



REGULATORY COMPLIANCE – MASTER TEST REPORT

**FCC SubPart C 15.247
ISED RSS-247 Issue 2**

TUVR116-U6_Master Rev D

Company: Sonos Inc

Test of: S23

REGULATORY COMPLIANCE TEST REPORT

Company: Sonos Inc.

Model Name: S23

To: FCC CFR 47 Part 15 Subpart E 15.407 / RSS-247 Issue 2

Test Report Serial No.: TUVR116-U6_Master Rev D

This report supersedes: NONE

Applicant: Sonos Inc
614 Chapala St.
Santa Barbara, California 93101
USA

Issue Date: 25th July 2019

Generated Reports	Document Number
Master:	<input checked="" type="checkbox"/> TUVR116-U6_Master
Conducted:	<input type="checkbox"/> TUVR116-U6_Conducted_Addendum
Radiated:	<input type="checkbox"/> TUVR116-U6_Radiated_Addendum
DFS:	<input type="checkbox"/> TUVR116-U6_DFS_Addendum

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

Table of Contents

1. ACCREDITATION, LISTINGS & RECOGNITION	4
1.1. TESTING ACCREDITATION	4
1.2. RECOGNITION	5
1.3. PRODUCT CERTIFICATION	6
2. DOCUMENT HISTORY	7
3. TEST RESULT CERTIFICATE	8
4. REFERENCES AND MEASUREMENT UNCERTAINTY	9
4.1. Normative References	9
4.2. Test and Uncertainty Procedure	10
5. PRODUCT DETAILS AND TEST CONFIGURATIONS	11
5.1. Technical Details	11
5.2. Scope Of Test Program	12
5.4. External A.C/D.C. Power Adaptor	12
5.5. Antenna Details	13
5.6. Cabling and I/O Ports	13
5.6. Test Configurations	14
5.7 . Equipment Modifications	14
5.8 . Deviations from the Test Standard	14
6. TEST SUMMARY	15
7. TEST EQUIPMENT CONFIGURATION(S)	16
7.1. Conducted Test Setup	16
7.2. Radiated Emissions - 3m Chamber	17
7.3. ac Wireline Emissions	19
7.4. Dynamic Frequency Selection (DFS)	20
8. MEASUREMENT AND PRESENTATION OF TEST DATA	21
8.1. Test System	21
8.2. Control of Test Item	22
8.3. Operational Mode Duty Cycle(s)	22

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>



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 April 2017).



Presented this 14th day of May 2018.



President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2019

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

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>



Accredited Product Certification Body

A2LA has accredited

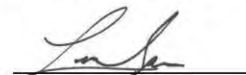
MiCOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the A2LA R322 – *Specific Requirements – Notified Body Accreditation Requirements* and A2LA R308 - *Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 14th day of May 2018




President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2019

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

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

2. DOCUMENT HISTORY

Released Document History			
Master Revision	Addendum Revision	Date	Comments
Draft	--	7 th May 2019	Initial Draft
Rev A 20 th May 2019	Rev A_Conducted	20 th May 2019	Initial Release
	Rev A_Radiated	20 th May 2019	
	Rev A_DFS	20 th May 2019	
Rev B 10 th June 2019	Rev A_Conducted	20 th May 2019	Modified section 5.1 Technical Details
	Rev A_Radiated	20 th May 2019	
	Rev A_DFS	20 th May 2019	
Rev C 17 th July 2019	Rev B_Conducted	17 th July 2019	Modified output power limits based on unequal antenna gains. Added plots confirming duty cycle and Section on Controlling Test Item
	Rev B_Radiated	16 th July 2019	
	Rev A_DFS	20 th May 2019	
Rev D 25 th July 2019	Rev B_Conducted	17 th July 2019	Client requested change to Section 5.6 Cabling and I/O Ports
	Rev B_Radiated	16 th July 2019	
	Rev A_DFS	20 th May 2019	

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

3. TEST RESULT CERTIFICATE

Manufacturer: Sonos Inc 614 Chapala St. Santa Barbara California 93101 USA	Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model: S23	Telephone: +1 925 462 0304
Equipment Type: Home Audio Equipment	Fax: +1 925 462 0306
S/N's: 48A6B820046C5, 48A6B820046E7	
Test Date(s): 23 rd – 26 th April 2019	Website: www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart E 15.407 ISED RSS-247 Issue 2	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.

