Test Report

Curtis-Straus LLC, *a wholly owned subsidiary of BV CPS*

Report No	EO3130-1
Client	ThingMagic, A division of Trimble Khaled El Mahgoub
Address	1 Merrill Street Woburn, MA 01801
Phone	(781) 305-4321
Items tested	M6E-MICRO
Standards	FCC 15.247 & RSS-210 (partial testing)
FCC ID IC	QV5MERCURY6E-M 5407A-MERCURY6EM
Results	As detailed within this report
Prepared by	Arik Zwirner – Test Engineer
Authorized by	Christopher Reynolds – EMC Supervisor
Issue Date	1/16/2015
Conditions of Issue	This Test Report is issued subject to the conditions stated in the '*Conditions of Testing*' section on page 25 of this report.

Contents

Contents 2
Summary 3
Product Tested 4
Modifications Required for Compliance 4
Test Results 5
PEAK OUTPUT POWER 5
NUMBER OF CHANNELS 12
CHANNEL SEPARATION 14
Jurisdictional Labeling and Required Instruction Manual Inserts 17
FCC Requirements 17
Conditions Of Testing 20

REV 28-MAR-12 (KK)

Summary

This report details the partial testing of the M6e-Micro board (with existing FCC ID:QV5MERCURY6E-M and IC:5407A-MERCURY6EM) with the following modifications:

The channel plan was changed to space the same number of channels (50), with a narrower spacing of 200kHz instead of the original 500kHz. Per client, this is only a software change of the frequency and the end user cannot switch between channel plans.

Original (MHz) Channel spacing is 500 kHz:

902.75,903.25,903.75,904.25,904.75,905.25,905.75,906.25,906.75,907.25,907.75,908.25,908.75,909.25, 909.75,910.25,910.75,911.25,911.75,912.25,912.75,913.25,913.75,914.25,914.75,915.25,915.75,916.25, 916.75,917.25,917.75,918.25,918.75,919.25,919.75,920.25,920.75,921.25,921.75,922.25,922.75,923.25, 923.75,924.25,924.75,925.25,925.75,926.25,926.75,927.25.

New (MHz) Channel spacing is 200 kHz:

917.4,917.6,917.8,918,918.2,918.4,918.6,918.8,919,919.2,919.4,919.6,919.8,9.200,920.2,920.4,920.6,92 0.8,921,921.2,921.4,921.6,921.8,92.20,922.2,922.4,922.6,922.8,923,923.2,923.4,923.6,923.8,92.40,924. 2,924.4,924.6,924.8,925,925.2,925.4,925.6,925.8,92.60,926.2,926.4,926.6,926.8,927,927.2.

Three transmitter tests were done to evaluate the above modifications: Number of Channels, Peak Output Power, and Frequency Separation. We found the product to be compliant with FCC part 15.247 and RSS-210 for the above tests. Testing of the original channel plan was previously performed under report EM2037-1.

Khaled El Mahgoub from ThingMagic was present during testing. The test sample was received in good condition.

Issue No.	Reason for change	Date Issued
1	Original Release	January 16, 2015

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One Distribution Center Circle, #1 • Littleton, MA • TEL (978) 486-8880 • FAX (978) 486-8828

ACCREDITED Cert. No. 1627-01

Product Tested

EUT Configuration

Work Order: O3130
Company: ThingMagic, A division of Trimble
Company Address: 1 Merrill Street
Woburn, MA 01801
Contact: Khaled ElMahgoub
Person Present: Khaled ElMahgoub

	MN	SN	FCCID	ICID
EUT:	M6E-MICRO	Sample 1	QV5MERCURY6E-M	5407A-MERCURY6EM

EUT Description: M6E-MICRO
EUT Max Frequency: <108MHz
EUT TX Frequency: 902-928MHz(FCC)

Support Equipment:	MN	SN
DC PS	--	--
Laptop	--	--
ThingMagic carrier board	--	--

EUT Ports:

Port Label	Port Type	No. of ports	No. Populated	Cable Type	Shielded	Ferrites	Length	Max Length	In/Out NEBS Type	Comment
AC/DC Power	DC Input	1	1	2-wire conductor	no	None	1m	>3m	Indoor	
USB	USB	1	1	USB	Yes	None	2m	5m	Indoor	
J1/J10	12-15ping	2	0	N/A	N/A	N/A	N/A	N/A	N/A	not used in this configuration
Antenna port	MMCX(ixp connector at board)	2	2	Coaxial	Yes	None	1m	1m	Indoor	

Software / Operating Mode Description:

EUT is set to transmit on 917.4, 922.4 and 927.2 MHz for FCC part 15 testing and was set to hopping mode for channel number testing.

Modifications Required for Compliance

None

Test Results

PEAK OUTPUT POWER

LIMIT

"The maximum peak conducted output power of the intentional radiator shall not exceed…1 watt for systems employing at least 50 hopping channels..." [FCC 15.247(b)(2)]

Limit = 30dBm

MEASUREMENTS

Results:

Peak Output Power

Date: 5-Dec-14	**Company:** ThingMagic		**Work Order:** O3130
Engineer: Arik Zwirner	**EUT Desc:** M6E-MICRO		**EUT Operating Voltage/Frequency:** 120Vac/60Hz
Temp: 22°C	**Humidity:** 12%		**Pressure:** 1011mbar

	Frequency (MHz)	SA Reading (dBm)	Cable & Attenuator Factor (dB)	Carrier Board Loss (dB)	Adjusted Reading (dBm)	Limit (dBm)	Margin (dB)	Result (Pass/Fail)
Antenna Port 1	917.4	-1.761	31.2	0.3	29.7	30.0	-0.3	Pass
Antenna Port 1	922.4	-1.751	31.0	0.3	29.5	30.0	-0.5	Pass
Antenna Port 1	927.2	-1.791	31.2	0.3	29.7	30.0	-0.3	Pass
Antenna Port 2	917.4	-1.761	31.2	0.3	29.7	30.0	-0.3	Pass
Antenna Port 2	922.4	-1.817	31.0	0.3	29.5	30.0	-0.5	Pass
Antenna Port 2	927.2	-1.791	31.2	0.3	29.7	30.0	-0.3	Pass

