FCC CFR47 PART 90

CERTIFICATION TEST REPORT

FOR

COMPACT SURVEILLANCE RADAR

MODEL NUMBER: C550

FCC ID: CO6-C550-LIC

REPORT NUMBER: 13U15472-1, REVISION A

ISSUE DATE: NOVEMBER 01, 2013

Prepared for
SPOTTER RF LLC
709 E. TECHNOLOGY AVE. BLDG E 3100
OREM, UTAH 84097, U.S.A.

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
---	09/16/13	Initial Issue	T. Chan

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SPOTTER RF LLC
709 E. TECHNOLOGY AVE. BLDG E 3100
OREM, UTAH 84097, U.S.A.

EUT DESCRIPTION: COMPACT SURVEILLANCE RADAR

MODEL: C550

SERIAL NUMBER: SP10305 (CONDUCTED) AND SP10300 (RADIATED)

DATE TESTED: AUGUST 15 - 30 AND SEPTEMBER 10, 2013

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 90	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
UL Verification Services Inc. By:

Thu Chan
WiSE Operations Manager
UL Verification Services Inc.

Tested By:

Mengistu Mekuria
WiSE Senior Engineer
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 90, and TIA 603.

3. FACILITIES AND ACCREDITATION

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

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ul.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. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	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 10 GHz medium range Compact Surveillance Radar (CSR). The unit operates only between channel 2 through 9 (10.0670 GHz to 10.4154 GHz)

The radio module is manufactured by SpotterRF LLC.

5.2. MAXIMUM OUTPUT POWER

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

Frequency (GHz)	Channel	Output Power (dBm)	Output Power (mW)
10.0018	2	22.19	165.58
10.2499	6	22.08	161.44
10.4978	9	22.13	163.31

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a patch antenna, with a maximum gain of 14 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Spotter RF C40 SP0003 v3.0.0-alpha.00502 (2012-10-16_12-19).

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission was performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The EUT has eight usable channels and each channel has 50MHz bandwidth with frequency modulation on continuous wave format. However, the test utility software used to run on the non-sweeping mode that is provided for the testing purpose only, not part of end product, helps to determine the worst case. Therefore, two scenarios were investigated as follows:

Non-Sweeping or single frequency mode at which using a utility software to stop sweeping at low, mid, and high frequencies of the sweeping range to evaluate the output power purpose only as shown below under 7.2 and 7.3.

Sweeping mode at which the continuous wave frequency sweeps inside the 50 MHz band while the output power measured as shown below under 7.2 and 7.3.

In both cases the peak power measurement values are the same and all the other tests have done on the worst-case that satisfies individual cases.

All final radiated testing was performed with the EUT in upright orientation as indicated by the installation instructions.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Power **O**ver **E**thernet Adapter	Phihng	POE31U-240	P104205531 A1	N/A

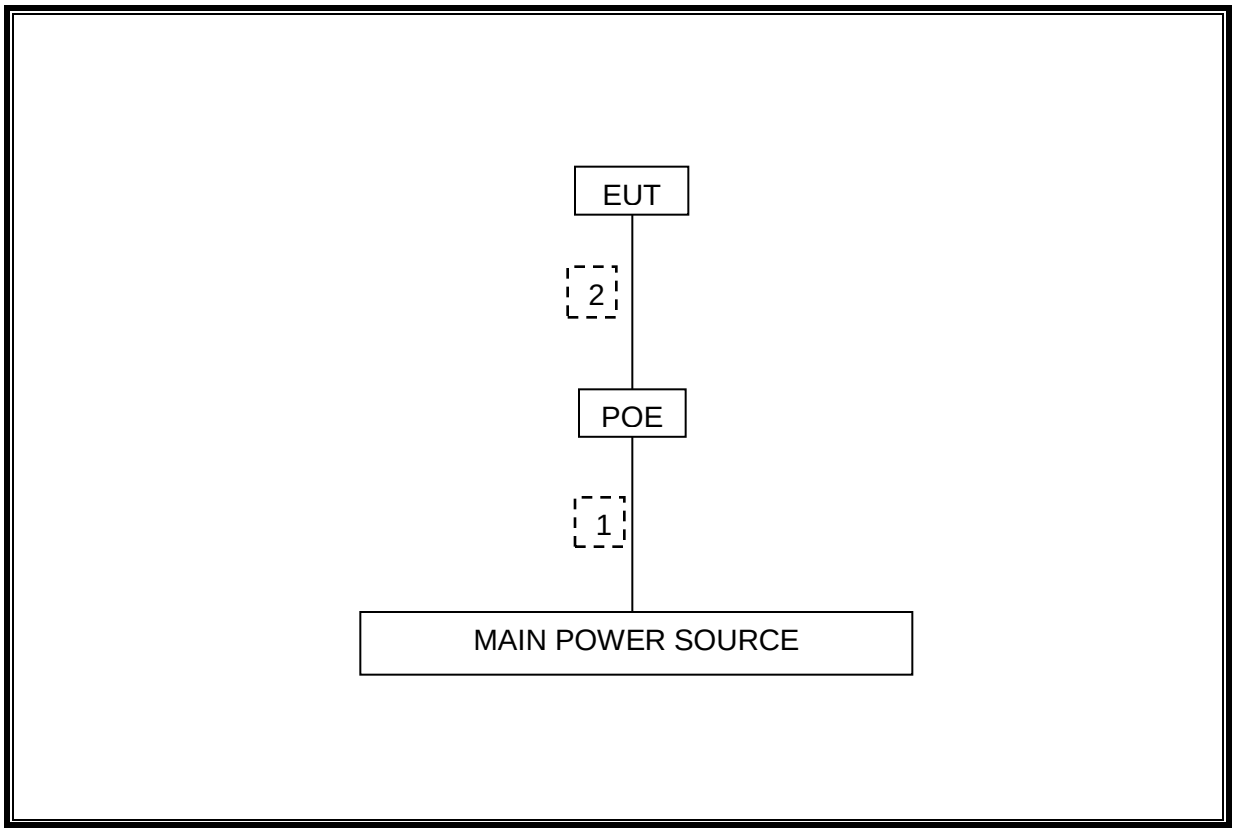
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC 2P	Unshielded	1.8m	None
2	LAN	1	CAT5	Unshielded	2m	None

TEST SETUP

The EUT is powered via the POE adapter. Test software exercised using the Laptop controlled through the Ethernet cables.

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**
Universal Power Meter	Giga-tronics	8651A	C0091	06/05/14
Power Sensor, 18 GHz	Giga-tronics	80701A	C00992	06/05/14
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	C00930	11/01/13
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01178	09/18/13
Spectrum Analyzer, 44 GHz	Agilent	E4446A	C00986	04/01/14
Spectrum Analyzer, 40 GHz	Agilent	8564E	C00951	07/29/14
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	C01016	08/22/14
Antenna, Horn, 18 GHz	ETS Lindgren	3117	C01022	02/21/14
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	11/14/13
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06/28/14
Harmonic Mixer, 50 GHz	Agilent	11970Q	C00769	10/21/13
Antenna, Horn, 50 GHz, 20 dBi	ATM	(0R8N4) 22-442-6	N02336	CNR
Harmonic Mixer, 75 GHz	Agilent	11970V	C00768	01/31/14
Antenna, Horn, 75 GHz, 20 dBi	ATM	15-442-6	N02342	CNR
Preamplifier, 1300 MHz	Agilent	8447D	C00885	01/16/14
PreAmplifier, 1-26.5GHz	Agilent	8449B	F00167	03/23/14
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/20/14

7. ANTENNA PORT TEST RESULTS

7.1. OCCUPIED BANDWIDTH

LIMITS

FCC §2.1049

None; for reporting purposes only.

TEST PROCEDURE

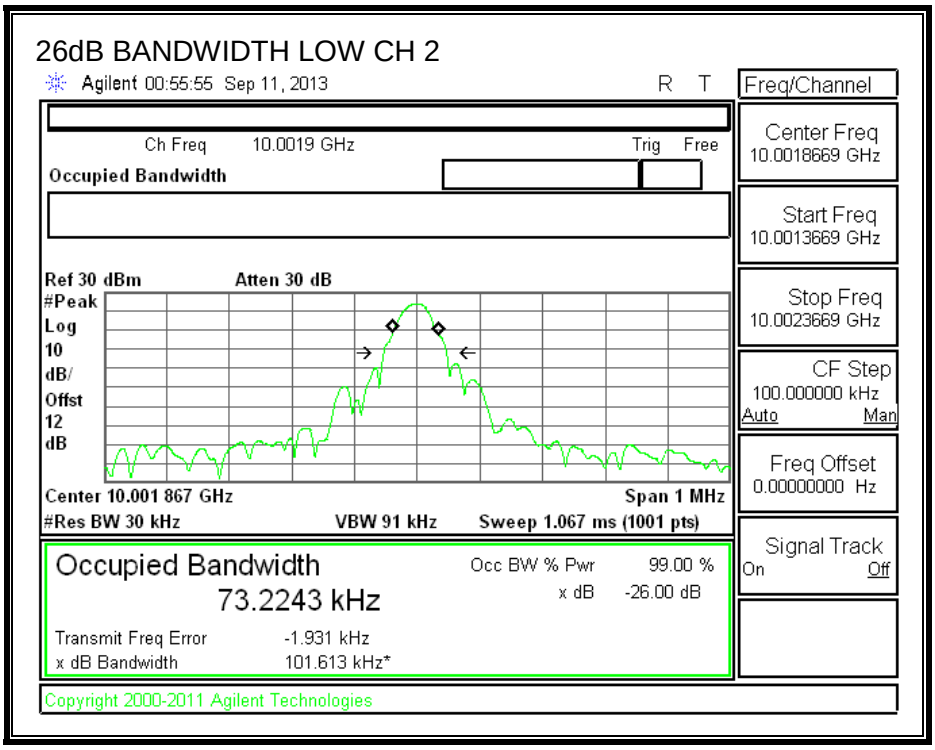
The transmitter output is connected to the spectrum analyzer. The sweep time is coupled. The spectrum analyzer internal 26dB bandwidth function is utilized.

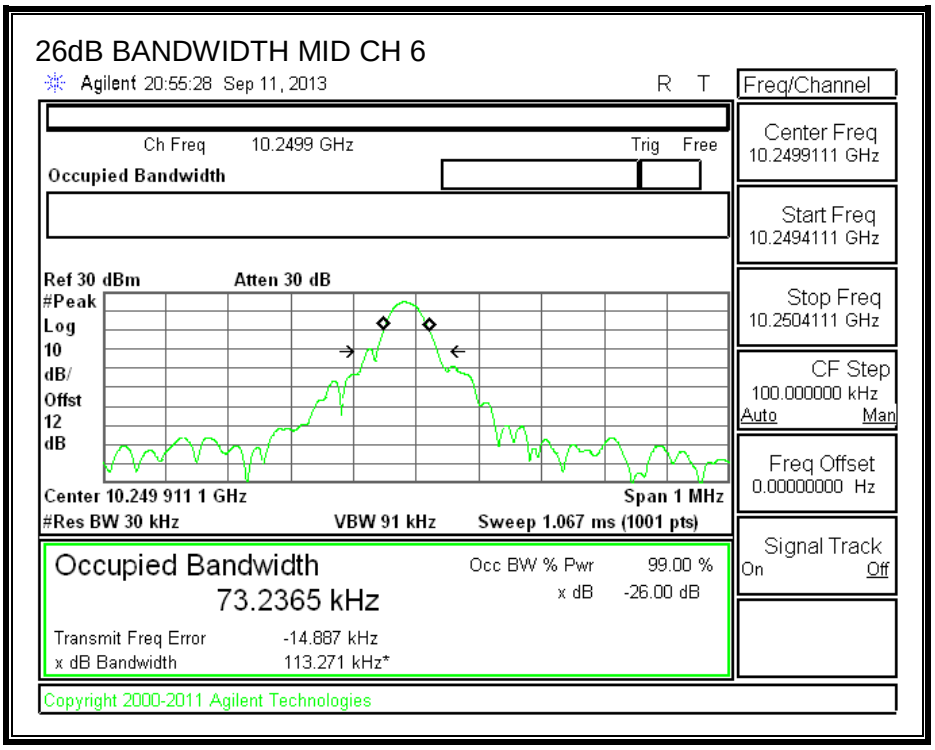
KDB 971168 Occupied bandwidth measurement method is used.

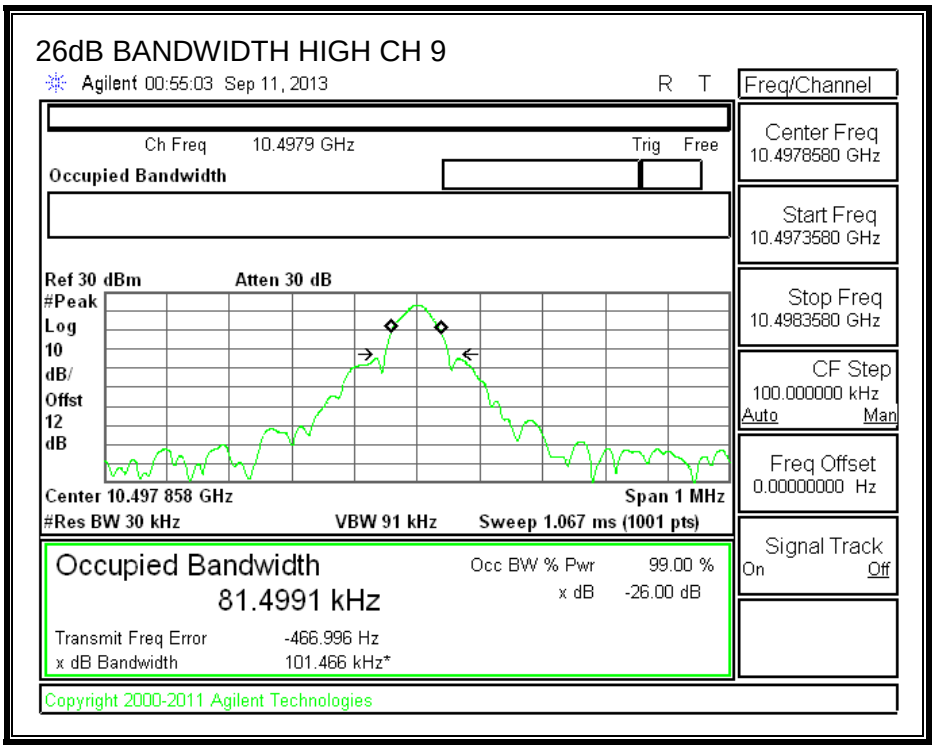
RESULTS

26dB BANDWIDTH NONE-SWEEPING MODE

Channel	Frequency (GHz)	26dB Bandwidth (KHz)
2	10.0018	101.613
6	10.2499	113.271
9	10.4978	101.466



