

EMC Test Report

Application for Grant of Equipment Authorization

FCC Part 15 Subpart C

Model: PowerFLARM Portable (Rev A)

IC CERTIFICATION #: N/A
FCC ID: ZKUGC625161

APPLICANT: Flarm GmbH
Haldenstr.1
CH-6340 Baar, Switzerland

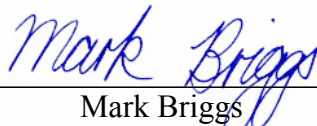
TEST SITE(S): Elliott Laboratories
41039 Boyce Road.
Fremont, CA. 94538-2435

IC SITE REGISTRATION #: 2845B-3 & 2845B-4

REPORT DATE: June 17, 2011

FINAL TEST DATES: June 2 and June 8, 2011

AUTHORIZED SIGNATORY:



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Testing Cert #2016.01

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	06-17-2011	First Release	

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SCOPE

An electromagnetic emissions test has been performed on the Flarm GmbH model PowerFLARM Portable (Rev A), pursuant to FCC Part 15 Subpart C.

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003

FHSS test procedure DA 00-0705A1, March 2000

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Flarm GmbH model PowerFLARM Portable (Rev A) complied with the requirements of FCC Part 15 Subpart C.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Flarm GmbH model PowerFLARM Portable (Rev A) and therefore apply only to the tested sample. The sample was selected and prepared by Urs Rothacher of Flarm GmbH.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY**FREQUENCY HOPPING SPREAD SPECTRUM (902 – 928 MHz, 50 channels or more)**

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247 (a) (1)	RSS 210 A8.1 (1)	20dB Bandwidth	362 kHz	Channel spacing > 20dB bandwidth / 25kHz	Complies
		Channel Separation	400 kHz		Complies
15.247 (a) (1) (i)	RSS 210 A8.1 (3)	Number of Channels	65	50 or more	Complies
15.247 (a) (1) (i)	RSS 210 A8.1 (3)	Channel Dwell Time	370 ms per 20 seconds	<0.4 second within a 20 second period	Complies
15.247 (a) (1)	RSS 210 A8.1 (1)	Channel Utilization	All channels are used equally - refer to the operational description for full explanation	All channels shall, on average, be used equally	Complies
15.247 (b) (3)	RSS 210 A8.4 (1)	Output Power	10.0 dBm (0.01 Watts) EIRP = 0.02 W ^{Note 1}	1 Watt, EIRP < 4 Watts	Complies
15.247 (c)	RSS 210 A8.5	Antenna Port Spurious Emissions 30MHz – 9.28 GHz	All spurious emissions < -20dBc	< -20dBc	Complies
15.247 (c) 15.209	RSS 210 A8.5 Table 2, 3	Radiated Spurious Emissions 30MHz – 9.28 GHz	63.9 dBuV/m @ 2706.4 MHz (- 10.1 dB)	15.207 in restricted bands, all others < -20dBc	Complies
15.247 (a) (1)	RSS 210 A8.1(2)	Receiver bandwidth	Refer to operational description	Shall match the channel bandwidth	Complies
Note 1: EIRP calculated using antenna gain of 3.0 dBi.					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector		Unique or integral antenna required	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	N/A - EUT is battery powered		
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions 30 – 3000 MHz	46.1dBuV/m @ 2425.0MHz	Refer to page 18	Complies (-7.9dB)
15.247 (b) (5) 15.407 (f)	-	RF Exposure Requirements	Output power is below the threshold to require evaluation	Refer to OET 65, FCC Part 1	Complies

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dB μ V/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dB μ V	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The Flarm GmbH model PowerFLARM Portable (Rev A) is a 902-928MHz FHSS radio that is designed to transmit GPS information. Since the EUT would be placed on a table top during operation, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The EUT is powered via six AA batteries.

The sample was received on May 24, 2011 and tested on June 2 and June 8, 2011. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Flarm	PowerFLARM	900MHz FHSS	N/A	

ANTENNA SYSTEM

The EUT antenna is a mono-pole (dipole) antenna. The antenna connects to the EUT via a standard SMA antenna connector. The manufacture states that they will secure the antenna using lock-tight thereby meeting the requirements of FCC 15.203.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 9.5 cm wide by 9.5 cm deep by 4.5 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

No support equipment was used during testing.

EUT OPERATION

During transmitter testing, the EUT was configured to continuously transmit at the noted channel at full power, modulated. Where noted, the EUT was configured to hop either on a single channel, or across all channels within the band.

Receiver spurious emissions were measured with the device active but not hopping and the receiver tuned to the low, center or high channel as detailed.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 3	769238	2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4	211948	2845B-4	
Chamber 7	A2LA accreditation	2845B-7	

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

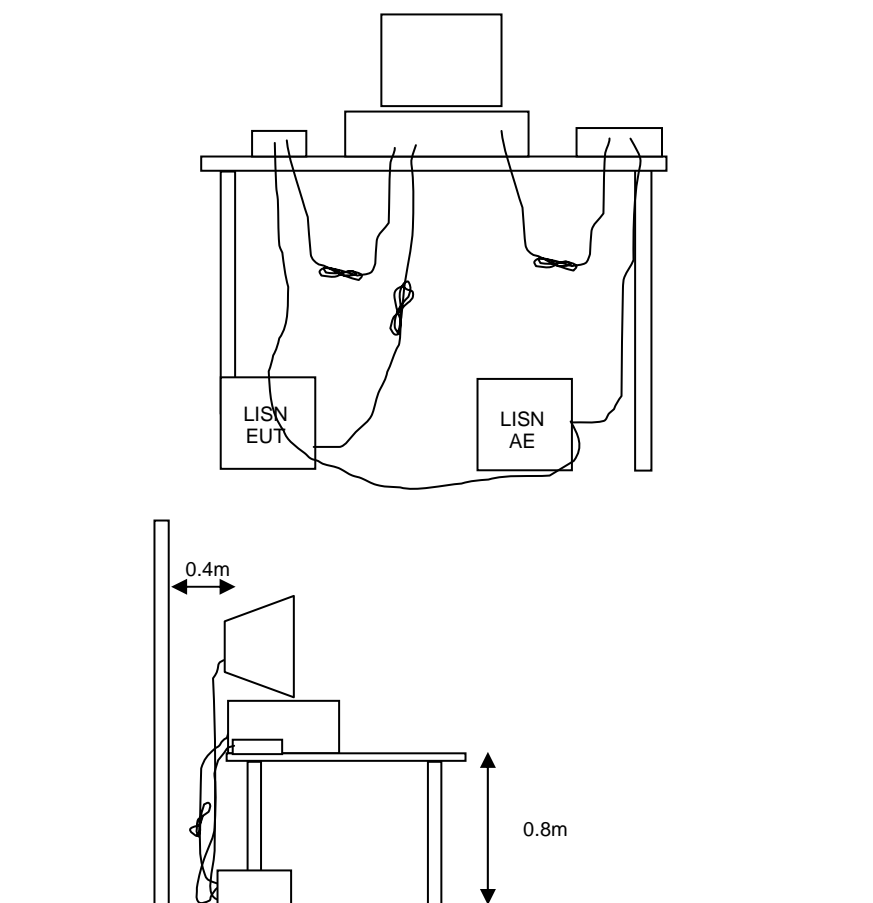
TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.



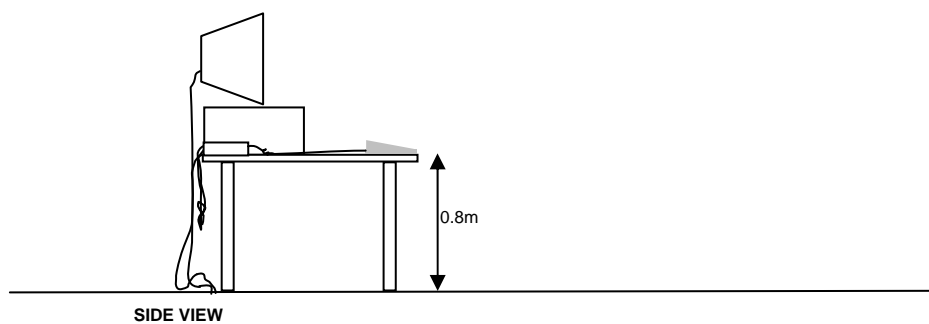
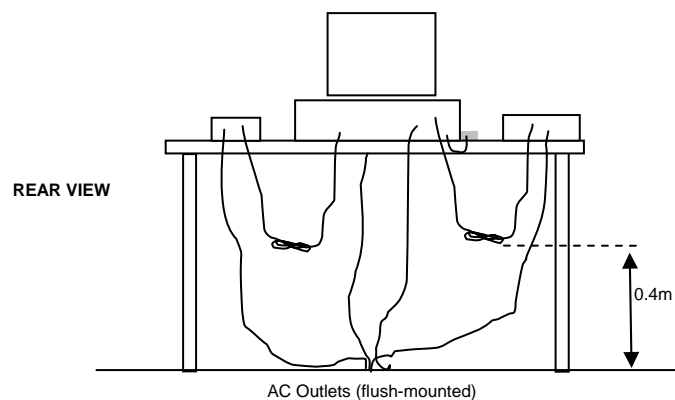
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