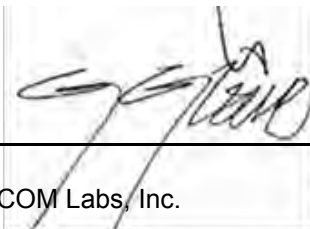
Notes:

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.

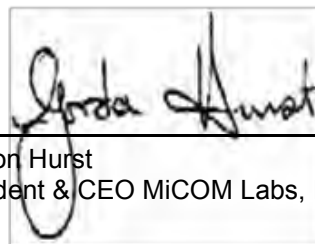
Approved & Released for MiCOM Labs, Inc. by:



Graeme Grieve
Quality Manager MiCOM Labs, Inc.



Gordon Hurst
President & CEO MiCOM Labs, Inc.



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 905462 D07 v02	22nd August 2016	Test guidance to demonstrate compliance for U-NII devices subject to DFS requirements.
III	KDB 926956 D01 v02	22nd August 2016	U-NII Device Transition Plan
IV	A2LA	August 2018	R105 - Requirement's When Making Reference to A2LA Accreditation Status
V	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
VI	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
VII	CISPR 32	2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
VIII	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
IX	FCC 06-96	Jun 30 2006	Memorandum Opinion and Order
X	FCC 47 CFR Part 15.407	2016	Radio Frequency Devices; Subpart E –Unlicensed National Information Infrastructure Devices
XI	ICES-003	Issue 6 Jan 2016; Updated April 2017	Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
XII	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
XIII	RSS-247 Issue 2	Feb 2017	Digital Transmission Systems (DTSS), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
XIV	RSS-Gen Issue 5	April 2018	General Requirements for Compliance of Radio Apparatus
XV	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.
XVI	KDB 905462 D02 v02	April 8 2016	Compliance Measurement Procedures for Unlicensed National Information Infrastructure devices operating in the 5250 to 5350 MHz and 5470 to 5725 MHz bands incorporating Dynamic Frequency Selection.
XVII	KDB 789033 D02 V02r01	14th December, 2017	Guidelines For Compliance Testing Of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E

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 Sonos Inc S23 to FCC CFR 47 Part 15 Subpart E 15.407. Compliance Measurement Procedures for Unlicensed National Information Infrastructure devices operating in the 5150 to 5250, 5250 to 5350, 5470 to 5725 and 5725 – 5850 MHz bands
Applicant:	Sonos Inc 614 Chapala St. Santa Barbara California 93101 USA
Manufacturer:	Sonos Inc
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	TUVR116-U6_Master
Date EUT received:	22 nd April 2019
Standard(s) applied:	FCC CFR 47 Part 15 Subpart E 15.407
Dates of test (from - to):	23 rd – 24 th April 2019
No of Units Tested:	2
Product Family Name:	N/A
Model(s):	S23
Location for use:	Indoors
Declared Frequency Range(s):	5150 - 5250; 5250 - 5350; 5470 – 5725, 5725 - 5850 MHz;
Type of Modulation:	OFDM
EUT Modes of Operation:	802.11a / nHT-20;
Declared Nominal Output Power (dBm):	5150 - 5250 MHz: 5250 - 5350 MHz: 5470 - 5725 MHz: 5725 - 5850 MHz:
Number of Antennas:	4 x Wi-Fi, 1 x BLE
Transmit/Receive Operation:	4x4 transmit and receive antenna chains
Rated Input Voltage and Current:	12Vdc 1.5A
Operating Temperature Range:	0°C - 40°C
ITU Emission Designator:	802.11a 17M4D1D 802.11nHT-20 18M3D1D
Hardware Rev:	A100
Firmware Ver:	See Software Rev.
Software Rev:	52.10-64150-1-29

