



EMC Test Data

Client:	Bitrage	Job Number:	J42216
Model:	5.3 & 5.8 GHz UNII	T-Log Number:	T42491
		Proj Eng:	Mark Briggs
Contact:	Chet Ferry		
Emissions Spec:	15.407	Class:	N/A
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Bitrage

Model

5.3 & 5.8 GHz UNII



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Emissions Spec:	15.407	Class:	N/A
Immunity Spec:	-	Environment:	-

EUT INFORMATION

General Description

The EUT is a UNII radio which is designed to operate in fixed link, point-to-point applications in the 5.25-5.35 and 5.725-5.825 GHz bands. Normally, the EUT would be mounted to a pole during operation. During radiated emissions testing the EUT was mounted on a pole such that it was at a height of 1m above the ground. The EUT was connected to a 2' or 6' dish antenna as appropriate for the frequency band being tested.

The EUT is powered from a dual voltage dc supply. During testing a bench power supply was used. When installed the end-user is responsible for providing dc power from a distributed dc power network or other dc power source.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
BitRage	CR45-A-58	5.8GHz UNII Transceiver	N/A	PGK-CR45-A-58
BitRage	CR45-A-53	5.3GHz UNII Transceiver	N/A	PGK-CR45-A-53
RadioWave	SP2-5.2NS	2' Dish antenna (28dBi)	297	N/A
RadioWave	SP6-5.2	6' Dish antenna (37 dBi)	N/A	N/A
RadioWave	SP3-5.2	3' Dish antenna (31 dBi)	N/A	N/A

Other EUT Details

The EUT operates at T3 data rates (44.736 Mb/s). One side of the link transmits in the 5.25 - 5.35 GHz band using a 2' diameter dish antenna with a gain of 28dBi. The other side of the link transmits in the 5.725 - 5.825 GHz band at two different power levels. The low power level can utilize dish antennas up to a maximum diameter of 6' (gain = 37dBi). The higher power level can utilize a dish of up to 3' in diameter (31dBi gain).



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Emissions Spec:	15.407	Class:	N/A
Immunity Spec:	-	Environment:	-

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 10 cm wide by 10 cm deep by 25 cm high.

Modification History

Mod. #	Test	Date	Modificaiton
1			



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Emissions Spec:	15.407	Class:	N/A
Immunity Spec:	-	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Tenma	72-6615	DC Power supply	9912036	N/A

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Sunrise Telecom	Sunset T3	T3 BER tester	9027	DoC

EUT Interface Ports

EUT Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
DC Power	DC Power meter	Alpha 3223 SL005	Shielded	30
T3 Rx/Tx	BER Tester	75 ohm coaxial (x2)	Shielded	15
Antenna	Antenna (note 1,2)	50 ohm coaxial (Belden 9913 or equivalent)	Shielded	1

- Note 1: The antenna port was connected to the spectrum analyzer or power meter for measurements made directly on the antenna port. The antenna port was connected to an antenna for radiated spurious emissions.
- The 5.3 GHz radio was connected to the 2' diameter dish, which represents the highest gain antenna that is intended to be used with the 5.3GHz radio. The 5.8 GHz radio was connected to a 6' dish and operated at full power. The high power setting is intended to be used with antennas up to 3' in diameter and the 6' dish is only intended to be used with the low power setting. For testing the purposes the combination of high power setting and high gain antenna were used since this configuration would represent the worst case configuration with respect to radiated spurious emissions.
- Note 2:

EUT Operation During Emissions

The EUT was configured to constantly transmit a pseudo random data sequence generated by the BER tester at the output power detailed for each test.



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Contact:	Chet Ferry		
Spec:	15.407	Class:	N/A

FCC Part 15 Subpart E Tests - 5.8GHz Radio (Low Power)

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/14/2001
Test Engineer: J Martinez, M Briggs
Test Location: Chamber #2

Config. Used: #1
Config Change: N/A
EUT Voltage: DC

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing. All remote support equipment was located approximately 15 meters from the EUT with all I/O connections running on top of the groundplane.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT unless stated otherwise.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Ambient Conditions: Temperature: 25°C
Rel. Humidity: 51%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Output Power	15.407(a) (3)	Pass	
2	Power Spectral Density (PSD)	15.407(a) (3)	Pass	
3	26dB Bandwidth	15.407	N/A	
4	Peak Excursion Envelope	15.407(a) (6)	Pass	
5	Antenna Conducted - Out of Band Spurious	15.407(b)	Pass	
6	RE, 1000 - 40000 MHz - Spurious Emissions	15.407(b)(6)	Pass	-13.7dB @ 23099MHz



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Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

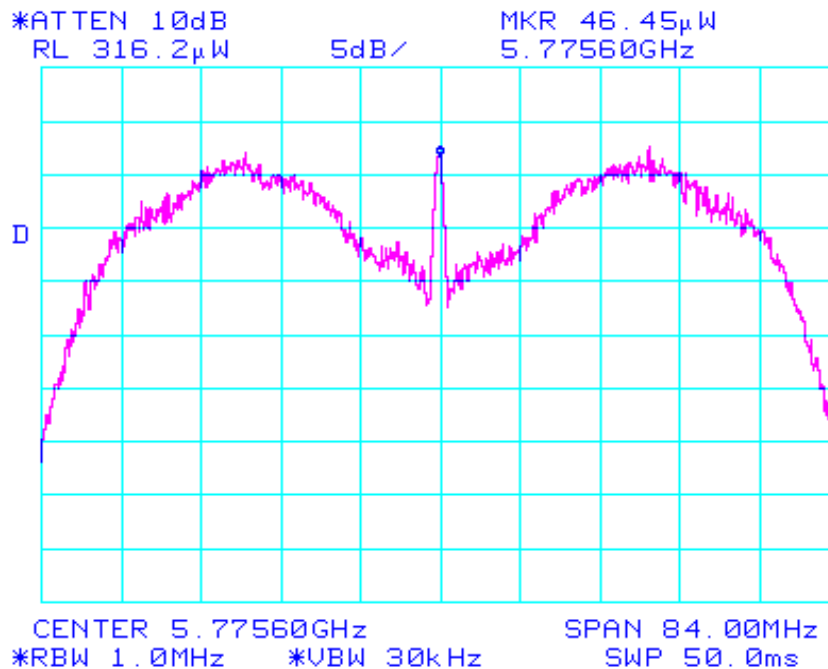
No deviations were made from the requirements of the standard.

Run #1: Output Power

The maximum antenna gain that can be used with the 5.8 GHz radio at the low output power is 37dBi (6' dish). The maximum power output for this setting is, therefore, 30 - (37-23) dBm, which is 16dBm.