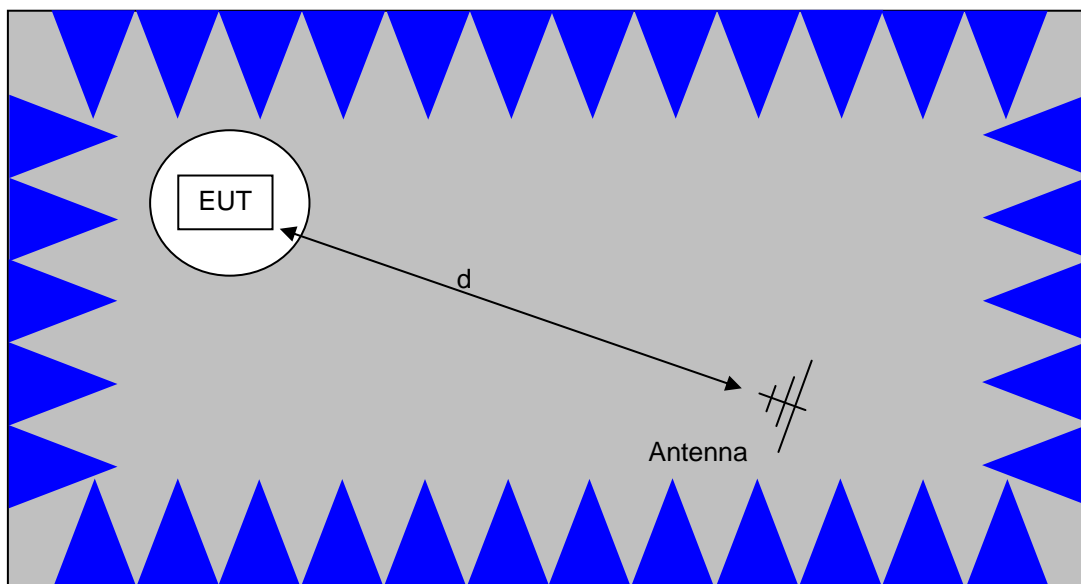
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1 meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

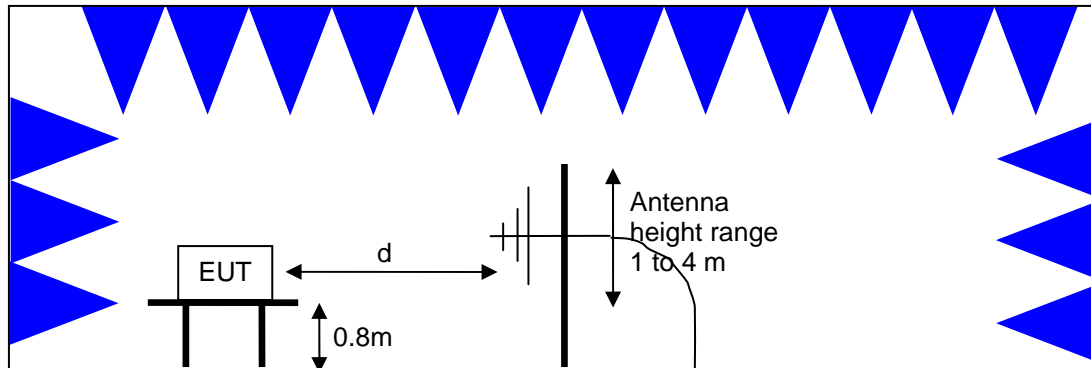


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

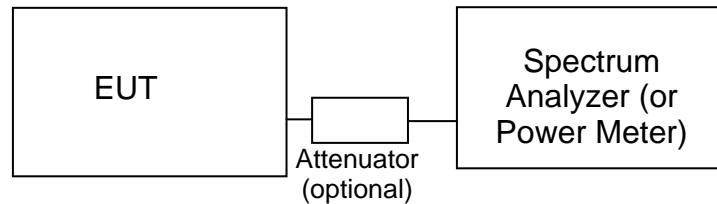
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

**Test Configuration for Antenna Port Measurements**

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and Elliott's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands¹ (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	2400/F _{KHz} @ 300m	67.6-20*log ₁₀ (F _{KHz}) @ 300m
0.490-1.705	24000/F _{KHz} @ 30m	87.6-20*log ₁₀ (F _{KHz}) @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

¹ The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

OUTPUT POWER LIMITS – FHSS SYSTEMS

The table below shows the limits for output power based on the number of channels available for the hopping system.

Operating Frequency (MHz)	Number of Channels	Output Power
902 – 928	≥ 50	1 Watt (30 dBm)
902 – 928	25 to 49	0.25 Watts (24 dBm)
2400 – 2483.5	≥ 75	1 Watt (30 dBm)
2400 – 2483.5	< 75	0.125 Watts (21 dBm)
5725 – 5850	75	1 Watt (30 dBm)

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

$$R_r = \text{Receiver Reading in dBuV/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_c = \text{Corrected Reading in dBuV/m}$$

$$L_s = \text{Specification Limit in dBuV/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

Appendix A Test Equipment Calibration Data**Radiated TX Spurious, 02-Jun-11**

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
Hewlett Packard	High Pass filter, 1.5 GHz (Blu System)	P/N 84300-80037 (84125C)	1389	5/4/2012
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/22/2012
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	4/13/2012
Hewlett Packard	9kHz-40GHz Analyzer	8564E	2190	6/21/2011
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/23/2012
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2237	7/14/2012

Antenna Port Measurements, 02-Jun-11

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
Rohde & Schwarz	Power Sensor 100 uW - 2 Watts use with #1994 20dB attenuator	NRV-Z32	1423	7/19/2011
Rohde & Schwarz	Power Meter, Single Channel, +1795+1796	NRVS	1534	5/17/2012
Tektronix	500MHz, 2CH, 5GS/s Scope	TDS5052B	2118	9/29/2011
Agilent	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	1/26/2012
RLC	Crystal Detector	CR-133-N	N/A	N/A

Radiated Emissions, 30 - 3000 MHz, 02-Jun-11

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	11/2/2011
Com-Power Corp.	Preamplifier, 30-1000 MHz	PA-103	1632	4/29/2012
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	5/28/2012

Radiated Emissions, 30 - 3,000 MHz, 08-Jun-11

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263	12/8/2011
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	5/18/2012
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	7/12/2011
Hewlett Packard	EMC Spectrum Analyzer, 9 KHz - 22 GHz	8593EM	1319	11/22/2011
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	1/17/2012
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	6/24/2012
Com-Power Corp.	Preamplifier, 30-1000 MHz	PA-103A	2359	2/15/2012

Appendix B Test Data

T83437 23 Pages



EMC Test Data

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
		Account Manager:	Christine Krebill
Contact:	Urs Rothacher		Mark Briggs
Emissions Standard(s):	FCC Part 15.247 (FHSS)	Class:	N/A
Immunity Standard(s):	-	Environment:	N/A

EMC Test Data

For The

Flarm

Model

PowerFLARM Portable (Rev A)

Date of Last Test: 6/8/2011

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

FCC 15.247 FHSS - Power, Bandwidth and Spurious Emissions

Test Specific Details

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

Date of Test: See individual runs
 Test Engineer: See individual runs
 Test Location: See individual runs

Config. Used: #1
 Config Change: None
 EUT Voltage: Battery

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

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

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

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 15-25 °C
 Rel. Humidity: 30-80 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	30 - 9300 MHz - Radiated Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	63.9dBµV/m @ 2706.4MHz (-10.1dB)
1	30 - 9300 MHz - Conducted Spurious Emissions	FCC Part 15.247(c)	Pass	All emissions are more than 20dBc
2	Output Power	15.247(b)		10.0 dBm (0.01 W) eirp = 13dBm, 0.02W
3	20dB Bandwidth	15.247(a)		362 kHz
3	99% bandwidth	15.247(a)		307 kHz
3	Channel Occupancy	15.247(a)		370ms
3	Number of Channels	15.247(a)		65 Channels

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 9300 MHz.

Date of Test: 6/2/2011

Test Engineer: Mark Hill

Test Location: FT#3

Run #1a: Radiated Spurious Emissions, 30 - 9300 MHz. Low Channel @ 902.2 MHz

Device transmitting continuously on the channel (hopping disabled)

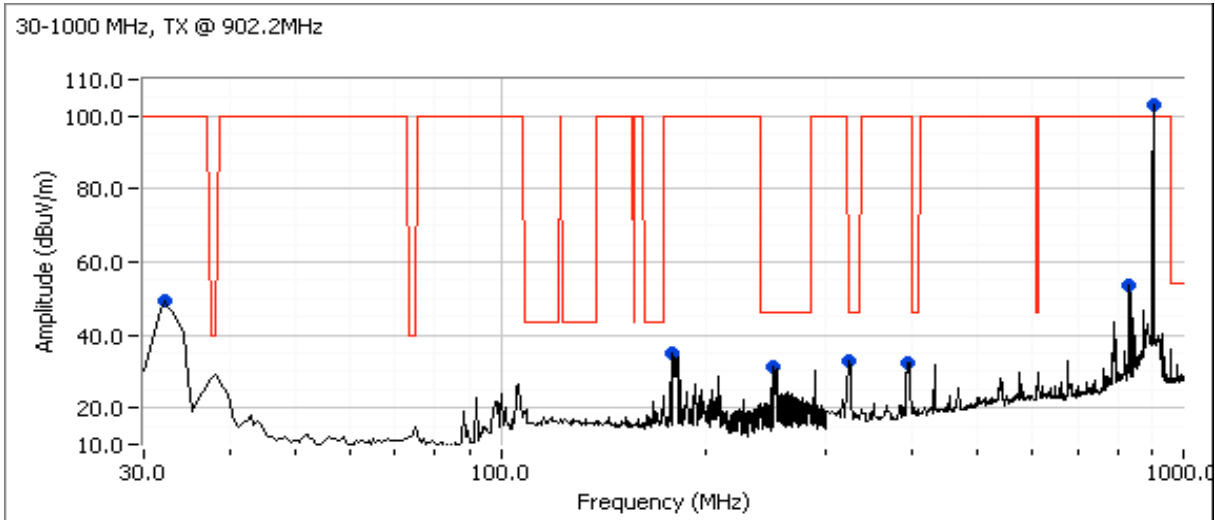
Fundamental Signal Field Strength: Peak values measured in 1 MHz and 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
902.200	106.2	v	-	-	Pk	306	1.6	RB = VB = 1MHz
902.200	105.4	v	-	-	Pk	306	1.6	RB = VB = 100kHz
902.200	109.2	h	-	-	Pk	240	1.0	RB = VB = 1MHz
902.200	108.4	h	-	-	Pk	240	1.0	RB = VB = 100kHz

