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EMC Test Report

Application for Grant of Equipment Authorization

Industry Canada RSS-Gen Issue 3 / RSS 210 Issue 8
FCC Part 15 Subpart C

Model: HIPER V and GRX2

IC CERTIFICATION #:	6050B-090511A
FCC ID:	LCB-090511
APPLICANT:	Topcon Positioning Systems 7400 National Drive Livermore, CA 94550
TEST SITE(S):	NTS Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	12-20-2012	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Topcon Positioning Systems model HIPER V and GRX2, pursuant to the following rules:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

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
FHSS test procedure DA 00-0705A1, March 2000

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

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

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.

Testing was performed on one configuration of the model HIPER V and GRX2. The configuration tested was considered representative of the following configurations.

1. GPS receiver with Bluetooth module, 900MHz module
2. GPS receiver with Bluetooth module, 900MHz module, HSPA module (configuration tested)

Note, the HSPA and Bluetooth modules used are FCC/IC pre-approved radio modules.

The Hiper V and GRX2 are identical systems. The GRX2 is the model number for an alternate brand.

OBJECTIVE

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

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

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.).

STATEMENT OF COMPLIANCE

The tested sample of Topcon Positioning Systems model HIPER V and GRX2 complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

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.

The test results recorded herein are based on a single type test of Topcon Positioning Systems model HIPER V and GRX2 and therefore apply only to the tested sample. The sample was selected and prepared by Ferdinand Riodique of Topcon Positioning Systems.

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS SUMMARY

FREQUENCY HOPPING SPREAD SPECTRUM (902 – 928 MHz, 50 channels or more)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247 (a) (1)	RSS 210 A8.1 (1)	20dB Bandwidth	158 kHz	Channel spacing > 20dB bandwidth / 25kHz	Complies
		Channel Separation	200 kHz		Complies
15.247 (a) (1) (i)	RSS 210 A8.1 (3)	Number of Channels	128	50 or more	Complies
15.247 (a) (1) (i)	RSS 210 A8.1 (3)	Channel Dwell Time	0.169 seconds per 20 seconds	<0.4 second within a 20 second period	Complies
15.247 (a) (1)	RSS 210 A8.1 (1)	Channel Utilization	All channels are used equally - refer to the operational description for full explanation	All channels shall, on average, be used equally	Complies
15.247 (b) (3)	RSS 210 A8.4 (1)	Output Power	28.8 dBm (0.764 Watts) EIRP = 1.36 W Note 1	1Watt, EIRP < 4 Watts	Complies
15.247 (c)	RSS 210 A8.5	Antenna Port Spurious Emissions 30MHz – 9.28 GHz	All spurious emissions < -20dBc	< -20dBc	Complies
15.247 (c) 15.209	RSS 210 A8.5 Table 2, 3	Radiated Spurious Emissions 30MHz – 9.28 GHz	53.7 dBµV/m @ 2706.7 MHz (-0.3 dB)	15.207 in restricted bands, all others < -20dBc	Complies
15.247 (a) (1)	RSS 210 A8.1(2)	Receiver bandwidth	Refer to operational description	Shall match the channel bandwidth	Complies
Note 1: EIRP calculated using antenna gain of 2.5 dBi for the highest EIRP system.					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	860-960 MHz Sleeve Dipole. TNC male reverse polarity	Unique or integral antenna required	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	36.2 dBµV @ 2.990 MHz (-23.8 dB)	Refer to page 17	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	43.8dBµV/m @ 2453.3MHz (-10.2dB)	Refer to page 18	Complies
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in Exhibit 11, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual	-	Statement required regarding non-interference	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual	-	Statement for products with detachable antenna	Complies
-	RSP 100 RSS GEN 4.4.1	99% Bandwidth	180kHz	Information only	N/A

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 and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBµV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Topcon Positioning Systems model HIPER V and GRX2 is a GPS GNS receiver that is designed for land surveying. The EUT was configured for testing, as a Topcon Positioning Systems, Inc. customer would normally use it. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). The EUT was tested in a table top configuration. The electrical rating of the EUT is 7.2 Volts dc, 100-240 Volts AC, 50-60 Hz, 2.20 mAH, (0.8 Amps - AC).

The sample was received on October 1, 2012 and tested on October 7 and 9, November 13 and December 3, 2012. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
TopCon	HIPER V	GPS Receiver	1132-PP001 1132-PP002 1133-PP003	

OTHER EUT DETAILS

The HIPER V and GRX2 comes in various configurations. All use the same GPS receiver circuitry and antenna.

1. GPS receiver with Bluetooth module, 900MHz module
2. GPS receiver with Bluetooth module, 900MHz module, HSPA module

Testing was performed using configuration 2.

The EUT is intended to be battery powered during normal operation. An optional AC/DC adapter is available to operate the device in the case of a discharged battery. The adapter cannot be used to charge the device battery.

ANTENNA SYSTEM

2.10dBi dipole antenna

ENCLOSURE

The EUT enclosure measures approximately 18 cm in diameter by 10 cm. It is primarily constructed of aluminum and plastic.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

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

Company	Model	Description	Serial Number	FCC ID
Phihong	PSC30U-120	AC/DC Adapter	P01702775C2	N/A

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
IBM	ThinkPad 2373	Laptop Computer	L3-X5ZKP	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Serial	Laptop Computer	Multiconductor	Shielded	10
Power	AC/DC Adapter	Multiconductor	Shielded	2
RF Port	Antenna (direct connection)	-	-	-

EUT OPERATION

During testing, the EUT was configured to continuously transmit at the noted channel at its maximum output power.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 7	A2LA accreditation	2845B-7	41039 Boyce Road Fremont, CA 94538-2435

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

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

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

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. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

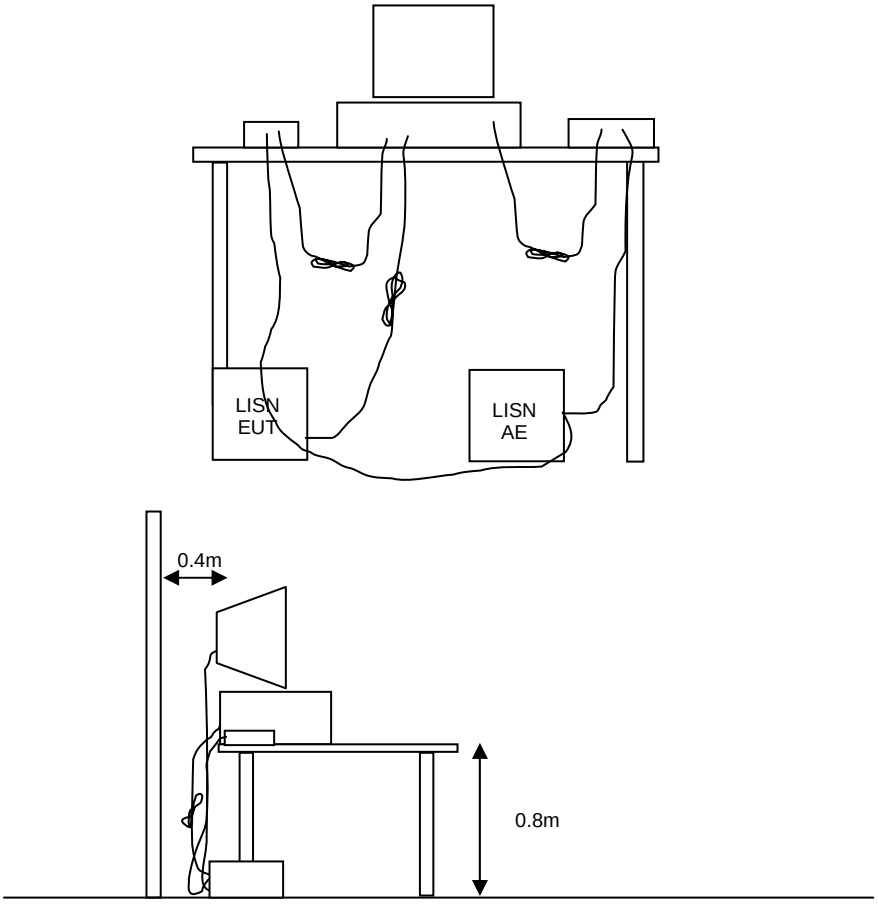


Figure 1 Typical Conducted Emissions Test Configuration

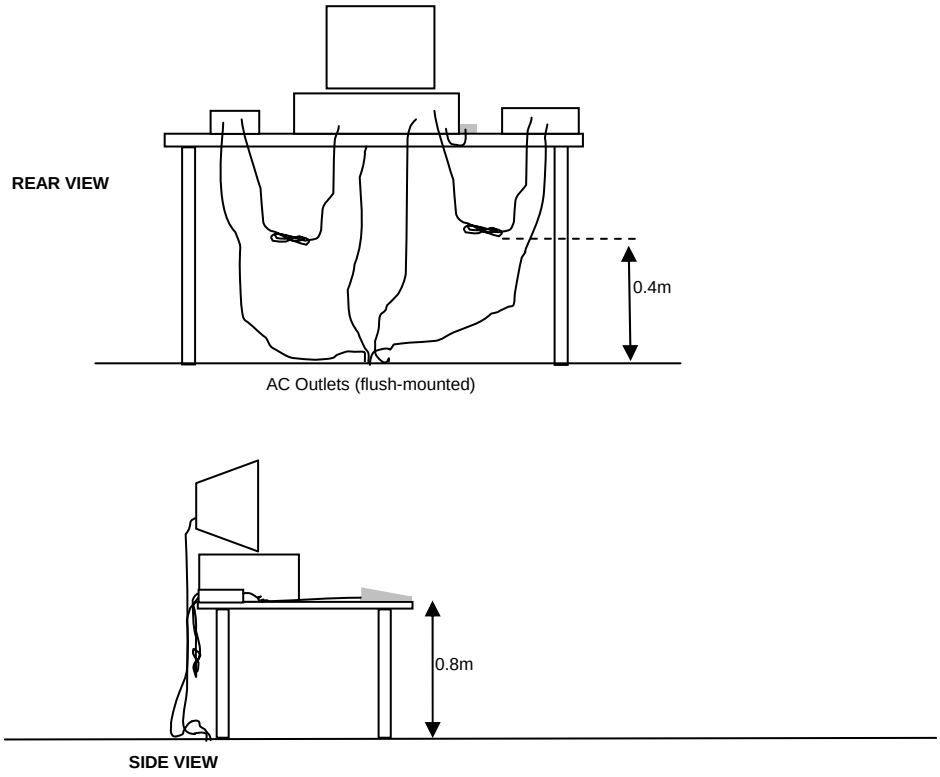
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

