



LS Research, LLC



Testing Cert. # 1255.01

W66 N220 Commerce Court • Cedarburg, WI 53012 • USA

Phone: 262.375.4400 • Fax: 262.375.4248

www.lsr.com

TEST REPORT # LSR R-567 TX LSR Job #:R-567

Compliance Testing of:
RateSaver

Test Date(s):
August 28th to September 3rd 2008

Prepared For:
LS Research, LLC
W66 N220 Commerce Court
Cedarburg, WI 53012

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Transmitters (DTS) Operating in the
Frequency Band 2400 MHz – 2483.5 MHz

This Test Report is issued under the Authority of:
Thomas T. Smith, Mgr. of EMC Test Services

Signature:

Date: September 5, 2008

Test Report Reviewed by:
Teresa A. White, Quality Manager

Signature:

Date: September 5, 2008

Tested by:
Khairul Aidi Zainal, Senior EMC Engineer

Signature:

Date: September 5, 2008

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LSC Revision Control

Date	Revision #	Revised By
9-06-06	2.0	AS/TAW

EXHIBIT 1. INTRODUCTION

1.1 SCOPE

References:	FCC Part 15, Subpart C, Section 15.247 FCC Part 2, Section 2.1043 paragraph (b)1.
Title:	Telecommunication – Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Digital Modulation Transmitters operating in the Frequency Band of 2400 MHz – 2483.5 MHz
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	<ul style="list-style-type: none"> • Commercial, Industrial or Business • Residential

1.2 NORMATIVE REFERENCES

Publication	Year	Title
47 CFR, Parts 0-15 (FCC)	2007	Code of Federal Regulations - Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-1-1	2006 A1: 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	2007	Measurement of Digital Transmission Systems operating under Section 15.247.

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1.3 LS Research, LLC TEST FACILITY

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation may be accessed on our web site: www.lsr.com. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at LS Research, LLC:

- Compact Chamber
- Semi-Anechoic Chamber
- Open Area Test Site (OATS)

1.5 TEST EQUIPMENT UTILIZED

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated in accordance with A2LA standards.

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EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	LS Research LLC
Address:	W66 N220 Commerce Ct. Cedarburg, WI 53012

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	RateSaver
Model Number:	RS-SE-24-01
Serial Number:	n/a

2.3 ASSOCIATED ANTENNA DESCRIPTION

PCB trace antenna.

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2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Frequency Range (in MHz)	2400 MHz to 2483.5 MHz
RF Power in Watts	0.199 Watts
Conducted Output Power (in dBm)	23.0 dBm
Field Strength (and at what distance)	127.2 dBuV/m at 1m (2405MHz)
Occupied Bandwidth	20dB: 2.68 MHz/ 2680 kHz 6dB : 1.64 MHz/ 1640 kHz
Type of Modulation	O-QPSK
Emission Designator	2M68G1D
EIRP (in mW)	175 mW
Transmitter Spurious (worst case)	56.1 dBuV/m at 1m (17325MHz)
Frequency Tolerance %, Hz, ppm	>100ppm
Microprocessor Model # (if applicable)	TI MSP430F2370IRHA
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	PCB trace antenna.
Gain (in dBi)	-0.6 dBi (calculated from measurement over conducting ground plane of the channel with maximum field strength.)
EUT will be operated under FCC Rule and IC Part(s)	CFR 47 15.247 RSS 210, Issue 7 (2007)
Modular Filing	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Portable or Mobile?	Mobile

RF Technical Information:

Type of Evaluation (check one)	<input type="checkbox"/>	SAR Evaluation: Device Used in the Vicinity of the Human Head
	<input type="checkbox"/>	SAR Evaluation: Body-worn Device
	<input checked="" type="checkbox"/>	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

- Evaluated against exposure limits: General Public Use Controlled Use
- Duty Cycle used in evaluation: 100%
- Standard used for evaluation: 15.247
- Measurement Distance: 1 m
- RF Value: 0.346 V/m A/m W/m²
 Measured Computed Calculated

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2.5 PRODUCT DESCRIPTION

In-home display unit to allow consumer to monitor energy usage and costs via wireless link to utility meter. Typical application would be stuck on kitchen refrigerator door (via internal magnets). The device is capable of communicating with Smart Energy Profile Compliant Energy Service Portals (ESP) within utility meters.

PHOTO (Optional)



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EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	70°
Humidity:	50%
Pressure:	737 mmHg

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Paragraph	Test Requirements	Compliance (yes/no)
15.207	Power Line Conducted Emissions Measurements	N/A
15.247(a)(2)	6 dB Bandwidth of a Digital Modulation System	Yes
15.247(b) & 1.1310	Maximum Output Power	Yes
15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(c)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d)	Transmitted Power Spectral Density of a Digital Modulation System	Yes
15.247(c), 15.209 & 15.205	Transmitter Radiated Emissions	Yes

The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers. The Receiver Test Report is available upon request.

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None Yes (explain below)

Power level for channel 19 (2475MHz) was lowered to -6 to satisfy upper band edge requirements.

Note: Channel numbering is in HEX.

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

None Yes (explain below)

Although the fundamental and the band edge measurements were made on 4 channels, the harmonics measurements were made on the lowest, medium and highest channel at full power (instead of reduced power on the highest channel). Based on sound engineering principles, it would be valid to conclude that if the harmonics on the highest channel operating at full power are below the limit, the harmonics of the remaining channels operating at reduced power levels will also.

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EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 7 (2007), Section Annex 8 (section 8.2) for a Digital Spread Spectrum (DTS) Transmitter.

If some emissions are seen to be within 3 dB of their respective limits:

As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

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EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit mode, using power as provided by a bench DC power supply (Normal operation of EUT is with batteries). The unit was tested with fresh batteries, replaced as needed. The unit has the capability to operate on 4 channels, controllable via hyper-terminal on a laptop PC.

The applicable limits apply at a 3 meter distance. Measurements above 1 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of 4 (4) standard channels: 2405 MHz, 2440 MHz, 2470 MHz and 2475 MHz to comply with FCC Part 15.35. The channels and operating modes were changed using a hyper-terminal connection from a PC.

5.2 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. From 18 GHz to 25 GHz, the EUT was measured at a 0.3 meter separation, using a standard gain Horn Antenna and pre-amplifier.

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5.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz. From 4 GHz to 18 GHz, an HP E4446A Spectrum Analyzer and an EMCO Horn Antenna were used. From 18 GHz to 25 GHz, the HP E4446A Spectrum Analyzer with a standard gain horn, and preamp were used.

Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
EMI Receiver	HP	8546A	3617A00320
EMI Receiver Pre-Select.	HP	85460A	3448A00296
Spectrum Analyzer	Agilent	E4446A	US45300564
Log Periodic Antenna	EMCO	93146	9701-4855
Horn Antenna	EMCO	3115	6907
Bicon Antenna	EMCO	93110B	9702-2918
Pre-Amp	Adv. Microwave	WLA612	1145A04094
Horn Antenna – Std. Gain	EMCO	3160-09	9809-1120

5.4 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for a DTS transmitter [Canada RSS-210, Issue 7 (2007), Annex 8 (section 8.2)]. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

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5.5 CALCULATION OF RADIATED EMISSIONS LIMITS

The maximum peak output power of an intentional radiator in the 2400-2483.5 MHz band, as specified in Title 47 CFR 15.247 (b)(3), is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d), shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c).

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands.

Frequency (MHz)	3 m Limit $\mu\text{V/m}$	3 m Limit (dB $\mu\text{V/m}$)	1 m Limit (dB $\mu\text{V/m}$)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

Sample conversion from field strength $\mu\text{V/m}$ to dB $\mu\text{V/m}$:

$$\begin{aligned} \text{dB}\mu\text{V/m} &= 20 \log_{10} (100) \\ &= 40 \text{ dB}\mu\text{V/m (from 30-88 MHz)} \end{aligned}$$

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

$$\begin{aligned} &960 \text{ MHz to } 10,000 \text{ MHz} \\ &500\mu\text{V/m or } 54.0 \text{ dB}/\mu\text{V/m at } 3 \text{ meters} \\ &54.0 + 9.5 = 63.5 \text{ dB}/\mu\text{V/m at } 1 \text{ meter} \end{aligned}$$

For measurements made at 0.3 meter, a 20 dB correction has been invoked.

$$\begin{aligned} &960 \text{ MHz to } 10,000 \text{ MHz} \\ &500\mu\text{V/m or } 54.0 \text{ dB}/\mu\text{V/m at } 3 \text{ meters} \\ &54.0 + 20 = 74 \text{ dB}/\mu\text{V/m at } 0.3 \text{ meters} \end{aligned}$$

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5.6

RADIATED EMISSIONS DATA CHART

3 Meter Measurements of Electromagnetic Radiated Emissions

Test Standard: 47CFR, Part 15.205 and 15.247(DTS)

Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	LS Research LLC				
Date(s) of Test:	August 28 th to September 3 rd 2008				
Test Engineer(s):	Khairul Aidi Zainal				
Voltage:	3.3 VDC				
Operation Mode:	continuous transmit				
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %				
EUT Power:		Single Phase ___ VAC		3 Phase ___ VAC	
		Battery	√	Other: Bench DC supply	
EUT Placement:	√	80cm non-conductive table		10cm Spacers	
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS	
Measurements:		Pre-Compliance		Preliminary	√ Final
Detectors Used:		Peak	√	Quasi-Peak	√ Average

