

EMC Test Report

Application for Grant of Equipment Authorization

Industry Canada RSS-Gen Issue 4 / RSS 247 Issue 1 FCC Part 15 Subpart C

Model: SDWS4 Wireless Stick

IC CERTIFICATION #: 4691A-SDWS4
FCC ID: R4V-SDWS4

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	June 15, 2015	First release	
1	June 23, 2015	Revised report to correct typos in the procedures	David Guidotti

TABLE OF CONTENTS

REVISION HISTORY	2
TABLE OF CONTENTS	3
SCOPE.....	4
OBJECTIVE	5
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.....	6
MEASUREMENT UNCERTAINTIES.....	7
EQUIPMENT UNDER TEST (EUT) DETAILS.....	8
GENERAL.....	8
OTHER EUT DETAILS.....	8
ANTENNA SYSTEM	8
ENCLOSURE.....	8
MODIFICATIONS.....	8
SUPPORT EQUIPMENT.....	8
EUT INTERFACE PORTS	9
EUT OPERATION	9
TEST SITE.....	10
GENERAL INFORMATION.....	10
CONDUCTED EMISSIONS CONSIDERATIONS	10
RADIATED EMISSIONS CONSIDERATIONS	10
MEASUREMENT INSTRUMENTATION	11
RECEIVER SYSTEM	11
INSTRUMENT CONTROL COMPUTER	11
LINE IMPEDANCE STABILIZATION NETWORK (LISN).....	11
FILTERS/ATTENUATORS	12
ANTENNAS.....	12
ANTENNA MAST AND EQUIPMENT TURNTABLE.....	12
INSTRUMENT CALIBRATION.....	12
TEST PROCEDURES	13
EUT AND CABLE PLACEMENT	13
CONDUCTED EMISSIONS.....	13
RADIATED EMISSIONS.....	14
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	19
TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS AND DTS SYSTEMS.....	19
SAMPLE CALCULATIONS - CONDUCTED EMISSIONS	20
SAMPLE CALCULATIONS - RADIATED EMISSIONS.....	20
SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION.....	21
APPENDIX A TEST EQUIPMENT CALIBRATION DATA	22
APPENDIX B TEST DATA	23
END OF REPORT	71

SCOPE

An electromagnetic emissions test has been performed on the SanDisk Corp. model SDWS4 Wireless Stick, pursuant to the following rules:

Industry Canada RSS-Gen Issue 4
RSS 247 Issue 1 “Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices”
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 National Technical Systems - Silicon Valley test procedures:

ANSI C63.10-2013
FCC DTS Measurement Guidance KDB558074

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 SanDisk Corp. model SDWS4 Wireless Stick complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 4
RSS 247 Issue 1 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices"
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 SanDisk Corp. model SDWS4 Wireless Stick and therefore apply only to the tested sample. The sample was selected and prepared by Jerry Reguero of SanDisk Corp.

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 247 5.2	Digital Modulation	Systems uses OFDM / DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 247 5.2	6dB Bandwidth	9.9MHz	>500kHz	Complies
15.247 (b) (3)	RSS 247 5.4(4)	Output Power (multipoint systems)	b: 9.5dBm; 8.9mW g: 9.6dBm; 9.1mW n20: 9.7dBm; 9.3mW EIRP = 4mW ^{Note 1}	1Watt, EIRP limited to 4 Watts.	Complies
15.247(e)	RSS 247 5.2	Power Spectral Density	b: -14.8dBm/3kHz g: -15.3dBm/3kHz n20: -14.0dBm/3kHz	8dBm/3kHz	Complies
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	All emissions >-30dBc	> -30dBc ^{Note 2}	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 30MHz – 25 GHz	51.7 dBµV/m @ 2390.0 MHz (-2.3 dB)	15.207 in restricted bands, all others > -30dBc ^{Note 2}	Complies

Note 1: EIRP calculated using antenna gain of -3.3 dBi for the highest EIRP system.

Note 2: Limit of -30dBc used because the power was measured using the UNII test procedure (maximum power averaged over a transmission burst).

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 product	Unique or integral antenna required	Complies
15.207	RSS GEN Table 3	AC Conducted Emissions	39.6dBµV @ 0.48MHz (-16.7dB)	Refer to page 18	Complies
15.247 (b) (5) / 15.407 (f)	RSS 102	RF Exposure Requirements	FCC: Refer to SAR Exclusion exhibit IC: Refer to SAR report and RSS 102 declaration	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP 100 RSS GEN 6.6	Occupied Bandwidth	b: 14.2MHz g: 18.3MHz n20: 18.5MHz	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 SanDisk Corp. model SDWS4 Wireless Stick is a USB drive that contains an 802.11bgn radio and internal battery. It can act as a conventional removable drive, or as an access point for the wireless transfer of data. It can be powered by a host (computer or charger) or its internal battery. Since the EUT would be placed on a tabletop during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 5 VDC, 500 mA.

The sample was received on May 20, 2015 and tested on June 1, 2, 3, 5, 8 and 11, 2015. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
San Disk	WFDv2N	Wireless flash drive	prototype	R4V-SDWS4

OTHER EUT DETAILS

Handheld
Supports 802.11bgn (20MHz only), 1Tx

ANTENNA SYSTEM

The antenna system consists of a pcb trace antenna, antenna gain of -3.3dBi.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 2 cm wide by 8 cm deep by 1 cm high.

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:

Radiated Spurious Emissions, AC conducted Emissions

Company	Model	Description	Serial Number	FCC ID
Samsung	ETA-P10X	USB AC/DC Adapter	N/A	-

Antenna Port Measurements

Company	Model	Description	Serial Number	FCC ID
Dell	ProBook 6570b	Laptop	NTS 2671	-

For all testing, the laptop was used to configure the device for 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)
EUT – USB	Laptop or USB Adapter	Multiconductor	Shielded	1.5m

EUT OPERATION

During testing, the EUT was configured for continuous transmission. Details on the channel tested, data rate used, power setting, and modulation/mode are noted in the test data.

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	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 7	US0027	2845B-7	41039 Boyce Road Fremont, CA 94538-2435

ANSI C63.4 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.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.10. 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 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

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 C63.10 specifies that the test height above ground for table mounted devices shall be 1.5 meters. 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 as specified in ANSI C63.4. 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 C63.10, 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.

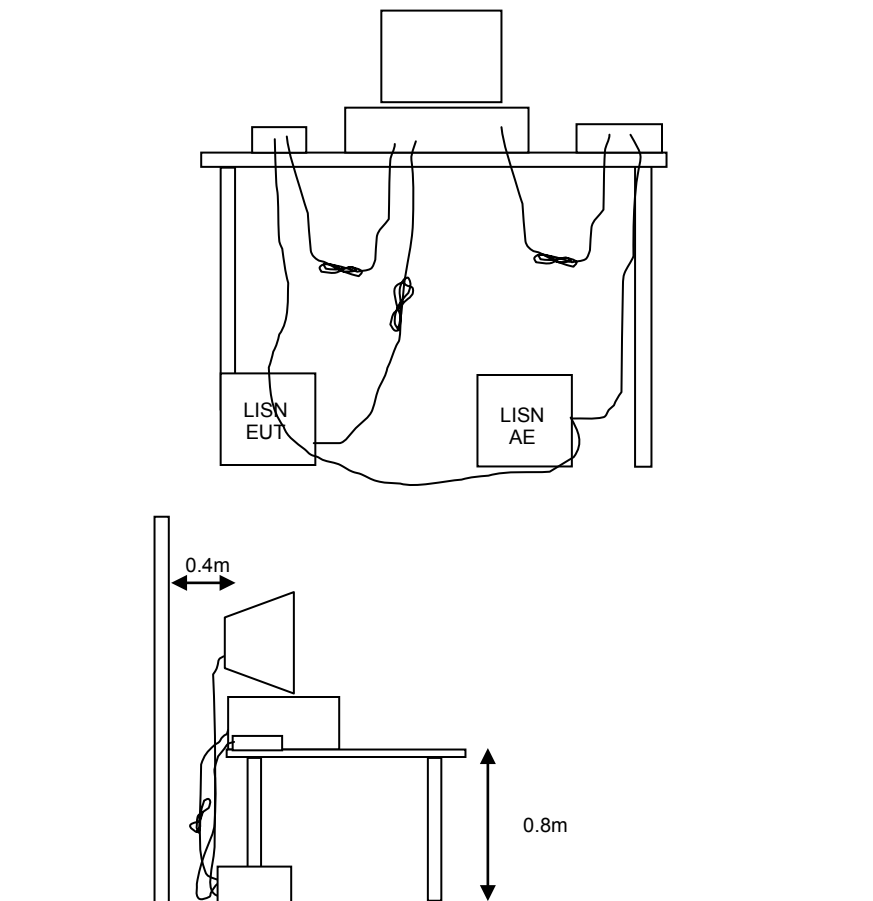


Figure 1 Typical Conducted Emissions Test Configuration

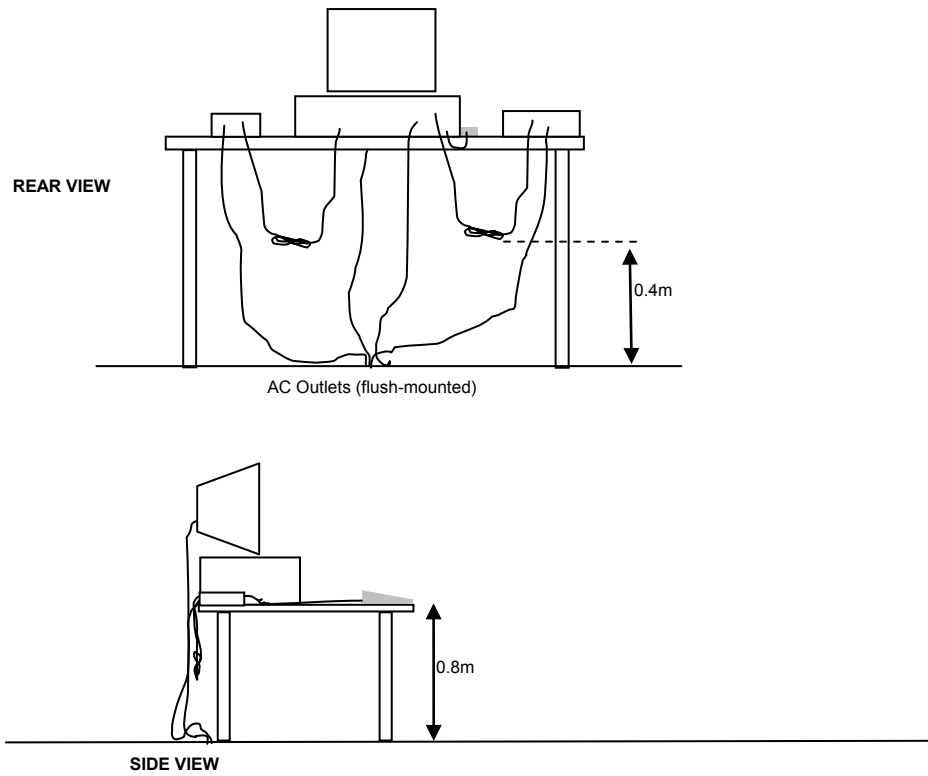
RADIATED EMISSIONS

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.

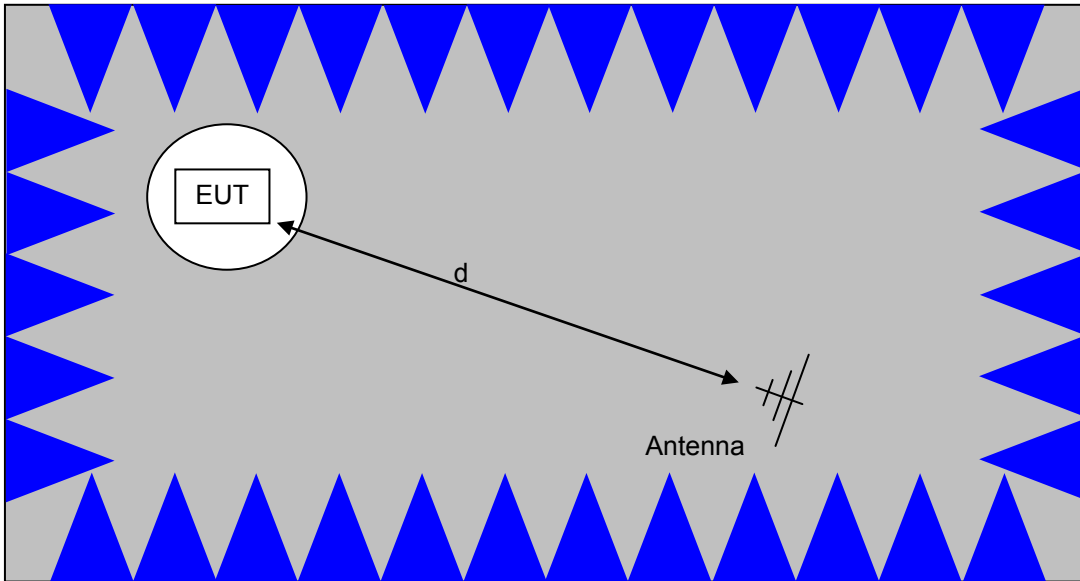
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

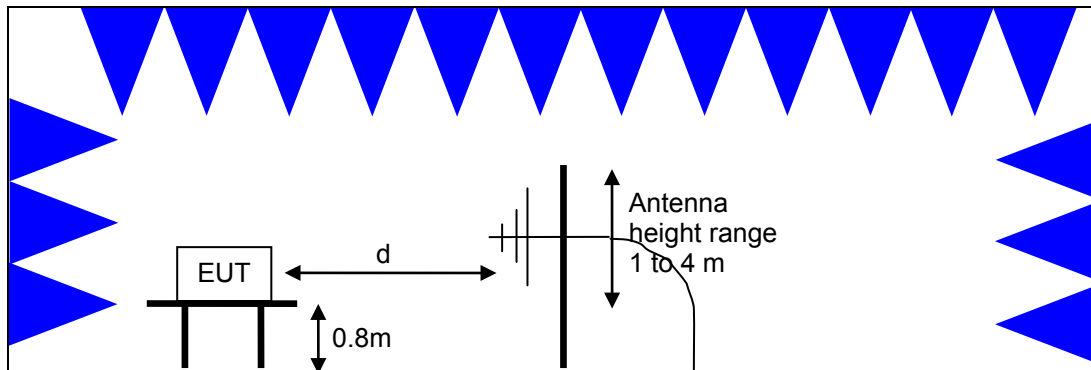


Typical Test Configuration for Radiated Field Strength Measurements



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.

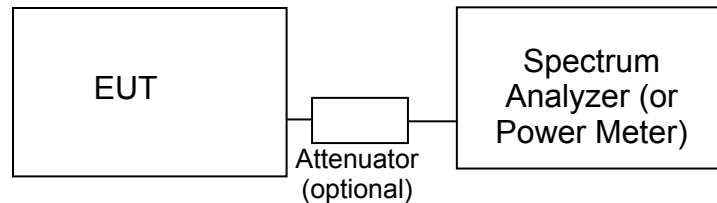
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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, 26dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and 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

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
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi.

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 15.205, 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:

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

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:

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

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 = 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, 1,000 - 6,500 MHz, 01-Jun-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016

Radiated Emissions, 1,000 - 26,500 MHz, 02-Jun-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/20/2013	12/20/2015
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	2/20/2015	2/20/2016
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/20/2014	9/20/2015
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2014	9/16/2015

Radiated Emissions, 1,000 - 8,000 MHz, 03-Jun-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/20/2013	12/20/2015
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	2/20/2015	2/20/2016
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/20/2014	9/20/2015

Radiated Emissions, 30 - 1,000 MHz, 05-Jun-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2197	2/13/2014	2/13/2016
Hewlett Packard	9KHz-1300MHz pre-amp	8447F	2777	3/4/2015	3/5/2016

Conducted Emissions - AC Power Ports, 08-Jun-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
EMCO	LISN, 10 kHz-100 MHz	3825/2	1293	6/2/2015	6/2/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1549	6/2/2015	6/2/2017

Radio Antenna Port (Power and Spurious Emissions), 11-Jun-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Agilent Technologies	USB Average Power Sensor	U2001A	2442	12/19/2014	12/19/2015
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	3/31/2015	3/31/2016

Appendix B Test Data

T98400 Pages 24 – 70



EMC Test Data

Client:	SanDisk Corp.	Job Number:	J98333
Product	SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number:	T98400
		Project Manager:	Deepa Shetty
Contact:	Jerry Reguero	Project Coordinator:	-
Emissions Standard(s):	FCC 15.247 / IC RSS-210 / LP0002	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

SanDisk Corp.

