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EMC Test Report

Application for Grant of Equipment Authorization

FCC Part 15 Subpart C

Model: HiPeR GA (01-860805-01)

FCC ID:	LCB-860805
APPLICANT:	Topcon Positioning Systems 7400 National Drive Livermore, CA 94550
TEST SITE(S):	NTS Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
REPORT DATE:	February 8, 2013
FINAL TEST DATES:	August 7, 8, 9, 17, 22 and 23, 2012
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Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	02-08-2013	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Topcon Positioning Systems model HiPeR GA (01-860805-01), pursuant to the following rules:

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.

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.

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 GA (01-860805-01) complied with the requirements of the following regulations:

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 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.

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 (2400 – 2483.5 MHz, 75 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	Basic: 856 kHz EDR: 1261 kHz0	Channel spacing > 20dB bandwidth	Complies
		Channel Separation	1000 kHz		Complies
15.247 (a) (1) (iii)	RSS 210 A8.1 (4)	Number of Channels	79	75 or more	Complies
15.247 (a) (1) (iii)	RSS 210 A8.1 (4)	Channel Dwell Time (*average time of occupancy)*	The system uses the Bluetooth algorithm and, therefore, meets all requirements for channel utilization.	<0.4 second within a period of 0.4 x number of channels	Complies
15.247 (a) (1)	RSS 210 A8.1 (1)	Channel Utilization		All channels shall, on average, be used equally	Complies
15.247 (b) (3)	RSS 210 A8.4 (2)	Output Power (multipoint systems)	Basic: -5.1dBm (0.31mW) EDR: -5.9dBm (0.22mW) EIRP = 0.31 mW [Note 1]	*0.125 Watts*	Complies
15.247(c)	RSS 210 A8.5	Spurious Emissions – 30MHz – 25GHz	All spurious emissions < -20dBc	< -20dBc	Complies
15.247(c) / 15.209	RSS 210 A8.5 Table 2, 3	Radiated Spurious Emissions 30MHz – 25GHz	41.9 dBµV/m @ 2484.3 MHz (-12.1 dB)	15.207 in restricted bands, all others < -20dBc	Complies (- ?.? dB)
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 0 dBi.					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Antenna is internal to the EUT	Unique or integral antenna required	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	45.4 dBµV @ 0.498 MHz (-10.6 dB)	Refer to page 17	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	N/A – the receiver tunes above 960MHz		
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in Exhibit 11 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	N/A – the antenna is internal		
-	RSP 100 RSS GEN 4.4.1	99% Bandwidth	Basic: 846 kHz EDR: 1256 kHz	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 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 IC: 6050B-860805
Phihong	PSC30U-120V	Power supply	PO3109830A1	N/A

ANTENNA SYSTEM

The antenna is internal to the EUT. The antenna gain is 0dBi

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

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

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 testing, the EUT was configured to transmit continuously at the noted channel and modulation.

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 3	769238	2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4	211948	2845B-4	

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.

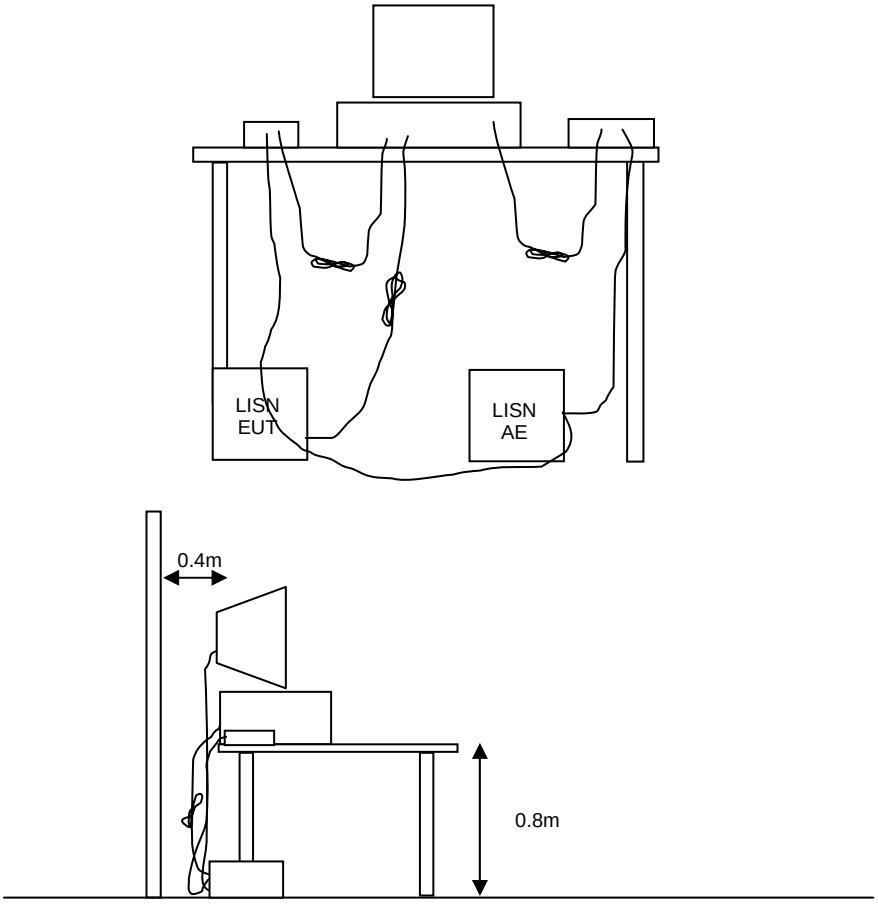


Figure 1 Typical Conducted Emissions Test Configuration

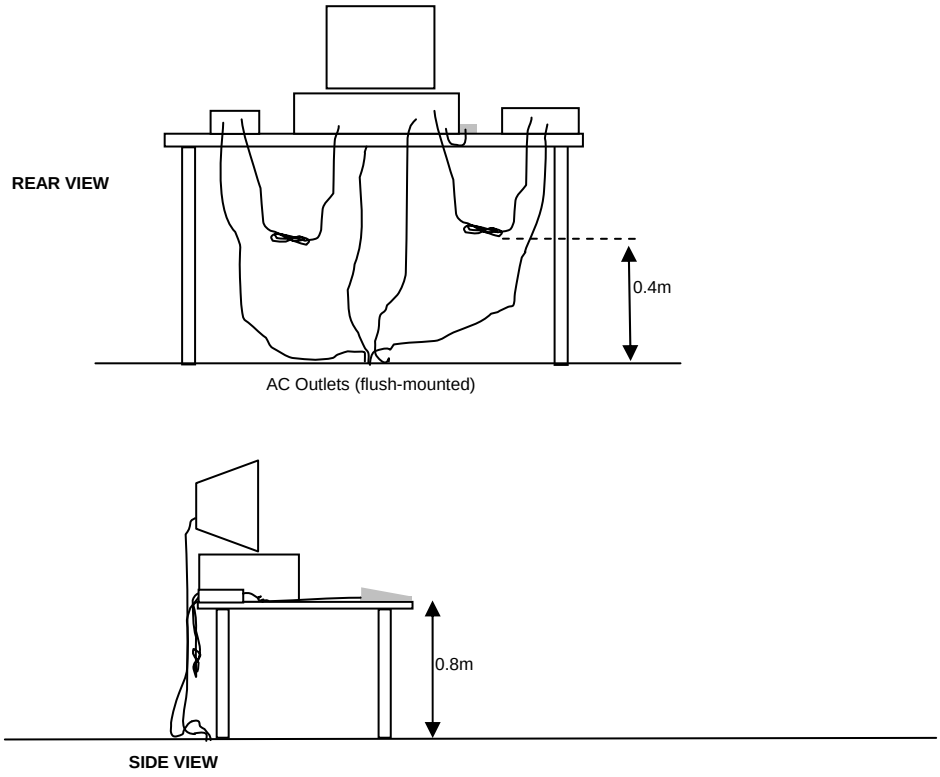
RADIATED EMISSIONS

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.

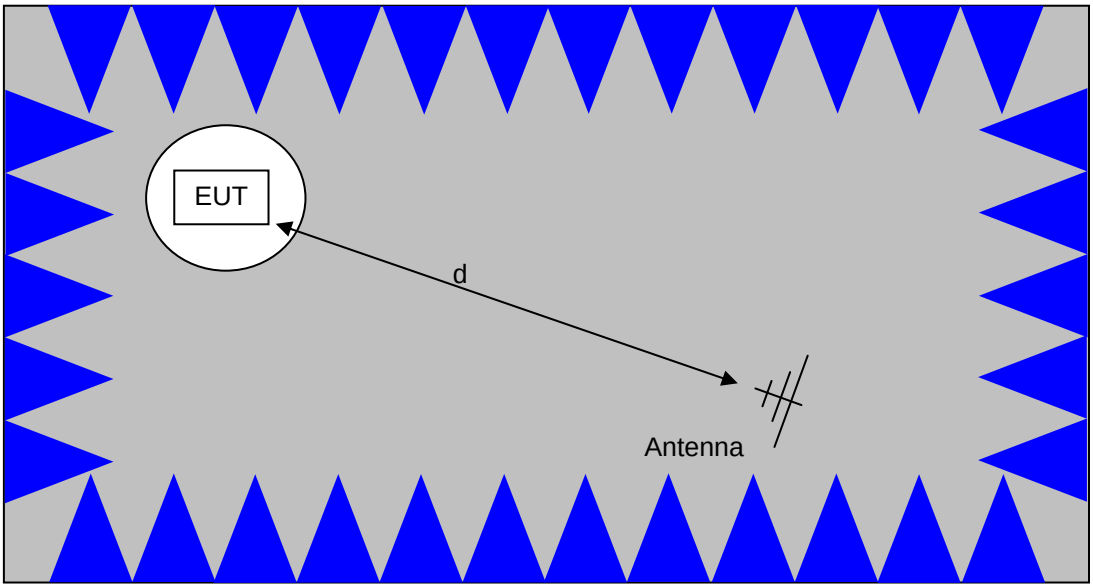
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

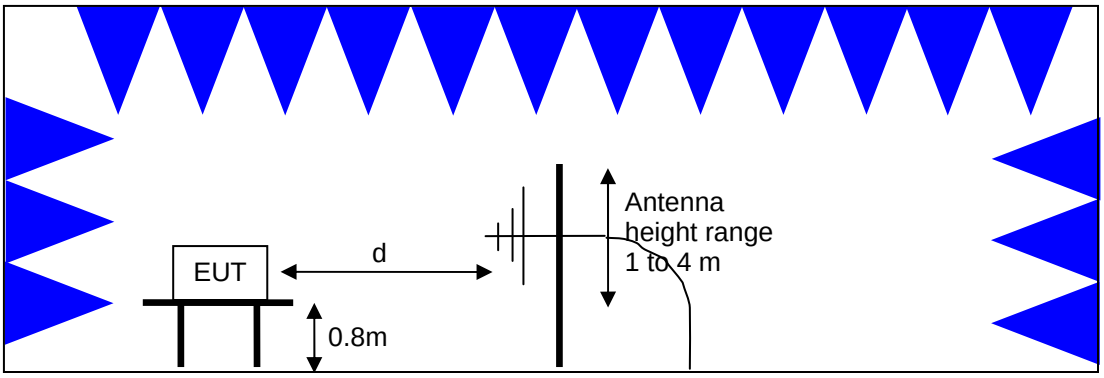


Typical Test Configuration for Radiated Field Strength Measurements



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.