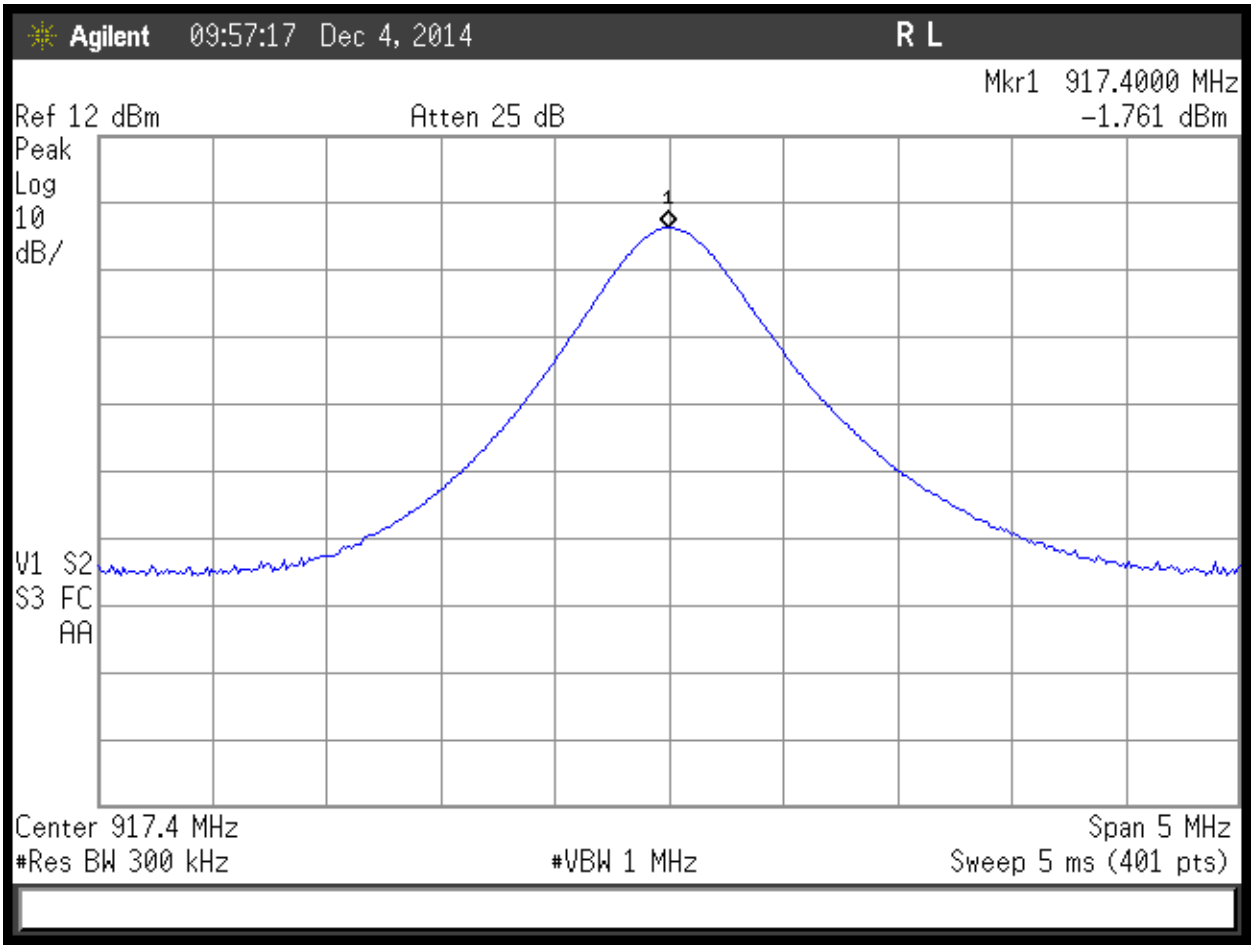
Rev. 11/30/2014

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Rental SA #2 (1860)	9kHz-26.5 GHz	E7405A	Agilent	MY45104916	1860	I	6/4/2015	6/4/2014

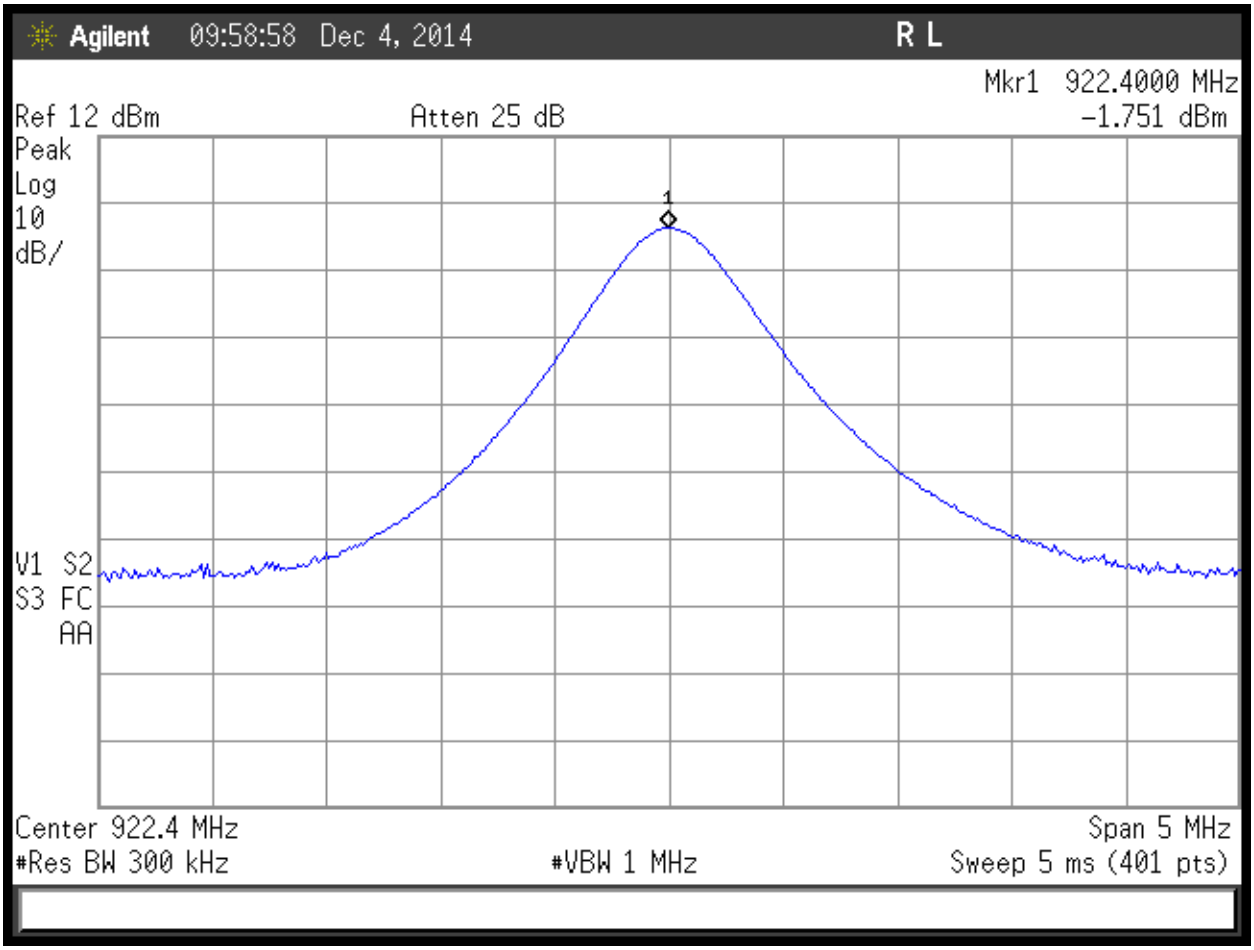
All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Note: Carrier board loss is declared by client and not calibrated by the test lab.