Product

SDWS4 (2.4GHz 1x1 20MHz)

Date of Last Test: 6/11/2015



EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Power vs. Data Rate

In normal operating modes the card uses power settings stored on EEPROM to set the output power. For a given nominal output power the actual transmit power normally is reduced as the data rate increases, therefore testing was performed at the data rate in the mode with highest power to determine compliance with the requirements.

The following power measurements were made using a GATED average power meter and with the device configured in a continuous transmit mode on Chain 1 at the various data rates in each mode to verify the highest power mode:

Sample Notes

Sample S/N: NTS Tag# 2015-2181

Driver: -

Date of Test: 5/29/2015
 Test Engineer: M. Birgani
 Test Location: Lab 4

Mode	Data Rate	Power (dBm)	Power setting
802.11b	1	14.4	16.0
	2	14.3	
	5.5	14.4	
	11	14.3	
802.11g	6	13.0	16.0
	9	12.7	
	12	12.7	
	18	12.6	
	24	12.5	
	36	12.5	
	48	12.4	
	54	12.5	



EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Mode	Data Rate	Power (dBm)	Power setting
802.11n 20MHz	6.5	12.9	16.0
	13	12.7	
	19.5	12.8	
	26	12.8	
	39	12.7	
	52	12.7	
	58.5	12.6	
	65	12.5	
	78	N/A	

<<-11ac mode only

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

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Duty Cycle

Date of Test: 5/29/2015
 Test Engineer: M. Birgani
 Test Location: Lab 4

Duty cycle measurements performed on the worse case data rate for power.

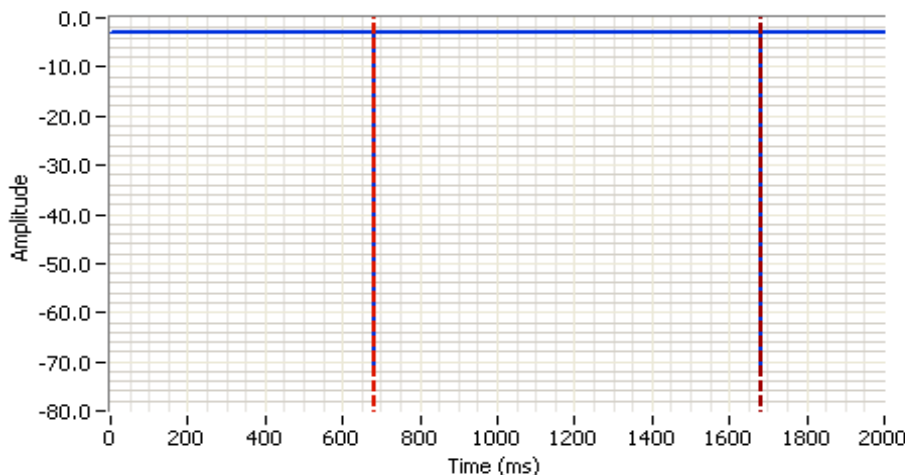
Notes: Measurements taken with maximum RBW/VBW settings allowed.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
11g	6 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
n20	MCS0	99.7%	Yes	2000	0.0	0.0	0.5

* Correction factor when using RMS/Power averaging - $10 \cdot \log(1/x)$

** Correction factor when using linear voltage average - $20 \cdot \log(1/x)$

T = Minimum transmission duration



Analyzer Settings

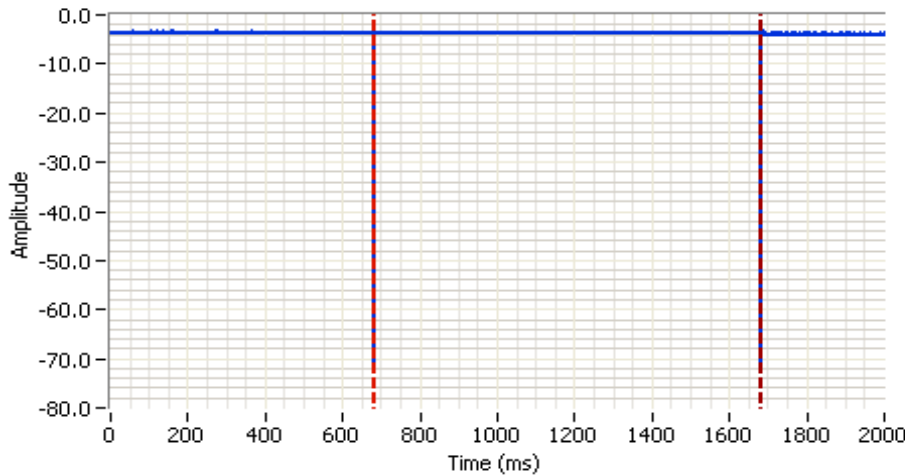
Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 0.000 MHz
 RB: 1.000 MHz
 VB: 3.000 MHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 0.0 DB
 Sweep Time: 2.0s
 Ref Lvl: -2.0 DBM

Comments

802.11b 1Mbps
 Off time: 3.3ms
 On time: 996.4ms
 Duty cycle: 99.7%

Cursor 1	680.3385	3.0		Delta Time (ms)	999.7
Cursor 2	1680.0781	3.0		Delta Amplitude	0.0

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
Contact: Jerry Reguero	Project Manager: Deepa Shetty
Standard: FCC 15.247 / IC RSS-210 / LP0002	Project Coordinator: -
	Class: N/A

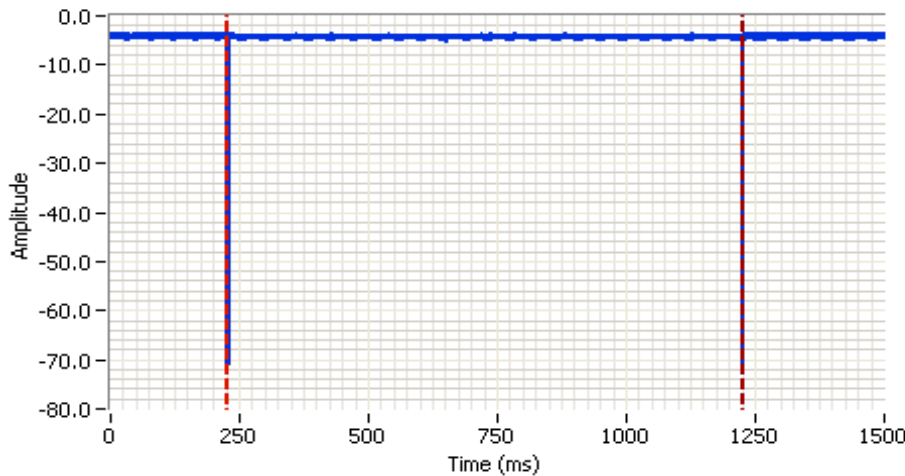


Analyzer Settings
 Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 0.000 MHz
 RB: 1.000 MHz
 VB: 3.000 MHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 0.0 DB
 Sweep Time: 2.0s
 Ref Lvl: -2.0 DBM

Comments
 802.11 g 6 Mbps
 Off time: 3.1ms
 On time: 996.4ms
 Duty cycle: 99.7%

Cursor 1 681.1198 3.0  Delta Time (ms) 999.9

Cursor 2 1680.9896 3.0  Delta Amplitude 0.0



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 0.000 MHz
 RB: 1.000 MHz
 VB: 3.000 MHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 0.0 DB
 Sweep Time: 2.0s
 Ref Lvl: -2.0 DBM

Comments
 802.n 20MHz MCS0
 Off time: 3.3ms
 On time: 996.4ms
 Duty cycle: 99.7%

Cursor 1 225.4687 3.0  Delta Time (ms) 999.7

Cursor 2 1225.2083 3.0  Delta Amplitude 0.0





EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	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, unless otherwise noted.

Ambient Conditions: Temperature: 20-22 °C
Rel. Humidity: 30-35 %

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

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	b	1 - 2412MHz	16	16	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	35.7 dBµV/m @ 2386.2 MHz (-18.3 dB)
	b	11 - 2462MHz	16	16	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	61.2 dBµV/m @ 2483.6 MHz (-12.8 dB)
2	g	1 - 2412MHz	16	15	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	51.7 dBµV/m @ 2390.0 MHz (-2.3 dB)
	g	11 - 2462MHz	16	16	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	46.5 dBµV/m @ 2483.5 MHz (-7.5 dB)
3	n20	1 - 2412MHz	14	14	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	72.5 dBµV/m @ 2389.1 MHz (-1.5 dB)
	n20	11 - 2462MHz	14	14	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	46.0 dBµV/m @ 2483.5 MHz (-8.0 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.

Notes

The product could be handheld. Testing performed in 3 orientations to ensure worse case emissions were observed
Product placed 1.5m above ground plane



EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Sample Notes

Sample S/N: NTS Tag: 2015-2180

Driver: -

Antenna: Internal

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
11g	6 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
n20	MCS0	99.7%	Yes	2000	0.0	0.0	0.5

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #1: Radiated Bandedge Measurements

Date of Test: 06/01/15

EUT Voltage: 120V/ 60Hz and charging via USB adpater

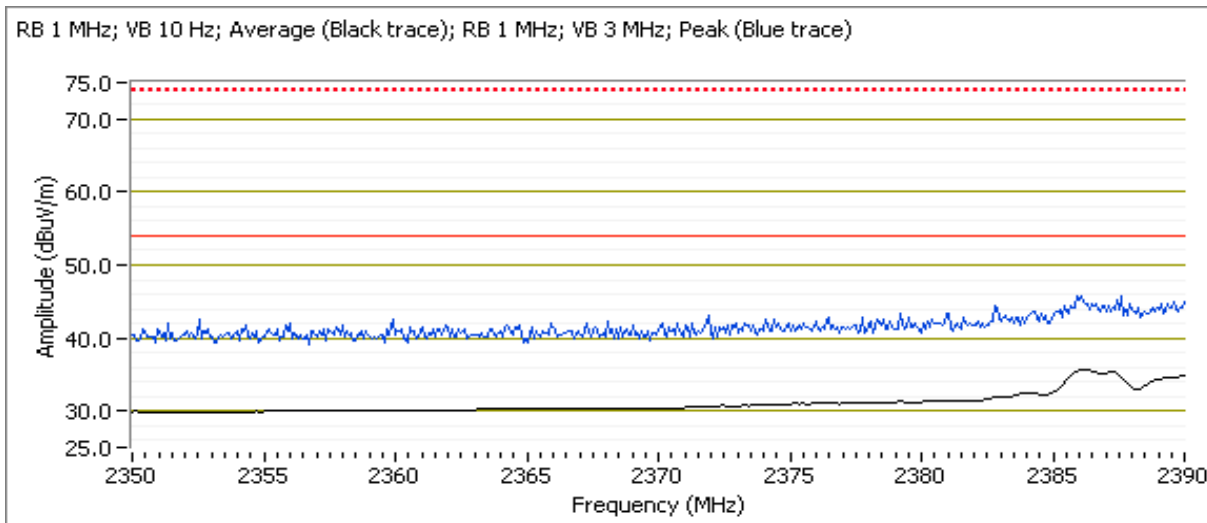
Test Engineer: M. Birgani

Test Location: Chamber 7

Channel: 1 Mode: b Orientation: Side
 Tx Chain: Main Data Rate: 1 Mbps Power Setting: 16

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2386.230	35.7	H	54.0	-18.3	AVG	131	1.7	POS; RB 1 MHz; VB: 10 Hz
2386.150	33.6	V	54.0	-20.4	AVG	171	1.0	POS; RB 1 MHz; VB: 10 Hz
2386.230	45.4	H	74.0	-28.6	PK	131	1.7	POS; RB 1 MHz; VB: 3 MHz
2386.550	44.5	V	74.0	-29.5	PK	171	1.0	POS; RB 1 MHz; VB: 3 MHz

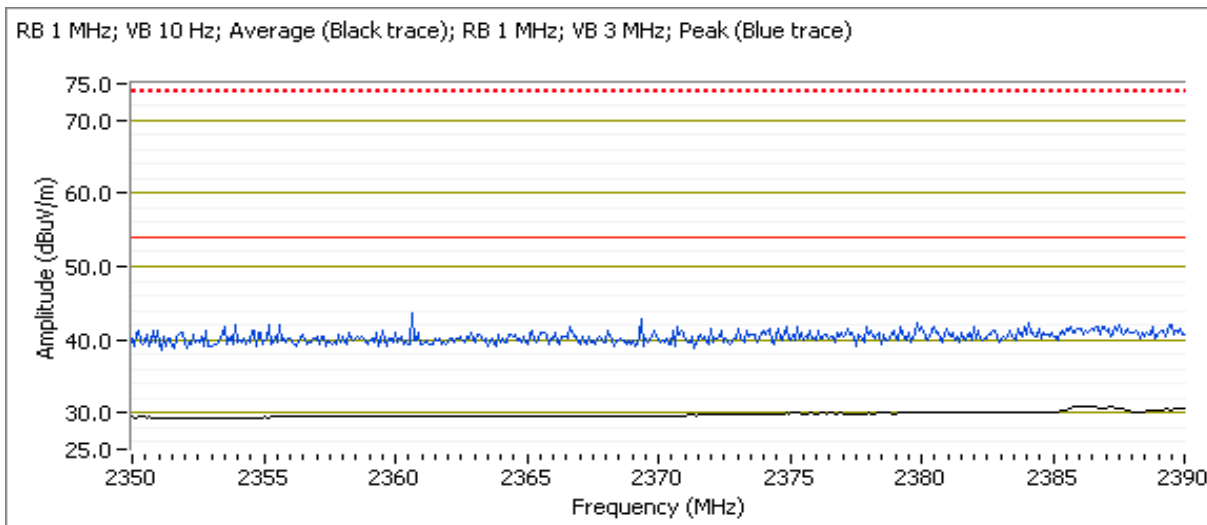


Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Channel: 1 Mode: b Orientation: Flat
 Tx Chain: Main Data Rate: 1 Mbps Power Setting: 16

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2386.230	32.3	V	54.0	-21.7	AVG	174	1.0	POS; RB 1 MHz; VB: 10 Hz
2386.150	30.9	H	54.0	-23.1	AVG	0	1.9	POS; RB 1 MHz; VB: 10 Hz
2384.710	43.4	V	74.0	-30.6	PK	174	1.0	POS; RB 1 MHz; VB: 3 MHz
2358.180	43.2	H	74.0	-30.8	PK	0	1.9	POS; RB 1 MHz; VB: 3 MHz





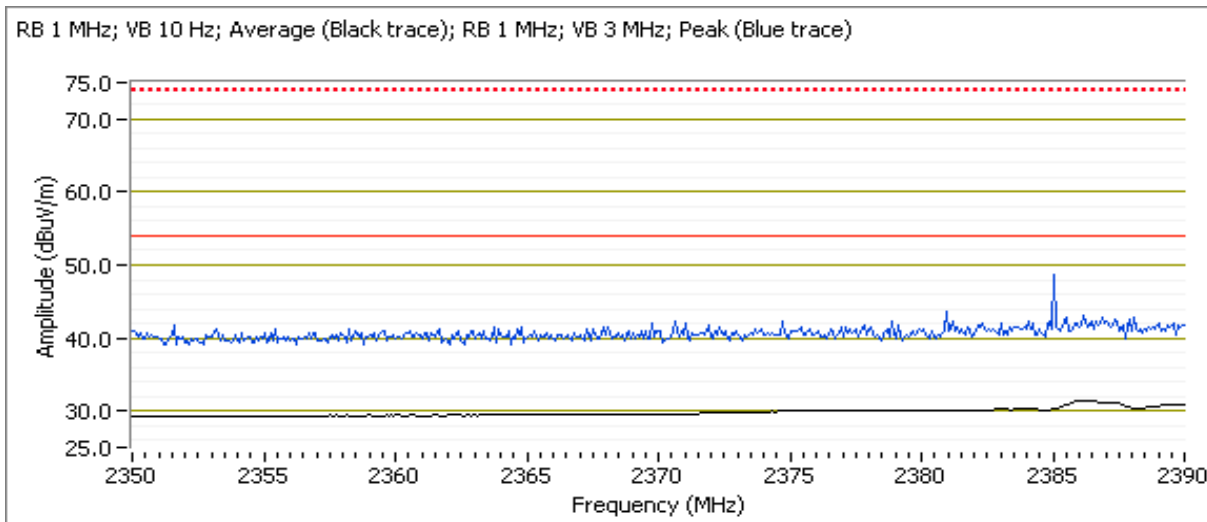
EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Channel: 1 Mode: b Orientation: Upright
 Tx Chain: Main Data Rate: 1 Mbps Power Setting: 16

