FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8
INDUSTRY CANADA RSS-102 ISSUE 4

CERTIFICATION TEST REPORT

FOR

60 GHz WIRELESSHD DISPLAY MINI CARD TRANSMITTER

MODEL NUMBER: SIL-SK63100

FCC ID: UK2-SIL-SK63100
IC: 6705A-SILSK63100

REPORT NUMBER: 12U14290-3, Revision C

ISSUE DATE: MAY 25, 2012

Prepared for
SILICON IMAGE
1140 EAST ARQUES AVE
SUNNYVALE, CA 94085, U.S.A.

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/02/2012	As Issued	M. Heckrotte
A	05/15/2012	Revised Peak and Average Power	M. Heckrotte
B	05/16/2012	Fixed corrupted I/O cable list and updated support equipment list	A. Zaffar
C	05/25/2012	Added RF Exposure Scaling	M. Heckrotte

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SILICON IMAGE
1140 EAST ARQUES AVE
SUNNYVALE, CA, 94085, U.S.A.

EUT DESCRIPTION: 60GHz WIRELESSHD DISPLAY MINI CARD TRANSMITTER

MODEL: SIL-SK63100

SERIAL NUMBER: 21D-0026-X013

DATE TESTED: FEBRUARY 21 TO MAY 15, 2012

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 13	Pass
INDUSTRY CANADA RSS-102 Issue 4	Pass

Compliance Certification Services (UL CCS) 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 CCS 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS 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 CCS By:

MICHAEL HECKROTTE
DIRECTOR OF ENGINEERING
UL CCS

Tested By:

MENGISTU MEKURIA
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC KDB 200443 Millimeter Wave Test Procedure, FCC Bulletin OET 65, IEEE C95.3-2002, RSS-210 Issue 8, RSS-GEN Issue 3 and RSS-102 Issue 4.

3. FACILITIES AND ACCREDITATION

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

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a WirelessHD Source radio module. It is designed to operate as part of a Wireless Video Audio Network (WVAN) in the 57 to 64 GHz band. The EUT sends High Definition Audio/Video to a WirelessHD Sink radio device.

The EUT transmits High Definition Audio/Video data on a single Medium Rate (MRP) or High Rate (HRP) channel at either 60.48 GHz or 62.64 GHz. The integral MRP/HRP transmit antenna is an adaptive beam-steering array with a maximum gain of 18 dBi.

The EUT transmits and receives control and management signals on one of five Low Rate (LRP) channels for each MRP/HRP channel. LRP channels range from 60.16275 to 60.79725 GHz (for MRP/HRP at 60.48 GHz) or from 62.32275 to 62.95725 GHz (for MRP/HRP at 62.64 GHz). The integral LRP transmit/receive antenna is a scanning beam-steering array with a maximum gain of 16 dBi.

The LRP modulation is BPSK. The MRP modulation is QPSK, at a data rate of 0.476, 0.952, 0.714 or 1.190 Gb/s The HRP modulation can be either QPSK or 16-QAM. Three system data rates are implemented: QPSK at 0.952 Gb/s (Quarter Rate), QPSK at 1.904 Gb/s (Half Rate) and 16-QAM at 3.807 Gb/s (Full Rate).

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 highest peak output power for LRP is 18.2 dBm (66.1 mW).

The highest peak output power for MRP is 16.5 dBm (44.7 mW)

The highest peak output power for HRP is 17.0 dBm (50.1 mW).

5.3. WORST-CASE CONFIGURATION AND MODE

The 1080p video mode was determined to be the worst case mode for emissions.

5.4. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Test Jig	Silicon Image	N/A	N/A
Power Supply	Agilent	E3632A	MY40012979
Power Supply	Cincon	TR20B033X	20033-0000540
Video Generator	Quantum Data	882E	9040041
WiHD Sink	Silicon Image	Prototype	Prototype
TV	Samsung	P23700HD	EM23HVLZ415106K

I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	AC	Un-Shielded	2.0 m	N/A
2	DC	1	DC	Un-Shielded	0.5 m	N/A
3	I/O	1	HDMI	Shielded	9 m	Excess bundled inside shielded box
4	AC	1	AC	Un-Shielded	1.0 m	N/A

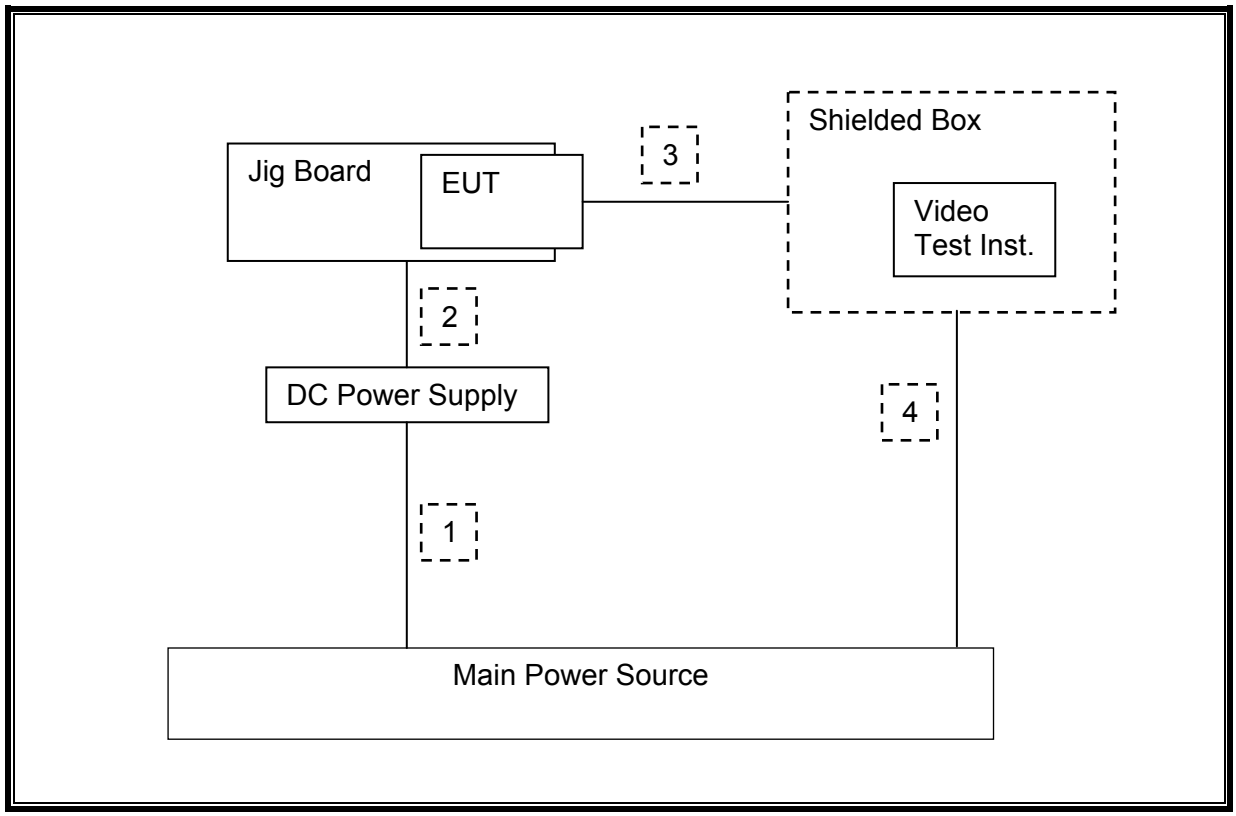
TEST SETUP

The QD generator was placed inside a shielded box. High Definition Audio / Video was sent from the QD generator to the EUT via a conducted HDMI cable connection to the test jig, then sent from the EUT to the Television via an over-the-air link to the WiHD Sink.

The Television and WiHD Sink were placed behind the measuring antenna.

A laptop computer was utilized to adjust the EUT for testing purposes. This computer was not connected during measurements.

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**	**Asset**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	9/2/2012
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	5/4/2012
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	22/03/2013
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	7/16/2012
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	11/11/2012
Antenna, Horn, 18 GHz	EMCO	3115	C00872	9/20/2012
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	7/18/2012
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	7/28/2012
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	6/14/2012
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	8/2/2012
Downconverter, 67 GHz	Agilent	MT-463	12020	10/10/2012
Millimeter-Wave Source, 75 GHz	OML	S15MS-AG	80708-4	CNR
Analog Signal Generator, 40 GHz	Agilent / HP	E8257D	C01177	8/18/2012
Harmonic Mixer, 50 GHz	Agilent / HP	11970Q	C00769	5/11/2013
Harmonic Mixer, 75 GHz	Agilent / HP	11970V	C00768	1/31/2014
Harmonic Mixer, 110 GHz	Agilent / HP	11970W	C00770	2/9/2014
Harmonic Mixer, 140 GHz	OML	M08HWA	C00868	CNR
Harmonic Mixer, 220 GHz	OML	M05HWA	C00867	CNR
Mixer Diplexer for HP	OML	DPL.313B	N02429	CNR
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	C00930	10/20/2012
Small Aperture WG Antenna	Space Machine	WR15 WG Probe	2706	1/13/2013
Power Meter	Agilent / HP	437B	CCS153	7/28/2012
Power Sensor, 50 to 75 GHz	Agilent / HP	V8486A	C01193	2/15/2013
LISN, 30 MHz	FCC	50/250-25-2	C00626	12/13/2012
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	12/13/2013

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

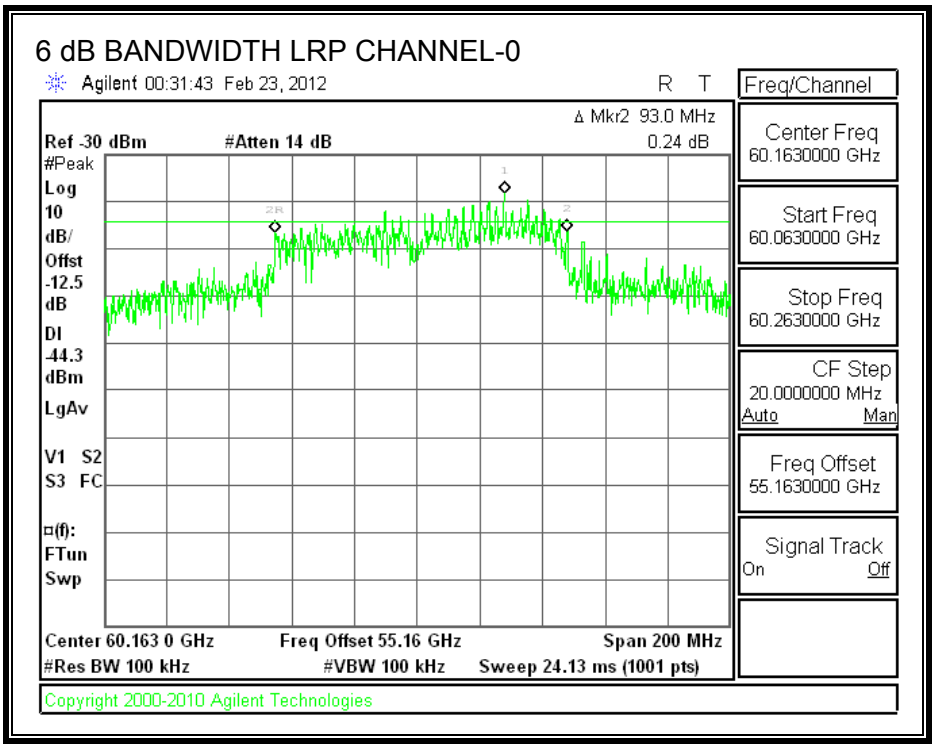
The spectrum analyzer and external mixer are set up to measure the radiated output of the transmitter.

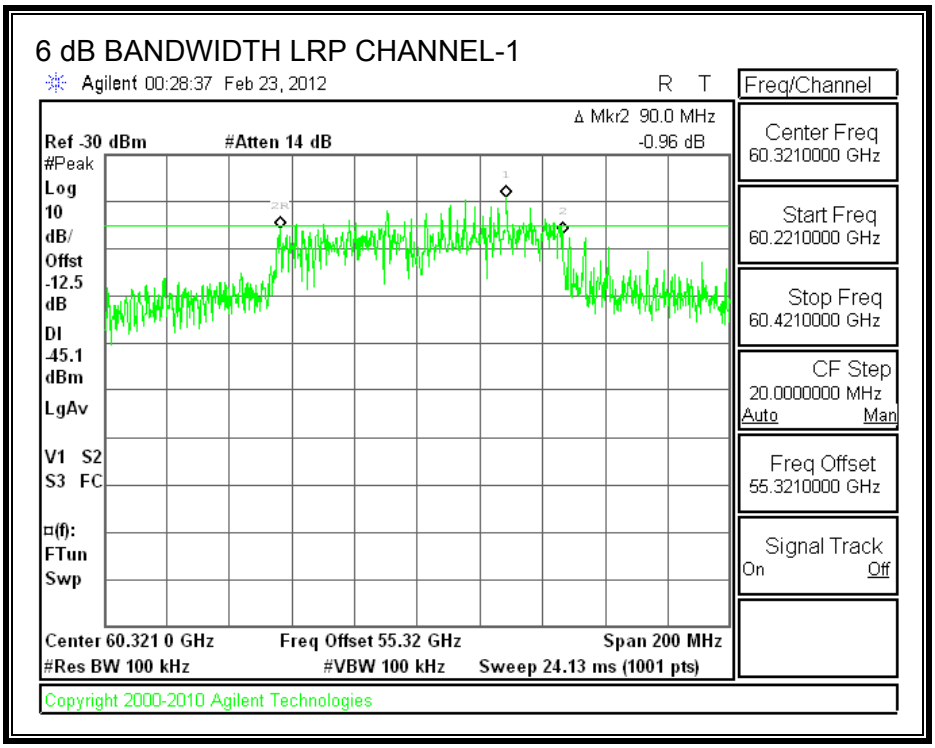
7.1.1. Results for MRP/HRP Channel 2 (Low) and associated LRP Channels

LRP RESULTS

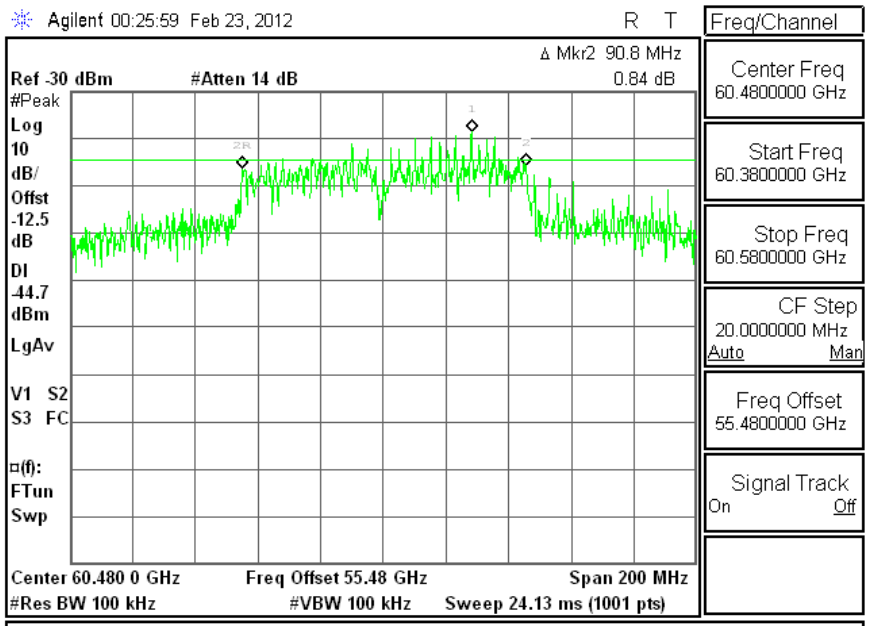
Channel	Frequency (GHz)	6 dB Bandwidth (MHz)
0	60.163	93.00
1	60.321	90.00
2	60.480	90.80
3	60.639	90.00
4	60.797	93.00

