FCC 47 CFR PART 15.255 SUBPART C

CERTIFICATION TEST REPORT

FOR

802.11ad MODULE

MODEL NUMBER: QCA9008-SBD1

FCC ID: PPD-QCA9008-SBD1

REPORT NUMBER: 15U20374-E1A

ISSUE DATE: AUGUST 11, 2015

Prepared for

QUALCOMM ATHEROS, INC
1700 TECHNOLOGY DRIVE
SAN JOSE, CA 95110-1383 U.S.A.

Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	07/02/2015	Initial Issue	M. Heckrotte
A	08/11/2015	Revised RF Exposure	M. Heckrotte

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: QUALCOMM ATHEROS, INC.
1700 TECHNOLOGY DRIVE
SAN JOSE, CA 95110, U.S.A.

EUT DESCRIPTION: 802.11ad MODULE

MODEL: QCA9008-SBD1

SERIAL NUMBER: 1351300100, 1351300114

DATE TESTED: JUNE 2 - JUNE 20, 2015

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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
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UL Verification Services Inc.

Tested By:

STEVE AGUILAR
WiSE ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A	☐ Chamber D
☒ Chamber B	☐ Chamber E
☐ Chamber C	☒ Chamber F
	☐ Chamber G

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.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. 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	±3.52 dB
Radiated Disturbance, 30 to 1000 MHz	±4.94 dB
Radiated Disturbance, 1 to 6 GHz	±3.86 dB
Radiated Disturbance, 6 to 18 GHz	±4.23 dB
Radiated Disturbance, 18 to 26 GHz	±5.30 dB
Radiated Disturbance, 26 to 40 GHz	±3.23 dB
Radiated Disturbance, 40 GHz above	±3.50dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

QCA9008-SBD1 is a wireless module that operates in the 60 GHz frequency band which supports 802.11ad.

5.2. OUTPUT POWER

The antenna is integral thus radiated measurements are made. The EIRP was measured at the worst-case condition, thus the EIRP measurement conditions correspond to the maximum EUT antenna gain. Therefore the maximum antenna gain is used to calculate the Peak Output Power.

The peak conducted output power for channel 1 is 10.20 dBm (10.5mW).
The peak conducted output power for channel 2 is 16.7dBm (46.8 mW).
The peak conducted output power for channel 3 is 15.2 dBm (33.1 mW).

5.3. DESCRIPTION OF AVAILABLE 60G ANTENNAS

The antenna is an integral phased-array antenna with a maximum gain of 14 dBi.
Antenna Configuration: 32 Antenna Elements
Patch and End Fire Antenna Elements

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was rev 2.0

The test utility software used during testing was DMTools v1.2 Build 5500,
Devmon Utility ver 1.0.0.11 Marlon, Falcon Gui 2014.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case data rate is determined to be MCS7 for Channel 1 and MCS 12 for Channel 2 and 3 as specified by the applicant.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	HP	8440p	CZC0457V8C
Laptop Power supply	HP	608425-003	WBGSV0AAR0L5U8
Wilocity PCI card with ribbon	Qualcomm	LABPCB006ECARD-0066	1756780
mPCIe Extender	Qualcomm	W0060	00601010023

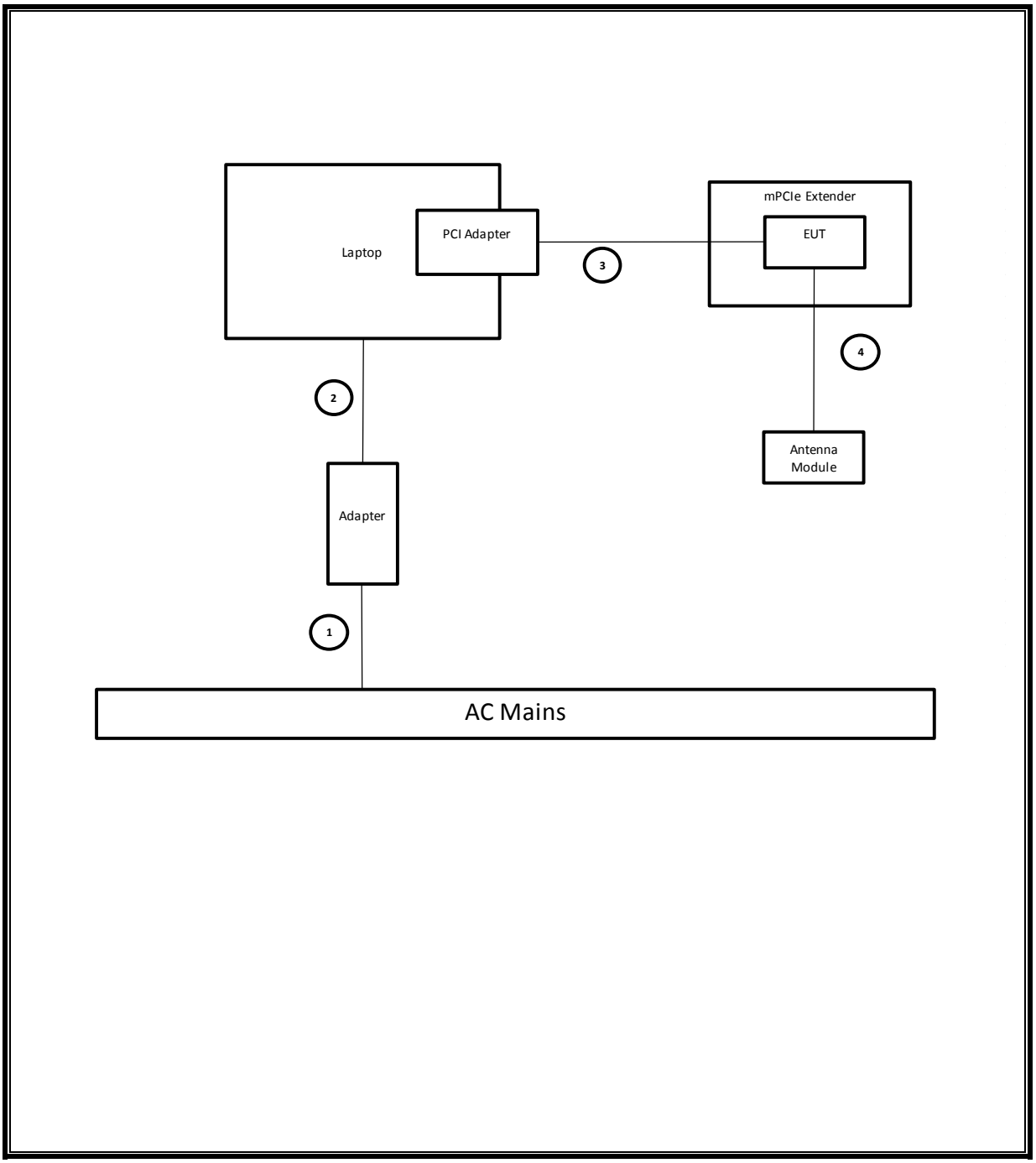
I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC	1	AC	Unshielded	0.9m	None
2	DC	1	DC	Shielded	1.6m	Ferrite on DC end
3	Data	1	Signal	Shielded - Ribbon	71cm	None
4	RF	1	U.FL-R	Shielded	55cm	None

TEST SETUP

A laptop computer was utilized to adjust the EUT for testing purposes. Connection to the EUT was by the use of a PCI Card adapter and mPCIe Extender exclusive for testing only.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment List					
Description	**Manufacturer**	**Model**	**S/N**	**Local ID (T No.)**	**Cal Due**
N9030A PXA Signal Analyzer	Agilent	N9030A	MY52350427	313	9/13/2015
Analog Signal Generator, 40 GHz	Agilent	E8257D	MY48050681	181	9/26/2015
Down Converter, 67 GHz	Agilent	MT-463	12020	499	CNR
mmWave Source 50 - 75 GHz	OML	S15MS-AG	80708-4	613	CNR
Mixer Diplexer for HP	OML	DPL.313B	N02429	52	CNR
Harmonic Mixer , 50 to 80 GHz	Agilent	M1970V	MY51390830	994	6/18/2015*
Harmonic Mixer , 75 to 110 GHz	Agilent	M1970W	MY51430784	993	6/12/2015*
Harmonic Mixer, 90 to 140 GHz	OML	M08HWA	F90519-2	50	6/17/2015*
Harmonic Mixer, 140 to 220 GHz	OML	M05HWA	G90519-1	51	6/17/2015*
Single Average Power Meter	Agilent	N1913A	MY53100006	412	5/7/2016
Waveguide Power Sensor	Agilent	V8486A	MY52300008	433	6/5/2015*
Spectrum Analyzer	Agilent	8564E	3943A01643	106	8/6/2015
Horn Antenna, 18 to 26.5GHz	ARA	MWH-1826/B	1049	89	12/17/2015
PreAmplifier, 1-26.5GHz	Agilent	8449B	3008A04710	404	4/13/2016
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	924343	88	4/7/2016
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	1029	90	7/15/2015
Oscilloscope 1GHz 4 Ch DSO	Agilent	DSA90804A	MY51420139	215	6/16/2016
Low Pass Filter, 10MHz	Solar Electronics	6623-10	136101	417	5/4/2016
Low Noise Amplifier	VIVAtech	VTLN-018-FB	51	CNR	CNR
Waveguide switch	mi-Wave	530V/387	1332	CNR	CNR
MM-Wave Isolator	Millitech	FBI-15-RSES0	1734	CNR	CNR
50-75GHZ RF Detector	Millitech	DET-15-RPFWI	41	CNR	CNR
Spectrum Analyzer, 44 GHz	Agilent	N9030A	MY51380911	341	2/20/2016
Antenna, Horn, 18 GHz	ETS Lindgren	3117	29310	120	3/26/2016
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	A121003	122	2/13/2016
RF PreAmplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	No Serial Number	742	1/31/2016
Preamp, 1000MHz	Sonoma	310N	185623	173	6/9/2016
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent	N9030A	MY53310593	907	5/15/2016
Amplifier, 10KHz to 1GHz, 32dB	Agilent	8447D	2944A06589	10	1/16/2016
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB1	A012712	243	12/8/2015
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	100935	284	9/6/2015
LISN, 30 MHz	FCC	50/250-25-2	114	24	1/6/2016
Chamber, Environmental	Cincinnati Sub Zero	ZPHS-8-3.5-SCT/WC	ZP1313652	1154	9/18/2015
True RMS Multimeter	Fluke	87V	23310084	360	3/12/2016
Power supply AC, 264Vac 19.5Amp 2500VA 47-63Hz	Elgar-Ametek	CW2501M	1307A03505	350	CNR
Radiated Software	UL	UL EMC	Ver 9.5, July 22, 2014		
Conducted Software	UL	UL EMC	Ver 9.5, May 17, 2012		

* Equipment used before due date.

7. APPLICABLE LIMITS AND TEST RESULTS

7.1. 6 dB BANDWIDTH

APPLICABLE RULE

§15.255 (e) (1) For the purposes of this paragraph (e)(1), emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

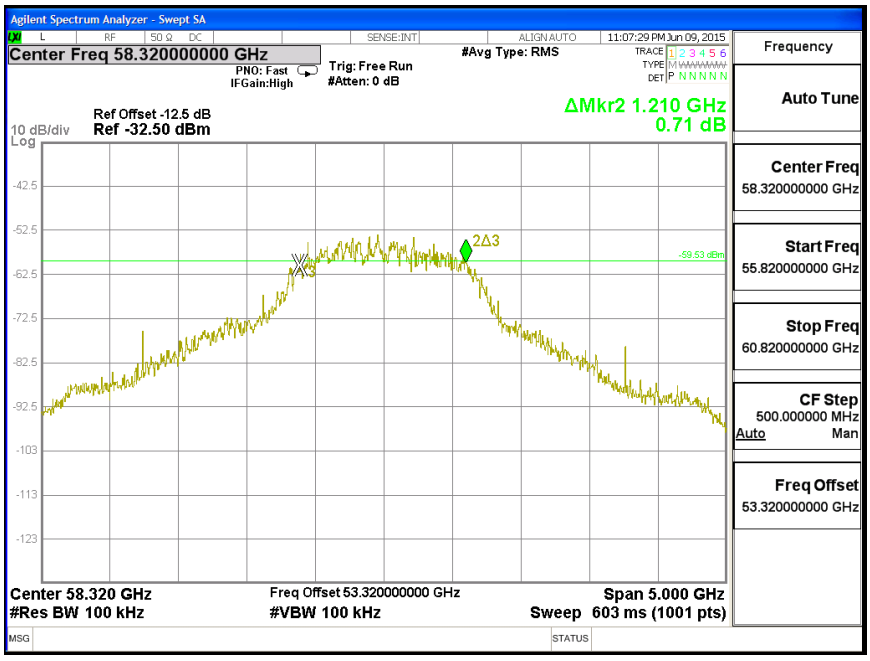
The spectrum analyzer and external mixer are set up to measure the radiated output of the transmitter.

