

FCC CFR47 PART 15 SUBPART E INDUSTRY CANADA RSS-210 ISSUE 7 CERTIFICATION TEST REPORT

FOR

ACCESS POINT

MODEL NUMBER: A1301

FCC ID: BCGA1301 IC: 579C-A1301

REPORT NUMBER: 08U12079-2, revision A

ISSUE DATE: FEBRUARY 09, 2009

Prepared for APPLE, INC. 1 INFINITE LOOP CUPERTINO, CA 95014, U.S.A.

Prepared by COMPLIANCE CERTIFICATION SERVICES 47173 BENICIA STREET FREMONT, CA 94538, U.S.A. TEL: (510) 771-1000 FAX: (510) 661-0888



Revision History

	Issue		
Rev.	Date	Revisions	Revised By
	01/20/09	Initial Issue	F. Ibrahim
А	02/09/09	Revised antenna gain.	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	APPLE, INC. 1 INFINITE LOOP CUPERTINO, CA 95014, U.S.A.
EUT DESCRIPTION:	ACCESS POINT
MODEL:	A1301
SERIAL NUMBER:	6F83403J31S
DATE TESTED:	September 9, 2008 - January 20, 2009

APPLICABLE STANDARDS				
STANDARD	TEST RESULTS			
CFR 47 Part 15 Subpart C and Subpart E	PASS			
RSS-210 Issue 7 Annex 8 and RSS-GEN Issue 2	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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS 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:

FRANK IBRAHIM ENGINEERING SUPERVISOR COMPLIANCE CERTIFICATION SERVICES Tested By:

Mautompuyin

THANH NGUYEN EMC ENGINEER COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

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
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 an 802.11a/b/g/n transceiver Access Point.

The radio module is manufactured by Ambit subsidiary of Foxconn, which is located in Hon Hai.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
5180 to 5240	802.11a	15.84	38.37
5180 to 5240	802.11n HT20	15.35	34.28
5190 to 5230	802.11n HT40	16.86	48.53

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes PIFA antennas, with a maximum gain of 2.72 dBi in the 5.2 GHz band.

5.4. SOFTWARE AND FIRMWARE

Firmware: k10_7.4d4auto20080826T0200

EUT Driver Software: ARTR07B13

The test utility software used during testing was ART Build #13, rev. 0.79

5.5. WORST-CASE CONFIGURATION AND MODE

For Radiated Emissions and Power line Conducted Emissions, the channel with the highest conducted output power was selected.

Worst-case data rates as provided by the manufacturer are: For 11a mode: 6Mbps For 11n HT20 (5.2 GHz band): MCS1 For 11n HT40 (5.2 GHz band): MCS0

Peak Power Spectral Density was investigated in the 11b mode at Low Channel, for individual chains versus combiner, and it was determined that combiner is worst-case; therefore, all other measurements of PPSD in other channels and modes were performed using a combiner.

RF Conducted Spurious was investigated in the 11a mode for Low Channel, for individual chains versus combiner, and it was determined that combiner is worst-case; therefore, all other measurements of RF conducted spurious were performed with combiner in the 5.2 GHz band.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST					
Description Manufacturer Model Serial Number					
Laptop	Apple Inc.	Mac Book	PT405200		
AC/DC adapter	Delta Electronics	ADP-20BH AA	MV83303WZ8REVT		
AC/DC adapter	Delta Electronics	ADP-60AD BR	MV83304125SDVT		

I/O CABLES

I/O CABLE LIST							
Cable	Port	# of	Connector	Cable	Cable	Remarks	
No.		Identica	Туре	Туре	Length		
		Ports					
1	AC	2	US 115V	Un-shielded	2m	N/A	
2	DC	2	DC	Un-shielded	2m	N/A	
3	Ethernet	1	RJ45	Un-shielded	1.5m	N/A	

TEST SETUP

The EUT is connected to a support laptop computer during the tests. Test software exercised the radio card

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	Cal Due			
			Number				
Peak Power Meter	Agilent / HP	E4416A	GB41291160	12/04/09			
Peak / Average Power Sensor	Agilent	E9327A	US40440755	12/07/09			
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY43360112	10/08/09			
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	09/29/09			
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	09/27/09			
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	10/15/09			
EMI Test Receiver	R&S	ESHS 20	827129/006	09/27/09			
SA Display Section 2	Agilent / HP	85662A	2816A16696	09/29/09			
SA RF Section, 1.5 GHz	Agilent / HP	85680B	2814A04227	09/29/09			
Quasi-Peak Adaptor	Agilent / HP	85650A	3145A01654	09/29/09			
Antenna, Bilog 30 MHz ~ 2 GHz	Sunol Sciences	JB1	A121003	09/28/09			
Preamp 30-1000MHz	Sonoma	310N	185623	07/20/09			
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	10/11/09			
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	01/29/09			
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	04/29/09			

7. ANTENNA PORT TEST RESULTS

7.1. 802.11a MODE IN THE 5.2 GHz BAND

7.1.1. 26 dB and 99% BANDWIDTH

<u>LIMITS</u>

None; for reporting purposes only.

TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Mode	Frequency	99% BW	99% BW	26 dB BW	26 dB BW
Channel		AP2	AP4	AP2	AP4
	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
802.11a Mode					
Low	5180	16.5450	16.6278	20.251	21.944
Middle	5220	16.5368	16.5210	21.945	21.452
High	5240	16.5482	16.4251	20.264	22.437
802.11n HT20) Mode				
Low	5180	17.6603	17.6599	21.192	21.052
Middle	5220	17.6935	17.6992	21.242	21.201
High	5240	17.5273	17.5613	20.931	20.225
802.11n HT40 Mode					
Low	5190	36.0552	36.0407	42.611	41.255
High	5230	36.2208	36.0812	41.118	41.074

26 dB and 99% BANDWIDTH

(802.11a MODE AP2)







(802.11a MODE AP4)





🔆 Agilent 11:46:07 Oct 10, 1	,		RT	Measure
Ch Freq 5.24 Occupied Bandwidth	GHz		Trig Free	Meas Off
Ducia et. 001/42070-2				Channel Power
Ref 20 dBm Atten 2 /Samp	20 dB			Occupied BW
IB/ IB/ ⊃ffst III.3 IB/ III.3 III.3 III.3 III.3 III.3 III.3 III.4 IIII.4 IIII.4 III.4 III.4 III.4 III.4		€ Internet		ACP
Center 5.240 00 GHz	#\/BW 620 kHz	#Sweep 100	Span 50 MHz	Multi Carrier Power
Occupied Bandwic	######################################	Occ BW % Pwr x dB	99.00 % -26.00 dB	Power Stat CCDF
Transmit Freq Error - x dB Bandwidth 2	22.846 kHz 22.437 MHz*			More 1 of 2

















