

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: UGWANBL2SME133A and UGWANBL2SME133U

IC CERTIFICATION #: 5125A-UGWANBL2
FCC ID: R8KUGWANBL2

APPLICANT: Unigen Corporation
45388 Warm Springs Blvd.
Fremont, CA 94539

TEST SITE(S): NTS Silicon Valley
41039 Boyce Road.
Fremont, CA. 94538-2435

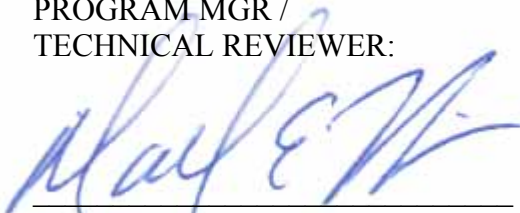
IC SITE REGISTRATION #: 2845B-3; 2845B-4, 2845B-5, 2845B-7

REPORT DATE: September 10, 2012

FINAL TEST DATES: August 7 and 8, 2012

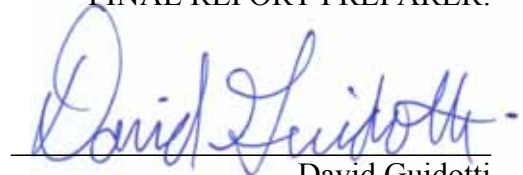
TOTAL NUMBER OF PAGES: 56

PROGRAM MGR /
TECHNICAL REVIEWER:



Mark E Hill
Staff Engineer

QUALITY ASSURANCE DELEGATE /
FINAL REPORT PREPARER:



David Guidotti
Senior Technical Writer



NTS Silicon Valley is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise. This report and the information contained herein represent the results of testing test articles identified and selected by the client performed to specifications and/or procedures selected by the client. National Technical Systems (NTS) makes no representations, expressed or implied, that such testing is adequate (or inadequate) to demonstrate efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it represent any statement whatsoever as to its merchantability or fitness of the test article, or similar products, for a particular purpose. This report shall not be reproduced except in full

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	09-10-2012	First release	

TABLE OF CONTENTS

REVISION HISTORY	2
TABLE OF CONTENTS	3
SCOPE.....	4
OBJECTIVE	4
STATEMENT OF COMPLIANCE.....	5
DEVIATIONS FROM THE STANDARDS.....	5
TEST RESULTS SUMMARY	6
DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)	6
GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS	7
MEASUREMENT UNCERTAINTIES.....	8
EQUIPMENT UNDER TEST (EUT) DETAILS.....	9
GENERAL.....	9
OTHER EUT DETAILS.....	9
ANTENNA SYSTEM	9
ENCLOSURE.....	9
MODIFICATIONS.....	9
SUPPORT EQUIPMENT.....	10
EUT INTERFACE PORTS	10
EUT OPERATION	10
TEST SITE.....	11
GENERAL INFORMATION.....	11
CONDUCTED EMISSIONS CONSIDERATIONS	11
RADIATED EMISSIONS CONSIDERATIONS	11
MEASUREMENT INSTRUMENTATION	12
RECEIVER SYSTEM	12
INSTRUMENT CONTROL COMPUTER	12
LINE IMPEDANCE STABILIZATION NETWORK (LISN).....	12
FILTERS/ATTENUATORS	13
ANTENNAS.....	13
ANTENNA MAST AND EQUIPMENT TURNTABLE.....	13
INSTRUMENT CALIBRATION.....	13
TEST PROCEDURES	14
EUT AND CABLE PLACEMENT	14
CONDUCTED EMISSIONS.....	14
RADIATED EMISSIONS.....	15
CONDUCTED EMISSIONS FROM ANTENNA PORT	17
BANDWIDTH MEASUREMENTS	17
SPECIFICATION LIMITS AND SAMPLE CALCULATIONS.....	18
CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(A), RSS GEN	18
GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS	19
OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS	20
TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS AND DTS SYSTEMS.....	20
SAMPLE CALCULATIONS - CONDUCTED EMISSIONS	20
SAMPLE CALCULATIONS - RADIATED EMISSIONS.....	21
SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION.....	22
APPENDIX A TEST EQUIPMENT CALIBRATION DATA	23
APPENDIX B TEST DATA	24
END OF REPORT	56

SCOPE

An electromagnetic emissions test has been performed on the Unigen Corporation model UGWANBL2SME133A and UGWANBL2SME133U, 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
FCC DTS Measurement Procedure KDB558074, March 2005

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.

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 Unigen Corporation model UGWANBL2SME133A and UGWANBL2SME133U 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 Unigen Corporation model UGWANBL2SME133A and UGWANBL2SME133U and therefore apply only to the tested sample. The sample was selected and prepared by Weerapol Seesanung of Unigen Corporation.

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS SUMMARY**DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)**

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 210 A8.2	Digital Modulation	Systems uses DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 210 A8.2 (1)	6dB Bandwidth	658 kHz	>500kHz	Complies
15.247 (b) (3)	RSS 210 A8.2 (4)	Output Power (multipoint systems)	-1.2 dBm (0.8 mW) EIRP = 2 mW ^{Note 1}	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)	RSS 210 A8.2 (2)	Power Spectral Density	-17.7 dBm/3kHz	8dBm/3kHz	Complies
15.247(c)	RSS 210 A8.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	> 20dB below the limit	< -20dBc	Complies
15.247(c) / 15.209	RSS 210 A8.5	Radiated Spurious Emissions 30MHz – 25 GHz	Internal Antenna: 57.0 dBμV/m @ 2484.0 MHz (-17.0 dB)	15.207 in restricted bands, all others < -20dBc	Complies
			External Antenna: 64.8 dBμV/m @ 2483.9 MHz (-9.2 dB)		
Note 1: EIRP calculated using antenna gain of 3 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	1) On board chip antenna - (2) external antenna connected via u.FL -	Unique or integral antenna required	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	55.3 dB μ V @ 0.197 MHz (-8.4 dB)	Refer to page 18	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	Receiver tunes above 960MHz	-	N/A
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	1.048 MHz	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)	dB μ V/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dB μ V	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The Unigen Corporation models UGWANBL2SME133A and UGWANBL2SME133U are Bluetooth v4.0 modules. Since the EUT would be placed on a table top during operation, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 3.3 VDC.

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

Company	Model	Description	Serial Number	FCC ID
Unigen	UGWANBL2SME133U	BT 4.0 module (external antenna)	0010	R8KUGWANBL2
Unigen	UGWANBL2SME133A	BT 4.0 module (internal antenna)	0001	R8KUGWANBL2

OTHER EUT DETAILS

The EUT supports the BLE mode only.

ANTENNA SYSTEM

There are two antenna configurations:

- (1) On board chip antenna – model UGWANBL2SME133A
- (2) External antenna connected via u.FL - model UGWANBL2SME133U

Radiated spurious emissions were performed using both devices. Antenna port measurements were only performed on the internal antenna version.

ENCLOSURE

The EUT does not have an enclosure as it is designed to be installed within the enclosure of a host computer or system.

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 support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
HP	ProBook 4530S	Laptop*	CNU1295BMJ	-
CSR	DK-CSR1000-10086-1A	Development Kit*	248839	-
Anthias	BLE Development Board	Test Board	-	-
Agilent	E3610A	Power Supply	-	-

* - Used to configured the EUT then disconnected during radiated testing. Present for AC conducted measurements.

No remote support equipment was used during testing.

EUT INTERFACE PORTS

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

Port	Connected To	Description	Cable(s) Shielded or Unshielded	Length(m)
Laptop USB	CSR1000 Mini USB	USB cable	Unshielded	1
CSR1000 Mini USB	Test Board Mini USB	Mini USB cable	Unshielded	<1
DC Power	Test Board Mini USB	cable x 2	Unshielded	1

EUT OPERATION

During emissions testing the EUT was configured to continuously transmit on the noted channel at the maximum output power setting.

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.

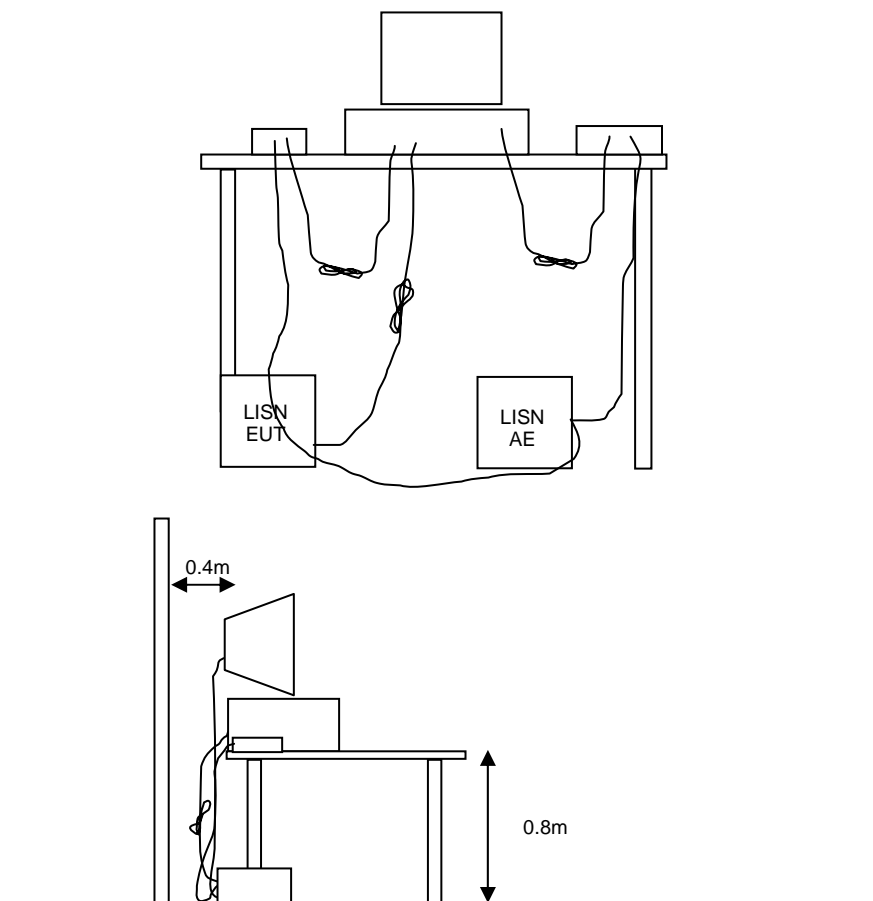


Figure 1 Typical Conducted Emissions Test Configuration

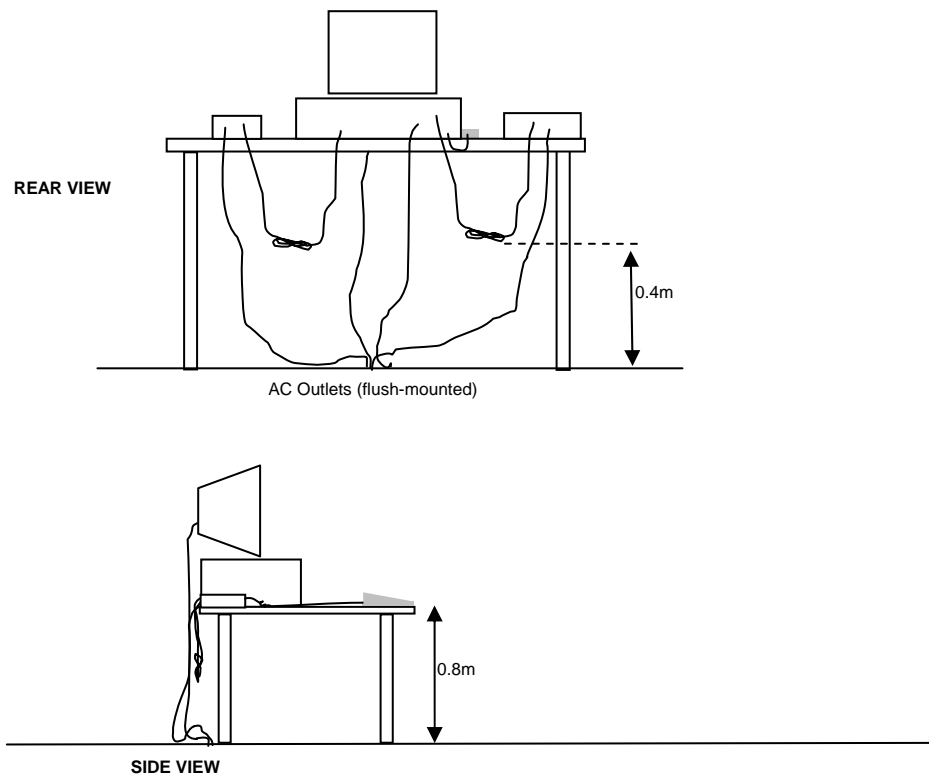
RADIATED EMISSIONS

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.