Channel	Frequency (MHz)	Res BW	Output Power	Graph reference #
Low	5775	N/A	1.7dBm	Power Meter
Low	5775	N/A	1.2dBm	Note 1

Note 1: Measured using spectrum analyzer (RBW = 1MHz, VBW = 30kHz) and summing the power in each 1MHz band across the entire emission bandwidth. Data is attached under "Output Power"





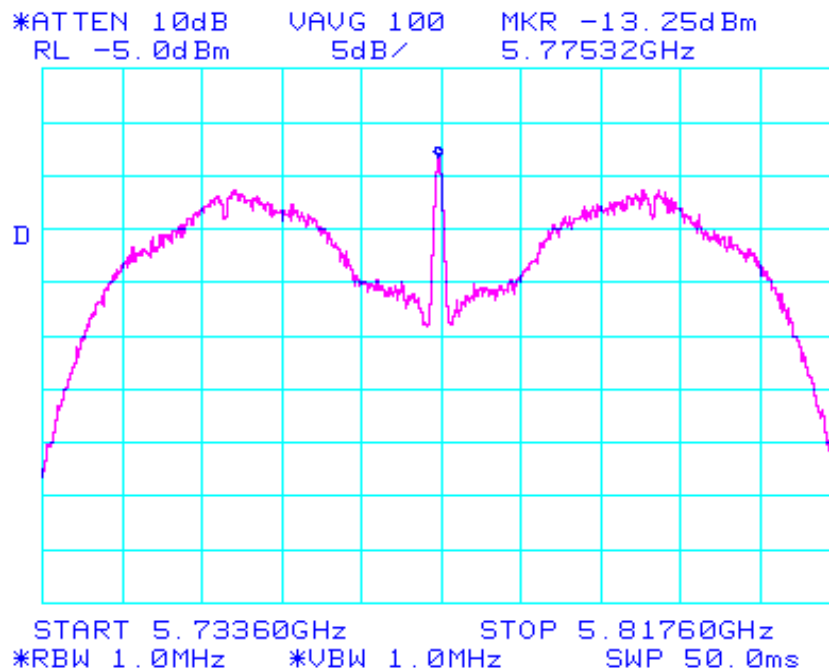
EMC Test Data

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Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Run #2: Power Spectral Density

The maximum antenna gain that can be used with the 5.8 GHz radio at the low output power is 37dBi (6' dish). The maximum power spectral density for this setting is, therefore, 17 - (37-23) dBm, which is 3dBm.

Channel	Frequency (MHz)	Res BW	P.S.D. in 1MHz, Video averaging of 100 samples.	Graph reference #
N/A	5775	1MHz	-13.1dBm	None



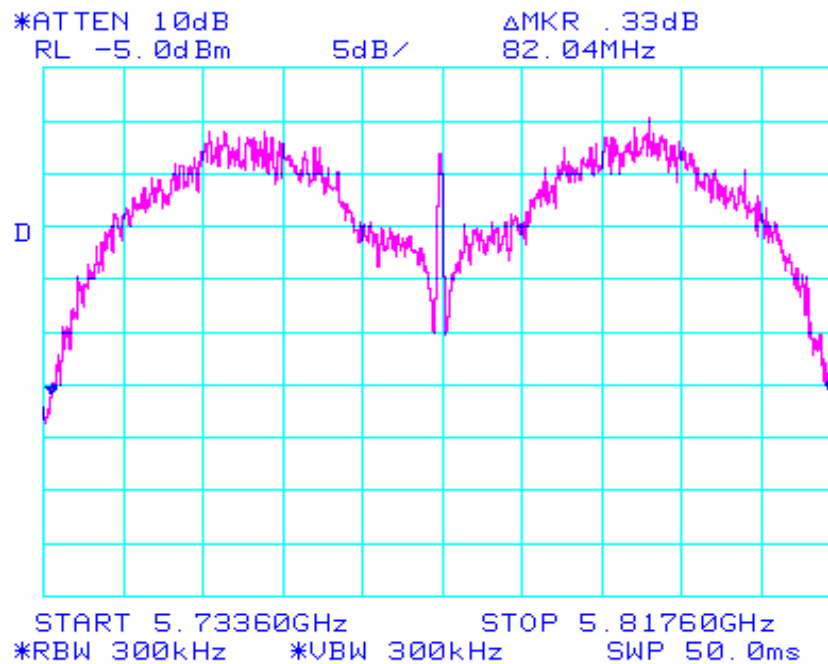


EMC Test Data

Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Run #3: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	26dB Signal Bandwidth	Graph reference #
N/A	5775	300kHz	82.04 MHz	



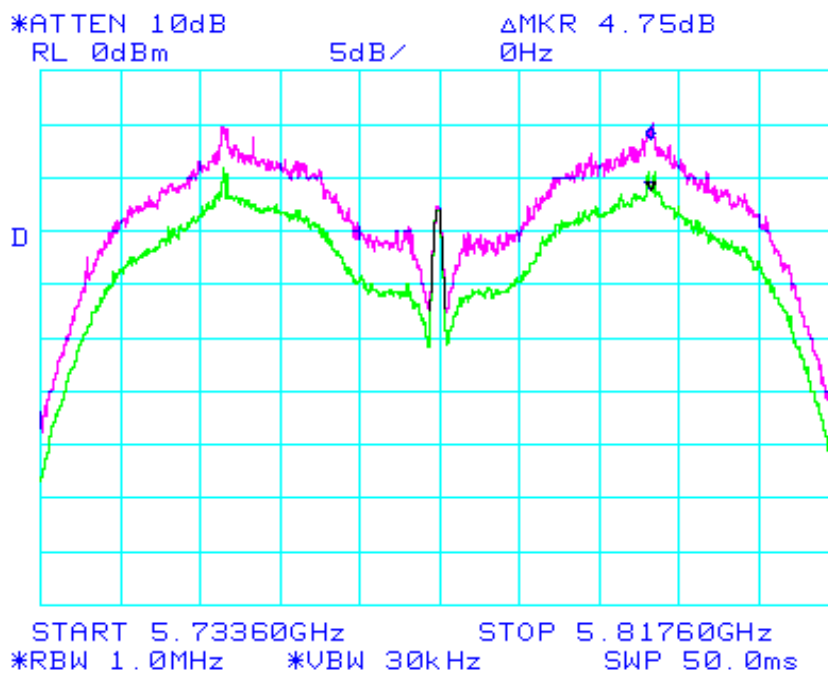


EMC Test Data

Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Run #4: Peak Excursion Measurement

The plot shows that the peak excursion was less than 13dB (approximately 4.5dB worst case)





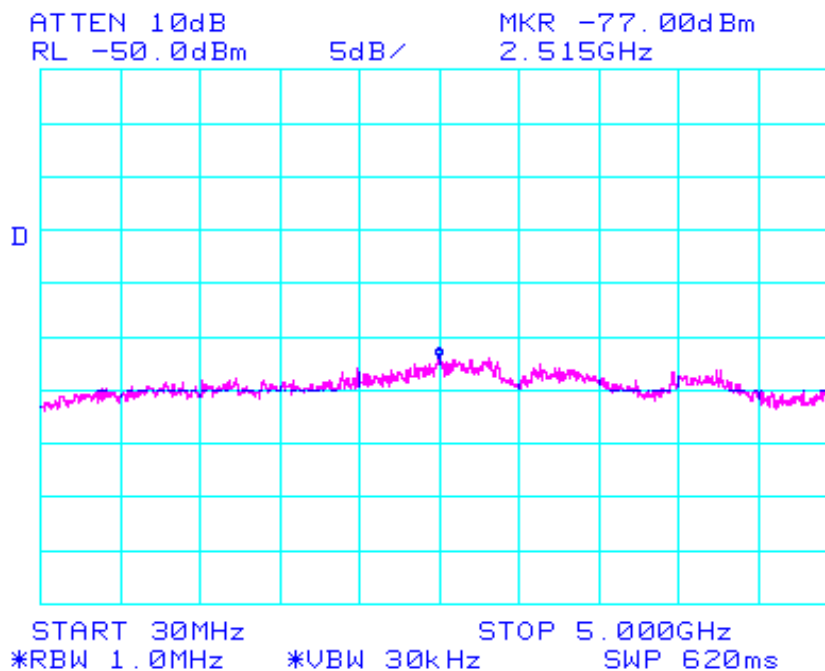
EMC Test Data

Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Run #5: Out Of Band Spurious Emissions - Antenna Conducted

