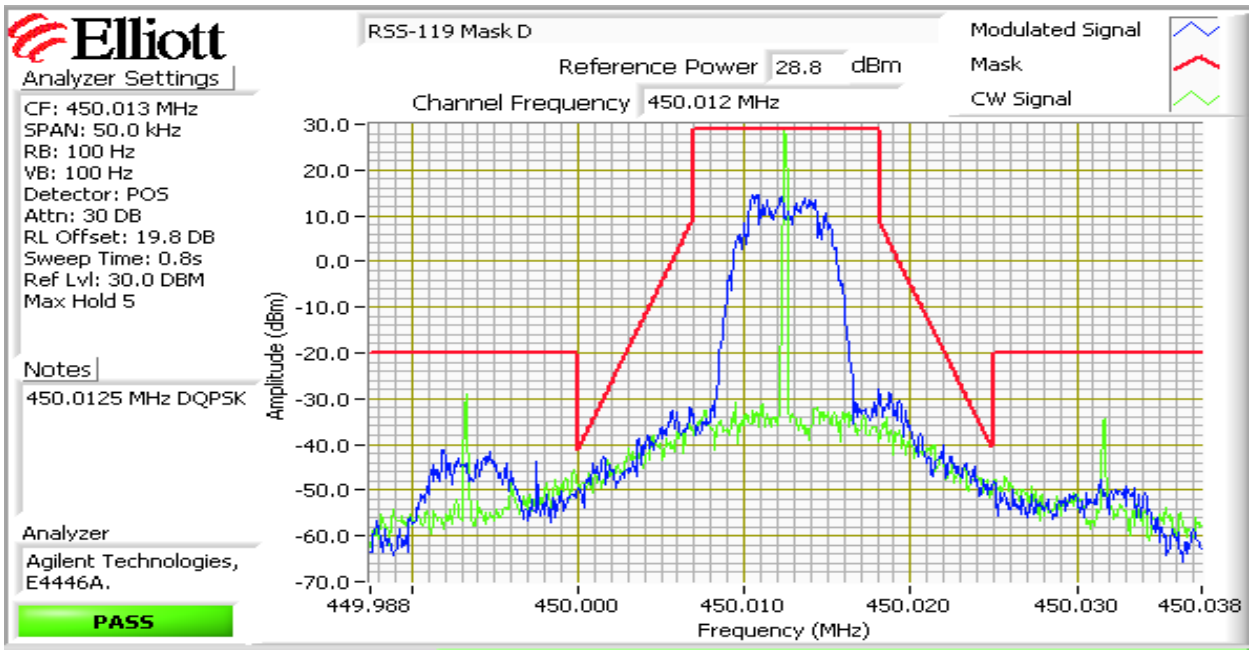
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A



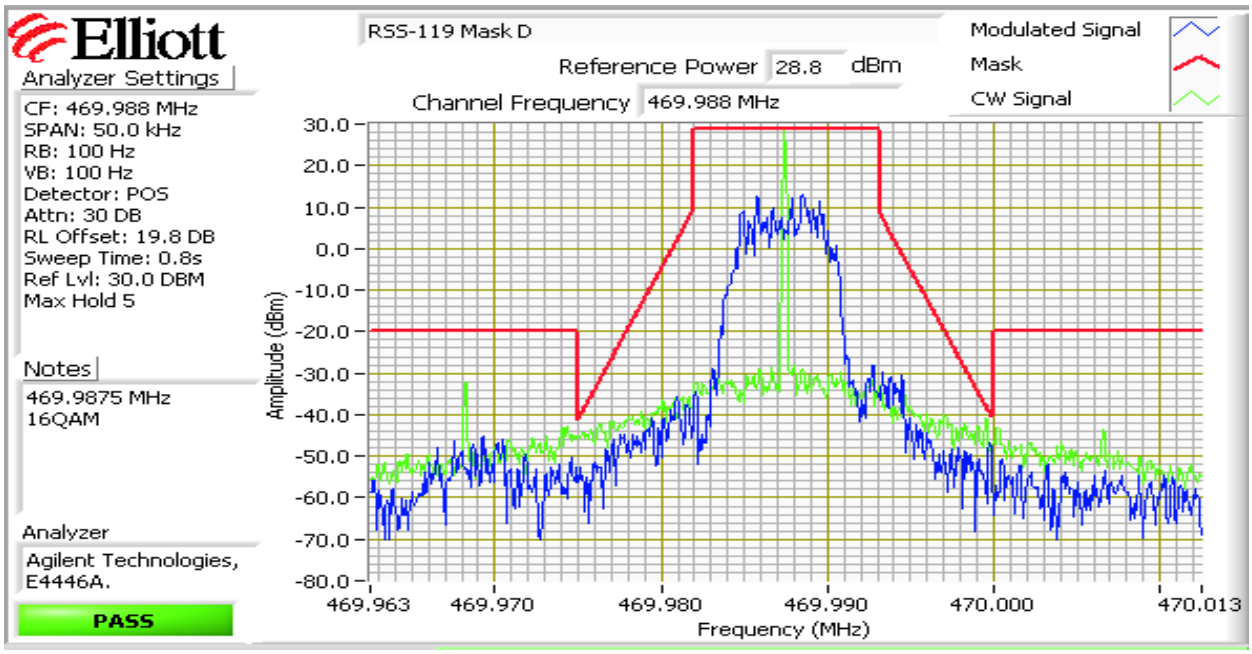


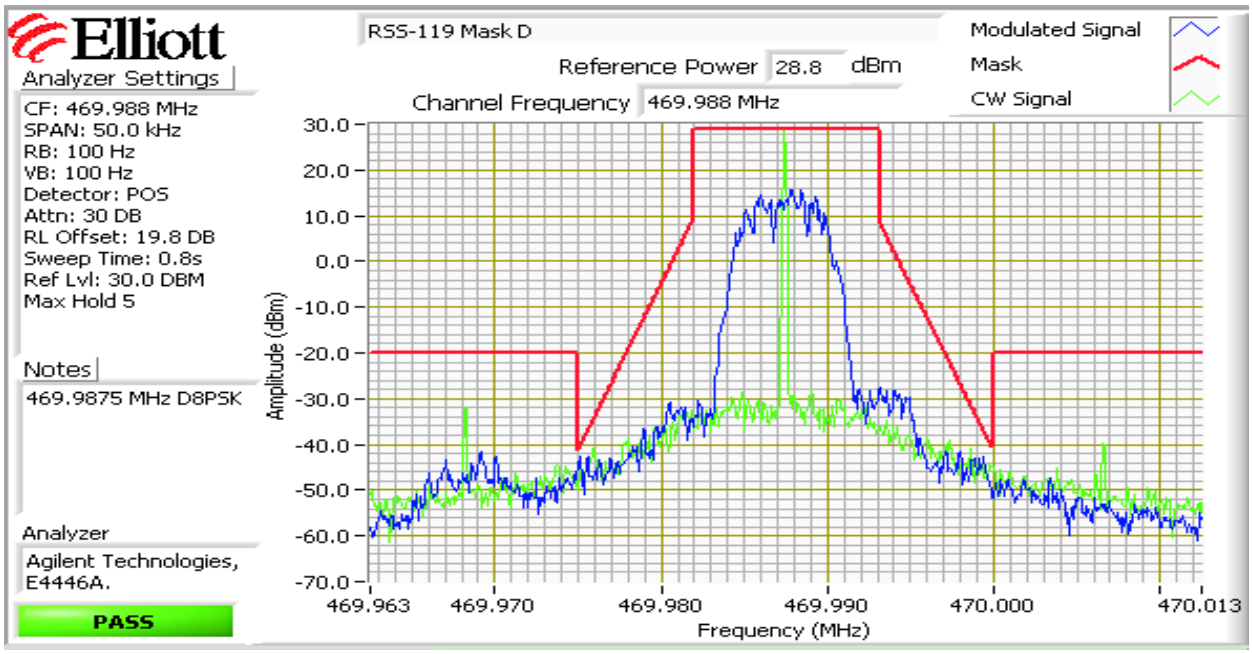
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A