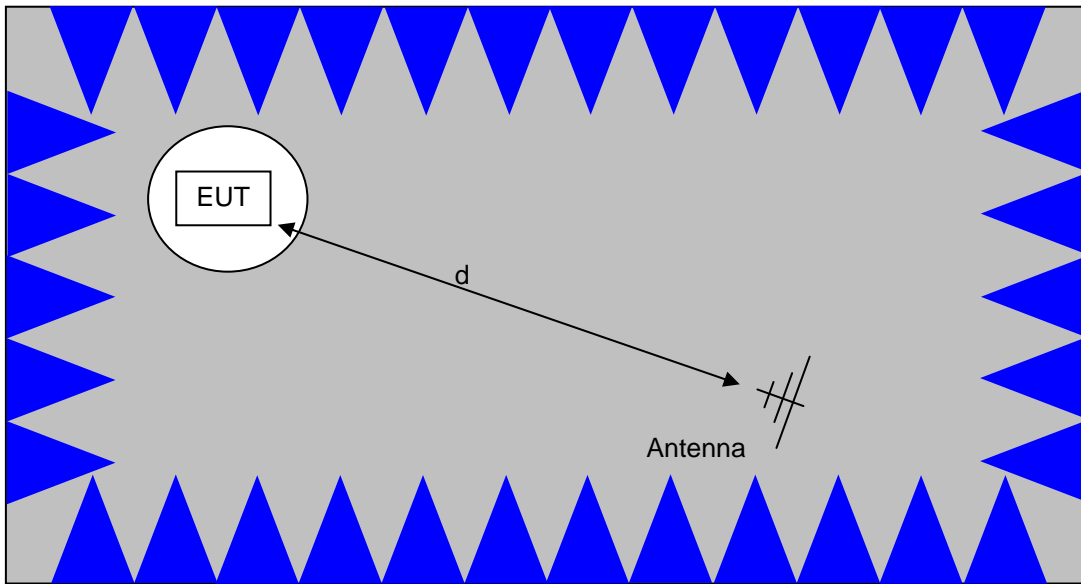
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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 1 meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

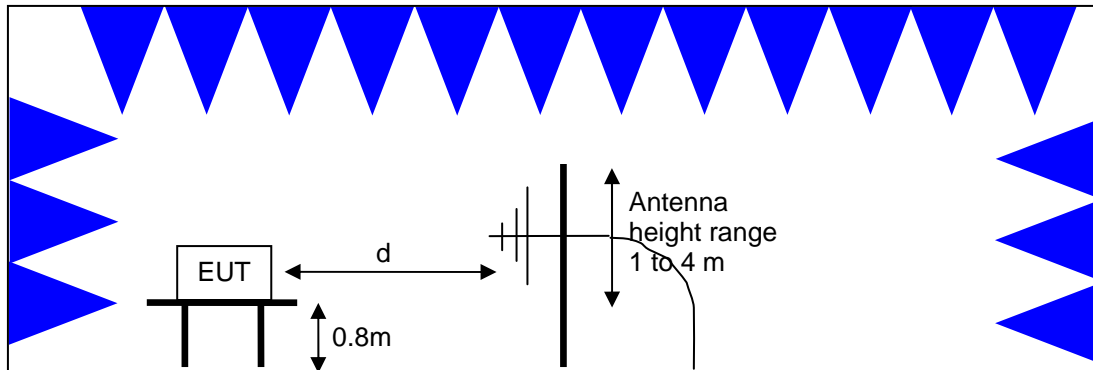


Typical Test Configuration for Radiated Field Strength Measurements



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.

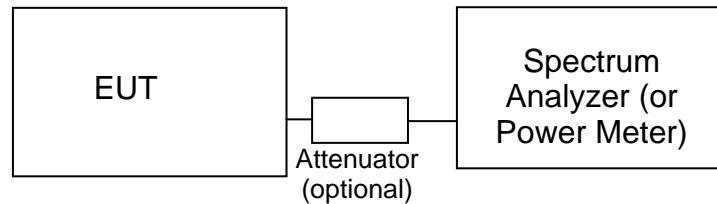
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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 bands¹ (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

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

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

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:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

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:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

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:

$$R_r = \text{Receiver Reading in dBuV/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_c = \text{Corrected Reading in dBuV/m}$$

$$L_s = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

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, 1,000 - 26,500 MHz, 07-Aug-12**

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
EMCO	Antenna, Horn, 1-18 GHz (SA40-Blu)	3115	1386	9/21/2012
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	5/21/2013
Hewlett Packard	Head (Inc W1-W4, 1946, 1947) Purple	84125C	1772	5/1/2013
A.H. Systems	Purple System Horn, 18-40GHz	SAS-574, p/n: 2581	2160	4/17/2013
Hewlett Packard	Microwave Preamplifier, 1- 26.5GHz	8449B	2199	2/23/2013
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2249	10/11/2012
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	1771	3/23/2013

Radiated Emissions, 30 - 1,000 MHz, 08-Aug-12

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
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	Preamplifier, 100 kHz - 1.3 GHz	8447D OPT 010	1826	5/18/2013

Radiated Emissions, 1000 - 18,000 MHz, 08-Aug-12

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
EMCO	Antenna, Horn, 1-18 GHz (SA40-Blu)	3115	1386	9/21/2012
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	1771	3/23/2013
Hewlett Packard	Microwave Preamplifier, 1- 26.5GHz	8449B	2199	2/23/2013
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2249	10/11/2012

Conducted Emissions - AC Power Ports, 08-Aug-12

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1398	1/26/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	5/21/2013
Fischer Custom Comm	LISN, 25A, 150kHz to 30MHz, 25 Amp,	FCC-LISN-50-25-2- 09	2001	2/15/2013

Appendix B Test Data

T88733 Pages 25 - 55

Client:	Unigen	Job Number:	J88630
Product:	UGWANBL2SME133A	T-Log Number:	T88733
		Account Manager:	Christine Krebill
Contact:	Weerapol Seesanung		-
Emissions Standard(s):	FCC 15.247	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Unigen

Product

UGWANBL2SME133A

Date of Last Test: 8/22/2012

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	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.

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

Ambient Conditions:

Temperature: 20.8 °C
 Rel. Humidity: 35 %

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	BLE	2402	default	-	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	31.2 dBµV/m @ 2332.6 MHz (-22.8 dB)
			default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	25.6 dBµV/m @ 842.55 MHz (-20.4 dB)
1b	BLE	2444	default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	33.6 dBµV/m @ 4888.0 MHz (-20.4 dB)
1c	BLE	2480	default	-	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	57.0 dBµV/m @ 2484.0 MHz (-17.0 dB)
			default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	32.0 dBµV/m @ 1120.0 MHz (-22.0 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.



EMC Test Data

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
		Account Manager:	Christine Krebill
Contact:	Weerapol Seesanung		
Standard:	FCC 15.247	Class:	N/A

Notes

Device only supports BLE operation
Testing performed using on board antenna

Sample: NTS(2012-2107); Unigen Corp P/N UGWANBL2SME133A ES
Software: CSR uEnergyTest Ver. 1.3.1.198
EUT Voltage: 3.3Vdc

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

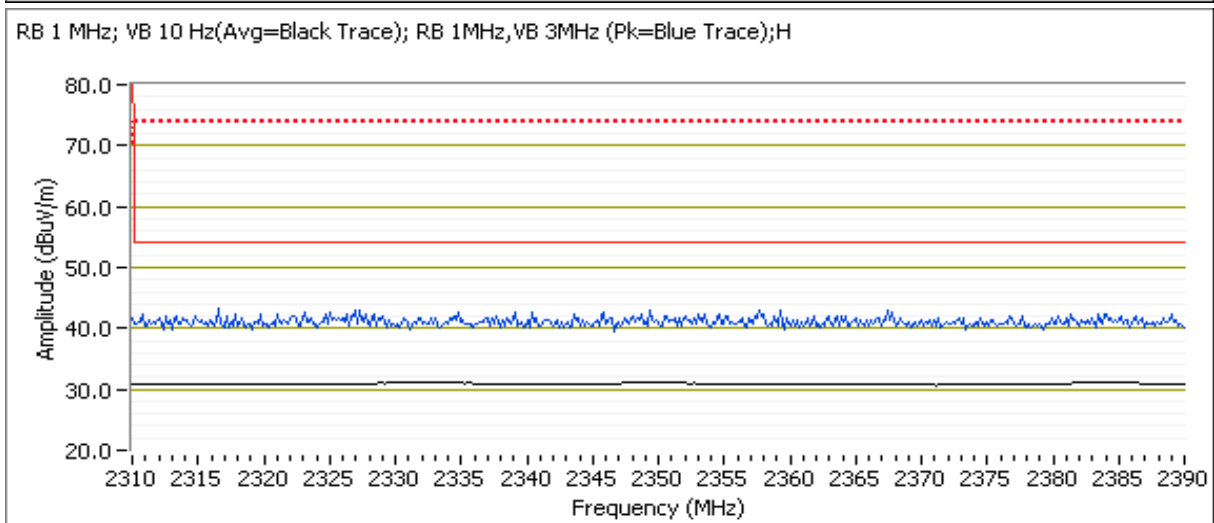
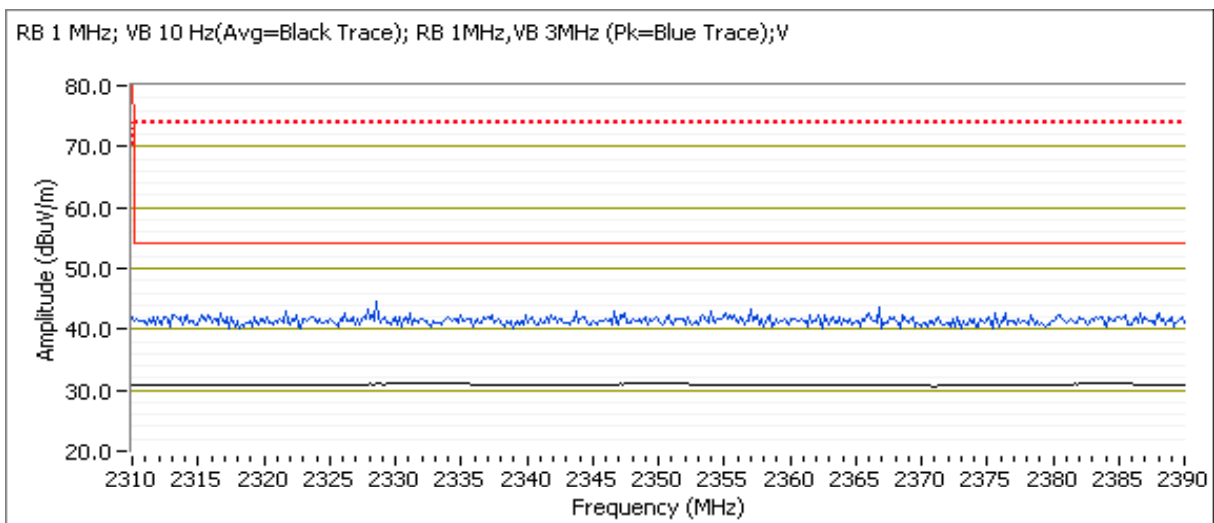
Run #1: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: BLE

