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EMC testing of the Tektelic Communication Inc. Smart AC Switch

in accordance with FCC Part 15.247, ANSI C63.4: 2014 and ANSI C63.10: 2013 as referenced by KDB 558074 D01 15.247 Measurement Guidance v05r02.

FCC ID: 2ALEPT0006624

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Prepared for:

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REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2020-04-01	I. Akram	Initial draft submitted for review.
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TABLE OF CONTENTS

1.0	INTR	ODUCTION	٨	5
	1.1		oplicant	
	1.3	Test Samp	ble Description	.5
	1.4	General Te	est Conditions and Assumptions	.5
	1.5	1.5.1 Te 1.5.2 Va 1.5.3 Te	Festing est Methodology ariations in Test Methodology est Sample Verification, Configuration & Modifications ncertainty of Measurement:	.6 .6 .6
2.0	TEST	CONCLUS	SION	7
	2.1	2.1.1 Te 2.1.2 De 2.1.3 Te 2.1.4 Te	Line Conducted Emissions est Guidance: ANSI C63.4-2014, Clause 7.3.1 & ANSI C63.10: 2013 eviations From The Standard: est Equipment est Sample Verification, Configuration & Modifications onducted Emissions Data:	.8 .8 .8 .9
	2.2	2.2.1 Te 558074 DC 2.2.2 De 2.2.3 Te 2.2.4 Te	Occupied Bandwidth (Hybrid Mode)	12 12 12 13
	2.3	2.3.1 Te 558074 D0 2.3.2 De 2.3.3 Te 2.3.4 Te	age Output Power (Hybrid Mode) est Guidance: ANSI C63.10-2013, Clause 11.9.2.2.2, Clause 7.8.5 / 01 15.247 Measurement Guidance v05r02 eviations From The Standard: est Equipment	15 16 16 16
	2.4	2.4.1 Te Measurem 2.4.2 De 2.4.3 Te 2.4.4 Te	ectral Density (Hybrid Mode)	19 19 20 20
	2.5	2.5.1 Te D01 15.24 2.5.2 De 2.5.3 Te 2.5.4 Te	e Attenuation (Hybrid Mode)	4 23 24 24 24

	2.6	2.6.1	ted Spurious Emissions in non-restricted frequency bands (Hybrid Mode) Test Guidance: ANSI C63.10-2013, Clause 6.7, 7.8.8 / 558074 D01 15.2 ement Guidance v05r02 Deviations From The Standard:	247 .27
		2.6.3	Test Equipment	.28
		2.6.4 2.6.5	Test Sample Verification, Configuration & Modifications Conducted Emissions Data: (Hybrid Mode)	
	2.7	Channe 2.7.1	el Separation (Hybrid Mode) Test Guidance: ANSI 63.10 Clause 7.8.2 / 558074 D01 15.247	32
		Measur	ement Guidance v05r02	
		2.7.2 2.7.3	Deviations From The Standard:	
		2.7.3	Test Sample Verification, Configuration & Modifications	
		2.7.5	Channel Separation Data:	
	2.8	Time of	Occupancy (Hybrid Mode)	34
		2.8.1	Test Guidance: ANSI 63.10 Clause 7.8.4 / 558074 D01 15.247	0.4
		2.8.2	ement Guidance v05r02 Deviations From The Standard:	
		2.8.3	Test Equipment	.34
		2.8.4 2.8.5	Test Sample Verification, Configuration & Modifications Dwell Time Data:	
	0.0			
	2.9		sitioning Assessment	
	2.10		ed Spurious Emissions in restricted frequency bands (TX Mode) Test Guidance: ANSI C63.10-2013, Clause 13.4.2	
			Deviations From The Standard:	
		2.10.3	Test Equipment	.39
			Test Sample Verification, Configuration & Modifications Radiated Emissions Data:	
	0 1 1			
			osure	
3.0	TEST	FACILI	ΤΥ	48
	3.1	Locatio	n	48
	3.2	Ground	ing Plan	48
	3.3	Power	Supply	48
Append	lix A (\	Norse E	mission test setup Block Diagram)	49
End of I	Docum	nent		49

1.0 INTRODUCTION

1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.247, ANSI C63.4-2014 and ANSI C63.10-2013 to gain FCC Certification Authorization for Low-Power License-Exempt transmitters. All test procedures, limits, criteria, and results described in this report apply only to the Tektelic Communication Inc. Smart AC Switch test sample, referred to herein as the EUT (Equipment Under Test).

The samples have been provided by the customer.

This report does not imply product endorsement by the Electronics Test Centre, A2LA, nor any Canadian Government agency.

1.2 Applicant

This test report has been prepared for Tektelic Communication Inc., located in Calgary, Alberta, Canada.

1.3 Test Sample Description

As provided to ETC (Airdrie) by Tektelic Communication Inc.:

Product I	Name:	Smart AC Switch
	Frequency Band	902 – 928 MHz
	Type of Modulation	Chirp Spread Spectrum
LoRa	BW/Frequency Range	Hybrid 125kHz, 902.3 – 914.9 MHz
Radio	Associated Antenna	Monopole, 0dBi
	Detachable/Non Detachable	Non-Detachable
	Model#	T0006624
	Serial#	n/a
Power su	ipply:	AC Main

Note: All three channels T0006624 in hybrid mode were evaluated. Worse Channel was selected for detail analysis for radiated emission.

1.4 General Test Conditions and Assumptions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.

In this report, the EUT is only tested for the 125 kHz Hybrid transmission mode. Test results regarding DTS 500 kHz transmission mode is provided in the separate report.

The environmental conditions are recorded during each test and are reported in the relevant sections of this document.

Modulation mode: Hybrid 125 kHz

Hybrid 125 kHz DTS and frequency hopping system, are meets part 15.247's requirements for hybrid system. The channels selected for the test are around **Low: 902.3MHz**, **Mid: 909.4 MHz** and **High: 914.9 MHz** in the frequency range.

1.5 Scope of Testing

Tests were performed in accordance with FCC Part 15.247, ANSI C63.4: 2014, ANSI C63.10: 2013 as referenced in KDB 558074 D01 15.247 Measurement Guidance v05r02.

The EUT was also tested as an unintentional radiator, as reported separately.

1.5.1 Test Methodology

Test methods are specified in the Basic Standard as referenced and/or modified by the Product Standard in the part of Section 2 of this report associated with each particular test case.

1.5.2 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

1.5.3 Test Sample Verification, Configuration & Modifications

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

1.5.4 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document "Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002." as based on the "ISO Guide to the Expression of Uncertainty in Measurement, 1995."

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

Test Method	Uncertainty
Radiated Emissions Level (9 KHz – 1 GHz)	±4.6 dB
Radiated Emissions Level (1 GHz – 26.5 GHz)	±5.31 dB
Conducted Emissions Level (150 KHz – 30 MHz)	±2.7 dB
Uncertainty Conducted Power level	±0.5 dB
Uncertainty Conducted Spurious emission level	±0.6 dB
Uncertainty for Bandwidth test	±1.5 %

2.0 TEST CONCLUSION

STATEMENT OF COMPLIANCE

The customer equipment referred to in this report was found to comply with the requirements, as summarized below.

