

Company: Silver Spring Networks

Test of: MicroAP 5
To: FCC CFR 47 Part 15.247 (DTS) &
IC RSS-247 (900- 928.0 MHz)

Report No.: SSNT135-U8_Master Rev A

MASTER TEST REPORT



MASTER TEST REPORT

FROM



Test of: Silver Spring Networks MicroAP 5

To: FCC CFR 47 Part 15 15.247 (DTS) &
IC RSS-247 (900 – 928.0 MHz)

Test Report Serial No.: SSNT135-U8_Master Rev A

As a result of the 6 Mbyte FCC file size limitation potentially large test reports require to be split into smaller components. This document is the Master document controlling Addendum reports as listed below. This Master document combined with the Addendums demonstrate compliance to the standard.

Master Document Number	Addendum Reports
SSNT135-U8_Master	SSNT135-U8_Conducted
	SSNT135-U8_Radiated

This report supersedes: NONE

Applicant: Silver Spring Networks
230 W Tasman Drive
San Jose, California 95134
USA

Product Function: Plug in Radio Device

Issue Date: 1st February 2017

This Test Report is Issued Under the Authority of:

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



MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. Testing Accreditation

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. 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>



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1.2. Recognition

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

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	

EU MRA – European Union Mutual Recognition Agreement.

NB – Notified Body

APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. 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

1.3. Product Certification

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. 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)

Industry Canada – Certification Body, CAB Identifier – US0159

Europe – Notified Body (NB), NB Identifier - 2280

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

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2. DOCUMENT HISTORY

Draft History		
Revision	Date	Comments
Draft	27 th January 2017	Initial

Released Document History			
Master Revision	Addendum Revision	Date	Comments
Rev A, 1 st February 2017	Rev A Conducted	1 st February 2017	Initial Release
	Rev A Radiated	1 st February 2017	

In the above table the latest report revision will replace all earlier versions.

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Title: Silver Spring Networks MicroAP 5
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3. TEST RESULT CERTIFICATE

Manufacturer: Silver Spring Networks
230 W Tasman Drive
San Jose California 95134
USA

Tested By: MiCOM Labs, Inc.
575 Boulder Court
Pleasanton California 94566
USA

Model: NIC 511-NA1-0313, NIC 511-SV1-0313 **Telephone:** +1 925 462 0304
Type Of Equipment: Plug in Radio Device **Fax:** +1 925 462 0306

S/N's: 00:13:50:07:00:00:0F:75
00:13:50:07:00:00:0F:70

Test Date(s): 4th January – 16th January 2017

Website: www.micomlabs.com

STANDARD(S)

FCC CFR 47 Part 15 Subpart C 15.247 (DTS)

TEST RESULTS

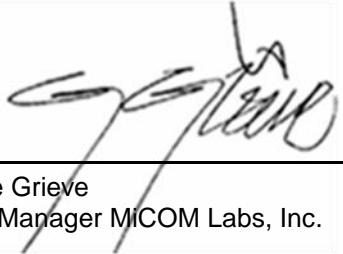
EQUIPMENT COMPLIES

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:

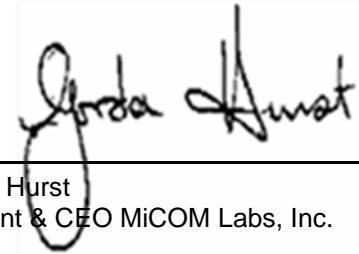
1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:


Graeme Grieve
Quality Manager MiCOM Labs, Inc.



TESTING CERT #2381.01


Gordon Hurst
President & CEO MiCOM Labs, Inc.

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4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	KDB 662911 D01 & D02	Oct 31 2013	Guidance for measurement of output emission of devices that employ single transmitter with multiple outputs or systems with multiple transmitters operating simultaneously in the same frequency band
II	KDB 558074 D01 v03r05	8th April 2016	Guidance for performing compliance measurements on Digital Transmission Systems (DTS) operating under section 15.247.
III	A2LA	June 2015	R105 - Requirement's When Making Reference to A2LA Accreditation Status
IV	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
V	ANSI C63.4	2014	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
VI	CISPR 22	2008	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
VII	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
VIII	FCC 47 CFR Part 15.247	2016	Radio Frequency Devices; Subpart C – Intentional Radiators
IX	ICES-003	Issue 6 Jan 2016	Spectrum Management and Telecommunications; Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
X	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
XI	RSS-247 Issue 1	May 2015	Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
XII	RSS-Gen Issue 4	November 2014	General Requirements and Information for the Certification of Radiocommunication Equipment
XIII	KDB 644545 D03 v01	August 14th 2014	Guidance for IEEE 802.11ac New Rules
XIV	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.