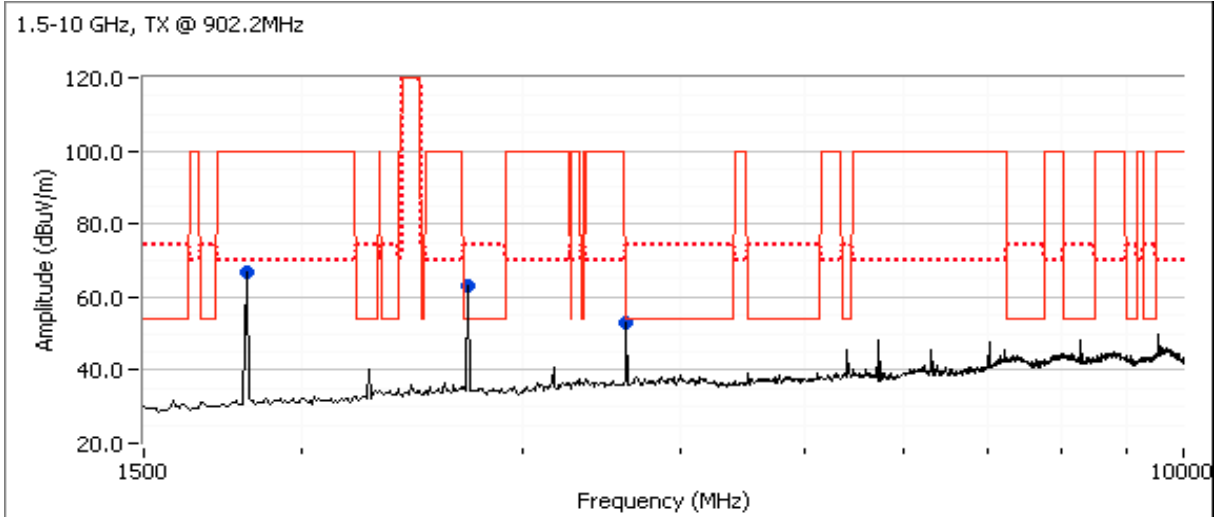
Fundamental emission level @ 3m in 100kHz RBW: 108.4

Limit for emissions outside of restricted bands: 88.4 dB μ V/m

Limit is -20dBc



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A



Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2706.400	63.9	V	74.0	-10.1	PK	80	1.0	RB 1 MHz;VB 3 MHz;Pk
2706.630	37.9	V	54.0	-16.1	AVG	80	1.0	Note 2
3608.810	30.2	V	54.0	-23.8	AVG	103	1.5	Note 2
3608.980	56.2	V	74.0	-17.8	PK	103	1.5	RB 1 MHz;VB 3 MHz;Pk
1804.300	67.3	V	88.4	-21.1	PK	135	1.0	RB 100 kHz;VB 100 kHz;Pk
32.560	49.3	H	88.4	-39.1	Pk	39	1.0	RBW=100kHz
178.870	35.7	V	88.4	-52.7	Pk	63	1.0	RBW=100kHz
830.020	35.4	V	88.4	-53.0	Pk	260	2.0	RBW=100kHz
32.561	41.7	H	100.0	-58.3	QP	39	1.0	QP (1.00s)
178.871	33.5	V	100.0	-66.5	QP	63	1.0	QP (1.00s)
830.022	30.8	V	100.0	-69.2	QP	260	2.0	QP (1.00s)

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: Average measurements calculated from peak reading corrected by duty cycle (26 dB).

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

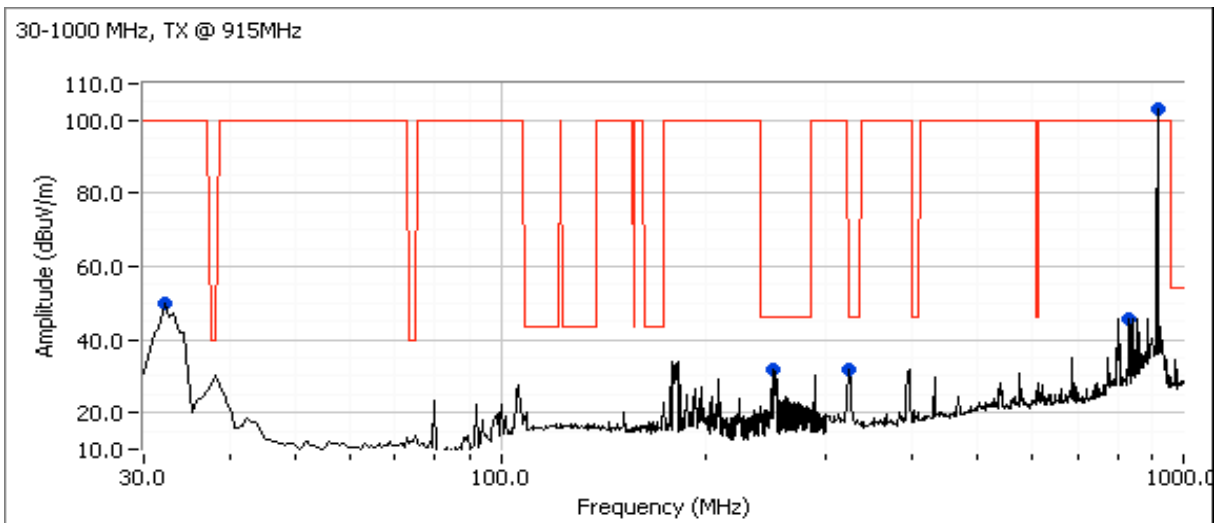
Run #1b: Radiated Spurious Emissions, 30 - 9300 MHz. Center Channel @ 915 MHz

Device transmitting continuously on the channel (hopping disabled)

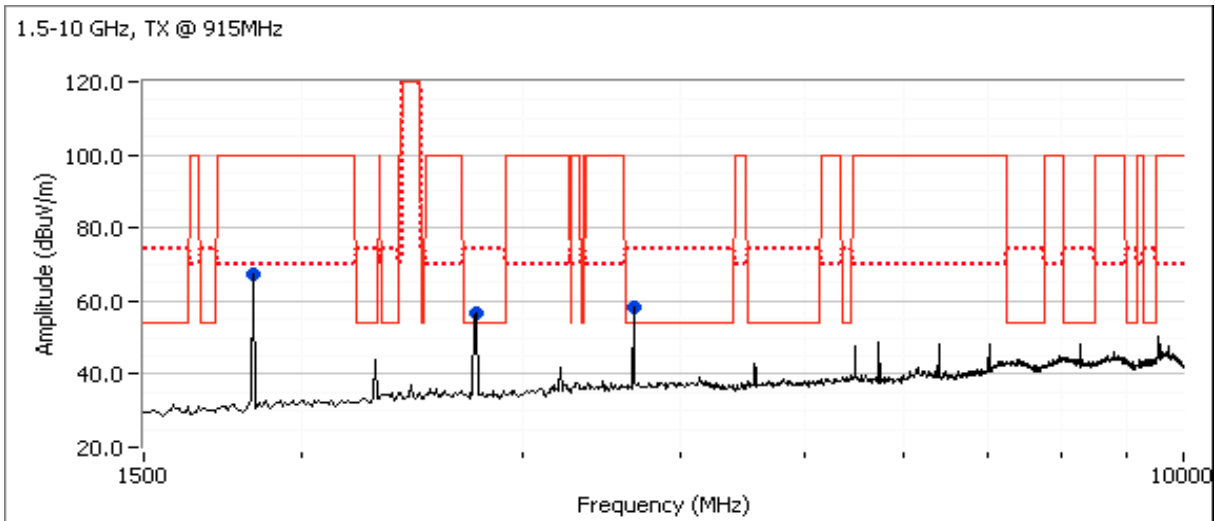
Fundamental Signal Field Strength: Peak values measured in 1 MHz and 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
915.000	103.1	v	-	-	Pk	301	1.6	RB = VB = 1MHz
915.000	104.0	v	-	-	Pk	301	1.6	RB = VB = 100kHz
915.000	106.5	h	-	-	Pk	235	1.0	RB = VB = 1MHz
915.000	105.6	h	-	-	Pk	235	1.0	RB = VB = 100kHz

Fundamental emission level @ 3m in 100kHz RBW:	105.6	
Limit for emissions outside of restricted bands:	85.6 dB μ V/m	Limit is -20dBc



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A



Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3660.230	59.6	V	74.0	-14.4	PK	103	1.3	RB 1 MHz;VB 3 MHz;Pk
322.880	30.7	H	46.0	-15.3	QP	259	1.0	QP (1.00s)
2744.830	58.2	V	74.0	-15.8	PK	84	1.0	RB 1 MHz;VB 3 MHz;Pk
253.137	29.4	H	46.0	-16.6	QP	87	1.0	QP (1.00s)
1830.120	67.8	V	85.6	-17.8	Pk	136	1.0	RB 100 kHz;VB 100 kHz;Pk
3659.990	33.6	V	54.0	-20.4	AVG	103	1.3	Note 2
2745.000	32.2	V	54.0	-21.8	AVG	84	1.0	Note 2
32.515	49.5	H	85.6	-36.1	Pk	70	1.1	RBW=100kHz
322.880	34.2	H	85.6	-51.4	Pk	259	1.0	RBW=100kHz
32.515	41.9	H	100.0	-58.1	QP	70	1.1	QP (1.00s)

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: Average measurements calculated from peak reading corrected by duty cycle (26 dB).