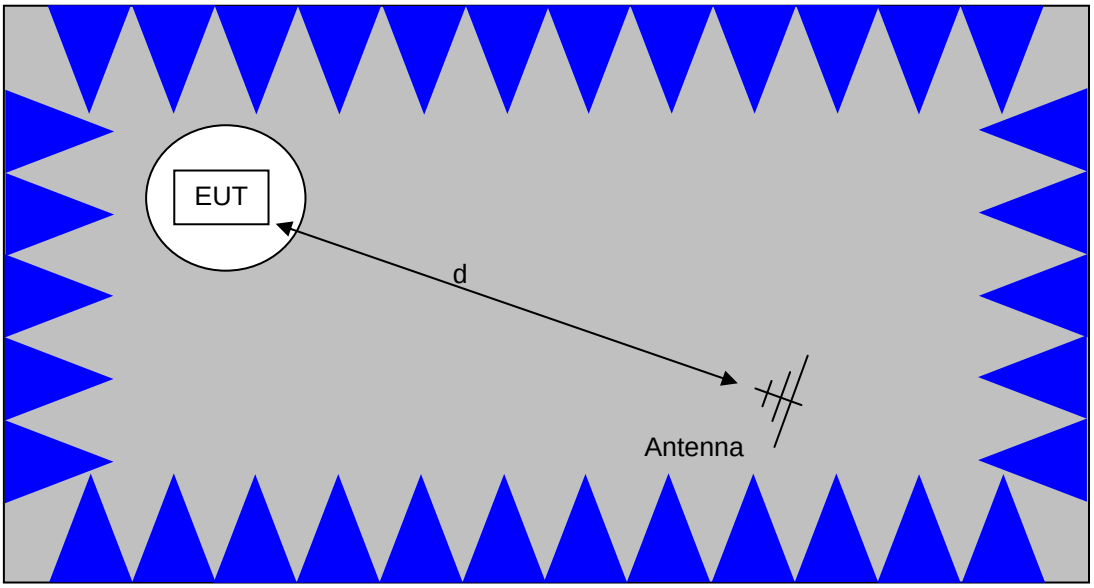
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

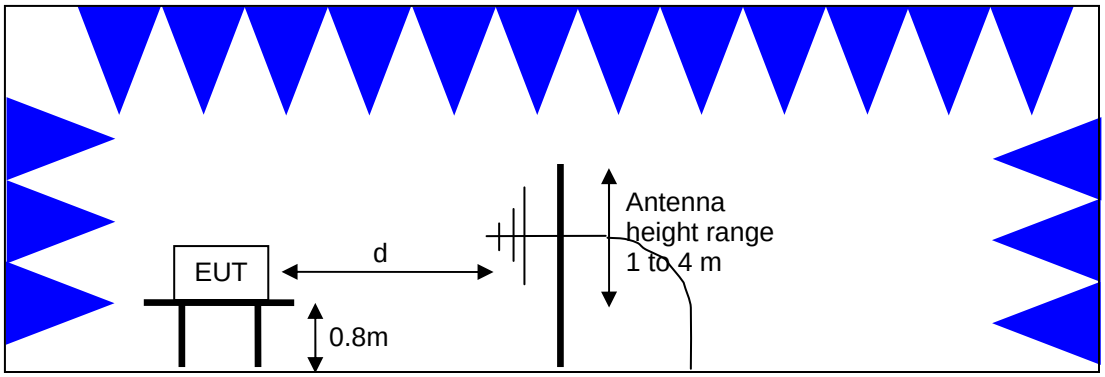


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

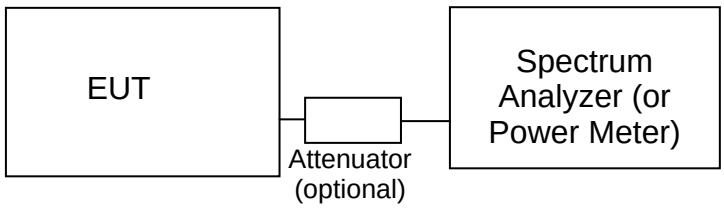
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.



Test Configuration for Antenna Port Measurements

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and NTS Silicon Valley's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

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.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

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

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

OUTPUT POWER LIMITS – FHSS SYSTEMS

The table below shows the limits for output power based on the number of channels available for the hopping system.

Operating Frequency (MHz)	Number of Channels	Output Power
902 – 928	≥ 50	1 Watt (30 dBm)
902 – 928	25 to 49	0.25 Watts (24 dBm)
2400 – 2483.5	≥ 75	1 Watt (30 dBm)
2400 – 2483.5	< 75	0.125 Watts (21 dBm)
5725 – 5850	75	1 Watt (30 dBm)

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally 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, when used for electric field measurements above 30MHz, is calculated 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:

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

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

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 - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{d} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

Radiated Emissions, 30 - 6,000 MHz, 10-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/19/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2013
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	8/9/2014
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
FCC	Decoupling Network	F-203I-DCN-23mm	2459	N/A

Radiated Emissions, 1000 - 8000 MHz, 15-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	SpecAn 9 KHz-26.5 GHz, Non-Program	8563E	284	1/13/2013
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	2/23/2013
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	7/12/2014

Radio Antenna Port (Power and Spurious Emissions), 07-Nov-12

Manufacturer	Description	Model	Asset #	Cal Due
Agilent	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	2/23/2013

Conducted Emissions - AC Power Ports, 13-Nov-12

Manufacturer	Description	Model	Asset #	Cal Due
EMCO	LISN, 10 kHz-100 MHz, 25A	3825/2	1292	2/16/2013
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	5/15/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	5/21/2013

Radiated Spurious Emissions, 30 - 10,000 MHz, 13-Nov-12

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2013
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	7/12/2014
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	6/4/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	5/21/2013
Hewlett Packard	High Pass filter, 1.5 GHz (Purple System)	P/N 84300-80037 (84125C)	1769	11/29/2012
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	11/22/2012

Radio Antenna Port , 03-Dec-12

Manufacturer	Description	Model	Asset #	Cal Due
Agilent	50GHz PSA Spectrum Analyzer	E4448A-M27	199979	11/15/2013

Appendix B Test Data

T89589 Pages 24 - 50

Client:	TopCon Positioning Systems	Job Number:	J89363
Product	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Emissions Standard(s):	FCC 15B/EN55022/15.247	Class:	A
Immunity Standard(s):	EN 301 489-1/-3	Environment:	-

EMC Test Data

For The

TopCon Positioning Systems

Product

HIPER V (w/900MHz and HSPA module)

Date of Last Test: 12/3/2012

Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	A

Conducted Emissions

(Elliott Laboratories Fremont Facility, Semi-Anechoic Chamber)

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.

Date of Test: 11/13/2012
Test Engineer: John Caizzi
Test Location: Fremont Chamber #7

Config. Used: 2
Config Change: none
EUT Voltage: 120V / 60Hz & 230V / 50Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80cm from the LISN. Remote support equipment was located outside of the semi-anechoic chamber. Any cables running to remote support equipment where routed through metal conduit and passed through a ferrite clamp upon exiting the chamber.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 43 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 230V/50Hz	Class A	Pass	36.6 dBµV @ 8.861 MHz (-23.4 dB)
2	CE, AC Power,120V/60Hz	Class A	Pass	36.2 dBµV @ 2.990 MHz (-23.8 dB)

Modifications Made During Testing

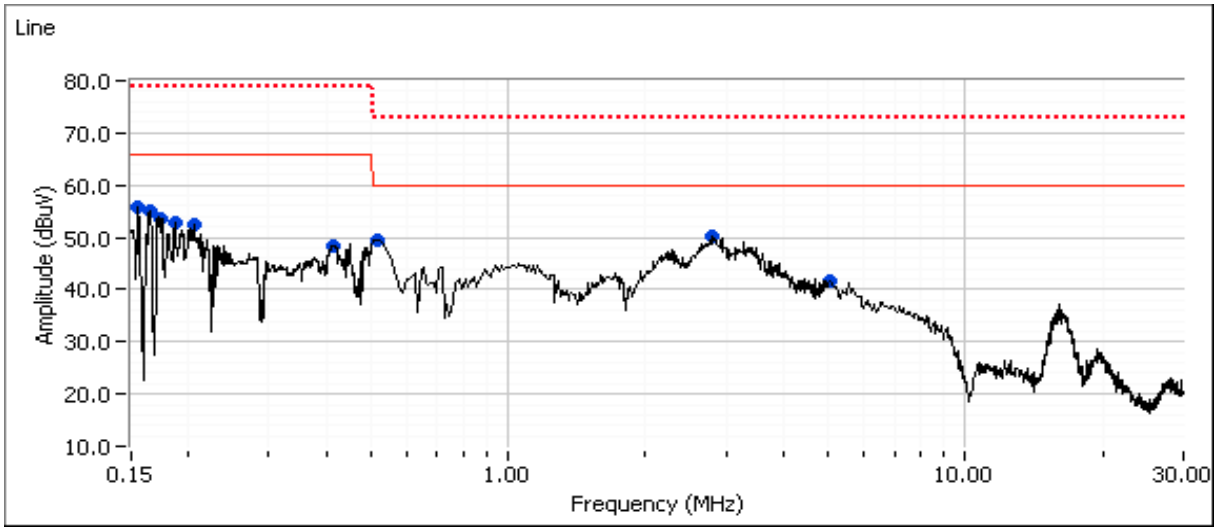
No modifications were made to the EUT during testing

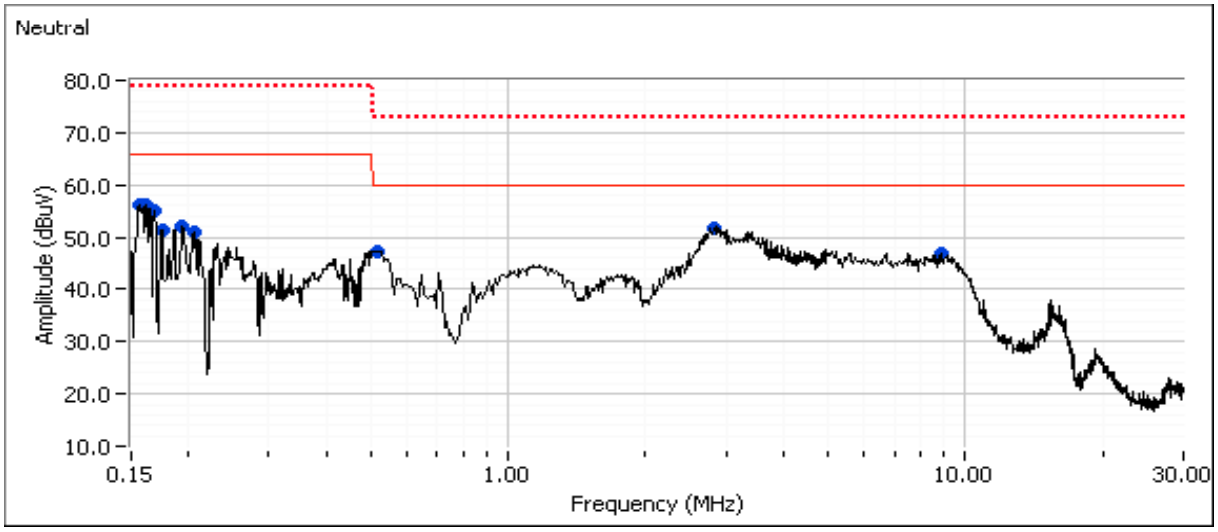
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	A