The maximum antenna gain that can be used with the 5.8 GHz radio at the low output power is 37dBi (6' dish). The EIRP limit is -17dBm for signals within 10 MHz of the band edge and -27dBm/MHz for all other signal. For signals within 10MHz of the band edge a limit of -54 dBm was used and for all other signals within 100 MHz of the band edge a limit of -64dBm was used. These limits assumed that the antenna gain at the band edges is the same as the in-band antenna gain. For signals removed from the band edge by more than 100MHz, radiated measurements were made (refer to run #6).

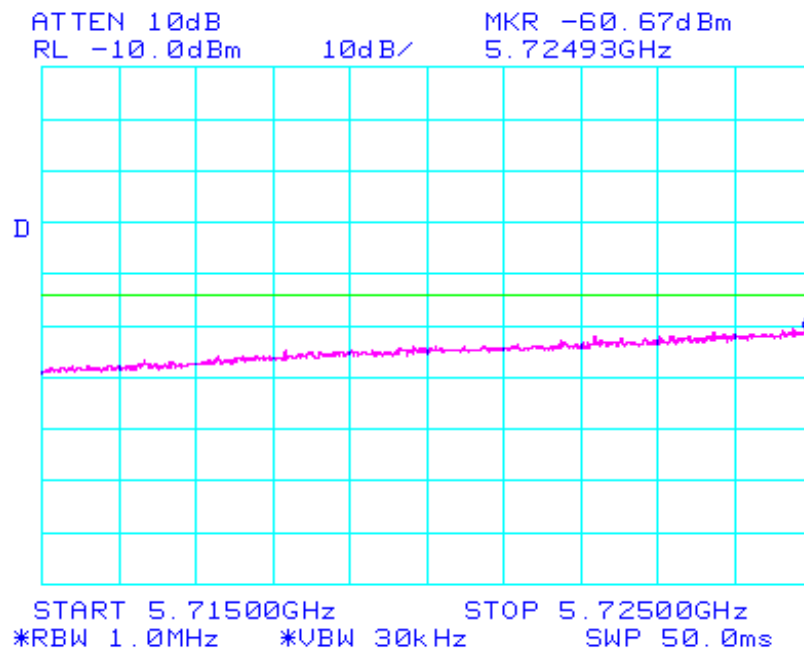
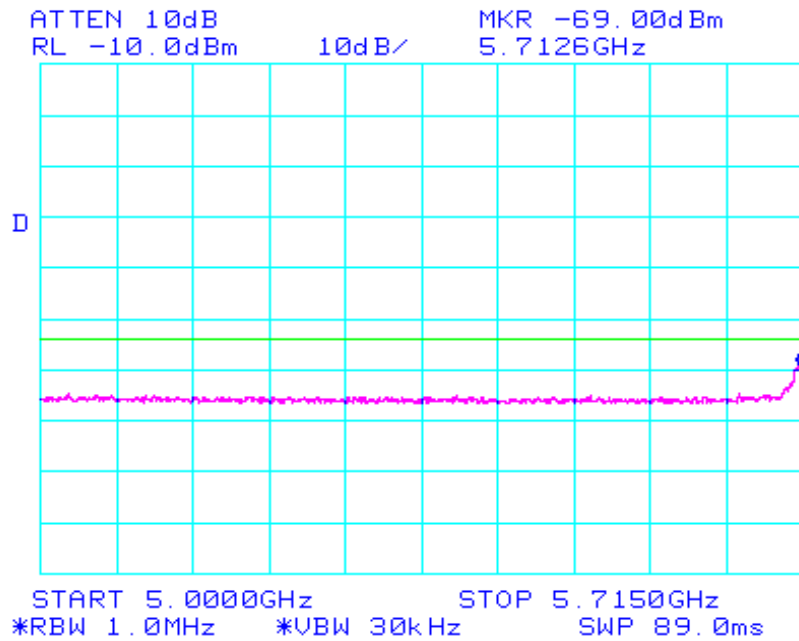
The highest signal within 10MHz of the band-edge was -60.7dBm. The highest signal removed by more than 10MHz but less than 100 MHz from the band edge was -67dBm. The only other signal observed above the instrumentation noise floor was at 28.875GHz (-68.9dBm). The EIRP was measured via a field strength measurement (refer to run #6).





EMC Test Data

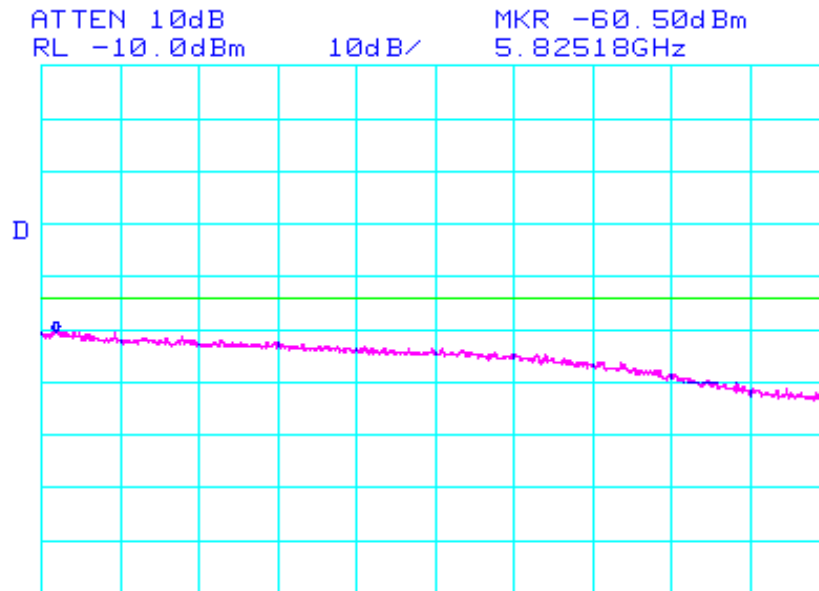
Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A



