FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

RFM MODULE

MODEL NUMBER: CM-CWC-1

FCC ID: 2ACQ6-RFM
IC: 11481A-RFM

REPORT NUMBER: R10015043-RF

ISSUE DATE: 2014-07-18

Prepared for
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NVLAP LAB CODE 200246-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	2014-05-05	Initial Issue	Jeff Moser
1	2014-07-18	Grantee Code Revised (previous one issued in error)	Jeff Moser

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CREE INC.
4600 SILICON DR.
DURHAM, NC 27709 USA

EUT DESCRIPTION: Transceiver Module for Light Fixture

MODEL: RFM Module, p/n CM-CWC-1

SERIAL NUMBER: Conducted (antenna-port & LC): Non-serialized samples
Radiated: JG40QA77357, JG40QA77067, JG40QA77103

DATE TESTED: 2013-07-19 through 2013-09-17, and
2014-03-06 through 2014-03-07

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL LLC based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released
For UL LLC By:

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2002460.htm.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	+/- 2.5 dB
Radiated Disturbance, 30 to 1000 MHz	+/- 3.4 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The RFM Module, p/n CM-CWC-1 is a 2.4 GHz DSSS transceiver used with light fixtures. The module uses an O-QPSK modulation and a 250 kbps data rate. The module will be installed with the light fixture to receive signals from other devices to control the fixture.

The radio module is manufactured by Cree Inc.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2405 - 2480	O-QPSK	3.5	2.24

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Monopole, PCB-Trace antenna, with a maximum gain of 1.4 dBi.

5.4. SOFTWARE AND FIRMWARE

RF Module – CM-CWC-1
128RFR2_MOD_11.hex
128RFR2_MOD_18.hex
128RFR2_MOD_22.hex
128RFR2_NO_RADIO.elf

All firmware has the following parameters:

- Channel 11 and 18 have transmit power of 3.5dBm, channel 26 has a transmit power of 1.2dBm.
- Channel 11 and 18 have no transmit filter, channel 26 uses a transmit filter.
- All firmware files labelled 128RFR2_MOD_XX.hex are radio tests for the ATMEGA128RFR2, where XX is the channel being constantly transmitted on.
- All firmware files labelled RFR2_MOD_XX.hex are the equivalent for the ATMEGA256RFR2.
- The 128RFR2_NO_RADIO and RFR2_NO_RADIO files put the ATMEGAXXXRFR2 into a non-transmitting, idle state.

LED Driver software is “V0.09.32”.

5.5. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X (flat),Y (side), Z (upright), it was determined that the Y orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y orientation. (Unit on its side as depicted in the set-up photos part of this report.)

For radiated emissions above 1GHz, all three channels (low, middle, and high) were investigated. Radiated emissions below 1GHz and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as the worst-case scenario.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
LED light	Cree	CR22-32L-40K-10V	None	NA
DC power supply	Extech	382202	None	NA

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
	The following was used during antenna-port measurements.					
1	AC	1	AC inlet	Unshielded	1	3C/18AWG power cord attached to light fixture.
	The following was used during radiated-emissions testing					
2	AC	1	AC inlet	Unshielded	1.5	AC input to DC power supply. 3C/18AWG power cord.
3	DC	1	DC	Unshielded	1	2-pin connector at RF-module end, banana leads at power-supply end. Two 22AWG wires.

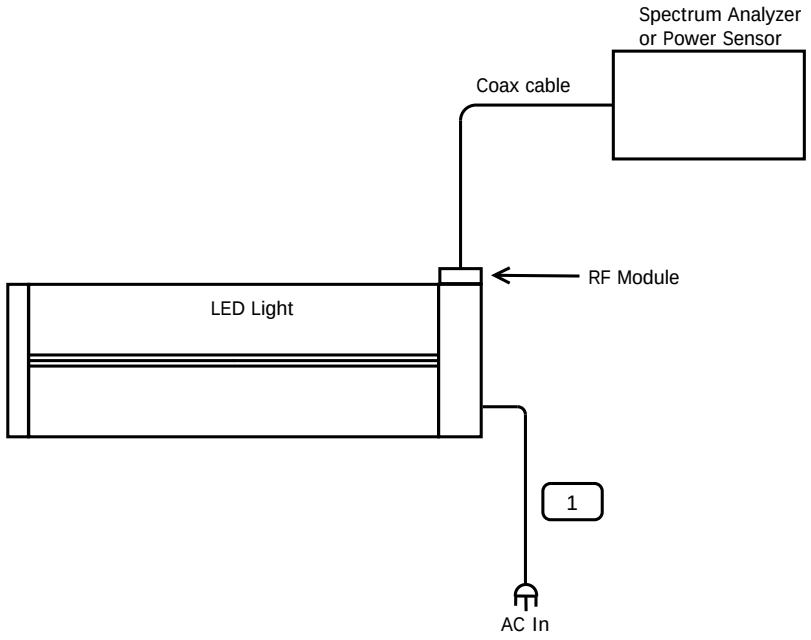
TEST SETUP

Different RFM Modules were provided. 3 modules were provided for Radiated Emissions testing (Low Channel, Mid Channel and High Channel) and 3 modules were provided for Conducted Port tests (Low Channel, Mid-Channel and High-Channel).

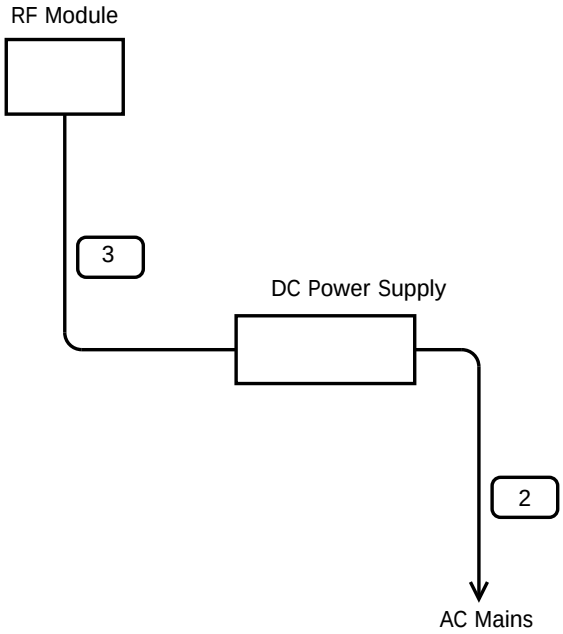
Note, the Low and Mid Channel's output power was set for 3.5dBm during testing. The High Channel output power was set for 1.2 dBm during testing.

SETUP DIAGRAM FOR TESTS

CONDUCTED PORT TESTS



RADIATED and AC LINE CONDUCTED



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Prior to 2013-08-31				
SA0016	Spectrum Analyzer / Receiver	Agilent Technologies	N9030A	2012-10-29	2013-10-31
PSENSOR001	RF Power Meter Sensor Head	Rohde & Schwartz	NRP-Z81 (w/ NRP-Z3 USB adapter)	2012-08-21	2013-08-31
HI0041	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2013-01-25	2014-01-31
	After 2013-08-31				
SA0016	Spectrum Analyzer / Receiver	Agilent Technologies	N9030A	2013-09-04	2014-09-30
PAR001	Power Sensor, DC to 18GHz	Rohde & Schwarz	NRV-Z51	2013-09-03	2014-09-30
PAR007	Power Meter, DC to 40GHz	Rohde & Schwarz	NRVD	2013-09-03	2014-09-30
HI0041	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2013-01-25	2014-01-31

Radiated Disturbance Emissions (E-field)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0037	Loop Antenna (Low Range)	Electro-Metrics	EM-6871	2013-06-19	2014-06-30
AT0036	Loop Antenna (High Range)	Electro-Metrics	EM-6872	2013-06-20	2014-06-30
AT0025	Biconical Antenna, 30 to 300 MHz	Schaffner-Chase EMC Ltd.	VBA6106A	2013-06-14	2014-06-30
AT0030	Log-periodic Antenna, 200 MHz to 1000 MHz	Schaffner	UPA6109	2013-06-12	2014-06-30
AT0062	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2013-08-27	2014-08-31
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2013-11-12	2014-11-30
SAC_C (BC antenna 3m location)	Gain-Loss string for biconical antenna at 3m	Various	Various	2013-09-06	2014-09-30
SAC_D (LP antenna 3m location)	Gain-Loss string for log-periodic antenna at 3m	Various	Various	2013-09-06	2014-09-30
SAC_E_LR (Loop antenna 3m location)	Gain-Loss string for loop/rod antenna at 3m	Various	Various	2013-09-06	2014-09-30

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SAR003	Spectrum Analyzer / Receiver	Rohde & Schwarz	ESIB40 (1088.7490.40)	2013-09-03	2014-09-30
SA0016	Spectrum Analyzer	Agilent	N9030A	2013-09-04	2014-09-30
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
AMP011	RF Amp, 1-20GHz	Miteq	AMF-6D-01002000-22-10P	2013-09-04	2014-09-30
AMP013	RF Amp, 18-40GHz	Miteq	JS44-18004000-33-8P	2013-09-04	2014-09-30
BRF003	Band Reject Filter - 2400 to 2500 MHz	Microtronics	BRM50702-01	2013-09-04	2014-09-30
HI0069	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2013-06-17	2014-06-17

Power-line Conducted Disturbance Emissions

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0015	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2012-08-28	2013-08-31
ATA016	Coaxial cable, 20 ft., BNC -male to BNC-male	UL	RG-223	2012-08-31	2013-08-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
ATA508	Transient Limiter, 0.009 to 100 MHz	Electro-Metrics	EM 7600	2012-08-31	2013-08-31
LISN002	LISN, 50-ohm/50-uH, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2013-01-09	2014-01-31
HI0041	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2013-01-25	2014-01-25

7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

7.1. ON TIME AND DUTY CYCLE RESULTS

ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
50.00	50.00	1.00	100.0%	0.00	0.010

7.1.1. DUTY CYCLE PLOTS

DUTY CYCLE

7.2. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v03r01, Section 8.1.

Output Power: KDB 558074 D01 v03r01, Section 9.1.1.

Power Spectral Density: KDB 558074 D01 v03r01, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r01, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r01, Section 12.1.

8. ANTENNA PORT TEST RESULTS

8.1. O-QPSK (DSSS) MODE IN THE 2.4 GHz BAND

8.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

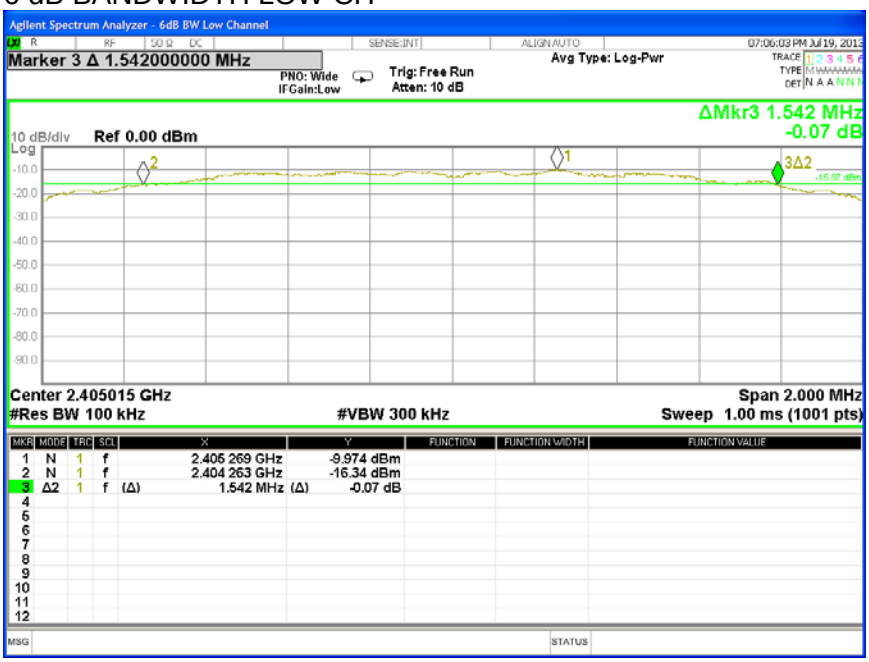
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2405	1.542	0.5
Middle	2440	1.590	0.5
High	2480	1.523	0.5

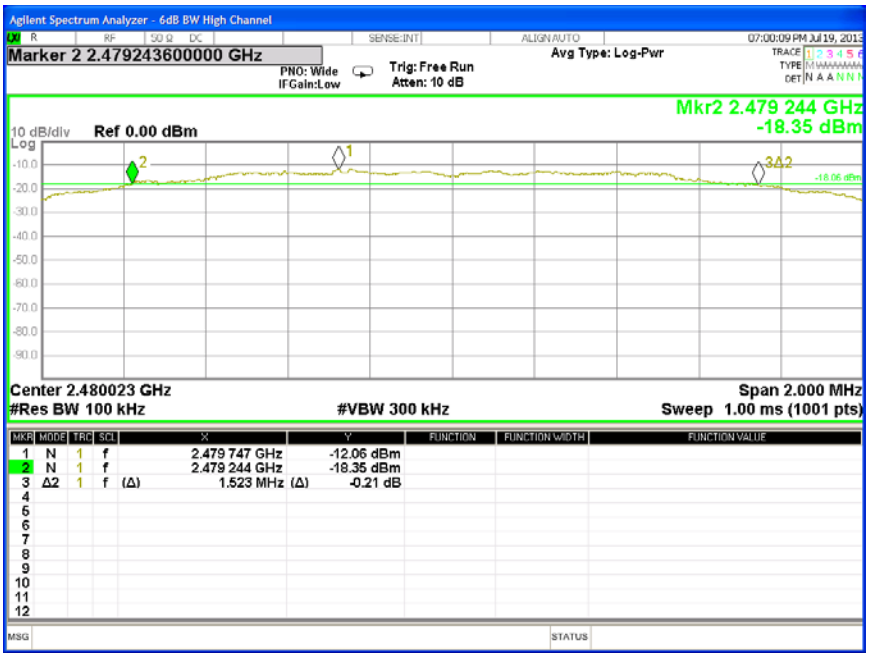
6 dB BANDWIDTH

6 dB BANDWIDTH LOW CH



6 dB BANDWIDTH MID CH

6 dB BANDWIDTH HIGH CH



8.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

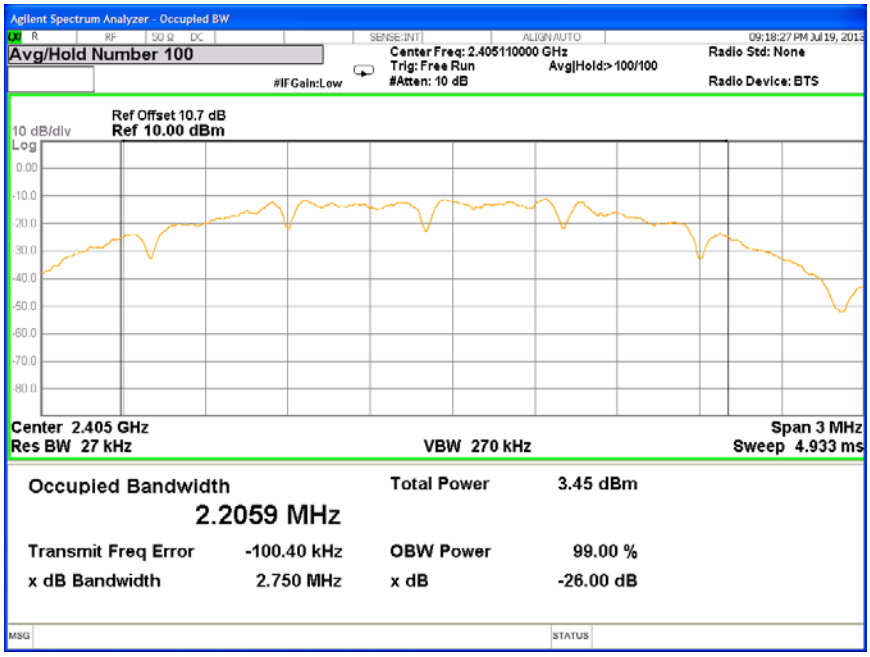
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

