



**FCC CFR47 PART 22, SUBPART E  
AND  
FCC CFR47 PART 90, SUBPART I  
CERTIFICATION TEST REPORT**

**FOR**

**RF POWER AMPLIFIER**

**MODEL NUMBER: PA3-1FE**

**FCC: BBD3-1FE**

**REPORT NUMBER: 08U12036-1A**

**ISSUE DATE: SEPTEMBER 08, 2008**

*Prepared for*

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**NVLAP LAB CODE 200065-0**

Revision History

Rev.	Issue Date	Revisions	Revised By
---	08/23/08	Initial Issue	T. Chan
A	09/08/08	Fixed description errors.	T. Chan

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** TPL COMMUNICATIONS, INC.  
3370 SAN FERNANDO ROAD, SUITE 206  
LOS ANGELES, CA 90065 USA

**EUT DESCRIPTION:** RF POWER AMPLIFIER

**MODEL:** PA3-1FE

**SERIAL NUMBER:** 1000

**DATE TESTED:** AUGUST 20 & 21, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 22 SUBPART E	PASS
FCC PART 90 SUBPART I	PASS

Compliance Certification Services, Inc. (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 CCS based on interpretations and/or observations of test results. 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 Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Tested By:



THU CHAN  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES



WILLIAM ZHUANG  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA/EIA 603C (2004), FCC CFR 47 Part 2, FCC CFR 47 Part 22, and FCC CFR 47 Part 90.

## 3. FACILITIES AND ACCREDITATION

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

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
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a RF Power Amplifier, the operation frequency range is: 150-174MHz, 140 Watts. The radio module is manufactured by TPL Communications, Inc.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

FCC Part	Frequency Range (MHz)	Modulation	Conducted Output Power (dBm)	Conducted Output Power (W)
22	152-159	CW	51.46	140.0
90	150-174	CW	51.48	140.6

### 5.3. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power. The highest measured output power was at 162.0125 MHz mid channel.

## 5.4. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
DC Power Supply	MTM Inc.	XHR 60-18	27519	NA
500 Watt 50 Ohm Terminator	Bird Electronic Corp	8201	13288	NA
Signal Generator, 20 GHz	Agilent / HP	83732B	C00774	7/5/2009
80-1000MHz Amplifier	Amplifier Research	150W1000M2	303370	CNR
Directional Coupler, 500W, 40 dB, 10 ~ 1000 MHz	Werlatone	C6021	8576	CNR

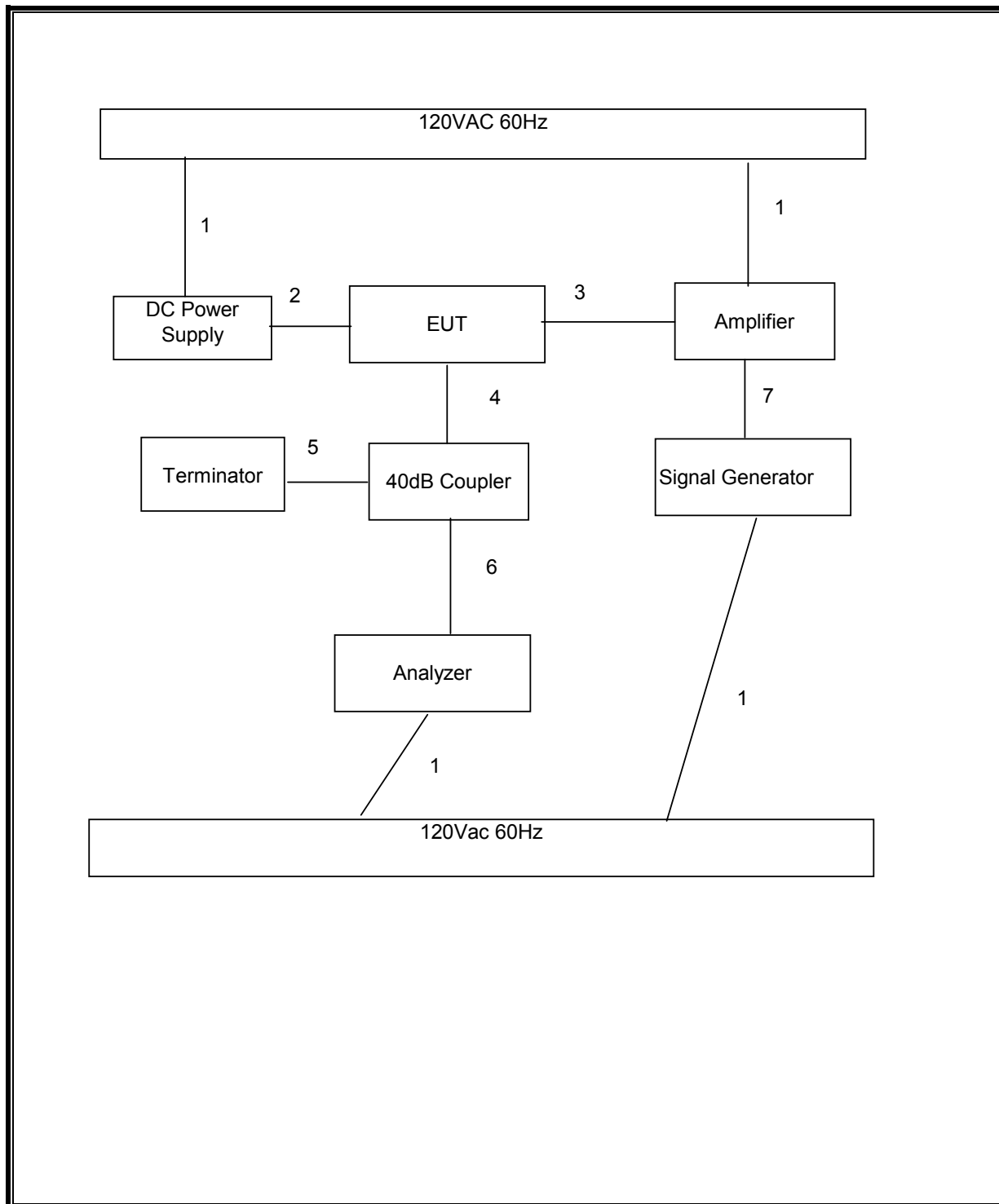
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	4	US 115V	Un-shielded	2m	N/A
2	DC	1	DC	Un-shielded	2m	N/A
3 to 7	Input / Output	5	N-Connector	Shielded	1m	N/A

### TEST SETUP

The EUT is a stand-alone device. The input was given by signal generator as the source modulations of CW and FM during the tests.

**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	Serial Number	Cal Due
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	02/04/09
RF Filter Section	HP	85420E	3705A00256	02/04/09
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	09/03/08
Amplifier	Agilent / HP	8447D	1937A02062	05/09/09
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent	E4446A	US42510266	10/19/08
Signal Generator, 1024 MHz	R & S	SMY01	C00979	07/05/09
Directional Coupler, 500W, 40 dB, 10 ~ 1000 MHz	Werlatone	C6021	8576	CNR
Antenna, Horn, 18 GHz	EMCO	3115	C00945	04/15/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	09/27/08

## 7. LIMITS AND RESULTS

### 7.1. OCCUPIED BANDWIDTH

#### LIMIT

None: for reporting purposes only.

#### TEST PROCEDURE

Measurements were made with the modulating signal at 2.5 KHz with 5 KHz of FM deviation. The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 3% of the 26 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

#### RESULTS

##### FM Modulation - Input

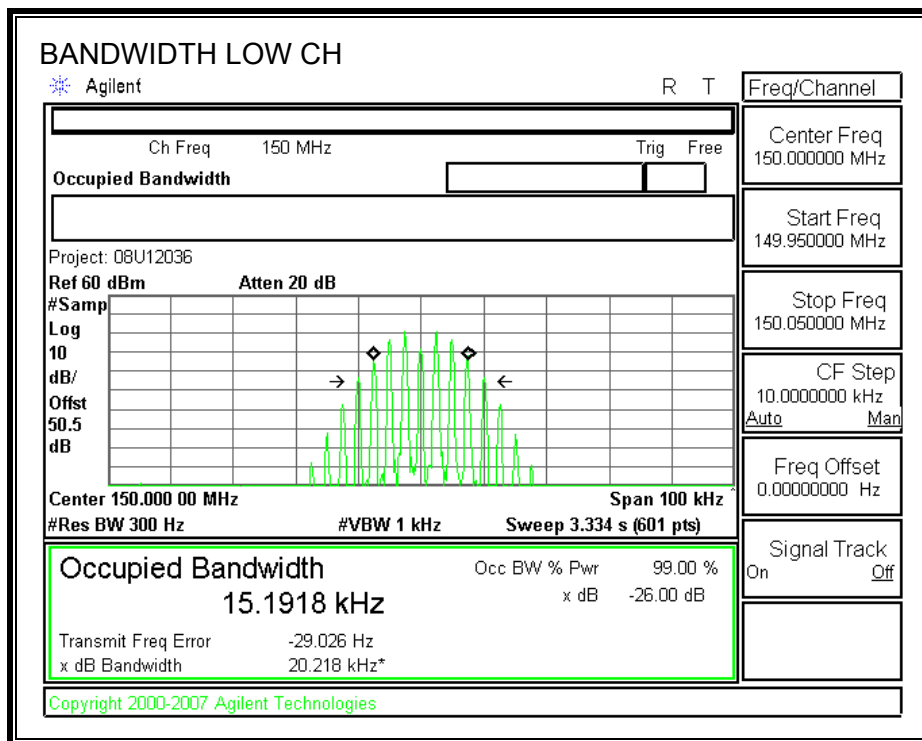
Channel	Frequency (MHz)	26dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	150	20.218	15.192
Mid	162.0125	20.274	15.210
High	174	20.201	15.184

