Radio Test Report

TTC7-23

Audio/Video Codec (802.11a/b/g/n/ac)

5150-5250 MHz

Against the following Specifications:

LP0002:2016 Section 2.8

ACCREDITED

Cisco Systems
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SECTION 1: OVERVIEW **3**

1.1 TEST SUMMARY 3

SECTION 2: ASSESSMENT INFORMATION **4**

2.1 GENERAL 4
2.2 UNITS OF MEASUREMENT 4
2.3 DATE OF TESTING (INITIAL SAMPLE RECEIPT DATE TO LAST DATE OF TESTING) 6
2.4 REPORT ISSUE DATE 6
2.5 TESTING FACILITIES 6
2.6 EQUIPMENT ASSESSED (EUT) 6
2.7 EUT DESCRIPTION 7

SECTION 3: RESULT SUMMARY **8**

3.1 RESULTS SUMMARY TABLE 8

SECTION 4: SAMPLE DETAILS **10**

APPENDIX A: EMISSION TEST RESULTS **11**

TRANSMITTER RADIATED SPURIOUS EMISSIONS 11
RECEIVER RADIATED SPURIOUS EMISSIONS 22

AC CONDUCTED EMISSIONS 33

APPENDIX B: LIST OF TEST EQUIPMENT USED TO PERFORM THE TEST **34**

APPENDIX C: ABBREVIATION KEY AND DEFINITIONS **36**

APPENDIX D: PHOTOGRAPHS OF EUT AND TEST SETUPS **37**

APPENDIX E: SOFTWARE USED TO PERFORM TESTING **40**

APPENDIX F: TEST PROCEDURES **41**

APPENDIX H: SCOPE OF ACCREDITATION (A2LA CERTIFICATE NUMBER 1178-01) **42**

APPENDIX I: TEST ASSESSMENT PLAN **43**

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Section 1: Overview

1.1 Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:

Specifications
LP0002:2016 Section 2.8

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Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Radio Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

e) All AC testing was performed at one or more of the following supply voltages:
220V 60 Hz (+/-20%)

2.2 Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

Emission level [dBuV] = Indicated voltage level [dBuV] + Cable Loss [dB] + Other correction factors [dB]

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss..

Note: to convert the results from dBuV/m to uV/m use the following formula:-

Level in uV/m = Common Antilogarithm [(X dBuV/m)/20] = Y uV/m

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Measurement Uncertainty Values

voltage and power measurements	± 2 dB
conducted EIRP measurements	± 1.4 dB
radiated measurements	± 3.2 dB
frequency measurements	± 2.4 10-7
temperature measurements	± 0.54º.
humidity measurements	± 2.3%
DC and low frequency measurements	± 2.5%.

Where relevant measurement uncertainty levels have been estimated for tests performed on the apparatus. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Radiated emissions (expanded uncertainty, confidence interval 95%)

30 MHz - 300 MHz	+/- 3.8 dB
300 MHz - 1000 MHz	+/- 4.3 dB
1 GHz - 10 GHz	+/- 4.0 dB
10 GHz - 18GHz	+/- 8.2 dB
18GHz - 26.5GHz	+/- 4.1 dB
26.5GHz - 40GHz	+/- 3.9 dB

Conducted emissions (expanded uncertainty, confidence interval 95%)

30 MHz – 40GHz	+/- 0.38 dB

A product is considered to comply with a requirement if the nominal measured value is below the limit line. The product is considered to not be in compliance in case the nominal measured value is above the limit line.

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2.3 Date of testing (initial sample receipt date to last date of testing)

08-May-2017 to 13-May-2017

2.4 Report Issue Date

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called Doc Central. The actual report issue date is embedded into the original file in Doc Central. Any copies of this report, either electronic or paper, that are not in Doc Central must be considered uncontrolled

2.5 Testing facilities

This assessment was performed by:

Testing Laboratory

Cisco Systems, Inc.
125 West Tasman Drive (Building P)
San Jose, CA 95134
USA

Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134
USA

Test Engineers
Allan Beecroft/Jose Aguirre/Chris Blair

2.6 Equipment Assessed (EUT)

TTC7-23

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2.7 EUT Description

The TTC7-23 and TTC7-23 have an Audio/Video codec (encoder/decoder) with a build-in camera and speakers for video-conferencing. The EUT is supplied with 12VDC power from an external AC/DC adapter. Operation of the EUT is via a Touch panel or cellphone. It supports Wifi (802.11a/b/g/n/ac 2.4GHz/5GHz, 2x2 MIMO) and Bluetooth 4.0.

The following antennas are supported by this product series.
The data included in this report represent the worst case data for all antennas.

Frequency	Antenna Type	Antenna Gain 1 (dBi)	Antenna Gain 2 (dBi)
5150	Internal	4.3	4.8
5250	Internal	4.1	5.6

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Section 3: Result Summary

3.1 Results Summary Table

Section	Test Item	Technical Regulation	Result
2	***General Regulations***		
2.3	RF voltage conducted back onto the AC power line	Freq. (MHz) Quasi Peak (dBuV) Average (dBuV) 0.15-0.5 66-56 56-46 0.5-5 56 46 5-30 60 50	Not tested*
2.8	Field Strength Limits (at 3 m) (at 3 m) (at 3 m) (at 3 m)	Frequency (MHz) Field Strength (uV/m) 30(inc.) - 88 (inc.) 100 88(exc.) - 216 (inc.) 150 216(exc.) - 960 (inc.) 200 above 960(exc.) 500	Pass
3.10	Operating band: 5725~5870 MHz 24.0-24.25 GHz	For frequency hopping or digitally modulated equipment	
3.10.1.2	Peak output power	≤ 1 W	Not tested*
3.10.1.5	Out of Band Radiated Emission Limits	> 20 dB below highest level in 100 kHz bandwidth or section 2.9 which has lesser attenuation	Not tested*
3.10.1.6(2)	***Digital Modulation Techniques Systems*** Minimum 6 dB bandwidth Transmitter power spectral density (into the antenna) Processing Gain	 ≥ 500 kHz ≤ 8 dBm (in any 3 kHz band any time of continuous transmission) > 10 dB	Not tested*
4.7	***UNII Equipment***		
4.7.3.1	Peak Transmit Power for the band 5150-5250 MHz	≤1 W Max. Power Density ≤17 dBm in any 1 MHz band	Not tested*
4.7.3.2	Peak Transmit Power for the band 5250-5350 MHz, and 5470-5725 MHz	≤250 mW or 11 dBm+10 log B (whichever smaller) Max. Power Density ≤11 dBm in any 1 MHz band	Not tested*
4.7.3.3	Peak Transmit Power for the band 5725-5850MHz	Max. Power Density ≤30 dBm in any 500 kHz band	Not tested*
4.7.4	***Out of Band Emissions***		
4.7.4.1	5250-5350 MHz & 5470-5725 MHz	EIPR ≤ -27 dBm/MHz	Not tested*
4.7.4.2	5725-5850 MHz	EIPR ≤ 27~15.6 dBm/MHz (within 5 MHz band edge) EIPR ≤ 15.6~10 dBm/MHz (within 5-25 MHz band edge) EIPR ≤ 10~-27 dBm/MHz (within 25-75 MHz band edge) EIPR ≤ -27 dBm/MHz (outside 75 MHz band edge)	Not tested*
4.7.6	Automatic Transmission Discontinue Limits	The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure.	Not tested*
4.7.7.1	Transmit Power Control (TPC)	Applicable in: 5250-5350 & 5470-5725 MHz 6 dB below the mean EIRP of 30dBm. EIPR < 500mW does not need to have TPC function	Not tested*
4.7.7.2	Dynamic Frequency Selection	Applicable in: 5250-5350 & 5470-5725 MHz	Not tested*

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	(DFS)	Threshold Level: ≤-62 dBm (<200 mW eirp & PSD<10 dBm/MHz) ≤-64 dBm (<200 mW eirp & PSD≥10 dBm/MHz) ≤-64 dBm (200 mW – 1 W eirp)	

*Radio module has previous approval. NCC ID: CCAJ15LP6160T6

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Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the "Justification for worst Case test Configuration" section of this report for further details on the selection of EUT samples.

4.1 Sample Details

Sample No.	Equipment Details	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01	TTC7-23	CISCO	G	N/A	s01828-1.3.0 59f36e3 2017-04-28 14:51:39 matchbox	FOC2101NPF4
S02	FSP070-AHAN2 AC/DC Adapter	FSP GROUP INC	A0	N/A	N/A	FST2047IAGX

4.2 System Details

System #	Description	Samples
1	EUT	S01, S02

4.3 Mode of Operation Details

Mode#	Description	Comments
1	802.11a 6Mbps Tx	Continuous transmit mode. Single antenna. See Test Assessment Plan for full details.
2	802.11n HT20 MCS0 Tx	Continuous transmit mode. Dual antenna. See Test Assessment Plan for full details.
3	802.11n HT40 MCS0 Tx	Continuous transmit mode. Dual antenna. See Test Assessment Plan for full details.
4	802.11ac HT80 MCS0 Tx	Continuous transmit mode. Dual antenna. See Test Assessment Plan for full details.
5	802.11a 6Mbps Rx	Receive only mode. Dual antenna. See Test Assessment Plan for full details.