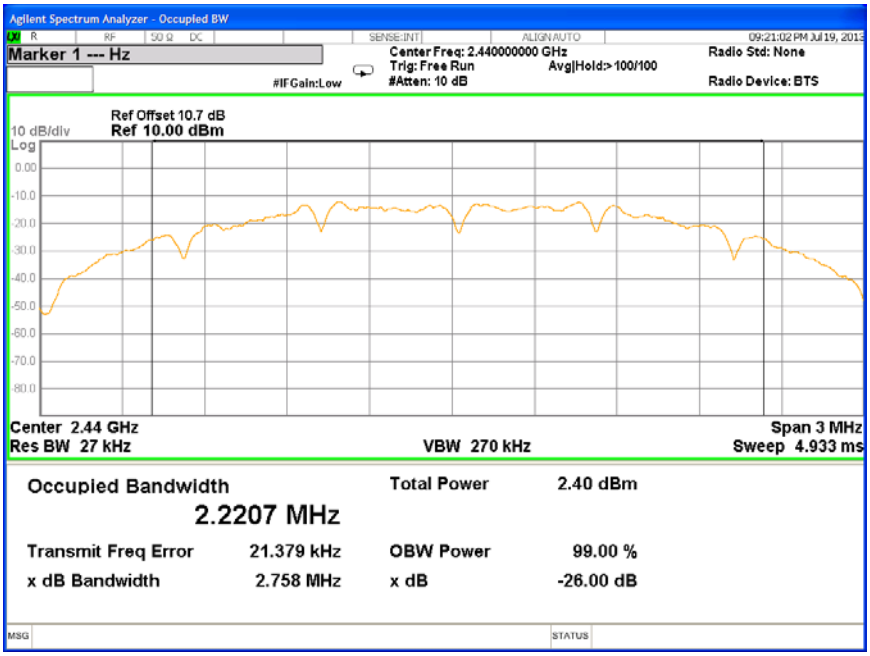
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2405	2.2059
Middle	2440	2.2207
High	2480	2.1838

99% BANDWIDTH

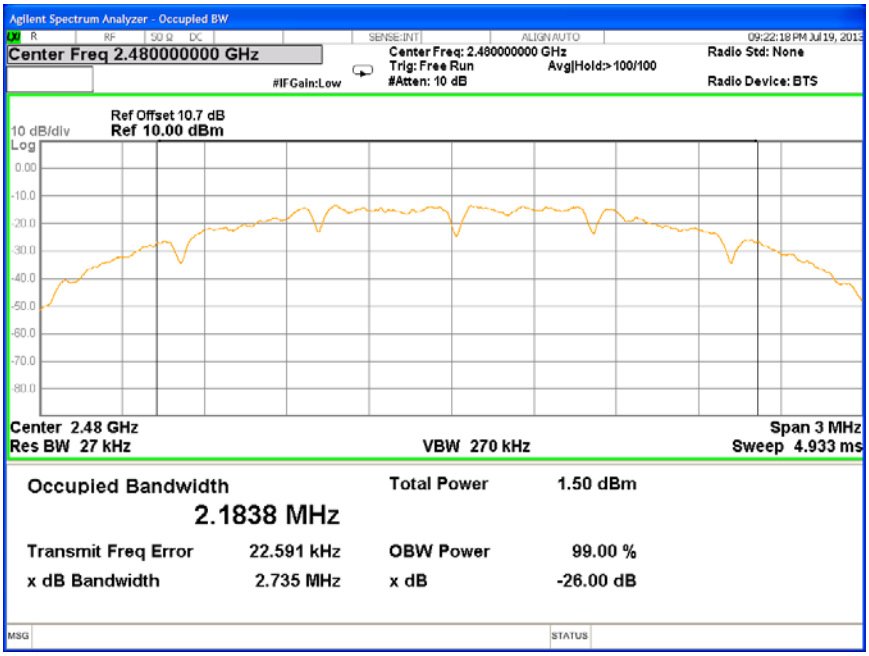
99% BANDWIDTH LOW CH



99% BANDWIDTH MID CH



99% BANDWIDTH HIGH CH



8.1.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

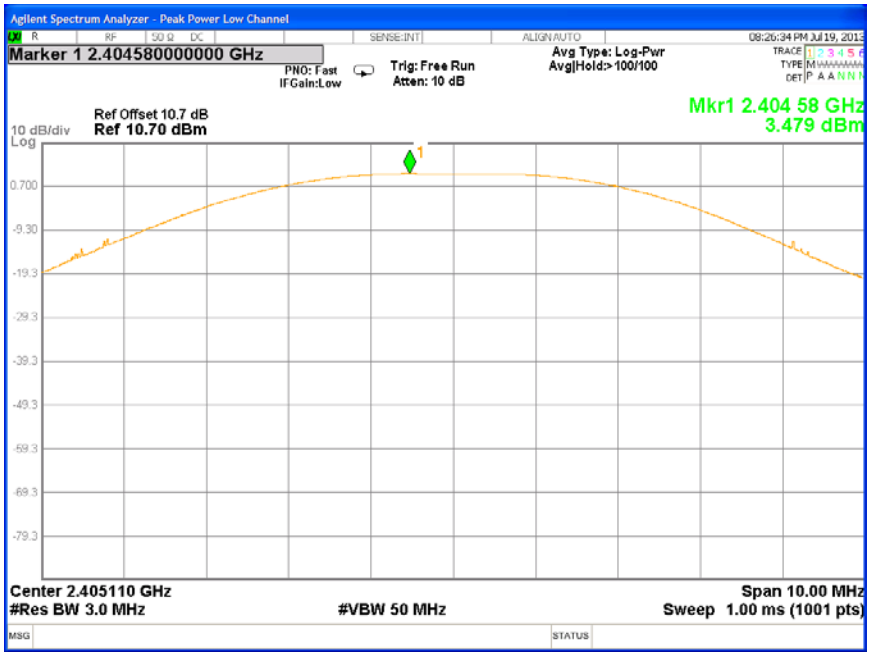
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 6dB bandwidth of the EUT.

RESULTS

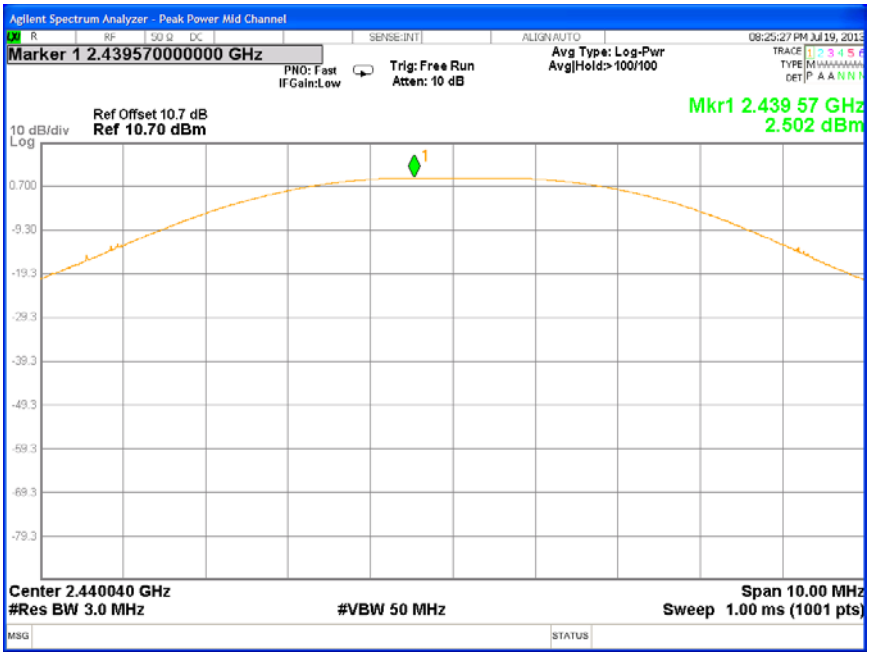
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2405	3.479	30	-26.5
Middle	2440	2.502	30	-27.5
High	2480	-0.842	30	-30.8

OUTPUT POWER

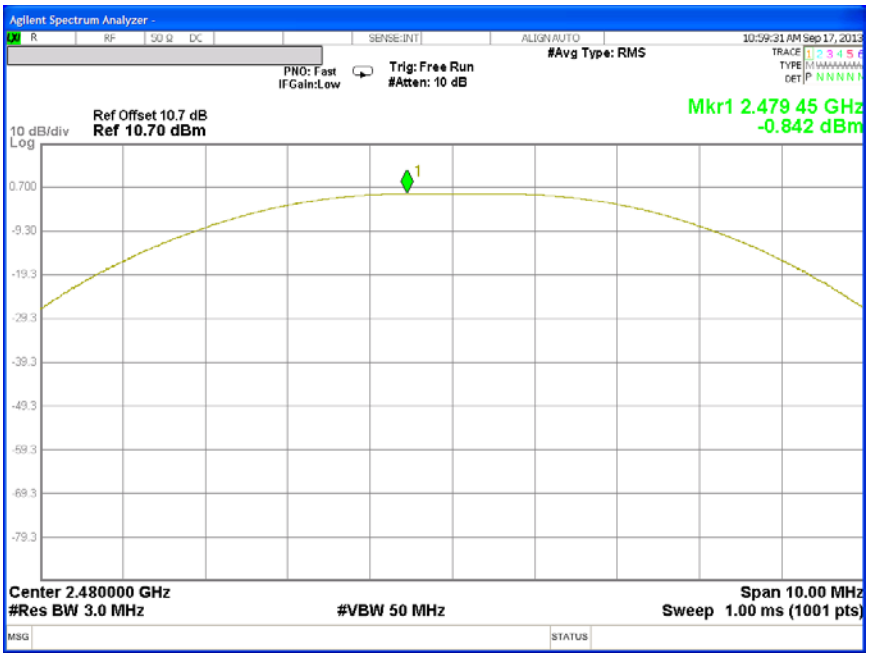
OUTPUT POWER LOW CH



OUTPUT POWER MID CH



OUTPUT POWER HIGH CH



8.1.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2405	3.470
Middle	2440	2.490
High	2480	-0.775

8.1.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST PROCEDURE

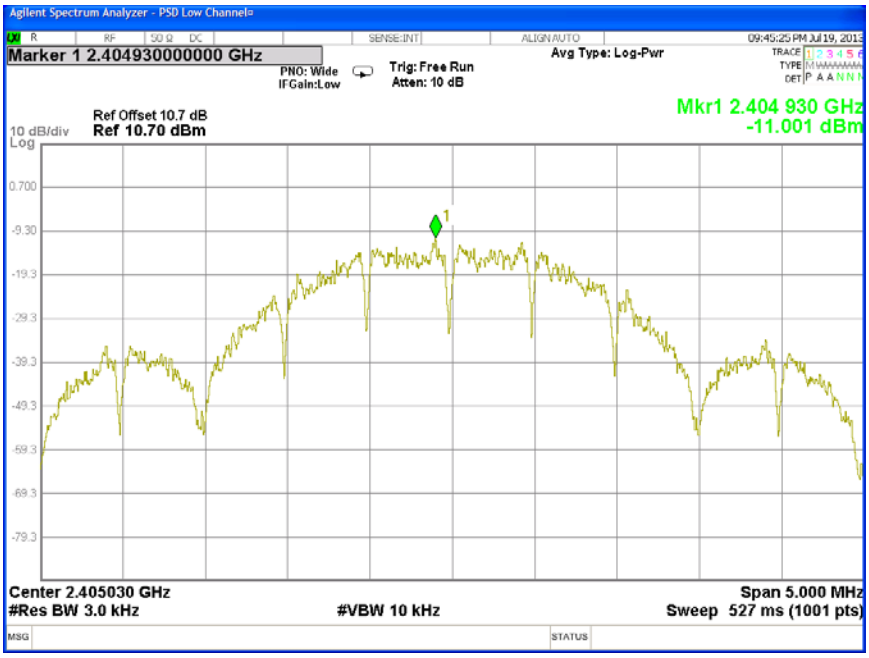
Output power was measured based on the use of a peak measurement.

RESULTS

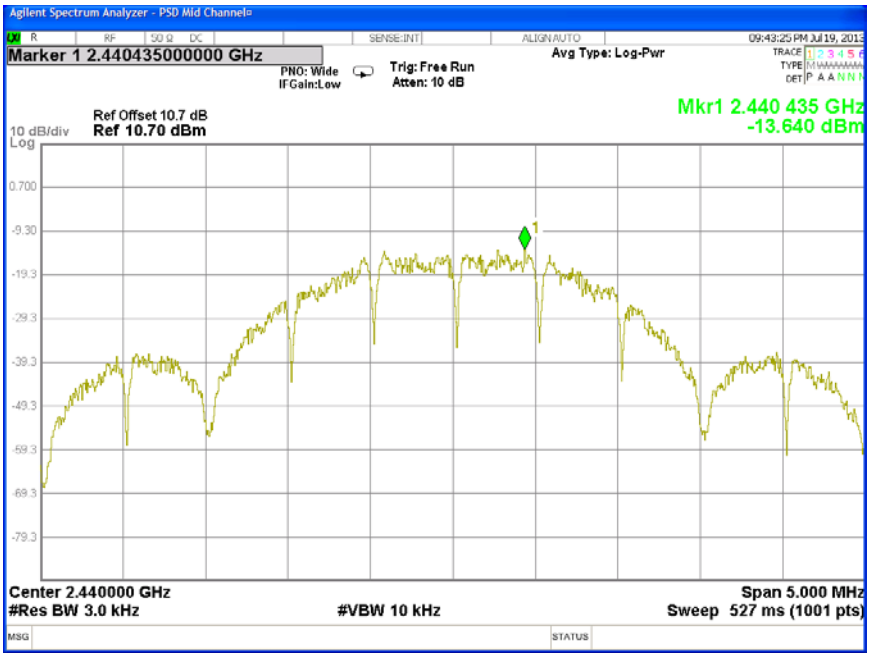
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2405	-11.00	8	-19.00
Middle	2440	-13.64	8	-21.64
High	2480	-15.31	8	-23.31