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Run #1c: Radiated Spurious Emissions, 30 - 9300 MHz. High Channel @ 927.8 MHz

Device transmitting continuously on the channel (hopping disabled)

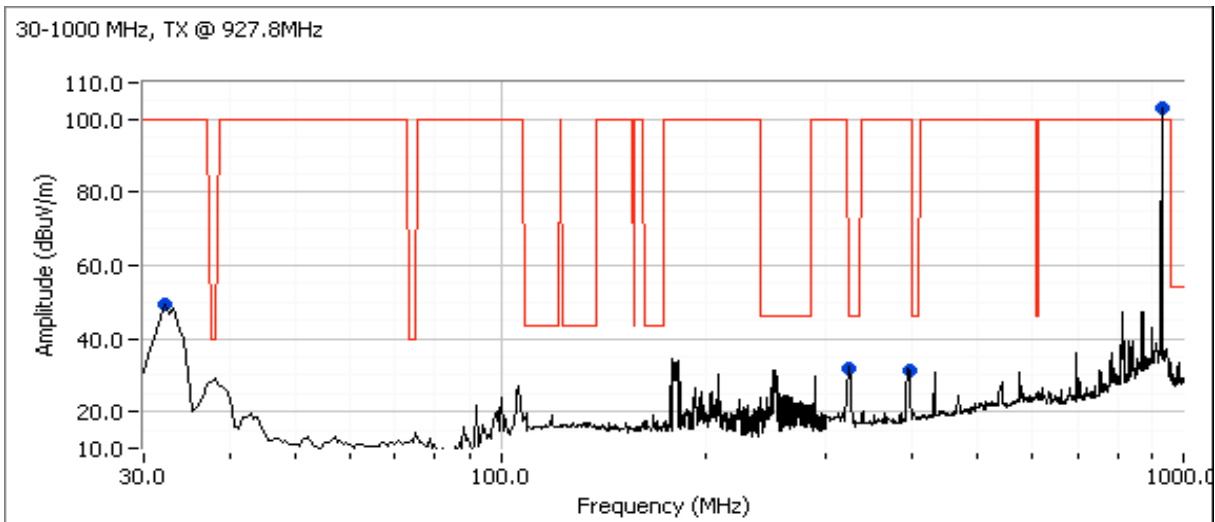
Fundamental Signal Field Strength: Peak values measured in 1 MHz and 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
927.800	102.4	v	-	-	Pk	298	1.1	RB = VB = 1MHz
927.800	101.5	v	-	-	Pk	298	1.1	RB = VB = 100kHz
927.800	104.7	h	-	-	Pk	241	1.0	RB = VB = 1MHz
927.800	103.9	h	-	-	Pk	241	1.0	RB = VB = 100kHz

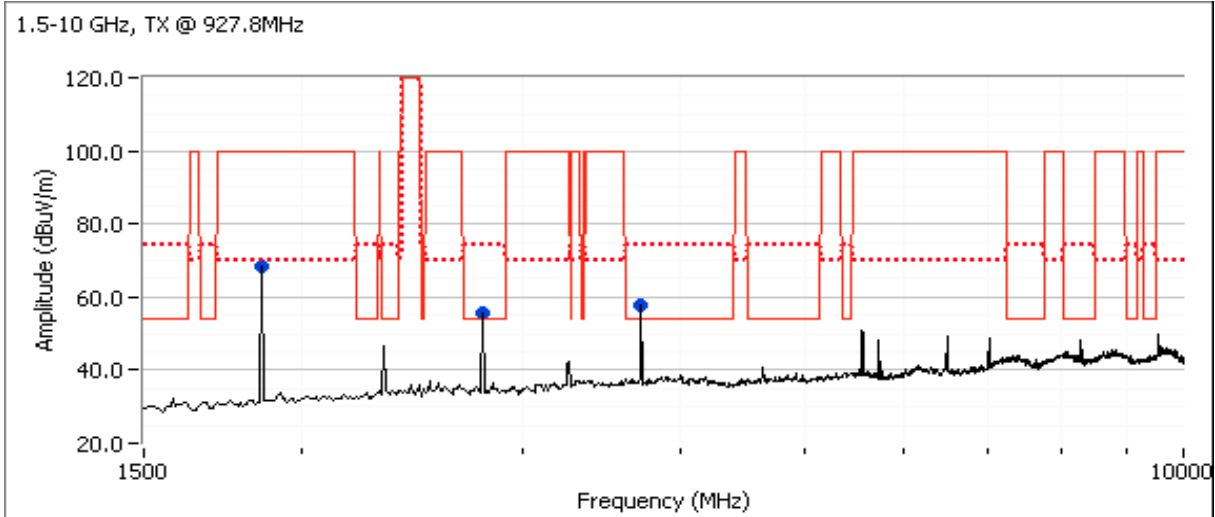
Fundamental emission level @ 3m in 100kHz RBW:	103.9	
Limit for emissions outside of restricted bands:	83.9 dB μ V/m	Limit is -20dBc

960 MHz Restricted Band Signal Field Strength (QP measurement)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
960.000	32.6	H	54.0	-21.4	QP	241	1.0	QP (1.00s)
960.000	31.6	V	54.0	-22.4	QP	298	1.1	QP (1.00s)



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A



Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3711.460	60.6	V	74.0	-13.4	PK	81	1.5	RB 1 MHz;VB 3 MHz;Pk
2783.420	59.7	V	74.0	-14.3	PK	88	1.6	RB 1 MHz;VB 3 MHz;Pk
1855.740	68.8	V	83.9	-15.1	Pk	176	1.0	RB 100 kHz;VB 100 kHz;Pk
325.125	30.6	H	46.0	-15.4	QP	259	1.0	QP (1.00s)
3711.210	34.6	V	54.0	-19.4	AVG	81	1.5	Note 2
2783.410	33.7	V	54.0	-20.3	AVG	88	1.6	Note 2
32.525	35.2	V	83.9	-48.7	Pk	211	1.0	RBW=100kHz

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: Average measurements calculated from peak reading corrected by duty cycle (26 dB).

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Run #1d: Antenna Conducted Spurious Emissions, 30 - 9300 MHz.

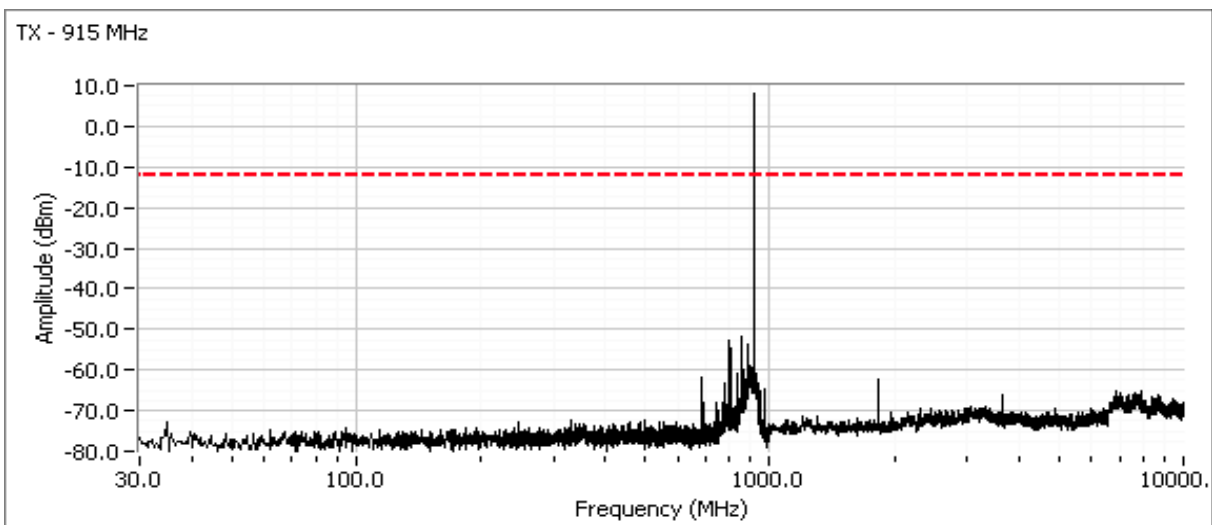
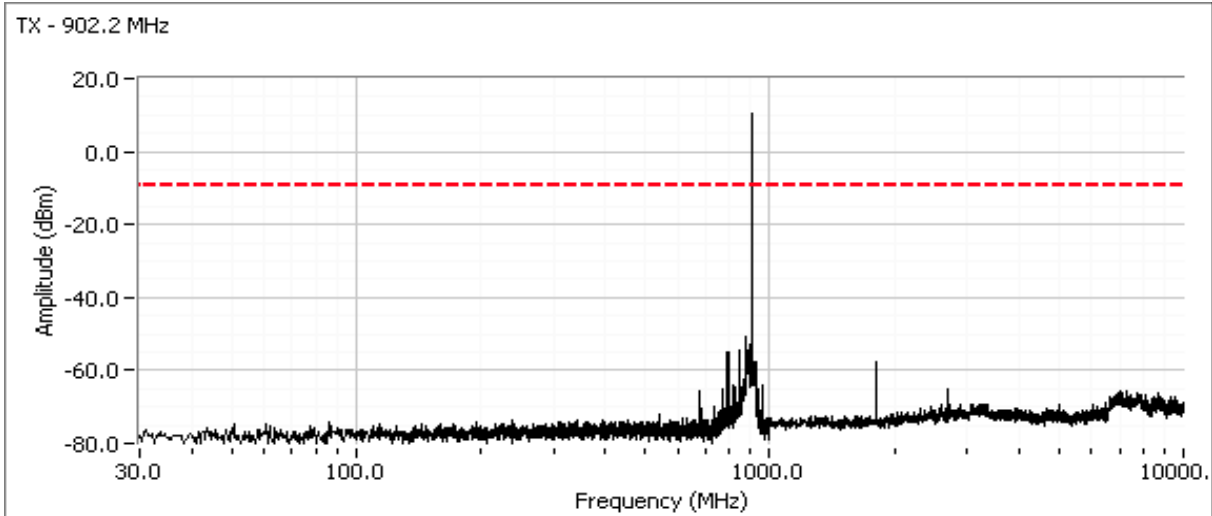
Date of Test: 6/2/2011

Test Engineer: Mark Hill

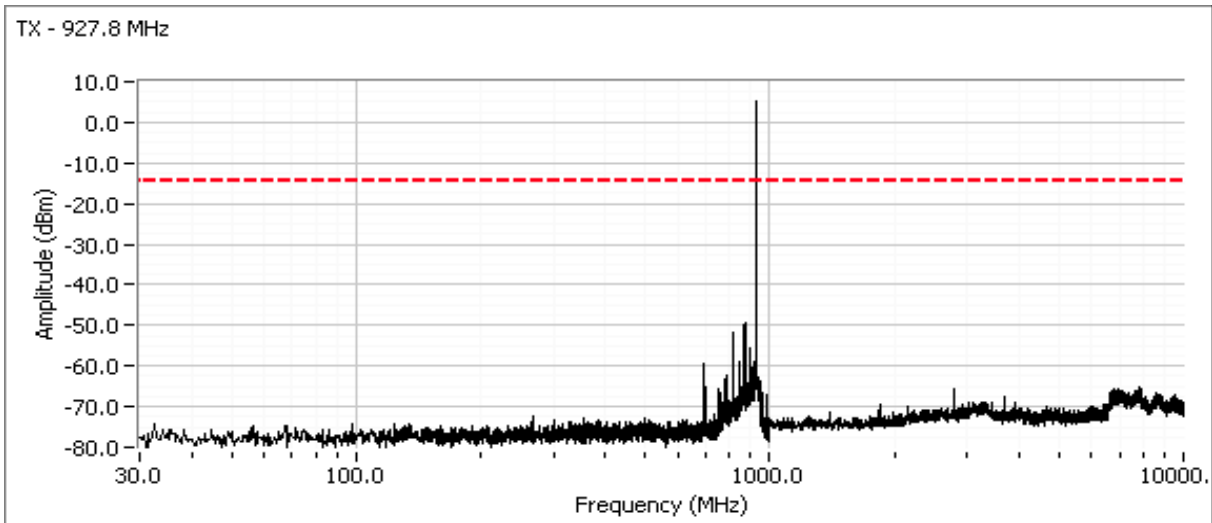
Test Location: FT Lab #4

Device transmitting continuously on the channel (hopping disabled)

Refer to plots below. Scans made using RBW=VB=100 KHz with the limit line set at 20dB below the highest in-band signal level.