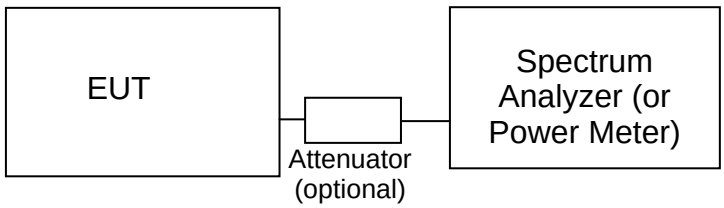
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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

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).

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

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:

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

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, 1000 - 18,000 MHz, 06-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	SpecAn 9 KHz-26.5 GHz, Non-Program	8563E	284	1/13/2013
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/19/2014
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	2/23/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/6/2012
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	8/2/2013

Radiated Emissions, 1000 - 6,500 MHz, 13-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/19/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	5/31/2013

Radio Antenna Port (Power and Spurious Emissions), 17-Oct-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, 23-Aug-12

Manufacturer	Description	Model	Asset #	Cal Due
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

T89494 Pages 23 – 44
T88703 Pages 45 - 48

Client:	Topcon Positioning Systems	Job Number:	J88658
Product	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		-
Emissions Standard(s):	RSS-210, Issue 8	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Topcon Positioning Systems

Product

HiPer GA

Date of Last Test: 10/17/2012

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated 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 approximately 30 meters from the EUT with all I/O connections running on top of the groundplane or routed in overhead in the GR-1089 test configuration.

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

Ambient Conditions:

Temperature: 25 °C
Rel. Humidity: 37 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	Basic	2402	Max		Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	33.6 dBµV/m @ 2386.1 MHz (-20.4 dB)
			Max		Band Edge (2400 MHz)	FCC Part 15.209 / 15.247(c)	Signals below -20dBc
			Max		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	31.3 dBµV/m @ 4805.7 MHz (-22.7 dB)
1b	Basic	2441	Max		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	31.0 dBµV/m @ 4895.7 MHz (-23.0 dB)
1c	Basic	2480	Max		Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	41.9 dBµV/m @ 2484.3 MHz (-12.1 dB)
			Max		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	34.9 dBµV/m @ 1179.9 MHz (-19.1 dB)

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
2a	EDR	2402	Max		Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	32.3 dBµV/m @ 2376.6 MHz (-21.7 dB)
			Max		Band Edge (2400 MHz)	FCC Part 15.209 / 15.247(c)	Signals below -20dBc
			Max		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	35.9 dBµV/m @ 2230.4 MHz (-18.1 dB)
2b	EDR	2441	Max		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	36.4 dBµV/m @ 2231.4 MHz (-17.6 dB)
2c	EDR	2480	Max		Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	40.7 dBµV/m @ 2484.2 MHz (-13.3 dB)
			Max		Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	36.2 dBµV/m @ 2230.2 MHz (-17.8 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.

Notes:

During the spurious emissions testing, near field scans were performed 18-26GHz. No emissions were observed.

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: Basic

Date of Test: 10/5/2012
Test Engineer: Joseph Cadigal
Test Location: FT Chamber#4

Run #1a: Low Channel @ 2402 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2402.030	91.5	V	-	-	AVG	223	1.0	POS; RB 1 MHz; VB: 10 Hz
2402.140	101.8	V	-	-	PK	223	1.0	POS; RB 1 MHz; VB: 3 MHz
2401.890	102.2	V	-	-	PK	223	1.0	POS; RB 100 kHz; VB: 100 kHz
2402.030	83.4	H	-	-	AVG	126	1.0	POS; RB 1 MHz; VB: 10 Hz
2401.810	93.7	H	-	-	PK	126	1.0	POS; RB 1 MHz; VB: 3 MHz
2401.790	93.6	H	-	-	PK	126	1.0	POS; RB 100 kHz; VB: 100 kHz

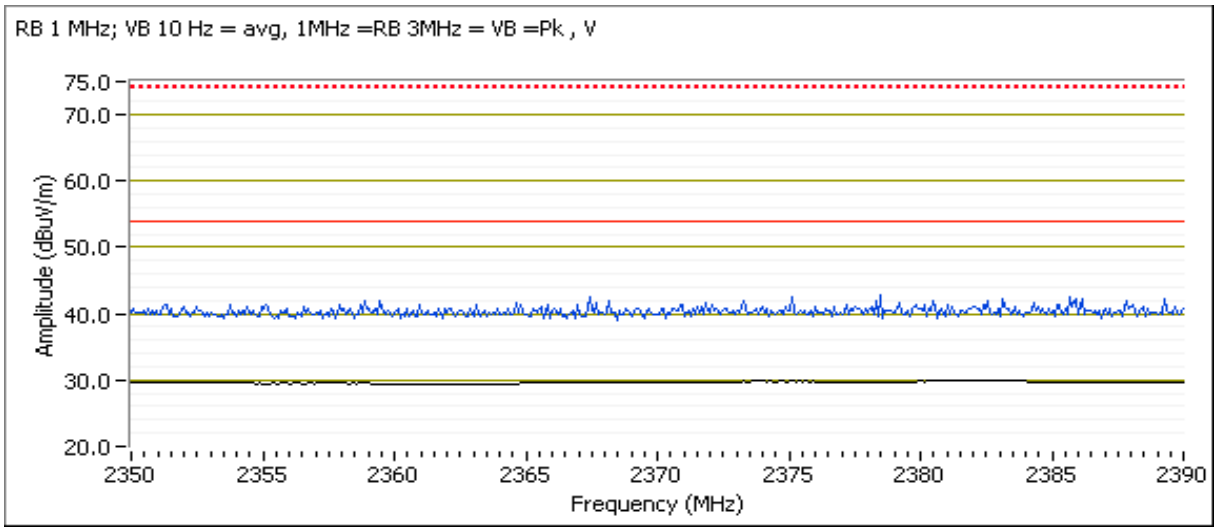
Fundamental emission level @ 3m in 100kHz RBW:	102.2	dBµV/m	
Limit for emissions outside of restricted bands:	82.2	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	72.2	dBµV/m	Limit is -30dBc (UNII power measurement)

Band Edge Signal Field Strength - Direct measurement of field strength

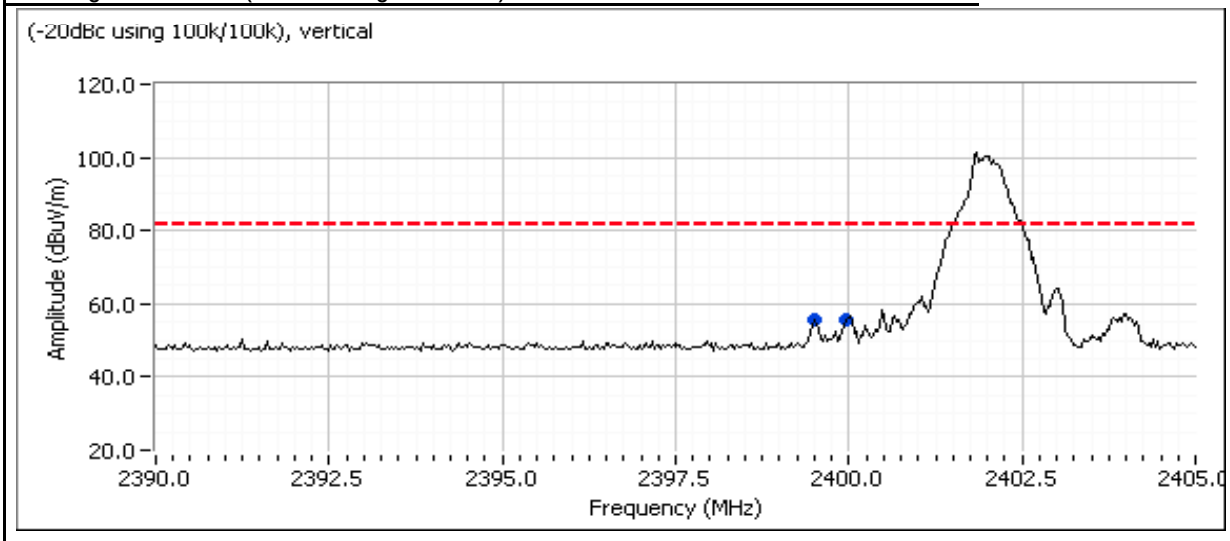
Restricted Bandedge at 2390MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2386.070	33.6	V	54.0	-20.4	AVG	120	1.0	POS; RB 1 MHz; VB: 10 Hz
2383.910	44.9	V	74.0	-29.1	PK	120	1.0	POS; RB 1 MHz; VB: 3 MHz
2385.990	30.2	H	54.0	-23.8	AVG	125	1.0	POS; RB 1 MHz; VB: 10 Hz
2379.660	41.5	H	74.0	-32.5	PK	125	1.0	POS; RB 1 MHz; VB: 3 MHz

