FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 7

CERTIFICATION TEST REPORT

FOR

RADIO HOLDER

MODEL NUMBER: RH-1/FH

FCC ID: LCB-080511
IC: 6050B-080511

REPORT NUMBER: 08J11938-1, REVISION B

ISSUE DATE: OCTOBER 22, 2008

Prepared for
TOPCON POSITIONING SYSTEMS, INC
7400 NATIONAL DRIVE
LIVERMORE, CA 94551 USA

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	09/08/08	Initial Issue	T. Chan
B	10/22/08	Revised Result Table On Sections 7.4 and 7.11; Added Co-Located MPE On Section 10	T. Chan

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: TOPCON CORPORATION
7400 NATIONAL DRIVE
LIVERMORE, CA 94551 USA

EUT DESCRIPTION: RADIO HOLDER

MODEL: RH-1/FH

SERIAL NUMBER: N/A

DATE TESTED: JULY 20 – 25, AND AUGUST 22, 2008

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 8	Pass
INDUSTRY CANADA 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:

THU CHAN
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

VIEN TRAN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

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

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is equipped with FH915 modem and Bluetooth transceiver. The FH915 modem operates at the frequency of 902-928MHz for frequency hopping operational mode.

The FH915 modem is manufactured by Topcon Positioning System, Inc.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
High Power			
902 - 928	FHSS	29.85	966.05
Low Power			
902 - 928	FHSS	24.03	252.93

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a dipole antenna, with a maximum gain of 2.4 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Modem FH915Plus, rev. V1.2p0 GR3 Test.

The test utility software used during testing was Frequency-Hopping Terminal, rev. 3.3 GR3.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	HP	Pavilion DV1000	CNF63289VZ	DoC
AC Adapter	HP	PA-1650-02H	PPP009L	N/A
AC Adapter	Topcon	LE-0309ADAP12V300	N/A	N/A

I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identica Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	US115	Shielded	1.5m	Laptop
2	AC	1	US115	Un-shielded	1m	EUT
3	D C	1	DC	Un-shielded	1.5m	Laptop
4	D C	1	DC	Un-shielded	1m	Ferrite at EUT end
5	Serial	1	DB9	Shielded	2m	USB - Serial adapter

TEST SETUP

The EUT is connected to a host laptop computer via DB9 – Serial adapter cable during the tests. Test software exercised the radio card.

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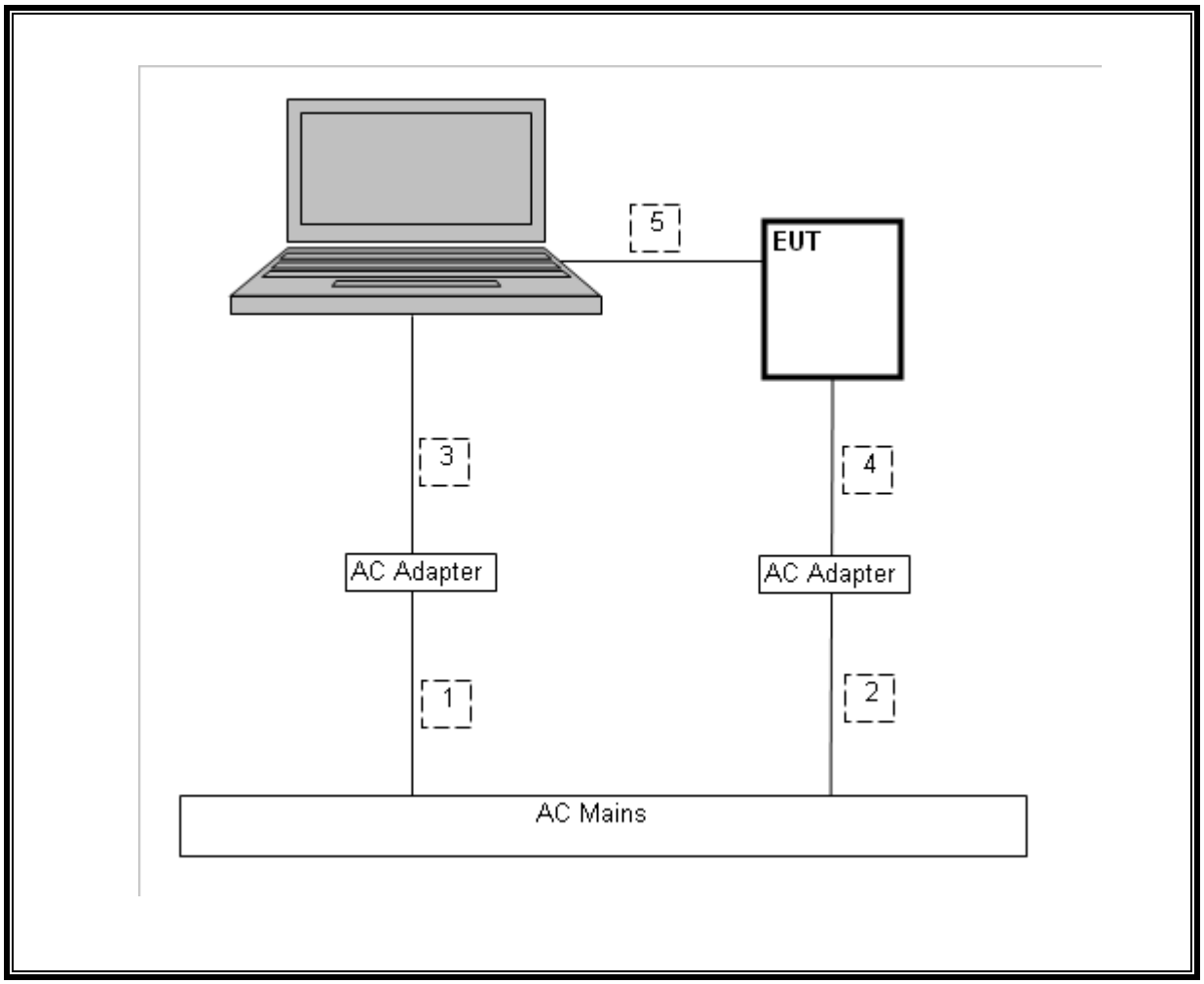
SETUP DIAGRAM FOR TESTS



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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset**	**Cal Due**
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	06/12/09
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	06/12/09
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	05/09/09
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/25/08
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	N02481	10/25/08
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	01/27/09
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	08/07/09
Antenna, Horn, 18 GHz	ETS	3117	C01006	04/15/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	08/03/09
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	10/13/08
Peak Power Meter	Agilent / HP	E4416A	C00963	12/02/08
Peak / Average Power Sensor	Agilent	E9327A	C00964	12/02/08
1.5 GHz High Pass Filter	Micro Tronics	HPM13351	N/A	N/A

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7. ANTENNA PORT TEST RESULTS

1000mW OUTPUT POWER

7.1. 20 dB AND 99% BANDWIDTH

LIMIT

The system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 3% of the 20 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	902.2	134.340	138.769
Middle	915.0	135.490	139.831
High	927.6	134.997	139.242

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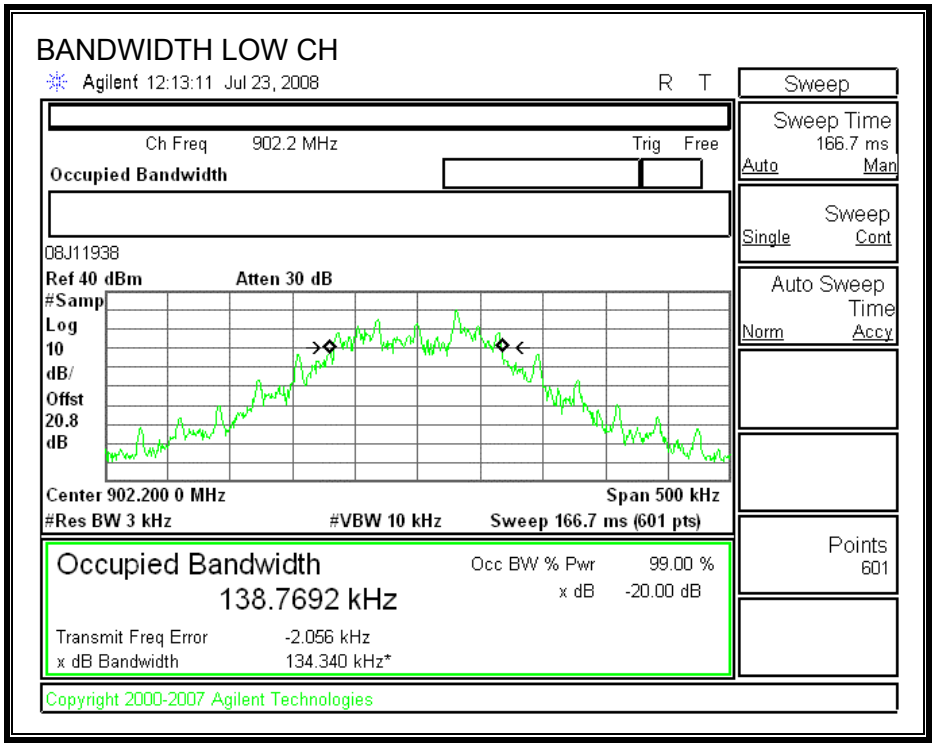
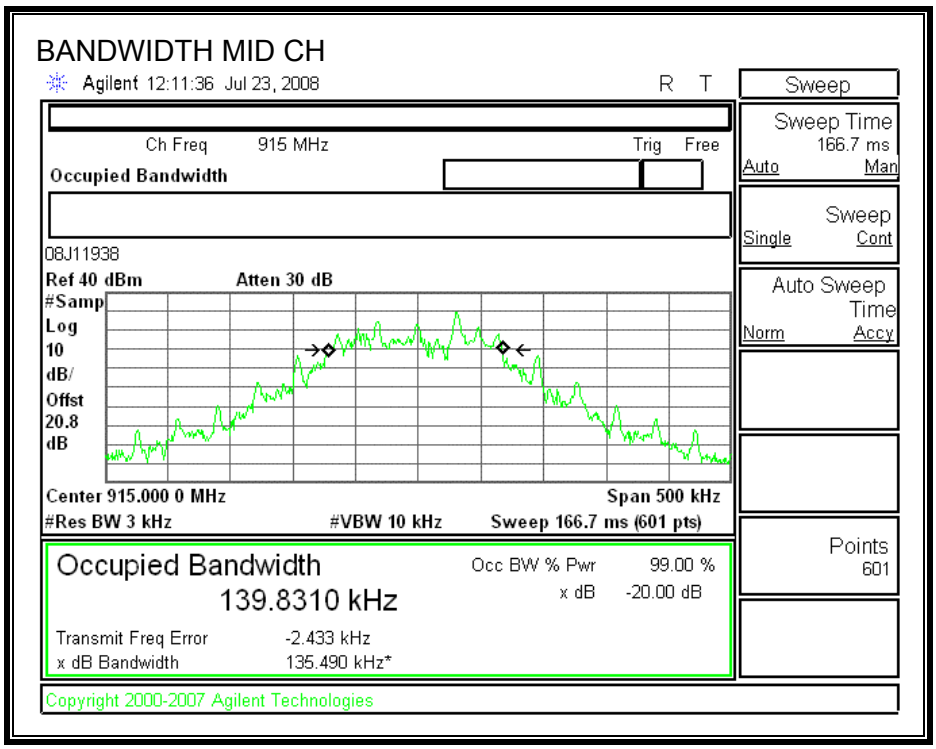
BANDWIDTH LOW CH



BANDWIDTH MID CH



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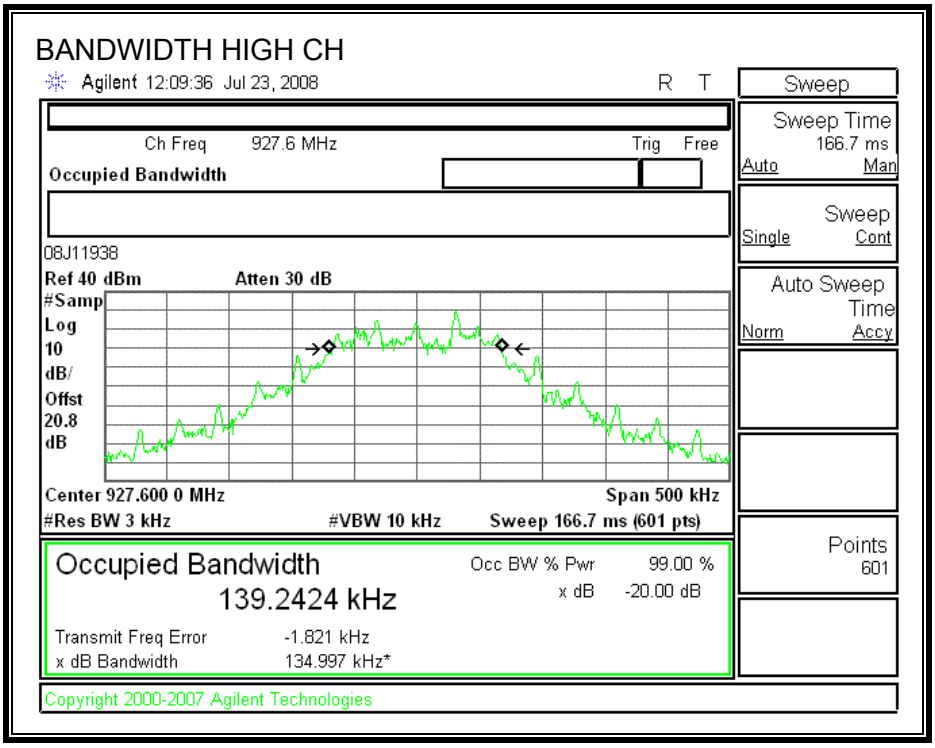

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7.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)
IC RSS-210 A8.1 (b)
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

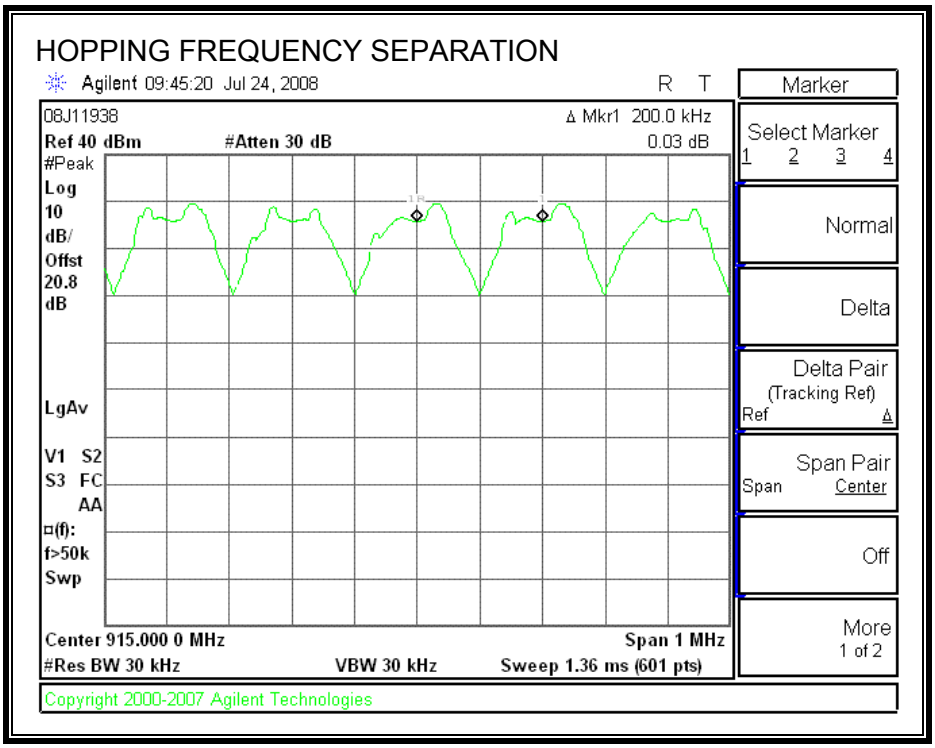
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	Hopping Separation (kHz)	>=25kHz or 20 dB BW (kHz)	Margin (kHz)
Mid	915	200	135.49	64.51

HOPPING FREQUENCY SEPARATION



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7.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)
IC RSS-210 A8.1 (d)
For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