The following table depicts the level of significant spurious radiated RF emissions found:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.205 Limit (dBμV/m)	Margin (dB)
120.0	V/V	1.00	159	20.1	43.0	22.9
168.0	V/V	1.00	154	24.4	43.0	18.6
2381.2	V/V	1.00	273	57.8	63.5	5.7

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RADIATED EMISSIONS DATA CHART (continued)

The following table depicts the level of significant radiated RF fundamental emissions seen at 1m separation distance:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
2405	V/V	1.00	269	127.2	134.8	7.6
2440	V/V	1.00	267	126.0	134.8	8.8
2470	V/V	1.00	276	124.6	134.8	10.2
2475	V/V	1.00	262	117.5	134.8	17.3

The following table depicts the level of significant harmonic emissions seen on channel 2405 MHz:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI Peak (dBμV/m)	Measured EFI Average (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
4810	H/V	1.00	122	59.7	49.4	63.5	14.1
7215	H/V	1.00	5	65.5	54.8	107.2	52.4
9620	V/V	1.00	140	63.2	53.1	107.2	54.1
12025	V/V	1.19	320	61.2	51.2	63.5	12.3
14430	V/V	1.00	194	64.2	54.1	107.2	53.1
16835	H/V	1.10	133	64.8	54.0	107.2	53.2
19240	H/V	1.00	158	53.7	43.5	73.9	30.4
21645	V/V	1.00	68	57.2	46.6	117.6	71.0
24050					Note 3		

The following table depicts the level of significant harmonic emissions seen on channel 2440 MHz:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI Peak (dBμV/m)	Measured EFI Average (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
4880	H/V	1.30	12	58.4	48.1	63.5	15.4
7320	H/V	1.00	0	65.7	55.1	63.5	8.4
9760	V/V	1.00	132	61.2	51.1	106.0	54.9
12200	V/V	1.17	143	64.5	54.3	63.5	9.2
14640	V/V	1.00	154	60.4	50.2	106	55.8
17080	H/V	1.12	136	65.6	55.4	106	50.6
19520	H/V	1.00	142	56.0	46.2	73.9	27.7
21960	V/V	1.00	90	55.9	45.4	116.5	71.1
24400					Note 3		

Notes:

- 1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
- 2) Measurements above 1GHz were made at 1 meters of separation from the EUT, and at 0.3 m separation for frequencies between 18 – 25 GHz.
- 3) Measurement at receiver system noise floor.
- 4) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.

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Harmonic measurements of the last channel (2475MHz) were made with the channel transmitting at maximum power (power level 3) even though in normal operation the channel transmit power will be set at -6. This is done to confirm that the harmonics of the adjacent lower channel (2470MHz) will comply.

The following table depicts the level of significant harmonic emissions seen on channel 2475MHz:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI Peak (dBμV/m)	Measured EFI Average (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
4950	H/V	1.17	13	57.4	47.1	63.5	16.4
7425	H/V	1.00	2	64.2	53.5	63.5	10
9900	V/V	1.00	181	58.8	48.9	97.5	48.6
12375	V/V	1.17	152	63.2	52.7	63.5	10.8
14850	V/V	1.05	156	63.0	52.8	97.5	44.7
17325	H/V	1.08	137	66.5	56.1	97.5	41.4
19800	H/V	1.00	141	51.9	41.6	73.9	32.3
22275	V/V	1.00	268	52.9	42.1	73.9	31.8
24750					Note 3		

Notes:

- 1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
- 2) Measurements above 1GHz were made at 1 meters of separation from the EUT, and at 0.3 m separation for frequencies between 18 – 25 GHz.
- 3) Measurement at receiver system noise floor.
- 4) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.

Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
Report #: LSR R-567 TX	FCC ID #: TFB-RATESAVER	Page 16 of 42

5.7 Test Setup Photo(s) – Radiated Emissions Test

EUT in vertical orientation



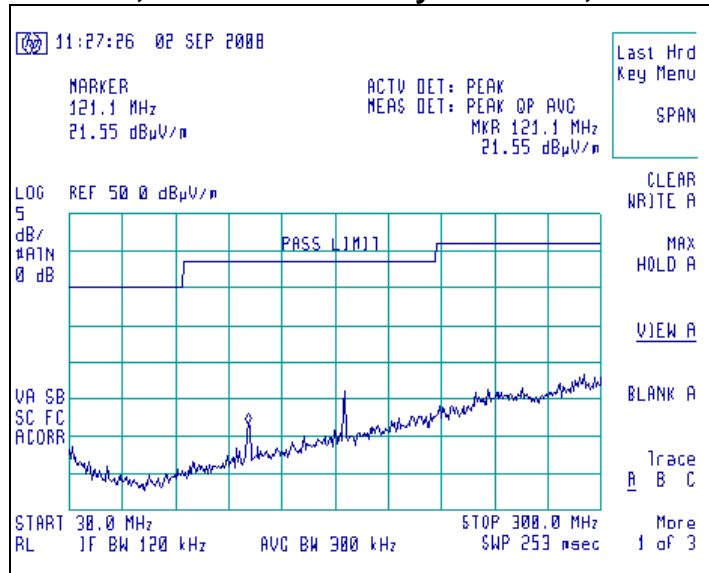
Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
Report #: LSR R-567 TX	FCC ID #: TFB-RATESAVER	Page 17 of 42

5.8 Screen Captures - Radiated Emissions Testing

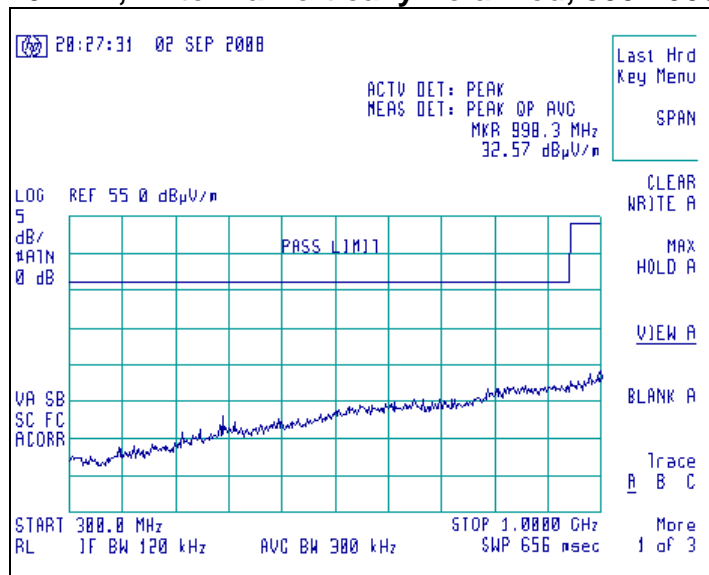
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 2405 MHz, 2440 MHz, 2470 MHz or 2475 MHz, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 2440 MHz, Antenna Vertically Polarized, 30-300 MHz, at 3m



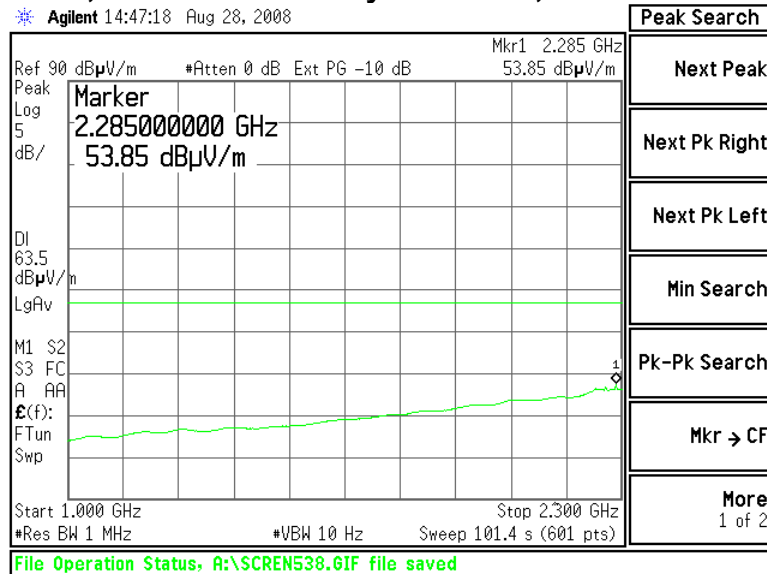
Channel 2440 MHz, Antenna Vertically Polarized, 300-1000 MHz, at 3m