Date of Test: 8/7/2012

Test Engineer: Jack Liu

Test Location: FT7

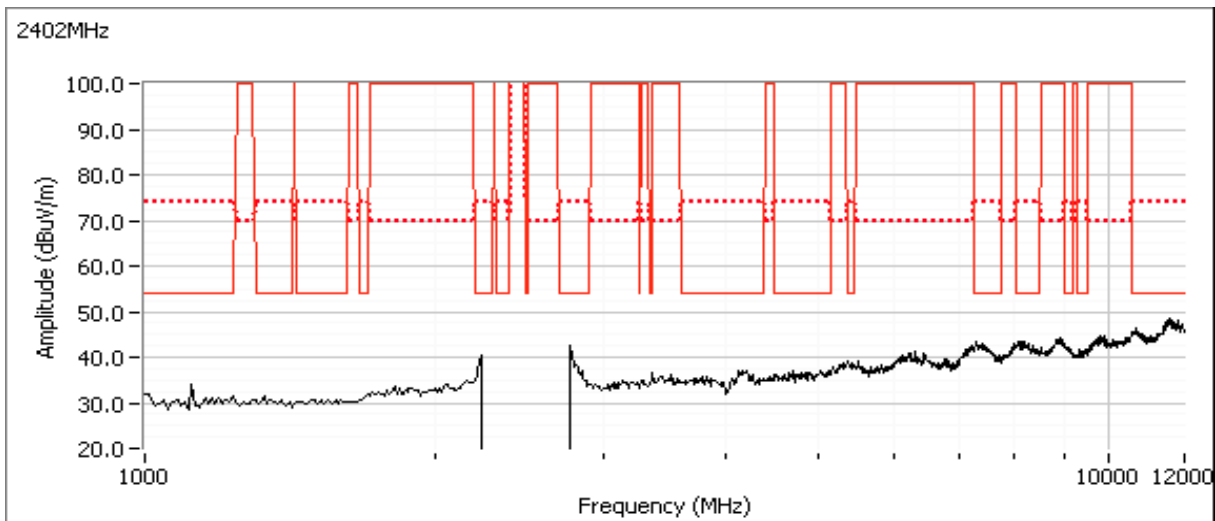
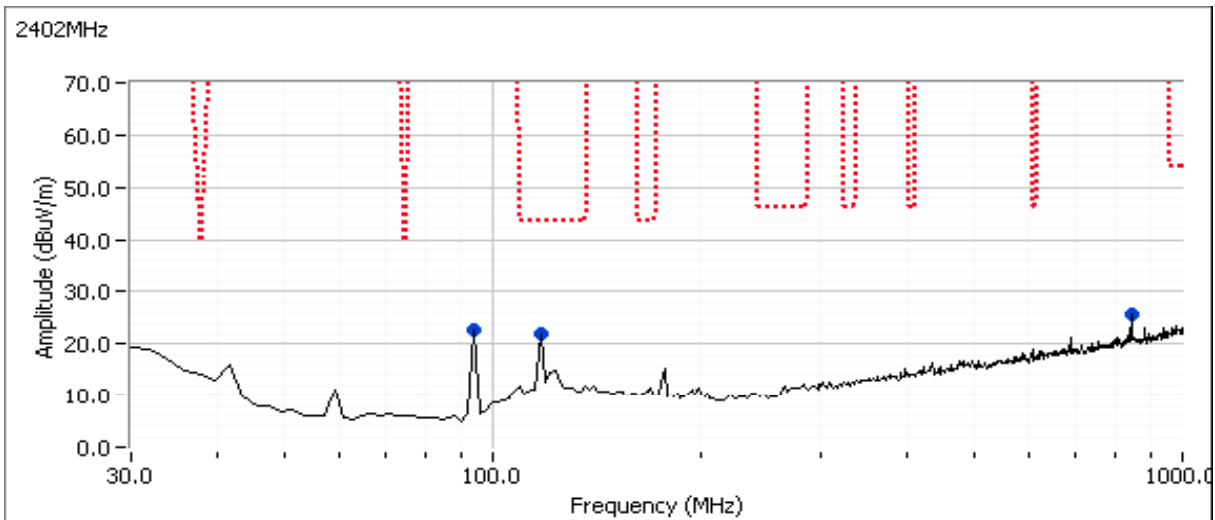
Run #1a: Low Channel @ 2402 MHz



Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	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	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
2332.610	31.2	H	54.0	-22.8	AVG	147	1.0	
2383.910	31.1	V	54.0	-22.9	AVG	340	1.0	
2327.310	43.0	H	74.0	-31.0	PK	147	1.0	
2372.040	42.9	V	74.0	-31.1	PK	340	1.0	



Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

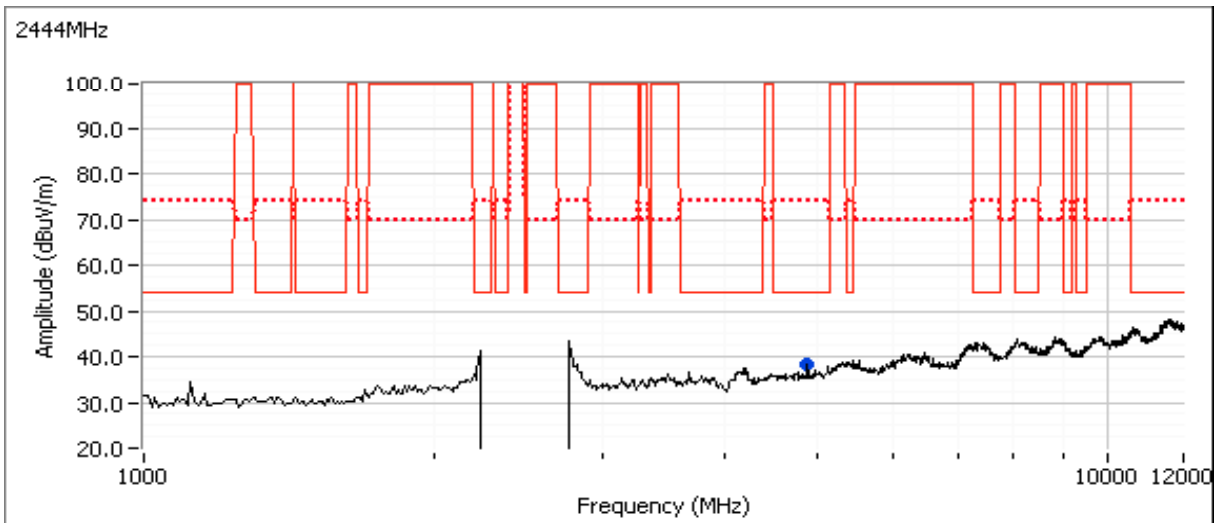
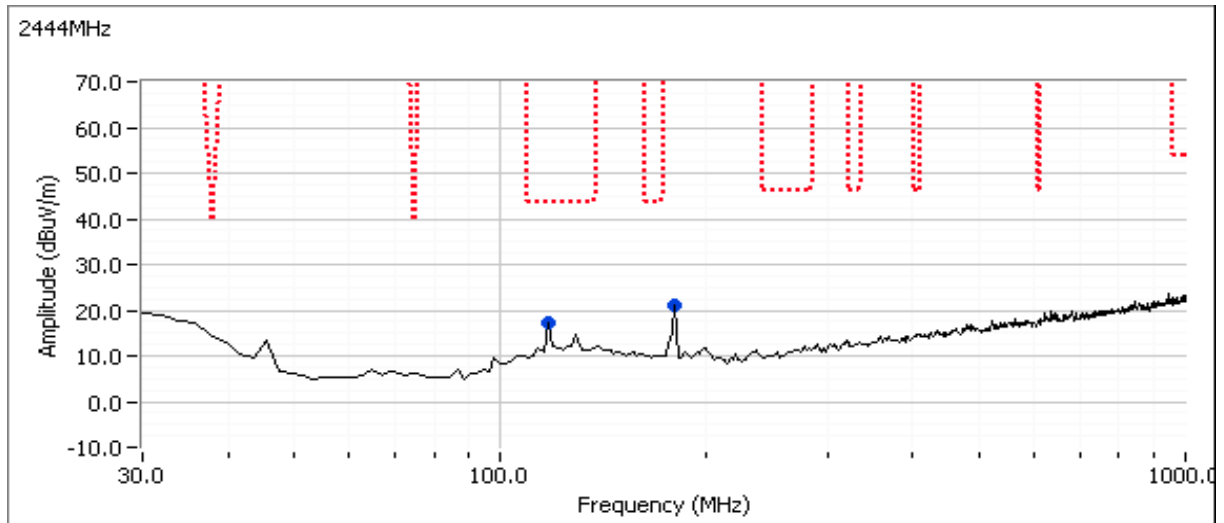
Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
842.545	25.6	V	46.0	-20.4	Peak	172	3.5	Restricted limit used
94.148	22.6	H	43.5	-20.9	Peak	168	2.5	Restricted limit used
117.475	21.9	V	43.5	-21.6	Peak	54	1.0	

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.