128 Channels observed.

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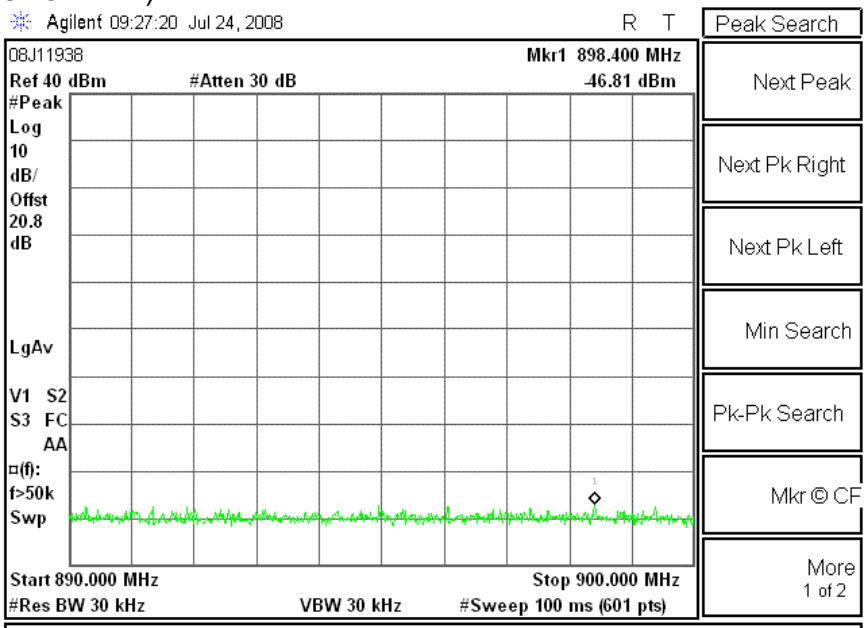
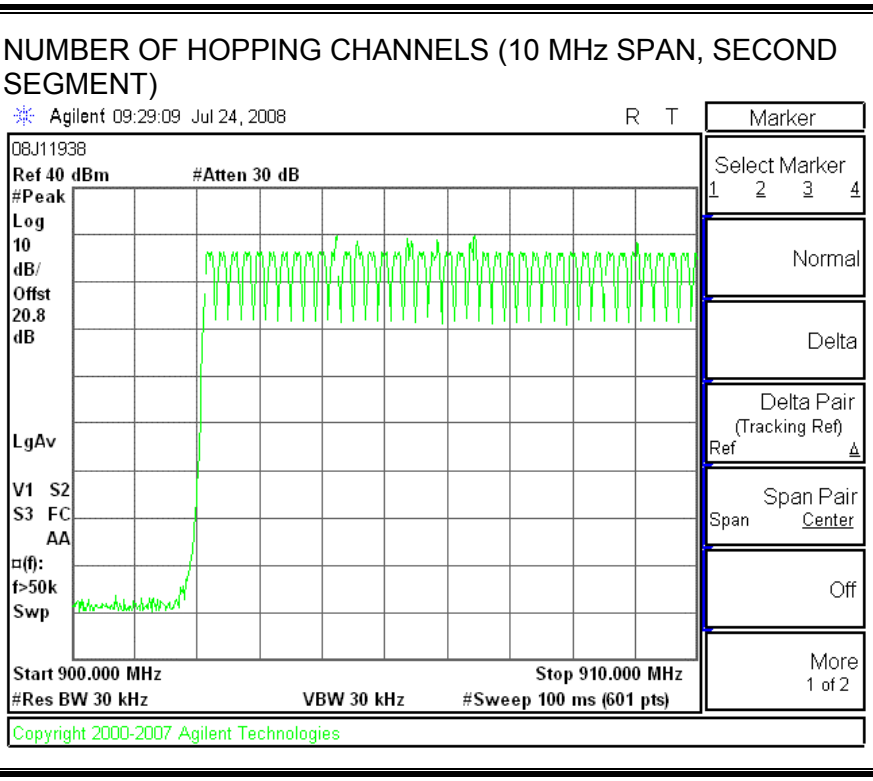
NUMBER OF HOPPING CHANNELS

NUMBER OF HOPPING CHANNELS (10 MHz SPAN, FIRST SEGMENT)



NUMBER OF HOPPING CHANNELS (10 MHz SPAN, SECOND SEGMENT)



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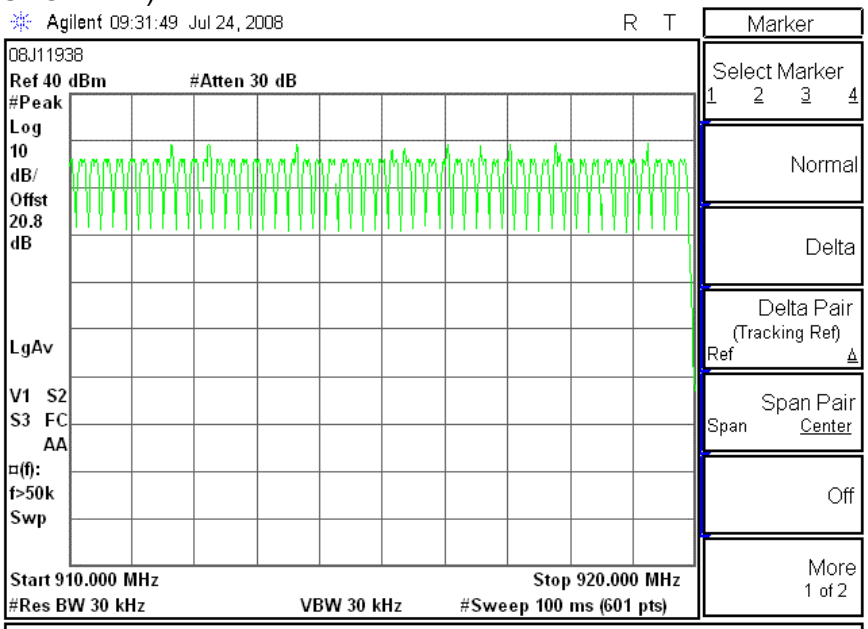
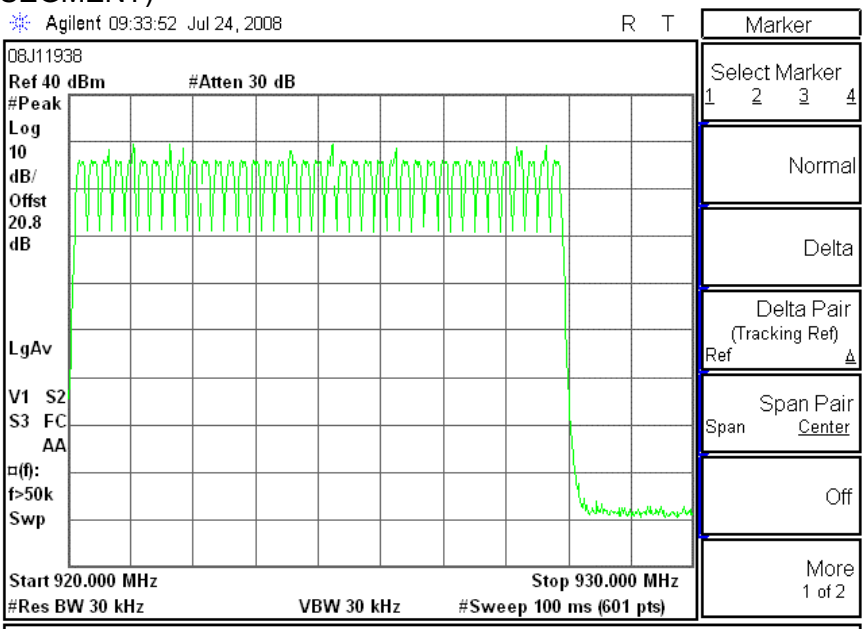
NUMBER OF HOPPING CHANNELS (10 MHz SPAN, THIRD SEGMENT)



NUMBER OF HOPPING CHANNELS (10 MHz SPAN, FOURTH SEGMENT)



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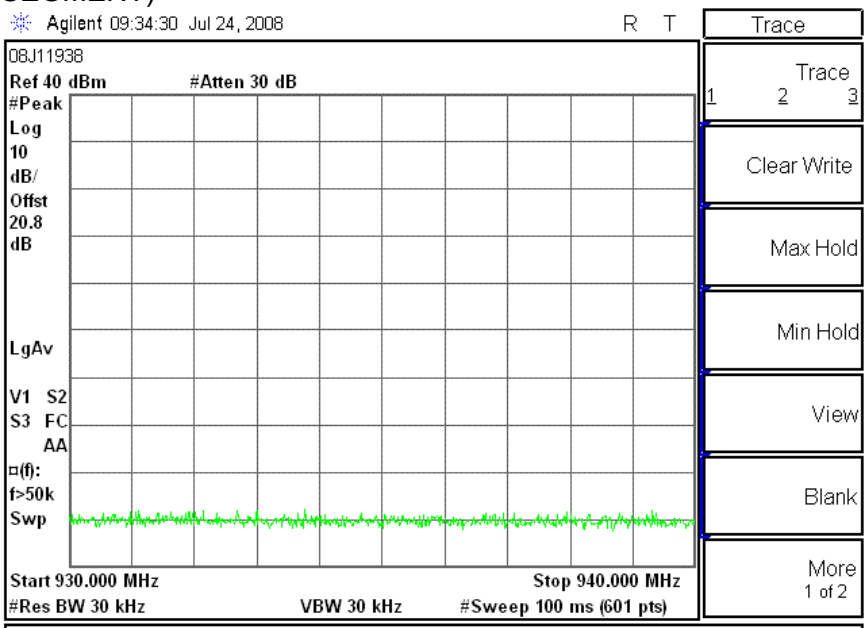
NUMBER OF HOPPING CHANNELS (10 MHz SPAN, FIFTH SEGMENT)



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7.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)
IC RSS-210 A8.1 (d)

§15.247 (a) (1) (i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a slow scan.

RESULTS

Pulse Width (msec)	Number of Pulses in 10 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
85.42	2	0.171	0.4	0.229

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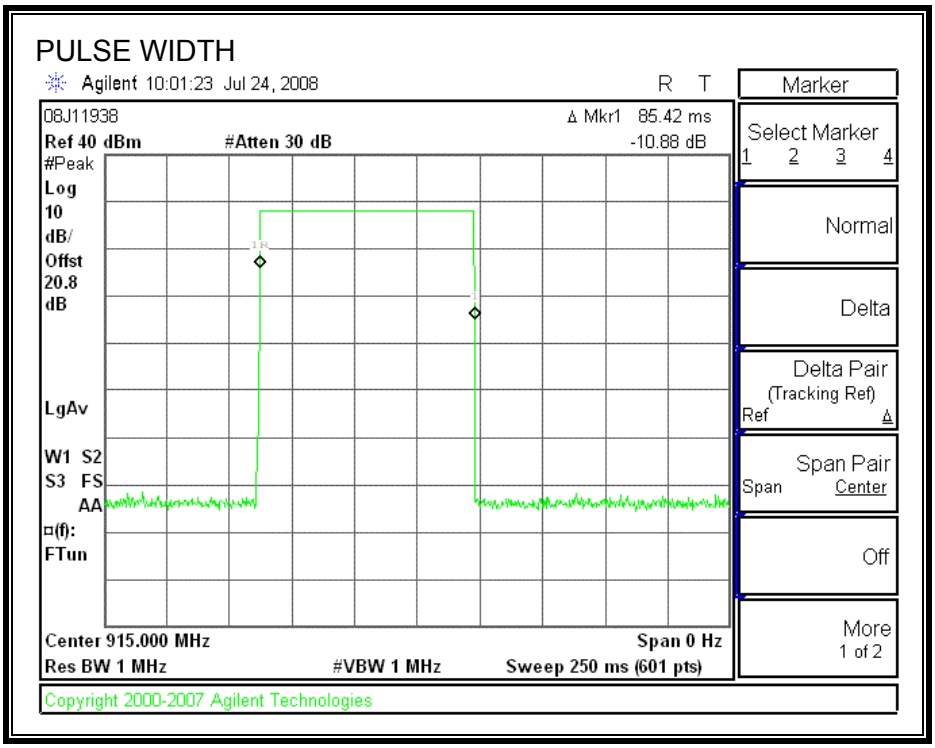
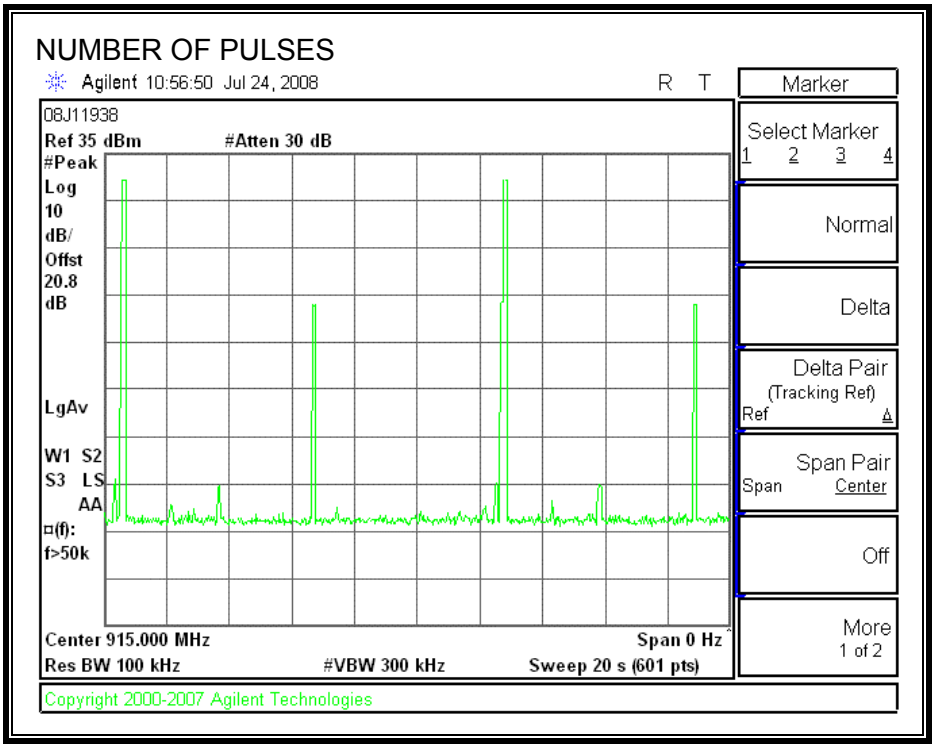
PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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7.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)
RSS-210 Issue 7 Clause A8.4

The maximum peak output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 902-928 MHz band , employing at least 50 hopping channels: 1 watt; and employing less than 50 hopping channels, but at least 25 hopping channels: 0.25 watt.

Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	902.2	29.85	30	-0.15
Middle	915.0	29.60	30	-0.40
High	927.6	29.47	30	-0.53

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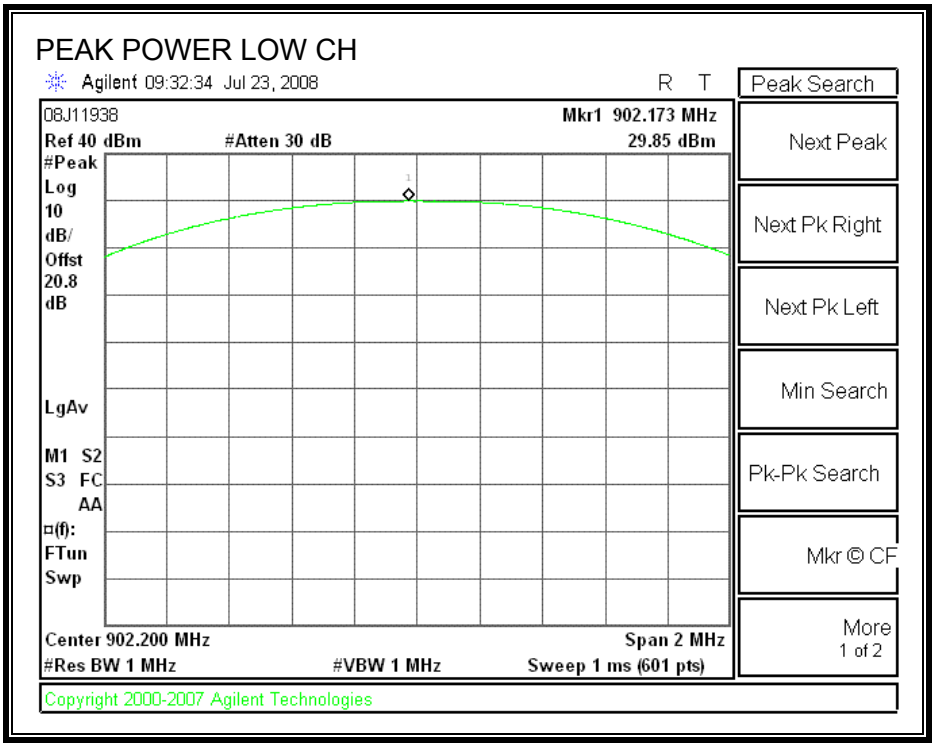
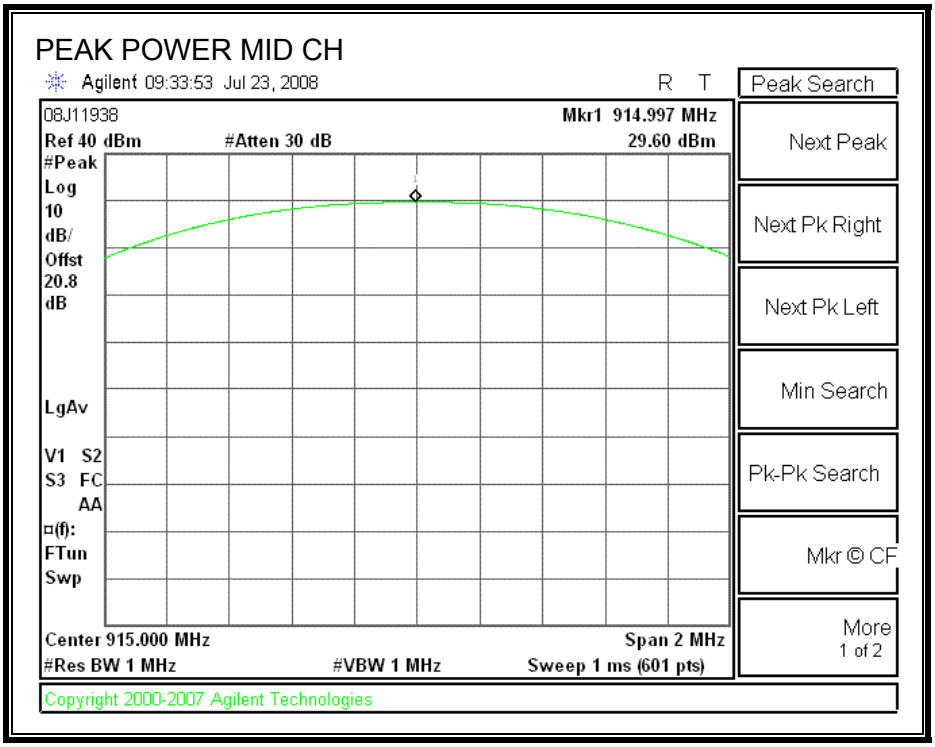
PEAK POWER LOW CH



