Test of: WiseConn Engineering, Inc. RF-X1

To: FCC CFR 47 Part 15 B & ICES-003

Test Report Serial No.: WICO01-U2 Rev C

Verification Report

from

Test of: WiseConn Engineering, Inc. RF-X1

To FCC CFR 47 Part 15 B & ICES-003

Test Report Serial No.: WICO01-U2 Rev C

This report supersedes: WICO01-U2 Rev B

Manufacturer: WiseConn Engineering, Inc.
2911 E.Barstow Ave, M/S OF 144
Fresno, California 93720, USA

Product Function: Wireless Sensor Network for Automation, Monitoring and Control

Copy No: pdf **Issue Date:** 4th February 2015

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
575 Boulder Court
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com

ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

TESTING ACCREDITATION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 28th day of February 2014.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2015

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification
N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

**NB – Notified Body

PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

United States of America – Telecommunication Certification Body (TCB)
TCB Identifier – US0159

Industry Canada – Certification Body
CAB Identifier – US0159

Europe – Notified Body
Notified Body Identifier - 2280

Japan – Recognized Certification Body (RCB)
RCB Identifier – 210

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	14th January 2015	Initial Release
Rev B	4th February 2015	Corrected typographical error on Page 9
Rev C	4th February 2015	Included Industry Canada references

1. TEST RESULT CERTIFICATE

Manufacturer:	WiseConn Engineering, Inc. 2911 E.Barstow Ave, M/S OF 144 Fresno California 93720, USA	Tested By:	MiCOM Labs, Inc. 575 Boulder Court, Pleasanton California, 94566, USA
EUT	Wireless Sensor Network for Automation, Monitoring and Control	Tel:	+1 925 462 0304
Model:	WPAN-V1	Fax:	+1 925 462 0306
S/N	1114-387		
Test Date(s):	23rd December, 2014	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 B & ICES-003.	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

A2LA ACCREDITED
TESTING CERT #2381.01

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
i.	FCC 47 CFR Part 15, Subpart B	2012	Title 47 CFR Part 15, SubPart B; Unintentional Radiators
ii.	ICES-003	2012	Information Technology Equipment (ITE) – Limits and methods of measurement.
iii.	RSS-GEN	2010	Radio Standards Specification-Gen, Issue 3, General Requirements and Information for the Certification of Radiocommunication Equipment
iv.	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
v.	CISPR 22	2008	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
vi.	M 3003	Edition 2 Jan 2007	Expression of Uncertainty and Confidence in Measurements
vii.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
viii.	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
ix.	A2LA	April 2014	Reference to A2LA Accreditation Status – A2LA Advertising Policy

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Verification test of the WPAN-V1 to FCC CFR 47, part 15, Subpart B, ICES-003
Applicant:	As Manufacturer
Manufacturer:	WiseConn Engineering, Inc. 2911 E.Barstow Ave, M/S OF 144, Fresno California 93720, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton, California 94566 USA
Test report reference number:	WICO01-U2 Rev C
Date EUT received:	17th December 2014
Dates of test (from - to):	23rd December, 2014
Standard(s) applied:	FCC CFR 47 Part 15 B & ICES-003;
No of Units Tested:	One
Type of Equipment:	Wireless Sensor Network for Automation, Monitoring and Control
Manufacturers Trade Name:	WiseConn Engineering, Inc. RF-X1
Model:	WPAN-V1
Serial Number	1114-387
Software Revision	2.7.1
Hardware revision	Rev A
Internal Clocks	25 MHz
Installation type:	Portable
Construction/Location for Use:	Outdoor
Operating Temperature Range ºC:	Declared range -10 to +60ºC
Rated Supply Voltage and Current	Batteries 2x 3.7V
Equipment Dimensions:	190 x 156 x 100 mm
Weight:	2 kg
Primary Function:	Wireless Sensor Network for Automation, Monitoring and Control

3.2. Scope of Test Program

The scope of the test program was to test the WiseConn Engineering, Inc. RF-X1 for compliance against the following specification:

FCC CFR 47 Part 15 Subpart B
Radio Frequency Devices; Subpart B – Unintentional Radiators

IC ICES-003
Information Technology Equipment (including Digital Apparatus)

