



**FCC CFR47 PART 22 SUBPART C
CERTIFICATION
TEST REPORT**

FOR

**450 – 470 MHZ RF POWER AMPLIFIER
100 WATTS, FM / CW MODULATION**

MODEL NUMBER: PA6-1AE

FCC ID: BBD6-1AE1

REPORT NUMBER: 05U3494-1B

ISSUE DATE: AUGUST 4, 2005

Prepared for
**TPL COMMUNICATION
3370 SAN FERNANDO ROAD, SUITE 206
LOS ANGELES, CA 90065, USA**

Prepared by
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NVLAP[®]
LAB CODE:200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
A	06/21/05	Initial Issue	YZ
B	08/04/05	Added Input data for Occupied Bandwidth	D.Z.

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: TPL COMMUNICATION
3370 SAN FERNANDO ROAD, SUITE 206
LOS ANGELES, CA 90065 USA

EUT DESCRIPTION: 450 - 470 MHZ RF POWER AMPLIFIER
100 WATTS, FM / CW MODULATION

MODEL: PA6-1AE

SERIAL NUMBER: N/A

DATE TESTED: JUNE 15 ~JUNE 16, 2005

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 22 SUBPART C	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. 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:



YAN ZHENG
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 603A (2001), FCC CFR 47 Part 2, FCC CFR 47 Part 22.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

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
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 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: 450 ~ 470MHz
The radio module is manufactured by TPL Communications.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Modulation	Conducted Output Power (dBm)	Conducted Output Power (W)
450 ~ 470	CW	49.9	97.7

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes device has no antenna. RF output provided by female “N” connector

5.4. 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 460MHz

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
Signal Generator, 9KHz -3200MHz	HP	8684C	3623AB3025	7/5/2006
Amplifier	Amplifier Research	150W1000M2	303370	CNR
Power Attenuator	Tenuline	8343-200	970	CNR
DC Power Supply	HP	6268A	6M1457	CNR

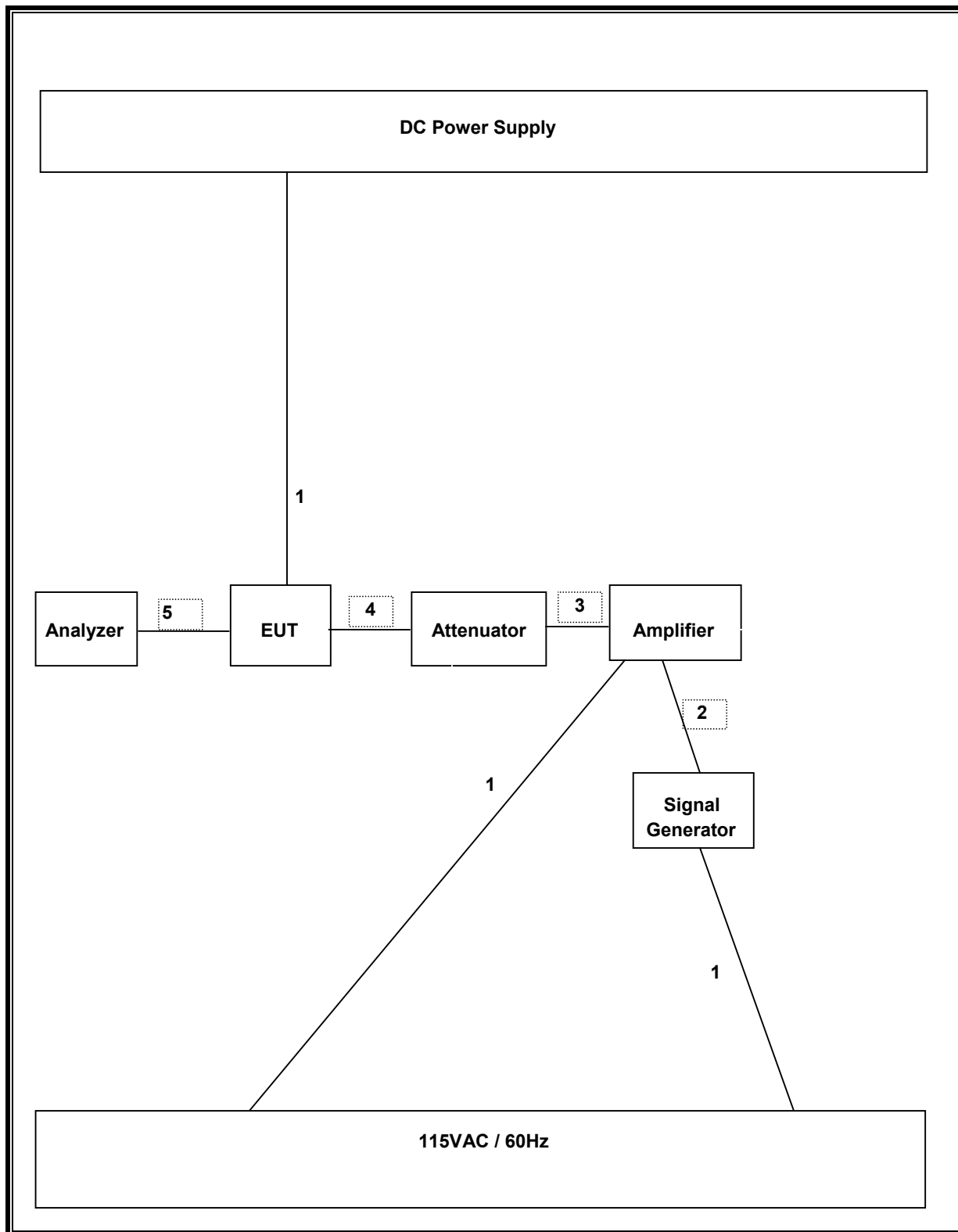
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	5	US115	Unshielded	1.8m	
2 -- 5	N-Connector	4	N-Type	Shilded	1m	
6	DC	1	Din	Unshielded	2m	

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
Peak / Average Power Sensor	Agilent	E9327A	US40440755	11/7/2005
Power Meter	Agilent	E4416A	GB41291160	11/7/2005
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/20/2005
RF Filter Section	HP	85420E	3705A00256	11/20/2005
Spectrum Analyzer 20 Hz ~ 44 GHz	Agilent	E4446A	US42070220	3/28/2006
Signal Generator, 10 MHz~20 GHz	HP	83732B	US34490599	7/7/2005
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	4/29/2005
Antenna, Bilog 30MHz ~ 2Ghz	Sunol Sciences	JB1	A121003	3/3/2006
Preamplifier, 1 ~ 26 GHz	Miteq	NSP2600-44	646456	8/17/2005

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

No non-compliance noted:

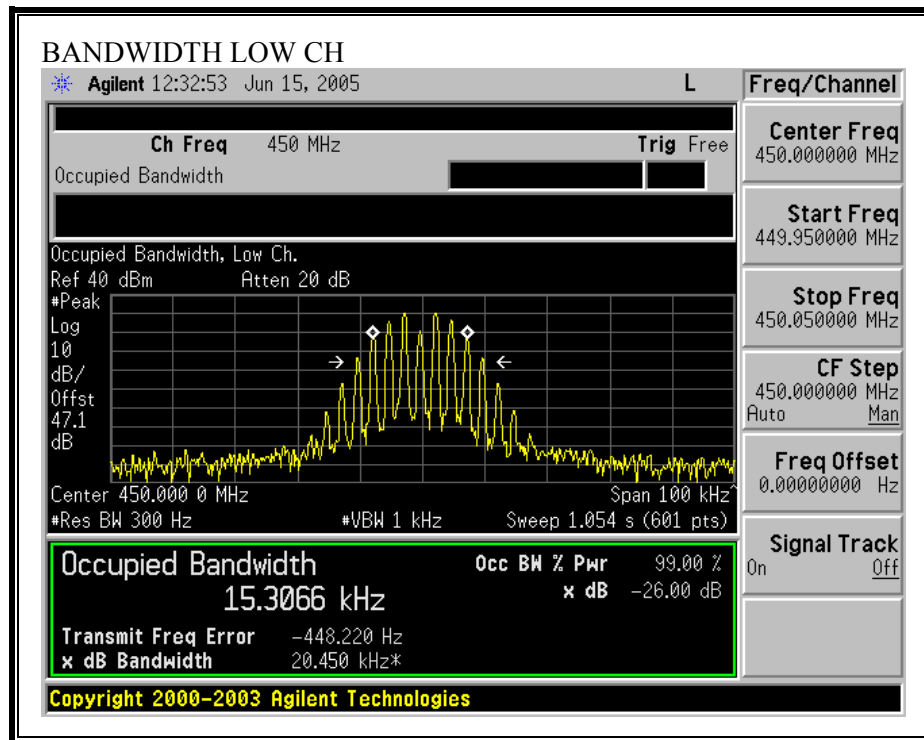
FM Modulation - Input

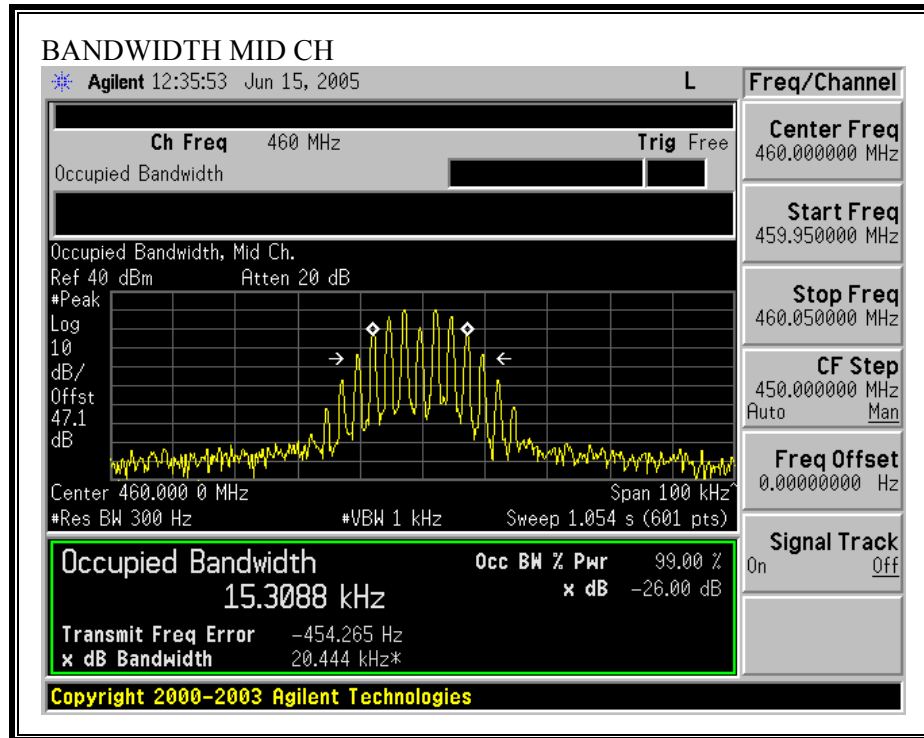
Channel	Frequency (MHz)	Bandwidth (KHz)
Low	450	20.450
Middle	460	20.444
High	470	20.426

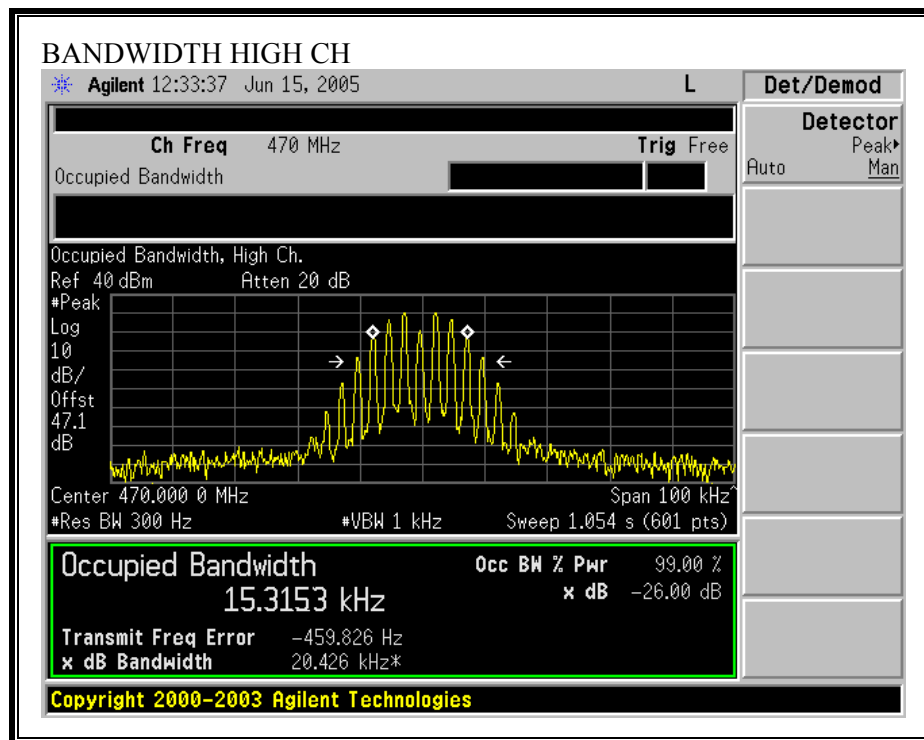
FM Modulation - Output

Channel	Frequency (MHz)	Bandwidth (MHz)
Low	450	20.424
Middle	460	20.440
High	470	20.440