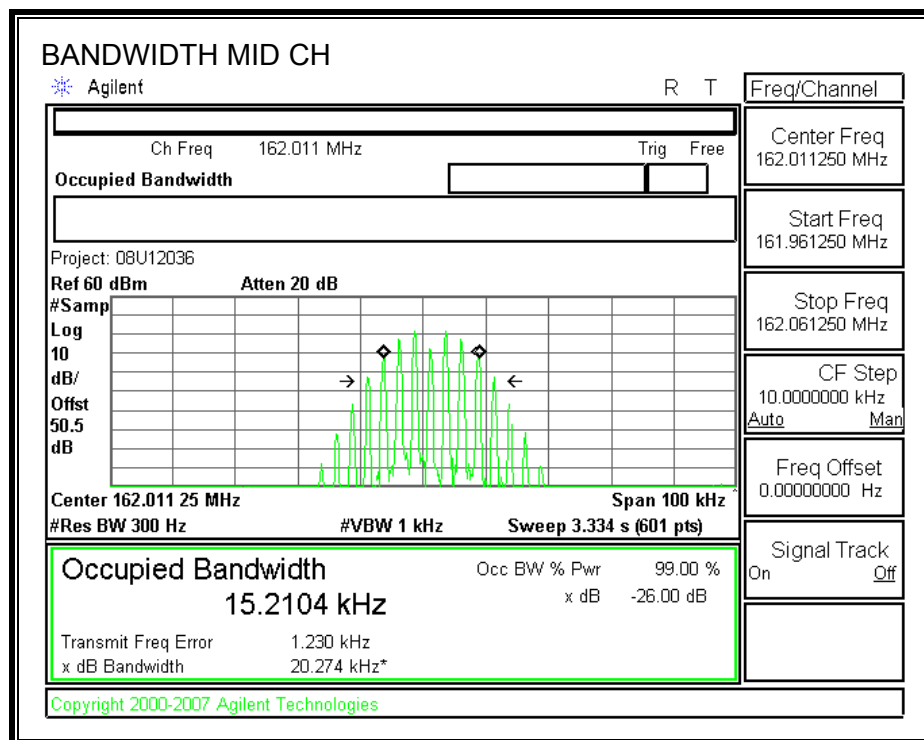
##### FM Modulation - Output

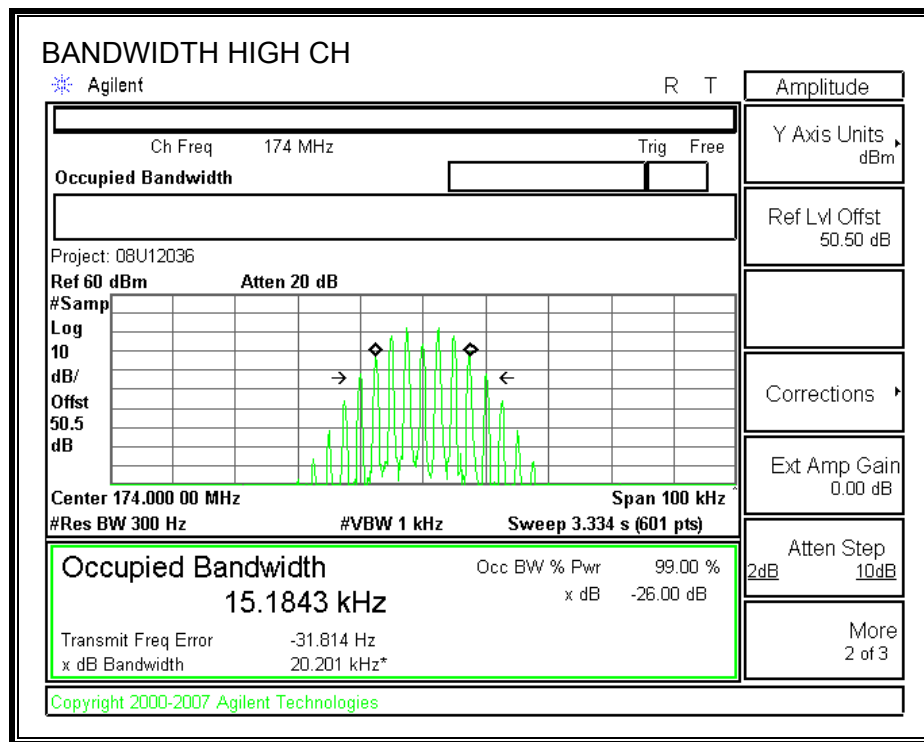
Channel	Frequency (MHz)	26dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	150	20.217	15.191
Mid	162.0125	20.221	15.194
High	174	20.201	15.184

:

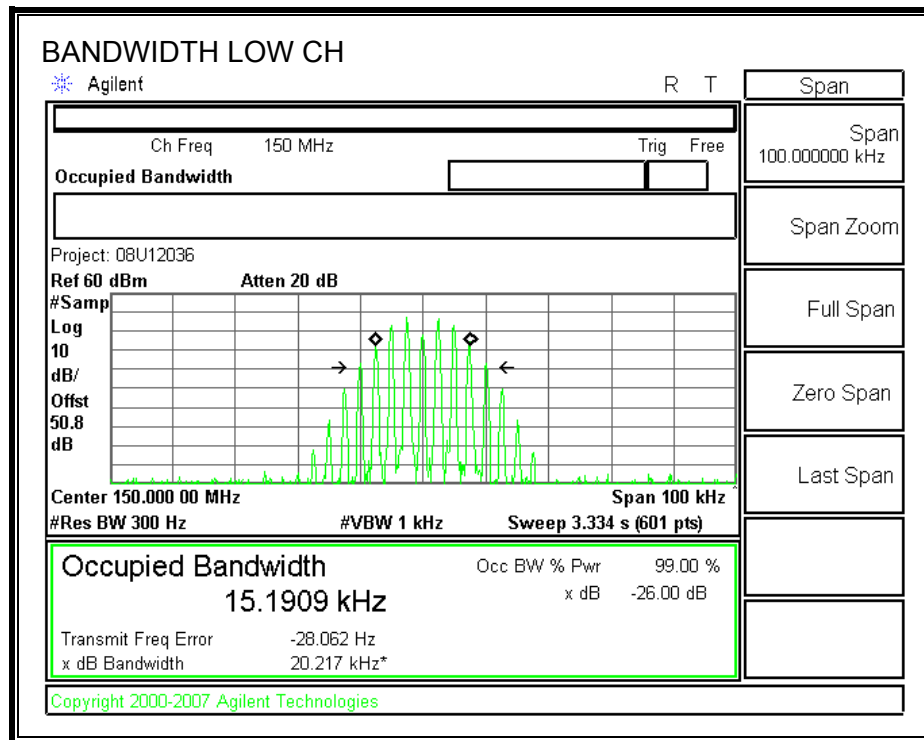
**FM 26 dB BANDWIDTH - INPUT**

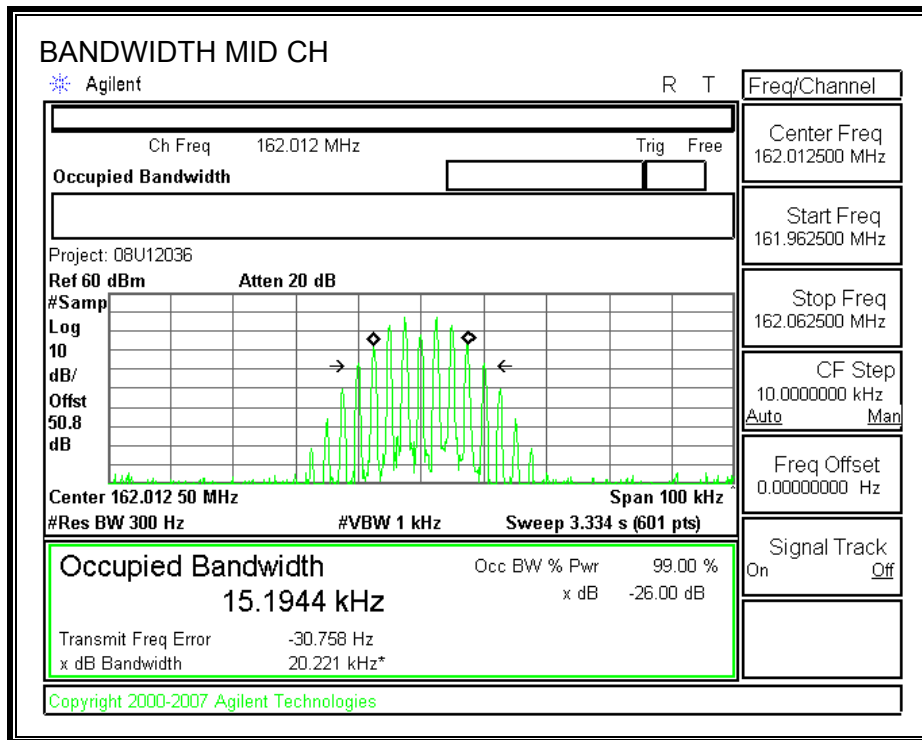


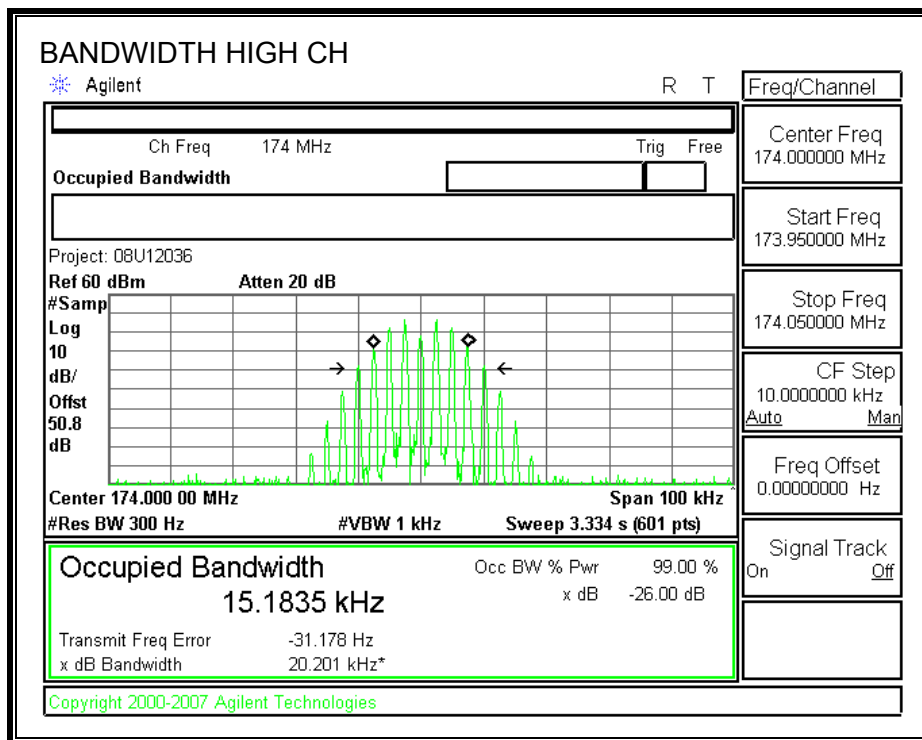




**FM 26 dB BANDWIDTH -OUTPUT**









## **7.2. FM EMISSION LIMITATION**

### **LIMIT**

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§22.359 & §90.210(c):

For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

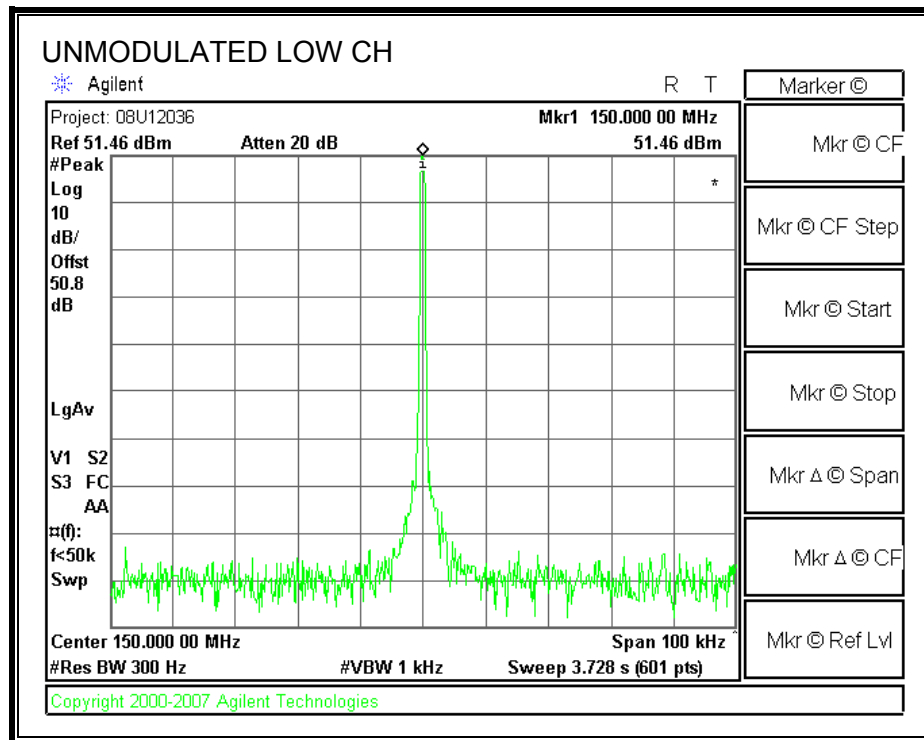
- (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5 kHz, but no more than 10 kHz: At least  $83 \log (f_d/5)$  dB;
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least  $29 \log (f_d/11)$  dB or 50 dB, whichever is the lesser attenuation;
- (3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least  $43 + 10 \log (P)$  dB.