(802.11 HT40 MODE AP4)





7.1.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

Each chain is measured separately and the total power is calculated using:

Total Power = 10 log (10[^] (Chain 0 Power / 10) + 10[^] (Chain 2 Power / 10))

RESULTS

802.11a MODE

Antenna Gain	10 Log (# Tx Chains)	Effective Legacy Gain	
(dBi)	(dB)	(dBi)	
2.72	3.01	5.73	

Limit

Channel	Frequency	Fixed	В	4 + 10 Log B	Antenna	Limit
		Limit		Limit	Gain	
	(MHz)	(dBm)	(MHz)	(dBm)	(dBi)	(dBm)
Low	5180	17	20.251	17.06	5.73	17.00
Mid	5220	17	21.452	17.31	5.73	17.00
High	5240	17	20.264	17.07	5.73	17.00

Individual Chain Results

Channel	Frequency	AP2	AP4	Total	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5180	13.28	12.33	15.84	17.00	-1.16
Mid	5220	12.62	12.92	15.78	17.00	-1.22
High	5240	11.39	11.02	14.22	17.00	-2.78

802.11n HT20 MODE

Limit

Channel	Frequency	Fixed	В	4 + 10 Log B	Antenna	Limit
		Limit		Limit	Gain	
	(MHz)	(dBm)	(MHz)	(dBm)	(dBi)	(dBm)
Low	5180	17	21.052	17.23	2.72	17.00
Mid	5220	17	21.201	17.26	2.72	17.00
High	5240	17	20.225	17.06	2.72	17.00

Individual Chain Results

Channel	Frequency	AP2	AP4	Total	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5180	12.73	11.25	15.06	17.00	-1.94
Mid	5220	11.77	12.02	14.91	17.00	-2.09
High	5240	10.80	13.47	15.35	17.00	-1.65

802.11n HT40 MODE

Limit

Channel	Frequency	Fixed	В	4 + 10 Log B	Antenna	Limit
		Limit		Limit	Gain	
	(MHz)	(dBm)	(MHz)	(dBm)	(dBi)	(dBm)
Low	5190	17	41.255	20.15	2.72	17.00
High	5230	17	41.074	20.14	2.72	17.00

Individual Chain Results

Channel	Frequency	Chain 1	Chain 2	Total	Limit	Margin
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5190	13.06	13.36	16.22	17.00	-0.78
High	5230	12.25	15.01	16.86	17.00	-0.14

(802.11a MODE AP2)



(802.11a MODE AP4)



(802.11a MODE AP2)



(802.11a MODE AP4)



(802.11a MODE AP2)



(802.11a MODE AP4)





(802.11 HT20 MODE AP4)





(802.11 HT20 MODE AP4)





(802.11 HT20 MODE AP4)





(802.11 HT40 MODE AP4)





(802.11 HT40 MODE AP4)



7.1.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the peak power spectral density shall not exceed 4 dBm in any 1 MHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

POWER SPECTRAL DENSITY WITH COMBINER

5150 to 5250MHz Band					
Antenna Gain (dBi) # 0	2.72				
Antenna Gain (dBi) # 2	2.72				
Effective Legacy Gain	5.73				

Mode	Frequency	PPSD With Combiner	Limit	Margin				
Channel	(MHz)	(dBm)	(dBm)	(dB)				
802.11a Mode	802.11a Mode							
Low	5180	3.96	4.00	-0.04				
Middle	5220	3.86	4.00	-0.15				
High	5240	3.93	4.00	-0.07				
802.11n HT20	802.11n HT20 Mode							
Low	5180	3.62	4.00	-0.38				
Middle	5220	3.87	4.00	-0.13				
High	5240	3.97	4.00	-0.03				
802.11n HT40 Mode								
Low	5190	3.86	4.00	-0.14				
High	5230	3.65	4.00	-0.35				

POWER SPECTRAL DENSITY WITH COMBINER (802.11a MODE)






(802.11n HT20 MODE)







(802.11n HT40 MODE)





7.1.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner.

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

Mode	Frequency	Peak Excursion	Peak Excursion	Limit	Worst Case
Channel		AP2	AP4		Margin
	(MHz)	(dBm)	(dBm)	(dBm)	(dB)
802.11a Mode	!				
Low	5180	9.34	9.93	13	-3.07
Middle	5200	11.21	10.72	13	-1.79
High	5240	11.47	8.90	13	-1.53
802.11n HT20	Mode				
Low	5180	9.76	11.30	13	-1.70
Middle	5200	10.79	10.52	13	-2.21
High	5240	10.77	11.48	13	-1.52
802.11n HT40	Mode				
Low	5190	9.45	10.10	13	-2.90
High	5230	9.31	10.34	13	-2.66

RESULTS

PEAK EXCURSION (802.11a MODE AP2)



(802.11a MODE AP4)



(802.11a MODE AP2)



(802.11a MODE AP4)



(802.11a MODE AP2)



(802.11a MODE AP4)



(802.11n HT20 MODE AP2)



(802.11n HT20 MODE AP4)



(802.11n HT20 MODE AP2)



(802.11n HT20 MODE AP4)



(802.11n HT20 MODE AP2)



(802.11n HT20 MODE AP4)



(802.11n HT40 MODE AP2)



(802.11n HT40 MODE AP4)



(802.11n HT40 MODE AP2)



(802.11n HT40 MODE AP4)



7.1.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm / MHz.

TEST PROCEDURE

Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements are made.

Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

Offset Value = Cable Loss + Attenuation + Antenna Gain + Combiner Loss

RESULTS

SPURIOUS EMISSIONS WITH COMBINER

(802.11a MODE)





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(802.11n HT20 MODE)













(802.11n HT40 MODE)





(802.11n HT40 MODE)





8. RADIATED TEST RESULTS

8.1LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

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 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 5.2 GHz band.

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.