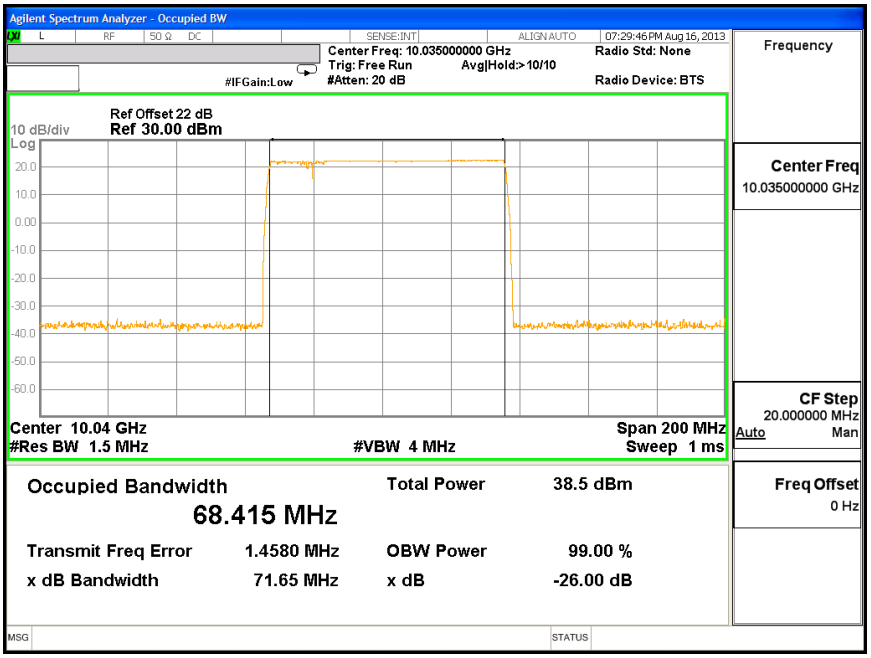




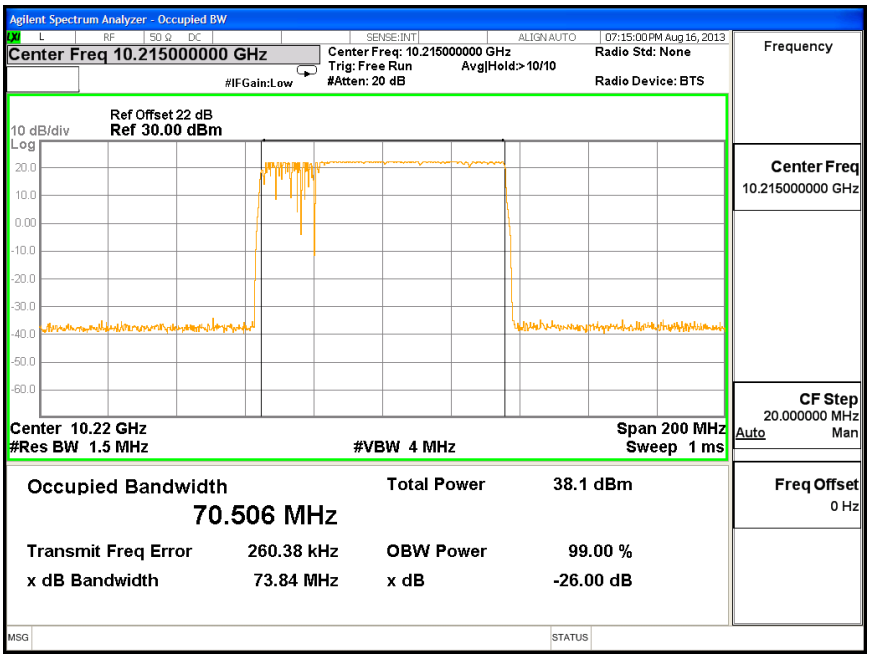
26dB BANDWIDTH SWEEPING MODE

Channel	Frequency (GHz)	26dB Bandwidth (MHz)
2	10.0400	71.650
6	10.2200	73.840
9	10.4600	76.530

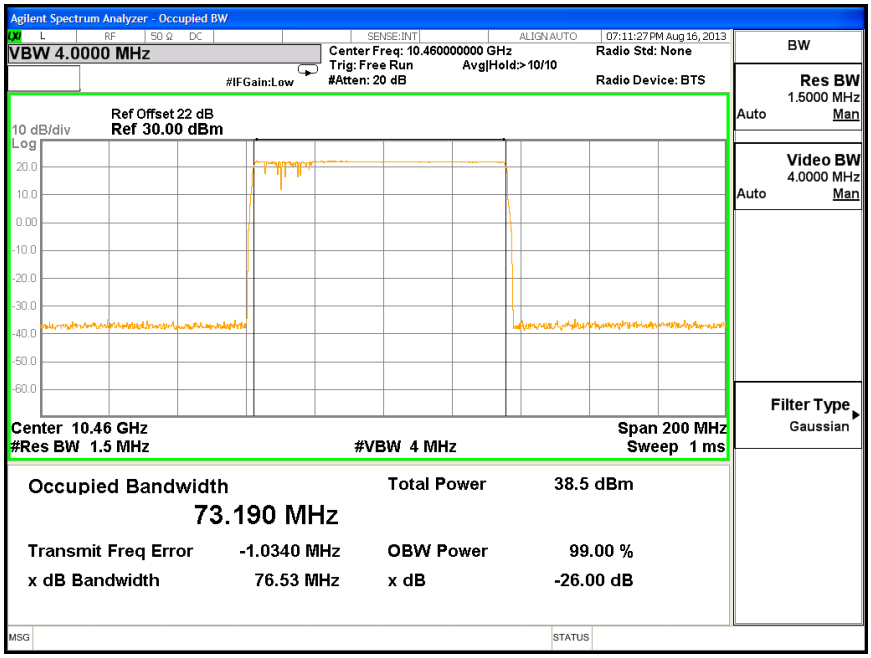
26dB BANDWIDTH LOW CH 2



26dB BANDWIDTH MID CH 6



26dB BANDWIDTH HIGH CH 9



7.2. OUTPUT POWER

LIMITS

FCC §2.1046

FCC §90.205(s) the output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List

FCC §90.103(c) (13) operations in this band are limited to survey operations using transmitters with a peak power not to exceed 5 watts into the antenna.

TEST PROCEDURE

The transmitter output was connected to the input terminal via calibrated coaxial cable. The output power was measured with the wideband power meter at the low, middle and high channel in each band.

KDB 971168 Wideband power measurement method is used.

RESULTS

Channel	Frequency (GHz)	Peak Power Reading (dBm)		Limit (dBm)	Margin None-Sweep mode (dBm)	Margin Sweep mode (dBm)
		None-Sweep mode	Sweep mode			
2	10.0018	22.19	22.11	37	-14.81	-14.89
6	10.2499	22.08	22.04	37	-14.92	-14.96
9	10.4978	22.13	22.01	37	-14.87	-14.99

7.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 22 dB (including 20dB pad and 2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

KDB 971168 Wideband power measurement method is used.

Channel	Frequency (GHz)	AV Power (dBm)	
		None-Sweep	Sweep
2	10.0018	22.15	22.08
6	10.2499	22.00	22.01
9	10.4978	22.05	21.97

7.4. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §2.1051 & FCC §90.210

Attenuation below carrier of 43 + 10 log (P) dB or -13dBm

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 1MHz. The video bandwidth is set to 3MHz.

The spectrum from 30MHz to 50GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

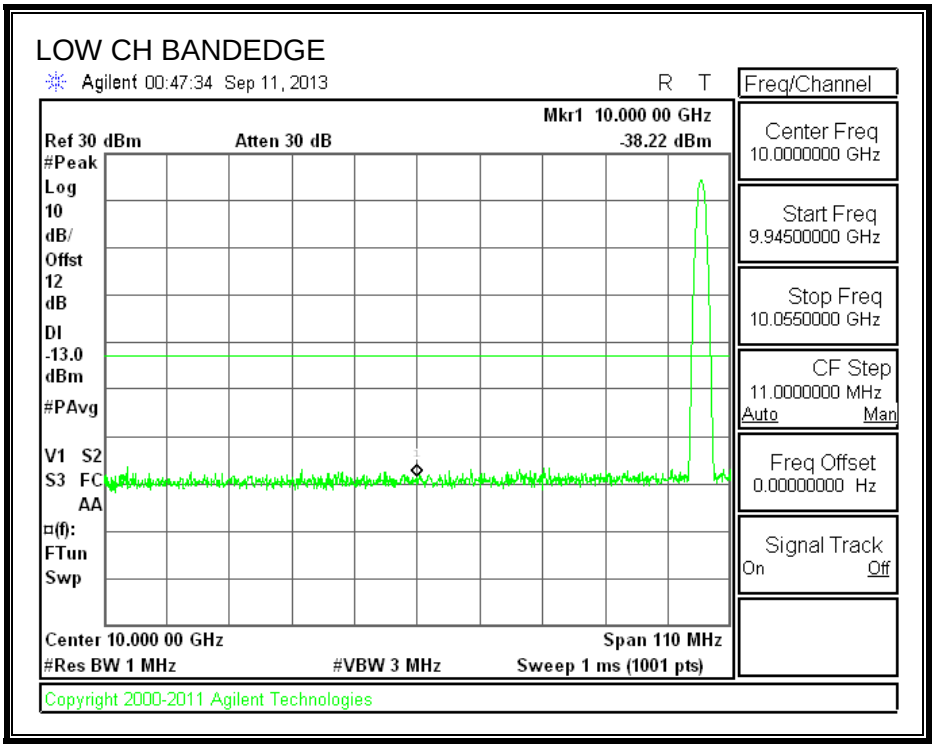
RESULTS

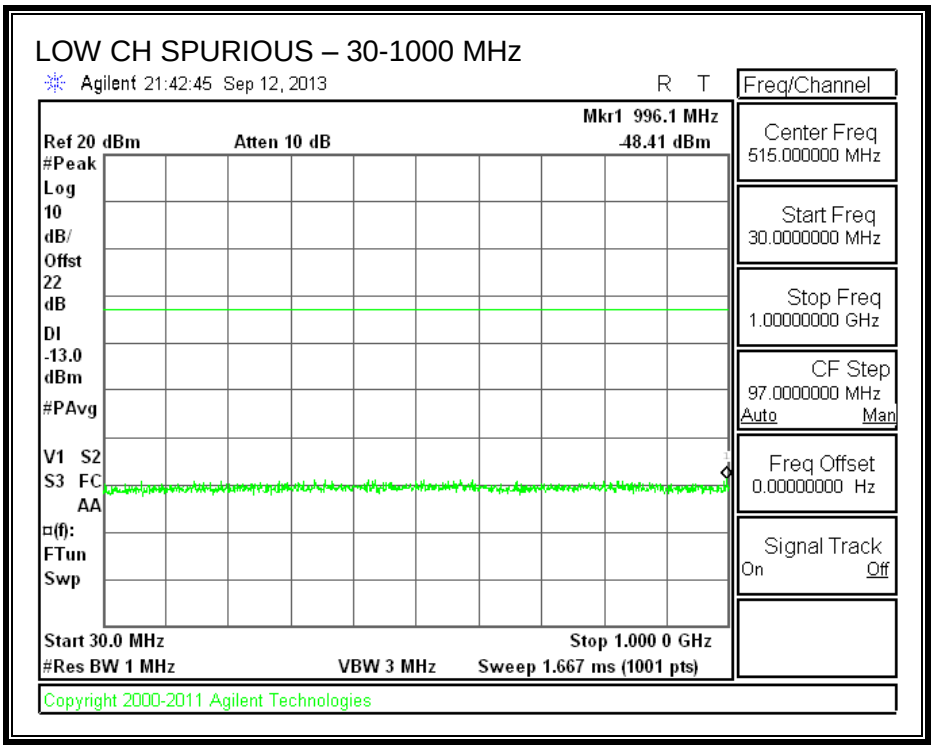
Note: The EUT was obtained from 40GHz – 50GHz using a Harmonic Mixer and no emissions were found.