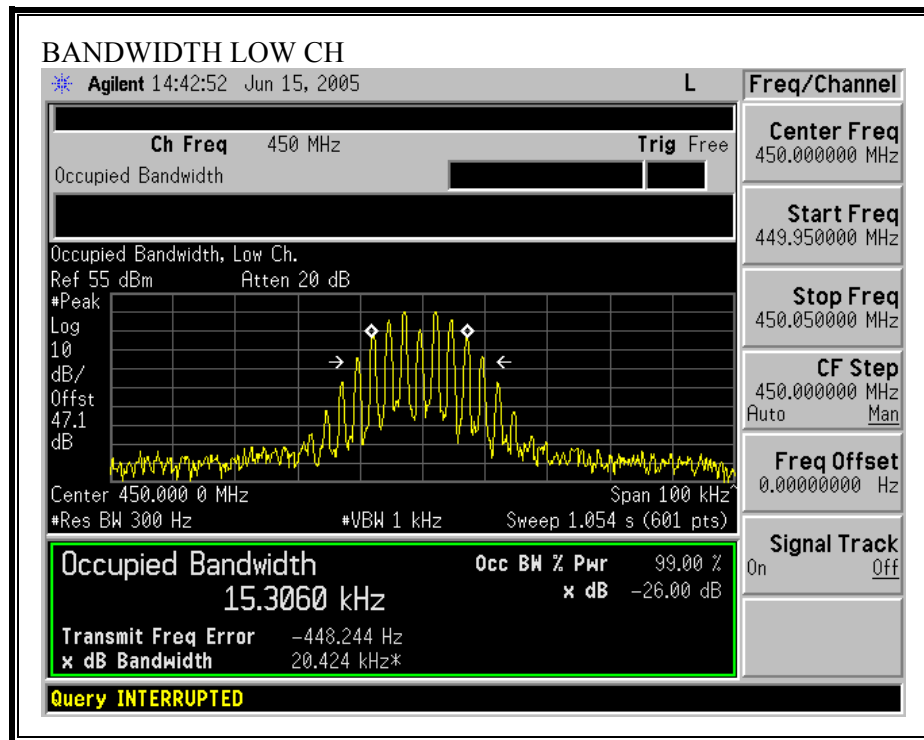
FM 26 dB BANDWIDTH - INPUT

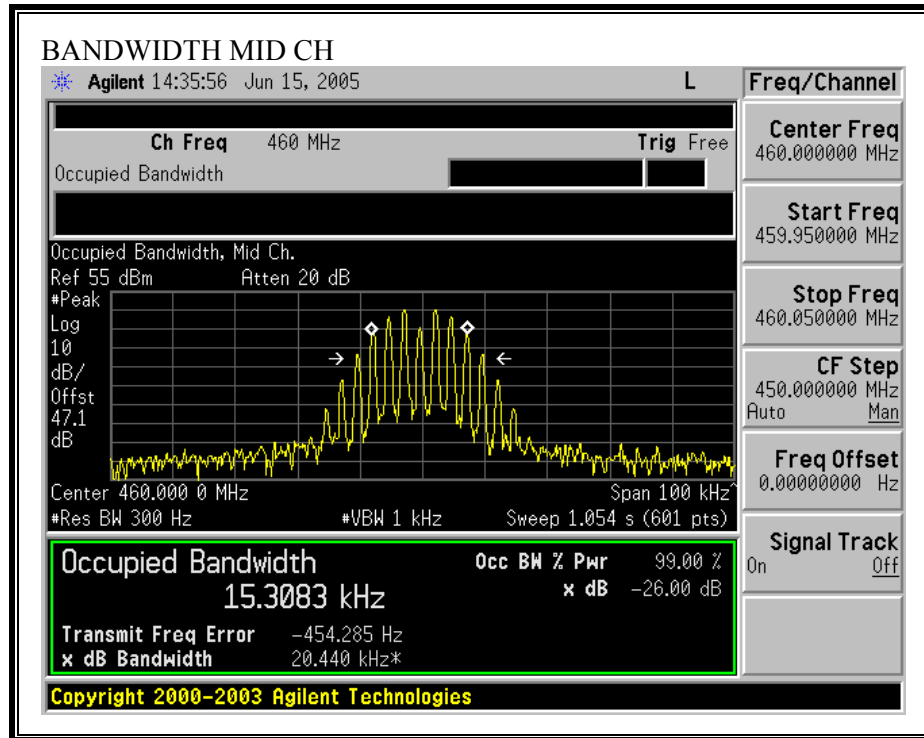


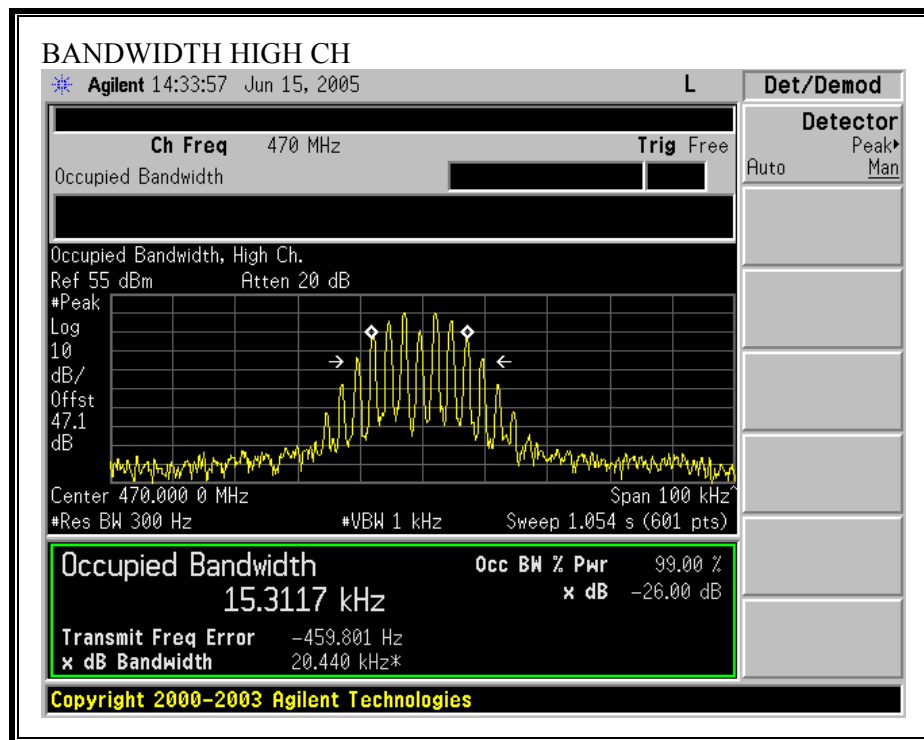




FM 26 dB BANDWIDTH -OUTPUT







7.2. FM EMISSION LIMITATION

LIMIT

§22.359(2) For transmitters that operate in the frequency ranges 450 to 512 MHz and 929 to 932 MHz,

(i) On any frequency removed from the center frequency of the assigned channel by a displacement frequency f_d (in kHz) of more than 5 kHz but not more than 10 kHz: at least $83 \log (f_d \div 5)$ dB; the center frequency of the assigned channel by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB:

(ii) On any frequency removed from the center frequency of the assigned channel 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 $116 \log (f_d \div 6.1)$ dB, or $50 + 10 \log P$ dB, or 70 dB, whichever is the lesser attenuation;

(iii) On any frequency removed from the center frequency of the assigned channel by more than 250 percent of the authorized bandwidth: at least $43 + 10 \log P$ dB, or 80 dB, whichever is the lesser attenuation.