8.1. TRANSMITTER ABOVE 1 GHz IN THE 5.2 GHz BAND 8.1.1. 802.11a MODE IN THE 5.2 GHz BAND RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

oject #: ate: est Engineer: onfiguration: ode:		08U12079-2 12/01/08 Thanh Nguye EUT and remo Transmit 802	n de suppo .11 a	rt Lapto	P										
est Equipment	<u>t:</u>	Pro o	mulifa	1 26	24-	Bro on	nlifor	26 40 CH	_	u	orn > 10	сu-		Linsit	
T73; S/N: 6717	7 @3m	▼ T34 HI	P 8449B	1-200	•	T88 Mit	eq 26-∕	logHz	∠ T39;	ARA 18-20	26GHz; S/N:1013				
Hi Frequency Cab 3' cable 2 3' cable 228	Hi Frequency Cables 3' cable 22807700 12' cable 2280760 12' cable 22807600					20' cal 20' cab	ble 22 le 2280	807500		HPF R			er <u>Pea</u> RE <u>Avera</u>	a <u>k Measurements</u> BW=VBW=1MHz rage Measurements	
f Dist GHz (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 Lin dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
igh Ch 52401 750 3.0 750 3.0	IHz 34.9 34.7	21.6 21.7	42.9 42.9	11.4 11.4	-32.2 -32.2	0.0 0.0	0.0 0.0	57.1 56.9	43.9 43.9	74 74	54 54	-169 -17.1	-10.1 -10.1	H	
fid Ch 5200M 600 3.0 600 3.0 aw Ch 5180M	Hz 35.3 34.2 Hz	22.2 21.8	42.5 42.5	11.4 11.4	-32.2 -32.2	0.0 0.0	0.0 0.0	57.0 55.9	43.9 43.5	74 74	54 54	-17.0 -18.1	-10.1 -10.5	H V	
540 3.0 540 3.0	35.3 34.4	22.3 22.6	42.A 42.A	113 113	-32.2 -32.2	0.0 0.0	0.0 0.0	56.8 55.9	43.8 44.1	74 74	54 54	-17.2 -18.1	-10.2 -9.9	H V	
) other emissions	s were detect	ed above 3rd h:	irmonic.												
r. 10.15.08 f Dist Read AF CL	Measureme Distance to Analyzer R Antenna Fa Cable Loss	ent Frequenc Antenna eading actor	у		Amp D Corr Avg Peak HPF	Preamp (Distance Average Calculate High Pas	Gain Corre Field S d Peal s Filter	ct to 3 mete Strength @ c Field Stre	ers 3 m ngth		Avg Lim Pk Lim Avg Mar Pk Mar	Average I Peak Fiel Margin vs Margin vs	Field Streng d Strength I :. Average I :. Peak Limi	th Limit .imit .imit t	