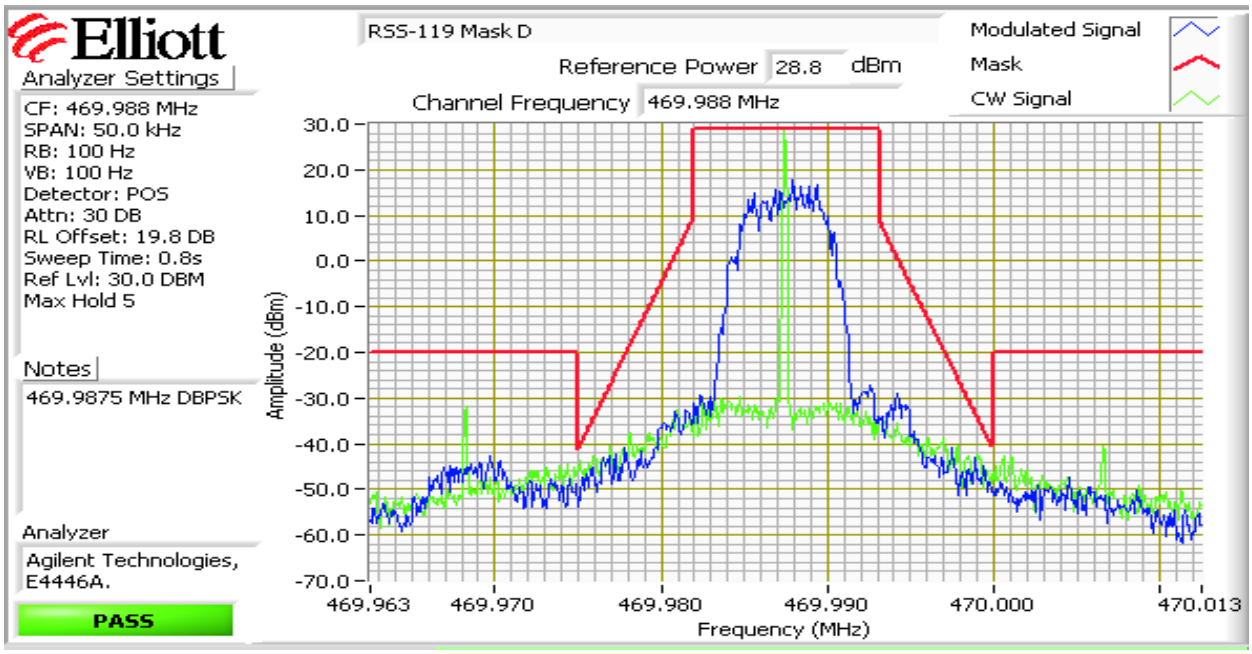


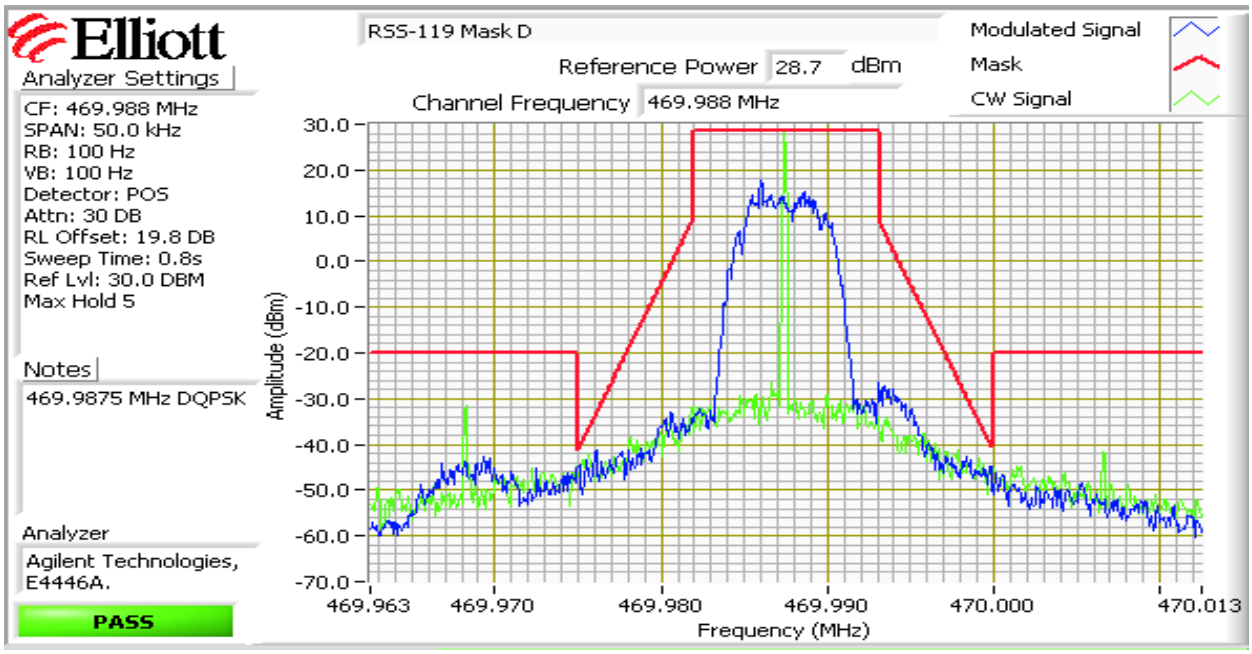
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A





Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A





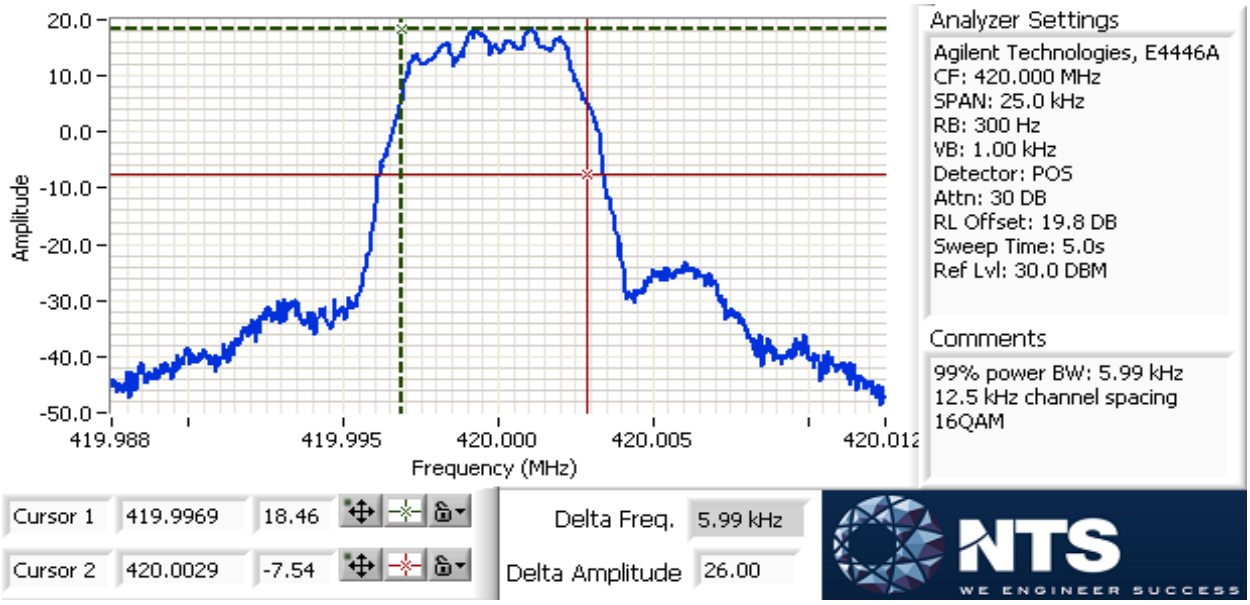
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

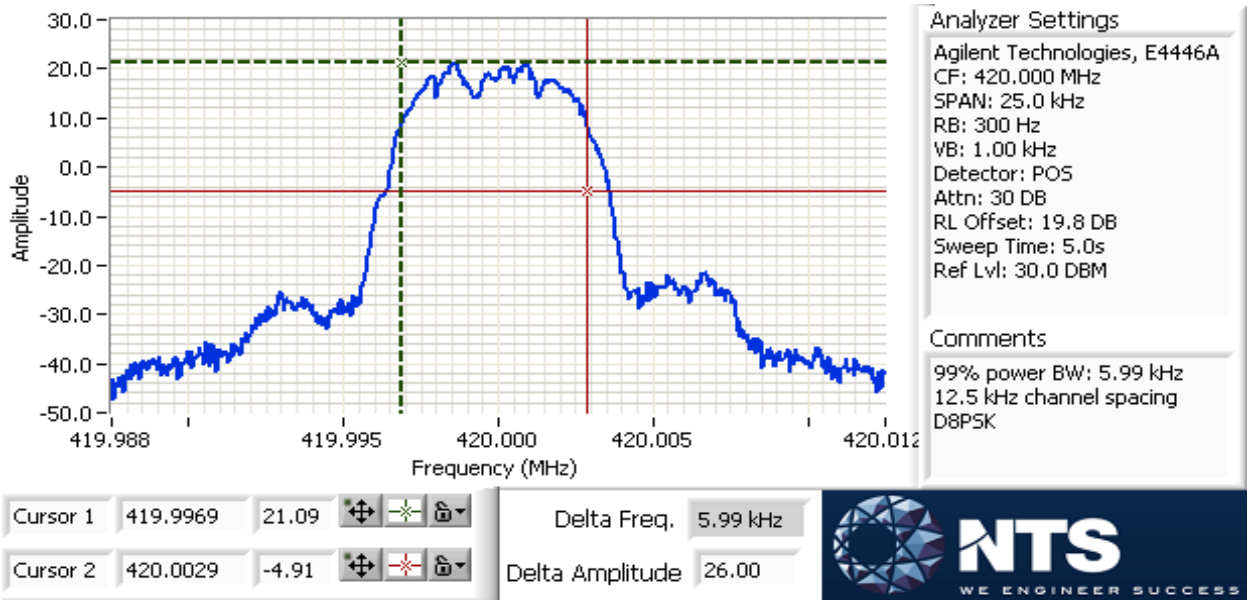
Run #3: Signal Bandwidth

Date: 8/7/2012 Engineer: Deniz Demirci Location: FT Lab# 4

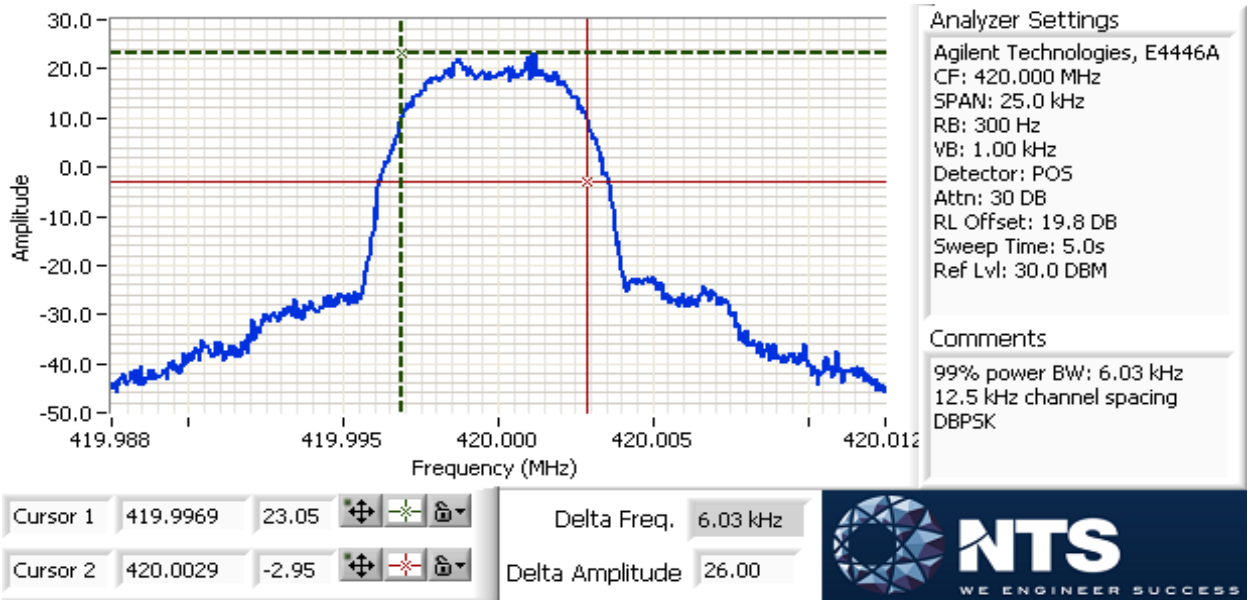
Frequency (MHz)	Power Setting	Modulation	Channel spacing	Authorized BW	Bandwidth (kHz)
420.0000	29 dBm	DBPSK	12.5 kHz	11.25 kHz	6.0
	29 dBm	DQPSK	12.5 kHz	11.25 kHz	6.1
	29 dBm	D8PSK	12.5 kHz	11.25 kHz	6.0
	29 dBm	16QAM	12.5 kHz	11.25 kHz	6.0
460.0000	29 dBm	DBPSK	12.5 kHz	11.25 kHz	6.0
	29 dBm	DQPSK	12.5 kHz	11.25 kHz	6.1
	29 dBm	D8PSK	12.5 kHz	11.25 kHz	6.0
	29 dBm	16QAM	12.5 kHz	11.25 kHz	6.0