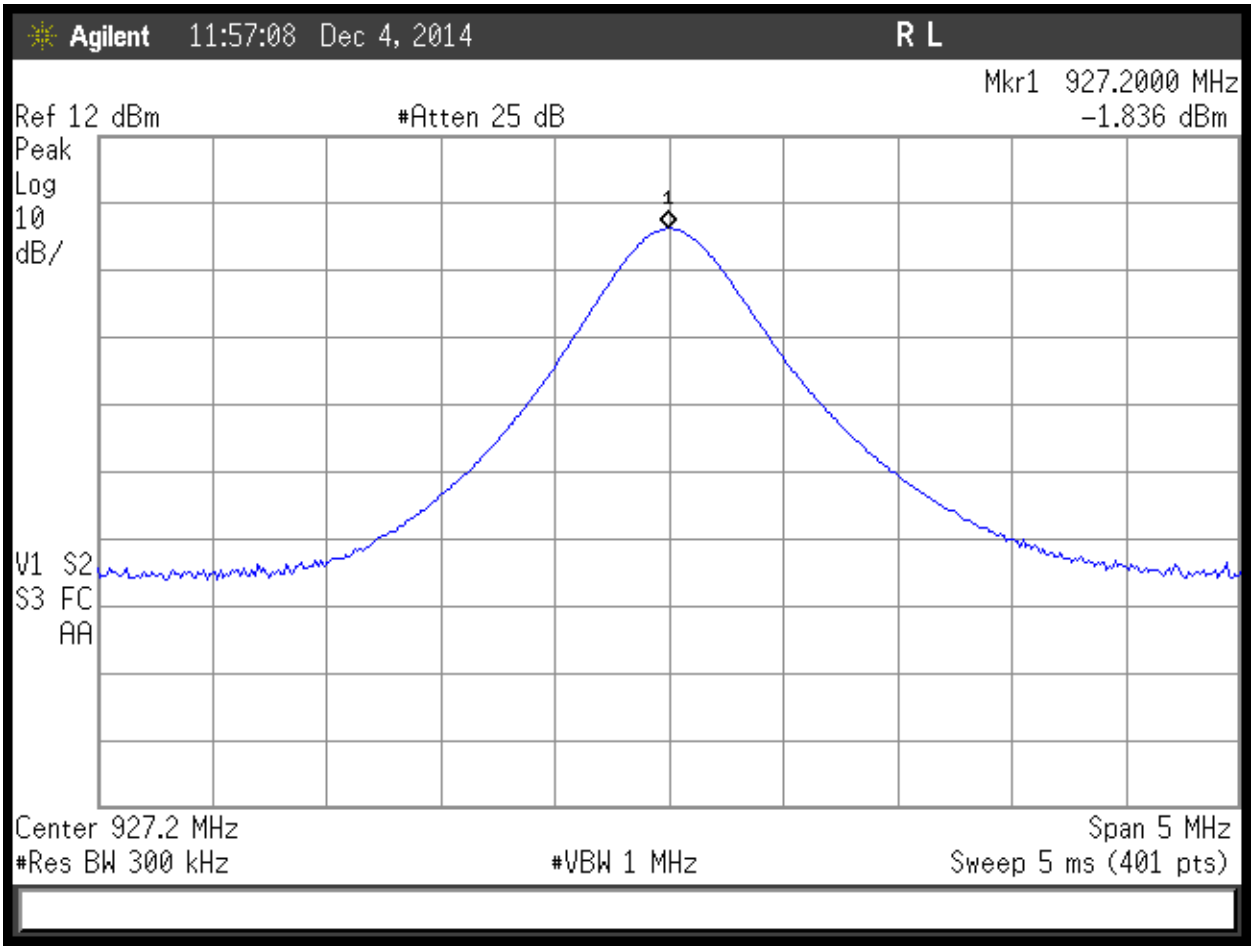
Antenna Port 1 Plots



Antenna Port 1 Low Channel

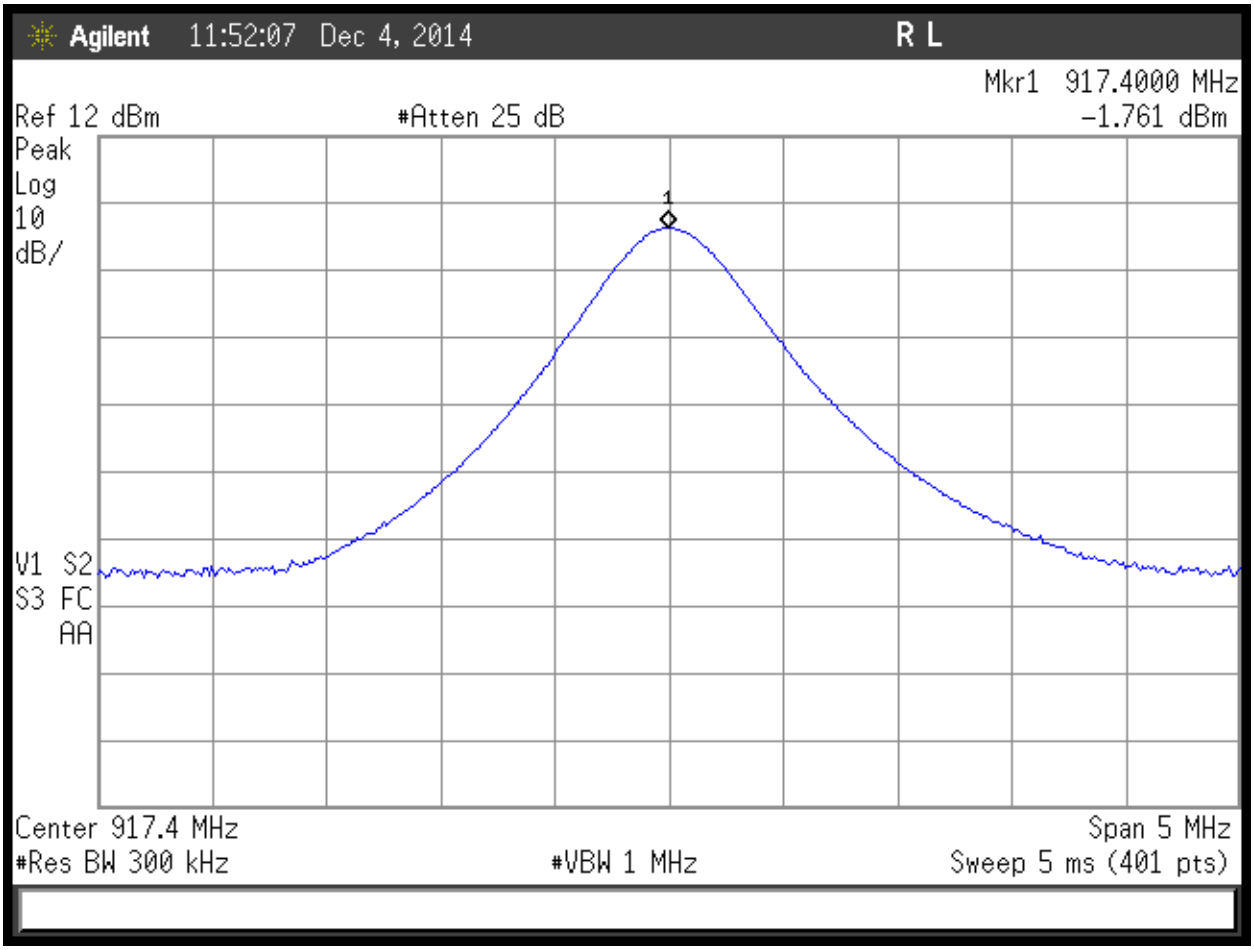


Antenna Port 1 Mid Channel

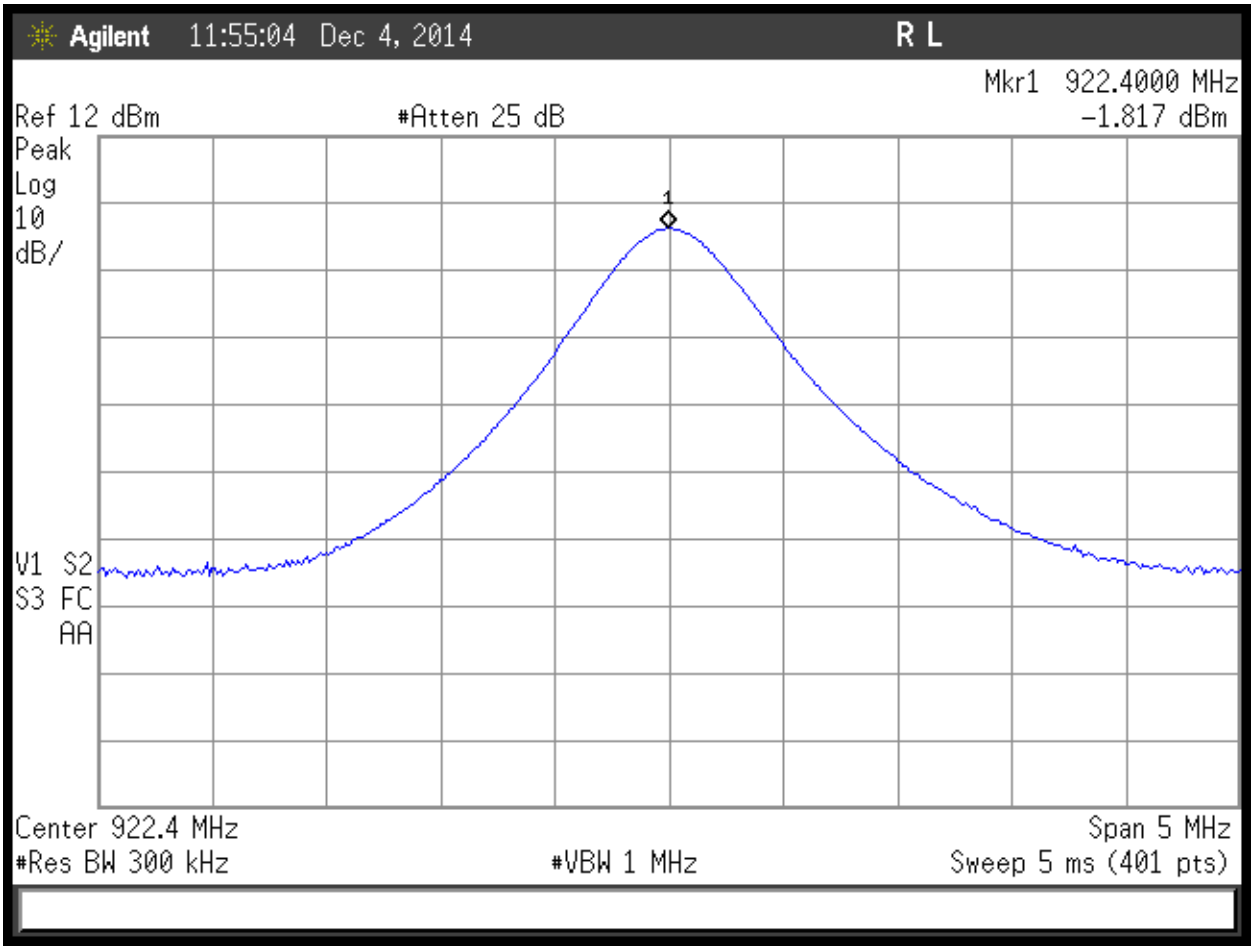


Antenna Port 1 High Channel

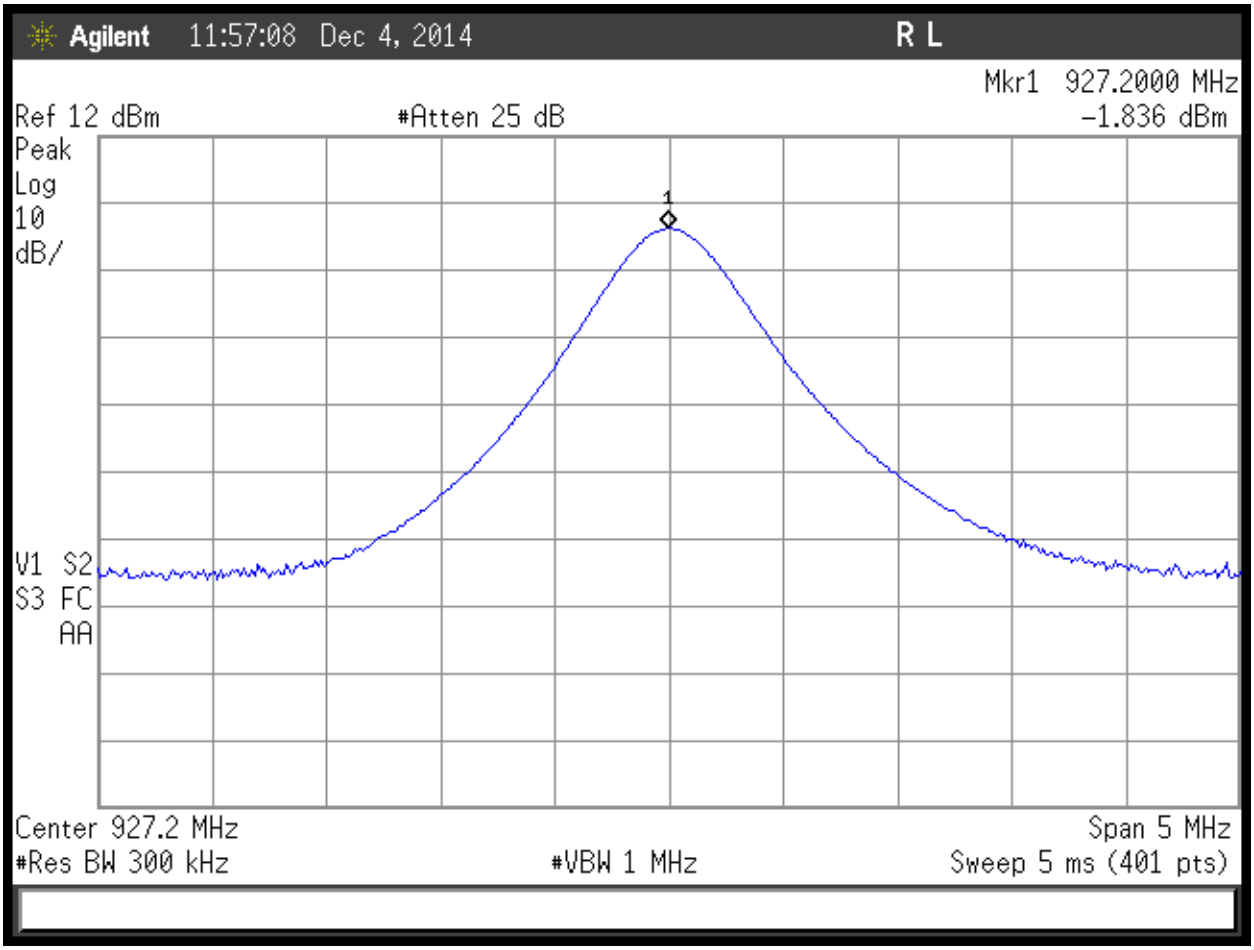