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 230V/50Hz





Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	A

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	AC	Class A		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
2.780	50.3	Line	60.0	-9.7	Peak	
0.155	55.8	Line	66.0	-10.2	Peak	
0.512	49.5	Line	60.0	-10.5	Peak	
0.164	55.0	Line	66.0	-11.0	Peak	
0.174	53.7	Line	66.0	-12.3	Peak	
0.189	52.8	Line	66.0	-13.2	Peak	
0.204	52.6	Line	66.0	-13.4	Peak	
0.416	*48.5*	*Line*	*66.0*	*-17.5*	*Peak*	
5.050	*41.7*	*Line*	*60.0*	*-18.3*	*Peak*	
2.841	51.8	Neutral	60.0	-8.2	Peak	
0.161	56.2	Neutral	66.0	-9.8	Peak	
0.157	56.1	Neutral	66.0	-9.9	Peak	
0.166	55.6	Neutral	66.0	-10.4	Peak	
0.170	55.0	Neutral	66.0	-11.0	Peak	
0.513	47.1	Neutral	60.0	-12.9	Peak	
8.861	46.7	Neutral	60.0	-13.3	Peak	
0.194	*52.2*	*Neutral*	*66.0*	*-13.8*	*Peak*	
0.175	*51.4*	*Neutral*	*66.0*	*-14.6*	*Peak*	
0.205	*50.8*	*Neutral*	*66.0*	*-15.2*	*Peak*	

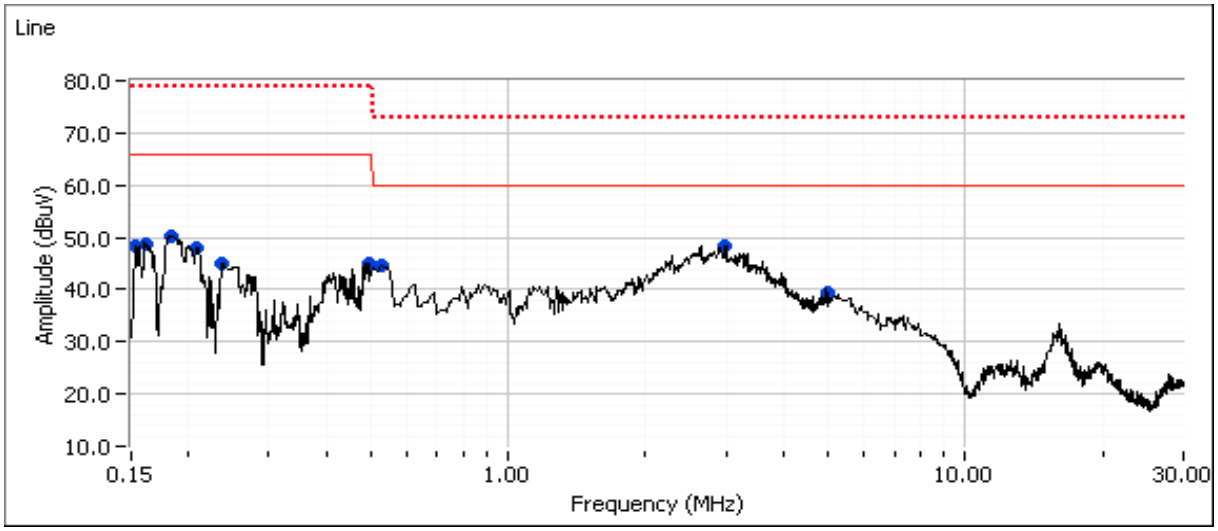
Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	A

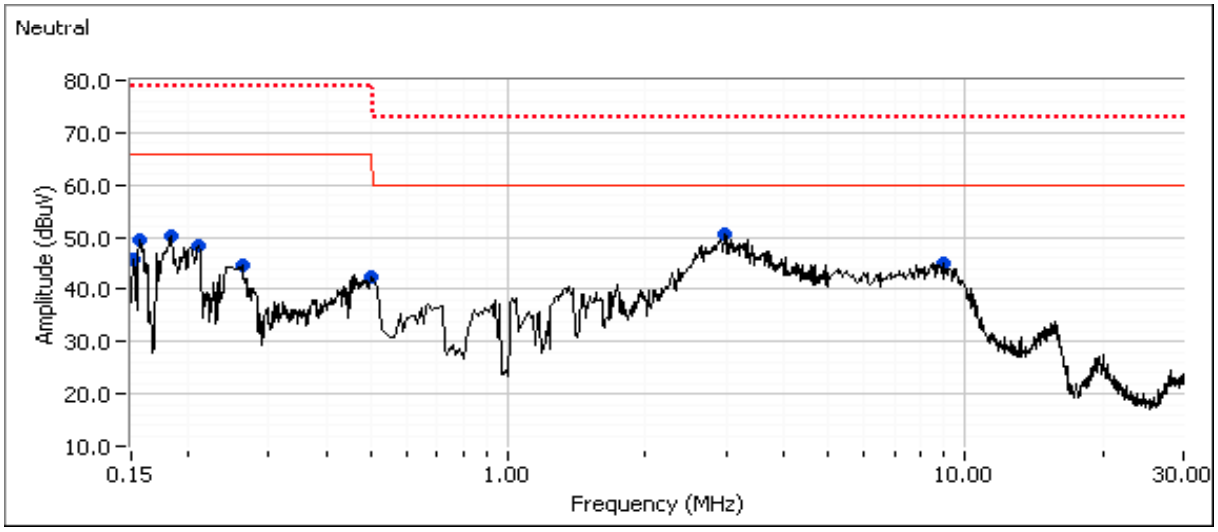
Final quasi-peak and average readings

Frequency	Level	AC	Class A		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
2.780	34.9	Line	60.0	-25.1	AVG	
2.780	46.9	Line	73.0	-26.1	QP	
0.155	18.2	Line	66.0	-47.8	AVG	
0.155	47.2	Line	79.0	-31.8	QP	
0.512	28.6	Line	60.0	-31.4	AVG	
0.512	46.5	Line	73.0	-26.5	QP	
0.164	17.3	Line	66.0	-48.7	AVG	
0.164	46.0	Line	79.0	-33.0	QP	
0.174	24.7	Line	66.0	-41.3	AVG	
0.174	45.1	Line	79.0	-33.9	QP	
0.204	34.3	Line	66.0	-31.7	AVG	
0.204	45.3	Line	79.0	-33.7	QP	
2.841	36.5	Neutral	60.0	-23.5	AVG	
2.841	49.2	Neutral	73.0	-23.8	QP	
0.161	17.6	Neutral	66.0	-48.4	AVG	
0.161	46.6	Neutral	79.0	-32.4	QP	
0.157	17.8	Neutral	66.0	-48.2	AVG	
0.157	47.0	Neutral	79.0	-32.0	QP	
0.166	18.0	Neutral	66.0	-48.0	AVG	
0.166	45.9	Neutral	79.0	-33.1	QP	
0.170	19.2	Neutral	66.0	-46.8	AVG	
0.170	45.5	Neutral	79.0	-33.5	QP	
0.513	27.6	Neutral	60.0	-32.4	AVG	
0.513	45.2	Neutral	73.0	-27.8	QP	
8.861	36.6	Neutral	60.0	-23.4	AVG	
8.861	42.3	Neutral	73.0	-30.7	QP	

Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	A

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz





Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	A

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	AC	Class A		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
2.982	48.4	Line	60.0	-11.6	Peak	
0.537	44.7	Line	60.0	-15.3	Peak	
0.183	50.2	Line	66.0	-15.8	Peak	
0.162	48.9	Line	66.0	-17.1	Peak	
0.152	48.4	Line	66.0	-17.6	Peak	
0.208	47.8	Line	66.0	-18.2	Peak	
5.000	*39.6*	*Line*	*60.0*	*-20.4*	*Peak*	
0.238	*45.0*	*Line*	*66.0*	*-21.0*	*Peak*	
0.494	*44.9*	*Line*	*66.0*	*-21.1*	*Peak*	
2.990	50.5	Neutral	60.0	-9.5	Peak	
8.999	44.9	Neutral	60.0	-15.1	Peak	
0.185	50.2	Neutral	66.0	-15.8	Peak	
0.158	49.5	Neutral	66.0	-16.5	Peak	
0.209	48.4	Neutral	66.0	-17.6	Peak	
0.154	45.6	Neutral	66.0	-20.4	Peak	
0.262	*44.7*	*Neutral*	*66.0*	*-21.3*	*Peak*	
0.500	*42.4*	*Neutral*	*66.0*	*-23.6*	*Peak*	

Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	A

Final quasi-peak and average readings

Frequency	Level	AC	Class A		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
2.982	32.8	Line	60.0	-27.2	AVG	
2.982	44.2	Line	73.0	-28.8	QP	
0.537	24.8	Line	60.0	-35.2	AVG	
0.537	41.8	Line	73.0	-31.2	QP	
0.183	30.4	Line	66.0	-35.6	AVG	
0.183	44.8	Line	79.0	-34.2	QP	
0.162	15.3	Line	66.0	-50.7	AVG	
0.162	39.2	Line	79.0	-39.8	QP	
0.152	17.0	Line	66.0	-49.0	AVG	
0.152	41.0	Line	79.0	-38.0	QP	
0.208	30.8	Line	66.0	-35.2	AVG	
0.208	44.3	Line	79.0	-34.7	QP	
2.990	36.2	Neutral	60.0	-23.8	AVG	
2.990	46.9	Neutral	73.0	-26.1	QP	
8.999	32.5	Neutral	60.0	-27.5	AVG	
8.999	40.5	Neutral	73.0	-32.5	QP	
0.185	30.8	Neutral	66.0	-35.2	AVG	
0.185	44.5	Neutral	79.0	-34.5	QP	
0.158	15.4	Neutral	66.0	-50.6	AVG	
0.158	40.2	Neutral	79.0	-38.8	QP	
0.209	30.7	Neutral	66.0	-35.3	AVG	
0.209	43.5	Neutral	79.0	-35.5	QP	
0.154	16.3	Neutral	66.0	-49.7	AVG	
0.154	40.9	Neutral	79.0	-38.1	QP	

Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

FCC 15.247 FHSS - Power, Bandwidth 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.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing. All remote support equipment was located outside the chamber.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 18-23 °C

Rel. Humidity: 35-45 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	30 - 10000 MHz - Transmitter Radiated Spurious Emissions	FCC Part 15.209 / 15.247(c)	PASS	53.7 dBµV/m @ 2706.7 MHz (-0.3 dB)
2	30 - 3000 MHz - Receiver Radiated Spurious Emissions	FCC Part 15.109 / RSS GEN	PASS	43.8dBµV/m @ 2453.3MHz (-10.2dB)
3	30 - 10000 MHz - Transmitter Conducted Spurious Emissions	FCC Part 15.247(c)	PASS	All emission were more than 20dB below the limit
4	Output Power	15.247(b)	PASS	28.83 dBm (0.764 W)
5	20dB Bandwidth	15.247(a)	PASS	158kHz
5	99% bandwidth	15.247(a)	-	180kHz
5	Channel Occupancy	15.247(a)	PASS	169.3 ms
5	Number of Channels	15.247(a)	PASS	128

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 10,000 MHz.