PEAK POWER MID CH



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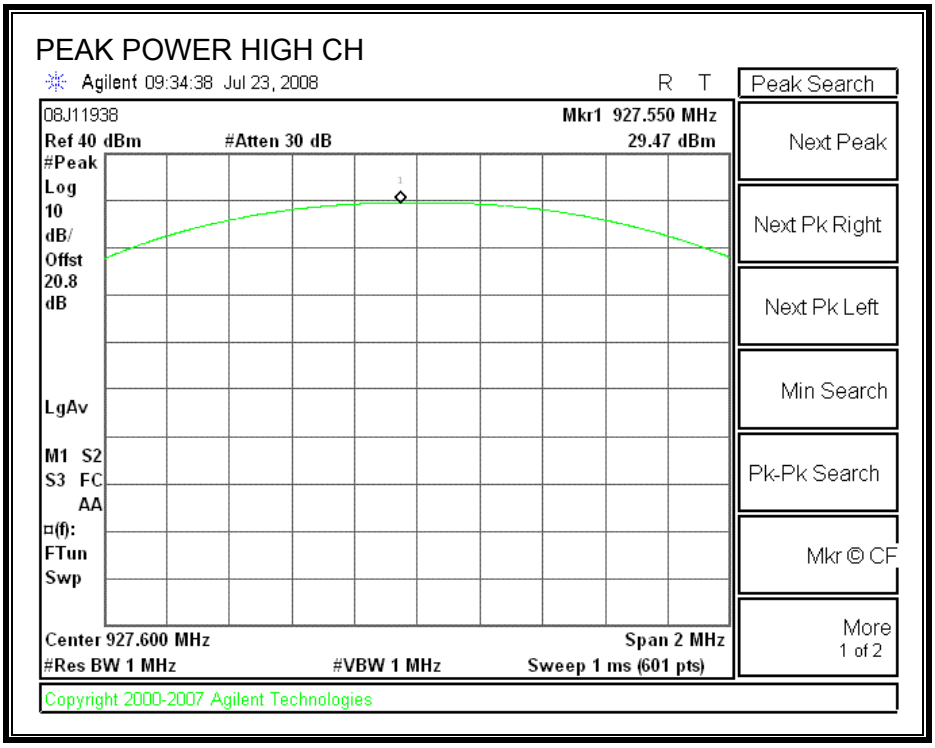
PEAK POWER HIGH CH



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7.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 20.8 dB (including 20 dB pad and 0.8 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	902.20	29.60
Middle	915.00	29.43
High	927.60	29.35

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7.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc
\
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 10 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

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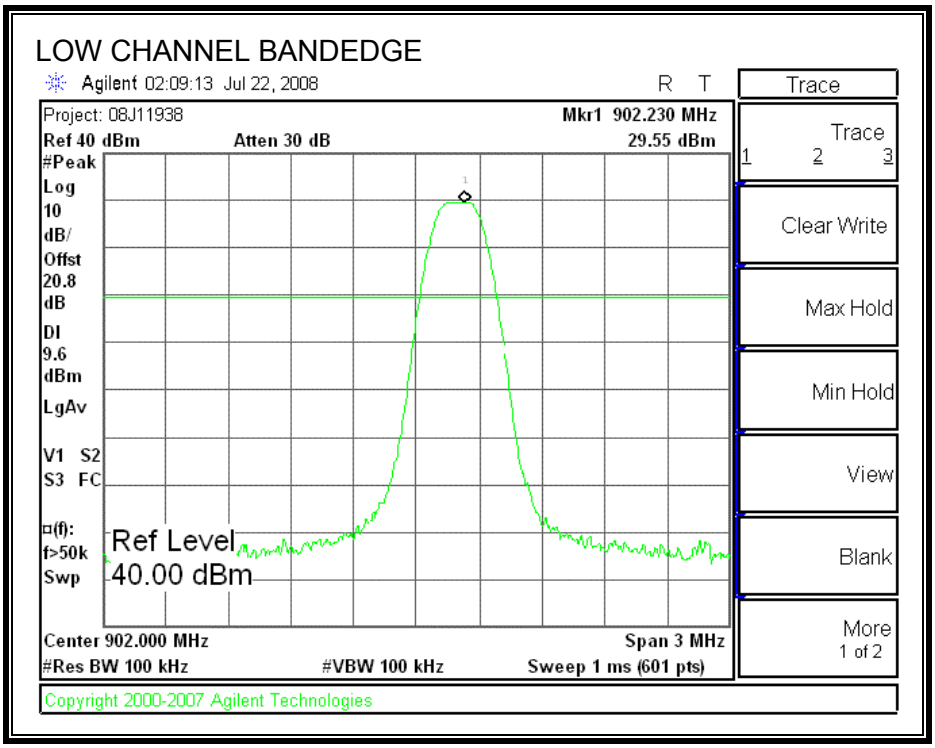
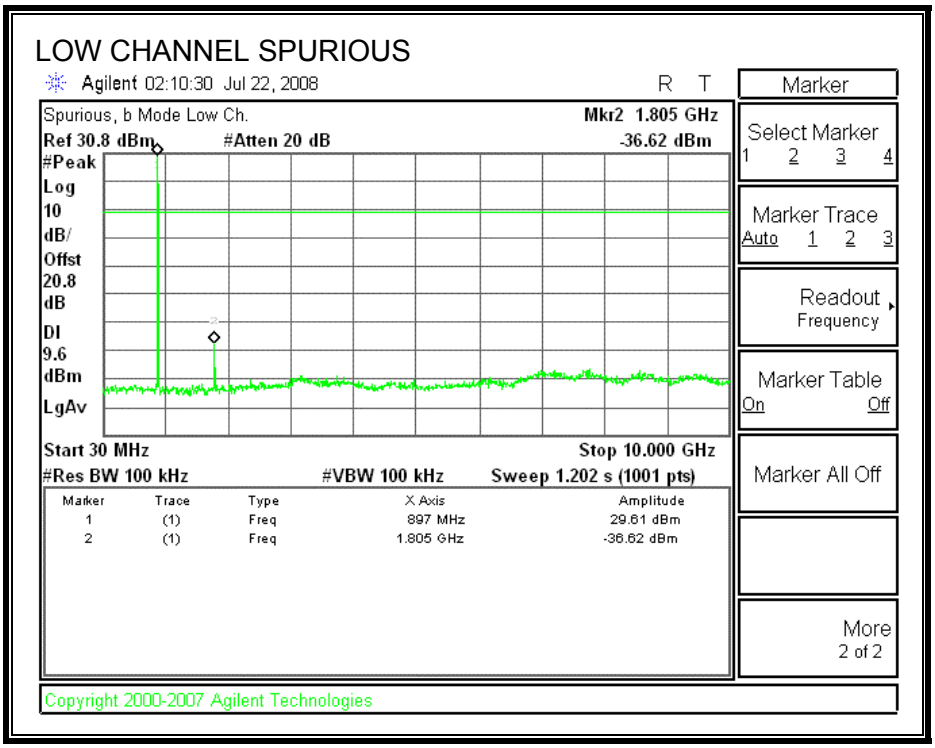
SPURIOUS EMISSIONS, LOW CHANNEL





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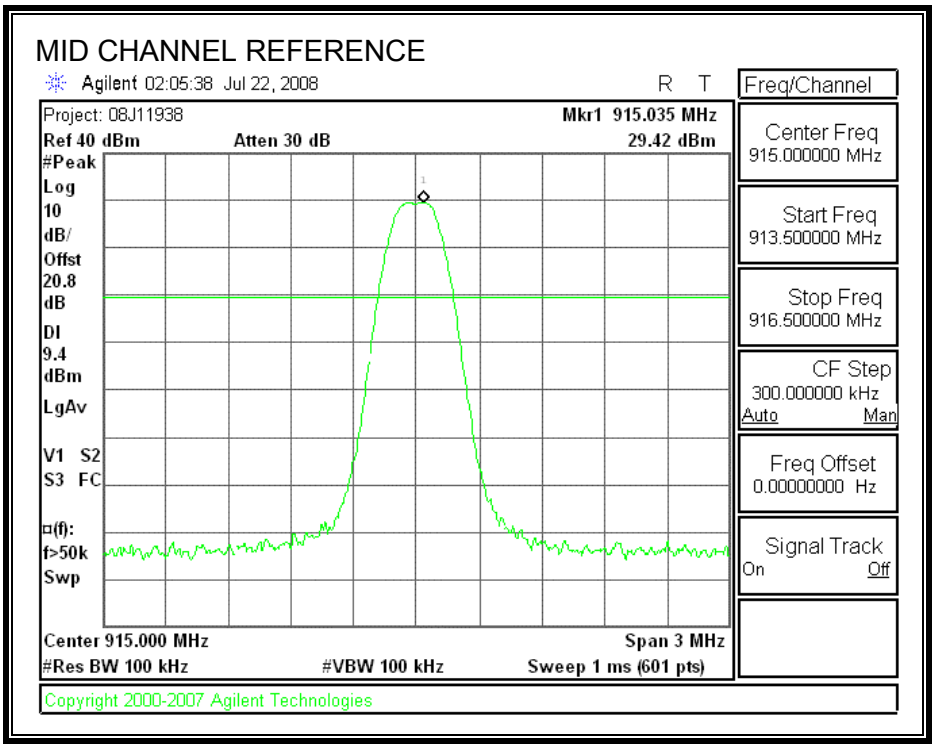
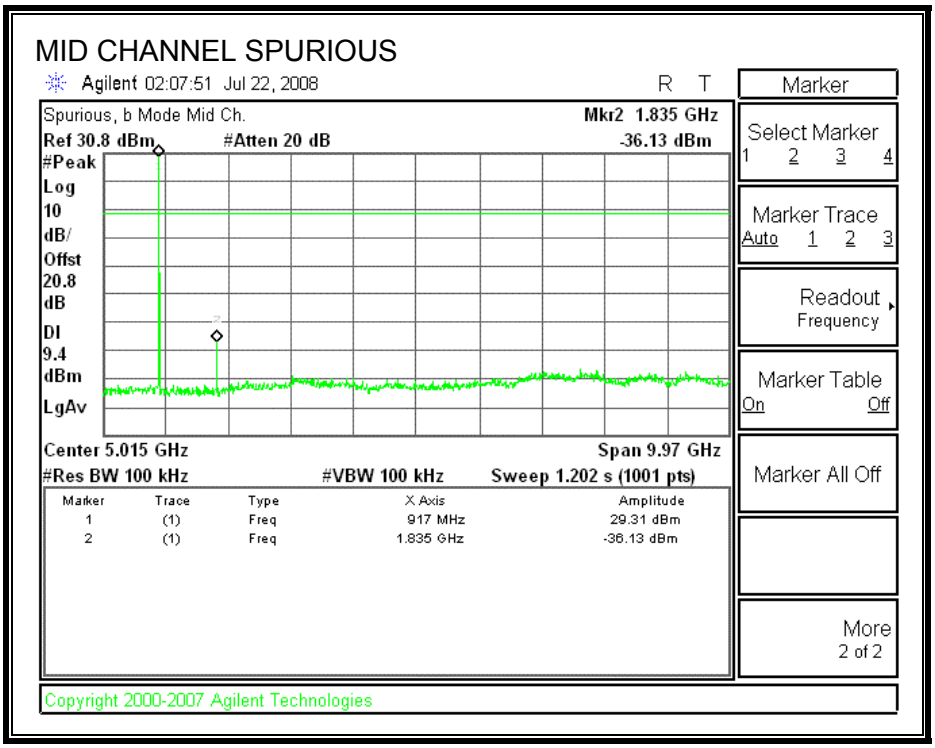
SPURIOUS EMISSIONS, MID CHANNEL





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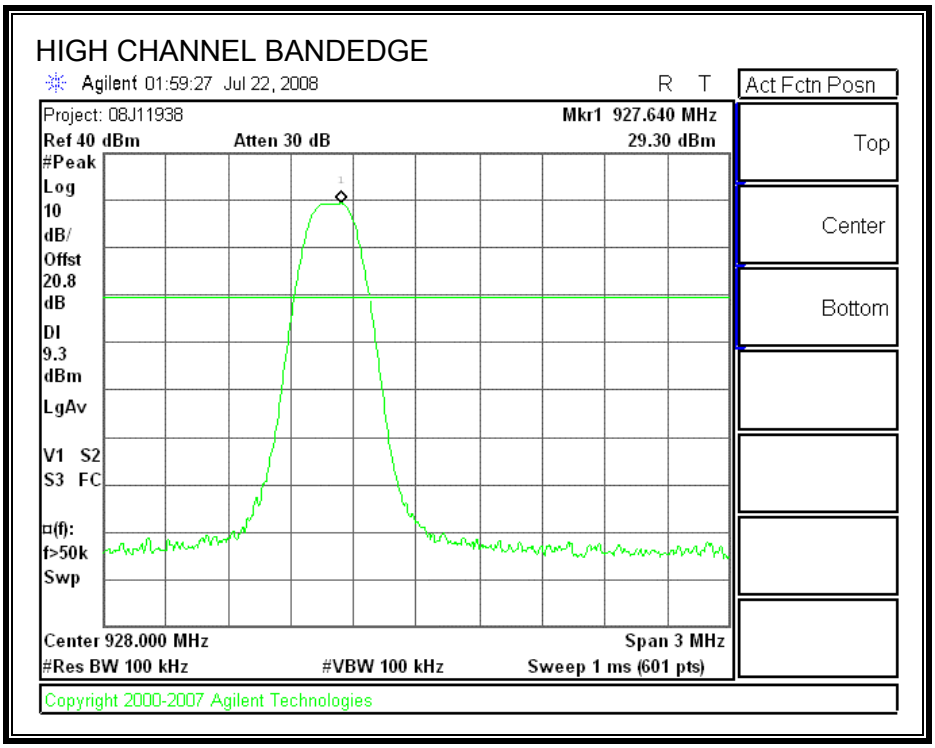
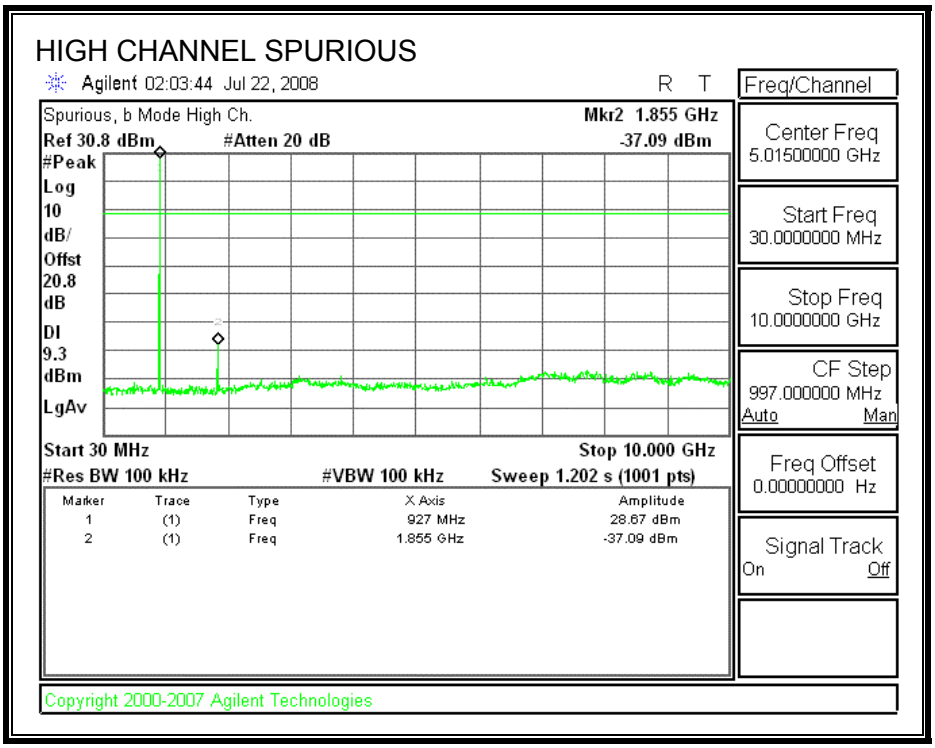
SPURIOUS EMISSIONS, HIGH CHANNEL