RESULT

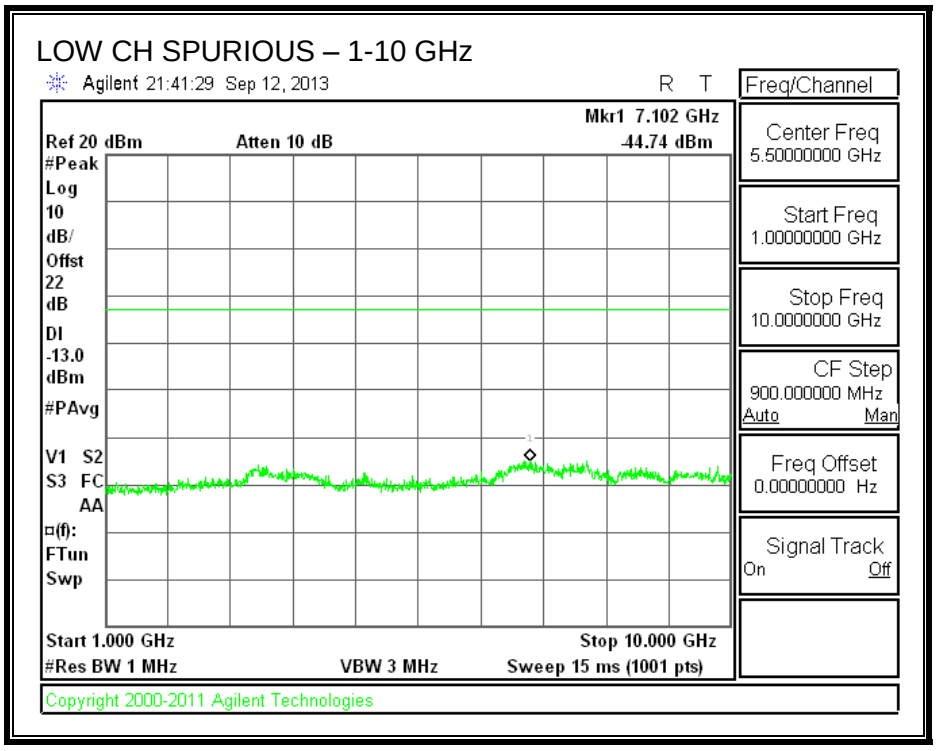
SPURIOUS EMISSIONS NONE-SWEEPING MODE

LOW CHANNEL

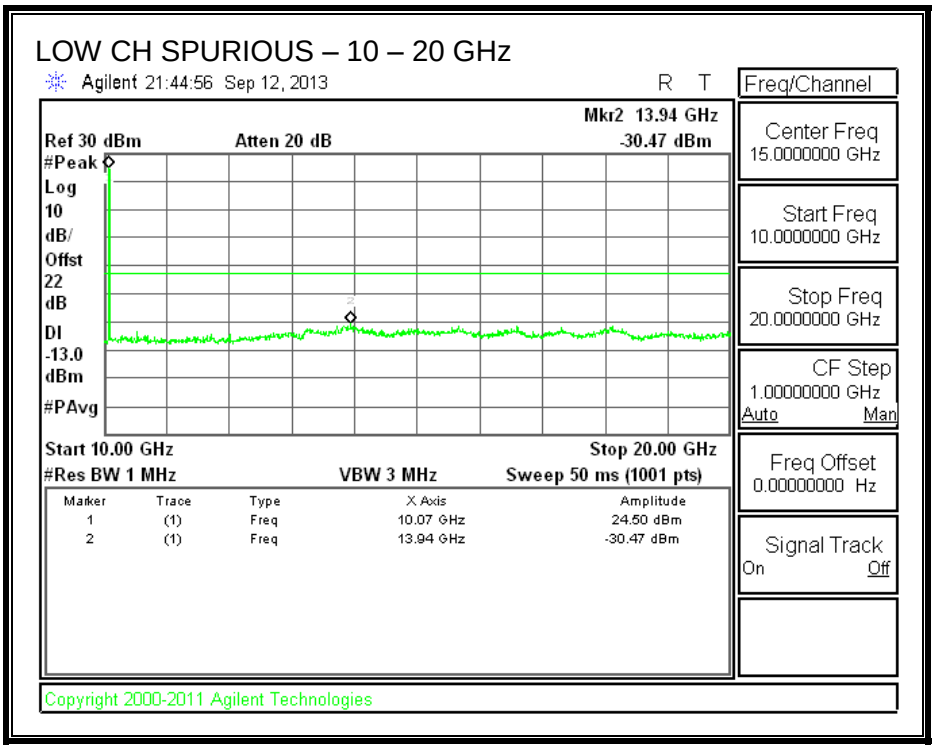




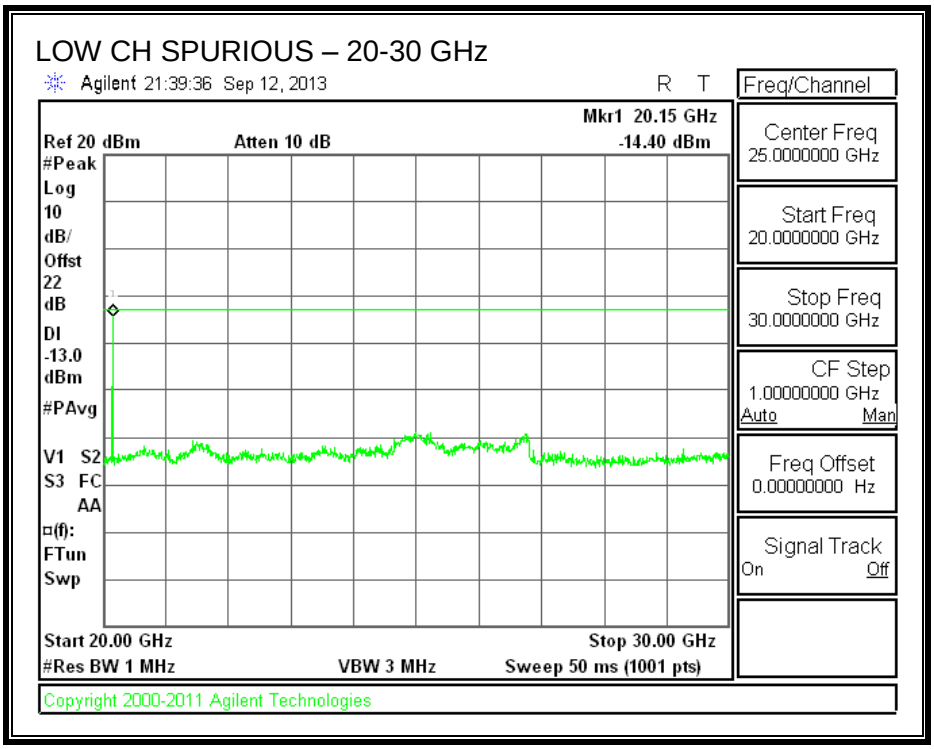
LOW CH SPURIOUS – 1-10 GHz



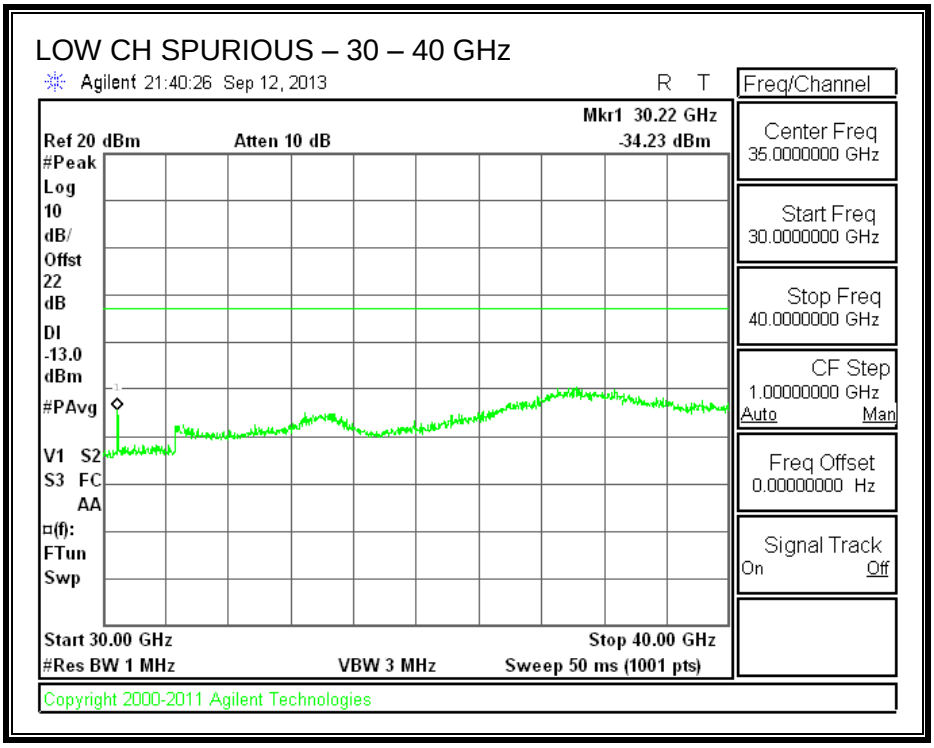
LOW CH SPURIOUS – 10 – 20 GHz



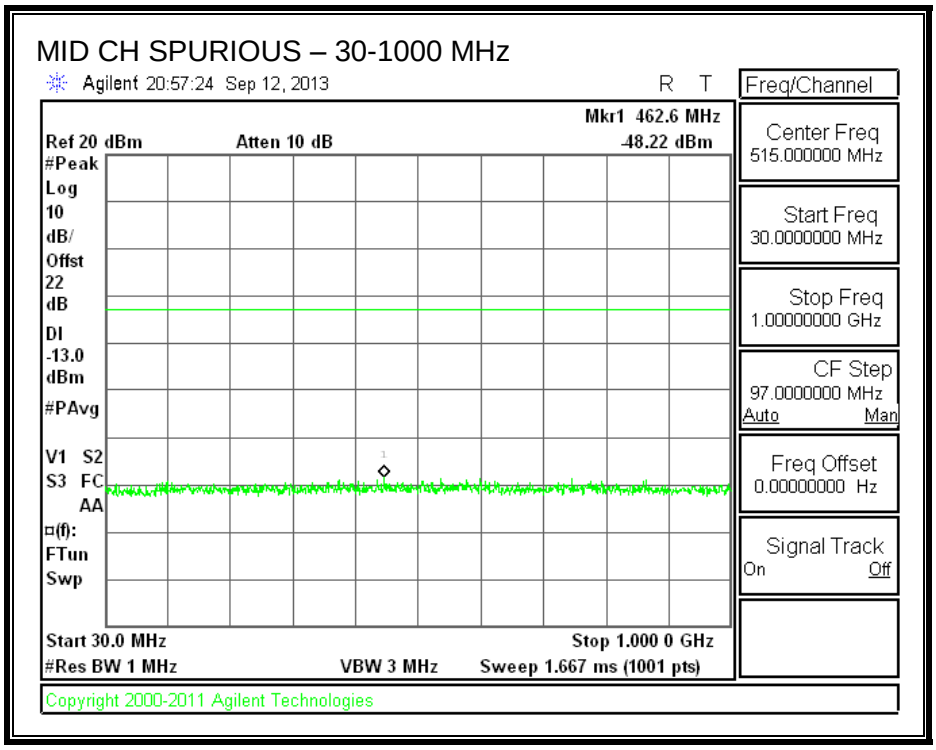
LOW CH SPURIOUS – 20-30 GHz

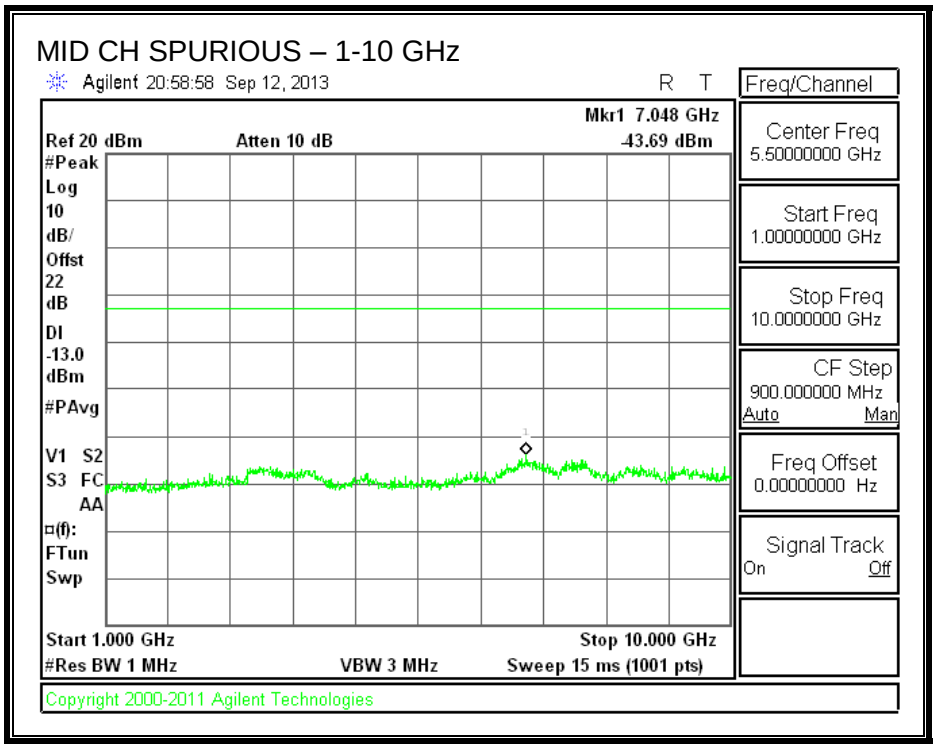


LOW CH SPURIOUS – 30 – 40 GHz