8.1.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

est Equipment: Horn 1-18GHz Pre-amplifer Pre-amplifer 26-040GHz Horn > 18-07Hz Limit T3; Sh: 6717 @3m T3 H HP 8449B T3 HP 8449B	Est Equipment: Horn 1-18GHz Pre-amplifer 126GHz Pre-amplifer 26-40GHz Horn > 18GHz Horn > 18GHz Limit T/3: Silk: 6717 @3m T34 HP 8449B T38 Mireq 26-40GHz T39-188 ARA 18-40GHz & Mixon > 40GHz EC 15205 3' cable 22807700 12' cable 22807600 20' cable 22807500 20' cable 22807500 EC 15205 ER Measurements 3' cable 22807700 12' cable 22807600 20' cable 22807500 20' cable 22807500 ER Measurements Roll Measurements 6 (Hz) (m) Break Mead Avg AF CL Amp D Corr Filt Peak Avg Peak May Mar Arg Mar Notes 6 (Hz) (m) dBrV dBn dB dB dB dB dB Mar Notes Notes 6 (Hz) (m) dBrV dBn dB dB dB dB dB dB dB dB Mar Notes Notes 6 (Hz) 0 dBrV dBn dB dB dB dB dB dB dB dD Notes Notes Notes Not	Equips Horr T73; S/N: Hi Frequence 3' cab 3' cab 3' cab 5 6 D 540 2 600 2 600 2 600 2 600 2 600 2 600 2 600 2 600 2 600 2 720 3	Innent: n 1-18GHz : 6717 @3m : 6717 @3m : cy Cables : cy Cables : ble 2280770 Dist Read (m) dBu 80MHz 344 3.0 344 3.0 344 3.0 344 3.0 344 3.0 344 3.0 344	z 700 Pk Re: V d 5 4	Pre-an T34 HF 12' c 12' ca ad Avg. BuV 21.8 22.4	AF	28076 07600	GHz 500	Pre-am T88 Mit 20' cab	plifer eq 26-⁄ ble 22 le 2280	26-40GH 40GHz 2807500	z • T39	H T88 ARA 1 HPF	orn > 184 8-40GHz & Re	GHz Mixer > 4 eject Filte	0GHz ▼ er <u>Peal</u> RB	Limit FCC 15.205
Horn 1-18GHz Pre-amplifer 1-26GHz Pre-amplifer 26-40GHz Horn > 18GHz Linit T33: SN: 6717 @3m T34 HP 8449B T88 Mireq 26-40GHz T33-T88 ARA 18-40GHz & Mixer > 40GHz FCC 15-205 3' cable 22807700 12' cable 22807600 20' cable 22807500 20' cable 22807500 Pre-amplifer 26-40GHz FCC 15-205 3' cable 22807700 12' cable 22807600 20' cable 22807500 20' cable 22807500 Pre-amplifer 26-40GHz FCC 15-205 f Dist Read Pik Read Avg. AF CL Amp D Corr Filr Peak Avg May Mar Avg Mar Notes GHz (m) dBuV dBuV dB dB dB dB dB dB dB U/M dBuV/m dBuV/m dBuV/m dBuV/m dB (V/H) Avg Mar Notes 6Hz (m) dBuV dB dB dB dB dB dB V/m dB dB V/M Mar Avg Mar Notes 6Hz 30 344 21.8 42.4 113 <td>Horn 1.18GHz Pre-amplifer 1.26GHz Pre-amplifer 2.64GHz T39-T88 ARA 18-40GHz Horn > 18GHz Limit T3; SN: 6717 @3m T34 HP 84498 T38 Mireq 26-40GHz T39-T88 ARA 18-40GHz & Mixer > 40GHz FCC 15.205 FCC 15</td> <td>Horr T73; S/N: Hi Frequence 3' cable 3' cable GHz () GHz () 540 2 540 2</td> <td>n 1-18GHz : 6717 @3m ncy Cables</td> <td>Z 700 V I Pk Re: V d 5 4</td> <td>Pre-an T34 HF 12' c 12' ca ad Avg. BuV 21.8 22.4</td> <td>AF</td> <td>28076 07600 CL dB</td> <td>500 •</td> <td>Pre-am T88 Mit 20' cal 20' cab</td> <td>plifer eq 26-⁄ ble 22 le 2280</td> <td>26-40GH 40GHz 2807500</td> <td>Z T39-</td> <td>H -T88 ARA 1 HPF</td> <td>orn > 18 8-40GHz & Re</td> <td>GHz Mixer > 40 eject Filte</td> <td>oGHz -</td> <td>Limit FCC 15.205 Measurements W=VBW=1MHz</td>	Horn 1.18GHz Pre-amplifer 1.26GHz Pre-amplifer 2.64GHz T39-T88 ARA 18-40GHz Horn > 18GHz Limit T3; SN: 6717 @3m T34 HP 84498 T38 Mireq 26-40GHz T39-T88 ARA 18-40GHz & Mixer > 40GHz FCC 15.205 FCC 15	Horr T73; S/N: Hi Frequence 3' cable 3' cable GHz () GHz () 540 2 540 2	n 1-18GHz : 6717 @3m ncy Cables	Z 700 V I Pk Re: V d 5 4	Pre-an T34 HF 12' c 12' ca ad Avg. BuV 21.8 22.4	AF	28076 07600 CL dB	500 •	Pre-am T88 Mit 20' cal 20' cab	plifer eq 26-⁄ ble 22 le 2280	26-40GH 40GHz 2807500	Z T39-	H -T88 ARA 1 HPF	orn > 18 8-40GHz & Re	GHz Mixer > 40 eject Filte	oGHz -	Limit FCC 15.205 Measurements W=VBW=1MHz
It is in origin It is in origin	If year of the grant of the product of the grant of t	Hi Frequence 3' cable 3' cable 3' cable 3' cable 10' CH2	Acy Cables	▼ 700 ▼ IPk Re: IV d 5 4 4	12' c 12' ca 12' ca ad Avg. BuV 21.8 22.4	able 2 ble 228 AF dB/m	28076 107600 CL dB	500	20' cal	ble 22	2807500		HPF	Re	eject Filte	er Peal	<u>k Measurements</u> W=VBW=1MHz
Image: Product V Cases 12' cable 22807700 12' cable 22807600 20' cable 22807500 Image: Product V Cases Peak Measurement Rew=rumment Rew=rum Rew=rumment Rew=rumment Rew=rumment Rew=rumment Rew=rumment Rew=rum Rew=rumment Rew=rum Rew=rumment Rew=rumment Rew=rum Rew=rumment Rew=rum Reward Rewardw Rew Rew Rew Rew Rew Rew Rew Rew Rewardw R	Image: Product Volume 12' cable 22807700 12' cable 22807600 20' cable 22807500 Percent Product Prod	f D 3' cable 3' cable 3' cable 3' cable f D GHz (i) 540 2 540 2 540 2 660 2 600 2 2600 2 29h Ch 52 720	ble 22807700 e 22807700 Dist Read (m) dBu 80MHz 3.0 34.4 3.0 36.4 00MHz 3.0 34.1 3.0 34.1 3.0 34.1 3.0 34.1 3.0 34.1 3.0 34.1 3.0 34.1	700 Pk Re: V d 5 4 0	12' c 12' ca ad Avg. BuV 21.8 22.4	able 2 ble 228 AF dB/m	28076 07600 CL dB	•	20' cal 20' cab	ble 22 le 2280	2807500		HPF	Re	eject Filte	er <u>Peal</u> RB	<u>k Measurements</u> W=VBW=1MHz
3' cable 22807700 12' cable 22807600 20' cable 22807500 R_001 Average Measurement RBW=IMHz, VBW=I0F f Dist Read Pk Read Avg AF CL Amp D Corr Fitr Peak Avg Pk Lin Avg Lin Pk Mar Avg Mar Notes GHz (m) dBuV dBuV dB' dB dB dB dB dB dB (V/H) owc Ch 5180hHz i	3' cable 22807700 12' cable 22807600 20' cable 22807500 R_001 Average Measurements RBW=1MHz, VBW=10Hz f Dist (m) Read Pk BW Read Avg, BW AF CL Amp B D Corr Fitr B Peak B Avg BWV/m Pk Lim BWV/m Avg Lim BW/m Pk Mar BW Avg Mar BW Notes Notes f Dist (m) dBv/dB dB dB dB dB dB dB V/V 5540 3.0 3.6.4 22.4 42.4 11.3 3.2.2 0.0 0.0 56.0 43.2 74 54 -18.0 -10.7 V 5540 3.0 3.6.4 22.4 42.4 11.3 -32.2 0.0 0.0 55.8 43.4 74 54 -18.0 -10.7 V 5600 3.0 34.0 21.7 42.5 11.4 -32.2 0.0 0.0 55.7 43.4 74 54 -18.2 -10.6 V 5720 3.0 34.0 21.7 42.5 11.4 -32.2 0.0 0.0 57.5 44.2 <t< td=""><td>3' cable f D GHz () ow Ch 518 2 540 2 540 2 600 2 600 2 600 2 720 2</td><td>e 22807700 Dist Read (m) dBu 80MHz 30 344 30 364 30 340 30 340 30 340</td><td>Pk Re: V d 5 4 0</td><td>12' ca ad Avg. BuV 21.8 22.4</td><td>AF dB/m</td><td>07600 CL dB</td><td>•</td><td>20' cab</td><td>le 2280</td><td>17500</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	3' cable f D GHz () ow Ch 518 2 540 2 540 2 600 2 600 2 600 2 720 2	e 22807700 Dist Read (m) dBu 80MHz 30 344 30 364 30 340 30 340 30 340	Pk Re: V d 5 4 0	12' ca ad Avg. BuV 21.8 22.4	AF dB/m	07600 CL dB	•	20' cab	le 2280	17500						
f Dist Read Pk Read Avg AF CL Amp D Corr Flt Peak Avg Pk Lim Avg Lim Pk Mar Avg Mar Notes GHz (m) dBuV dBuV dB/m dB dB dB dB dB dB dB dB dB dW/m dBuV/m dBuV/m dB dB (VH) ow Ch 5180MHz	f Dist Read Pk Read Avg AF CL Amp D Corr Fitr Peak Avg Pk Lim Avg Lim Pk Mar Avg Mar Notes GHz (m) dBuV dBuV dB' dB dB dB dB dB dB dB' dB' dB' dB' dB' dB' dB''/m	f D GHz (i) ow Ch 518 3 540 3 540 3 540 3 600 3 600 3 600 3 600 3 300 3 720 3	Dist Read (m) dBu 80MHz 30 3.0 34.2 3.0 36.4 00MHz 36.4 3.0 36.4 3.0 36.4 3.0 36.4 3.0 34.1 3.0 34.1	Pk Re: V d 5 4	ad Avg. BuV 21.8 22.4	AF dB/m	CL dB	:			×			• R_	001	Avera RBW=	<u>ige Measurements</u> =1MHz ; VBW=10Hz