RESULTS

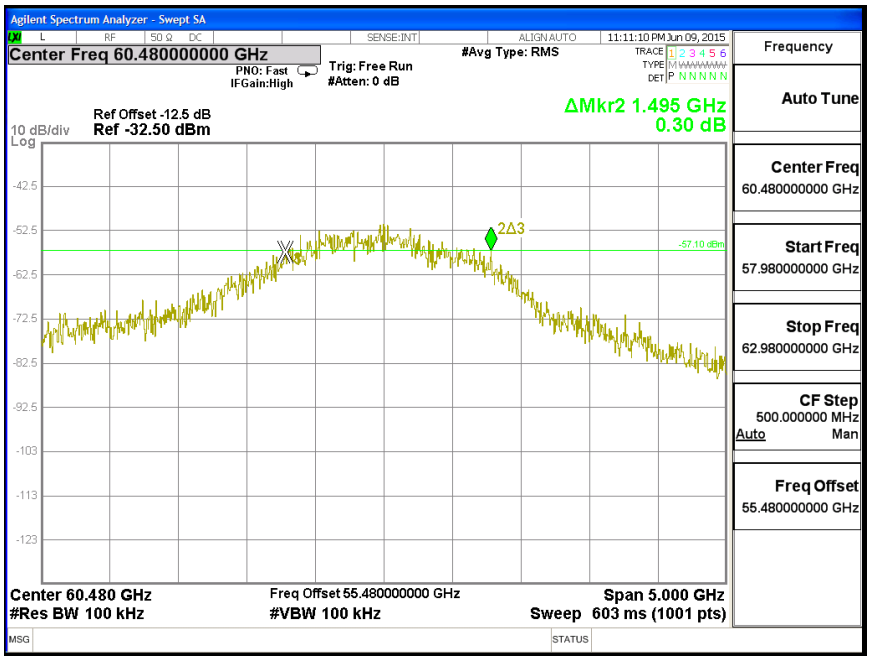
Channel	Frequency (GHz)	6 dB Bandwidth (MHz)
1	58.32	1210
2	60.48	1495
3	62.64	1515

6 dB BANDWIDTH

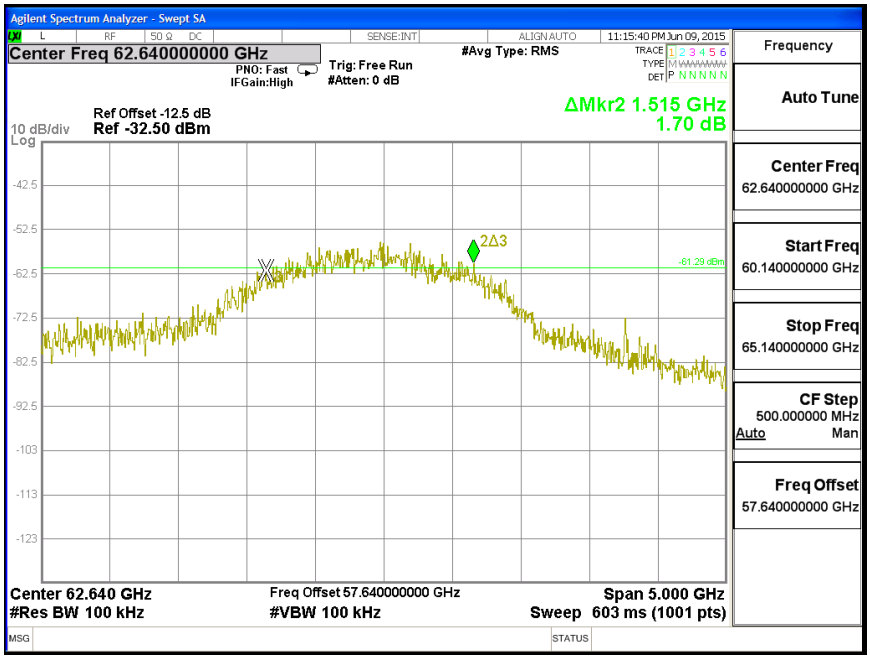
6 dB BANDWIDTH CHANNEL 1



6 dB BANDWIDTH CHANNEL 2



6 dB BANDWIDTH CHANNEL 3



7.2. 99% and 26 dB BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

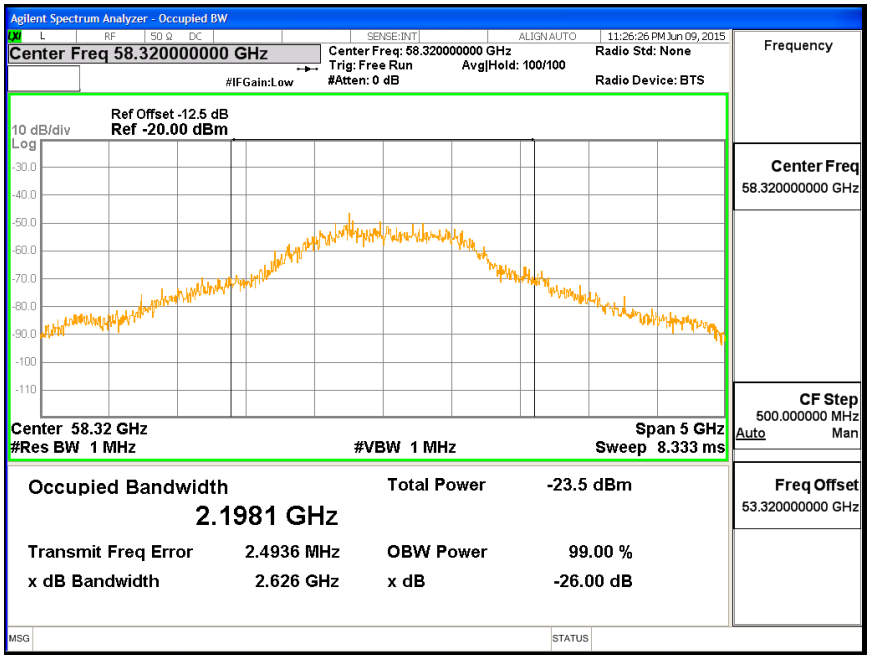
The spectrum analyzer and external mixer are set up to measure the radiated output of the transmitter.

RESULTS

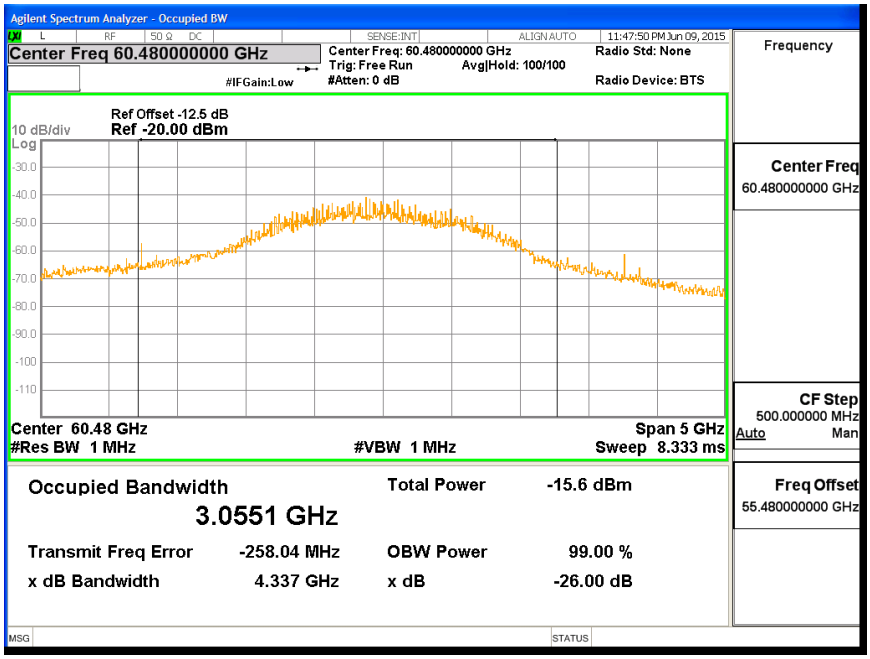
Channel	Frequency (GHz)	99% Bandwidth (GHz)	26 dB Bandwidth (GHz)
1	58.32	2.1981	2.6260
2	60.48	3.0551	4.3370
3	62.64	2.5445	3.8540

99% and 26 dB BANDWIDTH

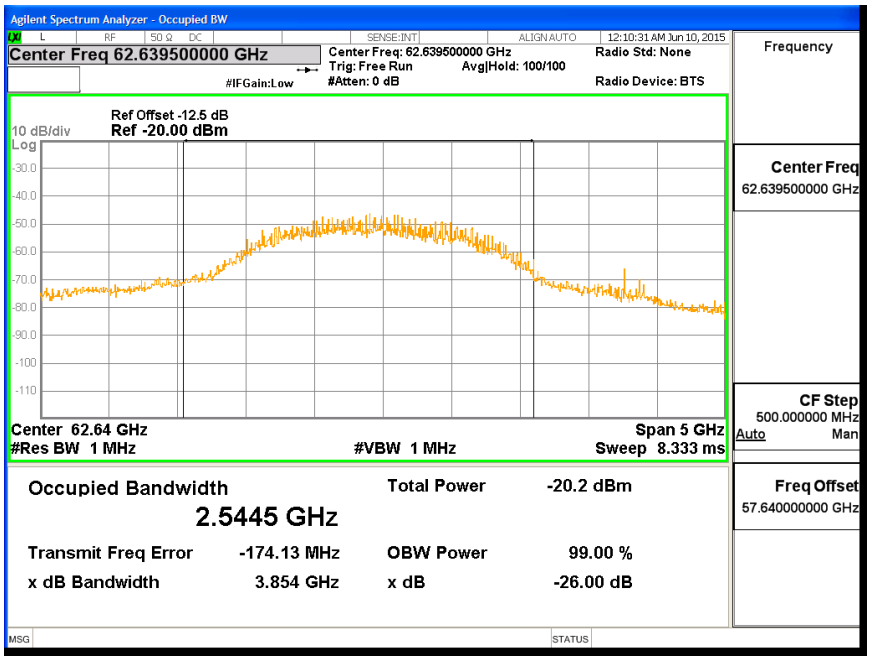
99% and 26 dB BANDWIDTH CH1



99% and 26 dB BANDWIDTH CH2



99% and 26 dB BANDWIDTH CH3



7.3. POWER

LIMIT

§ 15.255(b)(1)(i) Except as indicated in paragraph (b)(1)(ii) of this section, the average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm.

TEST PROCEDURE

ANSI C63.10

Measurements are made at a distance greater than or equal to the far field boundary distance.
The measured power level is converted to EIRP using the Friis equation:
$EIRP = P_T * G_T = (P_R / G_R) * (4 * Pi * D / \lambda)^2$
where:
G_R is the gain of the receive measurement antenna
D is the measurement distance
λ is the wavelength
The EIRP is converted to Power using the equation:
$P_D = EIRP / (4 * Pi * D_S^2)$
where:
D_S is the specification distance

Note: Calculations were made in the log form equivalent to the linear form listed above.
Measured Peak and Average voltages are only a reference value used in the RF detection measurement and are not part of the EIRP calculations.

FAR FIELD BOUNDARY CALCULATIONS

The far-field boundary is given as:

$R_{far\ field} = (2 * L^2) / \lambda$

where:

L = Largest Antenna Dimension, including the reflector, in meters
λ = wavelength in meters

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
58.32	0.01924	0.0051	0.14
60.48	0.01924	0.0050	0.15
62.64	0.01924	0.0048	0.15

RESULTS

Low Channel (1)

PEAK POWER

Frequency (GHz)	Measurement Distance (m)	Measured Peak Voltage (mV)	Raw Measured Power (dBm)	Measured Power (dBm)	Rx Antenna Gain (dBi)
58.32	3.00	8.10	-30.39	-30.09	23.00
EIRP (dBm)	**Limit (dBm)**	**Margin (dBm)**			
24.2	40.000	-15.8	--	--	--

AVERAGE POWER

Frequency (GHz)	Measurement Distance (m)	Measured Average Voltage (mV)	Raw Measured Power (dBm)	Measured Power (dBm)	Rx Antenna Gain (dBi)
58.32	3.00	5.39	-30.90	-30.60	23.00
EIRP (dBm)	**Limit (dBm)**	**Margin (dBm)**			
23.7	43.000	-19.3	--	--	--

Mid Channel (2)

PEAK POWER

Frequency (GHz)	Measurement Distance (m)	Measured Peak Voltage (mV)	Raw Measured Power (dBm)	Measured Power (dBm)	Rx Antenna Gain (dBi)
60.48	3.00	20.60	-24.24	-23.94	23.00
EIRP (dBm)	**Limit (dBm)**	**Margin (dBm)**			
30.7	40.000	-9.3	--	--	--

AVERAGE POWER

Frequency (GHz)	Measurement Distance (m)	Measured Average Voltage (mV)	Raw Measured Power (dBm)	Measured Power (dBm)	Rx Antenna Gain (dBi)
60.48	3.00	15.90	-25.09	-24.79	23.00
EIRP (dBm)	**Limit (dBm)**	**Margin (dBm)**			
29.8	43.000	-13.2	--	--	--

High Channel (3)

PEAK POWER

Frequency (GHz)	Measurement Distance (m)	Measured Peak Voltage (mV)	Raw Measured Power (dBm)	Measured Power (dBm)	Rx Antenna Gain (dBi)
62.64	3.00	13.45	-26.05	-25.75	23.00
EIRP (dBm)	**Limit (dBm)**	**Margin (dBm)**			
29.2	40.000	-10.8	--	--	--

AVERAGE POWER

Frequency (GHz)	Measurement Distance (m)	Measured Average Voltage (mV)	Raw Measured Power (dBm)	Measured Power (dBm)	Rx Antenna Gain (dBi)
62.64	3.00	10.58	-26.47	-26.17	23.00
EIRP (dBm)	**Limit (dBm)**	**Margin (dBm)**			
28.7	43.000	-14.3	--	--	--

7.4. PEAK OUTPUT POWER

LIMIT

§15.255 (e) Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

§15.255 (e)(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

PROCEDURE

The maximum EUT antenna gain is subtracted from the Peak EIRP.