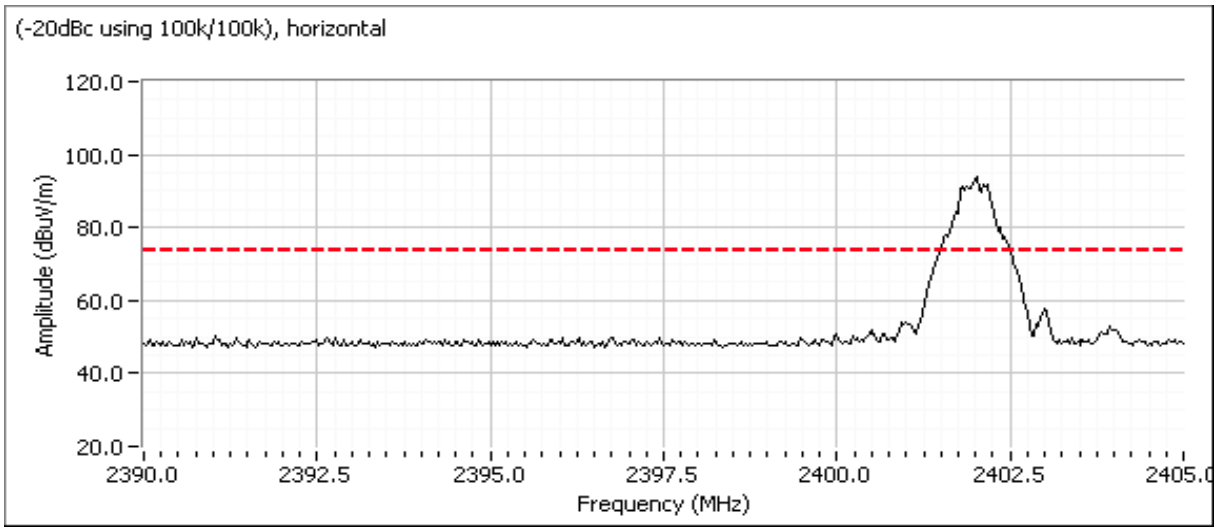
Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A



Bandedge at 2400MHz (-20dBc using 100k/100k)



Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

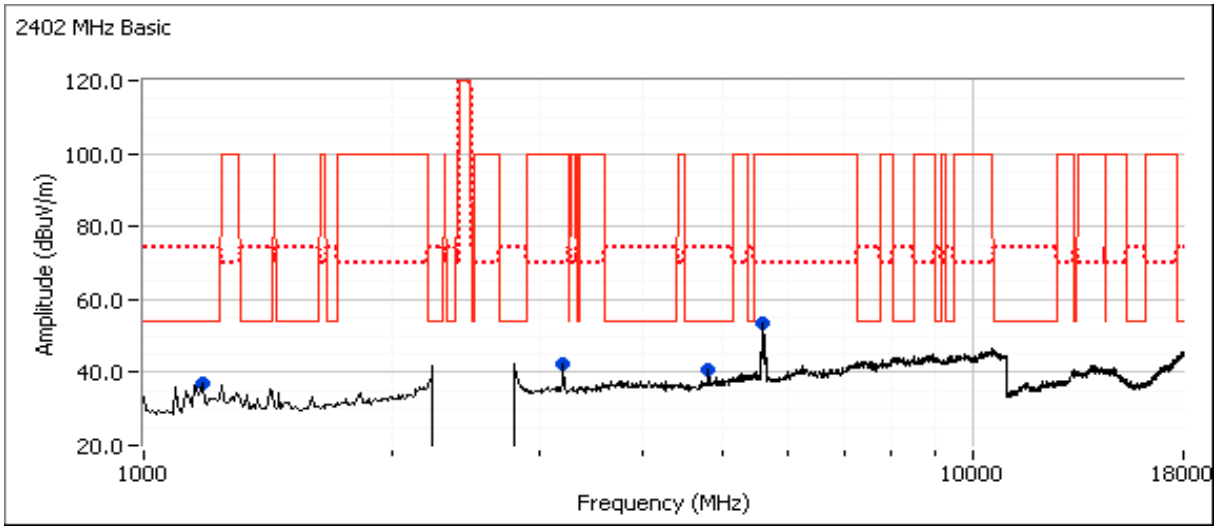


Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4805.700	31.3	V	54.0	-22.7	AVG	213	1.3	RB 1 MHz;VB 10 Hz;Peak
4808.530	42.4	V	74.0	-31.6	PK	213	1.3	RB 1 MHz;VB 3 MHz;Peak
1180.160	29.6	V	54.0	-24.4	AVG	64	1.3	RB 1 MHz;VB 10 Hz;Peak
1180.660	38.3	V	74.0	-35.7	PK	64	1.3	RB 1 MHz;VB 3 MHz;Peak
5571.450	33.2	V	82.2	-49.0	PK	99	1.3	RB 100 kHz;VB 100 kHz;Peak
3213.280	31.2	V	82.2	-51.0	PK	213	1.0	RB 100 kHz;VB 100 kHz;Peak

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 and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A



Run #1b: Center Channel @ 2441 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

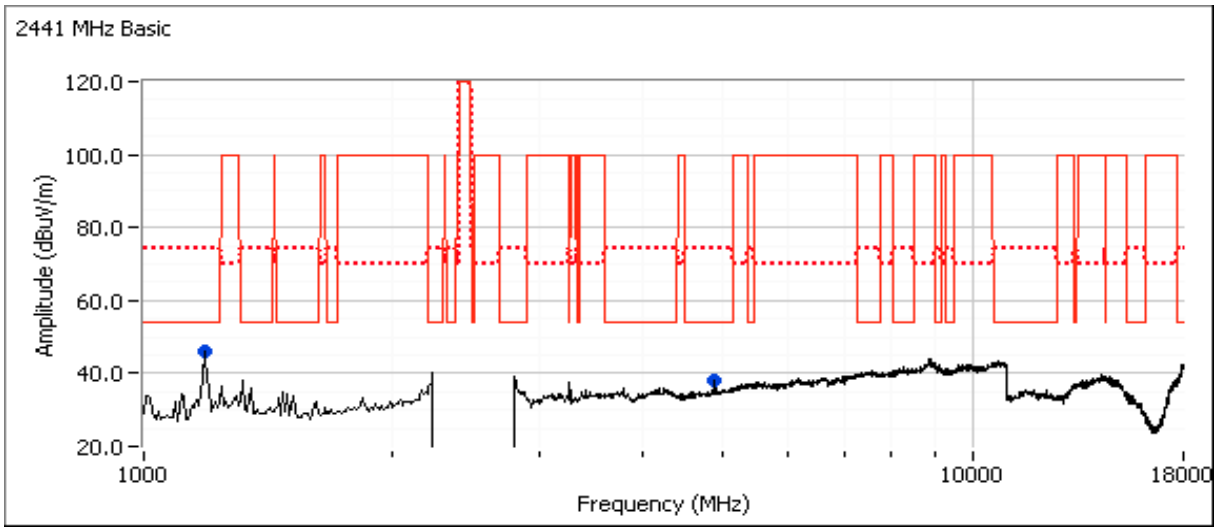
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2441.030	91.2	V	-	-	AVG	123	1.0	POS; RB 1 MHz; VB: 10 Hz
2441.120	101.4	V	-	-	PK	123	1.0	POS; RB 1 MHz; VB: 3 MHz
2440.990	102.0	V	-	-	PK	123	1.0	POS; RB 100 kHz; VB: 100 kHz
2441.030	82.6	H	-	-	AVG	129	0.9	POS; RB 1 MHz; VB: 10 Hz
2440.790	92.8	H	-	-	PK	129	0.9	POS; RB 1 MHz; VB: 3 MHz
2440.790	92.4	H	-	-	PK	129	0.9	POS; RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	102	dBµV/m	
Limit for emissions outside of restricted bands:	82	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	72	dBµV/m	Limit is -30dBc (UNII power measurement)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4895.670	31.0	V	54.0	-23.0	AVG	81	1.0	RB 1 MHz;VB 10 Hz;Peak
1177.140	25.6	V	54.0	-28.4	AVG	61	1.3	RB 1 MHz;VB 10 Hz;Peak
4895.720	42.5	V	74.0	-31.5	PK	81	1.0	RB 1 MHz;VB 3 MHz;Peak
1178.580	35.6	V	74.0	-38.4	PK	61	1.3	RB 1 MHz;VB 3 MHz;Peak

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 and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A



Run #1c: High Channel @ 2480 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

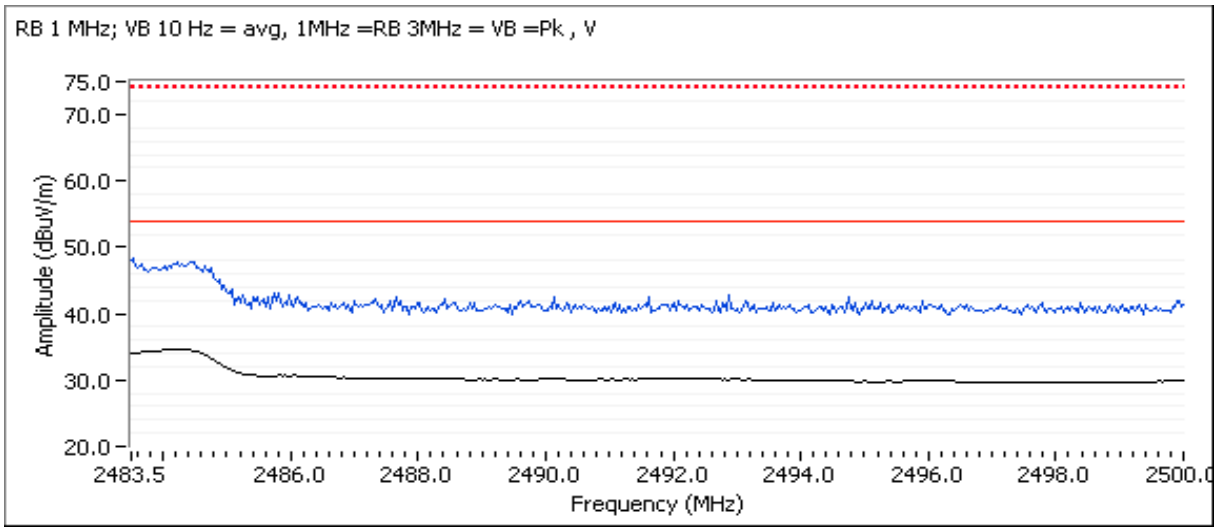
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2480.030	83.9	V	-	-	AVG	91	1.1	POS; RB 1 MHz; VB: 10 Hz
2480.140	94.2	V	-	-	PK	91	1.1	POS; RB 1 MHz; VB: 3 MHz
2479.990	95.8	V	-	-	PK	91	1.1	POS; RB 100 kHz; VB: 100 kHz
2480.030	83.1	H	-	-	AVG	92	0.9	POS; RB 1 MHz; VB: 10 Hz
2479.920	93.4	H	-	-	PK	92	0.9	POS; RB 1 MHz; VB: 3 MHz
2479.920	92.6	H	-	-	PK	92	0.9	POS; RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	95.8	dBµV/m	
Limit for emissions outside of restricted bands:	75.8	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	65.8	dBµV/m	Limit is -30dBc (UNII power measurement)