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	
2386.310	33.8	H	54.0	-20.2	AVG	204	1.0	POS; RB 1 MHz; VB: 10 Hz
2386.230	31.5	V	54.0	-22.5	AVG	28	2.0	POS; RB 1 MHz; VB: 10 Hz
2386.630	50.9	V	74.0	-23.1	PK	28	2.0	POS; RB 1 MHz; VB: 3 MHz
2385.510	44.4	H	74.0	-29.6	PK	204	1.0	POS; RB 1 MHz; VB: 3 MHz





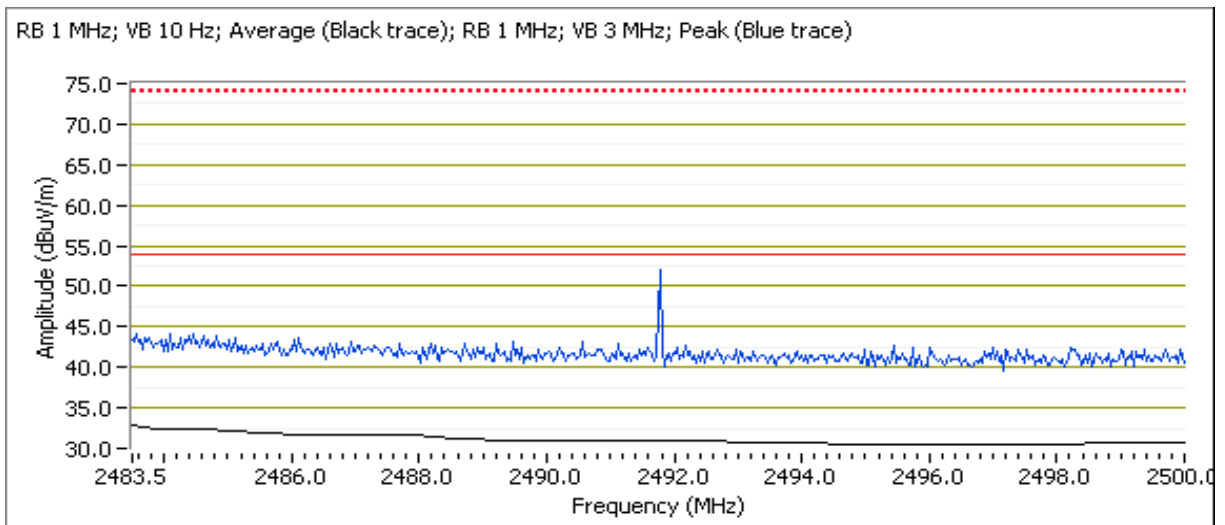
EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Channel: 11 Mode: b Orientation: Side
 Tx Chain: Main Data Rate: 1 Mbps Power Setting: 16

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	
2483.630	61.2	H	74.0	-12.8	PK	130	1.4	POS; RB 1 MHz; VB: 3 MHz
2483.500	32.7	H	54.0	-21.3	AVG	130	1.4	POS; RB 1 MHz; VB: 10 Hz
2491.780	31.3	H	54.0	-22.7	AVG	130	1.4	POS; RB 1 MHz; VB: 10 Hz
2491.780	52.6	H	74.0	-21.4	PK	130	1.4	POS; RB 1 MHz; VB: 3 MHz
2483.570	30.5	V	54.0	-23.5	AVG	152	1.0	POS; RB 1 MHz; VB: 10 Hz
2483.530	50.0	V	74.0	-24.0	PK	152	1.0	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #2: Radiated Bandedge Measurements

Date of Test: 06/01/15

Test Engineer: M. Birgani

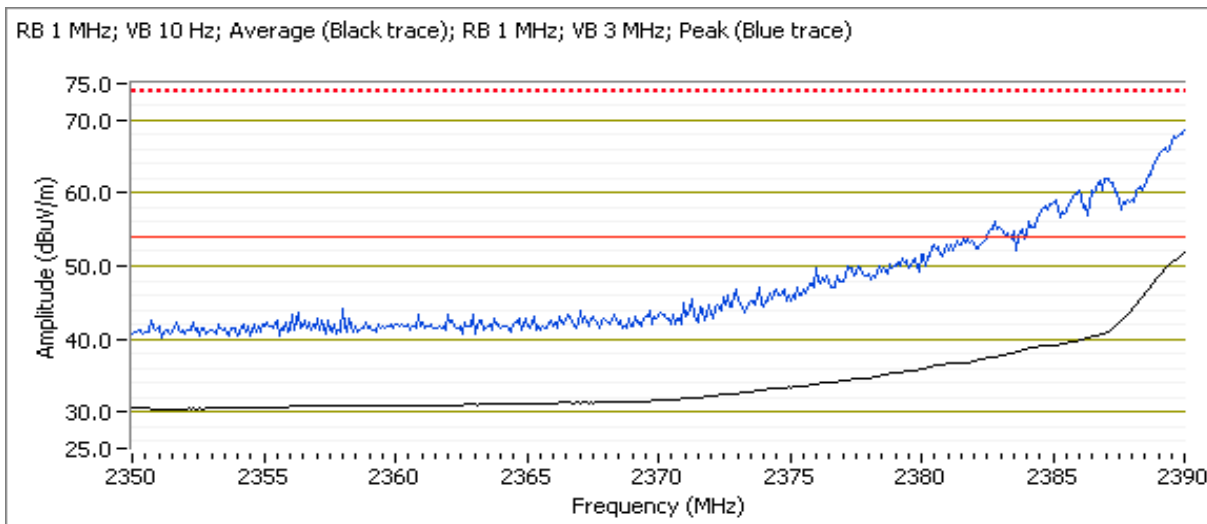
EUT Voltage: 120V/ 60Hz and charging via USB adpater

Test Location: Chamber 7

Channel: 1 Mode: g Orientation: Side
 Tx Chain: Main Data Rate: 6 Mbps Power Setting: 15

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	
2390.000	51.7	H	54.0	-2.3	AVG	129	2.1	POS; RB 1 MHz; VB: 10 Hz
2389.840	68.5	H	74.0	-5.5	PK	129	2.1	POS; RB 1 MHz; VB: 3 MHz
2390.000	45.6	V	54.0	-8.4	AVG	98	2.1	POS; RB 1 MHz; VB: 10 Hz
2389.840	62.3	V	74.0	-11.7	PK	98	2.1	POS; RB 1 MHz; VB: 3 MHz





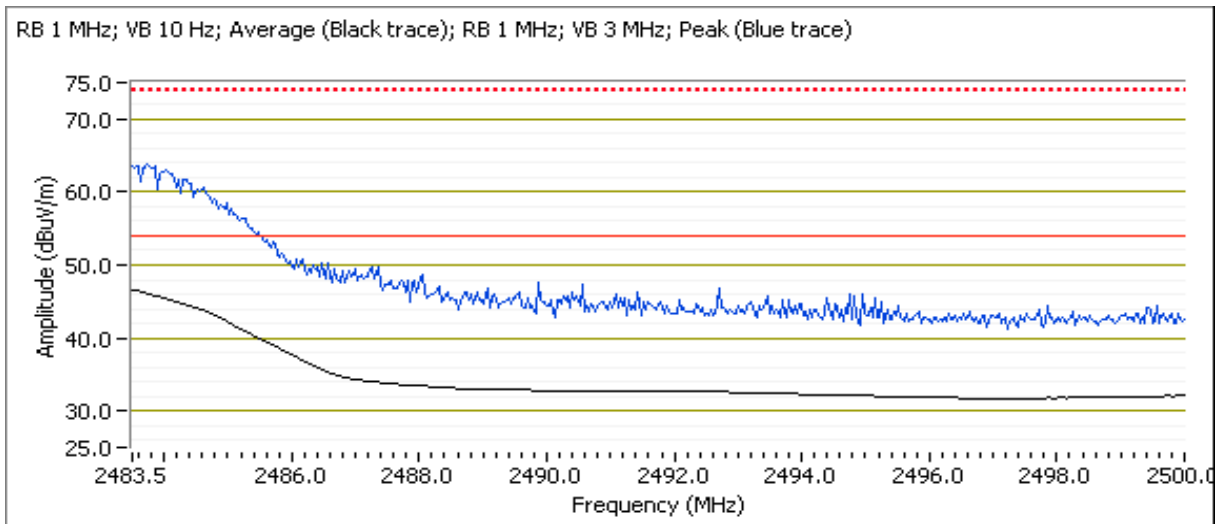
EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Channel: 11 Mode: g Orientation: Side
 Tx Chain: Main Data Rate: 6 Mbps Power Setting: 16

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	
2483.500	46.5	H	54.0	-7.5	AVG	192	1.4	POS; RB 1 MHz; VB: 10 Hz
2484.030	63.7	H	74.0	-10.3	PK	192	1.4	POS; RB 1 MHz; VB: 3 MHz
2483.500	41.9	V	54.0	-12.1	AVG	99	1.4	POS; RB 1 MHz; VB: 10 Hz
2483.530	59.2	V	74.0	-14.8	PK	99	1.4	POS; RB 1 MHz; VB: 3 MHz



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #3: Radiated Bandedge Measurements

Date of Test: 06/01/15

Test Engineer: M. Birgani

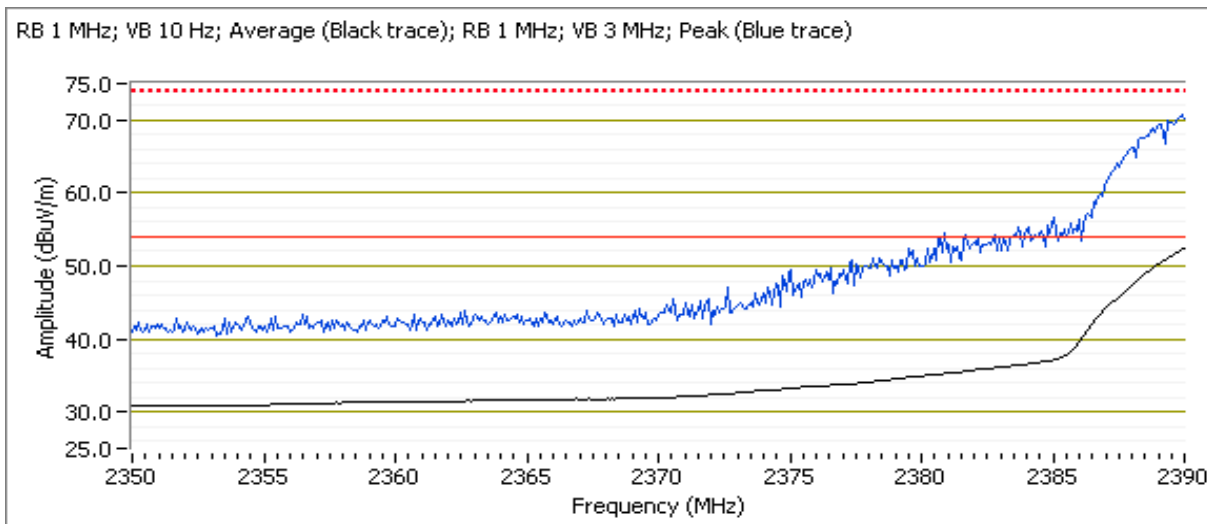
EUT Voltage: 120V/ 60Hz and charging via USB adpater

Test Location: Chamber 7

Channel: 1 Mode: n20 Orientation: Side
 Tx Chain: Main Data Rate: MCS0 Power Setting: 14

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	
2389.120	72.5	H	74.0	-1.5	PK	138	1.1	POS; RB 1 MHz; VB: 3 MHz
2390.000	52.4	H	54.0	-1.6	AVG	138	1.1	POS; RB 1 MHz; VB: 10 Hz
2390.000	46.8	V	54.0	-7.2	AVG	172	1.0	POS; RB 1 MHz; VB: 10 Hz
2389.440	66.1	V	74.0	-7.9	PK	172	1.0	POS; RB 1 MHz; VB: 3 MHz





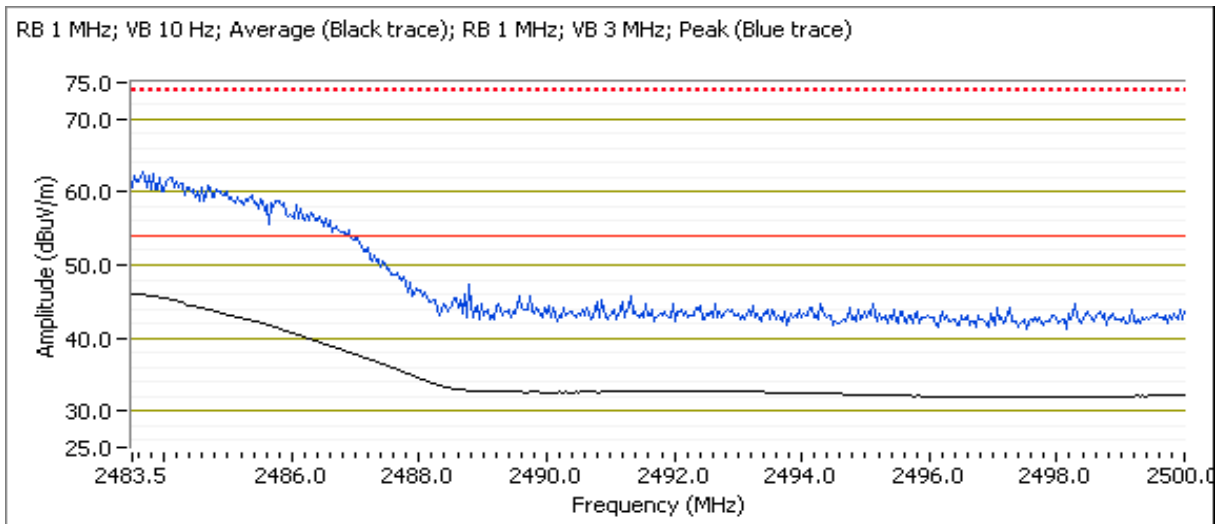
EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Channel: 1 Mode: n20 Orientation: Side
 Tx Chain: Main Data Rate: MCS0 Power Setting: 14

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	
2483.500	46.0	H	54.0	-8.0	AVG	128	1.1	POS; RB 1 MHz; VB: 10 Hz
2484.620	62.6	H	74.0	-11.4	PK	128	1.1	POS; RB 1 MHz; VB: 3 MHz
2483.530	37.8	V	54.0	-16.2	AVG	108	1.0	POS; RB 1 MHz; VB: 10 Hz
2483.930	54.0	V	74.0	-20.0	PK	108	1.0	POS; RB 1 MHz; VB: 3 MHz



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	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, unless otherwise noted.