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesamong	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

Run #1b: Center Channel @ 2444 MHz



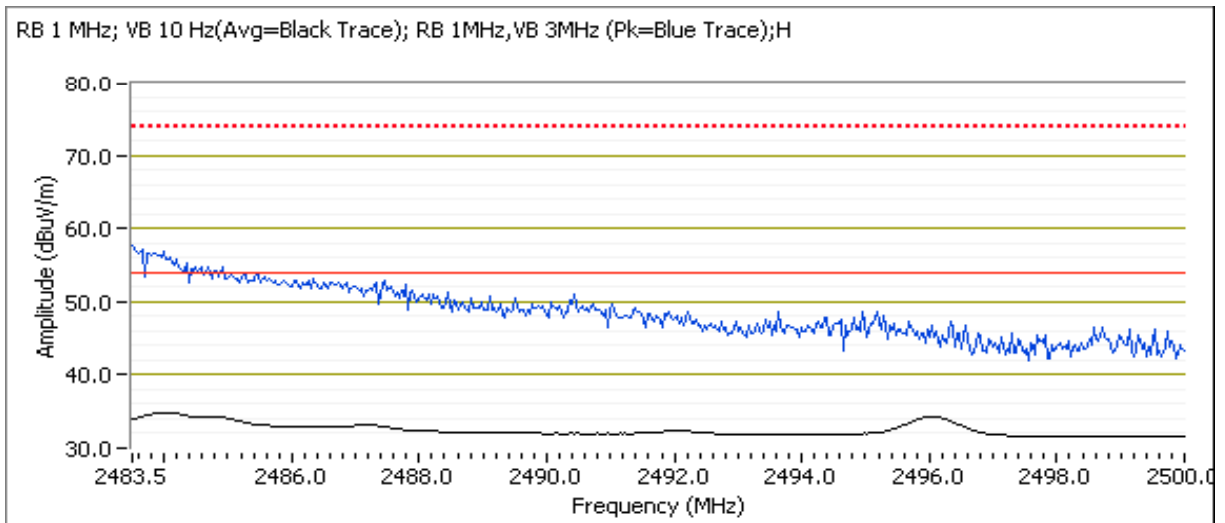
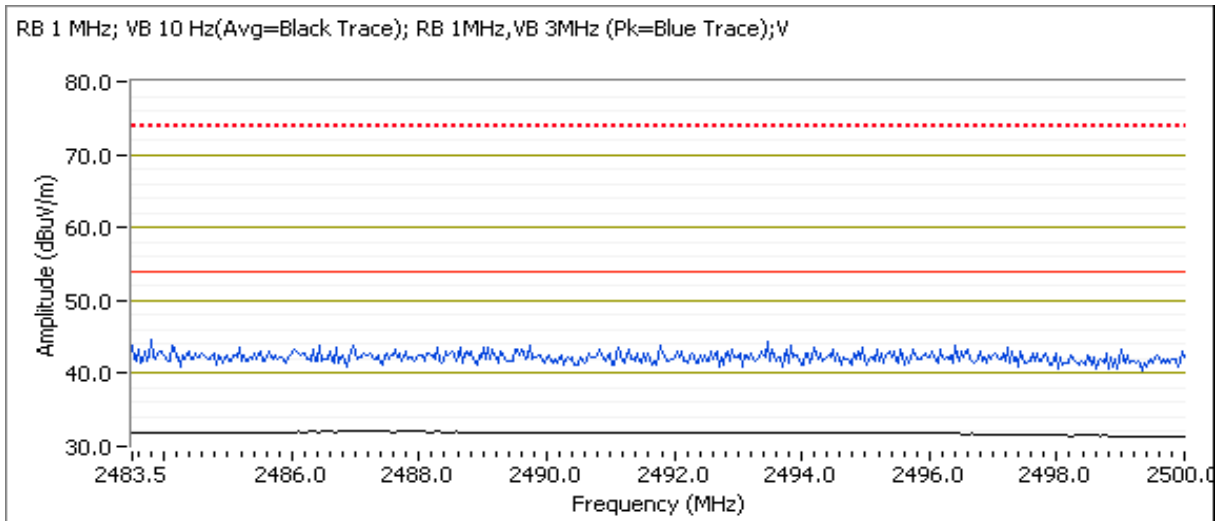
Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
117.475	17.1	H	43.5	-26.4	Peak	2	4.0	
179.679	20.9	H	43.5	-22.6	Peak	168	1.5	Restricted limit used
4887.950	33.6	H	54.0	-20.4	AVG	304	1.0	
4888.340	43.4	H	74.0	-30.6	PK	304	1.0	

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:	Scans made between 12 - 26GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range.

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesunung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

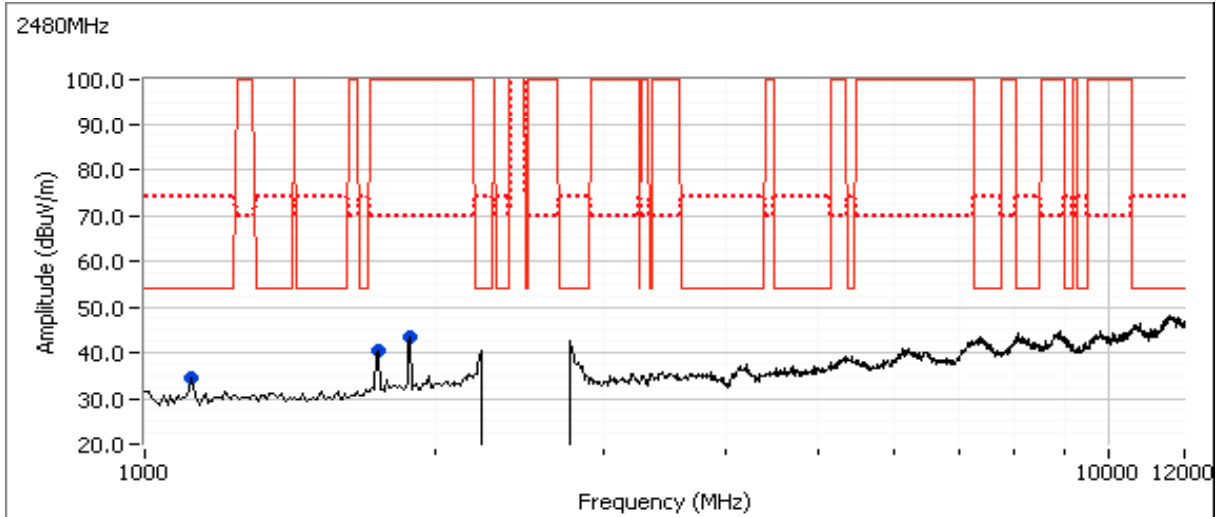
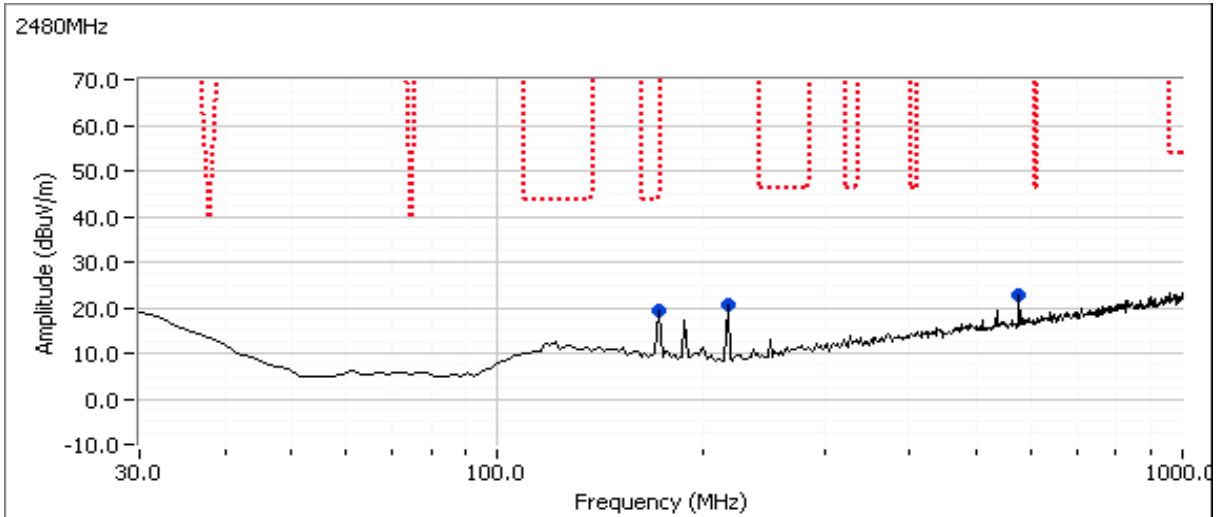
Run #1c: High Channel @ 2480 MHz



Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
2484.030	57.0	H	74.0	-17.0	PK	328	1.0	
2483.960	34.9	H	54.0	-19.1	AVG	328	1.0	
2487.070	32.1	V	54.0	-21.9	AVG	333	1.0	
2483.600	44.8	V	74.0	-29.2	PK	333	1.0	

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A



Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1119.950	32.0	V	54.0	-22.0	AVG	27	2.2	
1119.990	37.9	V	74.0	-36.1	PK	27	2.2	
1753.160	38.8	V	-	-	PK	287	2.2	Note 3
1889.700	38.2	V	-	-	PK	349	1.3	Note 3
171.904	19.5	V	43.5	-24.0	Peak	354	3.5	
216.613	20.5	V	46.0	-25.5	Peak	172	3.0	Restricted limit used
576.232	22.8	V	46.0	-23.2	Peak	169	1.5	Restricted limit used

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:	Scans made between 12 - 26GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range.
Note 3:	Signal is not in a restricted band, refer to antenna port measurements

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	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.

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

Ambient Conditions:

Temperature: 20.8 °C
 Rel. Humidity: 35 %

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	BLE	2402	default	-	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	31.0 dBµV/m @ 2332.6 MHz (-23.0 dB)
			default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	26.6 dBµV/m @ 253.55 MHz (-19.4 dB)
1b	BLE	2444	default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	21.0 dBµV/m @ 78.60 MHz (-19.0 dB)
1c	BLE	2480	default	-	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	64.8 dBµV/m @ 2483.9 MHz (-9.2 dB)
			default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	26.6 dBµV/m @ 360.46 MHz (-19.4 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.



EMC Test Data

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
		Account Manager:	Christine Krebill
Contact:	Weerapol Seesanung		
Standard:	FCC 15.247	Class:	N/A

Notes

Device only supports BLE operation
Testing performed using external 3dBi antenna

Sample: NTS(2012-2106); Unigen Corp P/N UGWANBL2SME133U ES
Software: CSR uEnergyTest Ver. 1.3.1.198
EUT Voltage: 3.3Vdc

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

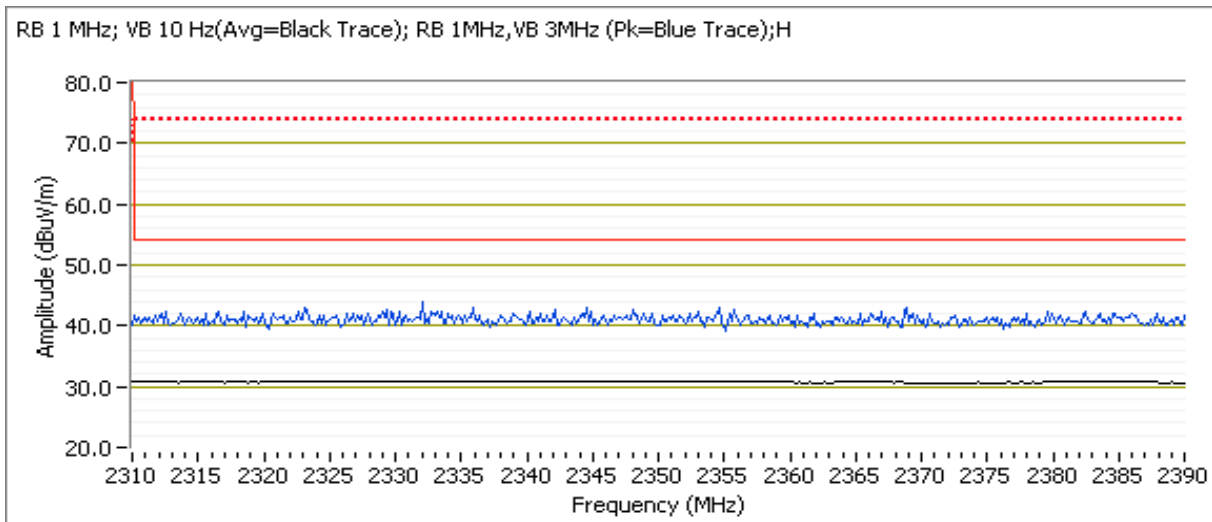
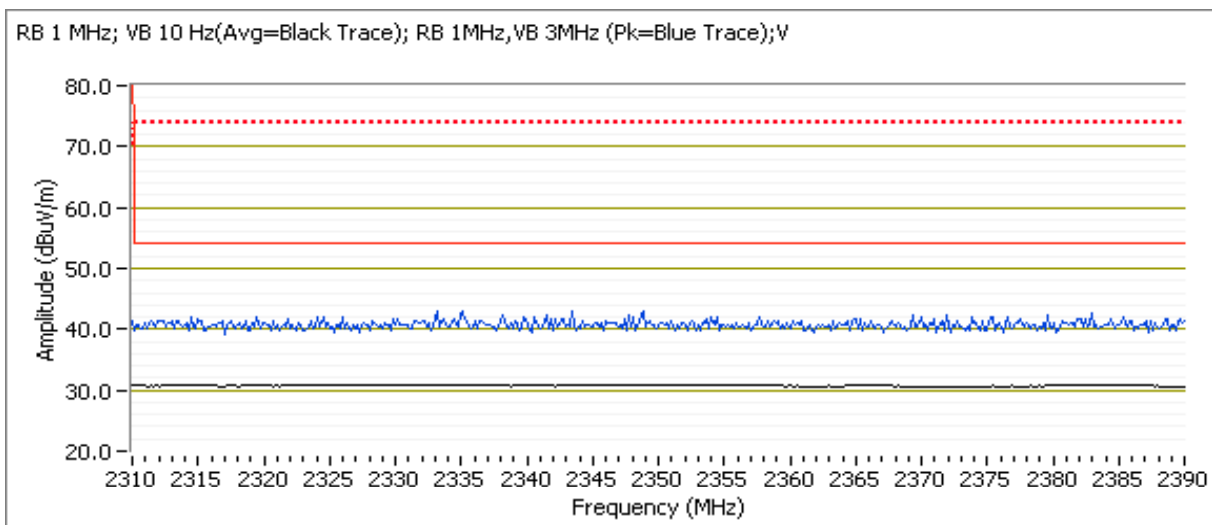
Run #1: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: BLE