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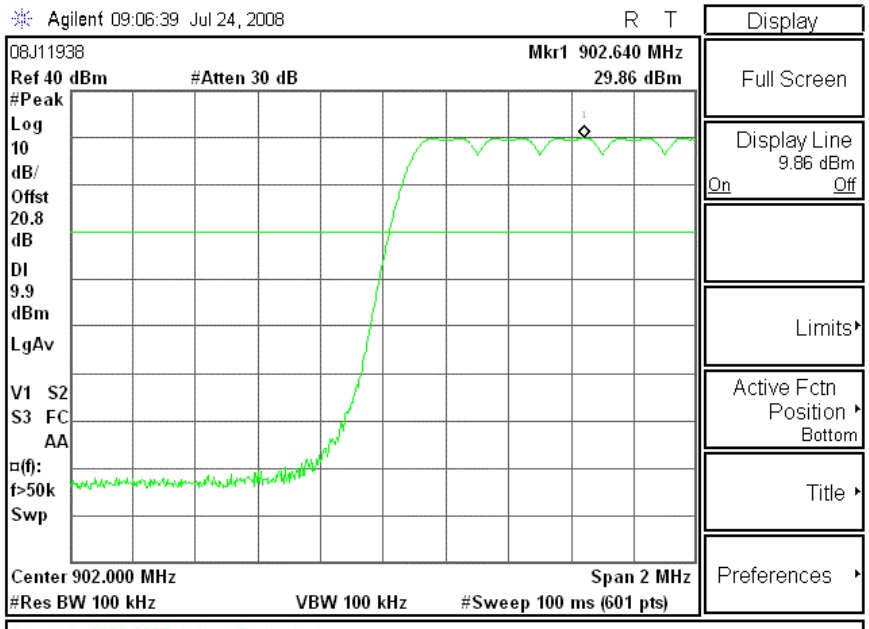
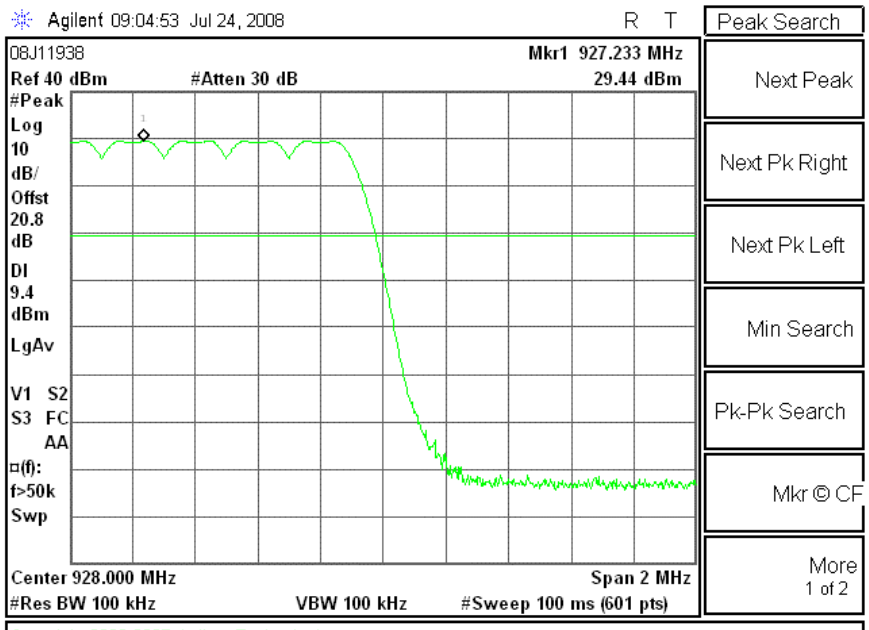
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



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250mW OUTPUT POWER

7.8. 20 dB AND 99% BANDWIDTH

LIMIT

The system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 3% of the 20 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	902.2	135.417	141.710
Middle	915.0	135.686	140.670
High	927.6	135.164	138.900

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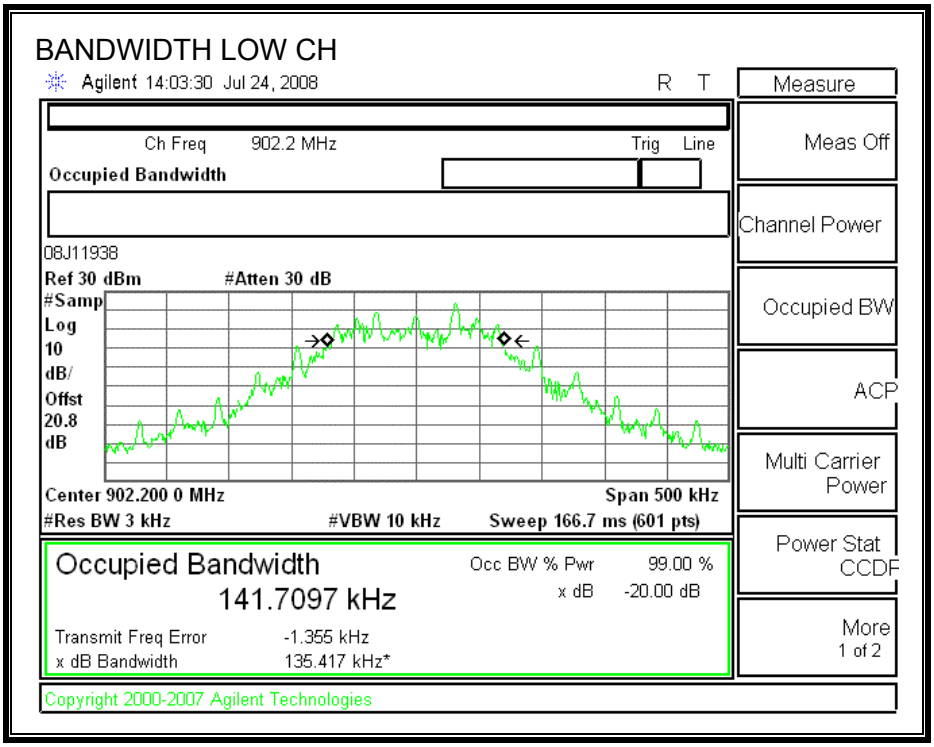

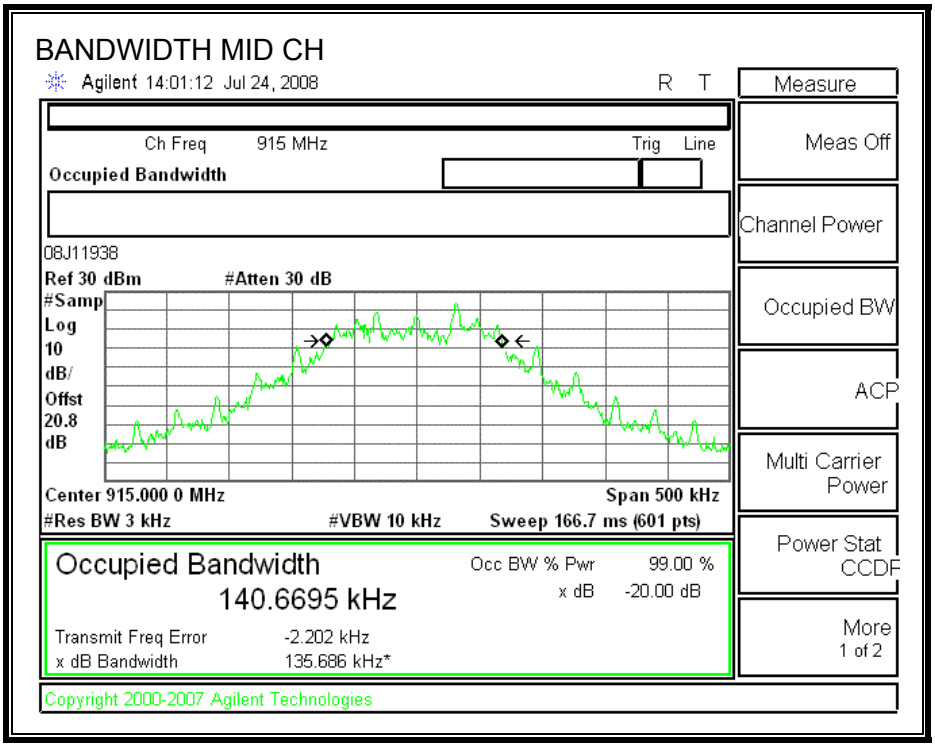

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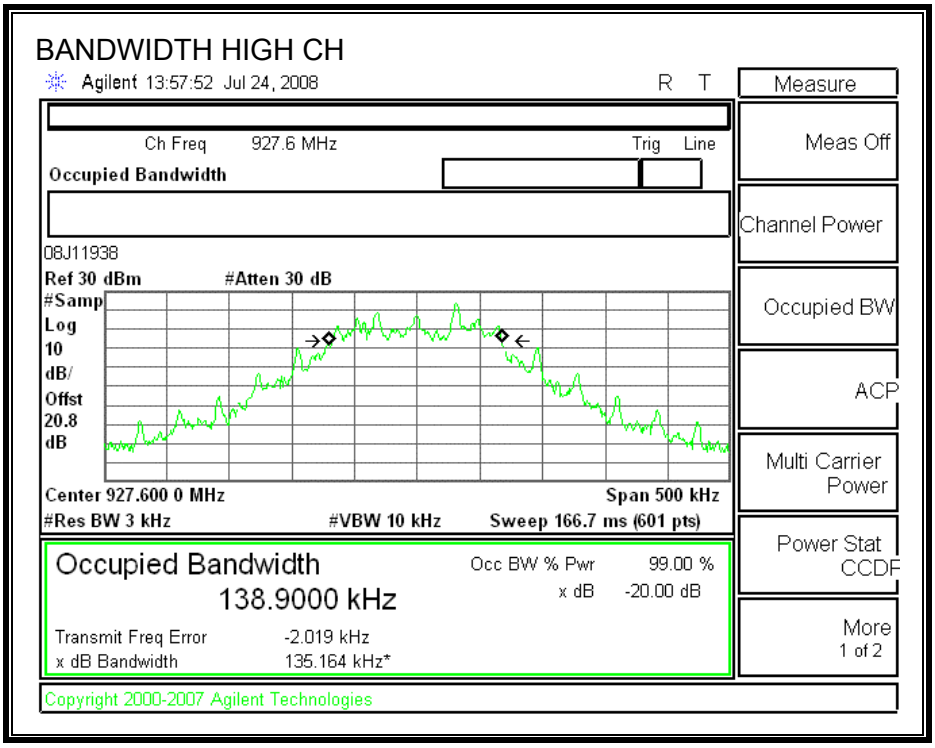

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7.9. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)
IC RSS-210 A8.1 (b)
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

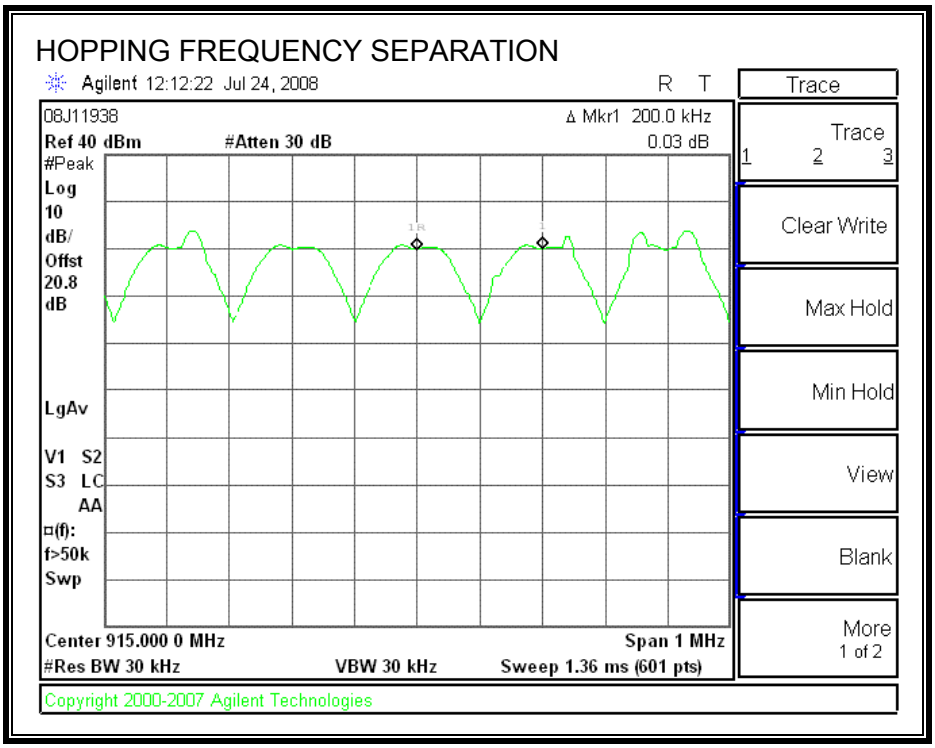
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	Hopping Separation (kHz)	>=25kHz or 20 dB BW (kHz)	Margin (kHz)
Mid	915	200	135.686	64.314

HOPPING FREQUENCY SEPARATION



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7.10. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)
IC RSS-210 A8.1 (d)
For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

128 Channels observed.

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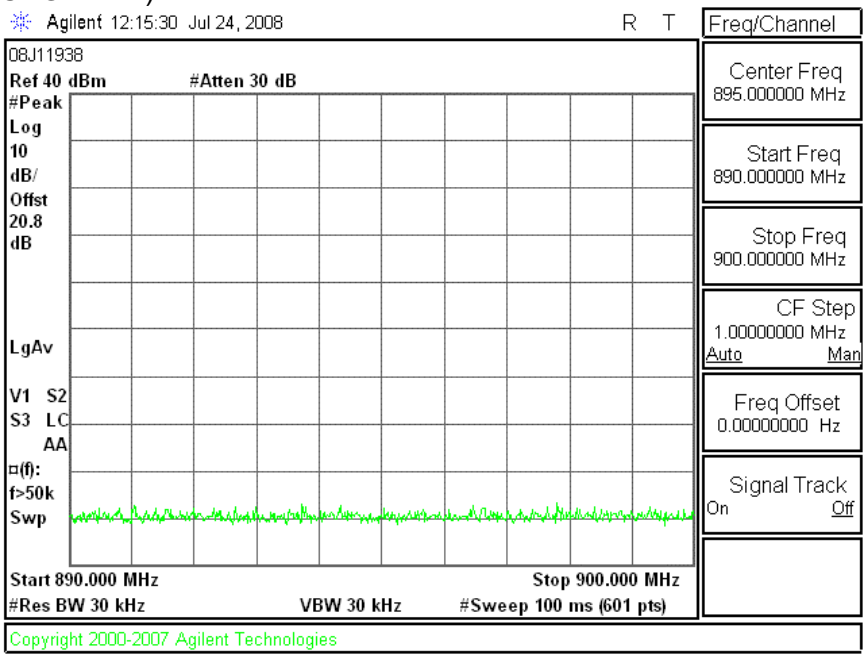
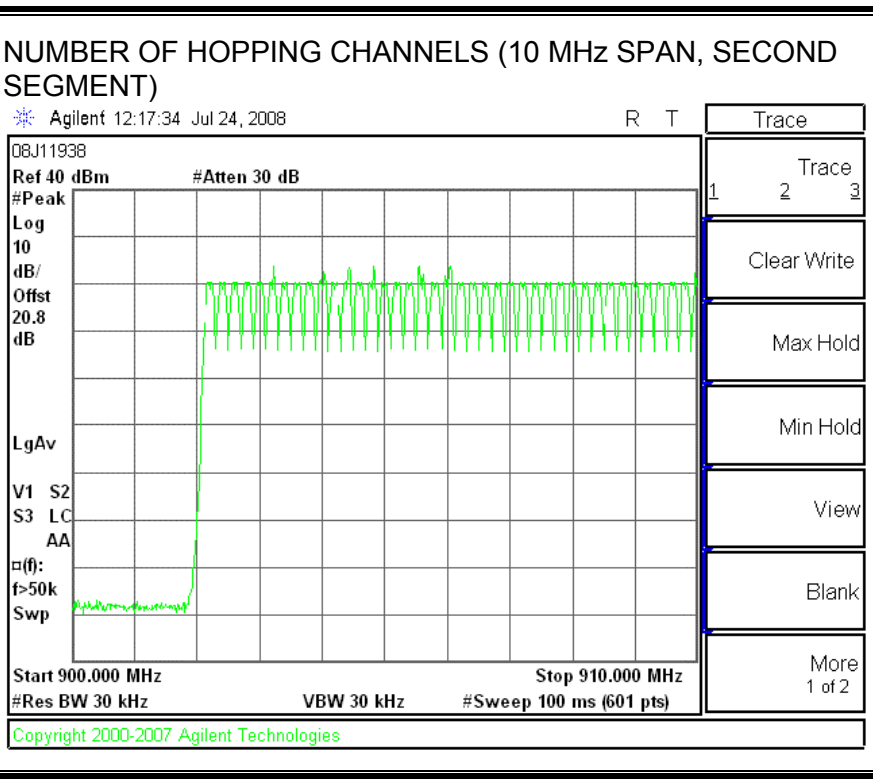
NUMBER OF HOPPING CHANNELS