Antenna Port 2 Plots



Antenna Port 2 Low Channel



Antenna Port 2 Mid Channel



Antenna Port 2 High Channel

Number of Hopping Frequencies

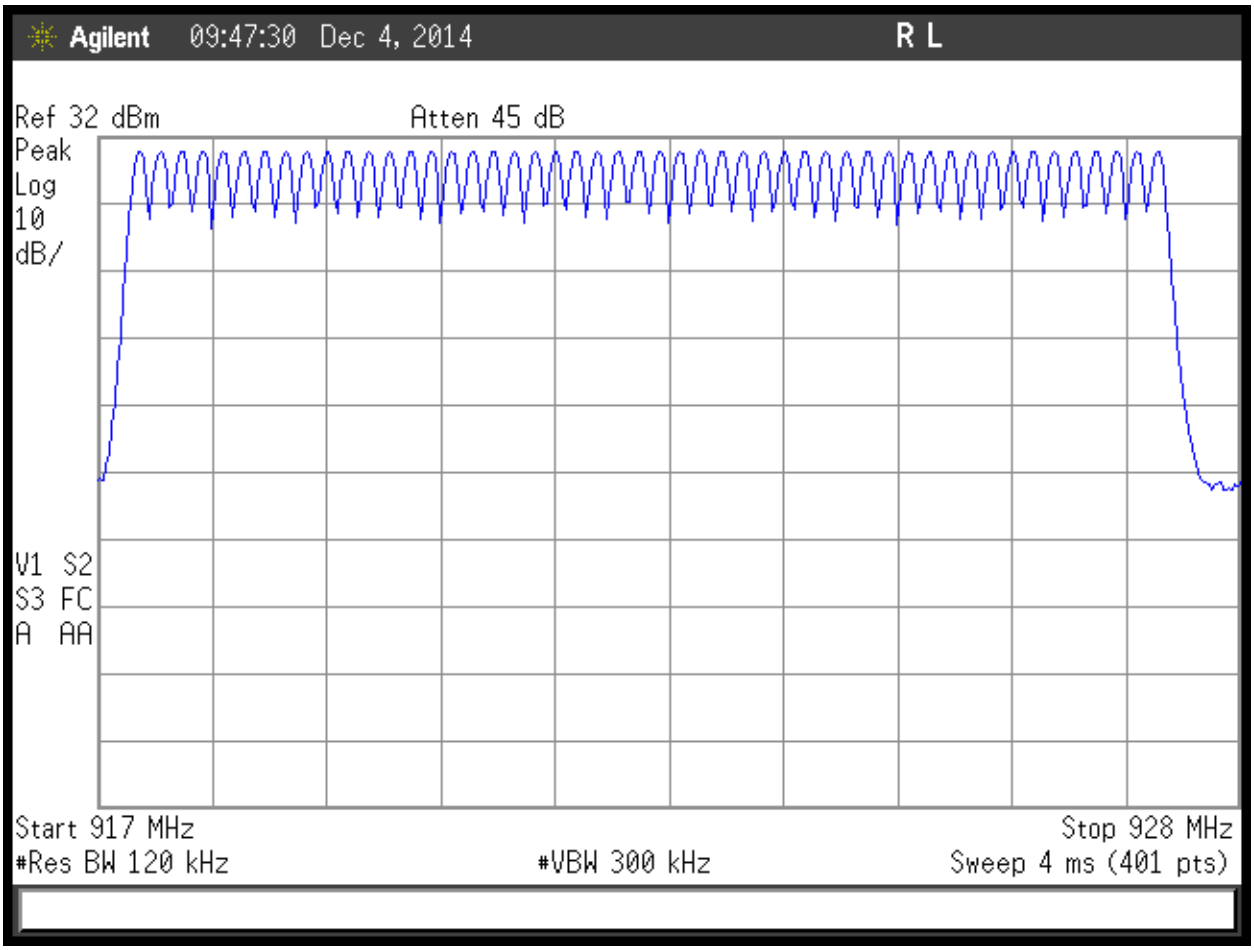
LIMIT

"…if the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping frequencies…