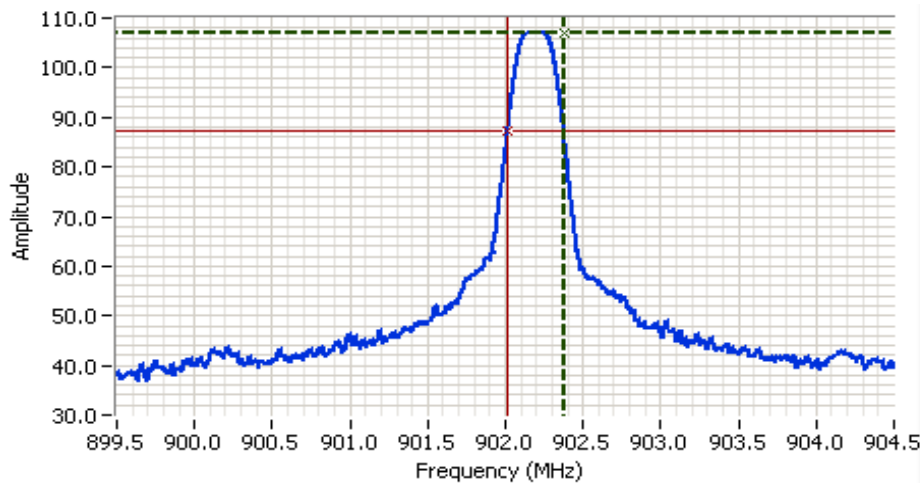
Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A



Client: Flarm	Job Number: J83288
Model: PowerFLARM Portable (Rev A)	T-Log Number: T83437
Contact: Urs Rothacher	Account Manager: Christine Krebill
Standard: FCC Part 15.247 (FHSS)	Class: N/A

Device in non-hopping mode - low and high channel 20dBc measurement:

Refer to plots below. Scans made using RBW=VB=100 KHz with the limit line set at 20dB below the highest in-band signal level.



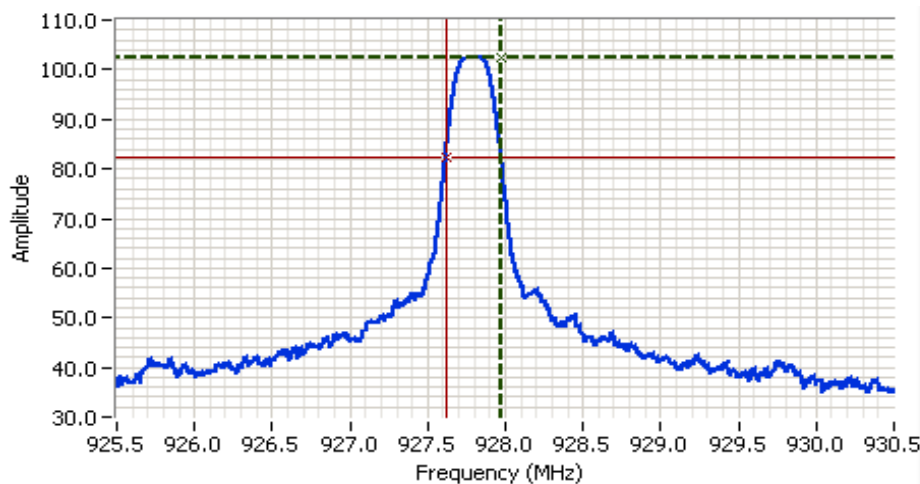
Analyzer Settings

Agilent Technologies, E4446A
CF: 902.000 MHz
SPAN: 5.000 MHz
RB: 120 kHz
VB: 100 kHz
Detector: PK (CISPR)
Attn: 20 DB
RL Offset: 0.0 DB
Sweep Time: 1.0ms
Ref Lvl: 116.0 DBUV

Comments

902.2 MHz NonHopping
Operation

Cursor 1 902.3776 107.05
Cursor 2 902.0158 87.09
Delta Freq. 362 kHz
Delta Amplitude 20.00



Analyzer Settings

Agilent Technologies, E4446A
CF: 928.000 MHz
SPAN: 5.000 MHz
RB: 120 kHz
VB: 100 kHz
Detector: PK (CISPR)
Attn: 20 DB
RL Offset: 0.0 DB
Sweep Time: 1.0ms
Ref Lvl: 116.0 DBUV

Comments

927.8 MHz NonHopping
Operation

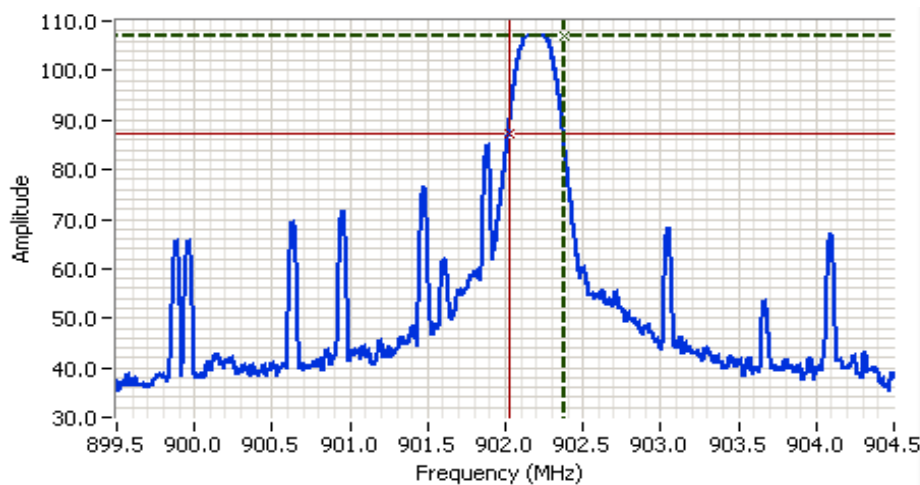
Cursor 1 927.9758 102.37
Cursor 2 927.6157 82.37
Delta Freq. 360 kHz
Delta Amplitude 20.00



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Device in hopping mode - low and high channel 20dBc measurement:

Refer to plots below. Scans made using RBW=VB=100 KHz with the limit line set at 20dB below the highest in-band signal level. Sweep was max hold and running for ~5 minutes to obtain a stable plot. For low channel span was 899.5 - 904.5 MHz, for high channel span was 925.5 - 930.5 MHz.



Analyzer Settings

Agilent Technologies, E4446A
CF: 902.000 MHz
SPAN: 5.000 MHz
RB: 120 kHz
VB: 100 kHz
Detector: PK (CISPR)
Attn: 20 DB
RL Offset: 0.0 DB
Sweep Time: 1.0ms
Ref Lvl: 116.0 DBUV

Comments

902.2 MHz Hopping Operation

Cursor 1 902.3760 107.13
Cursor 2 902.0208 87.13
Delta Freq. 355 kHz
Delta Amplitude 20.00



Analyzer Settings

Agilent Technologies, E4446A
CF: 928.000 MHz
SPAN: 5.000 MHz
RB: 120 kHz
VB: 100 kHz
Detector: PK (CISPR)
Attn: 20 DB
RL Offset: 0.0 DB
Sweep Time: 1.0ms
Ref Lvl: 9.0 DBM

Comments

927.8 MHz Hopping Mode

Cursor 1 927.7708 -4.73
Cursor 2 927.9625 -25.47
Delta Freq. 192 kHz
Delta Amplitude 20.74



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Run #2: Output Power

Device transmitting continuously on the channel (hopping disabled)

Date of Test: 6/2/2011

Test Engineer: Mark Hill

Test Location: FT Lab#4

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

Maximum antenna gain: 3.0 dBi

Channel	Frequency (MHz)	Res BW	Output Power (dBm)	Output Power (W)	EIRP (W)
Low	902.2	-	10.0	0.010	0.0200
Mid	915	-	7.6	0.006	0.0058
High	927.8	-	5.1	0.003	0.0032

Run #3: Bandwidth, Channel Occupancy, Spacing and Number of Channels

Date of Test: 6/2/2011

Test Engineer: Mark Hill

Test Location: FT Lab#4

20dB bandwidth measured with the device transmitting continuously on the channel (hopping disabled)

Channel	Frequency (MHz)	Resolution Bandwidth	20dB Bandwidth (kHz)	Resolution Bandwidth	99% Bandwidth (kHz)
Low	902.2	120k	362	120k	307
Mid	915	120k	362	120k	305
High	927.8	120k	360	120k	302

Note 1: 20dB bandwidth measured using RB = 120k VB = 100kHz (VB > RB)

Note 2: 99% bandwidth measured using RB = 120kHz VB = 1MHz (VB >=3RB)

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Occupancy measurements made with device in hopping mode.