ow Ch 5180MHz v <	ow Ch 5180MHz o <	w Ch 518 540 2 540 2 540 2 600 2 600 2 600 2 100 2 100 2 100 2 100 2 100 2 100 2 100 2 100 2 100 2 100 2 100 2 100 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2 110 2	80MHz 3.0 34.5 3.0 36.4 00MHz 3.0 34.0 3.0 34.0 3.0 34.0	5 4 0	21.8 22.4			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)
1340 345 118 424 113 322 0.0 0.0 570 433 74 54 -18.0 -10.7 Y 540 3.0 36.4 22.4 42.4 113 332.2 0.0 0.0 579 43.9 74 54 -16.1 -10.1 H 600 3.0 34.0 21.7 42.5 11.4 332.2 0.0 0.0 55.8 43.4 74 54 -18.2 -10.6 H 6300 3.0 34.0 21.7 42.5 11.4 -32.2 0.0 0.0 55.7 43.4 74 54 -18.3 -10.6 H 6400 3.0 34.0 21.8 42.9 11.4 -32.2 0.0 0.0 55.7 43.4 74 54 -16.5 9.8 H 5720 3.0 3.4.0 21.8 42.9 11.4 -32.2 0.0 0.0 57.5 44.2 74 54 -16.5 9.8 H 5720 3.0 3.0 <td< td=""><td>Statu 343 343 218 424 113 322 00 00 570 433 74 54 160 107 V 540 30 364 224 424 113 322 00 00 579 439 74 54 161 101 H 600 30 340 217 425 114 322 00 00 557 433 74 54 163 106 H 6600 30 340 217 425 114 322 00 00 557 433 74 54 163 106 H 6200 30 34.0 218 429 114 322 00 00 557 43.4 74 54 165 9.8 H 5720 30 35.4 22.1 42.9 11.4 32.2 0.0 0.57.5 44.2 74 54 165</td><td>540 2 540 3 540 3 600 3 600 3 igh Ch 52 3 .720 3</td><td>3.0 342 3.0 36.4 00MHz 3.0 34.0 3.0 34.0</td><td>5 4 0</td><td>21.8</td><td>101</td><td></td><td></td><td></td><td></td><td></td><td>42.2</td><td></td><td></td><td>10.0</td><td></td><td></td></td<>	Statu 343 343 218 424 113 322 00 00 570 433 74 54 160 107 V 540 30 364 224 424 113 322 00 00 579 439 74 54 161 101 H 600 30 340 217 425 114 322 00 00 557 433 74 54 163 106 H 6600 30 340 217 425 114 322 00 00 557 433 74 54 163 106 H 6200 30 34.0 218 429 114 322 00 00 557 43.4 74 54 165 9.8 H 5720 30 35.4 22.1 42.9 11.4 32.2 0.0 0.57.5 44.2 74 54 165	540 2 540 3 540 3 600 3 600 3 igh Ch 52 3 .720 3	3.0 342 3.0 36.4 00MHz 3.0 34.0 3.0 34.0	5 4 0	21.8	101						42.2			10.0		
fid Ch 5200MHz c <thc< th=""> <</thc<>	fid Ch S200MHz Image: Constraint of the second	id Ch 520 .600 3 .600 3 igh Ch 52 3 .720 3 .720 3	00MHz 3.0 34.0 3.0 34.0	0		42.4 42.4	113	-32.2 -32.2	40 40	0.0 0.0	56 JJ 57 9	43.3 43.9	74 74	54 54	-18,U -16,1	-10.7 -10.1	H N
300 340 21.7 42.5 11.4 32.2 0.0 0.0 55.6 43.4 74 54 -16.2 -10.0 H igh Ch 5240NHz 11.4 32.2 0.0 0.0 55.7 43.4 74 54 -18.3 -10.6 V igh Ch 5240NHz 11.4 32.2 0.0 0.0 55.7 43.4 74 54 -18.3 -10.6 V igh Ch 5240NHz 11.4 32.2 0.0 0.0 55.7 43.4 74 54 -17.9 -10.1 V igh Ch 5240NHz 11.4 32.2 0.0 0.0 55.7 43.4 74 54 -16.5 -9.8 H igh Ch 5240NHz 11.4 32.2 0.0 0.0 57.5 44.2 74 54 -16.5 -9.8 H istore to Anterna 22.1 42.9 11.4 -32.2 0.0 0.0 57.5 44.2 74 54 -16.5 -9.8 H other emissions were detected above 3rd harmonic. <td>300 340 21.7 42.5 11.4 32.2 0.0 0.0 55.7 43.4 74 54 -16.2 -10.0 H igh Ch 5240MHz 1 1 32.2 0.0 0.0 55.7 43.4 74 54 -18.2 -10.0 H igh Ch 5240MHz 1 1 32.2 0.0 0.0 55.7 43.4 74 54 -18.3 -10.6 V igh Ch 5240MHz 1 3.0 34.0 21.8 42.9 11.4 -32.2 0.0 0.0 56.1 43.9 74 54 -17.9 -10.1 V :720 3.0 35.4 22.1 42.9 11.4 -32.2 0.0 0.0 57.5 44.2 74 54 -16.5 9.8 H :0 1.4 -22.1 42.9 11.4 -32.2 0.0 0.0 57.5 44.2 74 54 -16.5 9.8 H :0 <</td> <td>600 3 igh Ch 52 .720 3 .720 3</td> <td>3.0 341 3.0 341</td> <td>U</td> <td>21.7</td> <td>12.5</td> <td>114</td> <td>22.2</td> <td>0.0</td> <td>0.0</td> <td></td> <td>12.1</td> <td></td> <td>E 4</td> <td>18.2</td> <td>10.4</td> <td></td>	300 340 21.7 42.5 11.4 32.2 0.0 0.0 55.7 43.4 74 54 -16.2 -10.0 H igh Ch 5240MHz 1 1 32.2 0.0 0.0 55.7 43.4 74 54 -18.2 -10.0 H igh Ch 5240MHz 1 1 32.2 0.0 0.0 55.7 43.4 74 54 -18.3 -10.6 V igh Ch 5240MHz 1 3.0 34.0 21.8 42.9 11.4 -32.2 0.0 0.0 56.1 43.9 74 54 -17.9 -10.1 V :720 3.0 35.4 22.1 42.9 11.4 -32.2 0.0 0.0 57.5 44.2 74 54 -16.5 9.8 H :0 1.4 -22.1 42.9 11.4 -32.2 0.0 0.0 57.5 44.2 74 54 -16.5 9.8 H :0 <	600 3 igh Ch 52 .720 3 .720 3	3.0 341 3.0 341	U	21.7	12.5	114	22.2	0.0	0.0		12.1		E 4	18.2	10.4	
igh Ch 5240MHz Image: Characterized and the second sec	igh Ch 5240MHz Image: Character of the second s	igh Ch 52 .720 : .720 :		0	21.7 21.7	425	114	-32.2	0.0 0.0	0.0	55.8 55.7	43.4 43.4	74 74	54 54	-18.2 -18.3	-10.6 -10.6	N N
f Measurement Frequency Amp Preamp Gain Avg Lim Avg Lim Average Field Strength Limit vr. 1015.08	Area 340 248 429 114 -322 000 001 561 433 74 54 -101 V 5720 30 354 22.1 42.9 114 -32.2 0.0 0.0 57.5 44.2 74 54 -16.5 -9.8 H 50 ther emissions were detected above 3rd harmonic.	.720 .720 .720 .720 .720 .720 .720 .720	240MHz	•	<u> </u>	12.0	114			0.0	563	44.0	~ ~ /		170	10.1	
youther emissions were detected above 3rd harmonic. Image: Constraint of the second secon	y other emissions were detected above 3rd harmonic. Image: Construction of the second sec		3.0 34.1 3.0 35.4	4	21.8	429	11.4	-32.2	0.0	0.0	50.1 57.5	43.9	74	54 54	-179 -16.5	-10.1 -9.8	H H
of the refussions were detected above 3rd narmonic. Image: Construction of the refussion of the refusion of the	of the remissions were defected above Sru farmonic. Image: Construction of the rest of the r			- 4 4- 3 - 1.													
sv. 10.15.08 f Measurement Frequency Distance to Antenna Read Amp Preamp Gain D Corr Avg Lim Average Field Strength Limit Pk Lim Read Analyzer Reading AF CL Avg Avg Average Field Strength Peak Pield Strength Limit Pass Filter Physical Peak Calculated Peak Field Strength Physical Pk Mar Margin vs. Peak Limit	ev. 10.15.08 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 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 Piter Piter	other emis	ssions were a	etected and	ove sru na	rmonic.											
ev. 10.15.08 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	rv. 10.15.08 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																
fMeasurement FrequencyAmpPreamp GainAvg LimAverage Field Strength LimitDistDistance to AntennaD CorrDistance Correct to 3 metersPk LimPeak Field Strength LimitReadAnalyzer ReadingAvgAverage Field Strength @ 3 mAvg MarMargin vs. Average LimitAFAntenna FactorPeakCalculated Peak Field StrengthPk MarMargin vs. Peak LimitCLCable LossHPFHigh Pass FilterFilter	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	v. 10.15.08		L						1	1			4			
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	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 Peak Margin vs. Peak Limit	f	Measu	rement F	requency	ÿ		Amp	Preamp (Gain				Avg Lim	Average I	Field Strengt	th Limit
AF Antenna Factor Peak Calculated Peak Field Strength Pk Mar Margin vs. Peak Limit CL Cable Loss HPF High Pass Filter	AF Antenna Factor Peak Calculated Peak Field Strength Pk Mar Margin vs. Peak Limit CL Cable Loss HPF High Pass Filter	Di	ist Distance and Applum	ce to Ant er Readi	enna			D Corr	Distance	Corre East 4	ct to 3 mete Strength @	ers 2 m		Pk Lim Aug Mor	Peak Fiel Margin vo	d Strength L Average I	imit imit
CL Cable Loss HPF High Pass Filter	CL Cable Loss HPF High Pass Filter	AI AI	F Antenn	na Factor				Peak.	Calculate	ed Peal	k Field Stre	ngth		Pk Mar	Margin vs	: Peak Limit	t
		CI	L Cable	Loss				HPF	High Pas	s Filter		0					