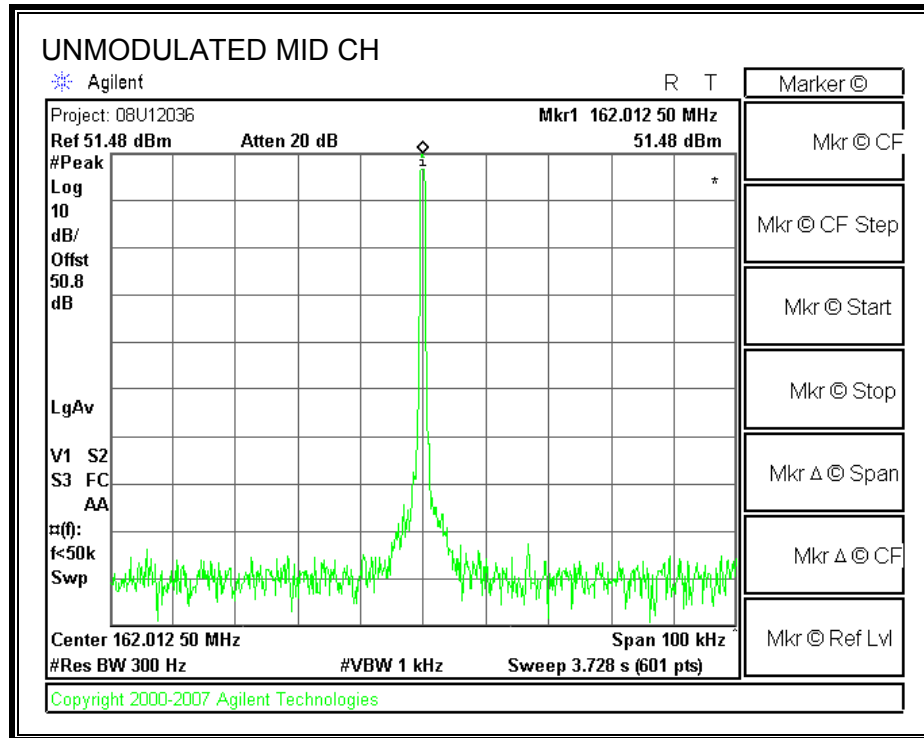
### **TEST PROCEDURE**

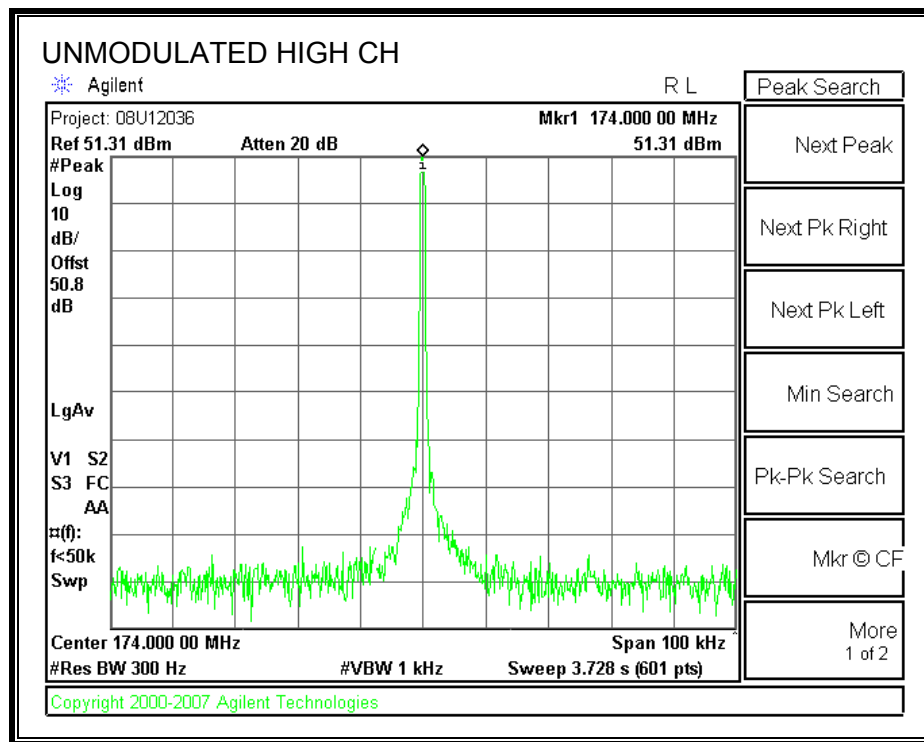
ANSI / TIA / EIA 603 Clause 3.2.11

### **RESULTS**

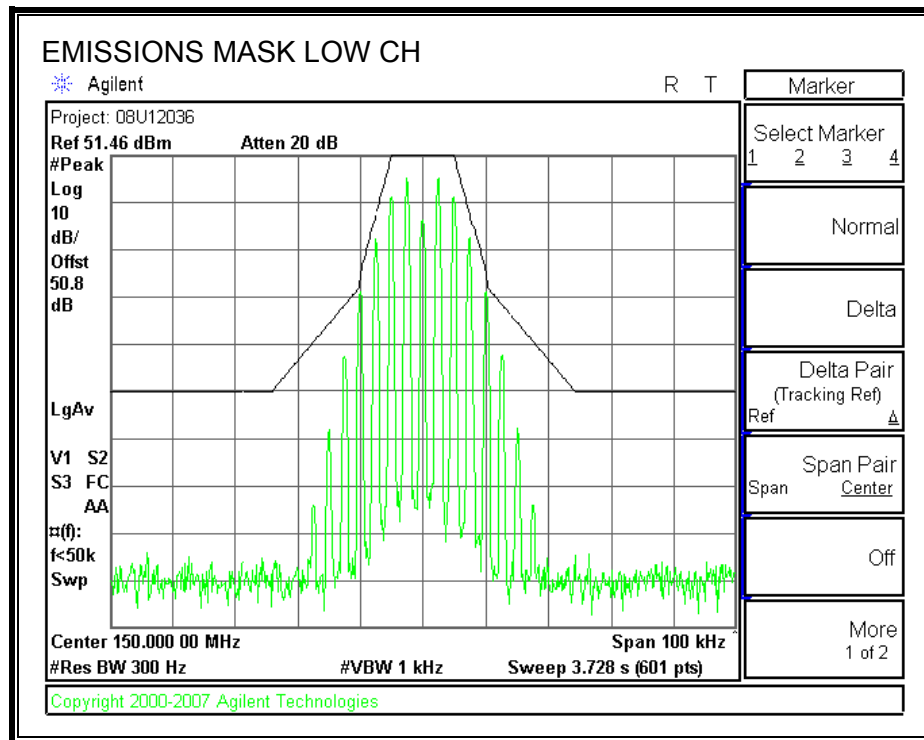
**Un-modulated Signal:**

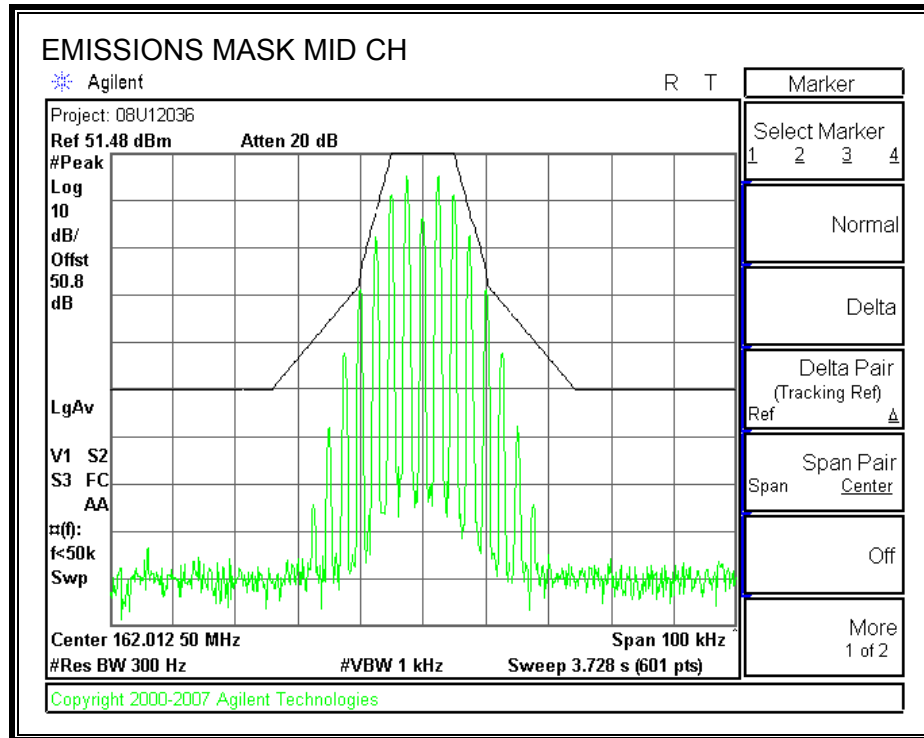


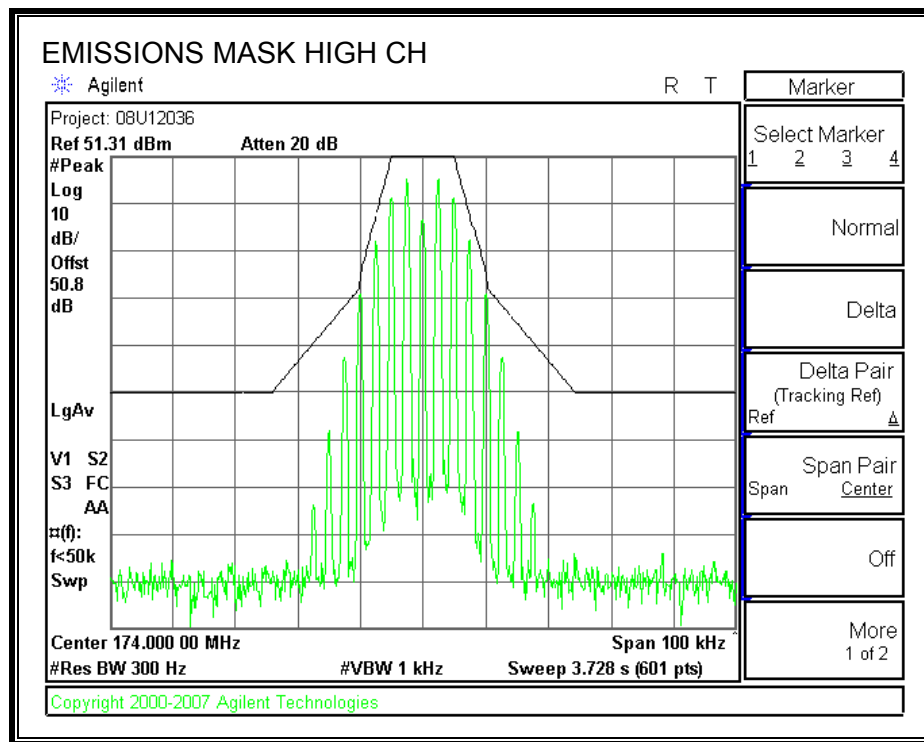




**FM EMISSIONS MASK**







### 7.3. MODULATION CHARACTERISTICS

Not Applicable. Due to this EUT is a power amplifier and has no Mix circuitry to modulate the RF signal.

### 7.4. RF POWER OUTPUT

#### LIMIT

§22.565(a): Frequency range 152 - 153MHz is 1400 Watts maximum (ERP), Frequency range 157 - 159MHz is 150 Watts maximum (ERP).

FCC part 90: The Maximum ERP transmitter power will be considered and authorized on a case-by-case basis. Please refer to the limitations on power and antenna heights are specified in §90.205, §90.279, and §90.309.

#### TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 3.2.1

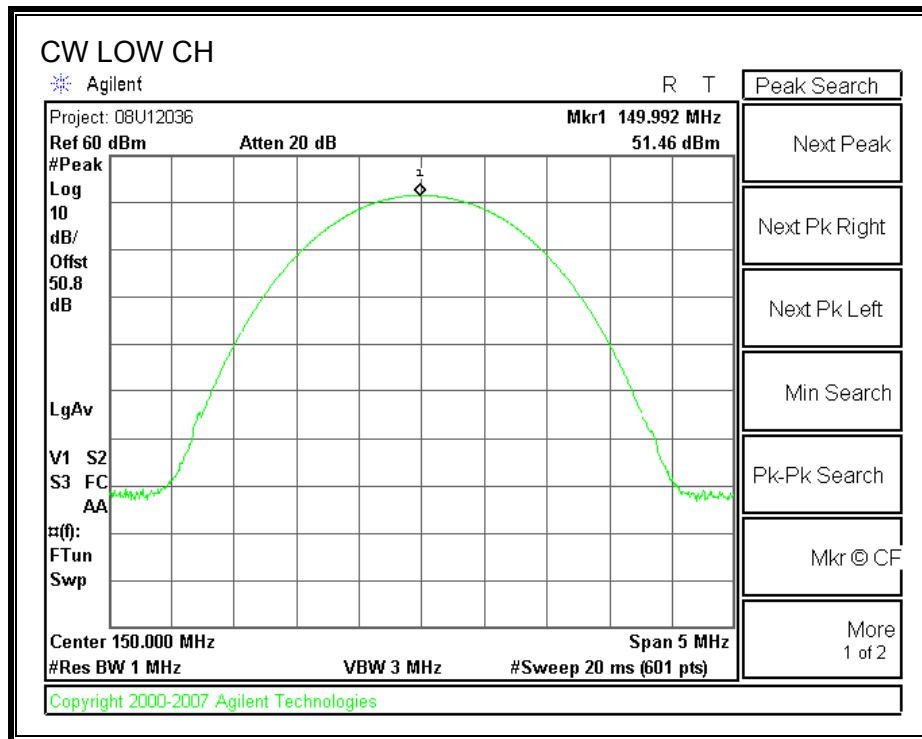
#### RESULTS

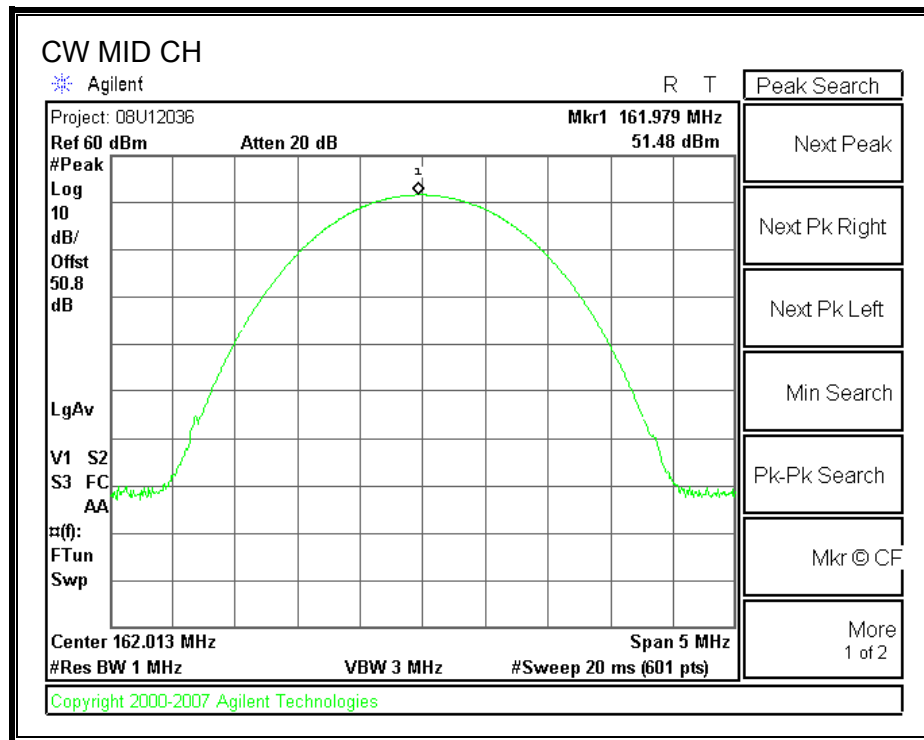
CW Output Power

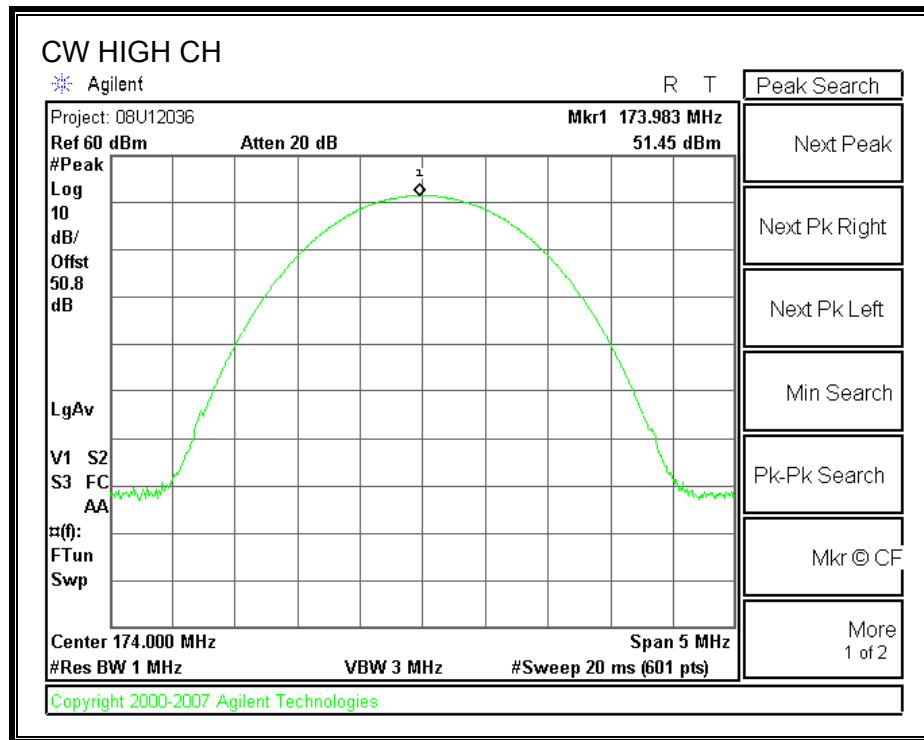
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	150	51.46	139.96
Mid	162.0125	51.48	140.60
High	174	51.45	139.64



**Conducted Output Power**







## 7.5. VOLTAGE STABILITY

### LIMIT

§22.565(a): Frequency range 152 - 153MHz is 1400 Watts maximum (ERP), Frequency range 157 - 159MHz is 150 Watts maximum (ERP).

FCC part 90: The Maximum ERP transmitter power will be considered and authorized on a case-by-case basis. Please refer to the limitations on power and antenna heights are specified in §90.205, §90.279, and §90.309.

### TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 3.2.1

### RESULTS

#### Conducted Output Power vs Voltage

##### CW Output Power vs Voltage

Channel Frequency (MHz)	Output Power at DC Normal Voltage 13.8		Output Power at 85% Voltage 11.73		Output Power at 115% Voltage 15.87	
	dBm	Watt	dBm	Watt	dBm	Watt
150	51.46	139.96	50.26	106.17	52.41	174.18
162.0125	51.48	140.60	50.48	111.69	52.44	175.39
174	51.45	139.64	49.99	99.77	52.39	173.38

## **7.6. SPURIOUS EMISSION AT ANTENNA TERMINAL**

### **LIMIT**

§22.861 and §90.210 Out of band emissions, The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