[15.247(a)(1)(i)]

Engineer	Arik Zwirner
Date	12/5/14

MEASUREMENTS / RESULTS

Number of hopping frequencies = 50 Pass



Rev. 11/30/2014

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Rental SA #2 (1860)	9kHz-26.5 GHz	E7405A	Agilent	MY45104916	1860	I	6/4/2015	6/4/2014

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Channel Frequency Separation

LIMIT

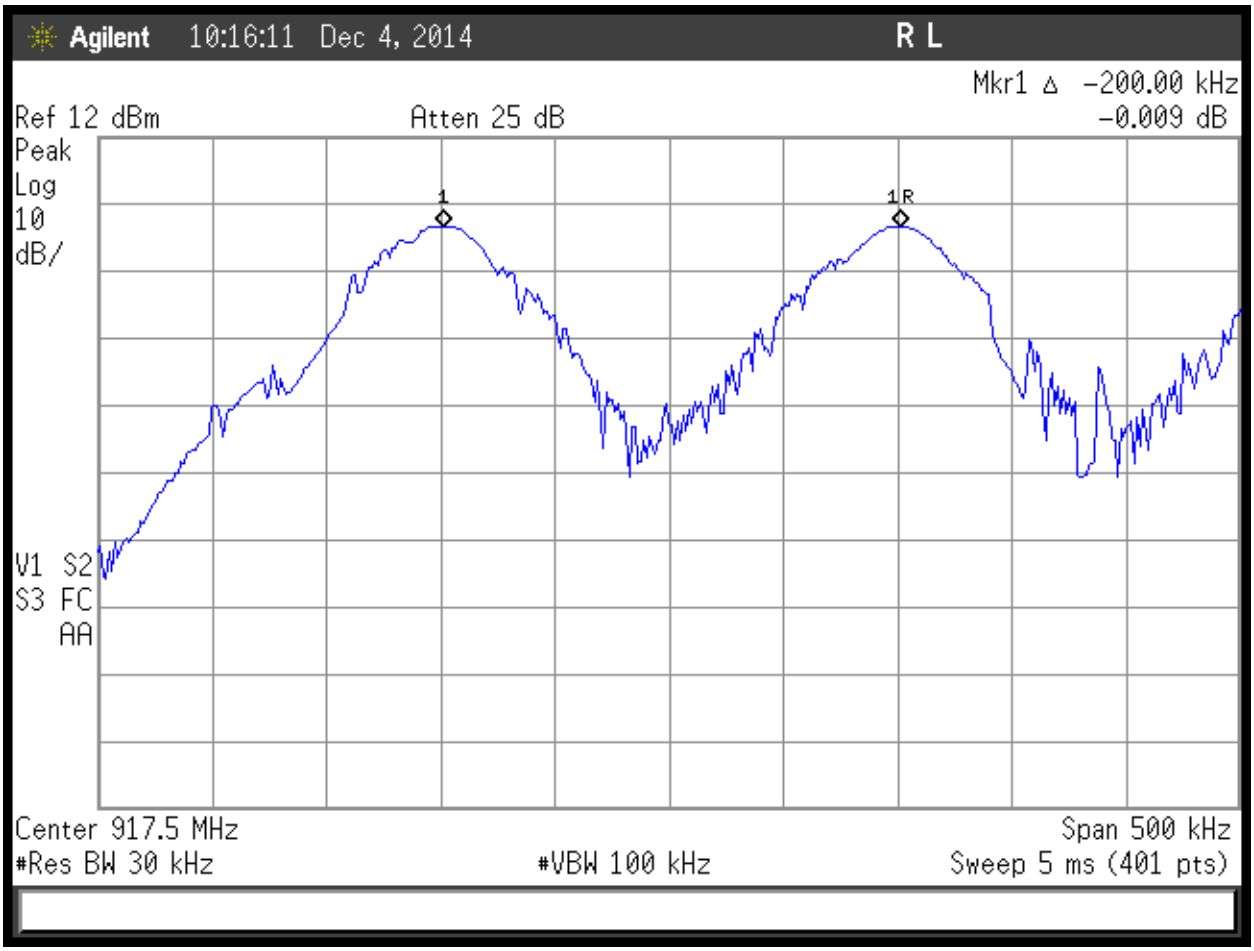
"Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater." [15.247(a)(1)]

Limit = 20dB bandwidth = 53.75kHz. (max 20dB BW observed from report EM2037-1)