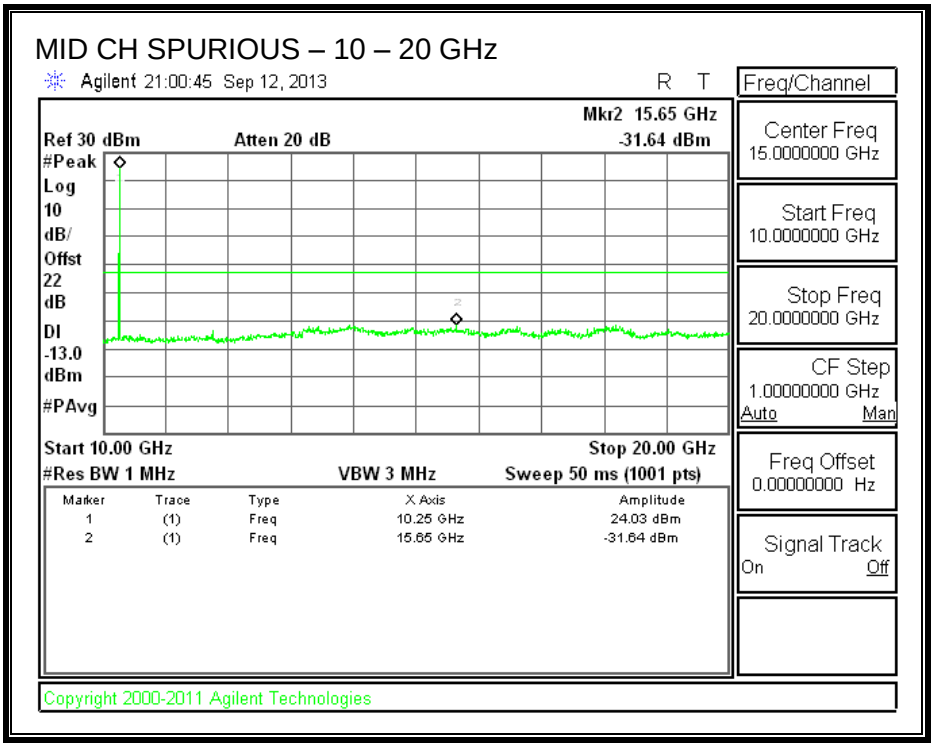


SPURIOUS EMISSIONS, MID CHANNEL

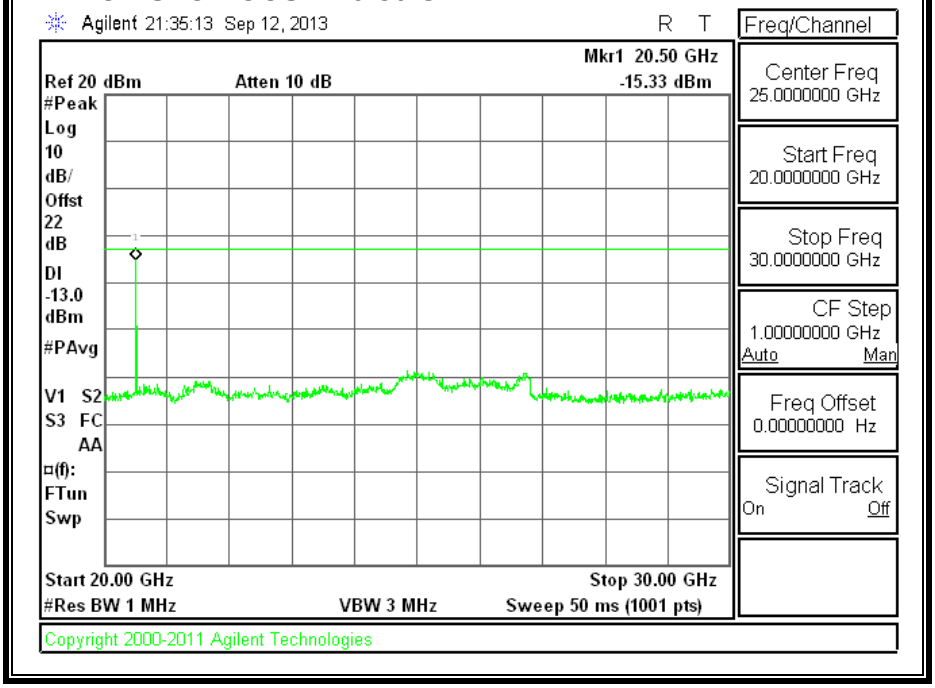


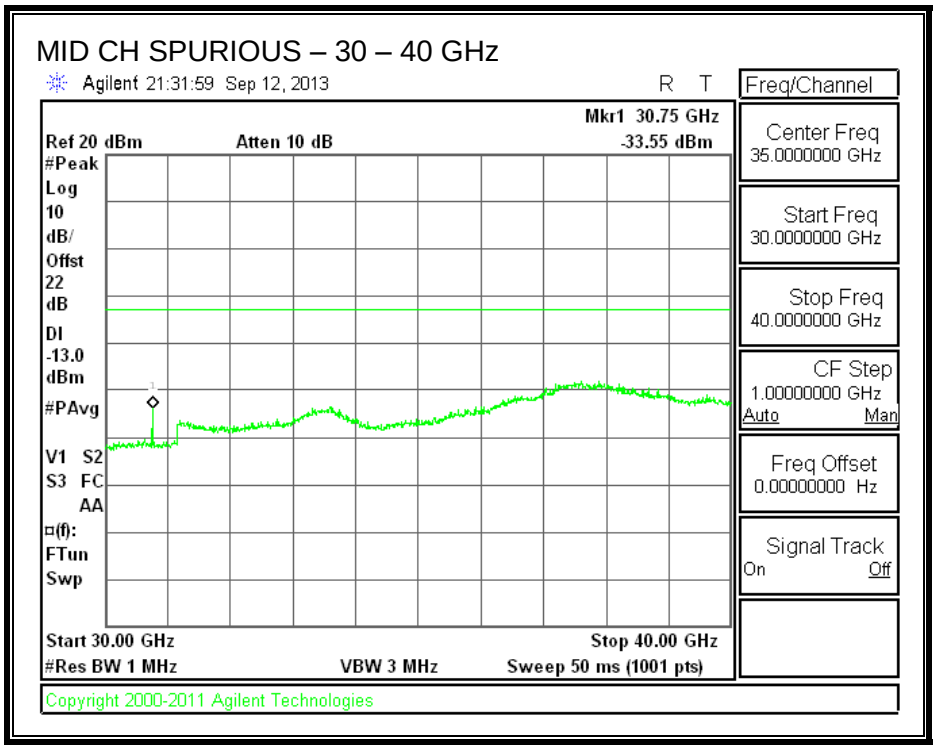


MID CH SPURIOUS – 10 – 20 GHz

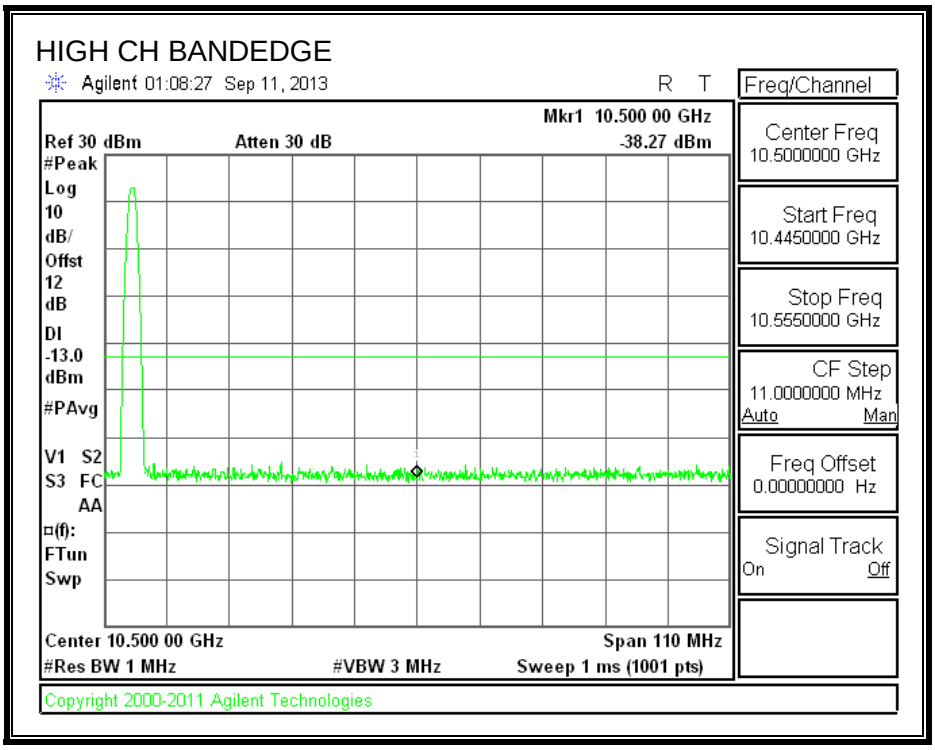


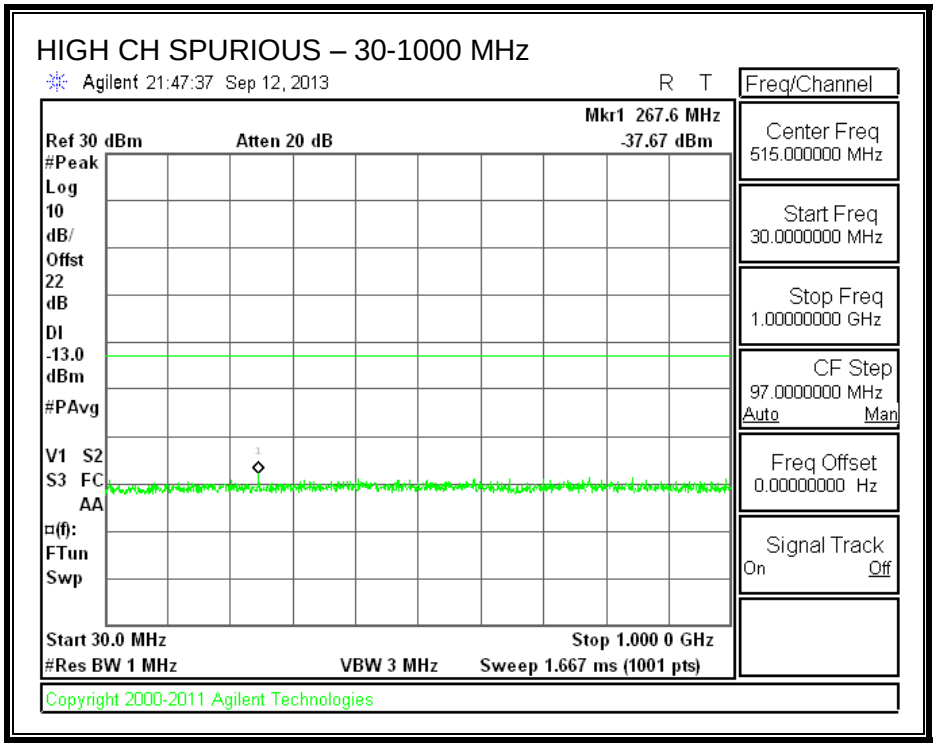
MID CH SPURIOUS – 20-30 GHz



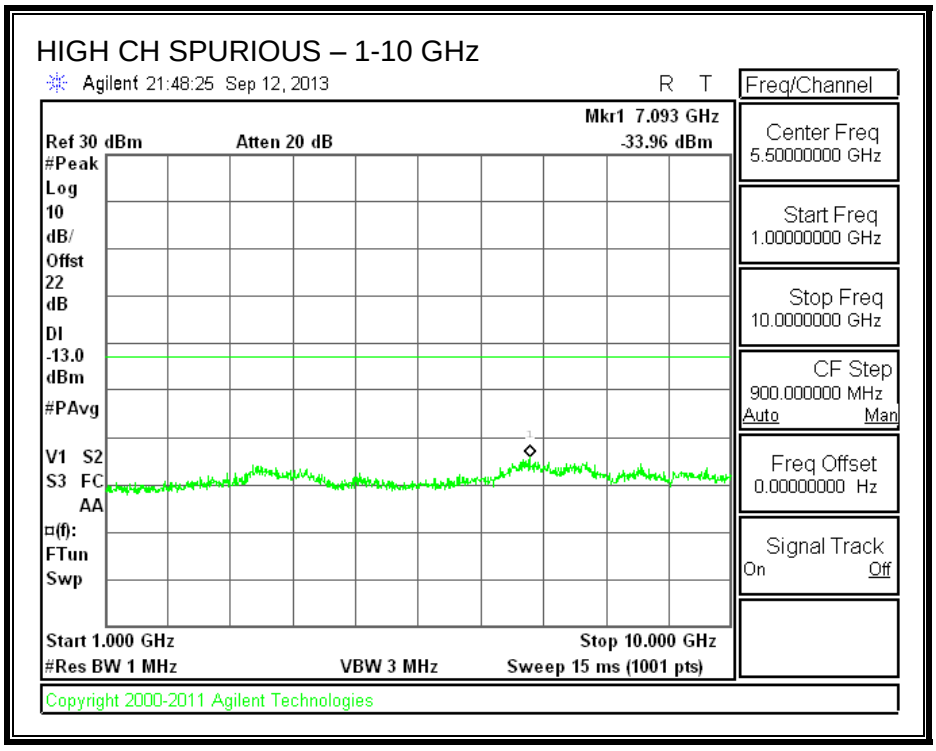


SPURIOUS EMISSIONS, HIGH CHANNEL

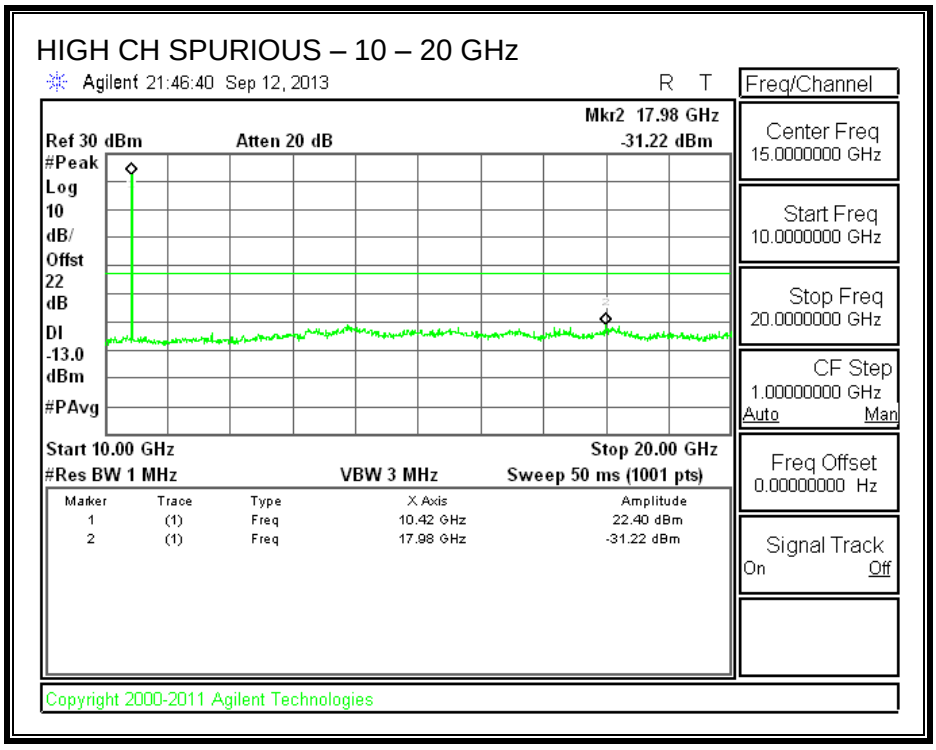