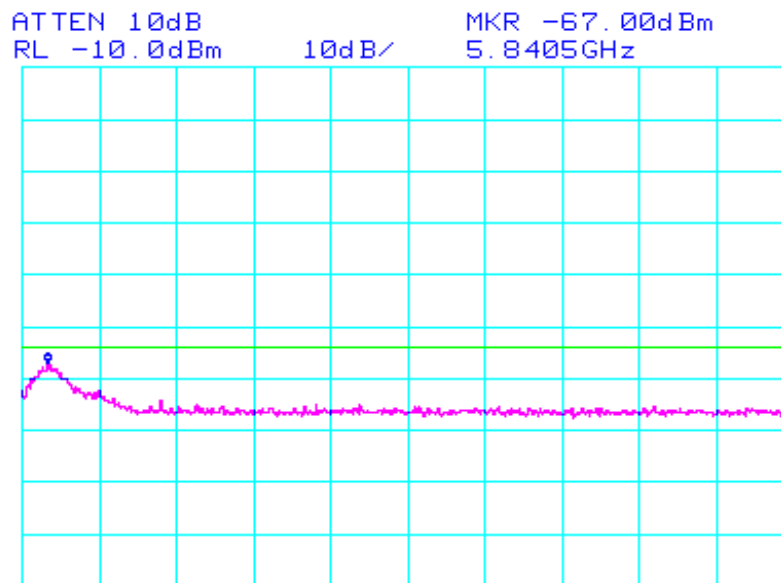


EMC Test Data

Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A



START 5.82500GHz STOP 5.83500GHz
*RBW 1.0MHz *VBW 30kHz SWP 50.0ms

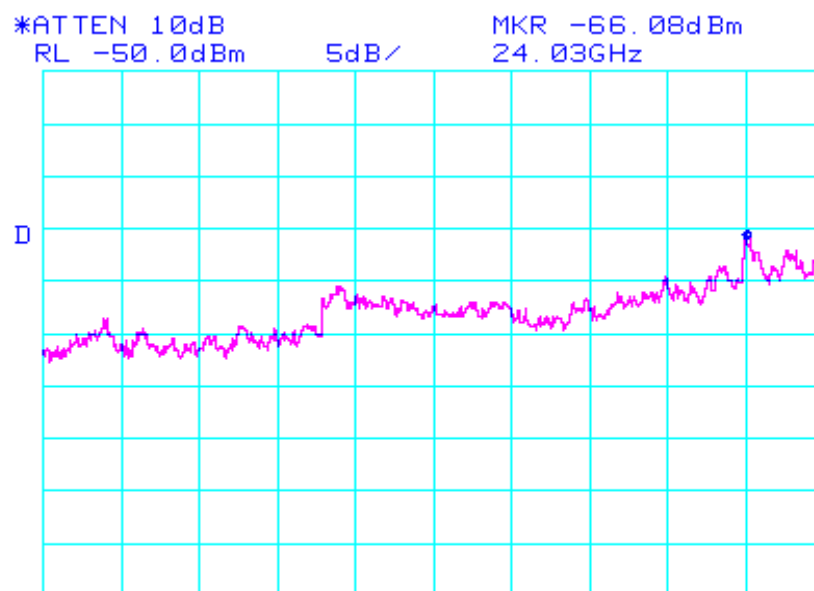


START 5.8350GHz STOP 6.0000GHz
*RBW 1.0MHz *VBW 30kHz SWP 50.0ms

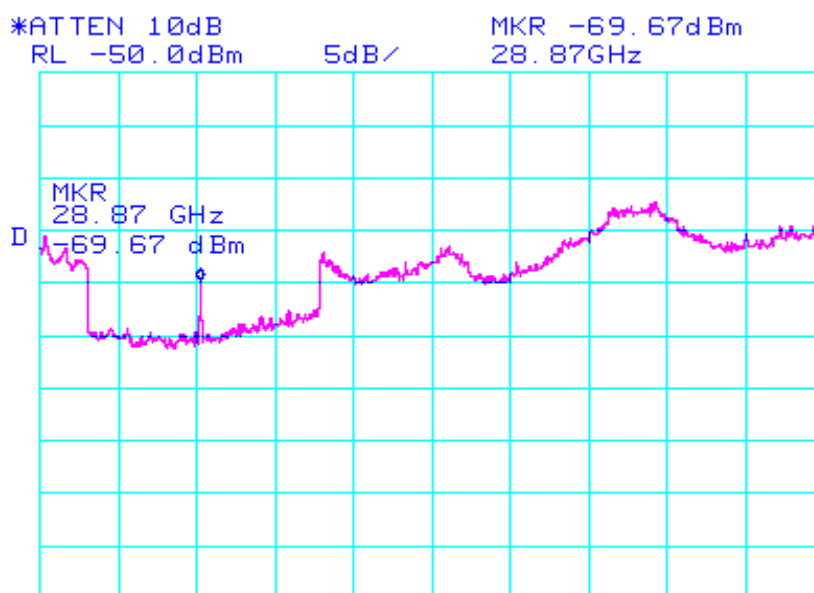


EMC Test Data

Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A



START 6.00GHz STOP 26.00GHz
*RBW 1.0MHz *VBW 30kHz SWP 2.50sec



START 26.00GHz STOP 40.00GHz
*RBW 1.0MHz *VBW 30kHz SWP 1.80sec



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		Proj Eng:	Mark Briggs
Contact:	Chet Ferry		
Spec:	15.407	Class:	N/A

Run #6: Radiated Spurious Emissions, 1000 - 40000 MHz

Spurious emissions from 30 - 1000 MHz were measured while performing emissions measurements of the digital device. The emissions were below the FCC Class B limit (refer to T42466).

Spurious emissions above 1000 MHz are covered by the radiated measurements performed on the 5.8GHz radio configured for maximum output power and connected to a 6' dish antenna (37dBi).

Output Power - 5.8GHz Radio operating at Low Power: Measured by summing the power measured on the analyzer (RBW=1MHz, VBW=30kHz)

Frequency (MHz)	Power (mW)	Frequency (MHz)	Power (mW)
5733.6	0.0001	5774.8	0.0071
5734.6	0.0002	5775.7	0.0341
5735.6	0.0004	5776.7	0.0026
5736.5	0.0006	5777.7	0.0041
5737.5	0.0017	5778.7	0.0046
5738.5	0.0019	5779.7	0.0053
5739.5	0.0030	5780.6	0.0042
5740.5	0.0053	5781.6	0.0048
5741.4	0.0076	5782.6	0.0046
5742.4	0.0091	5783.6	0.0060
5743.4	0.0086	5784.6	0.0081
5744.4	0.0096	5785.5	0.0136
5745.4	0.0121	5786.5	0.0117
5746.3	0.0181	5787.5	0.0224
5747.3	0.0136	5788.5	0.0203
5748.3	0.0150	5789.5	0.0266
5749.3	0.0185	5790.4	0.0266
5750.3	0.0220	5791.4	0.0287
5751.2	0.0299	5792.4	0.0271
5752.2	0.0362	5793.4	0.0335
5753.2	0.0369	5794.4	0.0299
5754.2	0.0430	5795.3	0.0261
5755.2	0.0414	5796.3	0.0406
5756.1	0.0341	5797.3	0.0348
5757.1	0.0266	5798.3	0.0362
5758.1	0.0304	5799.3	0.0348
5759.1	0.0211	5800.2	0.0246
5760.1	0.0271	5801.2	0.0211
5761.0	0.0282	5802.2	0.0261
5762.0	0.0256	5803.2	0.0207
5763.0	0.0168	5804.2	0.0117
5764.0	0.0141	5805.1	0.0136
5765.0	0.0133	5806.1	0.0121
5765.9	0.0075	5807.1	0.0144
5766.9	0.0054	5808.1	0.0112
5767.9	0.0063	5809.1	0.0098
5768.9	0.0047	5810.0	0.0079
5769.9	0.0066	5811.0	0.0046
5770.8	0.0049	5812.0	0.0029
5771.8	0.0060	5813.0	0.0019
5772.8	0.0049	5814.0	0.0013
5773.8	0.0044	5814.9	0.0005

