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October 4, 2022

S&C Electric Company
6601 N. Ridge Blvd.
Chicago IL 60626

Dear Muhammad Tabani,

Enclosed is the EMC Wireless test report for compliance testing of the S&C Electric Company, Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6) as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C for Intentional Radiators and RSS-247 for DTS devices, Issue 2, February 2017 for Intentional Radiators.

Thank you for using the services of Eurofins Electrical and Electronic Testing NA, Inc. If you have any questions regarding these results or if Eurofins Electrical and Electronic Testing NA, Inc. can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS ELECTRICAL AND ELECTRONIC TESTING NA, INC.

Michelle Tawmging
Documentation Department

Reference: (\S&C Electric Company\ WIR121392-FCC247_RSS247 Rev. 3)

A2LA ACCREDITED TESTINGCERT #0591.01

Electromagnetic Compatibility Criteria
Test Report

for the

S&C Electric Company
Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6
Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6)

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

the IC Certification Rules
contained in
RSS-247, Issue 2, February 2017 for Intentional Radiators

Report: WIR121392-FCC247_RSS247 Rev. 3

October 4, 2022

Prepared For:

S&C Electric Company
6601 N. Ridge Blvd.
Chicago IL 60626

Prepared By:
Eurofins Electrical and Electronic Testing NA, Inc.
914 W. Patapsco Avenue
Baltimore, MD 21230

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contained in
RSS-247, Issue 2, February 2017 for Intentional Radiators

Donald Salguero
Wireless Lab

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 and RSS-247 for DTS devices, Issue 2, February 2017 for Intentional Radiators under normal use and maintenance.

Michael Griffiths
Manager, Wireless Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	September 29, 2022	Initial Issue.
1	September 29, 2022	Updated Weight (lbs.), PMN, HVIN, FVIN, and HMN in Table 5.
2	October 3, 2022	Added (A2LA) (Certificate #: 0591.01) number to Test Site section. Updated Antenna Gain to +3.3dBi throughout.
3	October 4, 2022	Updated Table 11; Updated RF Exposure section.

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Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the S&C Electric Company Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6), with the requirements of Part 15, §15.247 and RSS-247 for DTS devices, Issue 2, February 2017 for Intentional Radiators. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6). S&C Electric Company should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6), has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247 and RSS-247 for DTS devices, Issue 2, February 2017 for Intentional Radiators, in accordance with S&C Electric Company, purchase order number 1160877. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	IC Reference RSS-247 Issue 2, 2017; RSS-GEN Issue 5: 2019	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	-	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-GEN(8.8)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(2)	RSS-247 (5.2) RSS-GEN(6.7)	6dB Occupied Bandwidth	Compliant
-		99% Occupied Bandwidth	
	RSS-247 (6.2.4.1)	Duty Cycle	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-247(5.4)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(c)	RSS-247(5.5)	Spurious Emissions in Non-restricted Bands	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	RSS-GEN (6.13), (8.9), & (8.10)	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	RSS-247(5.2)	Peak Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	-	Maximum Permissible Exposure (MPE)	Compliant
-	RSS-102(3.2)	RF Exposure Evaluation of Devices	

Table 1. Executive Summary of EMC Part 15.247 and RSS-247 for Intentional Radiators ComplianceTesting

Equipment Configuration

A. Overview

Eurofins Electrical and Electronic Testing NA, Inc. was contracted by S&C Electric Company to perform testing on the Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6), under S&C Electric Company's purchase order number 1160877.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the S&C Electric Company, Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6).

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6)	
Model(s) Covered:	Model TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6)	
EUT Specifications:	Primary Power: CT input 230 Vac, 2 A, 50/60 Hz J10 input 11-14.5	
	FCC ID: U3D-TSIICONTRL6	
	IC ID: 5349C-TSIICONTRL6	
	Type of Modulations:	GFSK / 1 Mbit/s O-QP
	Equipment Code:	DTS
	Peak RF Output Power:	8.98dBm
	EUT Frequency Ranges:	2405 -2480 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Donald Salguero	
Report Date(s):	October 4, 2022	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-247, Issue 2, February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN, Issue 5, March 2019	General Requirements and Information for the Certification of Radio Apparatus
RSS-102, Issue 5, March 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 558074 v05r02	Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under Section 15.247