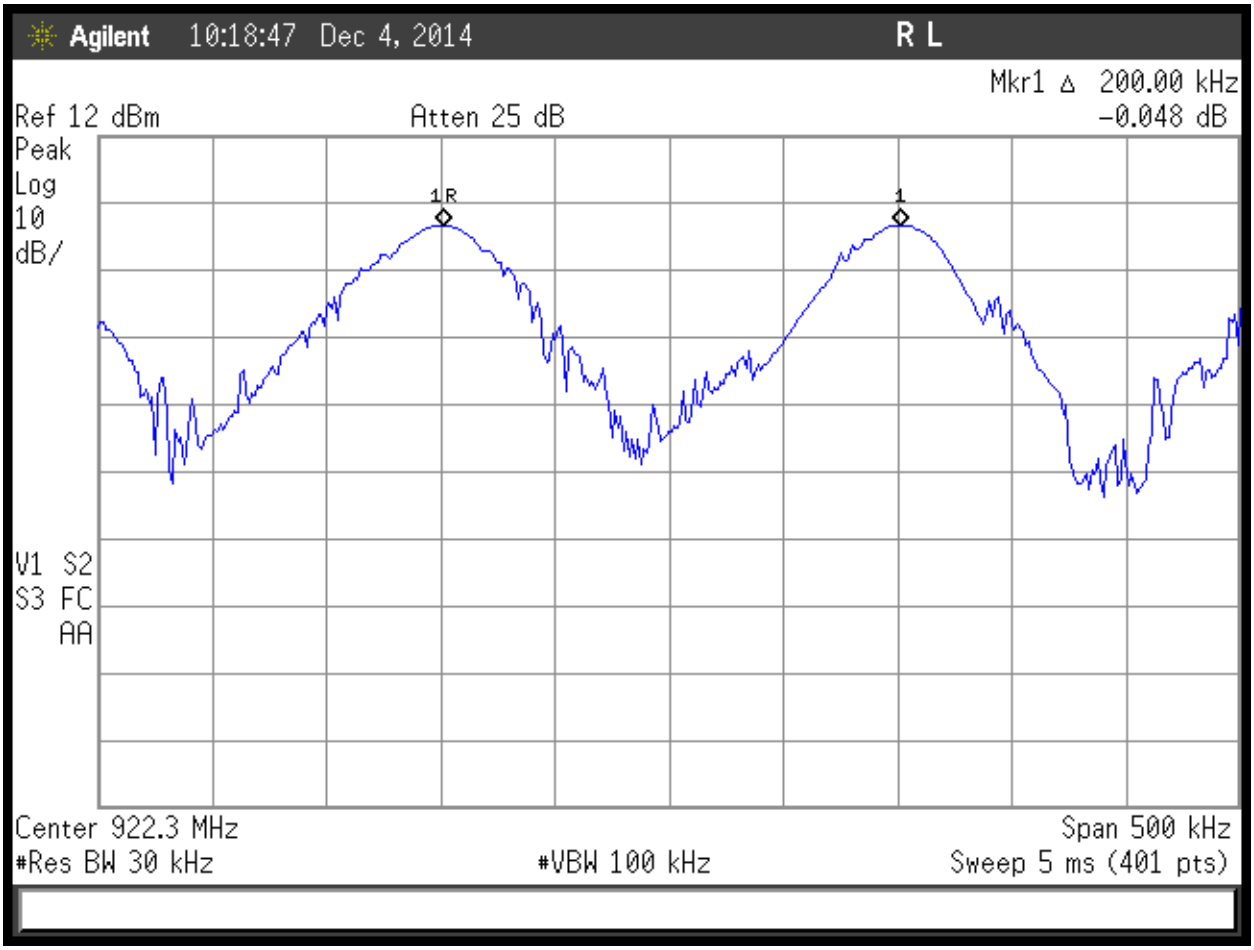
Engineer	Arik Zwirner
Date	12/5/14

MEASUREMENTS / RESULTS

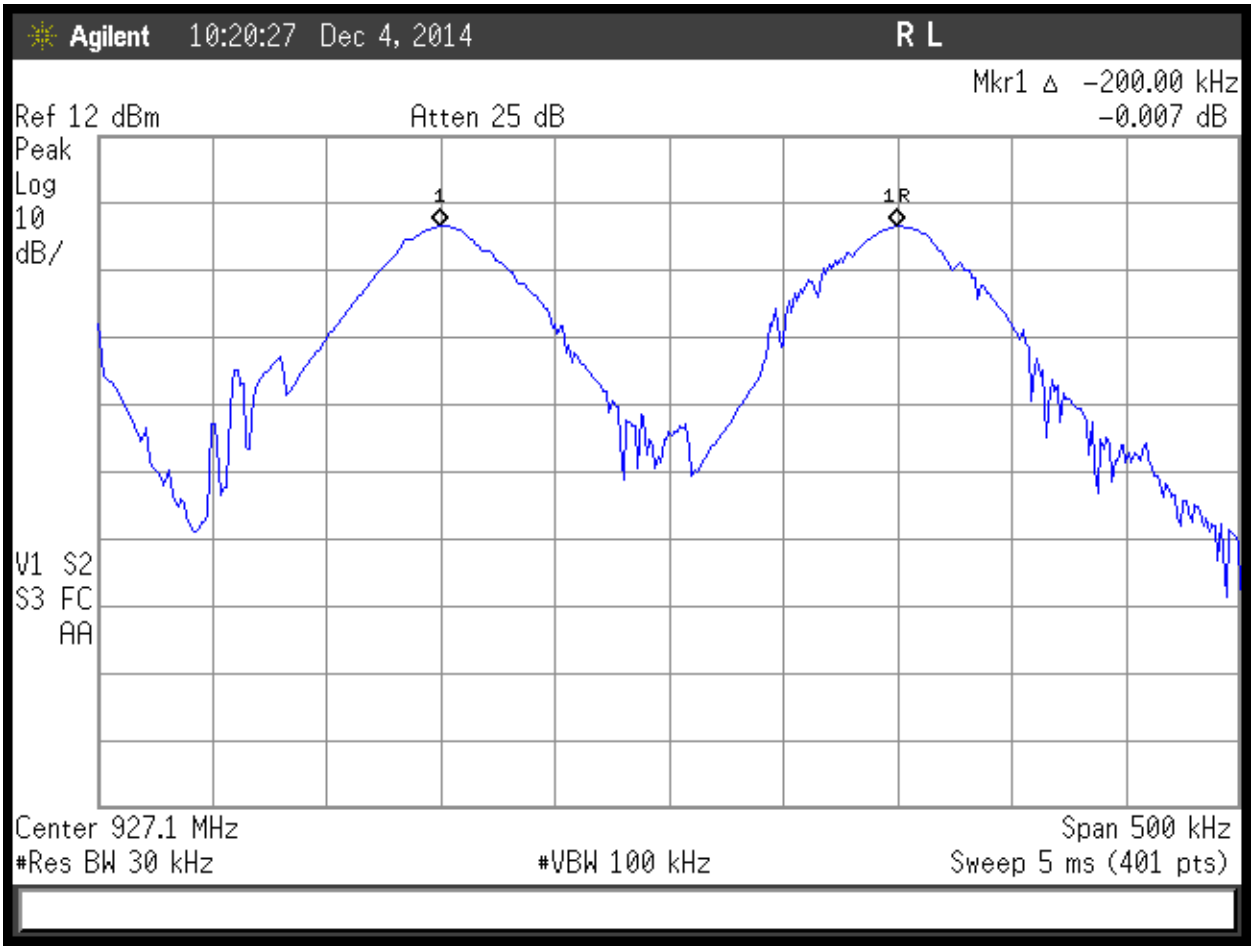
Channel Frequency Separation = 200kHz Pass