Total (mW) 1.306

Total (dBm) 1.2



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Contact:	Chet Ferry		
Spec:	15.407	Class:	N/A

FCC Part 15 Subpart E Tests - 5.8GHz Radio (High Power)

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/14/2001
Test Engineer: J Martinez, M Briggs
Test Location: Chamber #2, SV #3

Config. Used: #1
Config Change: N/A
EUT Voltage: 14Vdc and 18Vdc

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing. All remote support equipment was located approximately 15 meters from the EUT with all I/O connections running on top of the groundplane.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT unless stated otherwise.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Ambient Conditions: Temperature: 19.3°C
Rel. Humidity: 66%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Output Power	15.407(a) (3)	Pass	
2	Power Spectral Density (PSD)	15.407(a) (3)	Pass	
3	26dB Bandwidth	15.407	N/A	
4	Peak Excursion Envelope	15.407(a) (6)	Pass	
5	Antenna Conducted - Out of Band Spurious	15.407(b)	Pass	
6	RE, 1000 - 40000 MHz - Spurious Emissions	15.407(b)(6)	Pass	-13.7dB @ 23099MHz



EMC Test Data

Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

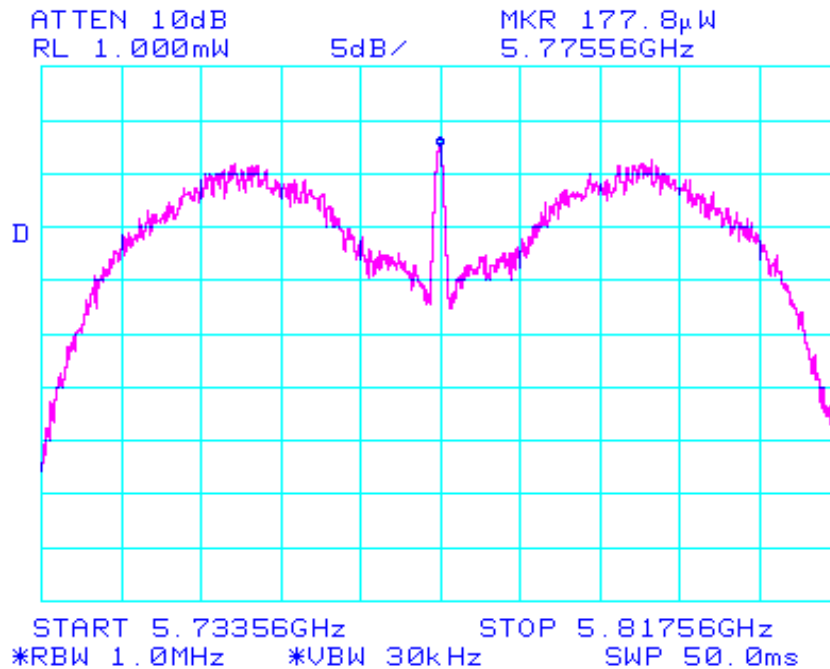
No deviations were made from the requirements of the standard.

Run #1: Output Power

The maximum antenna gain that can be used with the 5.8 GHz radio at maximum output power is 31dBi (3' dish). The maximum power output is, therefore, 30 - (31-23) dBm, which is 22dBm.

Channel	Frequency (MHz)	Res BW	Output Power	Graph reference #
Low	5775	N/A	6.4 dBm	Power Meter
Low	5775	N/A	5.5 dBm	Note 1

Note 1: Measured using spectrum analyzer (RBW = 1MHz, VBW = 30kHz) and summing the power in each 1MHz band across the entire emission bandwidth. Data is attached under "Output Power"





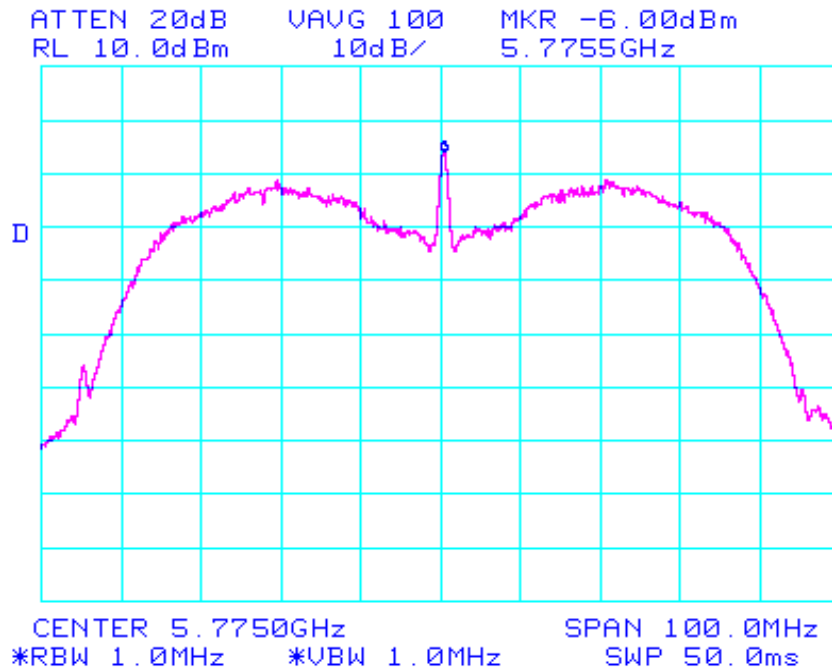
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Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Run #2: Power Spectral Density

The maximum antenna gain that can be used with the 5.8 GHz radio at maximum output power is 31dBi (3' dish). The maximum power output is, therefore, 17 - (31-23) dBm, which is 9dBm.