RESULTS

PEAK OUTPUT POWER

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
58.32	24.2	14.00	10.20	10.5	1210.0	500
60.48	30.7	14.00	16.70	46.8	1495.0	500
62.64	29.2	14.00	15.20	33.1	1515.0	500

7.5. FREQUENCY STABILITY

LIMIT

§15.255 (f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range - 20 to +50 degrees celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

TEST PROCEDURE

The radio module is placed in an environmental chamber, with power furnished by an adjustable source. The carrier frequency is counted at each condition and compared with the reference condition.

RESULTS

Reference Conditions: 115VAC @ 20ºC			CHANNEL 2
Power Supply (VAC)	**Environment Temperature (ºC)**	**Frequency (MHz)**	**Delta (kHz)**
115.00	70	60580.9912370	812.567
115.00	60	60580.4874950	308.825
115.00	50	60580.1709050	-7.765
115.00	40	60580.0760799	-102.590
115.00	30	60580.0935207	-85.149
115.00	***20***	***60580.1786700***	***Reference***
115.00	10	60580.2891170	110.447
115.00	0	60580.4084510	229.781
115.00	-10	60580.4971240	318.454
115.00	-20	60580.5244560	345.786
115.00	-30	60580.4359390	257.269
97.75	20	60580.1785370	-0.133
132.25	20	60580.1781391	-0.531

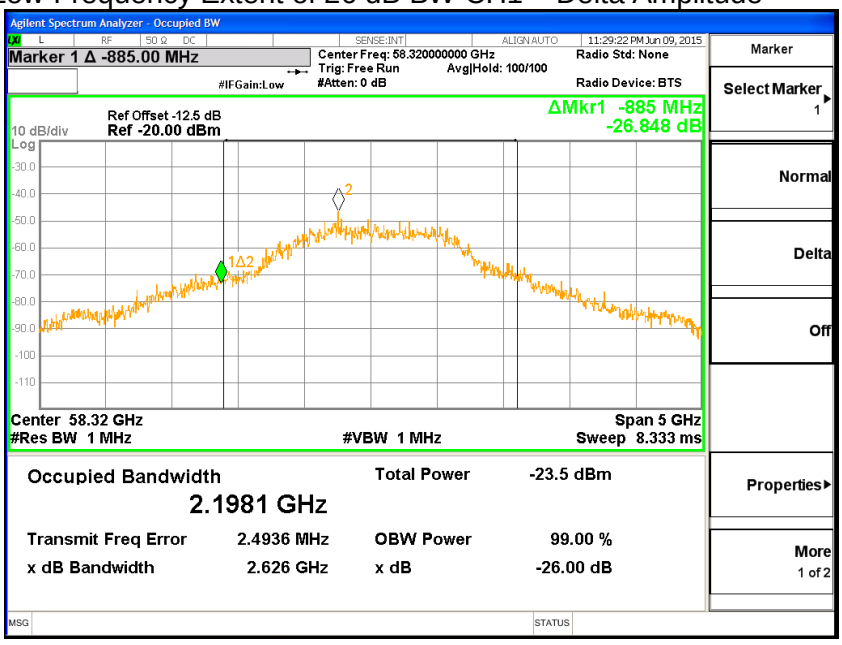
Applicant's declared operating temperature range is -30 deg C to +70 deg C.
100 MHz CW Baseband Signal yields offset from channel center frequency.

Worst-case drift = 812 kHz, round up to 900kHz for following calculations.

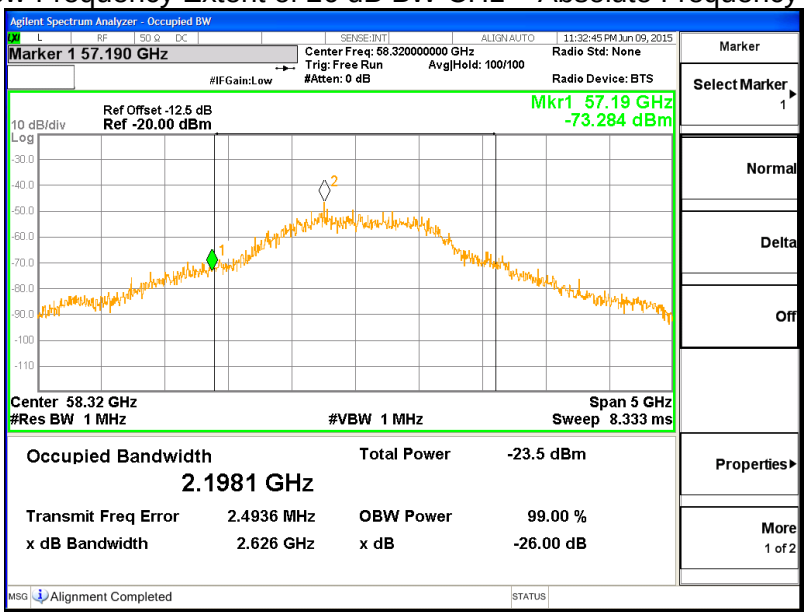
LOW-FREQUENCY EXTENT OF 26 dB BW COMPARED TO 57 GHz AUTHORIZED BAND EDGE

Extent of 26 dB BW (at normal temperature)	57.1900 GHz
Tolerance from Frequency Stability	± .0009 GHz
Extent of 26 dB BW (over temperature extremes)	57.1891 GHz

Low-Frequency Extent of 26 dB BW CH1 – Delta Amplitude



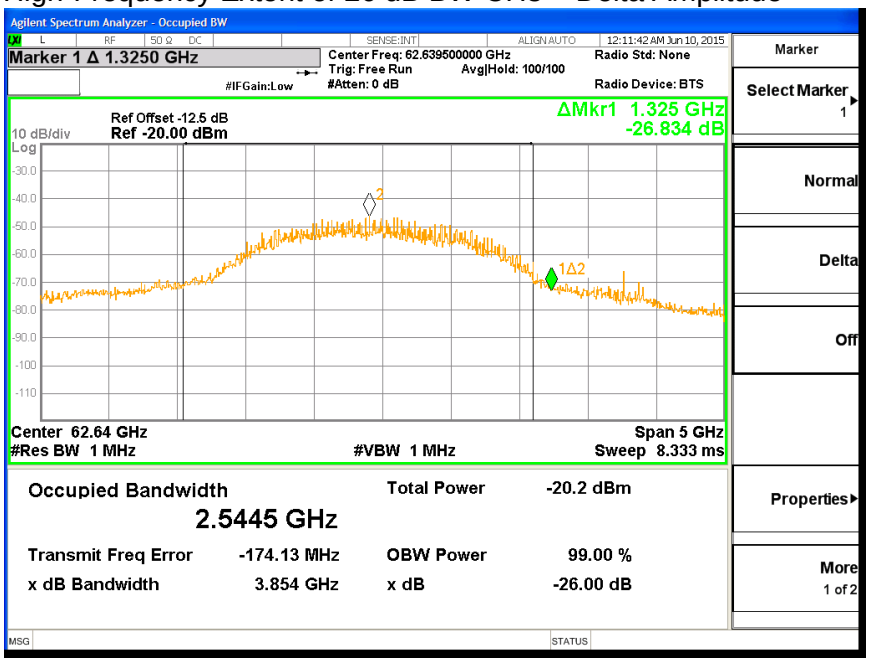
Low-Frequency Extent of 26 dB BW CH1 – Absolute Frequency



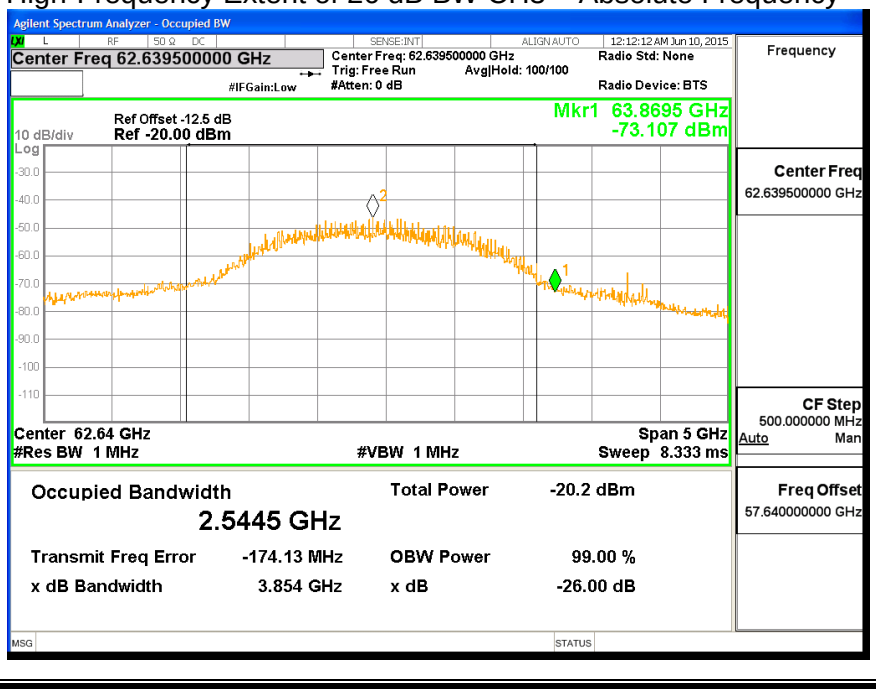
HIGH-FREQUENCY EXTENT OF 26 dB BW COMPARED TO 64 GHz AUTHORIZED BAND EDGE

Extent of 26 dB BW (at normal temperature)	63.8695 GHz
Tolerance from Frequency Stability	± .0009 GHz
Extent of 26 dB BW (over temperature extremes)	63.8704 GHz

High-Frequency Extent of 26 dB BW CH3 – Delta Amplitude



High-Frequency Extent of 26 dB BW CH3 – Absolute Frequency



7.6. TX SPURIOUS EMISSIONS

LIMITS

§15.255 (c) (1) The power density of any emissions outside the 57–64 GHz band shall consist solely of spurious emissions.

§15.255 (c) (2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

§15.255 (c) (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

§15.255 (c) (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

§15.255 (d) Only spurious emissions and transmissions related to a publicly accessible coordination channel, whose purpose is to coordinate operation between diverse transmitters with a view towards reducing the probability of interference throughout the 57–64 GHz band, are permitted in the 57–57.05 GHz band.

NOTE TO PARAGRAPH (d): The 57–57.05 GHz is reserved exclusively for a publicly-accessible coordination channel. The development of standards for this channel shall be performed pursuant to authorizations issued under part 5 of this chapter.