5.2. Scope Of Test Program

Sonos Inc S23

The scope of the test program was to test the Sonos Inc S23 configurations in the frequency ranges 5150 - 5250 MHz; 5250 - 5350 MHz; 5470 - 5725 MHz; 5725 - 5850 MHz; for compliance against the following specification:

FCC CFR 47 Part 15 Subpart E 15.407

Compliance Measurement Procedures for Unlicensed National Information Infrastructure devices operating in the 5250 to 5350 MHz and 5470 to 5725 MHz bands incorporating Dynamic Frequency Selection.

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

Type (EUT/ Support)	Equipment Description	Mfr	Model No.	Serial No.
EUT	Home Audio Equipment	SONOS Inc.	S23	48A6B820046C5
EUT	Home Audio Equipment	SONOS Inc.	S23	48A6B820046E7
EUT	Power Supply	SONOS Inc	CPS012027U	
Support	Laptop	Lenovo	X230	

5.4. External A.C/D.C. Power Adaptor

AC/DC Adaptor
Manufacturer: SONOS Model: CPS012027U I: 100 – 240 V _{AC} , 50/60 Hz O: +12 V _{DC} 1.00 A

5.5. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	ICT	Custom A1	Inverted F-Type	3.3	-	360	-	5150 - 5250
integral	ICT	Custom A1	Inverted F-Type	2.2	-	360	-	5250 - 5350
integral	ICT	Custom A1	Inverted F-Type	2.2	-	360	-	5470 - 5725
integral	ICT	Custom A1	Inverted F-Type	1.7	-	360	-	5725 - 5850
integral	ICT	Custom A2	Inverted F-Type	4.6	-	360	-	5150 - 5250
integral	ICT	Custom A2	Inverted F-Type	4.4	-	360	-	5250 - 5350
integral	ICT	Custom A2	Inverted F-Type	4.4	-	360	-	5470 - 5725
integral	ICT	Custom A2	Inverted F-Type	2.5	-	360	-	5725 - 5850
integral	ICT	Custom A3	Inverted F-Type	3.0	-	360	-	5150 - 5250
integral	ICT	Custom A3	Inverted F-Type	3.3	-	360	-	5250 - 5350
integral	ICT	Custom A3	Inverted F-Type	3.3	-	360	-	5470 - 5725
integral	ICT	Custom A3	Inverted F-Type	2.9	-	360	-	5725 - 5850
integral	ICT	Custom A4	Inverted F-Type	2.2	-	360	-	5150 - 5250
integral	ICT	Custom A4	Inverted F-Type	1.5	-	360	-	5250 - 5350
integral	ICT	Custom A4	Inverted F-Type	1.5	-	360	-	5470 - 5725
integral	ICT	Custom A4	Inverted F-Type	0.6	-	360	-	5725 - 5850

BF Gain - Beamforming Gain
Dir BW - Directional BeamWidth
X-Pol - Cross Polarization

5.6. Cabling and I/O Ports

Port Type	Max Cable Length	# of Ports	Conn Type	Data Type	Bit Rate	Environment
ENET	>10m	2	No	Conn Type	10,100,1000	
DC	1m	1				
Other Port Type*		*	*	*		

*This port(s) is fully described in the technical documentation included in the related FCC and ISSED filings.