For frequency hopping systems operating in the 902-928 MHz band:

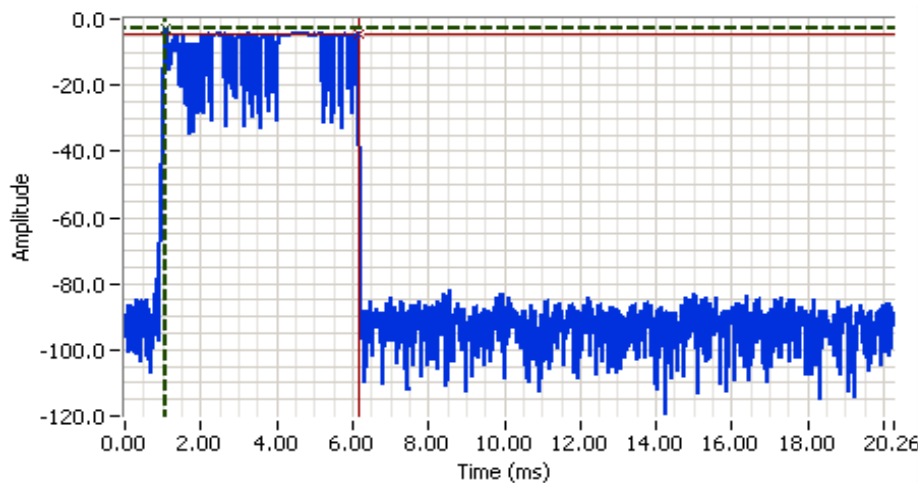
If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, 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.

The system uses 65 channels with a channel separation of 400kHz. The device dwells on a channel for 370ms, which is followed by a quiet time of 260ms before the next channel is used. During the dwell time the device will transmit for about 5ms at some time within the 370ms dwell time. This is described in the operational description and the plots and measurement below support this.

Maximum 20dB bandwidth:	362 kHz	Pass
Channel spacing:	400 kHz	Pass
Transmission time per hop:	5.05 ms	
The time between successive hops on a channel:	41000 ms	One transmission every 630ms, 65 channels
Number of channels (N):	65	Pass
Channel dwell time in 20 seconds:	370 ms	Pass
Channel dwell time in 10 seconds:	370 ms	Pass

The system transmits for 5ms in any 370ms period therefore an average duty cycle correction factor can be used to determine the average value of emissions. The worst case duty cycle in any 100ms period is 5/100 (0.05), therefore the duty cycle correction factor is $20\log(0.05) = -26\text{dB}$

Plot Showing Transmit Time per Hop



Analyzer Settings

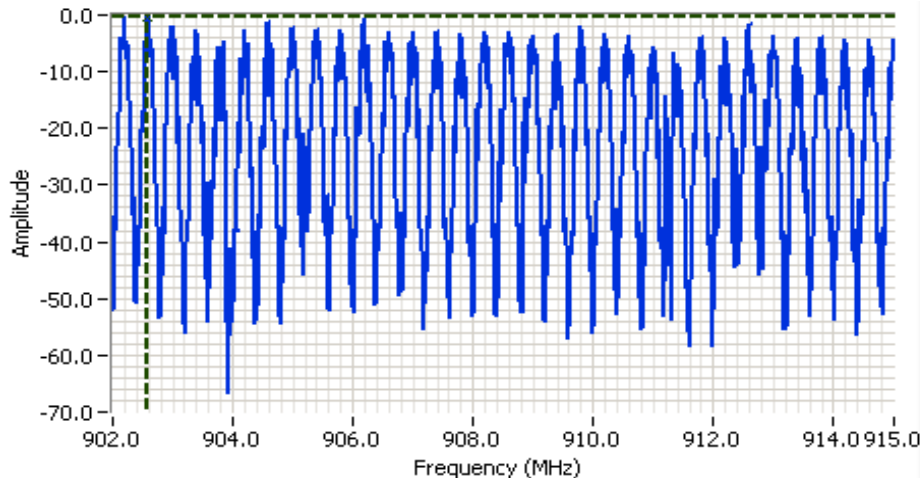
Agilent Technologies, E4446A
CF: 915.400 MHz
SPAN: 0.000 MHz
RB: 30.0 kHz
VB: 1.000 MHz
Detector: PK (CISPR)
Attn: 20 DB
RL Offset: 0.0 DB
Sweep Time: 20.3ms
Ref Lvl: 8.0 DBM

Comments

Cursor 1	1.0868	-2.97		Delta Time (ms)	5.05
Cursor 2	6.1383	-4.72		Delta Amplitude	1.75

Client: Flarm	Job Number: J83288
Model: PowerFLARM Portable (Rev A)	T-Log Number: T83437
Contact: Urs Rothacher	Account Manager: Christine Krebill
Standard: FCC Part 15.247 (FHSS)	Class: N/A

Plots Showing Number of Channels

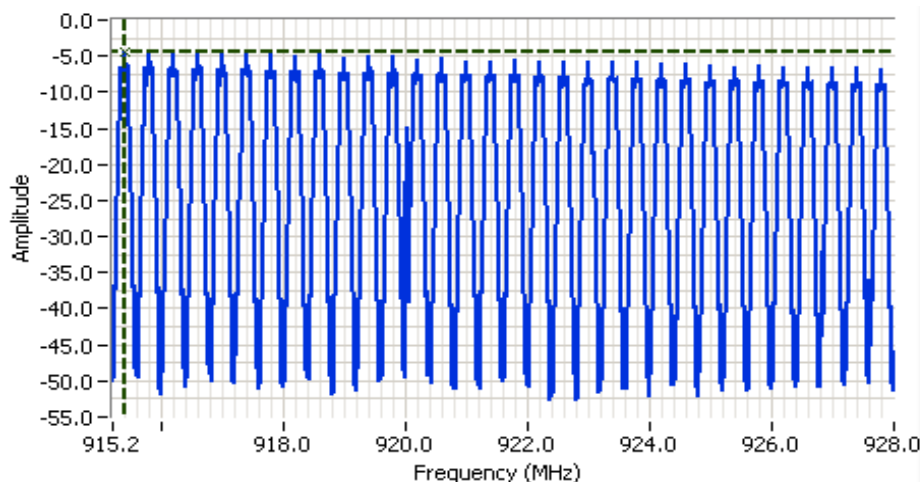
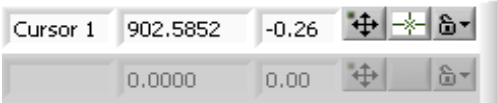


Analyzer Settings

Agilent Technologies, E4446A
 CF: 908.500 MHz
 SPAN: 13.000 MHz
 RB: 30.0 kHz
 VB: 1.000 MHz
 Detector: PK (CISPR)
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 30.0ms
 Ref Lvl: 9.0 DBM

Comments

33 channels

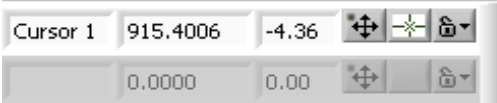


Analyzer Settings

Agilent Technologies, E4446A
 CF: 921.600 MHz
 SPAN: 12.800 MHz
 RB: 30.0 kHz
 VB: 1.000 MHz
 Detector: PK (CISPR)
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 29.6ms
 Ref Lvl: 9.0 DBM

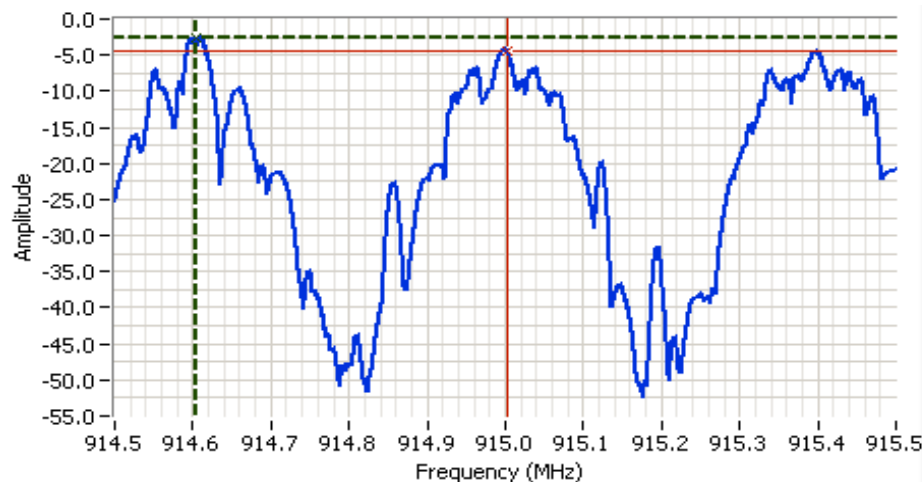
Comments

32 Channels



Client: Flarm	Job Number: J83288
Model: PowerFLARM Portable (Rev A)	T-Log Number: T83437
Contact: Urs Rothacher	Account Manager: Christine Krebill
Standard: FCC Part 15.247 (FHSS)	Class: N/A

Plot Showing Channel Spacing



Analyzer Settings

Agilent Technologies, E4446A
CF: 915.000 MHz
SPAN: 1.000 MHz
RB: 30.0 kHz
VB: 1.000 MHz
Detector: PK (CISPR)
Attn: 20 DB
RL Offset: 0.0 DB
Sweep Time: 2.4ms
Ref Lvl: 9.0 DBM

Comments

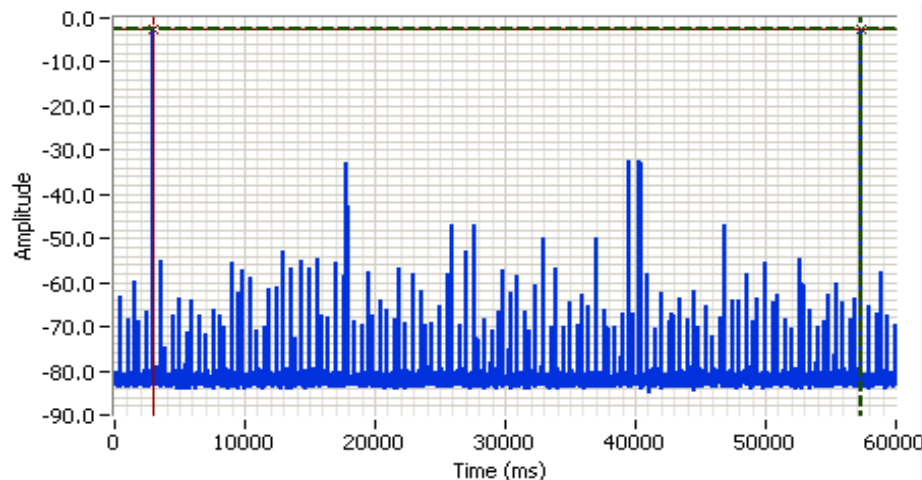
Cursor 1	914.6042	-2.61	
Cursor 1	915.0015	-4.37	