6 dB BANDWIDTH

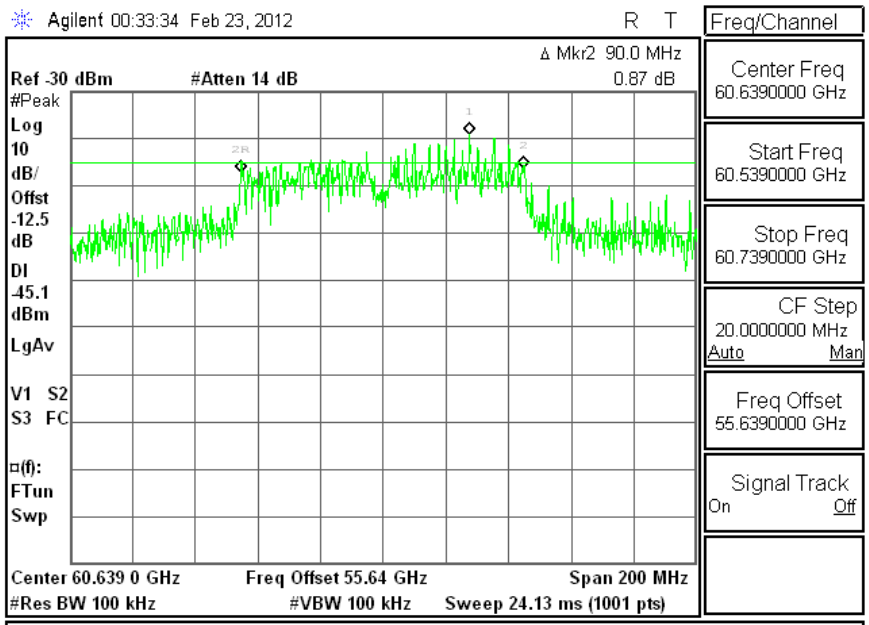


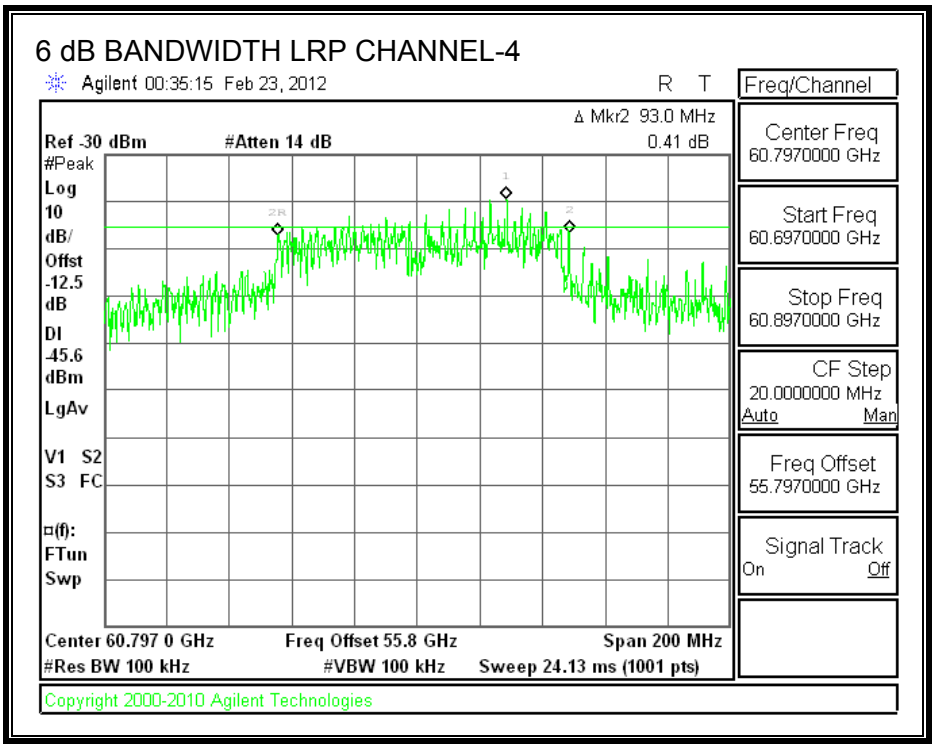


6 dB BANDWIDTH LRP CHANNEL-2



6 dB BANDWIDTH LRP CHANNEL-3

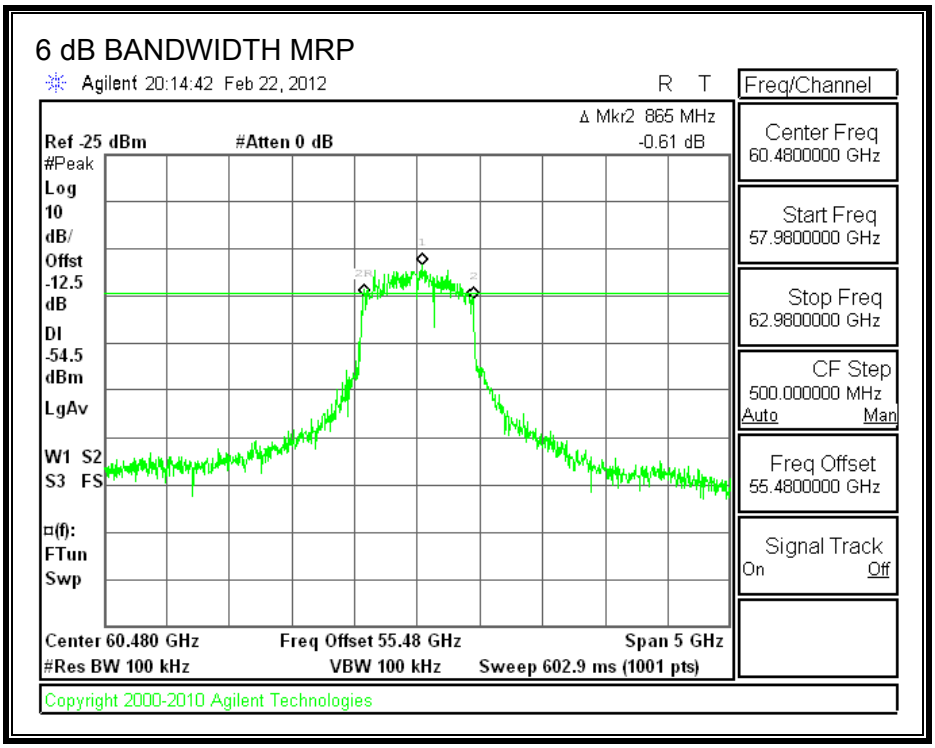


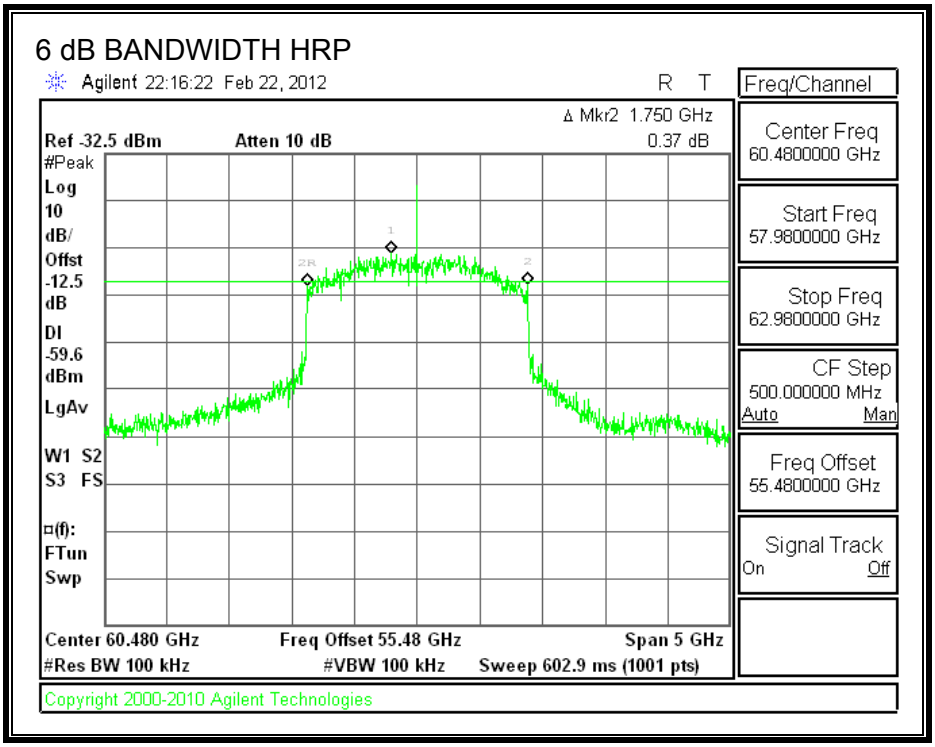


MRP and HRP RESULTS

Channel	Frequency (GHz)	6 dB Bandwidth (GHz)
MRP	60.48	0.865
HRP	60.48	1.750

6 dB BANDWIDTH



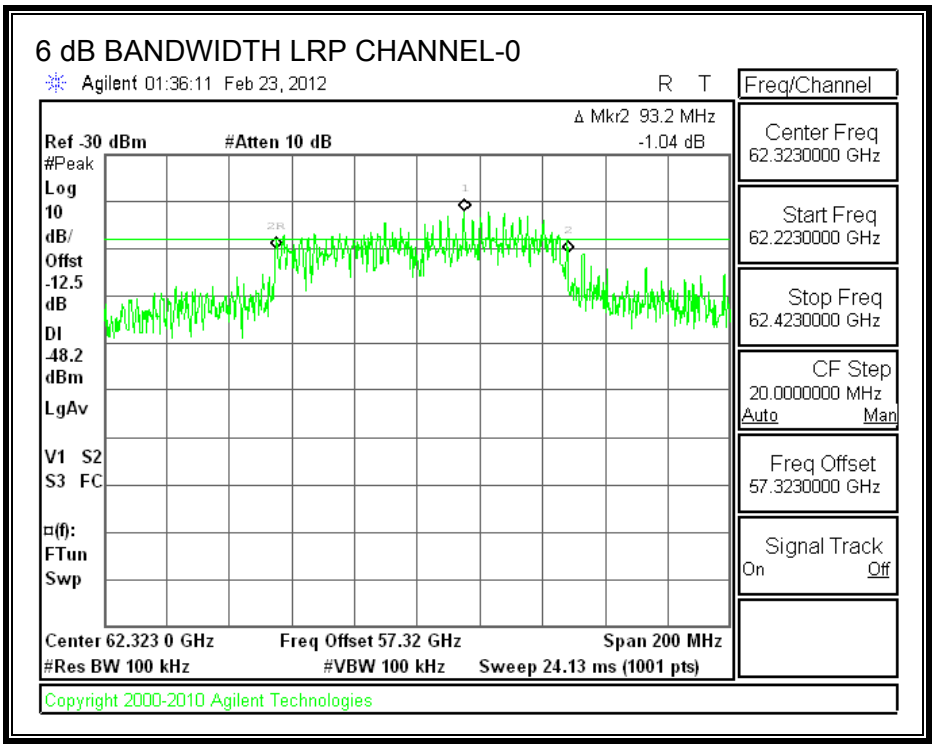


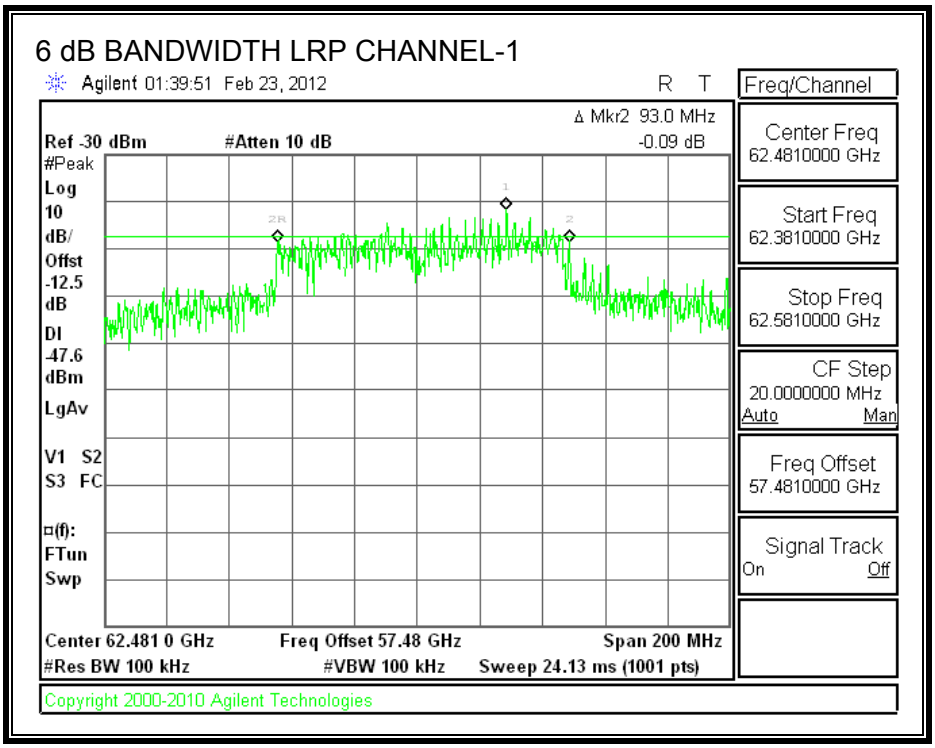
7.1.2. Results for MRP/HRP Channel 3 (High) and associated LRP Channels

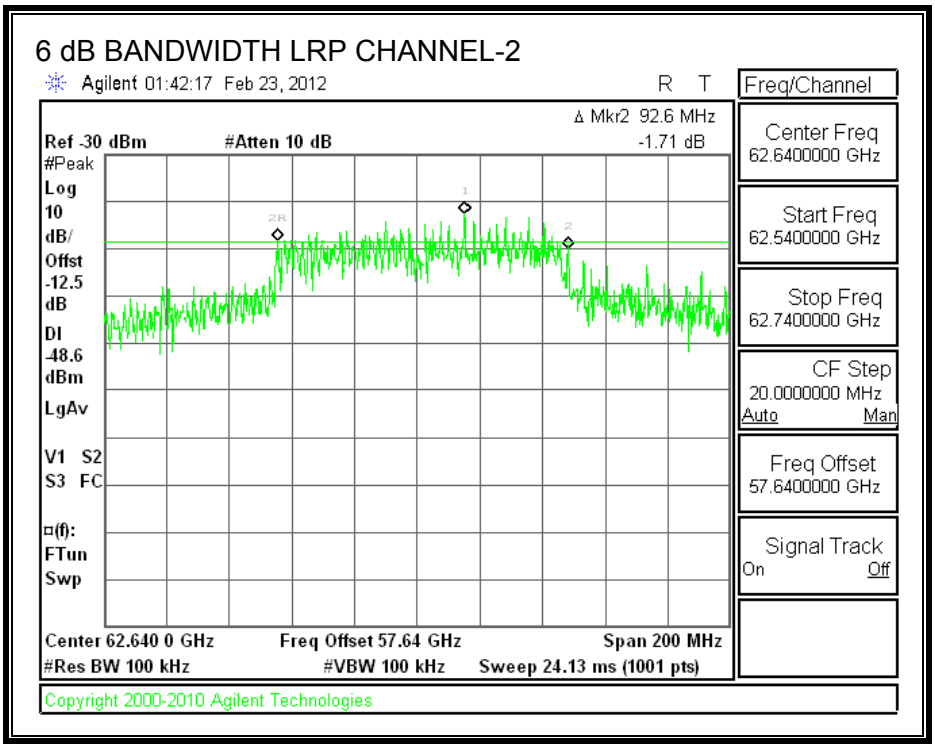
LRP RESULTS

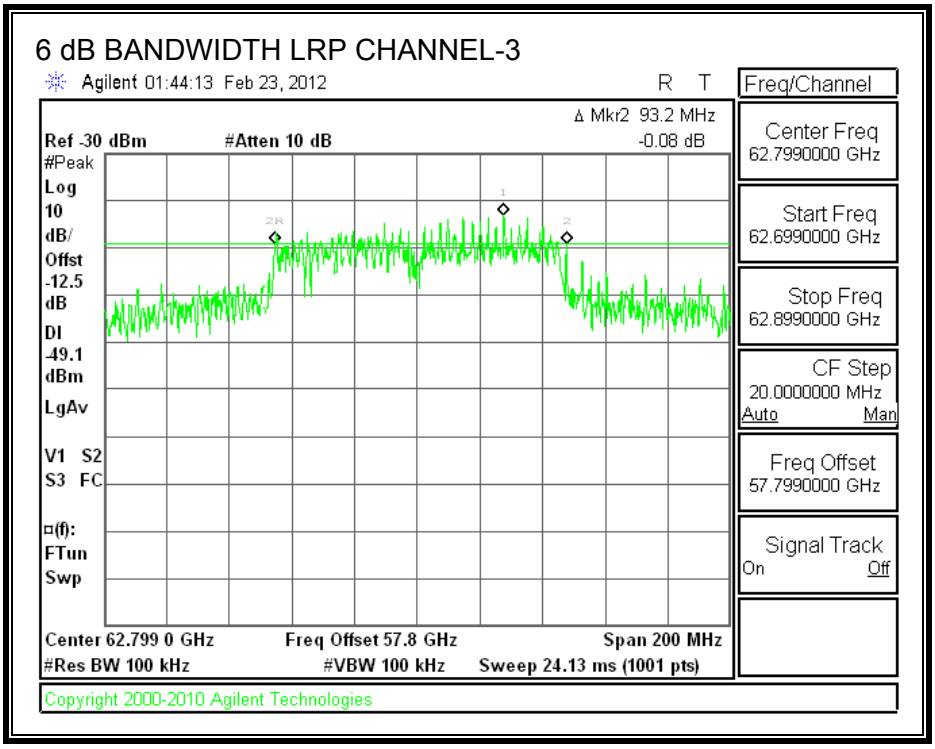
Channel	Frequency (GHz)	6 dB Bandwidth (MHz)
0	62.323	93.30
1	62.481	93.00
2	62.640	92.60
3	62.799	93.20
4	62.957	93.20

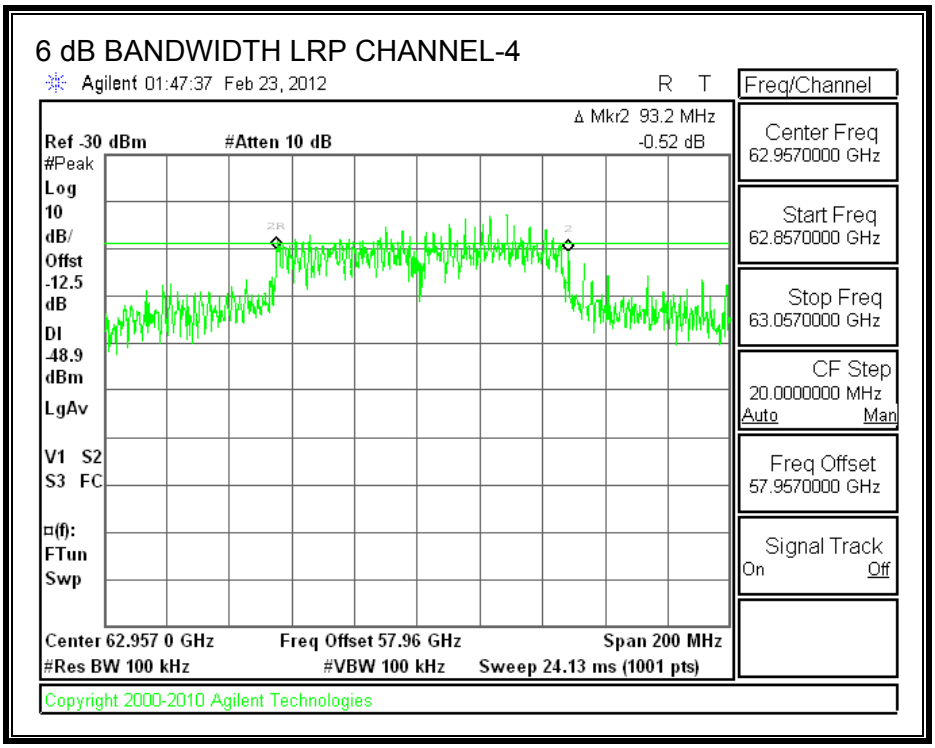
6 dB BANDWIDTH







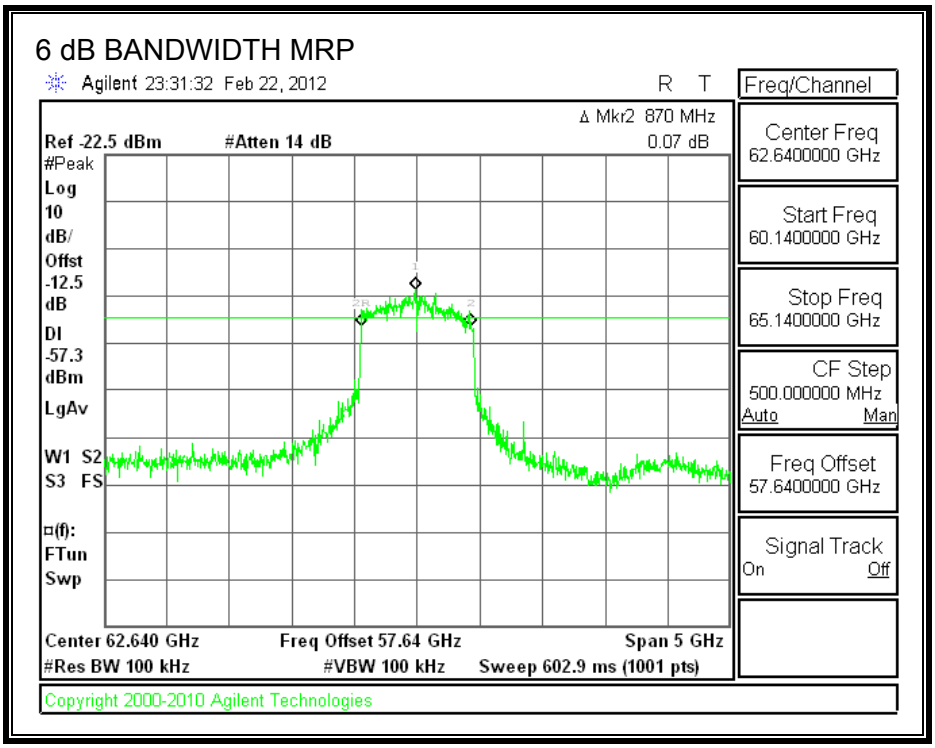


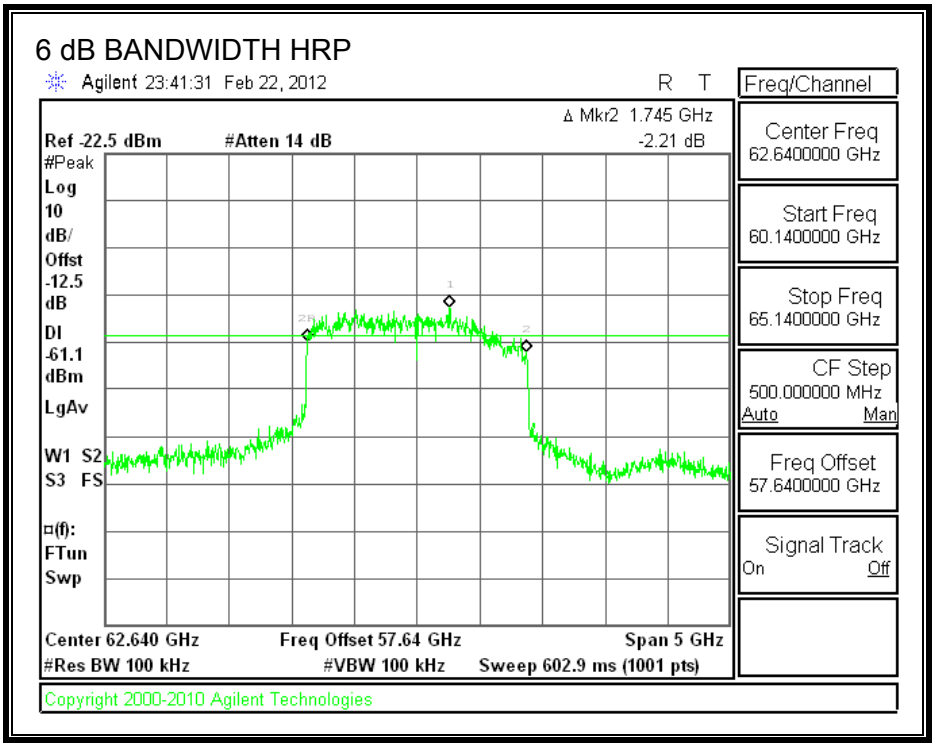


MRP and HRP RESULTS

Channel	Frequency (GHz)	6 dB Bandwidth (GHz)
MRP	62.64	0.870
HRP	62.64	1.745

6 dB BANDWIDTH





7.2. 99% and 26 dB BANDWIDTH

APPLICABLE RULE

§ 15.403 (c) as referenced by FCC KDB Publication 200443, Millimeter Wave Test Procedures