Band Edge Signal Field Strength - Direct measurement of 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	
2484.290	41.9	V	54.0	-12.1	AVG	91	1.0	POS; RB 1 MHz; VB: 10 Hz
2484.330	54.6	V	74.0	-19.4	PK	91	1.0	POS; RB 1 MHz; VB: 3 MHz
2484.230	35.8	H	54.0	-18.2	AVG	92	1.0	POS; RB 1 MHz; VB: 10 Hz
2484.190	48.9	H	74.0	-25.1	PK	92	1.0	POS; RB 1 MHz; VB: 3 MHz

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

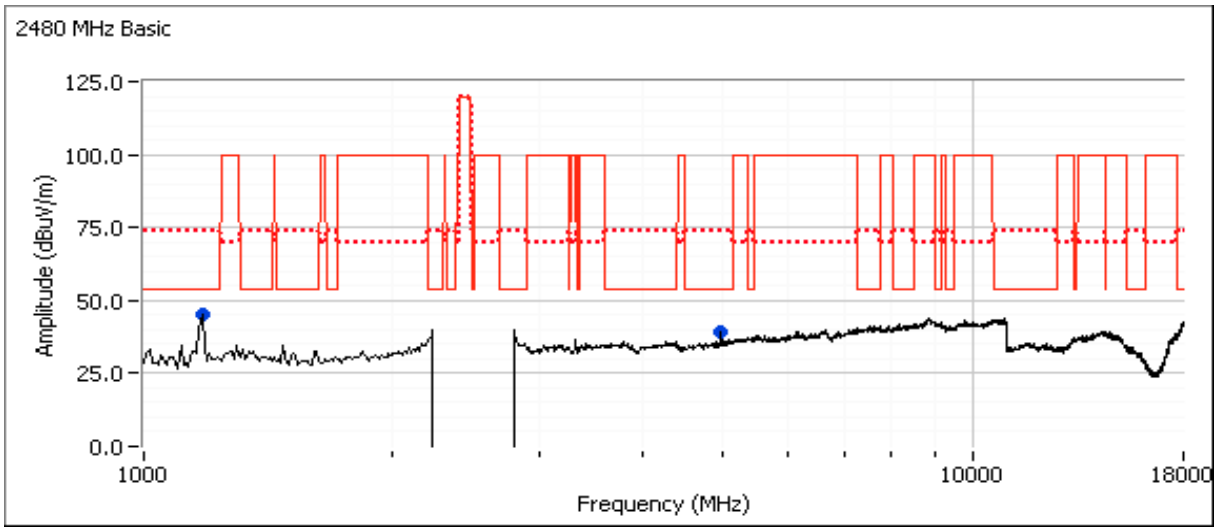


Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1179.890	34.9	V	54.0	-19.1	AVG	178	1.0	RB 1 MHz;VB 10 Hz;Peak
4977.230	31.1	V	54.0	-22.9	AVG	122	1.0	RB 1 MHz;VB 10 Hz;Peak
4978.060	42.6	V	74.0	-31.4	PK	122	1.0	RB 1 MHz;VB 3 MHz;Peak
1181.230	41.8	V	74.0	-32.2	PK	178	1.0	RB 1 MHz;VB 3 MHz;Peak

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 and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A



Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

Run #2: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: EDR

Date of Test: 10/12/2012
Test Engineer: Joseph Cadigal
Test Location: FT Chamber#3

Run #2a: Low Channel @ 2402 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2402.050	90.1	V	-	-	AVG	228	1.0	POS; RB 1 MHz; VB: 10 Hz
2401.850	100.3	V	-	-	PK	228	1.0	POS; RB 1 MHz; VB: 3 MHz
2402.010	100.3	V	-	-	PK	228	1.0	POS; RB 100 kHz; VB: 100 kHz
2402.050	79.8	H	-	-	AVG	51	1.3	POS; RB 1 MHz; VB: 10 Hz
2402.140	90.0	H	-	-	PK	51	1.3	POS; RB 1 MHz; VB: 3 MHz
2401.820	89.9	H	-	-	PK	51	1.3	POS; RB 100 kHz; VB: 100 kHz

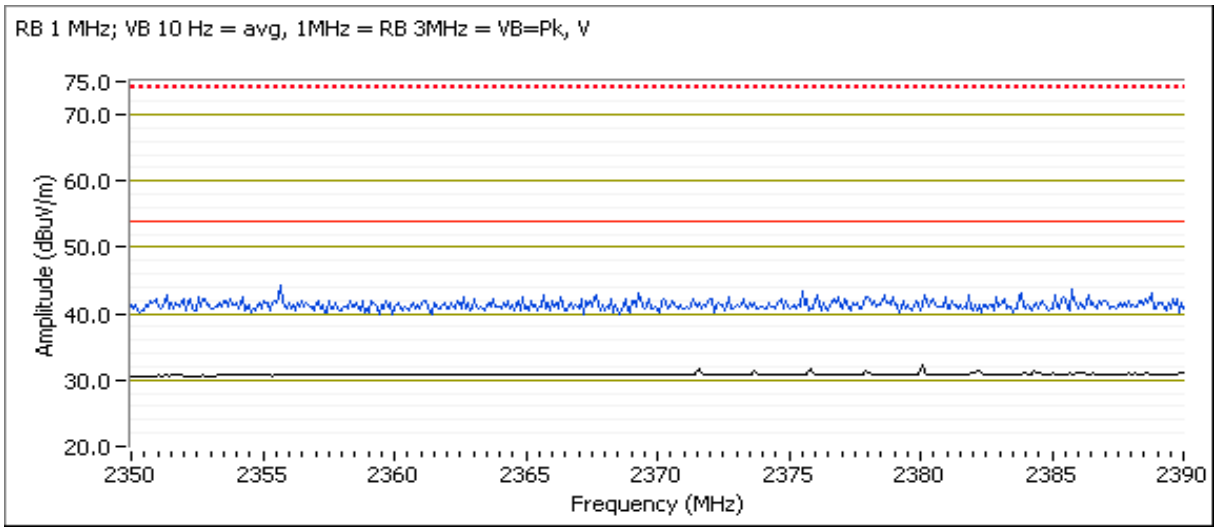
Fundamental emission level @ 3m in 100kHz RBW:	100.3	dBµV/m	
Limit for emissions outside of restricted bands:	80.3	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	70.3	dBµV/m	Limit is -30dBc (UNII power measurement)

Band Edge Signal Field Strength - Direct measurement of field strength

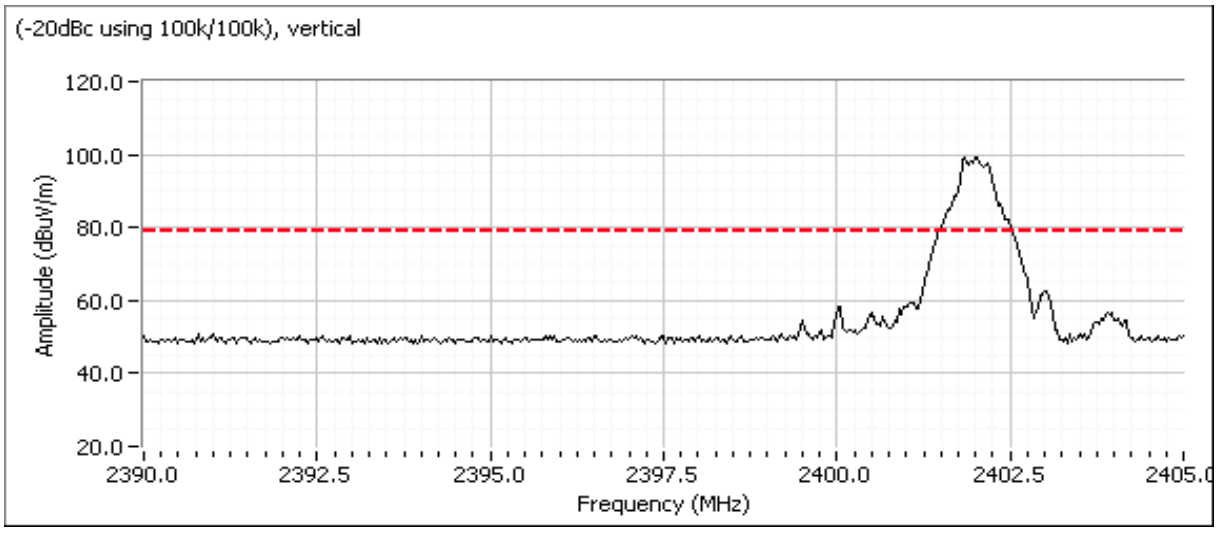
Restricted Bandedge at 2390MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2376.610	32.3	V	54.0	-21.7	AVG	242	1.7	POS; RB 1 MHz; VB: 10 Hz
2378.140	41.9	V	74.0	-32.1	PK	242	1.7	POS; RB 1 MHz; VB: 3 MHz
2377.580	31.3	H	54.0	-22.7	AVG	261	1.0	POS; RB 1 MHz; VB: 10 Hz
2354.730	43.4	H	74.0	-30.6	PK	261	1.0	POS; RB 1 MHz; VB: 3 MHz