Date of Test: 8/7/2012

Test Engineer: Jack Liu

Test Location: FT7

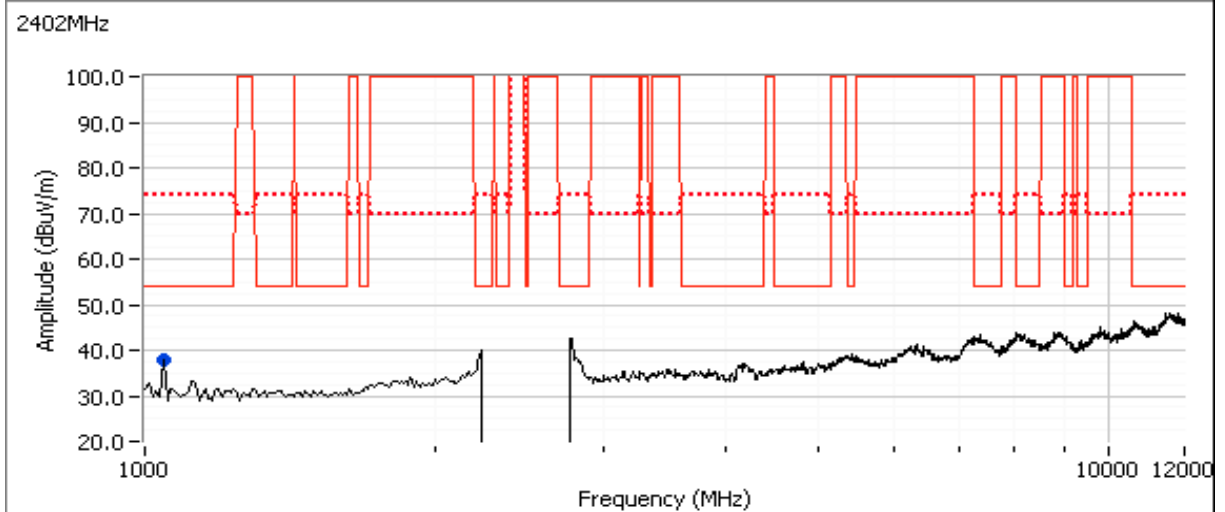
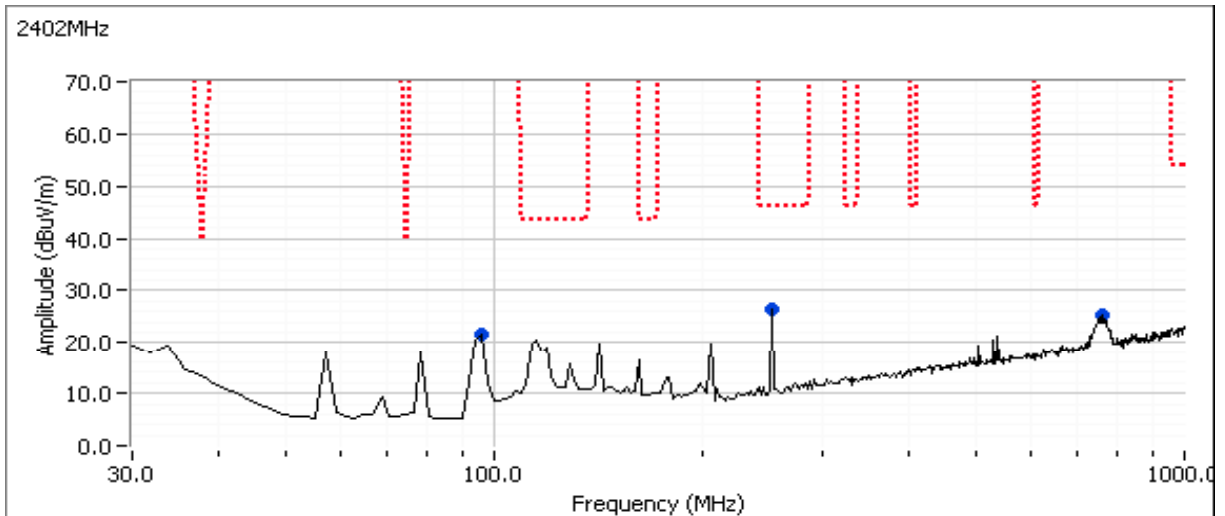
Run #1a: Low Channel @ 2402 MHz



Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesananug	Account Manager:	Christine Krebill
Standard:	FCC 15.247	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	
2332.610	31.0	H	54.0	-23.0	AVG	305	1.6	
2350.720	31.0	V	54.0	-23.0	AVG	199	1.1	
2360.500	43.1	H	74.0	-30.9	PK	305	1.6	
2311.920	42.4	V	74.0	-31.6	PK	199	1.1	



Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

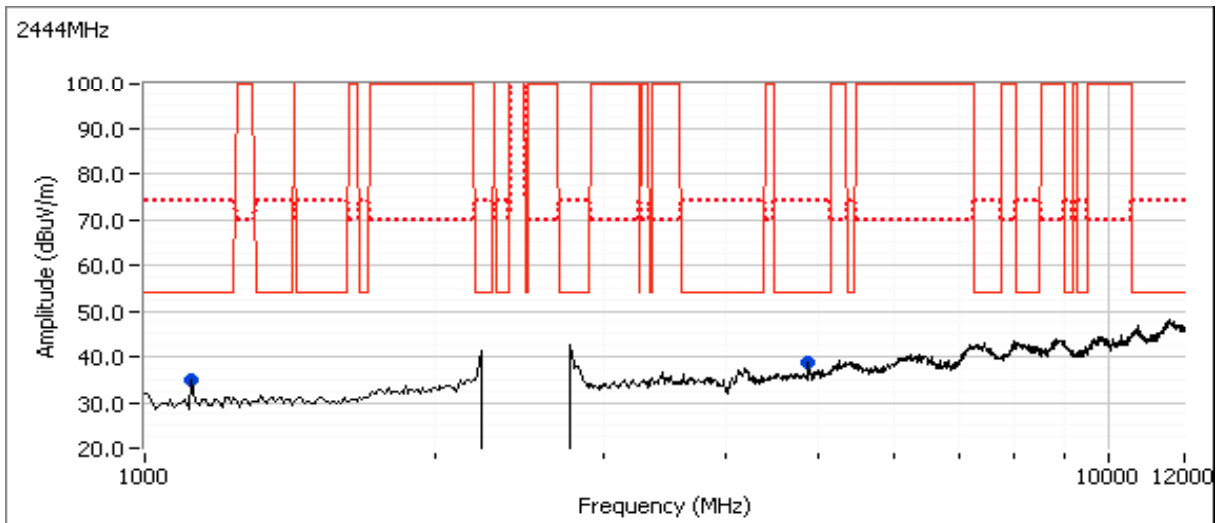
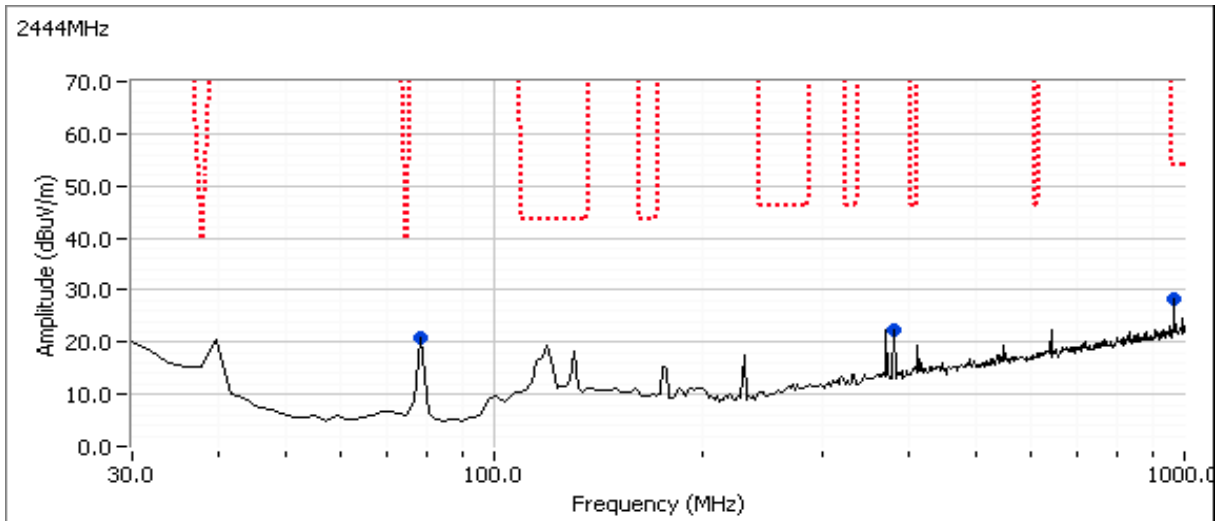
Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
253.547	26.6	H	46.0	-19.4	Peak	169	3.0	
1119.970	32.7	V	54.0	-21.3	AVG	336	2.2	RB 1 MHz;VB 10 Hz;Peak
1119.970	37.8	V	74.0	-36.2	PK	336	2.2	RB 1 MHz;VB 3 MHz;Peak
96.092	21.5	H	43.5	-22.0	Peak	358	4.0	Restricted limit used
760.902	25.2	H	46.0	-20.8	Peak	216	1.0	Restricted limit used

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:	Scans made between 12 - 26GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range.