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

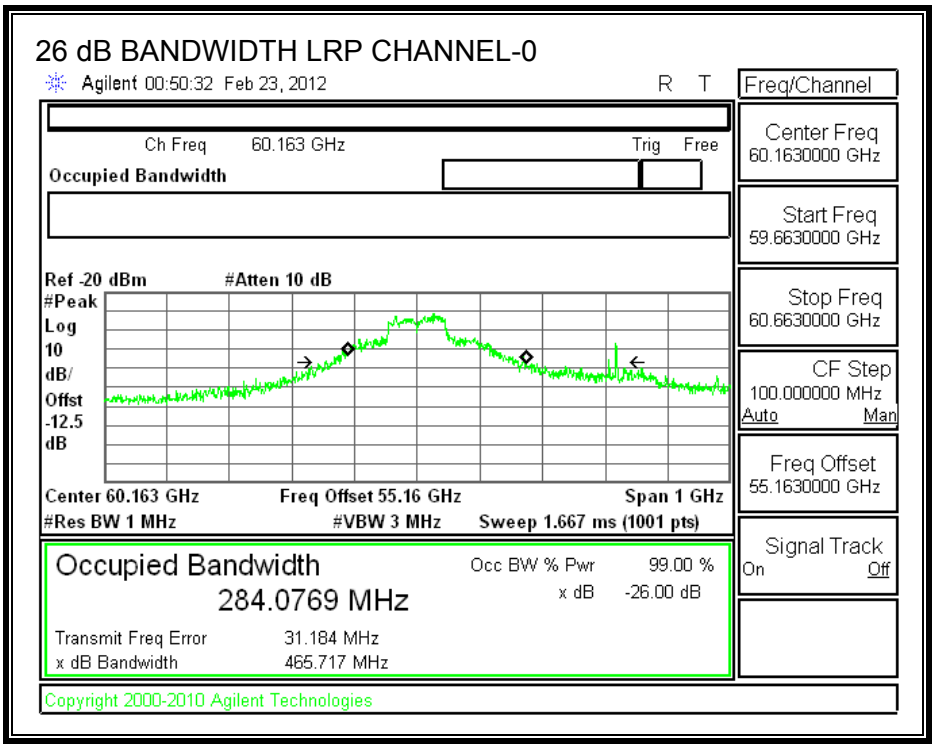
The spectrum analyzer and external mixer are set up to measure the radiated output of the transmitter.

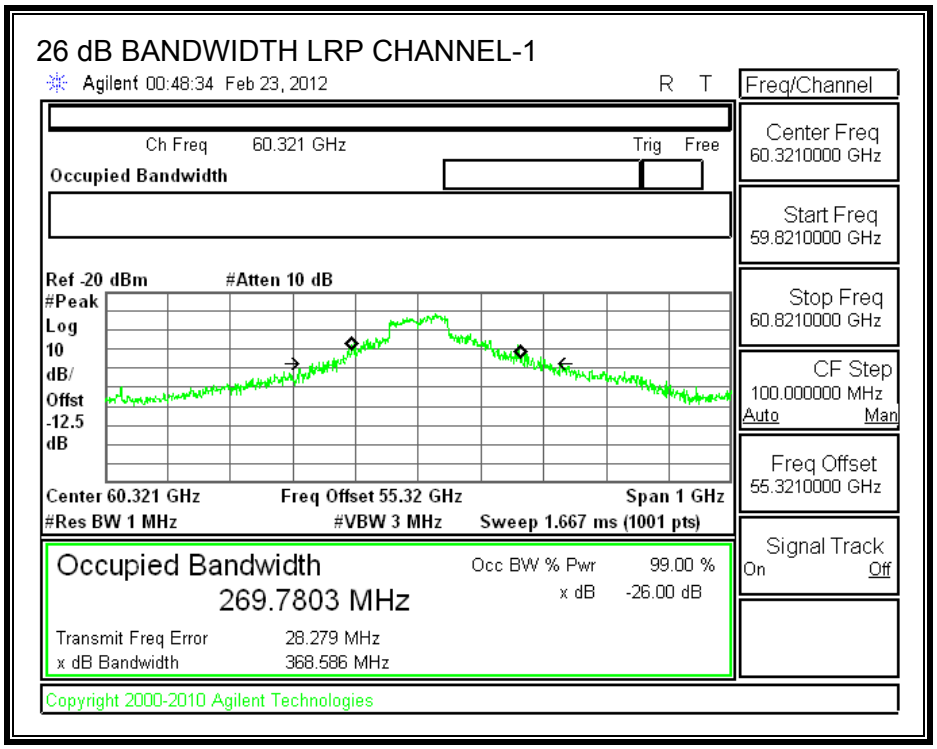
7.2.1. Results for MRP/HRP Channel 2 (Low) and associated LRP

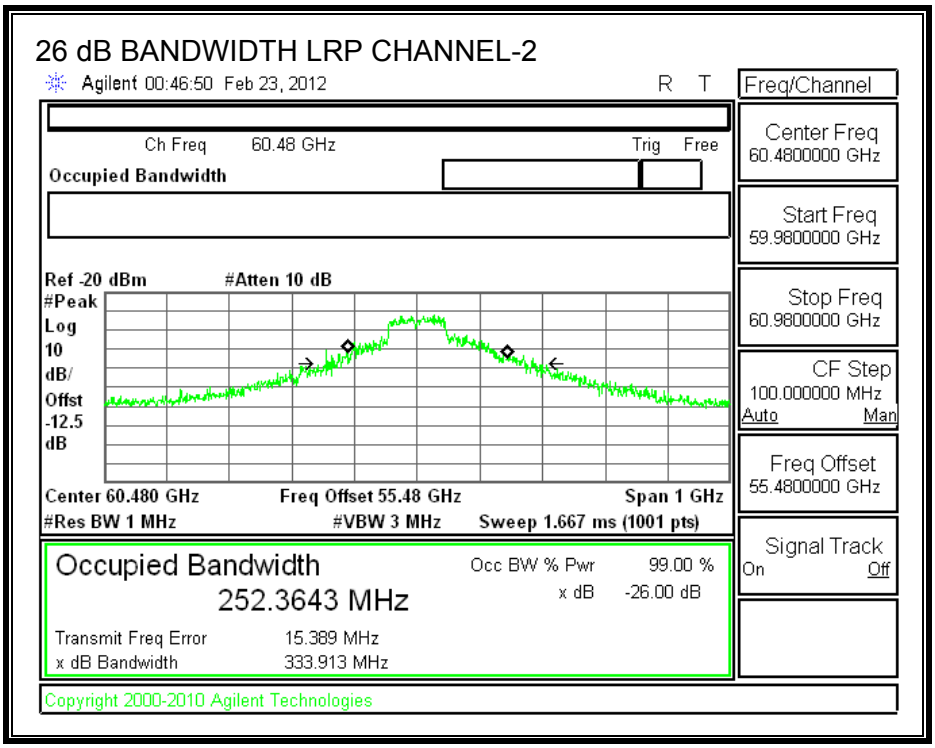
LRP RESULTS

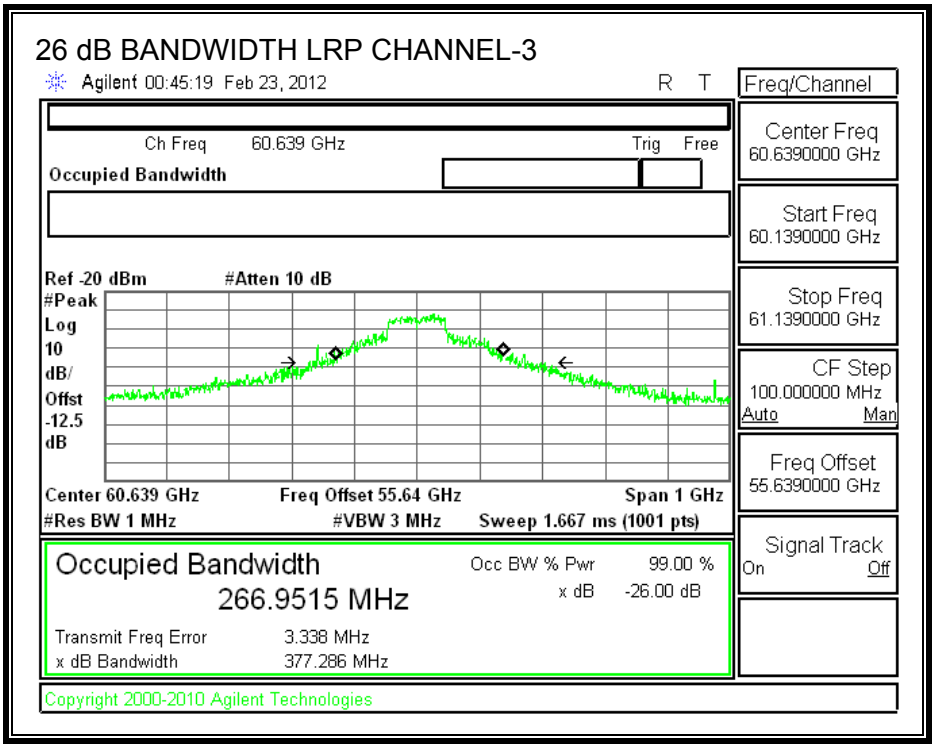
Channel	Frequency (GHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)
0	60.1630	284.0769	465.72
1	60.3210	269.7803	368.59
2	60.4800	252.3643	333.91
3	60.6390	266.9515	377.29
4	60.7970	315.7896	511.66

99% and 26 dB BANDWIDTH

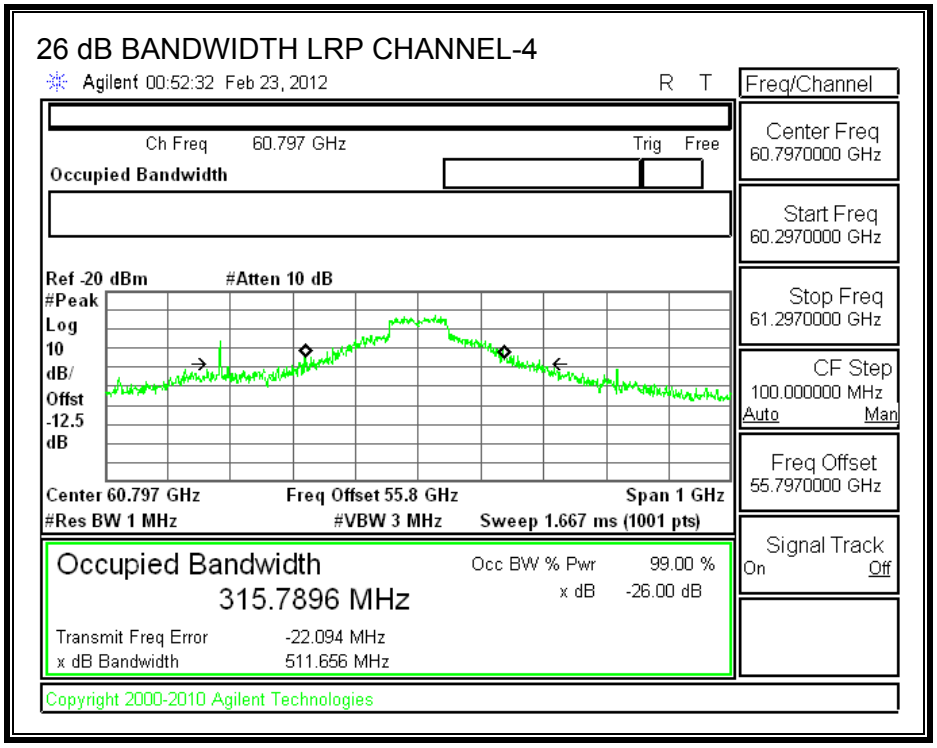








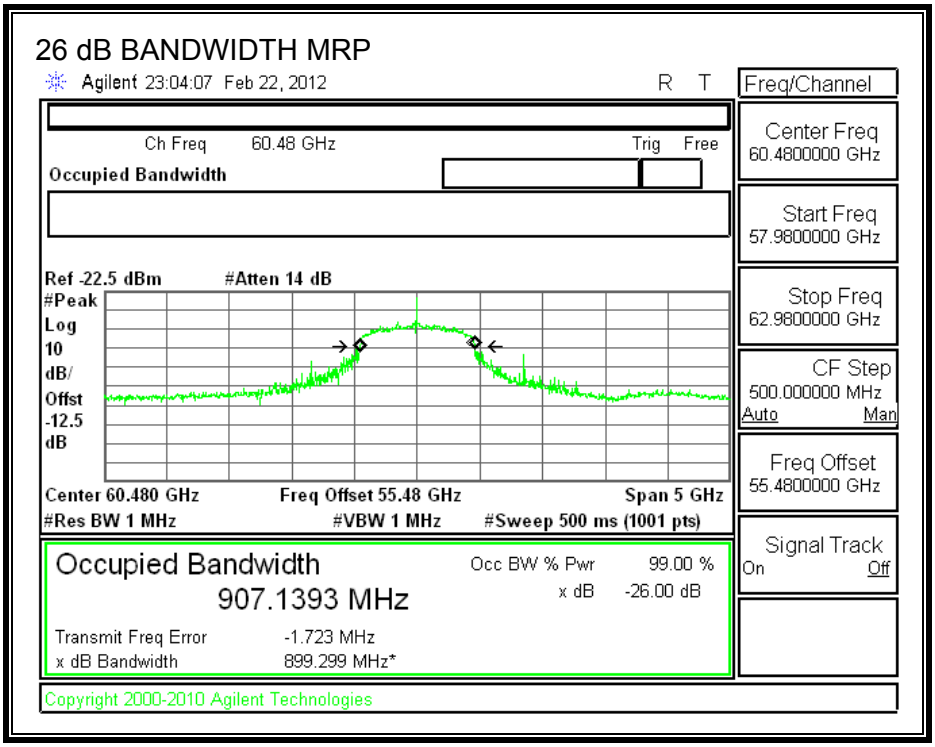
26 dB BANDWIDTH LRP CHANNEL-4

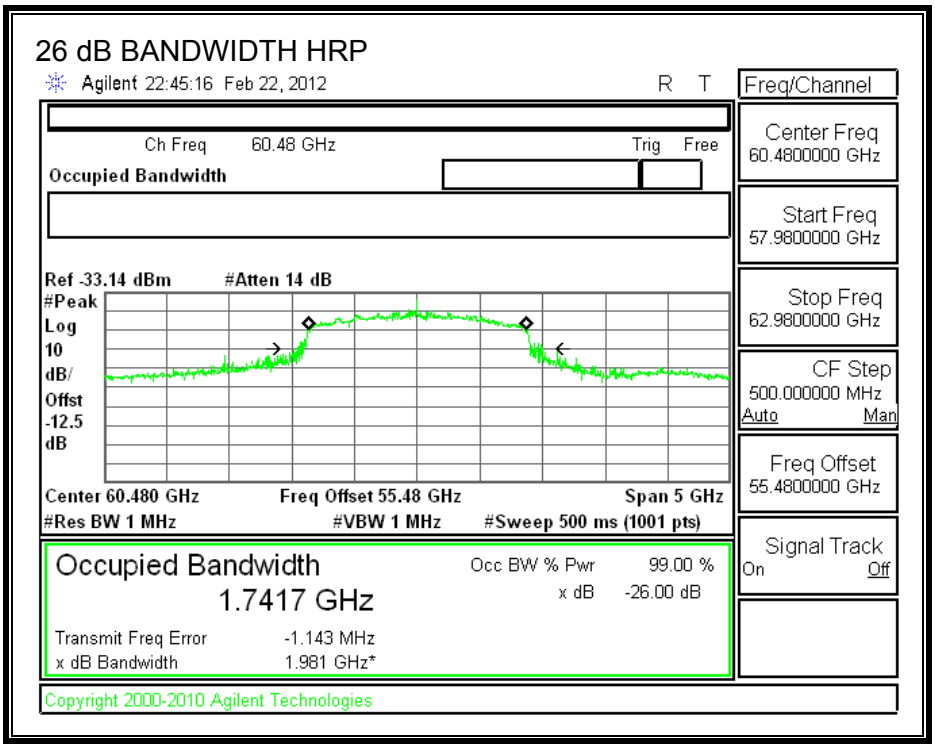


HRP RESULTS

Channel	Frequency (GHz)	99% Bandwidth (GHz)	26 dB Bandwidth (GHz)
MRP	60.48	0.9071	0.8993
HRP	60.48	1.7417	1.9810

99% and 26 dB BANDWIDTH



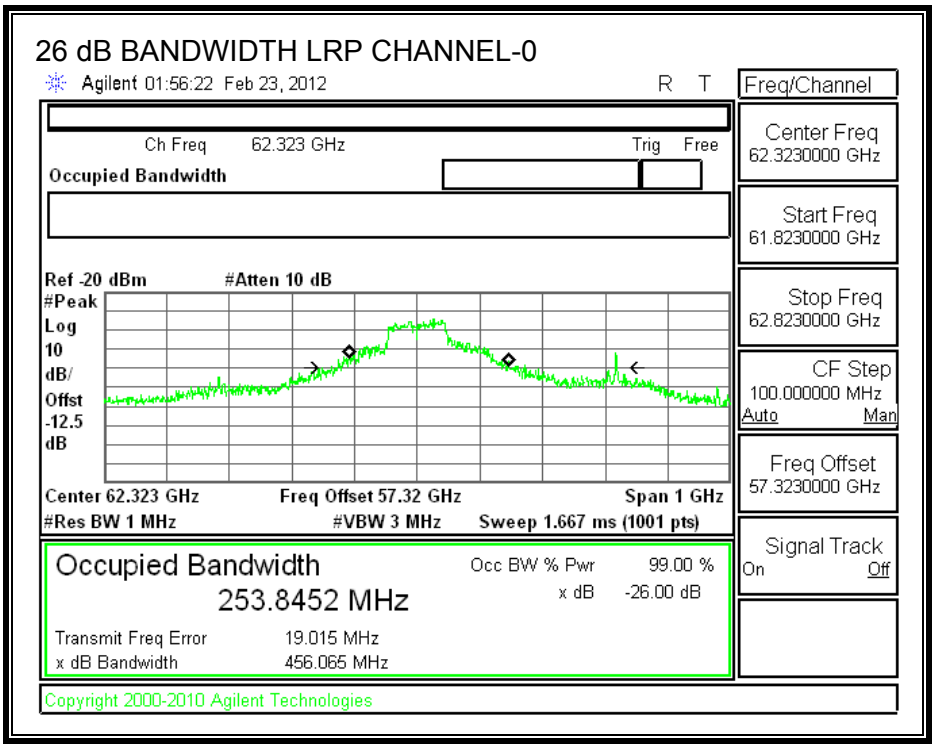


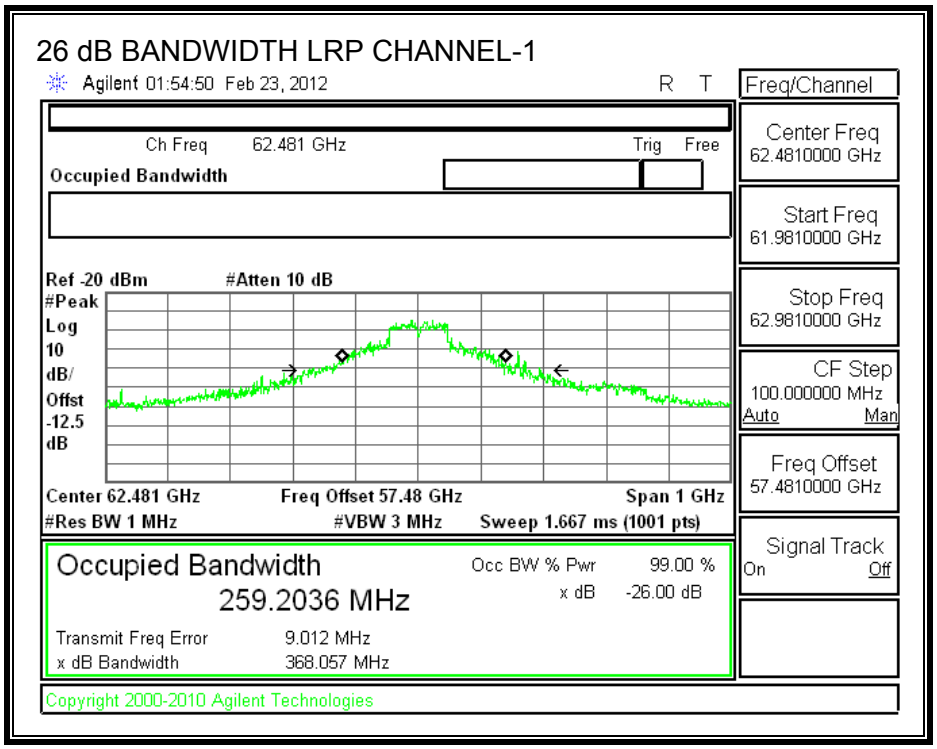
7.2.2. Results for MRP/HRP Channel 3 (High) and associated LRP