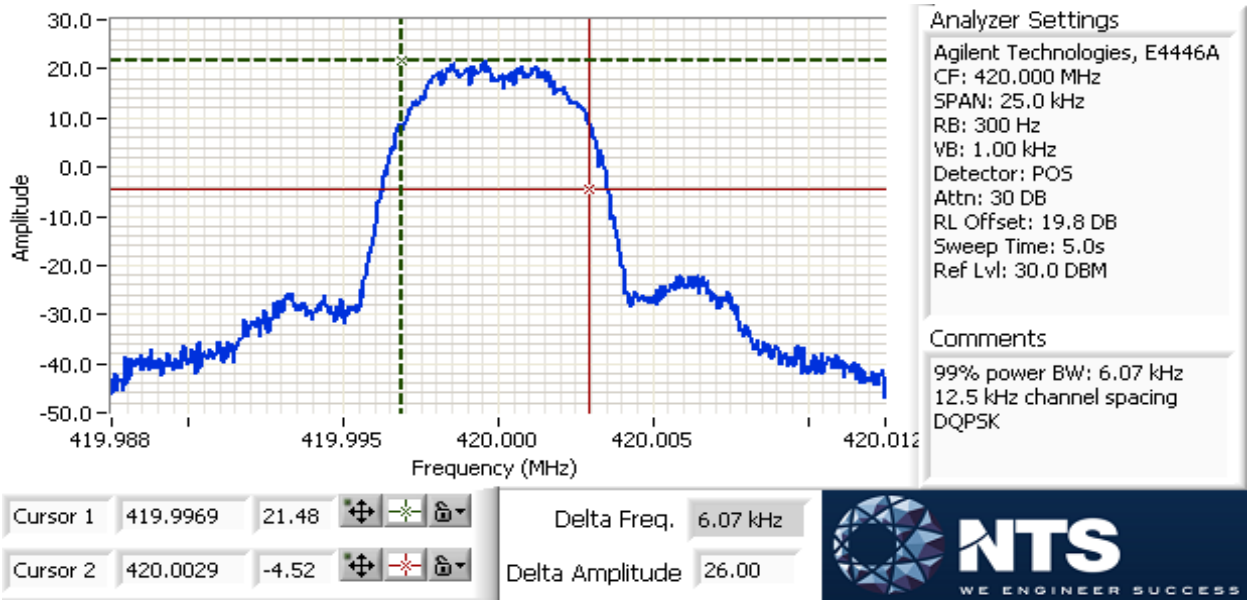
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A



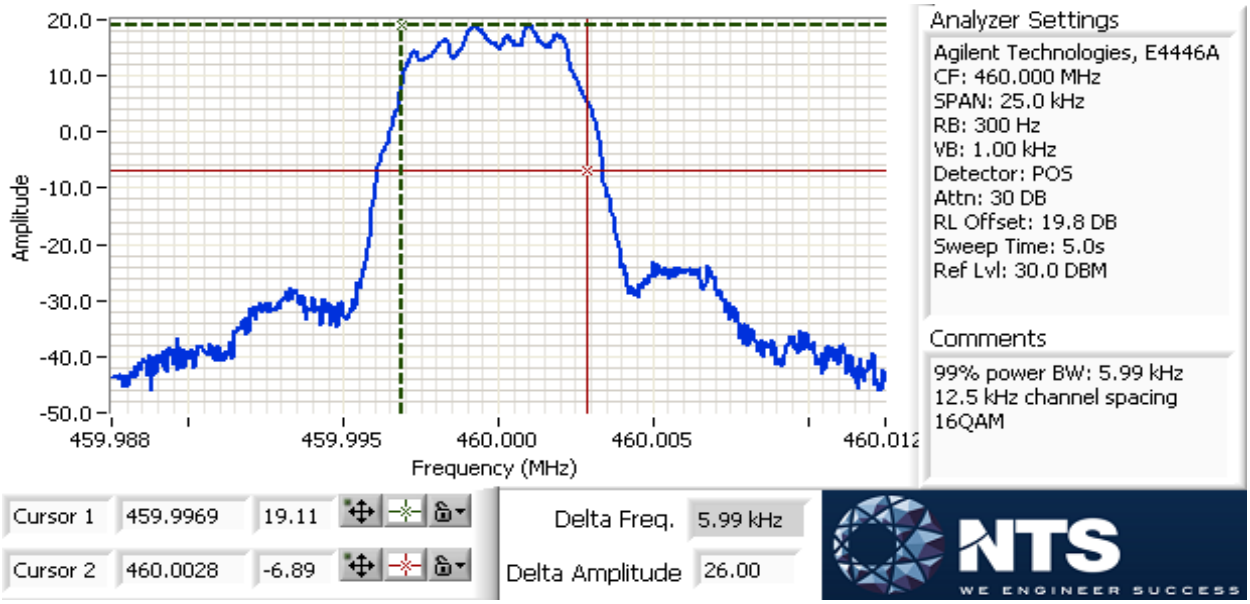


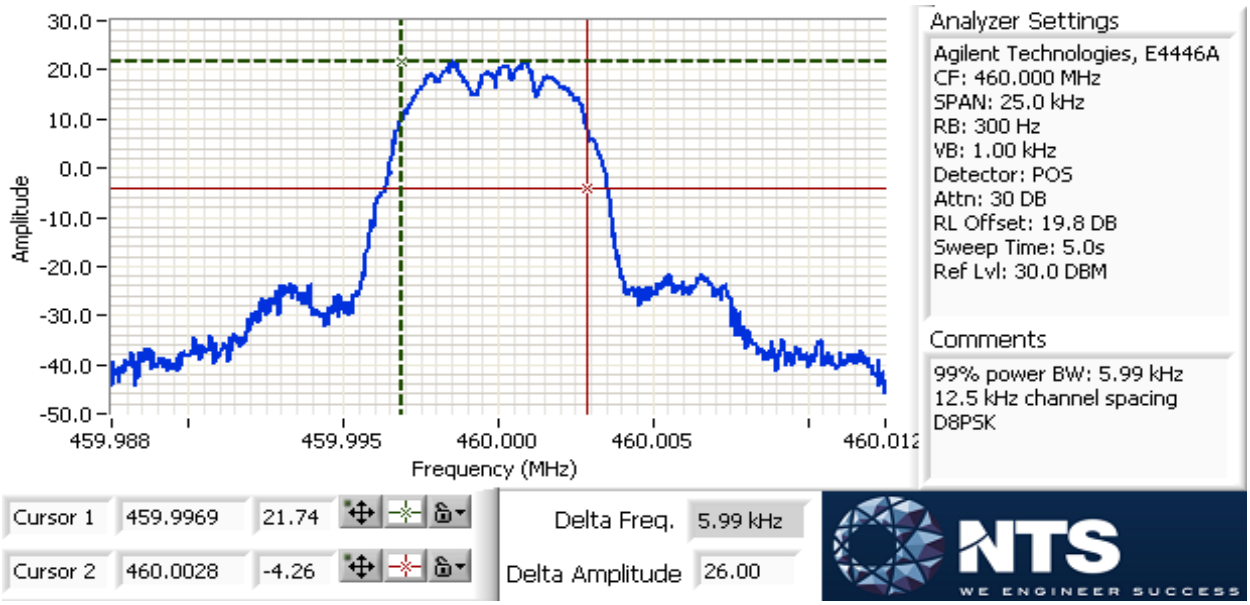
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A