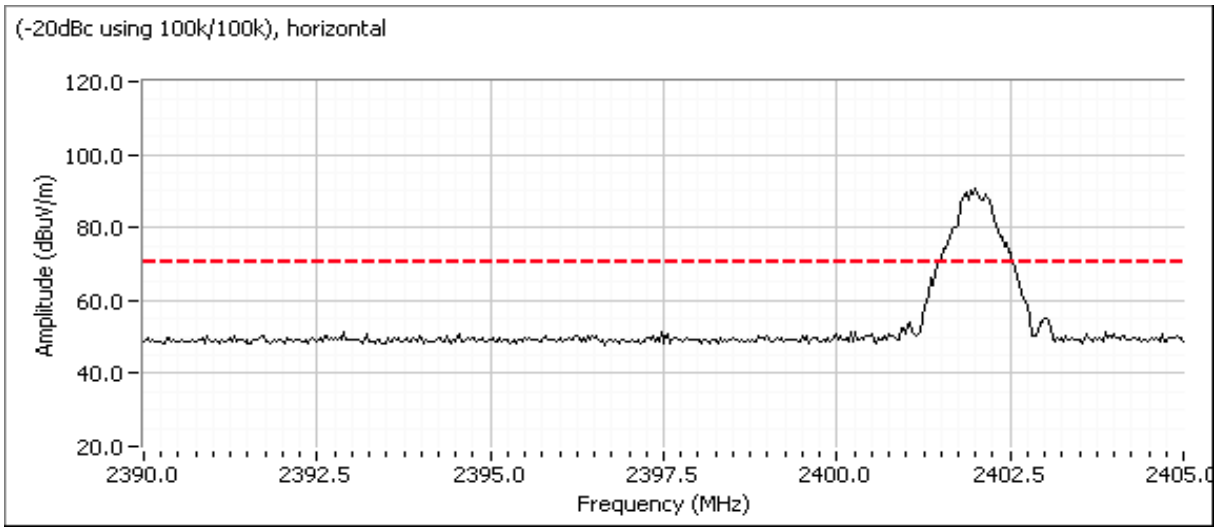
Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A



Bandedge at 2400MHz (-20dBc using 100k/100k)



Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

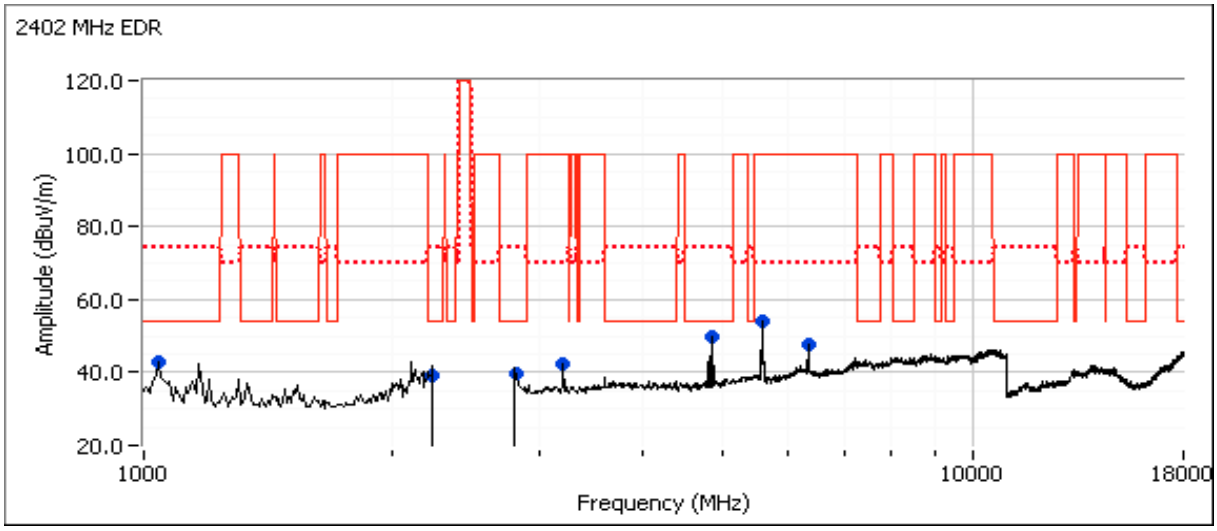


Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2230.440	35.9	H	54.0	-18.1	AVG	155	2.2	RB 1 MHz;VB 10 Hz;Peak
2232.220	47.4	H	74.0	-26.6	PK	155	2.2	RB 1 MHz;VB 3 MHz;Peak
6348.540	34.4	H	80.3	-45.9	Pk	70	1.0	RB 100 kHz;VB 100 kHz;Peak
5570.000	56.2	V	80.3	-24.1	Pk	154	1.3	RB 100 kHz;VB 100 kHz;Peak
3207.190	29.9	V	80.3	-50.4	Pk	216	1.0	RB 100 kHz;VB 100 kHz;Peak
1047.090	26.1	H	54.0	-27.9	AVG	99	1.6	RB 1 MHz;VB 10 Hz;Peak
1046.880	49.1	H	74.0	-24.9	PK	99	1.6	RB 1 MHz;VB 3 MHz;Peak
4850.000	31.0	V	54.0	-23.0	AVG	194	2.2	RB 1 MHz;VB 10 Hz;Peak
4850.550	42.1	V	74.0	-31.9	PK	194	2.2	RB 1 MHz;VB 3 MHz;Peak
2820.160	33.6	V	54.0	-20.4	AVG	205	1.3	RB 1 MHz;VB 10 Hz;Peak
2821.100	45.2	V	74.0	-28.8	PK	205	1.3	RB 1 MHz;VB 3 MHz;Peak

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 and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A



Run #2b: Center Channel @ 2441 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

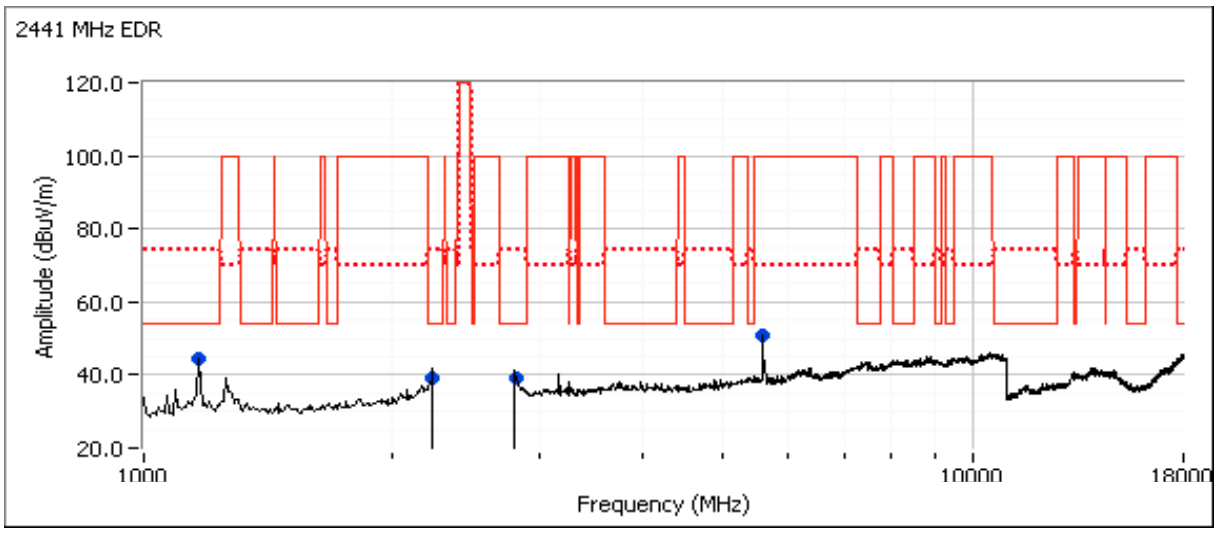
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2441.050	78.5	H	-	-	AVG	62	1.0	POS; RB 1 MHz; VB: 10 Hz
2441.190	88.6	H	-	-	PK	62	1.0	POS; RB 1 MHz; VB: 3 MHz
2440.980	88.3	H	-	-	PK	62	1.0	POS; RB 100 kHz; VB: 100 kHz
2441.050	89.2	V	-	-	AVG	225	1.0	POS; RB 1 MHz; VB: 10 Hz
2440.820	99.4	V	-	-	PK	225	1.0	POS; RB 1 MHz; VB: 3 MHz
2440.880	98.3	V	-	-	PK	225	1.0	POS; RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	98.3	dBµV/m	
Limit for emissions outside of restricted bands:	78.3	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	68.3	dBµV/m	Limit is -30dBc (UNII power measurement)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2231.430	36.4	H	54.0	-17.6	AVG	248	1.0	RB 1 MHz;VB 10 Hz;Peak
2233.080	47.7	H	74.0	-26.3	PK	248	1.0	RB 1 MHz;VB 3 MHz;Peak
2810.450	34.5	H	54.0	-19.5	AVG	127	1.0	RB 1 MHz;VB 10 Hz;Peak
2810.150	45.6	H	74.0	-28.4	PK	127	1.0	RB 1 MHz;VB 3 MHz;Peak
1159.460	34.7	V	54.0	-19.3	AVG	182	2.2	RB 1 MHz;VB 10 Hz;Peak
1160.110	44.4	V	74.0	-29.6	PK	182	2.2	RB 1 MHz;VB 3 MHz;Peak
5579.380	43.9	V	68.3	-24.4	PK	235	1.6	RB 1 MHz;VB 3 MHz;Peak

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

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 and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.