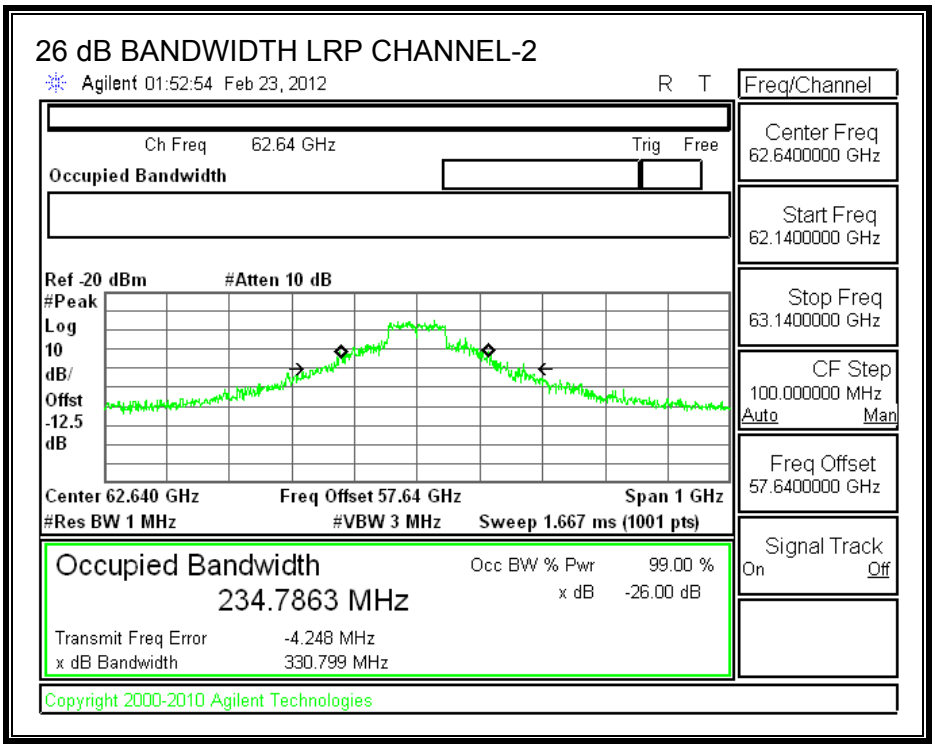
LRP RESULTS

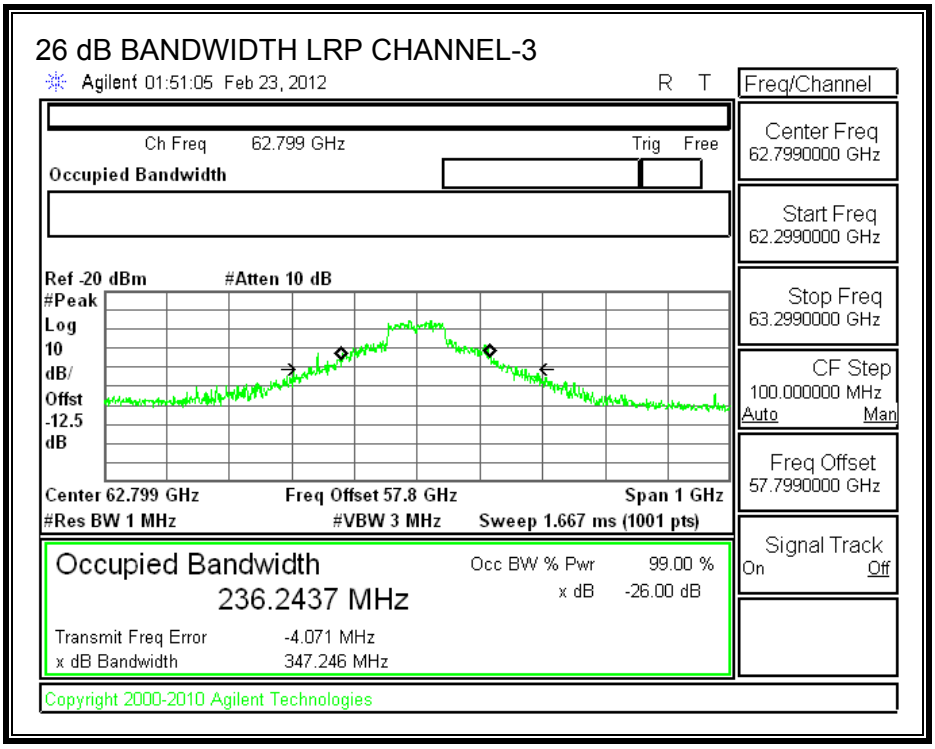
Channel	Frequency (GHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)
0	62.3230	253.8452	456.0650
1	62.4810	259.2036	368.0570
2	62.6400	234.7863	330.7990
3	62.7990	236.2437	347.2460
4	62.9570	266.3255	476.7210

99% and 26 dB BANDWIDTH

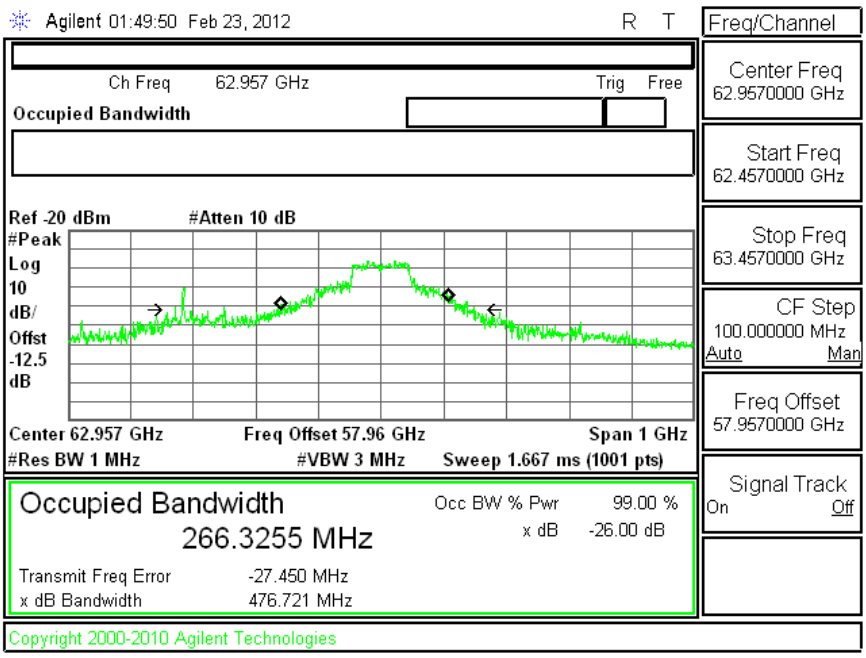








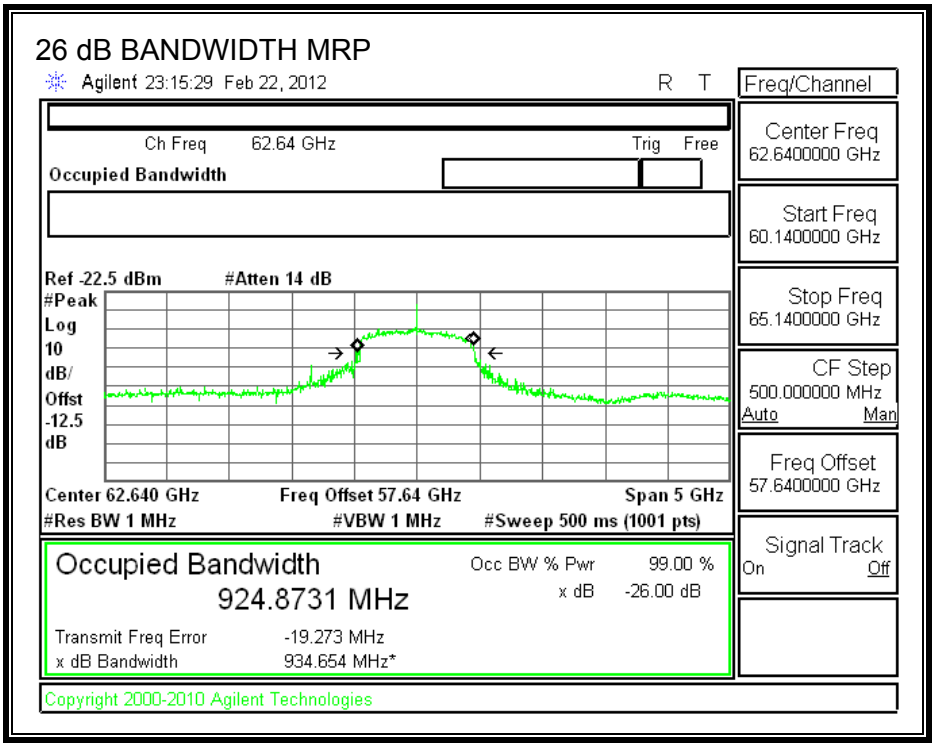
26 dB BANDWIDTH LRP CHANNEL-4

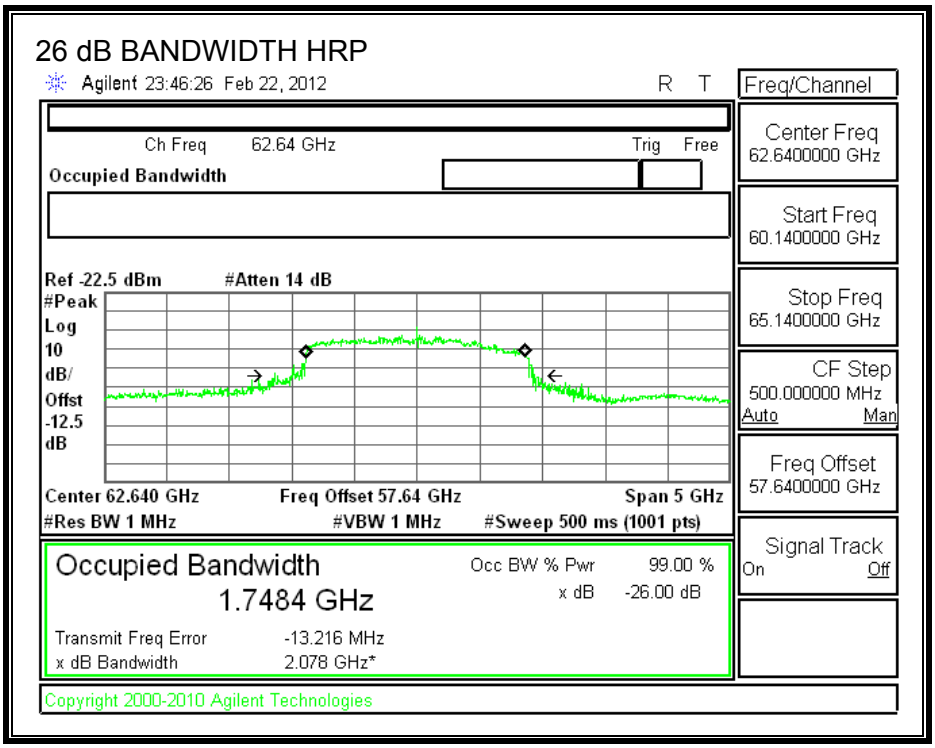


HRP RESULTS

Channel	Frequency (GHz)	99% Bandwidth (GHz)	26 dB Bandwidth (GHz)
MRP	62.64	0.9249	0.9347
HRP	62.64	1.7484	2.0780

99% and 26 dB BANDWIDTH





7.3. POWER DENSITY

LIMIT

§15.255 (b) Within the 57-64 GHz band, emission levels shall not exceed the following:

(1) For products other than fixed field disturbance sensors, the average power density of any emission, measured during the transmit interval, shall not exceed 9 uW/cm^2, as measured 3 meters from the radiating structure, and the peak power density of any emission shall not exceed 18 uW/cm^2, as measured 3 meters from the radiating structure.

(4) Peak power density shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-64 GHz band and has a video bandwidth of at least 10 MHz, or using an equivalent measurement method.

(5) The average emission limits shall be calculated, based on the measured peak levels, over the actual time period during which transmission occurs.

Per FCC KDB Publication 200443, Millimeter Wave Test Procedures, If the emission under investigation is not pulsed, then the average levels may be measured by using a video filtering technique (i.e., VBW << RBW).

TEST PROCEDURE

Measurements are made at a distance greater than or equal to the far field boundary distance.

The peak power is measured by integrating the spectral envelope over the 26 dB EBW.

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 Density using the equation:

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

where:

D_S is the specification distance

FAR FIELD BOUNDARY CALCULATIONS

The far-field boundary is given in FCC KDB Publication 200443 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)
60.48	0.015	0.0050	0.09
62.64	0.015	0.0048	0.09

7.3.1. Results for MRP/HRP Channel 2 (Low) and associated LRP

LRP POWER DENSITY RESULTS

PEAK POWER MEASUREMENTS
Note: The Peak Power Density complies with both the peak and average limits

CHANNEL-0

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
60.163	1.50	-15.24	23.00	33.3	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
2.141	3.0	0.0189	1.89	18	9

CHANNEL-1

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
60.321	1.50	-15.31	23.00	33.3	
EIRP (W)	**Specification Distance (m)**	**Power Density 23**	**3 Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
2.118	3.0	0.0187	1.87	18	9

CHANNEL-2

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
60.48	1.50	-15.40	23.00	33.2	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
2.085	3.0	0.0184	1.84	18	9

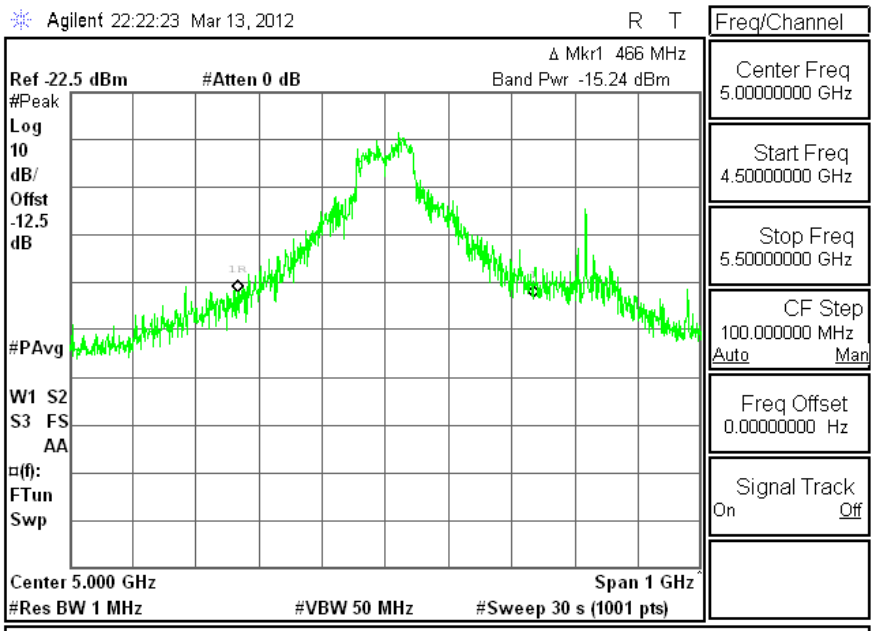
CHANNEL-3

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
60.639	1.50	-16.17	23.00	32.4	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
1.756	3.0	0.0155	1.55	18	9

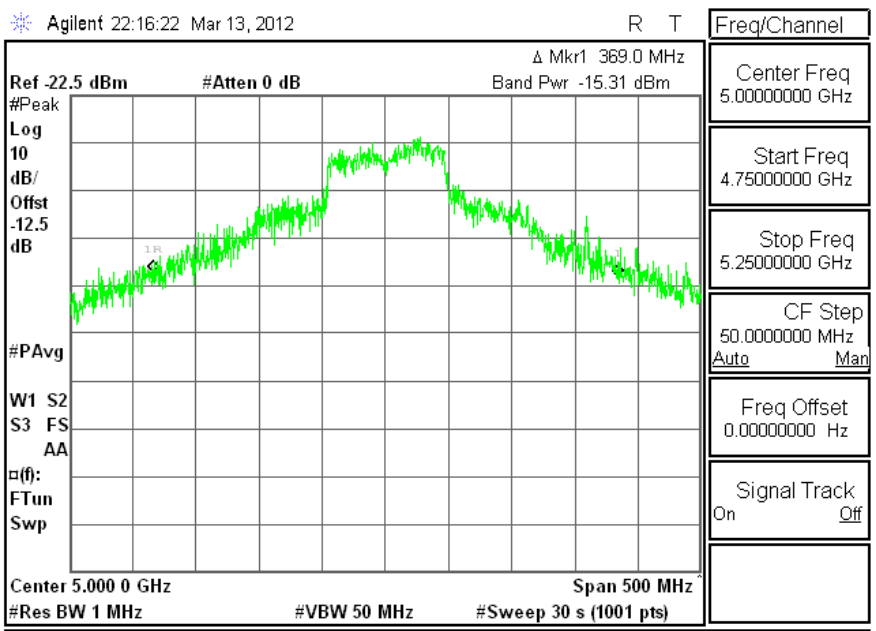
CHANNEL-4

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
60.797	1.50	-16.81	23.00	31.8	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
1.523	3.0	0.0135	1.35	18	9