NUMBER OF HOPPING CHANNELS (10 MHz SPAN, FIRST SEGMENT)



NUMBER OF HOPPING CHANNELS (10 MHz SPAN, SECOND SEGMENT)



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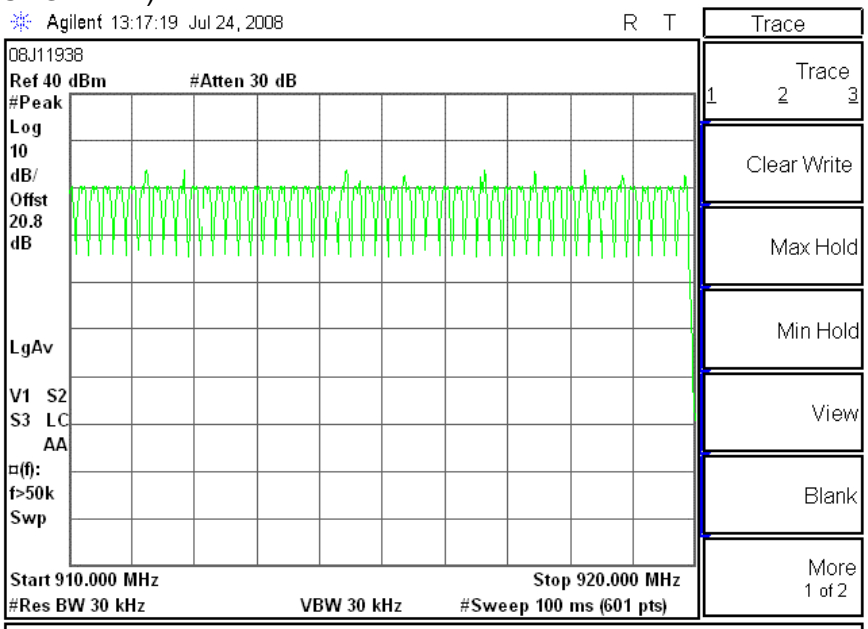
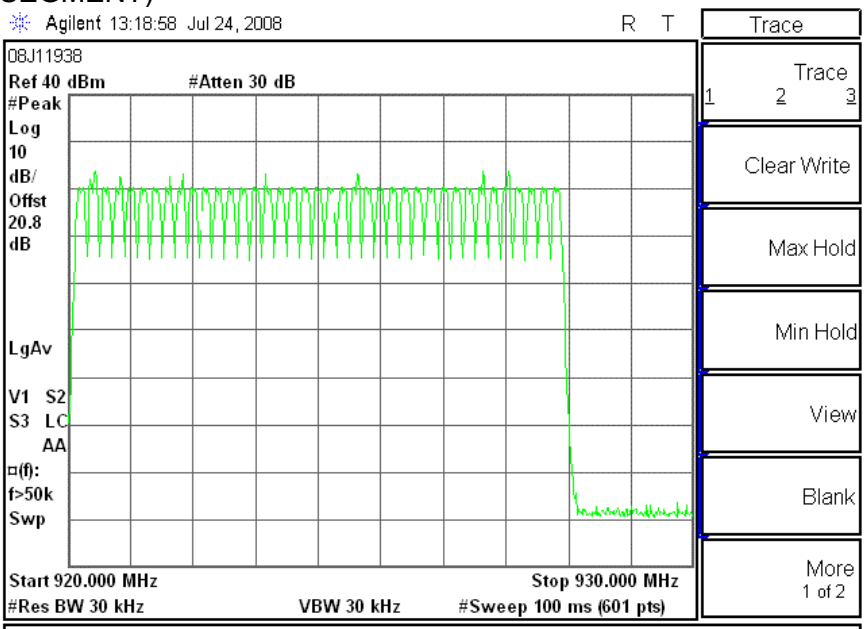
NUMBER OF HOPPING CHANNELS (10 MHz SPAN, THIRD SEGMENT)



NUMBER OF HOPPING CHANNELS (10 MHz SPAN, FOURTH SEGMENT)



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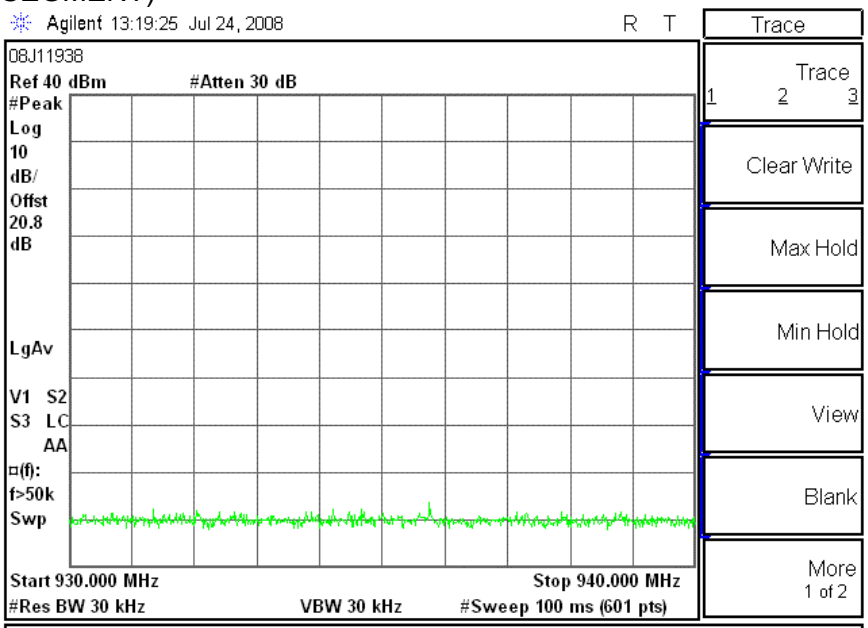
NUMBER OF HOPPING CHANNELS (10 MHz SPAN, FIFTH SEGMENT)



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7.11. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)
IC RSS-210 A8.1 (d)

§15.247 (a) (1) (i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a slow scan.

RESULTS

Pulse Width (msec)	Number of Pulses in 10 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
85.42	2	0.171	0.4	0.229

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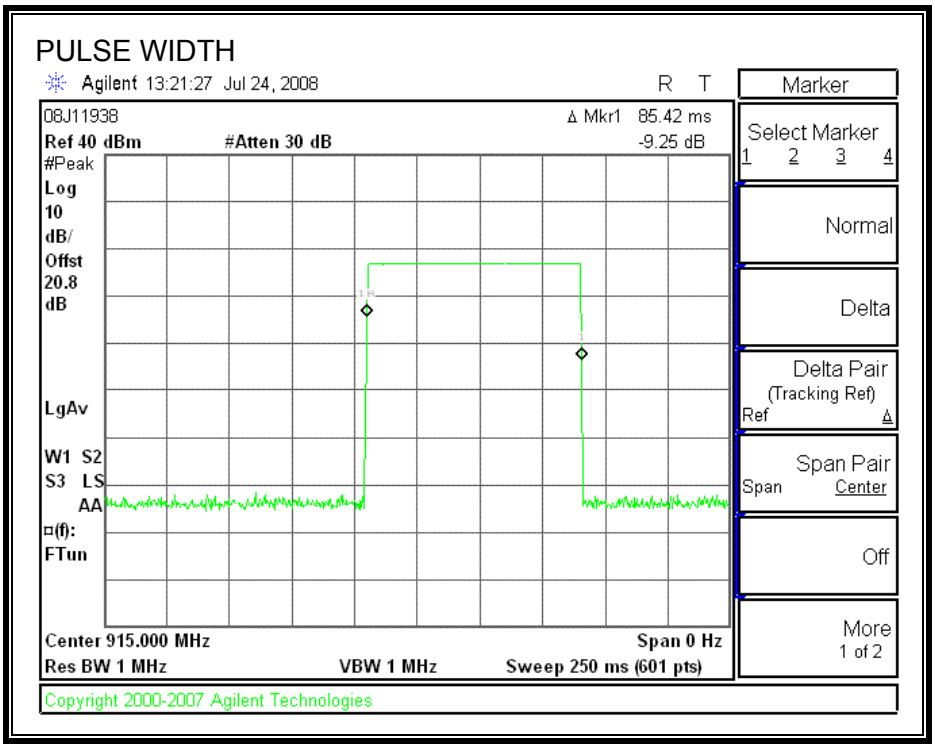
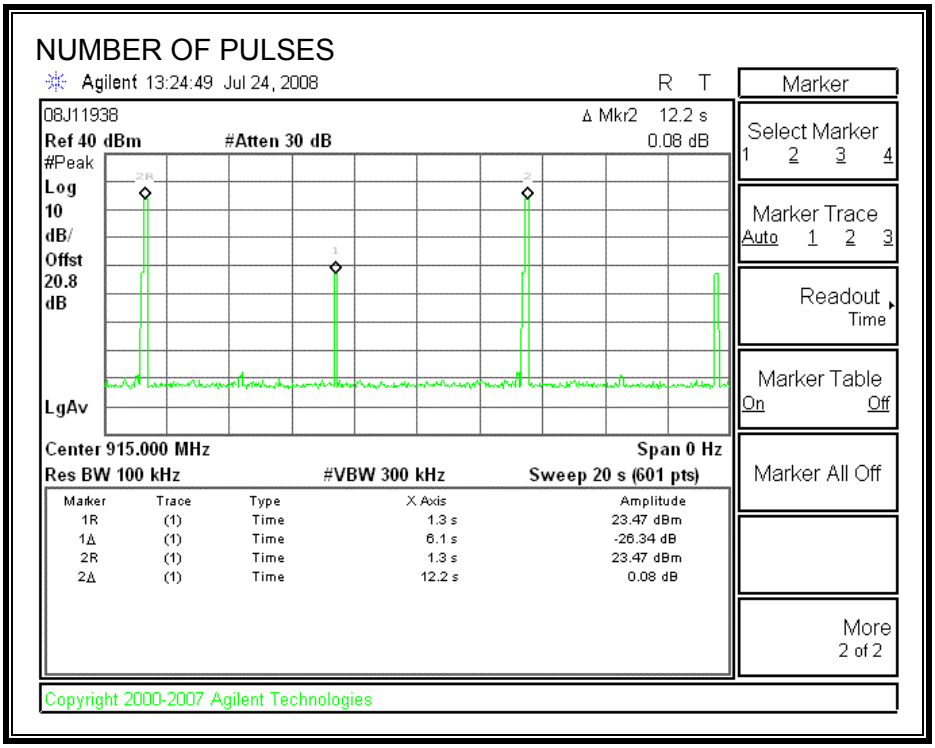
PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



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7.12. OUTPUT POWER

LIMIT

§15.247 (b) (1)
RSS-210 Issue 7 Clause A8.4

The maximum peak output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 902-928 MHz band , employing at least 50 hopping channels: 1 watt; and employing less than 50 hopping channels, but at least 25 hopping channels: 0.25 watt.

Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	902.2	24.03	30	-5.97
Middle	915.0	23.83	30	-6.17
High	927.6	23.73	30	-6.27

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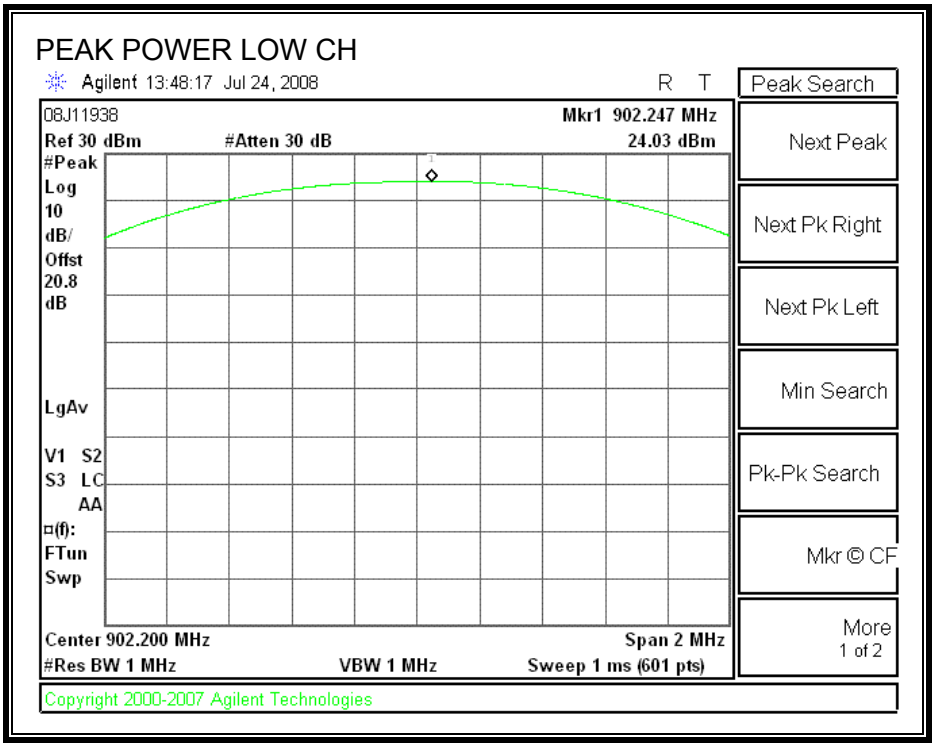
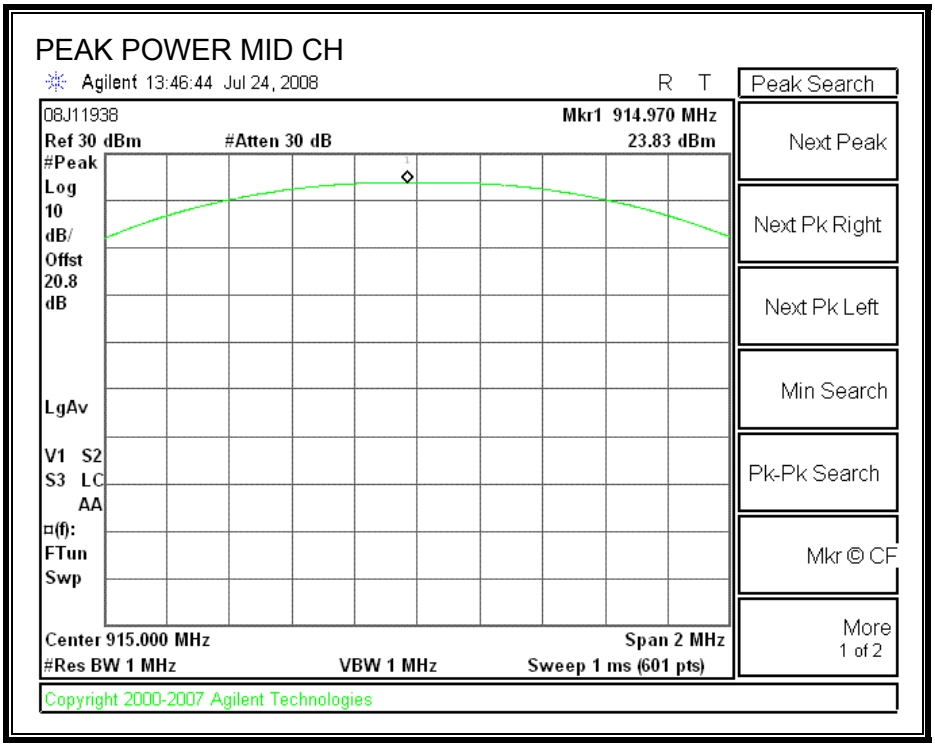
PEAK POWER LOW CH