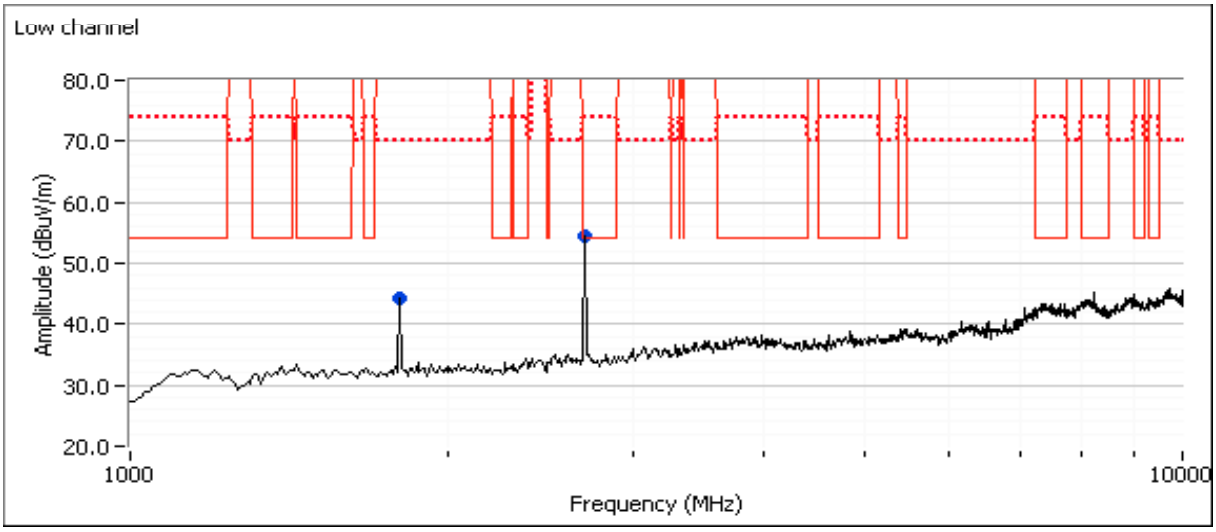
Date of Test: 11/13/2012
Test Engineer: John Caizzi
Test Location: Chamber 7

Run #1a: Low Channel @ 902.2 MHz

Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1800.000	44.2	V	54.0	-9.8	Peak	58	1.5	Note 2
2706.650	53.7	V	54.0	-0.3	AVG	62	1.23	
2706.770	55.0	V	74.0	-19.0	PK	62	1.23	

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2:	Emission is not in restricted band, but the more stringent restricted band limit was used. Peak reading vs average limit.



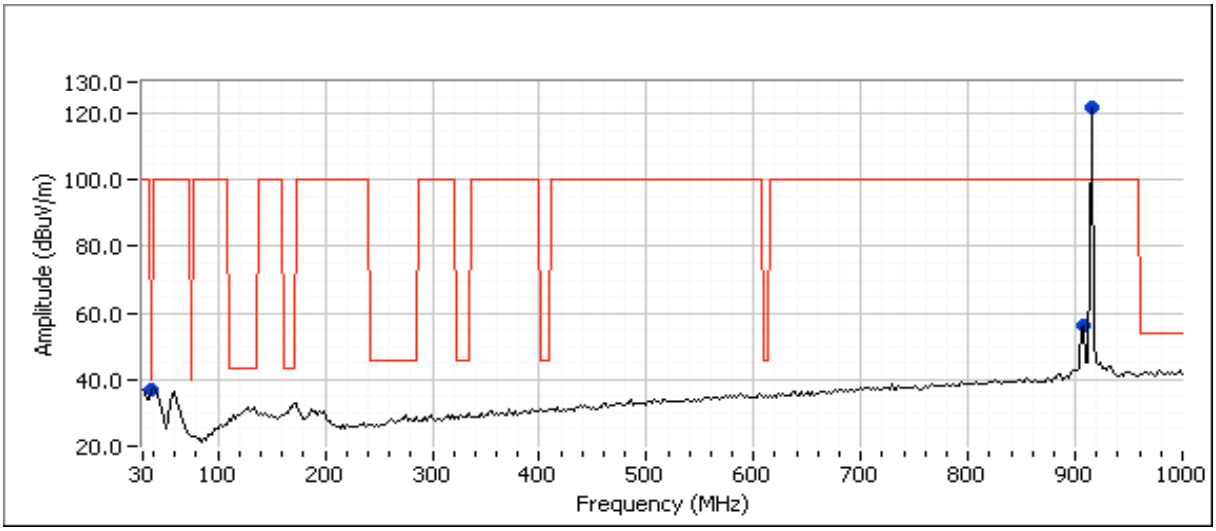
Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

Run #1b: Center Channel @ 915 MHz

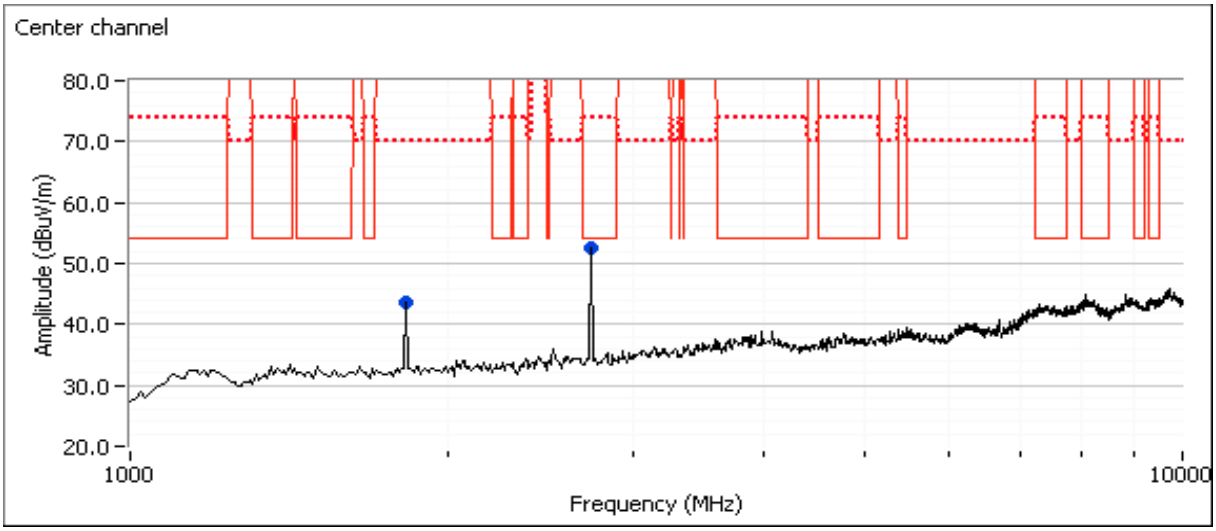
Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
916.413	121.6	V	-	-	Peak	333	1.0	Fundamental
908.637	56.2	H	-	-	Peak	122	3.0	
38.219	37.0	V	40.0	-3.0	Peak	353	1.0	
38.219	32.9	V	40.0	-7.1	QP	347	1.00	
1825.000	43.6	V	54.0	-10.4	Peak	324	1.01	Note 2
2745.120	52.2	V	54.0	-1.8	AVG	112	1.00	
2744.950	54.0	V	74.0	-20.0	PK	112	1.00	

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2:	Emission is not in restricted band, but the more stringent restricted band limit was used. Peak reading vs average limit.



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A



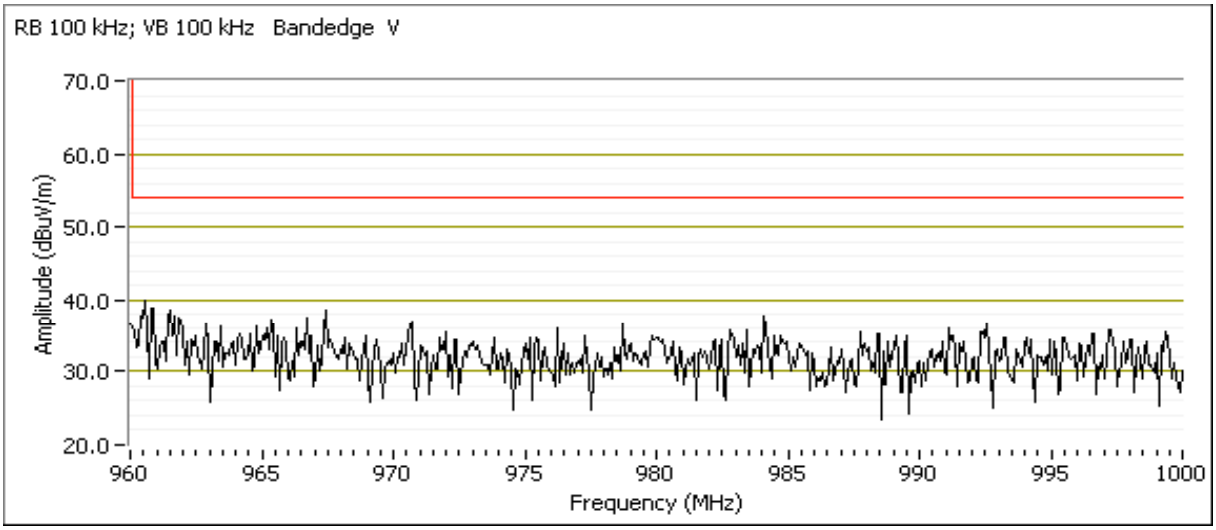
Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

Run #1c: High Channel @ 927.6 MHz

Band Edge Signal Field Strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
961.523	40.8	V	54.0	-13.2	PK	360	1.00	100 kHz; VB: 300 kHz
996.553	38.9	H	54.0	-15.1	PK	0	4.00	100 kHz; VB: 300 kHz

Note 1:	Peak detector used instead of QP detector called out in the standard. Peak is worst case.

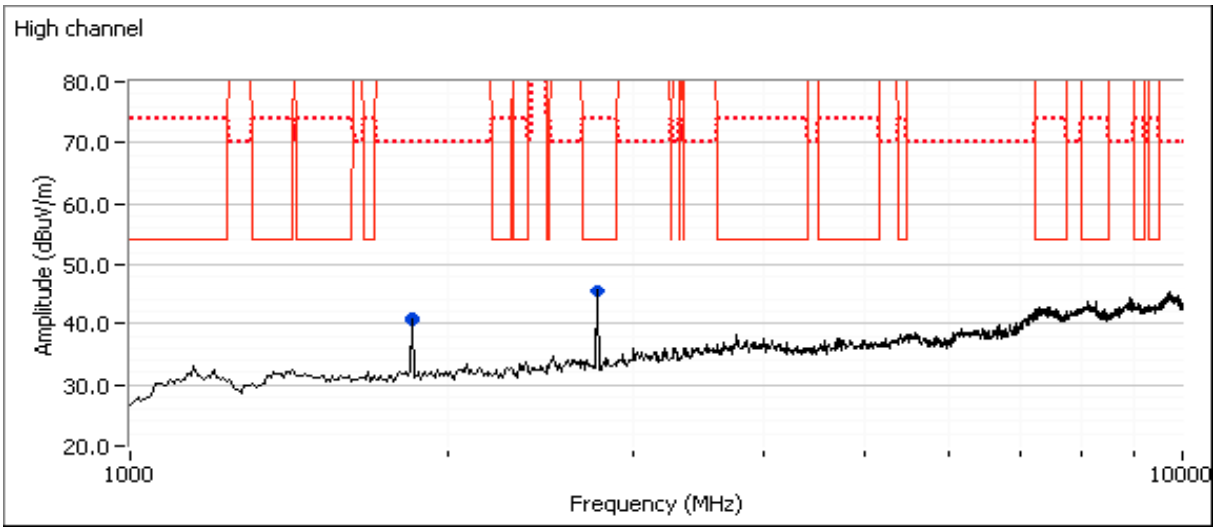


Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1850.000	40.6	V	54.0	-13.4	Peak	43	1.0	Note 2
2782.830	44.8	V	54.0	-9.2	AVG	245	1.00	
2783.250	47.5	V	74.0	-26.5	PK	245	1.00	

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2:	Emission is not in restricted band, but the more stringent restricted band limit was used. Peak reading vs average limit.