PROCEDURE FOR 30 MHz TO 40 GHz

ANSI C63.10

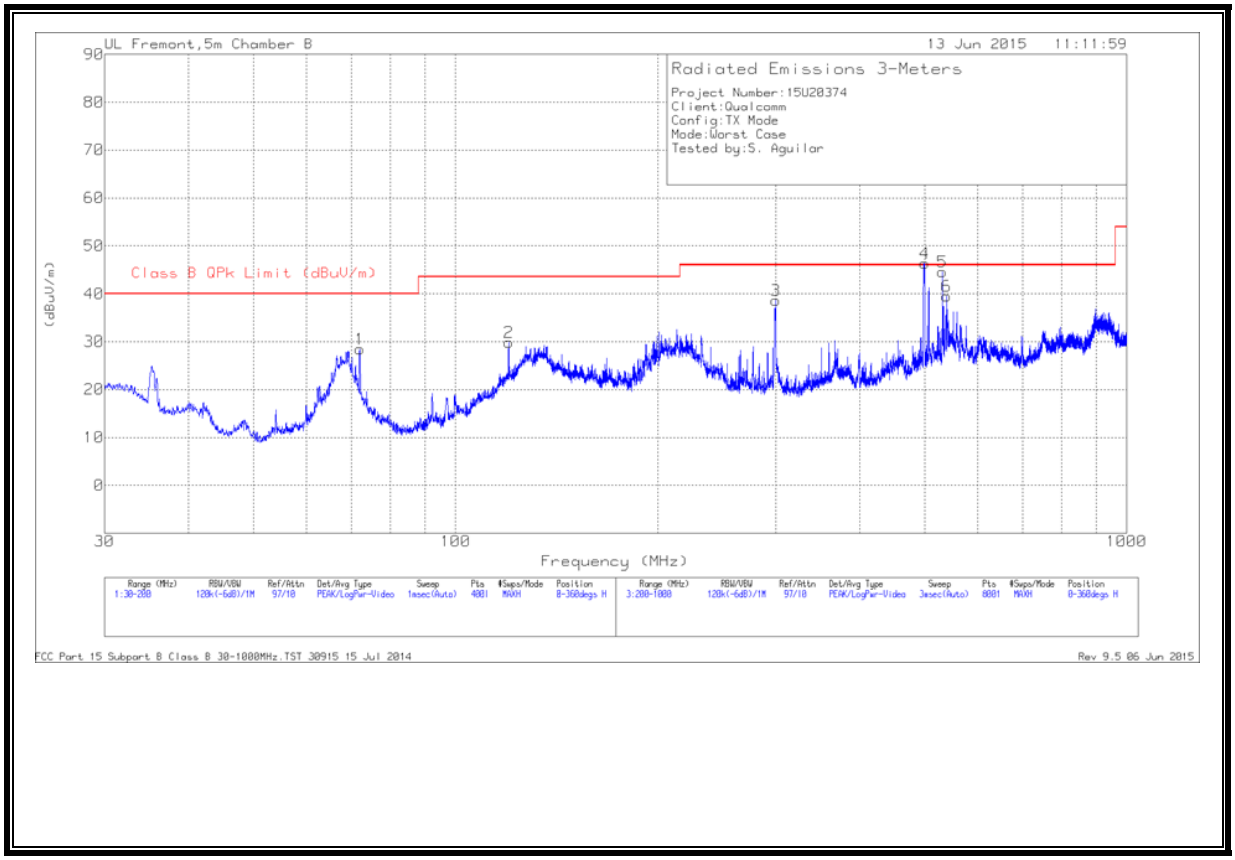
PROCEDURE FOR 40 TO 200 GHz

ANSI C63.10

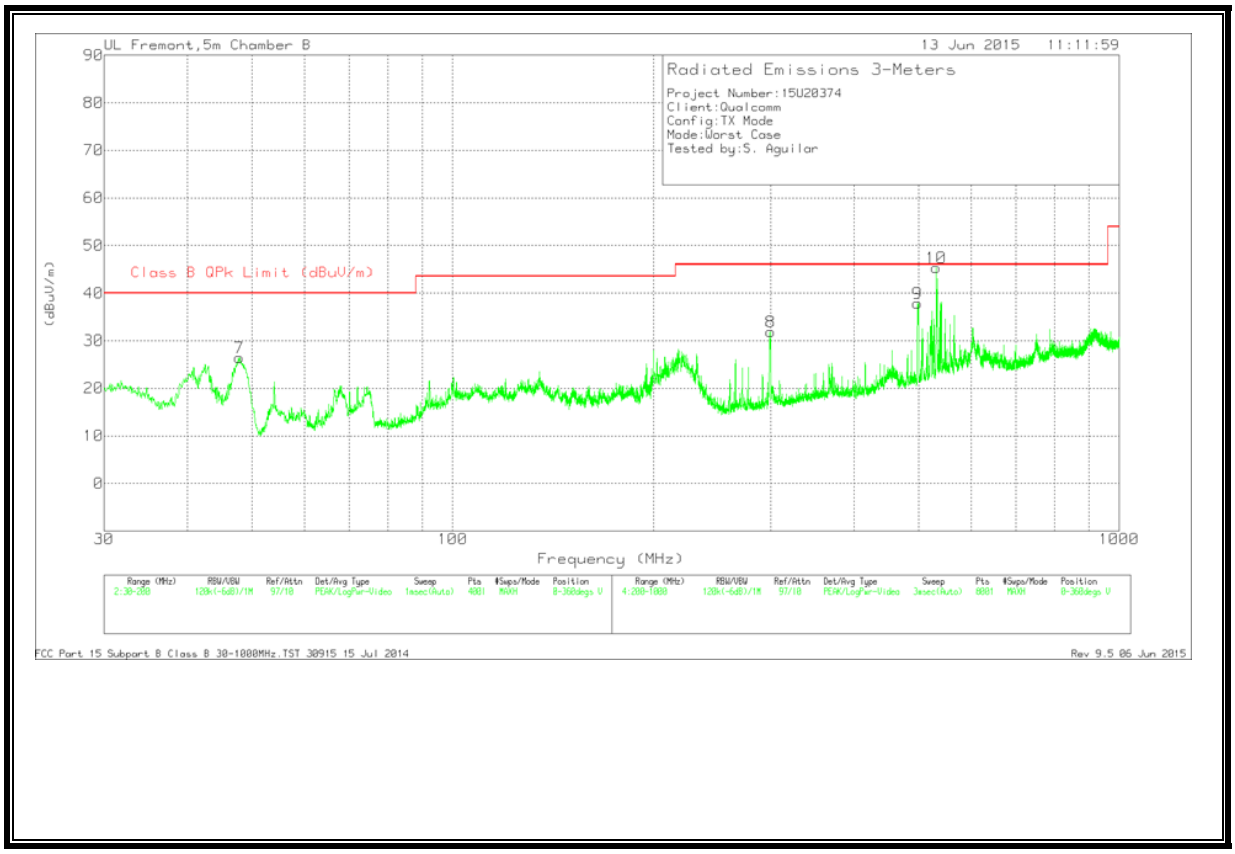
External harmonic mixers are utilized. The EIRP is measured, then the power density at a 3 meter distance is calculated.

7.6.1. Spurious Emissions 30 MHz TO 1 GHz

TX SPURIOUS EMISSION 30 TO 1000 MHz (HORIZONTAL PLOT)



TX SPURIOUS EMISSION 30 TO 1000 MHz (VERTICAL PLOT)



TX SPURIOUS EMISSION 30 MHz-1 GHz

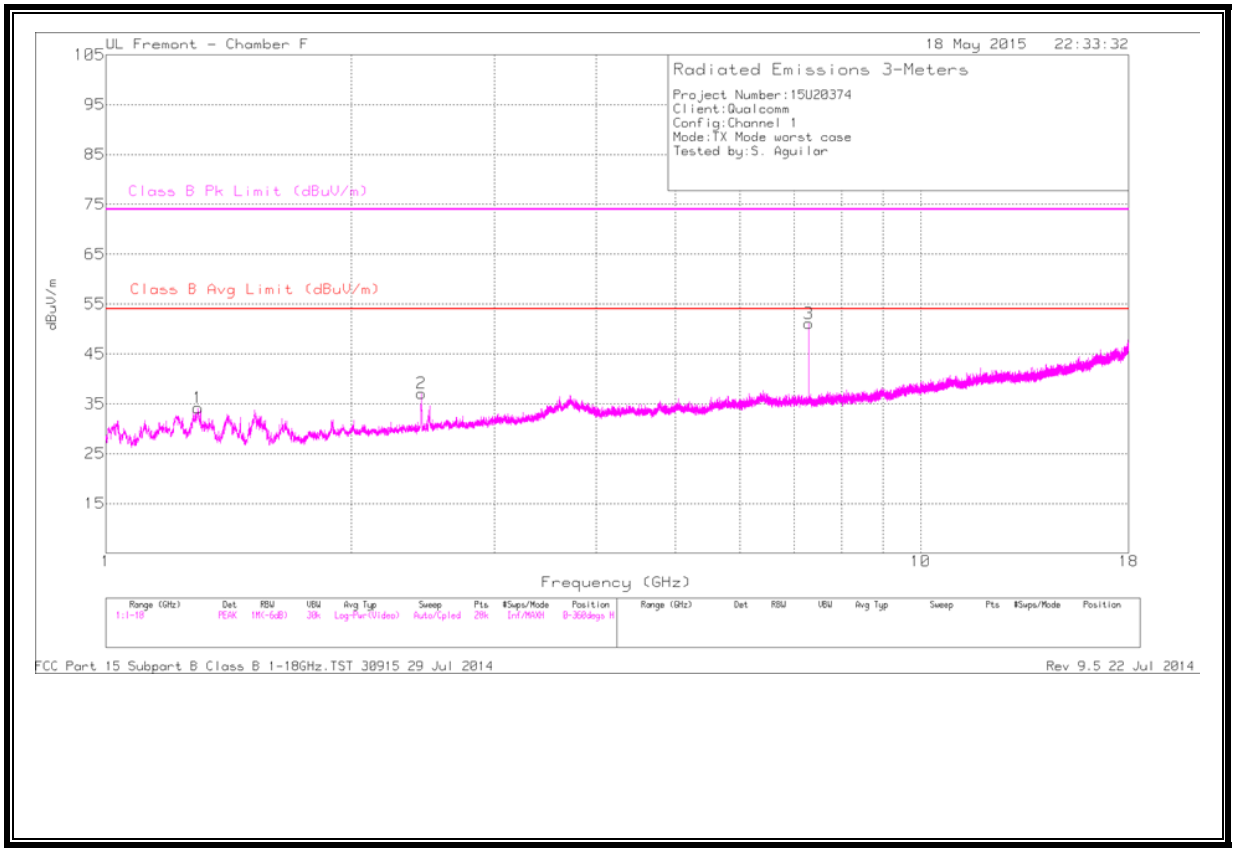
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7	47.8925	45.89	Pk	9	-28.5	26.39	40	-13.61	0-360	100	V
1	71.99	48.71	Pk	8.1	-28.3	28.51	40	-11.49	0-360	199	H
2	120.015	43.53	Pk	14.1	-27.8	29.83	43.52	-13.69	0-360	199	H
3	299.79	51.21	Pk	13.4	-25.9	38.71	46.02	-7.31	245	104	H
3	299.797	49.1	Qp	13.4	-25.9	36.6	46.02	-9.42	245	104	H
8	299.8	44.38	Pk	13.4	-25.9	31.88	46.02	-14.14	0-360	199	V
9	497.852	43.82	Pk	17.8	-25.6	36.02	46.02	-10	224	223	V
9	497.798	41.45	Qp	17.8	-25.6	33.65	46.02	-12.37	224	223	V
4	499.681	53.6	Pk	17.8	-25.7	45.7	46.02	-.32	93	208	H
4	499.694	51.22	Qp	17.8	-25.7	43.32	46.02	-2.7	93	208	H
5	531.2	60.96	Pk	18.1	-25.5	53.56	46.02	7.54	109	210	H
5	531.2	39.32	Qp	18.1	-25.5	31.92	46.02	-14.1	109	210	H
10	530.997	55.98	Pk	18	-25.5	48.48	46.02	2.46	256	230	V
10	531.001	35.02	Qp	18.1	-25.5	27.62	46.02	-18.4	256	230	V
6	539.384	27.78	Qp	18.3	-25.5	20.58	46.02	-25.44	295	311	H
6	539.389	47.59	Pk	18.3	-25.5	40.39	46.02	-5.63	295	311	H

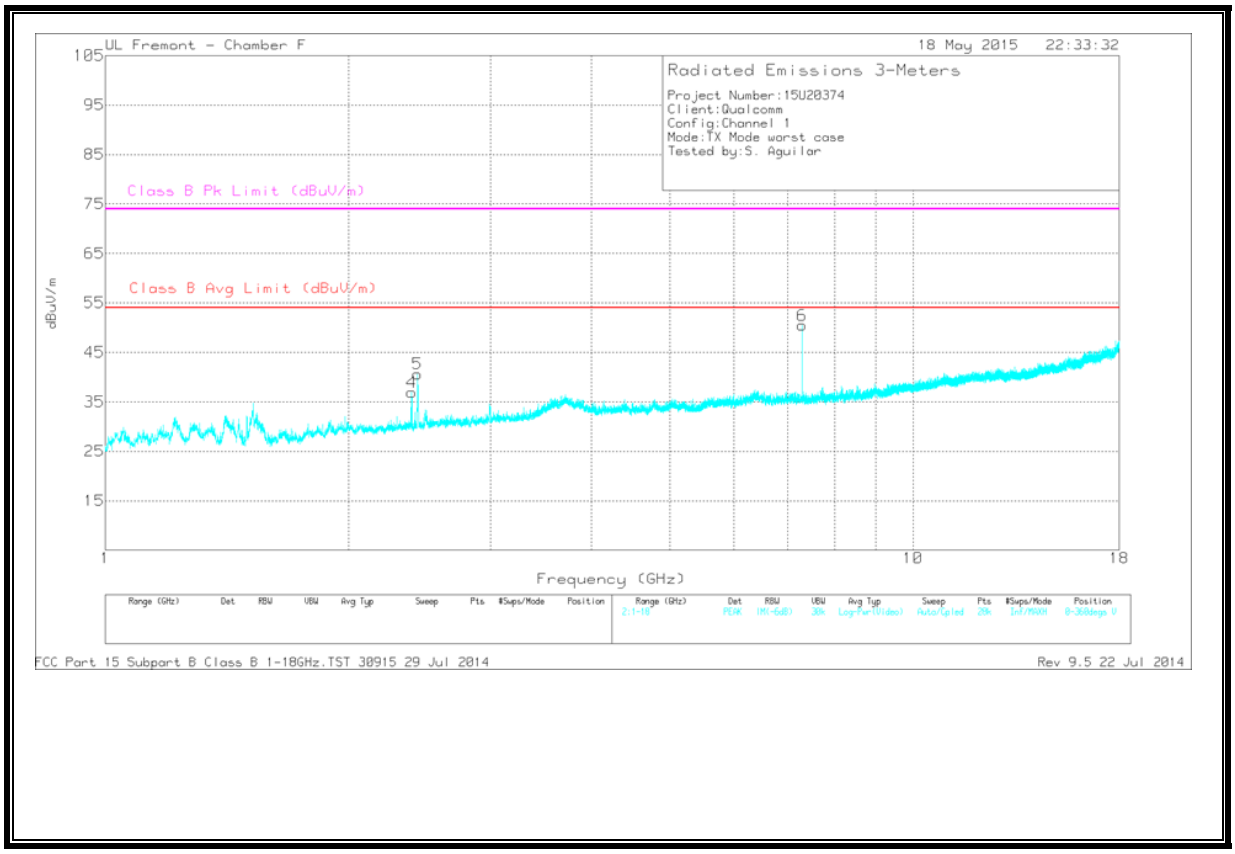
PK - Peak detector , QP - Quasi-Peak detector