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Appendix A: Emission Test Results

Transmitter Radiated Spurious Emissions

Radiated Emissions 30MHz to 1GHz

LP0002:2016 (2.8) Additional regulations shall apply except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	30MHz – 1GHz
Reference Level:	70 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	100kHz
Video Bandwidth:	300kHz
Detector:	Peak for Pre-scan, Quasi-Peak
.	Compliance shall be determined using CISPR quasi-peak detection

Antenna ports terminated in 50 Ohms.
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

This report represents the worst case data for all supported operating modes and antennas.

System Number	Description	Samples	System under test	Support equipment
1	EUT	S01, S02	✓	

Tested By : Allan Beecroft/Jose Aguirre	**Date of testing: 11/12-MAY-2017**
Test Result : PASS	

See Appendix B for list of test equipment

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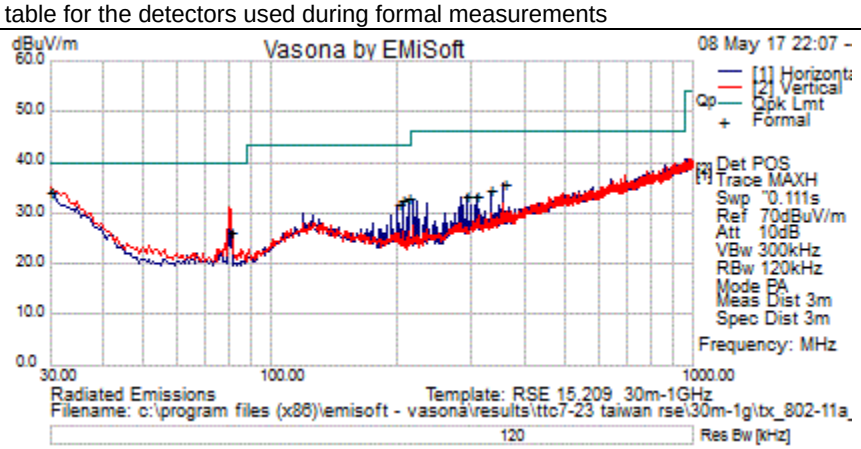
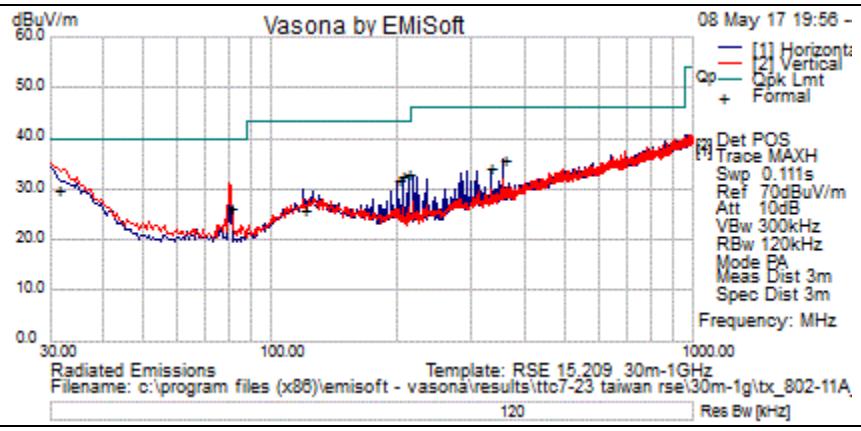
Graphical Test Results

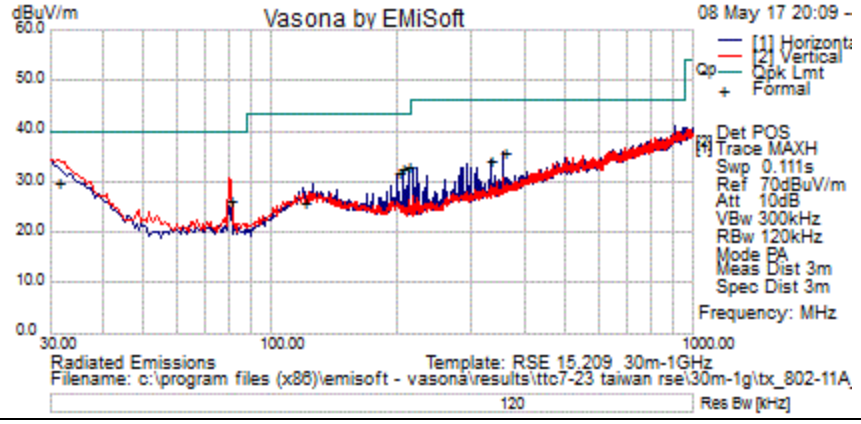
Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



RSE 30MHz to 1GHz Graph. 5180MHz



RSE 30MHz to 1GHz Graph. 5200MHz



RSE 30MHz to 1GHz Graph. 5240MHz

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Worst Case Test Results Table

Formal Data

No	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
1	30.000	12.3	.6	21.3	34.1	Quasi Max	V	125	161	40.0	-5.9	Pass	
2	80.003	17.7	.9	7.7	26.3	Quasi Max	V	158	30	40.0	-13.7	Pass	
3	356.351	19.1	1.9	14.7	35.8	Quasi Max	H	103	322	46.0	-10.2	Pass	
4	205.832	20.5	1.4	10.6	32.6	Quasi Max	H	155	186	43.5	-10.9	Pass	
5	211.966	21.2	1.5	10.4	33.0	Quasi Max	H	142	184	43.5	-10.5	Pass	
6	331.783	18.8	1.8	14.0	34.7	Quasi Max	H	102	193	46.0	-11.3	Pass	
7	199.691	18.2	1.4	12.4	32.0	Quasi Max	H	167	180	43.5	-11.5	Pass	
8	307.202	17.9	1.8	13.7	33.3	Quasi Max	H	104	188	46.0	-12.7	Pass	
9	291.836	18.4	1.7	13.3	33.5	Quasi Max	H	107	152	46.0	-12.5	Pass	

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Transmitter Radiated Spurious Emissions 1GHz to 18GHz

LP0002:2016 (2.8) Additional regulations shall apply except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

	Peak	Average
Span:	1GHz – 18 GHz	1GHz – 18 GHz
Reference Level:	70 dBuV	70 dBuV
Attenuation:	0 dB	0 dB
Sweep Time:	Auto	Auto
Resolution Bandwidth:	1MHz	1MHz
Video Bandwidth:	3 MHz	3 MHz
Detector:	Peak	RMS (Average)

Antenna ports terminated in 50 Ohms.
A notch filter at the fundamental frequency was used to prevent overloading the spectrum analyzer.
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV/m @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV/m @3m

This report represents the worst case data for all supported operating modes and antennas.

System Number	Description	Samples	System under test	Support equipment
1	EUT	S01, S02	✓	

Tested By : Jose Aguirre	**Date of testing:** 11-May-2017
Test Result : PASS	

See Appendix B for list of test equipment

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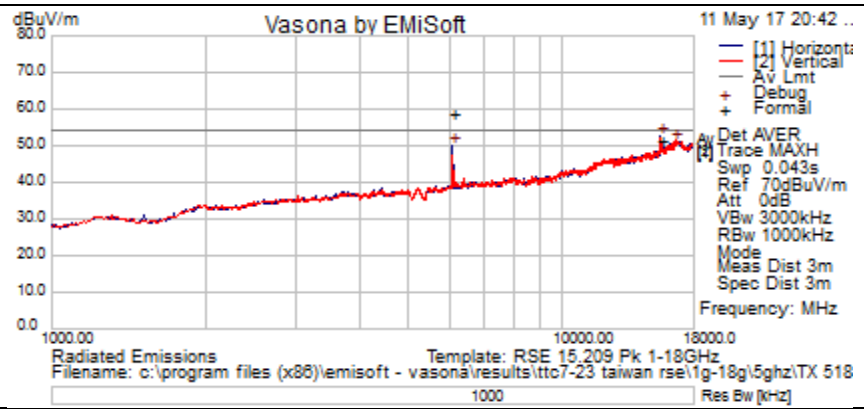
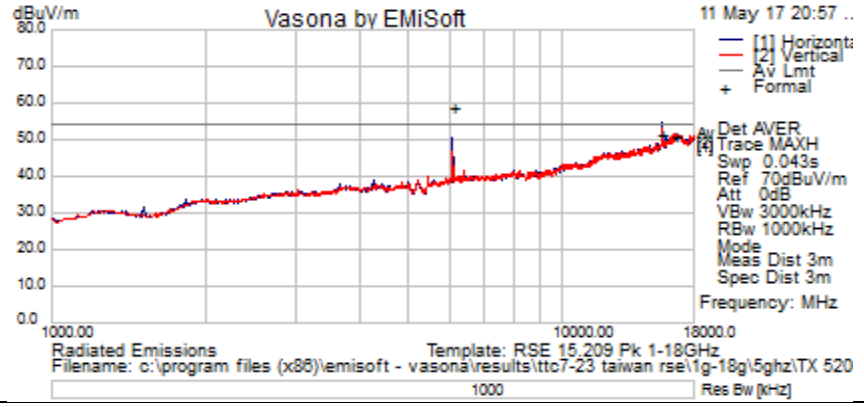
Graphs: Average Radiated Transmitter Spurious Emissions



RSE 1GHz to 18GHz Graph. 5180MHz

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
6086.719	51.19	9.13	-1.47	58.85	Average.	H	181	222	54	+4.85	n/a	Digital*
15539.06	30.46	16.17	5.1	51.73	Average.	H	154	185	54	-2.27	Pass	
16654.03	27.35	17.07	6.58	51	Average.	H	181	222	54	-3	Pass	

*Non-radio emission.