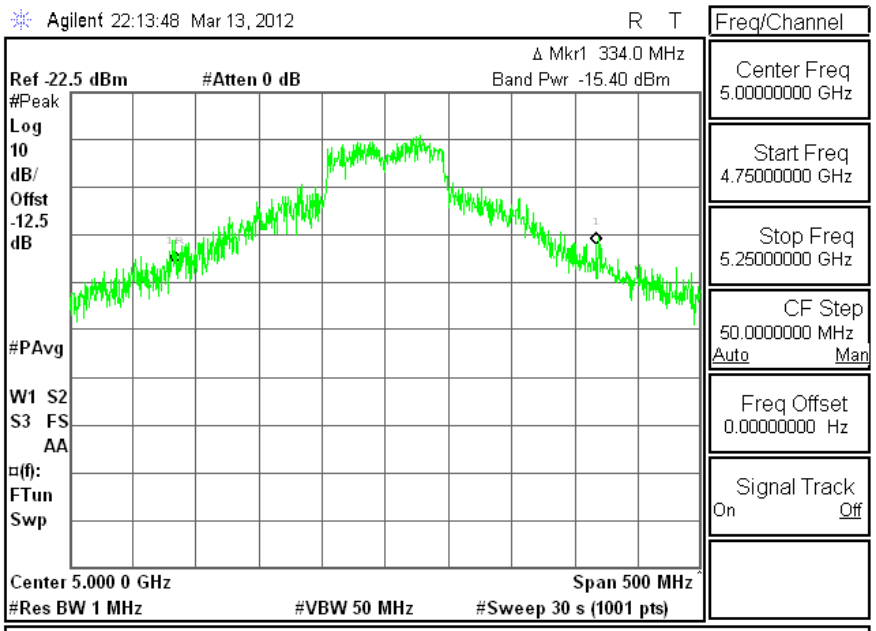
PEAK POWER LRP CHANNEL-0



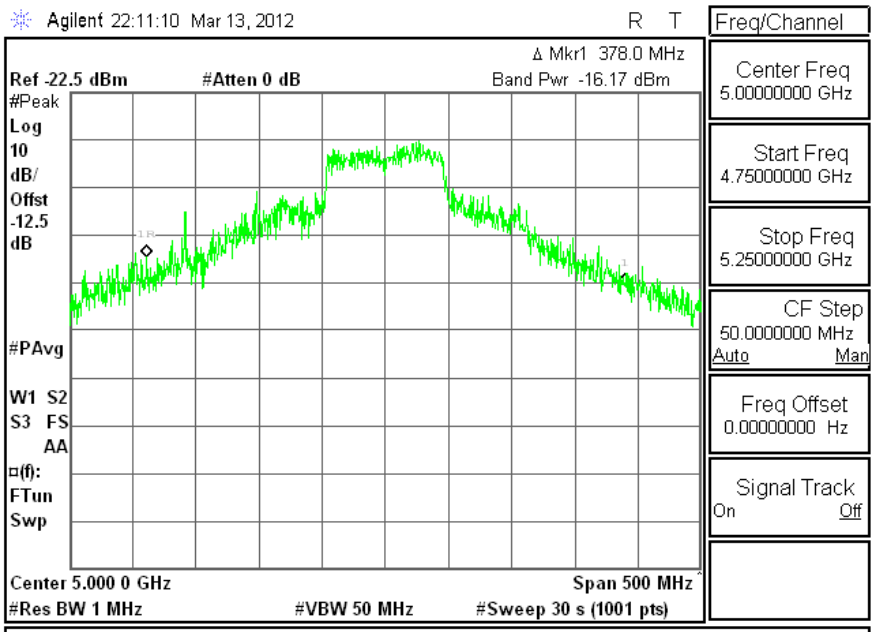
PEAK POWER LRP CHANNEL-1



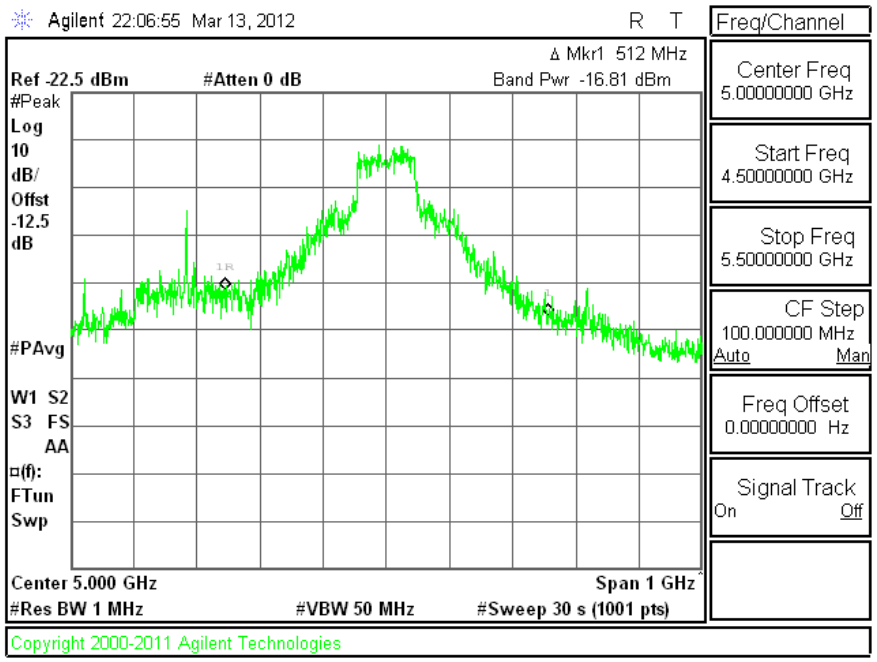
PEAK POWER LRP CHANNEL-2



PEAK POWER LRP CHANNEL-3



PEAK POWER LRP CHANNEL-4



MRP/HRP PEAK POWER DENSITY RESULTS

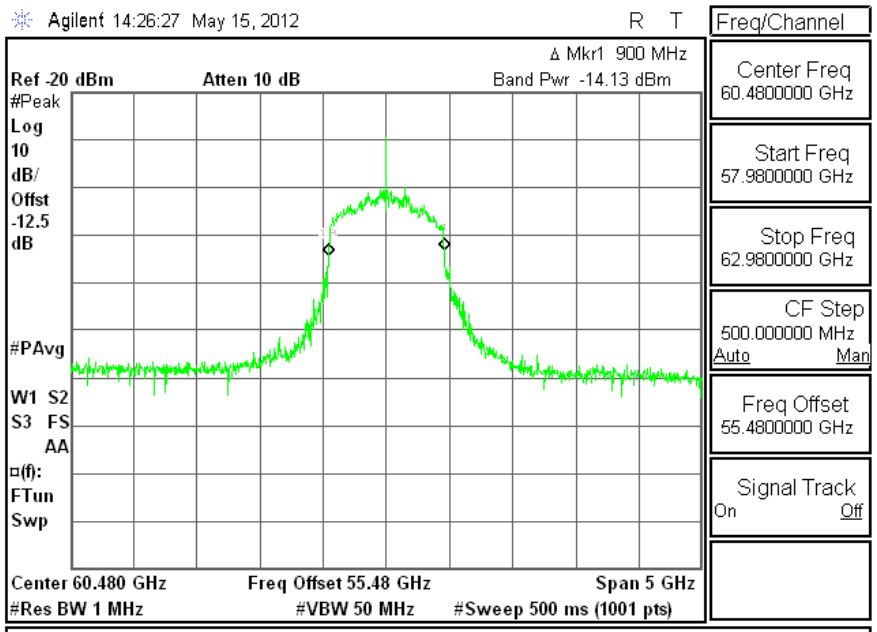
MRP PEAK POWER DENSITY

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
60.48	1.50	-14.13	23.00	34.5
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**
2.794	3.0	0.0247	2.47	18

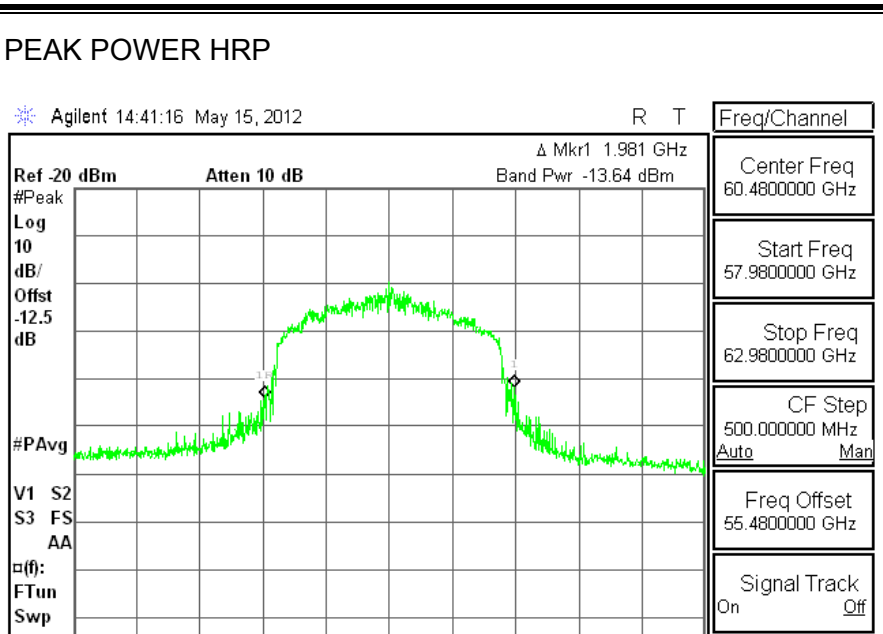
HRP PEAK POWER DENSITY

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
60.48	1.50	-13.64	23.00	35.0
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**
3.127	3.0	0.0277	2.77	18

PEAK POWER MRP



PEAK POWER HRP



MRP/HRP AVERAGE POWER DENSITY RESULTS

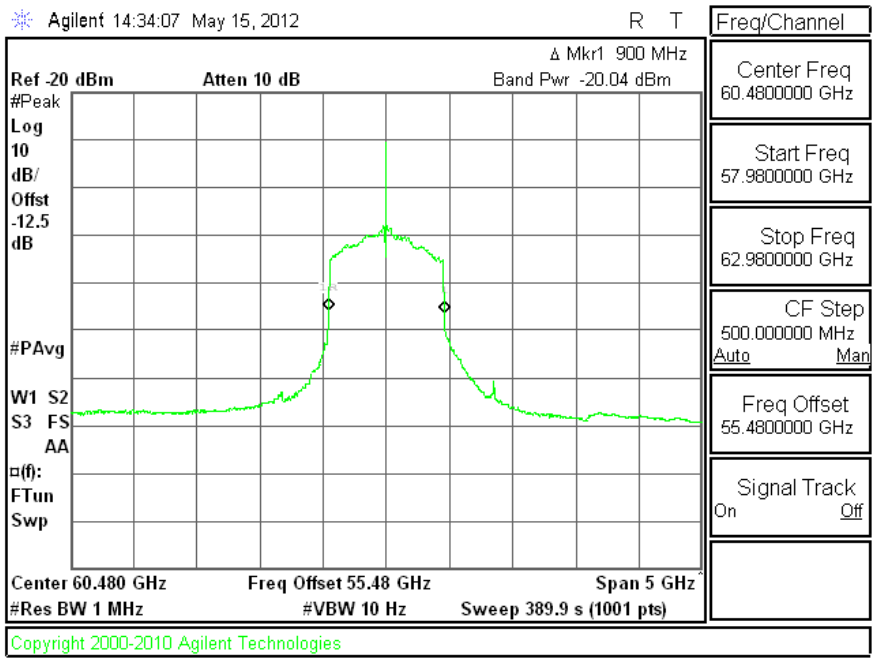
MRP AVERAGE POWER DENSITY

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
60.48	1.50	-20.04	23.00	28.6
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Average Limit (uW/cm^2)**
0.716	3.0	0.0063	0.63	9

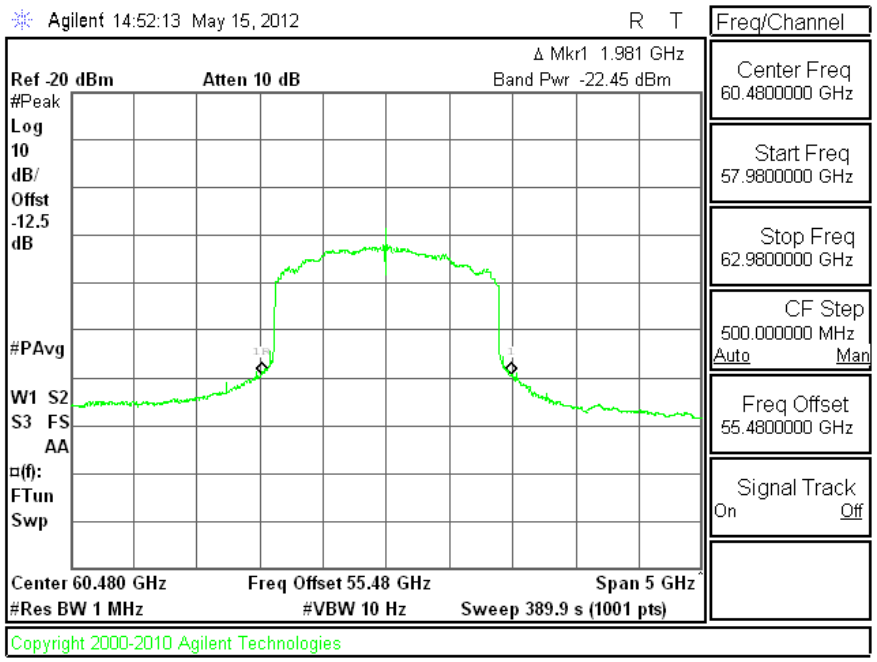
HRP AVERAGE POWER DENSITY

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
60.48	1.50	-22.45	23.00	26.1
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Average Limit (uW/cm^2)**
0.411	3.0	0.0036	0.36	9

AVERAGE POWER MRP



AVERAGE POWER HRP



7.3.2. Results for MRP/HRP Channel 3 (High) and associated LRP

LRP POWER DENSITY RESULTS

PEAK POWER MEASUREMENTS
Note: The Peak Power Density complies with both the peak and average limits

CHANNEL-0

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
62.323	1.50	-18.02	23.00	30.8	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
1.211	3.0	0.0107	1.07	18	9

CHANNEL-1

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
62.481	1.50	-18.54	23.00	30.3	
EIRP (W)	**Specification Distance (m)**	**Power Density 23**	**3 Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
1.080	3.0	0.0096	0.96	18	9

CHANNEL-2

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
62.64	1.50	-18.78	23.00	30.1	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
1.027	3.0	0.0091	0.91	18	9

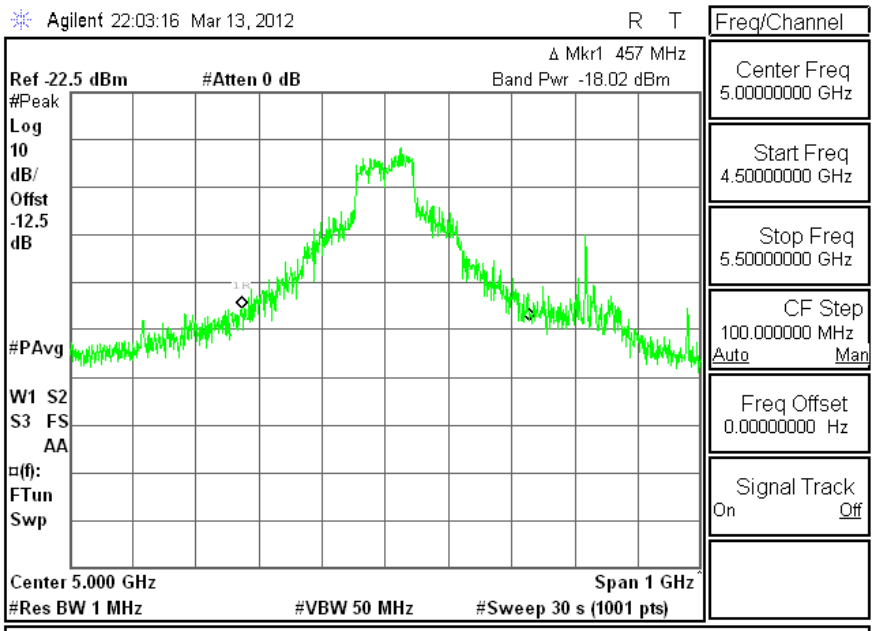
CHANNEL-3

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
62.799	1.50	-19.26	23.00	29.7	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
0.924	3.0	0.0082	0.82	18	9

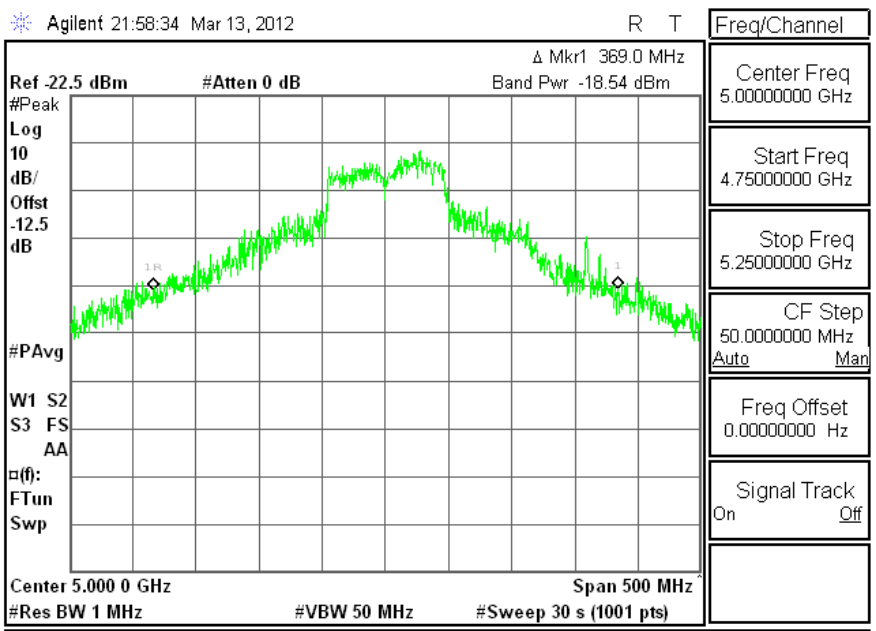
CHANNEL-4

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)	
62.957	1.50	-19.59	23.00	29.4	
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**	**Average Limit (uW/cm^2)**
0.861	3.0	0.0076	0.76	18	9