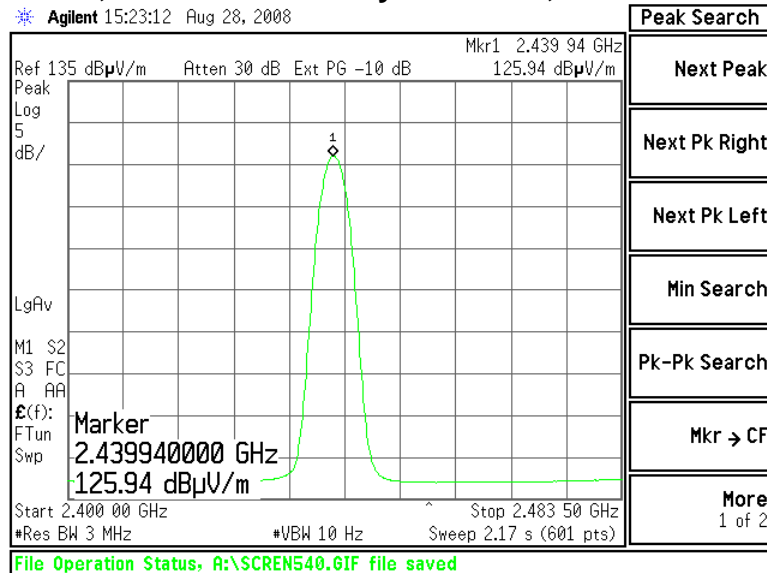
Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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Screen Captures - Radiated Emissions Testing (continued)

Channel low, Antenna Vertically Polarized, 1000-2300 MHz, at 1m

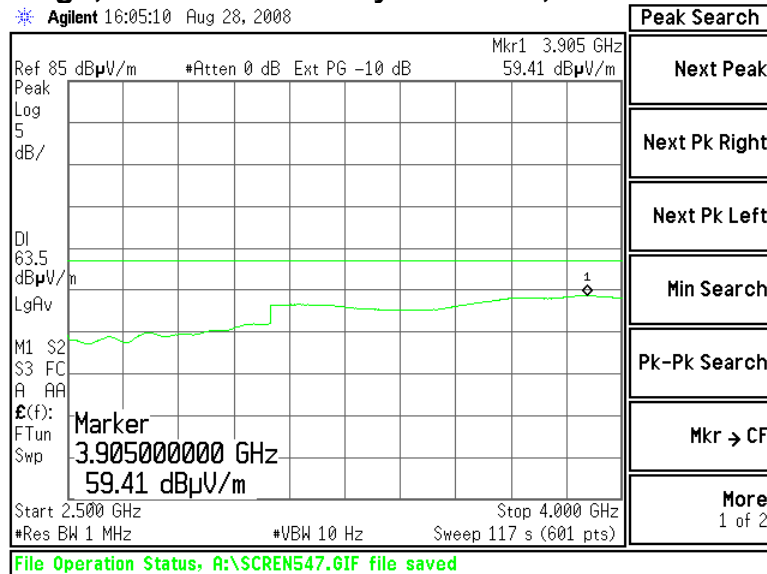


Channel middle, Antenna Vertically Polarized, 2400-2483.5 MHz, at 1m

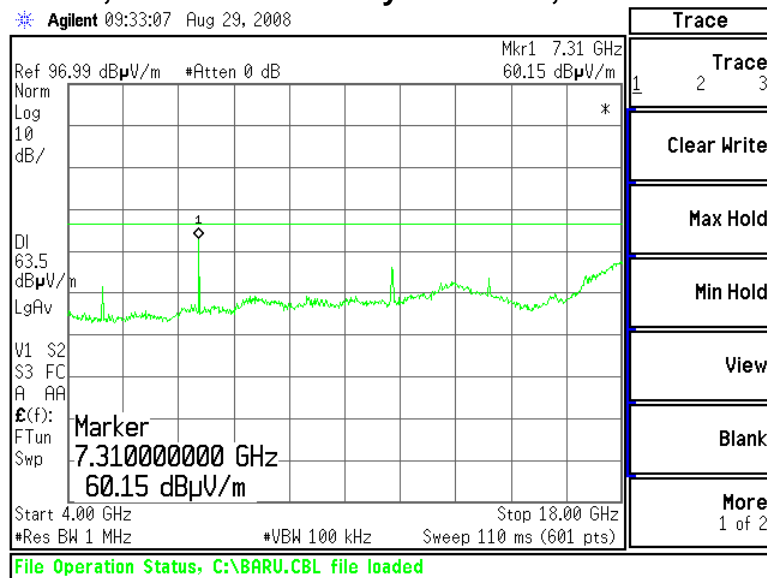


Screen Captures - Radiated Emissions Testing (continued)

Channel high, Antenna Vertically Polarized, 2500-4000 MHz, at 1m



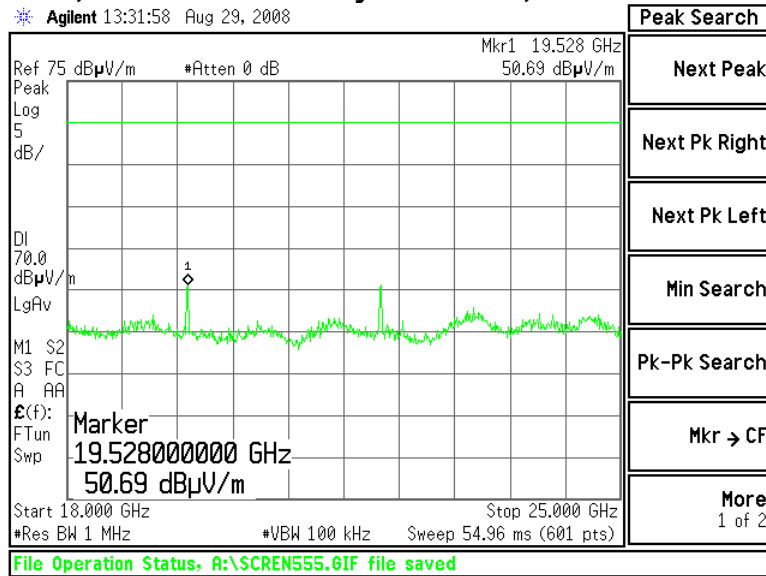
Channel middle, Antenna Vertically Polarized, 4000-18000 MHz, at 1m



Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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Screen Captures - Radiated Emissions Testing (continued)

Channel middle, Antenna Vertically Polarized, 18000-25000 MHz, at 30cm



Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE: 15.207

This test was not performed since the EUT operates on batteries (3.3VDC)

Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
Report #: LSR R-567 TX	FCC ID #: TFB-RATESAVER	Page 22 of 42

EXHIBIT 7. OCCUPIED BANDWIDTH: 15.247(a)(2)

7.1 Limits

For a Digital Modulation System, the 6 dB bandwidth shall be at least 500 kHz.

Note: The unit was tested with fresh batteries, replaced as needed.

7.2 Method of Measurements

Refer to ANSI C63.4 (2003) and FCC Procedures (2007) for Digital Transmission Systems operating under 15.247.

The transmitter output was connected to the Spectrum Analyzer. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 100 kHz RBW and VBW=300 kHz.

The bandwidth requirement found in FCC Part 15.247(a)(2) requires a minimum -6dBc occupied bandwidth of 500 kHz. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the HP E4446A spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct measurements, without the need for any further corrections. A Hewlett Packard model E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the closest measurement when compared to the specified limit is 1610kHz, which is above the minimum of 500 kHz.

Test Equipment List

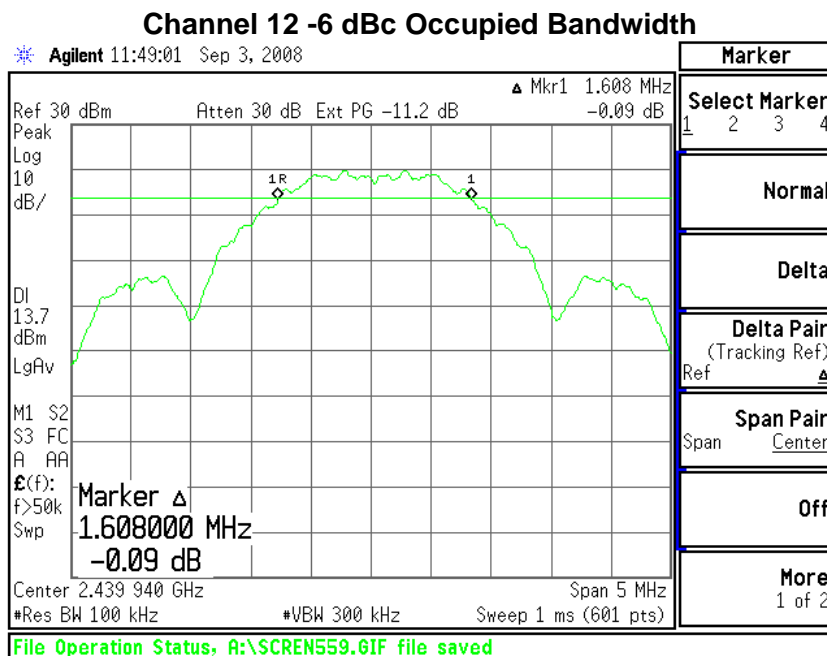
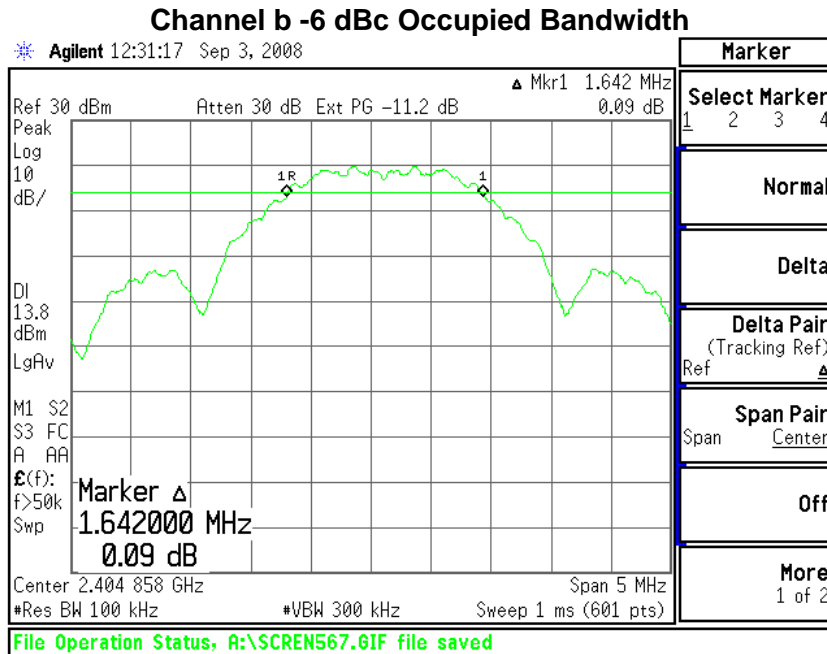
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