Low Pair of Channels



Mid Pair of Channels



High Pair of Channels

Rev. 11/30/2014

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Rental SA #2 (1860)	9kHz-26.5 GHz	E7405A	Agilent	MY45104916	1860	I	6/4/2015	6/4/2014

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Jurisdictional Labeling and Required Instruction Manual Inserts

FCC Requirements

Required Equipment Authorization for Device Type

Type of Device	Equipment Authorization Required
TV broadcast receiver	Verification
FM broadcast receiver	Verification
CB receiver	Declaration of Conformity or Certification
Superregenerative receiver	Declaration of Conformity or Certification
Scanning receiver	Certification
Radar detector	Certification
All other receivers subject to part 15	Declaration of Conformity or Certification
TV interface device	Declaration of Conformity or Certification
Cable system terminal device	Declaration of Conformity
Stand-alone cable input selector switch	Verification
Class B personal computers and peripherals	Declaration of Conformity or Certification
CPU boards and internal power supplies used with Class B personal computers	Declaration of Conformity or Certification
Class B personal computers assembled using authorized CPU boards or power supplies	Declaration of Conformity
Class B external switching power supplies	Verification
Other Class B digital devices & peripherals	Verification
Class A digital devices, peripherals & external switching power supplies	Verification
Access Broadband over Power Line (Access BPL)	Certification
All other devices	Verification

FCC Required labeling for Verified Devices 47 CFR Part 15.19

The specific labeling requirements for a device subject to the Verification or Certification procedure are contained in Section 15.19(a). These labelling requirements are:

- One of three compliance statements specified in Section 15.19(a);
- If the device is subject only to Verification include a label bearing a unique identifier - Section 2.954;
- If the device is subject to Certification (1) Section 2.925 contains information on identification of the equipment; (2) include a label bearing an FCC Identifier (FCC ID) - Section 2.926.

If the labeling area for the device is so small, and / or it is not practical to place the required statement on the device, then the statement can be placed in the user manual or product packaging - Section 15.19(a)(5). Generally, devices smaller than the palm of the hand are considered small. However, the device must still be labeled with the unique identifier (Verification) or the FCC ID (Certification).

Declaration of Conformity (DoC):

The labeling requirements for a device subject to the Declaration of Conformity (DoC) procedure are specified in Section 15.19(b). The label should include the FCC logo along with the Trade

Name and Model Number, which satisfies the unique identifier requirement of Section 2.1074 if it represents the identical equipment tested for DoC compliance. For personal computers assembled from authorized components, the following additional text must also be included: "Assembled from tested components," "Complete system not tested." When the device is so small and / or when it is not practical to place the required additional text on the device, the text may be placed in the user manual or pamphlet supplied to the user. However, the FCC logo, Trade Name, and Model Number must still be displayed on the device - Section 15.19(b)(3).

Part 15 Declaration of Conformity (DoC) Label Examples

FCC Required Instruction Manual Inserts CFR 47 Part 15.21 and 15.105

Section 15.21 requires that in the user manual, the user shall be cautioned that changes / modifications not approved by the responsible party could void the user's authority to operate the equipment. The acceptable formats for user information dissemination are paper, computer disk or over the Internet. Where special accessories, such as shielded cables and/or special connectors, are required to comply with the emission limits, the instruction manual shall include appropriate instructions on the first page of the text describing the installation of the device (Section 15.27(a)).

For a Class A or Class B digital device (unintentional radiator), as well as any composite device that is both an intentional and unintentional radiator, the text specified in Section 15.105 must be placed in the user manual.

Devices authorized under the Declaration of Conformity (DoC) procedure must also include a compliance information statement (in the user manual or on a separate sheet) as required by Section 2.1077. The objective of this compliance statement is to allow the FCC to associate the equipment with the party responsible for compliance with the DoC requirements.

Devices certified as software defined radio that use an electronic labeling method to display the FCC ID must provide instructions in the user manual on how to access the electronic display (Section 2.925(e)).

Additional statements and information may be required for compliance to specific or general rule parts. The following is an example of some additional user information requirements. The party responsible for compliance must provide any additional statement(s) required.

- Kits - TV interface and Cable system terminal device marketed as Kits: Section 15.25 (d);
- TV interface devices, including cable system terminal devices: Section 15.115 (c) (5);
- Labeling of digital cable ready products: Section 15.123 - use of the term cable ready/compatible;
- External power amplifiers and antenna modifications: Section 15:204 (d) (2) – 1 notice of authorized amplifiers;

- Cordless telephones: Section 15.214 (c) & (d) (3) - privacy statement & security code statement;
- Cordless telephones: Section 15.233 (b) (2) (ii) - interference to TV;
- Cordless telephones: Section 15.233 (h) - cordless phones without digital security (Section 15.214);
- Professionally installed systems: Section 15.247 (c) (1) (iii);
- Operation within the Band 92-95 GHz: Section 15.257 (a) (4) - indoor use only;
- Unlicensed PCS: Section 15.311 - notification and coordination with UTAM, Inc.;
- RF exposure statements: Section 2.1091 (d) (3) - Mobile devices (a minimum separation distance may be required).

Our facility codes can be found in the test equipment lists in each emissions section of this report.

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Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("Client"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "Conditions"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("Test Report") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.
2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.
3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.
4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.
5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "**BUREAU VERITAS," "BUREAU VERITAS CONSUMER PRODUCTS SERVICES," "BVCPS", "MTL", "ACTS", "MTL-ACTS" and CURTIS-STRAUS** (collectively, the "Marks") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.
6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.
7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.
8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.
9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.
10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.
11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only were such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.
12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.
13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.
14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B)NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

17. Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

The complete list of the Approved Subcontractors Curtis-Straus may use to delegate the performance of work can be provided upon request.
Rev.160009121(2)_#684340 v14CS