WiseConn Engineering, Inc. RF-X1 **(Top)**

WiseConn Engineering, Inc. RF-X1 **(Internal)**

3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Manufacturer	Model No.	Serial No.
EUT	Wireless Sensor Network for Automation, Monitoring and Control	Wiseconn	WPAN-V1	1114-387
EUT	Solar Panel	China Solar	KS-P5W5V	None

3.4. Antenna Details

1. No antenna testing performed as part of this test program.

3.5. Cabling and I/O Ports

1. Solar DC Cable > 3m

3.6. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

3.7. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

4. TEST SUMMARY / SETUP

List of Measurements

The following table represent the list of measurements required under the FCC CFR 47 part 15 standards;

TABLE OF REQUIRED TESTS – Emissions

Test Standard	Phenomenon/ Description	Limits	Compliance
FCC Part 15B / ICES-003	Radiated Emissions	Class B	Complies
FCC Part 15B / ICES-003	Conducted Emissions - ac power	Class B	Not Applicable*

* No AC Mains connection

Note 1: Test results reported in this document relate only to the items tested
Note 2: *The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria*
Note 3: *Section 3.6 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

5.1. EMC EMISSIONS TEST RESULTS

5.1.1. Radiated Emissions

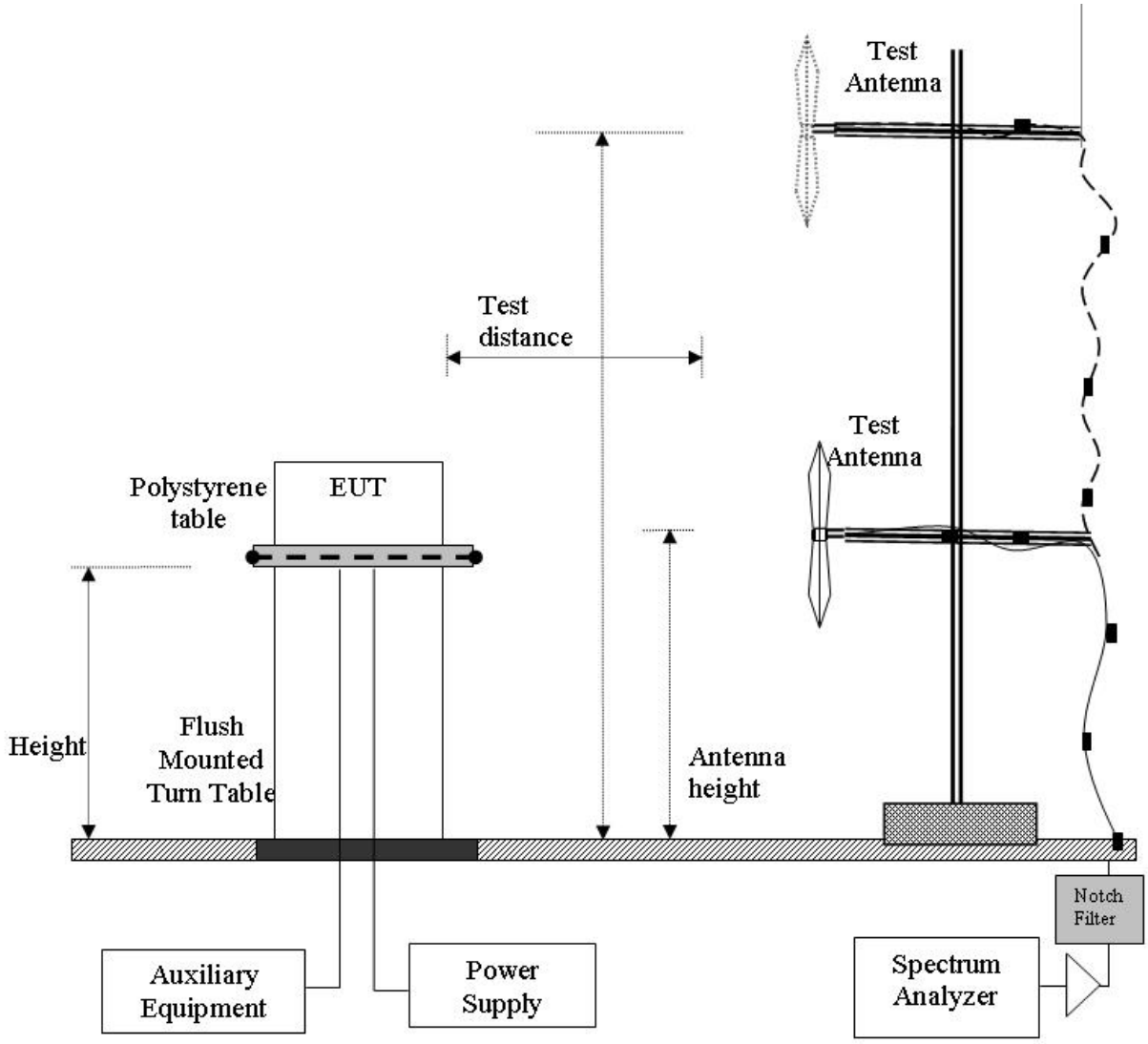
Test Procedure

FCC, Part 15 Subpart B §15.109
IC ICES-003 Section 3.2.2

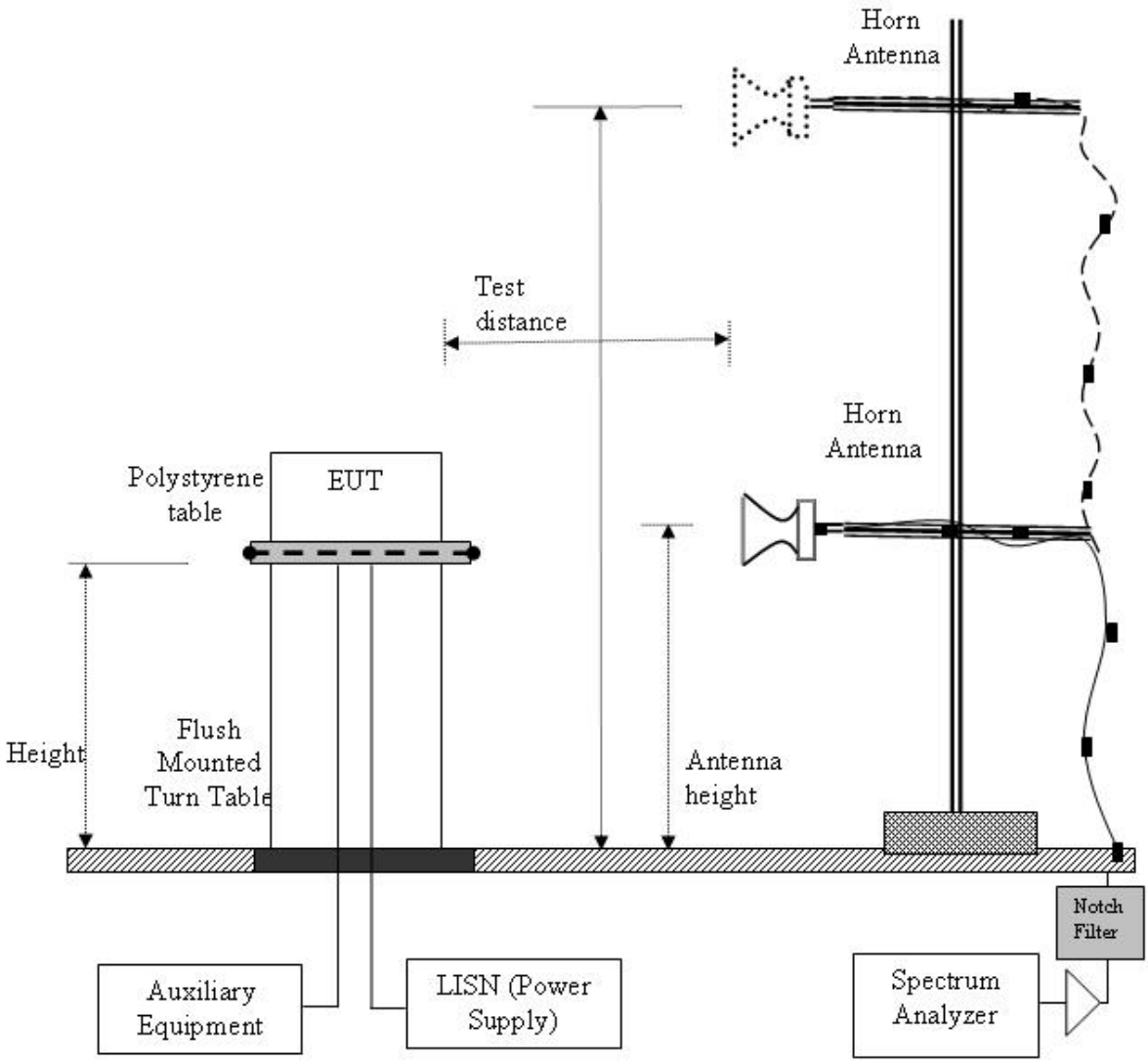
Testing 30 – 6,000 MHz was performed in a anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Only the highest emissions relative to the limit are listed.