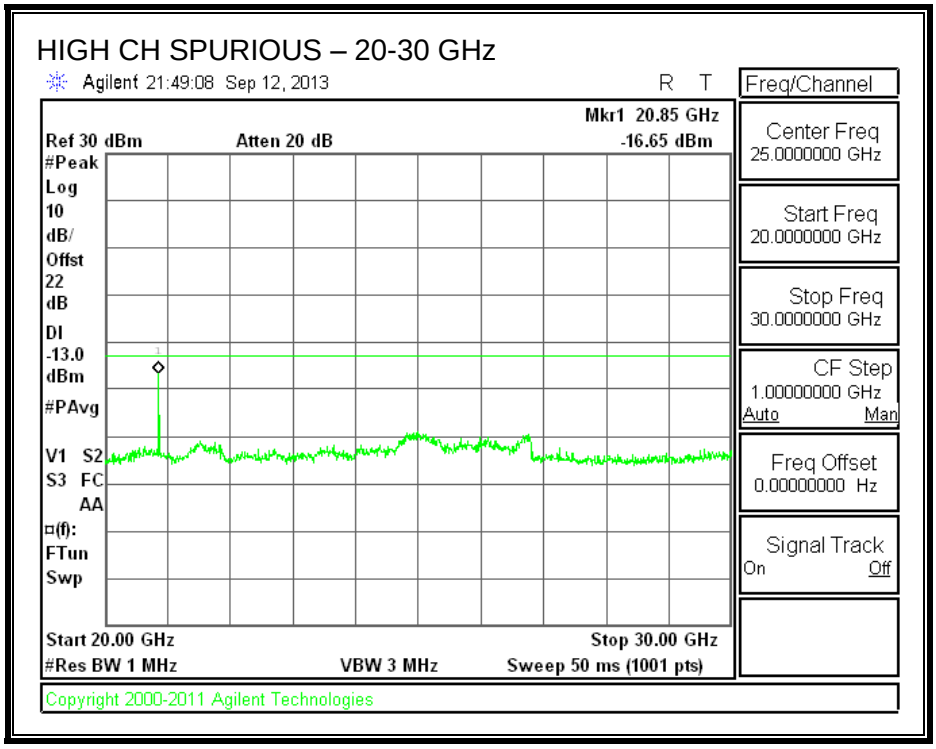
HIGH CH SPURIOUS – 1-10 GHz



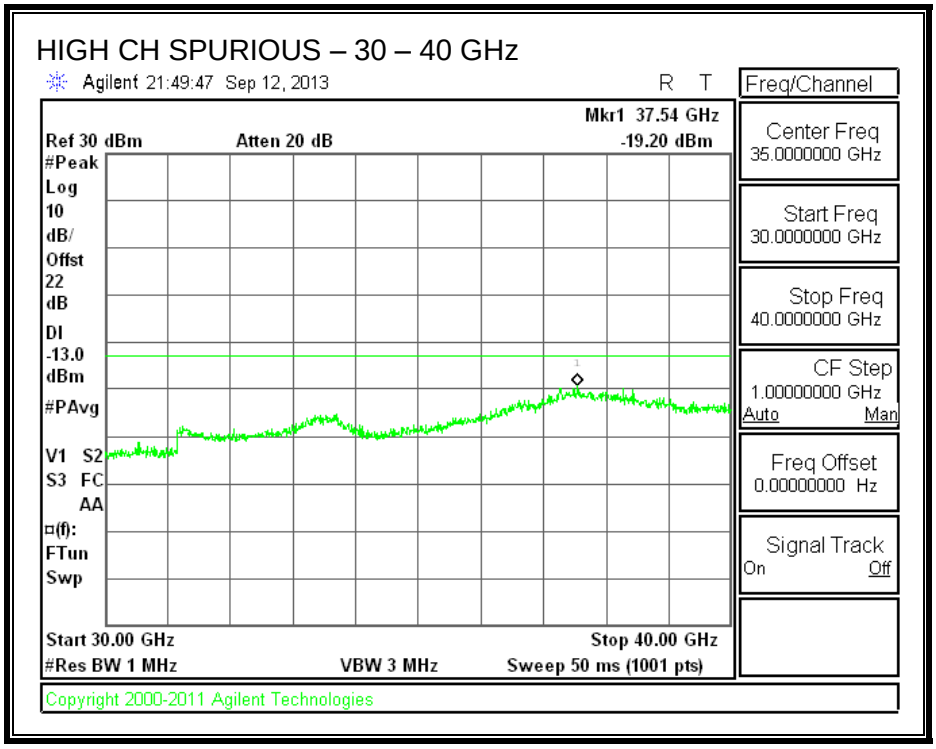
HIGH CH SPURIOUS – 10 – 20 GHz



HIGH CH SPURIOUS – 20-30 GHz



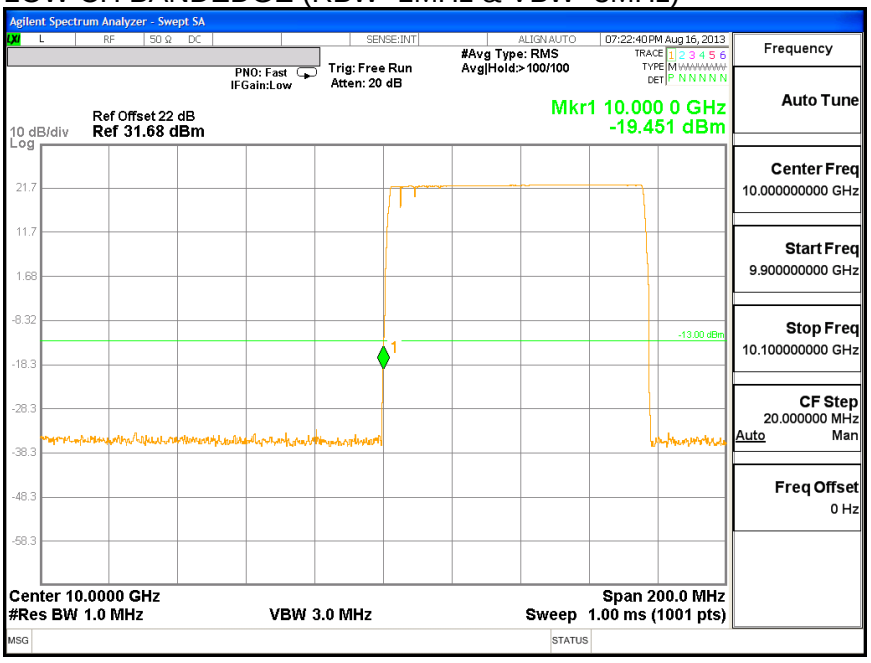
HIGH CH SPURIOUS – 30 – 40 GHz



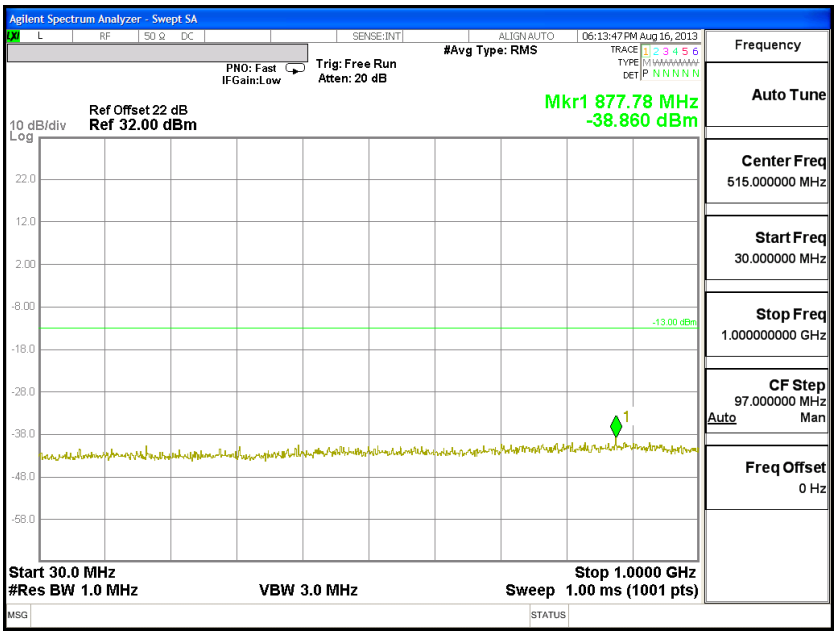
SPURIOUS EMISSIONS SWEEPING MODE

LOW CHANNEL

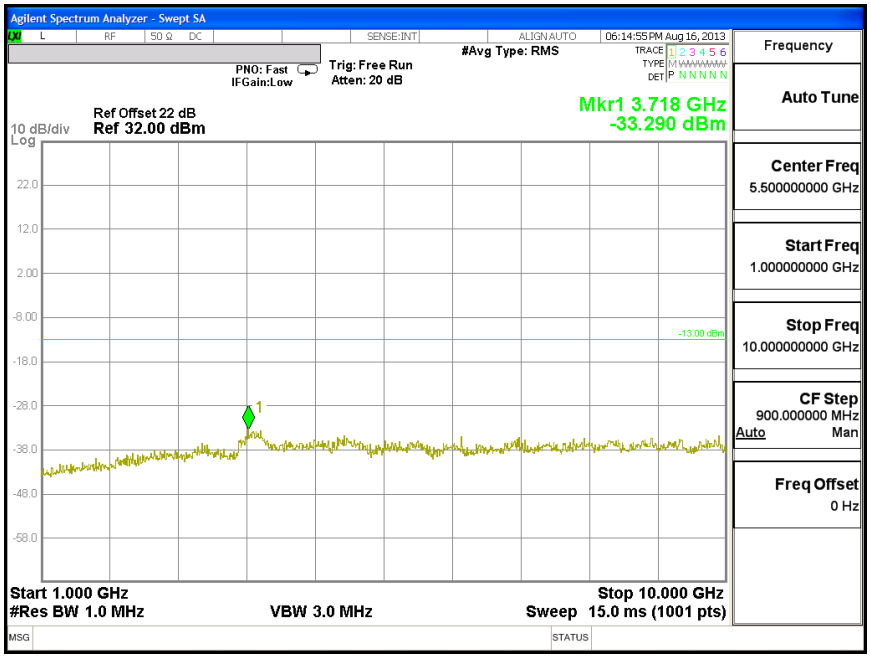
LOW CH BANDEDGE (RBW=1MHz & VBW=3MHz)