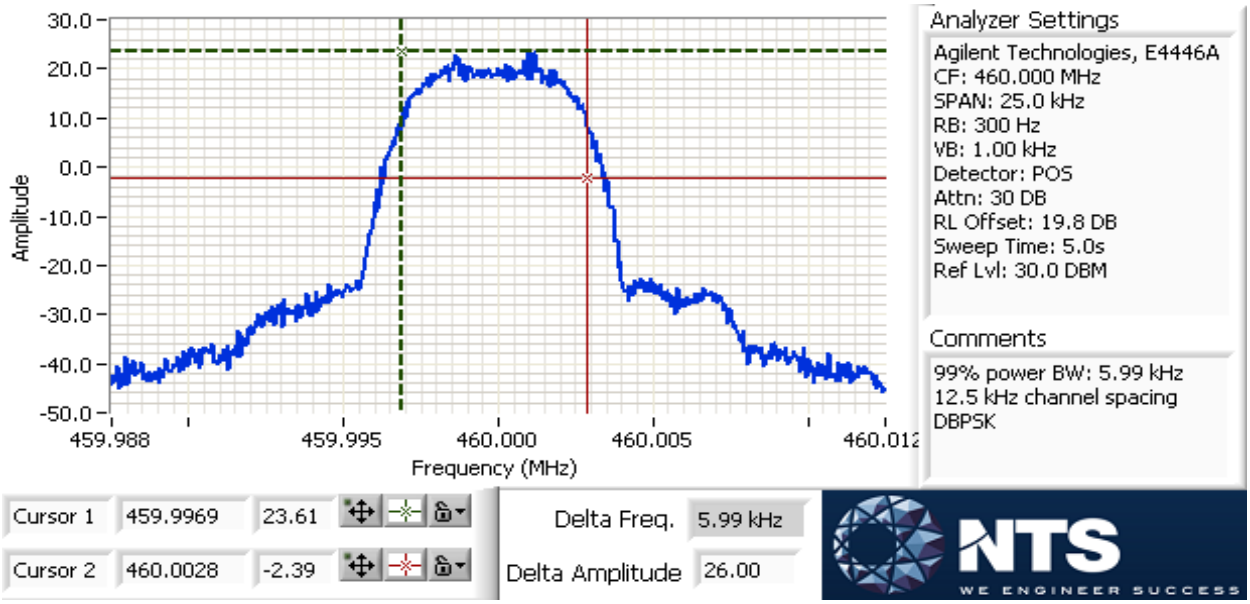


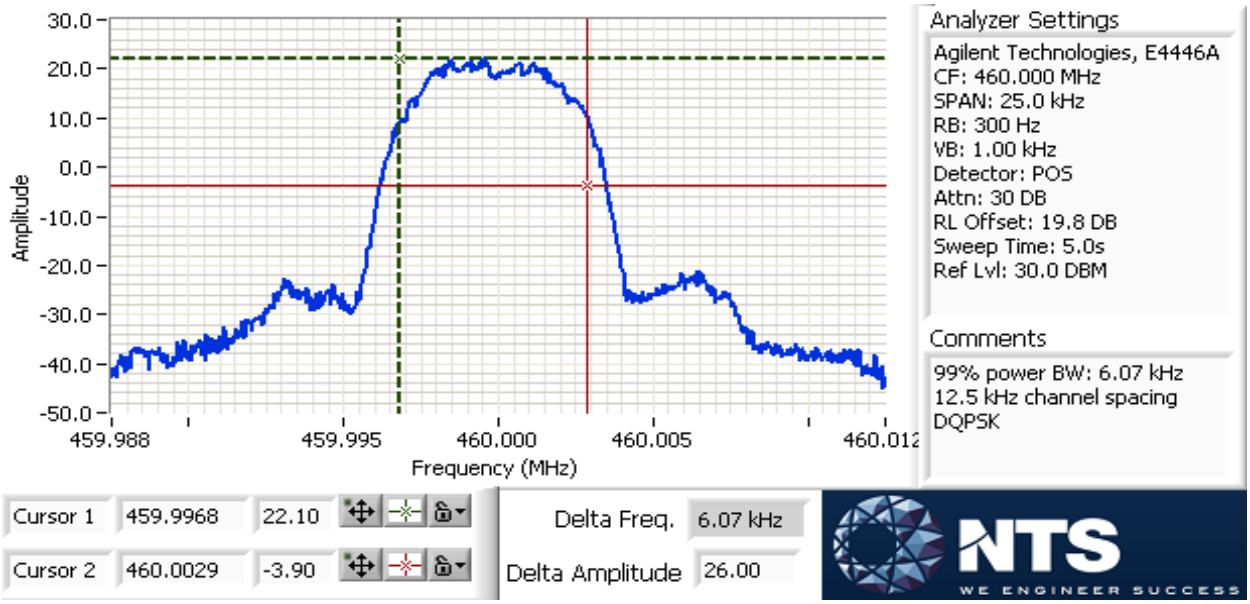
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A





Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A



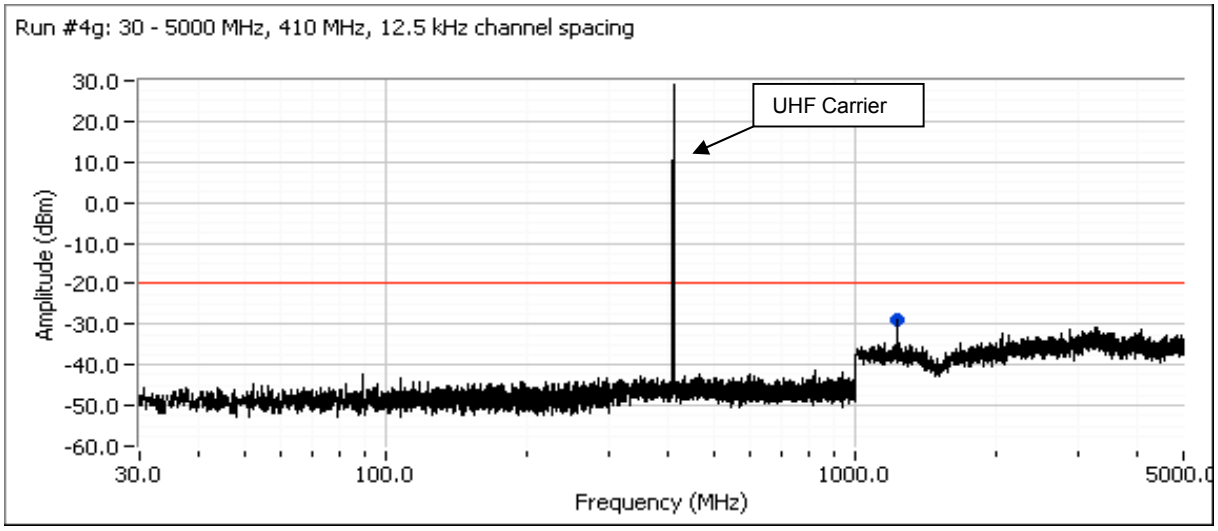


Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #4: Out of Band Spurious Emissions, Conducted

Date: 8/8/2012 Engineer: Deniz Demirci Location: FT Lab# 4

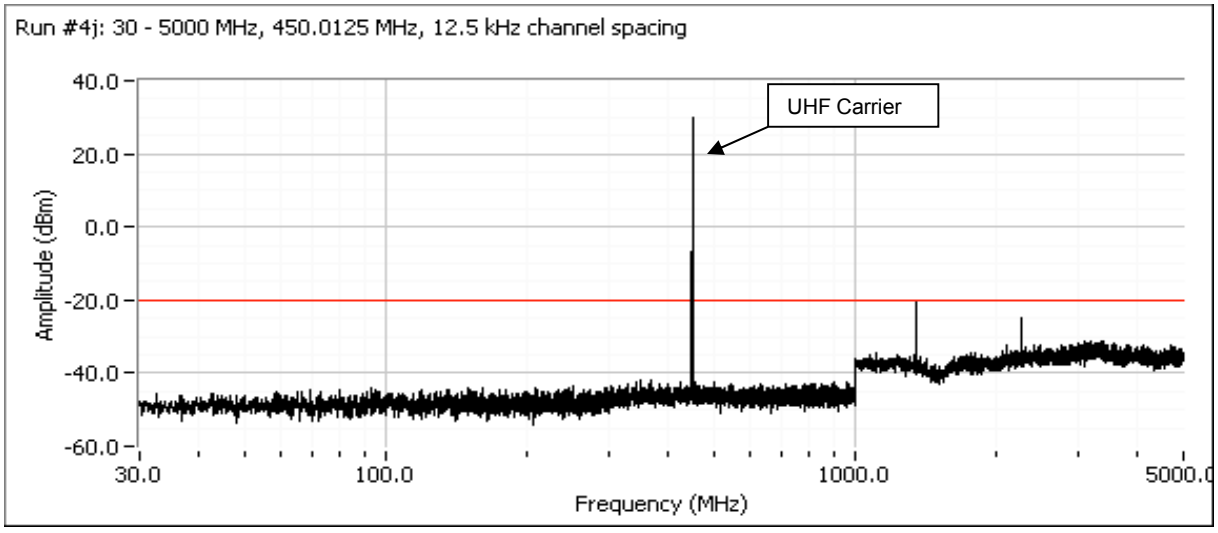
Plots for low channel, 410 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm



Frequency	Level	Port			Detector	Comments
MHz	dBm	-	Limit	Margin	Pk/QP/Avg	
1229.710	-28.7	RF Port	-20.0	-8.7	PK	PK (CISPR)-RB 1 MHz; VB: 8 MHz

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

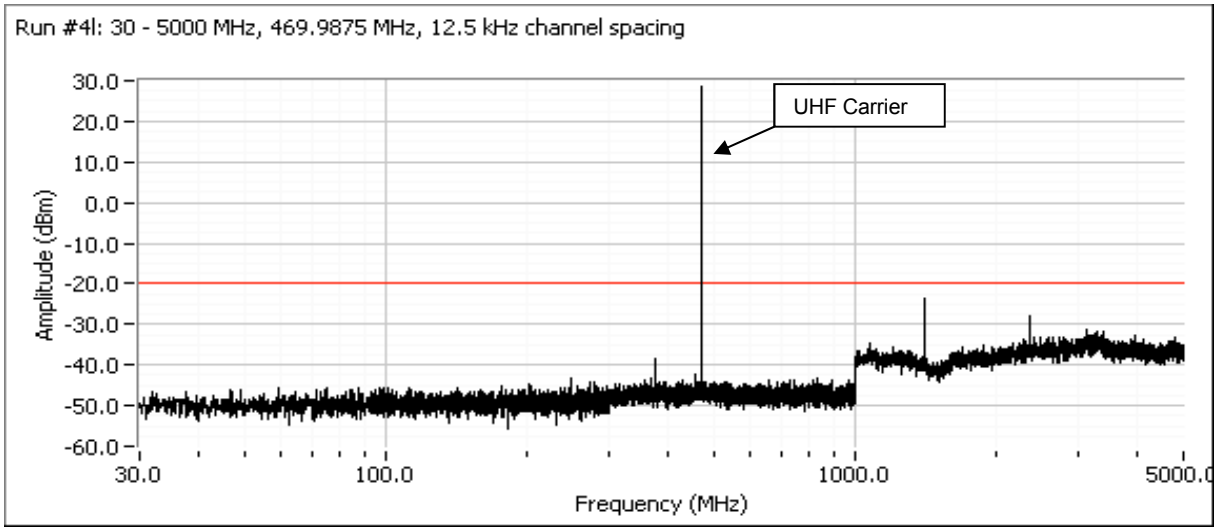
Plots for low channel, 450.0125 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm



Frequency	Level	Port			Detector	Comments
MHz	dBm	-	Limit	Margin	Pk/QP/Avg	
1350.030	-20.3	RF Port	-20.0	-0.3	PK	PK (CISPR)-RB 1 MHz; VB: 8 MHz
2249.900	-26.0	RF Port	-20.0	-6.0	PK	PK (CISPR)-RB 1 MHz; VB: 8 MHz

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Plots for High channel, 469.9875 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm



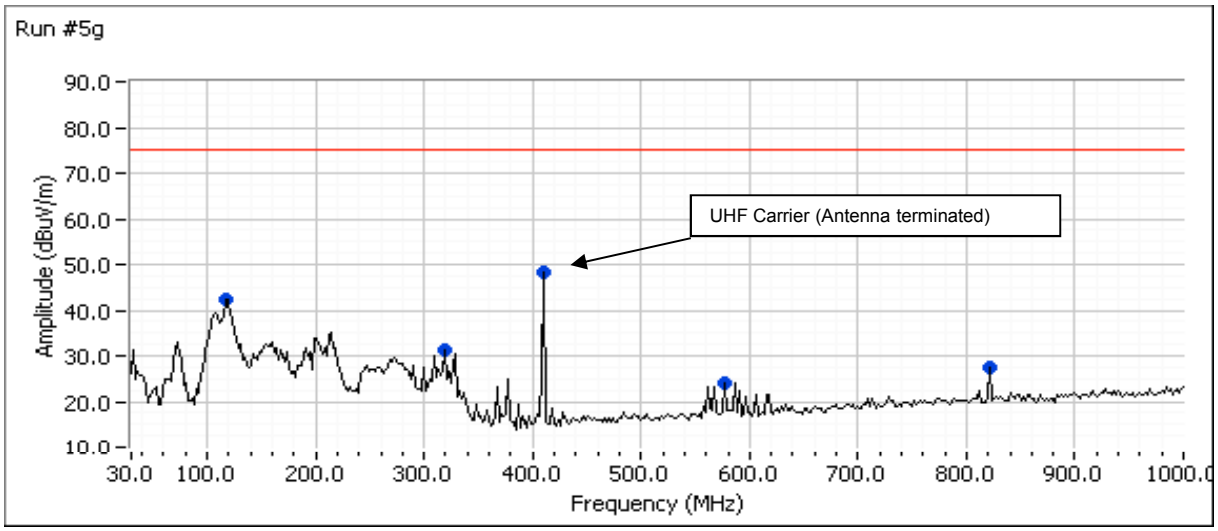
Frequency	Level	Port			Detector	Comments
MHz	dBm	-	Limit	Margin	Pk/QP/Avg	
1409.780	-24.2	RF Port	-20.0	-4.2	PK	PK (CISPR)-RB 1 MHz; VB: 8 MHz
2349.740	-27.8	RF Port	-20.0	-7.8	PK	PK (CISPR)-RB 1 MHz; VB: 8 MHz

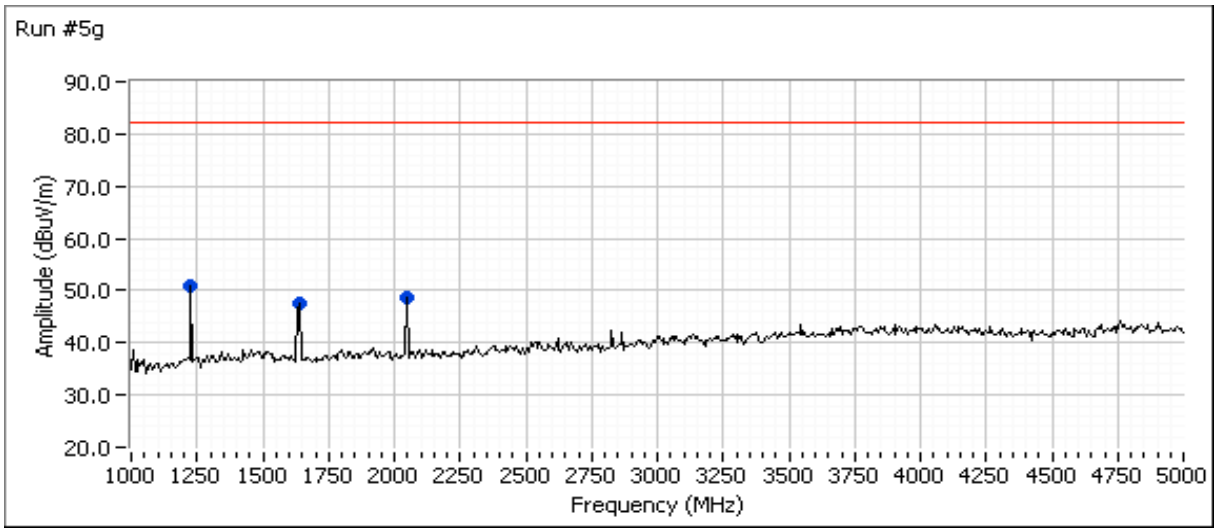
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #5: Out of Band Spurious Emissions, Radiated

Date: 8/17/2012 - 8/22/2012 Engineer: Deniz Demirci FT Chamber# 5 / #3

Plots for low channel, 410 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm





Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

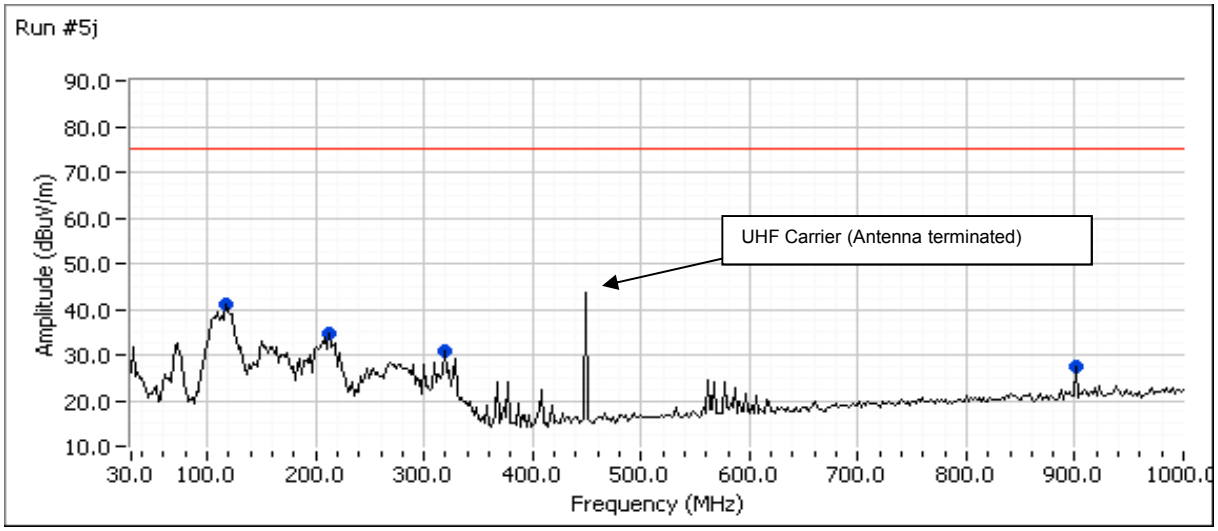
Low channel, 410 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm

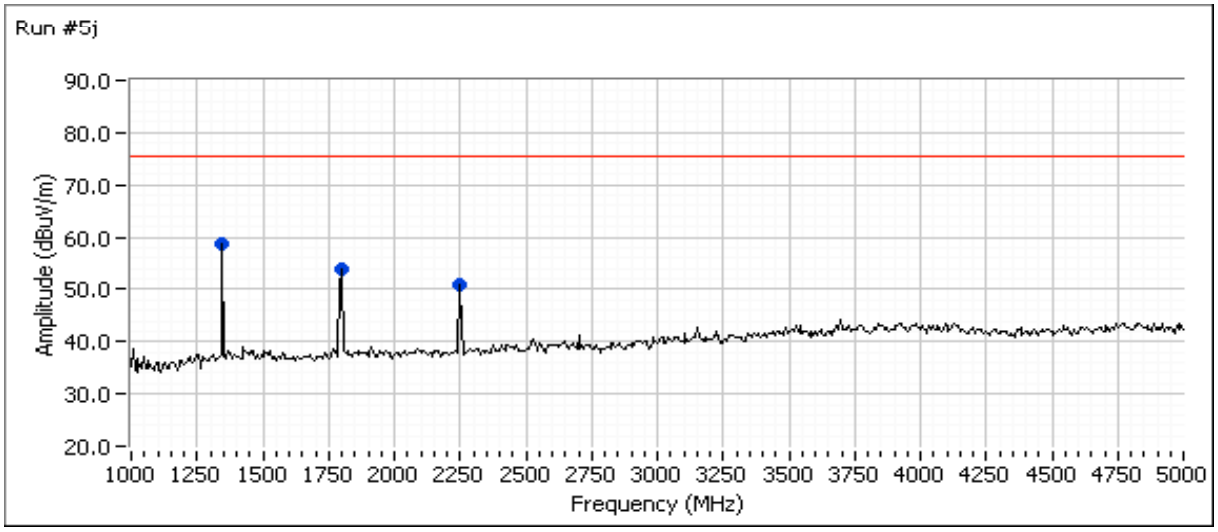
Frequency	Level	Pol	RSS-119		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
117.475	*42.3*	*V*	*75.3*	*-33.0*	*Peak*	*24*	*1.0*	
319.639	*31.4*	*H*	*75.3*	*-43.9*	*Peak*	*300*	*1.0*	
576.232	*24.0*	*H*	*75.3*	*-51.3*	*Peak*	*300*	*1.5*	
821.162	*27.6*	*H*	*75.3*	*-47.7*	*Peak*	*88*	*1.0*	
1226.670	*50.9*	*V*	*75.3*	*-24.4*	*Peak*	*208*	*2.0*	
1640.000	*47.7*	*V*	*75.3*	*-27.6*	*Peak*	*249*	*1.0*	
2046.670	*48.6*	*V*	*75.3*	*-26.7*	*Peak*	*305*	*1.0*	

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 20dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Measurements are made with the antenna port terminated.

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Plots for mid channel, 450.0125 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm





Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Mid channel, 450.0125 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm

Frequency	Level	Pol	RSS-119		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
117.475	*41.0*	*V*	*75.3*	*-34.3*	*Peak*	*316*	*1.0*	
212.725	*34.6*	*V*	*75.3*	*-40.7*	*Peak*	*234*	*1.0*	
319.639	*30.7*	*H*	*75.3*	*-44.6*	*Peak*	*310*	*1.0*	
900.862	*27.4*	*V*	*75.3*	*-47.9*	*Peak*	*71*	*1.0*	
1346.670	*58.9*	*V*	*75.3*	*-16.4*	*Peak*	*50*	*1.5*	
1800.000	*53.7*	*V*	*75.3*	*-21.6*	*Peak*	*197*	*2.0*	
2246.670	*50.9*	*V*	*75.3*	*-24.4*	*Peak*	*315*	*1.5*	

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 20dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Measurements are made with the antenna port terminated.