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

Note: Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

Test Case	Test Type	Specification	Test Sample	Modifications	Config.	Result			
	Frequency Range = 902.3 – 914.9 MHz 125 KHz Hybrid Mode Max. Conducted Tx Power=20.04dBm (0.101) Watt)								
2.1	AC Conducted Emissions (Tx)	15.207	Smart AC Switch	none	see § 2.1	Compliant			
2.2	Occupied Bandwidth	15.247(a)(1) 15.247(2)(2)	Smart AC Switch	none	see § 2.2	Compliant			
2.3	Max Output average Power Conducted	15.247(b)	Smart AC Switch	none	see § 2.3	Compliant			
2.4	Power Spectral Density	15.247(e) 15.247(f)	Smart AC Switch	none	see § 2.4	Compliant			
2.5	Band Edge	15.247(d)	Smart AC Switch	none	see § 2.5	Compliant			
2.6	Conducted Spurious Emission (Non-Restricted Band Operation)	15.247(d)	Smart AC Switch	none	see § 2.6	Compliant			
2.7	Minimum channel separation	15.247(a)(1)	Smart AC Switch	none	see § 2.7	Compliant			
2.8	Average time of Occupancy for hybrid System	15.247(f)	Smart AC Switch	none	see § 2.8	Compliant			
2.9	EUT Position	ANSI C63.4	Smart AC Switch	none	see § 2.9	Assessed			
2.10	Radiated Spurious Emission (Restricted Band Operation) (Tx Mode)	15.205, 15.209 15.247(d)	Smart AC Switch	none	see § 2.10	Compliant			
2.11	RF Exposure	15.247(i)	Smart AC Switch	none	see § 2.11	Exempt			

Refer to the test data for applicable test conditions.

2.1 AC Power Line Conducted Emissions

Test Lab: Electronics Test Centre, Airdrie	EUT Smart AC Switch		
Test Personnel: David Szczesniak / Imran Akram	Standard: FCC Part 15.207 Basic Standard: ANSI C63.10: 2013		
Date: 2020-03-25 (21.5°C,12.6% RH)	Dasic Standard, ANSI C03.10, 2013		

EUT status: Compliant

Comments:

Specification: Part15-207

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)			
0.15 – 0.5	66 – 56	56 – 46			
0.5 – 5	56	46			
5 – 30	60	50			
Oritaria. The sea dusted enviseing an dused by a device shell not even ad the limits as an eified					

Criteria: The conducted emissions produced by a device shall not exceed the limits as specified.

2.1.1 Test Guidance: ANSI C63.4-2014, Clause 7.3.1 & ANSI C63.10: 2013

Before any testing is performed, the Ambient (measurement noise floor) is recorded, and a QC check is performed to show that the system is functioning correctly.

Testing starts with a scan, performed under software control. After this is complete, the list of frequencies of interest is generated. These frequencies are then investigated for quasi-peak and average amplitude, as applicable. Emissions measured with a QP detector that fall below the Average limit are deemed to meet both requirements.

2.1.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.1.3 Test Equipment

Testing was performed with the following equipment:

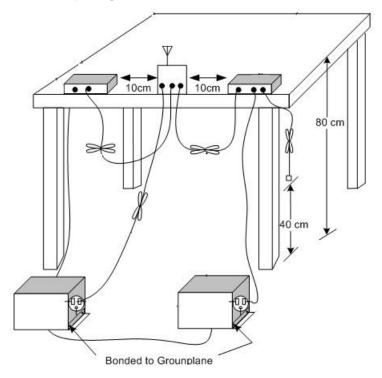
Equipment Manufacturer		Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
EMC Software	UL	Ver. 9.5	ETC-SW- EMC 2.1	N/A	N/A
MXE EMI Receiver	Keysight	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
LISN	Com-Power	LI-215A	6180	2018-06-06	2020-06-06
Temp/RH logger	Extech	42270	5892	2019-04-05	2020-04-05

2.1.4 Test Sample Verification, Configuration & Modifications

The EUT was set to selected channels with test-specific software. The output was modulated as in normal operation. Configuration in Tx mode.

The EUT met the requirements without modification.

Test setup diagram:



2.1.5 Conducted Emissions Data:

The EUT was evaluated in all transmit mode. No mode of transmission showed emission worst then another. The plots are from the DSS mode using Low-channel.

FCC Part 15.247

902 – 928 MHz

Freq. Marker	Freq. (MHz)	Raw reading (dBµv)	Det.	LISN Factor (dB)	Cable Loss (dB)	Corrected Reading (dBµV)	FCC 15.207 AV Limit (dBµV)	Delta (dB)	L/N
1	0.15023	52.68	AV	.1	.1	52.88	55.99	-3.11	Line
2	0.15875	51.89	AV	.1	.1	52.09	55.53	-3.44	Line
3	0.17891	49.53	AV	.1	.1	49.73	54.54	-4.81	Line
4	0.19296	48.25	AV	.1	0	48.35	53.91	-5.56	Line
5	0.20837	46.62	AV	0	0	46.62	53.27	-6.65	Line
6	0.23736	44.65	AV	0	.1	44.75	52.19	-7.44	Line
7	0.258	43.97	AV	0	0	43.97	51.5	-7.53	Line
8	0.291	43.83	AV	0	.1	43.93	50.5	-6.57	Line
9	0.3297	41.15	AV	0	.1	41.25	49.46	-8.21	Line
10	0.37782	38.43	AV	0	0	38.43	48.33	-9.9	Line
11	0.42087	38.58	AV	0	.1	38.68	47.43	-8.75	Line
1	0.15008	52.64	AV	.1	.1	52.84	56	-3.16	Neutral
2	0.1584	51.64	AV	.1	.1	51.84	55.55	-3.71	Neutral
3	0.17842	49.37	AV	.1	.1	49.57	54.56	-4.99	Neutral
4	0.19295	47.69	AV	.1	0	47.79	53.91	-6.12	Neutral
5	0.22107	45.71	AV	0	.1	45.81	52.78	-6.97	Neutral
6	0.23788	44.65	AV	0	.1	44.75	52.17	-7.42	Neutral
7	0.28344	41.29	AV	0	.1	41.39	50.71	-9.32	Neutral
8	0.3205	42.38	AV	0	.1	42.48	49.69	-7.21	Neutral
9	0.35414	41.71	AV	0	0	41.71	48.86	-7.15	Neutral

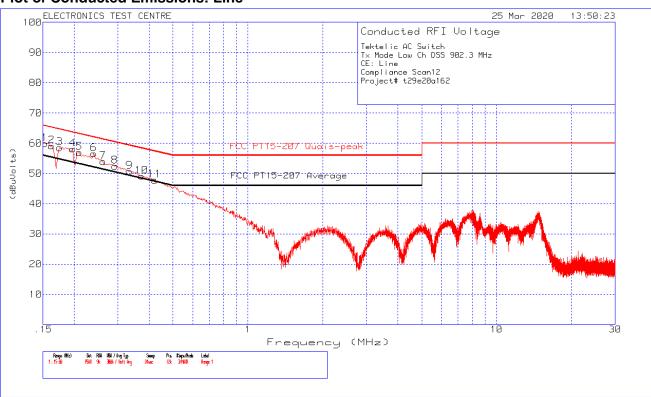
AV = Average Detector

Raw Reading in dB μ V + LISN FactordB + Gain/Loss Factor in dB = Corrected Field Strength in db μ V.

Note: When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.

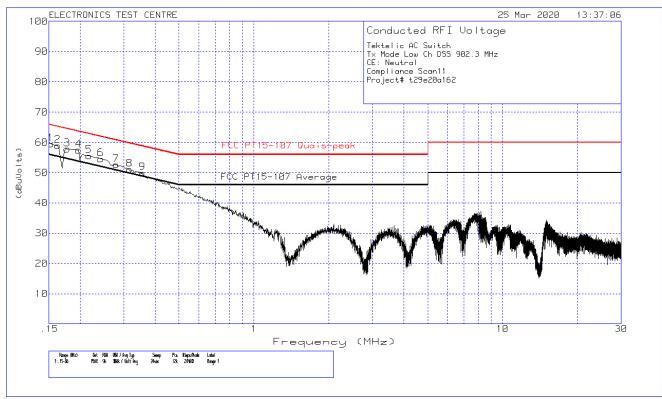
Negative values for Delta indicate compliance.

The Ground Bond was measured and found to be 1.25 m Ω .