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4.2. Test and Uncertainty Procedure

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.

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Silver Spring Networks MicroAP 5 to FCC CFR 47 Part 15 Subpart C 15.247 (DTS) & IC RSS-247
Applicant:	Silver Spring Networks 230 W Tasman Drive, San Jose California 95134 USA
Manufacturer:	Silver Spring Networks
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	SSNT135-U8_Master Rev A
Date EUT received:	4 th January 2017
Standard(s) applied:	FCC CFR 47 Part 15 Subpart C 15.247 (DTS) & IC RSS-247
Dates of test (from - to):	4 th January – 16 th January 2017
No of Units Tested:	2
Type of Equipment:	Plug in Radio Device
Product Family Name:	MicroAP 5
Model(s):	NIC 511-NA1-0313, NIC 511-NA1-0312, NIC 511-SV1-0313, NIC 511-SV1-0312,
Location for use:	Indoor/Outdoor
Declared Frequency Range(s):	902 - 928 MHz; 2400 - 2483.5 MHz;
Primary function of equipment:	Plug in Radio Device
Secondary function of equipment:	Not Provided
Type of Modulation:	DTS
EUT Modes of Operation:	OFDM
Declared Nominal Output Power (Ave):	30 dBm
Transmit/Receive Operation:	Transceiver - Full Duplex
Rated Input Voltage and Current:	4Vdc
Operating Temperature Range:	Declared Range -30°C to +70°C
ITU Emission Designator:	DTS: OFDM 1M25G1D
Equipment Dimensions:	62.0 mm (W) x 22.8 mm (H) x 110.0 mm (L)
Weight:	0.05 Kg
Hardware Rev:	170-0763-00
Software Rev:	4.2.0

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5.2. Scope Of Test Program

Silver Spring Networks MicroAP 5

The scope of the test program was to test the Silver Spring Networks MicroAP 5, Plug in Radio Device configurations in the frequency ranges 920 – 928.0 MHz; for compliance against the following specification:

FCC CFR 47 Part 15 Subpart C 15.247 (DTS) & Industry Canada RSS-247

Radio Frequency Devices; Subpart C – Intentional Radiators and Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Product Description

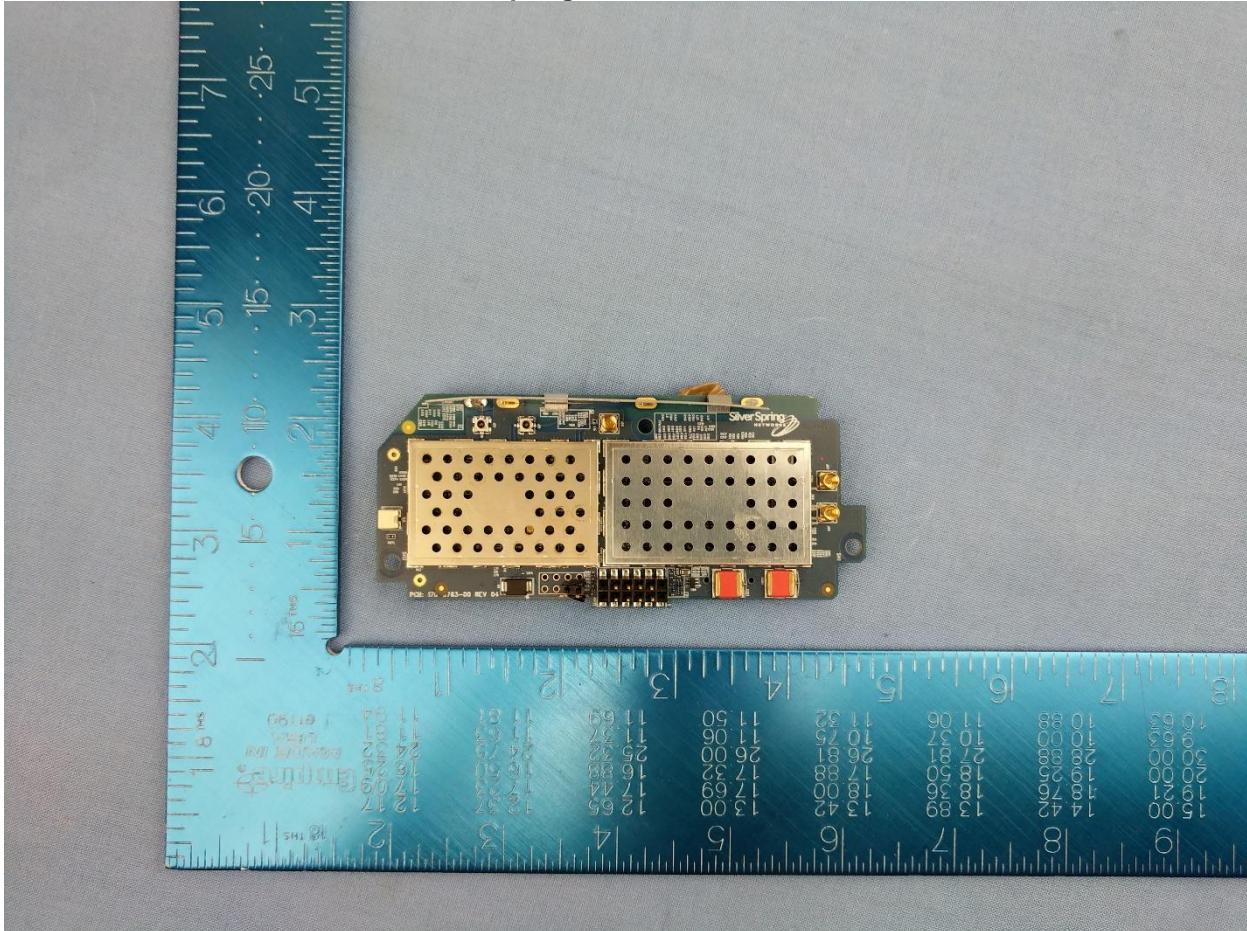
The following product description was provided by the manufacturer.