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

Run #2: Receiver Radiated Spurious Emissions, 30 - 3000 MHz.

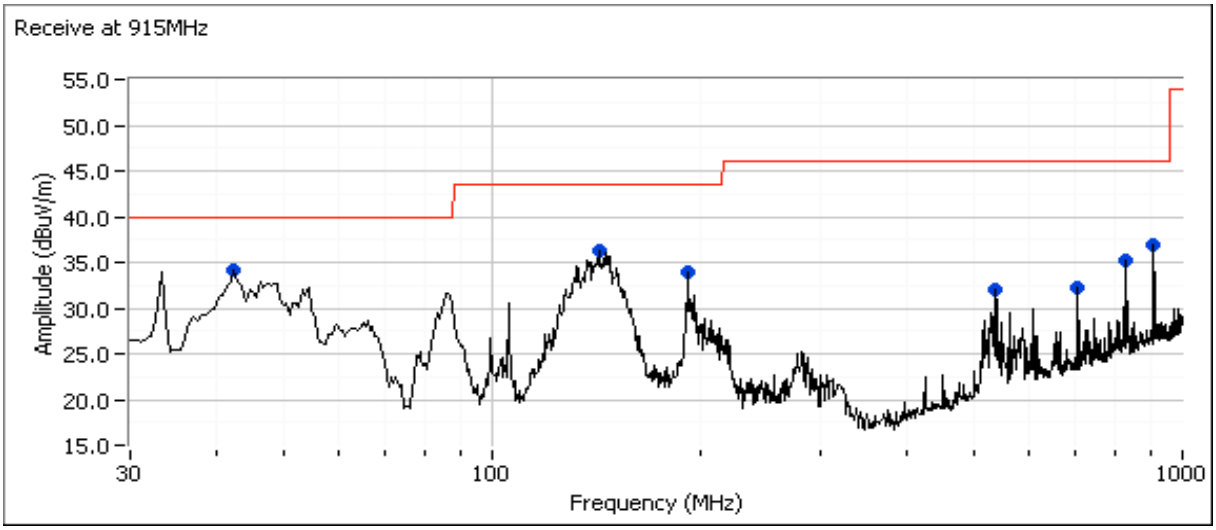
Date of Test: 10/09/12 Test Location: FT Chamber #3

Test Engineer: M. Birgani EUT Voltage: 120V, 60Hz

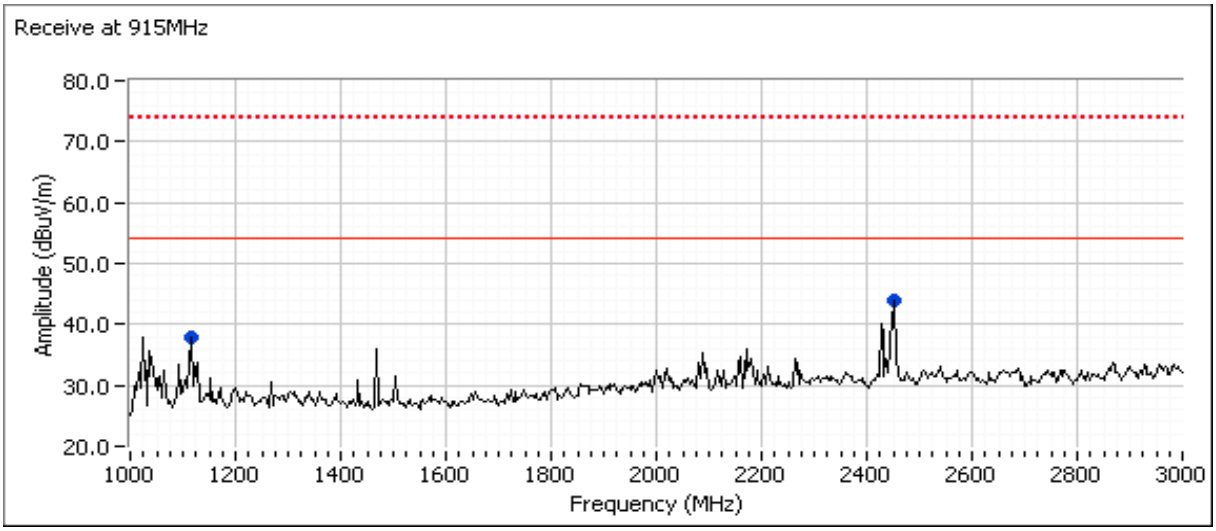
Run #2a: Receiver Radiated Spurious Emissions, 30 - 3000 MHz. Center Channel @ 915 MHz

Other Spurious Emissions

Frequency	Level	Pol	15.109 / RSS GEN		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2453.330	43.8	V	54.0	-10.2	Peak	130	1.0	Peak reading with average limit
43.039	29.1	V	40.0	-10.9	QP	177	1.0	QP (1.00s)
143.102	31.5	H	43.5	-12.0	QP	276	2.2	QP (1.00s)
912.244	30.8	H	46.0	-15.2	QP	360	2.2	QP (1.00s)
1116.670	38.0	H	54.0	-16.0	Peak	226	2.2	Peak reading with average limit
830.163	30.0	V	46.0	-16.0	QP	0	1.0	QP (1.00s)
707.776	28.3	V	46.0	-17.7	QP	10	2.7	QP (1.00s)
190.757	24.0	V	43.5	-19.5	QP	119	1.0	QP (1.00s)
534.136	26.4	H	46.0	-19.6	QP	274	2.2	QP (1.00s)



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

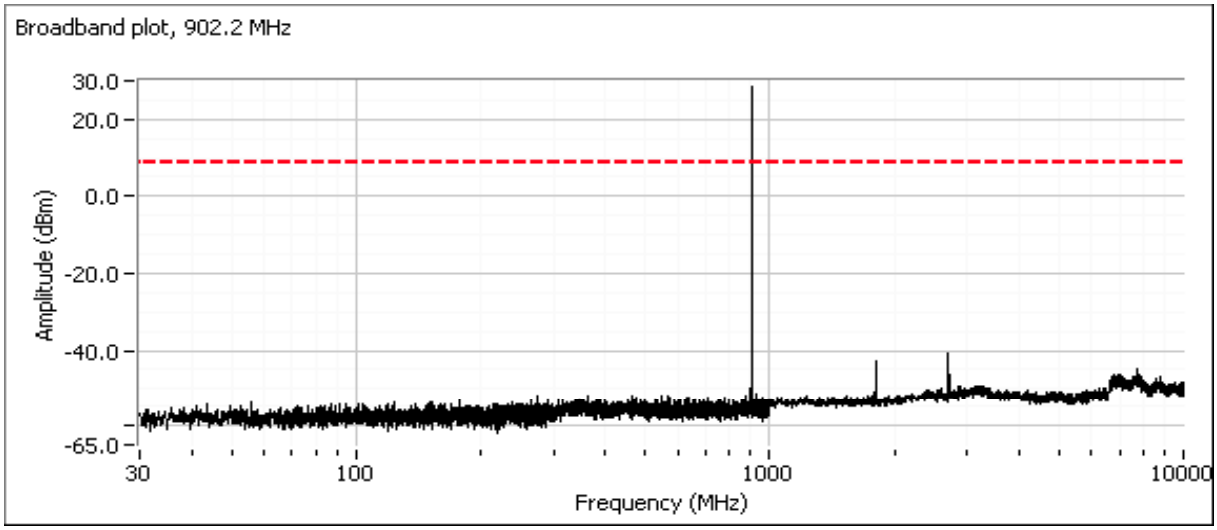
Run #3: Antenna Conducted Spurious Emissions, 30 - 10000 MHz.

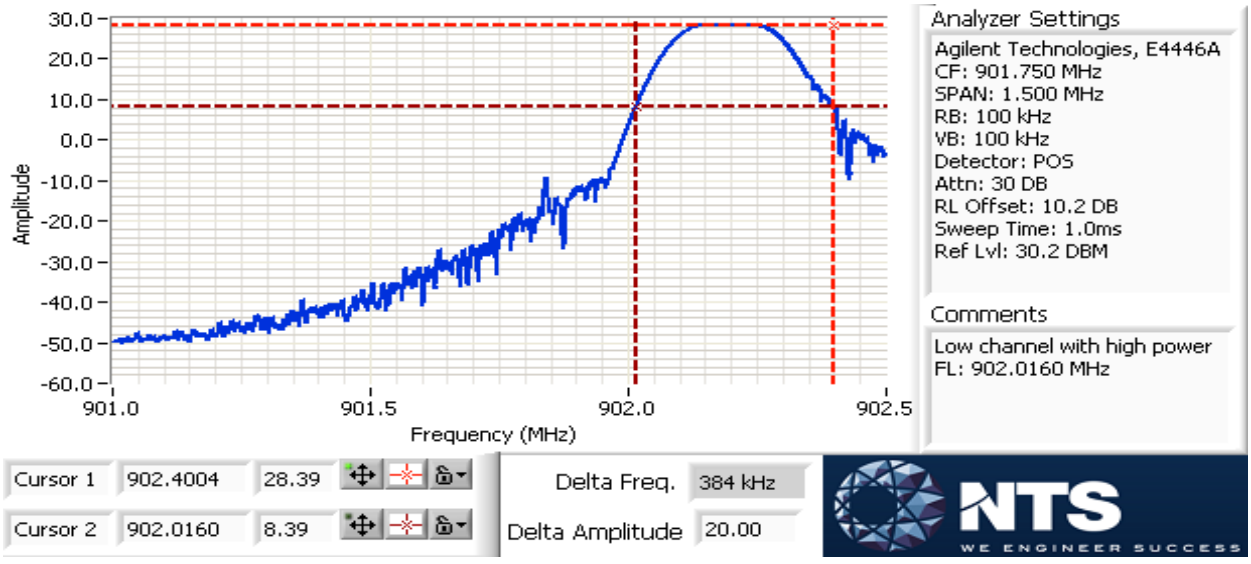
Date of Test: 10/07/12 Test Location: FT Lab #4

Test Engineer: M. Birgani

Refer to plots below. Scans made using RBW=VB=100 KHz with the limit line set at 20dB below the highest in-band signal level with the hopping feature disabled.