Plot of Conducted Emissions: Line

Plot of Conducted Emissions: Neutral



2.2 Channel Occupied Bandwidth (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie	EUT: Smart AC Switch
Test Personnel: Bushra Muharram/I.	Standard: FCC PART 15.247
Date: 2020-03-17 (20.1°C,10.7% RH)	Basic Standard: ANSI C63.10-2013

EUT status: Compliant

Specification: FCC 15.215 (c)

Criteria: For hybrid system there is no limit for the 20dB or 99% bandwidth.

2.2.1 Test Guidance: ANSI C63.10-2013, Clause 6.9.2, 6.9.3 &7.8.7 / KDB 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Use the following s	Use the following spectrum analyzer settings:				
Span	between two times and five times the channel center frequency OBW				
RBW	1% to 5% of the OBW				
VBW	approximately three times RBW				
Sweep	auto				
Detector function	peak				
Trace max hold					
Allow the trace to stabilize. The automated 99% BW function of the spectrum analyzer is engaged, 20 dB OBW is measured with the x dB function.					

2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.2.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.2.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation.

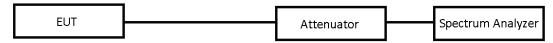
The EUT modified to provide the direct access to antenna port for conducted measurements.

For compliance purposes EUT met requirements without any modification

There is no Deviation and exclusions from test specifications.

Test setup diagrams for Occupied Bandwidth testing:

Conducted:



2.2.5 Channel Occupied Bandwidth Data: (Hybrid Mode) LoRa 125 KHz Channels

Channel	Freq. [MHz]	20 dB OBW [kHz]	99% OBW [KHz]
Low	902.3	138.3	128.26
Mid	908.5	138.6	128.08
High	914.9	138.8	128.30

Screen

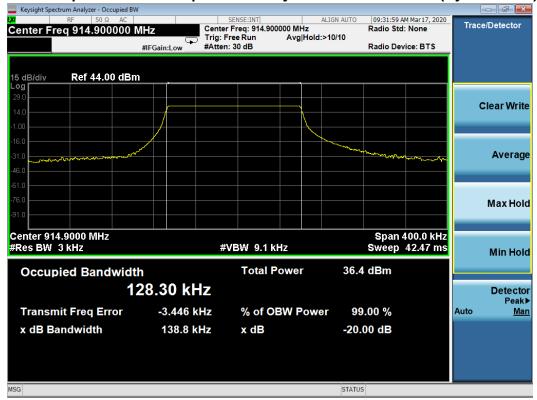
captures from the spectrum analyzer 125 KHz Channel (Hybrid Mode)



Screen captures from the spectrum analyzer 125 KHz Channel (Hybrid Mode)



Screen captures from the spectrum analyzer 125 KHz Channel (Hybrid Mode)



2.3 Max Average Output Power (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie	EUT: Smart AC Switch
Test Personnel: Bushra Muharram	Standard: FCC PART 15.247
Date: 2020-03-17 (20.1°C,10.7% RH)	Basic Standard: ANSI C63.10: 2013

EUT status: Compliant

Specification: FCC Part 15.247(b, 2)

Criteria For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels

2.3.1 Test Guidance: ANSI C63.10-2013, Clause 11.9.2.2.2, Clause 7.8.5 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Output Power Method AVGSA-1			
Span	≥ 1.5 times the OBW		
RBW $1-5\%$ of the OBW, ≤ 1 MHz			
VBW	≥ 3 x RBW		
Number of Points in sweep	≥ 2 x Span / RBW		
Sweep time	Auto		
Detector	RMS (Power Averaging)		
Sweep trigger	Free Run (Duty Cycle ≥98%)		
Trace Average	100 traces in power Averaging (RMS)		
Power measured	Integrated the spectrum across the OBW of the signal using the S/A band power measurement function, with band limit set equal to the OBW band edge.		

2.3.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.3.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.3.4 Test Sample Verification, Configuration & Modifications

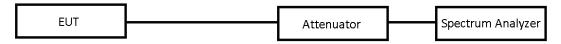
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT modified to provide the direct access to antenna port for conducted measurements.

For compliance purposes EUT met requirements without any modification

Test setup diagrams for Peak Power testing:

Conducted:

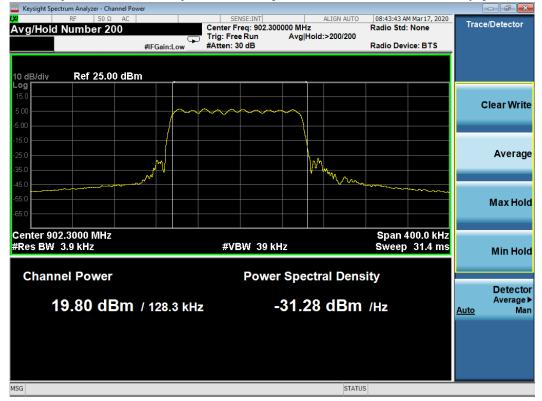


2.3.5 Average Output Power Data (Hybrid Mode)

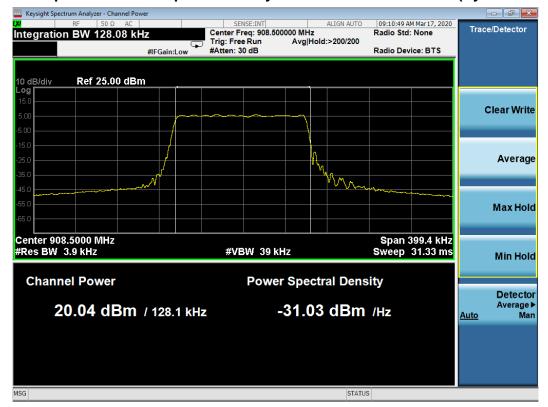
Lora 125 KHz

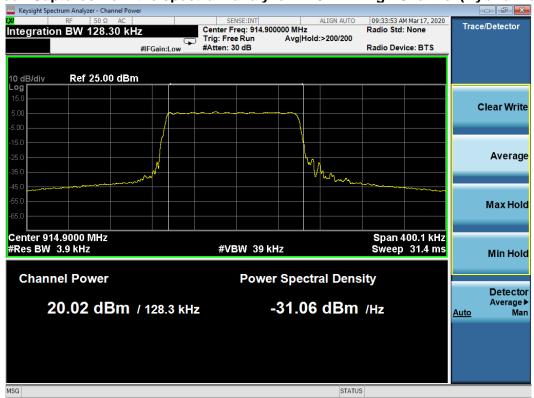
Channel	Freq. [MHz]	Out Put Power (dBm)	Out Put Power Limit (dBm	Margin (dB)
Low	902.3	19.80	30	10.2
Mid	908.5	20.04	30	9.96
High	914.9	20.02	30	9.98

Screen Captures from the spectrum analyzer: 125 KHz Low Channel (Hybrid Mode)



Screen Captures from the spectrum analyzer: 125 KHz MID Channel (Hybrid Mode)





Screen Captures from the spectrum analyzer: 125 KHz High Channel (Hybrid Mode)

2.4 Power Spectral Density (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Bushra Muharram

Date: 2020-03-17 (20.1°C,10.7% RH)

EUT: Smart AC Switch Standard: FCC PART 15.247 Basic Standard: ANSI C63.10: 2013

EUT status: Compliant

Specification: FCC Part 15.247(f)

Criteria For Hybrid system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

2.4.1 Test Guidance: ANSI C63.10-2013, Clause 11.10.3 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed at low, mid and high frequencies, in continuous transmission, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Use the following spectrum analyzer settings:			
Span	At least 1.5 times the OBW channel center frequency.		
RBW	Set RBW to: 3		
VBW	Set VBW ≥ 3 × RBW].		
Sweep	auto		
Detector function	Power averaging (RMS) or sample detector (when RMS not available).		
Trace Employ trace averaging (rms) mode over a minimum of 100 traces.			
Ensure that the number of measurement points in the sweep $\geq [2 \times \text{span} / \text{RBW}]$. Allow the			

trace to stabilize. Use the peak marker function to determine the maximum amplitude level.