The Silver Spring Networks MicroAP 5 is a unique implementation of cellular connectivity for meters. Unlike any other point-to-point cellular device, the Silver Spring MicroAP 5 Communications Module supports both cellular/mobile and RF mesh communications simultaneously. Designed to reside in our partner's meters or SocketAP, MicroAP leverages cellular communications for backhaul connectivity and can use the RF mesh communications to connect with other nearby Silver Spring devices using Silver Spring's innovative Micromesh technology.

Co-Location Testing

Co-location measurements were performed on the cellular frequency bands together with the 915 MHz and 2.4 GHz DSSS and FHSS technologies. Test results are available and will be kept on file by the laboratory.

Silver Spring Networks MicroAP 5



Top View

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

Type	Description	Manufacturer	Model	Serial no.	Delivery Date
EUT	Plug in Radio Device	Silver Spring Networks	MicroAP 5	00:13:50:07:00:00:0F:75	4 th January 2016
EUT	Plug in Radio Device	Silver Spring Networks	MicroAP 5	00:13:50:07:00:00:0F:70	4 th January 2016

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
external	larid	TRAB9023NP	10	3.0	-	360	-	902 - 928
external	larid	TRAB9023NP	10	3.0	-	360	-	2400 - 2483.5
external	Mobile Mark	MGRM-UMB-1C-BLK-120	10	3.0	-	360	-	902 - 928
external	Mobile Mark	MGRM-UMB-1C-BLK-120	10	3.0	-	360	-	2400 - 2483.5
integral	Tai Sheng Chen	155-0010-00	2	2.0	-	360	-	902 - 928
integral	Tai Sheng Chen	155-0010-00	2	5.0	-	360	-	2400 - 2483.5
external	TAOGLAS	G.30.B108111	10	1.0	-	360	-	902 - 928
external	TAOGLAS	G.30.B108111	10	3.0	-	360	-	2400 - 2483.5
external	TAOGLAS	GA.107.201111	10	0.0	-	360	-	902 - 928
external	TAOGLAS	GA.107.201111	10	0.0	-	360	-	2400 - 2483.5
external	WP	WPANT30017-CA	10	3.0	-	360	-	902 - 928
external	WP	WPANT30017-CA	10	4.5	-	360	-	2400 - 2483.5
external	WP	WPANT30104-S1C	10	6.0	-	360	-	902 - 928
external	WP	WPANT30104-S1C	10	0.0	-	360	-	2400 - 2483.5
external	WP	WPANT40010-C	2	1.0	-	360	-	902 - 928
external	WP	WPANT40010-C	2	3.5	-	360	-	2400 - 2483.5