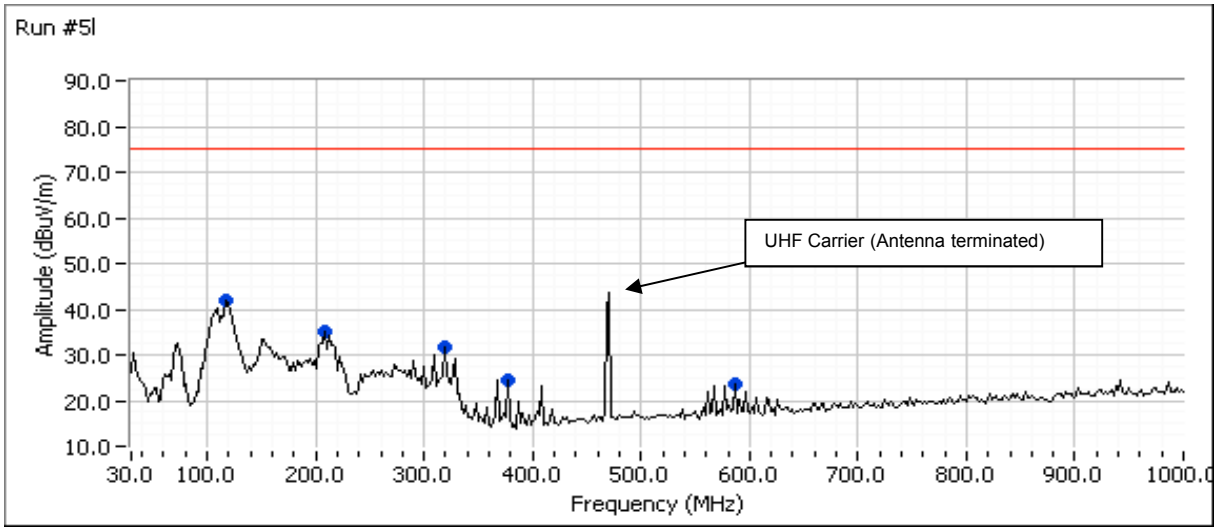
Substitution measurements
Vertical

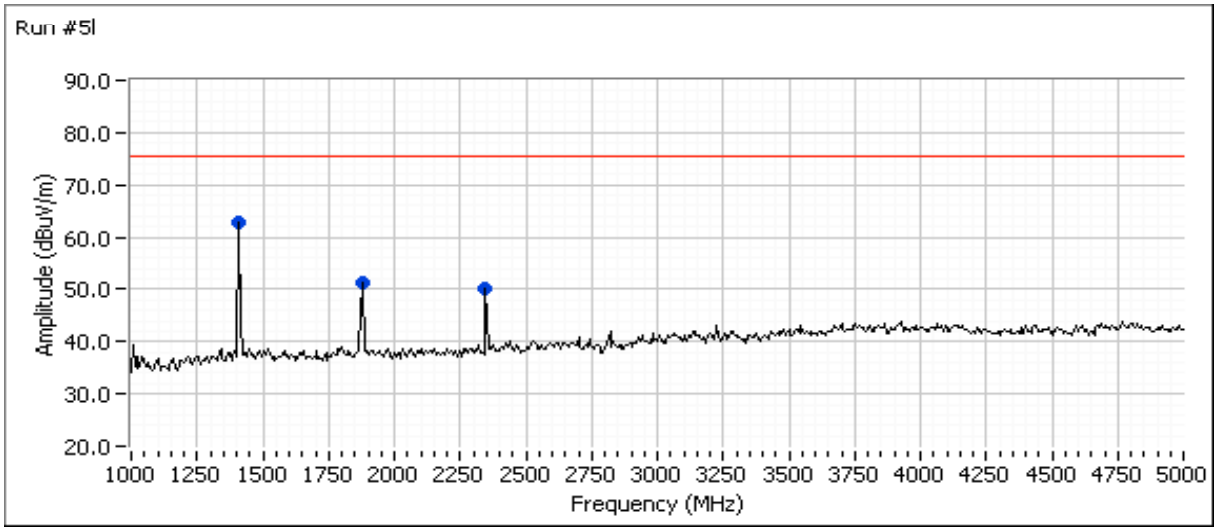
Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1346.670	-30.8	6.9	72.6	96.5	58.9	-37.6	-39.8		-20.0	-19.8

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

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Plots for High channel, 469.9875 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm





Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

High channel, 469.9875 MHz, 12.5 kHz Channel spacing, power setting(s) = 29 dBm

Frequency	Level	Pol	RSS-119		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
117.475	*41.8*	*V*	*75.3*	*-33.5*	*Peak*	*335*	*1.0*	
208.838	*34.9*	*V*	*75.3*	*-40.4*	*Peak*	*239*	*1.0*	
319.639	*31.6*	*H*	*75.3*	*-43.7*	*Peak*	*304*	*1.0*	
377.956	*24.6*	*H*	*75.3*	*-50.7*	*Peak*	*129*	*1.0*	
585.952	*23.6*	*V*	*75.3*	*-51.7*	*Peak*	*177*	*1.0*	
1406.670	*63.0*	*V*	*75.3*	*-12.3*	*Peak*	*357*	*1.0*	
1880.000	*51.1*	*V*	*75.3*	*-24.2*	*Peak*	*115*	*1.5*	
2346.670	*50.2*	*V*	*75.3*	*-25.1*	*Peak*	*237*	*1.5*	

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 20dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Measurements are made with the antenna port terminated.

Substitution measurements
Vertical

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1406.670	-30.8	7.8	73.7	96.7	63.0	-33.7	-35.9		-20.0	-15.9

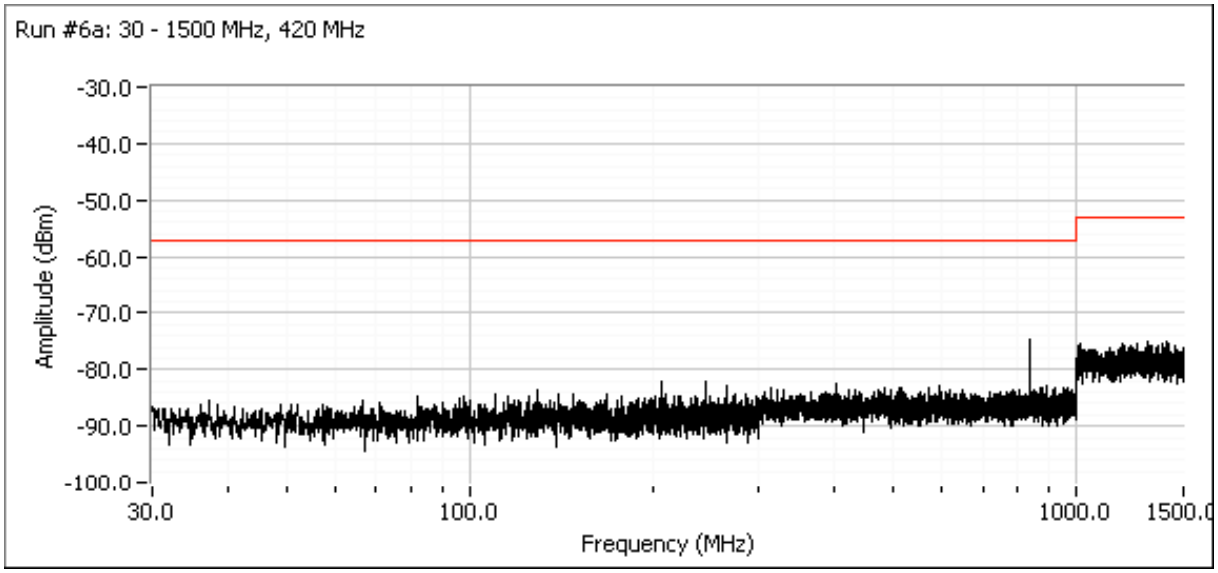
Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an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

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #6: RX Spurious Emissions, Conducted

Date: 8/8/2012 Engineer: Deniz Demirci Location: FT Lab# 4

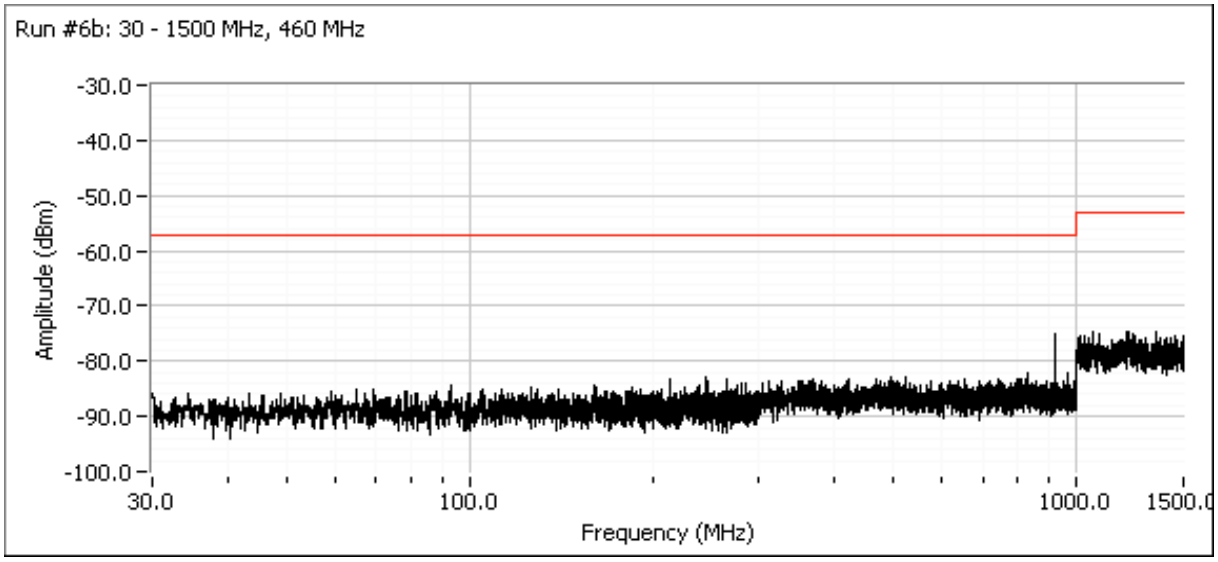
Plots for Mid channel, 420 MHz,



Frequency	Level	Port	RSS119		Detector	Comments
MHz	dBm	-	Limit	Margin	Pk/QP/Avg	
840.007	-73.6	RF Port	-57.0	-16.6	PK	PK (CISPR)-RB 120 kHz; VB: 1 MHz

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Plots for Mid channel, 460 MHz