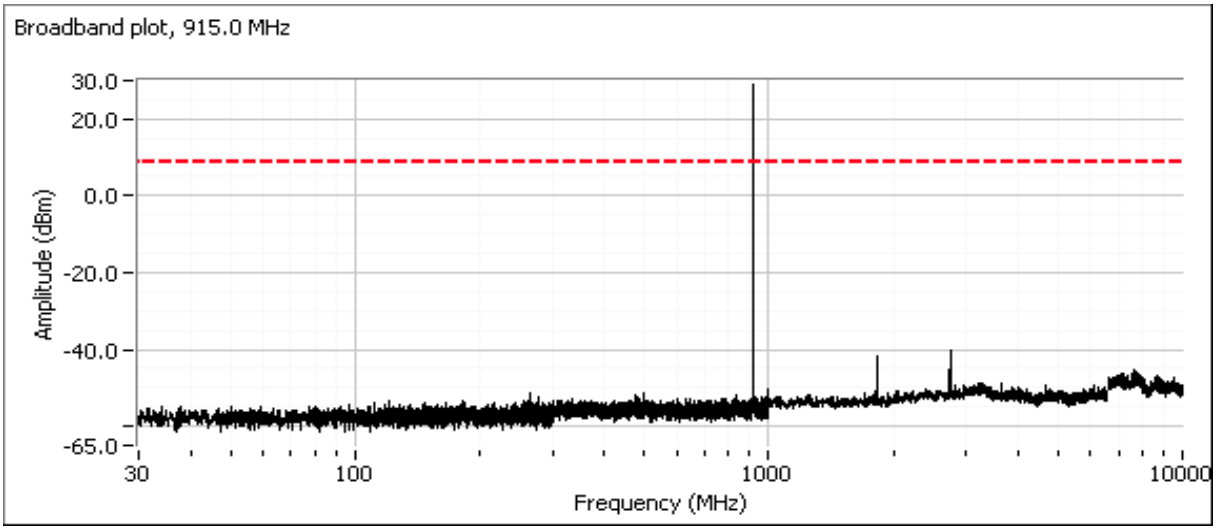
Low channel





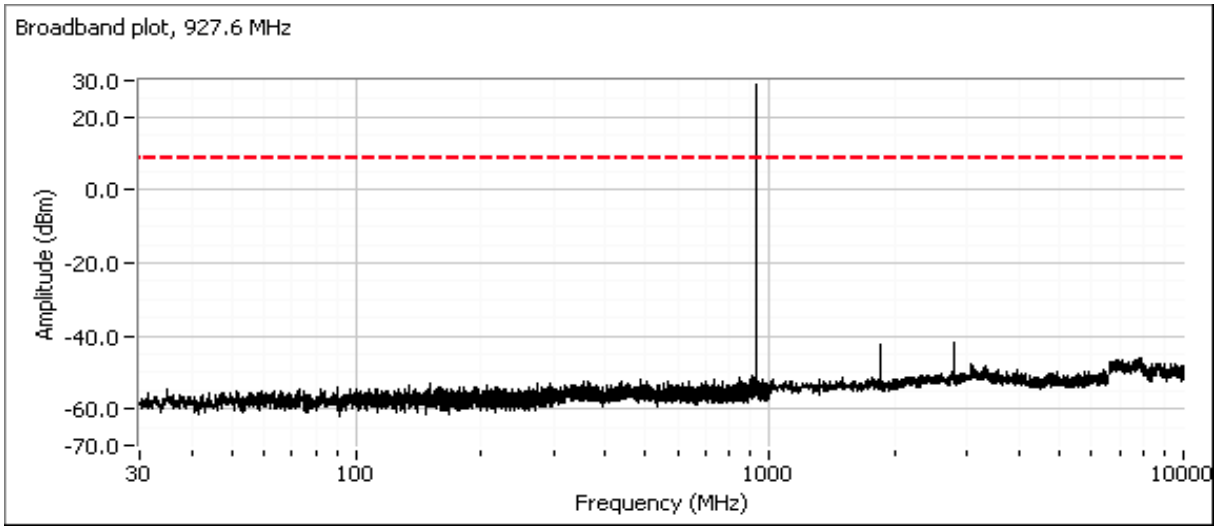
Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

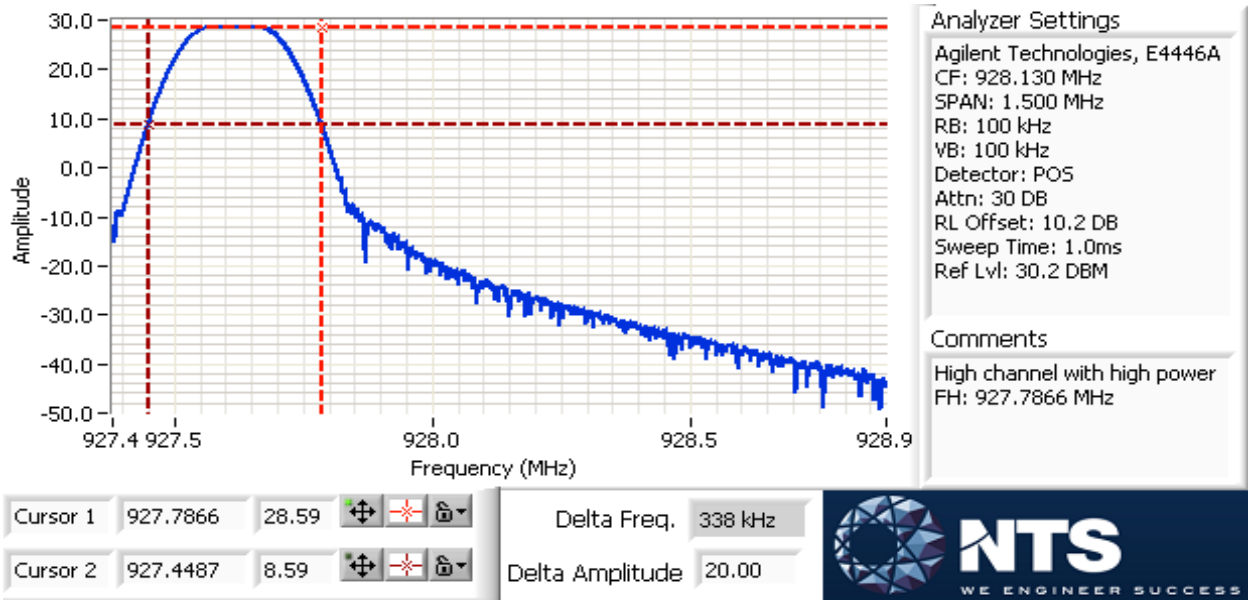
Center channel



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

High channel



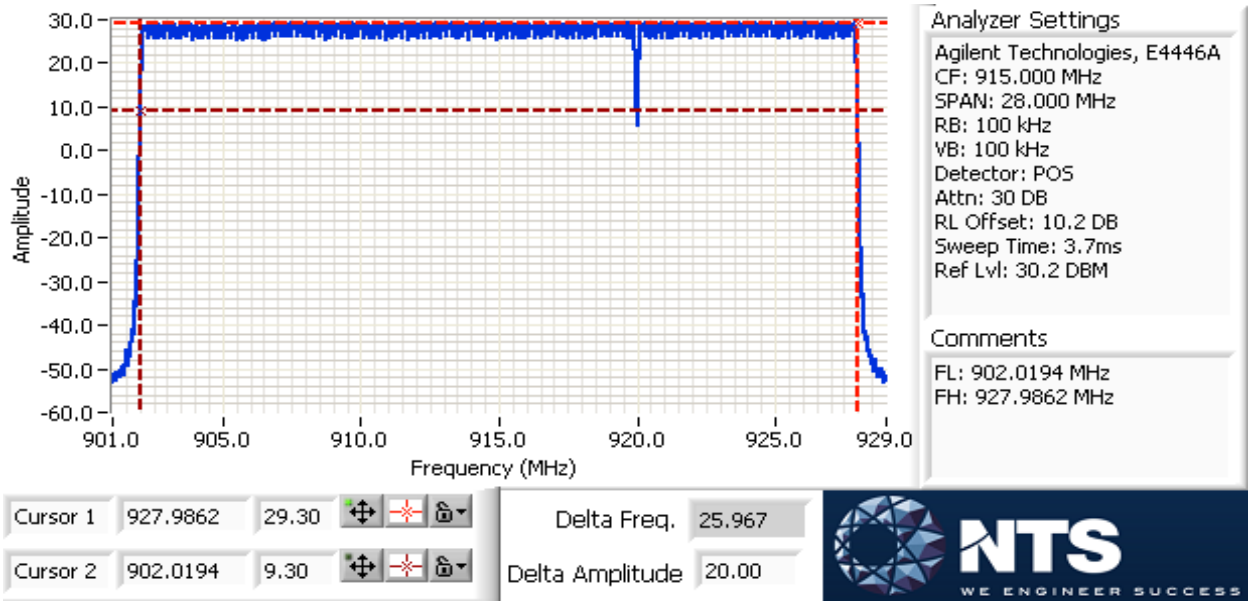


Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

Refer to plots below. Scans made using RBW=VB=100 KHz with the limit line set at 20dB below the highest in-band signal level with the hopping feature enabled to show compliance with the -20dBc requirement at the allocated band edge. The spectrum analyzer is left in max hold mode until the trace stabilizes.

Low and High channel, hopping enabled

Plot showing -20dBc at the lower band edge



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

Run #4: Output Power

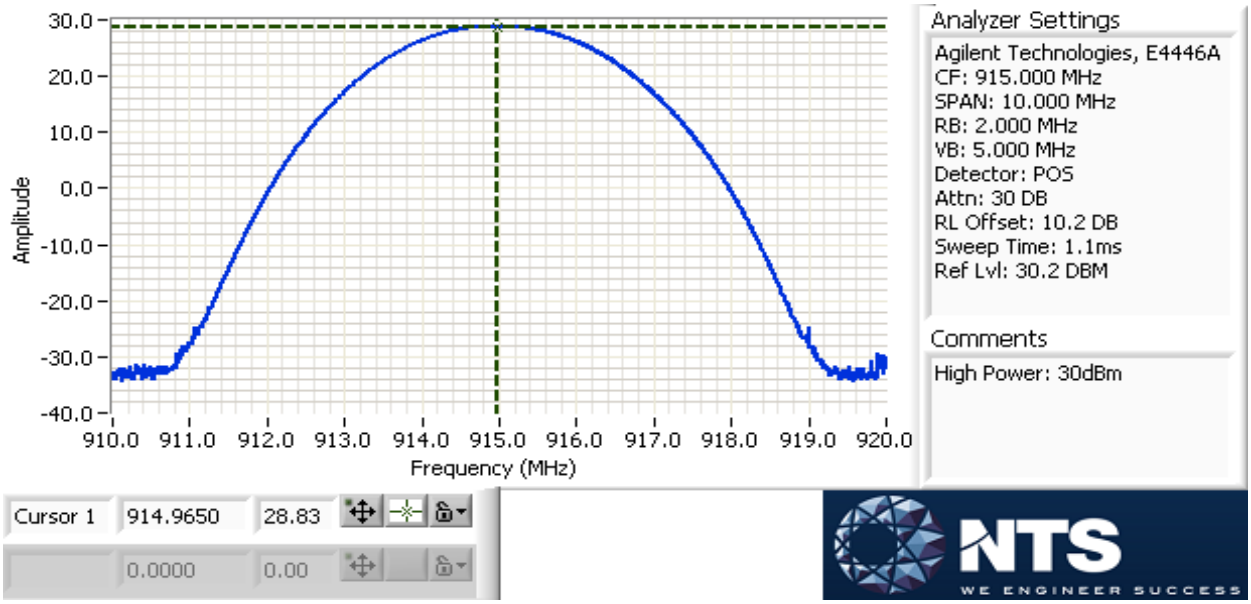
Date of Test: 10/07/12 Test Location: FT Lab #4