Ambient Conditions:
 Temperature: 20-23 °C
 Rel. Humidity: 30-35 %

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

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	b	1 - 2412MHz	16	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	46.8 dBµV/m @ 4824.1 MHz (-7.2 dB)
	b	6 - 2437MHz	16	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	45.6 dBµV/m @ 4874.1 MHz (-8.4 dB)
	b	11 - 2462MHz	16	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	39.9 dBµV/m @ 4924.0 MHz (-14.1 dB)
Scans on center channel in all OFDM modes to determine the worst case mode.							
2	g	6 - 2437MHz	16	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	38.3 dBµV/m @ 7310.8 MHz (-15.7 dB)
	n20	6 - 2437MHz	14	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	36.5 dBµV/m @ 7312.1 MHz (-17.5 dB)
Measurements on low and high channels in worst-case OFDM mode.							
3	g	1 - 2412MHz	16	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	36.3 dBµV/m @ 7240.1 MHz (-17.7 dB)
	g	11 - 2462MHz	16	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	37.8 dBµV/m @ 7385.0 MHz (-16.2 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: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Sample Notes

Sample S/N: NTS Tag: 2015-2180
 Driver: -
 Antenna: Internal

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074
 Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time
 Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.
 2.4GHz band reject filter used
 The product could be handheld. Testing performed in 3 orientations to ensure worse case emissions were observed
 Product placed 1.5m above ground plane

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
11g	6 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
n20	MCS0	99.7%	Yes	2000	0.0	0.0	0.5

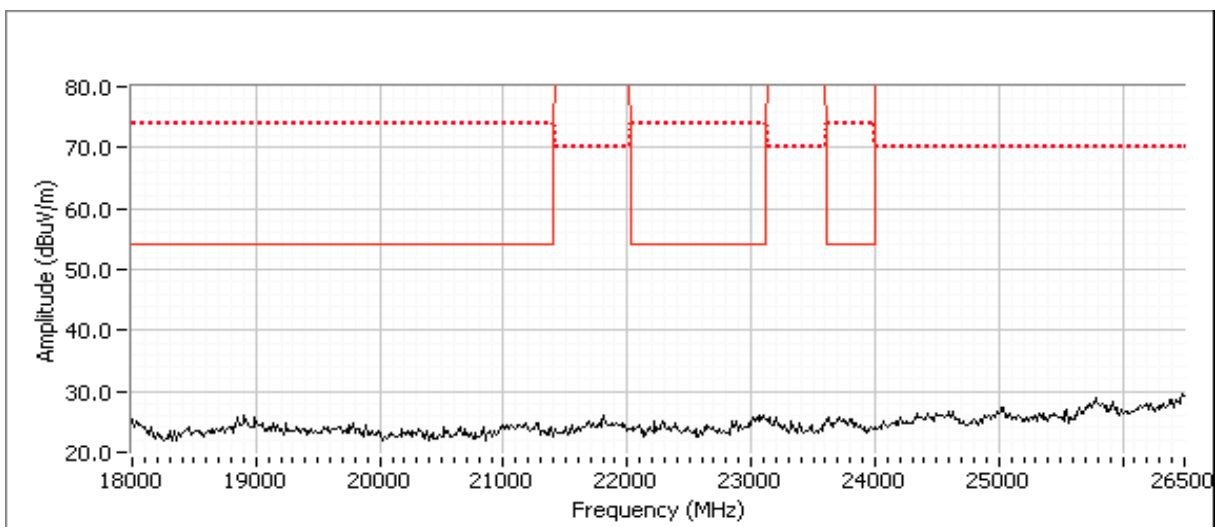
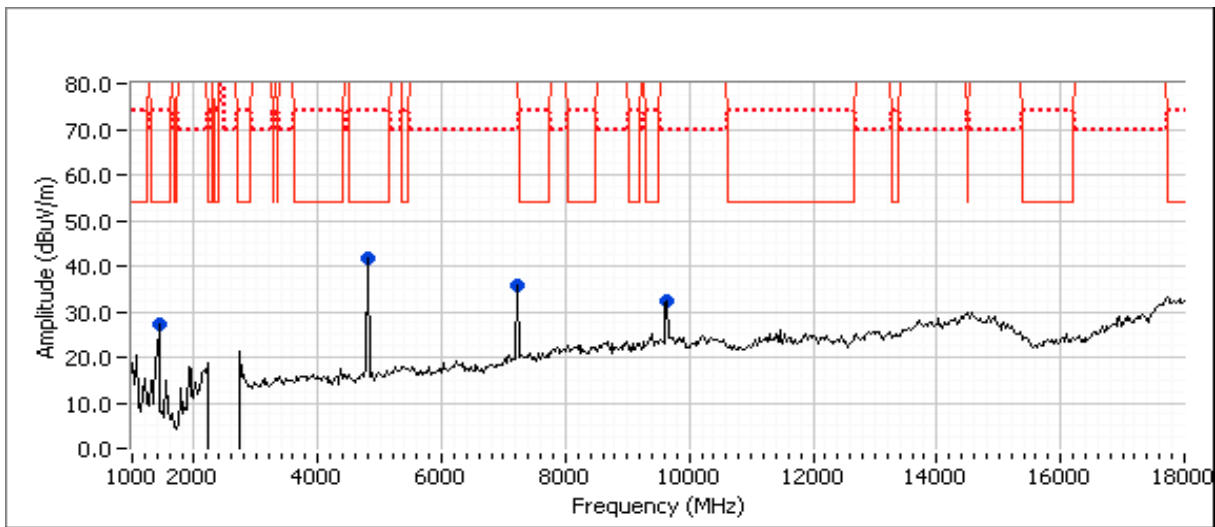
Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Notes

The product could be handheld. Testing performed in 3 orientations to ensure worst case emissions were observed. Plots below performed at 30cm away from the EUT and showed only 2nd, 3rd and 4th harmonics to be present. The collected frequencies were tested at 3 orientation in run 1a and showed the side orientation is worst case. All tests were performed on collected frequencies and at EUT at its side.





EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #1: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: 802.11b
 Date of Test: 06/02/15 EUT Voltage: 120V/ 60Hz and charging via USB adpater
 Test Engineer: M. Birgani Test Location: Chamber 7

Run #1a: Low Channel
 Channel: 1 Mode: b Orientation: All orientations
 Tx Chain: Main Data Rate: 1 Mbps Power Setting: 16

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	
4824.090	46.8	H	54.0	-7.2	AVG	194	1.1	Side; RB 1 MHz;VB 10 Hz;Peak
4824.090	46.1	H	54.0	-7.9	AVG	198	1.0	Flat; RB 1 MHz;VB 10 Hz;Peak
4824.080	45.1	V	54.0	-8.9	AVG	192	1.0	Upright; RB 1 MHz;VB 10 Hz;Peak
4824.080	41.6	V	54.0	-12.4	AVG	131	1.3	Flat; RB 1 MHz;VB 10 Hz;Peak
4824.100	41.1	V	54.0	-12.9	AVG	180	1.0	Side; RB 1 MHz;VB 10 Hz;Peak
4824.100	38.6	H	54.0	-15.4	AVG	208	1.0	Upright; RB 1 MHz;VB 10 Hz;Peak
4824.080	51.8	H	74.0	-22.2	PK	194	1.1	Side; RB 1 MHz;VB 3 MHz;Peak
4823.940	51.0	H	74.0	-23.0	PK	198	1.0	Flat; RB 1 MHz;VB 3 MHz;Peak
4823.830	50.1	V	74.0	-23.9	PK	192	1.0	Upright; RB 1 MHz;VB 3 MHz;Peak
4824.210	48.7	V	74.0	-25.3	PK	131	1.3	Flat; RB 1 MHz;VB 3 MHz;Peak
4824.080	48.6	V	74.0	-25.4	PK	180	1.0	Side; RB 1 MHz;VB 3 MHz;Peak
4823.960	47.1	H	74.0	-26.9	PK	208	1.0	Upright; RB 1 MHz;VB 3 MHz;Peak

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	
7237.080	37.4	H	54.0	-16.6	AVG	0	1.0	Side; Note 1
7233.120	49.5	H	74.0	-24.5	PK	0	1.0	Side; Note 1
7237.020	38.1	V	54.0	-15.9	AVG	350	1.5	Side; Note 1
7237.800	48.8	V	74.0	-25.2	PK	350	1.5	Side; Note 1
9648.050	40.7	H	54.0	-13.3	AVG	84	1.3	Side; Note 1
9649.230	52.0	H	74.0	-22.0	PK	84	1.3	Side; Note 1
1420.050	24.6	H	54.0	-29.4	AVG	360	1.1	Side; RB 1 MHz;VB 10 Hz;Peak
1426.020	35.7	H	74.0	-38.3	PK	360	1.1	Side; RB 1 MHz;VB 3 MHz;Peak
1420.000	24.7	V	54.0	-29.3	AVG	360	1.0	Side; RB 1 MHz;VB 10 Hz;Peak
1422.480	35.8	V	74.0	-38.2	PK	360	1.0	Side; RB 1 MHz;VB 3 MHz;Peak



EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #1b: Center Channel

Channel: 6 Mode: b Orientation: Side
 Tx Chain: Main Data Rate: 1 Mbps Power Setting: 16

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
4874.050	45.6	H	54.0	-8.4	AVG	195	1.0	RB 1 MHz;VB 10 Hz;Peak
7312.350	38.6	H	54.0	-15.4	AVG	0	1.0	RB 1 MHz;VB 10 Hz;Peak
4874.100	38.4	V	54.0	-15.6	AVG	158	1.0	RB 1 MHz;VB 10 Hz;Peak
7312.250	37.1	V	54.0	-16.9	AVG	332	1.5	RB 1 MHz;VB 10 Hz;Peak
7311.100	50.1	H	74.0	-23.9	PK	0	1.0	RB 1 MHz;VB 3 MHz;Peak
4873.990	49.9	H	74.0	-24.1	PK	195	1.0	RB 1 MHz;VB 3 MHz;Peak
7314.880	48.3	V	74.0	-25.7	PK	332	1.5	RB 1 MHz;VB 3 MHz;Peak
4874.110	46.5	V	74.0	-27.5	PK	158	1.0	RB 1 MHz;VB 3 MHz;Peak

Run #1c: High Channel

Channel: 11 Mode: b Orientation: Side
 Tx Chain: Main Data Rate: 1 Mbps Power Setting: 16

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
4924.040	39.9	H	54.0	-14.1	AVG	196	1.1	RB 1 MHz;VB 10 Hz;Peak
7383.620	36.6	H	54.0	-17.4	AVG	44	1.0	RB 1 MHz;VB 10 Hz;Peak
7381.970	36.4	V	54.0	-17.6	AVG	50	1.0	RB 1 MHz;VB 10 Hz;Peak
4924.090	35.4	V	54.0	-18.6	AVG	148	1.0	RB 1 MHz;VB 10 Hz;Peak
7384.330	47.7	H	74.0	-26.3	PK	44	1.0	RB 1 MHz;VB 3 MHz;Peak
7386.300	47.6	V	74.0	-26.4	PK	50	1.0	RB 1 MHz;VB 3 MHz;Peak
4924.150	46.6	H	74.0	-27.4	PK	196	1.1	RB 1 MHz;VB 3 MHz;Peak
4924.150	45.0	V	74.0	-29.0	PK	148	1.0	RB 1 MHz;VB 3 MHz;Peak



EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #2: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: OFDM
 Date of Test: 06/02/15 EUT Voltage: 120V/ 60Hz and charging via USB adpater
 Test Engineer: M. Birgani Test Location: Chamber 7

Run #2a: Center Channel
 Channel: 6 Mode: g Orientation: Side
 Tx Chain: Main Data Rate: 6 Mbps Power Setting: 16

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
7310.780	38.3	V	54.0	-15.7	AVG	344	1.2	RB 1 MHz;VB 10 Hz;Peak
7312.780	36.5	H	54.0	-17.5	AVG	63	1.0	RB 1 MHz;VB 10 Hz;Peak
4874.310	34.6	H	54.0	-19.4	AVG	196	1.1	RB 1 MHz;VB 10 Hz;Peak
4876.380	32.5	V	54.0	-21.5	AVG	184	1.0	RB 1 MHz;VB 10 Hz;Peak
7310.770	49.7	V	74.0	-24.3	PK	344	1.2	RB 1 MHz;VB 3 MHz;Peak
7314.500	48.5	H	74.0	-25.5	PK	63	1.0	RB 1 MHz;VB 3 MHz;Peak
4874.050	47.6	H	74.0	-26.4	PK	196	1.1	RB 1 MHz;VB 3 MHz;Peak
4878.070	44.1	V	74.0	-29.9	PK	184	1.0	RB 1 MHz;VB 3 MHz;Peak

Run #2b: Center Channel
 Channel: 6 Mode: n20 Orientation: Side
 Tx Chain: Main Data Rate: MCS0 Power Setting: 16

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
7312.080	36.5	H	54.0	-17.5	AVG	7	1.0	RB 1 MHz;VB 10 Hz;Peak
7310.880	36.5	V	54.0	-17.5	AVG	0	1.3	RB 1 MHz;VB 10 Hz;Peak
4874.580	34.1	H	54.0	-19.9	AVG	196	1.2	RB 1 MHz;VB 10 Hz;Peak
4875.440	32.7	V	54.0	-21.3	AVG	158	2.5	RB 1 MHz;VB 10 Hz;Peak
7308.600	48.8	H	74.0	-25.2	PK	7	1.0	RB 1 MHz;VB 3 MHz;Peak
7313.720	48.3	V	74.0	-25.7	PK	0	1.3	RB 1 MHz;VB 3 MHz;Peak
4872.330	46.6	H	74.0	-27.4	PK	196	1.2	RB 1 MHz;VB 3 MHz;Peak
4874.230	45.2	V	74.0	-28.8	PK	158	2.5	RB 1 MHz;VB 3 MHz;Peak



EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #3: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: Worse case from Run #2
 Date of Test: 06/02/15 EUT Voltage: 120V/ 60Hz and charging via USB adpater
 Test Engineer: M. Birgani Test Location: Chamber 7

Run #3a: Low Channel

Channel: 1 Mode: g Orientation: Side
 Tx Chain: Main Data Rate: 6 Mbps Power Setting: 16

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
7240.070	36.3	H	54.0	-17.7	AVG	67	1.0	Note 1; RB 1 MHz;VB 10 Hz;Peak
4824.290	35.6	H	54.0	-18.4	AVG	197	1.2	RB 1 MHz;VB 10 Hz;Peak
4823.850	33.7	V	54.0	-20.3	AVG	182	1.0	RB 1 MHz;VB 10 Hz;Peak
7237.170	48.3	H	74.0	-25.7	PK	67	1.0	Note 1; RB 1 MHz;VB 3 MHz;Peak
4823.050	47.8	H	74.0	-26.2	PK	197	1.2	RB 1 MHz;VB 3 MHz;Peak
4822.550	45.3	V	74.0	-28.7	PK	182	1.0	RB 1 MHz;VB 3 MHz;Peak

Run #3b: High Channel

Channel: 11 Mode: g Orientation: Side
 Tx Chain: Main Data Rate: 6 Mbps Power Setting: 16

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
7385.040	37.8	V	54.0	-16.2	AVG	0	1.0	RB 1 MHz;VB 10 Hz;Peak
7377.070	36.4	H	54.0	-17.6	AVG	281	1.0	RB 1 MHz;VB 10 Hz;Peak
4924.070	32.7	H	54.0	-21.3	AVG	44	1.0	RB 1 MHz;VB 10 Hz;Peak
4914.130	32.1	V	54.0	-21.9	AVG	131	1.9	RB 1 MHz;VB 10 Hz;Peak
7385.100	49.7	V	74.0	-24.3	PK	0	1.0	RB 1 MHz;VB 3 MHz;Peak
7382.270	48.1	H	74.0	-25.9	PK	281	1.0	RB 1 MHz;VB 3 MHz;Peak
4924.920	44.5	H	74.0	-29.5	PK	44	1.0	RB 1 MHz;VB 3 MHz;Peak
4923.530	43.7	V	74.0	-30.3	PK	131	1.9	RB 1 MHz;VB 3 MHz;Peak



EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	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, unless otherwise noted.

Ambient Conditions:

Temperature: 18-20 °C
Rel. Humidity: 35-40 %

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

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	11b	6 - 2437MHz	16	16	Radiated Emissions 30 - 1000 MHz	FCC Part 15.209 / 15.247(c)	23.7 dBµV/m @ 170.68 MHz (-19.8 dB)
	Rx	6 - 2437MHz			Radiated Emissions 30 - 1000 MHz	LP0002 2.8	26.1 dBµV/m @ 181.01 MHz (-17.4 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.

Sample Notes

Sample S/N: NTS Tag: 2015-2180

Driver: -

Antenna: Internal

Notes

The product could be handheld. Testing performed in 3 orientations to ensure worse case emissions were observed
Preliminary evaluation showed when EUT is located at its side has highest emission. All tests were performed with EUT on its side.