5.6. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s) (802.11a/b/g/n/ac)	Data Rate (MBit/s)	Channel Frequency (MHz)		
		Low	Mid	High
5150 - 5250 MHz				
a	6	5,180.00	5,200.00	5,240.00
HT-20	6.5	5,180.00	5,200.00	5,240.00
5250 - 5350 MHz				
a	6	5,260.00	5,300.00	5,320.00
HT-20	6.5	5,260.00	5,300.00	5,320.00
5470 - 5725 MHz				
a	6	5,500.00	5,580.00	5,700.00
HT-20	6.5	5,500.00	5,580.00	5,700.00
5725 - 5850 MHz				
a	6	5,745.00	5,785.00	5,825.00
HT-20	6.5	5,745.00	5,785.00	5,825.00

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
Peak Transmit Power	Complies
26 dB & 99% Bandwidth	Complies
6 dB & 99% Bandwidth	Complies
Power Spectral Density	Complies
Frequency Stability	Complies
Dynamic Frequency Selection (DFS) – Client Device	Complies
Channel Availability Check	Complies
Initial CAC	*Not Tested
Beginning CAC	*Not Tested
End CAC	*Not Tested
Channel Close / Transmission Time	Complies
Non-Occupancy Period	Complies
Probability of Detection	*Not Tested
Detection Bandwidth	*Not Tested
Radiated	Complies
TX Spurious & Restricted Band Emissions	Complies
Restricted Edge & Band-Edge Emissions	Complies
Digital Emissions	Complies
AC Wireline Emissions	Complies

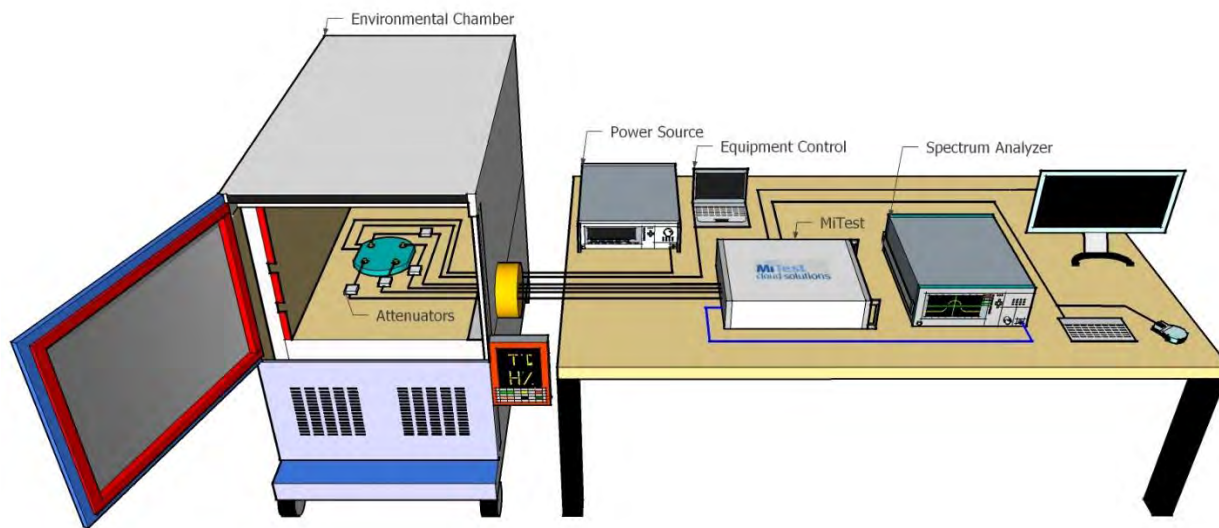
*EUT was a client device without radar detection

NOTE: In this report antenna chains are reported as chains ‘a’ through ‘d’. This is equivalent to CH0-CH3 on all Sonos documentation.