Test Engineer: M. Birgani

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

Maximum antenna gain: 2.5 dBi

Channel	Frequency (MHz)	Res BW	Output Power (dBm)	Output Power (W)	EIRP (W)
Low	902.2	2.0 MHz	23.21	0.2094112	0.2094
Mid	915.0	2.0 MHz	23.22	0.2098940	0.2099
High	927.6	2.0 MHz	23.27	0.2123244	0.2123
Low	902.2	2.0 MHz	28.6	0.7244360	1.2882
Mid	915.0	2.0 MHz	28.83	0.7638358	1.3583
High	927.6	2.0 MHz	28.23	0.6652732	1.1830



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

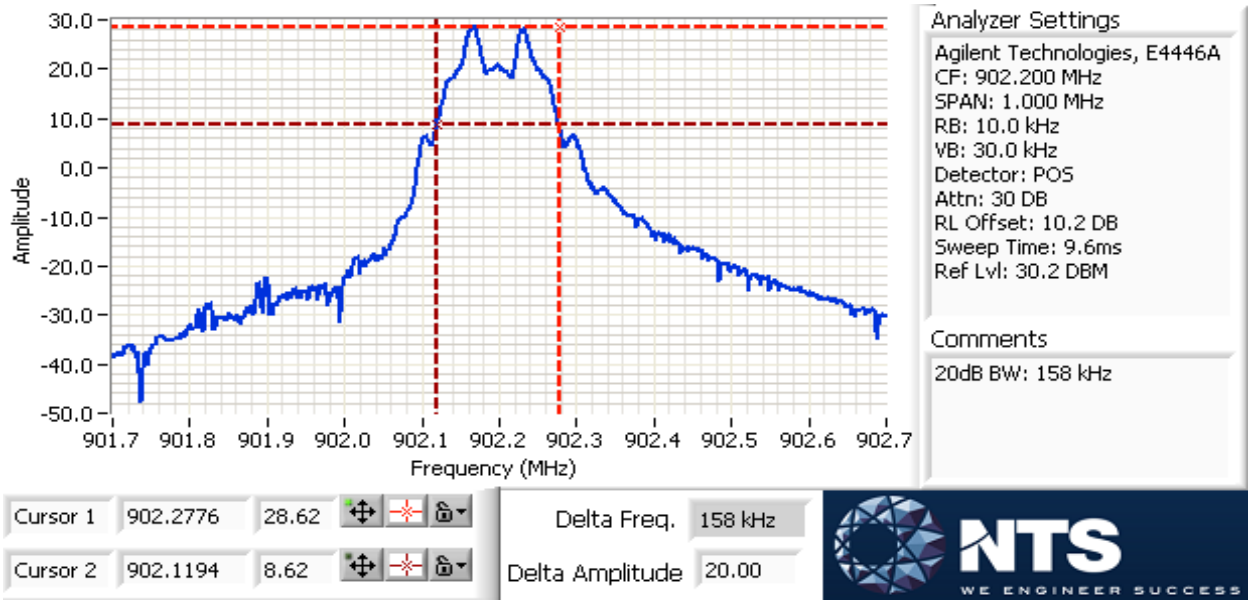
Run #5: Bandwidth, Channel Occupancy, Spacing and Number of Channels

Date of Test: 10/7/2012 & 12/3/12 Test Location: FT Lab #4

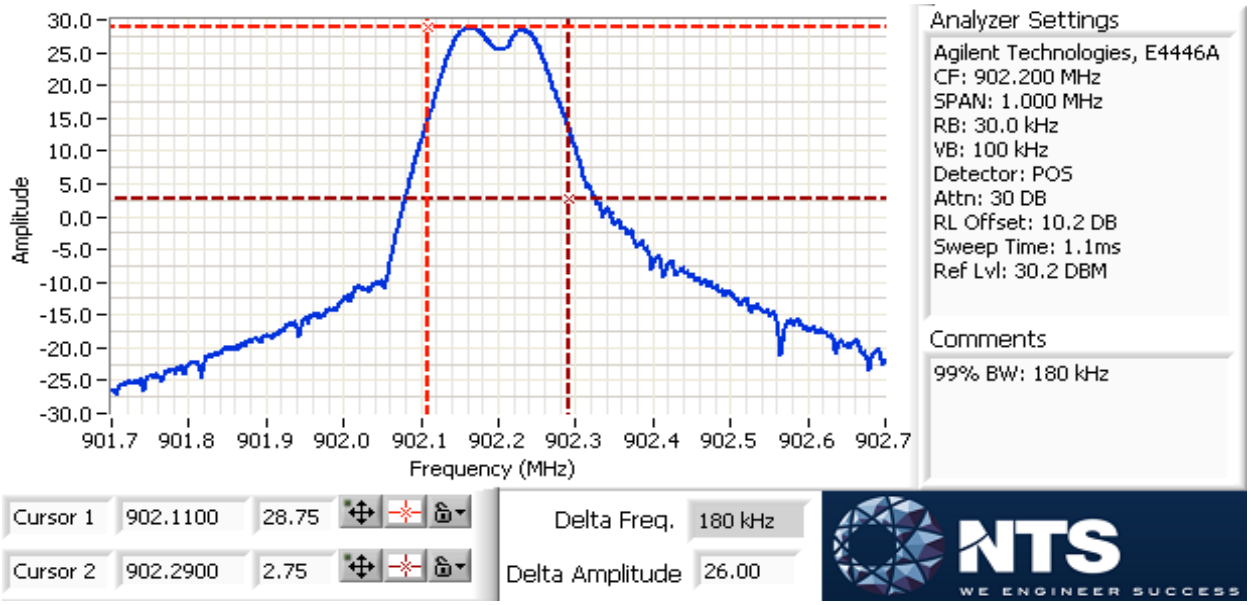
Test Engineer: M. Birgani & J. Caizzi

Channel	Frequency (MHz)	Resolution Bandwidth	20dB Bandwidth (kHz)	Resolution Bandwidth	99% Bandwidth (kHz)
Low	902.2	10kHz	158	30kHz	180
Mid	915.0	10kHz	157	30kHz	177
High	927.6	10kHz	154	30kHz	175

Note 1:	20dB bandwidth measured using RB = 10kHz, VB = 30kHz (VB > RB)
Note 2:	99% bandwidth measured using RB = 30kHz, VB = 100kHz (VB >=3RB)



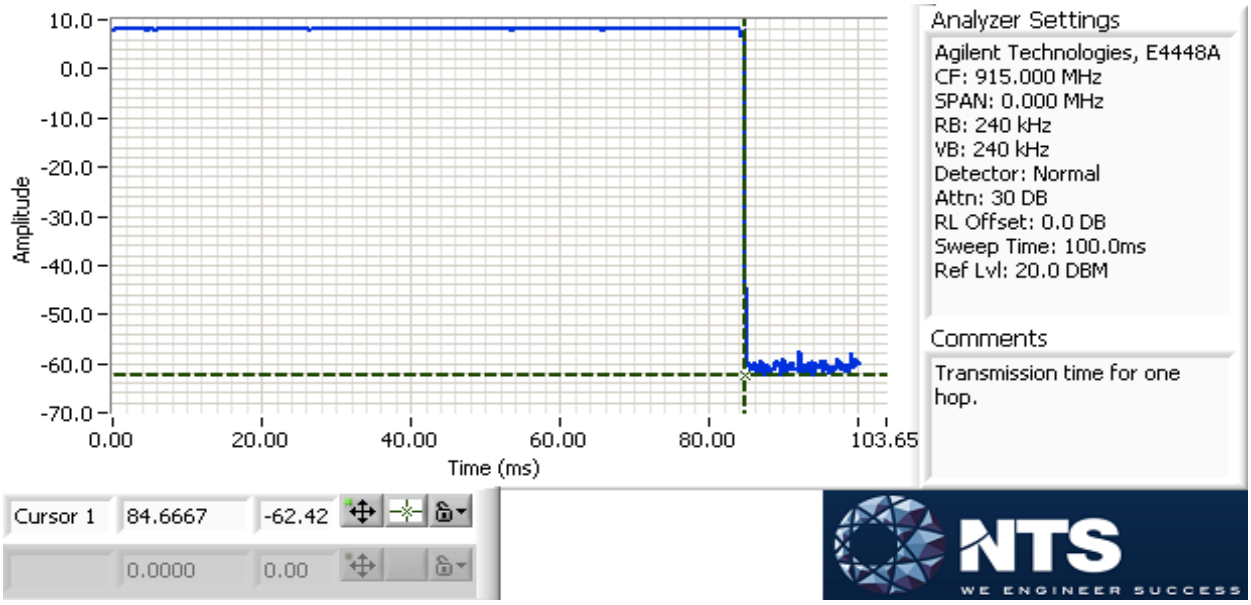
Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

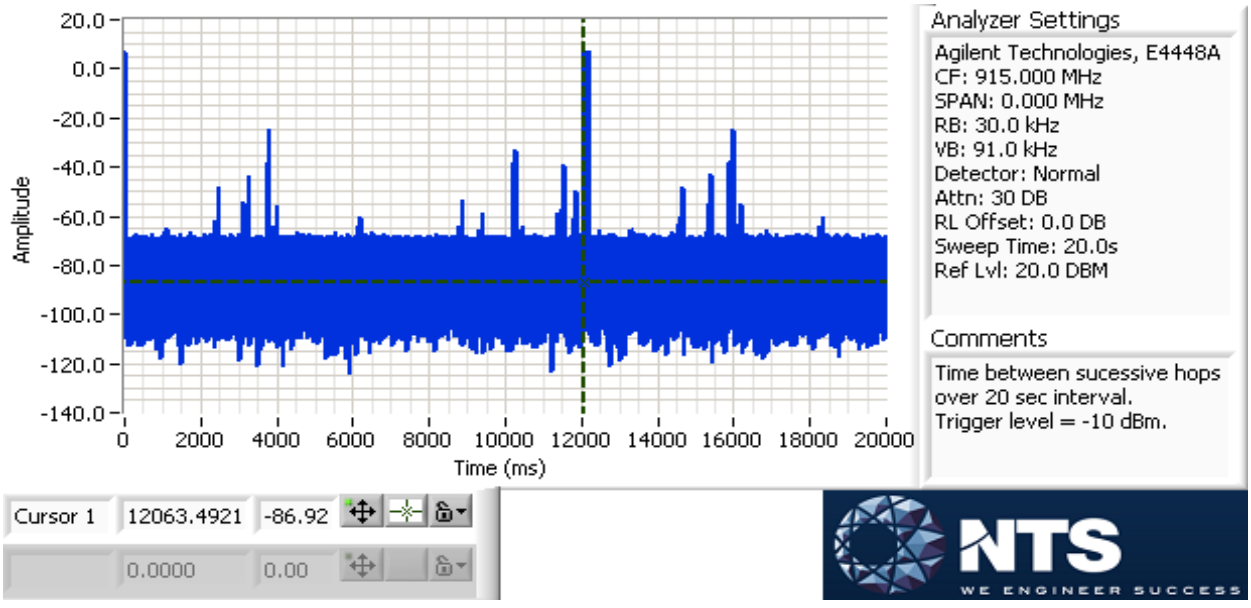


For frequency hopping systems operating in the 902-928 MHz band:
If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.
The channel dwell time is calculated from the transmit time on a channel multiplied by the number of times a channel could be used in the 20 second period (i.e. 20s divided by the time between successive hops, rounded up to the closest integer), unless the time between successive hops exceeds 20s in which case the channel dwell time is the transmit time on a channel.