Delta Freq. 397 kHz

Delta Amplitude 1.77



Plot Showing Time Between Hops on the Same Channel



Analyzer Settings

Agilent Technologies, E4446A
CF: 915.400 MHz
SPAN: 0.000 MHz
RB: 30.0 kHz
VB: 1.000 MHz
Detector: PK (CISPR)
Attn: 20 DB
RL Offset: 0.0 DB
Sweep Time: 60.0s
Ref Lvl: 8.0 DBM

Comments

Time between 2 pulses on single hop

Cursor 1	57390.152C	-2.65	
Cursor 2	2985.3979	-2.63	

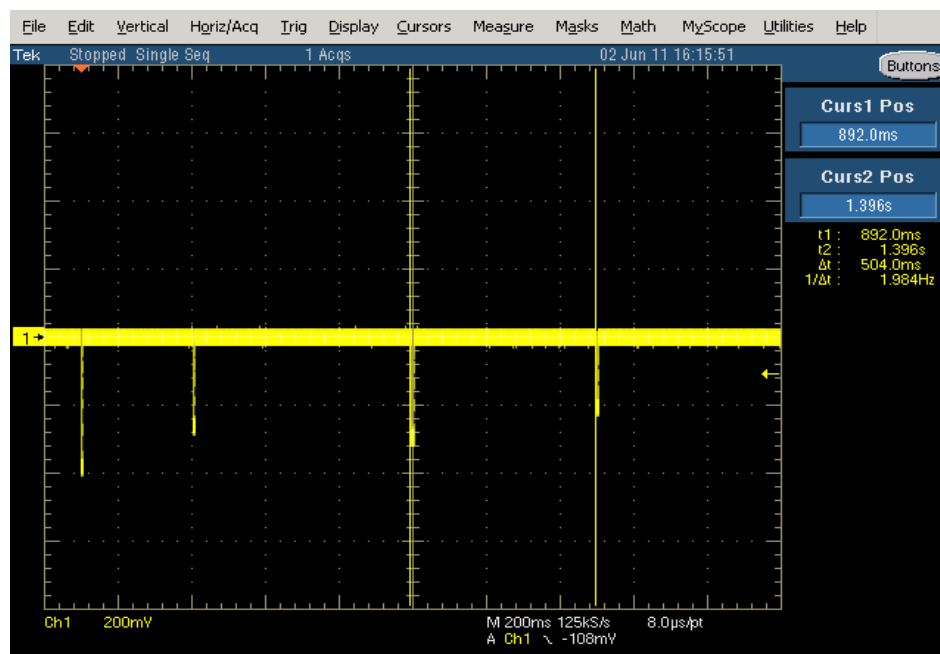
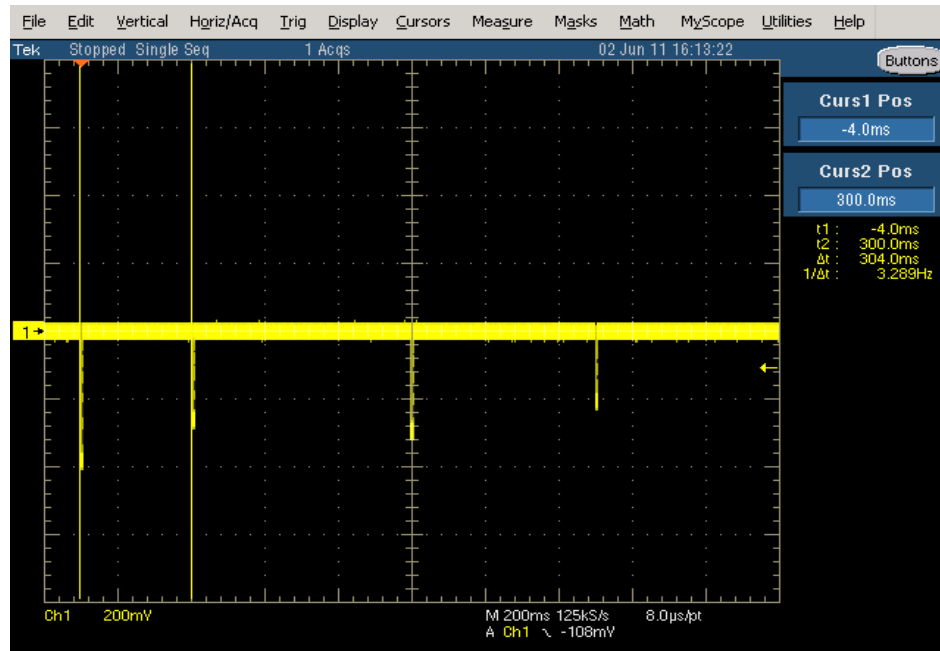
Delta Time (ms) 54404.75

Delta Amplitude 0.01



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Plots Showing Time Between Transmissions



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
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Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

Radiated Emissions

(Elliott Laboratories Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

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

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.

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

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 18-23 °C
Rel. Humidity: 30-40 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1a (Center Channel)	Radiated Emissions 30 - 3000 MHz, Maximized	FCC 15.109 RSS GEN	PASS	24.8dBμV/m @ 180.68MHz (Margin: -18.7dB)
1b (Low Channel)	Radiated Emissions 30 - 3000 MHz, Maximized	FCC 15.109 RSS GEN	PASS	46.1dBμV/m @ 2425.0MHz (Margin: -7.9dB)
1c (High Channel)	Radiated Emissions 30 - 3000 MHz, Maximized	FCC 15.109 RSS GEN	PASS	44.8dBμV/m @ 2419.2MHz (Margin: -9.2dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 - 3000 MHz	3	3	0.0

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Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

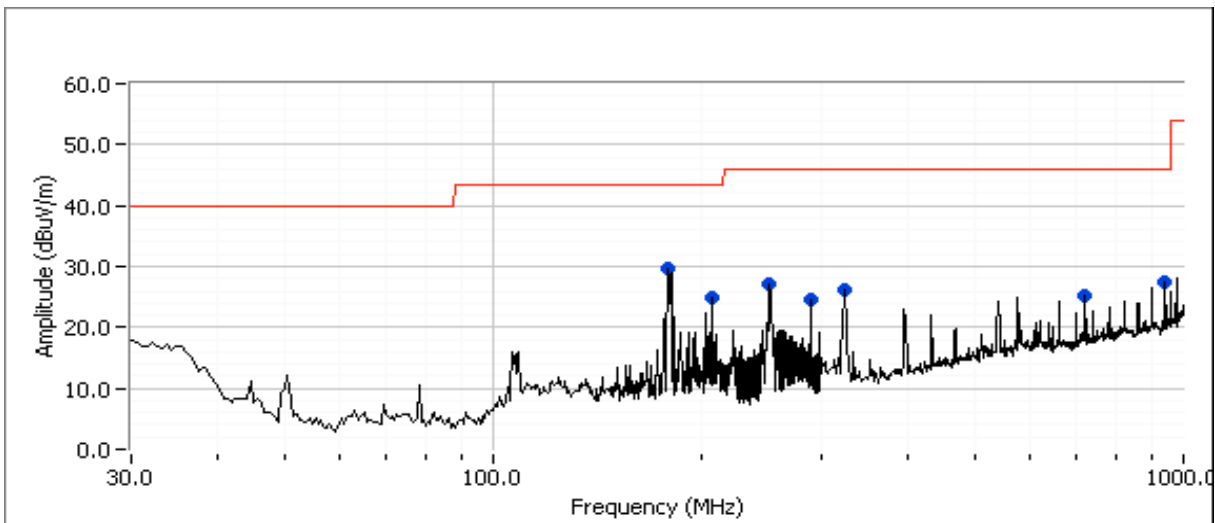
Run # 1a: Rx mode @ 915 MHz (center channel)

Date of Test: 6/2/2011
 Test Engineer: Rafael Varelas
 Test Location: Fremont Chamber #4

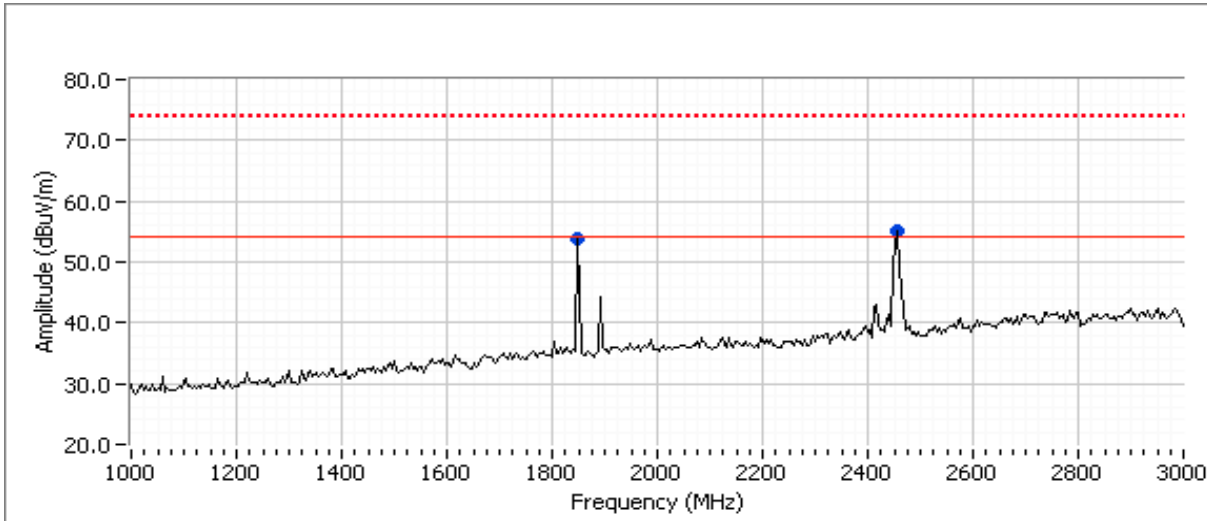
Config. Used: #1
 Config Change: None
 EUT Voltage: Battery