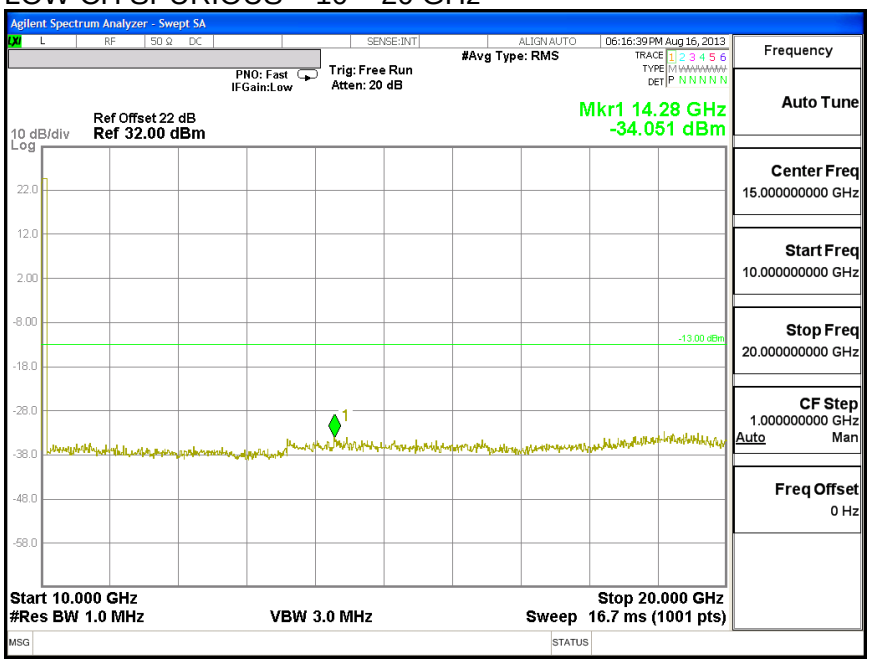
LOW CH SPURIOUS – 30-1000 MHz



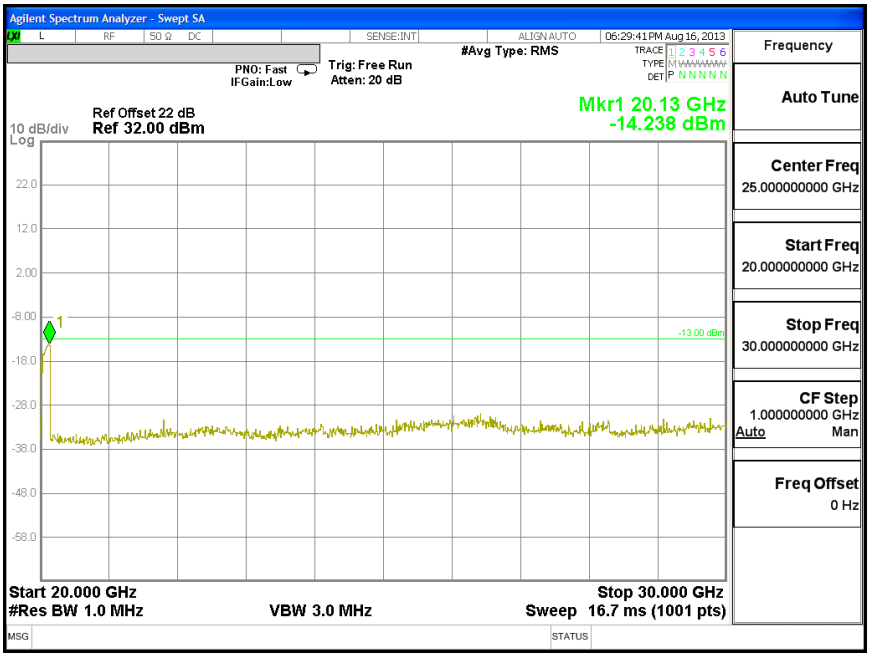
LOW CH SPURIOUS – 1-10 GHz



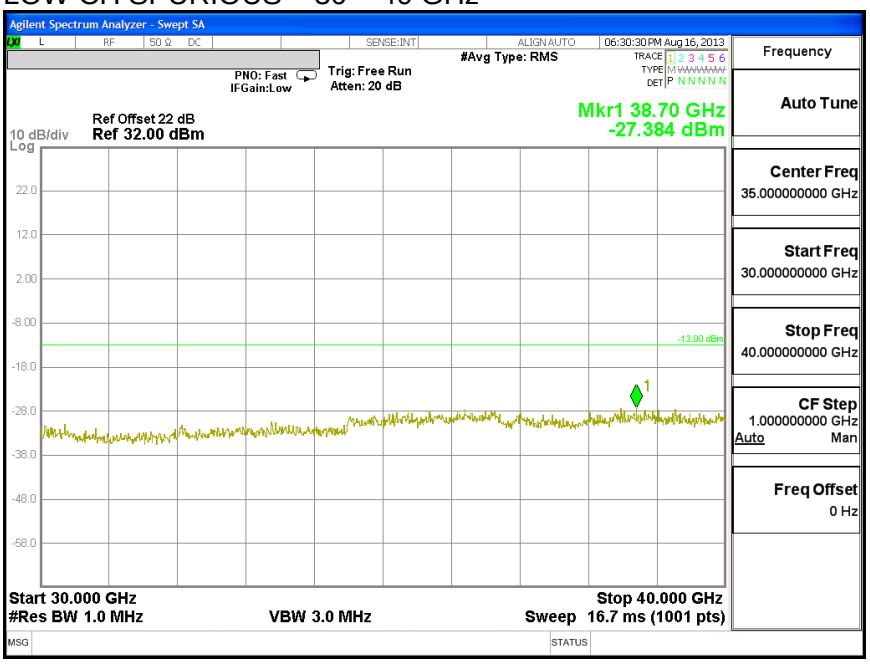
LOW CH SPURIOUS – 10 – 20 GHz



LOW CH SPURIOUS – 20-30 GHz

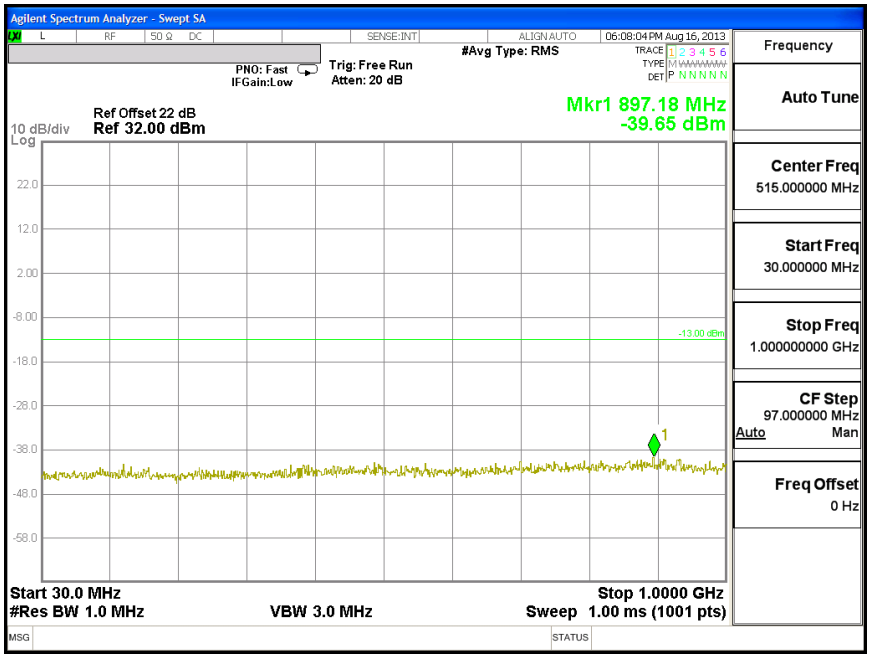


LOW CH SPURIOUS – 30 – 40 GHz

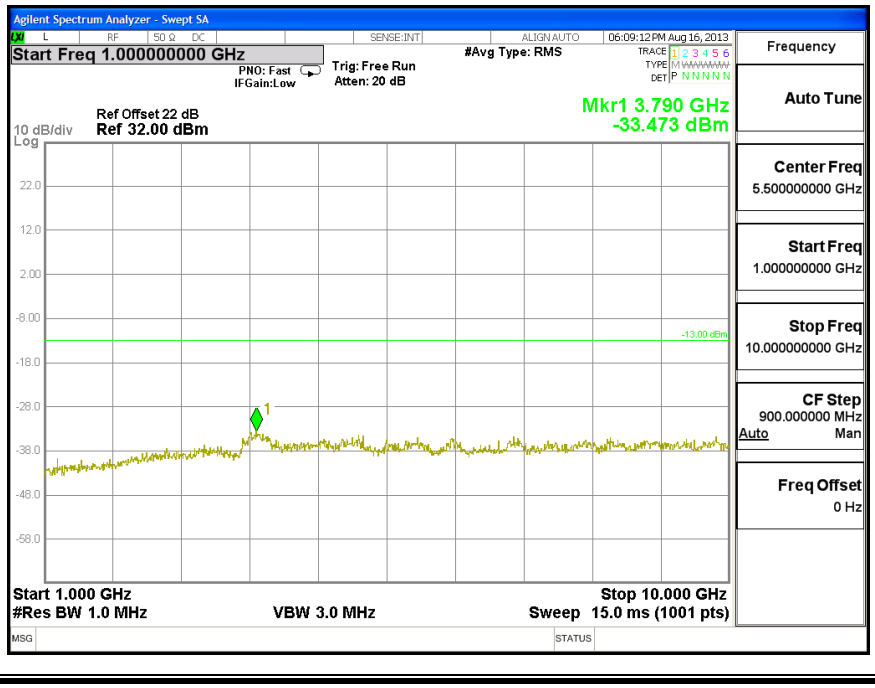


SPURIOUS EMISSIONS, MID CHANNEL

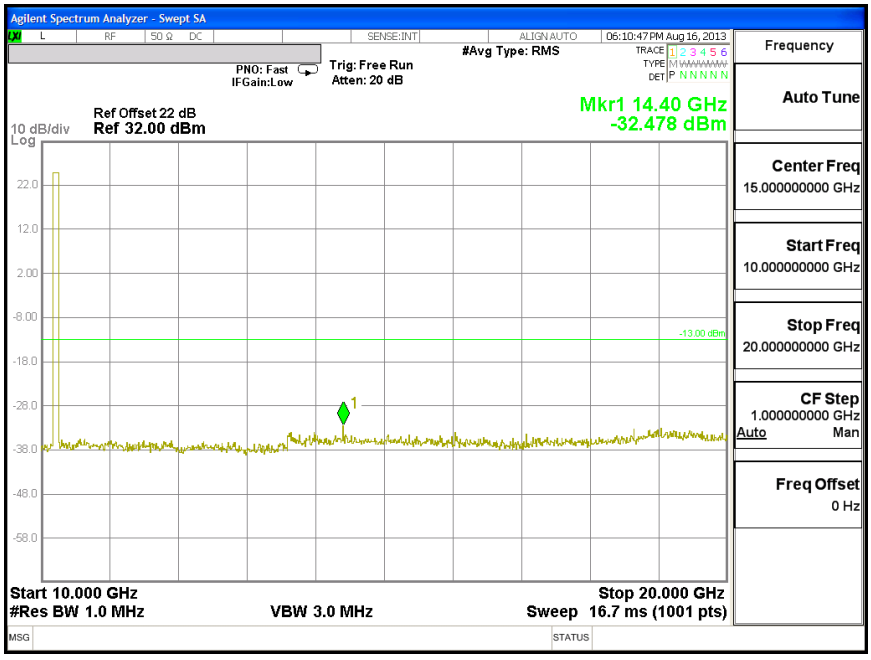
MID CH SPURIOUS – 30-1000 MHz



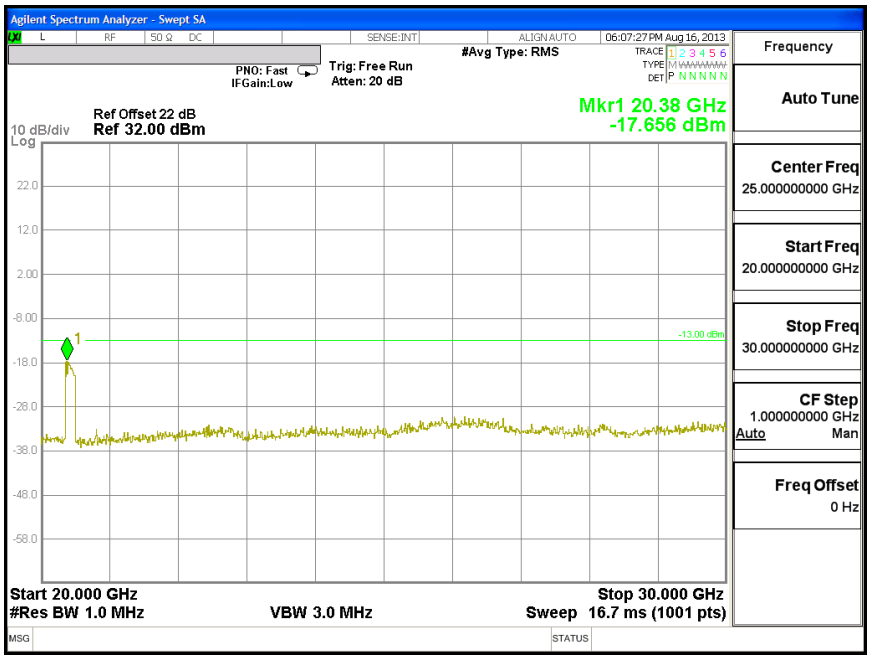
MID CH SPURIOUS – 1-10 GHz



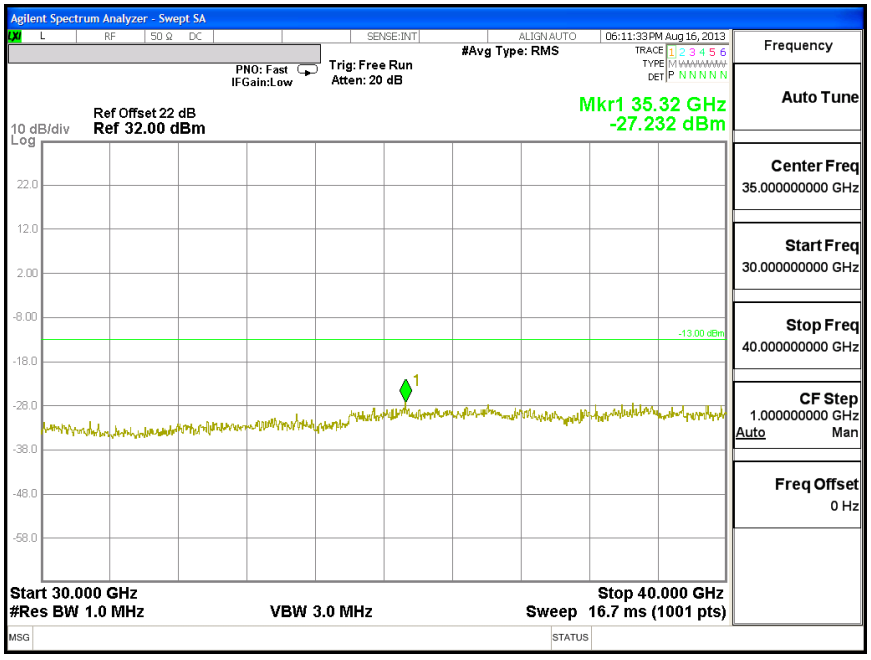
MID CH SPURIOUS – 10 – 20 GHz



MID CH SPURIOUS – 20-30 GHz

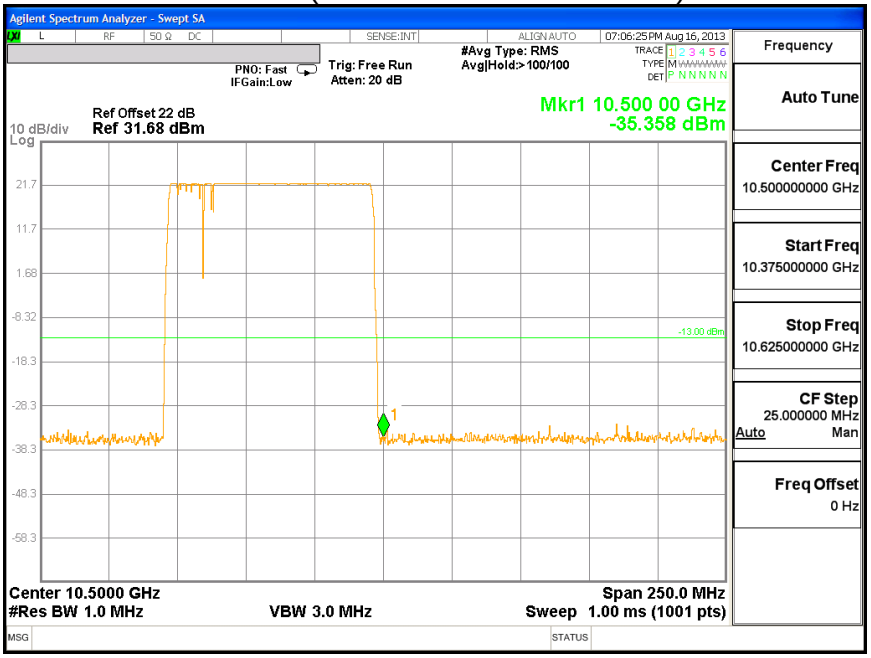


MID CH SPURIOUS – 30 – 40 GHz

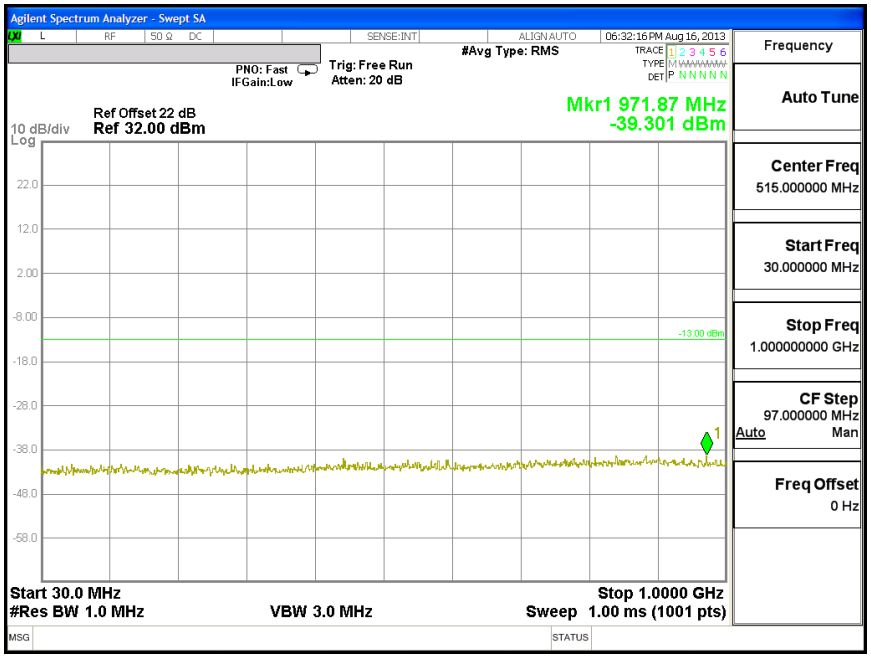


SPURIOUS EMISSIONS, HIGH CHANNEL

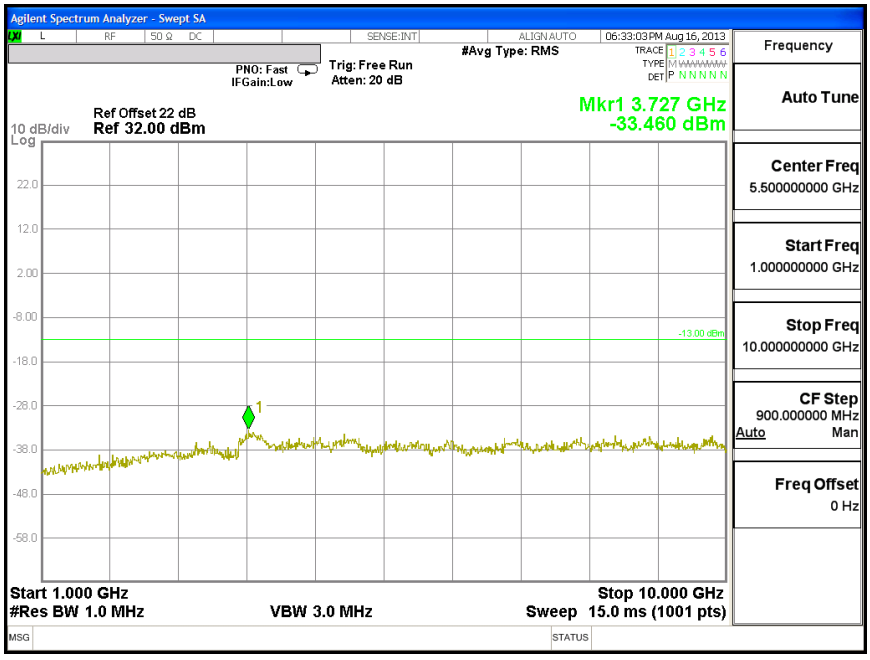
HIGH CH BANDEDGE (RBW=1MHz & VBW=3MHz)