7.6.2. Spurious Emissions 1 TO 18 GHz

CHANNEL 1 - TX SPURIOUS EMISSION 1-18 GHz (HORIZONTAL PLOT)



CHANNEL 1 – TX SPURIOUS EMISSION 1-18 GHz (VERTICAL PLOT)



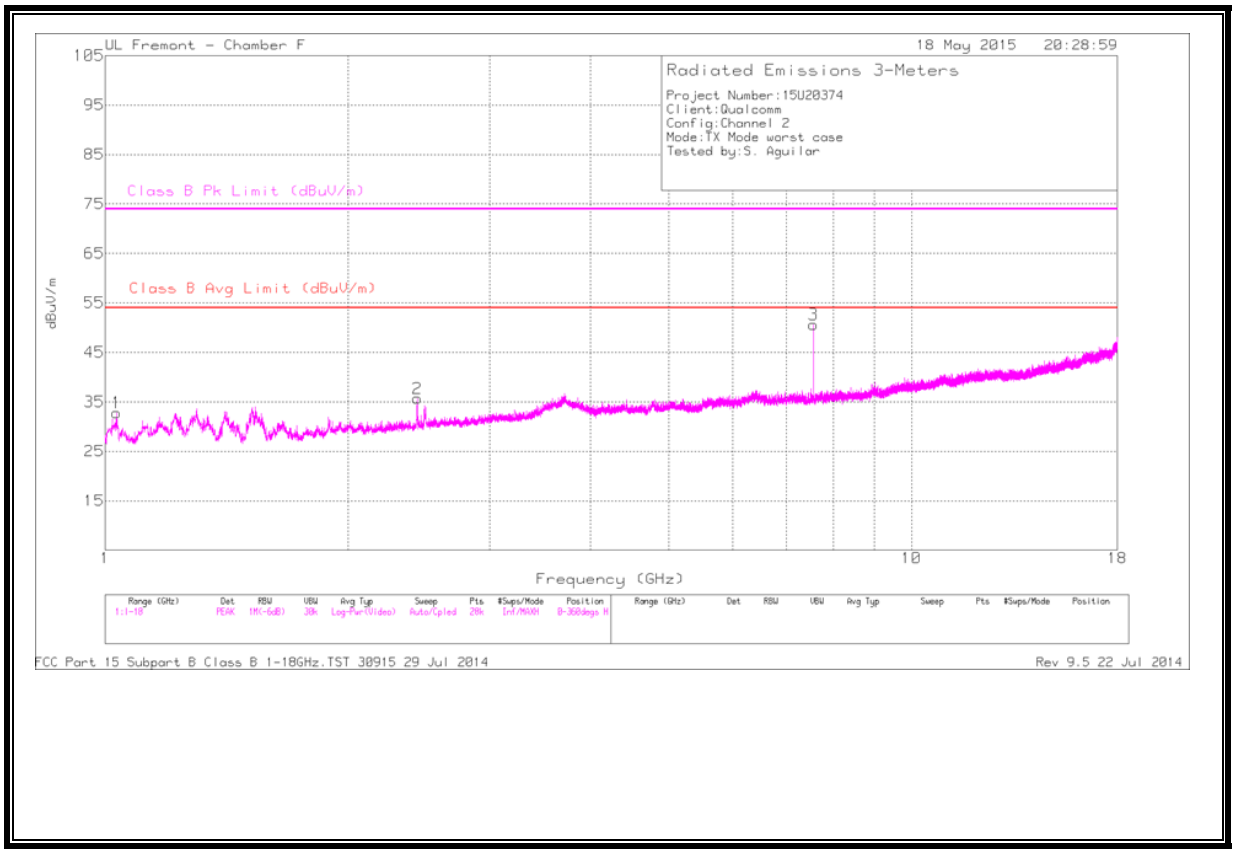
CHANNEL 1 TX SPURIOUS EMISSION 1-18 GHz

Trace Markers

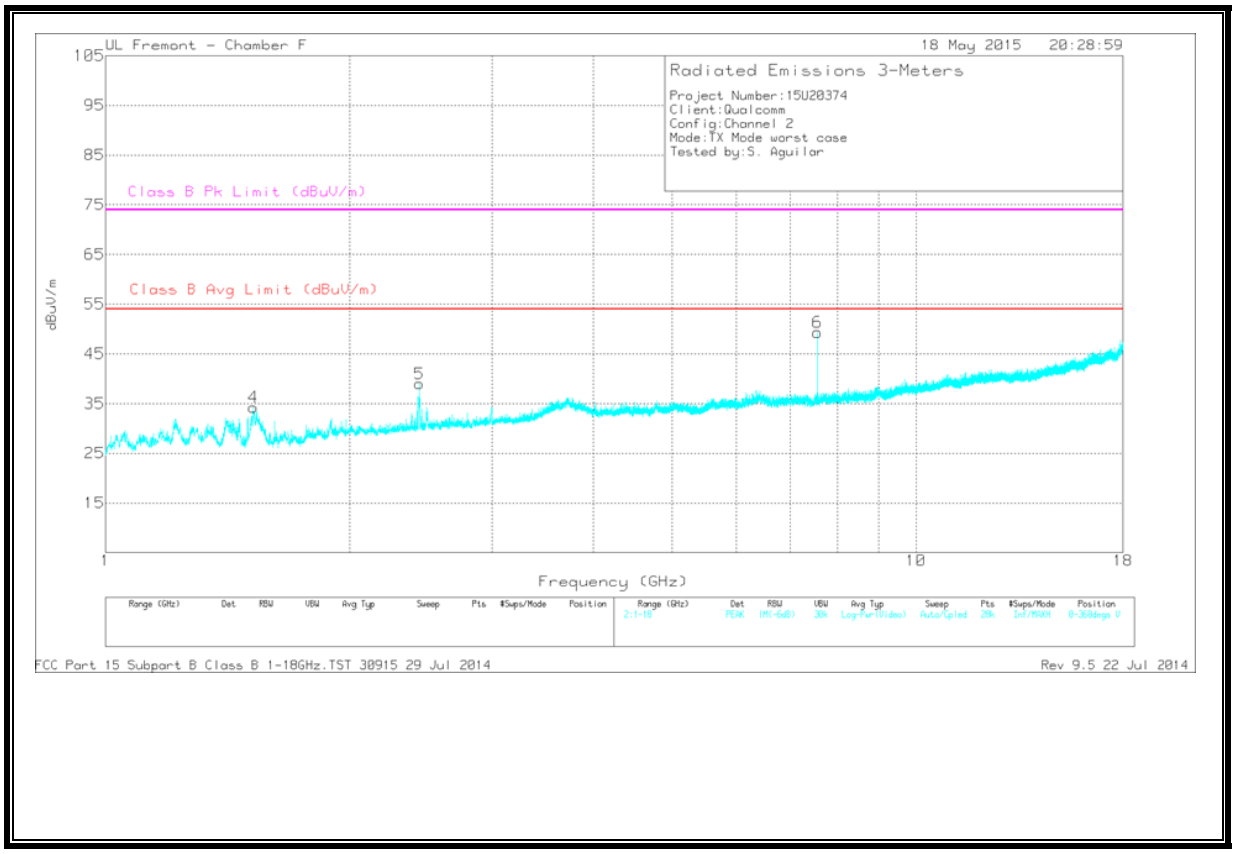
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av(CISPR) Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.298	36.18	PK	30	-32	34.18	-	-	74	-39.82	0-360	101	H
2	2.439	36	PK	32	-30.9	37.1	-	-	74	-36.9	0-360	201	H
3	7.29	45.32	PK	35.7	-26.8	54.22	-	-	74	-19.78	22	276	H
3	7.29	42.59	Avg	35.7	-26.8	51.49	54	-2.51	-	-	22	276	H
4	2.396	35.81	PK	31.9	-30.8	36.91	-	-	74	-37.09	0-360	201	V
5	2.435	39.65	PK	32	-31	40.65	-	-	74	-33.35	0-360	201	V
6	7.29	44.97	PK	35.7	-26.8	53.87	-	-	74	-20.13	30	171	V
6	7.29	42.21	Avg	35.7	-26.8	51.11	54	-2.89	-	-	30	171	V

PK - Peak detector
Avg - Video bandwidth < Resolution bandwidth

CHANNEL 2 - TX SPURIOUS EMISSION 1-18 GHz (HORIZONTAL PLOT)



CHANNEL 2 – TX SPURIOUS EMISSION 1-18 GHz (VERTICAL PLOT)