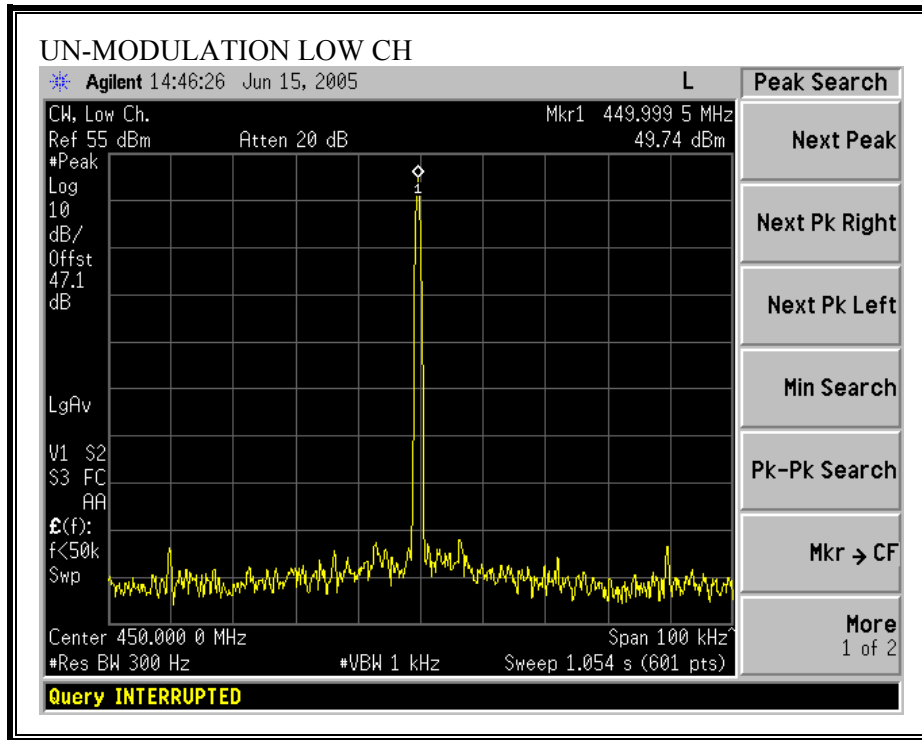
TEST PROCEDURE

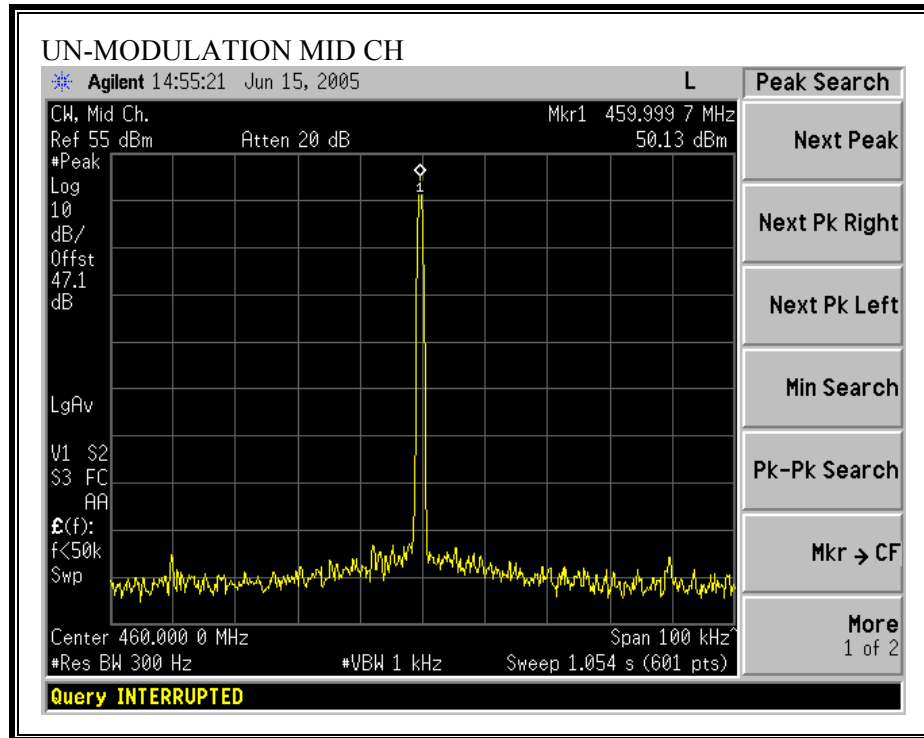
ANSI / TIA / EIA 603 Clause 2.4.10

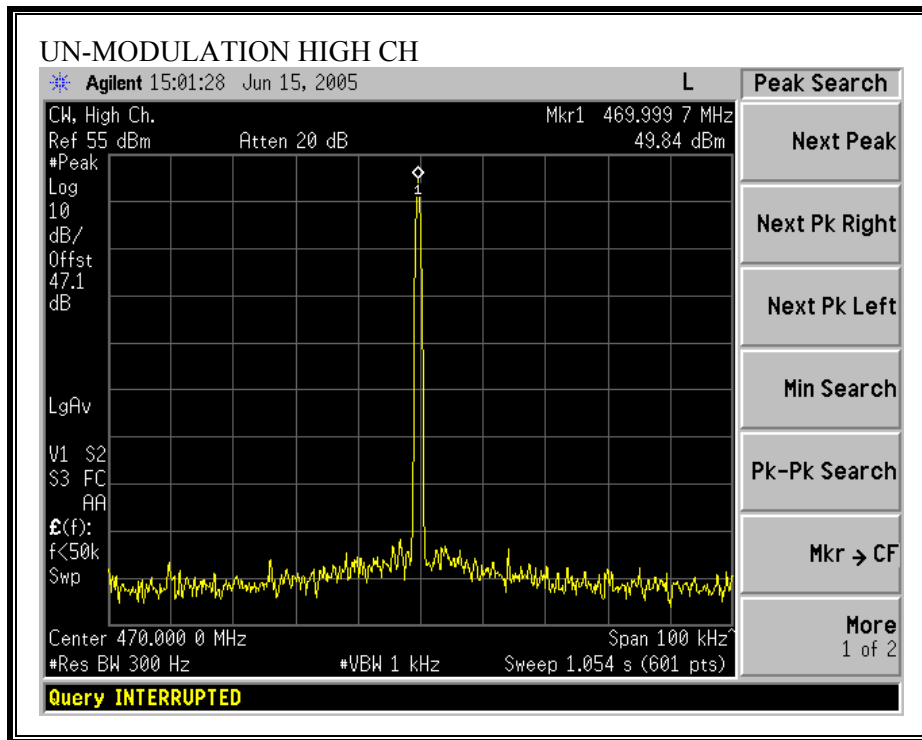
RESULTS

No non-compliance noted:

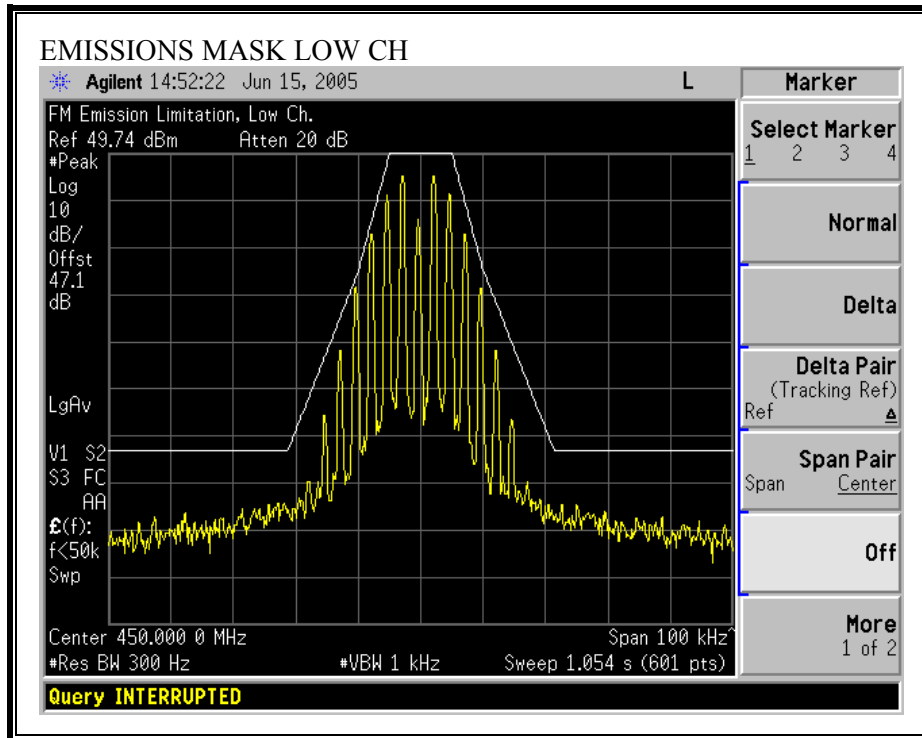
Un-modulation Signal:

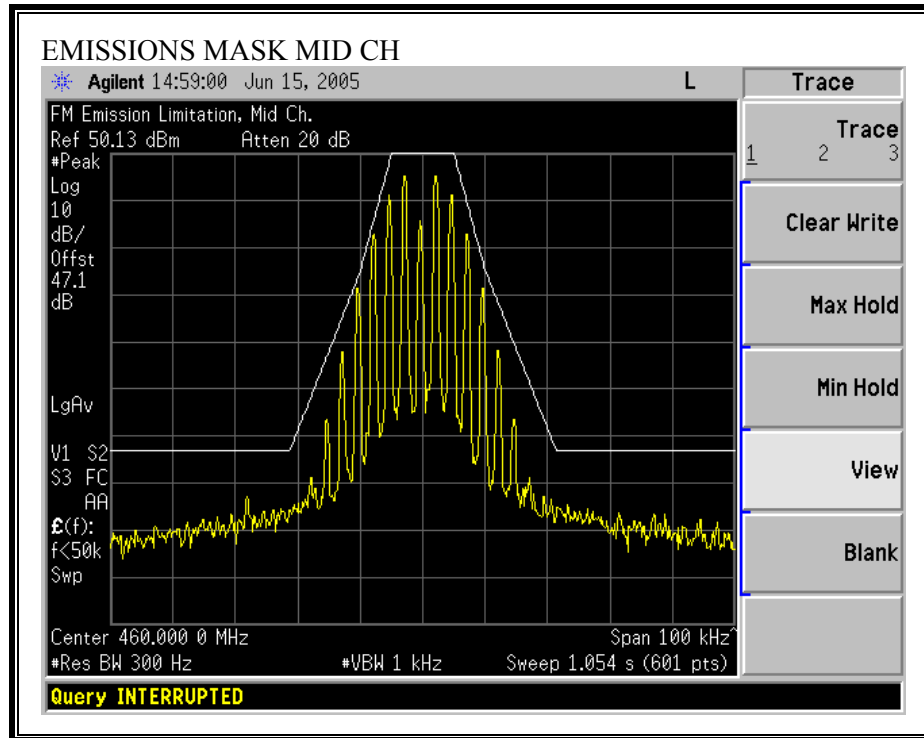


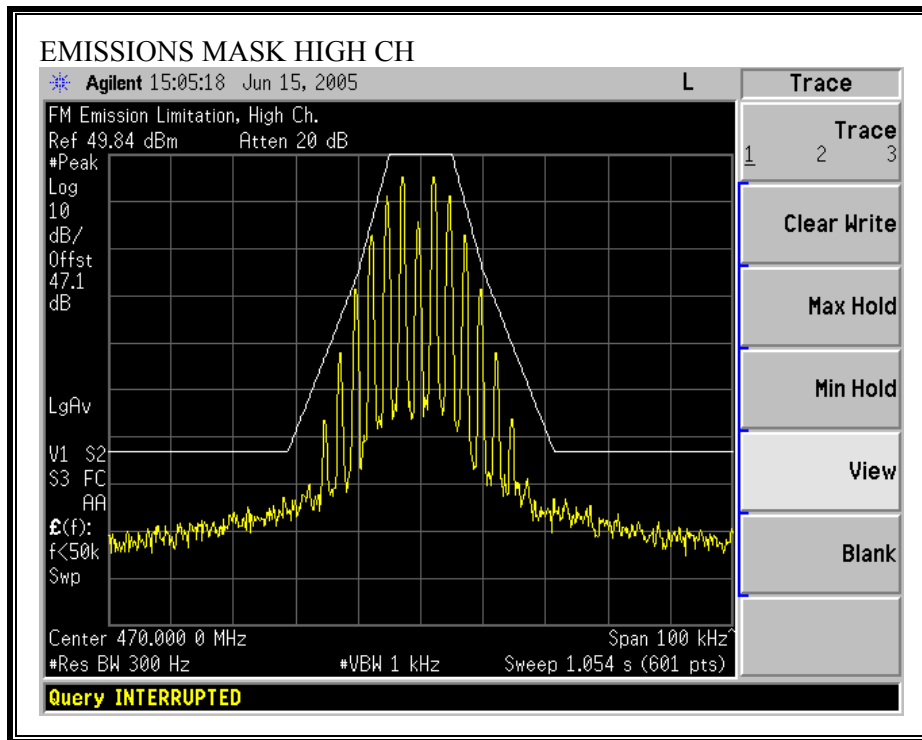




FM EMISSIONS MASK







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

The Maximum ERP of base transmitters and cellular repeaters must not exceed 500 Watts.

TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 2.2.17

RESULTS

No non-compliance noted.