6. TEST EQUIPMENT CONFIGURATION(S)

6.1. Conducted Test Setup

MiTest Automated Test System



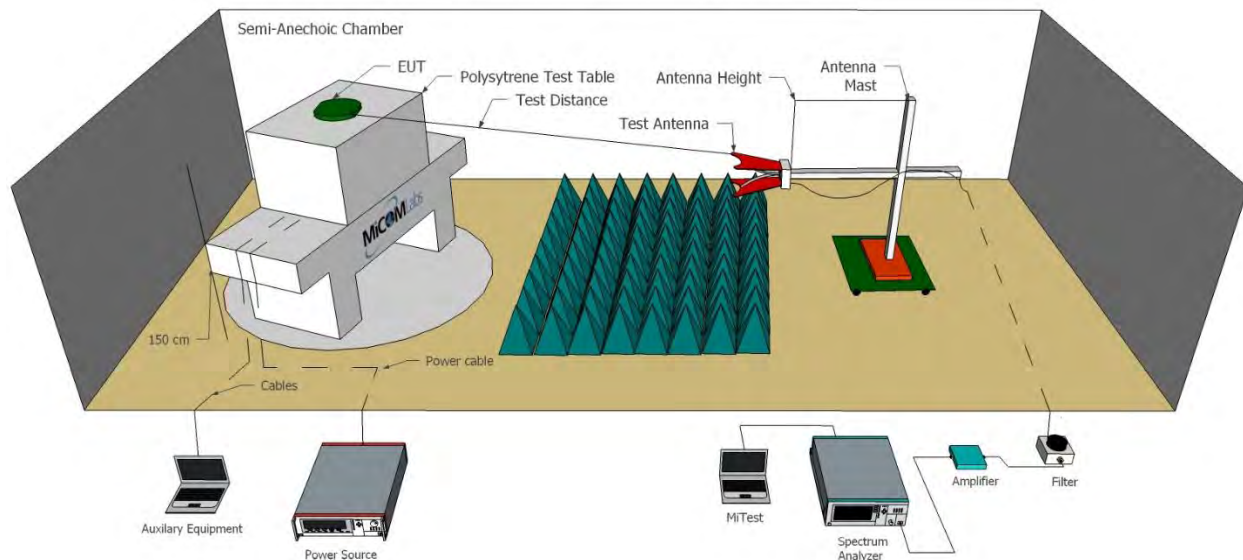
A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
249	Resistance Thermometer	Thermotronics	GR2105-02	9340 #2	30 Oct 2019
361	Desktop for RF#1, Labview Software installed	Dell	Vostro 220	WS RF#1	Not Required
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2019
405	DC Power Supply 0-60V	Agilent	6654A	MY4001826	Cal when used
408	USB to GPIB interface	National Instruments	GPIB-USB HS	14C0DE9	Not Required
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	20 Sep 2019
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019
75	Environmental Chamber	Thermatron	SE-300-2-2	27946	24 Feb 2020

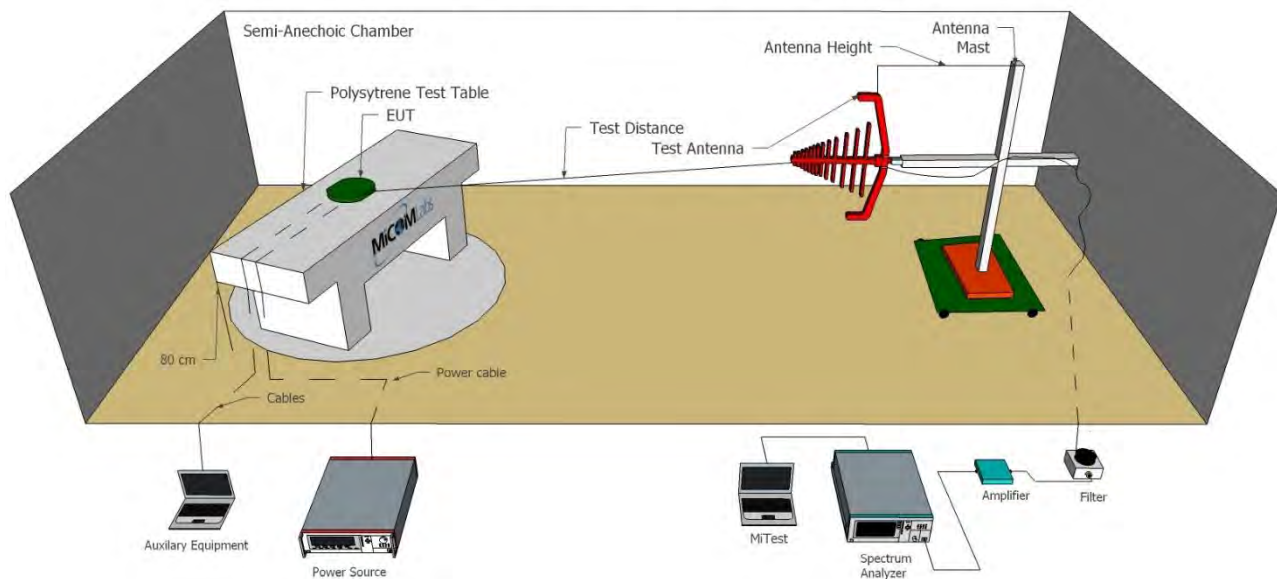
6.2. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagram below.
Radiated emissions above and below 1GHz.