RSE 1GHz to 18GHz Graph. 5200MHz

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
6086.719	51.19	9.13	-1.47	58.85	Average.	H	181	222	54	+4.85	n/a	Digital*
15539.06	30.46	16.17	5.1	51.73	Average.	H	154	185	54	-2.27	Pass	
16654.03	27.35	17.07	6.58	51	Average.	H	181	222	54	-3	Pass	

*Non-radio emission.

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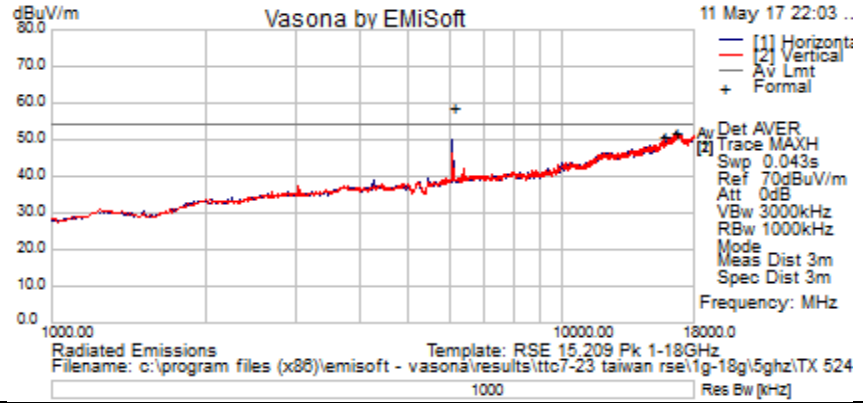

RSE 1GHz to 18GHz Graph. 5240MHz

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
16565.63	28.6	17.02	6.28	51.89	Average.	H	200	138	54	-2.11	Pass	
15715.2	29.31	16.31	5.25	50.87	Average.	V	101	360	54	-3.13	Pass	
6086.719	51.19	9.13	-1.47	58.85	Average.	H	181	222	54	+4.85	n/a	Digital*

*Non-radio emission.

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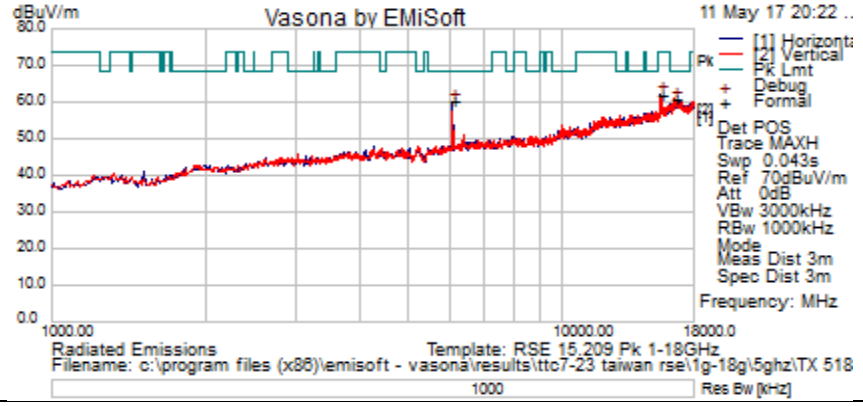
Graphs: Peak Radiated Transmitter Spurious Emissions

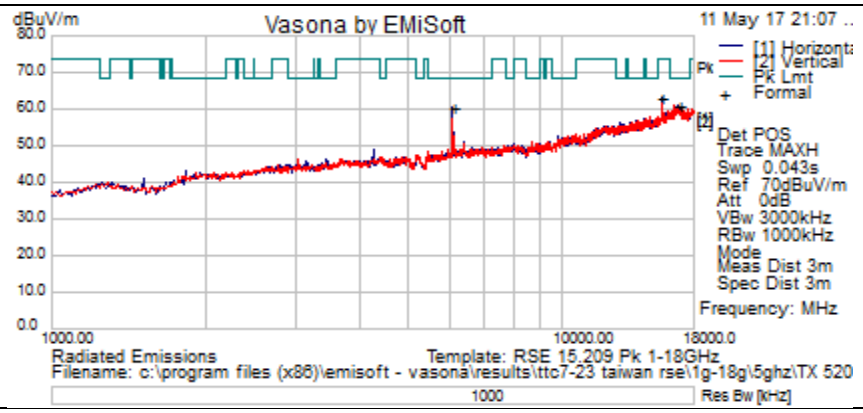
The limit line in the following graphs is incorrect. The correct limit line is 74dBuV/m from 1GHz to 18GHz.



RSE 1GHz to 18GHz Graph. 5180MHz

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
6086.715	53.1	9.13	-1.47	60.75	Peak.	H	166	218	74	-13.25	n/a	Digital*
15545.63	40.76	16.16	5.16	62.08	Peak.	H	150	180	74	-11.92	Pass	
16533.66	38.08	16.76	6.04	60.88	Peak.	V	100	360	74	-13.12	Pass	

*Non-radio emission.



RSE 1GHz to 18GHz Graph. 5200MHz

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
15609.38	41.7	16.22	5.07	62.99	Peak.	H	150	186	74	-11.01	Pass	
16831.25	37.65	17.4	5.8	60.85	Peak.	H	200	183	74	-13.15	Pass	
6089.375	52.6	9.13	-1.46	60.27	Peak.	H	200	223	74	-13.73	n/a	Digital*

*Non-radio emission.

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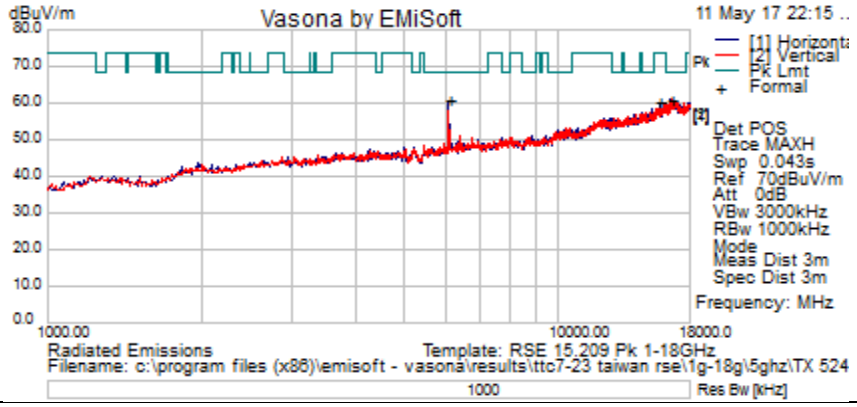

RSE 1GHz to 18GHz Graph. 5240MHz

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
6086.719	53.25	9.13	-1.47	60.91	Peak.	H	185	221	74	-13.09	n/a	Digital*
16523.13	38.68	16.77	5.79	61.24	Peak.	H	100	131	74	-12.76	Pass	
15721.38	38.9	16.4	5.3	60.6	Peak.	V	100	360	74	-13.4	Pass	

*Non-radio emission.

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Transmitter Radiated Spurious Emissions 18GHz to 40GHz

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Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

	Peak	Average
Span:	18GHz – 40 GHz	18GHz – 40 GHz
Reference Level:	80 dBuV	80 dBuV
Attenuation:	5 dB	0 dB
Sweep Time:	Auto	Auto
Resolution Bandwidth:	1MHz	1MHz
Video Bandwidth:	3 MHz	3 MHz
Detector:	Peak	RMS (Average)

Antenna ports terminated in 50 Ohms.
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV/m @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV/m @3m

This report represents the worst case data for all supported operating modes and antennas.