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

Run #1b: Center Channel @ 2444 MHz

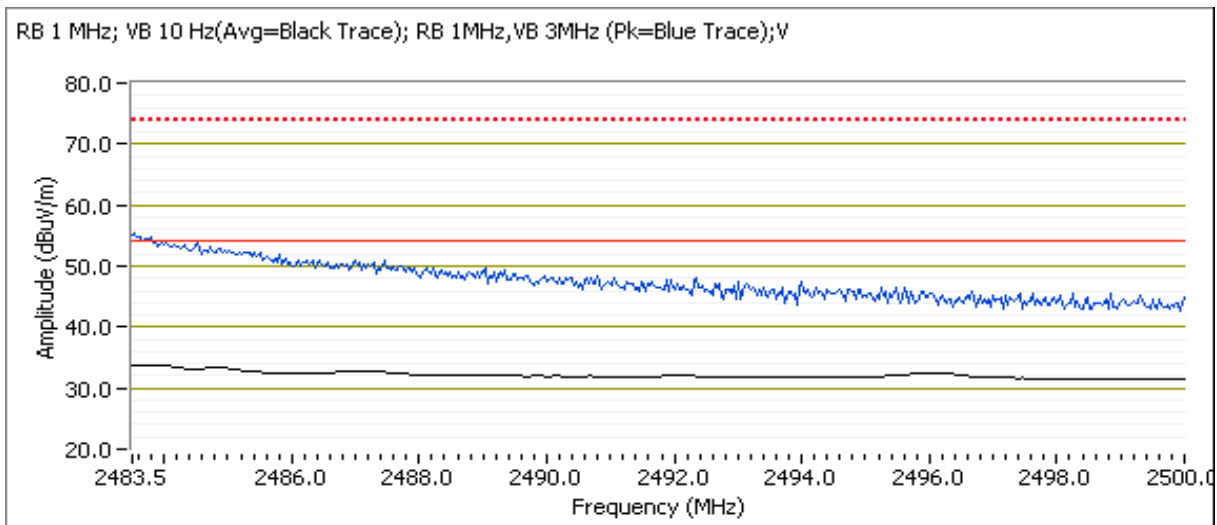


Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

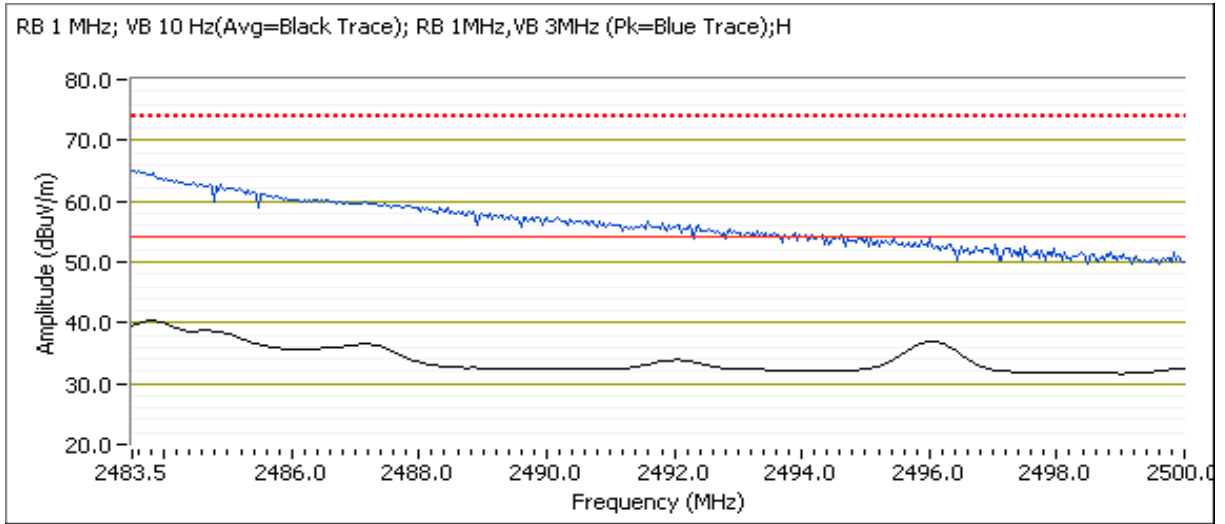
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
78.597	21.0	V	40.0	-19.0	Peak	167	2.5	Restricted limit used
379.900	22.3	V	46.0	-23.7	Peak	176	2.0	Restricted limit used
965.010	28.3	H	54.0	-25.7	Peak	173	3.5	
4888.040	34.0	V	54.0	-20.0	AVG	27	1.3	RB 1 MHz;VB 10 Hz;Peak
1119.950	32.5	V	54.0	-21.5	AVG	341	2.2	RB 1 MHz;VB 10 Hz;Peak
4888.500	44.0	V	74.0	-30.0	PK	27	1.3	RB 1 MHz;VB 3 MHz;Peak
1119.820	37.9	V	74.0	-36.1	PK	341	2.2	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:	Scans made between 12 - 26GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range.

Run #1c: High Channel @ 2480 MHz

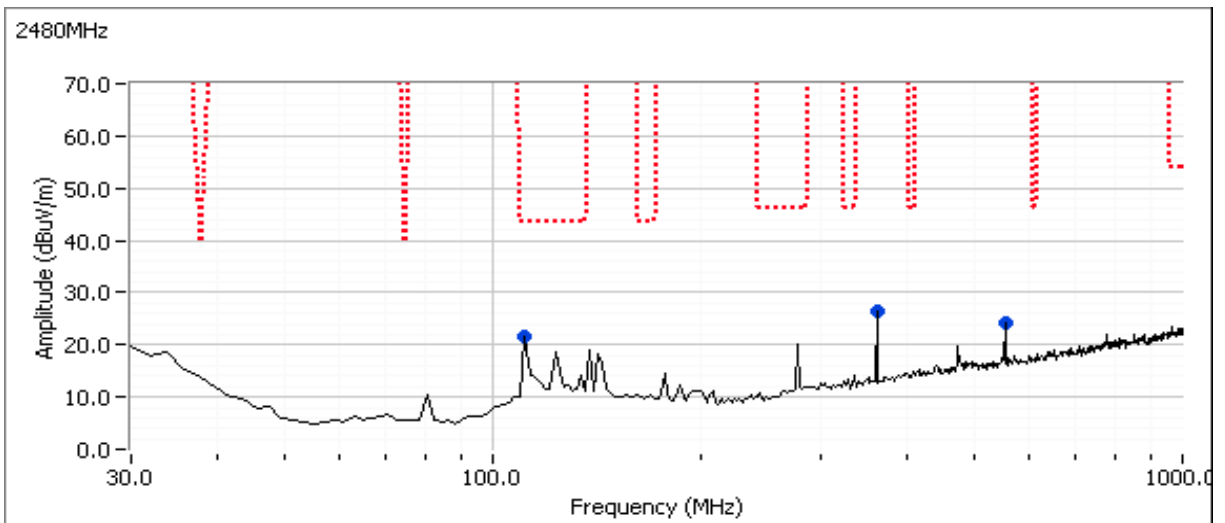


Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

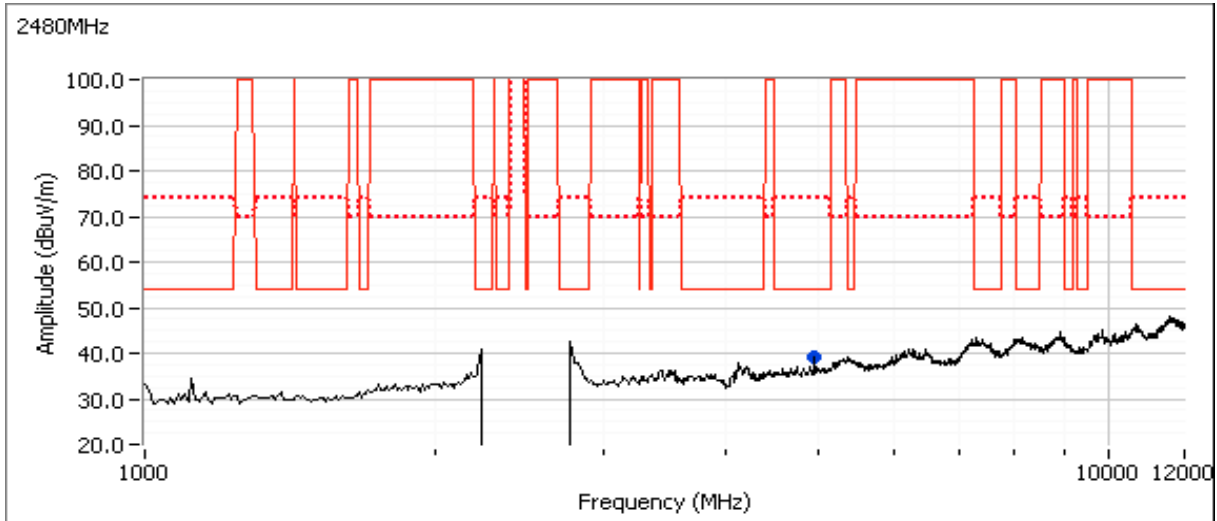


Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
2483.930	64.8	H	74.0	-9.2	PK	34	1.4	
2483.760	40.4	H	54.0	-13.6	AVG	34	1.4	
2483.760	33.9	V	54.0	-20.1	AVG	71	1.8	
2484.000	53.6	V	74.0	-20.4	PK	71	1.8	



Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A



Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
360.461	26.6	H	46.0	-19.4	Peak	173	3.0	Restricted limit used
4959.760	34.5	H	54.0	-19.5	AVG	125	1.0	
4959.730	43.5	H	74.0	-30.5	PK	125	1.0	
111.643	21.7	V	43.5	-21.8	Peak	6	1.5	
552.906	24.2	H	46.0	-21.8	Peak	169	1.0	Restricted limit used

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.

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements Power, PSD, 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: 8/8/2012
 Test Engineer: Jack Liu / R. Varelas
 Test Location: FT7

Config. Used: 1
 Config Change: None
 EUT Voltage: 3.3VDC

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.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 25 °C
 Rel. Humidity: 35 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	default	-	Output Power	15.247(b)	Pass	-1.2 dBm
2	default	-	Power spectral Density (PSD)	15.247(d)	Pass	-17.7 dBm/3kHz
3	default	-	Minimum 6dB Bandwidth	15.247(a)	Pass	658 kHz
3	default	-	99% Bandwidth	RSS GEN	-	1.048 MHz
4	default	-	Spurious emissions	15.247(b)	Pass	> 20dB below the limit

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:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

Notes

Device only supports BLE operation

Sample: NTS(2012-2106); Unigen Corp P/N UGWANBL2SME133U ES

Software: CSR uEnergyTest Ver. 1.3.1.198

Run #1: Output Power

Power Setting ²	Frequency (MHz)	Output Power		Antenna Gain (dBi)	Result	EIRP ^{Note 2}		Output Power	
		(dBm) ¹	mW			dBm	W	(dBm) ³	mW
BLE					Pass				
default	2402	-3.8	0.4	3.0	Pass	-0.8	0.001		
default	2444	-2.1	0.6	3.0	Pass	0.9	0.001		
default	2480	-1.2	0.8	3.0	Pass	1.8	0.002		

Note 1: Output power measured using a peak power meter, spurious limit is -20dBc.

Note 2: Power setting - the software power setting used during testing, included for reference only.

Note 3: Power measured using average power meter and is included for reference only.