Conducted Output Power

CW Output Power vs Voltage			
Channel Freq.	Output Power at normal voltage 13.8 VDC	Output Power at 85% voltage 11.7 VDC	Output Power at 115% voltage 15.9 VDC
450 MHz	49.7 dBm / 93.3 W	48.3 dBm / 67.6 W	50.4 dBm / 109.6 W
460 MHz	49.9 dBm / 97.7 W	48.6 dBm / 72.4 W	50.7 dBm / 117.5 W
470 MHz	49.8 dBm / 95.5 W	48.3 dBm / 67.6 W	50.4 dBm / 109.6 W

7.5. FREQUENCY STABILITY

Not Applicable. Due to this EUT is a power amplifier and has no Local Oscillator circuitry to shift the RF signal.

7.6. SPURIOUS EMISSION AT ANTENNA TERMINAL

LIMIT

§22.917 (a) 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.

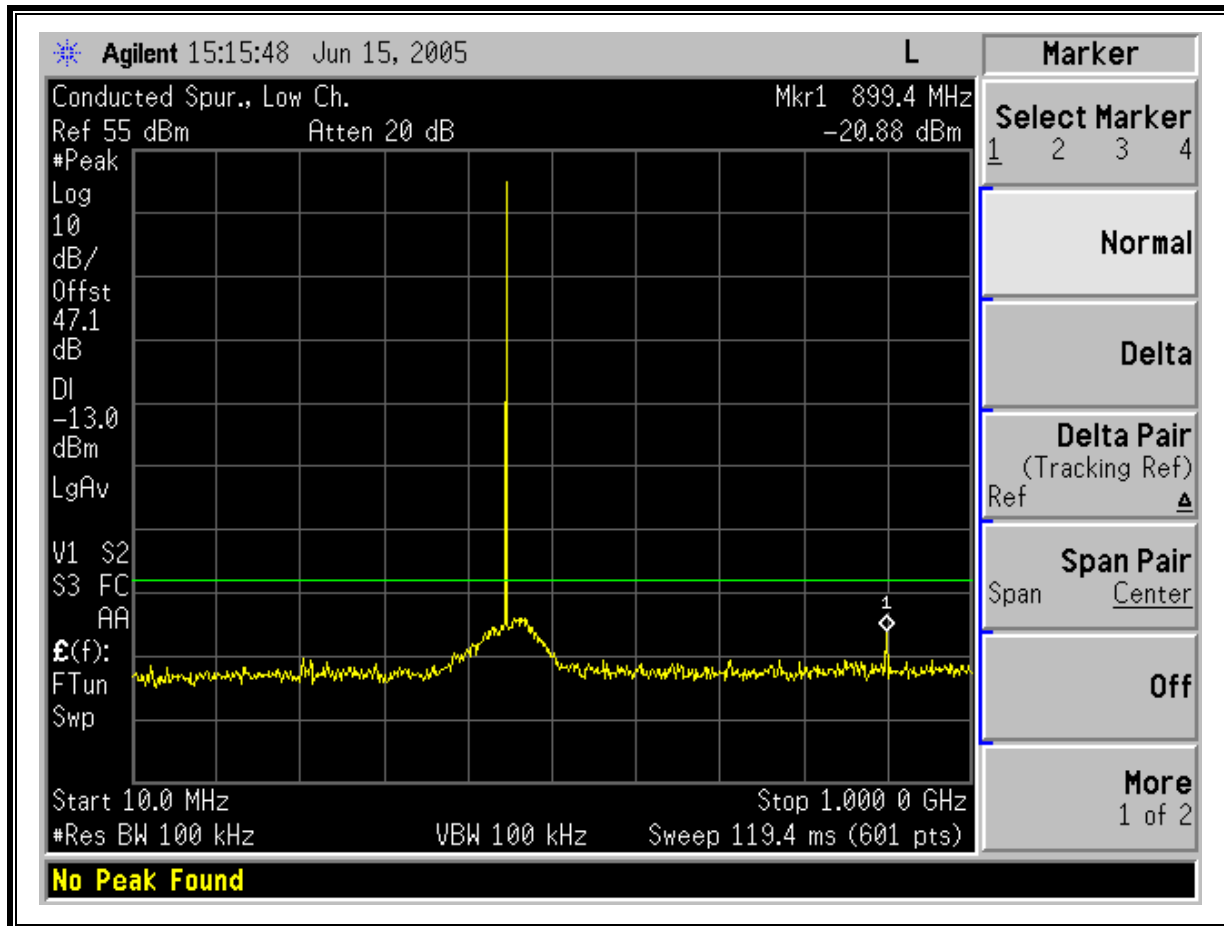
TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 3.2.13 & FCC 22.917 (b)

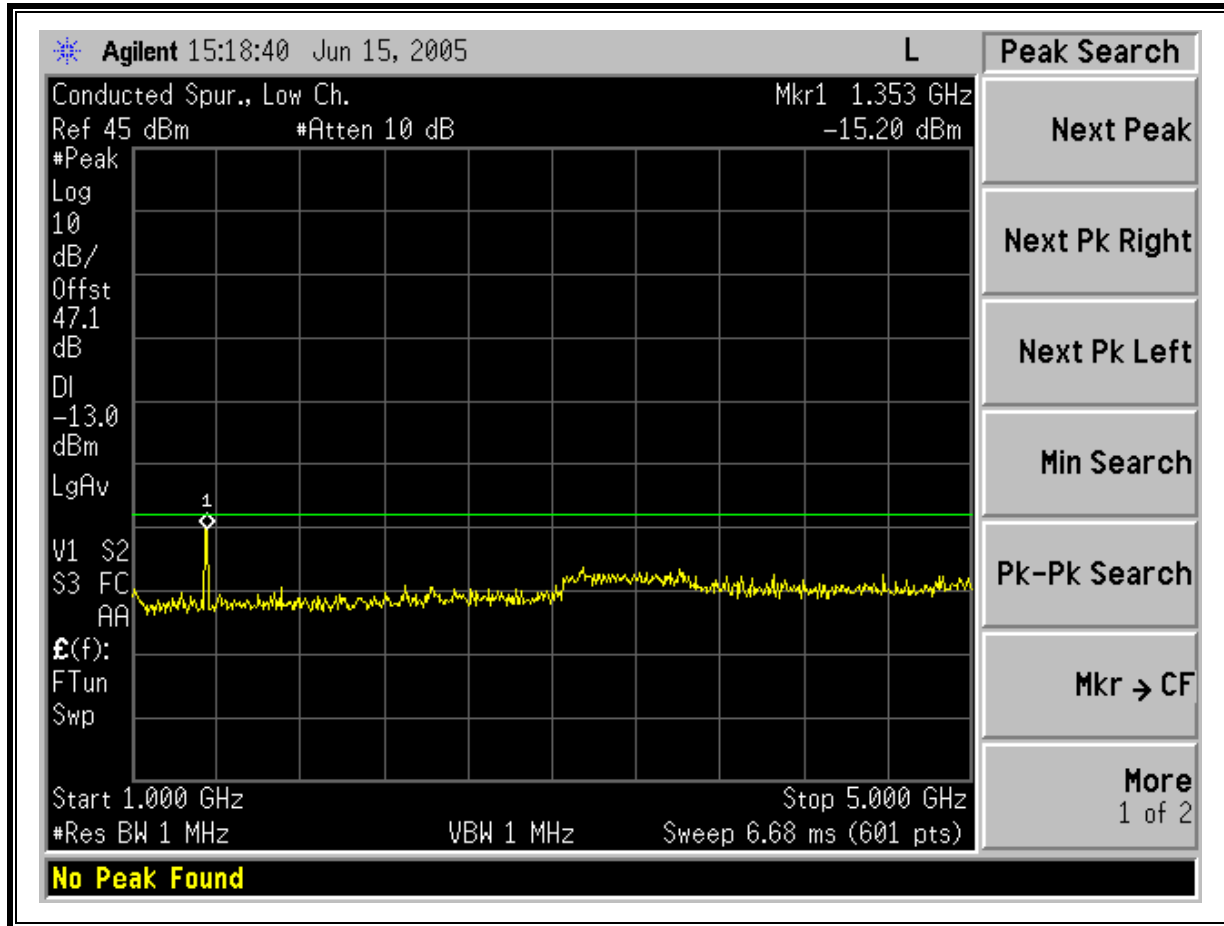
RESULTS

No non-compliance noted.