Run #2c: High Channel @ 2480 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

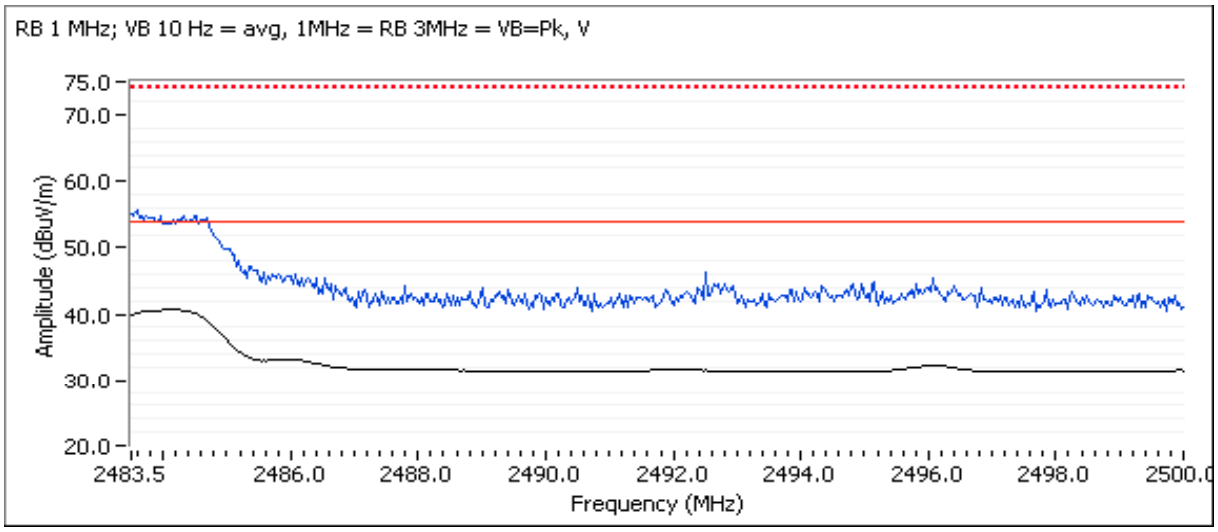
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2480.050	89.5	V	-	-	AVG	225	1.0	POS; RB 1 MHz; VB: 10 Hz
2480.150	99.7	V	-	-	PK	225	1.0	POS; RB 1 MHz; VB: 3 MHz
2479.990	99.7	V	-	-	PK	225	1.0	POS; RB 100 kHz; VB: 100 kHz
2480.040	76.8	H	-	-	AVG	66	1.0	POS; RB 1 MHz; VB: 10 Hz
2480.140	87.0	H	-	-	PK	66	1.0	POS; RB 1 MHz; VB: 3 MHz
2480.000	85.3	H	-	-	PK	66	1.0	POS; RB 100 kHz; VB: 100 kHz

Fundamental emission level @ 3m in 100kHz RBW:	99.7	dBµV/m	
Limit for emissions outside of restricted bands:	79.7	dBµV/m	Limit is -20dBc (Peak power measurement)
Limit for emissions outside of restricted bands:	69.7	dBµV/m	Limit is -30dBc (UNII power measurement)

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

Band Edge Signal Field Strength - Direct measurement of 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	
2484.160	40.7	V	54.0	-13.3	AVG	225	1.0	POS; RB 1 MHz; VB: 10 Hz
2484.390	54.2	V	74.0	-19.8	PK	225	1.0	POS; RB 1 MHz; VB: 3 MHz
2494.110	34.9	H	54.0	-19.1	AVG	190	1.0	POS; RB 1 MHz; VB: 10 Hz
2495.670	42.5	H	74.0	-31.5	PK	190	1.0	POS; RB 1 MHz; VB: 3 MHz

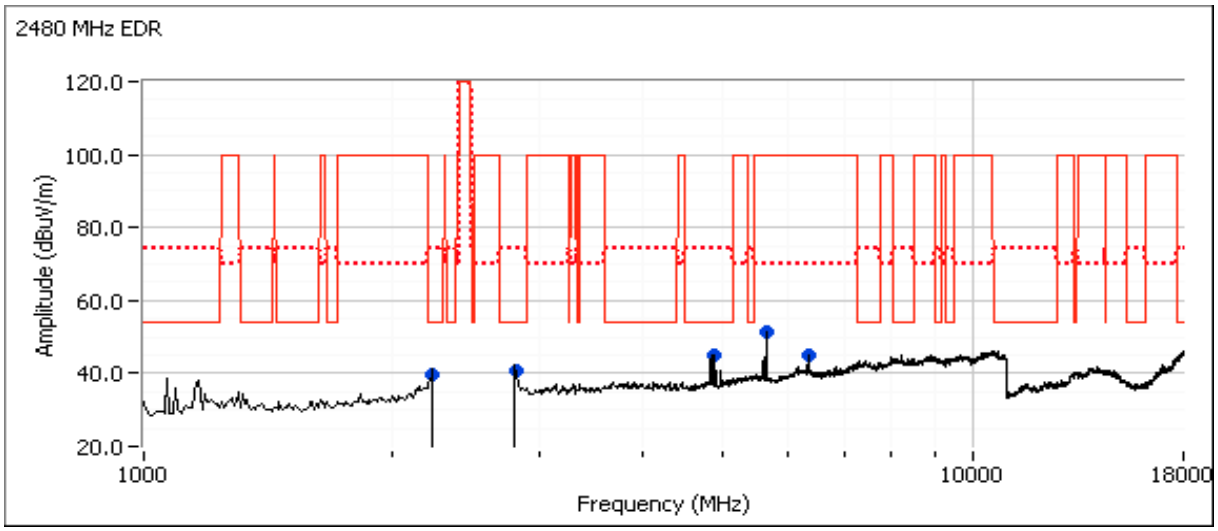


Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2230.220	36.2	H	54.0	-17.8	AVG	4	1.0	RB 1 MHz;VB 10 Hz;Peak
2231.600	47.2	H	74.0	-26.8	PK	4	1.0	RB 1 MHz;VB 3 MHz;Peak
5648.080	46.4	V	70.0	-23.6	PK	124	1.0	RB 1 MHz;VB 3 MHz;Peak
4898.420	31.4	V	54.0	-22.6	AVG	191	2.2	RB 1 MHz;VB 10 Hz;Peak
4900.330	43.8	V	74.0	-30.2	PK	191	2.2	RB 1 MHz;VB 3 MHz;Peak
6348.390	45.6	H	70.0	-24.4	PK	272	2.2	RB 1 MHz;VB 3 MHz;Peak
2809.740	34.9	H	54.0	-19.1	AVG	321	2.5	RB 1 MHz;VB 10 Hz;Peak
2807.340	46.2	H	74.0	-27.8	PK	321	2.5	RB 1 MHz;VB 3 MHz;Peak

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 and measured in 100kHz.
Note 2:	Signal is not in a restricted band but the more stringent restricted band limit was used.

Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A



Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	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.

Date of Test: 10/17/2012
Test Engineer: M. Birgani
Test Location: Fremont EMC Lab #4

Config. Used: -
Config Change: -
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

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: 18-20 °C
Rel. Humidity: 30-35 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Output Power	15.247(b)	PASS	-5.1dBm (0.0003W)
2	20dB Bandwidth	15.247(a)	PASS	1261kHz
2	99% bandwidth	15.247(a)	PASS	1256kHz
2	Channel Occupancy	15.247(a)	PASS	less than 400ms
2	Number of Channels	15.247(a)	PASS	79

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:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

Run #1: Output Power

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels.
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Maximum antenna gain: 0 dBi

Mode	Frequency (MHz)	Res BW	Output Power (dBm)	Output Power (W)	EIRP (mW)
Basic	2402	2MHz	-6.0	0.00025	0.25
Basic	2441	2MHz	-5.3	0.00030	0.30
Basic	2480	2MHz	-5.1	0.00031	0.31
EDR	2402	2MHz	-6.7	0.00022	0.22
EDR	2441	2MHz	-5.9	0.00026	0.26
EDR	2480	2MHz	-5.9	0.00026	0.26

Note - Power measured with a spectrum analyzer with RBW=2MHz, VBW >= 3xRBW

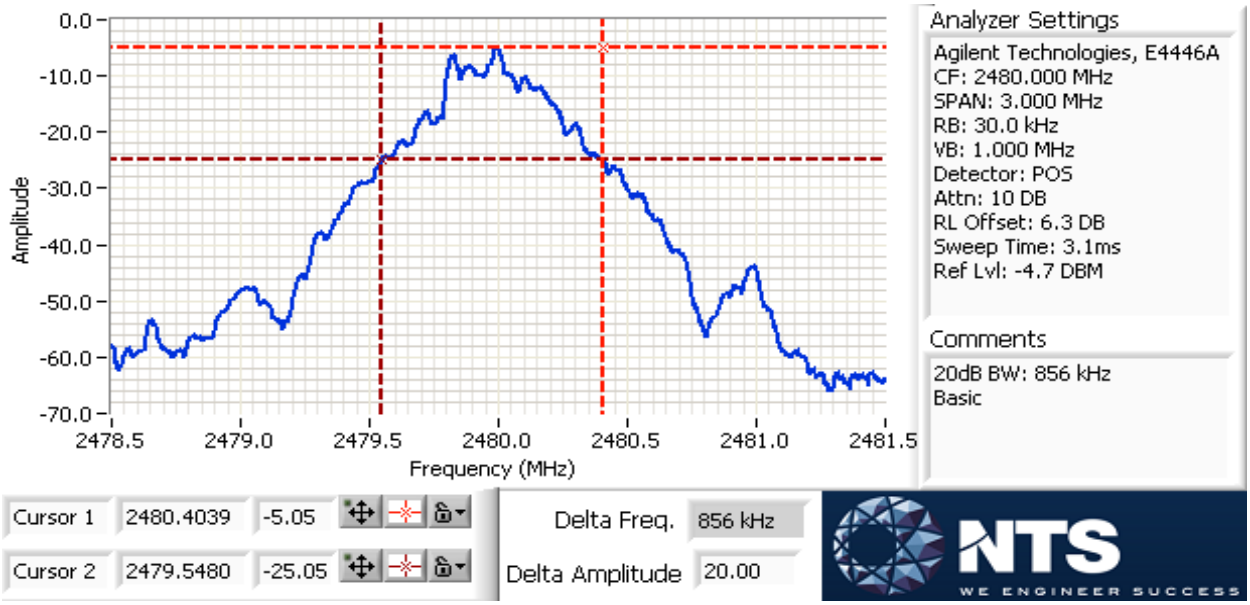
Run #2: Bandwidth, Channel Occupancy, Spacing and Number of Channels