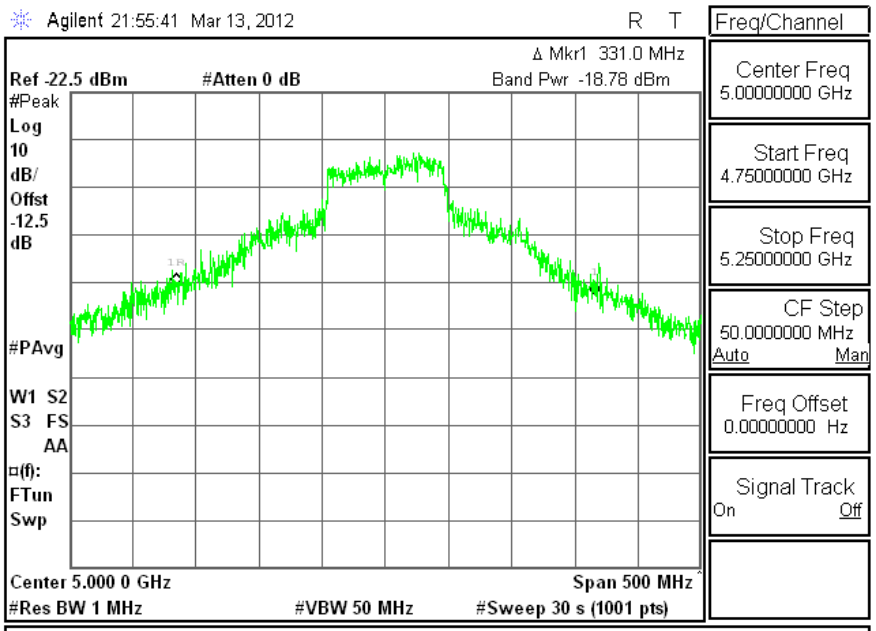
PEAK POWER LRP CHANNEL-0



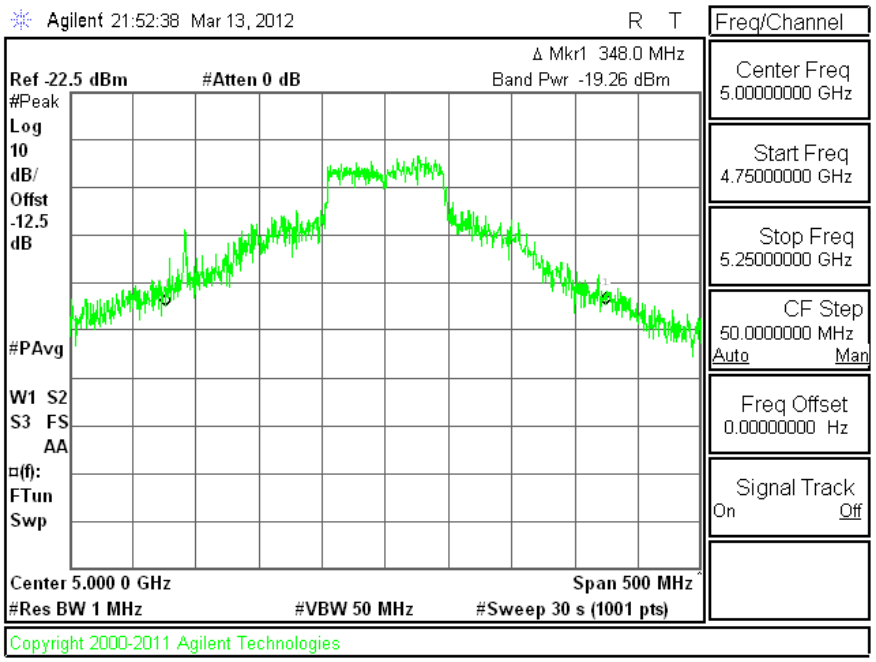
PEAK POWER LRP CHANNEL-1



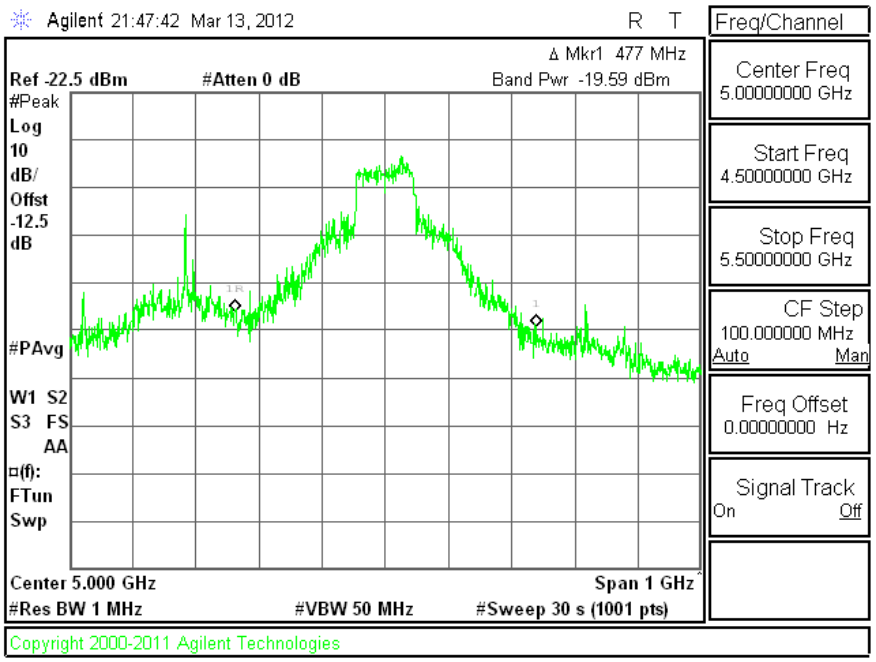
PEAK POWER LRP CHANNEL-2



PEAK POWER LRP CHANNEL-3



PEAK POWER LRP CHANNEL-4



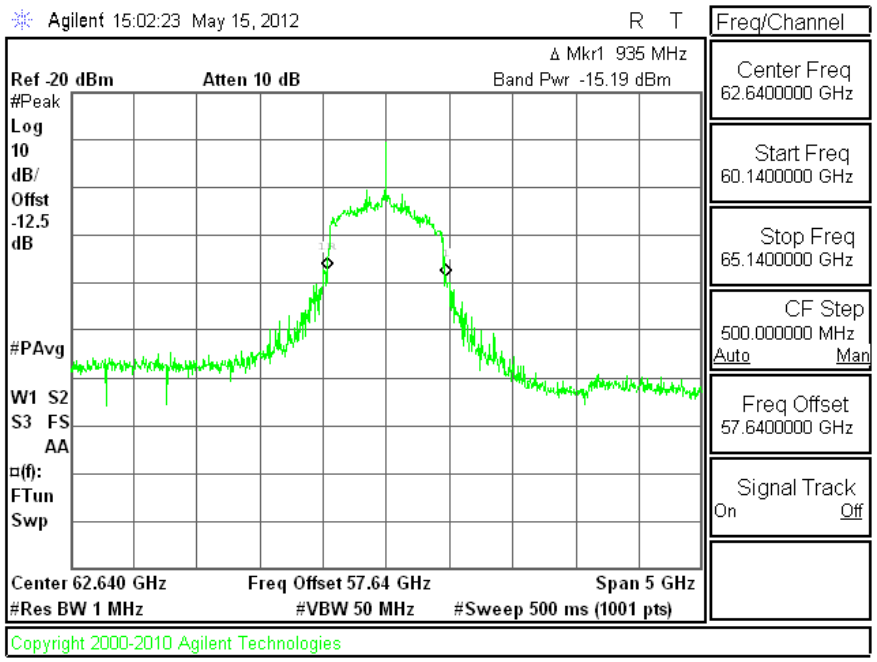
MRP/HRP PEAK POWER DENSITY RESULTS

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
62.64	1.50	-15.19	23.00	33.7
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**
2.348	3.0	0.0208	2.08	18

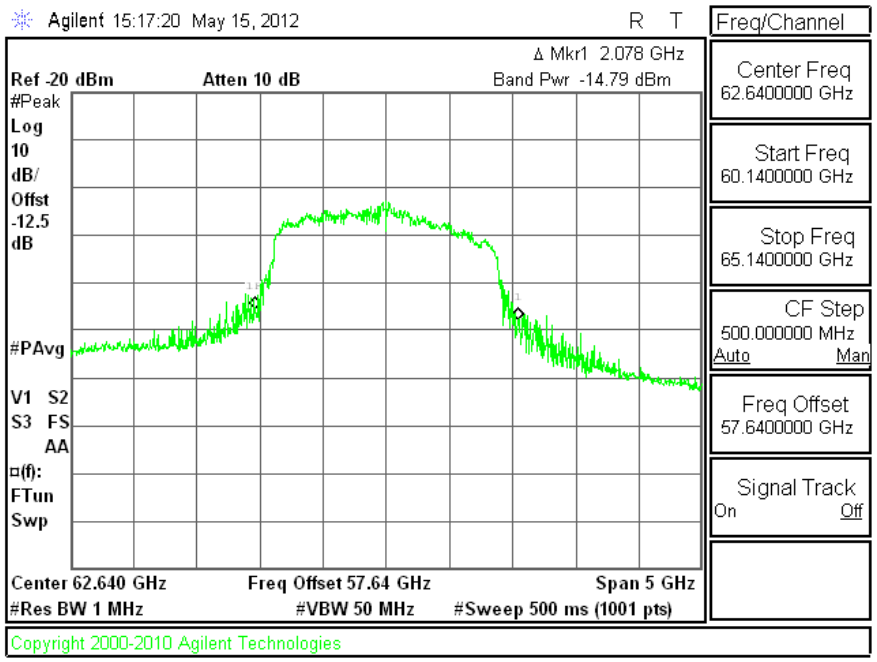
HRP PEAK POWER DENSITY

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
62.64	1.50	-14.79	23.00	34.1
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Peak Limit (uW/cm^2)**
2.574	3.0	0.0228	2.28	18

PEAK POWER MRP



PEAK POWER HRP



MRP/HRP AVERAGE POWER DENSITY RESULTS

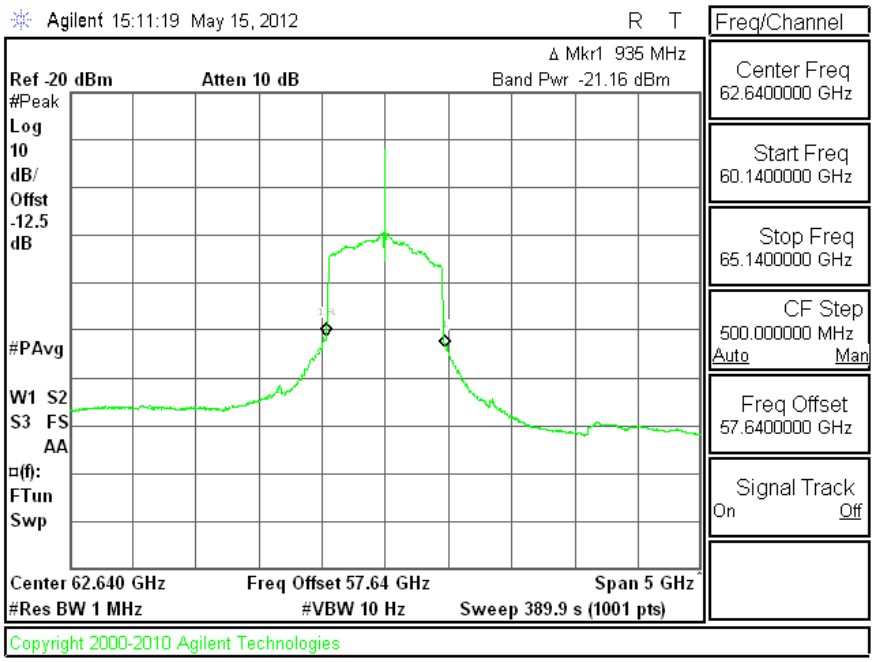
MRP AVERAGE POWER DENSITY

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
62.64	1.50	-21.16	23.00	27.7
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Average Limit (uW/cm^2)**
0.594	3.0	0.0053	0.53	9

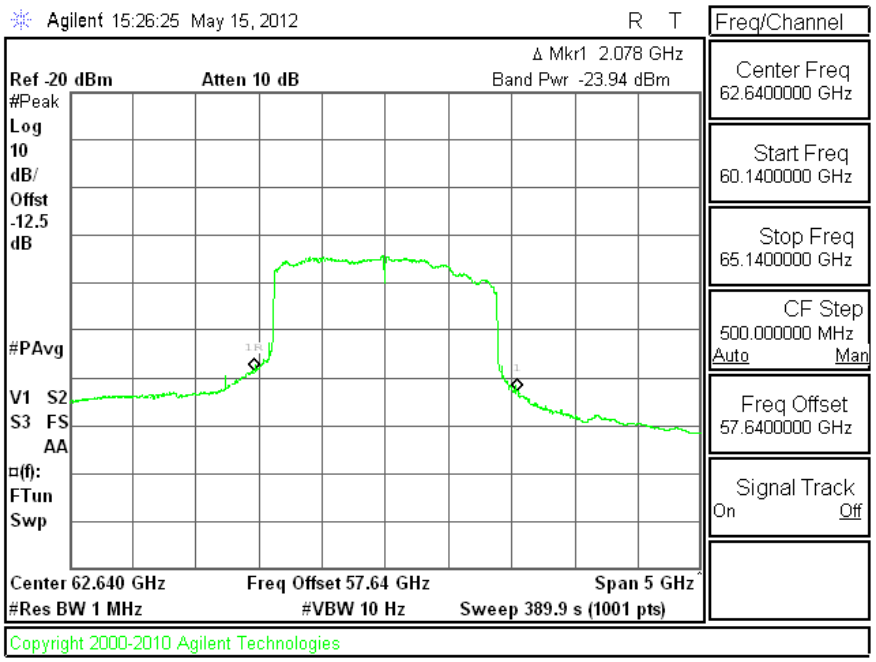
HRP AVERAGE POWER DENSITY

Frequency (GHz)	Measurement Distance (m)	Measured Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
62.64	1.50	-23.94	23.00	25.0
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (uW/cm^2)**	**Average Limit (uW/cm^2)**
0.313	3.0	0.0028	0.28	9

AVERAGE POWER MRP



AVERAGE POWER HRP



7.4. PEAK OUTPUT POWER

LIMIT

§15.255 (e) Except as specified elsewhere in this paragraph (e), the total peak transmitter output power shall not exceed 500 mW.

§15.255 (e) (1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. 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).

§15.255 (e) (2) Peak transmitter output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57–64 GHz band and that has a video bandwidth of at least 10 MHz, or using an equivalent measurement method.

§15.255 (e) (2) For purposes of demonstrating compliance with this paragraph (e), corrections to the transmitter output power may be made due to the antenna and circuit loss.

PROCEDURE

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

7.4.1. Results for MRP/HRP Channel 2 (Low) and associated LRP

LRP RESULTS

PEAK OUTPUT POWER

CHANNEL-0

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
60.163	33.6	16.00	17.60	57.5	93.0	465

CHANNEL-1

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
60.321	33.7	16.00	17.70	58.9	90.0	450

CHANNEL-2

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
60.48	34.2	16.00	18.20	66.1	90.8	454

CHANNEL-3

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
60.639	33.9	16.00	17.90	61.7	90.0	450

CHANNEL-4

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
60.797	33.2	16.00	17.20	52.5	93.0	465

MRP/HRP RESULTS

MRP 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)
60.48	34.5	18.00	16.50	44.7	865	500

HRP 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)
60.48	35.0	18.00	17.00	50.1	1750	500

7.4.2. Results for MRP/HRP Channel 3 (High) and associated LRP

LRP RESULTS

PEAK OUTPUT POWER

CHANNEL-0

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
62.323	31.7	16.00	15.70	37.2	93.3	467

CHANNEL-1

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
62.481	31.3	16.00	15.30	33.9	93.0	465

CHANNEL-2

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
62.64	31.3	16.00	15.30	33.9	92.6	463

CHANNEL-3

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
62.799	30.9	16.00	14.90	30.9	93.2	466

CHANNEL-4

Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	6 dB Bandwidth (MHz)	Output Power Limit (mW)
62.957	30.7	16.00	14.70	29.5	93.2	466

MRP/HRP RESULTS

MRP 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)
62.64	33.7	18.00	15.70	37.2	870	500

HRP 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)
62.64	34.1	18.00	16.10	40.7	1745	500

7.5. AVERAGE OUTPUT POWER

LIMIT

For reporting purposes.

PROCEDURE

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

MRP/HRP RESULTS

AVERAGE OUTPUT POWER

MODE	Frequency (GHz)	EIRP (dBm)	EUT Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)
MRP	60.48	28.6	18.00	10.60	11.48
HRP	60.48	26.1	18.00	8.10	6.46
MRP	62.64	27.7	18.00	9.70	9.33
HRP	62.64	25.0	18.00	7.00	5.01

7.6. 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

Measurements are made with the antenna feeding a spectrum analyzer via a preamplifier and cables.

PROCEDURE FOR 40 TO 200 GHz

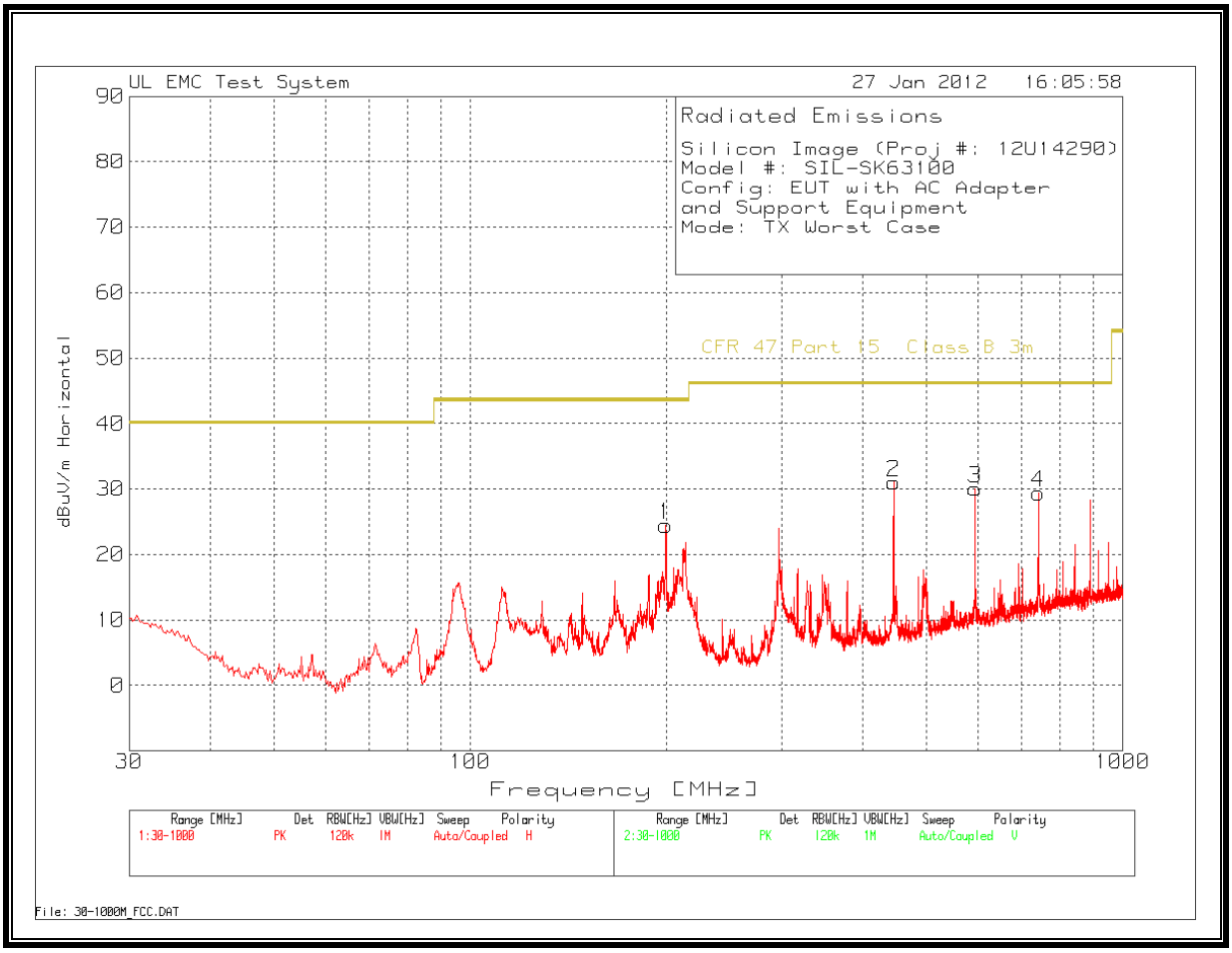
External harmonic mixers are utilized.

The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations, at a maximum distance of 5 cm from the EUT.