EMC Test Data

Client:	SanDisk Corp.	Job Number:	J98333
Model:	SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number:	T98400
		Project Manager:	Deepa Shetty
Contact:	Jerry Reguero	Project Coordinator:	-
Standard:	FCC 15.247 / IC RSS-210 / LP0002	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mbps	99.7%	Yes	2000	0.0	0.0	0.5

Measurement Specific Notes:

Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
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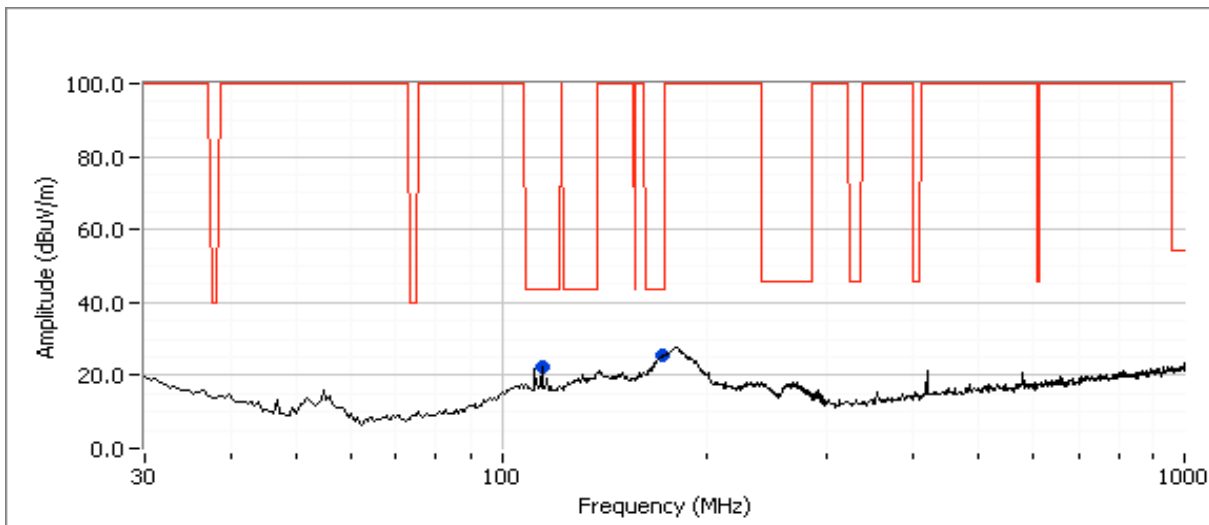
EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #1: Radiated Spurious Emissions, 30-1000MHz. Operating Mode: 11b
 Date of Test: 06/05/15 EUT Voltage: 120V/ 60Hz and charging via USB adpater
 Test Engineer: M. Birgani Test Location: Chamber 7

Run #1a:
 Channel: 6 Mode: Tx Orientation: Side
 Tx Chain: Main Data Rate: -

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
170.681	23.7	H	43.5	-19.8	QP	232	2.1	QP (1.00s)
112.310	8.6	H	43.5	-34.9	QP	244	2.0	QP (1.00s)



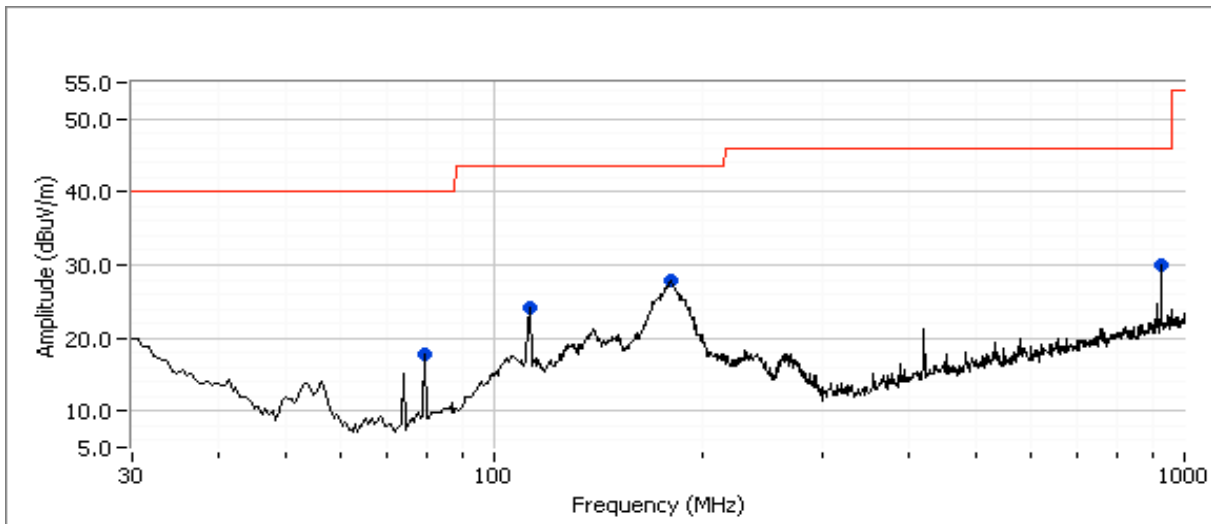


EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
Contact: Jerry Reguero	Project Manager: Deepa Shetty
Standard: FCC 15.247 / IC RSS-210 / LP0002	Project Coordinator: -
	Class: N/A

Run #1b:
Channel: 6 Mode: Rx Orientation: Side
Tx Chain: Main Data Rate: -

Frequency MHz	Level dB μ V/m	Pol v/h	LP 0002		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
181.010	26.1	H	43.5	-17.4	QP	266	2.0	QP (1.00s)
929.265	18.3	H	46.0	-27.7	QP	298	3.0	QP (1.00s)
79.620	10.0	V	40.0	-30.0	QP	77	1.5	QP (1.00s)
111.422	9.9	V	43.5	-33.6	QP	224	1.5	QP (1.00s)





EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	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: 6/11/2015
 Test Engineer: M. Birgani
 Test Location: Lab 4

Config. Used: 1
 Config Change: -
 Host 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.

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

Ambient Conditions: Temperature: 18-20 °C
 Rel. Humidity: 30-35 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1			Output Power	15.247(b)	Pass	b: 9.5dBm; 8.9mW g: 9.6dBm; 9.1mW n20: 9.7dBm; 9.3mW
2			Power spectral Density (PSD)	15.247(d)	Pass	b: -14.8dBm/3kHz g: -15.3dBm/3kHz n20: -14.0dBm/3kHz
3			Minimum 6dB Bandwidth	15.247(a)	Pass	9.9MHz
3			99% Bandwidth	RSS GEN	-	b: 14.2MHz g: 18.3MHz n20: 18.5MHz
4			Spurious emissions	15.247(b)	Pass	> -30dBc

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: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
11g	6 Mbps	99.7%	Yes	2000	0.0	0.0	0.5
n20	MCS0	99.7%	Yes	2000	0.0	0.0	0.5

Sample Notes

Sample S/N: NTS Tag: 2015-2181

Driver: -

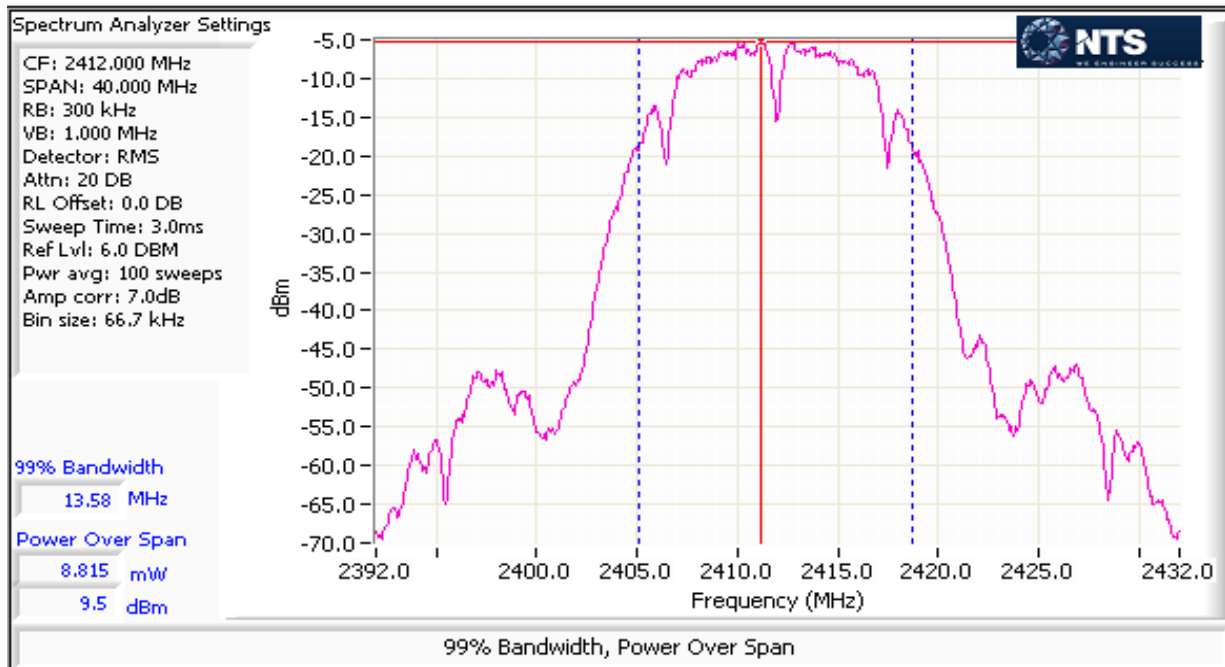
Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #1: Output Power

Note 1:	Duty Cycle \geq 98%. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB \geq 3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces. Spurious limit becomes -30dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Power measured using average power meter (non-gated) and is included for reference only.

Mode: 11b

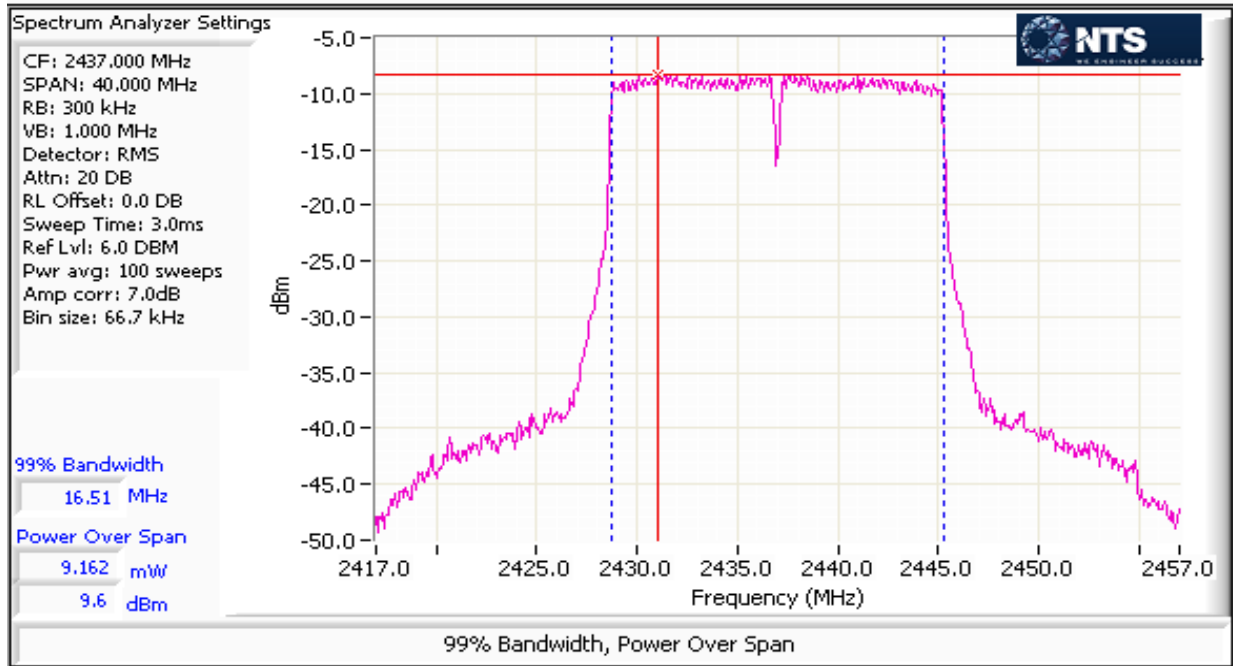
Power Setting ²	Frequency (MHz)	Output Power		Antenna Gain (dBi)	Result	EIRP		Output Power	
		(dBm) ¹	mW			dBm	W	(dBm) ³	mW
11	2412	9.5	8.9	-3.3	Pass	6.2	0.004	9.5	8.9
11	2437	9.1	8.1	-3.3	Pass	5.8	0.004	9.1	8.1
12	2462	9.3	8.5	-3.3	Pass	6.0	0.004	9.2	8.3



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Mode: 11g

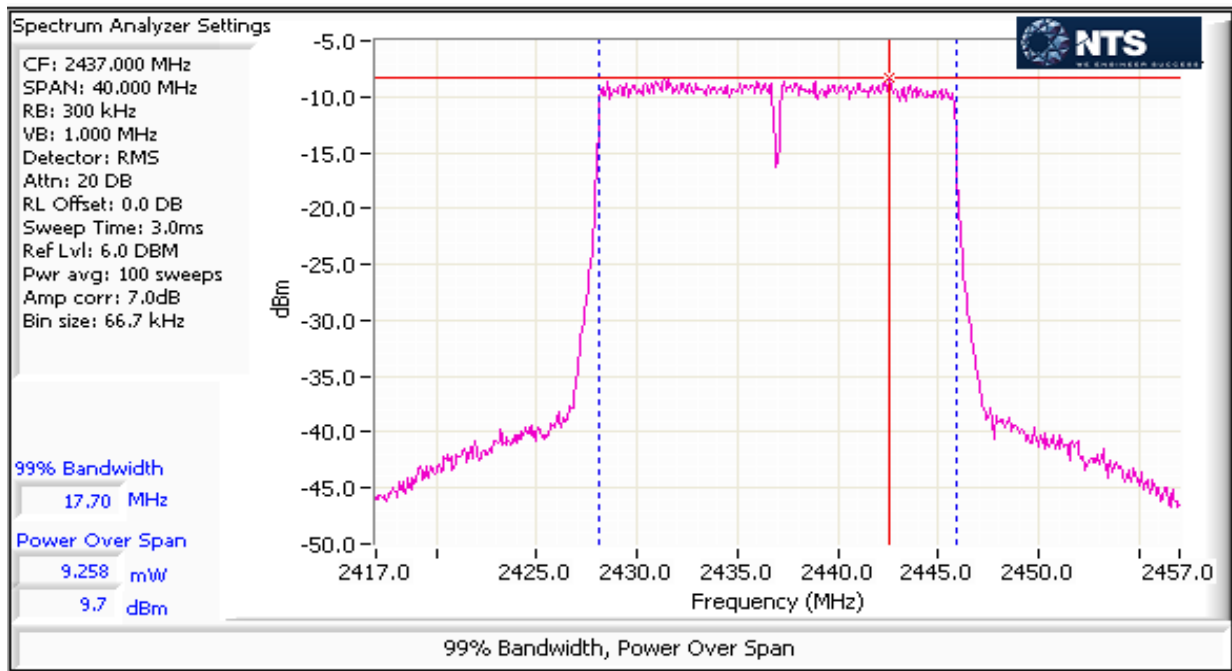
Power Setting ²	Frequency (MHz)	Output Power		Antenna Gain (dBi)	Result	EIRP		Output Power	
		(dBm) ¹	mW			dBm	W	(dBm) ³	mW
11	2412	8.1	6.5	-3.3	Pass	4.8	0.003	8.2	6.6
13	2437	9.6	9.1	-3.3	Pass	6.3	0.004	9.4	8.7
13	2462	9.2	8.3	-3.3	Pass	5.9	0.004	9.0	7.9



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Mode: n20

Power Setting ²	Frequency (MHz)	Output Power		Antenna Gain (dBi)	Result	EIRP		Output Power	
		(dBm) ¹	mW			dBm	W	(dBm) ³	mW
11	2412	8.0	6.3	-3.3	Pass	4.7	0.003	8.2	6.6
13	2437	9.7	9.3	-3.3	Pass	6.4	0.004	9.5	8.9
13	2462	9.3	8.5	-3.3	Pass	6.0	0.004	8.9	7.8





EMC Test Data

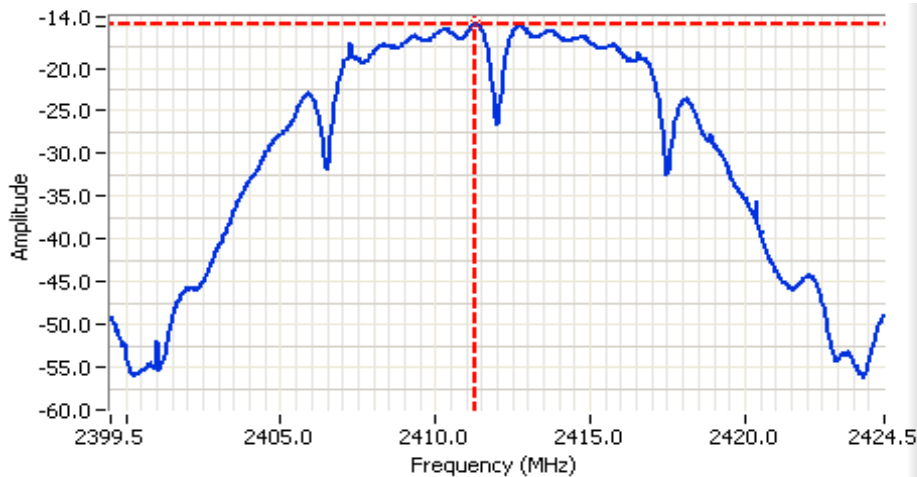
Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #2: Power spectral Density

Note 1: Test performed per method PKSPD, in KDB 558074. Power spectral density measured using: $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$, $\text{VBW}=3*\text{RBW}$, peak detector, span = $1.5*\text{DTS BW}$, auto sweep time, max hold.