POWER SPECTRAL DENSITY

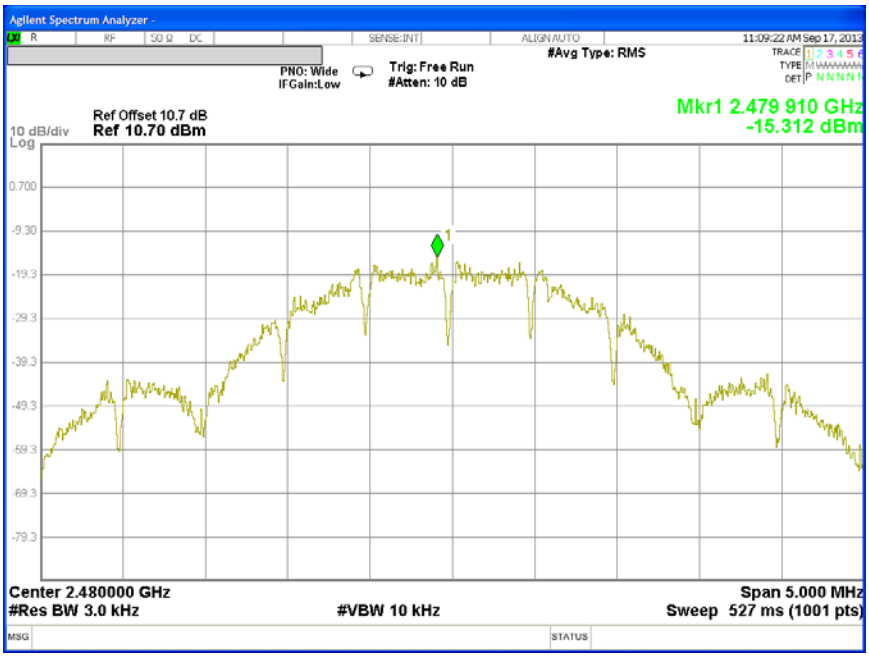
PSD LOW CH



PSD MID CH



PSD HIGH CH



8.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

TEST PROCEDURE

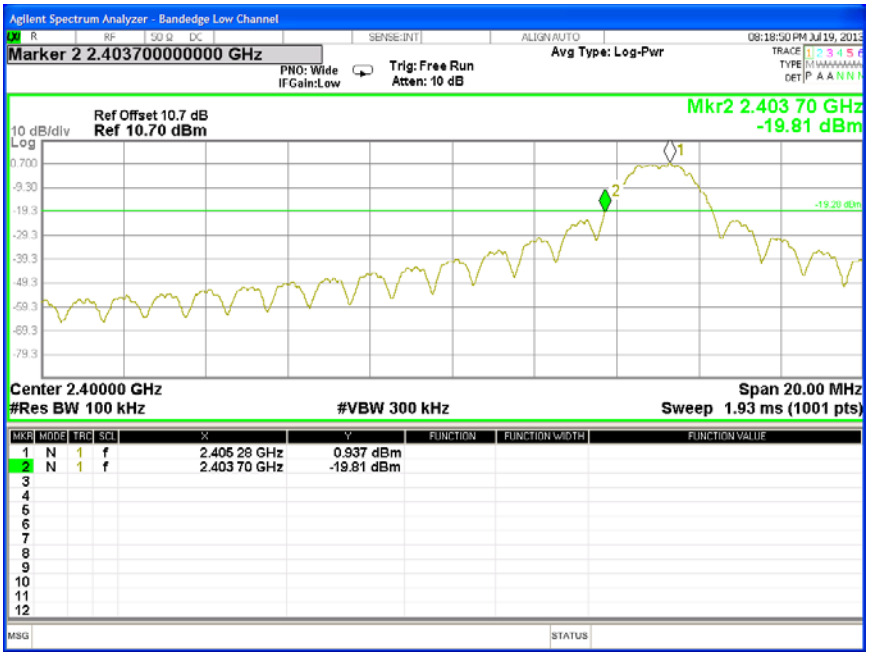
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

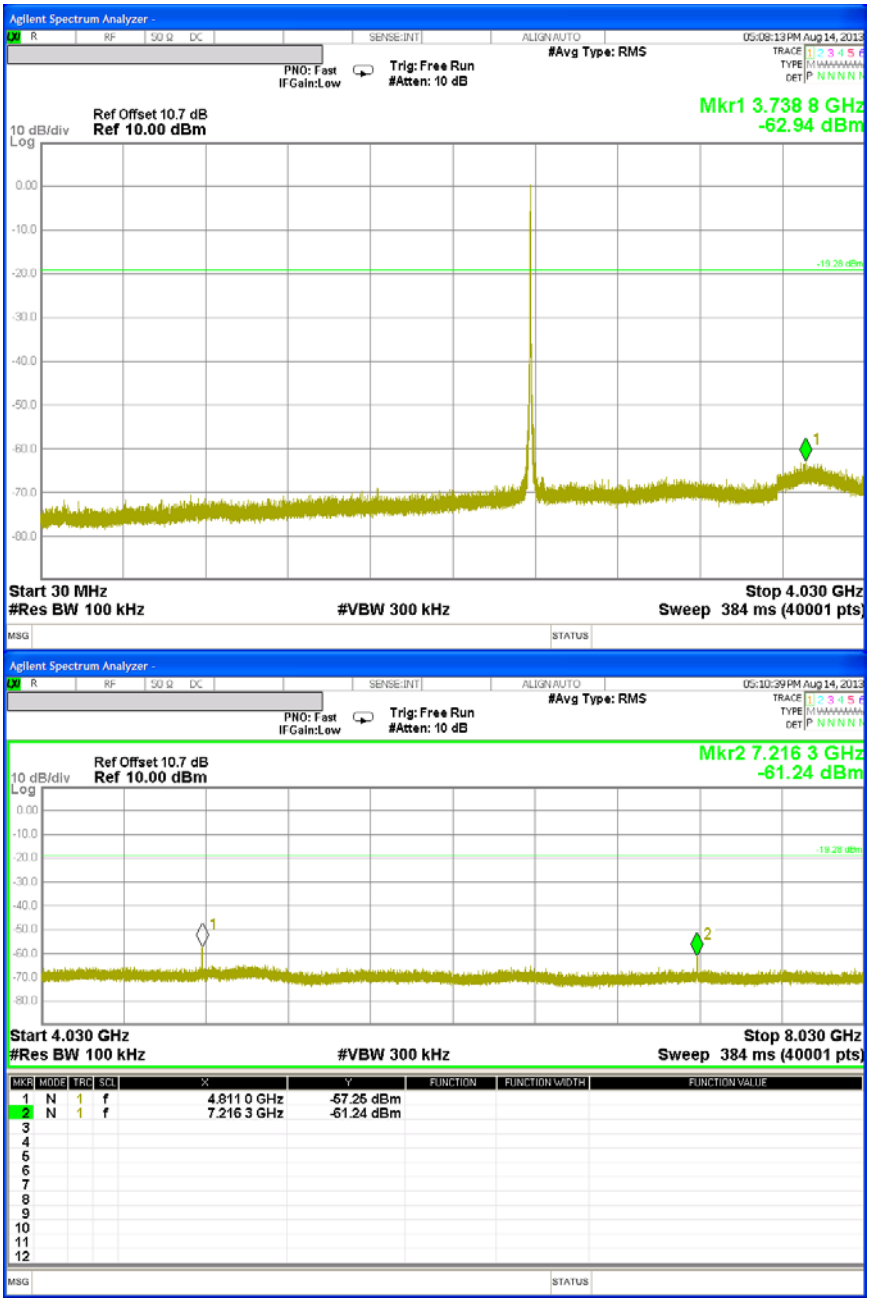
LOW CH BANDEDGE AND REFERENCE



Note 1 - Low channel had the highest peak power. Therefore, the low channel was used as the reference.

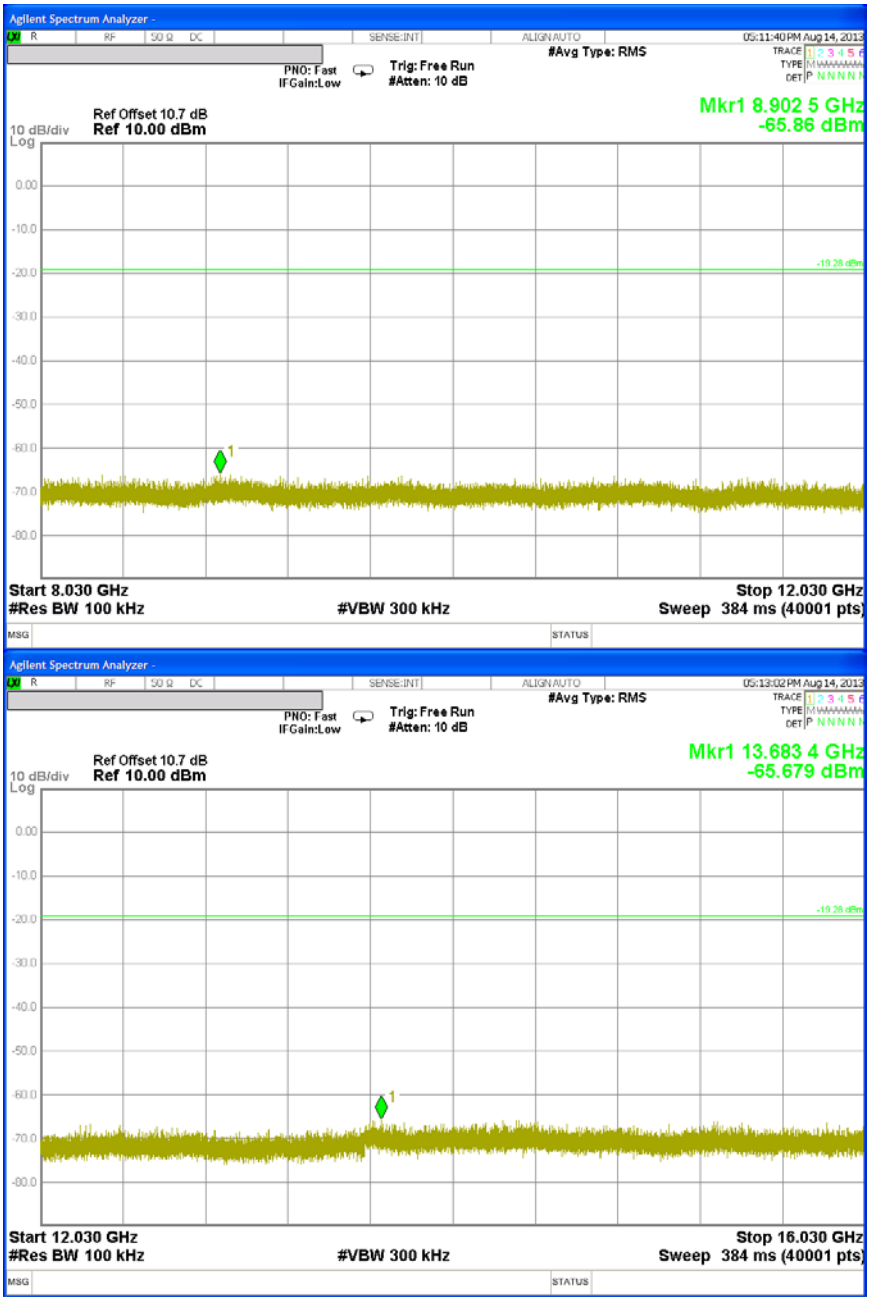
Note 2 – The waveform was measured at the point on the signal that is 20dB below the reference channel peak (Low Channel). For the Low Bandedge, this is 2.403 GHz. Based on this, the band edge is below the 20 dB threshold.

LOW CH SPURIOUS: 30MHz-8.03GHz

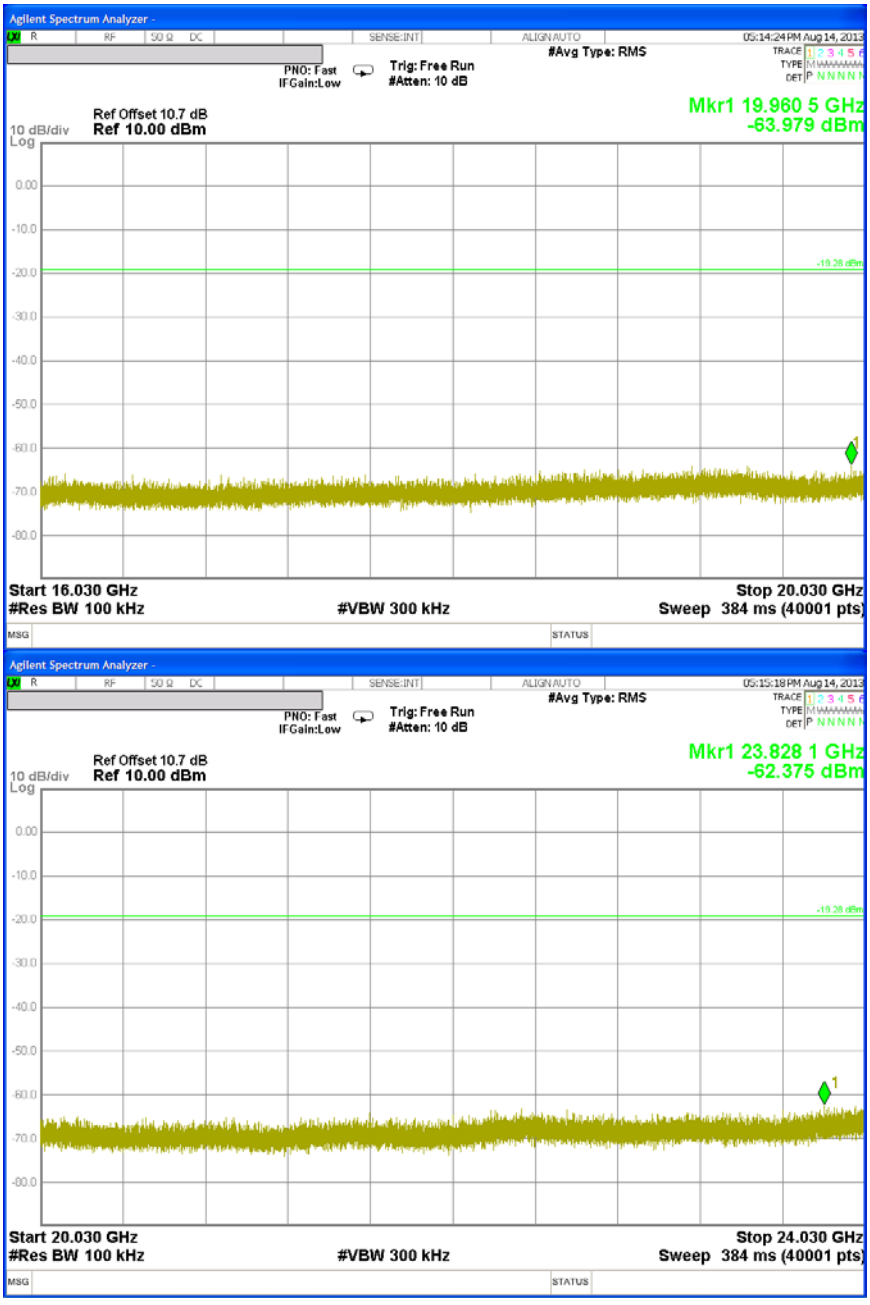


Note: Per 11.3 of KDB 558074 (v03r01), number of points must be >/= Span/RBW. Therefore, seven plots are needed to satisfy this requirement over the range of 30MHz-26GHz.