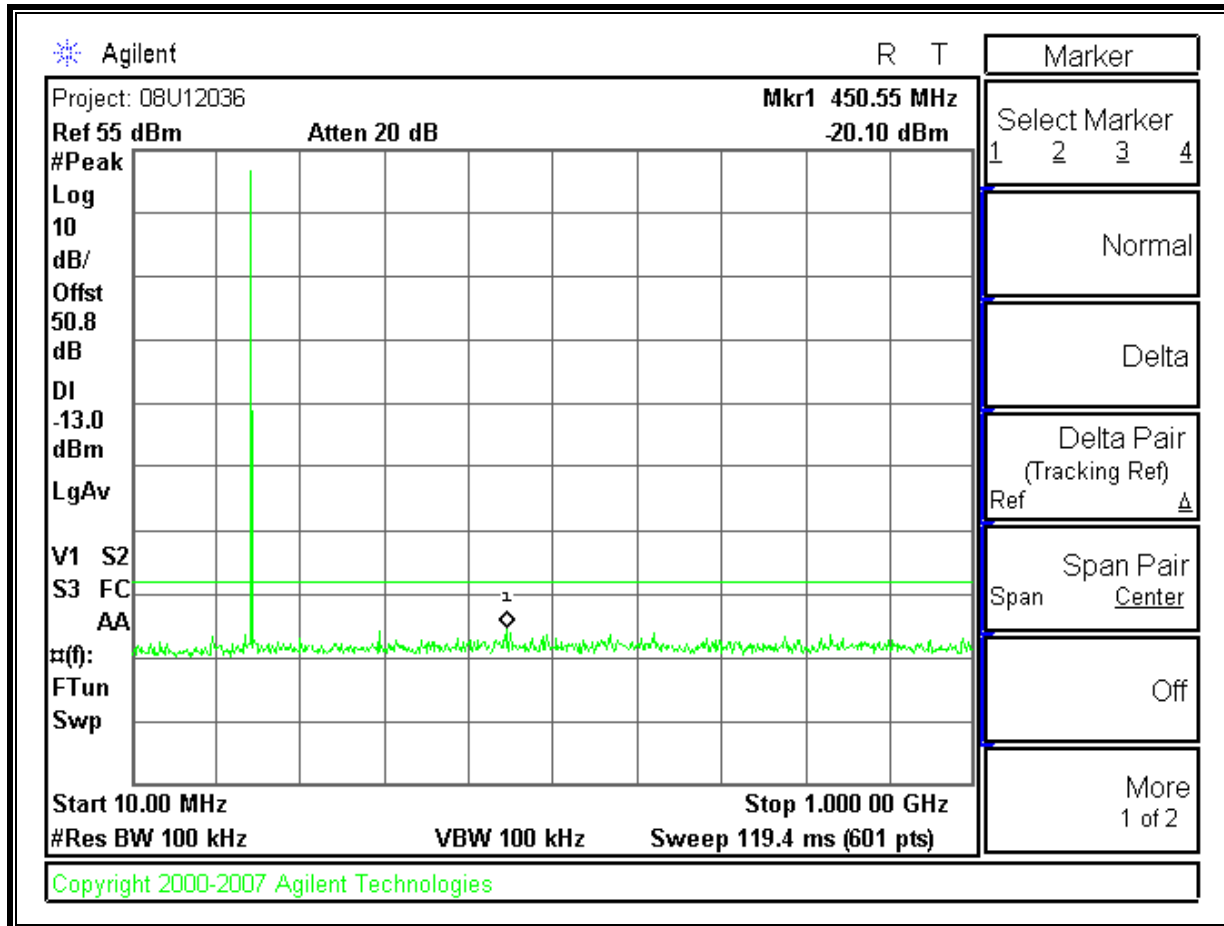
### **TEST PROCEDURE**

ANSI / TIA / EIA 603 Clause 3.2.13, & RSS-131 §4.4.2

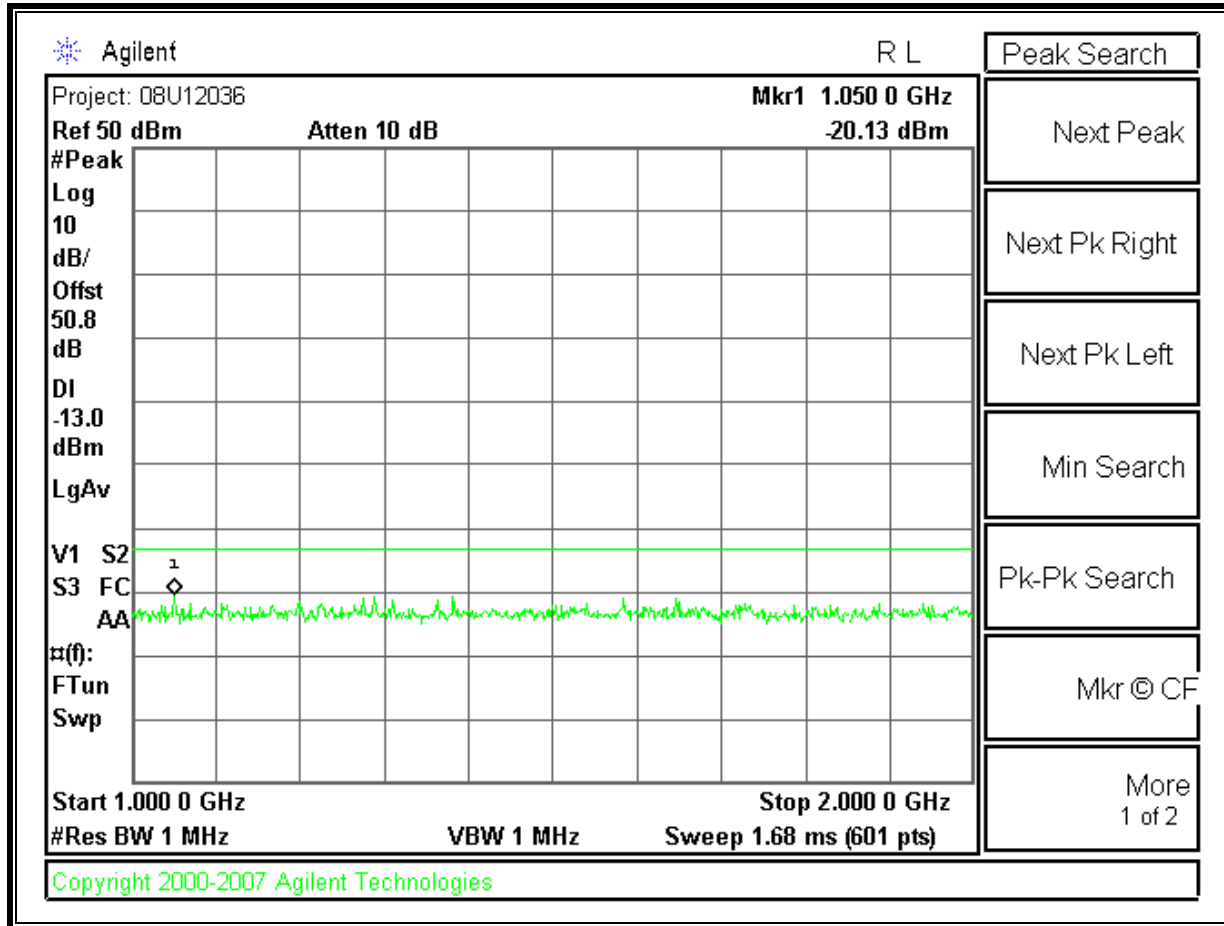
### **RESULTS**

No non-compliance noted.