System Number	Description	Samples	System under test	Support equipment
1	EUT	S01, S02	✓	

Tested By : Jose Aguirre	**Date of testing:** 13-May-2017
Test Result : PASS	

See Appendix B for list of test equipment

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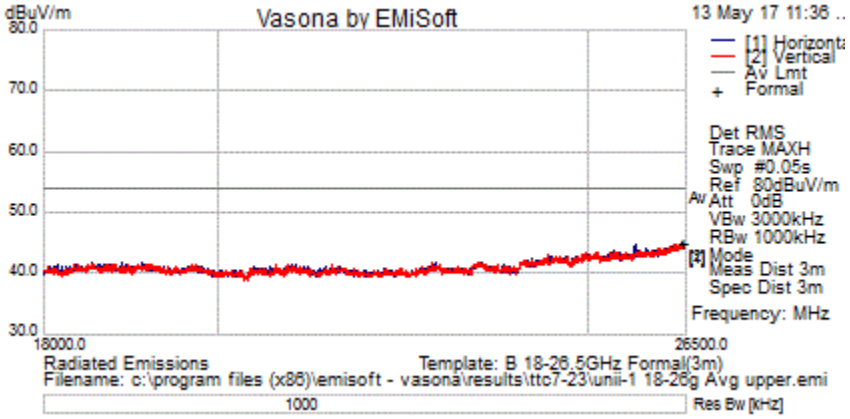
Graphs: Average Radiated Transmitter Spurious Emissions 18GHz – 26.5GHz

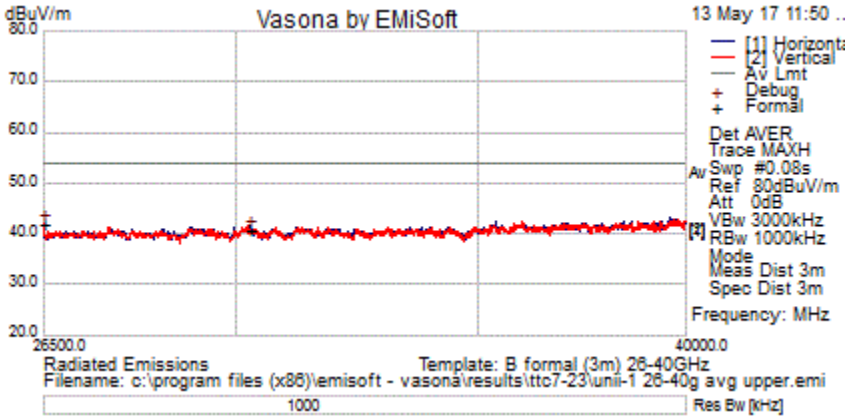


Worst Case Test Results Table Average

Formal Data

No	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
1	26436.249	27.6	.0	17.5	45.0	Average.	H	100	0	54.0	-9.0	Pass	

Graphs: Average Radiated Transmitter Spurious Emissions 26.5GHz – 40GHz



Worst Case Test Results Table Average

Formal Data

No	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
1	30256.871	42.3	.0	-1.4	40.9	Average.	V	100	0	54.0	-13.1	Pass	
2	26508.337	49.0	.0	-6.9	42.1	Average.	V	100	0	54.0	-11.9	Pass	

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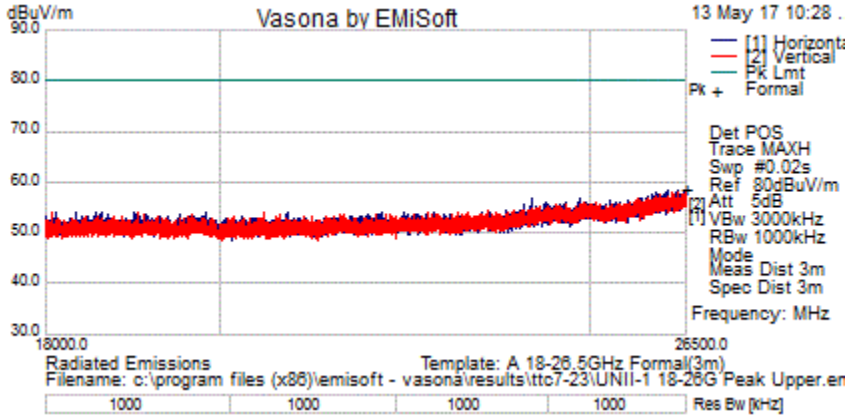
Graphs: Peak Radiated Transmitter Spurious Emissions 18GHz – 26.5GHz

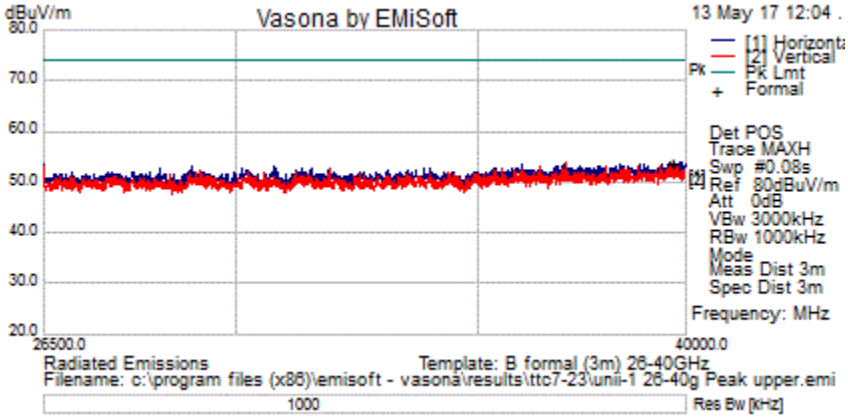
Note: Limit line incorrectly displayed as 80dBuV/m. Correct limit is 74dBuV/m.



Worst Case Test Results Table Peak

Formal Data													
No	**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**
1	26475.562	40.9	.0	17.6	58.5	Peak.	H	100	0	80.0	-21.5	Pass	

Graphs: Peak Radiated Transmitter Spurious Emissions 26.5GHz – 40GHz



Worst Case Test Results Table Peak

Formal Data													
No	**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**
1	39615.250	46.6	.0	7.3	54.0	Peak.	H	100	0	74.0	-20.0	Pass	

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Receiver Radiated Spurious Emissions

Receiver Radiated Emissions 30MHz to 1GHz

LP0002:2016 (2.8) Additional regulations shall apply except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	30MHz – 1GHz
Reference Level:	80 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	100kHz
Video Bandwidth:	300kHz
Detector:	Peak for Pre-scan, Quasi-Peak
.	Compliance shall be determined using CISPR quasi-peak detection

Antenna ports terminated in 50 Ohms.
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

This report represents the worst case data for all supported operating modes and antennas.

System Number	Description	Samples	System under test	Support equipment
1	EUT	S01, S02	✓	

Tested By : Allan Beecroft	**Date of testing: 09-MAY-2017**
Test Result : PASS	

See Appendix B for list of test equipment

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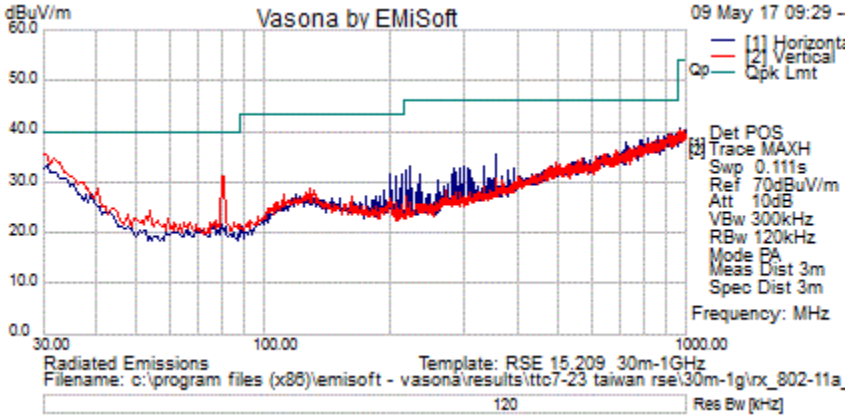
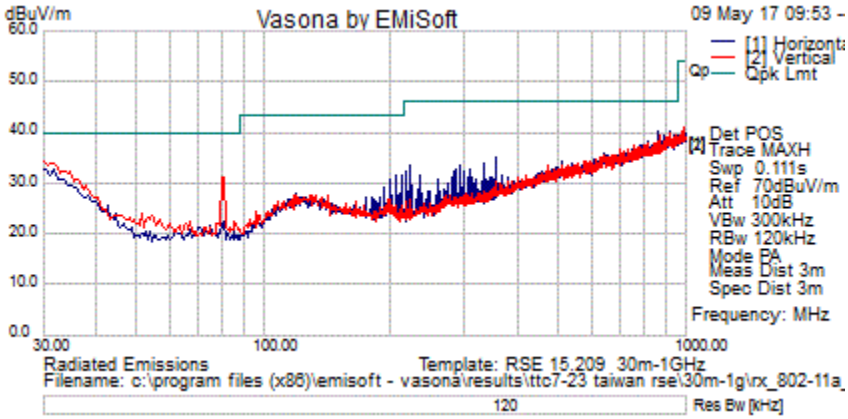
Graphical Test Results