7.3 Test Data

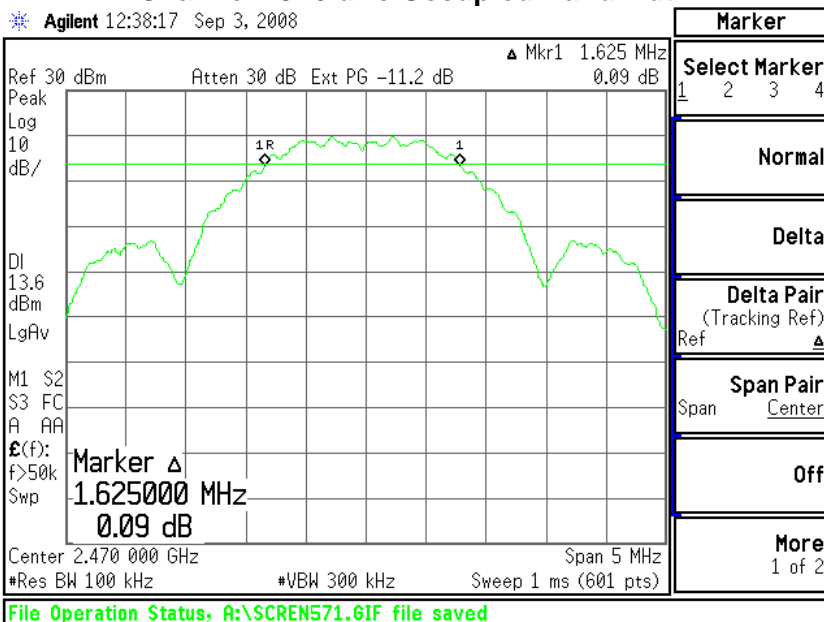
Channel	Center Frequency (MHz)	Measured -6 dBc Occ. BW (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc Occ.Bw (kHz)
b	2405	1640	500	2670
12	2440	1610	500	2680
18	2470	1620	500	2650
19	2475	1620	500	2670

Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
Report #: LSR R-567 TX	FCC ID #: TFB-RATESAVER	Page 23 of 42

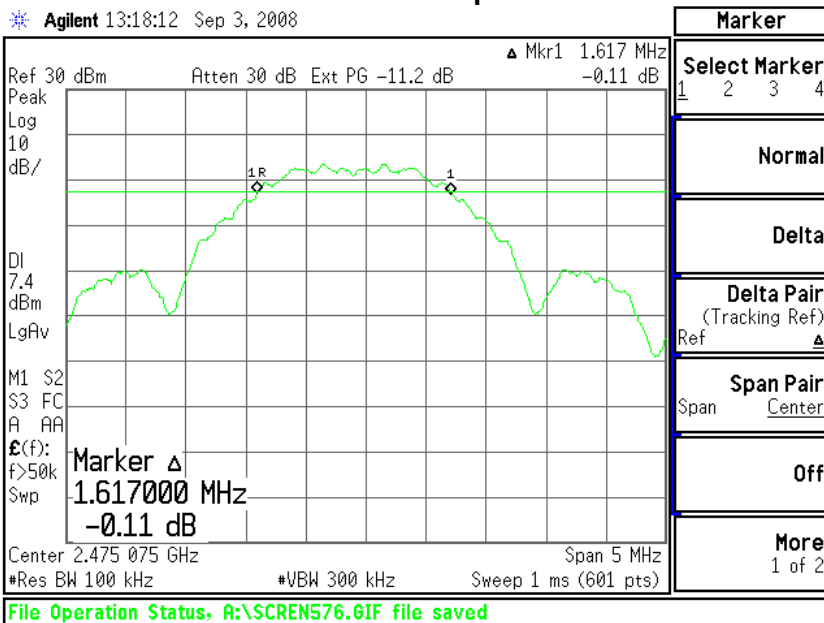
7.4 Screen Captures - OCCUPIED BANDWIDTH