8.1.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)




HARMONICS AND SPURIOUS EMISSIONS

Project : Date: Fest En Configu Mode:	#: gineer: ration:		08U12079-2 12/01/08 Thanh Nguye: EUT and remo Transmit HT ⁴	n nte suppo: 10	rt Laptoj	Ņ										
<u>Fest Eq</u> H T73; S	uipmen orn 1- 5/N: 6717	<u>t:</u> 18GHz 7 @3m	Pre-ar	nplifer P 8449B	1-260	GHz	Pre-am	plifer eq 26-∕	26-40GH	z	T39	H	orn > 18 GHz; S/N:	GHz 1013	•	Limit FCC 15.205
Hi Freq 3' (3' ci	uency Cal cable 2 able 228	2807700	12' c	able 2 ble 228	28076 07600	00	20' cal 20' cab	ble 22 le 228	2807500 07500			HPF	Re R	ject Filte 001	er <u>Pea</u> RE <u>Aver</u> RBW=	<u>k Measurements</u> W=VBW=1MHz age Measurements =1MHz ; VBW=10Hz
f	Dist	Read Pk	Read Avg.	AF	CL	Amp	D Corr	Fltr	Peak	A	vg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	(m)	dBuV	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBu	ıV/m	dBuV/m	dBuV/m	dB	dB	(V/H)
5.570	3.0	35.3	22.1	42.5	11.4	-32.2	0.0	0.0	57.0	4:	3.7	74	54	- 17.0	-10.3	v
5.570 figh Ch	3.0 5230N	34.2 THz	22.0	42.5	11.4	-32.2	0.0	0.0	55.8	4:	3.6	74	54	-18.2	-10.4	Н
5.690	3.0	33.9	21.8	42.8	11.4	-32.2	0.0	0.0	55.9	4:	3.8	74	54	-18.1	-10.2	v
5.690	3.0	35.3	21.9	42.8	11.4	-32.2	0.0	0.0	57.3	42	3.9	74	54	-16.7	-10.1	H
o other o	mission	s were detect	ed above 3rd h:	rmonic.											-	
ev. 10.15	f Dist	Measurem Distance to	ent Frequenc	у		Amp D Corr	Preamp (Distance	Gain Corre	ct to 3 mete	ers			Avg Lim Pk Lim	Average I Peak Fiel	Field Streng d Strength I	th Limit jimit
	Read AF CL	Analyzer R Antenna Fa Cable Loss	eading actor :			Avg Peak HPF	Average Calculate High Pas	Field : d Peal s Filter	Strength @ k Field Stre :	3 m ngth			Avg Mar Pk Mar	Margin vs Margin vs	s. Average I s. Peak Limi	.imit t