Radiated Emission Measurement Setup – Below 1 GHz



Radiated Emission Measurement Setup – Above 1 GHz



Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR – FO

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Field Strength Calculation Example:

Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB/m; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

FCC Spurious Emissions Limits

FCC, Part 15 Subpart B §15.109
IC ICES-003 Section 3.2.2

Limits below 1 GHz:
Class A limits

Frequency(MHz)	Quasi-peak Limit (dBµV/m)	Measurement Distance (meters)	Quasi-peak Limit (dBµV/m)	Measurement Distance (meters)
30 to 88	40	10	49.5	3
88-216	43.5	10	54	3
216-960	46.4	10	56.5	3
960-1000	49.5	10	60	3

Class B limits

Frequency(MHz)	Quasi-peak Limit (dBµV/m)	Measurement Distance (meters)	Quasi-peak Limit (dBµV/m)	Measurement Distance (meters)
30 to 88	29.5	10	40	3
88-216	33	10	43.5	3
216-960	35.6	10	46	3
960-1000	43.5	10	54	3

Limits above 1GHz:

Frequency(MHz)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)	Measurement Distance (meters)	Class (A/B)
1 000 to 6000	54	74	3	Class B

Frequency(MHz)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)	Measurement Distance (meters)	Class (A/B)
1 000 to 6000	60	80	3	Class A

Laboratory Measurement Uncertainty for Spectrum Measurement

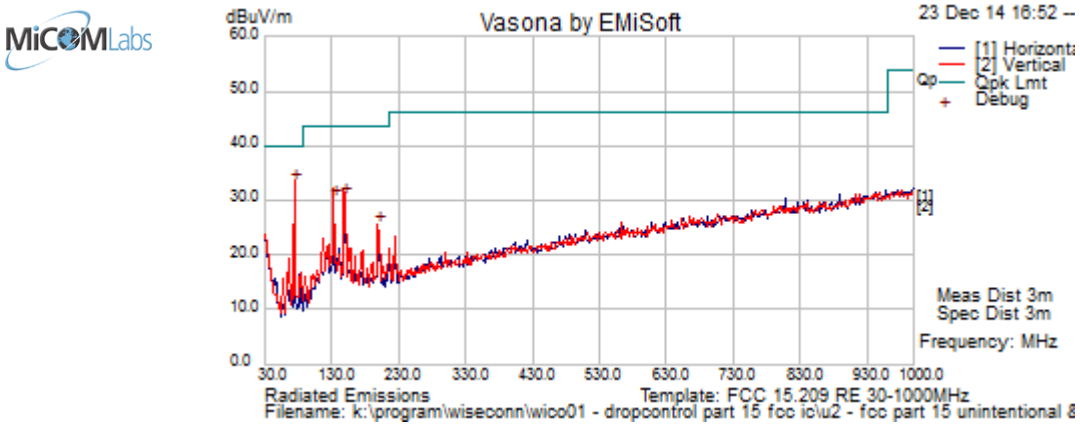
Measurement Uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Work instruction WI-03	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

Measurement Results: Radiated Emissions; 30-1000MHz, RCV Mode

EUT	DropControl	**Engineer**	JMH
Variant	Digital Emissions	**Temp (ºC)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	42
Standard Limit	FCC Class B, ICES-003 Class B	**Press. (mBars)**	1007
Support Equip	None		
Test Notes	EUT in RCV Mode, Solar Panel Connected		