PEAK POWER MID CH



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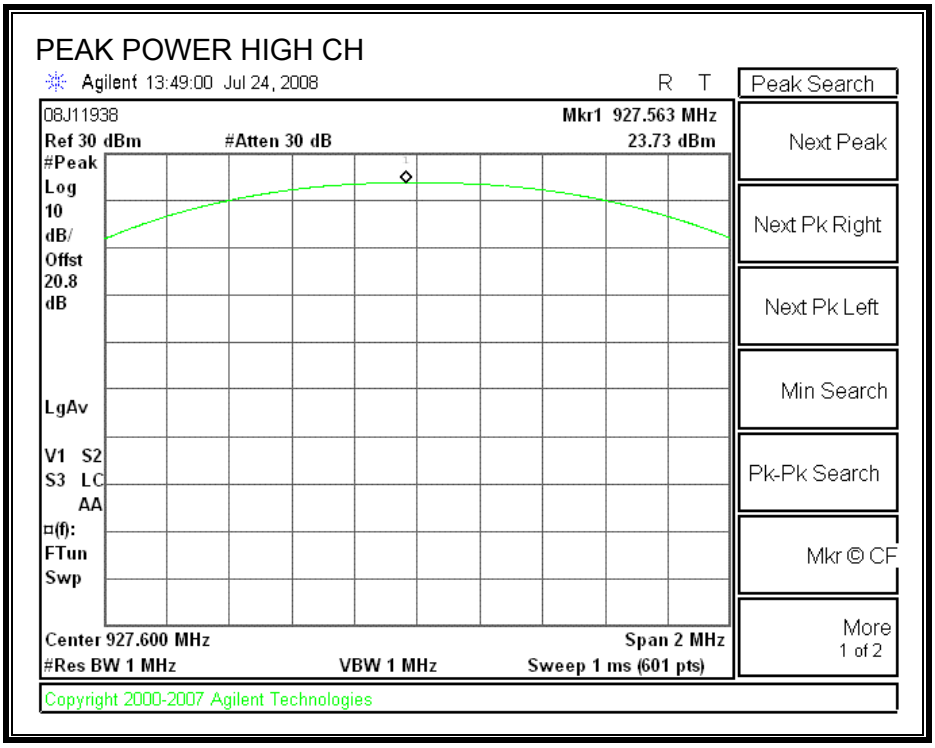
PEAK POWER HIGH CH



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7.13. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 20.8 dB (including 20 dB pad and 0.8 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	902.20	23.29
Middle	915.00	23.23
High	927.60	23.17

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7.14. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 10 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

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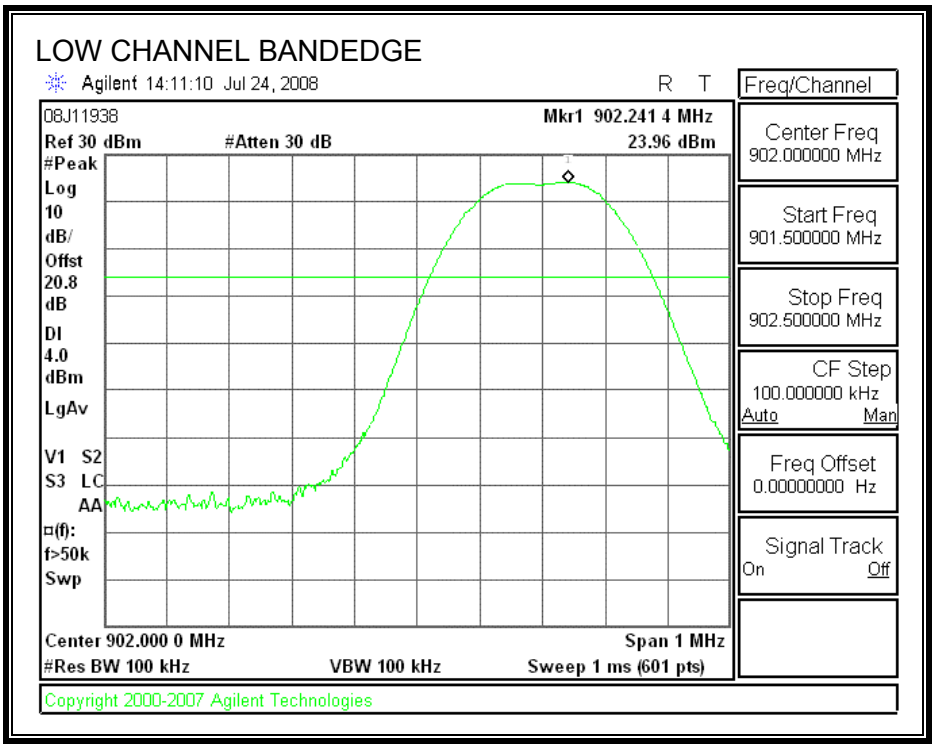
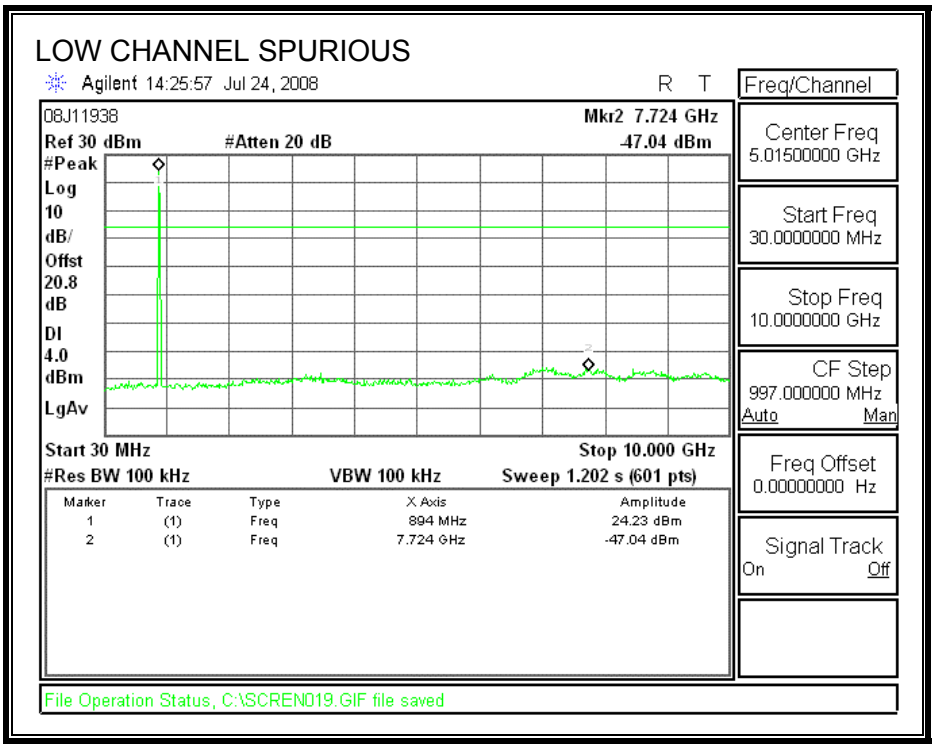
SPURIOUS EMISSIONS, LOW CHANNEL





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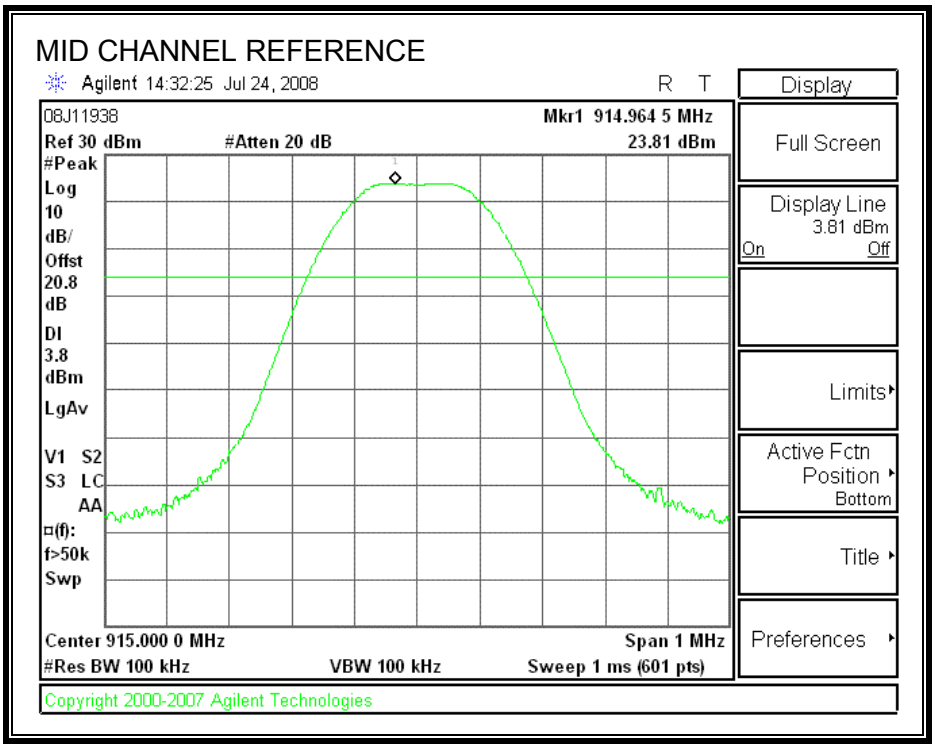
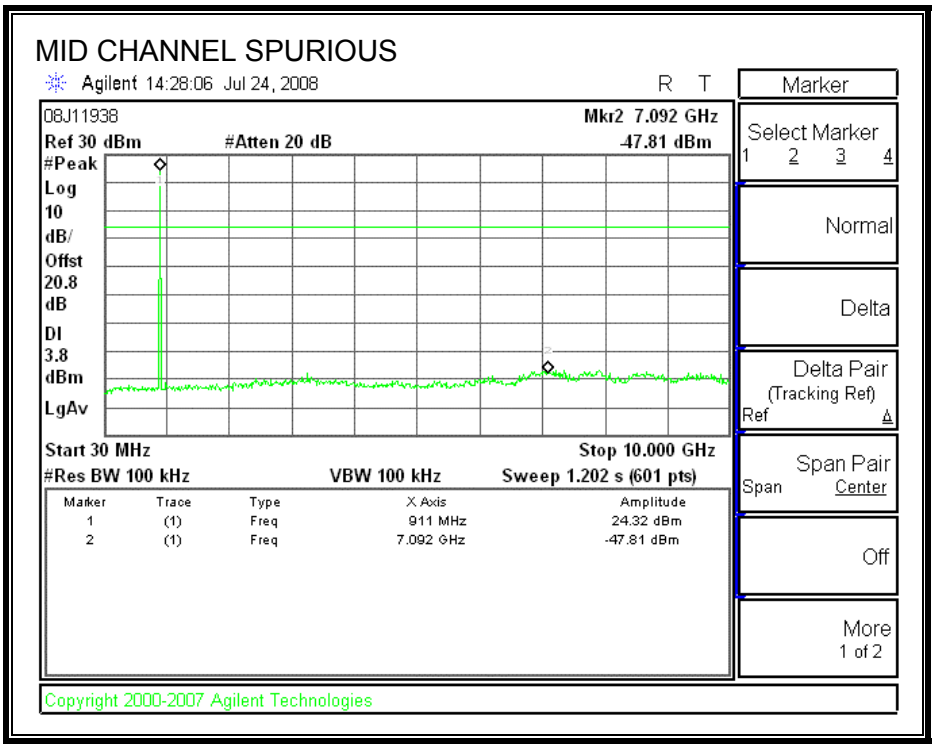
SPURIOUS EMISSIONS, MID CHANNEL





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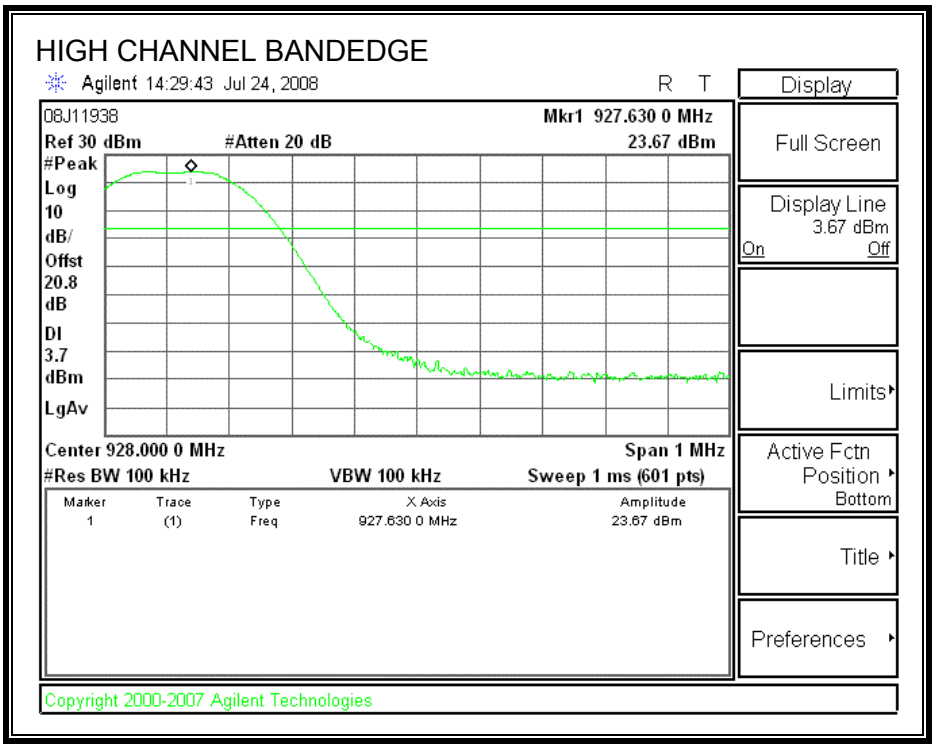
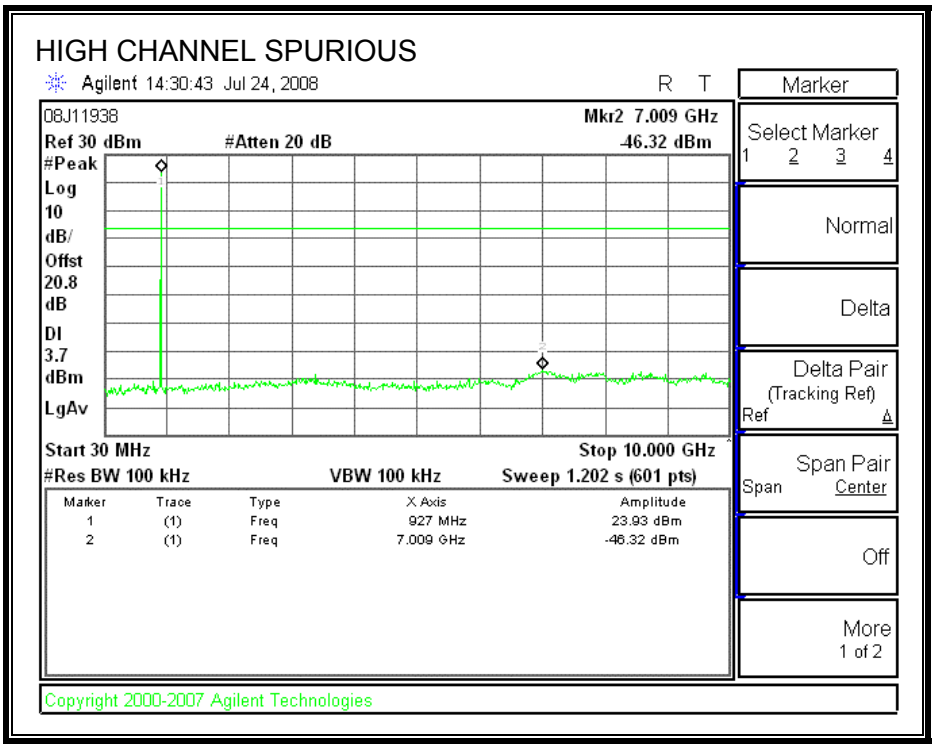
SPURIOUS EMISSIONS, HIGH CHANNEL