8.2. RECEIVER ABOVE 1 GHz IN THE WORST CASE MODE

8.2.1. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 5.2 GHz BAND

Complia Company Project # Date:	nce Ce y: ≠:	rtification \$	Services, Fr Apple Inc. 08U12079-2 12/01/08	emont :	5m Ch	amber									
Fest Eng Configur	gineer: ation:		Thanh Nguye: FIIT and remo	n de summo	rt Lanto										
/lode:	ation.		Receive mode	20MHz	1 1 1 1 1 1 1 1										
est Equ	iipmen	<u>:</u>													
Но	orn 1-	18GHz	Pre-ar	nplifer	1-260	Hz	Pre-am	plifer	26-40GH	z	н	orn > 18	GHz		Limit
T73; S	/N: 6717	'@3m		P 8449B		-				-				-	RX RSS 210 🗸
- Hi Frequ	uency Cał	les —													
3' c	able 2	2807700	12' c	able 2	28076	00	20' ca	ble 22	2807500		HPF	Re	eject Filter	Peal	<u>k Measurements</u> W-UBW-1MHz
3' ca	ble 228	07700	, 12' ca	ıble 228	07600	•	20' cab	le 2280	07500 🖕			•		Avera	ge Measurements
									_					RBW=	1MHz ; VBW=10Hz
f CH7	Dist	Read Pk dBnV	Read Avg.	AF dB/m	CL	Amp dB	D Coit JB	Fltr	Peak dBnV/m	Avg dBuV/m	Pk Lim dBnV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
GHZ	(m)	шыція	ubuv	ub/m	ш	ш	- UD	ш		ubu v/m	ubu v/m	ubu v/m	ub		(V/H)
000	3.0	53.9	46.8	25.7	2.4	-38.3	0.0	0.0	43.8	36.7	74	54	-30.2	-17.3	v
627	3.0	49.1	30.9	27.4	3.1	-37.4	0.0	0.0	42.2	24.0	74	54	-31.8	-30.0	V
997 497	3.0 3.0	48.4	32.1	28.4	30	-30.9	0.0	0.0	43.4	27.1	74 74	54 54	-30.0	-20.9	v
D33	3.0	50.9	43.0	25.8	2.4	-38.2	0.0	0.0	40.9	33.0	74	54	-33.1	-21.0	H
527	3.0	49.6	22.3	27.1	3.0	-37.5	0.0	0.0	42.2	14.8	74	54	-31.8	-39.2	Н
.000	3.0	46 <i>.</i> 3	39.9	28.4	3.5	-36.9	0.0	0.0	41.2	34.9	74	54	-32.8	- 19.1	H
447	3.0	48.2	28.9	29.4	3.9	-36.3	0.0	0.0	45.2	25.9	74	54	-28.8	-28.1	H
o other e	mission	were detecte	d above 2.5GF	j Iz											
				Ī											
ev. 10.15.	.08			1			I			L			1		
	f	Measureme	ent Frequenc	у		Amp	Preamp (Gain				Avg Lim	Average F	ield Strengt	h Limit
	Dist	Distance to	Antenna			D Corr	Distance	Corre	ct to 3 mete	ers		Pk Lm	Peak Field	Strength L	umit
	Kead	Analyzer R	eading			AVg	Average	rield 5	strength @	5 m		Avg Mar	Margin vs.	Average L	umit
	AF CT	Antenna Fa	ictor			reak unt	Calculate	d Peal	к rield Stre	ngth		FK Mar	Margin vs.	reak Limit	
	CL.	Capie Loss				TTL L	rngu Fas	s ruter							

8.2.2. RX ABOVE 1 GHz FOR 40 MHz BANDWIDTH IN THE 5.2 GHz BAND

Compan Project : Date: Test En Configu Mode:	y: #: gineer: ration:		Apple Inc. 08U12079-2 12/01/08 Thanh Nguyer EUT and remo Receive mode	n te suppor 40MHz	rt Lapto	P									
Test Eq H T73; S	uipmen orn 1- 5/N: 671	<u>ıt:</u> 18GHz 7 @3m	Pre-ar	nplifer 9 8449B	1-26	GHz •	Pre-am	plifer	26-40GH	z	H	orn > 18	GHz	T	Limit RX RSS 210
Hi Freq 3' c	uency Ca able 2 able 220	bles 22807700 807700	12' c	able 2 ble 228	28076 07600	500 •	20' cal 20' cab	ble 22 le 228(2807500 07500		HPF	Re	eject Filte	er <u>Peal</u> RB <u>Avera</u> RBW=	<u>x Measurements</u> W=VBW=1MHz ge Measurements 1MHz ; VBW=10Hz
f	Dist	Read Pk	Read Avg.	AF	CL	Amp	D Corr	Fltr	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	(m)	dBuV	dBuV	dB/m	٩B	(LB	dВ	٩B	dBuV/m	dBuV/m	dBuV/m	dBuV/m	٩B	٩B	(V/H)
.030	3.0	58.3	47.5	25.8	2.4	-38.2	0.0	0.0	48.3	37.4	74	54	-25.7	-16.6	v
.627	3.0	49.1	30.9	27.4	3.1	-37.4	0.0	0.0	42.2	24.0	74	54	-31.8	-30.0	<u>v</u>
997 497	3.0 3.0	50.0	35.0	28.4 29.5	35	-36.9	U.U 0.0	0.0 0.0	51.5 49.7	30.5	74	54 54	-22.5	-23.5	v
.033	3.0	50.9	43.0	25.8	2.4	-38.2	0.0	0.0	40.9	33.0	74	54	-33.1	-21.0	H
.330	3.0	53 <i>.</i> 3	38.6	26.6	2.7	-37.8	0.0	0.0	44.8	30.1	74	54	-29.2	-23.9	Н
2.000	3.0	57.4	43.4	28.4	3.5	-36.9	0.0	0.0 0.0	52.3	38.3	74	54 54	-21.7	-15.7	H
	30	4/./	515	29.A	33	-302	0.0	0.0	44./	20.5	,4	24	-47-3	-40.7	п
No other e	mission	s were detect	ed above 2.5 GH	lz.											
Rev. 10.15	.08														
	f	Measurem	ent Frequenci			Amn	Preamn (Fain				Aug Tim	Auerage	Field Strengt	h Timit
	Dist	Distance to	Antenna	<i>,</i>		D Corr	Distance	Correi	ct to 3 mete	erc		Pk Lim	Peak Field	d Strenoth L	imit
Dist Distance to Antenna D Corr Distance Correct to 3 meters							Average	Field S	Strength @	3 m		Avg Mar	Margin vs	. Average L	imit
	Read Analyzer Reading Avg Average Field Str AF Astorno Foster Deals Coloviated Deals I					Peak	Calculate	d Peal	k Field Stre	ngth		Pk Mar	Margin vs	. Peak Limit	
	AF					HPF	High Pas	s Filter		-	a renta magni vo. reactonin				