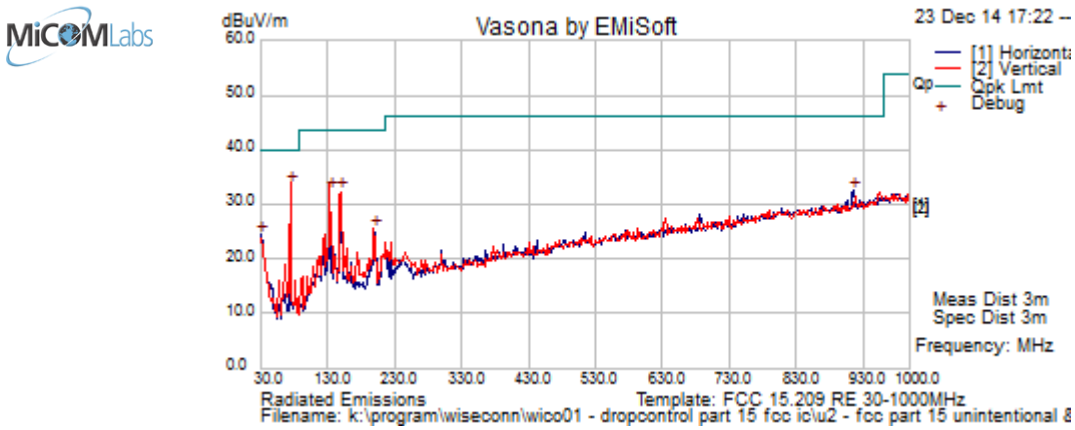
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
74.990	52.4	3.9	-23.2	33.1	Quasi Max	V	109	202	40	-6.9	Pass	
133.415	43.4	4.3	-17.6	30.1	Quasi Max	V	105	270	43.5	-13.4	Pass	
150.009	45.0	4.4	-18.8	30.6	Quasi Max	V	119	361	43.5	-12.9	Pass	
199.141	39.2	4.6	-18.4	25.4	Peak [Scan]	V	98	361	43.5	-18.1	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	TRNS= Transient Emission, Brbnd= Broadband emission

Measurement Results: Radiated Emissions; 30-1000MHz, Xmit Mode

EUT	DropControl	**Engineer**	JMH
Variant	Digital Emissions	**Temp (ºC)**	21.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	42
Standard Limit	FCC Class B, ICES-003 Class B	**Press. (mBars)**	1007
Support Equip	None		
Test Notes	EUT in TX Mode, Solar Panel Connected, 900 MHz filter connected before amp.		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
74.994	52.9	3.9	-23.2	33.620	Quasi Max	V	108	223	40.0	-6.4	Pass	
133.320	45.7	4.3	-17.6	32.4	Quasi Max	V	99	313	43.5	-11.1	Pass	
150.370	46.7	4.4	-18.8	32.240	Peak [Scan]	V	98	361	43.5	-11.3	Pass	
199.149	39.2	4.6	-18.3	25.5	Peak [Scan]	V	98	361	43.5	-18.0	Pass	
30.000	30.7	3.5	-9.7	24.500	Peak [Scan]	H	98	361	40.0	-15.5	Pass	
916.143	33.0	7.2	-7.7	32.5	Peak [Scan]	H	98	361	46.0	-13.5	Pass	FUND thru notch

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	TRNS= Transient Emission, Brbnd= Broadband emission

5.1.1. AC Mains Conducted Emissions

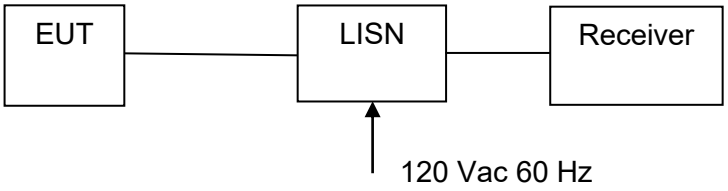
Not required - EUT is Battery powered.

Scope

This test assesses the ability of the EUT to limit its internal noise from being present on the AC mains power input/output ports.

Test Procedure

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.



Measurement Setup for Conducted Emissions Test

Limits

The equipment shall meet the class B limits given in FCC 15.207 & ICES-003. Alternatively, for equipment intended to be used in non-residential environments, the class A limits given in FCC Part 15: 207 may be used.

Class B Emissions

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

Class A Emissions

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	79	66
0.5-30	73	60

Traceability

All conducted emission measurements are traceable to national standards. The uncertainty of measurement at a confidence level of not less than 95 %, with a coverage factor of k=2, in the range 9 kHz – 30 MHz (Average & Quasi-peak) is ±2.64 dB.