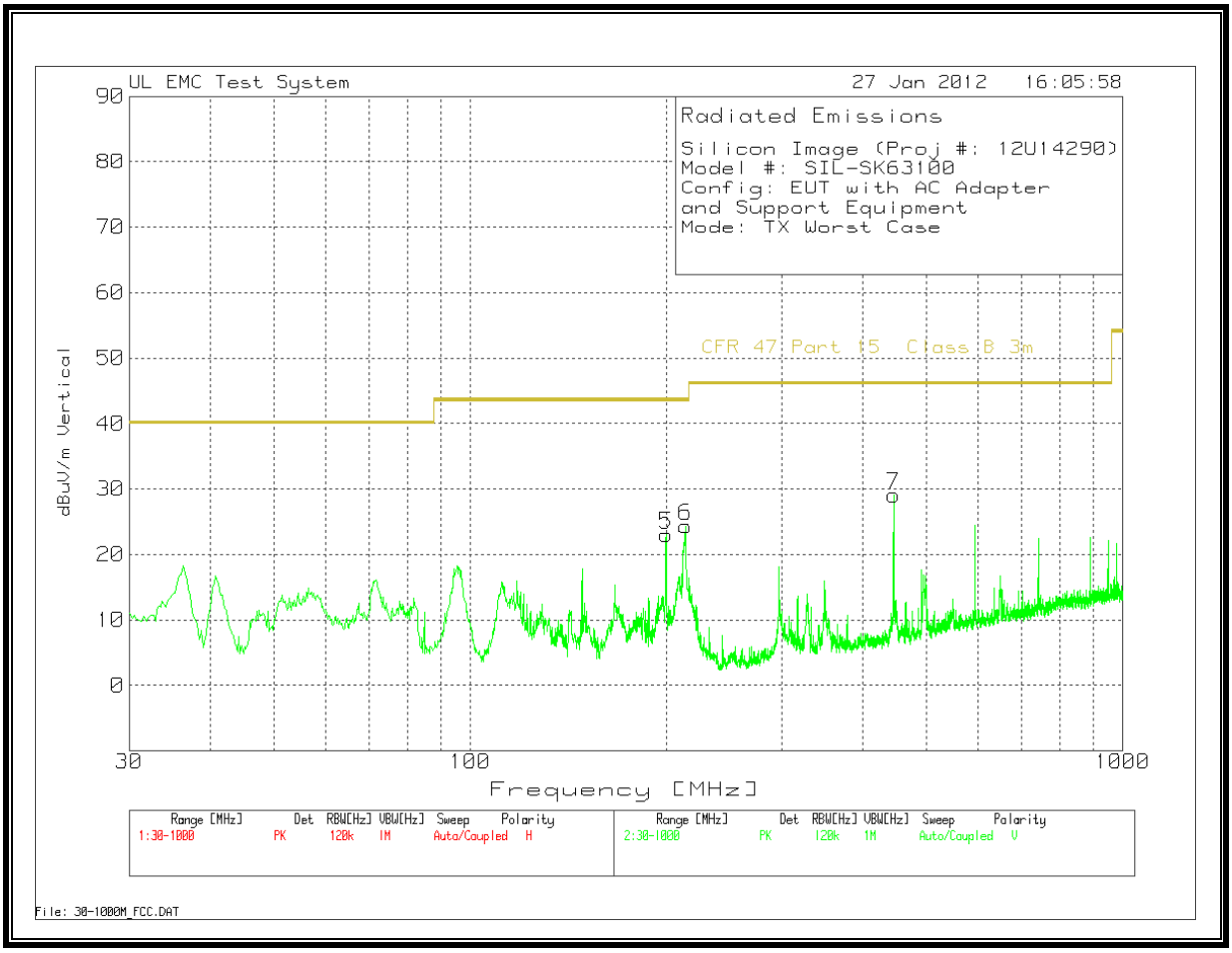
A final test is made at any frequencies at which emissions are found. During this final scan, the antenna is kept no further from the EUT than the maximum distance calculated for each mixer band that yields a minimum system noise floor at least 6 dB below the spurious emissions limit.

The power is measured, the EIRP is calculated, then the extrapolated power density at a 3 meter distance is calculated.

TX AND RX SPURIOUS EMISSION 30 TO 1000 MHz (HORIZONTAL PLOT)



TX AND RX SPURIOUS EMISSION 30 TO 1000 MHz (VERTICAL PLOT)



TX AND RX SPURIOUS EMISSION 30 TO 1000 MHz VERTICAL AND HORIZONTAL DATA

Silicon Image (Proj #: 12U14290)										
Model #: SIL-SK63100										
Config: EUT with AC Adapter										
and Support Equipment										
Mode: TX Worst Case										
Range 1 30 - 1000MHz										
Test Frequency	Meter Reading	Detector	25MHz-1GHz ChmbrA Amplified.TX [dB]	5m A T122 Bilog below 1GHz.TXT [dB]	10m to 3m Conversion [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
199.2266	49.25	PK	-26.2	11.9	-10.5	24.45	43.5	-19.05	100	Horz
445.6035	51.02	PK	-25.2	15.7	-10.5	31.02	46	-14.98	100	Horz
593.8949	46.36	PK	-24.1	18.3	-10.5	30.06	46	-15.94	200	Horz
742.5739	43.08	PK	-23.4	20.2	-10.5	29.38	46	-16.62	100	Horz
Range 2 30 - 1000MHz										
Test Frequency	Meter Reading	Detector	25MHz-1GHz ChmbrA Amplified.TX [dB]	5m A T122 Bilog below 1GHz.TXT [dB]	10m to 3m Conversion [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
199.6143	47.71	PK	-26.2	12	-10.5	23.01	43.5	-20.49	100	Vert
213.765	49.05	PK	-26.1	11.9	-10.5	24.35	43.5	-19.15	100	Vert
445.6035	49.08	PK	-25.2	15.7	-10.5	29.08	46	-16.92	100	Vert

The amplitude of the above spurious emissions are independent of mode (MRP/HRP), data rate, and MRP/HRP Channel number.

TX AND RX SPURIOUS EMISSIONS 1 TO 40 GHz VERTICAL AND HORIZONTAL DATA

High Frequency Measurement
Compliance Certification Services, Fremont 3m Chamber

Company: SILCON IMAGE
Project #: 12U14290
Date: 11/10/2011
Test Engineer: MENGISTU MEKURIA
Configuration: EUT AND SUPPORT EQUIPMENT
Mode: VIDEO AND AUDIO TX/RX

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B	T88 Miteq 26-40GHz	T39; ARA 18-26GHz; S/N:1013	FCC 15.209

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.040	3.0	63.6	56.1	25.0	2.8	-37.8	0.0	0.0	53.7	46.2	74	54	-20.3	-7.8	V
1.180	3.0	56.0	49.7	25.5	3.0	-37.5	0.0	0.0	46.9	40.6	74	54	-27.1	-13.4	V
1.267	3.0	63.6	61.9	25.7	3.1	-37.4	0.0	0.0	55.0	53.3	74	54	-19.0	-0.7	V
1.333	3.0	59.6	53.5	25.9	3.2	-37.3	0.0	0.0	51.5	45.3	74	54	-22.5	-8.7	V
1.373	3.0	63.8	48.1	26.1	3.3	-37.3	0.0	0.0	55.9	40.2	74	54	-18.1	-13.8	V
1.633	3.0	60.0	54.1	26.9	3.6	-36.9	0.0	0.0	53.6	47.7	74	54	-20.4	-6.3	V
1.733	3.0	55.5	34.9	27.2	3.7	-36.7	0.0	0.0	49.7	29.1	74	54	-24.3	-24.9	V
2.227	3.0	60.6	40.9	28.3	4.3	-36.0	0.0	0.0	57.3	37.5	74	54	-16.7	-16.5	V
2.373	3.0	57.6	39.6	28.5	4.5	-35.8	0.0	0.0	54.9	36.9	74	54	-19.1	-17.1	V
2.527	3.0	51.4	46.0	28.9	4.7	-35.6	0.0	0.0	49.4	43.9	74	54	-24.6	-10.1	V
2.673	3.0	55.3	47.6	29.3	4.8	-35.5	0.0	0.0	53.9	46.2	74	54	-20.1	-7.8	V
2.967	3.0	55.5	50.3	30.2	5.1	-35.3	0.0	0.0	55.4	50.2	74	54	-18.6	-3.8	V
3.713	3.0	50.5	39.6	31.9	5.9	-34.6	0.0	0.0	53.7	42.8	74	54	-20.3	-11.2	V
4.453	3.0	47.2	38.1	32.9	6.5	-34.2	0.0	0.0	52.4	43.3	74	54	-21.6	-10.7	V
5.075	3.0	46.3	42.2	33.4	6.9	-34.0	0.0	0.0	52.6	48.5	74	54	-21.4	-5.5	V
10.152	3.0	41.9	38.0	38.4	9.3	-32.5	0.0	0.0	57.1	53.1	74	54	-16.9	-0.9	V
24.192	3.0	34.6	23.8	33.6	17.2	-32.2	0.0	0.0	53.2	42.4	74	54	-20.8	-11.6	V
25.056	3.0	37.1	26.4	33.8	18.6	-31.9	0.0	0.0	57.5	46.8	74	54	-16.5	-7.2	V
1.267	3.0	60.5	59.3	25.7	3.1	-37.4	0.0	0.0	51.9	50.7	74	54	-22.1	-3.3	H
1.336	3.0	51.3	45.3	26.0	3.2	-37.3	0.0	0.0	43.2	37.1	74	54	-30.8	-16.9	H
1.376	3.0	56.3	37.3	26.1	3.3	-37.2	0.0	0.0	48.4	29.4	74	54	-25.6	-24.6	H
2.227	3.0	52.1	46.4	28.3	4.3	-36.0	0.0	0.0	48.8	43.1	74	54	-25.2	-10.9	H
2.373	3.0	50.8	48.0	28.5	4.5	-35.8	0.0	0.0	48.1	45.2	74	54	-25.9	-8.8	H
2.527	3.0	53.8	49.0	28.9	4.7	-35.6	0.0	0.0	51.7	46.9	74	54	-22.3	-7.1	H
2.820	3.0	51.7	47.2	29.8	4.9	-35.4	0.0	0.0	51.0	46.5	74	54	-23.0	-7.5	H
5.075	3.0	43.8	39.1	33.4	6.9	-34.0	0.0	0.0	50.1	45.5	74	54	-23.9	-8.5	H
10.152	3.0	38.4	32.2	38.4	9.3	-32.5	0.0	0.0	53.5	47.3	74	54	-20.5	-6.7	H
24.192	3.0	35.4	24.4	33.6	17.2	-32.2	0.0	0.0	53.9	43.0	74	54	-20.1	-11.0	H
25.056	3.0	38.8	28.7	33.8	18.6	-31.9	0.0	0.0	59.2	49.1	74	54	-14.8	-4.9	H

Rev. 07.08.11

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

The amplitude of the above spurious emissions are independent of mode (MRP/HRP) and data rate. The emission at 24.192 GHz corresponds to MRP/HRP Channel 2 and the emission at 25.056 GHz corresponds to MRP/HRP Channel 3.

TX AND RX SPURIOUS EMISSIONS 40 TO 200 GHz

PEAK MEASUREMENT

Note: The peak density is less than the average limit

MRP/HRP Channel 2 (Low)

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
48.384	0.400	-76.93	20.00	-38.8
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (pW/cm^2)**	**Limit (pW/cm^2)**
1.33E-07	3.0	1.18E-09	0.12	90

MRP/HRP Channel 3 (High)

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
50.112	0.400	-84.42	20.00	-45.9
EIRP (W)	**Specification Distance (m)**	**Power Density (W/m^2)**	**Power Density (pW/cm^2)**	**Limit (pW/cm^2)**
2.55E-08	3.0	2.25E-10	0.02	90

The amplitude of the above spurious emissions are independent of mode (MRP/HRP) and data rate.

7.7. RECEIVER SPURIOUS EMISSIONS

LIMITS

The Rx spurious emission limits are the same as the Tx spurious emission limits. All emissions were measured with the transmitters and receivers operating simultaneously. The receiver spurious performance is documented by the transmit spurious results above.

7.8. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

§15.207
IC RSS-GEN, Section 7.2.2

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 C63.4

6 WORST EMISSIONS

Silicon Image (Proj #: 12U14290)
Model #: SIL-SK63100
Config.: EUT With AC Adapter and Supppt Equipment
Tested: M. Mekuria

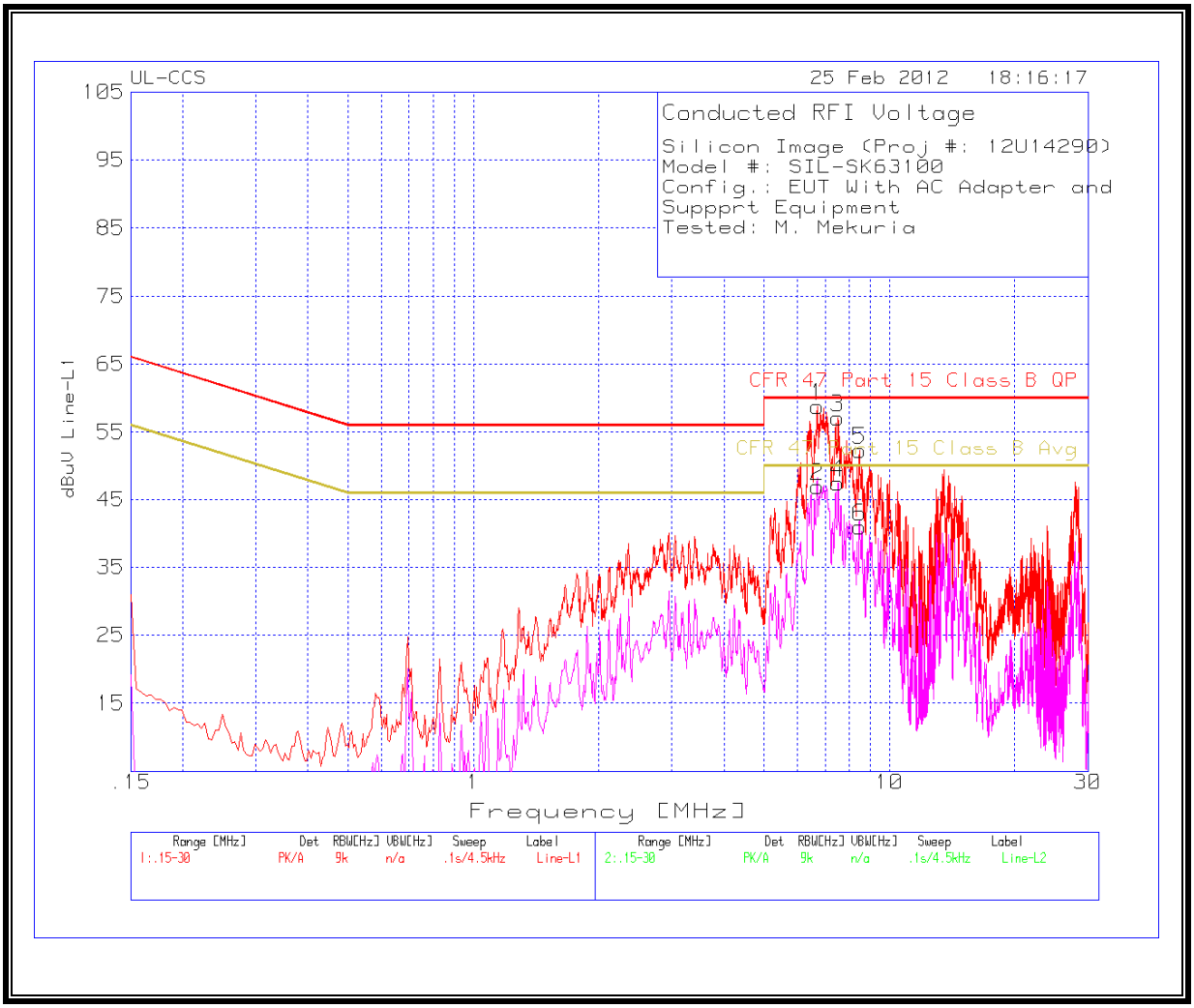
Line-L1 .15 - 30MHz

Test Frequency	Meter Reading	Detector	T24 IL L1.TXT [dB]	LC Cables 1&3.TXT [dB]	dBuV	CFR 47 Part 15 Class B QP	Margin	CFR 47 Part 15 Class B Avg	Margin
6.711	58.55	PK	0.1	0.1	58.75	60	-1.25		
6.711	46.82	Av	0.1	0.1	47.02	60	-12.98	50	-2.98
7.5255	56.87	PK	0.1	0.1	57.07	60	-2.93		
7.5255	47.35	Av	0.1	0.1	47.55	60	-12.45	50	-2.45
8.466	52.11	PK	0.1	0.1	52.31	60	-7.69		
8.466	40.74	Av	0.1	0.1	40.94	60	-19.06	50	-9.06

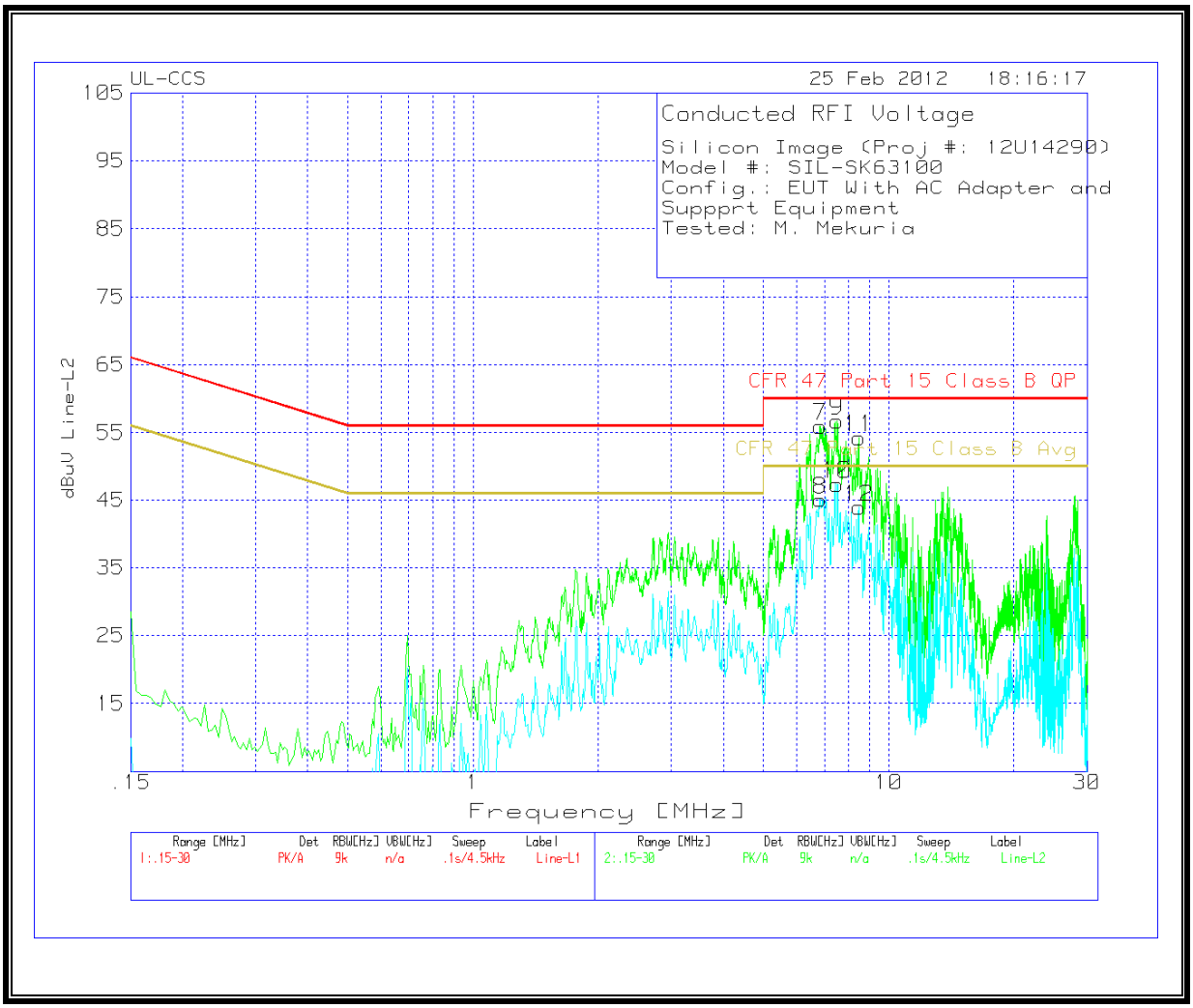
Line-L2 .15 - 30MHz

Test Frequency	Meter Reading	Detector	T24 IL L1.TXT [dB]	LC Cables 1&3.TXT [dB]	dBuV	CFR 47 Part 15 Class B QP	Margin	CFR 47 Part 15 Class B	Margin
6.837	55.72	PK	0.1	0.1	55.92	60	-4.08		
6.837	44.87	Av	0.1	0.1	45.07	60	-14.93	50	-4.93
7.5255	56.52	PK	0.1	0.1	56.72	60	-3.28		
7.5255	47.16	Av	0.1	0.1	47.36	60	-12.64	50	-2.64
8.4615	54.08	PK	0.1	0.1	54.28	60	-5.72		
8.4615	43.75	Av	0.1	0.1	43.95	60	-16.05	50	-6.05

LINE 1 RESULTS



LINE 2 RESULTS



7.9. 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.