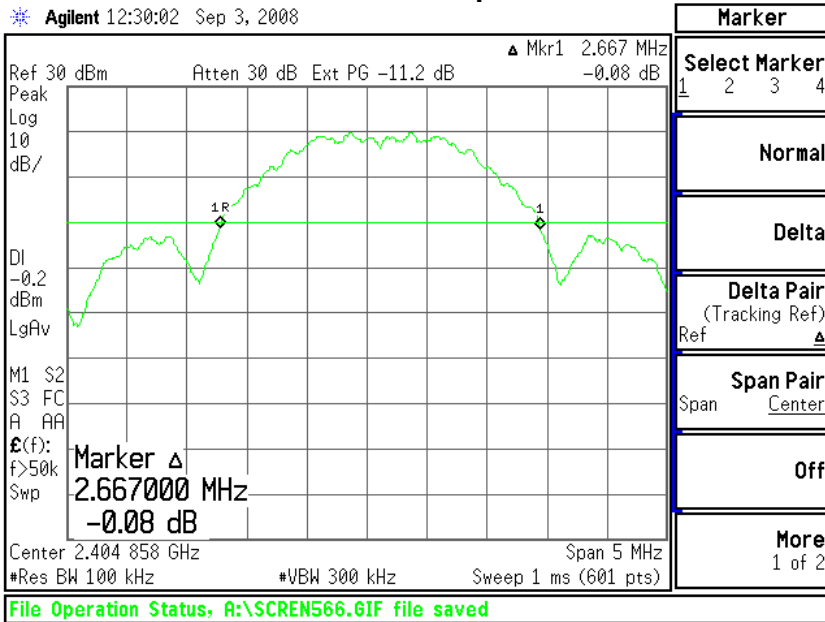
Channel 18 -6 dBc Occupied Bandwidth



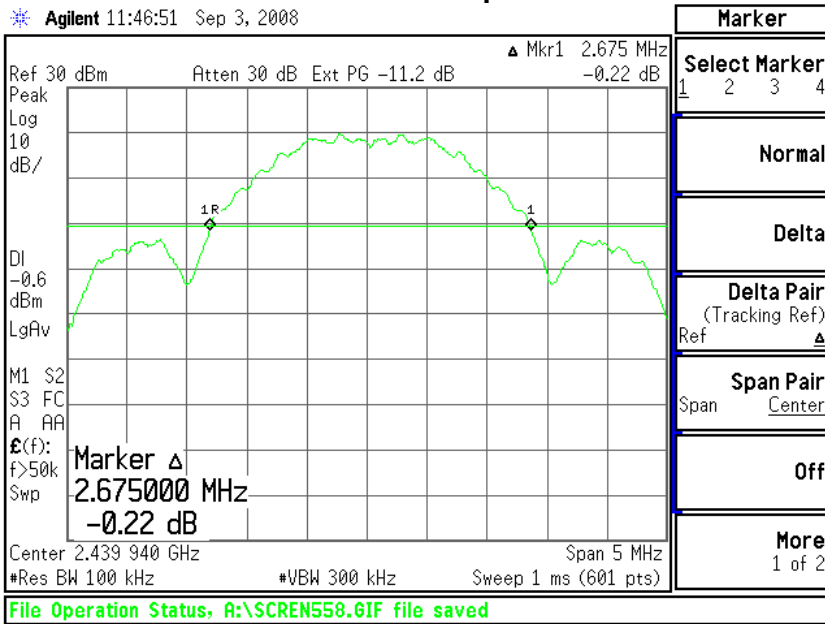
Channel 19 -6 dBc Occupied Bandwidth



Channel b -20 dBc Occupied Bandwidth

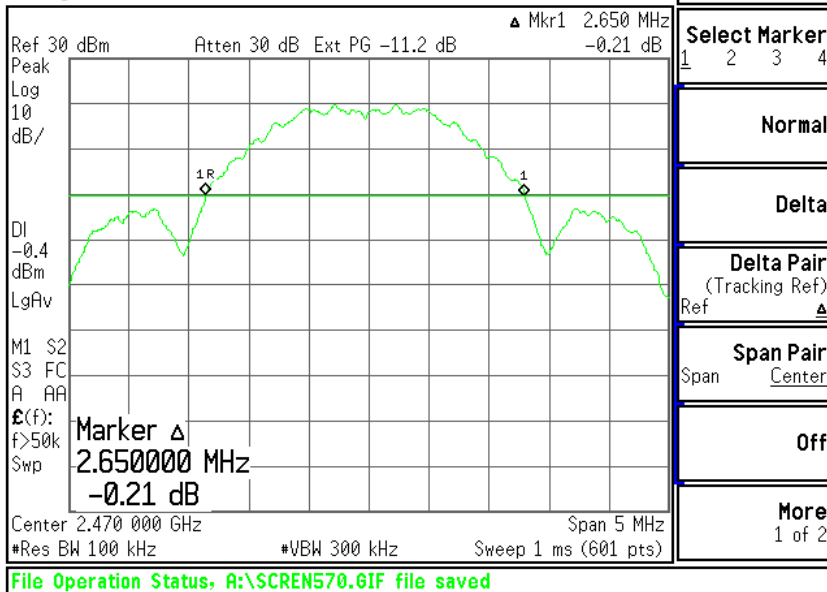


Channel 12 -20 dBc Occupied Bandwidth



Channel 18 -20 dBc Occupied Bandwidth

Agilent 12:37:25 Sep 3, 2008



Channel 19 -20 dBc Occupied Bandwidth

Agilent 13:17:15 Sep 3, 2008

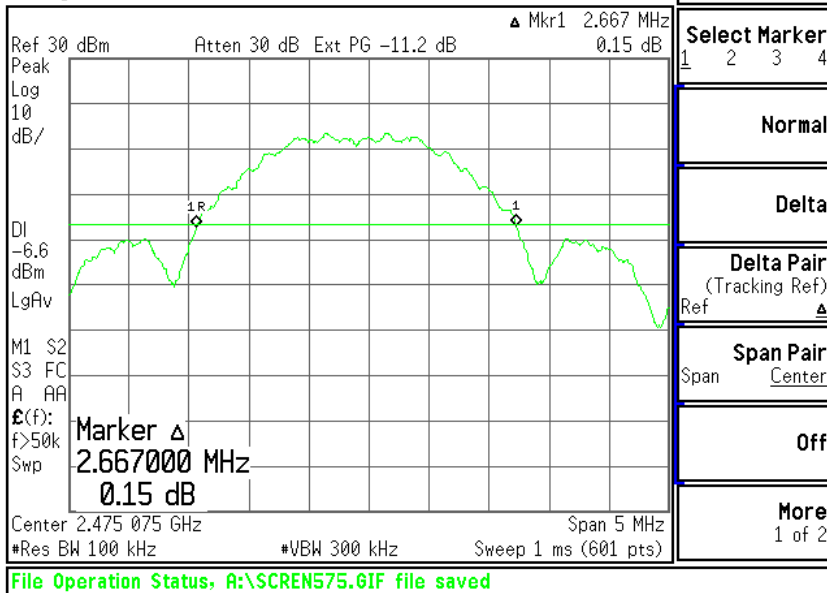


EXHIBIT 8. BAND-EDGE MEASUREMENTS

8.1 Method of Measurements

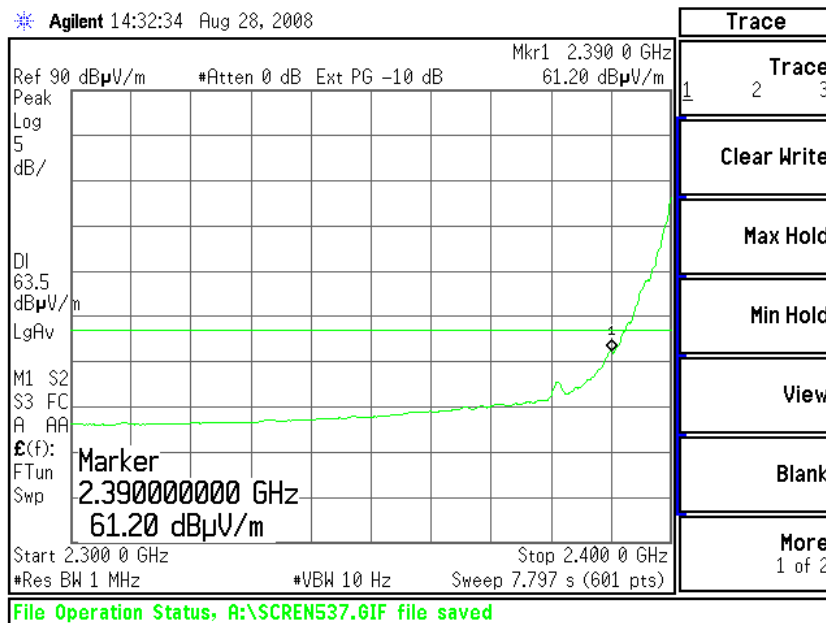
Note: The unit was tested with fresh batteries, replaced as needed.

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. The following screen captures demonstrate compliance of the intentional radiator at the 2400-2483.5 MHz Band-Edges. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channels for the investigation of the higher Band-Edge.

The Lower Band-Edge limit, in this case, would be -20 dBc with respect to the fundamental level (107.2 dBuV/m).

The Upper Band-Edge limit, in this case, would be + 63.5 dBuV/m at 1m.

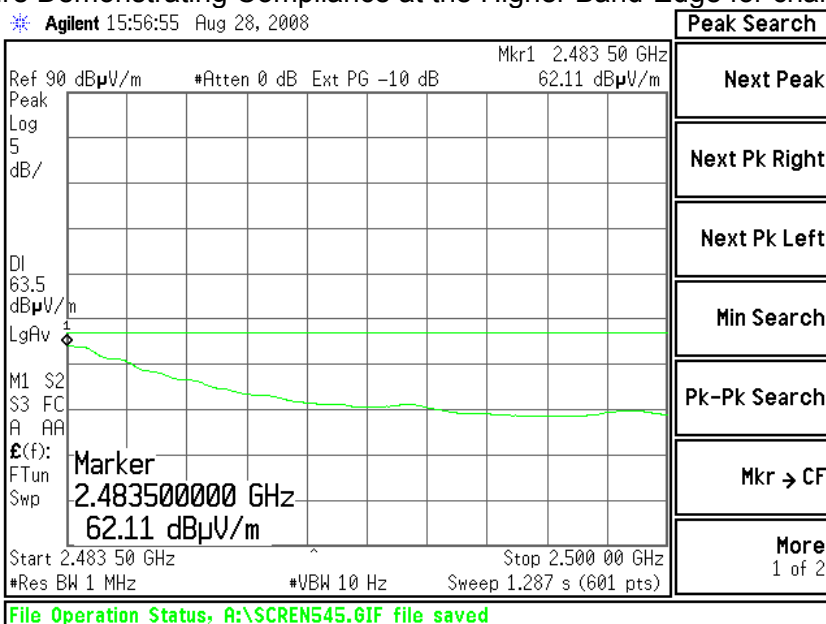
Screen Capture Demonstrating Compliance at the Lower Band-Edge



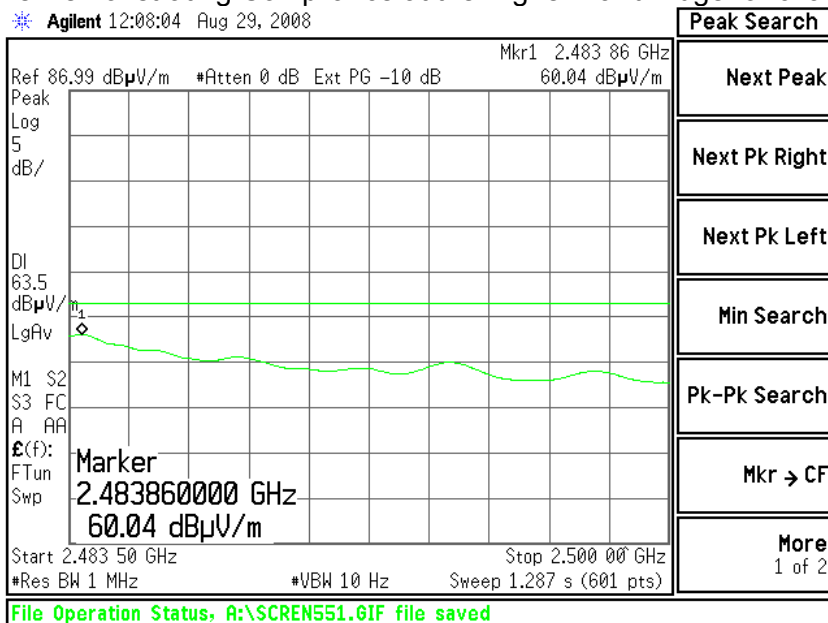
Note: Marker is set at 2390MHz (restricted band) to show compliance.

Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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Screen Capture Demonstrating Compliance at the Higher Band-Edge for channel 2475MHz



Screen Capture Demonstrating Compliance at the Higher Band-Edge for channel 2470Mhz



Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
Report #: LSR R-567 TX	FCC ID #: TFB-RATESAVER	Page 29 of 42

EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

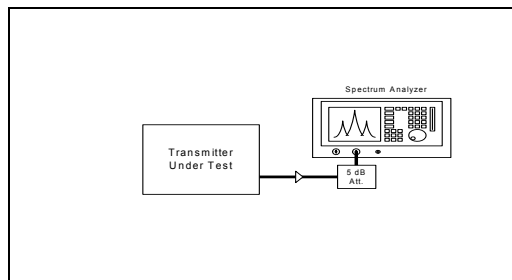
9.1 Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with resolution and video bandwidths set to 3 MHz, and a span of 10 MHz, with measurements from a peak detector presented in the chart below.

Note: The unit was tested with fresh batteries, replaced as needed.

9.2 Test Data

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
b	2405	+30 dBm	23.0	7.0
12	2440	+30 dBm	22.8	7.2
18	2470	+30 dBm	22.9	7.1
19	2475	+30 dBm	16.6	13.4



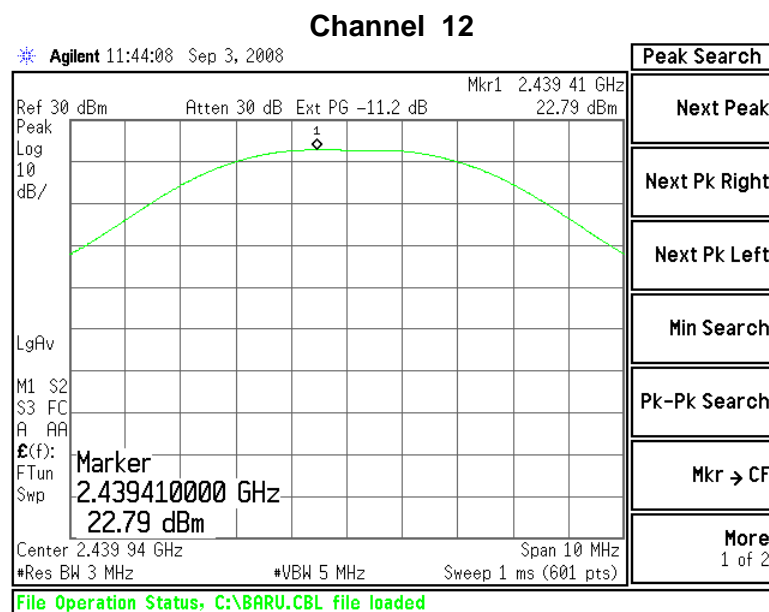
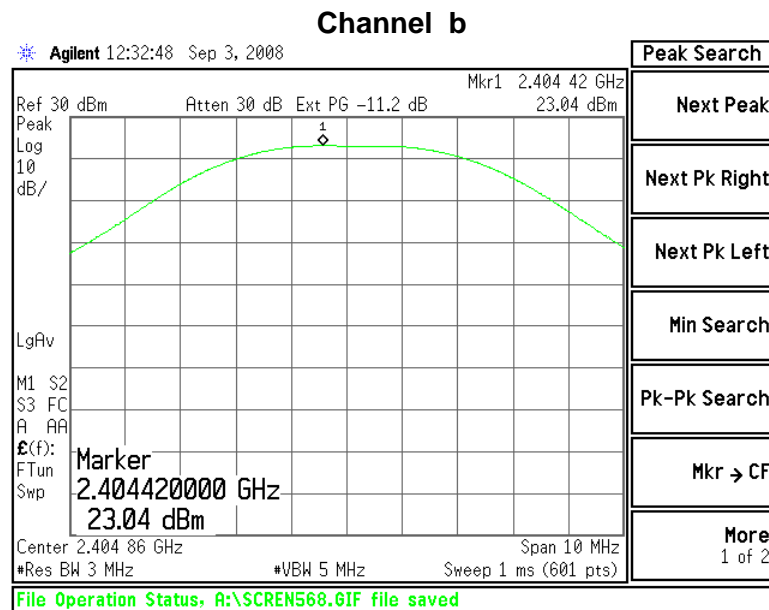
Maximum measured RF Power Output (in Watts): 0.199 watts

Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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9.3 Test Equipment List

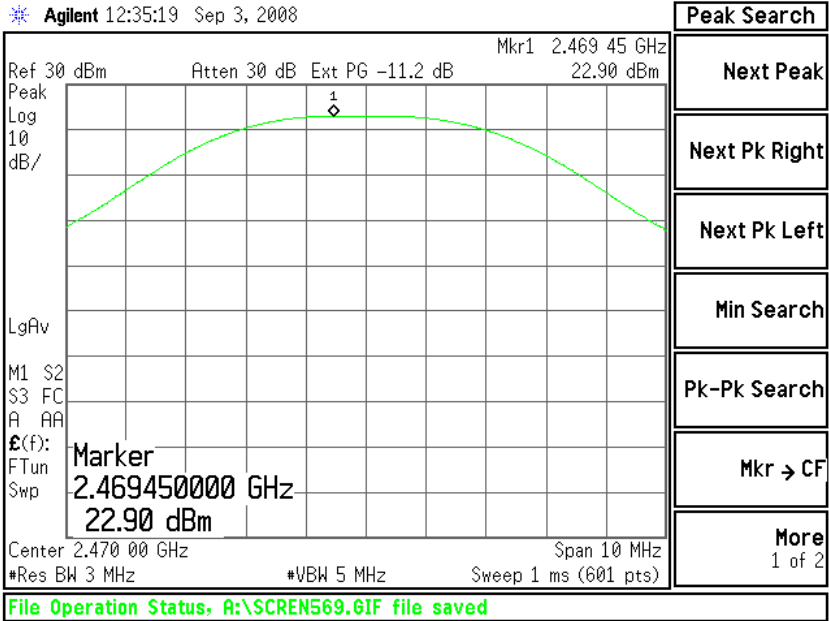
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

9.4 Screen Captures – Power Output (Conducted)



Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
Report #: LSR R-567 TX	FCC ID #: TFB-RATESAVER	Page 31 of 42

Channel 18



Channel 19

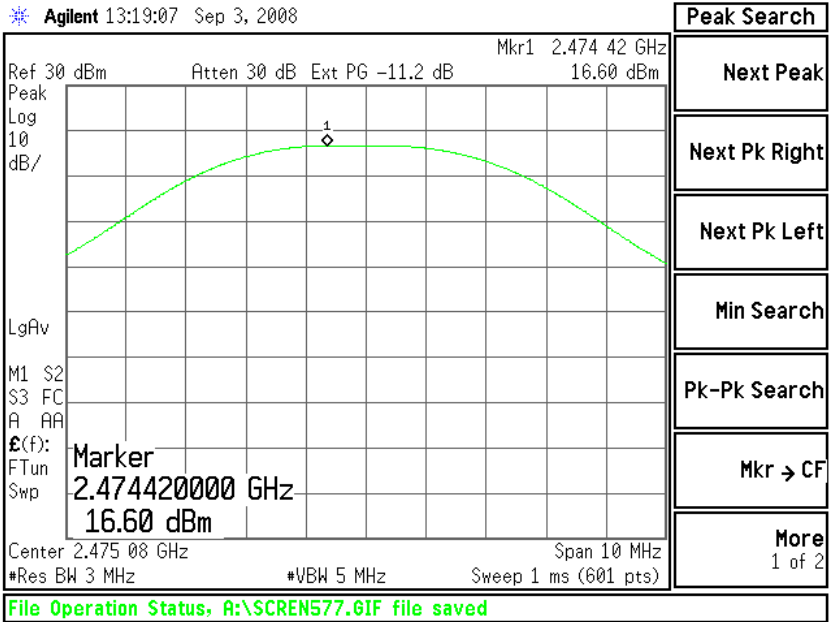


EXHIBIT 10. POWER SPECTRAL DENSITY: 15.247(e)

10.1 Limits

For digitally modulate systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed using the noise marker (1Hz) utility built into the HP Analyzer. The resultant density was then corrected to a 3 kHz bandwidth. The highest density was found to be no greater than +4.5dBm, which is under the allowable limit by 3.5 dB.

Note: The unit was tested with fresh batteries, replaced as needed.