2.4.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.4.3 Test Equipment

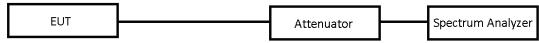
Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.4.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagrams for Peak Power Spectral Density testing: Conducted:

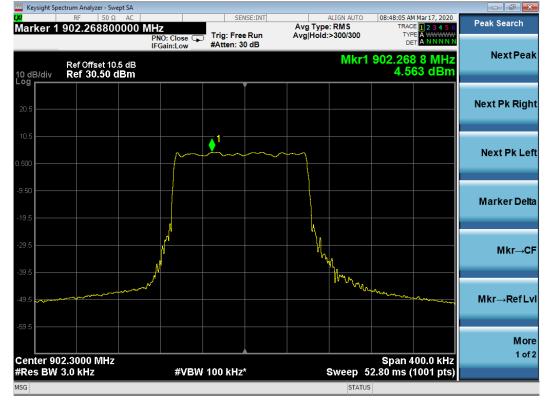


2.4.5 Peak PSD Data (Hybrid Mode)

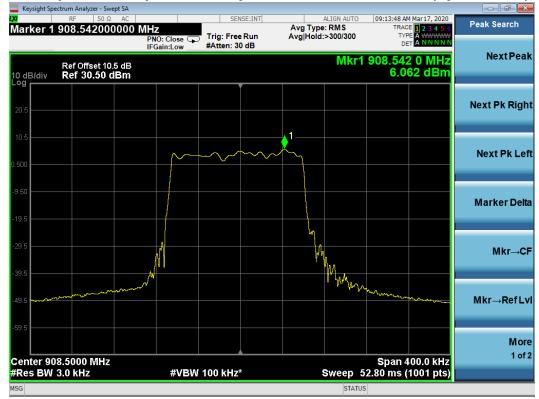
125 KHz Channels

Channel	Freq. [MHz]	PSD (dBm/3kHz)	PSD Limit (dBm/3kHz)
Low	902.3	4.563	8
Mid	908.5	6.062	8
High	914.9	5.907	8

Screen Capture from Spectrum Analyzer: 125 KHz Channel LOW (Hybrid Mode)



Screen Capture from Spectrum Analyzer: 125 KHz Channel MID (Hybrid Mode)



Screen Capture from Spectrum Analyzer: 125 KHz Channel High (Hybrid Mode)



2.5 Band Edge Attenuation (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie	EUT: Smart AC Switch
Test Personnel: Imran Akram/B. Muharram	Standard: FCC PART 15.247
Date: 2020-03-17 (20.1°C,10.7% RH)	Basic Standard: ANSI C63.10: 2013

EUT status: Compliant

Specification: FCC Part 15.247(d)

Criteria: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.209(a) (see §15.205(c)).

2.5.1 Test Guidance: ANSI C63.10-2013 Clause 6.10.4, 6.10.6 & 7.8.6 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed at the low and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Use the following s	Use the following spectrum analyzer settings:			
Span	Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.			
Attenuation	Auto (at least 10 dB preferred).			
RBW	100 kHz			
VBW	300 kHz			
Sweep	Coupled			
Detector function	peak			
Trace	max hold			
Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.				

2.5.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.5.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.5.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagrams for Band Edge Attenuation testing:

Conducted:



2.5.5 Band Edge Data (Hybrid Mode)

Modulation	Channel	Attenuation at Band Edge	Attenuation Limit at Band Edge
Lora 125KHz Channels	902.3	49.891 dBc	30 dBc
(Non Hopping)	914.9	71.993 dBc	30 dBc
Lora 125KHz Channels	902.3	56.073 dBc	30 dBc
(Hopping)	914.9	71.770 dBc	30 dBc

Screen Capture from the spectrum analyzer: Lower Band Edge (125 KHz)



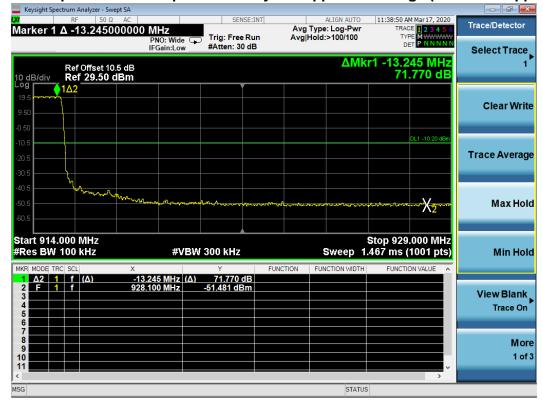
Screen Capture from the spectrum analyzer: Upper Band Edge (125 KHz)

₩ RF 50 Ω AC Marker 1 Δ -13.243500000) MHz	Avg Type: Log-Pwr	09:41:27 AM Mar 17, 2020 TRACE 1 2 3 4 5 6	Trace/Detector
	PNO: Wide Trig: Free Ru IFGain:Low #Atten: 30 dl	3		Select Trace
Ref Offset 10.5 dB 10 dB/div Ref 29.50 dBm		ΔMkr	1 -13.243 5 MHz 71.993 dB	1
Log 19.5 9.50				Clear Write
-0.50			DL1 -9.98 dBm	Trace Average
-30.5	And a	and the second	~~~X2~~~~~~	Max Hold
^{-80.5} Start 914.500 MHz #Res BW 100 kHz	#VBW 300 kHz	Sweep 1	Stop 930.000 MHz I.533 ms (1001 pts)	Min Hold
	243 5 MHz (Δ) 71.993 dB 100 0 MHz -51.869 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	
3 4 5 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				View Blank Trace On
7 8 9 9 9 10 10 10 10 10 10 10 10 10 10 10 10 10				More 1 of 3
< MSG		STATU	s	

Screen Capture from the spectrum analyzer: Lower Band Edge (125 KHz Hopping)



Screen Capture from the spectrum analyzer: Upper Band Edge (125 KHz Hopping)



2.6 Conducted Spurious Emissions in non-restricted frequency bands (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Bushra Muharram Date: 2020-03-17 (20.1°C,10.7% RH) EUT: Smart AC Switch Standard: FCC PART 15.247 Basic Standard: ANSI C63.10-2013

EUT status: Compliant

Specification: FCC Part 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

2.6.1 Test Guidance: ANSI C63.10-2013, Clause 6.7, 7.8.8 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed at the low, mid and high frequencies, with modulation. The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Use the following spectrum analyzer settings:							
Span	Set the center frequency and span to encompass frequency range to be measured.						
RBW	100 kHz						
VBW	300 kHz						
Sweep	Auto Coupled						
Detector function	peak						
Trace	max hold						
Allow the trace to	stabilize. Use the peak marker function to determine the maximum amplitude						

Allow the trace to stabilize. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in

2.6.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.6.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Equipment Manufacturer		Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.6.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

The EUT modified to provide the direct access to antenna trace for conducted measurements.