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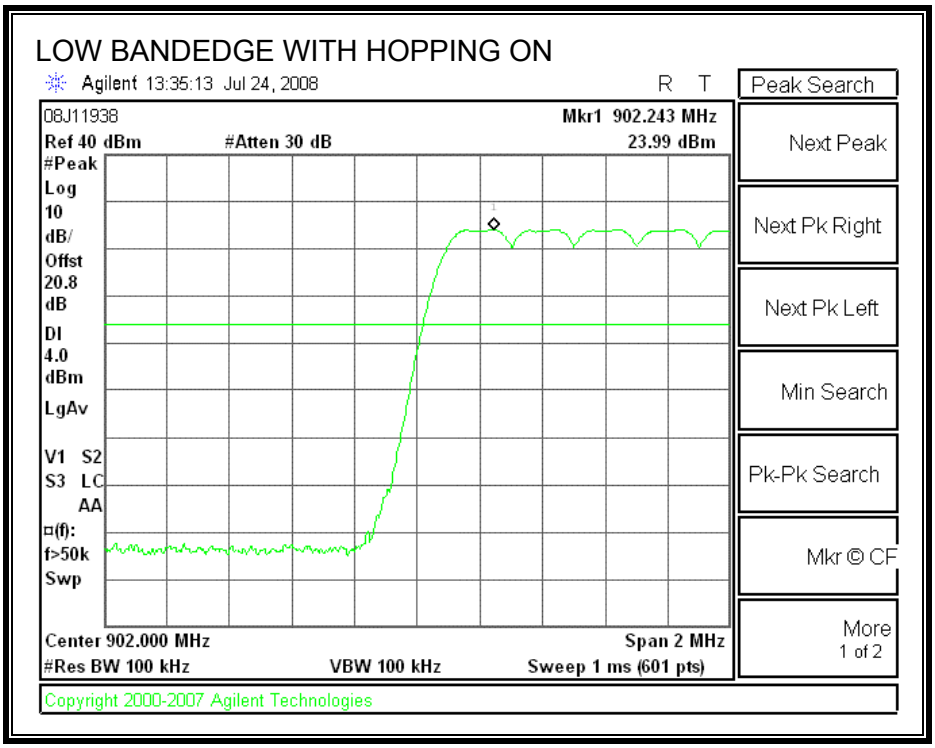
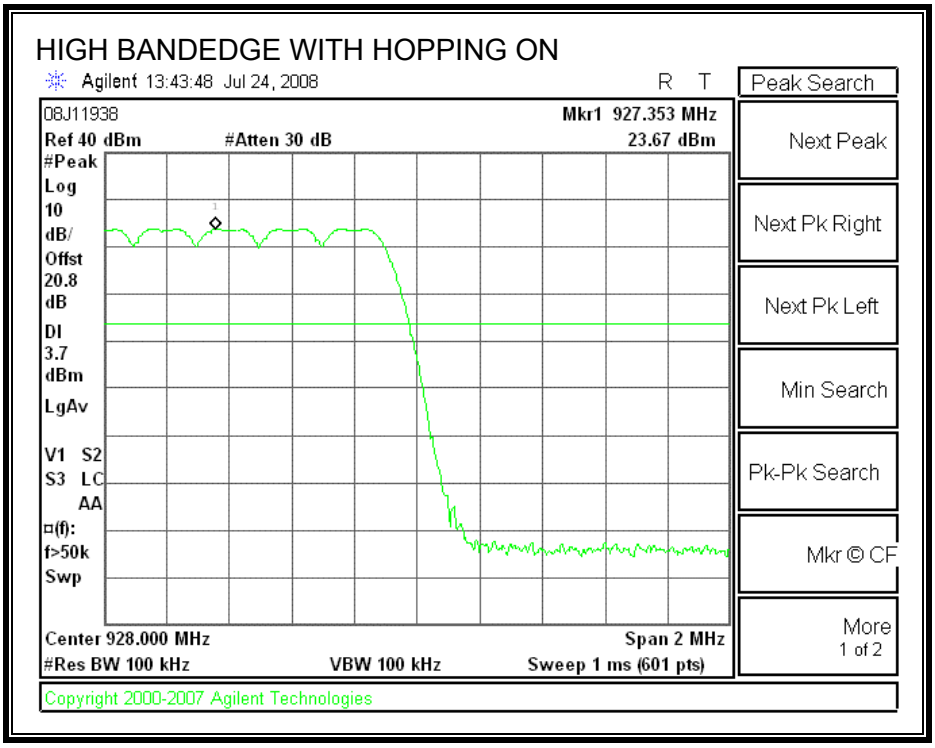
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



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8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

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 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 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.

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8.2. TRANSMITTER ABOVE 1 GHz

HARMONICS AND SPURIOUS EMISSIONS (HIGH POWER @ 1 W)

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: TOPCON
Project #: 08J11938
Date: 8/22/2008
Test Engineer: Can Ming Chung
Configuration: EUT 1 and Laptop
Mode: TX

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T136; M/N: 3117 @3m	T144 Miteq 3008A00931			FCC 15.109

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_1.5GHz	

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (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 Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
LOW CHANNEL (902.20 MHz)															V
2.706	3.0	55.3	53.4	31.2	5.1	-37.4	0.0	0.6	54.7	52.8	74	54	-19.3	-1.2	V
3.609	3.0	51.3	48.9	32.2	5.8	-36.9	0.0	0.6	53.0	50.6	74	54	-21.0	-3.4	V
4.511	3.0	50.3	47.0	32.6	6.6	-36.5	0.0	0.6	53.6	50.3	74	54	-20.4	-3.7	V
5.413	3.0	45.4	41.0	33.2	7.3	-36.3	0.0	0.5	50.1	45.7	74	54	-23.9	-8.3	V
8.120	3.0	41.7	36.8	34.9	8.7	-36.2	0.0	0.7	49.7	44.8	74	54	-24.3	-9.2	V
2.706	3.0	54.2	52.3	31.2	5.1	-37.4	0.0	0.6	53.6	51.7	74	54	-20.4	-2.3	H
3.609	3.0	50.5	47.7	32.2	5.8	-36.9	0.0	0.6	52.2	49.4	74	54	-21.8	-4.6	H
4.511	3.0	50.2	47.4	32.6	6.6	-36.5	0.0	0.6	53.5	50.7	74	54	-20.5	-3.3	H
5.413	3.0	45.6	42.3	33.2	7.3	-36.3	0.0	0.5	50.3	47.0	74	54	-23.7	-7.0	H
8.120	3.0	42.6	34.7	34.9	8.7	-36.2	0.0	0.7	50.6	42.7	74	54	-23.4	-11.3	H
LOW CHANNEL (915.00 MHz)															H
2.745	3.0	54.7	52.3	31.2	5.1	-37.4	0.0	0.6	54.2	51.8	74	54	-19.8	-2.2	V
3.660	3.0	52.7	50.4	32.3	5.9	-36.9	0.0	0.6	54.6	52.3	74	54	-19.4	-1.7	V
4.575	3.0	50.7	47.7	32.6	6.7	-36.5	0.0	0.6	54.0	51.0	74	54	-20.0	-3.0	V
5.490	3.0	45.1	38.9	33.3	7.4	-36.4	0.0	0.5	49.9	43.7	74	54	-24.1	-10.3	V
8.235	3.0	41.0	35.3	35.0	8.7	-36.3	0.0	0.7	49.1	43.4	74	54	-24.9	-10.6	V
2.745	3.0	54.3	51.7	31.2	5.1	-37.4	0.0	0.6	53.8	51.2	74	54	-20.2	-2.8	V
3.660	3.0	50.4	47.9	32.3	5.9	-36.9	0.0	0.6	52.3	49.7	74	54	-21.7	-4.3	H
4.575	3.0	50.8	48.0	32.6	6.7	-36.5	0.0	0.6	54.2	51.4	74	54	-19.8	-2.6	H
5.490	3.0	47.2	43.1	33.3	7.4	-36.4	0.0	0.5	52.0	47.9	74	54	-22.0	-6.1	H
8.235	3.0	41.4	34.1	35.0	8.7	-36.3	0.0	0.7	49.5	42.2	74	54	-24.5	-11.8	H
															H
HI CHANNEL, 927.6 MHz															H
2.783	3.0	53.5	51.4	31.3	5.1	-37.4	0.0	0.6	53.1	51.0	74	54	-20.9	-3.0	V
3.710	3.0	50.8	49.7	32.3	5.9	-36.8	0.0	0.6	52.8	51.7	74	54	-21.2	-2.3	V
4.638	3.0	53.0	50.5	32.6	6.7	-36.5	0.0	0.6	56.4	53.9	74	54	-17.6	-0.1	V
5.565	3.0	47.2	44.3	33.4	7.4	-36.4	0.0	0.5	52.0	49.1	74	54	-22.0	-4.9	V
8.348	3.0	42.1	33.0	35.0	8.8	-36.4	0.0	0.7	50.3	41.2	74	54	-23.7	-12.8	V
2.783	3.0	51.4	49.4	31.3	5.1	-37.4	0.0	0.6	51.0	49.0	74	54	-23.0	-5.0	V
3.710	3.0	49.9	47.9	32.3	5.9	-36.8	0.0	0.6	51.9	49.9	74	54	-22.1	-4.1	H
4.638	3.0	51.8	49.2	32.6	6.7	-36.5	0.0	0.6	55.2	52.7	74	54	-18.8	-1.3	H
5.565	3.0	48.5	43.9	33.4	7.4	-36.4	0.0	0.5	53.3	48.7	74	54	-20.7	-5.3	H
8.348	3.0	42.1	34.1	35.0	8.8	-36.4	0.0	0.7	50.3	42.3	74	54	-23.7	-11.7	H

Rev. 4.12.7

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		

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HARMONICS AND SPURIOUS EMISSIONS (HIGH POWER @ 250 mW)

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: TOPCON
Project #: 08J11938
Date: 8/26/2008
Test Engineer: Chin Pang
Configuration: EUT 2 and Laptop
Mode: TX (low power at 250mw)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T34 HP 8449B			FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
	Thanh 187215003	C-5m Chamber	HPF_1.5GHz	

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (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 Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch, 902.20 MHz															
2.707	3.0	56.2	53.4	30.9	2.1	-36.1	0.0	0.6	53.6	50.8	74	54	-20.4	-3.2	V
3.609	3.0	47.6	36.8	31.4	2.3	-35.3	0.0	0.6	46.6	35.8	74	54	-27.4	-18.2	V
4.511	3.0	44.0	32.0	32.0	2.5	-34.9	0.0	0.6	44.2	32.2	74	54	-29.8	-21.8	V
5.413	3.0	45.3	34.0	32.7	3.1	-34.7	0.0	0.5	46.9	35.6	74	54	-27.1	-18.4	V
2.707	3.0	54.6	51.8	30.9	2.1	-36.1	0.0	0.6	52.0	49.2	74	54	-22.0	-4.8	H
3.609	3.0	53.2	51.6	31.4	2.3	-35.3	0.0	0.6	52.1	50.6	74	54	-21.9	-3.4	H
4.511	3.0	44.4	33.6	32.0	2.5	-34.9	0.0	0.6	44.6	33.8	74	54	-29.4	-20.2	H
5.413	3.0	45.6	35.5	32.7	3.1	-34.7	0.0	0.5	47.2	37.1	74	54	-26.8	-16.9	H
Mid Ch, 915MHz															
2.745	3.0	56.0	53.4	30.9	2.1	-36.1	0.0	0.6	53.5	50.9	74	54	-20.5	-3.1	V
3.660	3.0	47.3	38.4	31.4	2.3	-35.3	0.0	0.6	46.3	37.4	74	54	-27.7	-16.6	V
4.575	3.0	45.0	32.0	32.1	2.5	-34.9	0.0	0.6	45.3	32.3	74	54	-28.7	-21.7	V
2.745	3.0	53.2	50.5	30.9	2.1	-36.1	0.0	0.6	50.7	48.0	74	54	-23.3	-6.0	H
3.660	3.0	49.5	42.7	31.4	2.3	-35.3	0.0	0.6	48.5	41.7	74	54	-25.5	-12.3	H
4.575	3.0	46.3	38.0	32.1	2.5	-34.9	0.0	0.6	46.6	38.3	74	54	-27.4	-15.7	H
HighCh, 927.6MHz															
2.783	3.0	54.0	50.3	31.0	2.1	-36.1	0.0	0.6	51.6	47.9	74	54	-22.4	-6.1	V
3.710	3.0	49.0	43.8	31.5	2.3	-35.2	0.0	0.6	48.1	42.9	74	54	-25.9	-11.1	V
4.638	3.0	47.0	39.4	32.1	2.5	-34.9	0.0	0.6	47.3	39.7	74	54	-26.7	-14.3	V
2.783	3.0	53.8	50.0	31.0	2.1	-36.1	0.0	0.6	51.4	47.6	74	54	-22.6	-6.4	H
3.710	3.0	48.0	41.6	31.5	2.3	-35.2	0.0	0.6	47.1	40.7	74	54	-26.9	-13.3	H
4.638	3.0	46.7	39.2	32.1	2.5	-34.9	0.0	0.6	47.0	39.5	74	54	-27.0	-14.5	H

Rev. 4.12.7

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		

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8.3. RECEIVER ABOVE 1 GHz (WORST CASE)

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	TOPCON
Project #:	08J11938
Date:	8/22/2008
Test Engineer:	Can Ming Chung
Configuration:	EUT 1 alone
Mode:	RX

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T136; M/N: 3117 @3m	T144 Miteq 3008A00931			RX RSS 210

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber		

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (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 Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.090	3.0	46.6	32.2	27.5	3.1	-39.4	0.0	0.0	37.8	23.4	74	54	-36.2	-30.6	V
2.230	3.0	41.5	33.4	30.6	4.6	-37.7	0.0	0.0	38.9	30.9	74	54	-35.1	-23.1	V
1.050	3.0	49.4	35.1	27.4	3.1	-39.4	0.0	0.0	40.4	26.1	74	54	-33.6	-27.9	H
2.137	3.0	43.2	32.6	30.6	4.5	-37.9	0.0	0.0	40.4	29.8	74	54	-33.6	-24.2	H

Rev. 4.12.7

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		

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8.4. TRANSMITTER WORST-CASE BELOW 1 GHz

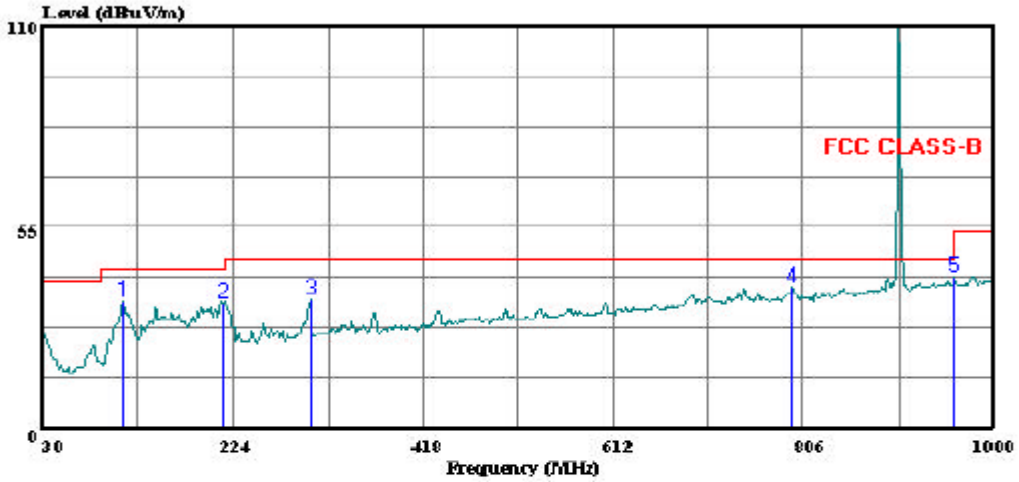
LOW CHANNELS, 902.2 MHz

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

HORIZONTAL

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 14 File#: 08J11938.EMI Date: 07-21-2008 Time: 10:54:23



Trace: 11 Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT with laptop
Mode : : TX low channel
Target: : FCC Class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	111.480	52.44	-17.70	34.74	43.50	-8.76	Peak
2	215.270	50.79	-16.38	34.40	43.50	-9.10	Peak
3	303.540	49.82	-14.38	35.44	46.00	-10.56	Peak
4	795.330	41.96	-3.59	38.37	46.00	-7.63	Peak
5	960.230	41.15	0.07	41.22	54.00	-12.78	Peak