Maximized readings

Frequency	Level	Pol	FCC 15.109/RSS GEN		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2451.030	42.8	H	54.0	-11.2	AVG	34	1.0	AVG (0.10s)
1860.950	39.0	H	54.0	-15.0	AVG	54	2.4	AVG (0.10s)
2451.030	57.4	H	74.0	-16.6	PK	34	1.0	PK (0.10s)
180.681	24.8	V	43.5	-18.7	QP	139	1.0	QP (1.00s)
939.993	26.8	H	46.0	-19.2	QP	119	1.5	QP (1.00s)
719.978	25.6	H	46.0	-20.4	QP	101	1.0	QP (1.00s)
1860.950	50.7	H	74.0	-23.3	PK	54	2.4	PK (0.10s)
288.005	22.6	H	46.0	-23.4	QP	265	1.0	QP (1.00s)
210.102	15.1	V	43.5	-28.4	QP	146	1.0	QP (1.00s)
249.559	14.9	H	46.0	-31.1	QP	257	1.0	QP (1.00s)



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A



Run # 1b: Rx mode @ 902.2 MHz (low channel)

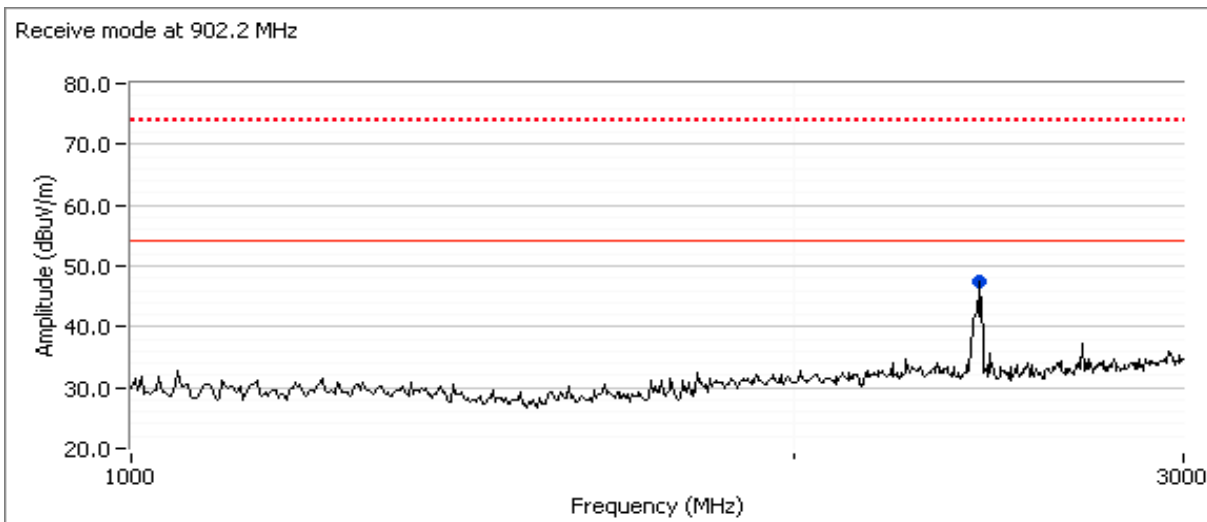
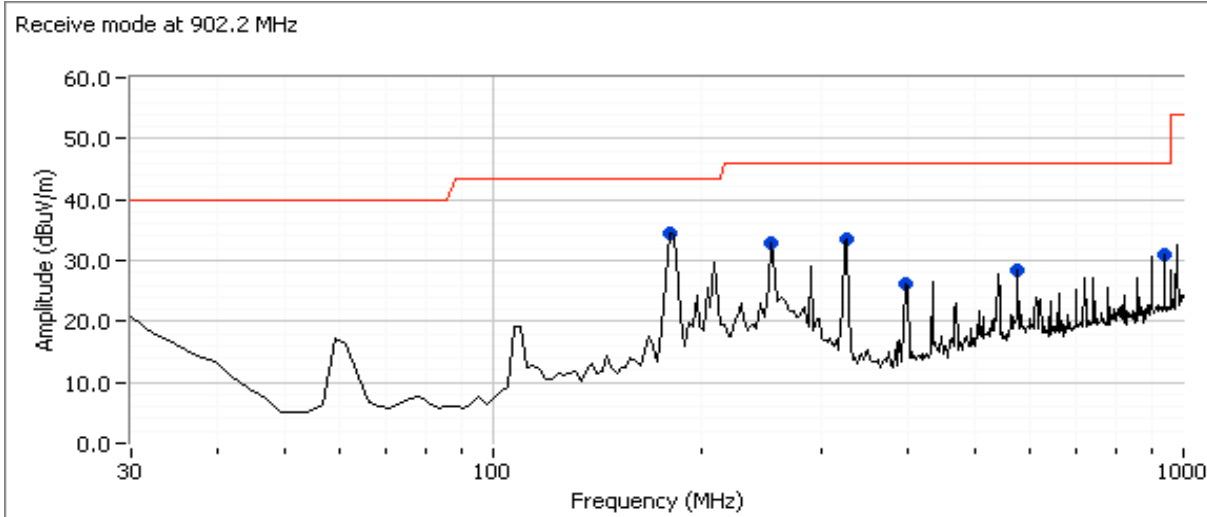
Date of Test: 6/8/2011
 Test Engineer: M. Birgani
 Test Location: FT Chamber #7

Config. Used: #1
 Config Change: None
 EUT Voltage: Battery

Maximized readings

Frequency	Level	Pol	FCC 15.109/RSS GEN		Detector	Azimuth	Height	Comments
MHz	dBμV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2424.990	46.1	V	54.0	-7.9	AVG	180	1.0	RB 1 MHz;VB 10 Hz;Pk
181.095	30.0	V	43.5	-13.5	QP	118	1.1	QP (1.00s)
940.001	31.9	H	46.0	-14.1	QP	106	1.0	QP (1.00s)
2425.360	50.2	V	74.0	-23.8	PK	180	1.0	RB 1 MHz;VB 3 MHz;Pk
258.942	20.1	H	46.0	-25.9	QP	69	1.1	QP (1.00s)
393.066	18.8	H	46.0	-27.2	QP	110	1.0	QP (1.00s)
322.463	17.9	H	46.0	-28.1	QP	60	1.0	QP (1.00s)
574.186	16.4	H	46.0	-29.6	QP	118	1.2	QP (1.00s)

Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

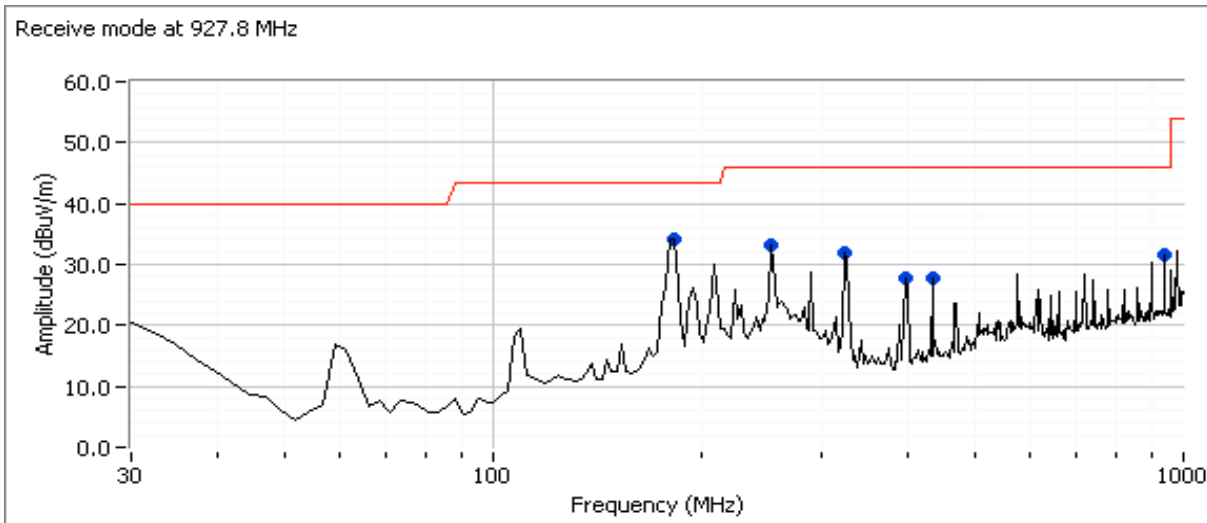
Run # 1c: Rx mode @ 927.8 MHz (high channel)

Date of Test: 6/8/2011
 Test Engineer: M. Birgani
 Test Location: FT Chamber #7

Config. Used: #1
 Config Change: None
 EUT Voltage: Battery

Maximized readings

Frequency	Level	Pol	FCC 15.109/RSS GEN		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2419.180	44.8	V	54.0	-9.2	AVG	150	1.0	RB 1 MHz;VB 10 Hz;Pk
431.995	28.6	H	46.0	-17.4	QP	270	1.0	QP (1.00s)
182.944	26.0	V	43.5	-17.5	QP	275	1.0	QP (1.00s)
395.302	24.9	H	46.0	-21.1	QP	273	1.0	QP (1.00s)
2419.030	50.0	V	74.0	-24.0	PK	150	1.0	RB 1 MHz;VB 3 MHz;Pk
257.285	21.4	H	46.0	-24.6	QP	109	1.0	QP (1.00s)
1866.910	28.9	V	54.0	-25.1	AVG	205	1.0	RB 1 MHz;VB 10 Hz;Pk
935.992	19.0	H	46.0	-27.0	QP	158	1.0	QP (1.00s)
319.216	14.9	H	46.0	-31.1	QP	101	1.0	QP (1.00s)
1869.440	40.0	V	74.0	-34.0	PK	205	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Flarm	Job Number:	J83288
Model:	PowerFLARM Portable (Rev A)	T-Log Number:	T83437
Contact:	Urs Rothacher	Account Manager:	Christine Krebill
Standard:	FCC Part 15.247 (FHSS)	Class:	N/A