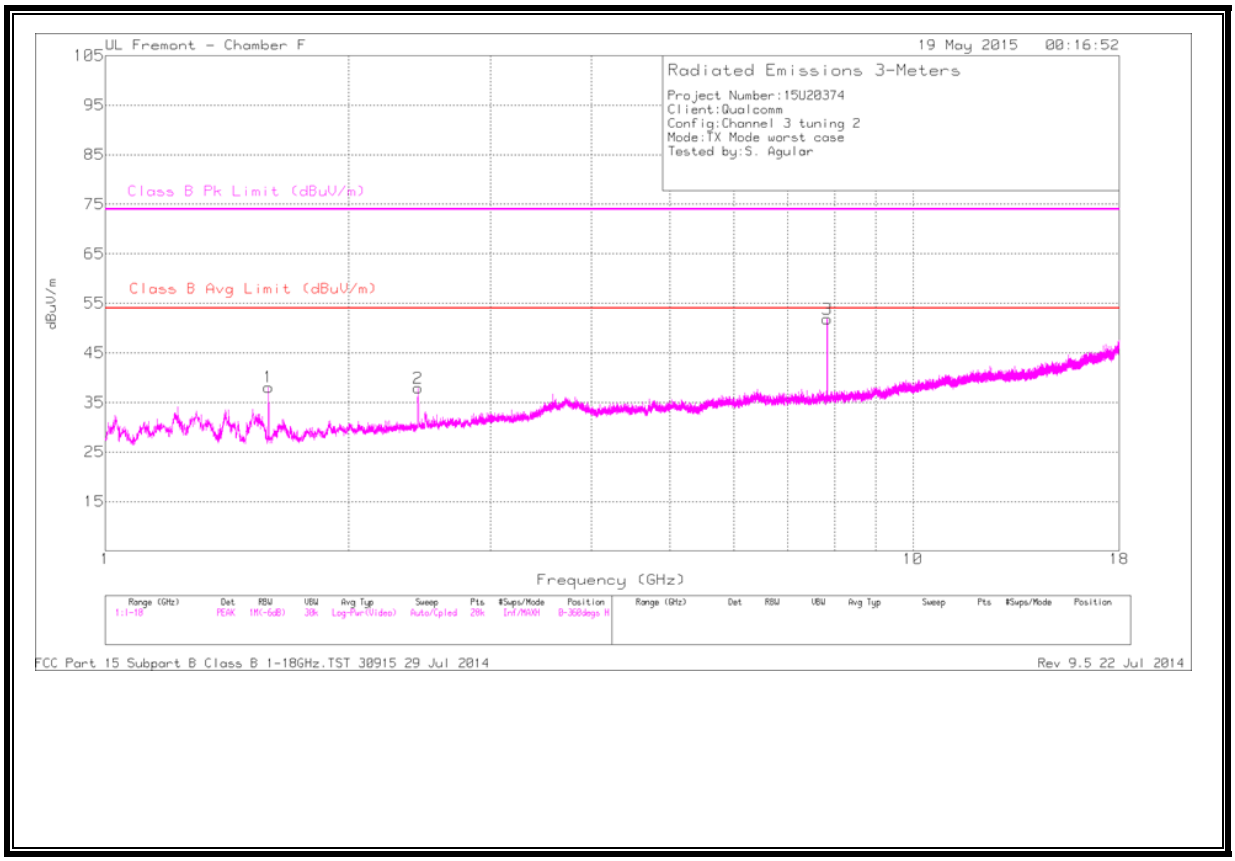
CHANNEL 2 TX SPURIOUS EMISSION 1-18 GHz

Trace Markers

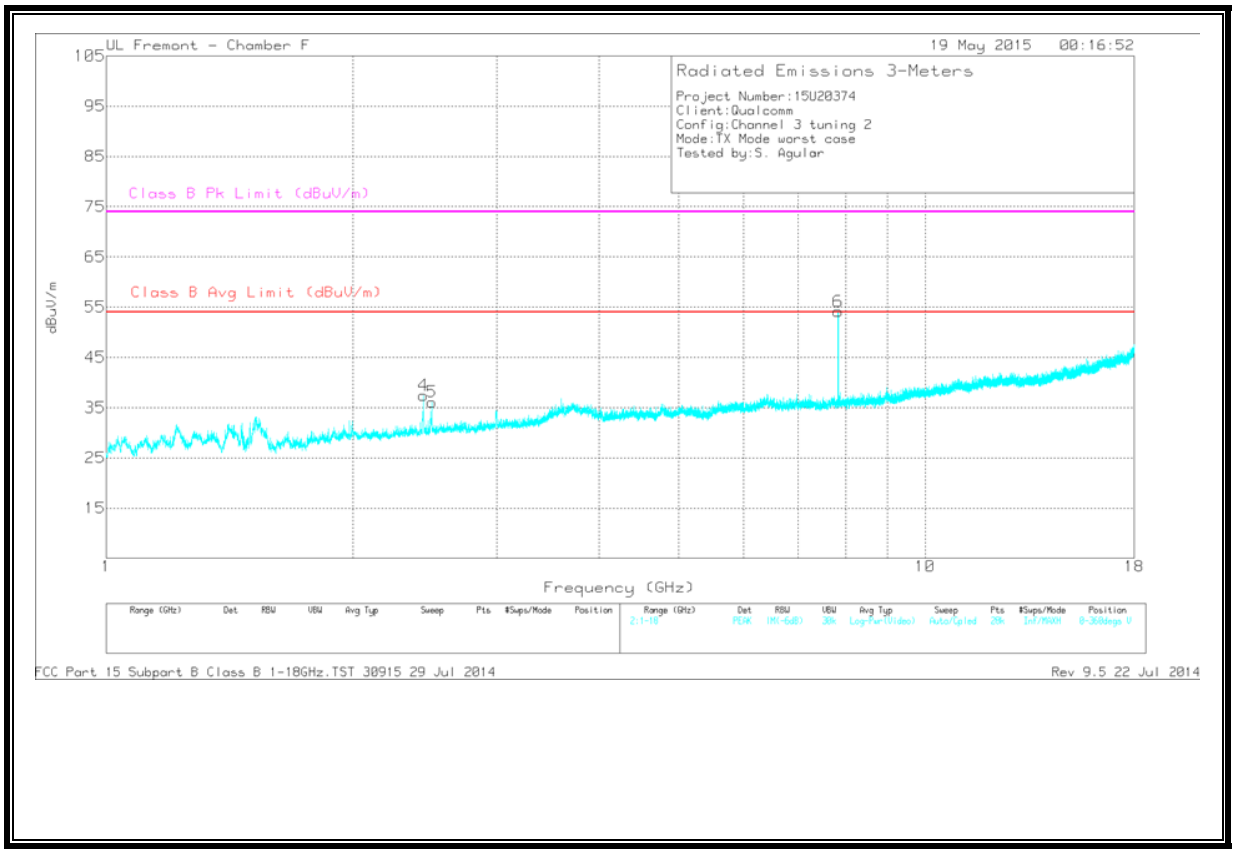
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av(CISPR) Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.034	38	PK	27.3	-32.5	32.8	-	-	74	-41.2	0-360	100	H
2	2.438	34.6	PK	32	-30.9	35.7	-	-	74	-38.3	0-360	100	H
3	7.56	45.49	PK	35.8	-26.2	55.09	-	-	74	-18.91	353	110	H
3	7.56	42.22	Avg	35.8	-26.2	51.82	54	-2.81	-	-	353	110	H
4	1.521	37.87	PK	28.2	-31.8	34.27	-	-	74	-39.73	0-360	201	V
5	2.439	37.9	PK	32	-30.9	39	-	-	74	-35	0-360	101	V
6	7.56	46.08	PK	35.8	-26.2	55.68	-	-	74	-18.32	338	212	V
6	7.56	42.77	Avg	35.8	-26.2	52.37	54	-1.63	-	-	338	212	V

PK - Peak detector
Avg - Video bandwidth < Resolution bandwidth

CHANNEL 3 - TX SPURIOUS EMISSION 1-18 GHz (HORIZONTAL PLOT)



CHANNEL 3 – TX SPURIOUS EMISSION 1-18 GHz (VERTICAL PLOT)



CHANNEL 3 TX SPURIOUS EMISSION 1-18 GHz

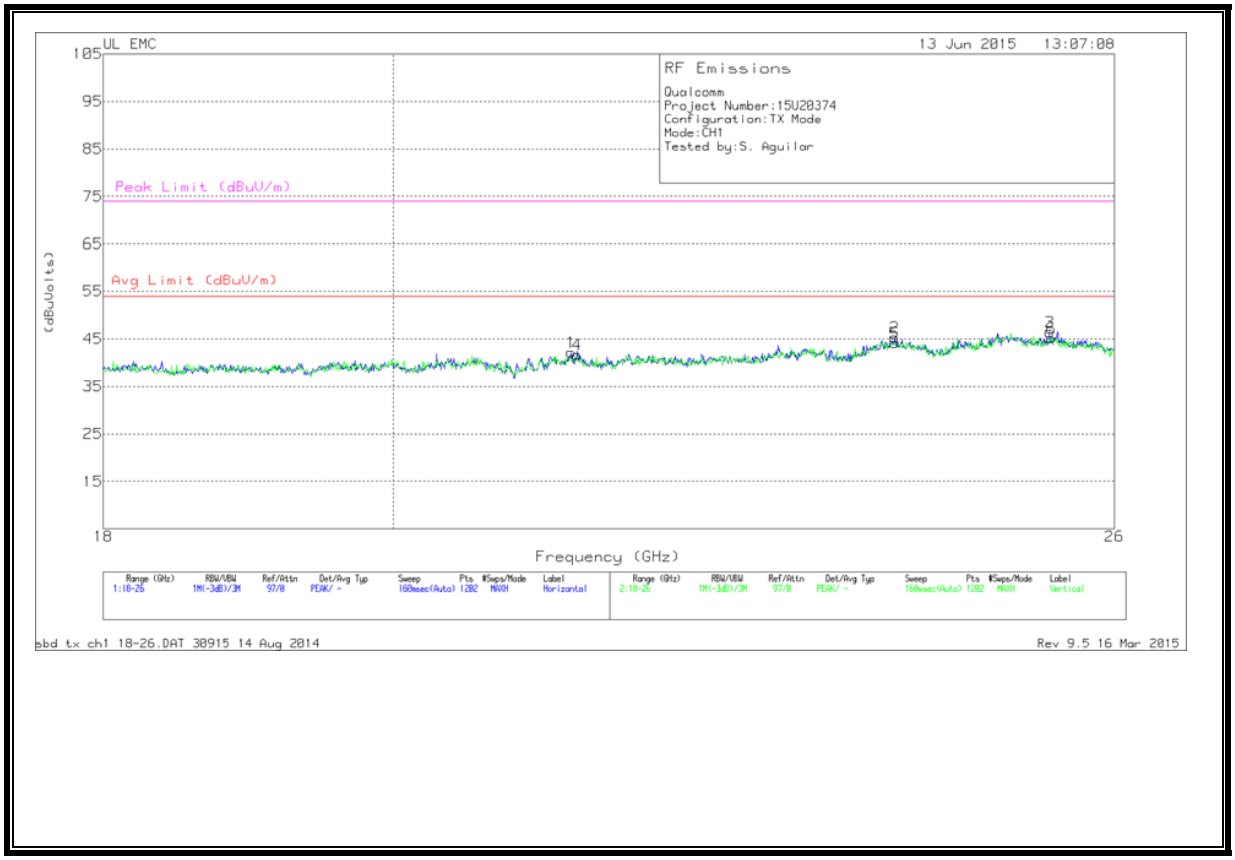
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av(CISPR) Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.593	41.68	PK	28.1	-31.7	38.08	-	-	74	-35.92	0-360	201	H
2	2.439	36.8	PK	32	-30.9	37.9	-	-	74	-36.1	0-360	201	H
3	7.83	44.09	PK	35.7	-26.1	53.69	-	-	74	-20.31	58	134	H
3	7.83	40.7	Avg	35.7	-26.1	50.3	54	-3.7	-	-	58	134	H
4	2.439	36.35	PK	32	-30.9	37.45	-	-	74	-36.55	0-360	101	V
5	2.499	34.43	PK	32.3	-30.6	36.13	-	-	74	-37.87	0-360	201	V
6	7.83	45.38	PK	35.7	-26.1	54.98	-	-	74	-19.02	64	149	V
6	7.83	43.07	Avg	35.7	-26.1	52.67	54	-1.33	-	-	64	149	V

PK - Peak detector
Avg - Video bandwidth < Resolution bandwidth

7.6.3. Spurious Emissions 18 to 26 GHz

CHANNEL 1 - TX SPURIOUS EMISSION 18 TO 26 GHz (HORIZONTAL AND VERTICAL PLOT)



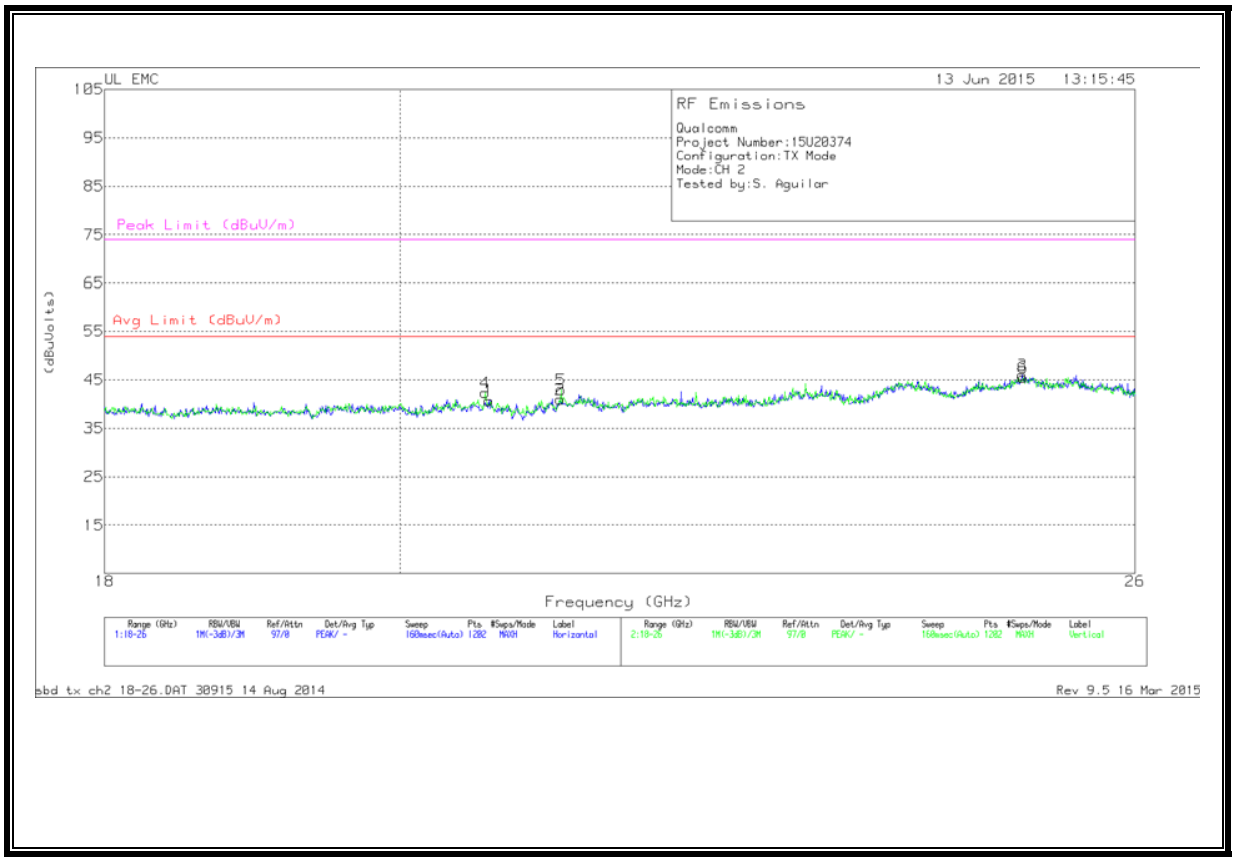
CHANNEL 1 -TX SPURIOUS EMISSION 18 TO 26 GHz

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T89 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	21.337	42.57	Pk	33.1	-24	-9.5	42.16	54	-11.83	74	-31.83
2	24.002	44.33	Pk	33.2	-22.7	-9.5	45.333	54	-8.66	74	-28.66
3	25.394	45.3	Pk	33.7	-23	-9.5	46.5	54	-7.5	74	-27.5
4	21.384	41.77	Pk	33.1	-23.7	-9.5	41.66	54	-12.33	74	-32.33
5	24.002	43.17	Pk	33.2	-22.7	-9.5	44.16	54	-9.83	74	-29.83
6	25.407	43.67	Pk	33.8	-22.8	-9.5	45.16	54	-8.83	74	-28.83

Pk - Peak detector

CHANNEL 2 - TX SPURIOUS EMISSION 18 TO 26 GHz (HORIZONTAL AND VERTICAL PLOT)