Mode: 11b

Power Setting	Frequency (MHz)	PSD	Limit dBm/3kHz	Result
		(dBm/3.0kHz) ^{Note 1}		
16	2412	-14.8	8.0	Pass
16	2437	-14.9	8.0	Pass
16	2462	-15.7	8.0	Pass



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 25.000 MHz
 RB: 3.00 kHz
 VB: 10.0 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 7.0 DB
 Sweep Time: 2.6s
 Ref Lvl: -8.0 DBM

Comments

802.11b 1Mbps
 PSD: -14.8 dBm/3kHz

Cursor 1 2411.2917 -14.8

0.0000 0.0



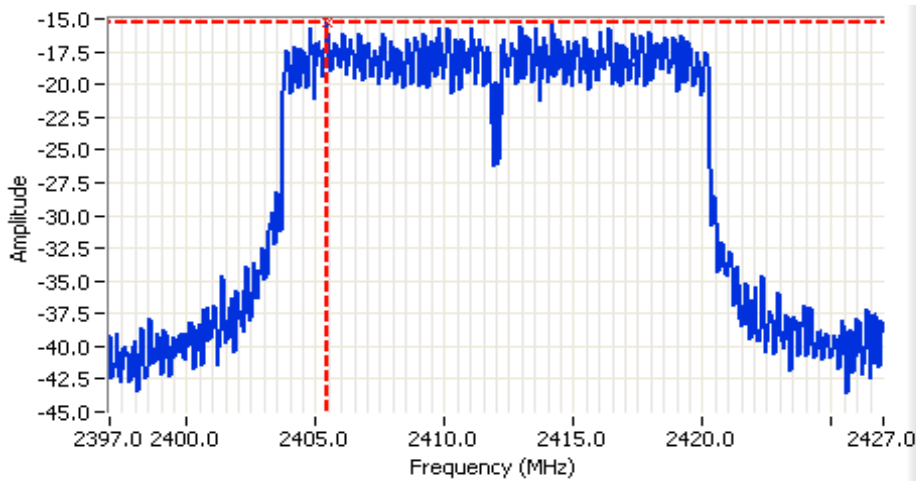


EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Mode: 11g

Power Setting	Frequency (MHz)	PSD	Limit	Result
		(dBm/3.0kHz) <small>Note 1</small>		
16	2412	-15.3	8.0	Pass
16	2437	-15.7	8.0	Pass
16	2462	-15.8	8.0	Pass



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 30.000 MHz
 RB: 3.00 kHz
 VB: 10.0 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 7.0 DB
 Sweep Time: 3.2s
 Ref Lvl: -8.0 DBM

Comments
 802.11g 6Mbps
 PSD: -15.3 dBm/3kHz

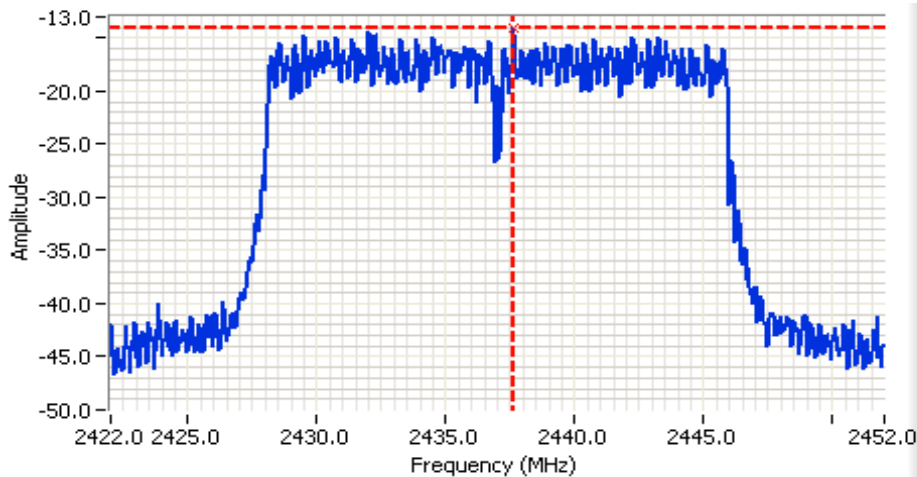
Cursor 1 2405.4000 -15.3 [Icons]
 0.0000 0.0 [Icons]



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Mode: n20

Power Setting	Frequency (MHz)	PSD	Limit dBm/3kHz	Result
		(dBm/3.0kHz) <small>Note 1</small>		
15	2412	-14.0	8.0	Pass
15	2437	-14.0	8.0	Pass
15	2462	-14.5	8.0	Pass



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2437.000 MHz
 SPAN: 30.000 MHz
 RB: 3.00 kHz
 VB: 10.0 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 7.0 DB
 Sweep Time: 3.2s
 Ref Lvl: -8.0 DBM

Comments

802.11n 20 MCS0
 PSD: -14.0 dBm/3kHz

Cursor 1 2437.6000 -14.0

0.0000 0.0



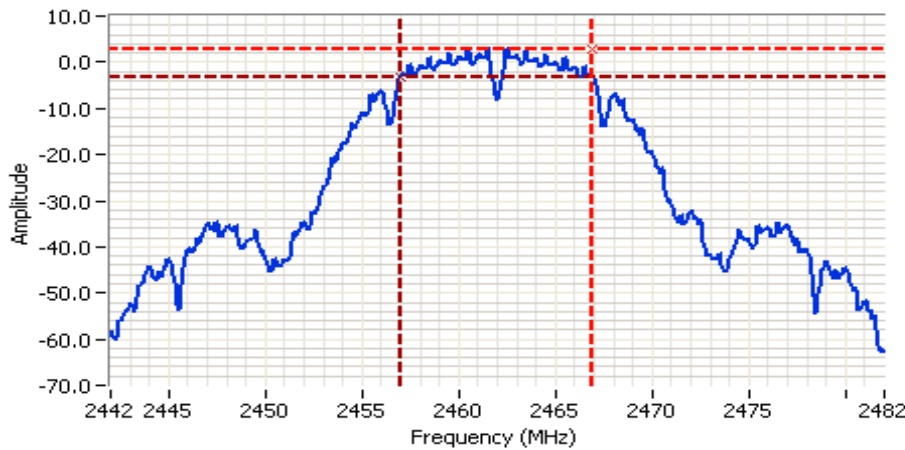
Run #3: Signal Bandwidth

Note 1: DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time.
 99% BW: RBW=1-5% of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time.

Mode: 11b

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
16	2412	10.0	14.2	100	300
16	2437	9.9	13.9	100	300
16	2462	9.9	13.8	100	300

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
Contact: Jerry Reguero	Project Manager: Deepa Shetty
Standard: FCC 15.247 / IC RSS-210 / LP0002	Project Coordinator: -
	Class: N/A

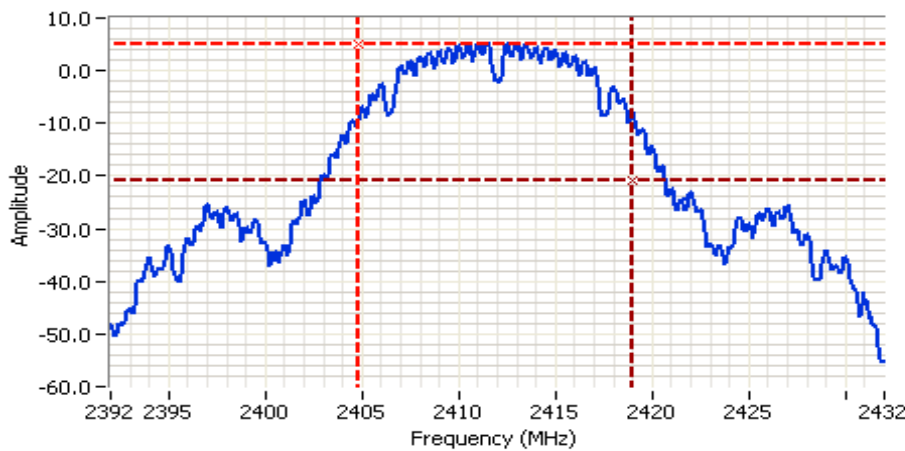


Analyzer Settings
 Agilent Technologies, E4446A
 CF: 2462.000 MHz
 SPAN: 40.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 7.0 DB
 Sweep Time: 3.8ms
 Ref Lvl: 7.0 DBM

Comments
 802.11b 1Mbps
 6dB BW: 9.9 MHz

Cursor 1 2466.9333 2.8
 Cursor 2 2457.0000 -3.2

Delta Freq. 9.933
 Delta Amplitude 6.0



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 40.000 MHz
 RB: 300 kHz
 VB: 1.000 MHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 7.0 DB
 Sweep Time: 1.0ms
 Ref Lvl: 7.0 DBM

Comments
 802.11b 1Mbps
 99% BW: 14.2 MHz

Cursor 1 2404.7787 5.2
 Cursor 2 2418.9551 -20.8

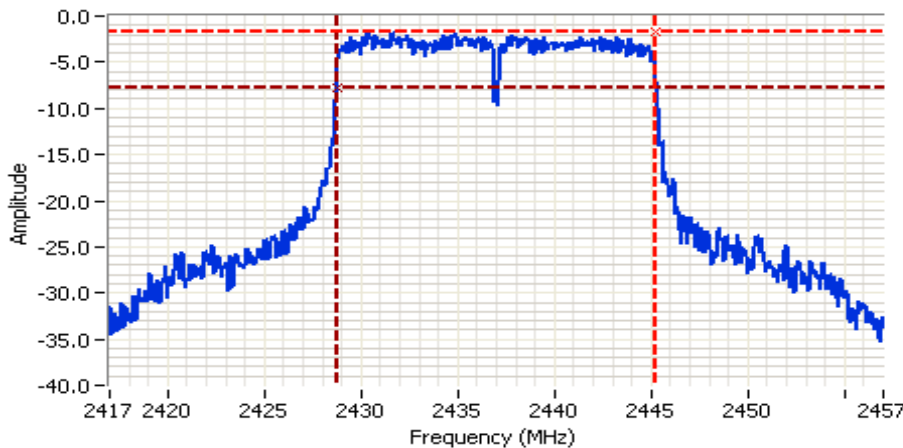
Delta Freq. 14.176
 Delta Amplitude 26.0



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
Contact: Jerry Reguero	Project Manager: Deepa Shetty
Standard: FCC 15.247 / IC RSS-210 / LP0002	Project Coordinator: -
	Class: N/A

Mode: 11g

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
16	2412	16.5	18.3	100	300
16	2437	16.5	17.4	100	300
16	2462	16.5	17.0	100	300



Analyzer Settings

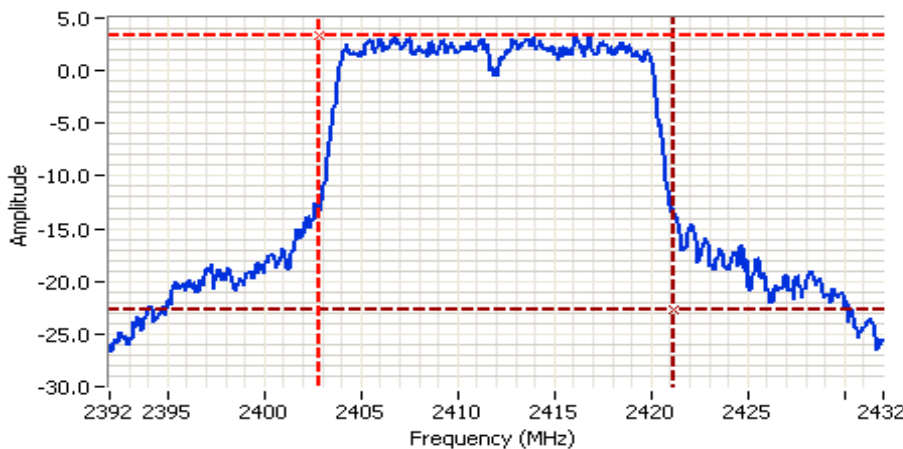
Agilent Technologies, E4446A
 CF: 2437.000 MHz
 SPAN: 40.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 7.0 DB
 Sweep Time: 3.8ms
 Ref Lvl: 7.0 DBM

Comments

802.11g 6Mbps
 6dB BW: 16.5 MHz

Cursor 1	2445.2667	-1.7	
Cursor 2	2428.7333	-7.7	

Delta Freq. 16.533
 Delta Amplitude 6.0



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 40.000 MHz
 RB: 300 kHz
 VB: 1.000 MHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 7.0 DB
 Sweep Time: 1.0ms
 Ref Lvl: 7.0 DBM

Comments

802.11g 6Mbps
 99% BW: 18.3 MHz

Cursor 1	2402.8486	3.3	
Cursor 2	2421.1514	-22.7	

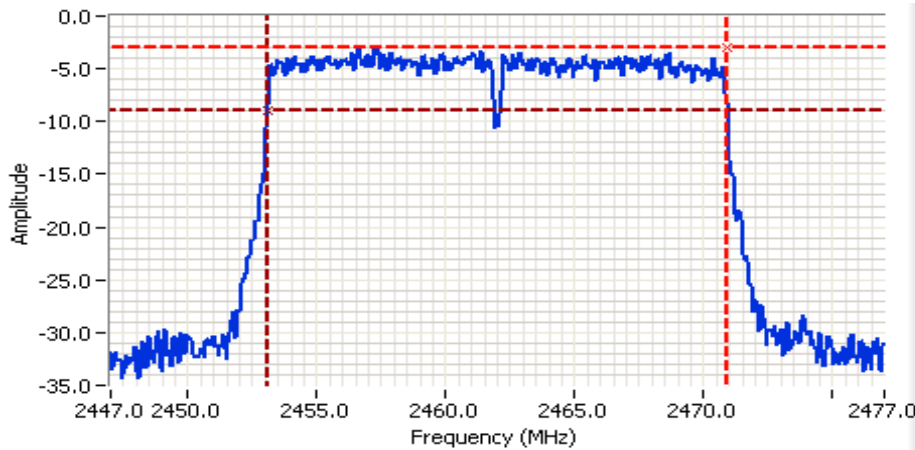
Delta Freq. 18.303
 Delta Amplitude 26.0



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
Contact: Jerry Reguero	Project Manager: Deepa Shetty
Standard: FCC 15.247 / IC RSS-210 / LP0002	Project Coordinator: -
	Class: N/A

Mode: n20

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
15	2412	17.9	18.5	100	300
15	2437	17.8	18.2	100	300
15	2462	17.8	18.4	100	300



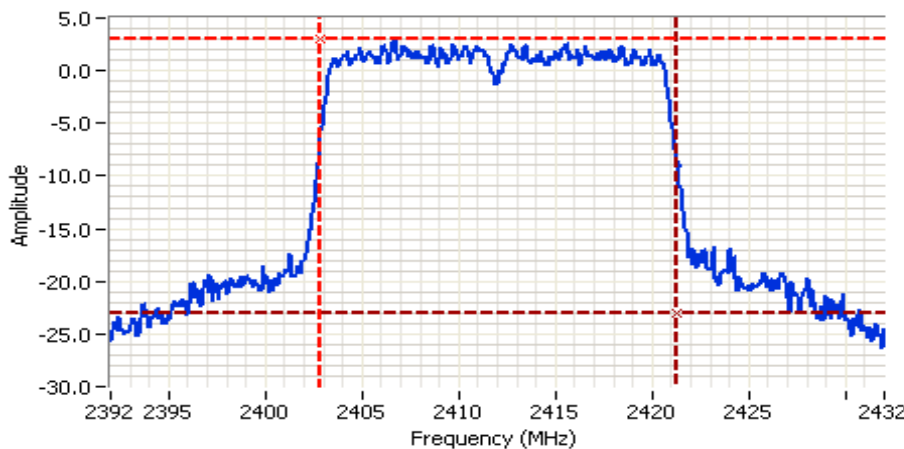
Analyzer Settings

Agilent Technologies, E4446A
 CF: 2462.000 MHz
 SPAN: 30.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 7.0 DB
 Sweep Time: 2.9ms
 Ref Lvl: 3.0 DBM

Comments

802.11n 20 MCS0
 6dB BW: 17.8 MHz

Cursor 1	2470.9000	-2.9	Delta Freq.	17.800
Cursor 2	2453.1000	-8.9	Delta Amplitude	6.0



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 40.000 MHz
 RB: 300 kHz
 VB: 1.000 MHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 7.0 DB
 Sweep Time: 1.0ms
 Ref Lvl: 7.0 DBM

Comments

802.11n 20 MCS0
 99% BW: 18.5 MHz

Cursor 1	2402.7820	3.0	Delta Freq.	18.502
Cursor 2	2421.2845	-23.0	Delta Amplitude	26.0