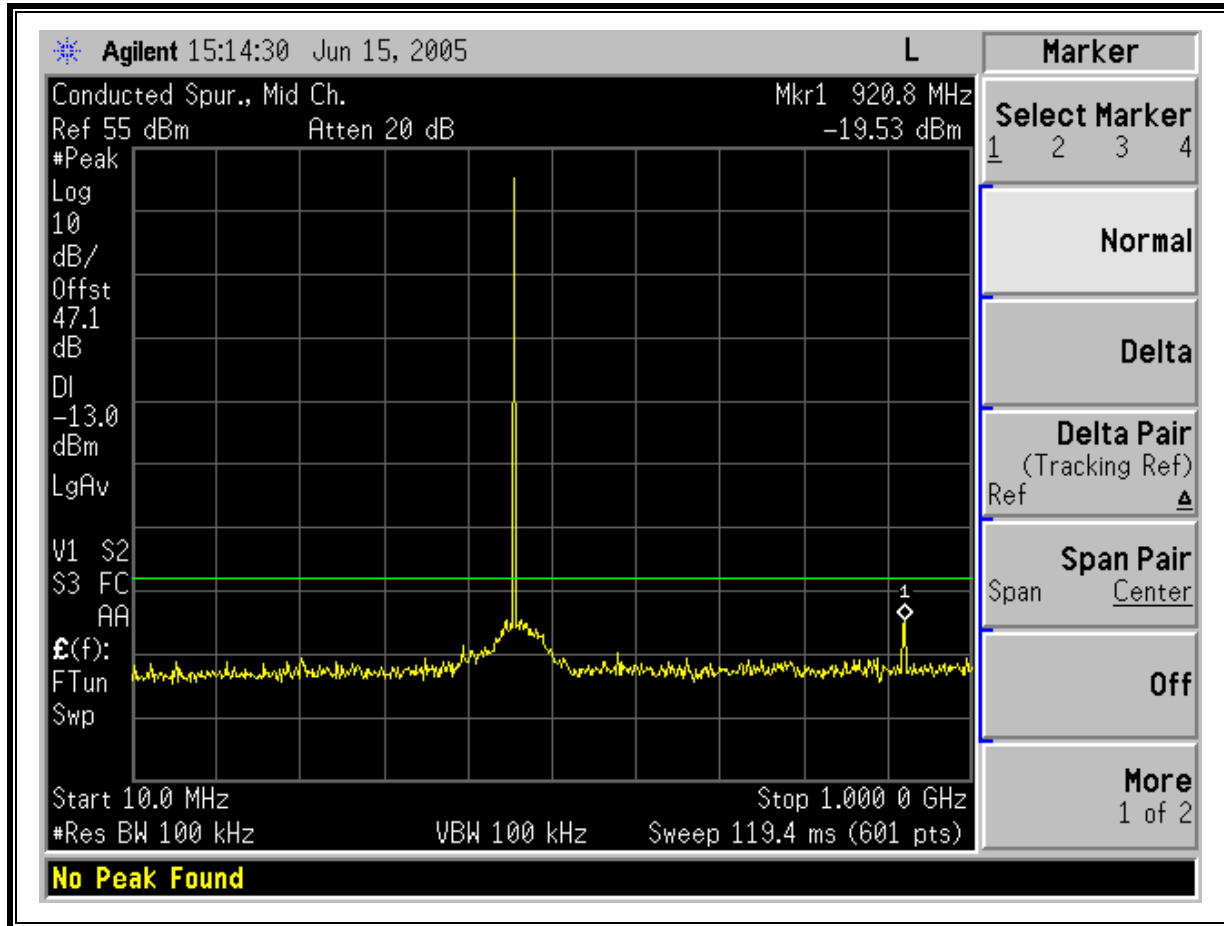
Low Channel, 10MHz to 1000MHz



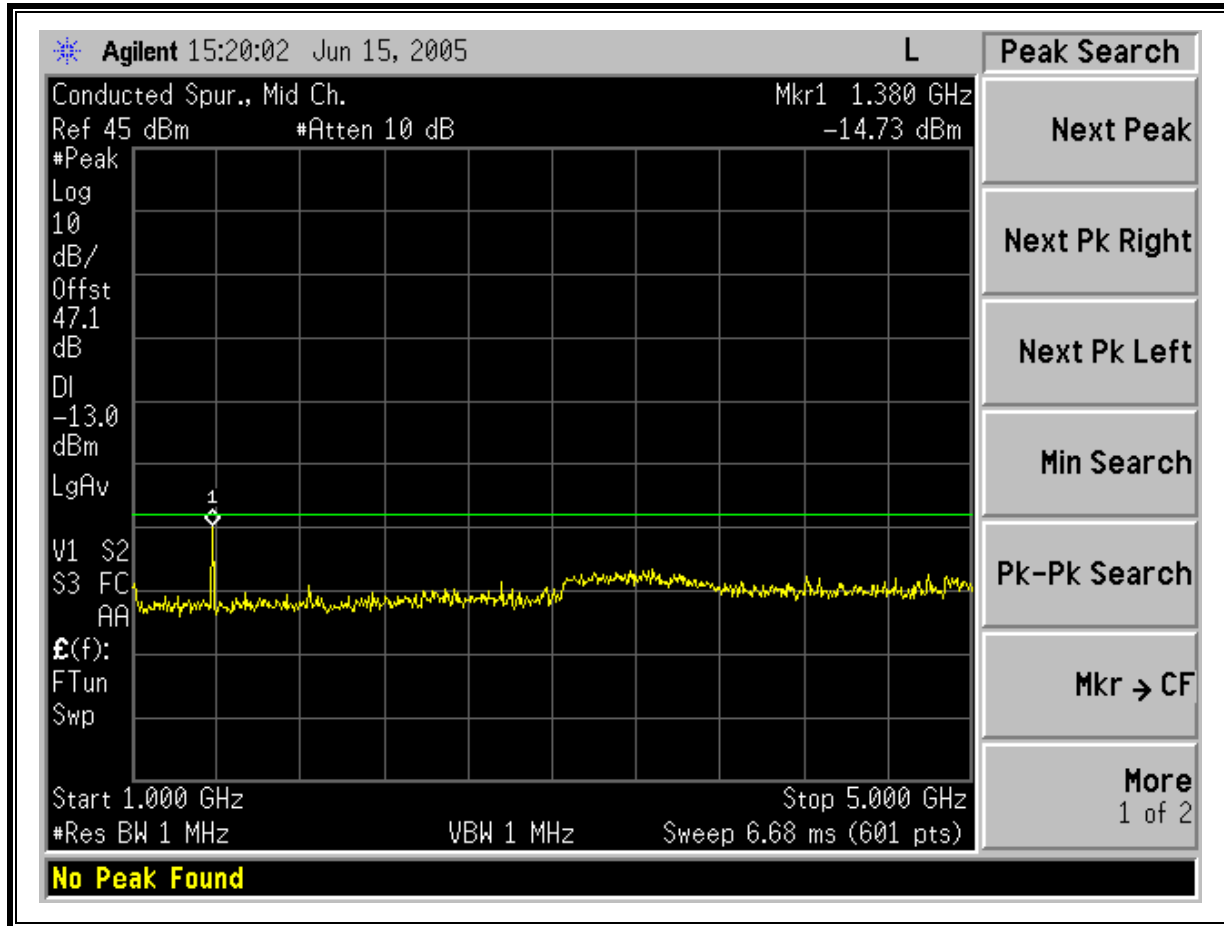
Low Channel, 1000MHz to 5000MHz



Mid Channel, 10MHz to 1000MHz



Mid Channel, 1000MHz to 5000MHz



Agilent 15:12:40 Jun 15, 2005 L

Conducted Spur., High Ch. Mkr1 940.6 MHz
Ref 55 dBm Atten 20 dB -21.75 dBm

#Peak
Log
10
dB/
Offst
47.1
dB
DI
-13.0
dBm
LgAv

V1 S2
S3 FC
AA

f(f):
FTun
Swp

Start 10.0 MHz Stop 1.000 0 GHz
#Res BW 100 kHz VBW 100 kHz Sweep 119.4 ms (601 pts)