Channel	Frequency (MHz)	Res BW	P.S.D. in 1MHz, Video averaging of 100 samples.	Graph reference #
Low	5775	1 MHz	-6dBm	None



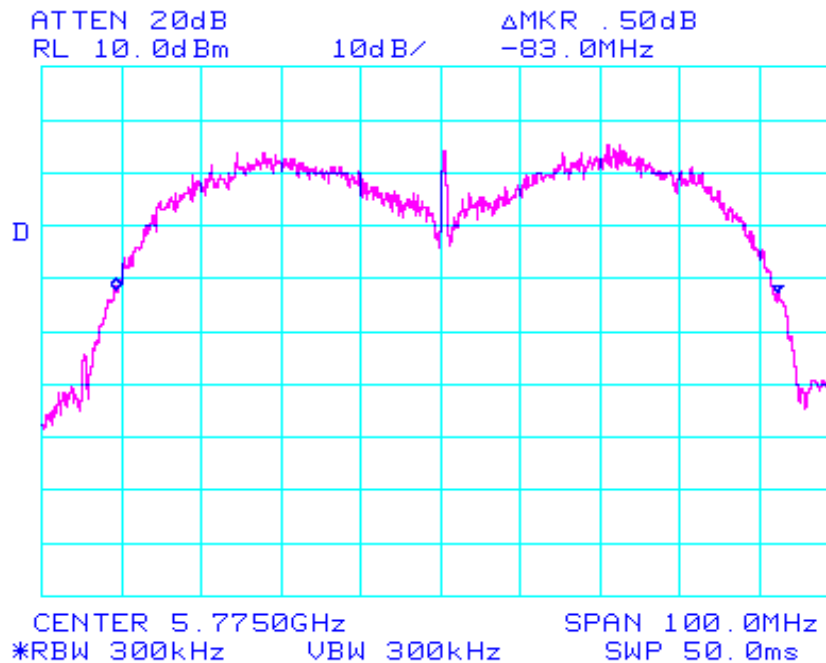


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Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Run #3: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	26dB Signal Bandwidth	Graph reference #
NA	5775	300 kHz	83 MHz	None



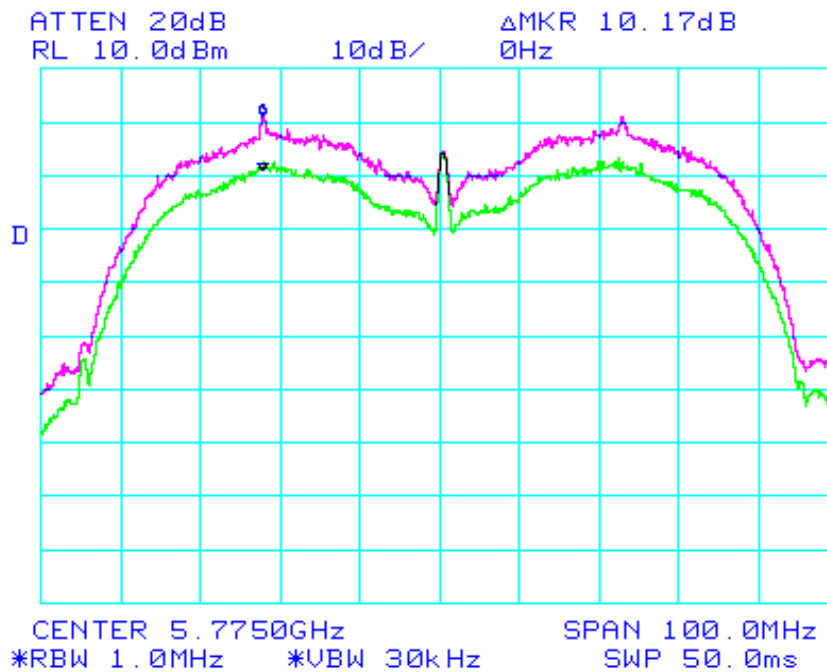


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Spec: 15.407	Class: N/A

Run #4: Peak Excursion Measurement

The plot shows that the peak excursion was less than 13dB (approximately 10.2dB worst case)





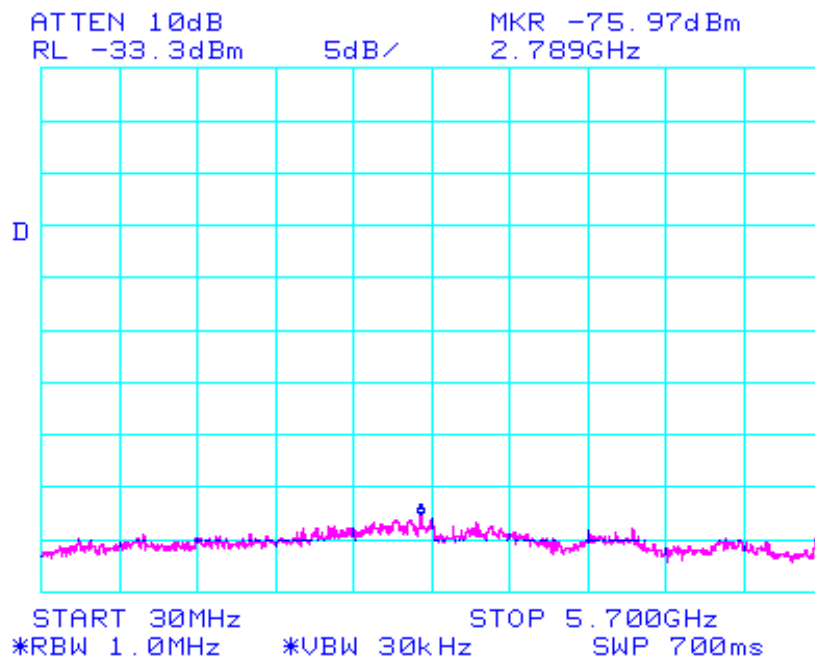
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Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

Run #5: Out Of Band Spurious Emissions - Antenna Conducted

The maximum antenna gain that can be used with the 5.8 GHz radio at the high output power is 31dBi (4' dish). The EIRP limit is -17dBm for signals within 10 MHz of the band edge and -27dBm/MHz for all other signal. For signals within 10MHz of the band edge a limit of -48 dBm was used and for all other signals within 100 MHz of the band edge a limit of -58dBm was used. These limits assumed that the antenna gain at the band edges is the same as the in-band antenna gain. For signals removed from the band edge by more than 100MHz, radiated measurements were made (refer to run #6).

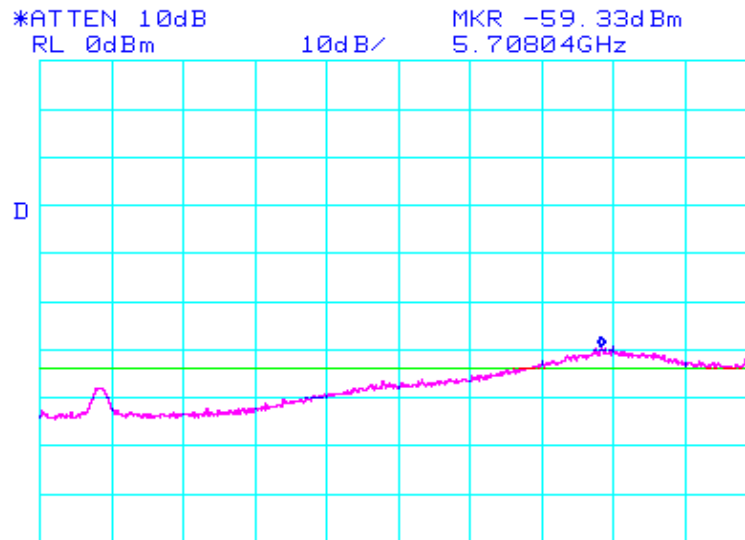
The highest signal within 10MHz of the band-edge was -56.9dBm. The highest signal removed by more than 10MHz but less than 100 MHz from the band edge was -59.3dBm. Outside of this band signals were observed at 23.099 GHz (-63.5dBm) and 28.875 GHz (-70.6dBm). The radiated field strength of these signals was measured during run #6.