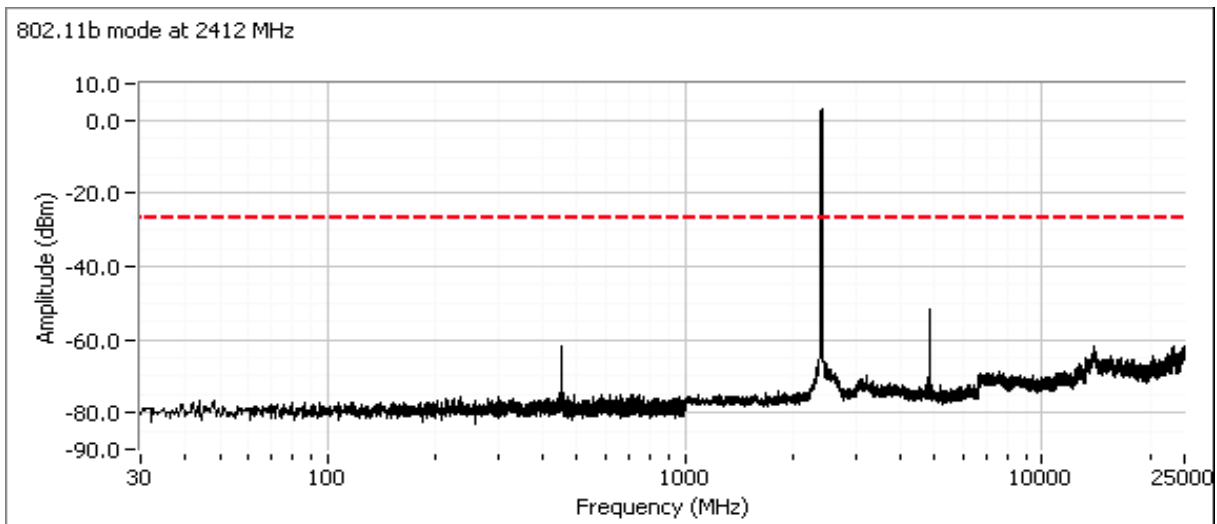
Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Run #4a: Out of Band Spurious Emissions

All measurements performed using RB=100kHz, VBW=300kHz, peak detector, max hold

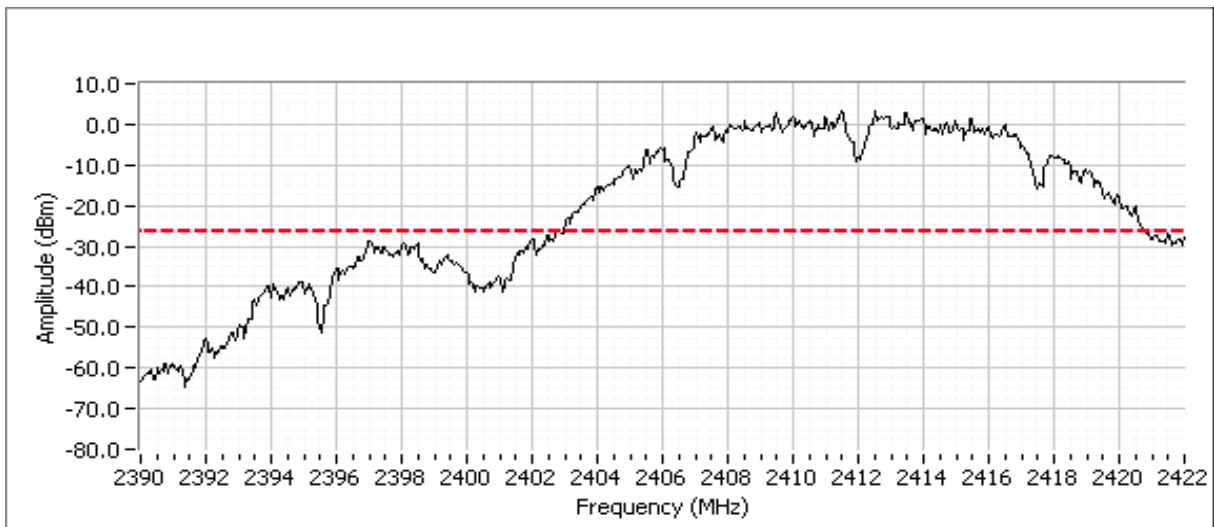
Frequency (MHz)	Power Setting	Mode	Limit	Result
2412	16	b	-30dBc	Pass
2437	16	b	-30dBc	Pass
2462	16	b	-30dBc	Pass

Plots for low channel

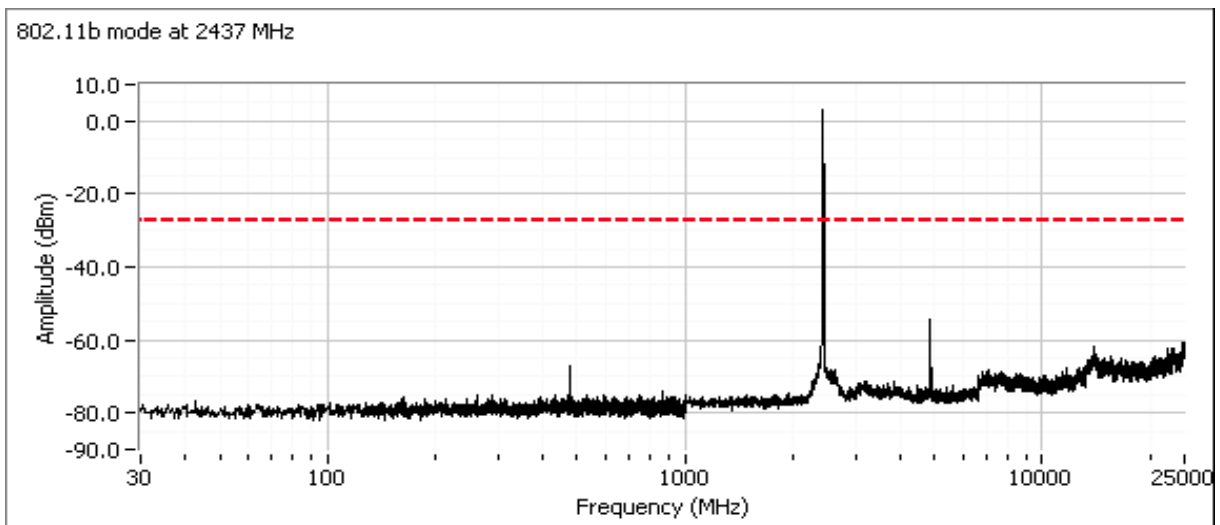


Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

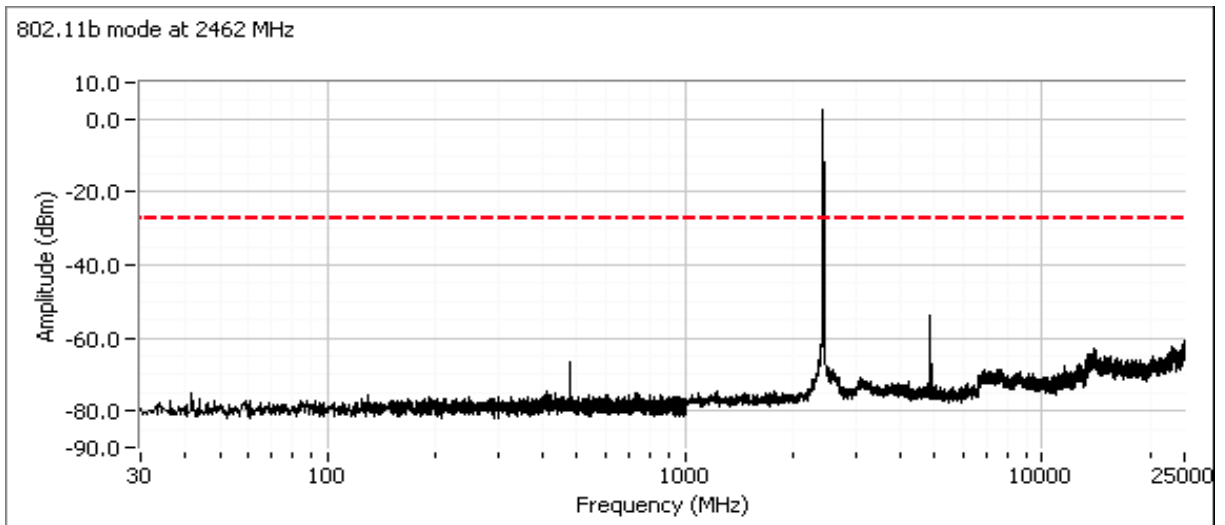


Plots for center channel



Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

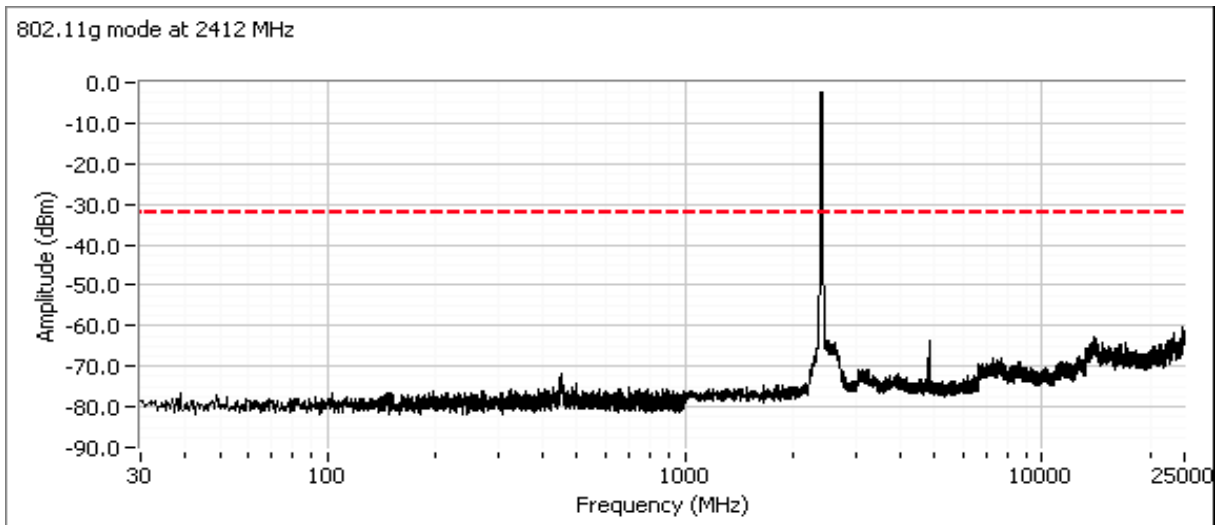
Plots for high channel



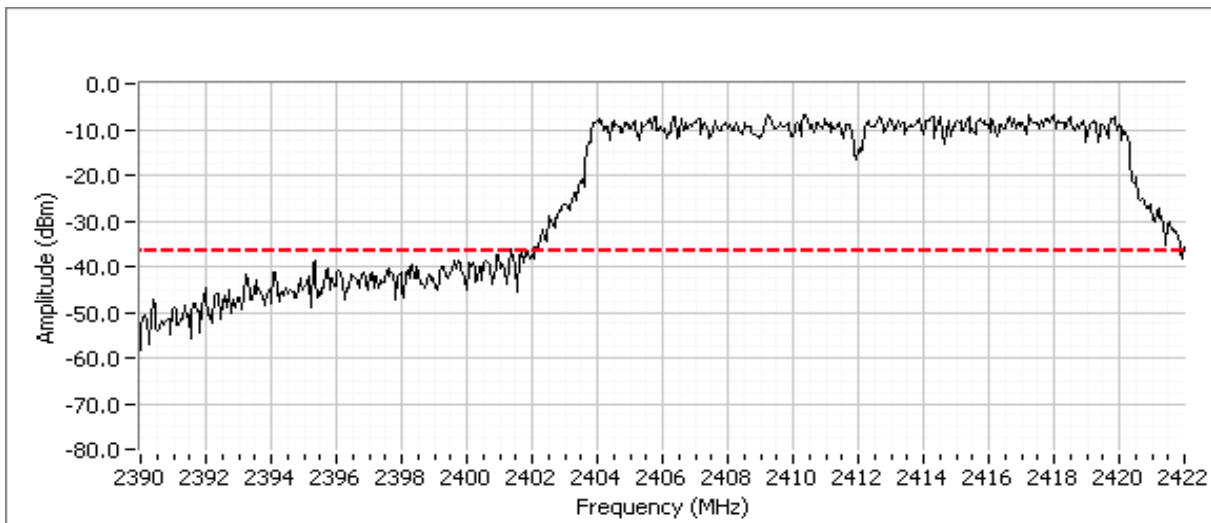
Frequency (MHz)	Power Setting	Mode	Limit	Result
2412	11	g	-20dBc	Pass
2437	16	g	-20dBc	Pass
2462	16	g	-20dBc	Pass