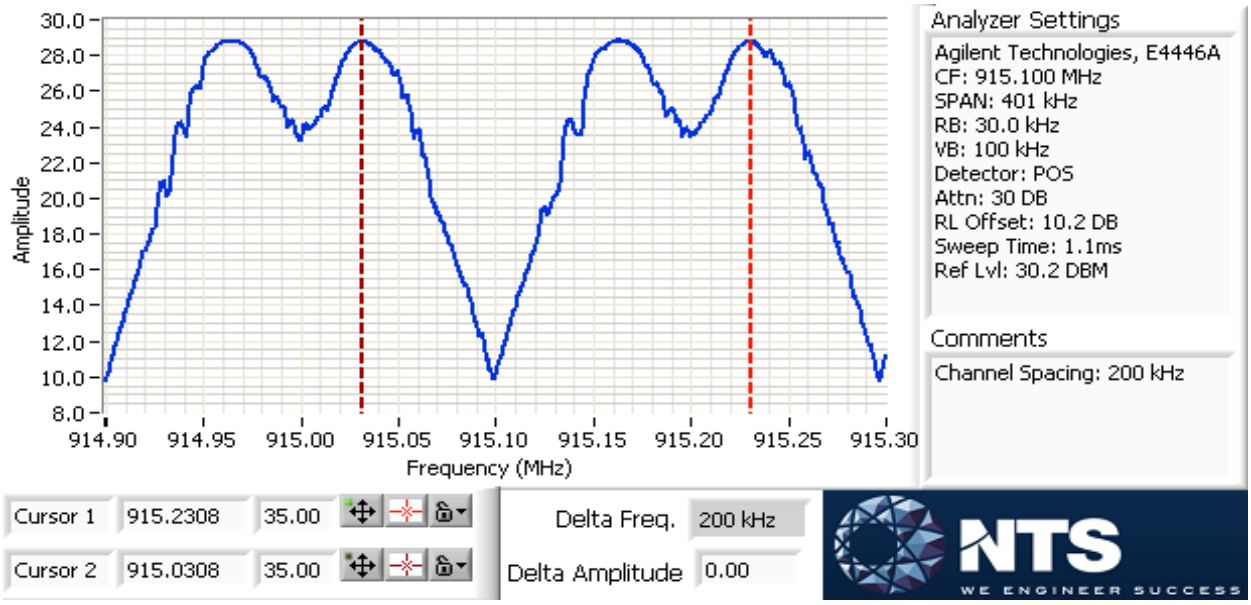
Maximum 20dB bandwidth:	158	kHz	Pass
Channel spacing:	200	kHz	Pass
Transmission time per hop:	84.67	ms	
The time between successive hops on a channel:	12070	ms	
Number of channels (N):	128		Pass
Channel dwell time in 20 seconds:	169.3	ms	Pass

Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A

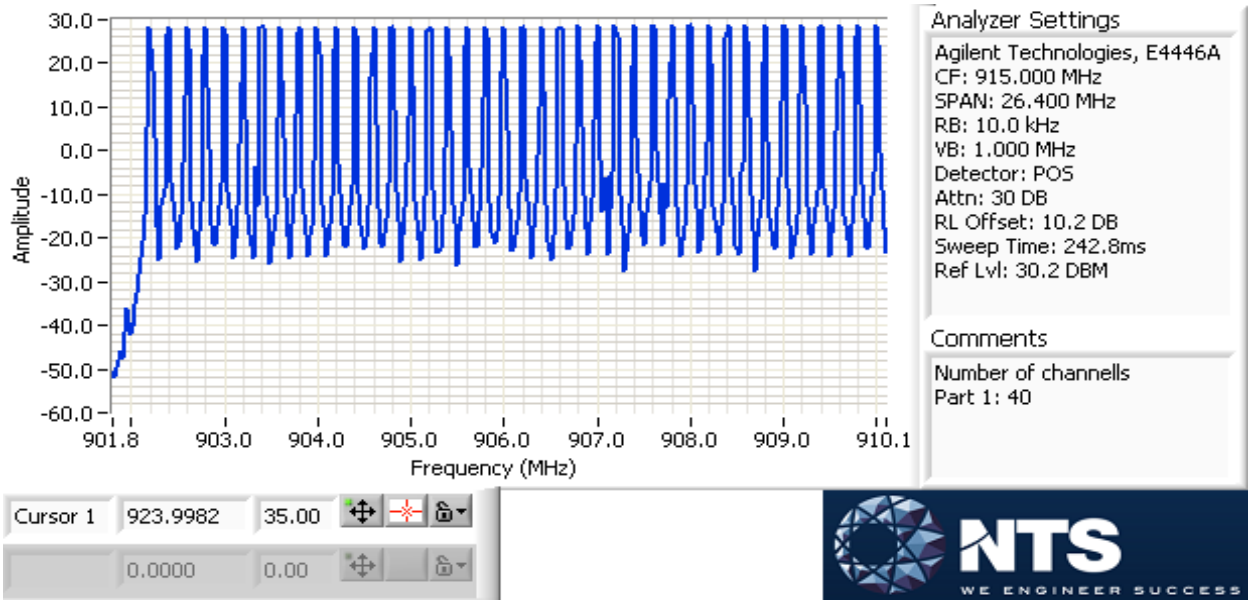


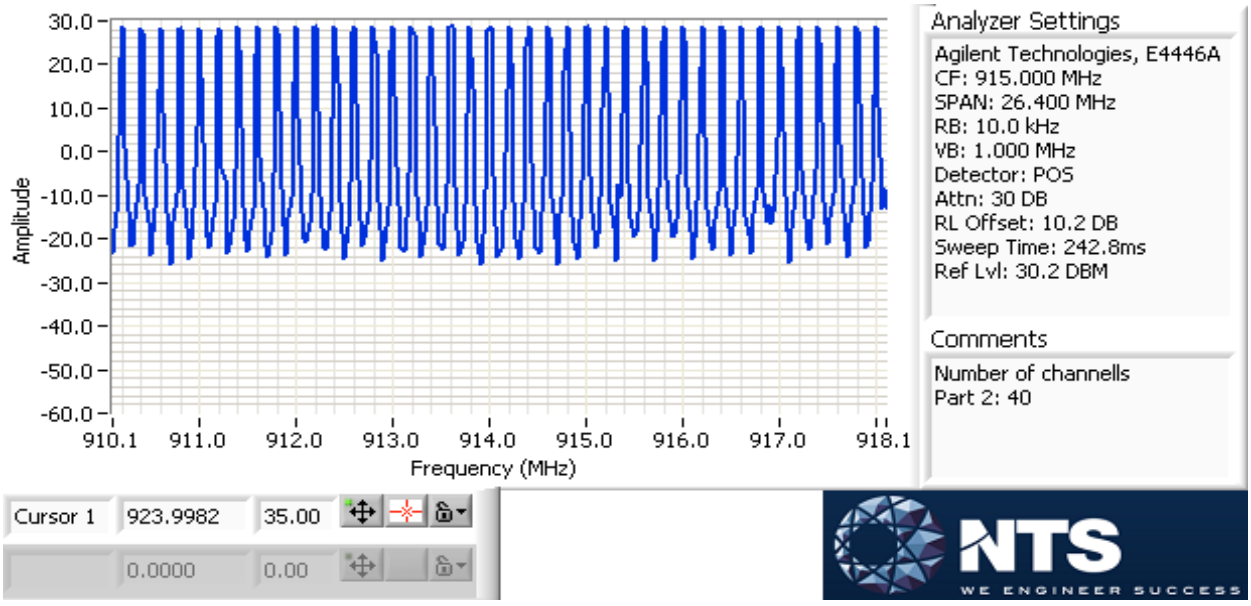


Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A



Client:	TopCon Positioning Systems	Job Number:	J89363
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A





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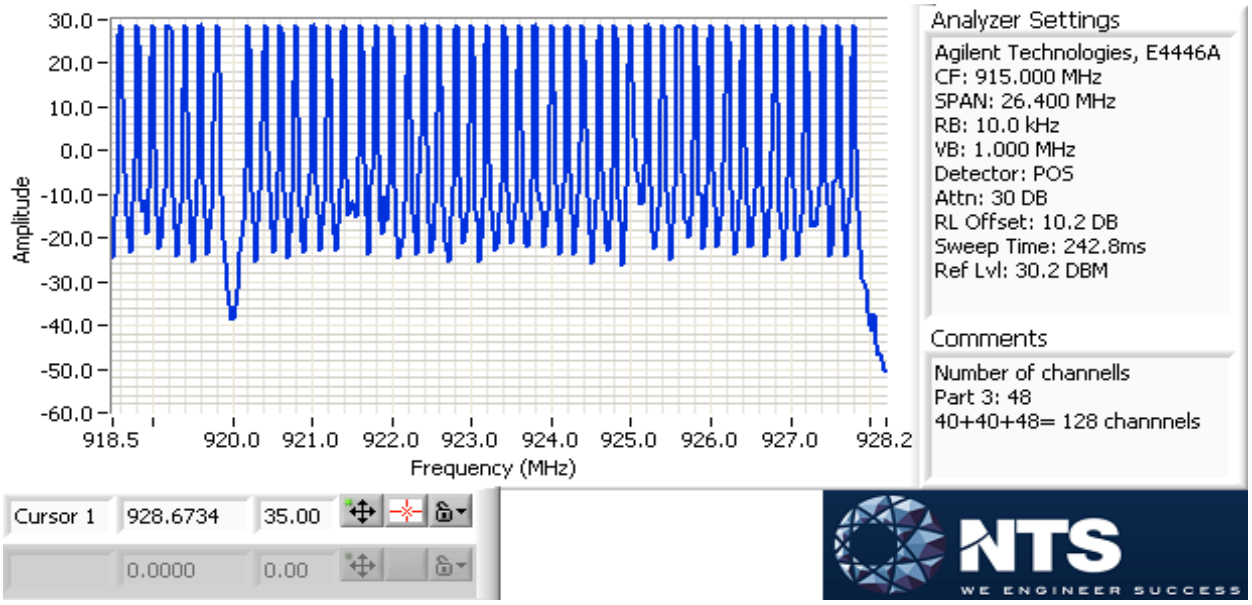
Model:	HIPER V (w/900MHz and HSPA module)	T-Log Number:	T89589
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	FCC 15B/EN55022/15.247	Class:	N/A



End of Report

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