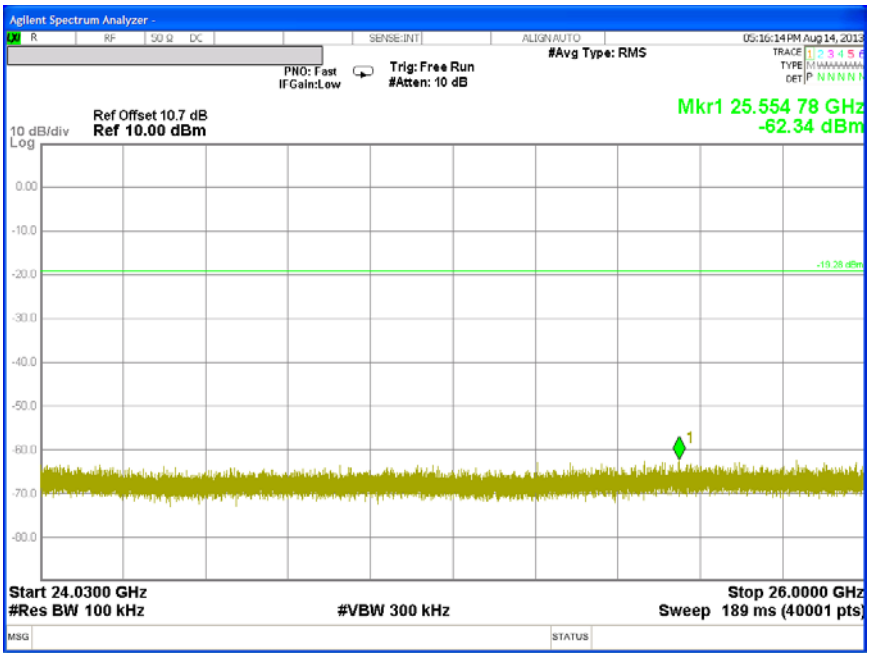
LOW CH SPURIOUS: 8.03-16.03GHz



LOW CH SPURIOUS: 16.03-24.03GHz

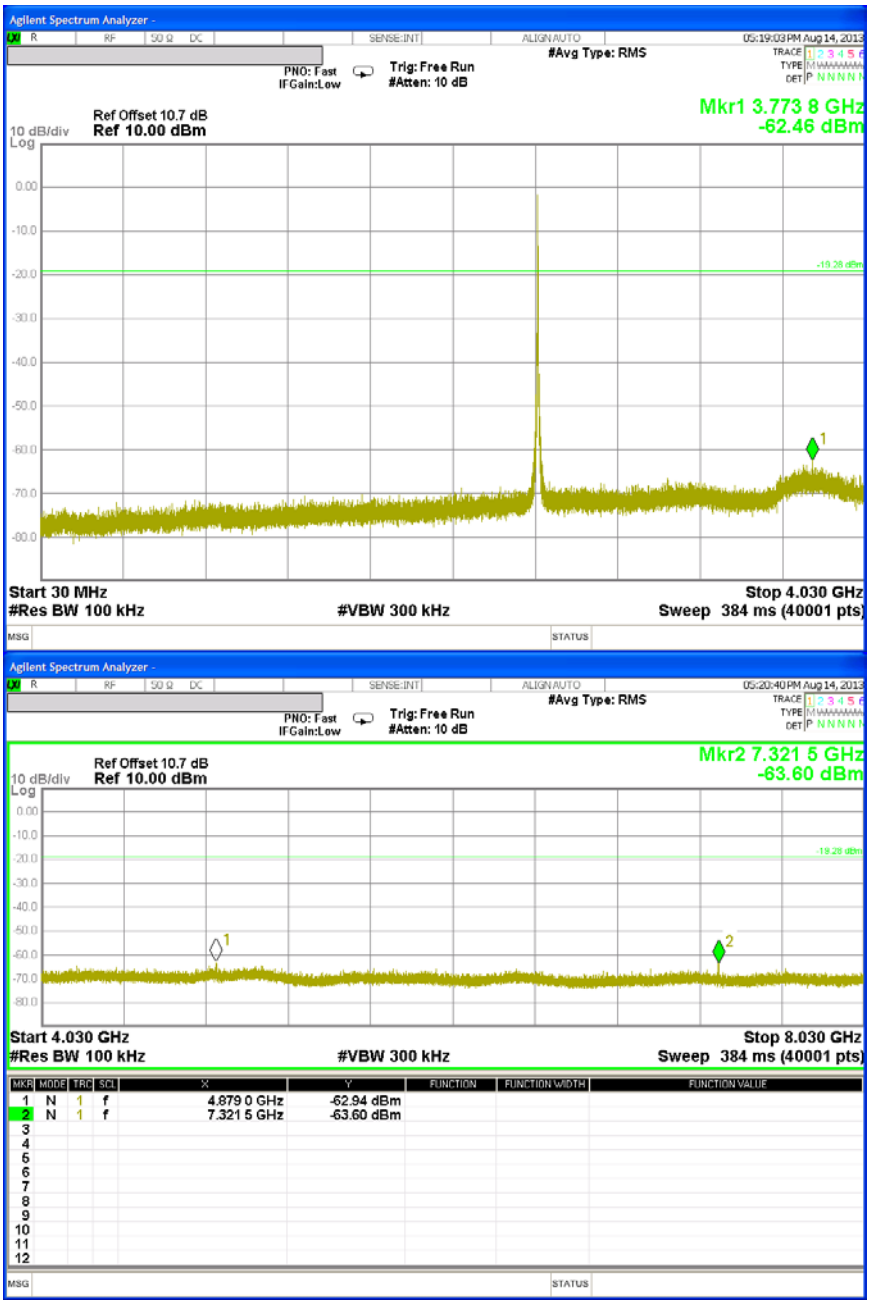


LOW CH SPURIOUS: 24.03-26GHz



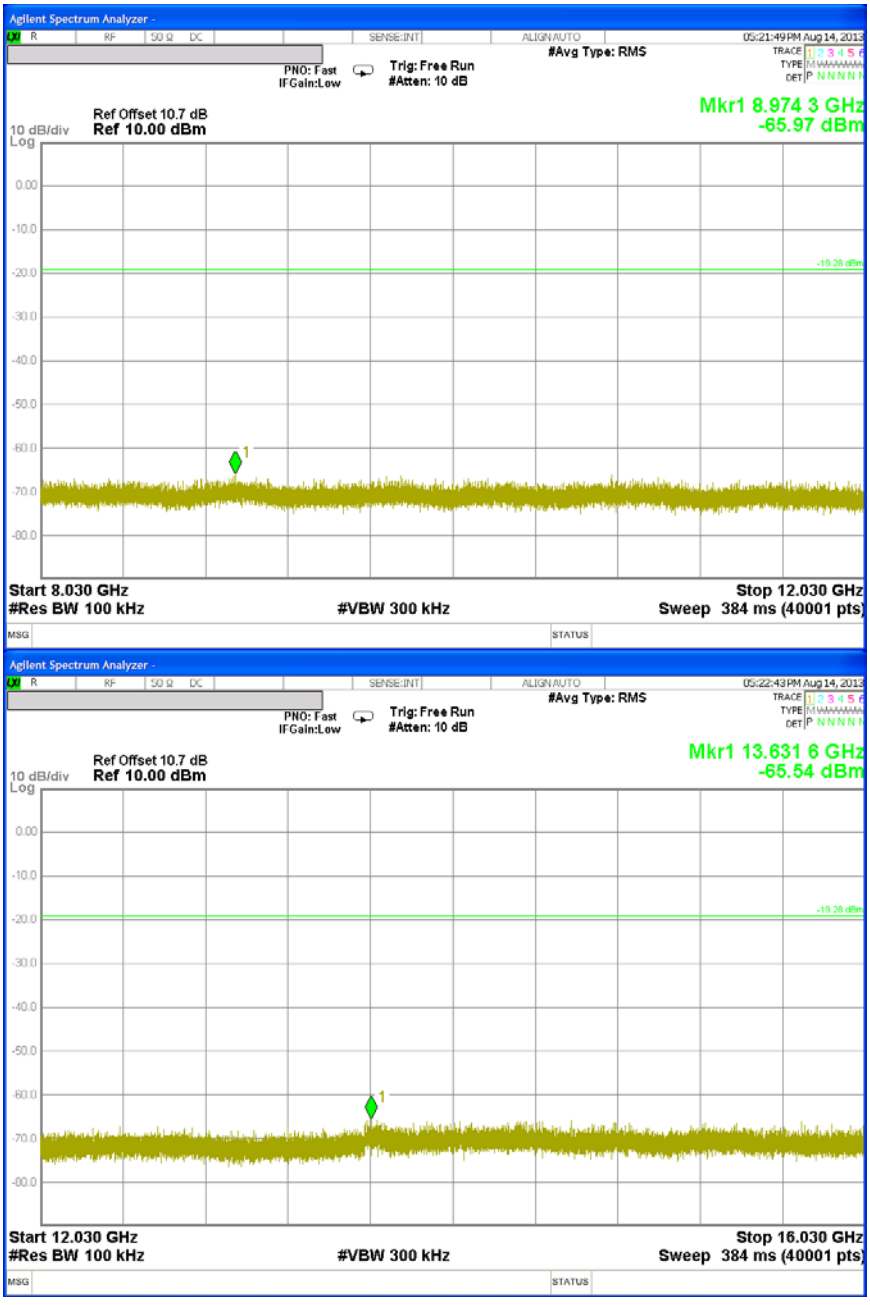
SPURIOUS EMISSIONS, MID CHANNEL

MID CH SPURIOUS: 30MHz-8.03GHz

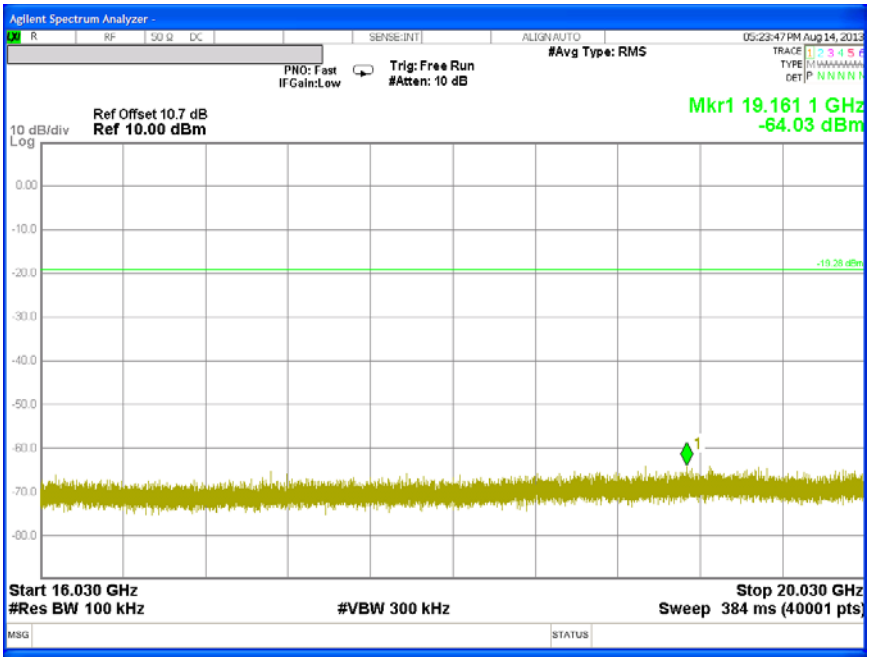


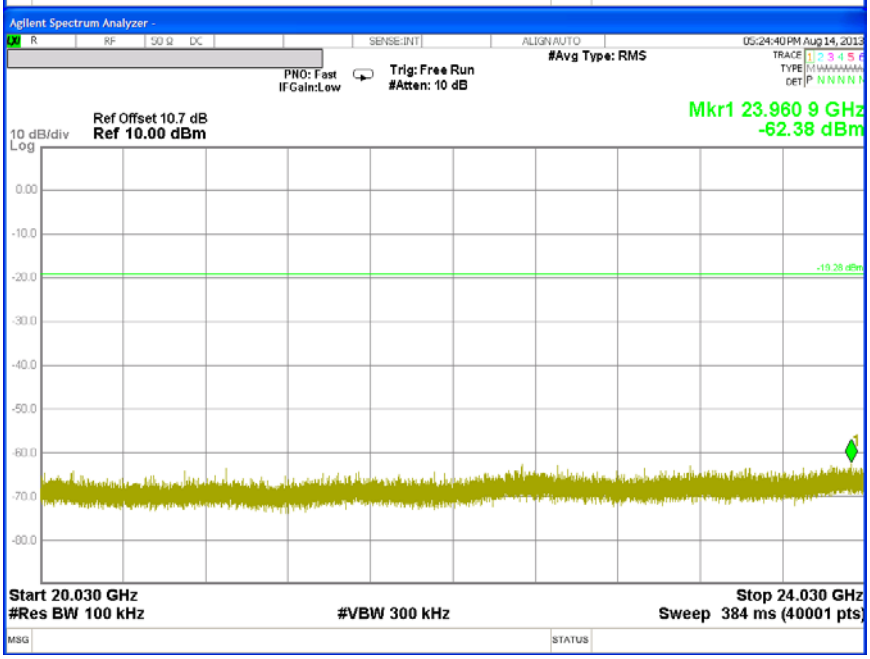
Note: Per 11.3 of KDB 558074 (v03r01), number of points must be >/= Span/RBW. Therefore, seven plots are needed to satisfy this requirement over the range of 30MHz-26GHz.