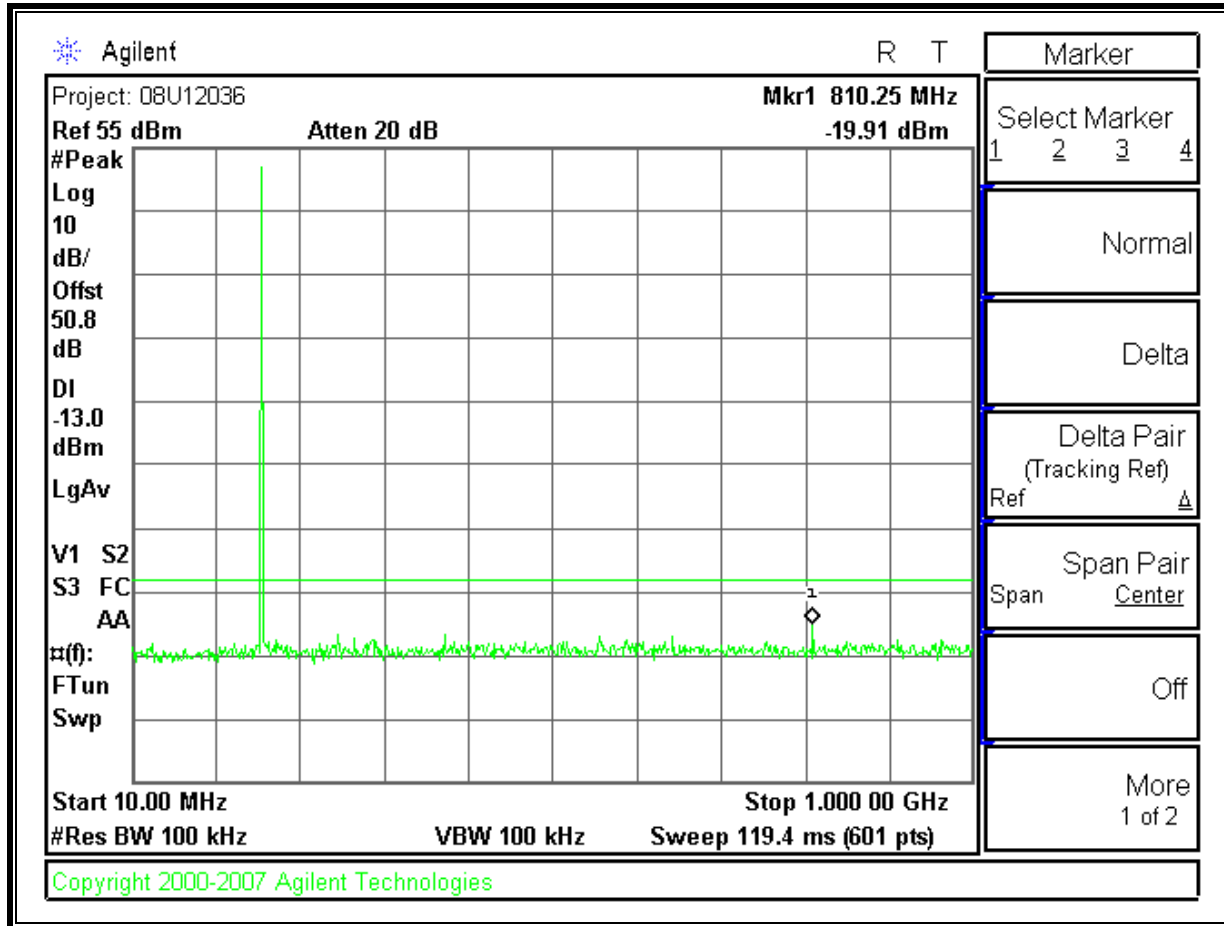
**Low Channel, 10MHz to 1000MHz**



**Low Channel, 1000MHz to 2000MHz**

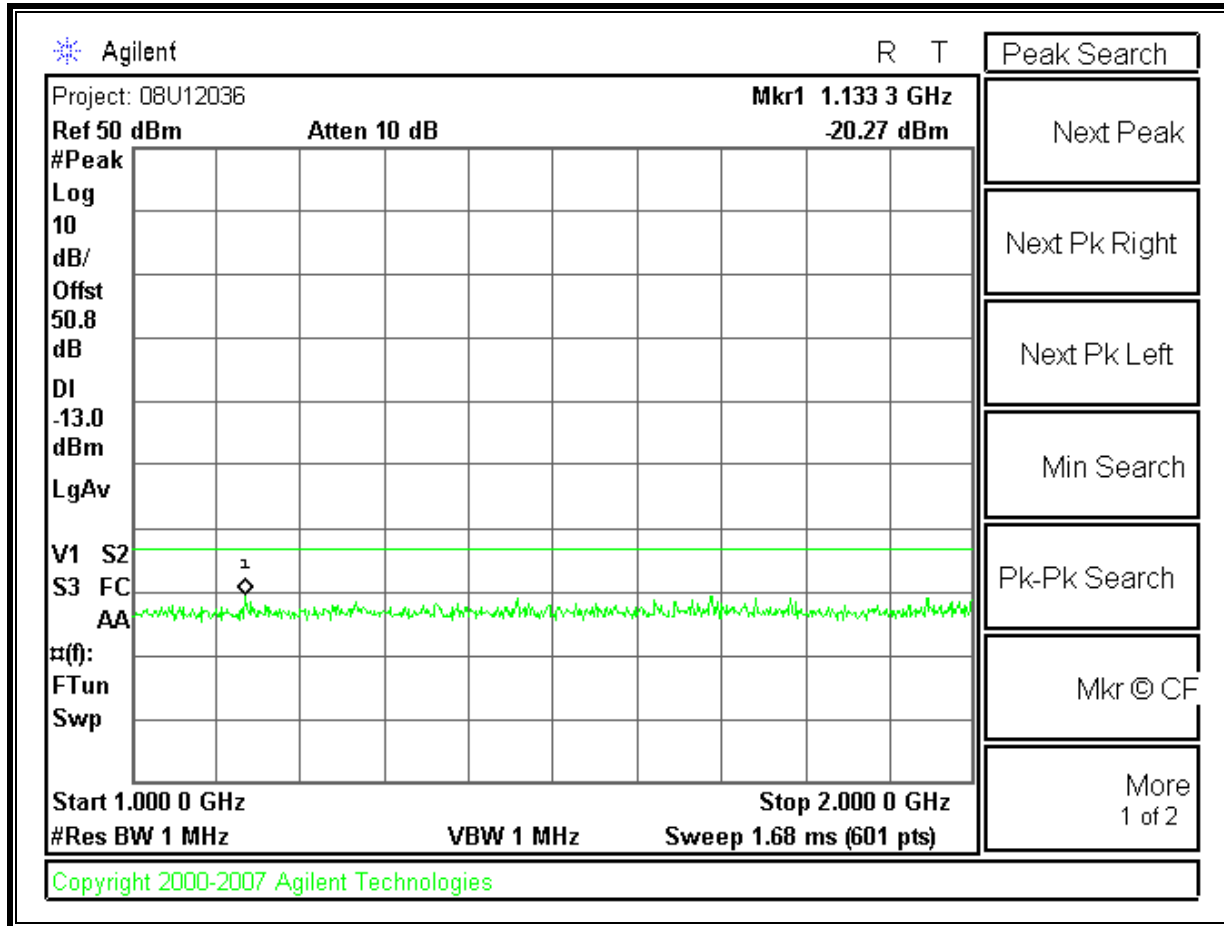


**Mid Channel, 10MHz to 1000MHz**

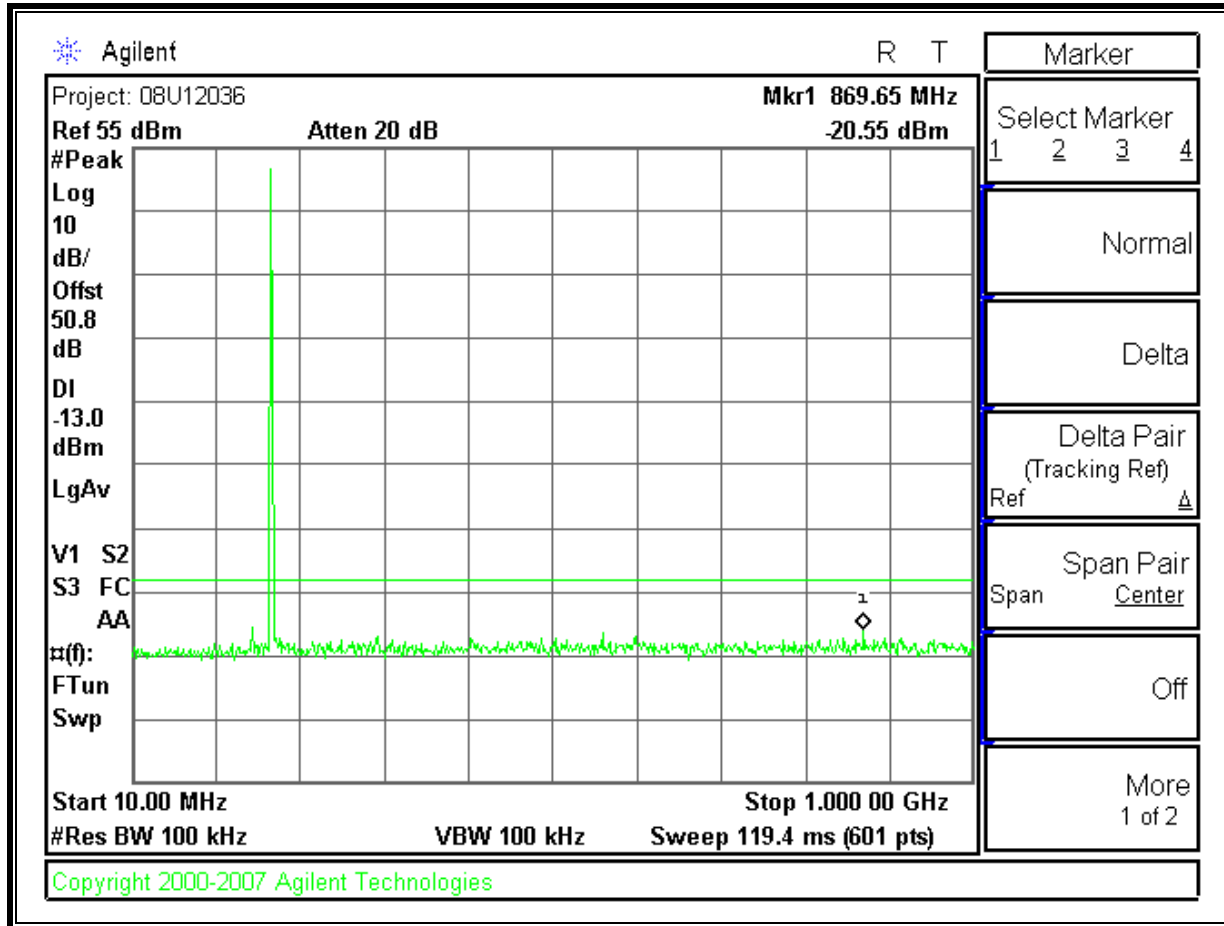




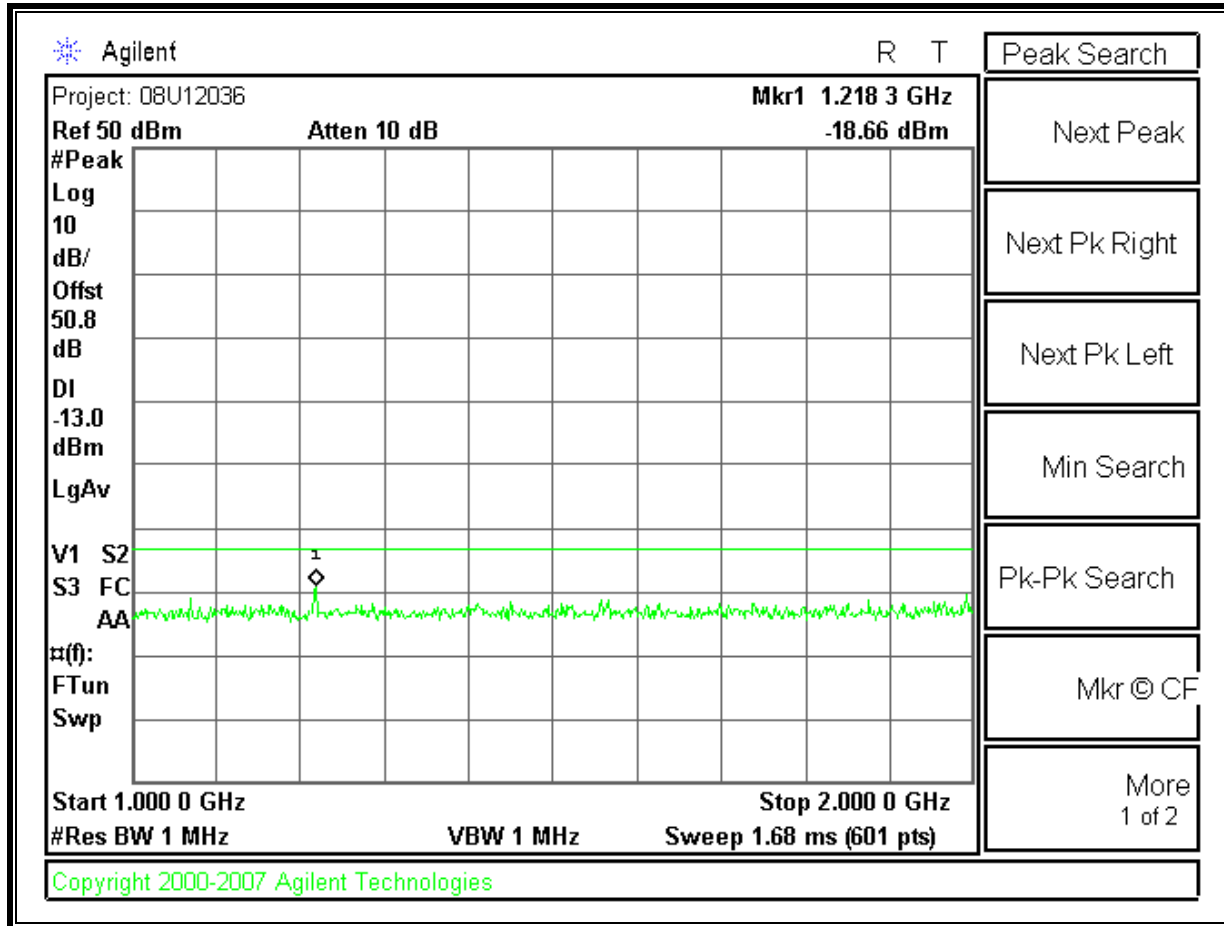
**Mid Channel, 1000MHz to 2000MHz**



**High Channel, 10MHz to 1000MHz**



**High Channel, 1000MHz to 2000MHz**



## **7.7. FIELD STRENGTH OF SPURIOUS RADIATION**

### **LIMIT**

22.861 and §90.210 Out of band emissions, The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