Test setup diagram for Conducted Spurious Emissions testing:

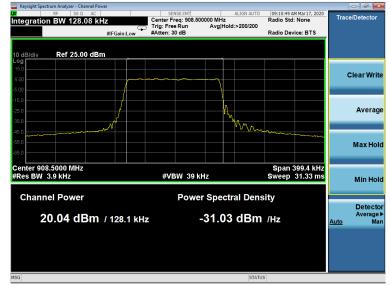


2.6.5 Conducted Emissions Data: (Hybrid Mode) 125 KHz Low Channel



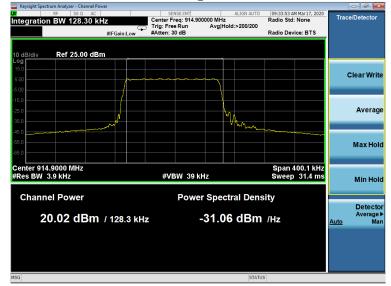
LXI		- Spurious Emissions -0 Ω A DC - 50 IFGair	Center Freq: 90 Trig: Free Run #Atten: 30 dB		08:57:57 AM Mar17, 2020 Radio Std: None Radio Device: BTS 89.949 KHz	Range Table Range Table	<mark>x</mark> Ref Valu		r - Spurious Emissions 50 Ω AC IBM IFGain:L	Trig: Free Ru	902.300000 MHz in Avg Hold:>50/	Radio Std: None	Range Table
15 dB/div		set 10.5 dB 5 .00 dBm			-55.440 dBm	<u>On</u> Off	15 dB/div	Ref Of	fset 11.5 dB 6.00 dBm			20.963 dB	
-20.0						Start Freq 30.000 kHz	41.0 26.0						Start Freq 30.000000 MHz
-35.0 -50.0 -65.0						Stop Freq 30.000000 MHz	-4.00 -19.0 -34.0						Stop Freq 10.000000000 GHz
-80.0 -95.0 -110						Res BW 10.000 kHz Auto <u>Man</u>	-49.0 -64.0 -79.0						Res BW 100.00 kHz Auto <u>Man</u>
Start 30	kHz				Stop 30 MHz FFT	30.000 kHz	Start 30	MHz				Stop 10 Gł	Z Video BW 300.00 kHz
Spur	Range	Frequency	Amplitude	Limit	Δ Limit	Auto <u>Man</u>	Spur	Range	Frequency	Amplitude	Limit	∆ Limit	Auto <u>Man</u>
1 2 3	1 1 1	<mark>89.95 kHz</mark> 132.8 kHz 167.0 kHz	-49.31 dBm -52.93 dBm -56.14 dBm	-10.20 dBm - -10.20 dBm -	39.11 dB △ 42.73 dB 45.94 dB	Filter Type Gaussian	1 2 3	2 2 2	902.4 MHz 1.805 GHz 2.707 GHz	20.95 dBm -32.19 dBm -42.33 dBm	-10.20 dBm -10.20 dBm -10.20 dBm	31.15 dB -21.99 dB -32.13 dB	Filter Type Gaussian
4	1	5.100 MHz	-57.30 dBm		47.10 dB		4	2	2.556 GHz	-46.43 dBm	-10.20 dBm	-36.23 dB	
5 6 7	1 1 1	197.0 kHz 286.9 kHz 423.9 kHz	-57.52 dBm -61.75 dBm -62.11 dBm	-10.20 dBm -	47.32 dB 51.55 dB 51.91 dB	More 1 of 3	5 6 7	2 2 2	3.184 GHz 3.015 GHz 3.602 GHz	-46.72 dBm -46.76 dBm -47.02 dBm	-10.20 dBm -10.20 dBm -10.20 dBm	-36.52 dB -36.56 dB -36.82 dB	More 1 of 3
MSG				STAT	rus 1 DC Coupled		MSG					STATUS	

125 KHz MID Channel



LXI		ter - Spurious Emissions 50 Ω <u>Δ</u> DC	SENSE:IN Center Freq: S	NT ALIGN AUTO 908.500000 MHz	09:19:09 AM Mar 17, 2020 Radio Std: None	Range Table	(XI		r - Spurious Emissions 50 Ω AC JBm		: 908.500000 MHz	Radio Std:	Mar 17, 2020	Range Table
PASS			n:Low Trig: Free Run #Atten: 30 dB		Radio Device: BTS	Range	PASS		IFGain:	Low Trig: Free R #Atten: 30 d		50 Radio Devi	ice: BTS	Range
15 dB/d		offset 10.5 dB 26.00 dBm			128.49 kHz -56.126 dBm	0n Off	15 dB/div		ffset 11.5 dB 57.00 dBm				40 MHz 00 dBm	2 <u>On</u> Off
Log 11.0 -4.00 -19.0						Start Freq 30.000 kHz	42.0 27.0 12.0	1						Start Freq 30.000000 MHz
-34.0 -49.0 -64.0						Stop Freq 30.000000 MHz	-3.00 -18.0 -33.0							Stop Freq 10.000000000 GHz
-79.0 -94.0 -109						Res BW 10.000 kHz Auto <u>Man</u>	-48.0 -63.0 -78.0	~ <u>k</u> ~~~~						Res BW 100.00 kHz Auto <u>Man</u>
Start :	30 kHz		Ŷ		Stop 30 MHz FFT	Video BW 30.000 kHz	Start 30	MHz				Sto	p 10 GHz	Video BW 300.00 kHz
Spu	r Range	Frequency	Amplitude	Limit	Δ Limit	Auto <u>Man</u>	Spur	Range	Frequency	Amplitude	Limit	Δ Limit		Auto <u>Man</u>
1 2 3 4	1 1 1 1	128.5 kHz 72.82 kHz 227.0 kHz 5.100 MHz	-52.16 dBm -54.81 dBm -54.91 dBm -59.36 dBm	-9.960 dBm - -9.960 dBm -	42.20 dB ^ 44.85 dB 44.95 dB 49.40 dB	Filter Type Gaussian	1 2 3 4	2 2 2 2	908.4 MHz 1.817 GHz 2.726 GHz 3.053 GHz	21.01 dBm -30.17 dBm -41.71 dBm -46.37 dBm	-9.960 dBm -9.960 dBm -9.960 dBm -9.960 dBm	30.97 dB -20.21 dB -31.75 dB -36.41 dB	^	Filter Type Gaussian
5 6 7	1 1 1	252.7 kHz 13.77 MHz 21.26 MHz	-59.81 dBm -63.50 dBm -63.82 dBm	-9.960 dBm - -9.960 dBm -	49.85 dB 53.54 dB 53.86 dB	More 1 of 3	5 6 7	2 2 2 2	2.973 GHz 3.595 GHz 3.753 GHz	-47.05 dBm -47.33 dBm -47.45 dBm	-9.960 dBm -9.960 dBm -9.960 dBm	-37.09 dB -37.37 dB -37.49 dB	~	More 1 of 3
MSG				STAT	us 🚺 DC Coupled	-	MSG					STATUS		

125 KHz High Channel



LXI		- Spurious Emissions 50 ହ <u>ଲ</u> DC B M	SENSE:INT Center Freq: 91		09:44:09 AM Mar 17, 2020 Radio Std: None			X		- Spurious Emissions 50 Ω AC IBM		914.900000 MHz	Radio Std: None		Range Table
PASS		IFGain:	_ow Trig: Free Run #Atten: 30 dB	Avg Hold:>50/50	Radio Device: BTS	F	Range	PASS		IFGain:L	_ow Trig: Free R #Atten: 30 d		0 Radio Device: B	тѕ	Range
15 dB/div		set 10.5 dB 7.00 dBm			115.64 kHz -56.357 dBm	<u>On</u>		15 dB/div	Ref Of Ref 5	fset 11.5 dB 8.00 dBm			914.88 I 21.081 d		2 <u>On</u> Off
Log 12.0 -3.00 -18.0							rt Freq 000 kHz	43.0 28.0 13.0	1						Start Freq 30.000000 MHz
-33.0 -48.0 -63.0						Stoj 30.0000	p Freq 00 MHz	-2.00 -17.0 -32.0							Stop Freq 10.00000000 GHz
-78.0 -93.0 -108						Re 10.0 Auto	es BW 000 kHz <u>Man</u>	-47.0 -62.0 -77.0							Res BW 100.00 kHz Auto <u>Man</u>
Start 3) kHz				Stop 30 MHz FFT	Vide	eo BW 000 kHz	Start 30	MHz	^			Stop 10	GHz	Video BW 300.00 kHz
Spur	Range	Frequency	Amplitude	Limit	Δ Limit	Auto	Man	Spur	Range	Frequency	Amplitude	Limit	∆ Limit		Auto <u>Man</u>
1 2 3 4	1 1 1	115.6 kHz 179.9 kHz 77.10 kHz 5.100 MHz	-51.73 dBm -52.33 dBm -55.71 dBm -58.61 dBm	-9.980 dBm -4 -9.980 dBm -4	41.75 dB ^ 42.35 dB 45.73 dB 48.63 dB	Filter Gau	Type Issian ►	1 2 3 4	2 2 2 2	914.9 MHz 1.830 GHz 2.744 GHz 3.056 GHz	21.08 dBm -29.16 dBm -43.26 dBm -45.08 dBm	- <mark>9.980 dBm</mark> -9.980 dBm -9.980 dBm -9.980 dBm	31.06 dB -19.18 dB -33.28 dB -35.10 dB	^	Filter Type Gaussian
5 6 7	1 1 1	398.3 kHz 13.77 MHz 21.53 MHz	-63.20 dBm -63.28 dBm -64.60 dBm	-9.980 dBm -5 -9.980 dBm -5	53.22 dB 53.30 dB 54.62 dB		More 1 of 3	5 6 7	2 2 2 2	3.155 GHz 3.659 GHz 2.441 GHz	-45.50 dBm -45.67 dBm -45.89 dBm	-9.980 dBm -9.980 dBm -9.980 dBm	-35.52 dB -35.69 dB -35.91 dB	Ŷ	More 1 of 3
MSG				STAT	us 🚹 DC Coupled		N	ISG					STATUS		