APPLIED LIMIT

The EUT is intended for indoor use only with a manufacturer's specified temperature range of 0 to 50 ºC, and for installation in host devices that furnish DC supply voltage regulated to within +/- 10% of the rated input voltage.

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: 3.3VDC @ 20ºC			
Power Supply (VDC)	**Environment Temperature (ºC)**	**Frequency (MHz)**	**Delta (kHz)**
3.30	50	60479.6822710	-190.708
3.30	40	60479.7520210	-120.958
3.30	30	60479.9175040	44.525
3.30	***20***	***60479.8729790***	***Reference***
3.30	10	60479.7161020	-156.877
3.30	0	60479.7922070	-80.772
3.63	20	60479.8105210	-62.458
2.97	20	60479.9004820	27.503

7.10. 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.

7.11. TRANSMITTER IDENTIFICATION

LIMIT

§15.255 (i) For all transmissions that emanate from inside of a building, within any one second interval of signal transmission, each transmitter with a peak output power equal to or greater than 0.1 mW or a peak power density equal to or greater than 3 nW/cm2, as measured 3 meters from the radiating structure, must transmit a transmitter identification at least once. Each application for equipment authorization for equipment that will be used inside of a building must declare that the equipment contains the required transmitter identification feature and must specify a method whereby interested parties can obtain sufficient information, at no cost, to enable them to fully detect and decode this transmitter identification information. Upon the completion of decoding, the transmitter identification data block must provide the following fields:

(1) FCC Identifier, which shall be programmed at the factory.

(2) Manufacturer's serial number, which shall be programmed at the factory.

(3) Provision for at least 24 bytes of data relevant to the specific device, which shall be field programmable. The grantee must implement a method that makes it possible for users to specify and update this data. The recommended content of this field is information to assist in contacting the operator.

RESULTS

Not Applicable.

The EUT is part of a WVAN. All components of the WVAN are for indoor operation only. There are no outdoor units therefore no transmissions are directed outside the building.

8. RF EXPOSURE

8.1. RULES AND LIMITS

FCC RULES

§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.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

8.2. INTRODUCTORY INFORMATION

8.2.1. OPERATING MODES

The setup phase (LRP) and normal operation (MRP/HRP) do not occur simultaneously; therefore it is appropriate to consider the RF exposure during these two operating modes independently.

8.2.2. LAPTOP CONFIGURATIONS

The EUT may be installed in one of three laptop configurations. The EUT is installed in the display section of the laptop, with the bottom of the transmitting antenna located one of three distances from the base of the laptop.

Configuration	Distance from bottom of TX antenna to base of laptop
#1	3.9 cm
#2	4.5 cm
#3	4.9 cm

8.2.3. SMALL APERTURE PROBE

The required measurements at a distance no closer than 5 cm were made using a small aperture rectangular waveguide probe antenna as specified in IEEE C95.3.

The measurement probe consists of an 8-inch long straight section of WG-15 rectangular waveguide. One end of this waveguide is equipped with a standard WG-15 flange. The other end of this waveguide is open.

The probe gain was measured using two probes spaced at a 5 cm distance, and the Friis equation assuming the gain of the two probes is identical.

(Friis equation)

$$G^2 = G_R G_T = \frac{P_R}{P_T}\left(\frac{4\pi D}{\lambda}\right)^2$$

where

$G = G_R = G_T$ = Gain of small aperture probe antennas
P_T = Power Transmitted
P_R = Power Received
D = Measurement distance
λ = wavelength

8.3. SETUP PHASE (LRP) EVALUATION

8.3.1. SETUP PHASE (LRP) PROCEDURE

The maximum power of the Setup Phase (LRP) emission is measured on-axis at a 5 cm distance using the small aperture waveguide probe antenna.

The RF Exposure calculations for LRP assume that the off-axis power density in all possible beam orientations is equal to the maximum on-axis power density, and the separation distance is the height of the lowest TX antenna element.

The probe antenna is connected to a spectrum analyzer via a downconverter. The spectrum analyzer is set to measure channel power using peak detection with the Max Hold mode activated, to capture the maximum peak emission level as the LRP beam is scanned over the normal range of beam orientations. The source-based duty cycle is applied to this peak measurement to yield the maximum average emission level.

The power density is calculated using the Friis equation and OET 65 Equation 18:

(Friis equation)

$$(P_T G_T)_{eff} = \frac{P_R}{G_R}\left(\frac{4\pi D}{\lambda}\right)^2$$

where

$(P_T G_T)$eff = effective radiated power at measurement distance
P_R = Power Received
G_R = Gain of small aperture Receive probe antenna
D = Measurement distance
λ = wavelength

(OET 65 Equation 18)

$$S = (P_T G_T)_{eff} / (4\pi D^2)$$

where

S = Power Density
$(P_T G_T)$eff = effective radiated power at measurement distance
D = Separation Distance

8.3.2. SETUP PHASE (LRP) DUTY CYCLE

The Worst-case Source-based Duty Cycle = 100 * (0.3 ms / 20 ms) = 1.5%.

The Worst-case Source-based Duty Cycle Factor = 10 * Log (0.3 ms / 20 ms) = -18.2 dB.

The Worst-case Source-based Duty Cycle Factor is applied to all peak measured values of the LRP transmission to derive average measured LRP values.

8.3.3. SETUP PHASE (LRP) RESULTS

For reference the Average Far Field EIRP is included in the table below and denoted as Far Field EIRP.

Average Far Field EIRP = Peak Far Field EIRP + Worst-case Source-based Duty Dycle Factor.

Where Peak Far Field EIRP is based on RF Regulatory measurements of the LRP transmission.

Far Field EIRP = Average Far Field EIRP = 33.2 dBm – 21.8 dB = 15 dBm.

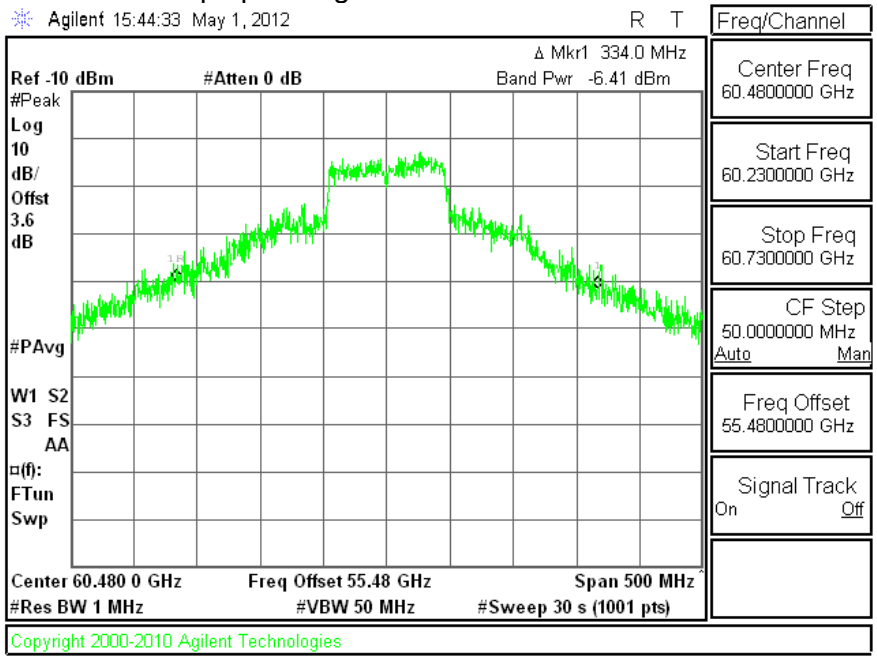
All other measurements in table below are based on small aperture probe measurements.

LRP POWER DENSITY

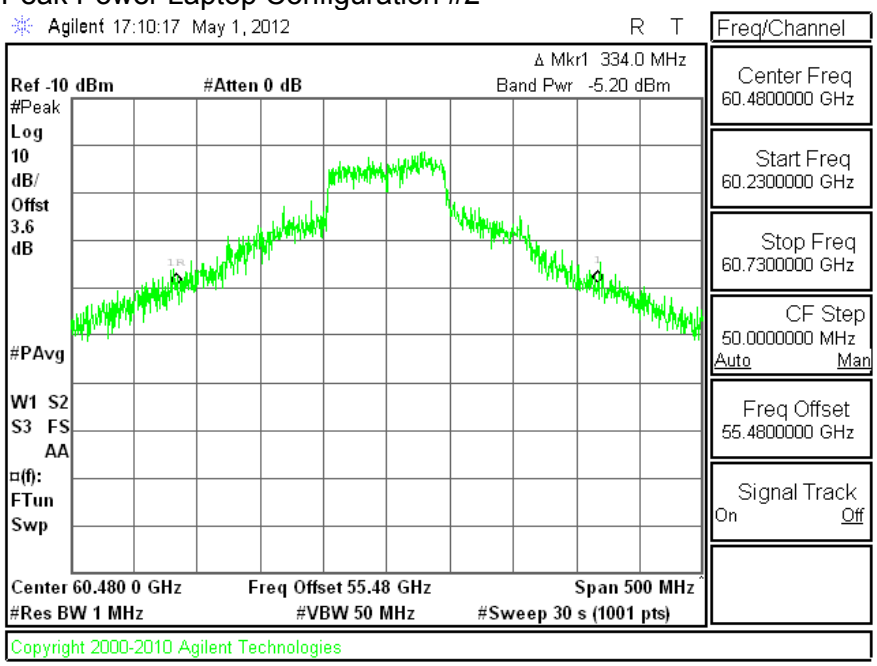
Freq	Far Field EIRP	Meas Dist	Meas Peak Power	Duty Cycle Factor	Probe Gain	Average (Pt*Gt)	Average (Pt*Gt)	Separation Distance	Power Density	FCC Pwr Density Limit
(GHz)	(dBm)	(cm)	(dBm)	(dB)	(dBi)	(dBm)	(mw)	(cm)	(mW/cm^2)	(mW/cm^2)
Worst-case LRP Channel for Laptop Configuration #1										
60.480	15.0	5.0	-6.41	-18.20	6.53	10.9	12.3	3.9	0.0645	1.0
Worst-case LRP Channel for Laptop Configuration #2										
60.480	15.0	5.0	-5.20	-18.20	6.53	12.1	16.3	4.5	0.0640	1.0
Worst-case LRP Channel for Laptop Configuration #3										
60.639	15.0	5.0	-8.21	-18.20	6.53	9.1	8.2	4.9	0.0272	1.0

8.3.4. PEAK ON-AXIS LRP POWER

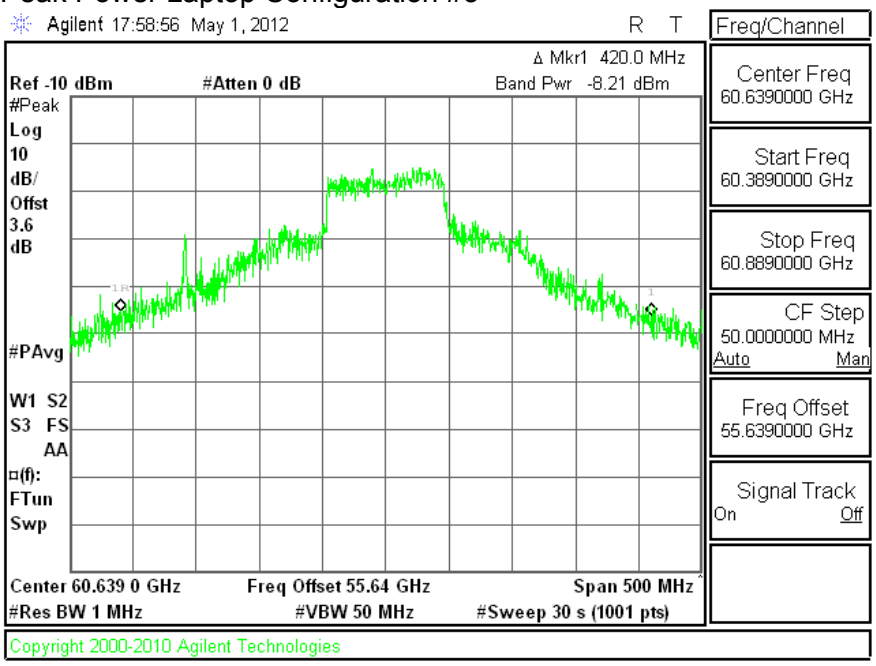
Peak Power Laptop Configuration #1



Peak Power Laptop Configuration #2



Peak Power Laptop Configuration #3



8.4. NORMAL OPERATION (MRP/HRP) EVALUATION

8.4.1. NORMAL OPERATION (MRP/HRP) PROCEDURE

The worst-case average power of the Normal Operation Phase (MRPHRP) emission is measured directly using the small aperture waveguide probe antenna.

The probe antenna is connected to an average power sensor. Since the transmitting antenna beam is locked during the measurement and the sensor responds across ON and OFF times of the EUT, the inherent source-based duty cycle is included in the measurement and no duty cycle factor is applied to subsequent calculations.

The measurement is made with the EUT TX beam angle oriented in the worst-case direction, with the measurement probe bore-sighted to this beam, and with the aperture of the probe in the plane of the base of the host laptop. The measurement distance is equal to the separation distance corresponding to the location of this worst-case power density.

The power density is calculated using the Friis equation and OET 65 Equation 18:

(Friis equation)

$$(P_T G_T)_{eff} = \frac{P_R}{G_R}\left(\frac{4\pi D}{\lambda}\right)^2$$

Where

$(P_T G_T)$eff = effective radiated power at measurement distance
P_R = Power Received
G_R = Gain of small aperture Receive probe antenna
D = Measurement distance
λ = wavelength

(OET 65 Equation 18)

$$S = (P_T G_T)_{eff} / (4\pi D^2)$$

Where

S = Power Density
$(P_T G_T)$eff = effective radiated power at measurement distance
D = Separation Distance

8.4.2. NORMAL OPERATION (MRP/HRP) RESULTS

For reference the Average Far Field EIRP is included in the table below and denoted as Far Field EIRP. The Average Far Field EIRP is based on RF Regulatory measurements of the MRP and HRP emissions.

All other measurements in table below are based on small aperture probe measurements.

Freq	Far Field EIRP	Meas Dist	Meas Avg Power	Probe Gain	Boresight (Pt*Gt)	Boresight (Pt*Gt)	Separation Distance	Power Density	FCC Pwr Density Limit
(GHz)	(dBm)	(cm)	(dBm)	(dBi)	(dBm)	(mw)	(cm)	(mW/cm^2)	(mW/cm^2)
MRP for Laptop Configuration #1									
60.480	28.6	5.5	-13.70	6.53	22.6	184.0	5.5	0.4842	1.0
62.640	27.7	5.5	-12.99	6.49	23.7	234.5	5.5	0.6173	1.0
HRP for Laptop Configuration #1									
60.480	26.1	5.5	-14.50	6.53	21.8	153.0	5.5	0.4027	1.0
62.640	25.0	5.5	-15.21	6.49	21.5	140.7	5.5	0.3702	1.0
MRP for Laptop Configuration #2									
60.480	28.6	6.4	-14.84	6.53	22.8	191.6	6.4	0.3724	1.0
62.640	27.7	6.4	-15.03	6.49	23.0	198.5	6.4	0.3859	1.0
HRP for Laptop Configuration #2									
60.480	26.1	6.4	-15.31	6.53	22.4	171.9	6.4	0.3342	1.0
62.640	25.0	6.4	-16.22	6.49	21.8	150.9	6.4	0.2934	1.0
MRP for Laptop Configuration #3									
60.480	28.6	6.9	-16.79	6.53	21.5	142.1	6.9	0.2377	1.0
62.640	27.7	6.9	-18.22	6.49	20.4	110.7	6.9	0.1851	1.0
HRP for Laptop Configuration #3									
60.480	26.1	6.9	-17.95	6.53	20.4	108.8	6.9	0.1820	1.0
62.640	25.0	6.9	-19.55	6.49	19.1	81.5	6.9	0.1363	1.0

8.5. RESULTS BASED ON WORST-CASE POWER SCALING

8.5.1. POWER SCALING

The HRP mode is the reference mode for device output power.
The output power of the LRP mode and the MRP mode tracks the output power of the HRP mode.
The maximum output power is limited by the maximum specified tolerance limit for HRP power.

Therefore the maximum upward scaling of the output power in all transmitting modes (LRP, HRP and MRP) is determined by the difference between the maximum HRP tolerance limit and the highest measured HRP EIRP on the sample tested. These parameters are average values.

The maximum HRP tolerance limit is 28 dBm EIRP.
The highest measured Average HRP EIRP on the sample tested was 26.1 dBm.
The maximum upward power scaling for the sample tested is 28 dBm EIRP – 26.1 dBm EIRP = 1.9 dB.

8.5.2. SETUP PHASE (LRP) RESULTS WITH POWER SCALING

The Far Field EIRP of the LRP mode is scaled upward by 1.9 dB.
All other measurements in table below are based on small aperture probe measurements, scaled upward by 1.9 dB.

LRP POWER DENSITY SCALED UPWARD BY 1.9 dB

Freq	Scaled Far-field EIRP	Meas Dist	Scaled Peak Power	Duty Cycle Factor	Probe Gain	Average (Pt*Gt)	Average (Pt*Gt)	Separation Distance	Power Density	FCC Pwr Density Limit
(GHz)	(dBm)	(cm)	(dBm)	(dB)	(dBi)	(dBm)	(mw)	(cm)	(mW/cm^2)	(mW/cm^2)
Worst-case LRP Channel for Laptop Configuration #1										
60.480	16.9	5.0	-4.51	-18.20	6.53	12.8	19.1	3.9	0.1000	1.0
Worst-case LRP Channel for Laptop Configuration #2										
60.480	16.9	5.0	-3.30	-18.20	6.53	14.0	25.2	4.5	0.0992	1.0
Worst-case LRP Channel for Laptop Configuration #3										
60.639	16.9	5.0	-6.28	-18.20	6.53	11.1	12.8	4.9	0.0423	1.0

8.5.3. NORMAL OPERATION (MRP/HRP) RESULTS WITH POWER SCALING

The Far Field EIRP of each of the HRP and MRP modes is scaled upward by 1.9 dB.

All other measurements in table below are based on small aperture probe measurements, scaled up by 1.9 dB.

Freq	Scaled Far-field EIRP	Meas Dist	Scaled Avg Power	Probe Gain	Boresight (Pt*Gt)	Boresight (Pt*Gt)	Separation Distance	Power Density	FCC Pwr Density Limit
(GHz)	(dBm)	(cm)	(dBm)	(dBi)	(dBm)	(mw)	(cm)	(mW/cm^2)	(mW/cm^2)
MRP for Laptop Configuration #1									
60.480	30.5	5.5	-11.80	6.53	24.5	284.9	5.5	0.7499	1.0
62.640	29.6	5.5	-11.09	6.49	25.6	363.2	5.5	0.9560	1.0
HRP for Laptop Configuration #1									
60.480	28.0	5.5	-12.60	6.53	23.7	237.0	5.5	0.6237	1.0
62.640	26.9	5.5	-13.31	6.49	23.4	217.9	5.5	0.5734	1.0
MRP for Laptop Configuration #2									
60.480	30.5	6.4	-12.94	6.53	24.7	296.7	6.4	0.5768	1.0
62.640	29.6	6.4	-13.13	6.49	24.9	307.5	6.4	0.5977	1.0
HRP for Laptop Configuration #2									
60.480	28.0	6.4	-13.41	6.53	24.3	266.3	6.4	0.5176	1.0
62.640	26.9	6.4	-14.32	6.49	23.7	233.8	6.4	0.4544	1.0
MRP for Laptop Configuration #3									
60.480	30.5	6.9	-14.89	6.53	23.4	220.1	6.9	0.3681	1.0
62.640	29.6	6.9	-16.32	6.49	22.3	171.5	6.9	0.2867	1.0
HRP for Laptop Configuration #3									
60.480	28.0	6.9	-16.05	6.53	22.3	168.5	6.9	0.2818	1.0
62.640	26.9	6.9	-17.65	6.49	21.0	126.2	6.9	0.2111	1.0