### **TEST PROCEDURE**

ANSI / TIA / EIA 603 Clause 3.2.13, & RSS-131 §4.4.2

### **RESULTS**

## 7.7.1. SPURIOUS RADIATION 30 – 1000 MHz

### Spurious & Harmonic (ERP),

30 - 1000MHz Substitution Measurement										
Compliance Certification Services, Fremont 5m B-Chamber										
Company: TPL Communication										
Project #: 08U12036										
Date: 8/21/2008										
Test Engineer: William Zhuang										
Configuration: EUT with support equipment										
Mode: Tx with 50 ohm load										
Test Equipment:										
Bilog Antenna		Cable		Pre-amplifier 8447D		Limit				
5m Chamber Sunol Bilog		5m Chamber Cable		T5 8447D		ERP				
f MHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch. 150 MHz										
85.00	85.3	V	-25.9	1.2	-0.4	-2.5	-29.7	-13.0	-16.7	
300.00	85.7	V	-21.6	2.1	6.0	3.9	-19.8	-13.0	-6.8	
450.30	87.9	V	-16.0	2.5	6.1	4.0	-14.6	-13.0	-1.6	
600.70	63.3	V	-38.9	2.9	6.9	4.8	-37.1	-13.0	-24.1	
749.40	64.9	V	-35.3	3.3	6.7	4.6	-34.0	-13.0	-21.0	
899.80	73.0	V	-24.2	3.6	6.7	4.6	-23.2	-13.0	-10.2	
86.60	79.2	H	-34.9	1.2	-0.3	-2.5	-38.6	-13.0	-25.6	
300.00	87.5	H	-18.8	2.1	6.0	3.9	-17.1	-13.0	-4.1	
450.30	83.3	H	-20.7	2.5	6.1	4.0	-19.3	-13.0	-6.3	
600.70	76.5	H	-26.4	2.9	6.9	4.8	-24.5	-13.0	-11.5	
749.40	77.1	H	-21.8	3.3	6.7	4.6	-20.5	-13.0	-7.5	
899.80	78.6	H	-19.1	3.6	6.7	4.6	-18.1	-13.0	-5.1	
Mid Ch. 162.0125 MHz										
86.60	81.2	H	-32.9	1.2	-0.3	-2.5	-36.6	-13.0	-23.6	
324.20	86.4	H	-19.4	2.2	6.0	3.9	-17.7	-13.0	-4.7	
485.90	82.4	H	-21.1	2.6	6.2	4.0	-19.7	-13.0	-6.7	
647.60	82.8	H	-19.2	3.0	6.8	4.7	-17.5	-13.0	-4.5	
810.80	76.9	H	-21.9	3.4	6.7	4.5	-20.7	-13.0	-7.7	
972.50	70.2	H	-26.5	3.8	6.9	4.8	-25.5	-13.0	-12.5	
85.00	75.8	V	-35.4	1.2	-0.4	-2.5	-39.2	-13.0	-26.2	
324.20	82.2	V	-24.5	2.2	6.0	3.9	-22.8	-13.0	-9.8	
485.90	78.6	V	-24.7	2.6	6.2	4.0	-23.3	-13.0	-10.3	
647.60	63.6	V	-37.8	3.0	6.8	4.7	-36.1	-13.0	-23.1	
810.80	61.7	V	-36.6	3.4	6.7	4.5	-35.5	-13.0	-22.5	
972.50	67.8	V	-28.7	3.8	6.9	4.8	-27.7	-13.0	-14.7	
High Ch. 174 MHz										
86.60	76.4	V	-34.6	1.2	-0.3	-2.5	-38.4	-13.0	-25.4	
348.50	90.3	V	-15.9	2.2	6.0	3.9	-14.3	-13.0	-1.3	
521.50	87.2	V	-15.8	2.7	6.3	4.2	-14.3	-13.0	-1.3	
696.10	70.4	V	-30.1	3.1	6.8	4.6	-28.6	-13.0	-15.6	
870.70	65.1	V	-32.5	3.5	6.7	4.6	-31.5	-13.0	-18.5	
85.00	67.4	H	-46.9	1.2	-0.4	-2.5	-50.6	-13.0	-37.6	
348.50	88.2	H	-17.1	2.2	6.0	3.9	-15.4	-13.0	-2.4	
521.50	85.7	H	-17.6	2.7	6.3	4.2	-16.2	-13.0	-3.2	
696.10	82.4	H	-18.7	3.1	6.8	4.6	-17.2	-13.0	-4.2	
870.80	77.8	H	-20.3	3.5	6.7	4.6	-19.2	-13.0	-6.2	

## 7.7.2. SPURIOUS RADIATION 1000 – 2000 MHz

### Spurious & Harmonic (ERP),

**High Frequency Substitution Measurement**  
Compliance Certification Services, Fremont 5m B-Chamber

Company: TPL Communication  
Project #: 08U12036  
Date: 8/21/2008  
Test Engineer: William Zhuang  
Configuration: EUT with support equipment  
Mode: Tx with 50 ohm load

**Test Equipment:**

EMCO Horn 1-18GHz

T73; S/N: 6717 @3m

Horn > 18GHz

Limit

ERP

☐ High Pass Filter

Hi Frequency Cables

☒ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☒ (12 ft)

Pre-amplifier 1-26GHz

T145 Agilent 3008A

Pre-amplifier 26-40GHz

f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
<b>Low Ch. 150 MHz</b>										
1.050	80.8	H	-27.6	3.4	6.5	4.4	-26.6	-13.0	-13.6	
1.200	77.8	H	-29.9	3.6	6.9	4.7	-28.7	-13.0	-15.7	
1.350	71.9	H	-35.1	3.8	7.3	5.1	-33.8	-13.0	-20.8	
1.500	73.8	H	-32.6	4.0	7.6	5.5	-31.1	-13.0	-18.1	
1.050	77.4	V	-31.7	3.4	6.5	4.4	-30.7	-13.0	-17.7	
1.200	77.9	V	-30.5	3.6	6.9	4.7	-29.3	-13.0	-16.3	
1.350	73.5	V	-34.2	3.8	7.3	5.1	-32.9	-13.0	-19.9	
1.500	75.7	V	-31.4	4.0	7.6	5.5	-29.8	-13.0	-16.8	
<b>Mid Ch. 162.0125 MHz</b>										
1.133	75.7	V	-33.0	3.5	6.7	4.6	-31.9	-13.0	-18.9	
1.297	68.3	V	-39.7	3.7	7.1	5.0	-38.4	-13.0	-25.4	
1.458	74.9	V	-32.4	3.9	7.5	5.4	-30.9	-13.0	-17.9	
1.620	62.8	V	-43.7	4.1	7.9	5.8	-42.0	-13.0	-29.0	
1.133	75.8	H	-32.2	3.5	6.7	4.6	-31.1	-13.0	-18.1	
1.297	65.0	H	-42.3	3.7	7.1	5.0	-41.0	-13.0	-28.0	
1.458	75.0	H	-31.5	3.9	7.5	5.4	-30.0	-13.0	-17.0	
1.620	64.2	H	-41.6	4.1	7.9	5.8	-40.0	-13.0	-27.0	
<b>High Ch. 174 MHz</b>										
1.043	87.1	H	-21.3	3.4	6.5	4.4	-20.3	-13.0	-7.3	
1.218	79.1	H	-28.6	3.6	6.9	4.8	-27.4	-13.0	-14.4	
1.392	71.8	H	-35.0	3.8	7.4	5.2	-33.6	-13.0	-20.6	
1.567	69.6	H	-36.4	4.0	7.8	5.6	-34.9	-13.0	-21.9	
1.740	67.9	H	-37.3	4.3	8.2	6.0	-35.6	-13.0	-22.6	
1.043	85.2	V	-24.0	3.4	6.5	4.4	-23.0	-13.0	-10.0	
1.218	79.1	V	-29.3	3.6	6.9	4.8	-28.1	-13.0	-15.1	
1.392	72.9	V	-34.6	3.8	7.4	5.2	-33.2	-13.0	-20.2	
1.567	68.9	V	-37.8	4.0	7.8	5.6	-36.3	-13.0	-23.3	
1.740	67.2	V	-38.7	4.3	8.2	6.0	-37.0	-13.0	-24.0	

## 8. MAXIMUM PERMISSIBLE EXPOSURE

### 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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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.

## **CALCULATIONS**

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm<sup>2</sup>

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10^{((P + G) / 10)} / (d^2)$$

The power density in units of mW/cm<sup>2</sup> is converted to units of W/m<sup>2</sup> by multiplying by a factor of 10.



### **LIMITS**

From FCC §1.1310 Table 1 (B), the maximum value of  $S = 0.2 \text{ mW/cm}^2$

### **RESULTS**

(MPE distance is greater than 20 cm)

Mode	FCC Limit (mW/cm <sup>2</sup> )	Output (dBm)	Antenna (dBi)	MPE Distance (cm)
CW	0.2	51.48	0.00	236.45