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Plots for low channel

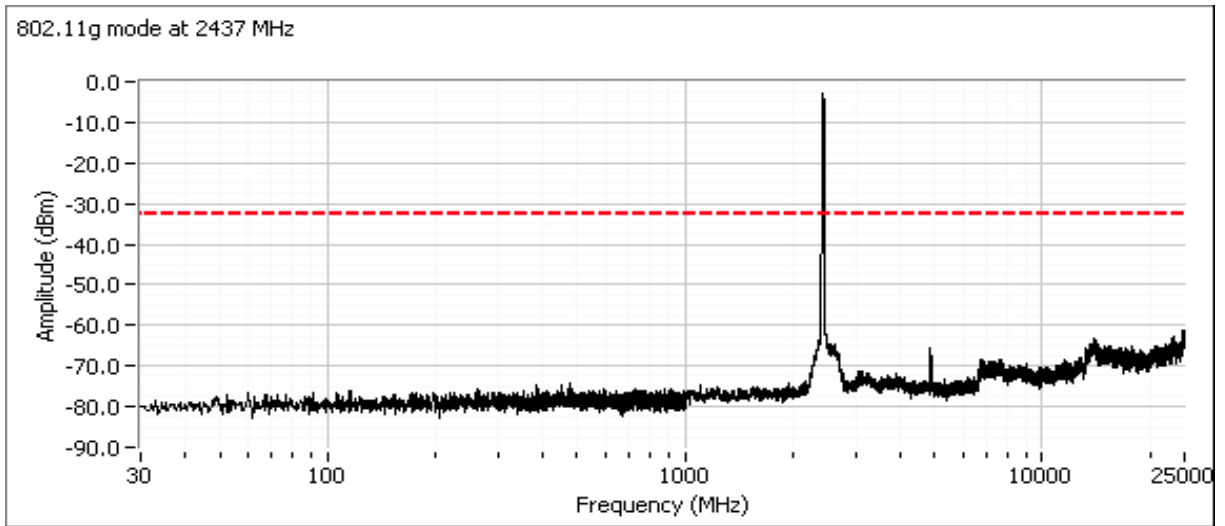


Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

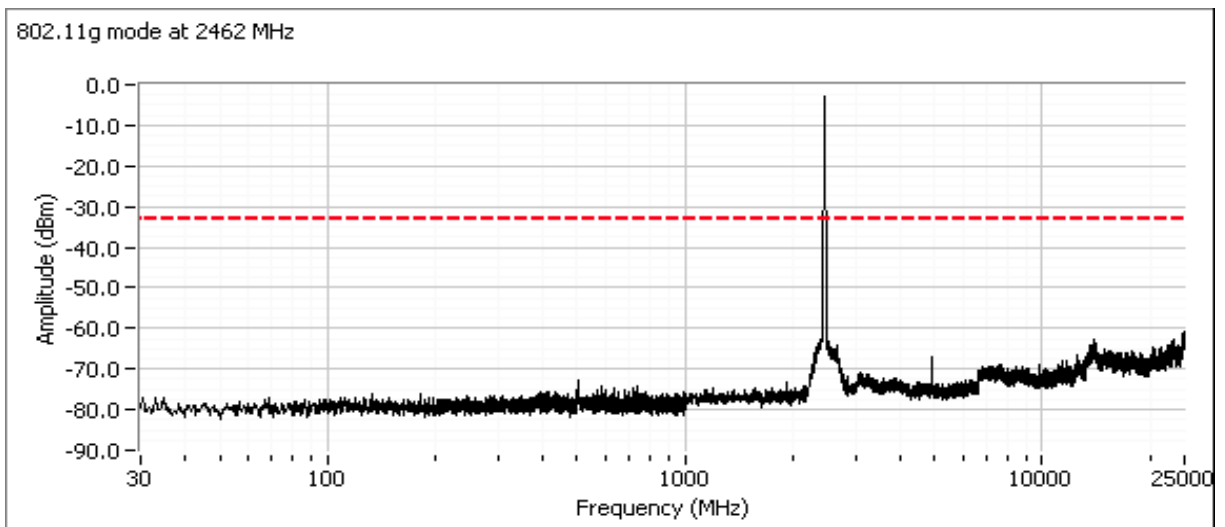


Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Plots for center channel



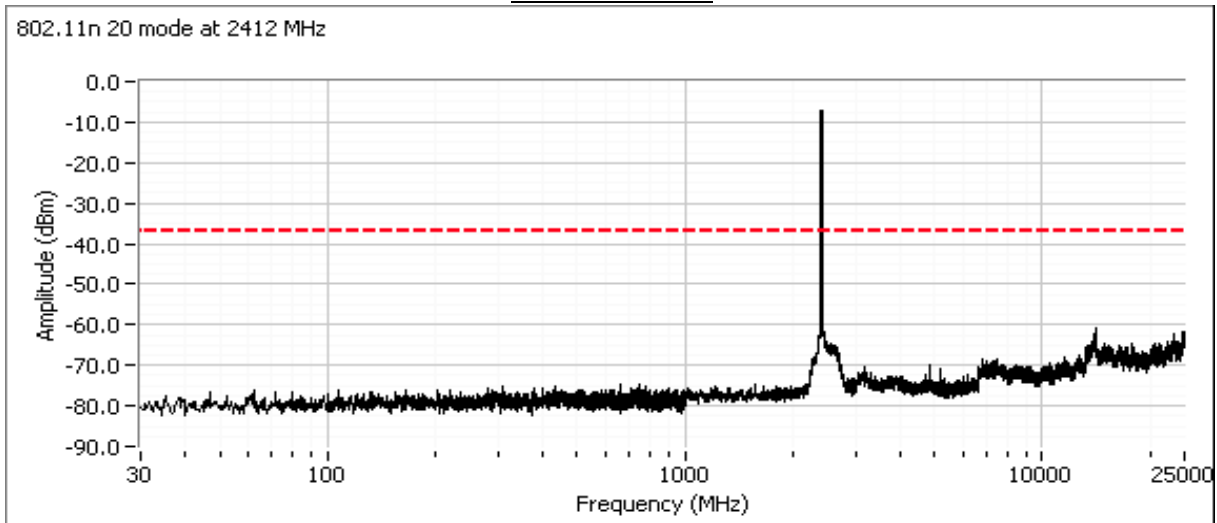
Plots for high channel



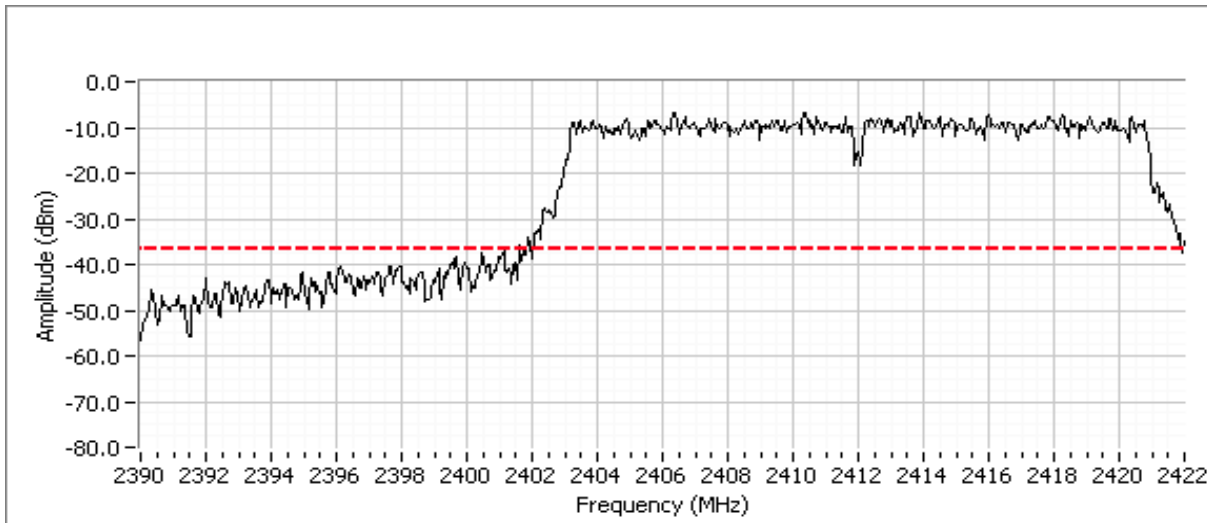
Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Frequency (MHz)	Power Setting	Mode	Limit	Result
2412	11	n20	-20dBc	Pass
2437	15	n20	-20dBc	Pass
2462	15	n20	-20dBc	Pass

Plots for low channel

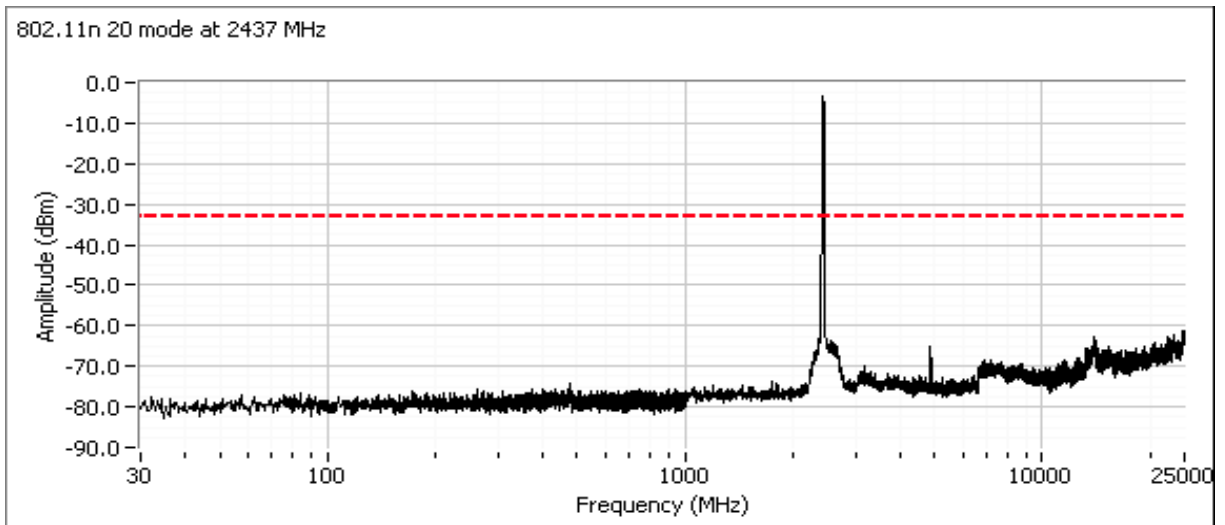


Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

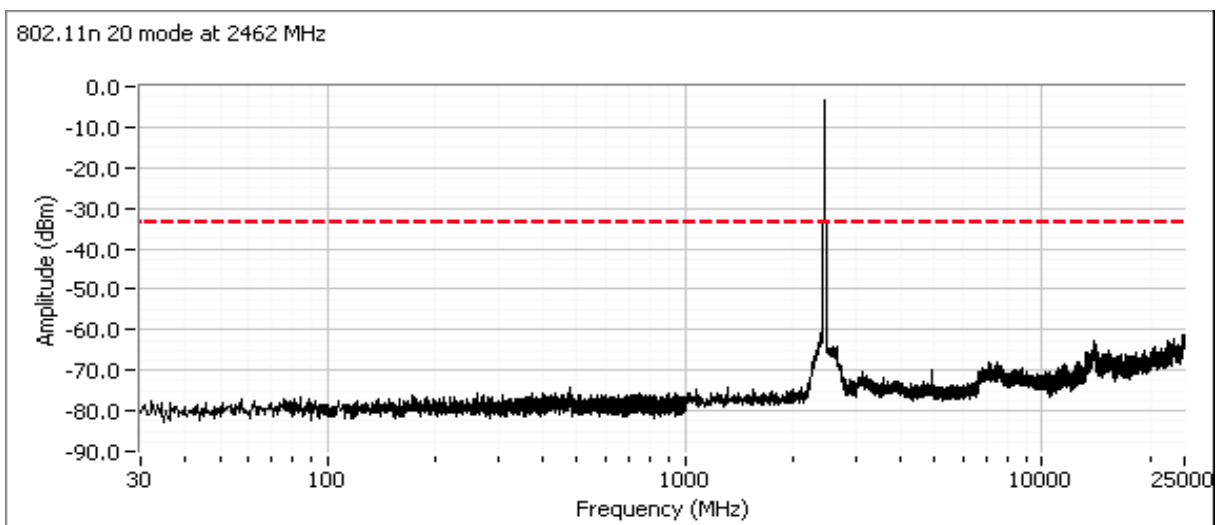


Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: N/A

Plots for center channel



Plots for high channel





EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: B

Conducted Emissions

(NTS Silicon Valley, 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: 6/8/2015	Config. Used: 1
Test Engineer: M. Birgani	Config Change: -
Test Location: Chamber #7	EUT Voltage: 120V/ 60Hz and charging via USB adapter

General Test Configuration

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.

Ambient Conditions:	Temperature: 22-24 °C
	Rel. Humidity: 28-33 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 120V/60Hz	15.207	Pass	39.6dBµV @ 0.48MHz (-16.7dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

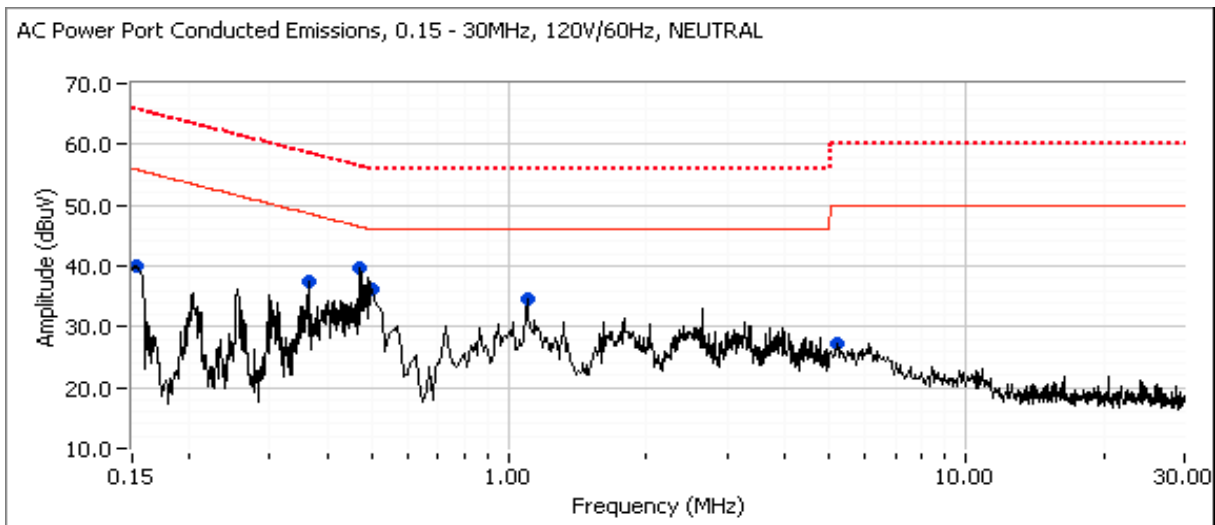
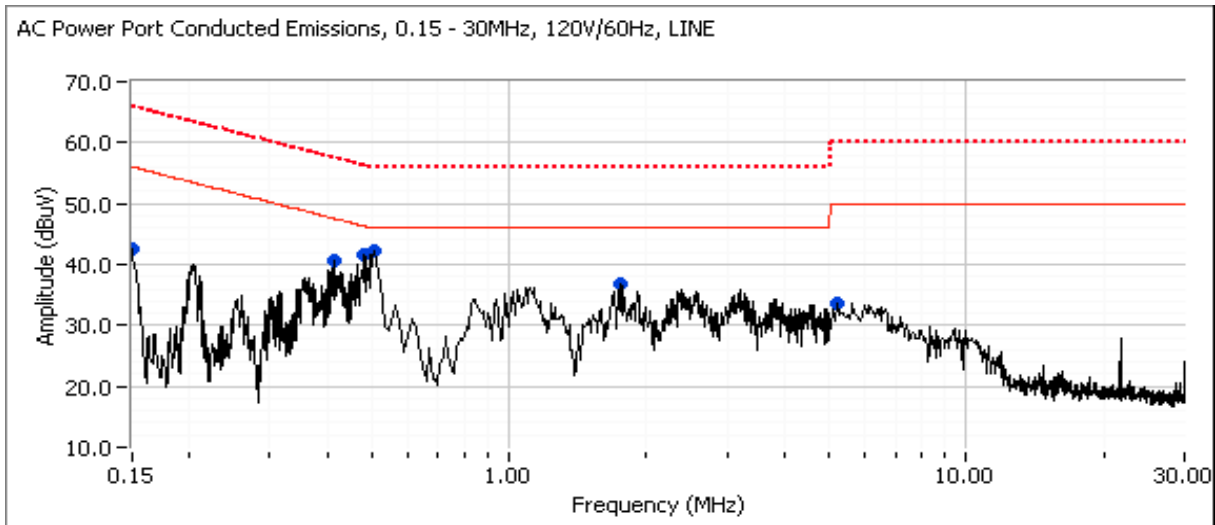
No deviations were made from the requirements of the standard.

Notes

The EUT was transmitting continuously at 11b, 2437MHz at maximum power setting.

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
Contact: Jerry Reguero	Project Manager: Deepa Shetty
Standard: FCC 15.247 / IC RSS-210 / LP0002	Project Coordinator: -
	Class: B

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





EMC Test Data

Client: SanDisk Corp.	Job Number: J98333
Model: SDWS4 (2.4GHz 1x1 20MHz)	T-Log Number: T98400
	Project Manager: Deepa Shetty
Contact: Jerry Reguero	Project Coordinator: -
Standard: FCC 15.247 / IC RSS-210 / LP0002	Class: B

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

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

Frequency MHz	Level dB μ V	AC Line	FCC 15.207		Detector QP/Ave	Comments
			Limit	Margin		
0.150	42.5	Line	56.0	-13.5	Peak	
0.153	39.9	Neutral	55.8	-15.9	Peak	
0.365	37.3	Neutral	48.6	-11.3	Peak	
0.415	40.5	Line	47.5	-7.0	Peak	
0.473	39.7	Neutral	46.5	-6.8	Peak	
0.480	41.7	Line	46.3	-4.6	Peak	
0.500	36.2	Neutral	46.0	-9.8	Peak	
0.509	42.2	Line	46.0	-3.8	Peak	
1.095	34.6	Neutral	46.0	-11.4	Peak	
1.744	36.7	Line	46.0	-9.3	Peak	
5.200	33.5	Line	50.0	-16.5	Peak	Peak with average limit
5.200	27.2	Neutral	50.0	-22.8	Peak	Peak with average limit

Final quasi-peak and average readings

Frequency MHz	Level dB μ V	AC Line	FCC 15.207		Detector QP/Ave	Comments
			Limit	Margin		
0.480	39.6	Line	56.3	-16.7	QP	QP (1.00s)
0.480	29.3	Line	46.3	-17.0	AVG	AVG (0.10s)
0.509	38.2	Line	56.0	-17.8	QP	QP (1.00s)
0.509	28.1	Line	46.0	-17.9	AVG	AVG (0.10s)
0.500	26.6	Neutral	46.0	-19.4	AVG	AVG (0.10s)
0.415	27.1	Line	47.5	-20.4	AVG	AVG (0.10s)
0.473	26.1	Neutral	46.5	-20.4	AVG	AVG (0.10s)
0.415	36.5	Line	57.5	-21.0	QP	QP (1.00s)
0.500	34.6	Neutral	56.0	-21.4	QP	QP (1.00s)
0.473	34.1	Neutral	56.5	-22.4	QP	QP (1.00s)
1.744	22.1	Line	46.0	-23.9	AVG	AVG (0.10s)
1.744	31.7	Line	56.0	-24.3	QP	QP (1.00s)
0.365	22.6	Neutral	48.6	-26.0	AVG	AVG (0.10s)
1.095	19.7	Neutral	46.0	-26.3	AVG	AVG (0.10s)
0.153	38.7	Neutral	65.8	-27.1	QP	QP (1.00s)
0.365	29.5	Neutral	58.6	-29.1	QP	QP (1.00s)
1.095	26.7	Neutral	56.0	-29.3	QP	QP (1.00s)
0.153	25.0	Neutral	55.8	-30.8	AVG	AVG (0.10s)
0.150	31.2	Line	66.0	-34.8	QP	QP (1.00s)
0.150	18.2	Line	56.0	-37.8	AVG	AVG (0.10s)

End of Report

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