MID CH SPURIOUS: 8.03-16.03GHz

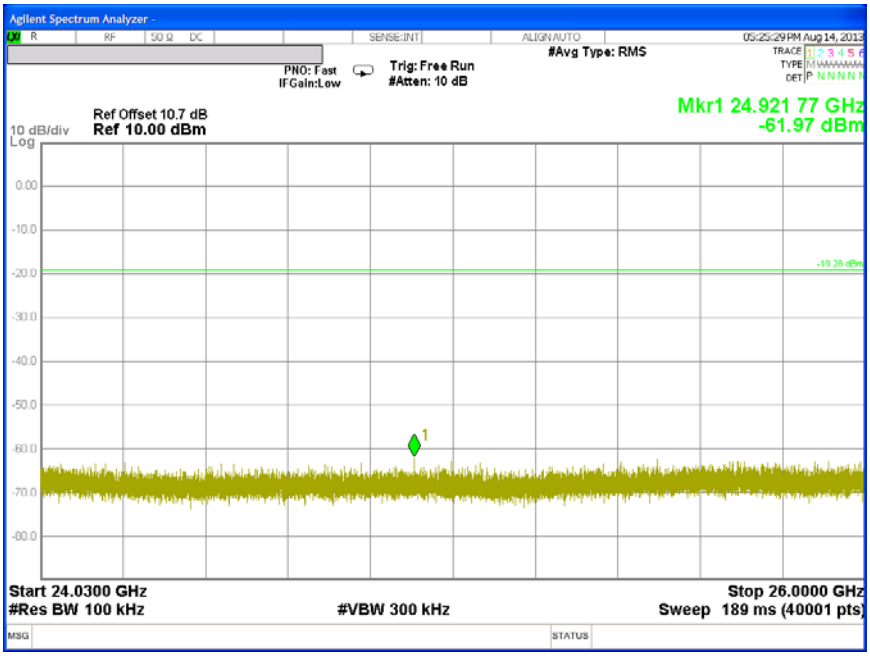


MID CH SPURIOUS: 16.03-24.03GHz



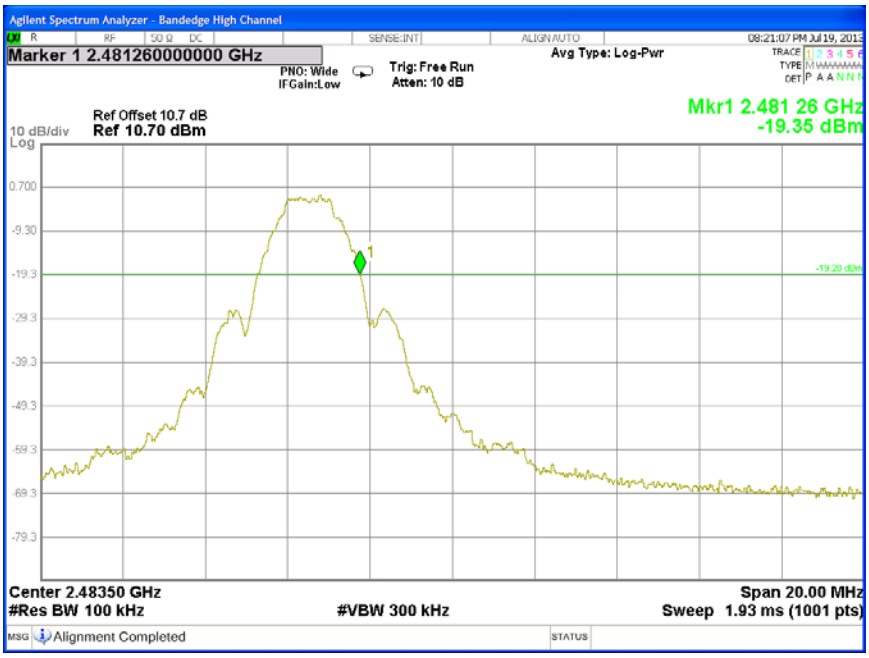


MID CH SPURIOUS: 24.03-26GHz



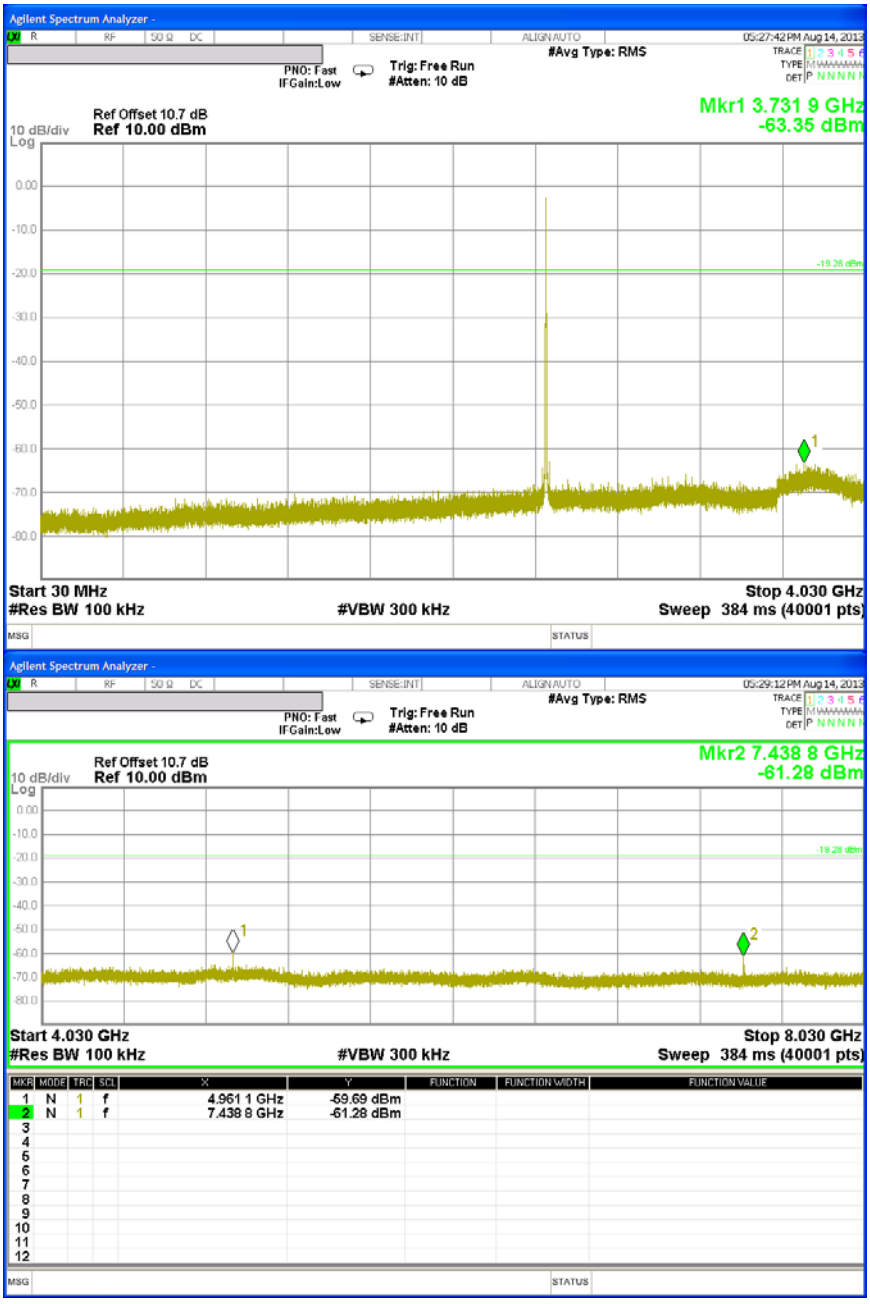
SPURIOUS EMISSIONS, HIGH CHANNEL

HIGH CH BANDEDGE



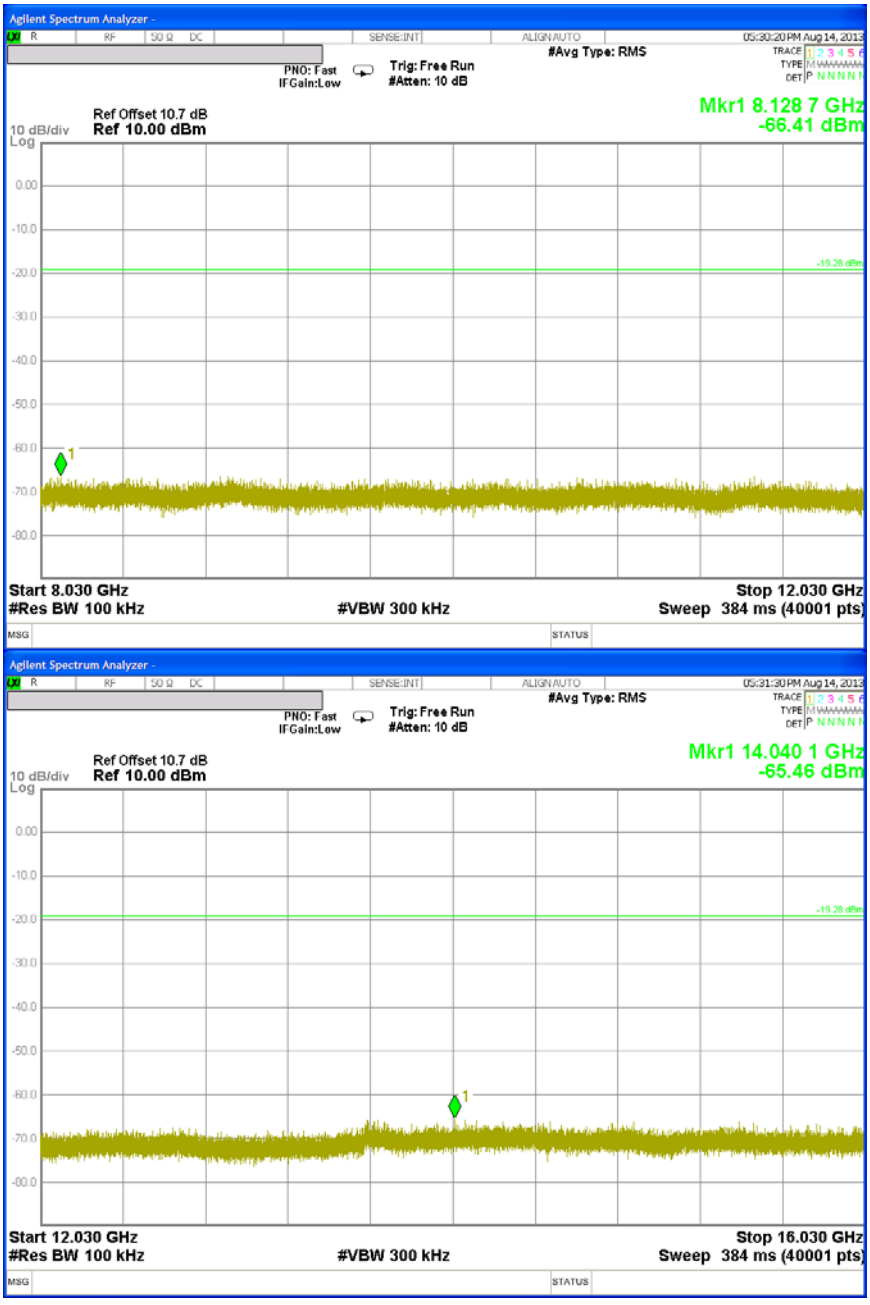
Note 1 – The waveform was measured at the point on the signal that is 20dB below the reference channel peak (Low Channel). For the High Bandedge, this is 2.481 GHz. Based on this, the band edge is below the 20 dB threshold.

HIGH CH SPURIOUS: 30MHz-8.03GHz

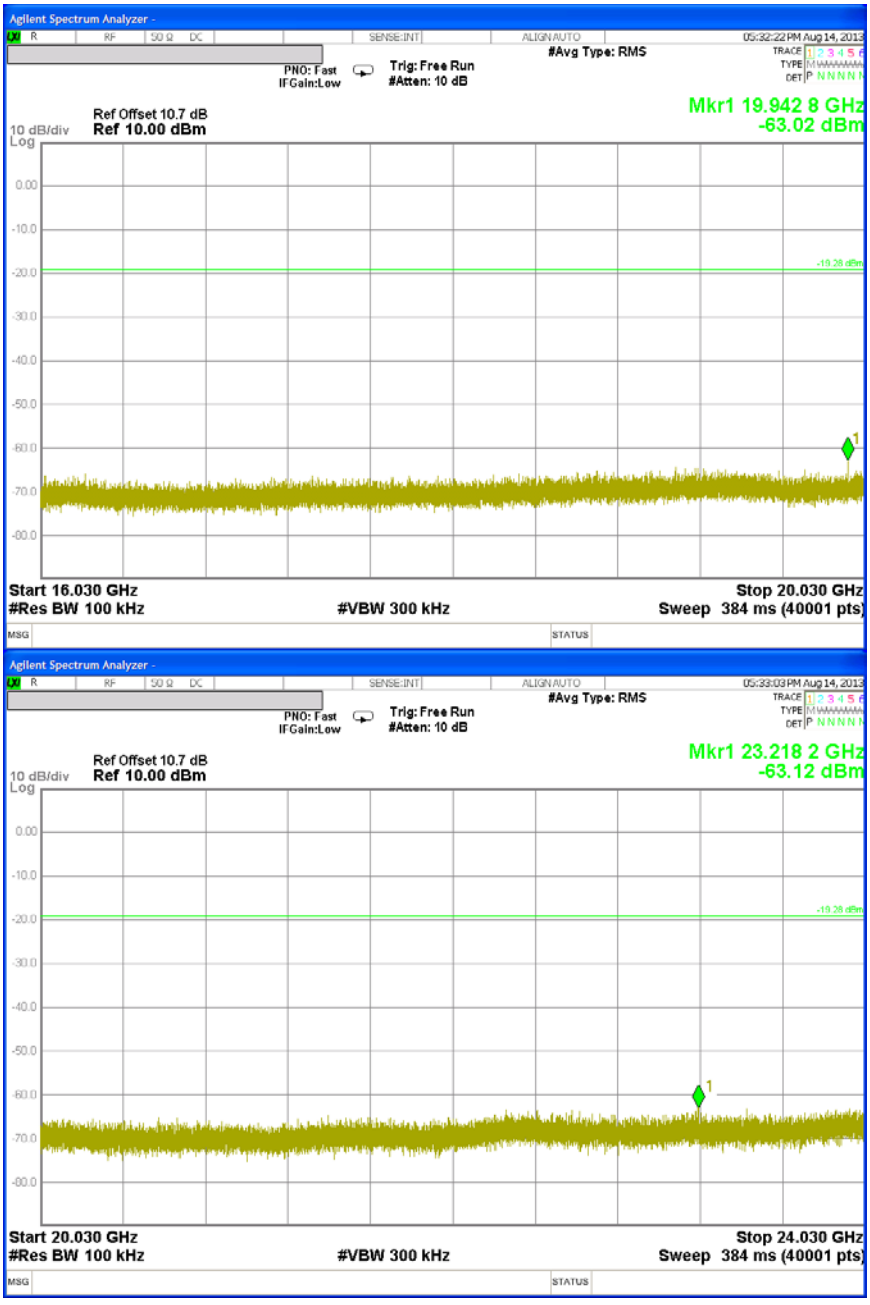


Note: Per 11.3 of KDB 558074 (v03r01), number of points must be >/= Span/RBW. Therefore, seven plots are needed to satisfy this requirement over the range of 30MHz-26GHz.

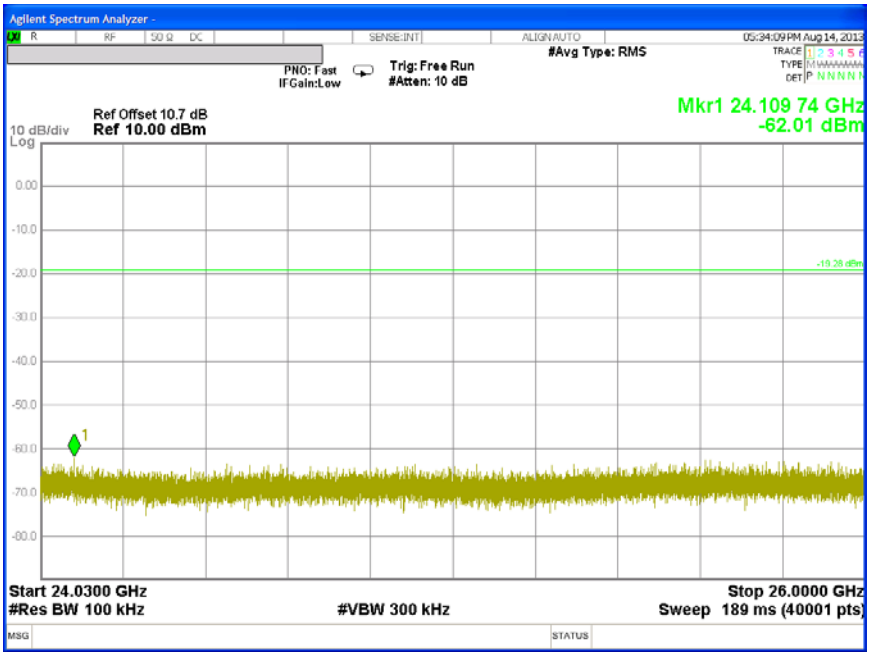
HIGH CH SPURIOUS: 8.03-16.03GHz



HIGH CH SPURIOUS: 16.03-24.03GHz



HIGH CH SPURIOUS: 24.03-26GHz



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements between 30 MHz and 1 GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

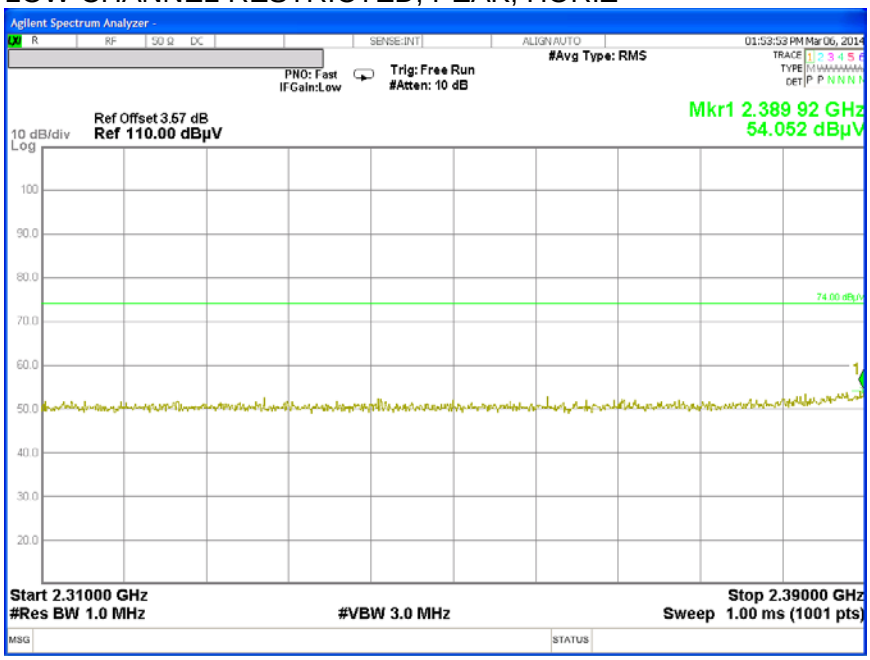
For measurements below 30 MHz loop antennas were used per FCC requirements, and measurement equipment settings test method were consistent with ANSI C63.4.