Radiated Emissions Above 1GHz Test Setup



Radiated Emissions Below 1GHz Test Setup

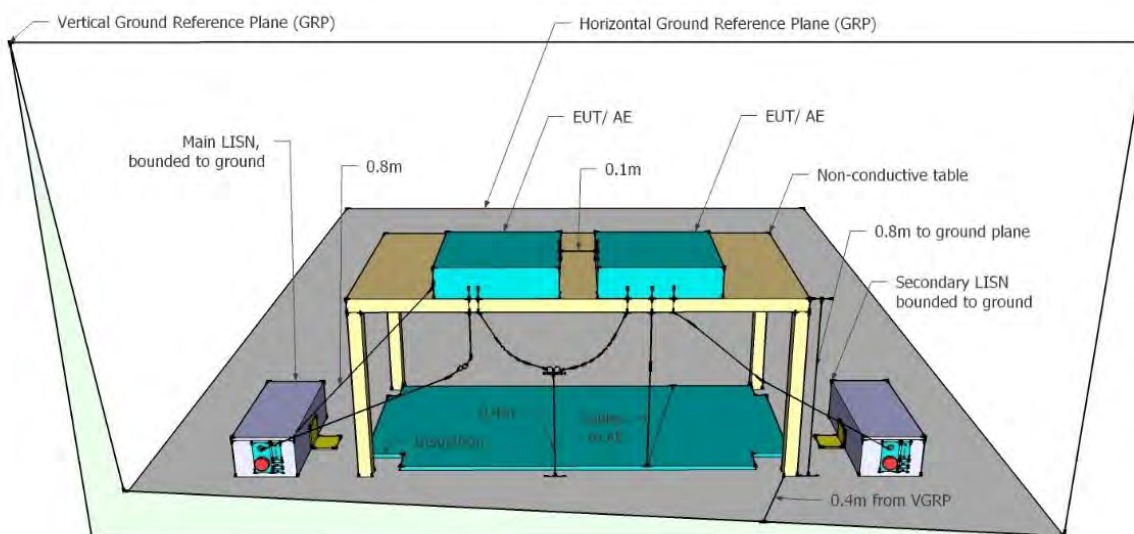


A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
107	26-40 GHz Horn Antenna	Millimeter Products	261A	None	599
145	18-26 GHz Horn Antenna	Millimeter Products	261K	None	595
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	21 Apr 2020
336	Active Loop Antenna	Emco	6502	00060498	29 Nov 2019
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	4 Apr 2020
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2019
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	12 Apr 2020
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 Oct 2019
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	12 Apr 2020
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	MiTest Rad Emissions Test Software	MiCOM	Version 1.0	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	9 Oct 2019
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	9 Oct 2019
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	9 Oct 2019
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	9 Oct 2019
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	24 Aug 2019
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	24 Aug 2019
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019
518	Cable - Amp to Antenna	SRC Haverhill	157-3051574	518	24 Aug 2019