Marker
Select Marker
1 2 3 4

Normal
Delta
Delta Pair
(Tracking Ref)
Ref

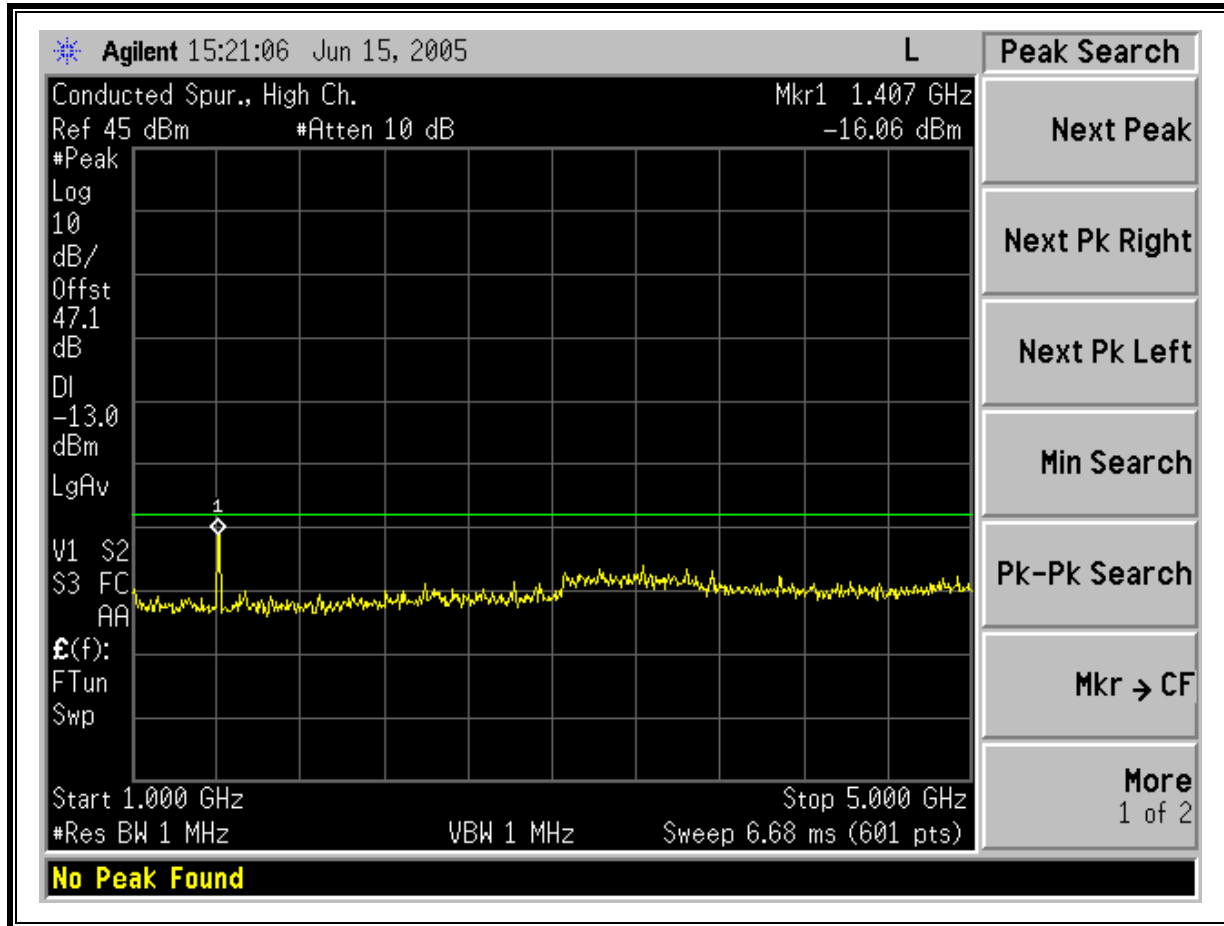
Span Pair
Span Center

Off

More
1 of 2

No Peak Found

High Channel, 1000MHz to 5000MHz



7.7. FIELD STRENGTH OF SPURIOUS RADIATION

LIMIT

§22.917 (a) 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 3.2.12 & FCC 22.917 (b)

RESULTS

No non-compliance noted.

7.7.1. 10MHz TO 1000MHz SPURIOUS RADIATION

06/15/05 30 - 1000MHz Substitution Measurement
Compliance Certification Services, Morgan Hill 5m Chamber Site

Test Engr: William Zhuang
Project #: 05U3494
Company: TPL Communications
EUT Descrip.: RF Power Amplifier, 450-470MHz, Single Channel, 13.8VDC
EUT M/N: PA6-1AE
Test Target: FCC22
Mode Oper: Turn On, Worst case, Mid Ch.

Test Equipment:

Bilog Antenna	Cable	Pre-amplifier 8447D	Limit
5m Chamber Sunol Bilog	5m Chamber Cable		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
102.80	17.8	H	-64.3	1.3	-1.2	-3.3	-69.0	-13.0	-56.0	
180.40	24.9	H	-57.2	1.7	3.1	0.9	-58.0	-13.0	-45.0	
226.40	20.8	H	-62.0	1.9	5.9	3.7	-60.1	-13.0	-47.1	
333.10	18.5	H	-60.0	2.2	6.0	3.9	-58.3	-13.0	-45.3	
677.50	21.1	H	-52.1	3.1	6.8	4.6	-50.5	-13.0	-37.5	
924.80	36.6	H	-33.0	3.7	6.8	4.7	-32.1	-13.0	-19.1	
56.70	23.6	V	-64.9	1.1	-3.1	-5.2	-71.2	-13.0	-58.2	
95.50	22.8	V	-60.8	1.3	-0.6	-2.8	-64.8	-13.0	-51.8	
170.70	22.1	V	-60.5	1.6	2.2	0.1	-62.0	-13.0	-49.0	
204.60	23.6	V	-57.9	1.8	5.0	2.8	-56.9	-13.0	-43.9	
231.30	25.8	V	-56.7	1.9	5.9	3.8	-54.8	-13.0	-41.8	
260.40	26.1	V	-55.8	2.0	6.1	3.9	-53.8	-13.0	-40.8	
927.30	42.4	V	-27.0	3.7	6.8	4.7	-26.0	-13.0	-13.0	

7.7.2. ABOVE 1000MHz SPURIOUS RADIATION

Spurious & Harmonic (ERP), Low Channel

06/15/05 High Frequency Substitution Measurement Compliance Certification Services, Morgan Hill 5m Chamber Site Test Engr: William Zhuang Project #: 05U3494 Company: TPL Communications EUT Descr: RF Power Amplifier, 450-470MHz, Single Channel, 13.8VDC EUT M/N: PA6-1AE Test Target: FCC22 Mode Oper: Turn On Test Equipment:										
EMCO Horn 1-18GHz		Horn > 18GHz		Limit		High Pass Filter				
T73; S/N: 6717 @3m				FCC 22						
Hi Frequency Cables ☐ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☒ (12 ft)				Pre-amplifier 1-26GHz		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
Low Ch. 450MHz										
1.350	49.5	V	-60.2	1.2	7.6	5.5	-55.9	-13.0	-42.9	
1.800	53.9	V	-54.3	1.3	8.7	6.5	-49.1	-13.0	-36.1	
2.250	44.1	V	-62.7	1.5	9.5	7.4	-56.8	-13.0	-43.8	
2.700	45.8	V	-59.5	1.7	9.7	7.5	-53.6	-13.0	-40.6	
3.150	37.9	V	-66.0	1.8	9.7	7.6	-60.2	-13.0	-47.2	
3.600	28.8	V	-74.1	2.0	10.0	7.9	-68.1	-13.0	-55.1	
4.050	31.9	V	-70.0	2.1	10.4	8.2	-63.9	-13.0	-50.9	
4.500	37.9	V	-63.4	2.3	10.8	8.6	-57.0	-13.0	-44.0	
4.950	40.1	V	-60.6	2.4	11.2	9.0	-54.0	-13.0	-41.0	
1.350	45.5	H	-63.6	1.2	7.6	5.5	-59.3	-13.0	-46.3	
1.800	45.5	H	-62.0	1.3	8.7	6.5	-56.8	-13.0	-43.8	
2.250	39.9	H	-66.6	1.5	9.5	7.4	-60.8	-13.0	-47.8	
2.700	44.1	H	-61.0	1.7	9.7	7.5	-55.1	-13.0	-42.1	
3.150	32.4	H	-71.4	1.8	9.7	7.6	-65.6	-13.0	-52.6	
3.600	29.7	H	-73.1	2.0	10.0	7.9	-67.2	-13.0	-54.2	
4.050	34.3	H	-67.3	2.1	10.4	8.2	-61.2	-13.0	-48.2	
4.500	39.0	H	-61.9	2.3	10.8	8.6	-55.6	-13.0	-42.6	
4.950	30.4	H	-69.9	2.4	11.2	9.0	-63.4	-13.0	-50.4	

Spurious & Harmonic (ERP), Mid Channel

06/15/05 **High Frequency Substitution Measurement**
Compliance Certification Services, Morgan Hill 5m Chamber Site

Test Engr: William Zhuang
Project #: 05U3494
Company: TPL Communications
EUT Descrip.: RF Power Amplifier, 450-470MHz, Single Channel, 13.8VDC
EUT M/N: PA6-1AE
Test Target: FCC22
Mode Oper: Turn On

Test Equipment:

EMCO Horn 1-18GHz
T73; S/N: 6717 @3m

Horn > 18GHz

Limit
FCC 22

☐ High Pass Filter

Hi Frequency Cables
☐ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☒ (12 ft)