9.2. TRANSMITTER ABOVE 1 GHz

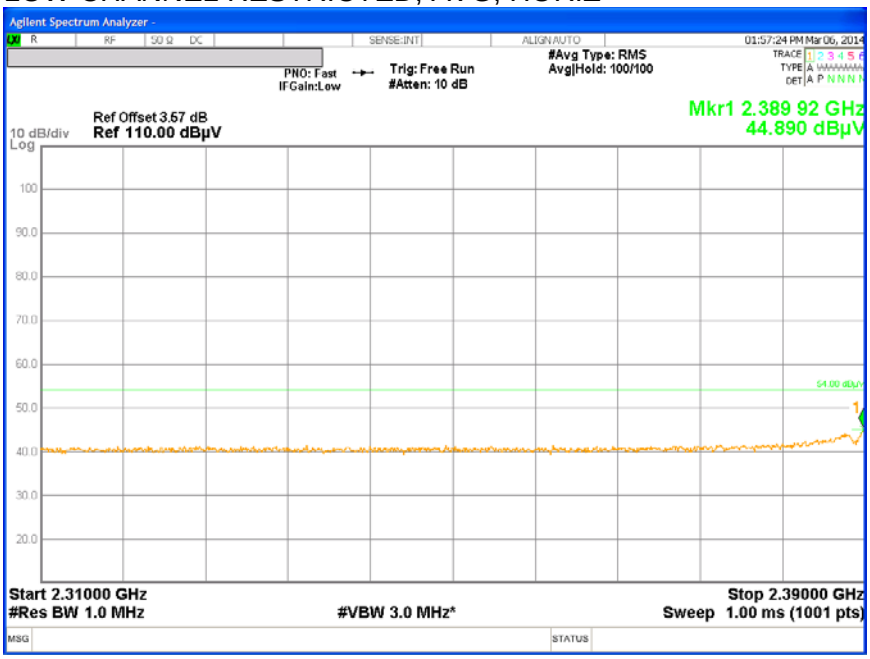
9.2.1. TX ABOVE 1 GHz FOR O-QPSK (DSSS) MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, PEAK, HORIZ