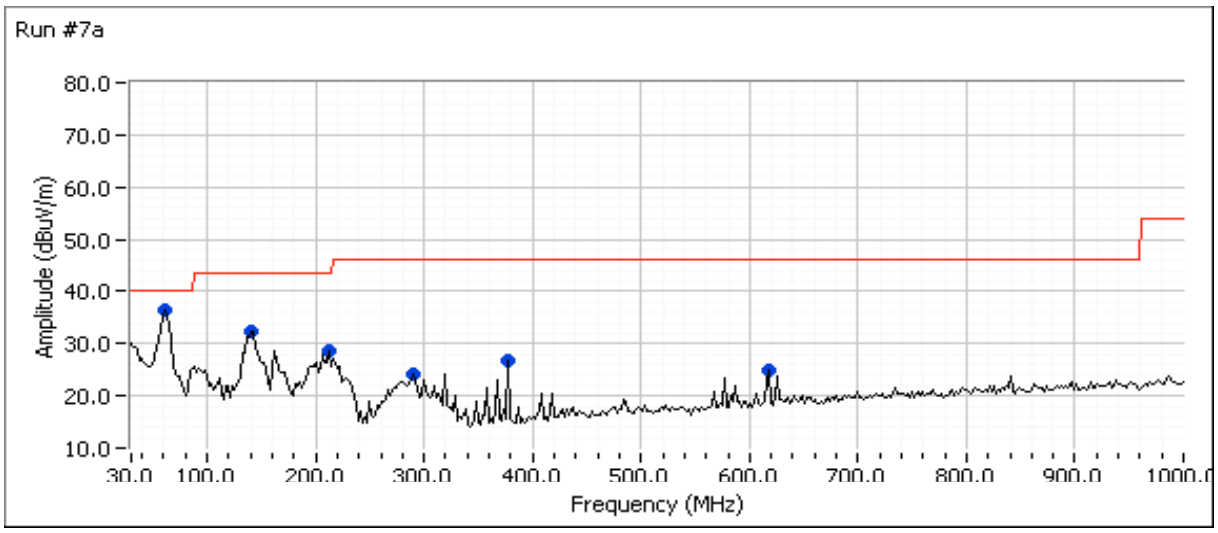
Frequency	Level	Port	RSS119		Detector	Comments
MHz	dBm	-	Limit	Margin	Pk/QP/Avg	
920.009	-74.0	RF Port	-57.0	-17.0	PK	PK (CISPR)-RB 120 kHz; VB: 1 MHz

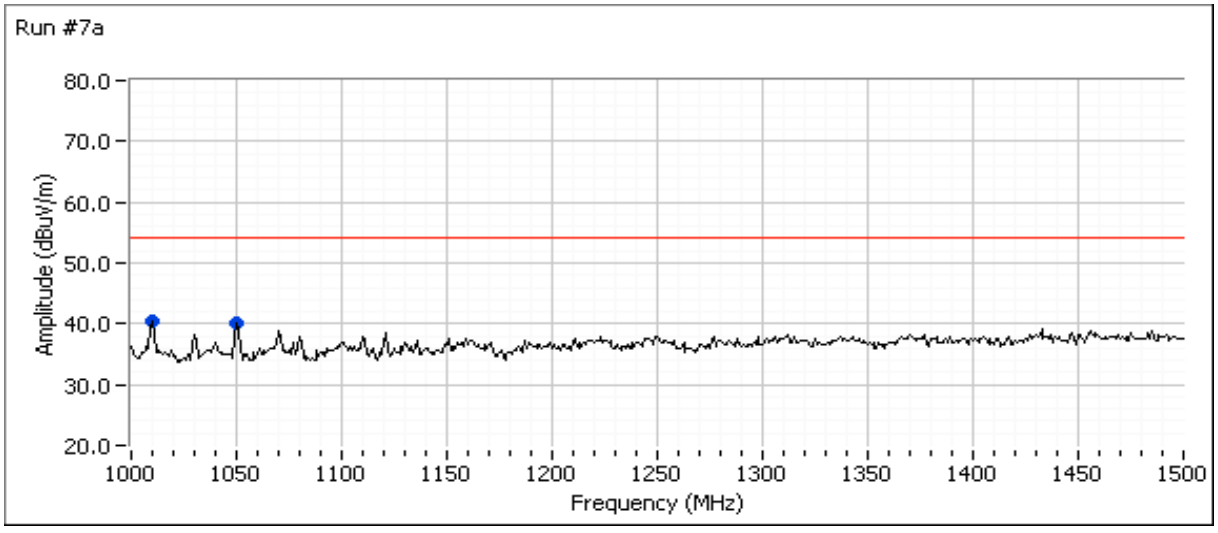
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #7: RX Spurious Emissions, Radiated

Date: 8/22/2012 Engineer: Deniz Demirci FT Chamber#3

Plots for Mid channel, 420 MHz,





Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

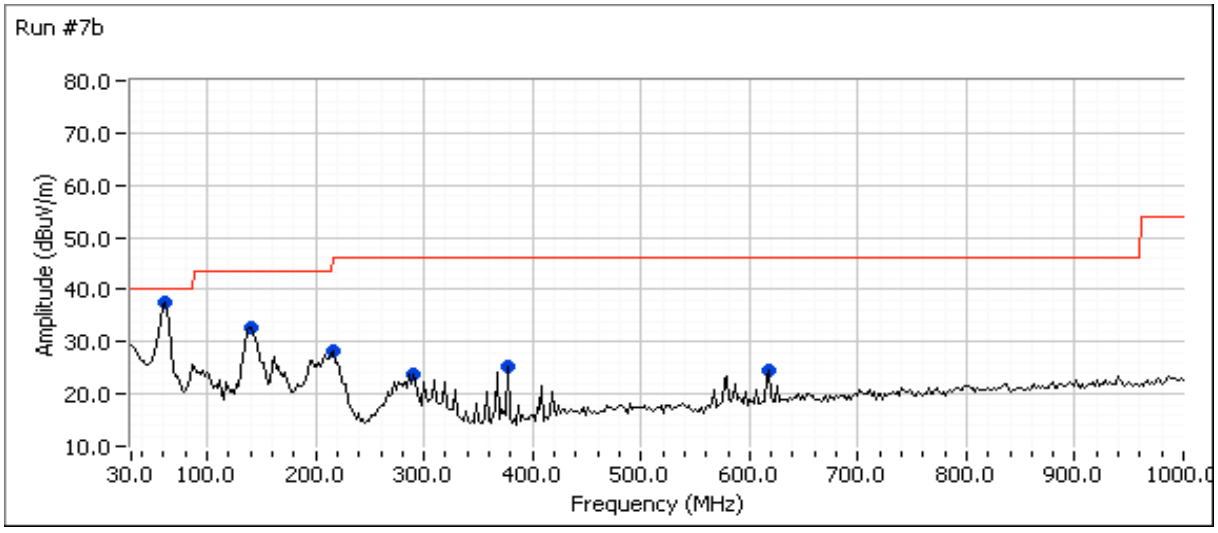
Rx Mid channel, 420 MHz,

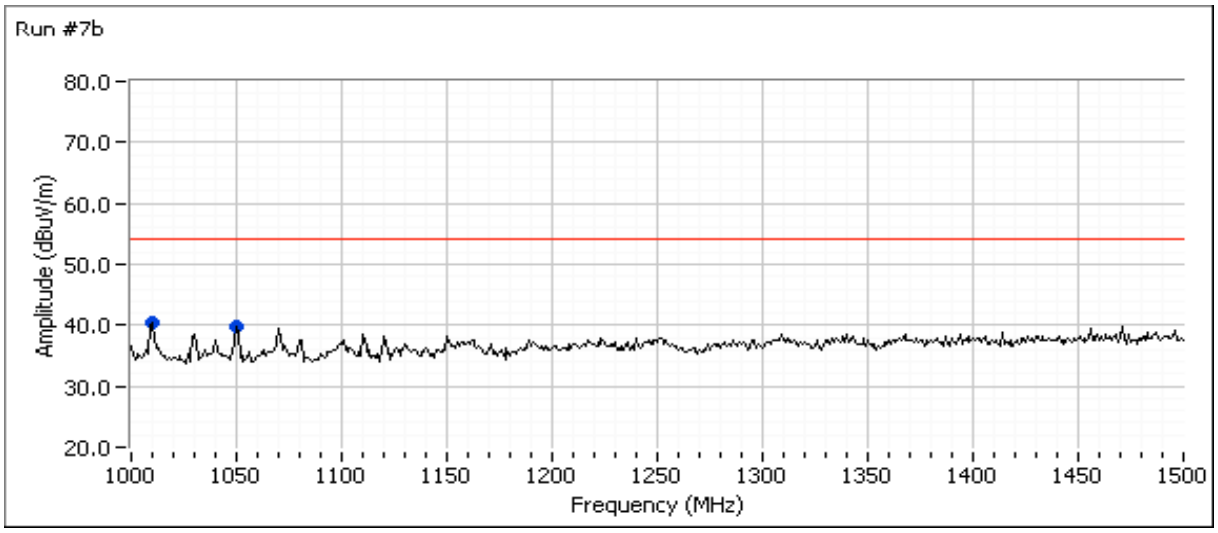
Frequency	Level	Pol	RSS-Gen		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
61.347	*35.0*	*V*	*40.0*	*-5.0*	*QP*	*303*	*1.0*	*QP (1.00s)*
140.806	*29.6*	*V*	*43.5*	*-13.9*	*QP*	*287*	*1.0*	*QP (1.00s)*
211.244	*23.4*	*V*	*43.5*	*-20.1*	*QP*	*78*	*1.0*	*QP (1.00s)*
290.011	*23.0*	*H*	*46.0*	*-23.0*	*QP*	*278*	*1.0*	*QP (1.00s)*
378.473	*26.6*	*H*	*46.0*	*-19.4*	*QP*	*75*	*1.0*	*QP (1.00s)*
616.008	*21.6*	*H*	*46.0*	*-24.4*	*QP*	*107*	*2.5*	*QP (1.00s)*
1010.000	*40.5*	*V*	*54.0*	*-13.5*	*Peak*	*320*	*2.0*	*PK*
1050.000	*40.2*	*V*	*54.0*	*-13.8*	*Peak*	*262*	*1.5*	*PK*

Note 1:	Measurements are made with the antenna connected to the EUT

Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Plots for Mid channel, 460 MHz





Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Rx Mid channel, 460 MHz

Frequency	Level	Pol	RSS-Gen		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
61.417	*35.3*	*V*	*40.0*	*-4.7*	*QP*	*257*	*1.0*	*QP (1.00s)*
139.399	*29.1*	*V*	*43.5*	*-14.4*	*QP*	*268*	*1.0*	*QP (1.00s)*
215.217	*22.2*	*V*	*43.5*	*-21.3*	*QP*	*48*	*1.0*	*QP (1.00s)*
290.011	*22.5*	*H*	*46.0*	*-23.5*	*QP*	*96*	*1.0*	*QP (1.00s)*
378.403	*20.3*	*H*	*46.0*	*-25.7*	*QP*	*86*	*1.0*	*QP (1.00s)*
617.524	*14.7*	*H*	*46.0*	*-31.3*	*QP*	*343*	*1.4*	*QP (1.00s)*
1010.000	*40.4*	*V*	*54.0*	*-13.6*	*Peak*	*0*	*2.0*	*PK*
1050.000	*39.7*	*V*	*54.0*	*-14.3*	*Peak*	*228*	*1.5*	*PK*