2.7 Channel Separation (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie	EUT: Smart AC Switch
Test Personnel: Bushra Muharram	Standard: FCC Part 15.247
Date: 2020-03-17 (20.1°C,10.7% RH)	Basic Standard: ANSI C63.10: 2013

EUT status: Compliant

Specification: FCC Part 15.247(a, 1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

2.7.1 Test Guidance: ANSI 63.10 Clause 7.8.2 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed with the EUT transmitter frequency hopping function active.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

The spectrum analyzer is set for a frequency span wide enough to capture at least two adjacent channels. The RBW is set to at least 1% of the span. The Peak detector is used, with the trace set to Max Hold. Channel Separation is displayed with the Marker Delta function.

2.7.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

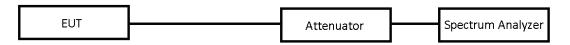
2.7.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Manufacturer Model # Asset #		Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.7.4 Test Sample Verification, Configuration & Modifications

EUT configuration for Channel Separation testing:



2.7.5 Channel Separation Data:

Compliant: The channel separation measured for this device is 200 kHz.

Screen Captures from the spectrum analyzer: Hybrid 125 KHz

🔤 Keysight Spe	ectrum Analyzer - Swept SA					
<mark>X</mark> Marker 1	RF 50 Ω AC Δ 200.000000 k	Hz	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	11:55:21 AM Mar 17, 2020 TRACE 1 2 3 4 5 6	Trace/Detector
	A 200.000000 K	PNO: Wide IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Hold:>100/100	DET PNNNN	Select Trace
10 dB/div Log	Ref Offset 10.5 dB Ref 29.50 dBm				ΔMkr1 200 kHz 0.123 dB	1
19.5				1Δ2		Clear Write
9.50			X2			
-0.50						Trace Average
-10.5						_
-20.5						Max Hold
-30.5						
-40.5						Min Hold
-50.5						View Blank
-60.5						Trace On
						More 1 of 3
Center 90 #Res BW	8.0000 MHz 100 kHz	#VBW	300 kHz	Sweep 1	Span 1.000 MHz .000 ms (1001 pts)	
MSG				STATUS		

2.8 Time of Occupancy (Hybrid Mode)

Test Lab: Electronics Test Centre, Airdrie	EUT: Smart AC Switch
Test Personnel: Bushra. Muharram	Standard: FCC PART 15.247
Date: 2020-03-17 (20.1°C,10.7% RH)	Basic Standard: ANSI C63.10: 20013

EUT status: Compliant

Specification: FCC Part 15.247 (f)

The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4

2.8.1 Test Guidance: ANSI 63.10 Clause 7.8.4 / 558074 D01 15.247 Measurement Guidance v05r02

This measurement is performed with the EUT frequency hopping function active.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

The spectrum analyzer is set for Peak detection over a 0 Hz frequency span (time domain) centered on a hopping channel. The RBW shall be \leq Channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel. VBW \geq RBW. The sweep time is adjusted to clearly capture one transmission. The Dwell time is measured with the Marker Delta function.

Another sweep is set to capture enough transmission events to calculate the number of events within the specified period of time. The Peak detector is used, with the trace set to Max Hold.

2.8.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.8.3 Test Equipment

Testing was performed with the following equipment:

2.8.4 Test Sample Verification, Configuration & Modifications

The EUT was operating in normal mode. The EUT met the requirements without modification.

EUT configuration for Dwell Time testing:

EUT	Attenuator		Spectrum Analyzer
-----	------------	--	-------------------

2.8.5 Dwell Time Data:

Measured Dwell time = 370.8 ms

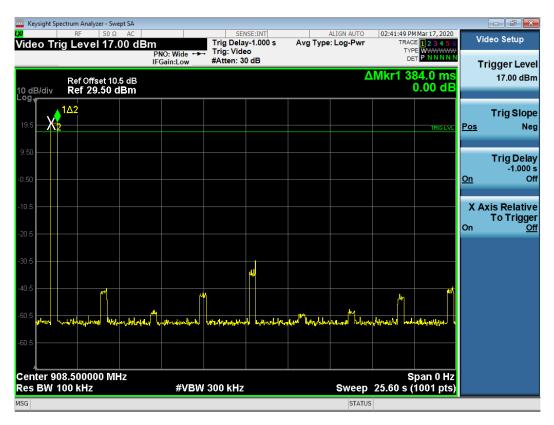
Window of measurement is equal to number of hopping channels multiple by $400ms = 0.4 \times 64 = 25.6Sec$

Number of events in 25.6Sec = 1

Margin = 400 - 370.8 = 29.2 ms

🔤 Keysight Spectrum Analyzer - Swept SA - -ALIGN AUTO 03:23:01 PM Mar 17, 2020 Video Setup TRACE 1 2 3 4 5 (TYPE WWWWW DET P NNNN Video Trig Level 17.00 dBm Trig Delay-100.0 ms Avg Type: Log-Pwr Trig: Video #Atten: 30 dB PNO: Fast ++-IFGain:Low Trigger Level ΔMkr1 370.8 ms 17.00 dBm Ref Offset 10.5 dB Ref 29.50 dBm -0.05 dB 10 dB/div 1Δ2 Trig Slope X Pos Neg Trig Delay -100.0 ms <u>On</u> Of X Axis Relative To Trigger On A MARINE es also Center 908.500000 MHz Span 0 Hz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 600.0 ms (1001 pts) MSG STATUS

Screen Capture from the spectrum analyzer: Dwell time in 600ms



Screen Capture from the spectrum analyzer: Dwell Time in 25.6 Sec

2.9 EUT Positioning Assessment

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Bushra Muharram/I. Akram Date: 2020-02-12 (20.9°C.13.8% RH) EUT: Smart AC Switch Standard: FCC PART 15.247 Basic Standard: ANSI C63.4-2014

Not Applicable

Comments: EUT be installed in a fix one orientation

Specification: ANSI C63.4-2014, Clause 6.3.2.1

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs (see Figure 6, Figure 7, and Figure 9). For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

2.10 Radiated Spurious Emissions in restricted frequency bands (TX Mode)

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: David Szczesniak /

Imran Akram

Standard: FCC PART 15.247 Basic Standard: ANSI C63.10-2013

EUT: Smart AC Switch

Date: 2020-03-26/27/31 (20.1°C,10.7 % RH)

EUT status: Compliant

Specification: FCC PART 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.10.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

From 9 kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discrete increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 - 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

2.10.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.10.3 Test Equipment

Testing was performed with the following equipment:

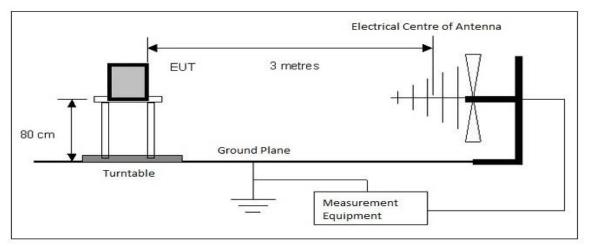
Equipment	Manufacturer	Model # Asset #		Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)	
EMC Software	Software UL Ver. 9.5		ETC-SW-EMC 2.1	N/A		
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2019-05-10	2020-05-10	
Loop Antenna	EMCO	6502	10868	2019-04-11	2021-04-11	
Biconilog Antenna	ARA	LPB-2520/A	4318	2018-09-19	2020-09-19	
DRG Horn	EMCO	3115	19357	2018-09-12	2020-09-12	
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2019-04-05	2020-04-05	
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800- 21-5P	4354	2020-01-03	2021-01-03	
Pre-Amplifier (30 – 1300 MHz)	HP	8447D	9291	2020-01-03	2021-01-03	
RE Cable below 1GHz	Insulated Wire Inc.	KPS-1501A- 3600-KPA- 01102006	4419	2020-01-03	2021-01-03	
Re Cable Above 1 GHz	A.H. System Inc.	SAC-26G-8.23	6187	2020-01-03	2021-01-03	
High Pass Filter	K&L	4DH21	-	2020-01-03	2021-01-03	

2.10.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

Test setup diagram for Radiated Spurious Emissions testing (below 1GHz):



Above 1GHz, the EUT is raised using a low permittivity material (polystyrene) to a height of 1.5m.

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

FCC Part 15.205 Restricted Bands of Operation:

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz, ² Above 38.6

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in 15.209 shall be demonstrated based on the average value of the measured emissions.

Specification: FCC15.209 Radiated emission limits.

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)	
0.009 - 0.490	2400 / F(KHz)	300	
0.490 - 1.705	24000 / F(KHz)	30	
1.705 - 30.0	30	30	
30 - 88	100	3	
88 – 216	150	3	
216 - 960	200	3	
Above 960	500	3	

2.10.5 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Meter Reading in $dB_{\mu}V$ + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in $db_{\mu}V/m$. Delta = Field Strength - Limit

Notes:

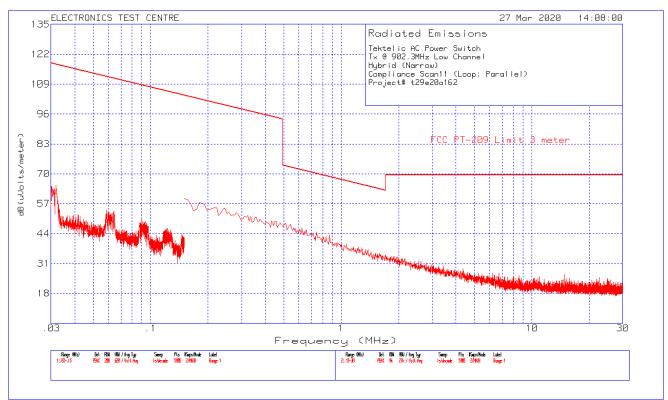
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discrete increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- Preliminary scans were performed for all channels in Transmit modes. The Low band channel 902.3 MHz was selected as the worst-case condition for detailed examination.
- In Transmit mode, the EUT was assessed up to 10.0 GHz.

Negative values for Delta indicate compliance.

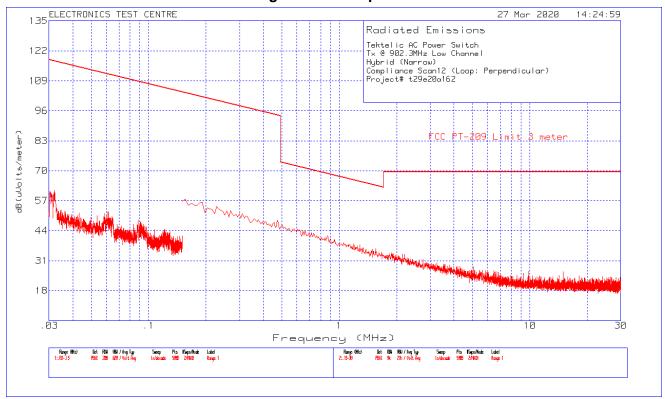
			Raw		Antenna	Pre amp	Corrected	FCC 15.209				
	Freq.	Freq.	reading		Factor	Gain	Reading	Limit	Delta	Azimuth	Height	
Band	Marker	[MHz]	[dBµv]	Det	[dB/m]	[dB]	[dBµv/m]	[dBµv/m]	[dB]	[Deg]	[cm]	Polarization
					Freq	luency Rai	nge 30 – 100	00 MHz				
NRB	1	78.112	43.43	QP	10.6	-23.9	30.13	40	-9.87	287	124	Vertical
					Frequ	iency Rang	ge 1400 – 36	600 MHz				
RB	1	2707.0	54.37	AV	29.6	-33.9	50.07	54	-3.93	197	104	Horizontal
RB	2	2707.0	57.51	PK	29.6	-33.9	53.21	74	-20.79	197	104	Horizontal
RB	2	2707.0	48.68	AV	29.6	-33.9	44.38	54	-9.62	185	199	Vertical
RB	2	2707.0	51.06	PK	29.6	-33.9	46.76	74	-7.24	185	199	Vertical
					Frequ	ency Rang	je 3600 – 10	000 MHz				
RB	1	3609.2	52.34	AV	31.5	-32.8	51.04	54	-2.96	204	216	Horizontal
RB	1	3609.2	54.49	PK	31.5	-32.8	53.19	74	-20.81	204	216	Horizontal
RB	2	4511.5	47.88	AV	32.4	-32.4	47.88	54	-6.12	209	252	Horizontal
RB	2	4511.5	50.51	PK	32.4	-32.4	50.51	74	-23.49	209	252	Horizontal
RB	3	5413.5	37.46	AV	34	-30.6	40.86	54	-13.14	11	200	Horizontal
RB	3	5413.5	44.22	PK	34	-30.6	47.62	74	-26.38	11	200	Horizontal
RB	4	8120.7	34.15	AV	36.7	-26.1	44.75	54	-9.25	298	182	Horizontal
RB	4	8120.7	40.01	PK	36.7	-26.1	50.61	74	-23.39	298	182	Horizontal
RB	5	3609.2	52.23	AV	31.5	-32.8	50.93	54	-3.07	147	149	Vertical
RB	5	3609.2	53.93	PK	31.5	-32.8	52.63	74	-21.37	147	149	Vertical
RB	6	4511.4	48.24	AV	32.4	-32.4	48.24	54	-5.76	167	271	Vertical
RB	6	4511.4	50.87	PK	32.4	-32.4	50.87	74	-23.13	167	271	Vertical
RB	7	5413.5	37.87	AV	34	-30.6	41.27	54	-12.73	148	207	Vertical
RB	7	5413.5	44.34	PK	34	-30.6	47.24	74	-26.26	148	207	Vertical
RB	8	8120.8	31.94	AV	36.37	-26.1	42.54	54	-11.46	32	180	Vertical
RB	8	8120.8	38.79	PK	36.7	-26.1	49.39	74	-24.61	32	180	Vertical
A A		Dataatar								_		

Av: Average Detector, PK: Peak Detector ***** Restricted Band (RB), Non Restricted Band (NRB)