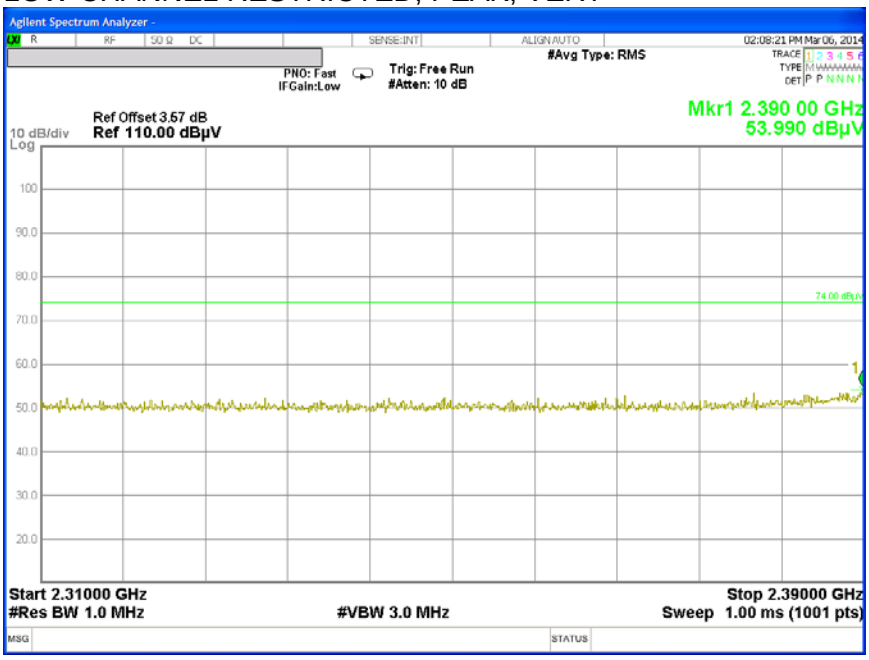


LOW CHANNEL RESTRICTED, AVG, HORIZ

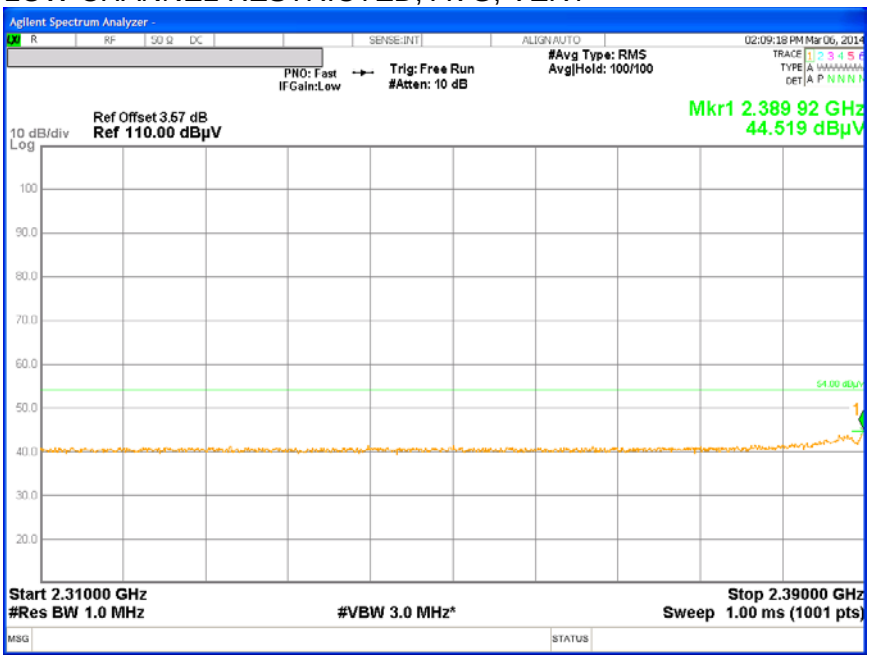


RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL RESTRICTED, PEAK, VERT

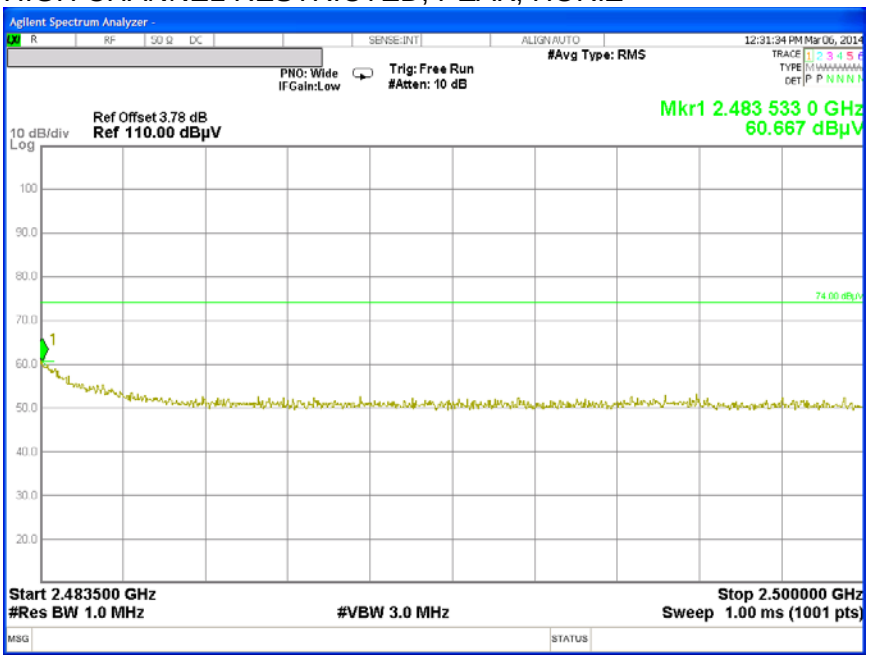


LOW CHANNEL RESTRICTED, AVG, VERT

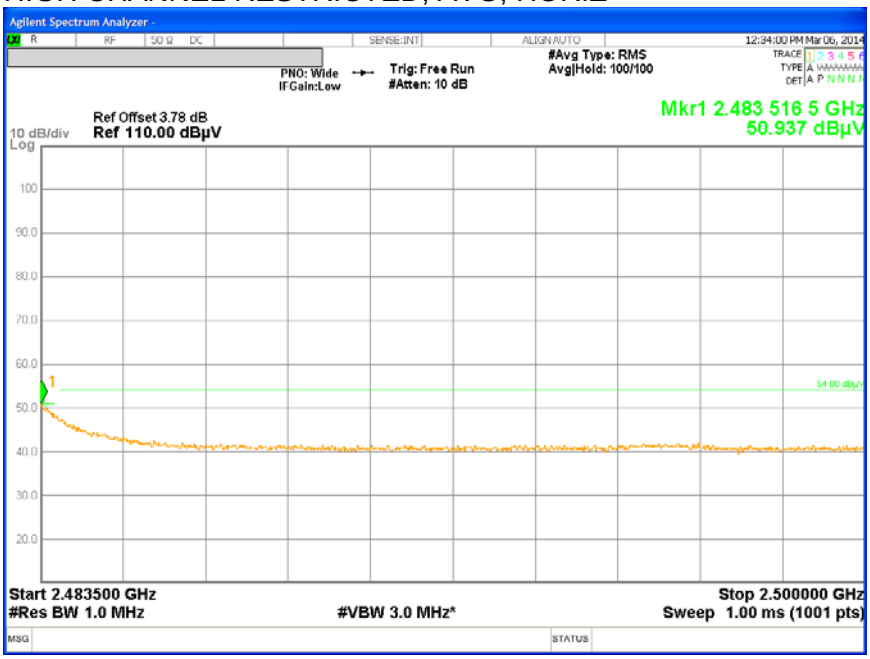


RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL RESTRICTED, PEAK, HORIZ

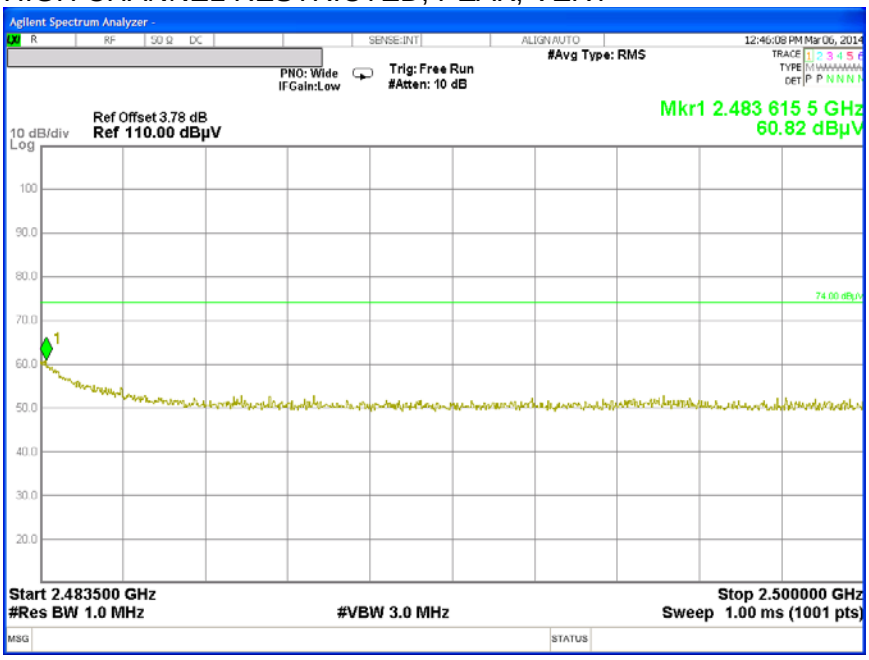


HIGH CHANNEL RESTRICTED, AVG, HORIZ

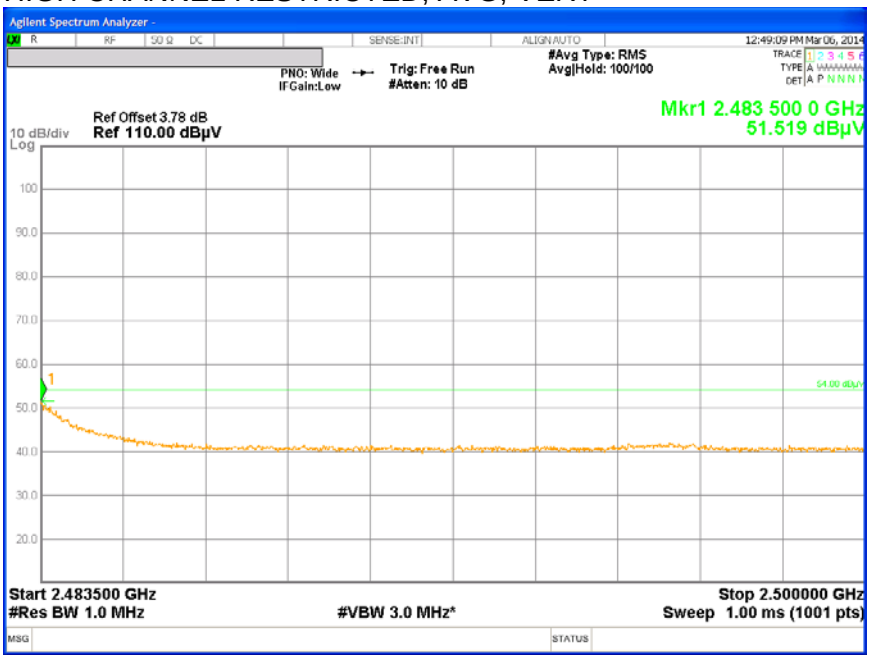


RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL RESTRICTED, PEAK, VERT

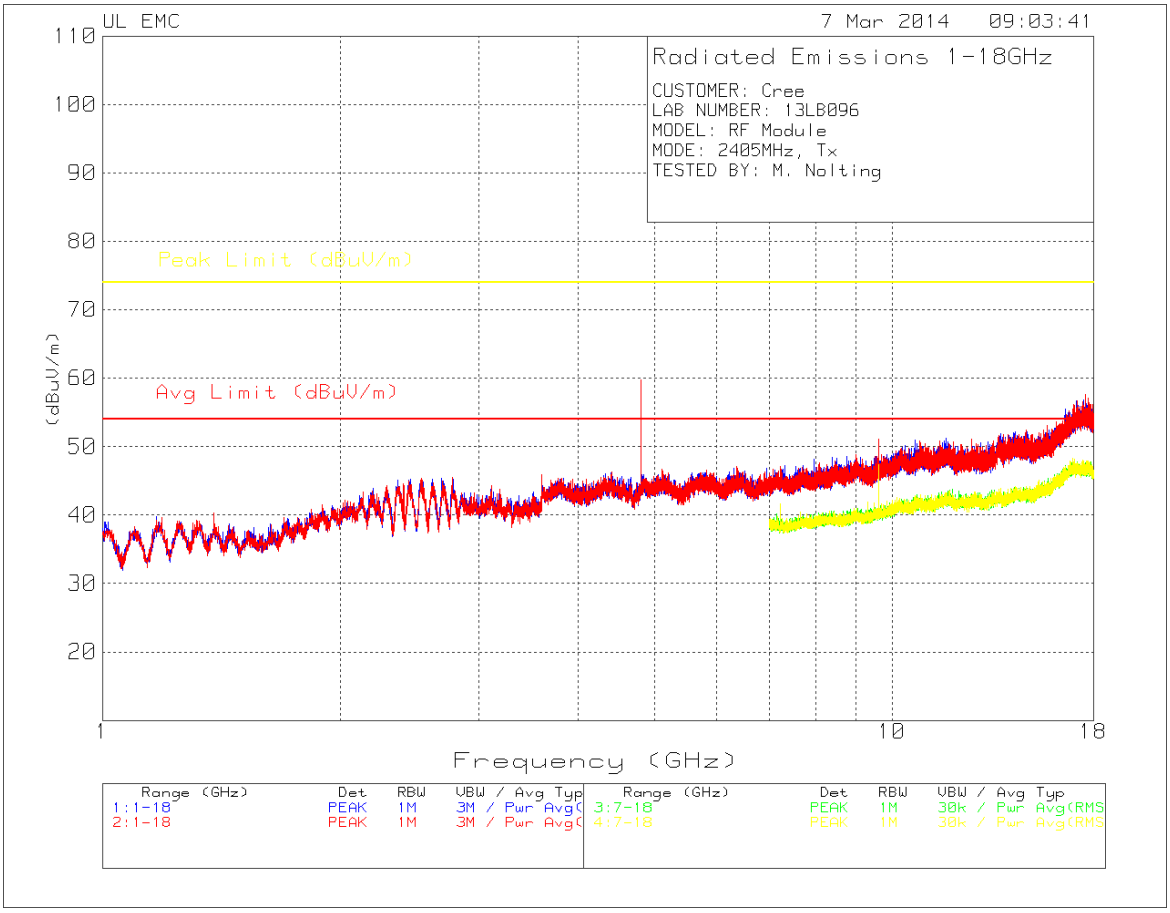


HIGH CHANNEL RESTRICTED, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

Low Channel: Horizontal/Vertical Plot



Low Channel: Tabular Data

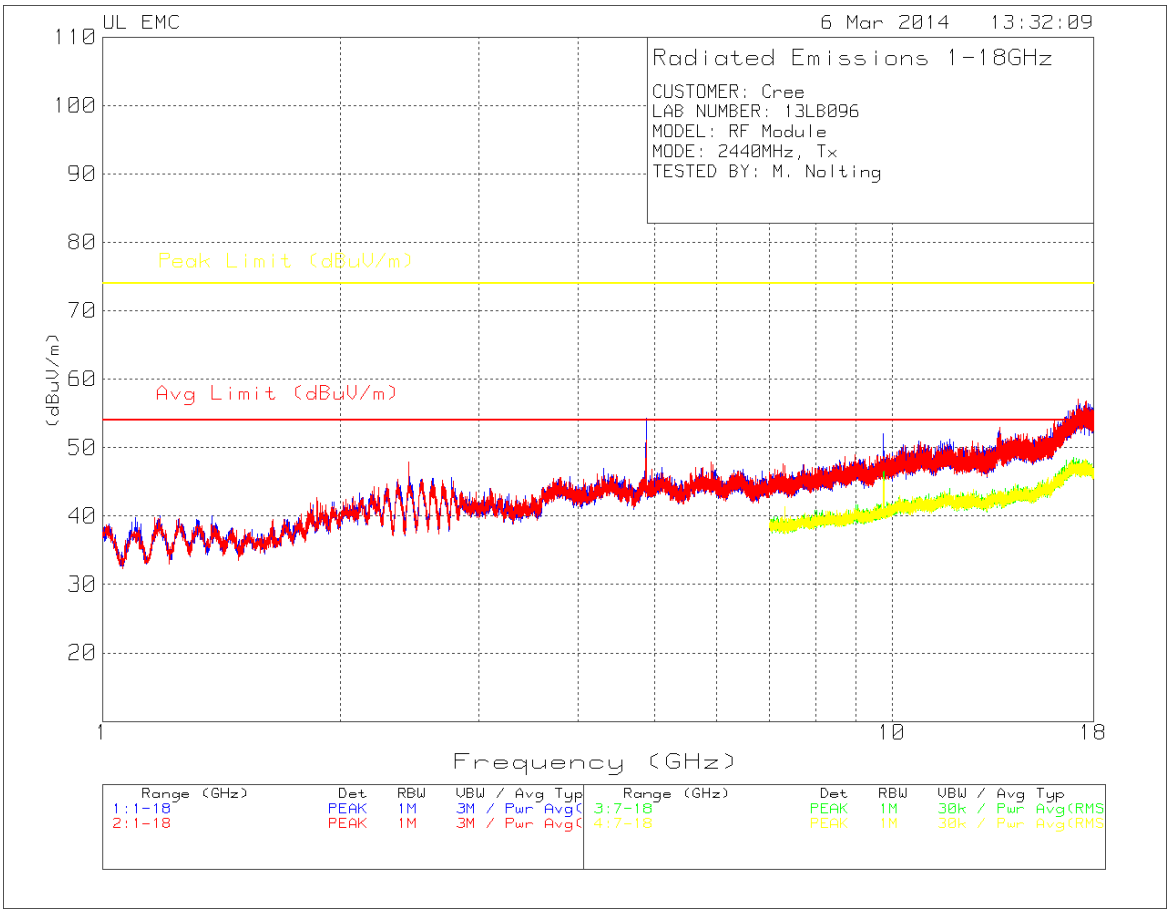
CUSTOMER: Cree
LAB NUMBER: 13LB096
MODEL: RF Module
MODE: Tx, 2405MHz
TESTED BY: M. Nolting

Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
4.809	55.02	PK	34.00	-36.20	52.8	-	-	74.0	-21.2	H	Y
4.809	47.25	MAv2	34.00	-36.20	45.1	54.0	-8.9	-	-	H	Y
4.809	62.75	PK	34.00	-36.20	60.6	-	-	74.0	-13.4	V	Y
4.809	55.90	MAv2	34.00	-36.20	53.7	54.0	-0.3	-	-	V	Y
7.214	44.65	PK	35.50	-32.70	47.5	-	-	-	-26.5	H	N
9.631	43.01	PK	37.00	-31.90	48.1	-	-	-	-	H	N
7.217	47.29	PK	35.50	-32.70	50.1	-	-	-	-	V	N
9.619	46.05	PK	37.00	-31.90	51.2	-	-	-	-	V	N

PK - Peak detector
MAv1 - KDB558074 v03 12.2.5.1 d) RMS Average
MAv2 - KDB558074 v03 12.2.5.1 d) 1) Voltage Average

18-26GHz frequency range: No EUT-related noise observed in this range.

Middle Channel: Horizontal/Vertical Plot



Middle Channel: Tabular Data

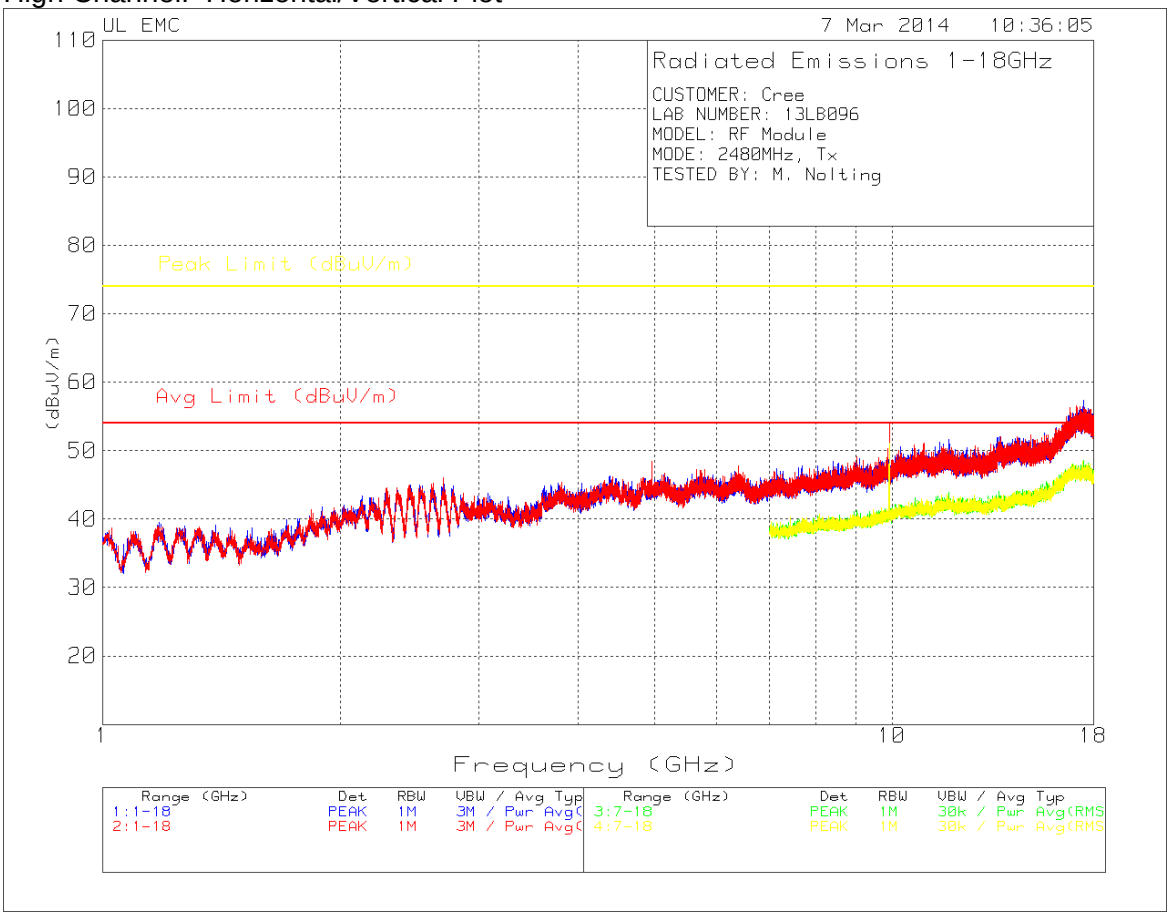
CUSTOMER: Cree
LAB NUMBER: 13LB096
MODEL: RF Module
MODE: Tx, 2440MHz
TESTED BY: M. Nolting

Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
4.881	58.41	PK	34.00	-36.20	56.2	-	-	74.0	-17.8	H	Y
7.322	44.23	PK	35.60	-32.60	47.2	-	-	74.0	-26.7	H	Y
4.879	51.94	MAv2	34.00	-36.20	49.7	54.0	-4.2	-	-	H	Y
7.321	33.83	MAv2	35.60	-32.60	36.8	54.0	-17.1	-	-	H	Y
4.881	56.61	PK	34.00	-36.20	54.4	-	-	74.0	-19.6	V	Y
7.322	46.45	PK	35.60	-32.60	49.5	-	-	74.0	-24.5	V	Y
4.881	48.94	MAv2	34.00	-36.20	46.7	54.0	-7.2	-	-	V	Y
7.321	36.43	MAv2	35.60	-32.60	39.4	54.0	-14.5	-	-	V	Y
9.760	46.69	PK	37.20	-31.90	52.0	-	-	-	-	H	N
9.759	43.37	PK	37.20	-31.90	48.7	-	-	-	-	V	N

PK - Peak detector
MAv1 - KDB558074 v03 12.2.5.1 d) RMS Average
MAv2 - KDB558074 v03 12.2.5.1 d) 1) Voltage Average

18-26GHz frequency range: No EUT-related noise observed in this range.

High Channel: Horizontal/Vertical Plot



High Channel: Tabular Data

CUSTOMER: Cree
LAB NUMBER: 13LB096
MODEL: RF Module
MODE: Tx, 2480MHz
TESTED BY: M. Nolting

Freq (GHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Peak Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
4.959	48.67	PK	34.00	-36.00	46.7	-	-	74.0	-27.3	H	Y
7.439	43.10	PK	35.60	-32.40	46.3	-	-	74.0	-27.7	H	Y
4.959	40.17	MAv1	34.00	-36.00	38.2	54.0	-15.8	-	-	H	Y
7.439	32.97	MAv1	35.60	-32.40	36.2	54.0	-17.8	-	-	H	Y
4.959	52.85	PK	34.00	-36.00	50.9	-	-	74.0	-23.1	V	Y
7.438	44.50	PK	35.60	-32.40	47.7	-	-	74.0	-26.3	V	Y
4.959	45.75	MAv1	34.00	-36.00	43.8	54.0	-10.2	-	-	V	Y
7.439	35.52	MAv1	35.60	-32.40	38.7	54.0	-15.3	-	-	V	Y
9.920	44.85	PK	37.50	-31.70	50.7	-	-	-	-	H	N
9.920	48.11	PK	37.50	-31.70	53.9	-	-	-	-	V	N

PK - Peak detector
MAv1 - KDB558074 v03 12.2.5.1 d) RMS Average
MAv2 - KDB558074 v03 12.2.5.1 d) 1) Voltage Average

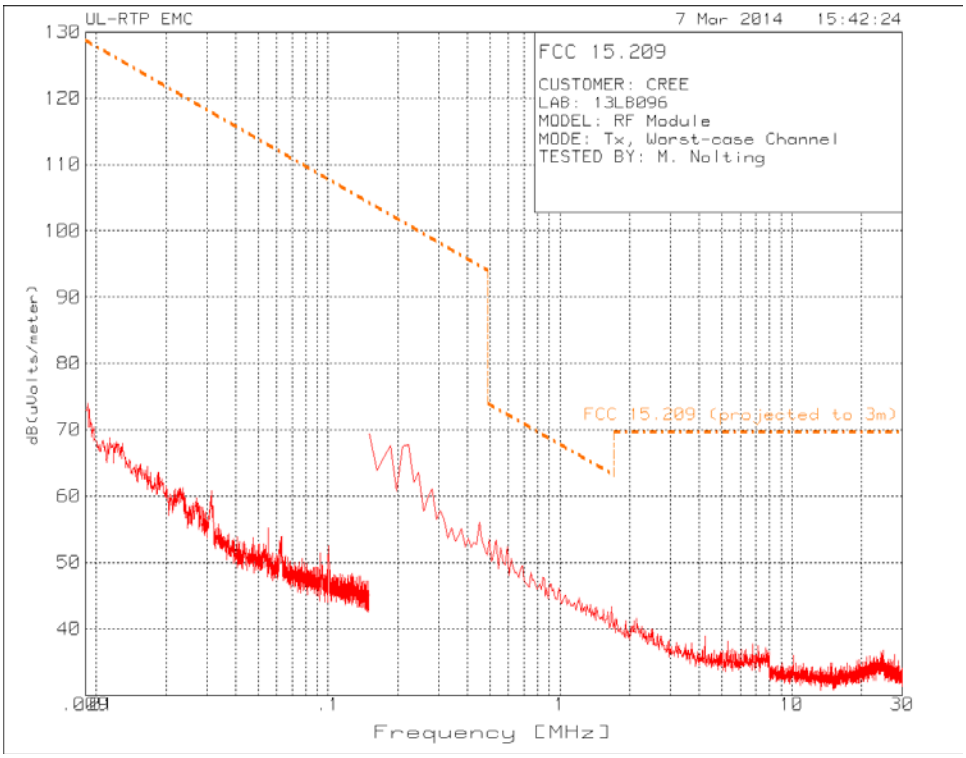
18-26GHz frequency range: No EUT-related noise observed in this range.