Laboratory Measurement Uncertainty	
Measurement uncertainty	±2.64 dB

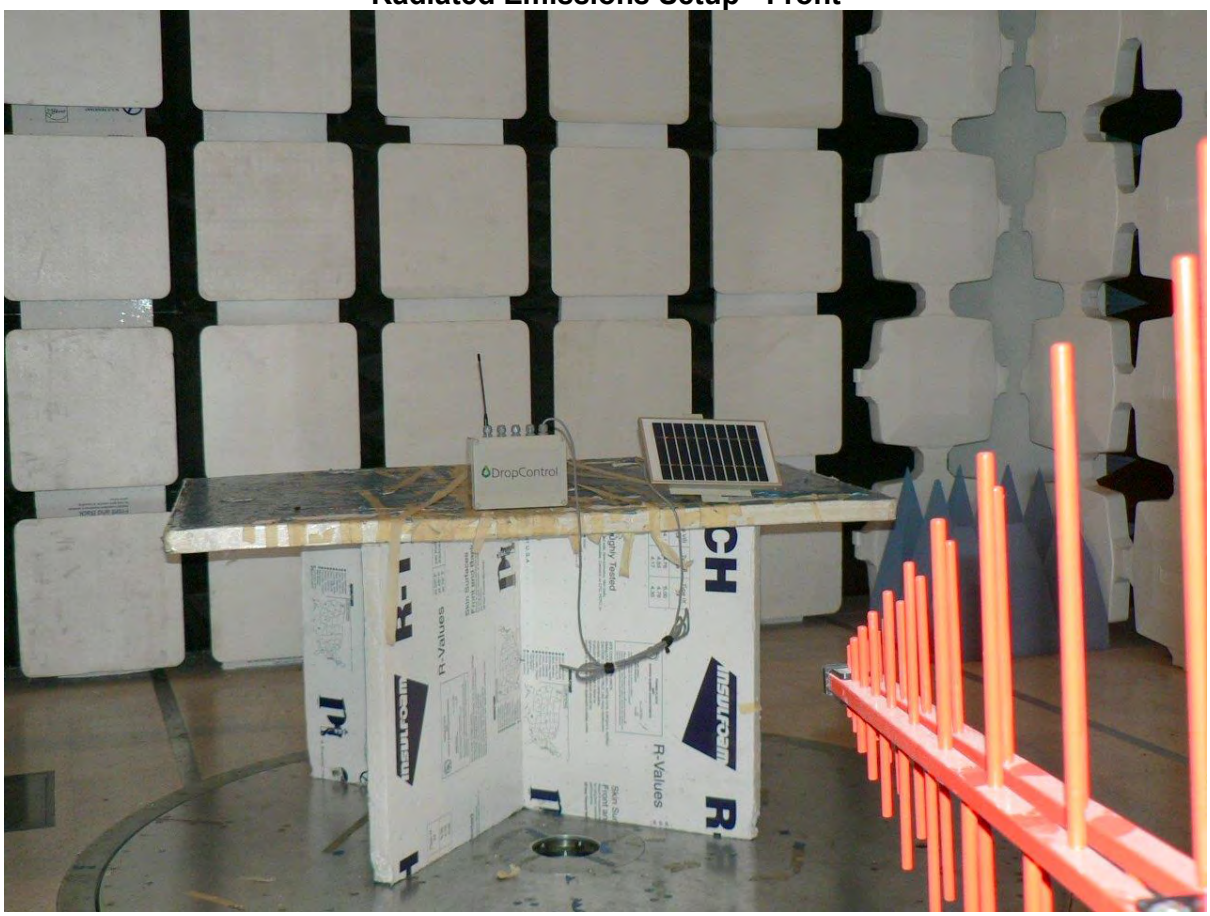
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307, 156, 193, 190