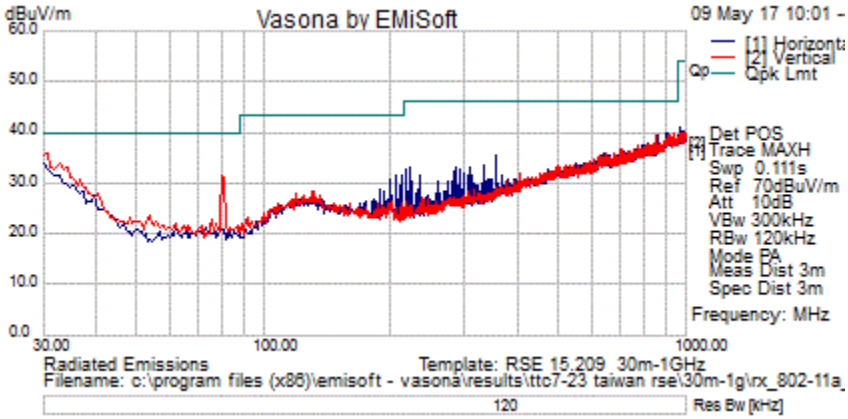
Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



RSE 30MHz to 1GHz Graph. 5180MHz



RSE 30MHz to 1GHz Graph. 5200MHz



RSE 30MHz to 1GHz Graph. 5240MHz

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Worst Case Test Results Table

Formal Data

No	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
1	847.853	10.2	3.0	21.8	35.0	Quasi Max	V	203	126	46.0	-11.0	Pass	
2	30.606	8.9	.6	20.8	30.3	Quasi Max	V	177	76	40.0	-9.7	Pass	
3	80.000	17.9	.9	7.7	26.5	Quasi Max	V	169	360	40.0	-13.5	Pass	
4	356.359	19.0	1.9	14.7	35.6	Quasi Max	H	105	324	46.0	-10.4	Pass	
5	205.828	19.5	1.4	10.6	31.6	Quasi Max	H	168	12	43.5	-11.9	Pass	
6	331.781	18.2	1.8	14.0	34.0	Quasi Max	H	108	203	46.0	-12.0	Pass	

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Receiver Radiated Spurious Emissions 1GHz to 18GHz

LP0002:2016 (2.8) Additional regulations shall apply except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

	Peak	Average
Span:	1GHz – 18 GHz	1GHz – 18 GHz
Reference Level:	80 dBuV	80 dBuV
Attenuation:	10 dB	10 dB
Sweep Time:	Auto	Auto
Resolution Bandwidth:	1MHz	1MHz
Video Bandwidth:	3 MHz	3 MHz
Detector:	Peak	RMS (Average)

Antenna ports terminated in 50 Ohms.
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV/m @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV/m @3m

This report represents the worst case data for all supported operating modes and antennas.

System Number	Description	Samples	System under test	Support equipment
1	EUT	S01, S02	✓	

Tested By : Jose Aguirre	**Date of testing:** 12-May-2017
Test Result : PASS	

See Appendix B for list of test equipment

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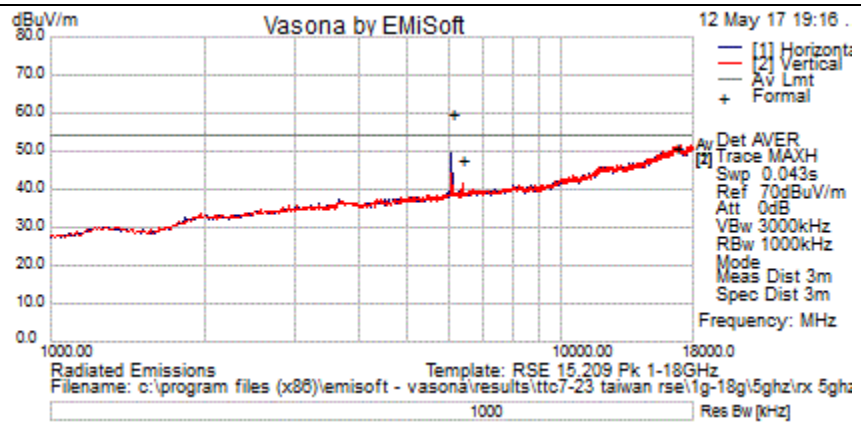
Graphs: Average Radiated Receiver Spurious Emissions

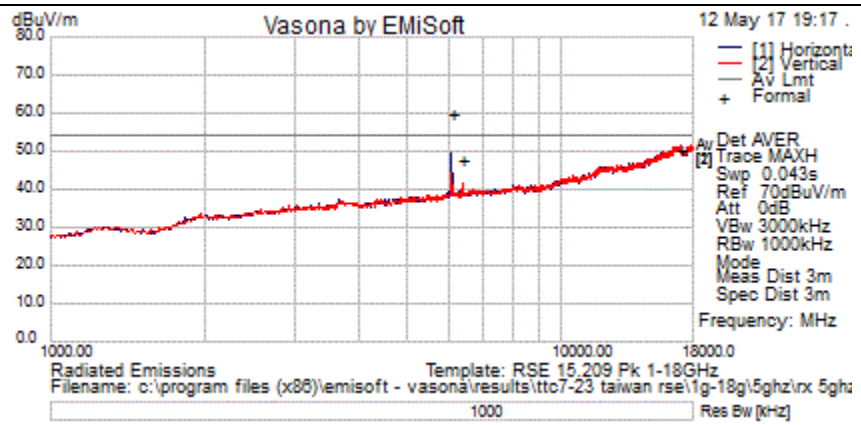


RSE 1GHz to 18GHz Graph. 5180MHz

Formal Data

No	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
1	6391.063	39.6	9.4	-1.2	47.8	Average.	H	149	218	54.0	-6.2	n/a	Digital*
2	6086.813	52.1	9.1	-1.5	59.8	Average.	H	188	211	54.0	5.8	n/a	Digital*
3	16663.813	27.5	17.2	6.4	51.1	Average.	V	173	179	54.0	-2.9	Pass	

*Non-radio emission



RSE 1GHz to 18GHz Graph. 5200MHz

Formal Data

No	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
1	6391.063	39.6	9.4	-1.2	47.8	Average.	H	149	218	54.0	-6.2	n/a	Digital*
2	6086.813	52.1	9.1	-1.5	59.8	Average.	H	188	211	54.0	5.8	n/a	Digital*
3	17063.259	27.3	17.5	5.9	50.7	Average.	H	146	90	54.0	-3.3	Pass	

*Non-radio emission

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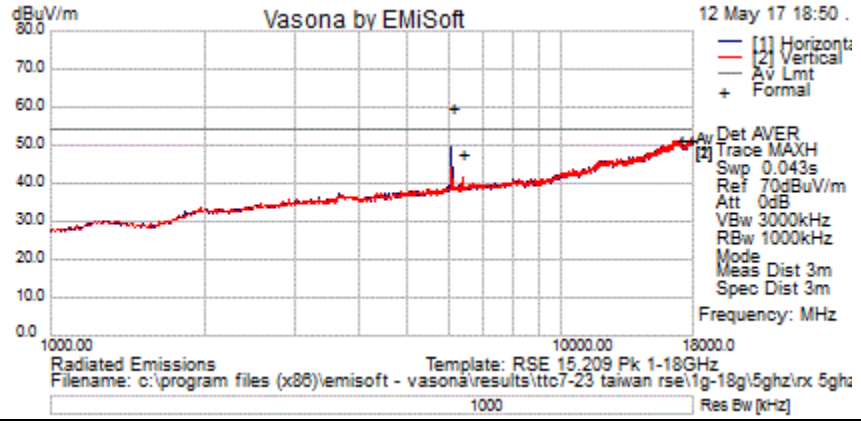

RSE 1GHz to 18GHz Graph. 5240MHz

Formal Data

No	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
1	6391.063	39.6	9.4	-1.2	47.8	Average.	H	145	181	54.0	-6.2	n/a	Digital*
2	6086.813	52.1	9.1	-1.5	59.8	Average.	H	199	220	54.0	5.8	n/a	Digital*
3	17851.250	27.2	18.2	6.1	51.5	Average.	V	150	208	54.0	-2.5	Pass	
4	17075.625	28.0	17.6	5.8	51.3	Average.	V	150	147	54.0	-2.7	Pass	

*Non-radio emission

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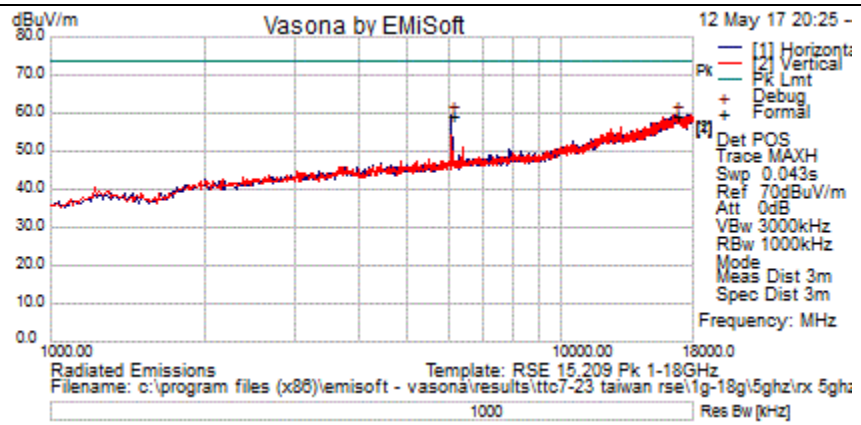
Graphs: Peak Radiated Receiver Spurious Emissions