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

Run #2: Power spectral Density

Power Setting	Frequency (MHz)	PSD	Limit dBm/3kHz	Result
		(dBm/3kHz) ^{Note 1}		
BLE			8.0	Pass
default	2402	-20.7	8.0	Pass
default	2444	-18.7	8.0	Pass
default	2480	-17.7	8.0	Pass

Note 1:

Power spectral density measured using RB=3 kHz, VB=10kHz, analyzer with peak detector and with a sweep time set to ensure a dwell time of at least 1 second per 3kHz. The measurement is made at the frequency of PPSD determined from preliminary scans using RB=3kHz using multiple sweeps at a faster rate over the 6dB bandwidth of the signal.



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2480.000 MHz
 SPAN: 300 kHz
 RB: 3.00 kHz
 VB: 10.0 kHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 10.5 DB
 Sweep Time: 100.0s
 Ref Lvl: -4.5 DBM

Comments

PSD: -17.7 dBm/3kHz
 2480 MHz

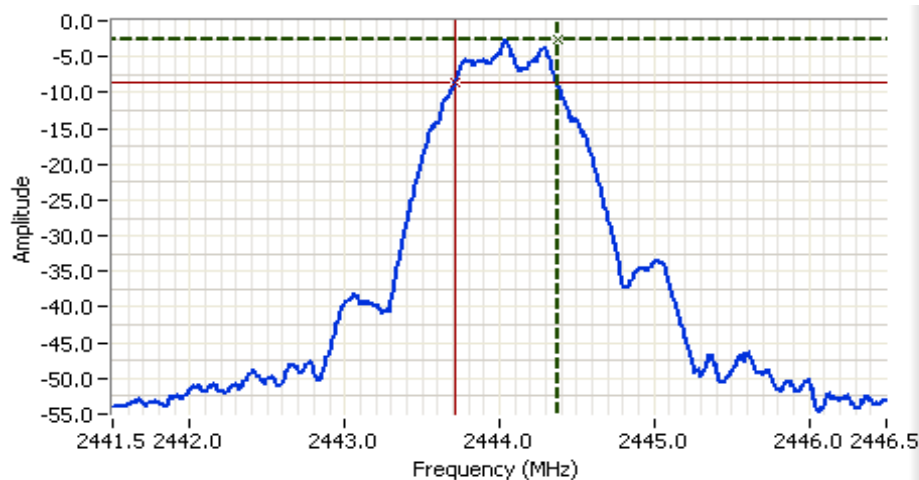
Cursor 1	2479.8620	-17.65		
	0.0000	0.00		

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

Run #3: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	6dB Bandwidth (kHz)	Resolution Bandwidth	99% Bandwidth (MHz)
BLE					
Low	2402	100kHz	658	100kHz	1.048
Mid	2444	100kHz	658	100kHz	1.057
High	2480	100kHz	658	100kHz	1.048

Note 1: 99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB



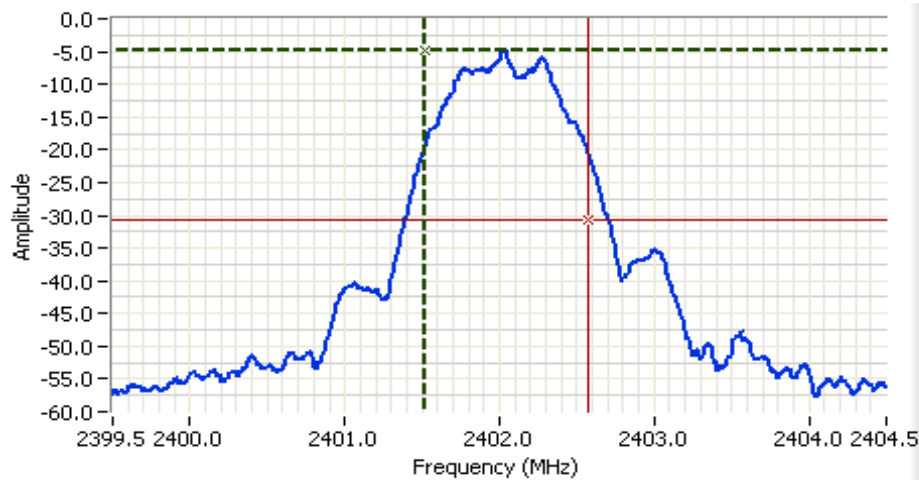
Analyzer Settings
 HP8564E,EMICF: 2444.000 MHz
 SPAN: 5.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 0 DB
 RL Offset: 11.0 DB
 Sweep Time: 50.0ms
 Ref Lvl: 0.0 DBM

Comments
 6dB BW: 658 kHz

Cursor 1	2444.3750	-2.67	
Cursor 2	2443.7167	-8.67	

Delta Freq. 658 kHz
 Delta Amplitude 6.00

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A



Analyzer Settings

HP8564E,EMICF: 2402.000 MHz
 SPAN: 5.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 0 DB
 RL Offset: 11.0 DB
 Sweep Time: 50.0ms
 Ref Lvl: 0.0 DBM

Comments

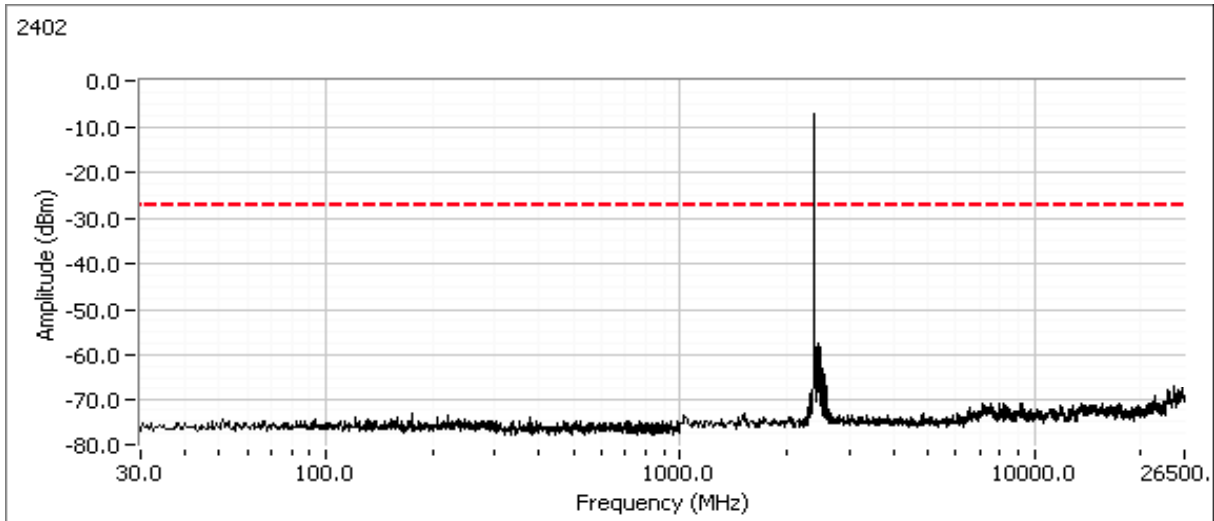
99% power BW: 1.048 MHz

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

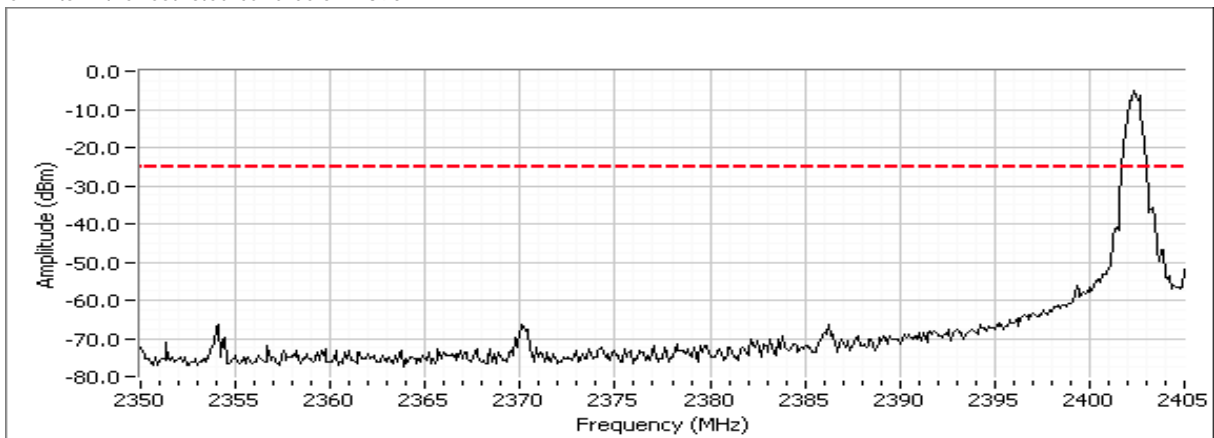
Run #4: Out of Band Spurious Emissions

Frequency (MHz)	Limit	Result
2402	-20dBc	Pass
2444	-20dBc	Pass
2480	-20dBc	Pass

Plots for low channel, power setting(s) = default

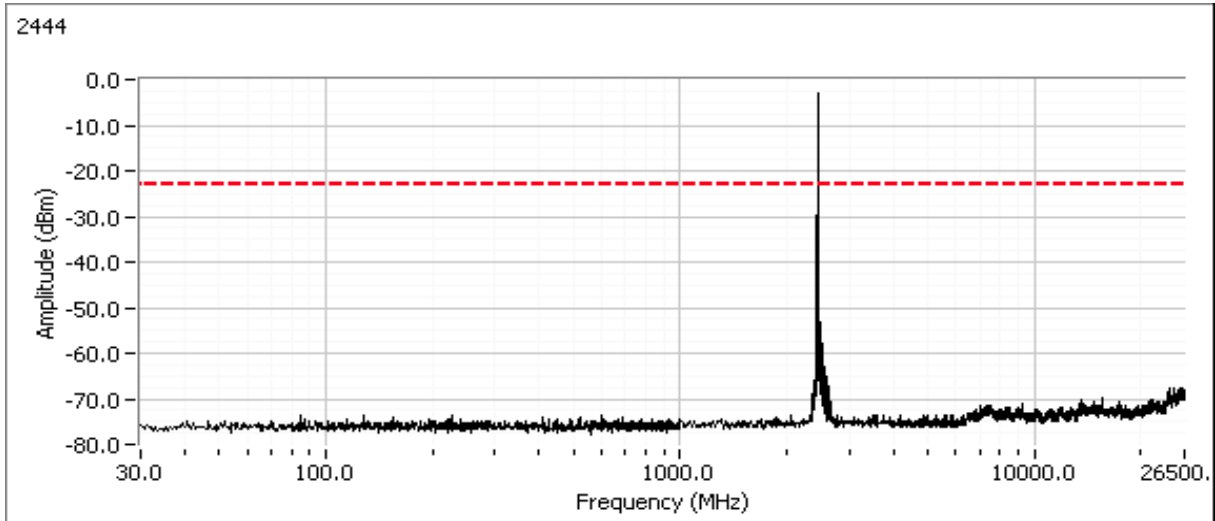


Additional plot showing compliance with -20dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