9.3. WORST-CASE BELOW 1 GHz

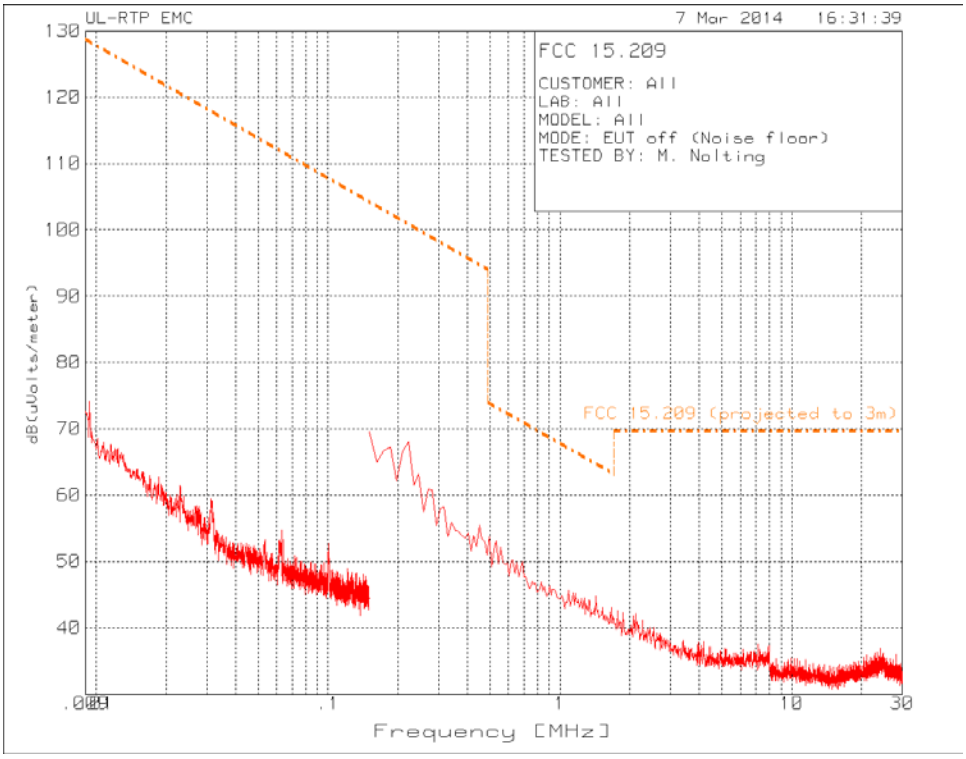
SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

Note: All measurements were made at a test distance of 3 m. The limits in the plots and tabular data are the FCC/IC limits extrapolated from the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to the measurement distance to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (specification distance / test distance).

EUT PLOT



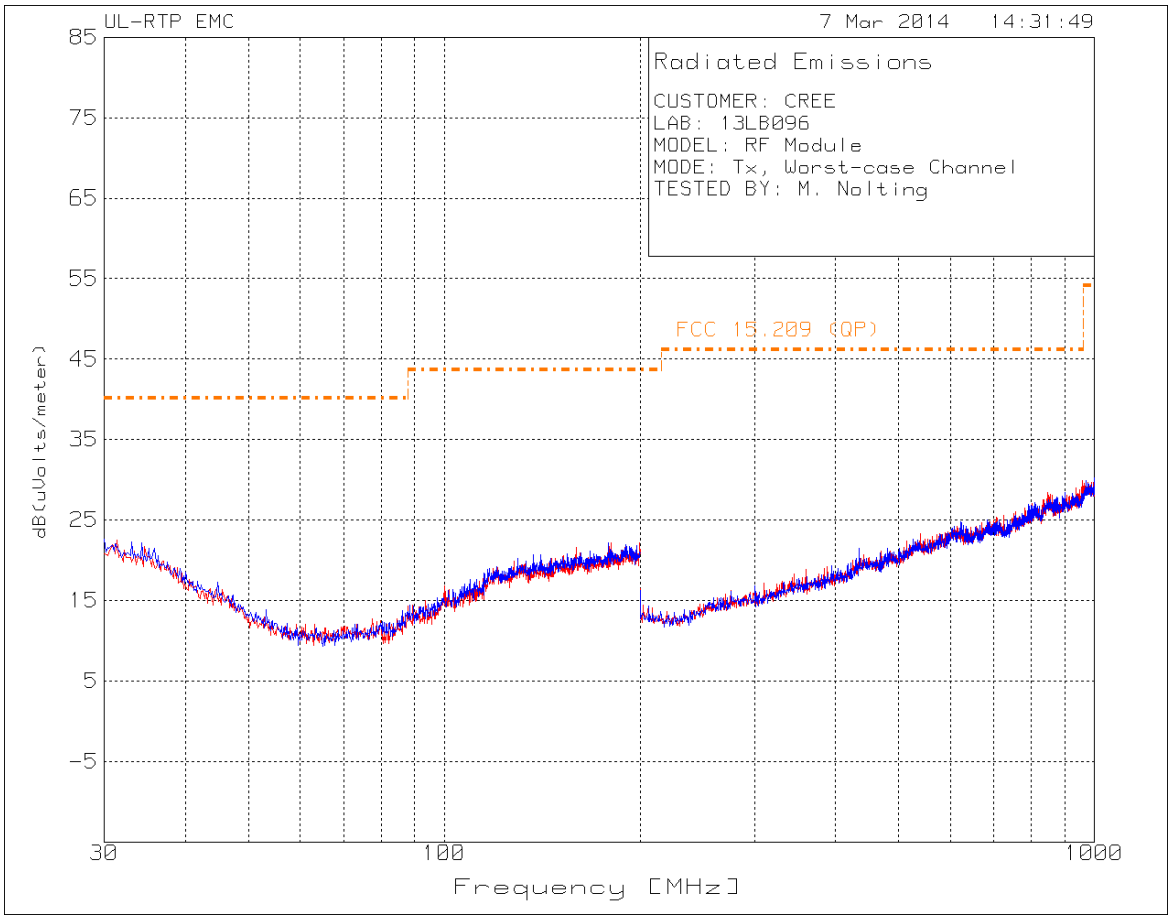
NOISE-FLOOR PLOT



The above plots demonstrate there were no EUT-related emissions of interest relative to the FCC 15.209 limit below 30MHz.

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)

HORIZONTAL/VERTICAL PLOT



HORIZONTAL/VERTICAL TABULAR DATA

CUSTOMER: Cree
LAB #: 13LB096
MODEL: RF Module
MODE: Tx, Worst-case Channel
TESTED BY: M. Nolting

Freq (MHz)	Meter Reading [dBuV]	Detector	Antenna Factor [dB/m]	Gain/Loss [dB]	Field Strength [dBuV/m]	15.209 QP Limit [dBuV/m]	Margin [dB]	Antenna Polarity	In Restricted Band?
434.82	31.72	PK	16.60	-26.90	21.4	-	-	H	N
31.36	29.56	PK	17.10	-24.20	22.5	-	-	V	N
159.50	30.17	PK	14.70	-23.30	21.6	-	-	V	N
180.77	30.21	PK	15.10	-23.10	22.2	-	-	V	N
846.30	32.21	PK	22.70	-26.50	28.4	-	-	V	N
959.44	33.29	PK	23.50	-26.90	29.9	-	-	V	N

PK - Peak detector
QP - Quasi-peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

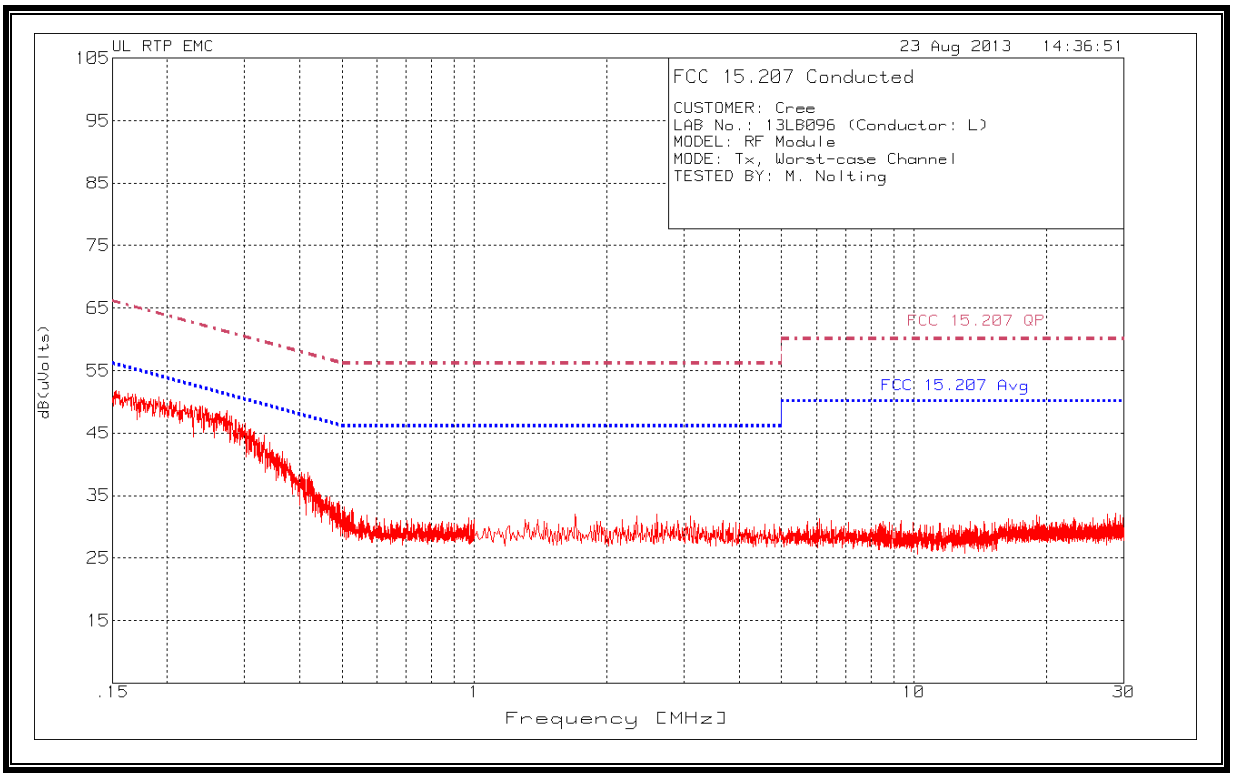
* Decreases with the logarithm of the frequency.

TEST PROCEDURE

ANSI C63.4

RESULTS

LINE CONDUCTOR PLOT



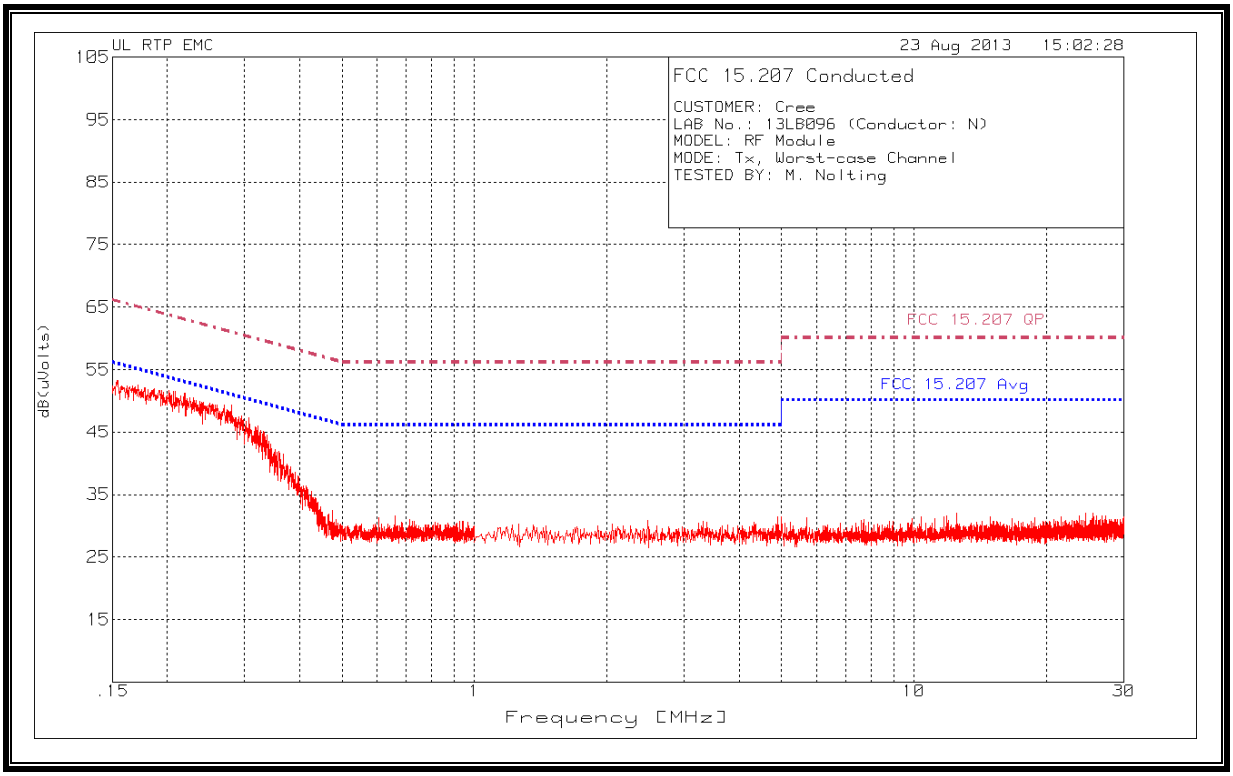
LINE CONDUCTOR TABULAR DATA

CUSTOMER: Cree
LAB No.: 13LB127 (Conductor: L)
MODEL: RF Module
MODE: Tx, Worst-case Channel
TESTED BY: M. Nolting

Test Frequency [MHz]	Meter Reading [dBuV]	Detector*	LISN [dB]	Cable Loss [dB]	RF Line Voltage [dBuV]	FCC 15.207 (QP) [dBuV]	Margin [dB]	FCC 15.207 (AV) [dBuV]	Margin [dB]
0.153	32.71	QP	0.4	9.5	42.6	65.8	-23.2	-	-
0.200	31.74	QP	0.3	9.5	41.5	63.6	-22.1	-	-
0.274	28.60	QP	0.2	9.6	38.4	61.0	-22.6	-	-
0.418	27.95	PK	0.1	9.6	37.7	57.5	-19.9	47.5	-9.9
1.695	22.38	PK	0.1	9.6	32.1	56.0	-23.9	46.0	-13.9
8.469	20.15	PK	0.1	9.7	30.0	60.0	-30.1	50.0	-20.1
0.153	2.87	AV	0.4	9.5	12.8	-	-	55.8	-43.0
0.200	3.29	AV	0.3	9.5	13.1	-	-	53.6	-40.5
0.274	2.13	AV	0.2	9.6	11.9	-	-	51.0	-39.1

*PK = Peak, QP = Quasi-Peak, AV = Average

NEUTRAL CONDUCTOR PLOT



NEUTRAL CONDUCTOR TABULAR DATA

CUSTOMER: Cree
LAB No.: 13LB127 (Conductor: N)
MODEL: RF Module
MODE: Tx, Worst-case Channel
TESTED BY: M. Nolting

Test Frequency [MHz]	Meter Reading [dBuV]	Detector*	LISN [dB]	Cable Loss [dB]	RF Line Voltage [dBuV]	FCC 15.207 (QP) [dBuV]	Margin [dB]	FCC 15.207 (AV) [dBuV]	Margin [dB]
0.155	32.94	QP	0.4	9.5	42.84	65.8	-23.0	-	-
0.219	31.16	QP	0.2	9.5	40.86	62.8	-21.9	-	-
0.280	27.57	QP	0.2	9.6	37.37	60.8	-23.4	-	-
0.329	23.50	QP	0.1	9.6	33.20	59.5	-26.3	-	-
4.318	20.77	PK	0.1	9.7	30.57	56.0	-25.4	46.0	-15.4
4.883	21.66	PK	0.1	9.7	31.46	56.0	-24.5	46.0	-14.5
0.155	2.94	AV	0.4	9.5	12.84	-	-	55.8	-43.0
0.219	0.71	AV	0.2	9.5	10.41	-	-	52.8	-42.4
0.280	1.83	AV	0.2	9.6	11.63	-	-	50.8	-39.2
0.329	0.41	AV	0.1	9.6	10.11	-	-	49.5	-39.4

*PK = Peak, QP = Quasi-Peak, AV = Average

END OF REPORT