Note 1:	Measurements are made with the antenna connected to the EUT

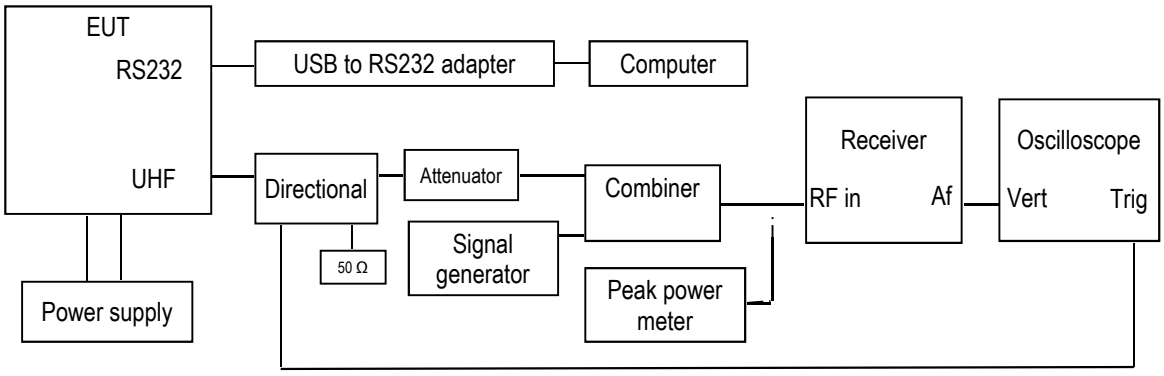
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #8: Transient Frequency Behaviour

Date: 8/8/2012 Engineer: Deniz Location: FT Lab# 4

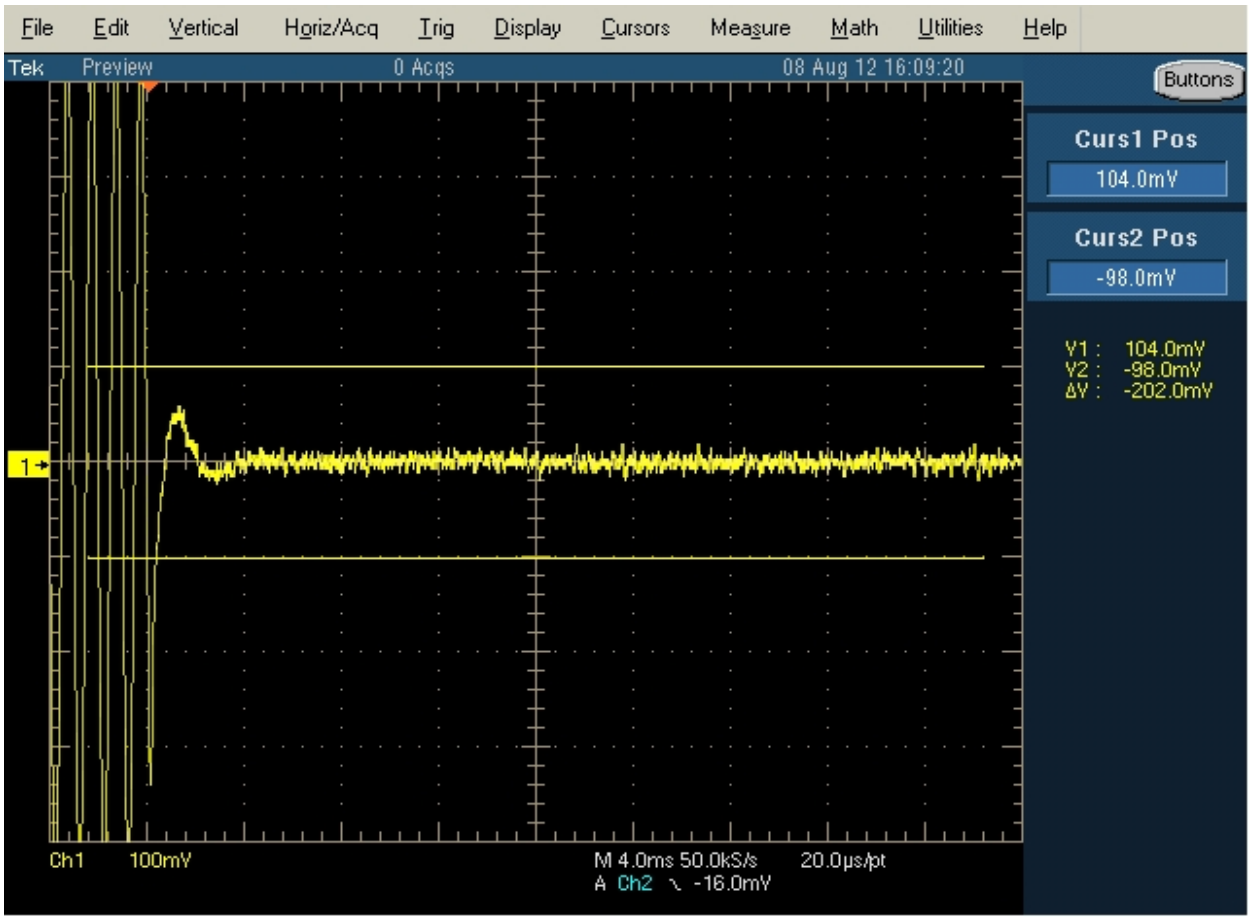
Transient frequency Behaviour measurements setup

Note: The test has been performed with the method given in ANSI / TIA 603-C (2.2.19)



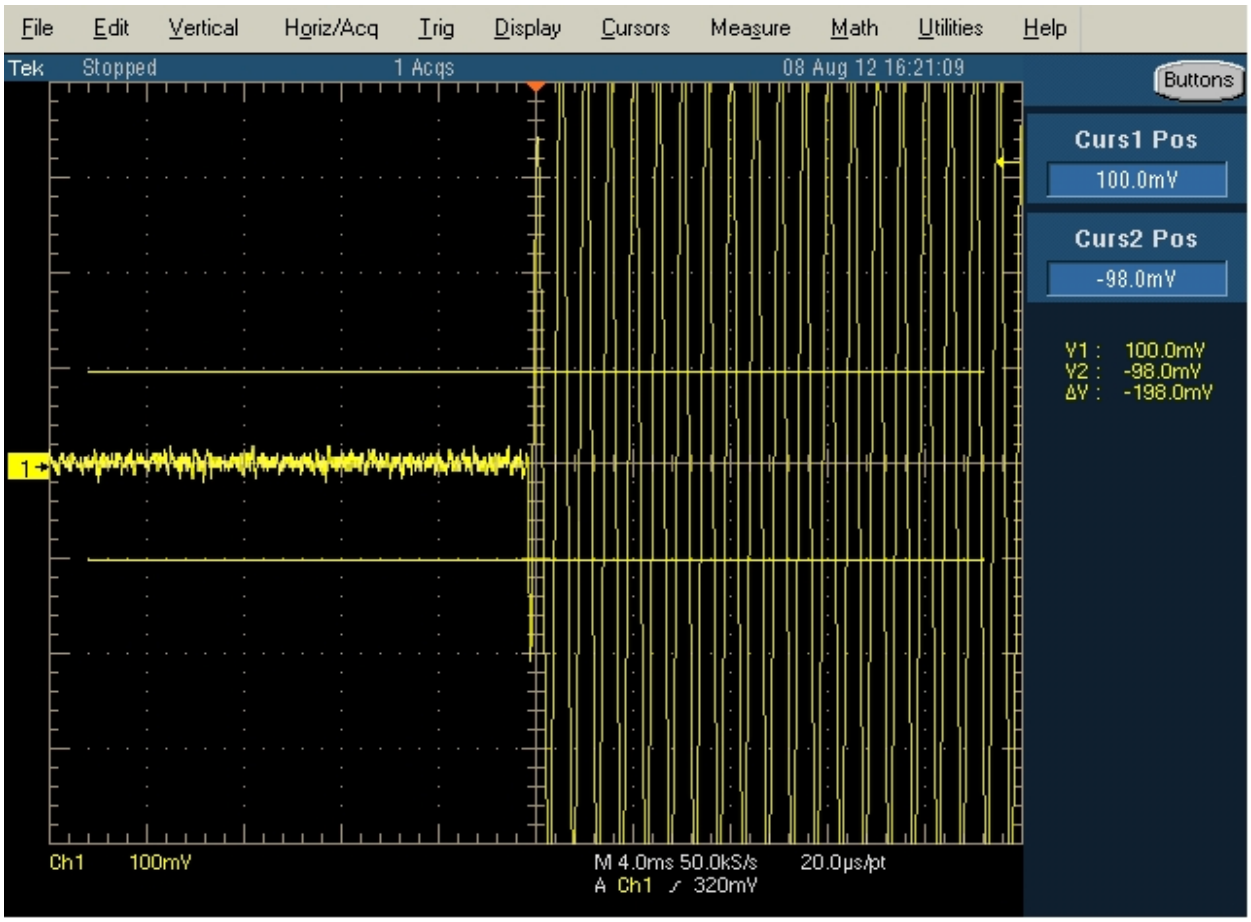
Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #9a
Carrier Frequency: 420 MHz
Channel Spacing: None
Modulation: CW
Description: Switch on condition ton, t1, and t2



Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #9b
Carrier Frequency: 420 MHz
Channel Spacing: None
Modulation: CW
Description: Switch off condition t3 and toff



Client:	Topcon Positioning Systems	Job Number:	J90758
Model:	HiPer GA	T-Log Number:	T88703
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC Part 90	Class:	N/A

Run #9: Frequency stability

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
-23	419.999520	-480	1.1
-20	419.999520	-480	1.1
-10	419.999552	-448	1.1
0	419.999598	-402	1.0
10	419.999598	-402	1.0
20	419.999492	-508	1.2
30	419.999488	-512	1.2
40	419.999472	-528	1.3
50	419.999493	-507	1.2
Worst case:	419.999472	-528	1.3

Frequency Stability Over Input Voltage
Nominal Voltage is 7.4 Vdc (Battery voltage).
Battery endpoint is 5.2. Vdc

Voltage	Frequency Measured	Drift	
(Dc)	(MHz)	(Hz)	(ppm)
5.2	419.999499	-501	1.2

Note 1: Maximum drift of fundamental frequency before it shut down at 5.2 Vdc.

End of Report

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