8.3. WORST-CASE BELOW 1 GHz

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



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



8.4. **POWERLINE CONDUCTED EMISSIONS**

<u>LIMIT</u>

RSS-Gen 7.2.2

Except when the requirements applicable to a given device state otherwise, for any licenceexempt radio communication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 2. The tighter limit applies at the frequency range boundaries.

Table 2 – AC Power Lines Conducted Emission Limits

Frequency of Emission (MHz)	Conducted Limit (dBuV)				
	Quasi-peak	Average			
0.15-0.5	66 to 56 *	56 to 46 *			
0.5-5	56	46			
5-30	60	50			

Decreases with the logarithm of the frequency.

<u>RESULTS</u>

6 WORST EMISSIONS

	CONDUCTED EMISSIONS DATA (115VAC 60Hz)												
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark				
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV(dB)	L1/L2				
0.20	46.99			0.00	63.69	53.69	-16.70	-6.70	L1				
1.58	35.99			0.00	56.00	46.00	-20.01	-10.01	L1				
6.59	40.30			0.00	60.00	50.00	-19.70	-9.70	L1				
0.20	47.33			0.00	63.69	53.69	-16.36	-6.36	L2				
2.78	39.87			0.00	56.00	46.00	-16.13	-6.13	L2				
6.59	39.40			0.00	60.00	50.00	-20.60	-10.60	L2				
6 Worst I	Data												

LINE 1 RESULTS



LINE 2 RESULTS



9. 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.

			()								
Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)							
(A) Limits for Occupational/Controlled Exposures											
0.3–3.0 3.0–30 30–300 300–1500 1500–100,000	614 1842/f 61.4	1.63 4.89/f 0.163	*(100) *(900/f²) 1.0 f/300 5	6 6 6 8							
(B) Limits for General Population/Uncontrolled Exposure											
0.3–1.34	614 824 <i>/</i> f	1.63 2.19/f	*(100) *(180/f²)	30 30							

TABLE 1-LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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/cm²)	Averaging time (minutes)	
30–300 300–1500	27.5	0.073	0.2 f/1500	30 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 occu-tion to the state of the here the exposure also apply in situations when an individual is transient through a location where occu-tion to the state of the here the exposure also apply in situations.

pational/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 ex-posed, 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 Ex-
posed 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/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> ^{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 x 10 ⁻⁴ f ^{0.5}	6.67 x 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 .
- A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

CALCULATIONS

Given

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

where

and

E = Field Strength in Volts/meter

P = Power in Watts

S = E ^ 2 / 3770

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^2

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/cm² is converted to units of W/m² by multiplying by a factor of 10.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm²

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m²

<u>RESULTS</u>

Mode	Band	MPE	Output	Antenna	FCC Power	IC Power
		Distance	Power	Gain	Density	Density
		(cm)	(dBm)	(dBi)	(mW/cm^2)	(W/m^2)
WLAN, 11b	2.4 GHz	20.0	26.39	4.22	0.23	2.29
WLAN, 11g	2.4 GHz	20.0	28.11	4.22	0.34	3.40
WLAN, HT20	2.4 GHz	20.0	28.29	1.21	0.18	1.77
WLAN, 11a	5.8 GHz	20.0	26.98	5.19	0.33	3.28
WLAN, HT20	5.8 GHz	20.0	26.99	2.18	0.16	1.64
WLAN, HT40	5.8 GHz	20.0	26.56	2.18	0.15	1.49
WLAN, 11a	5.2 GHz	20.0	15.84	5.73	0.03	0.29
WLAN, HT20	5.2 GHz	20.0	15.35	2.72	0.01	0.13
WLAN, HT40	5.2 GHz	20.0	16.86	2.72	0.02	0.18

Notes:

Antenna Gain for 11b, 11g and 11a is the combined antenna gain for both chains. Antenna gain for HT20 and HT40 is the maximum antenna gain of both chains. Output power is the combined output power for both chains.

CO-LOCATED MPE CALCULATIONS

For multiple colocated transmitters operating simultaneously the total power density can be calculated by summing the Power * Gain product (in linear units) of each transmitter.

yields

d = 0.282 * $\sqrt{((P1 * G1) + (P2 * G2) + ... + (Pn * Pn)) / S)}$ where d = distance in cm

Px = Power of transmitter x in mW Gx = Numeric gain of antenna x S = Power Density in mW/cm^2

In the table below, Power and Gain are entered in units of dBm and dBi respectively, then converted to their linear forms for the purpose of the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm²

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m²

RESULTS

Mode	Band	Output	Antenna	MPE	FCC Power	IC Power
		Power	Gain	Distance	Density	Density
		(dBm)	(dBi)	(cm)	(mW/cm^2)	(W/m^2)
WLAN, 11g	2.4 GHz	28.11	4.22			
WLAN, 11a	5.8 GHz	26.98	5.19			
Combine			20.0	0.67	6.67	