10.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

10.3 Test Data

Channel	Frequency (MHz)	Noise Marker (dBm/1 Hz)	RF Power Level In 3 kHz BW (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Comments Pass/Fail
b	2405	-30.9	3.9	+8	4.1	Pass
12	2440	-30.3	4.5	+8	3.5	Pass
18	2470	-30.6	4.2	+8	3.8	Pass
19	2475	-35.8	-1.0	+8	9.0	Pass

Example calculation for PSD in 3kHz:

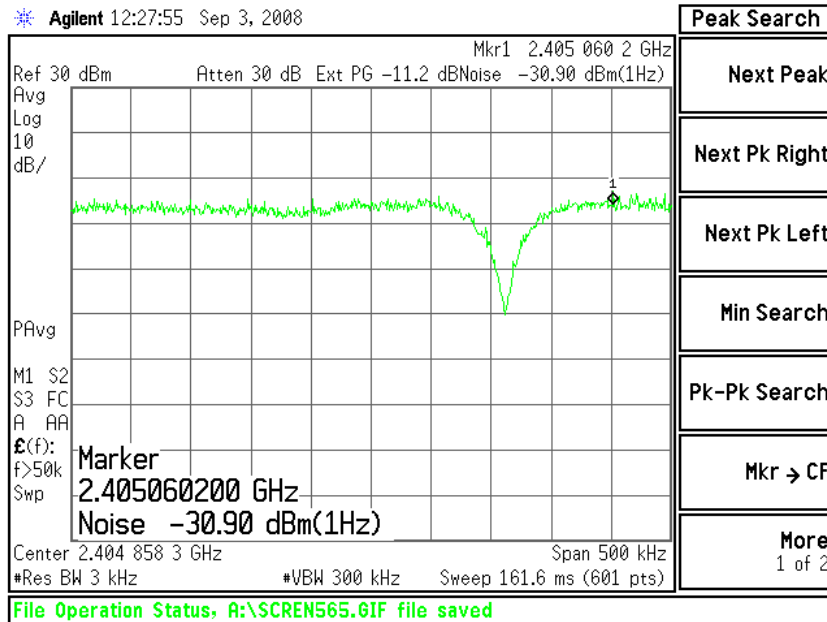
Correction factor = $10\log(3\text{kHz}/1\text{Hz}) = 34.77\text{dB}$

PSD(3kHz BW at 2405MHz) = $-30.9\text{dBm} + 34.77 = 3.9\text{dBm}$

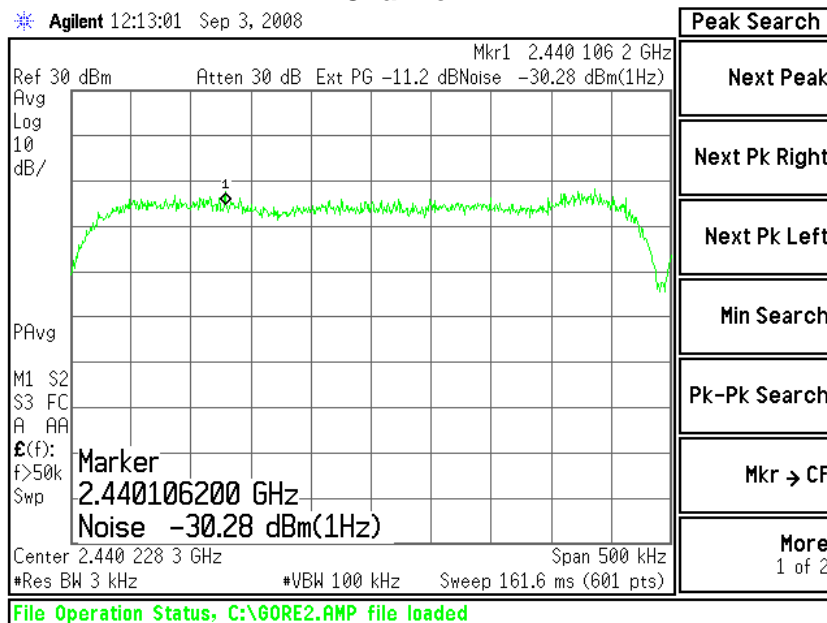
Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
Report #: LSR R-567 TX	FCC ID #: TFB-RATESAVER	Page 33 of 42

10.4 Screen Captures – Power Spectral Density

Channel b

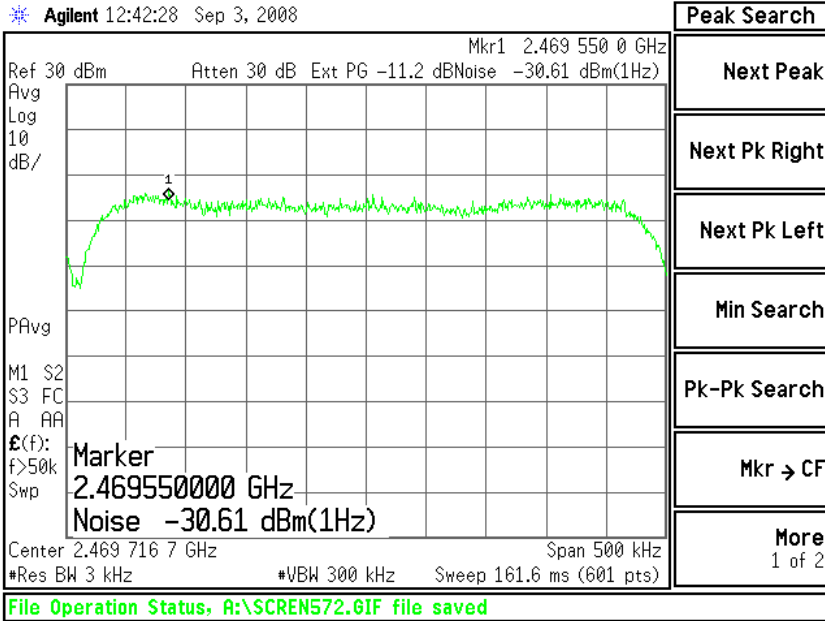


Channel 12

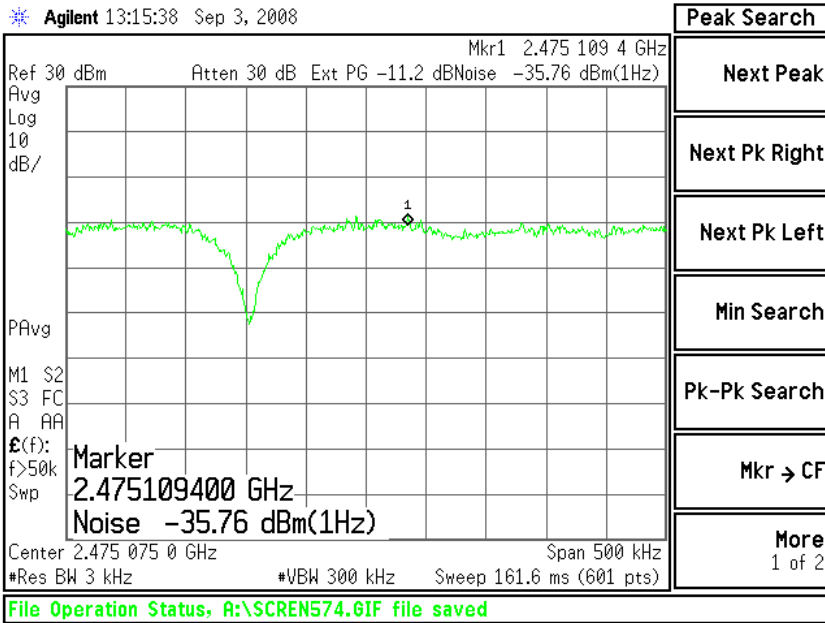


Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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Channel 18



Channel 19



Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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EXHIBIT 11. SPURIOUS RADIATED EMISSIONS: 15.247(d)

11.1 Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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.

In addition, radiated emissions, which fall in the restricted band, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(e)

Note: The unit was tested with fresh batteries, replaced as needed.

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in Section 15.35 for limiting peak emissions apply.

FCC 47 CFR 15.205(a) – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 – 0.110	162.0125 – 167.17	2310 – 2390	9.3 – 9.5
0.49 – 0.51	167.72 – 173.2	2483.5 – 2500	10.6 – 12.7
2.1735 – 2.1905	240 – 285	2655 – 2900	13.25 – 13.4
8.362 – 8.366	322 – 335.4	3260 – 3267	14.47 – 14.5
13.36 – 13.41	399.9 – 410	3332 – 3339	14.35 – 16.2
25.5 – 25.67	608 – 614	3345.8 – 3358	17.7 – 21.4
37.5 – 38.25	960 – 1240	3600 – 4400	22.01 – 23.12
73 – 75.4	1300 – 1427	4500 – 5250	23.6 – 24.0
108 – 121.94	1435 – 1626.5	5350 – 5460	31.2 – 31.8
123 – 138	1660 – 1710	7250 – 7750	36.43 – 36.5
149.9 – 150.05	1718.8 – 1722.2	8025 – 8500	Above 38.6
156.7 – 156.9	2200 – 2300	9000 – 9200	

FCC 47 CFR 15.209(a) Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 – 0.490	2,400 / F (kHz)	300
0.490 – 1.705	24,000 / F (kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

Calculation of Radiated Emission Measurements

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-25,000	500	54.0	63.5

Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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FCC Part 15.247(d) requires a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. An Agilent model E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

11.2 Test Data (All values are in dBm)

	Channel b	Channel 12	Channel 18	Channel 19 (Reduced level)
Fundamental	19.3	19.2	19.0	12.8
2 nd Harmonic	-44.1	-43.1	-43.1	Note1
3 rd Harmonic	-46.3	-46.5	-50.6	-65.6
4 th Harmonic	-58.7	-60.4	-63.0	Note1
5 th Harmonic	-61.4	-62.1	-55.2	Note1
6 th Harmonic	-55.2	-58.2	-56.6	Note1
7 th Harmonic	-61.7	-67.2	-71.9	Note1
8 th Harmonic	-64.8	-69.3	Note1	Note1
9 th Harmonic	-63.7	Note1	Note1	Note1
10 th Harmonic	Note1	Note1	Note1	Note1