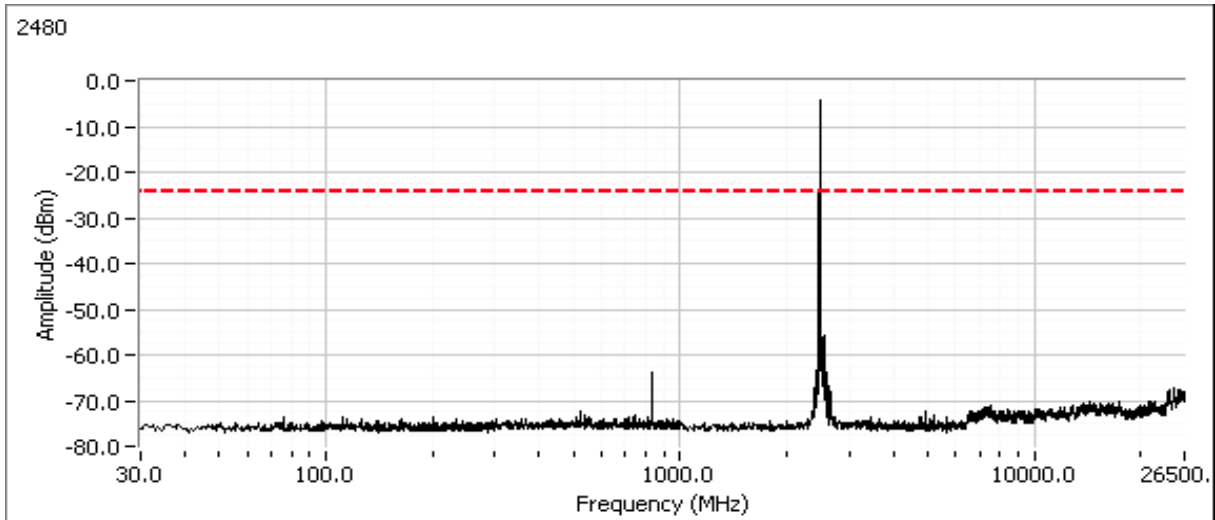


Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	N/A

Plots for center channel, power setting(s) = default

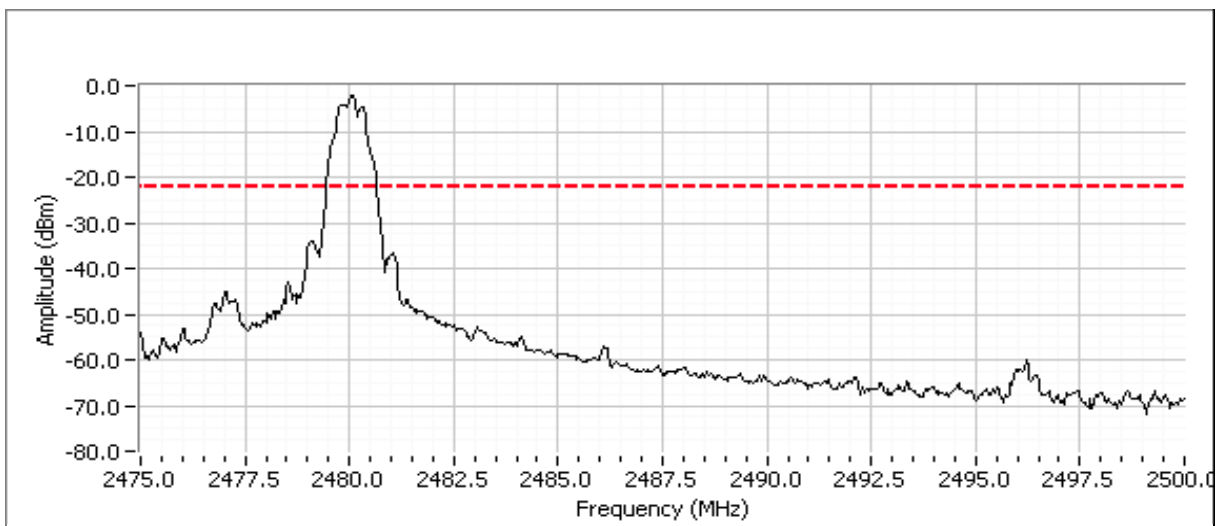


Plots for high channel, power setting(s) = default



Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesanung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: N/A

Additional plot showing compliance with -20dBc limit from 2483.5 MHz to 2500 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2483.5 MHz.





EMC Test Data

Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	-

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: 8/8/2012
Test Engineer: Jack Liu
Test Location: FT7

Config. Used: 1
Config Change: None
EUT Host Voltage: 120V/60Hz

General Test Configuration

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

Ambient Conditions:
Temperature: 25 °C
Rel. Humidity: 32 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	CE, AC Power, 120V/60Hz	Class B	Pass	55.3 dBµV @ 0.197 MHz (-8.4 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.

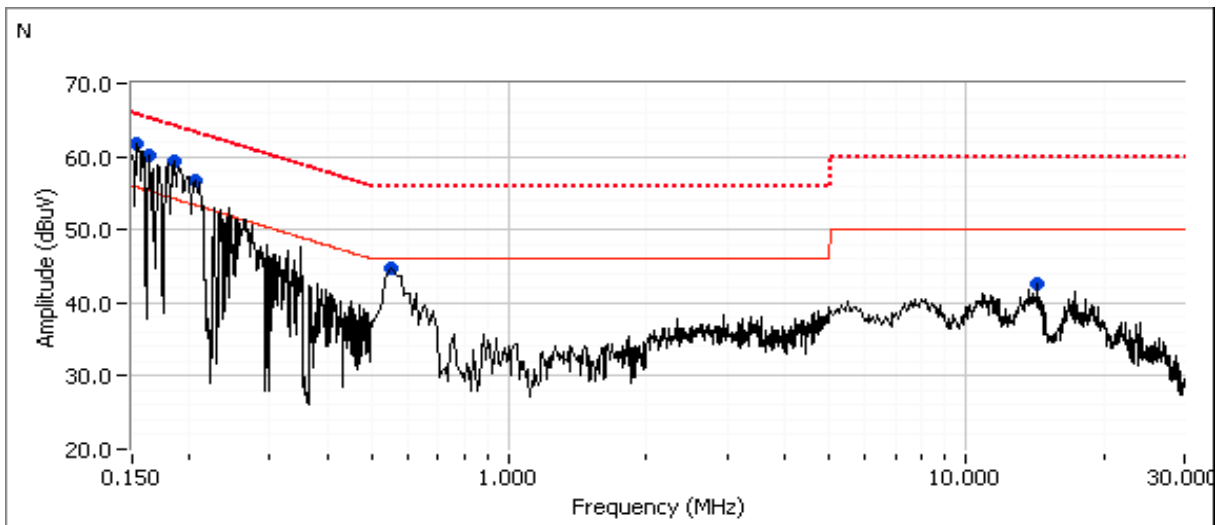
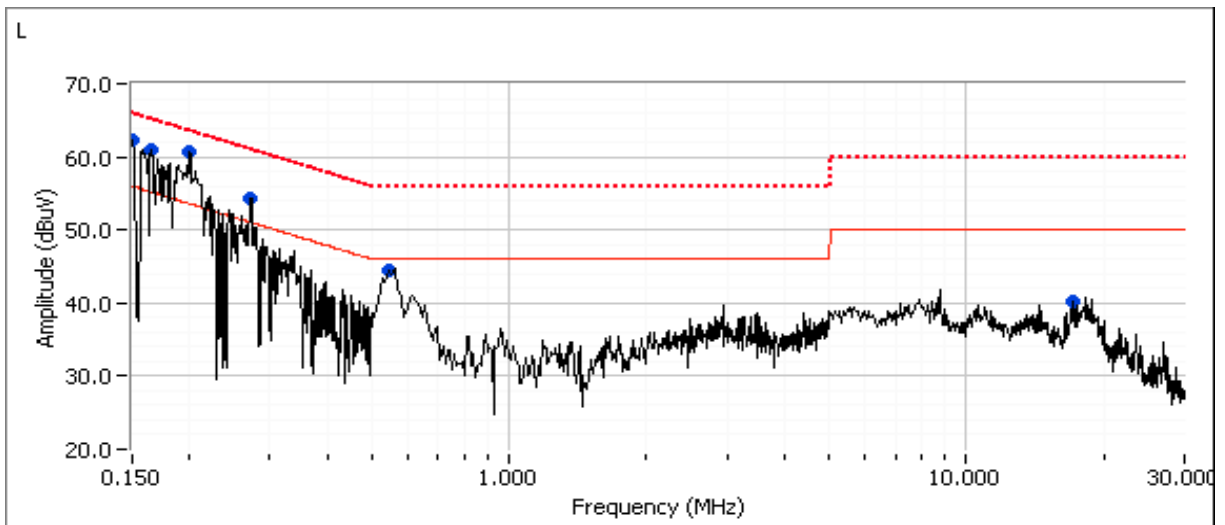
Notes

Device only supports BLE operation
Testing performed using external 3dBi antenna

Sample: NTS(2012-2106); Unigen Corp P/N UGWANBL2SME133U ES
Software: CSR uEnergyTest Ver. 1.3.1.198

Client: Unigen	Job Number: J88630
Model: UGWANBL2SME133A	T-Log Number: T88733
Contact: Weerapol Seesantung	Account Manager: Christine Krebill
Standard: FCC 15.247	Class: -

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



Client:	Unigen	Job Number:	J88630
Model:	UGWANBL2SME133A	T-Log Number:	T88733
Contact:	Weerapol Seesanung	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	-

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

Frequency MHz	Level dBμV	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.151	62.2	Line 1	56.0	6.2	Peak	
0.161	60.9	Line 1	55.2	5.7	Peak	
0.197	60.8	Line 1	53.6	7.2	Peak	
0.273	54.3	Line 1	51.0	3.3	Peak	
0.533	44.5	Line 1	46.0	-1.5	Peak	
17.325	40.1	Line 1	50.0	-9.9	Peak	
0.153	61.8	Neutral	55.8	6.0	Peak	
0.158	60.2	Neutral	55.3	4.9	Peak	
0.190	59.4	Neutral	54.3	5.1	Peak	
0.207	56.8	Neutral	53.4	3.4	Peak	
0.557	44.8	Neutral	46.0	-1.2	Peak	
14.083	42.5	Neutral	50.0	-7.5	Peak	

Final quasi-peak and average readings

Frequency MHz	Level dBμV	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.197	55.3	Line 1	63.7	-8.4	QP	
0.190	55.4	Neutral	64.0	-8.6	QP	
0.207	54.3	Neutral	63.3	-9.0	QP	
0.151	54.8	Line 1	65.9	-11.1	QP	
0.153	54.3	Neutral	65.8	-11.5	QP	
0.161	53.6	Line 1	65.4	-11.8	QP	
0.158	53.7	Neutral	65.6	-11.9	QP	
0.557	42.9	Neutral	56.0	-13.1	QP	
0.273	47.4	Line 1	61.0	-13.6	QP	
0.557	31.0	Neutral	46.0	-15.0	AVG	
0.533	41.0	Line 1	56.0	-15.0	QP	
0.197	38.1	Line 1	53.7	-15.6	AVG	
0.207	37.0	Neutral	53.3	-16.3	AVG	
0.533	28.9	Line 1	46.0	-17.1	AVG	
0.190	35.6	Neutral	54.0	-18.4	AVG	
0.273	31.9	Line 1	51.0	-19.1	AVG	
14.083	30.2	Neutral	50.0	-19.8	AVG	
17.325	28.0	Line 1	50.0	-22.0	AVG	
14.083	35.8	Neutral	60.0	-24.2	QP	
17.325	33.7	Line 1	60.0	-26.3	QP	
0.151	28.6	Line 1	55.9	-27.3	AVG	
0.153	27.7	Neutral	55.8	-28.1	AVG	
0.161	26.6	Line 1	55.4	-28.8	AVG	
0.158	26.5	Neutral	55.6	-29.1	AVG	

End of Report

This page is intentionally blank and marks the last page of this test report.