Pre-amplifier 1-26GHz

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
Mid Ch. 460MHz										
1.380	49.9	H	-59.1	1.2	7.7	5.5	-54.7	-13.0	-41.7	
1.840	56.5	H	-50.9	1.4	8.8	6.6	-45.6	-13.0	-32.6	
2.300	38.8	H	-67.6	1.5	9.6	7.4	-61.7	-13.0	-48.7	
2.760	42.6	H	-62.2	1.7	9.7	7.5	-56.4	-13.0	-43.4	
3.220	31.1	H	-72.5	1.8	9.8	7.6	-66.7	-13.0	-53.7	
3.680	32.6	H	-70.0	2.0	10.1	7.9	-64.1	-13.0	-51.1	
4.140	27.4	H	-74.0	2.2	10.4	8.3	-67.9	-13.0	-54.9	
4.600	42.1	H	-58.7	2.3	10.9	8.7	-52.3	-13.0	-39.3	
5.050	36.6	H	-61.6	2.5	11.2	9.0	-55.0	-13.0	-42.0	
1.380	52.6	V	-57.0	1.2	7.7	5.5	-52.7	-13.0	-39.7	
1.840	62.8	V	-45.3	1.4	8.8	6.6	-40.0	-13.0	-27.0	
2.300	45.6	V	-61.0	1.5	9.6	7.4	-55.1	-13.0	-42.1	
2.760	43.9	V	-61.1	1.7	9.7	7.5	-55.3	-13.0	-42.3	
3.220	30.1	V	-73.5	1.8	9.8	7.6	-67.8	-13.0	-54.8	
3.680	36.1	V	-66.6	2.0	10.1	7.9	-60.7	-13.0	-47.7	
4.140	31.9	V	-69.8	2.2	10.4	8.3	-63.7	-13.0	-50.7	
4.600	44.9	V	-56.2	2.3	10.9	8.7	-49.8	-13.0	-36.8	
5.050	44.5	V	-54.7	2.5	11.2	9.0	-48.1	-13.0	-35.1	

Spurious & Harmonic (ERP), High Channel

06/15/05 **High Frequency Substitution Measurement**
Compliance Certification Services, Morgan Hill 5m Chamber Site

Test Engr: William Zhuang
Project #: 05U3494
Company: TPL Communications
EUT Descrip.: RF Power Amplifier, 450-470MHz, Single Channel, 13.8VDC
EUT M/N: PA6-1AE
Test Target: FCC22
Mode Oper: Turn On

Test Equipment:

EMCO Horn 1-18GHz
T73; S/N: 6717 @3m

Horn > 18GHz

Limit
FCC 22

☐ High Pass Filter

Hi Frequency Cables
☐ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☒ (12 ft)

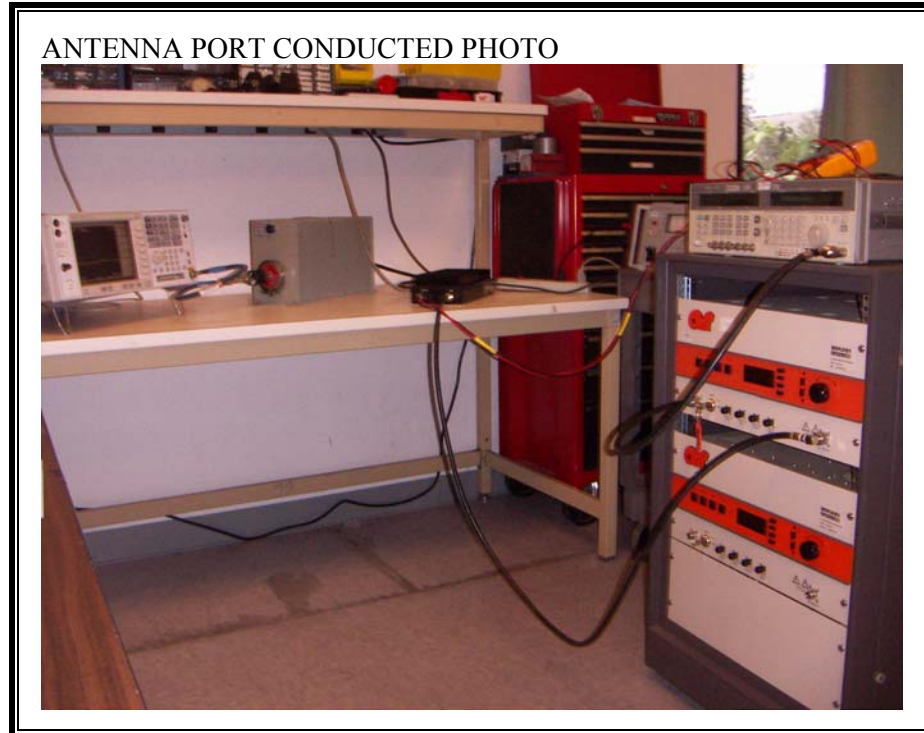
Pre-amplifier 1-26GHz

Pre-amplifier 26-40GHz

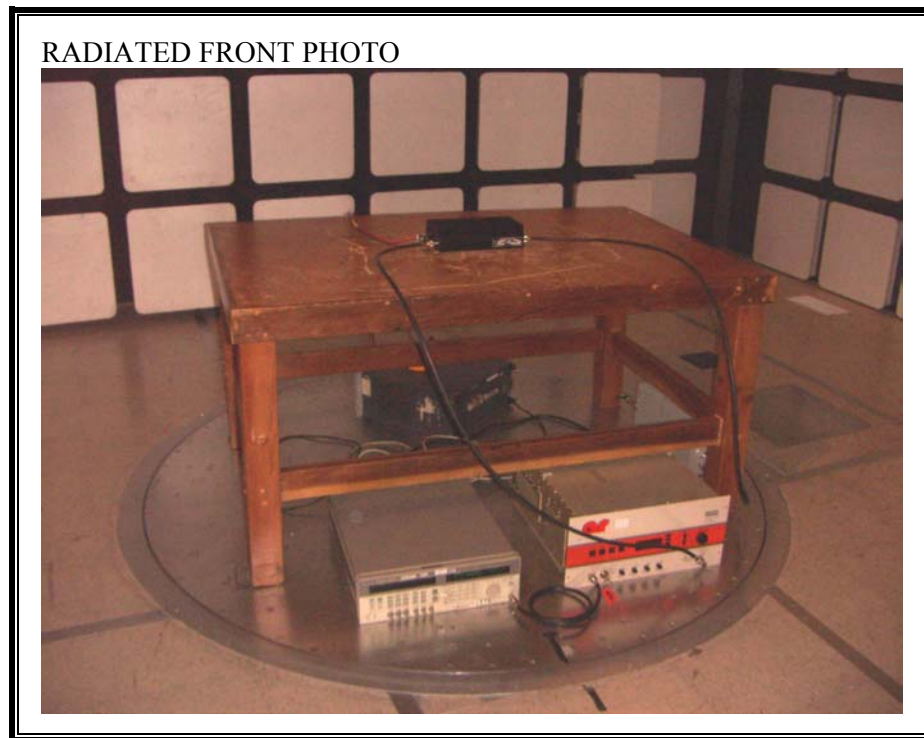
f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
High Ch. 470MHz										
1.410	55.4	V	-54.1	1.2	7.8	5.6	-49.7	-13.0	-36.7	
1.880	55.7	V	-52.2	1.4	8.9	6.7	-46.9	-13.0	-33.9	
2.350	51.1	V	-55.4	1.6	9.6	7.5	-49.5	-13.0	-36.5	
2.820	46.2	V	-58.6	1.7	9.6	7.5	-52.8	-13.0	-39.8	
3.290	30.6	V	-72.9	1.9	9.8	7.7	-67.1	-13.0	-54.1	
3.760	44.5	V	-58.1	2.0	10.2	8.0	-52.1	-13.0	-39.1	
4.230	40.9	V	-60.8	2.2	10.5	8.4	-54.6	-13.0	-41.6	
4.700	45.9	V	-55.1	2.3	10.9	8.8	-48.7	-13.0	-35.7	
5.170	36.4	V	-62.4	2.5	11.1	9.0	-56.0	-13.0	-43.0	
1.410	55.1	H	-53.7	1.2	7.8	5.6	-49.3	-13.0	-36.3	
1.880	49.3	H	-57.9	1.4	8.9	6.7	-52.5	-13.0	-39.5	
2.350	43.8	H	-62.5	1.6	9.6	7.5	-56.6	-13.0	-43.6	
2.820	43.4	H	-61.2	1.7	9.6	7.5	-55.4	-13.0	-42.4	
3.290	29.4	H	-74.0	1.9	9.8	7.7	-68.2	-13.0	-55.2	
3.760	45.6	H	-56.8	2.0	10.2	8.0	-50.8	-13.0	-37.8	
4.230	38.9	H	-62.4	2.2	10.5	8.4	-56.2	-13.0	-43.2	
4.700	37.7	H	-63.0	2.3	10.9	8.8	-56.5	-13.0	-43.5	
5.170	29.3	H	-68.5	2.5	11.1	9.0	-62.1	-13.0	-49.1	

8. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



RADIATED RF MEASUREMENT SETUP



RADIATED BACK PHOTO



END OF REPORT