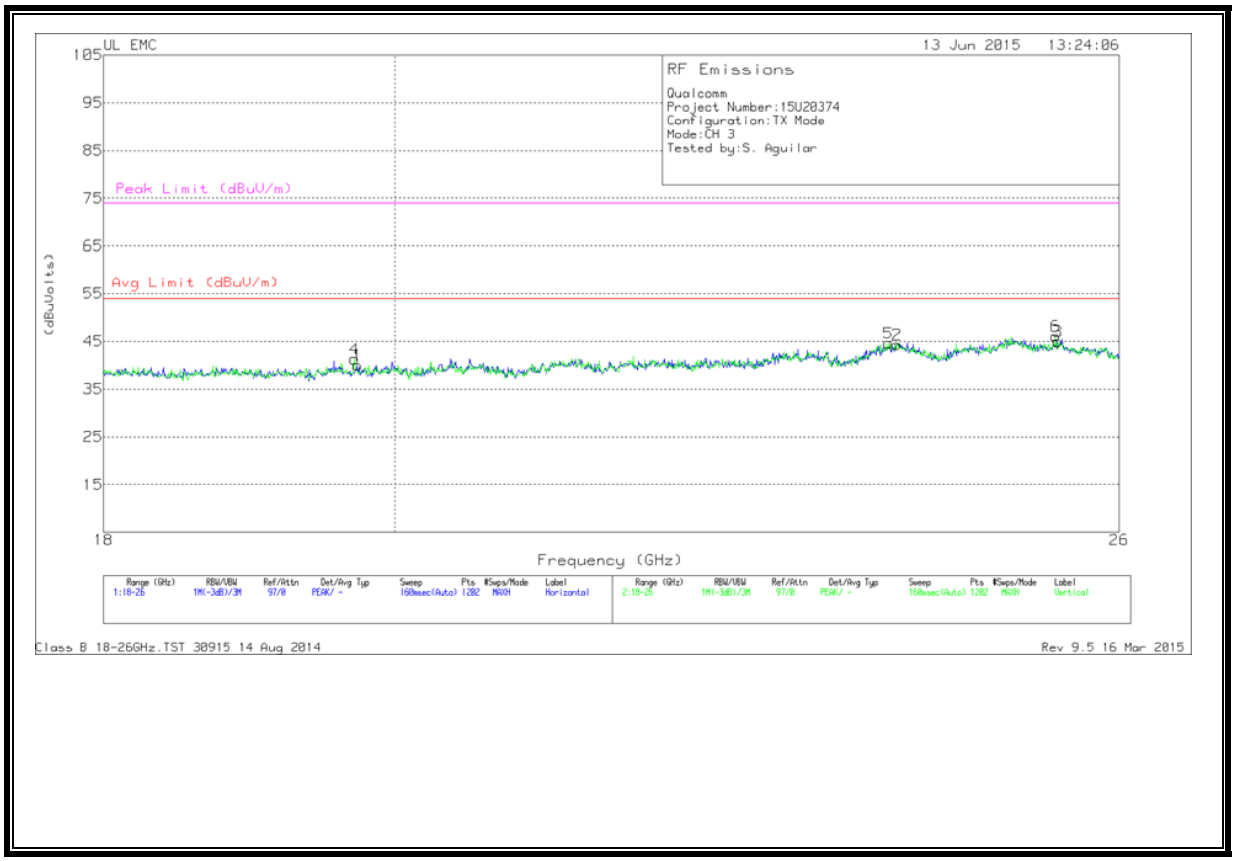
CHANNEL 2 -TX SPURIOUS EMISSION 18 TO 26 GHz

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T89 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	20.644	40.77	Pk	32.7	-23.3	-9.5	40.66	54	-13.33	74	-33.33
2	21.177	41	Pk	33	-23.5	-9.5	41	54	-13	74	-33
3	24.974	44.3	Pk	34.1	-22.9	-9.5	46	54	-8	74	-28
4	20.618	42.73	Pk	32.7	-23.6	-9.5	42.33	54	-11.66	74	-31.66
5	21.184	43	Pk	33	-23.5	-9.5	43	54	-11	74	-31
6	24.981	43.7	Pk	34.2	-22.9	-9.5	45.5	54	-8.5	74	-28.5

Pk - Peak detector

CHANNEL 3 - TX SPURIOUS EMISSION 18 TO 26 GHz (HORIZONTAL AND VERTICAL PLOT)



CHANNEL 3 -TX SPURIOUS EMISSION 18 TO 26 GHz

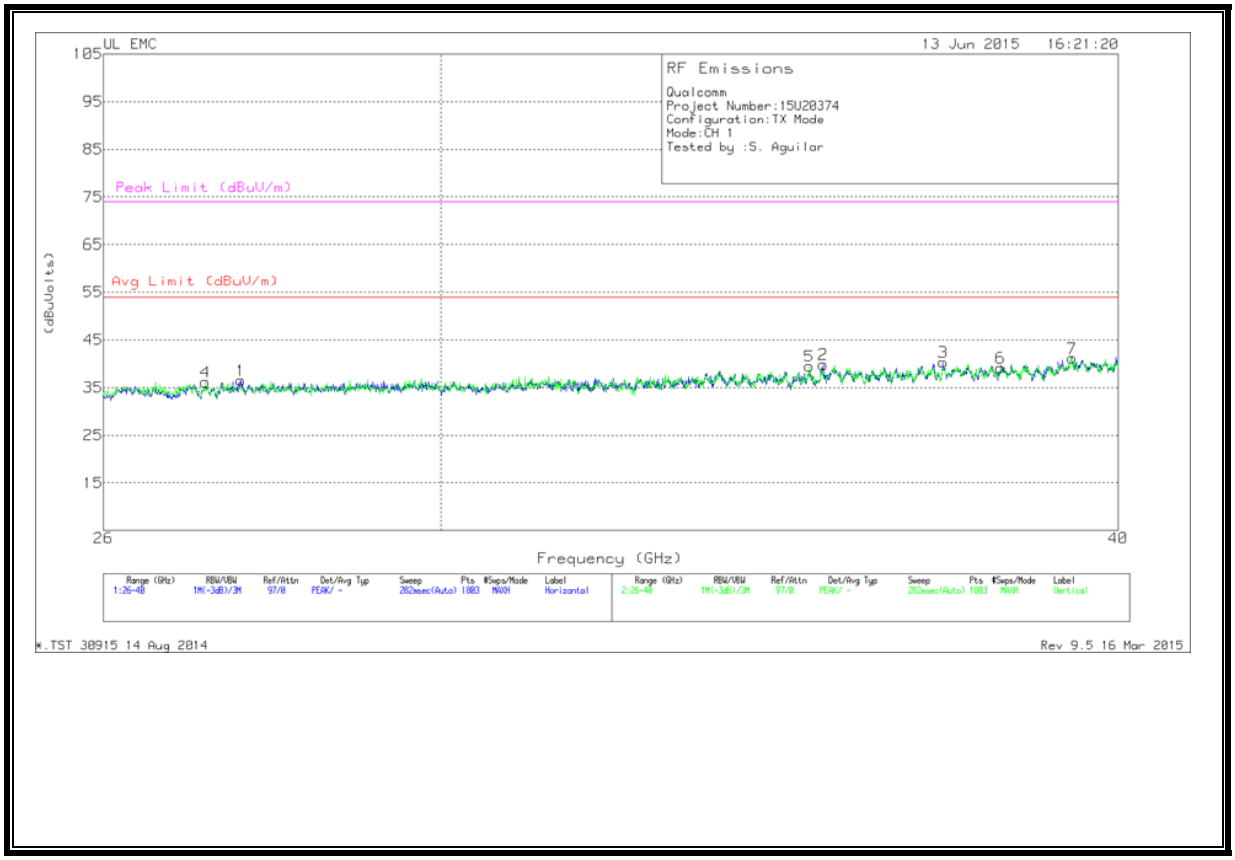
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T89 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	19.732	40.9	Pk	32.5	-23.9	-9.5	40	54	-14	74	-34
2	23.988	43.23	Pk	33.3	-22.7	-9.5	44.33	54	-9.66	74	-29.66
3	25.427	43.8	Pk	33.8	-23.1	-9.5	45	54	-9	74	-29
4	19.712	42.33	Pk	32.5	-24	-9.5	41.33	54	-12.66	74	-32.66
5	23.915	43.47	Pk	33.4	-22.7	-9.5	44.66	54	-9.33	74	-29.33
6	25.407	44.67	Pk	33.8	-22.8	-9.5	46.16	54	-7.83	74	-27.83

Pk - Peak detector

7.6.4. Spurious Emissions 26 TO 40 GHz

CHANNEL 1 - TX SPURIOUS EMISSION 26 TO 40 GHz (HORIZONTAL AND VERTICAL PLOT)



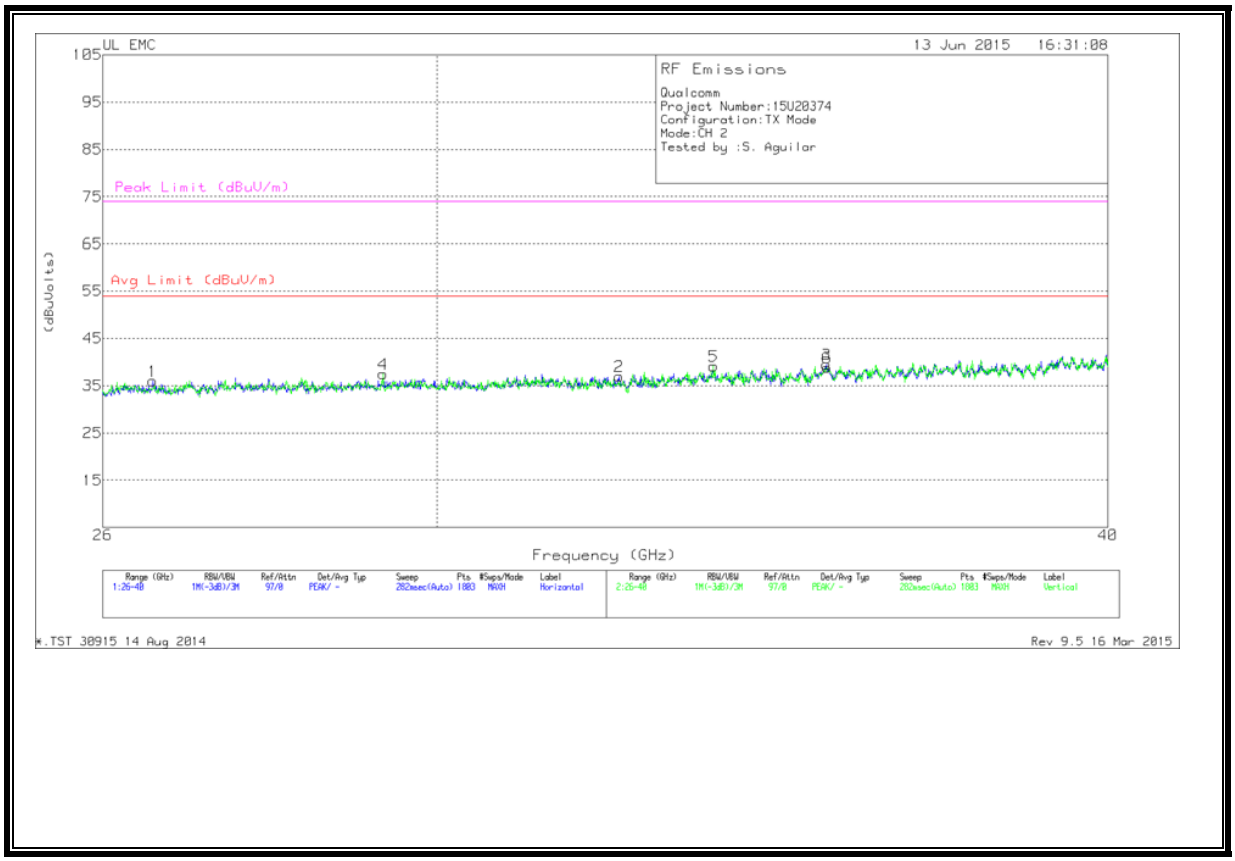
CHANNEL 1 -TX SPURIOUS EMISSION 26 TO 40 GHz

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	27.562	44.7	Pk	35.7	-34.4	-9.5	36.5	54	-17.5	74	-37.5
2	35.292	48.53	Pk	37.7	-36.9	-9.5	39.83	54	-14.16	74	-34.16
3	37.133	50.03	Pk	37.2	-37.4	-9.5	40.33	54	-13.66	74	-33.66
4	27.15	43.97	Pk	35.5	-33.8	-9.5	36.16	54	-17.83	74	-37.83
5	35.082	48.5	Pk	37.4	-36.9	-9.5	39.5	54	-14.5	74	-34.5
6	38.05	49.07	Pk	37.2	-37.6	-9.5	39.16	54	-14.83	74	-34.83
7	39.223	48.17	Pk	38.5	-36	-9.5	41.16	54	-12.83	74	-32.83

Pk - Peak detector

CHANNEL 2 - TX SPURIOUS EMISSION 26 TO 40 GHz (HORIZONTAL AND VERTICAL PLOT)



CHANNEL 2 -TX SPURIOUS EMISSION 26 TO 40 GHz

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	26.559	43.3	Pk	35.4	-33.2	-9.5	36	54	-18	74	-38
2	32.441	46.3	Pk	36.2	-36	-9.5	37	54	-17	74	-37
3	35.455	48.5	Pk	37.9	-37.4	-9.5	39.5	54	-14.5	74	-34.5
4	29.317	46.1	Pk	35.9	-35	-9.5	37.5	54	-16.5	74	-36.5
5	33.777	48.37	Pk	36.8	-36.5	-9.5	39.16	54	-14.83	74	-34.83
6	35.463	47.83	Pk	37.9	-37.4	-9.5	38.83	54	-15.16	74	-35.16

Pk - Peak detector

CHANNEL 3 - TX SPURIOUS EMISSION 26 TO 40 GHz (HORIZONTAL AND VERTICAL PLOT)

CHANNEL 3 -TX SPURIOUS EMISSION 26 TO 40 GHz

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	29.558	46.07	Pk	35.9	-35.3	-9.5	37.16	54	-16.83	74	-36.83
2	31.019	47.03	Pk	35.9	-35.6	-9.5	37.83	54	-16.16	74	-36.16
3	39.192	49.27	Pk	38.3	-35.9	-9.5	42.16	54	-11.83	74	-31.83
4	28.121	45.1	Pk	35.8	-34.9	-9.5	36.5	54	-17.5	74	-37.5
5	31.671	46.8	Pk	36.3	-36.1	-9.5	37.5	54	-16.5	74	-36.5
6	35.665	49.33	Pk	37.4	-37.4	-9.5	39.83	54	-14.16	74	-34.16

Pk - Peak detector

7.6.5. Spurious Emissions 40 TO 200 GHz

No other emissions up to 200 GHz detected above the noise floor.