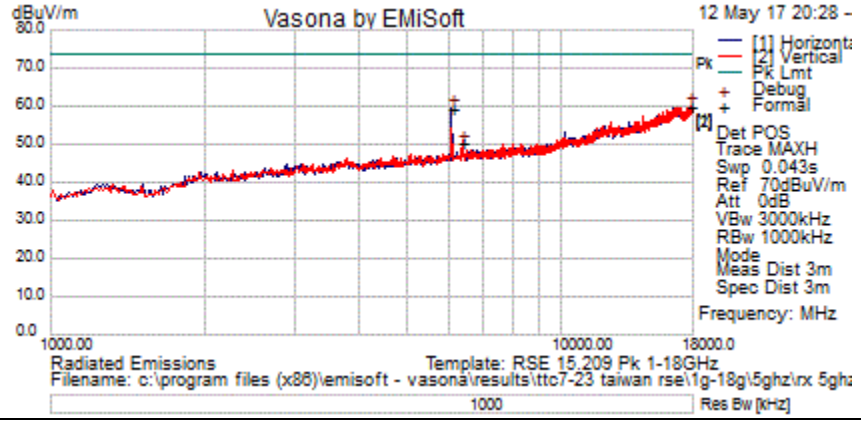


RSE 1GHz to 18GHz Graph. 5180MHz

Formal Data

No	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
1	6089.375	52.4	8.6	-1.5	59.6	Peak.	H	150	222	74.0	-14.4	n/a	Digital*
2	16756.875	36.8	16.2	6.5	59.5	Peak.	V	150	113	74.0	-14.5	Pass	

*Non-radio emission



RSE 1GHz to 18GHz Graph. 5200MHz

Formal Data

No	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
1	17872.500	36.4	17.4	6.3	60.0	Peak.	V	150	240	74.0	-14.0	Pass	
2	6086.375	52.3	8.6	-1.5	59.5	Peak.	H	150	218	74.0	-14.5	n/a	Digital*
3	6386.904	42.5	8.9	-1.2	50.2	Peak.	H	148	222	74.0	-23.8	n/a	Digital*

*Non-radio emission

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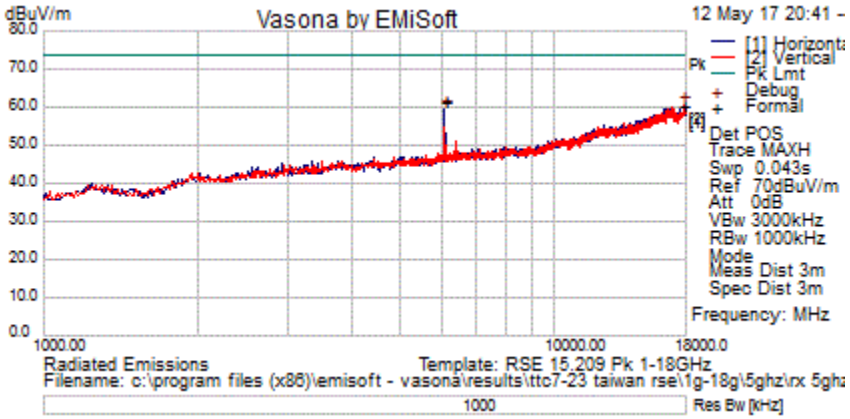

RSE 1GHz to 18GHz Graph. 5240MHz

Formal Data

No	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
1	6086.719	54.2	8.6	-1.5	61.4	Peak.	H	204	222	74.0	-12.6	n/a	Digital*
2	17861.875	37.0	17.4	6.2	60.5	Peak.	V	150	287	74.0	-13.5	Pass	

*Non-radio emission

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Receiver Radiated Spurious Emissions 18GHz to 40GHz

LP0002:2016 (2.8) Additional regulations shall apply except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

	Peak	Average
Span:	18GHz – 40 GHz	18GHz – 40 GHz
Reference Level:	80 dBuV	80 dBuV
Attenuation:	0 dB	0 dB
Sweep Time:	Auto	Auto
Resolution Bandwidth:	1MHz	1MHz
Video Bandwidth:	3 MHz	3 MHz
Detector:	Peak	RMS (Average)

Antenna ports terminated in 50 Ohms.
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV/m @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV/m @3m

This report represents the worst case data for all supported operating modes and antennas.

System Number	Description	Samples	System under test	Support equipment
1	EUT	S01, S02	✓	

Tested By : Jose Aguirre	**Date of testing:** 13-May-2017
Test Result : PASS	

See Appendix B for list of test equipment

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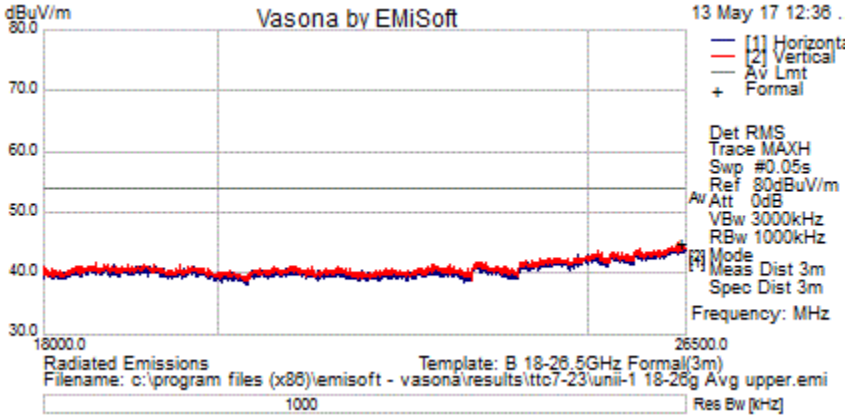
Graphs: Average Radiated Receiver Spurious Emissions 18GHz – 26.5GHz

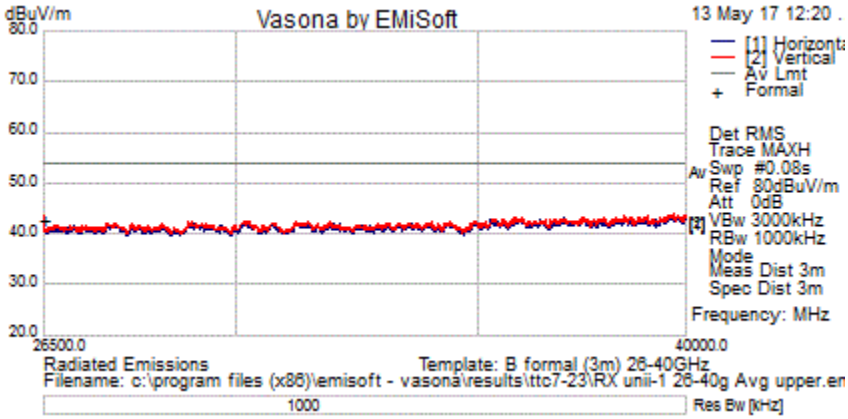


Worst Case Test Results Table Average

Formal Data

No	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
1	26389.499	27.7	.0	17.3	45.0	Average.	V	100	0	54.0	-9.0	Pass	

Graphs: Average Radiated Receiver Spurious Emissions 26.5GHz – 40GHz



Worst Case Test Results Table Average

Formal Data

No	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
1	26500.000	47.4	.0	-4.4	43.0	Average.	V	100	0	54.0	-11.0	Pass	

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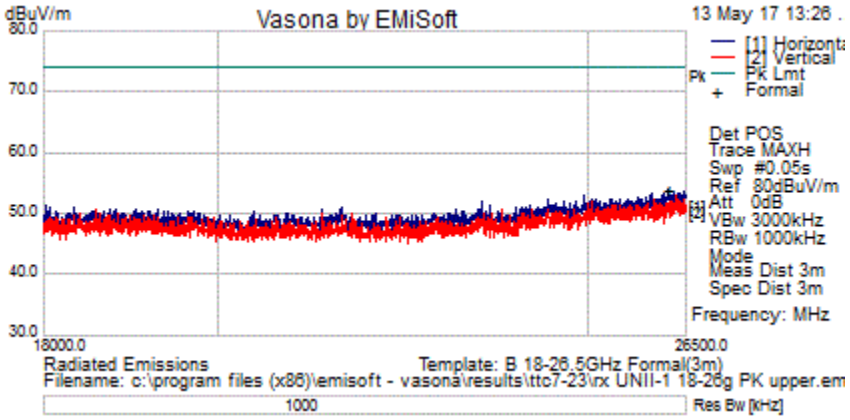
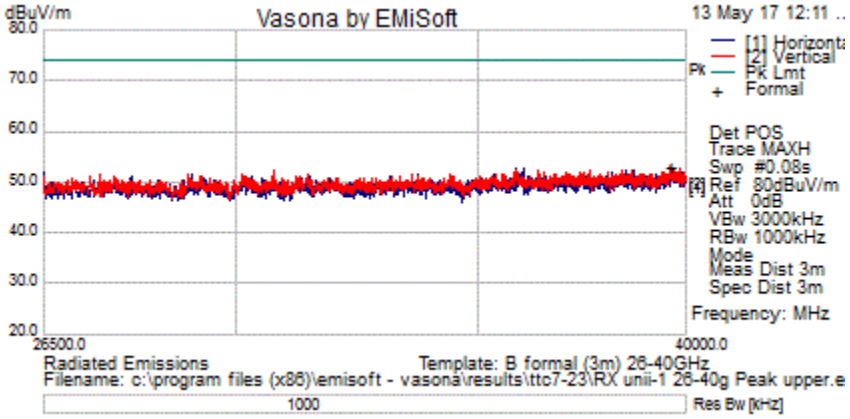
Graphs: Peak Radiated Receiver Spurious Emissions 18GHz – 26.5GHz