BF Gain - Beamforming Gain

Dir BW - Directional BeamWidth

X-Pol - Cross Polarization

5.5. Cabling and I/O Ports

* None

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5.6. Test Configurations

Results for the following configurations are provided in this report:

Channel Spacing (kHz)	Operational Mode(s) (DTS)	Data Rate with Highest Power (Kbps)	Channel Frequency (MHz)		
			Low	Mid	High
900 – 928.0 MHz					
1100.00	OFDM	2400.00	903.2	914.0	926.0

5.7. Equipment Modifications

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

1. NONE

5.8. Deviations from the Test Standard

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

1. NONE

6. TEST SUMMARY

List of Measurements

Test Header	Result	Data Link
Conducted Results	See Report SSNT135-U8_Conducted	
15.247(a)(2) 6 dB & 99% Bandwidth	Complies	
15.247(b), 15.31(e) Conducted Output Power	Complies	
15.247(d) Emissions	Complies	
(1) Conducted Emissions	Complies	
(i) Conducted Spurious Emissions	Complies	
(ii) Conducted Band-Edge Emissions	Complies	
15.247(e) Power Spectral Density	Complies	
Radiated Emissions	See Report SSNT135-U8_Radiated	
(i) 15.205 Restricted Band Emissions	Complies	
(ii) 15.205 Restricted Band-Edge Emissions	Complies	
(3) 15.209 Digital Emissions (0.03 - 1 GHz)	Complies	
15.207 AC Wireline Emissions	Not applicable – EUT is DC powered.	

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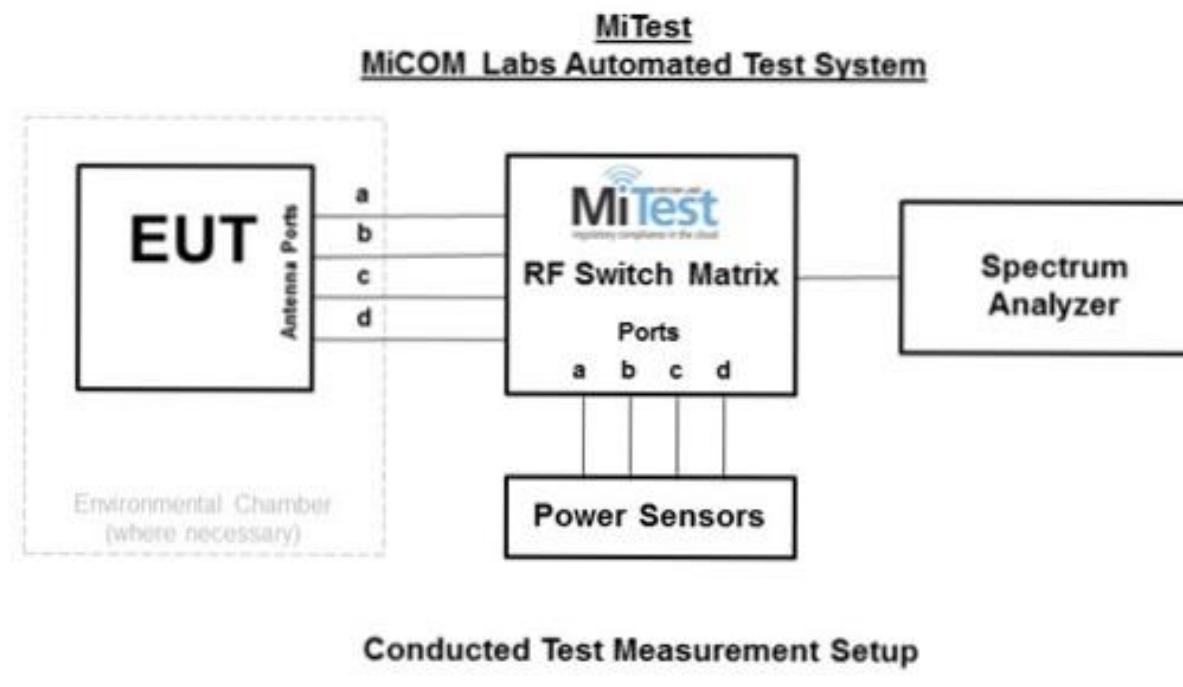
7. TEST EQUIPMENT CONFIGURATION(S)

7.1. Conducted

Conducted RF Emission Test Set-up(s)

The following tests were performed using the conducted test set-up shown in the diagram below.

1. 6 dB & 99% Bandwidth
2. Peak Output Power
3. Power Spectral Density- Peak
4. Conducted Low Band-Edge Emission - Peak
5. Conducted Spurious Emissions - Peak
6. Conducted High Band-Edge Emission - Peak



A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.