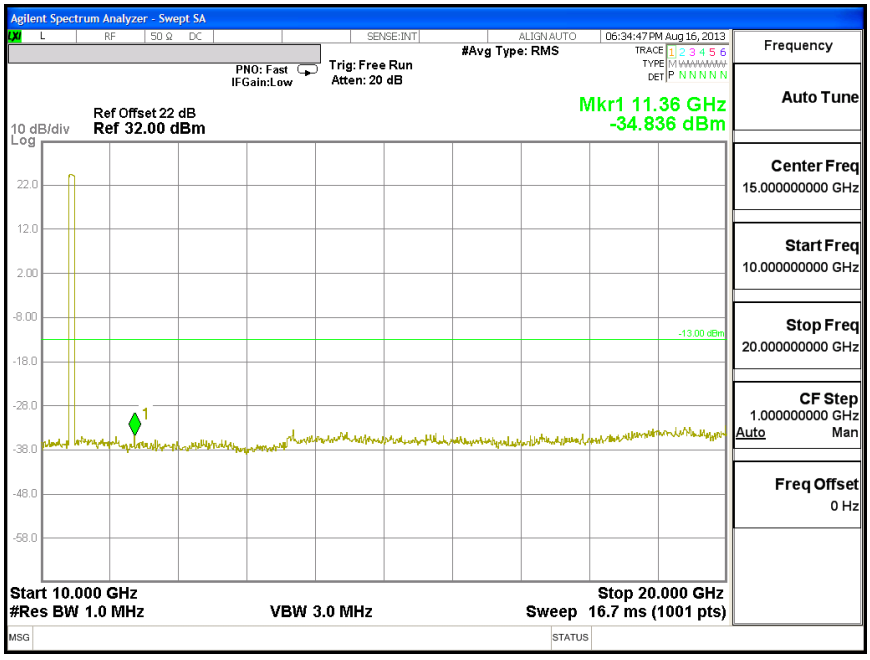
HIGH CH SPURIOUS – 30-1000 MHz



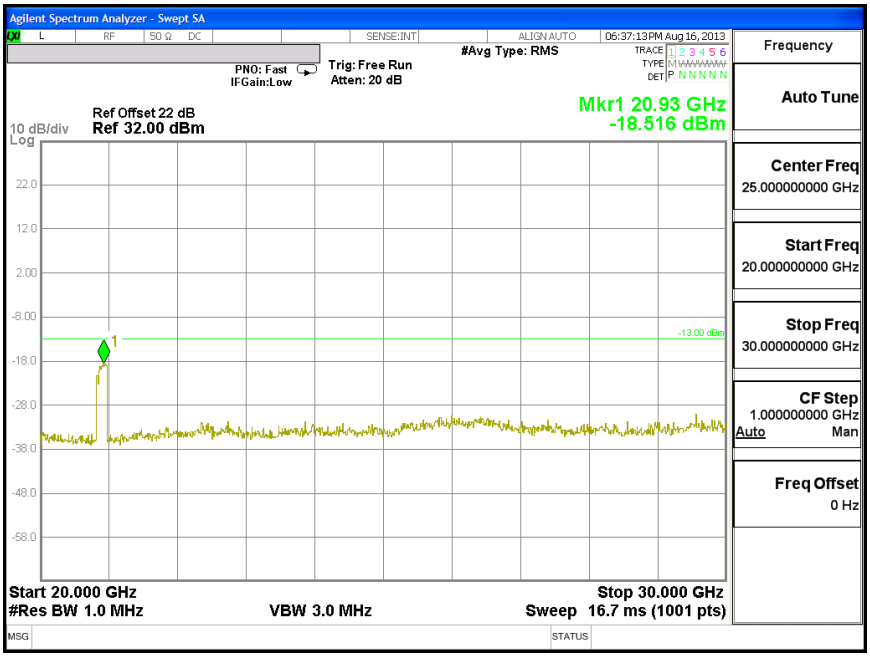
HIGH CH SPURIOUS – 1-10 GHz



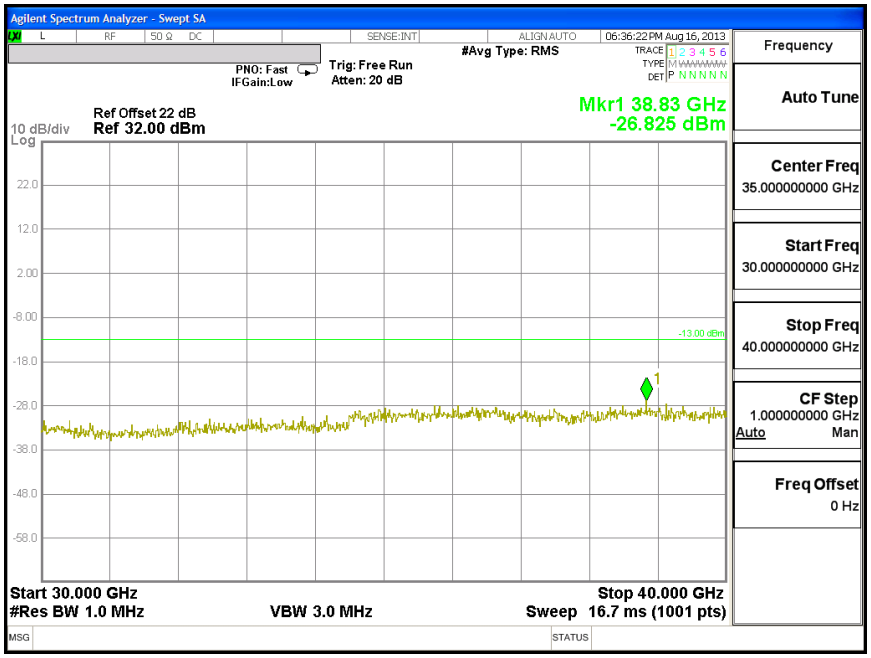
HIGH CH SPURIOUS – 10 – 20 GHz



HIGH CH SPURIOUS – 20-30 GHz



HIGH CH SPURIOUS – 30 – 40 GHz



7.5. FREQUENCY STABILITY

LIMIT

FCC §2.1053 The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency, over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

FCC §90.213 (b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 2.3.1 and 2.3.2

RESULTS

Reference Frequency: EUT Mid Channel @ 20ºC **Limit: ± 100 ppm = 102498.544 kHz**				
Power Supply (Vac)	**Environment Temperature (ºC)**	**Frequency Deviation Measureed with Time Elapse**		
		(MHz)	**Delta (ppm)**	**Limit (ppm)**
115.00	60	10249.8438150	0.010	± 15
115.00	50	10249.8268080	0.027	± 15
115.00	40	10249.8346260	0.019	± 15
115.00	30	10249.8549150	0.000	± 15
115.00	***20***	***10249.8544090***	***0.000***	± 15
115.00	10	10249.9048360	-0.049	± 15
115.00	0	10249.9608376	-0.104	± 15
115.00	-10	10249.9851640	-0.128	± 15
115.00	-20	10250.0092680	-0.151	± 15

8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §2.1053 & FCC §90.210

13dBm (~ 82dBuV/m)

TEST PROCEDURE

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

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 55 GHz is investigated with the transmitter set at the worst case channel.

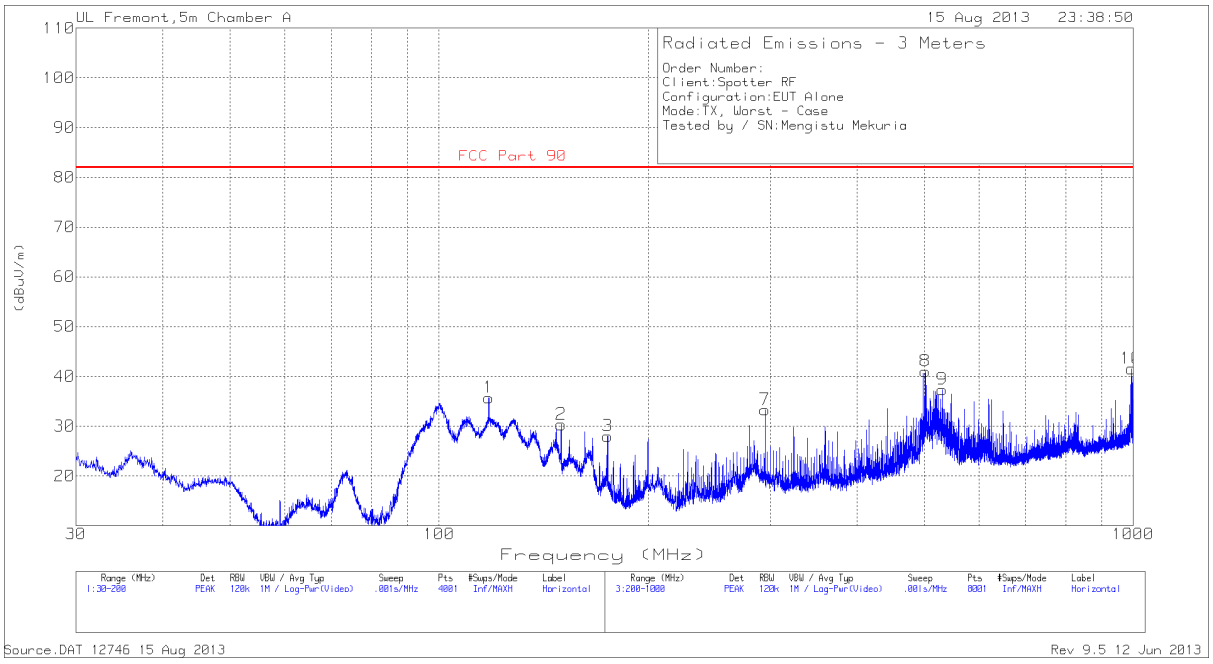
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