6.3. ac Wireline Emissions

Test Setup – Power Input / Output Port

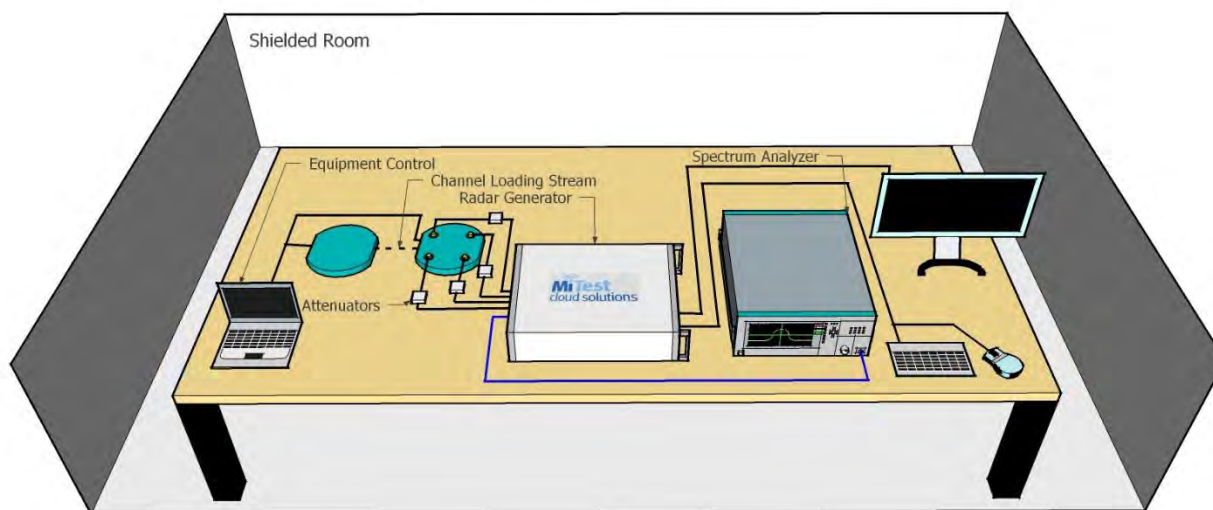


A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
184	Pulse Limiter	Rhode & Schwarz	ESH3Z2	357.8810.52	6 Oct 2019
190	LISN (two-line V-network)	Rhode & Schwarz	ESH3Z5	836679/006	18 Oct 2019
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 Jul 2019
295	Conducted Emissions Chamber Maintenance Check	MiCOM	Conducted Emissions Chamber	295	19 Jun 2019
307	BNC-CABLE	Megaphase	1689 1GVT4	15F50B002	11 Jun 2019
316	Dell desktop computer workstation	Dell	Desktop	WS04	Not Required
372	AC Variable PS	California Instruments	1251P	L06951	Cal when used
388	LISN (3 Phase) 9kHz - 30MHz	Rohde & Schwarz	ESH2-Z5	892107/022	20 Oct 2019
496	MiTest Conducted Emissions test software.	MiCOM	Conducted Emissions Test Software Version 1.0	496	Not Required
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019

6.4. Dynamic Frequency Selection (DFS)

Dynamic Frequency Selection (DFS) - Conducted



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.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
507	Power Meter EPM Series	Agilent	E4418B	MY40511221	20 Oct 2019
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019
71	Spectrum Analyser 9KHz-50GHz	HP	8565E	3425A00181	6 Aug 2019
512	MiTest DFS Test System	MiCOM Labs Inc.	MiTest	3C:FD:FE:9F:B4:58	15 Jul 2019
DFS SMA#1	SMA Cable for DFS	Megaphase	SMA Cable	None	Cal when used
DFS SMA#2	SMA Cable for DFS	Megaphase	SMA Cable	None	Cal when used
DFS SMA#3	SMA Cable for DFS	Megaphase	SMA Cable	None	Cal when used
DFS SMA#4	SMA Cable for DFS	Megaphase	SMA Cable	None	Cal when used

7. MEASUREMENT AND PRESENTATION OF TEST DATA

7.1. Test System

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)

7.2. Control of Test Item

The EUT was controlled via the Sonos GUI. This gave access to operational channels, output power and antenna port activation. As the device was a 4x4 MIMO all the antenna ports were activated to operate simultaneously during conducted and radiated testing. Duty cycle was fixed as reported in Section 8.3.