7.7. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

§15.207

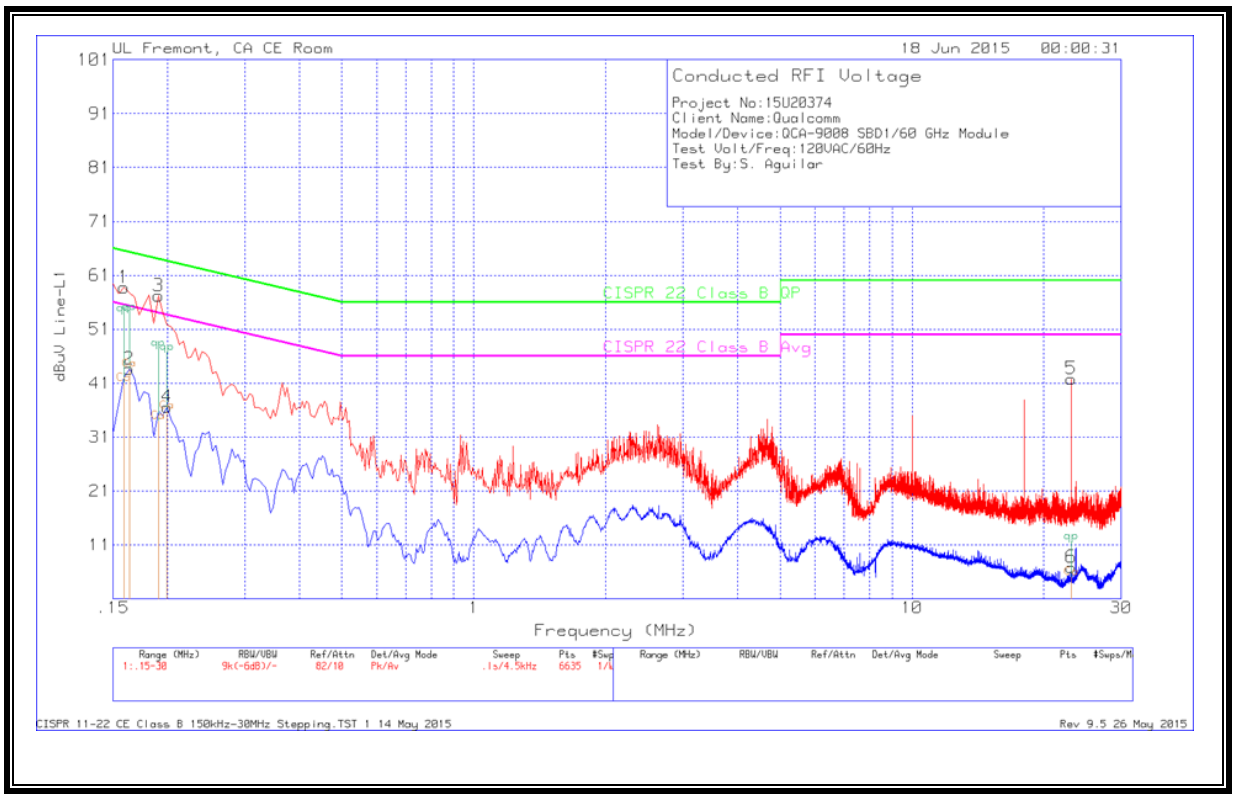
Frequency range (MHz)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

TEST PROCEDURE

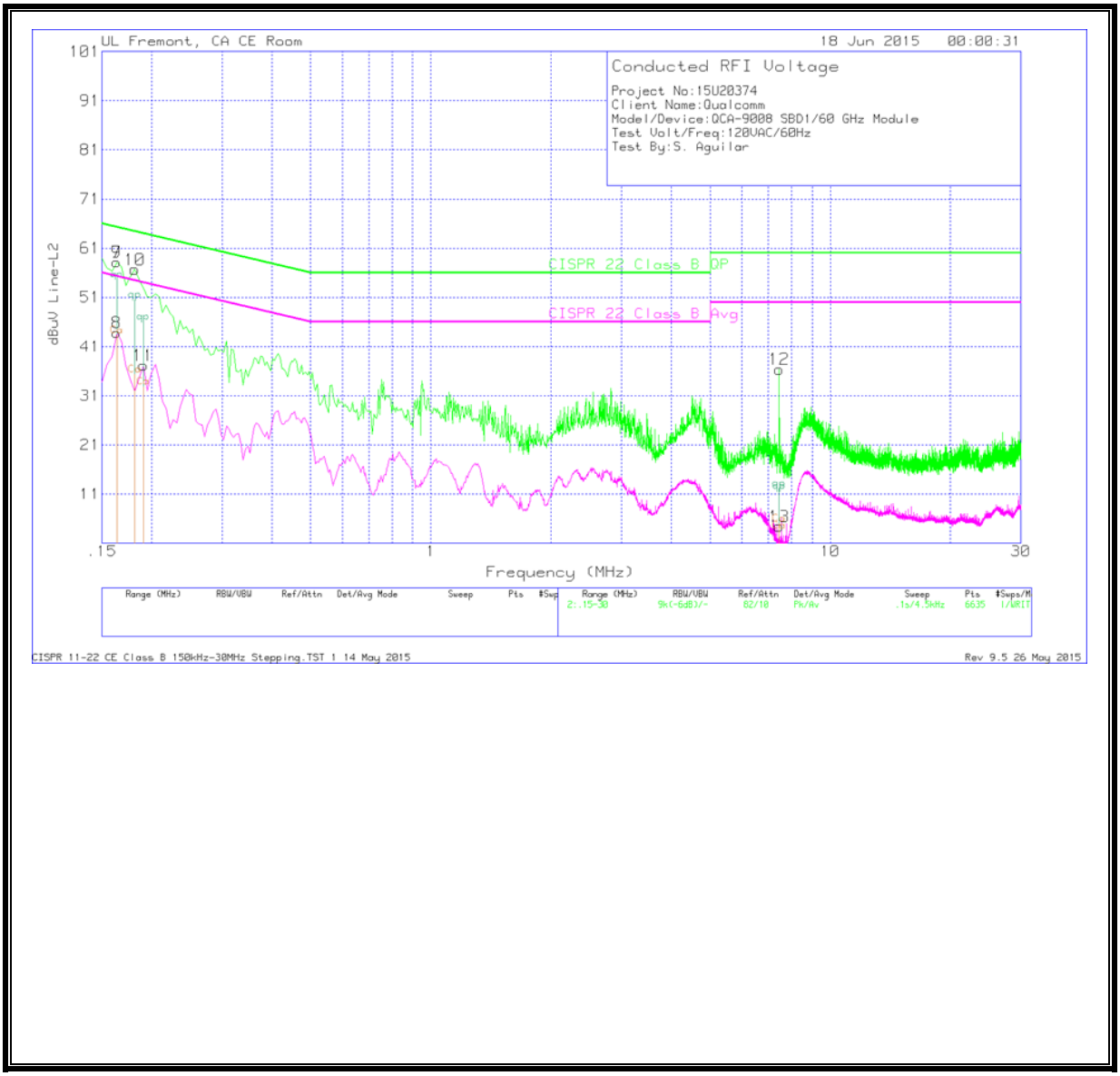
ANSI C63.10

RESULTS

6 WORST EMISSIONS



LINE 2 RESULTS



LINE 1 and 2 RESULTS

Trace Markers

Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
1	.159	52.52	Qp	1.3	0	53.82	65.52	-11.7	-	-
1	.159	39.62	Ca	1.3	0	40.92	-	-	55.52	-14.6
2	.1635	52.87	Qp	1.2	0	54.07	65.28	-11.21	-	-
2	.1635	42.41	Av	1.2	0	43.61	-	-	55.28	-11.67
2	.1635	42.34	Ca	1.2	0	43.54	-	-	55.28	-11.74
3	.1905	46.38	Qp	1	0	47.38	64.01	-16.63	-	-
3	.1905	32.9	Ca	1	0	33.9	-	-	54.01	-20.11
4	.1995	45.78	Qp	.9	0	46.68	63.63	-16.95	-	-
4	.1995	35.66	Av	.9	0	36.56	-	-	53.63	-17.07
4	.1995	34.88	Ca	.9	0	35.78	-	-	53.63	-17.85
5	23.1135	11.03	Qp	.3	.2	11.53	60	-48.47	-	-
6	23.1135	6.34	Av	.3	.2	6.84	-	-	50	-43.16
6	23.1135	4.43	Ca	.3	.2	4.93	-	-	50	-45.07

Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
7	.1635	53.32	Qp	1.3	0	54.62	65.28	-10.66	-	-
7	.1635	41.94	Ca	1.3	0	43.24	-	-	55.28	-12.04
8	.1635	42.55	Av	1.3	0	43.85	-	-	55.28	-11.43
10	.1815	49.29	Qp	1.2	0	50.49	64.42	-13.93	-	-
10	.1815	34.08	Ca	1.2	0	35.28	-	-	54.42	-19.14
11	.1905	44.92	Qp	1.1	0	46.02	64.01	-17.99	-	-
11	.1905	36.08	Av	1.1	0	37.18	-	-	54.01	-16.83
11	.1905	31.7	Ca	1.1	0	32.8	-	-	54.01	-21.21
12	7.449	11.28	Qp	.2	.1	11.58	60	-48.42	-	-
12	7.449	3.18	Ca	.2	.1	3.48	-	-	50	-46.52
13	7.4445	11.81	Qp	.2	.1	12.11	60	-47.89	-	-
13	7.4445	4.12	Av	.2	.1	4.42	-	-	50	-45.58
13	7.4445	4.65	Ca	.2	.1	4.95	-	-	50	-45.05

Pk - Peak detector, Av - Average detection, Peak/Average/RMS Emissions, Ca - CISPR average detection, Quasi-Peak Emissions

8. GROUP INSTALLATION

LIMIT

§15.255 (h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

RESULTS

The frequency, amplitude and phase of the transmit signal are set within the EUT. There are no external phase-locking inputs or any other means of combining two or more units together to realize a beam-forming array.

9. RF EXPOSURE

FCC RULES

§15.255 (g) Regardless of the power density levels permitted under this section, devices operating under the provisions of this section are subject to the radiofrequency radiation exposure requirements specified in §§1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

TECHNICAL INFORMATION IN ACCORDANCE WITH 15.255 (g) SHOWING BASIS OF UPPER BOUND RESULTS FOR BOTH FUNDAMENTAL AND UNWANTED EMISSIONS

Worst-case possible Integrated Band Power, assuming unwanted emissions encompass the entire band and the power density at every frequency is equal to the spurious emissions average limit								
Band	Start (MHz)	Stop (MHz)	Limit (dBuV/m at 3m)	Limit (dBm EIRP)	Limit (mW EIRP)	RBW (MHz)	Num Intervals (stop-start)/(RBW)	Integrated Band Power (mW EIRP)
30 to 88 MHz	30	88	40	-55.2	3.01995E-06	0.1	580	0.002
88 to 216 MHz	88	216	43.5	-51.7	6.76083E-06	0.1	1280	0.009
216 to 960 MHz	216	960	46	-49.2	1.20226E-05	0.1	7440	0.089
960 to 1000 MHz	960	1000	54	-41.2	7.58578E-05	0.1	400	0.030
1 to 40 GHz	1000	40000	55	-40.2	9.54993E-05	1	39000	3.724
30 MHz to 40 GHz								3.855

Integrated Band Power, equal to the sum of the power of all measured emissions within the band. Unwanted emissions measurements are peak, thus will over-estimate the average level. Fundamental emissions measurements are average								
Freq or Band (GHz)	EUT Channel			Actual Emissions (dBm EIRP)	Actual Power (mW EIRP)			Integrated Band Power (mW EIRP)
58.32	1			23.7	234.423			
40 to 200 GHz	1							234.423
60.48	2			29.8	954.993			
40 to 200 GHz	2							954.993
62.64	3			28.7	741.310			
40 to 200 GHz	3							741.310

Total Integrated Band Power, equal to the worst-case possible 30 MHz to 40 GHz band power plus the measured 40 to 200 GHz band power								
Band	EUT Channel							Integrated Band Power (mW EIRP)
30 MHz to 200 GHz	1							238.278
30 MHz to 200 GHz	2							958.847
30 MHz to 200 GHz	3							745.165

CALCULATIONS

EIRP is converted to Power Density using the equation:

P_D = EIRP / (4 * Pi * D_S^2)

where:

P_D = power density in mW/m^2
EIRP = Equivalent Isotropic Radiated Power in mW
D_S = separation distance in cm

RESULTS FOR FUNDAMENTAL EMISSIONS

Channel	Average EIRP (dBm)	Average EIRP (mW)	Separation Distance (cm)	Power Density (mW/cm^2)	FCC Limit (mW/cm^2)
1	23.7	234.423	20	0.05	1
2	29.8	954.993	20	0.19	1
3	28.7	741.310	20	0.15	1

UPPER BOUND RESULTS FOR BOTH FUNDAMENTAL AND UNWANTED EMISSIONS

Channel	Integrated EIRP (mW)	Separation Distance (cm)	Power Density (mW/cm^2)	FCC Limit (mW/cm^2)
1	238.278	20	0.05	1
2	958.847	20	0.19	1
3	745.165	20	0.15	1