Worst Case Test Results Table Peak

Formal Data													
No	**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**
1	26223.749	37.2	.0	16.8	54.1	Peak.	H	100	0	74.0	-19.9	Pass	

Graphs: Peak Radiated Receiver Spurious Emissions 26.5GHz – 40GHz



Worst Case Test Results Table Peak

Formal Data													
No	**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**
1	39608.500	45.9	.0	7.4	53.3	Peak.	V	100	0	74.0	-20.7	Pass	

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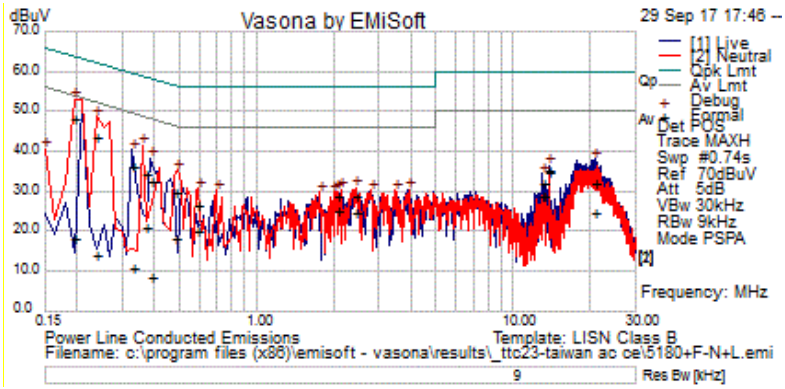
AC Conducted Emissions

The results for AC Conducted Emissions herein, are representative for all channels and modes of operation.



Formal Data

No	Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
1	20.896	11.6	20.4	.3	32.3	Quasi Peak	Live	60.0	-27.7	Pass	bb
2	2.078	9.0	20.0	.1	29.0	Quasi Peak	Live	56.0	-27.0	Pass	hand/series
3	2.078	5.2	20.0	.1	25.2	Average	Live	46.0	-20.8	Pass	
4	.329	-9.6	20.3	.1	10.7	Average	Live	49.5	-38.8	Pass	
5	13.824	14.5	20.2	.2	34.9	Average	Live	50.0	-15.1	Pass	
6	.329	15.9	20.3	.1	36.3	Quasi Peak	Live	59.5	-23.2	Pass	fhss
7	13.824	14.9	20.2	.2	35.4	Quasi Peak	Live	60.0	-24.6	Pass	hand
8	13.056	8.6	20.2	.1	29.0	Average	Live	50.0	-21.0	Pass	
9	20.896	3.9	20.4	.3	24.6	Average	Live	50.0	-25.4	Pass	
10	.389	12.5	20.1	.0	32.6	Quasi Peak	Live	58.1	-25.5	Pass	fhss
11	13.056	11.9	20.2	.1	32.2	Quasi Peak	Live	60.0	-27.8	Pass	hand
12	.389	-11.7	20.1	.0	8.4	Average	Live	48.1	-39.7	Pass	
13	2.448	4.6	20.0	.1	24.6	Average	Neutral	46.0	-21.4	Pass	
14	.370	14.2	20.1	.0	34.4	Quasi Peak	Neutral	58.5	-24.1	Pass	fhss/hump
15	.593	.0	19.9	.0	20.0	Average	Neutral	46.0	-26.0	Pass	
16	2.448	8.8	20.0	.1	28.9	Quasi Peak	Neutral	56.0	-27.2	Pass	hand/series
17	.195	27.5	20.8	.2	48.4	Quasi Peak	Neutral	63.8	-15.4	Pass	fhss
18	.482	-1.5	19.9	.0	18.5	Average	Neutral	46.3	-27.8	Pass	
19	.240	22.9	20.6	.1	43.6	Quasi Peak	Neutral	62.1	-18.6	Pass	fhss
20	.482	9.8	19.9	.0	29.7	Quasi Peak	Neutral	56.3	-26.6	Pass	fhss/hump
21	.370	.7	20.1	.0	20.8	Average	Neutral	48.5	-27.7	Pass	
22	.593	6.7	19.9	.0	26.7	Quasi Peak	Neutral	56.0	-29.3	Pass	fhss/hump
23	.195	-2.6	20.8	.2	18.3	Average	Neutral	53.8	-35.5	Pass	
24	.240	-6.5	20.6	.1	14.2	Average	Neutral	52.1	-38.0	Pass	

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Appendix B: List of Test Equipment Used to perform the test

Equip#	Manufacturer/ Model	Description	Last Cal	Next Due	
Test Equipment used for Radiated Emissions 30MHz to 1GHz					
30654	SUNOL SCIENCES/JB1	Combination Antenna, 30MHz-2GHz	19-JAN-2017	19-JAN-2018	
49563	HUBER + SUHNER/ Sucoflex 106A	Coaxial Cable, 8m	22-AUG-2016	22-AUG-2017	
21117	MICRO-COAX/ UFB311A-0-2484-520520	Coaxial Cable-18Ghz	19-AUG-2016	19-AUG-2017	
25662	MICRO-COAX/ UFB311A-1-0840-504504	Coaxial Cable, 84.0 in. to 18GHz	21-FEB-2017	21-FEB-2018	
47300	Keysight (Agilent/HP)/ N9038A	EMI Receiver	28-MAR-2017	28-MAR-2018	
54230	NEWPORT/ iBTHP-5-DB9	5 inch Temp/RH/Press Sensor w/20ft cable	11-FEB-2017	11-FEB-2018	
8448	CISCO/ NSA 5m Chamber	NSA 5m Chamber	07-OCT-2016	07-OCT-2017	
54647	STANLEY/ 33-605	Tape Measure, 10m	Cal Not Required	Cal Not Required	
18963	YORK/CNE V	COMPARISON NOISE EMITTER	Cal Not Required	Cal Not Required	
Test Equipment used for Radiated Emissions 1GHz to 18GHz					
32544	ETS Lindgren/3117	Double Ridged Horn Antenna	20-JUN-2016	20-JUN-2017	
7295	MITEQ/NSP1800-25-S1	PREAMPLIFIER	11-OCT-2016	11-OCT-2017	
47300	Keysight (Agilent/HP)/ N9038A	EMI Receiver	28-MAR-2017	28-MAR-2018	
40597	CISCO/Above 1GHz Site Cal	1GHz Cispr Site Verification	25-SEP-2016	25-SEP-2017	
34075	SCHAFFNER/ RSG 2000	Reference Spectrum Generator, 1-18GHz	Cal Not Required	Cal Not Required	
4883	EMCO/3115	HORN ANTENNA	Cal Not Required	Cal Not Required	
49563	HUBER + SUHNER/ Sucoflex 106A	Coaxial Cable, 8m	22-AUG-2016	22-AUG-2017	
21117	MICRO-COAX/ UFB311A-0-2484-520520	Coaxial Cable-18Ghz	19-AUG-2016	19-AUG-2017	
25001					
25662	MICRO-COAX/ UFB311A-1-0840-504504	Coaxial Cable, 84.0 in. to 18GHz	21-FEB-2017	21-FEB-2018	
54230	NEWPORT/ iBTHP-5-DB9	5 inch Temp/RH/Press Sensor w/20ft cable	11-FEB-2017	11-FEB-2018	
54647	STANLEY/ 33-605	Tape Measure, 10m	Cal Not Required	Cal Not Required	
Test Equipment used for Radiated Emissions 18GHz to 40GHz					
41979	CISCO/1840	18-40GHz EMI Test Head/Verification Fixture	02-SEP-2016	02-SEP-2017	
44940	Rohde & Schwarz/ESU40	EMI Receiver, 40GHz	14-NOV-2016	14-NOV-2017	
37236	JFW/50CB-015	Control Box, GPIB	Cal Not Required	Cal Not Required	
54230	NEWPORT/ iBTHP-5-DB9	5 inch Temp/RH/Press Sensor w/20ft cable	11-FEB-2017	11-FEB-2018	
Test Equipment Used For AC Conducted Emissions					
5466	Keithley 580	MICRO OHMMETER	31 Oct 2016	31 Oct 2017	

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33041	Fluke 175	True RMS Multimeter	01 Jun 2017	01 Jun 2018	
41933	Newport iBTHP-5-DB9	5 inch Temp/RH/Press Sensor w/20ft cable	22 Dec 2016	22 Dec 2017	
49531	TTE H785-150K-50-21378	HIGH PASS FILTER 150kHz	03 May 2017	03 May 2018	
8496	FCC-450B-2.4-N	Pulse Limiter	16 May 2017	16 May 2018	
49468	Coleman RG223	BNC cable	10 Mar 2017	10 Mar 2018	
45990	FCC F-090527-1009-1	LISN	15 Jun 2017	15 Jun 2018	
45991	FCC F-090527-1009-2	LISN adapter	15 Jun 2017	15 Jun 2018	
45050	R&S ESCI	EMI receiver	09 Nov 2016	09 Nov 2017	
46715	Bird 5-T-MB	Termination	16 Mar 2017	16 Mar 2018	
46714	Bird 5-T-MB	Termination	28 Nov 2016	28 Nov 2017	
18963	York CNE V	COMPARISON NOISE EMITTER	NA	NA	
04003	FCC FCC-801-M2-32A	DECOUPLING NETWORK	16 Mar 2017	16 Mar 2018	
8357	Coleman RG223	BNC cable	12 Apr 2017	12 Apr 2018	
54647	Stanley 33-605	10m tape measure	NA	NA	

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Appendix C: Abbreviation Key and Definitions

The following table defines abbreviations used within this test report.