The power setting reported in TUV116-U6_Conducted Addendum Peak Transmit Power is the final power setting found in order to prove compliance for radiated and conducted testing for the Sonos S23.

Output Power

In the case of average power measurements an average power sensor was utilized using connected to each antenna port. Power measurements on all ports were measured simultaneously, the EUT was set to transmit maximum power during the test program (compliant power setting logged for each test mode). As the Duty Cycle was constant (see Section 8.2 Operational Mode Duty Cycle) the duty cycle correction factor was used to correct the power reading.

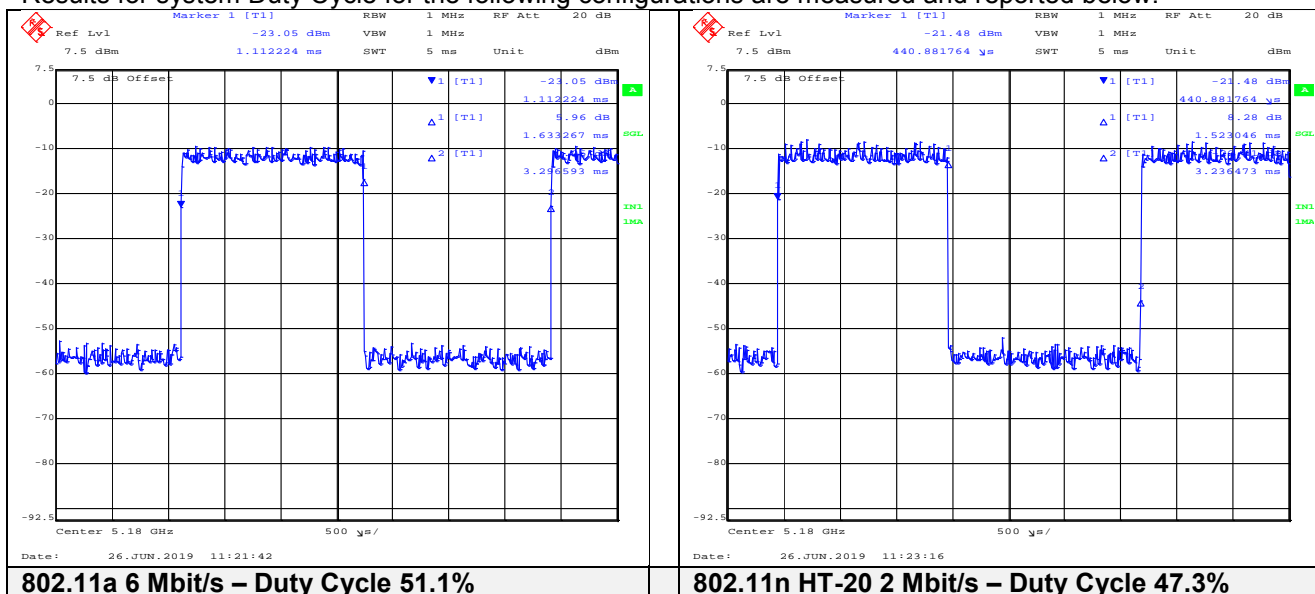
The lowest data rate for each operational mode was used to exercise the test sample:

802.11a – 6 Mbit/s

802.11n HT-20 – 6.5 Mbit/s

7.3. Operational Mode Duty Cycle(s)

Results for system Duty Cycle for the following configurations are measured and reported below:





575 Boulder Court
Pleasanton, California 94566, USA
Tel: +1 (925) 462 0304
Fax: +1 (925) 462 0306
www.micomlabs.com