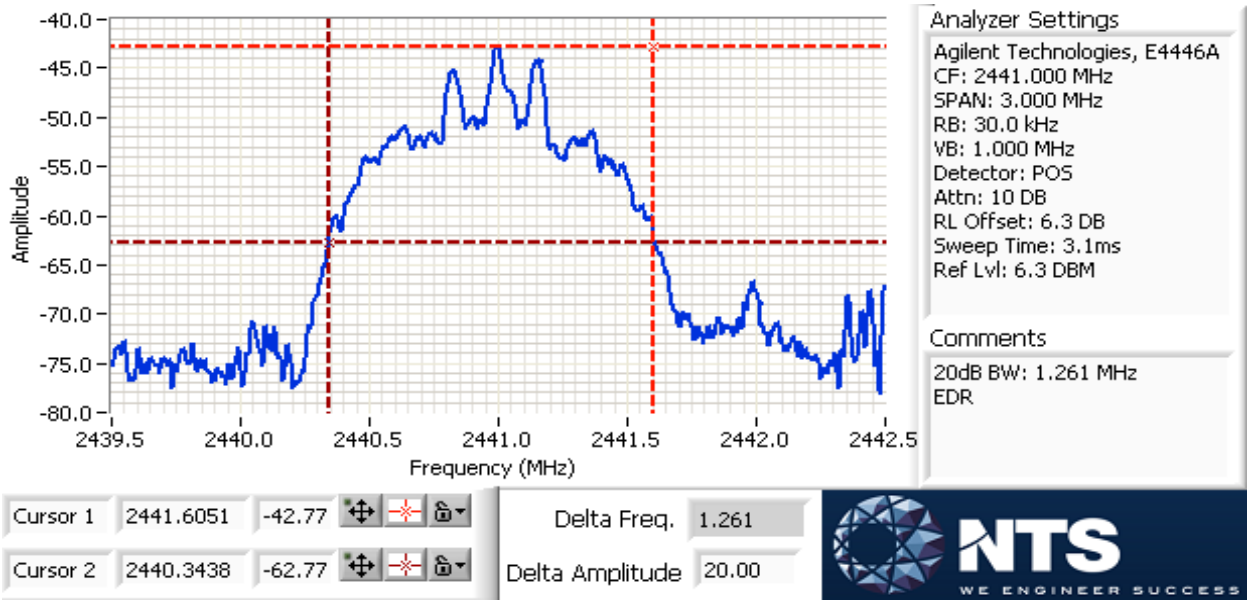
Channel	Frequency (MHz)	Resolution Bandwidth	20dB Bandwidth (kHz)	Resolution Bandwidth	99% Bandwidth (kHz)
Low	2402	30kHz	847	30kHz	843
Mid	2441	30kHz	850	30kHz	843
High	2480	30kHz	856	30kHz	846
Low	2402	30kHz	1255	30kHz	1200
Mid	2441	30kHz	1261	30kHz	1256
High	2480	30kHz	1258	30kHz	1194

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

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. (Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.)
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 a period of 0.4 times the number of channels, N (i.e. 0.4N divided by the time between successive hops, rounded up to the closest integer), unless the time between successive hops exceeds 0.4N, in which case the channel dwell time is the transmit time on a channel

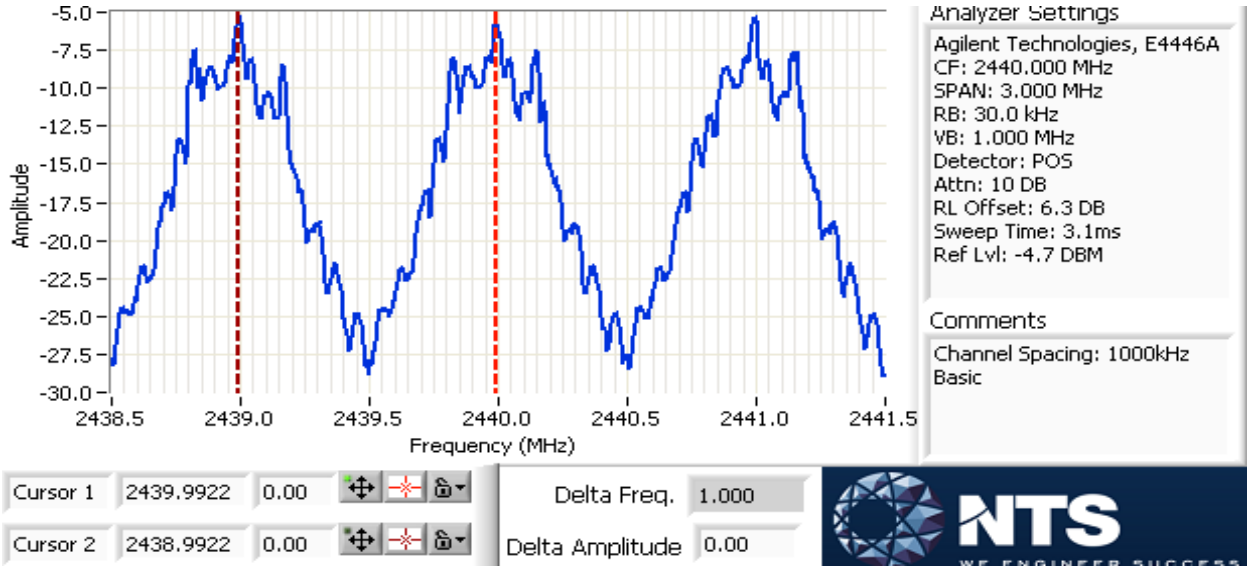
Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

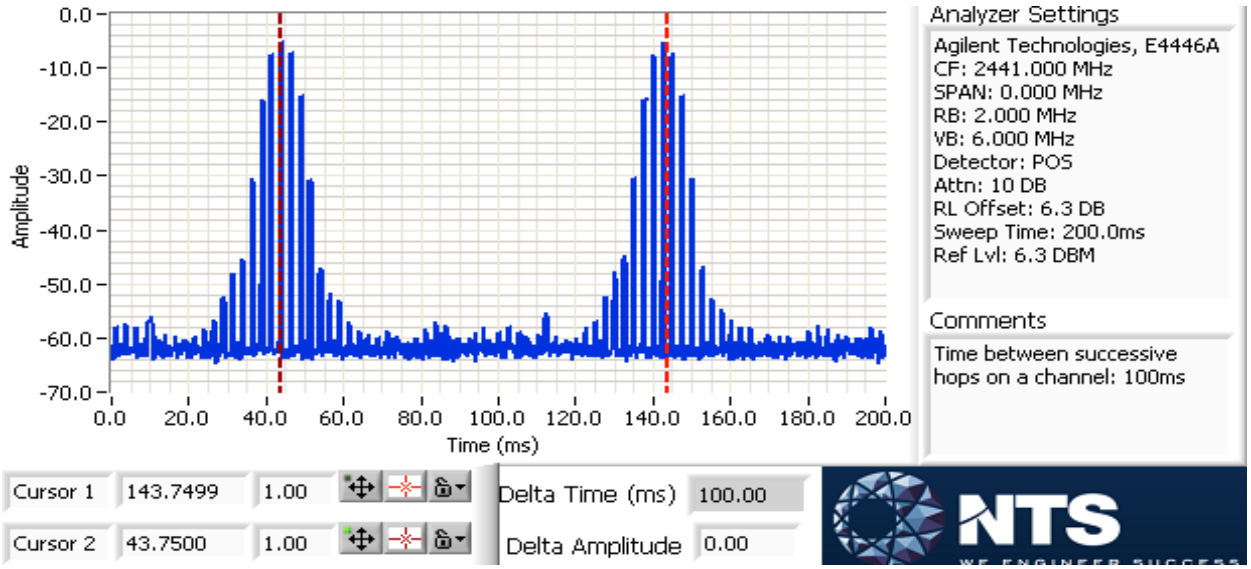




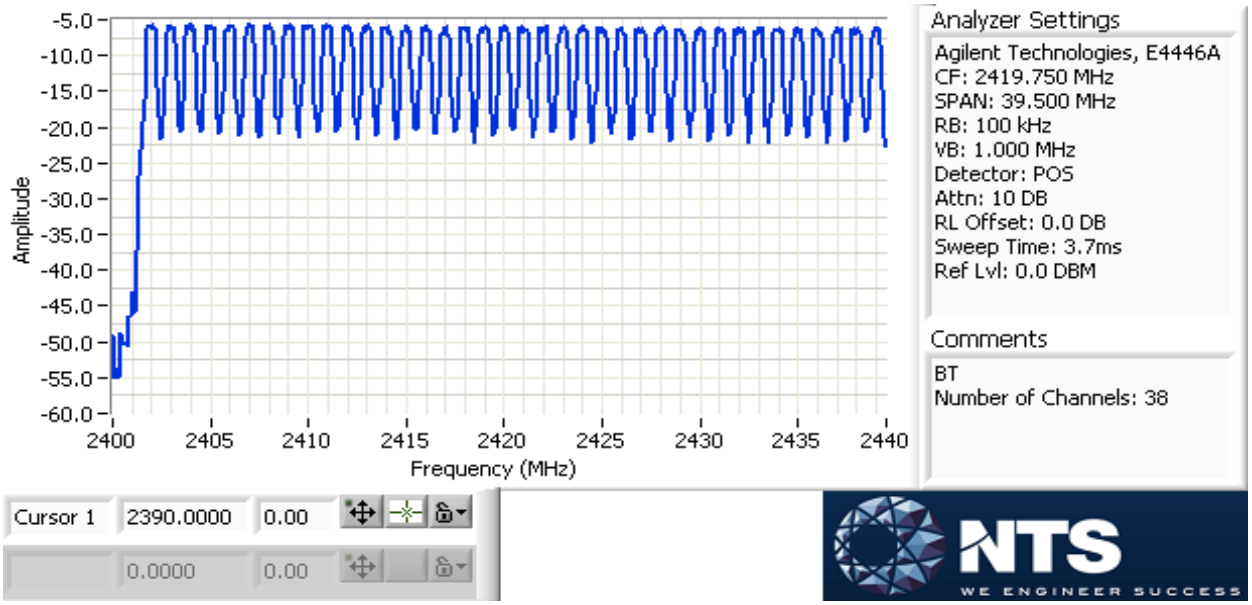
Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A