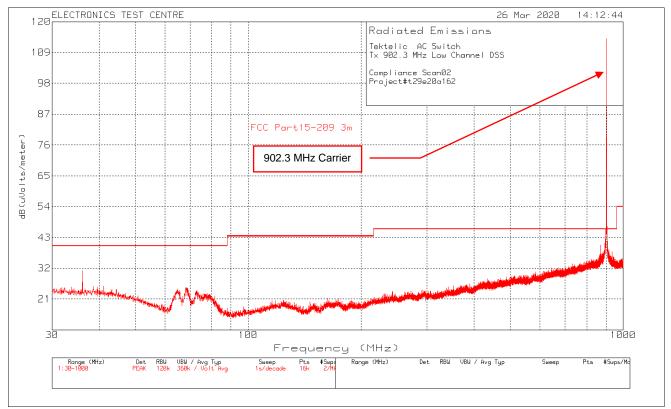
Plot of Radiated Emissions: Measuring Antenna Parallel

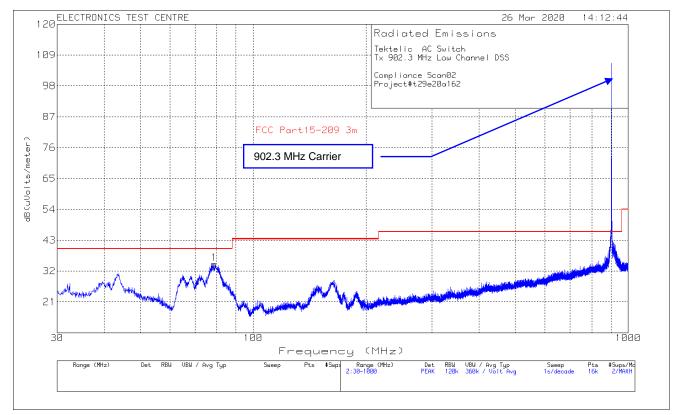


Plot of Radiated Emissions: Measuring Antenna Perpendicular

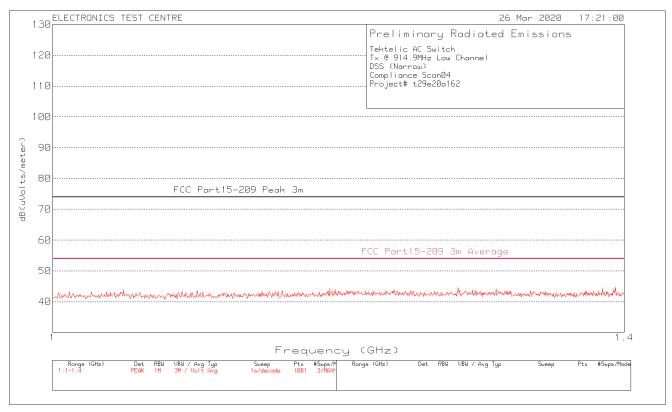








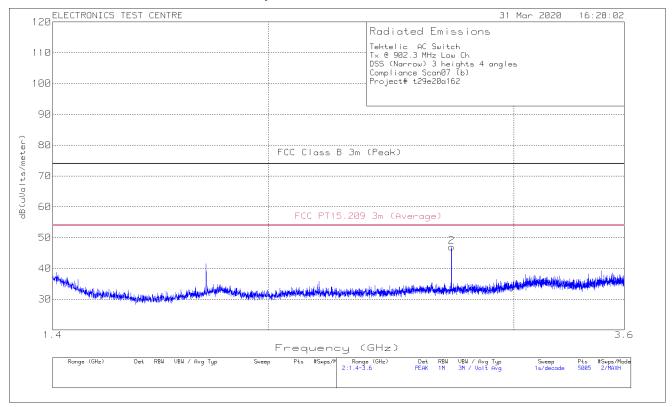
Plot of Radiated Emissions: Horizontal polarization



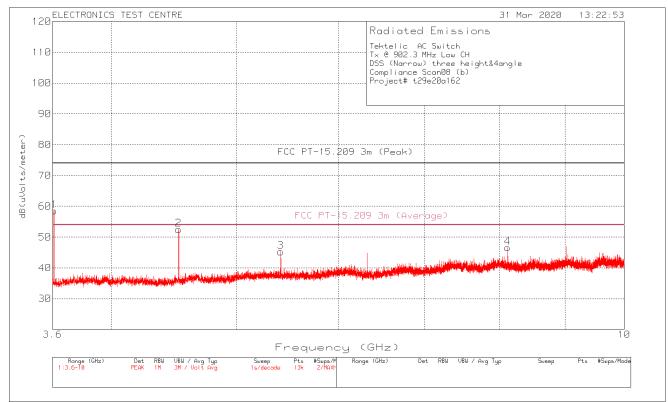


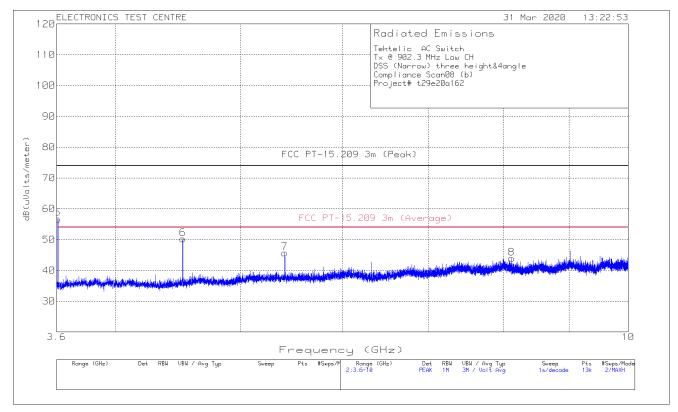
Plot of Radiated Emissions: Horizontal polarization

128	ELECTRONICS TEST CENTRE	31 Mar 2020 16:28:02
110		Radiated Emissions Tektelic AC Switch Tx @ 902.3 MHz Low Ch DSS (Narrow) 3 heights 4 angles Compliance Scan07 (b) Project# t29e20a162
100	3	Project# t29e20a162
98	3	
80	a FCC	Class B 3m (Peak)
76	3	
68		FCC PT15.209 3m (Average)
58	3	1
40		
30		
1		;; 3.6 equency (GHz)
	Ronge (CHz) Det RBU VBU / Avg Typ Sweep P 1:1.4-3.6 PEAK IM 3M / Volt Avg 1s/decade 50	ts #Swps/M Range (GHz) Det RBW UBW / Avg Typ Sweep Pts #Swps/Made 005 2/Max0-



Plot of Radiated Emissions: Horizontal polarization





2.11 RF Exposure

Test Lab: Electronics Test Centre, Airdrie Test Personnel:	EUT: Smart AC Switch Standard: FCC PART 15.247				
Date:					
EUT status: Exempt					

Compliant: RF exposure assessment to be provided in a separate Exhibit.

3.0 TEST FACILITY

3.1 Location

The Smart AC Switch was tested for emissions at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

Measurements taken at this site are accepted by Industry Canada as evidence of conformity per registration file # 2046A. This site is also listed with the FCC under Registration Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

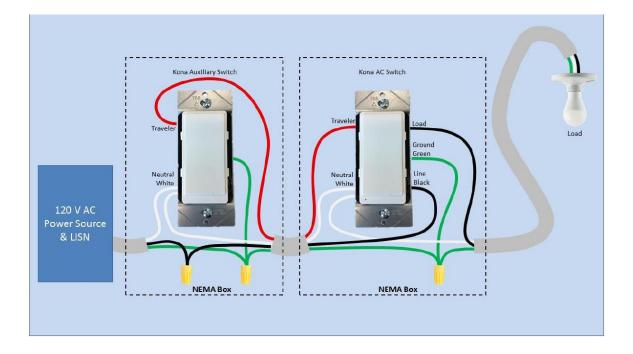
3.2 Grounding Plan

The Smart AC Switch was placed at the center of the test chamber turntable on top of polystyrene foam table. The provision is made within the Smart AC Switch for an earth ground connection.

3.3 Power Supply

AC Main is used to provide EUT power (120VAC / 60 Hz).

Appendix A (Worse Emission test setup Block Diagram)



End of Document