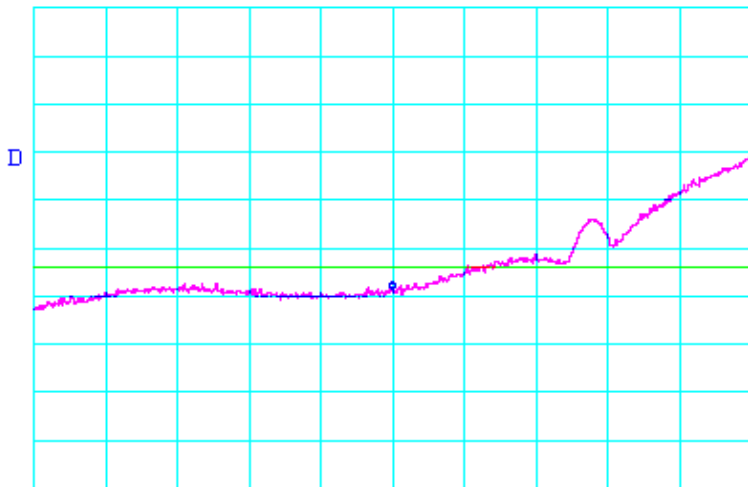


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Spec: 15.407	Class: N/A



START 5.68287GHz STOP 5.71500GHz
*RBW 1.0MHz *VBW 30kHz SWP 50.0ms
*ATTEN 10dB MKR -58.83dBm
RL 0dBm 10dB/ 5.72499GHz

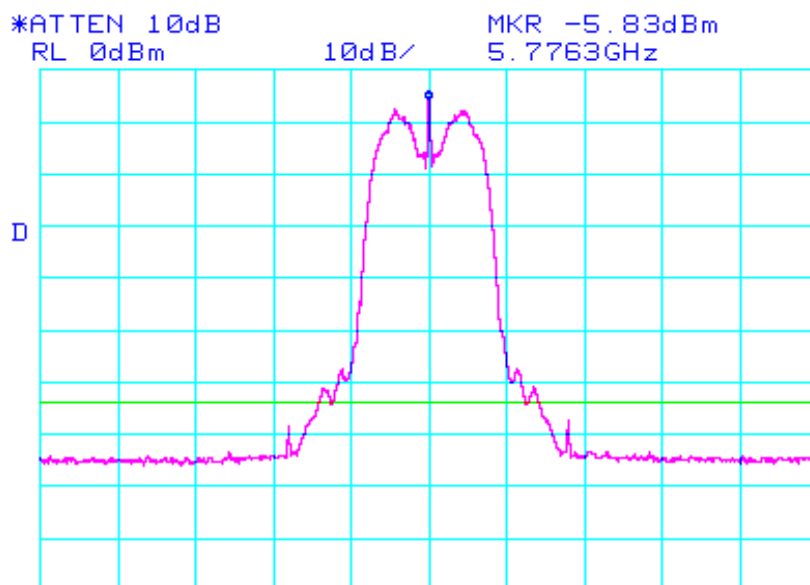


START 5.71500GHz STOP 5.73497GHz
*RBW 1.0MHz *VBW 30kHz SWP 50.0ms

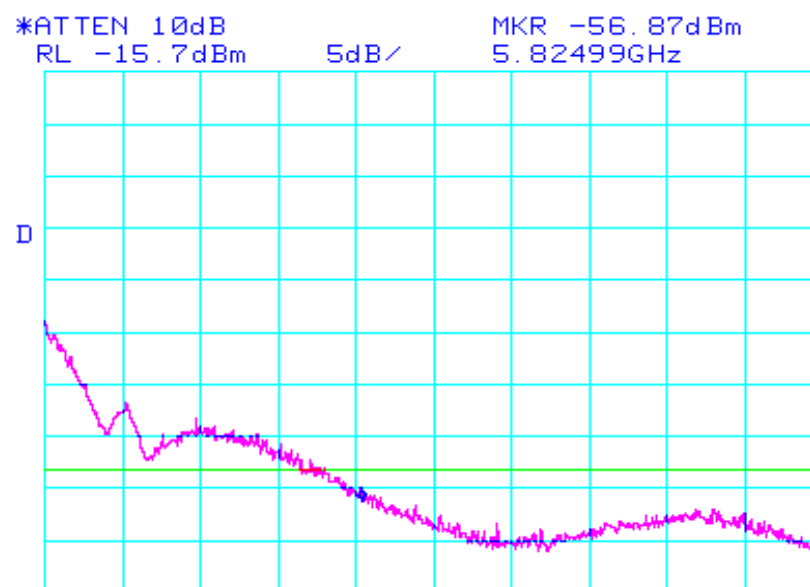


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Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A



CENTER 5.7763GHz SPAN 500.0MHz
*RBW 1.0MHz *VBW 30kHz SWP 62.0ms



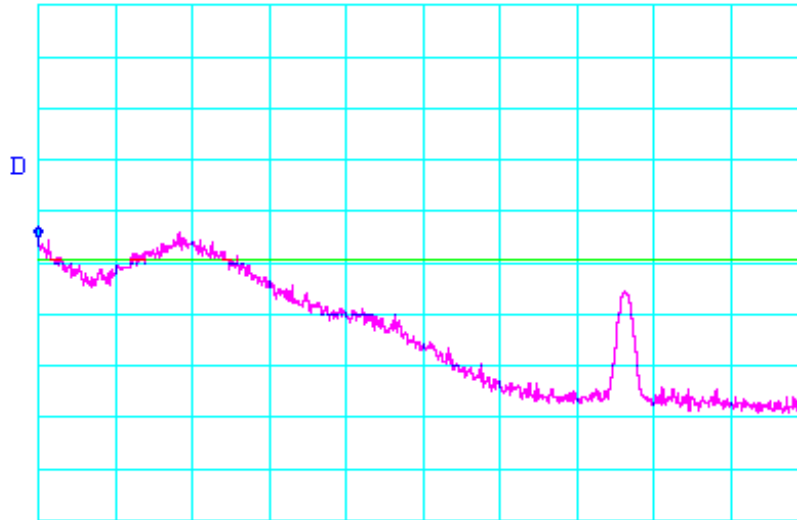
START 5.81808GHz STOP 5.83500GHz
*RBW 1.0MHz *VBW 30kHz SWP 50.0ms