RESULTS

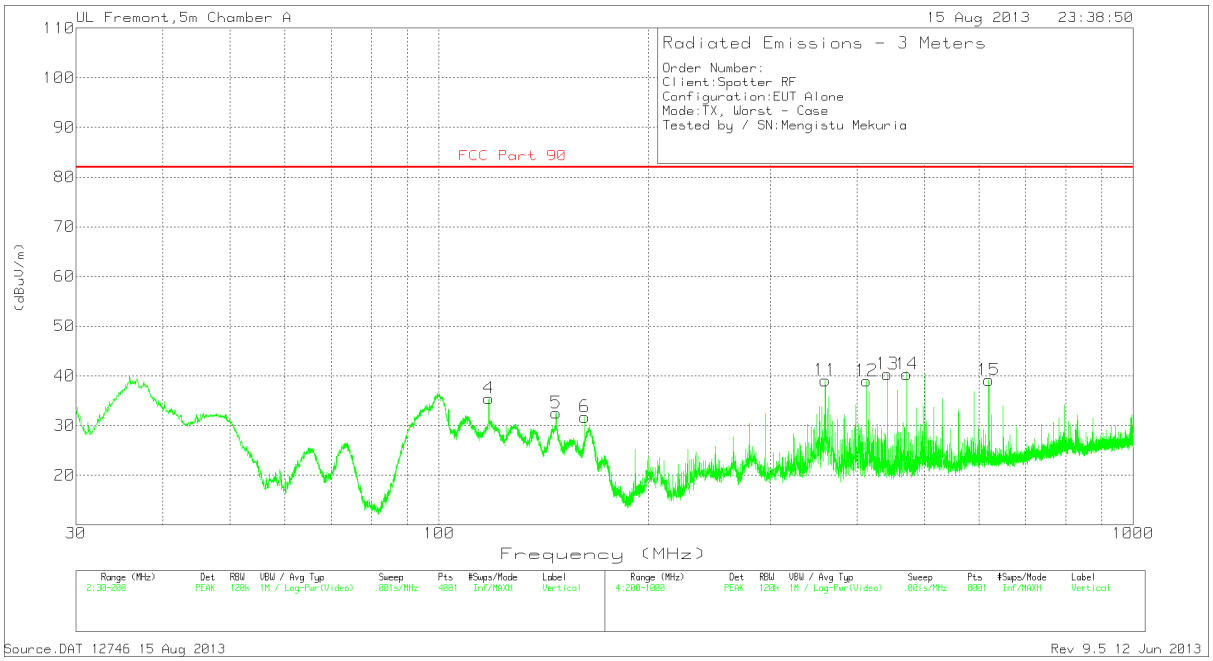
8.2. WORST-CASE BELOW 1 GHz

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

30 TO 1000 MHz HORIZONTAL PLOT



30 TO 1000 MHz VERTICAL PLOT

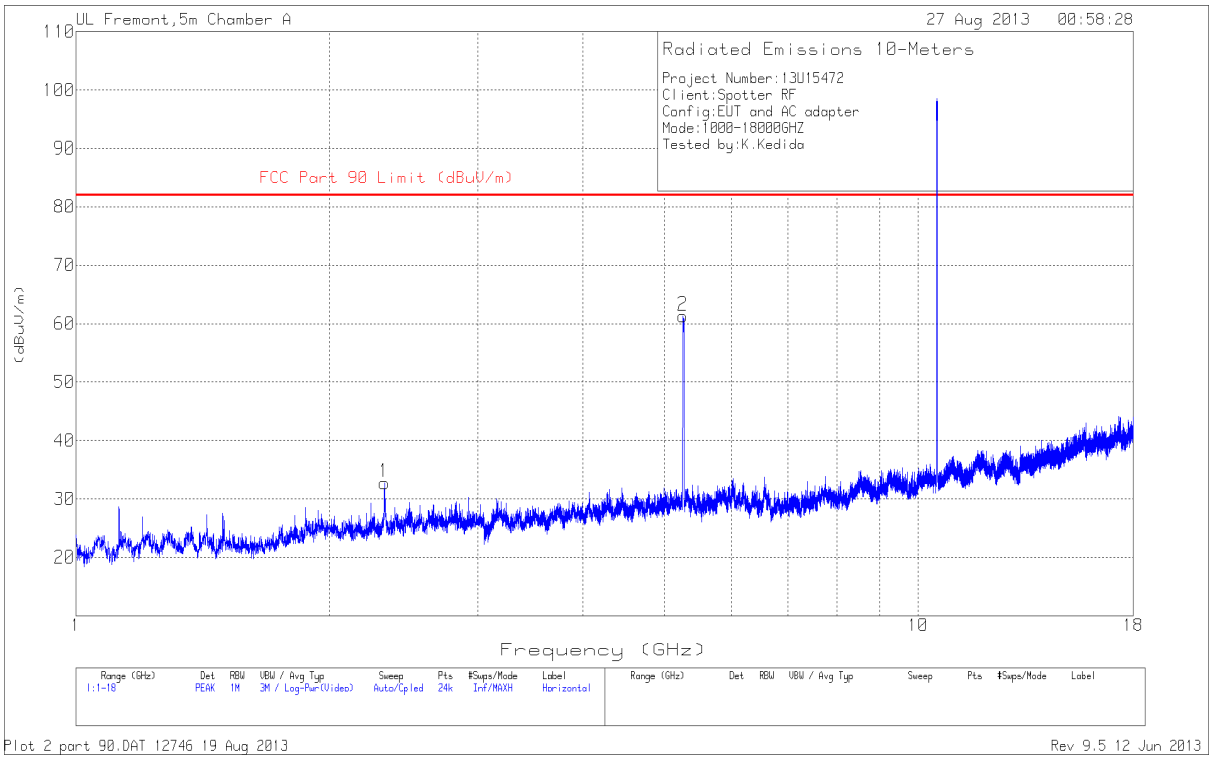


BELOW 1 GHz HORIZONTAL AND VERTICAL DATA

Frequency (MHz)	Meter Reading (dBuV)	Det.	AF T477 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	FCC Part 90	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
117.9325	48.93	PK	13.6	-26.8	35.73	82	-46.27	0-360	300	H
149.9775	44.52	PK	12.3	-26.5	30.32	82	-51.68	0-360	200	H
175.01	42.81	PK	11.5	-26.3	28.01	82	-53.99	0-360	100	H
117.975	48.67	PK	13.6	-26.8	35.47	82	-46.53	0-360	100	V
147.47	46.74	PK	12.4	-26.6	32.54	82	-49.46	0-360	100	V
162.2175	45.92	PK	12.2	-26.4	31.72	82	-50.28	0-360	100	V
294.9	45.59	PK	13.3	-25.6	33.29	82	-48.71	0-360	100	H
501.8	47.53	PK	17.7	-24.2	41.03	82	-40.97	0-360	100	H
530.8	43.26	PK	18.2	-24.1	37.36	82	-44.64	0-360	100	H
993.6	41.26	PK	22.7	-22.4	41.56	82	-40.44	0-360	100	H
360.0	49.47	PK	14.8	-25.2	39.07	82	-42.93	0-360	100	V
412.9	48.07	PK	15.8	-24.9	38.97	82	-43.03	0-360	100	V
442.4	48.33	PK	16.8	-24.8	40.33	82	-41.67	0-360	100	V
471.9	47.81	PK	17.1	-24.6	40.31	82	-41.69	0-360	100	V
619.3	43.46	PK	18.9	-23.2	39.16	82	-42.84	0-360	100	V

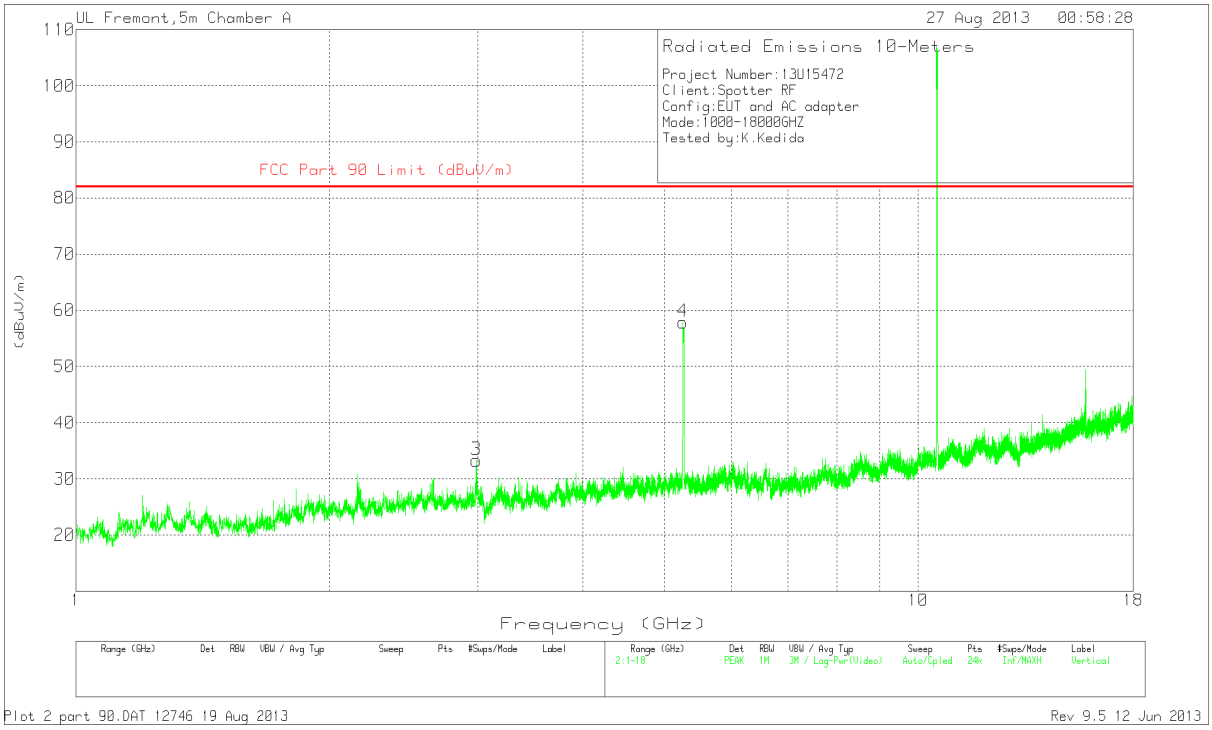
8.3. TRANSMITTER ABOVE 1 GHz

1000 TO 18000 MHz HORIZONTAL PLOT



Note that the signal over the limit line is the fundamental frequency of the EUT

1000 TO 18000 MHz VERTICAL PLOT

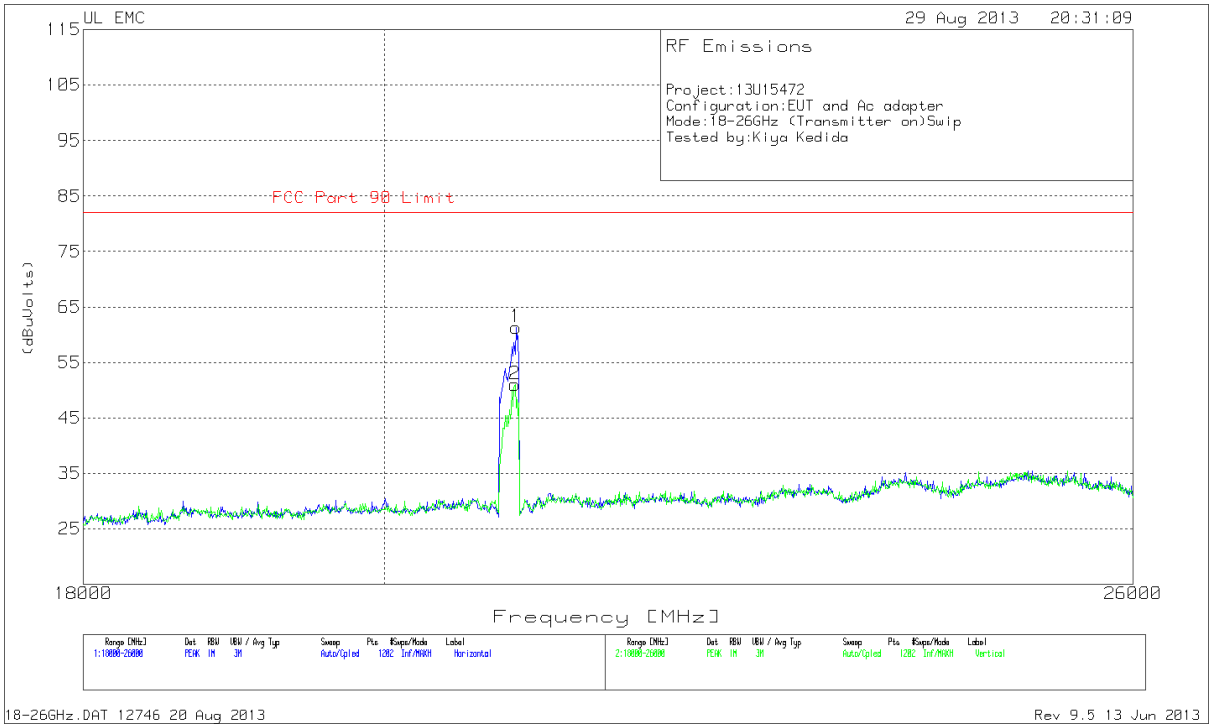


Note that the signal over the limit line is the fundamental frequency of the EUT

ABOVE 1 GHz HORIZONTAL AND VERTICAL DATA

Frequency (GHz)	Meter Reading (dBuV)	Det.	AF T136 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Dist. Cor. (dB)	Corrected Reading (dBuV/m)	FCC Part 90 Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Heig ht (cm)	Polarit y
2.324	44.07	PK	31.7	-32.5	-10.5	32.77	82	-49.23	0-360	100	H
5.253	66.31	PK	34.3	-28.8	-10.5	61.31	82	-20.69	0-360	100	H
2.987	43.19	PK	32.7	-32.1	-10.5	33.29	82	-48.71	0-360	100	V
5.254	62.9	PK	34.3	-28.8	-10.5	57.90	82	-24.10	0-360	100	V

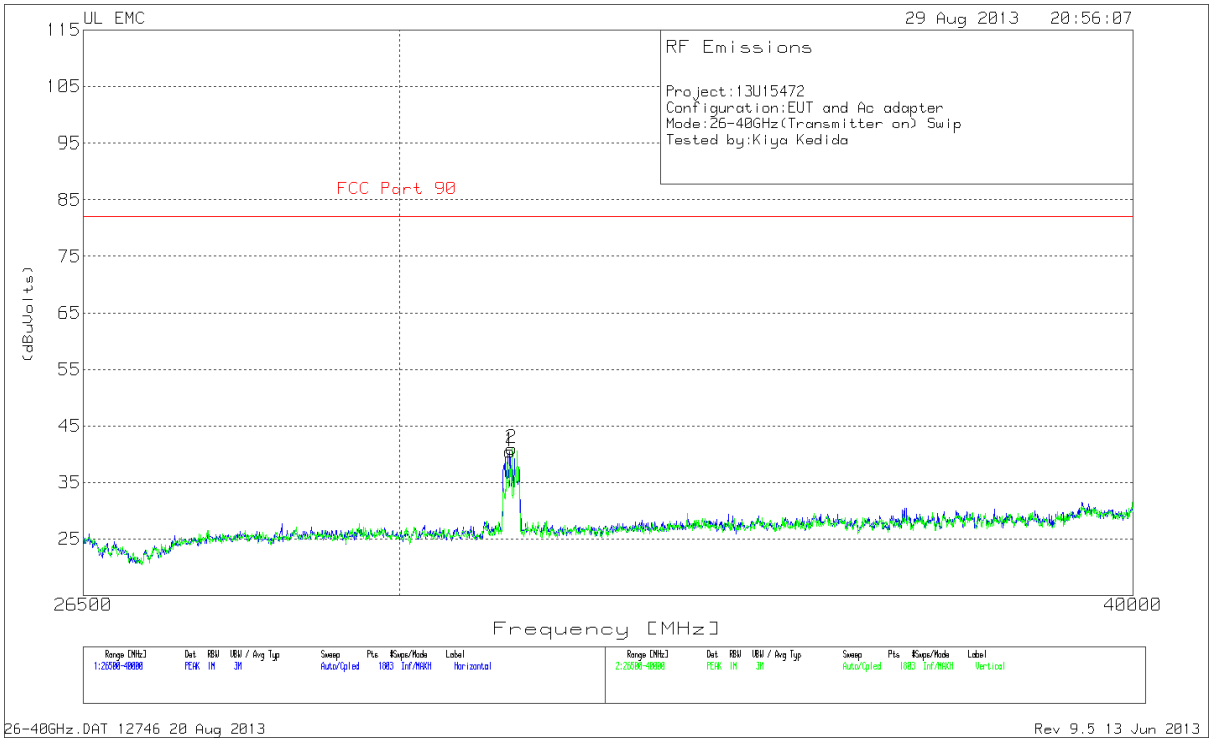
18000TO 26000 MHz HORIZONTAL &VERTICAL PLOT



18000 TO 26000 MHz HORIZONTAL & VERTICAL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det.	T89 AF (dB/m)	Amp/Cbl (dB)	Dist. Corr. (dB)	Corrected Reading (dBuVolts)	FCC Part 90 Limit	Margin (dB)	Polarity
1	20.944	73.33	PK	32.5	-24.5	-20	61.33	82	-20.66	H
2	20.938	62.80	PK	32.5	-24.3	-20	51.00	82	-31.00	V

26000 TO 40000 MHz HORIZONTAL & VERTICAL PLOT



26000 TO 40000 MHz HORIZONTAL & VERTICAL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det.	T90 AF (dB/m)	Amp/Cbl (dB)	Dist. Corr. (dB)	Corrected Reading (dBuVolts)	FCC Part 90 Limit	Margin (dB)	Polarity
1	31.325	60.5	PK	36.1	-36.1	-20	40.5	82	-41.5	H
2	31.347	61.0	PK	36.1	-36.1	-20	41.0	82	-41.0	V

Note: The EUT was obtained from 40GHz – 50GHz using a Harmonic Mixer and no emissions were found.

9. MAXIMUM PERMISSIBLE RF EXPOSURE

9.1. 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.

9.2. 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).

9.3. EQUATIONS

POWER DENSITY

Power density is given by:

S = EIRP / (4 * Pi * D^2)

Where

S = Power density in mW/cm^2
EIRP = Equivalent Isotropic Radiated Power in mW
D = Separation distance in cm

Power density in units of mW/cm^2 is converted to units of W/m^2 by multiplying by 10.

DISTANCE

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

Where

D = Separation distance in cm
EIRP = Equivalent Isotropic Radiated Power in mW
S = Power density in mW/cm^2

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

Source-based time-averaged EIRP = (DC / 100) * EIRP

Where

DC = Duty Cycle in %, as applicable
EIRP = Equivalent Isotropic Radiated Power in W

9.4. RF EXPOSURE RESULTS

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

Band	Mode	Separation Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
10 GHz	Transmit	20	22.15	14.00	100.0	4121.0	0.820	8.20

FCC Limit = 1 mW/cm^2
IC Limit = 10 W/m^2