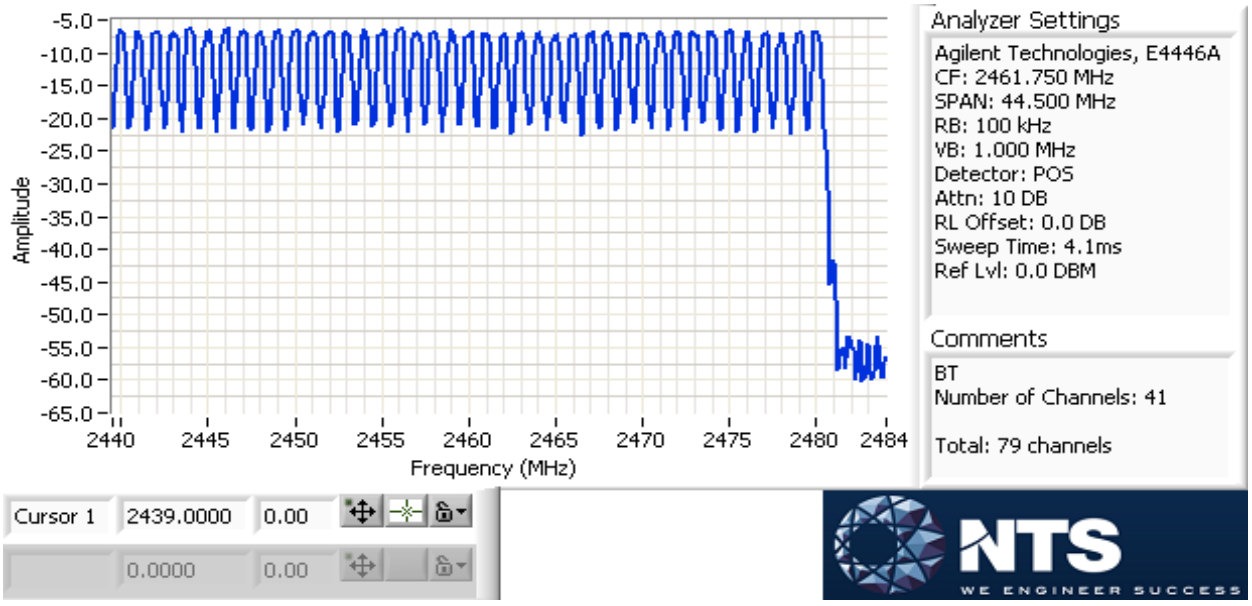
Maximum 20dB bandwidth:	856	kHz	
Channel spacing:	1000	kHz	Pass
Transmission time per hop:	1.266	ms	
The time between successive hops on a channel:	100.0	ms	
Number of channels (N):	79		Pass
Channel dwell time in 31.6 seconds:	400	ms	Pass





Client:	Topcon Positioning Systems	Job Number:	J88658
Model:	HiPer GA	T-Log Number:	T89494
		Account Manager:	Deepa Shetty
Contact:	Ferdinand Riodique		
Standard:	RSS-210, Issue 8	Class:	N/A





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:	B

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: 8/23/2012
Test Engineer: Deniz Demirci
Test Location: Fremont Chamber #3
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

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. No local support equipment or remote support equipment were used

Ambient Conditions:

Temperature: 24 °C
Rel. Humidity: 37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	Class B	Pass	45.4 dBµV @ 0.498 MHz (-10.6 dB)

Modifications Made During Testing

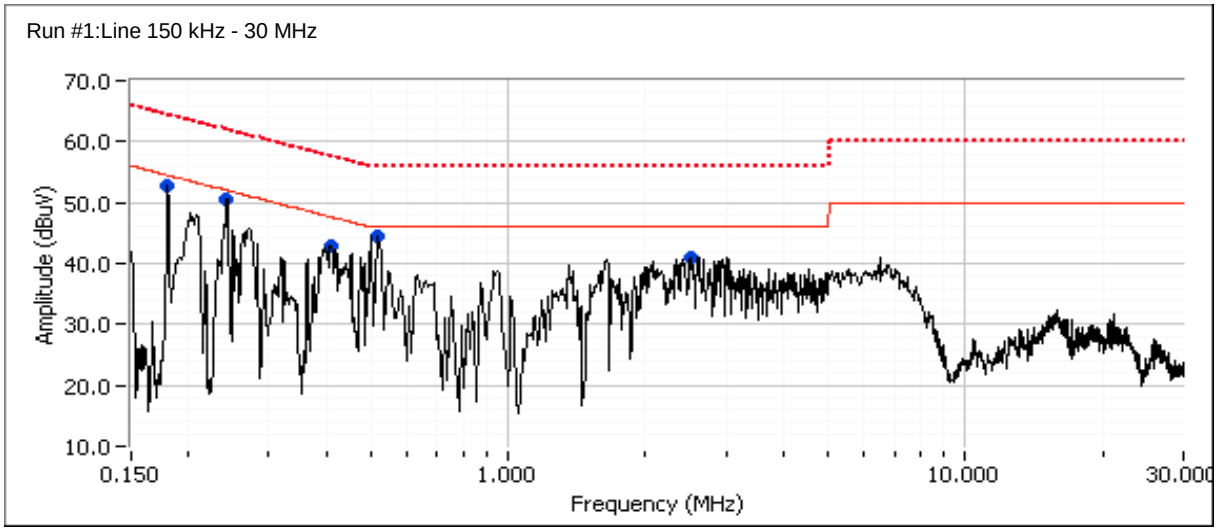
No modifications were made to the EUT during testing
EUT was transmitting at 420 MHz with Full power

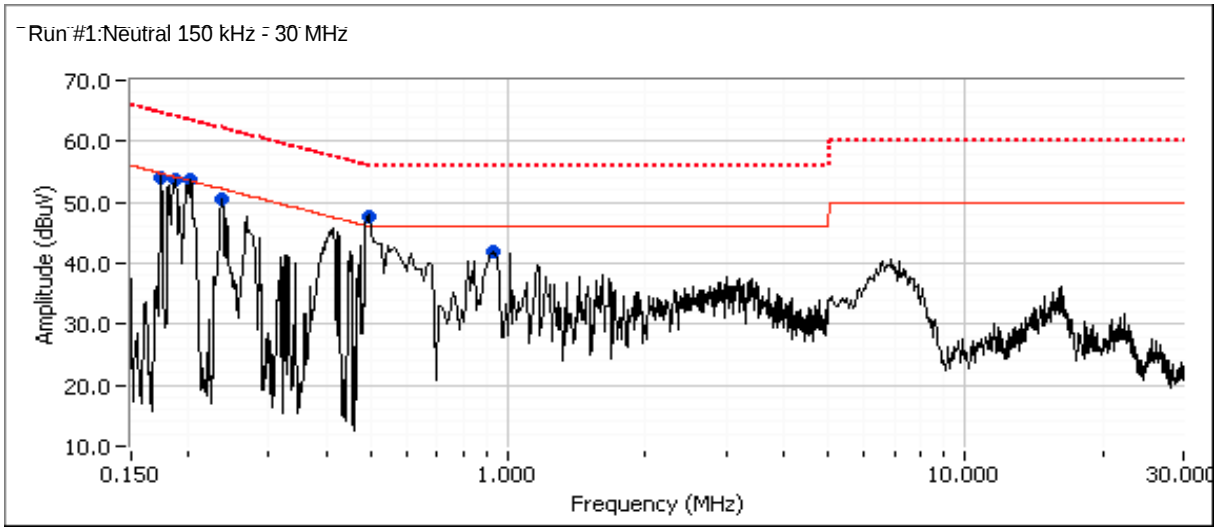
Deviations From The Standard

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:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30 MHz, 120 V / 60 Hz





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:	B

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

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.181	52.9	Line 1	54.5	-1.6	Peak	
0.243	50.4	Line 1	52.0	-1.6	Peak	
0.411	*42.9*	*Line 1*	*47.6*	*-4.7*	*Peak*	
0.518	*44.5*	*Line 1*	*46.0*	*-1.5*	*Peak*	
2.502	*41.1*	*Line 1*	*46.0*	*-4.9*	*Peak*	
0.175	*54.1*	*Neutral*	*54.7*	*-0.6*	*Peak*	
0.187	*53.6*	*Neutral*	*54.2*	*-0.6*	*Peak*	
0.203	*53.6*	*Neutral*	*53.5*	*0.1*	*Peak*	
0.237	*50.6*	*Neutral*	*52.2*	*-1.6*	*Peak*	
0.497	*47.8*	*Neutral*	*46.0*	*1.8*	*Peak*	
0.933	*41.8*	*Neutral*	*46.0*	*-4.2*	*Peak*	

Final quasi-peak and average readings

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.498	45.4	Neutral	56.0	-10.6	QP	QP (1.00s)
0.517	43.1	Line 1	56.0	-12.9	QP	QP (1.00s)
0.202	50.0	Neutral	63.5	-13.5	QP	QP (1.00s)
0.175	50.5	Neutral	64.7	-14.2	QP	QP (1.00s)
0.187	49.6	Neutral	64.2	-14.6	QP	QP (1.00s)
0.202	38.8	Neutral	53.5	-14.7	AVG	AVG (0.10s)
0.181	49.4	Line 1	64.4	-15.0	QP	QP (1.00s)
0.412	42.3	Line 1	57.6	-15.3	QP	QP (1.00s)
0.243	46.2	Line 1	62.0	-15.8	QP	QP (1.00s)
0.237	46.2	Neutral	62.2	-16.0	QP	QP (1.00s)
0.412	31.4	Line 1	47.6	-16.2	AVG	AVG (0.10s)
0.925	38.5	Neutral	56.0	-17.5	QP	QP (1.00s)
0.498	27.7	Neutral	46.0	-18.3	AVG	AVG (0.10s)
0.187	35.7	Neutral	54.2	-18.5	AVG	AVG (0.10s)
0.181	35.4	Line 1	54.4	-19.0	AVG	AVG (0.10s)
2.494	36.8	Line 1	56.0	-19.2	QP	QP (1.00s)
0.243	32.3	Line 1	52.0	-19.7	AVG	AVG (0.10s)
0.237	31.9	Neutral	52.2	-20.3	AVG	AVG (0.10s)
0.517	25.6	Line 1	46.0	-20.4	AVG	AVG (0.10s)
0.175	33.8	Neutral	54.7	-20.9	AVG	AVG (0.10s)
0.925	22.3	Neutral	46.0	-23.7	AVG	AVG (0.10s)
2.494	22.2	Line 1	46.0	-23.8	AVG	AVG (0.10s)

End of Report

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