EMC Test Data

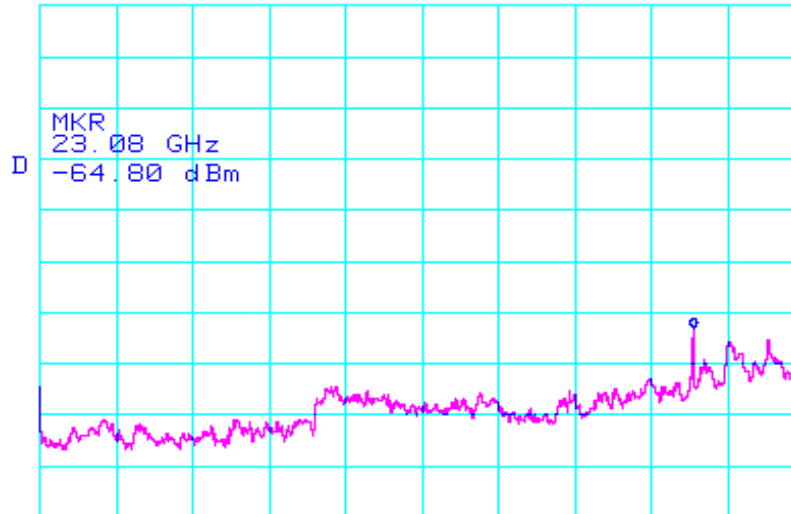
Client: Bitrage	Job Number: J42216
Model: 5.3 & 5.8 GHz UNII	T-Log Number: T42491
Contact: Chet Ferry	Proj Eng: Mark Briggs
Spec: 15.407	Class: N/A

*ATTEN 10dB MKR -61.70dBm
RL -39.2dBm 5dB/ 5.83500GHz



START 5.83500GHz STOP 5.87363GHz
*RBW 1.0MHz *VBW 30kHz SWP 50.0ms

ATTEN 10dB MKR -64.80dBm
RL -33.3dBm 5dB/ 23.08GHz

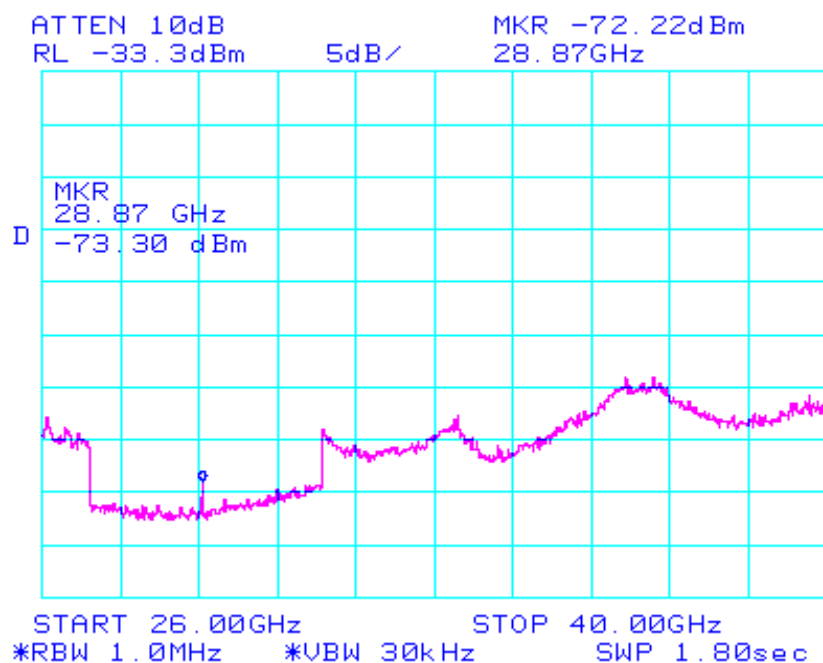


START 5.87GHz STOP 26.00GHz
*RBW 1.0MHz *VBW 30kHz SWP 2.50sec



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Run #6: Radiated Spurious Emissions, 1000 - 40000 MHz

Spurious emissions from 30 - 1000 MHz were measured while performing emissions measurements of the digital device. The emissions were below the FCC Class B limit (refer to T42466).

Limit for emissions in restricted bands:	54dBuV/m (Average)
Limit for emissions outside of restricted bands:	EIRP < -27dBm/MHz

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
23099.0	40.3	h	54.0	-13.7	Avg	173	1.7	Note 2
28875.0	53.0	v	68.0	-15.0	Note 4	170	1.6	
28875.0	51.0	h	68.0	-17.0	Note 4	170	1.6	
23099.0	34.3	v	54.0	-19.7	Avg	171	1.6	Note 2
23099.0	52.8	h	74.0	-21.2	Pk	173	1.7	Note 2
23099.0	48.8	v	74.0	-25.2	Pk	171	1.6	Note 2

Note 1:	For emissions falling in the restricted bands detailed in 15.205 the general limits of 15.209 apply. For all other emissions the limit is EIRP < -27dBm (equivalent to a field strength at 3m of 68dBuV/m)
Note 2:	Signal is in a restricted band
Note 3:	All other harmonic emissions were 20 dB below the limit.
Note 4:	Restricted Band Peak Measurements: Resolution and Video BW: 1 MHz, Restricted Band Average Measurements: Resolution Bw: 1MHz and Video Bw: 10 Hz. All other measurements, RBW = 1MHz and VBW = 30kHz.

Output Power - 5.8GHz Radio operating at High Power: Measured by summing the power measured on the analyzer (RBW=1MHz, VBW=30kHz) at

Frequency (MHz)	Power (mW)	Frequency (MHz)	Power (mW)
5733.6	0.0003	5774.7	0.0192
5734.5	0.0006	5775.7	0.1468
5735.5	0.0010	5776.7	0.0060
5736.5	0.0019	5777.7	0.0093
5737.5	0.0035	5778.6	0.0133
5738.5	0.0081	5779.6	0.0147
5739.4	0.0104	5780.6	0.0098
5740.4	0.0158	5781.6	0.0153
5741.4	0.0224	5782.6	0.0181
5742.4	0.0168	5783.5	0.0203
5743.4	0.0246	5784.5	0.0228
5744.3	0.0246	5785.5	0.0299
5745.3	0.0287	5786.5	0.0287
5746.3	0.0398	5787.5	0.0541
5747.3	0.0383	5788.4	0.0430
5748.3	0.0511	5789.4	0.0492
5749.2	0.0573	5790.4	0.0531
5750.2	0.0668	5791.4	0.0492
5751.2	0.0858	5792.4	0.0722
5752.2	0.0874	5793.3	0.0891
5753.2	0.1019	5794.3	0.0926
5754.1	0.0981	5795.3	0.0962
5755.1	0.0810	5796.3	0.1144
5756.1	0.0858	5797.3	0.1039
5757.1	0.0668	5798.2	0.0891
5758.1	0.0764	5799.2	0.1019
5759.0	0.0909	5800.2	0.0810
5760.0	0.0681	5801.2	0.0810
5761.0	0.0607	5802.2	0.0681
5762.0	0.0562	5803.1	0.0541
5763.0	0.0473	5804.1	0.0391
5763.9	0.0422	5805.1	0.0369
5764.9	0.0329	5806.1	0.0391
5765.9	0.0192	5807.1	0.0369
5766.9	0.0188	5808.0	0.0271
5767.9	0.0131	5809.0	0.0233
5768.8	0.0171	5810.0	0.0168
5769.8	0.0128	5811.0	0.0102
5770.8	0.0168	5812.0	0.0079
5771.8	0.0119	5812.9	0.0055
5772.8	0.0121	5813.9	0.0046
5773.7	0.0078	5814.9	0.0015

Total (mW) 3.518

Total (dBm) 5.5