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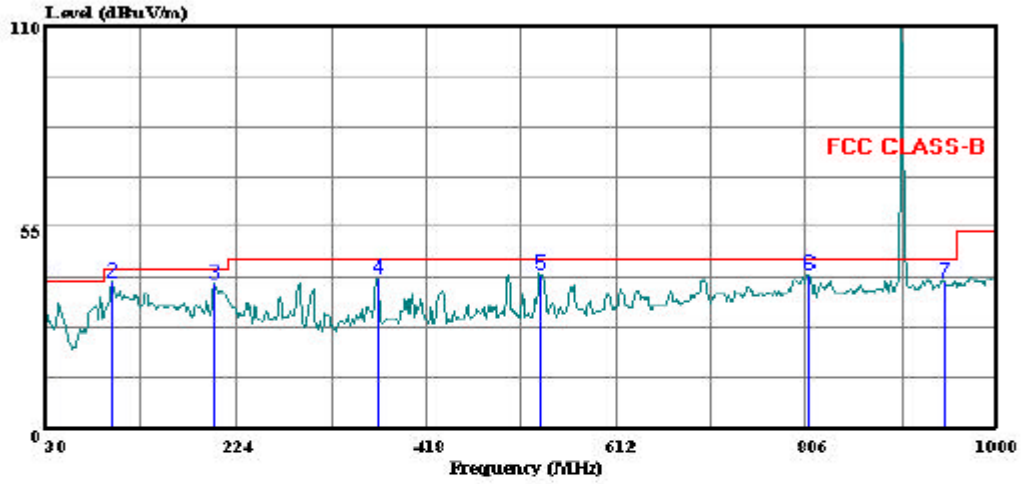
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 13 File#: 08J11938.EMI Date: 07-21-2008 Time: 10:53:42



Trace: 12 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT with laptop
Mode : : TX low channel
Target: : FCC Class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	30.000	48.27	-10.79	37.48	40.00	-2.52	Peak
2	96.930	60.73	-20.67	40.06	43.50	-3.44	Peak
3	201.690	55.98	-16.39	39.59	43.50	-3.91	Peak
4	368.530	53.30	-12.47	40.83	46.00	-5.17	Peak
5	535.370	50.16	-8.18	41.98	46.00	-4.02	Peak
6	808.910	45.29	-3.38	41.91	46.00	-4.09	Peak
7	946.650	40.33	-0.27	40.06	46.00	-5.94	Peak

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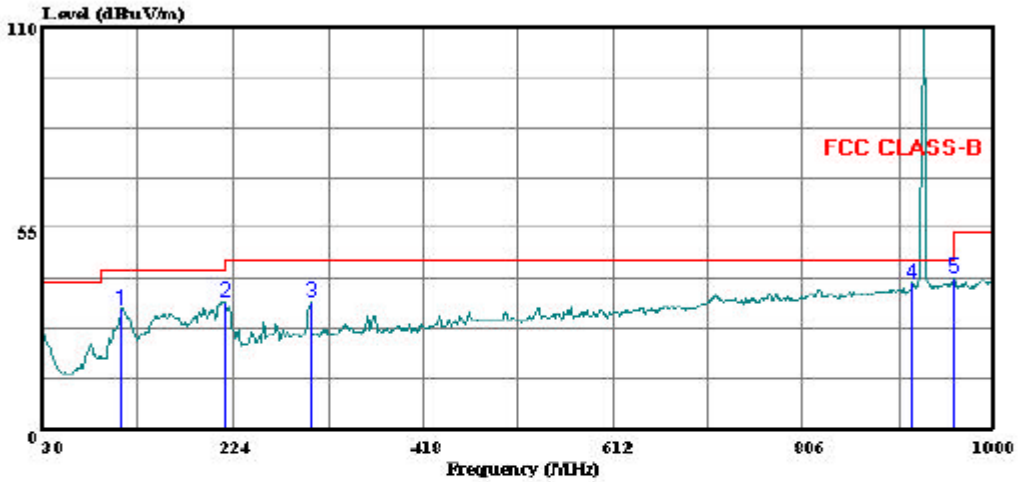
HIGH CHANNELS, 927.6 MHz

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

HORIZONTAL

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 18 File#: 08J11938.EMI Date: 07-21-2008 Time: 11:15:28



Trace: 17 Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT with laptop
Mode : : TX Hi channeL
Target: : FCC Class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	110.510	50.75	-17.95	32.80	43.50	-10.70	Peak
2	216.240	51.34	-16.39	34.95	46.00	-11.05	Peak
3	303.540	49.17	-14.38	34.79	46.00	-11.21	Peak
4	916.580	40.97	-0.98	39.99	46.00	-6.01	Peak
5	960.230	41.44	0.07	41.51	54.00	-12.49	Peak

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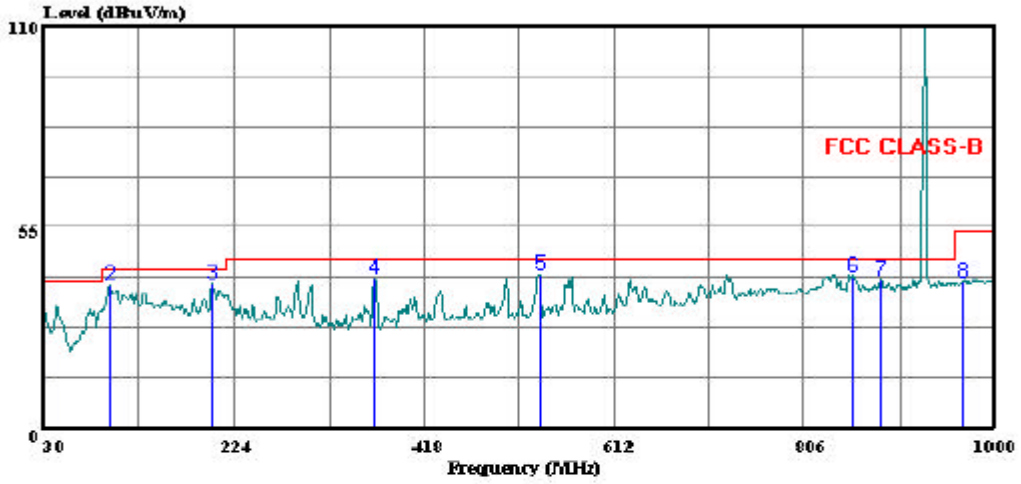
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 16 File#: 08J11938.EMI Date: 07-21-2008 Time: 11:12:08



Trace: 15 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT with laptop
Mode : : TX Hi channeL
Target: : FCC Class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	30.000	47.43	-10.79	36.64	40.00	-3.36	Peak
2	96.930	59.60	-20.67	38.93	43.50	-4.57	Peak
3	201.690	56.03	-16.39	39.64	43.50	-3.86	Peak
4	367.560	53.30	-12.53	40.77	46.00	-5.23	Peak
5	536.340	50.09	-8.30	41.79	46.00	-4.21	Peak
6	855.470	43.93	-2.31	41.62	46.00	-4.38	Peak
7	884.570	41.93	-1.58	40.34	46.00	-5.66	Peak
8	968.960	39.75	0.36	40.10	54.00	-13.90	Peak

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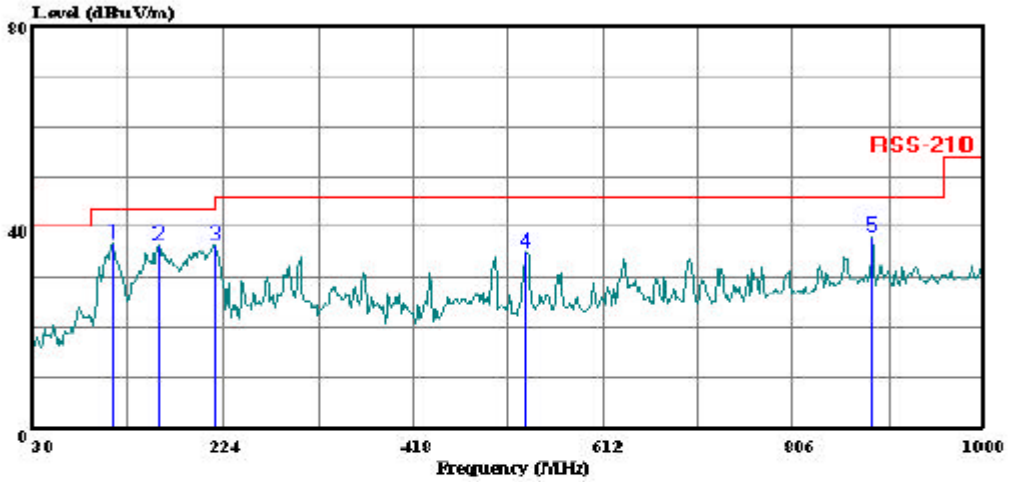
8.5. RECEIVER WORST-CASE BELOW 1 GHz

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

HORIZONTAL

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 22 File#: 08J11938.EMI Date: 07-21-2008 Time: 11:33:09



Trace: 21 Ref Trace:

Condition: RSS-210 HORIZONTAL
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT with laptop
Mode : : Rx Worst case
Target: : FCC Class B (RSS-210)

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	111.480	54.36	-17.70	36.66	43.50	-6.84	Peak
2	158.040	54.13	-17.74	36.39	43.50	-7.11	Peak
3	216.240	52.80	-16.39	36.41	46.00	-9.59	Peak
4	533.430	43.02	-8.12	34.90	46.00	-11.10	Peak
5	887.480	39.66	-1.55	38.11	46.00	-7.89	Peak

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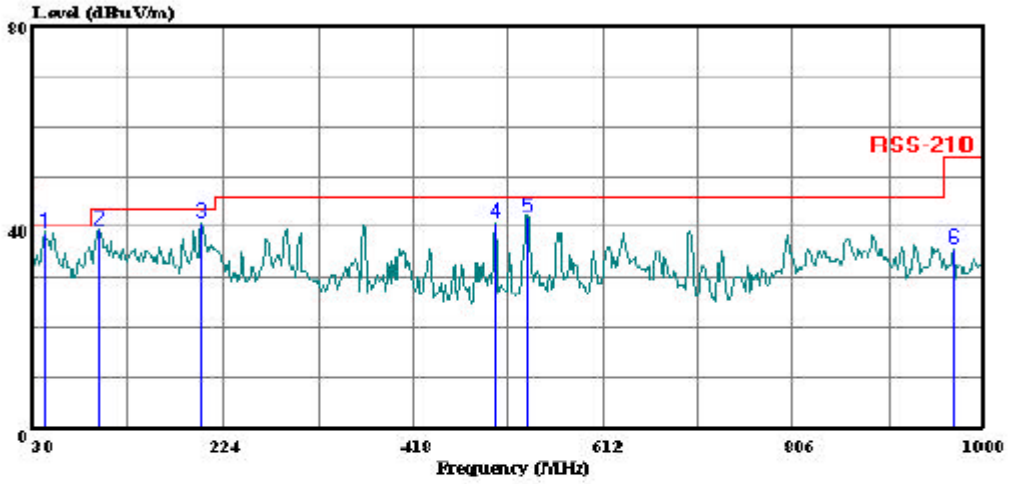
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 24 File#: 08J11938.EMI Date: 07-21-2008 Time: 11:41:58



Trace: 23 Ref Trace:

Condition: RSS-210 VERTICAL
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT with laptop
Mode : : Rx Worst case
Target: : FCC Class B (RSS-210)

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	42.610	58.69	-19.95	38.73	40.00	-1.27	Peak
2	96.930	60.17	-20.67	39.50	43.50	-4.00	Peak
3	201.690	57.30	-16.39	40.91	43.50	-2.59	Peak
4	502.390	49.51	-8.73	40.78	46.00	-5.22	Peak
5	535.370	50.18	-8.18	41.99	46.00	-4.01	Peak
6	969.930	35.31	0.32	35.63	54.00	-18.37	Peak

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9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

Note: EUT is in charging mode, transmitting is OFF.

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6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	FCC_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.16	59.71	--	40.61	0.00	65.57	55.57	-5.86	-14.96	L1
0.24	50.93	--	33.51	0.00	62.13	52.13	-11.20	-18.62	L1
18.33	39.47	--	26.65	0.00	60.00	50.00	-20.53	-23.35	L1
0.16	59.61	--	42.13	0.00	65.57	55.57	-5.96	-13.44	L2
0.24	51.36	--	34.62	0.00	62.13	52.13	-10.77	-17.51	L2
18.33	41.16	--	27.06	0.00	60.00	50.00	-18.84	-22.94	L2
6 Worst Data									

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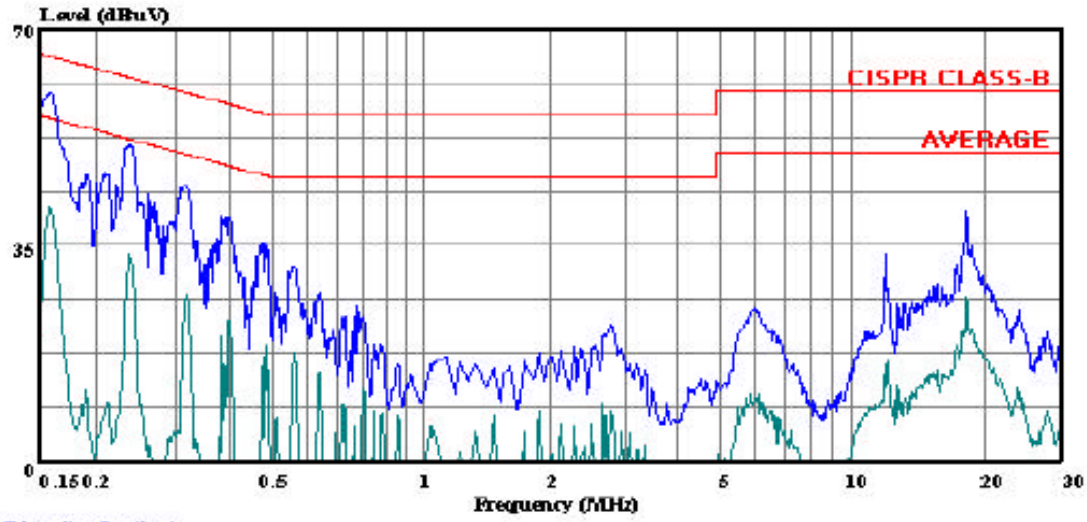
LINE 1 RESULTS

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 21 File#: 08j11938.emi Date: 07-23-2008 Time: 15:10:12



(Line Conduction)

Trace: 19 Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT alone
Mode: : In Charging (Transmitting OFF)
Target: : FCC Class B
Voltage: : 115VAC / 60Hz
: L1: Peak (Blue); Average (Green)

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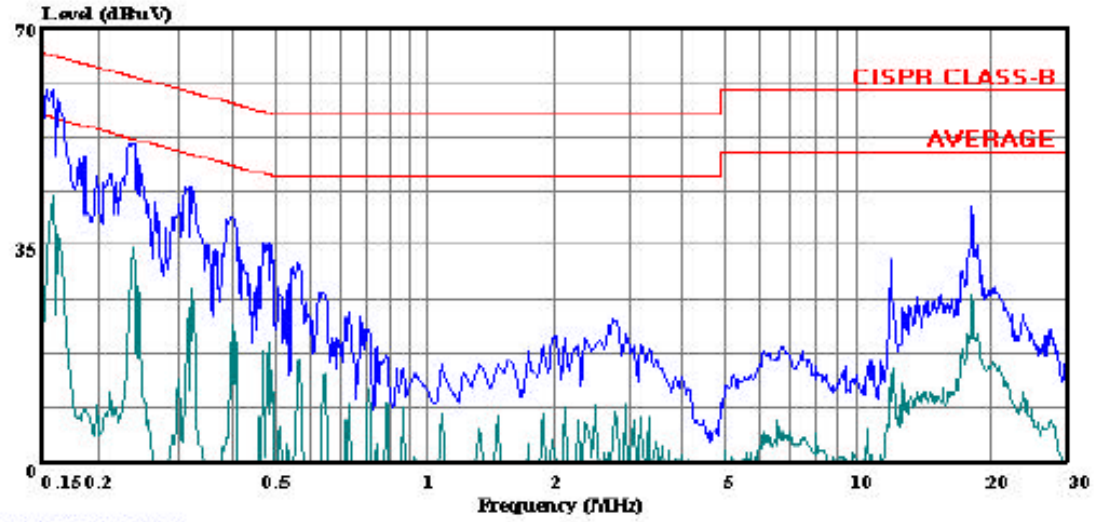
LINE 2 RESULTS

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 28 File#: 08j11938.emi Date: 07-23-2008 Time: 15:19:36



(Line Conduction)

Trace: 26 Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Vien Tran
Project #: : 08J11938
Company: : Topcon
Configuration:: EUT Alone
Mode: : In charging (Transmitting OFF)
Target: : FCC Class B
Voltage: : 115VAC / 60Hz
: L2: Peak (Blue); Average (Green)

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10. 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^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

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IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

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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^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/cm^2 is converted to units of W/m^2 by multiplying by a factor of 10.

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LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
FHSS	915MHz	20.0	29.85	2.40	0.33	3.34

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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/cm^2

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

Mode	Band	Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
Bluetooth	2.4 GHz	1.98	2.00			
FHSS	915MHz	29.85	2.40			
Combined				20.0	0.33	3.34

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