Abbreviation	Description	Abbreviation	Description
EMC	Electro Magnetic Compatibility	°F	Degrees Fahrenheit
EMI	Electro Magnetic Interference	°C	Degrees Celsius
EUT	Equipment Under Test	Temp	Temperature
ITE	Information Technology Equipment	S/N	Serial Number
TAP	Test Assessment Schedule	Qty	Quantity
ESD	Electro Static Discharge	emf	Electromotive force
EFT	Electric Fast Transient	RMS	Root mean square
EDCS	Engineering Document Control System	Qp	Quasi Peak
Config	Configuration	Av	Average
CIS#	Cisco Number (unique identification number for Cisco test equipment)	Pk	Peak
Cal	Calibration	kHz	Kilohertz ($1x10^3$)
EN	European Norm	MHz	MegaHertz ($1x10^6$)
IEC	International Electro technical Commission	GHz	Gigahertz ($1x10^9$)
CISPR	International Special Committee on Radio Interference	H	Horizontal
CDN	Coupling/Decoupling Network	V	Vertical
LISN	Line Impedance Stabilization Network	dB	decibel
PE	Protective Earth	V	Volt
GND	Ground	kV	Kilovolt ($1x10^3$)
L1	Line 1	µV	Microvolt ($1x10^{-6}$)
L2	Line2	A	Amp
L3	Line 3	µA	Micro Amp ($1x10^{-6}$)
DC	Direct Current	mS	Milli Second ($1x10^{-3}$)
RAW	Uncorrected measurement value, as indicated by the measuring device	µS	Micro Second ($1x10^{-6}$)
RF	Radio Frequency	µS	Micro Second ($1x10^{-6}$)
SLCE	Signal Line Conducted Emissions	m	Meter
Meas dist	Measurement distance	Spec dist	Specification distance
N/A or NA	Not Applicable	SL	Signal Line (or Telecom Line)
P	Power Line	L	Live Line
N	Neutral Line	R	Return
S	Supply	AC	Alternating Current

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Appendix D: Photographs of EUT and Test Setups

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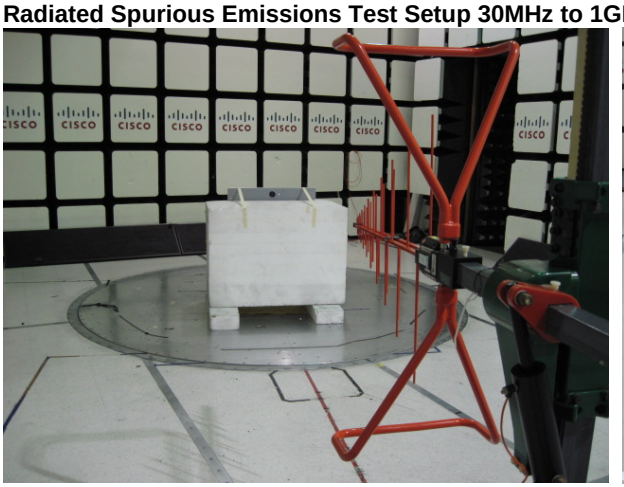
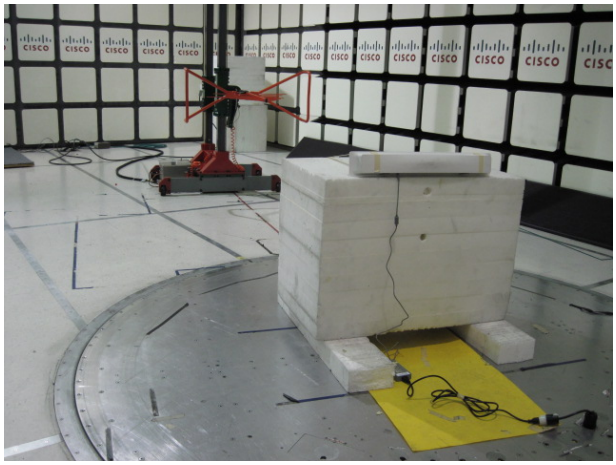
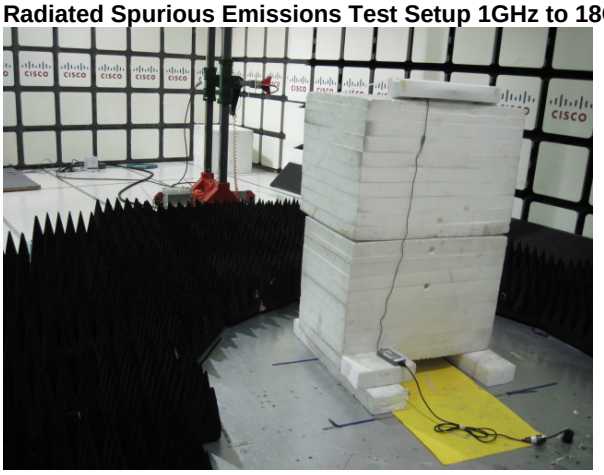
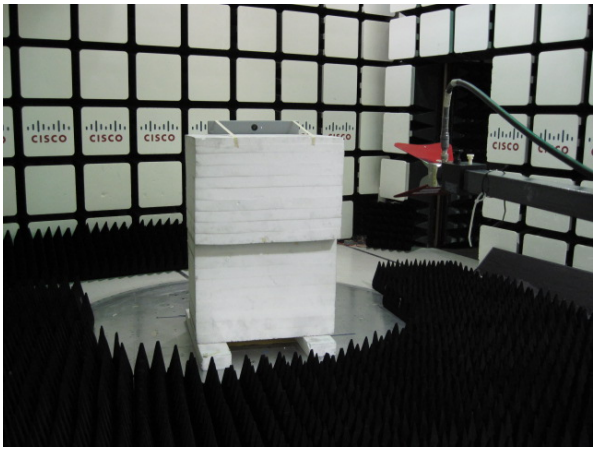
Radiated Spurious Emissions Test Setup 30MHz to 1GHz



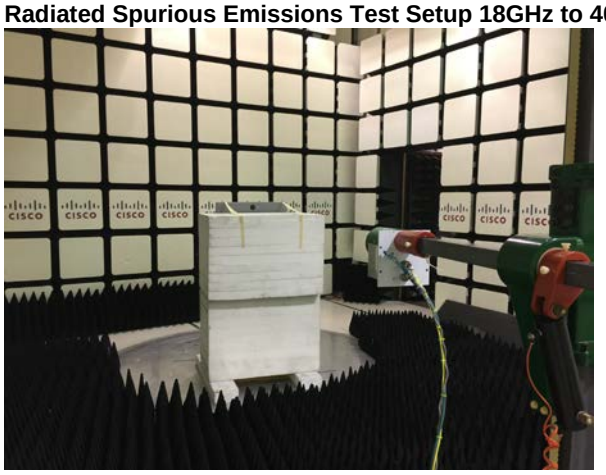


Radiated Spurious Emissions Test Setup 1GHz to 18GHz





Radiated Spurious Emissions Test Setup 18GHz to 40GHz



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AC Conducted Emissions Test Setup

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Appendix E: Software Used to Perform Testing

EMIsoft Vasona, version 6.024

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Appendix F: Test Procedures

Measurements were made in accordance with

- KDB 789033 - D02 General UNII Test Procedures New Rules v01r02
- KDB 662911 - MIMO
- ANSI C63.10 2013 Intentional Radiators
- LP0002:2016

Test procedures are summarized below:

FCC 5GHz Test Procedures	EDCS # 1445048
FCC 5GHz RSE Test Procedures	EDCS # 1511600

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Appendix H: Scope of Accreditation (A2LA certificate number 1178-01)

The scope of accreditation of Cisco Systems, Inc. can be found on the A2LA web page at:

https://www.a2la.org/scopepdf/1178-01.pdf

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Appendix I: Test Assessment Plan

Compliance Test Plan (Excel) EDCS# 11633051.

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