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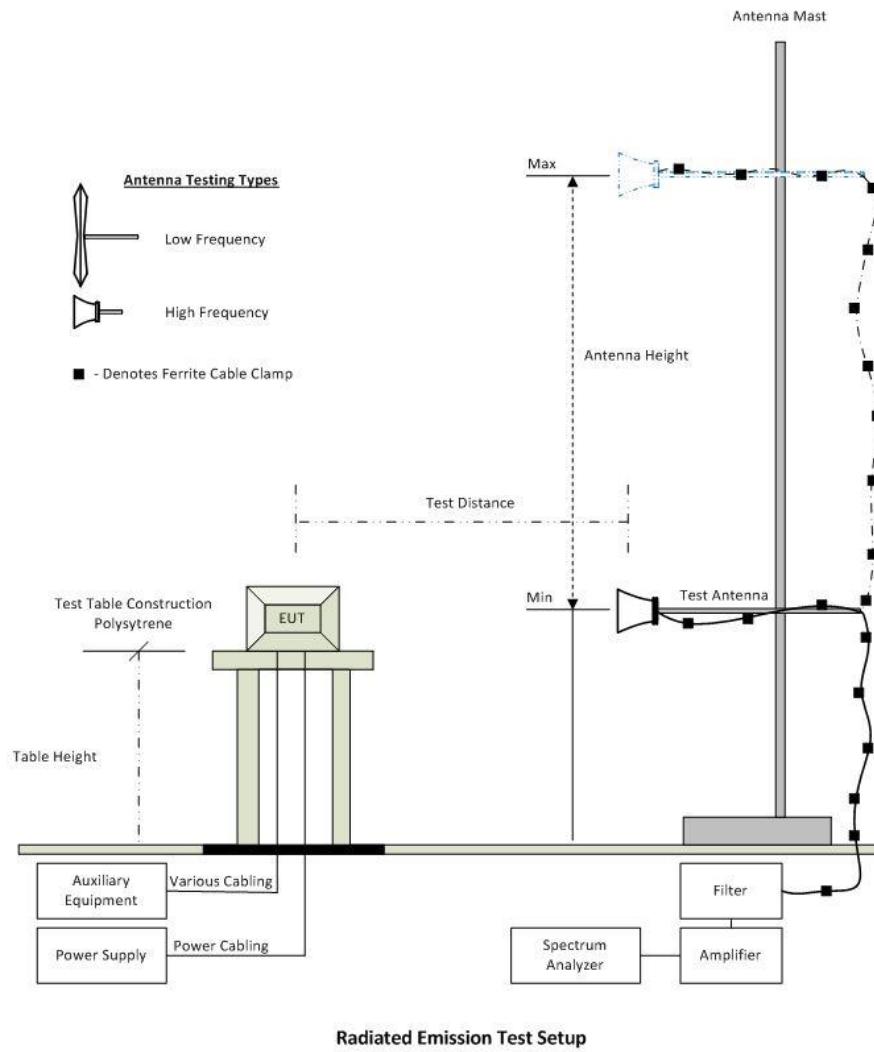
Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
127	Power Supply	HP	6674A	US36370530	Cal when used
158	Barometer/Thermometer	Control Company	4196	E2846	30 Nov 2017
248	Resistance Thermometer	Thermotronics	GR2105-02	9340 #1	21 Oct 2017
287	R & S 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2017
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	4 Aug 2017
381	4x4 RF Switch Box	MiCOM Labs	MiTest RF Switch Box	MIC002	2 Jun 2017
398	Test Software	MiCOM	MiTest ATS	Version 4.1.0.76	Not Required
419	Laptop with Labview Software	Lenova	W520	TS02	Not Required
420	USB to GPIB Interface	National Instruments	GPIB-USB HS	1346738	Not Required
440	USB Wideband Power Sensor	Boonton	55006	9178	25 Sep 2017
442	USB Wideband Power Sensor	Boonton	55006	9181	6 Oct 2017
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
460	Dell Computer	Dell	Optiplex330	BC944G1	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	13 Aug 2017
493	USB Wideband Power Sensor	Boonton	55006	9634	10 Mar 2017
494	USB Wideband Power Sensor	Boonton	55006	9726	10 Mar 2017
74	Environmental Chamber Chamber 3	Tenney	TTC	12808-1	29 Sep 2017
RF#2 GPIB#1	GPIB cable to Power Supply	HP	GPIB	None	Not Required
RF#2 SMA#1	EUT to Mitest box port 1	Flexco	SMA Cable port1	None	2 Jun 2017
RF#2 SMA#2	EUT to Mitest box port 2	Flexco	SMA Cable port2	None	2 Jun 2017
RF#2 SMA#3	EUT to Mitest box port 3	Flexco	SMA Cable port3	None	2 Jun 2017
RF#2 SMA#4	EUT to Mitest box port 4	Flexco	SMA Cable port4	None	2 Jun 2017
RF#2 SMA#SA	Mitest box to SA	Flexco	SMA Cable SA	None	2 Jun 2017
RF#2 USB#1	USB Cable to Mitest Box	Dynex	USB Cable	None	Not Required