	Channel 19 (Power set at maximum instead of the reduced setting -6)
Fundamental	18.8
2 nd Harmonic	-44.0
3 rd Harmonic	-50.8
4 th Harmonic	-63.4
5 th Harmonic	-54.8
6 th Harmonic	-57.8
7 th Harmonic	Note1
8 th Harmonic	Note1
9 th Harmonic	Note1
10 th Harmonic	-66.9

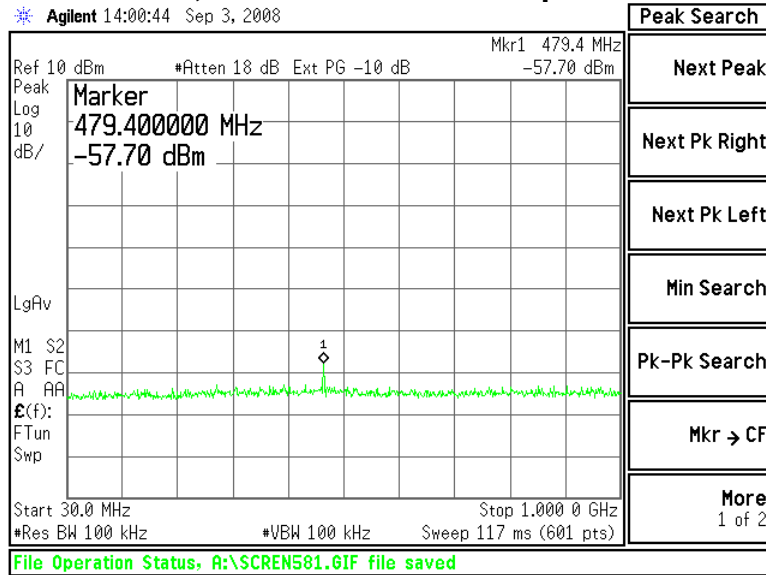
Notes:
 (1) Measurement at system noise floor.

11.3 Test Equipment

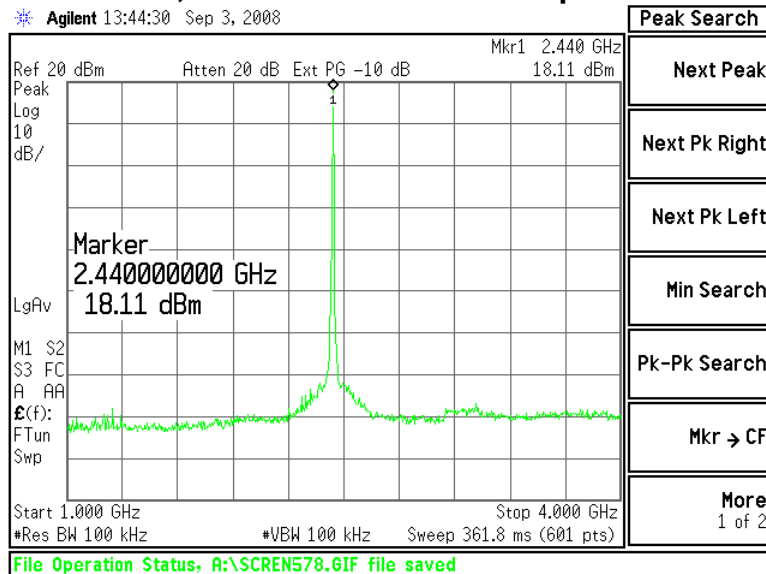
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	To 44 GHz

11.4 Screen Captures – Spurious Radiated Emissions

Channel 12, shown from 30 MHz up to 1000 MHz



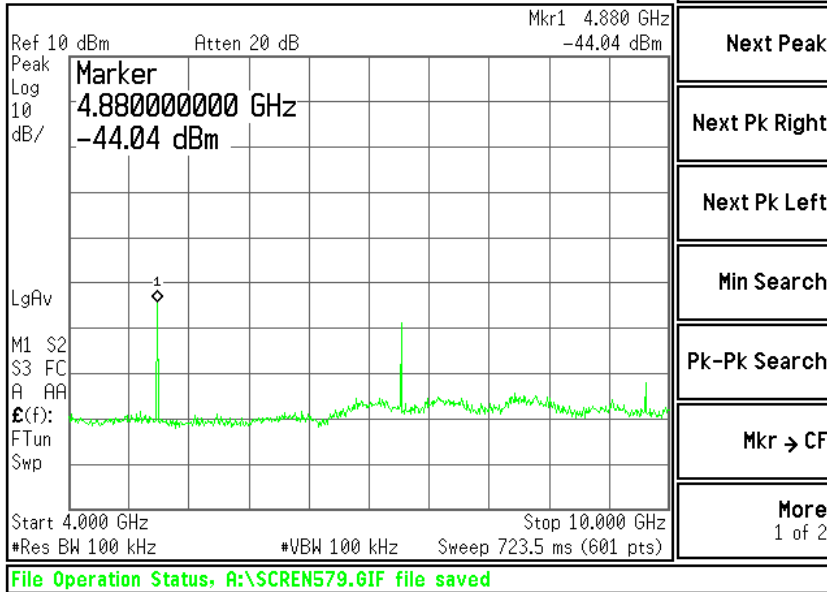
Channel 12, shown from 1000 MHz up to 4000 MHz



Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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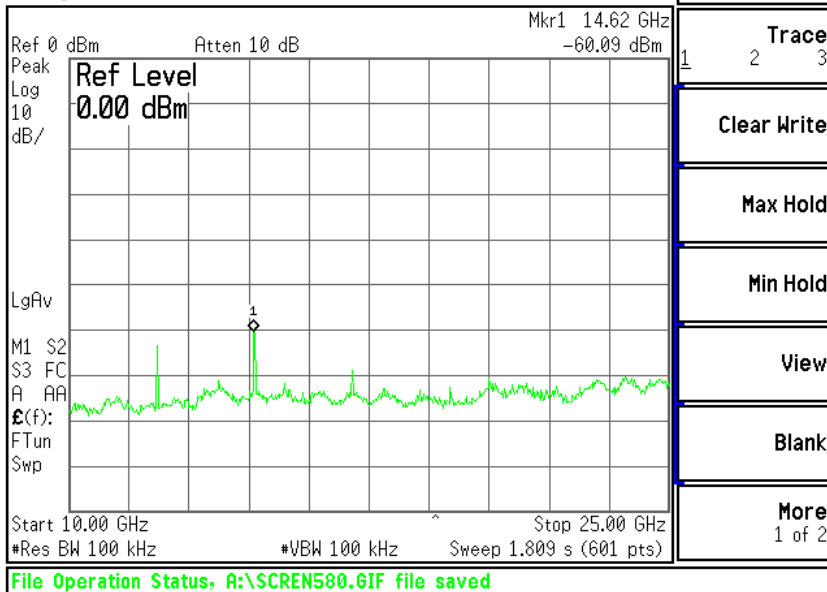
Channel 12, shown from 4000 MHz up to 10000 MHz

Agilent 13:53:04 Sep 3, 2008



Channel 12, shown from 10000 MHz up to 25000 MHz

Agilent 13:54:11 Sep 3, 2008



Prepared For: LS Research, LLC	Model #: RS-SE-24-01	LS Research, LLC
EUT: RateSaver	IC: 5969A-RATESAVER	Template: 15.247 DTS TX (V2 9-06-06)
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EXHIBIT 12. MPE CALCULATIONS

The following MPE calculations are based on a printed circuit board trace antenna with measured field strength of 127.2 dB μ V/m (at 1 meter) and conducted RF power of +23.0 dBm as presented to the antenna. The calculated gain of this antenna, based on the field strength measurement is -0.6 dBi (measured over a conducting ground plane).

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S \square \frac{PG}{4R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	<u>23.00</u>	(dBm)
Maximum peak output power at antenna input terminal:	<u>199.526</u>	(mW)
Antenna gain(typical):	<u>-0.6</u>	(dBi)
Maximum antenna gain:	<u>0.871</u>	(numeric)
Prediction distance:	<u>20</u>	(cm)
Prediction frequency:	<u>2405</u>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	<u>1</u>	(mW/cm ²)
Power density at prediction frequency:	0.034572	(mW/cm ²)
Maximum allowable antenna gain:	14.0	(dBi)
Margin of Compliance at 20 cm =	14.6	dB

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APPENDIX A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	12/6/07	12/6/08
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/19/07	9/19/08
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/19/07	9/19/08
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	12/04/07	12/04/08
CC00221C	HP	E4407B	US39160256	Spectrum Analyzer	1/11/07	1/11/08
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/20/07	9/20/08
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/20/07	9/20/08
EE960073	Agilent	E4446A	US45300564	Spectrum Analyzer	8/17/07	8/17/08
N/A	LSC	Cable	0011	3 Meter 1/2" Armored Cable	Note 1	Note 1
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	Note 1	Note 1
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1

Note 1 - Equipment calibrated within a traceable system.

Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 - Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V

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