Measurement Results

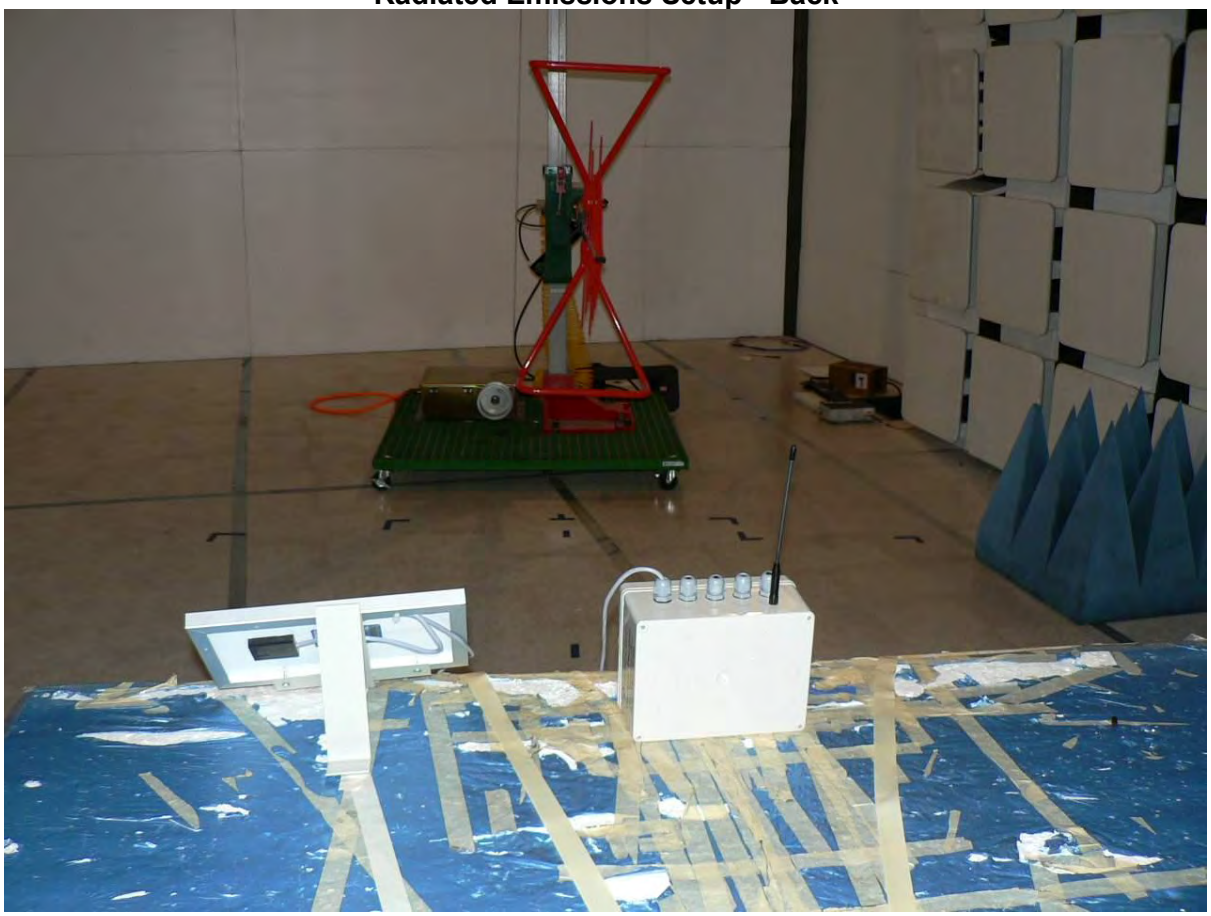
Not required - EUT is Battery powered.

6. PHOTOGRAPHS

Radiated Emissions Setup - Front



Radiated Emissions Setup - Back



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration Due Date
158	Barometer/ Thermometer	Control Co.	4196	E2844	8th Jan '15
184	Pulse limiter	Rhode & Schwartz	ESH3-Z2	357.8810.52	N/A
190	Line Impedance Stabilization Network	Rhode & Schwartz	ESH3Z5	836679/006	12 Sep '15
191	Multi-device controller	ETS EMCO	2090	1537	N/A
193	EMI Receiver	Rhode & Schwarz	ESI 7	838496/007	14 Jan '15
338	30 - 3000 MHz Antenna	Sunol	JB3	A052907	14 Aug '15
399	Horn Antenna 1-18G	ETS	3117	00154575	10 Oct '15
406	Preamp 1-18 GHz	MiCOM Labs		0406	30 May '15
411	Mast/Turntable Control	Sunol Sciences	SC98V	060199-1D	N/A
413	Mast Controller	Sunol Sciences	TWR95-4	030801-3	N/A
415	Turntable Controller	Sunol Sciences		0415	N/A

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