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7.2. Radiated Emissions

The following tests were performed using the conducted test set-up shown in the diagram below.

1. Spurious Emissions
2. Restricted Band-Edge Emissions
3. Radiated Digital Emissions



A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

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Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
158	Barometer/Termometer	Control Company	4196	E2846	30 Nov 2017
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2017
301	5470 to 5725 MHz Notch Filter	Microtronics	RBC50704	001	16 Aug 2017
302	5150 to 5350 MHz Notch Filter	Microtronics	BRC50703	002	16 Aug 2017
303	5725 to 5875 MHz Notch filter	Microtronics	BRC50705	003	16 Aug 2017
330	Variac 0-280 Vac	Staco Energy Co	3PN1020B	0546	Cal when used
336	Active loop Ant 10kHz to 30 MHz	EMCO	EMCO 6502	00060498	26 Sep 2017
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	15 Aug 2017
341	900MHz Notch Filter	EWT	EWT-14-0199	H1	16 Aug 2017
342	2.4 GHz Notch Filter	EWT	EWT-14-0203	H1	16 Aug 2017
343	5.15 GHz Notch Filter	EWT	EWT-14-0200	H1	16 Aug 2017
344	5.35 GHz Notch Filter	EWT	EWT-14-0201	H1	16 Aug 2017
345	5.46 GHz Notch Filter	EWT	EWT-14-0202	H1	16 Aug 2017
346	1.6 TO 10GHz High Pass Filter	EWT	EWT-57-0112	H1	16 Aug 2017
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	26 Oct 2017
377	Band Rejection Filter 5150 to 5880MHz	Microtronics	BRM50716	034	16 Aug 2017
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	4 Aug 2017
393	DC - 1050 MHz Low Pass Filter	Microcircuits	VLFX-1050	N/A	16 Aug 2017
396	2.4 GHz Notch Filter	Microtronics	BRM50701	001	16 Aug 2017
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	9 Jun 2017
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	10 Apr 2017
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	9 Jun 2017
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required

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412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
414	DC Power Supply 0-60V	HP	6274	1029A01285	Cal when used
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0.109	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	31 May 2017
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	31 May 2017
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	31 May 2017
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	2 Jun 2017
466	Low Pass Filter DC-1500 MHz	Mini-Circuits	NLP-1750+	VUU10401438	2 Jun 2017
467	2495 to 2650 MHz notch filter	MicroTronics	BRM50709	011	16 Aug 2017
468	Low pass filter	Mini Circuits	SLP-550	None	16 Aug 2017
469	Low pass filter	Mini Circuit	SLP-1000	None	16 Aug 2017
470	High Pass filter	Mini Circuits	SHP-700	None	16 Aug 2017
476	Low Pass dc-2200MHz filter	Mini Circuits	15542 NLP-2400+	VUU13801345	16 Aug 2017
480	Cable - Bulkhead to Amp	SRC Haverhill	157-157-3050360	480	2 Jun 2017
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-151-3050787	481	2 Jun 2017
482	Cable - Amp to Antenna	SRC Haverhill	157-157-3051574	482	2 Jun 2017
502	Test Software for Radiated Emissions	EMISoft	Vasona	Version 5 Build 59	Not Required
87	Uninterruptible Power Supply	Falcon Electric	ED2000-1/2LC	F3471 02/01	Cal when used
CC05	Confidence Check	MiCOM	CC05	None	26 Apr 2017
VLF-1700	Low pass filter DC-1700 MHz	Mini Circuits	VLF-1700	None	31 May 2017

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8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by [MiTest](#). [MiTest](#) is an automated test system developed by MiCOM Labs. [MiTest](#) is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.



The MiCOM Labs "[MiTest](#)" Automated Test System" (Patent Pending)

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