Table 3. References

C. Test Site

All testing was performed at Eurofins Electrical and Electronic Testing NA, Inc., 914 W. Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology. Eurofins Electrical and Electronic Testing NA, Inc. has been accredited by the American Association for Laboratory Accreditation (A2LA) (Certificate #: 0591.01) in accordance with ISO/IEC 17025:2017.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at Eurofins Electrical and Electronic Testing NA, Inc.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
Radiated Emissions, (30 MHz – 1 GHz)	±3.20	2	95%
Radiated Emissions, (1 GHz – 6 GHz)	±2.52	2	95%
Conducted Emission Voltage	±2.03	2	95%
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

Table 4. Uncertainty Calculations Summary

E. Equipment Details

Name of EUT/Model:	TripSaver II Cutout-Mounted Recloser Controller TSII-CONTRL5 and TSII-CONTRL6 Model # FDA-1943-1 (TSII-CONTRL5) Model # FDA-1943-2 (TSII-CONTRL6)
Description of EUT and Intended Use:	The S&C TripSaver II cutout-mounted recloser Controller (Model Number TSII-CONTRL5 and TSII-CONTRL6) is an electronic control module used to control the self-powered S&C TripSaver II Cutout-Mounted Recloser. Housed in the TripSaver II recloser, the control module processes all electronic / electrical functions required for the proper operation of the TripSaver II cutout-mounted recloser. Aside from its primary functions, the controller can be wirelessly accessed via the IEEE 802.15.4 protocol for performing TripSaver II recloser maintenance.
Selected Operation Mode(s):	Set by S&C Product Engineering – on-site personnel
Rational for the selection of the Operation Mode(s):	Set by S&C Product Engineering – on-site personnel
Susceptibility Criteria:	The FCC testing software has a visual connectivity feature that allow Tester to monitor the connectivity between EUT and TripSaver II Dongle. No connection message will be display in the testing software is the connectivity between EUT and Controller is disconnected.
Monitoring Method(s):	The FCC testing Software has a beacon feature that will allow tester to monitor the connectivity between EUT and TripSaver II Dongle.
Emissions Class Declaration:	Class A
Configurations:	The EUT required FCC Testing Software and need connectivity with TripSaver II Controller. The test was performed for non-modulation and modulation continues transmission using FCC testing software for low, middle and higher channels.
Rated Power Input	
Input Voltage Range:	CT input 230 Vac, 2 A, 50/60 Hz J10 input 11-14.5
AC or DC:	AC
Voltage Frequency:	50/60 Hz
Number of Phases:	1
Current:	2A
Uses an external AC/DC Adapter:	True
Manufacturer:	CUI Inc
Model #:	SM16-12
Part #:	SM16-12-V-P5
Serial #:	SM16-12-V-P5
The EUT can be battery powered:	False
Power Input Under Test	
Input Voltage:	CT input 230 Vac, 2 A, 50/60 Hz J10 input 11-14.5
Frequency:	50/60 Hz
Physical Description	
EUT Arrangement:	Table Top
System with Multiple Chassis?	True
Size (HxWxD) inches:	6.53 in. (16.6 cm) x 5.198 in. (13.2 cm) x 2.98 in
Weight (lbs.):	17.6 oz. (499 g) for TSII-CONTRL5 20 oz. (567 g) for TSII-CONTRL6
Highest Internal Frequency (MHz):	2480 MHz

Other Info	
EUT Software (Internal to EUT):	Yes
Support Software (used by support PC to exercise EUT):	Use PC to run appropriate test
Firmware:	
Transmitter Parameters	
Description of your unit:	DSSS
Modulation Type:	GFSK / 1 Mbit/s O-QP
Number of Channels:	16
Frequency Range (MHz):	2402 -2480 MHz
Antenna Type:	PCB Antenna
Antenna Gain (dB):	+3.3 dBi
PMN:	TripSaver II Cutout-Mounted Recloser TSII-CONTRL5 – Standard configuration TSII-CONTRL6 – with Extended delay
HVIN:	FDA-1943-1 (TSII-CONTRL5) FDA-1943-2 (TSII-CONTRL6)
FVIN:	01.03.06.B6 or Higher
HMN:	TripSaver II Cutout-Mounted Recloser
Data Rates:	250 kbit/s
Expected Power Level:	9.8 dBm
Number of Antenna:	1
Number of Intentional Transmitters:	1
Number of Certified Intentional Transmitter Modules:	0
FCC ID:	U3D-TSIICONTRL6
IC ID:	5349C-TSIICONTRL6

Table 5. Equipment Details

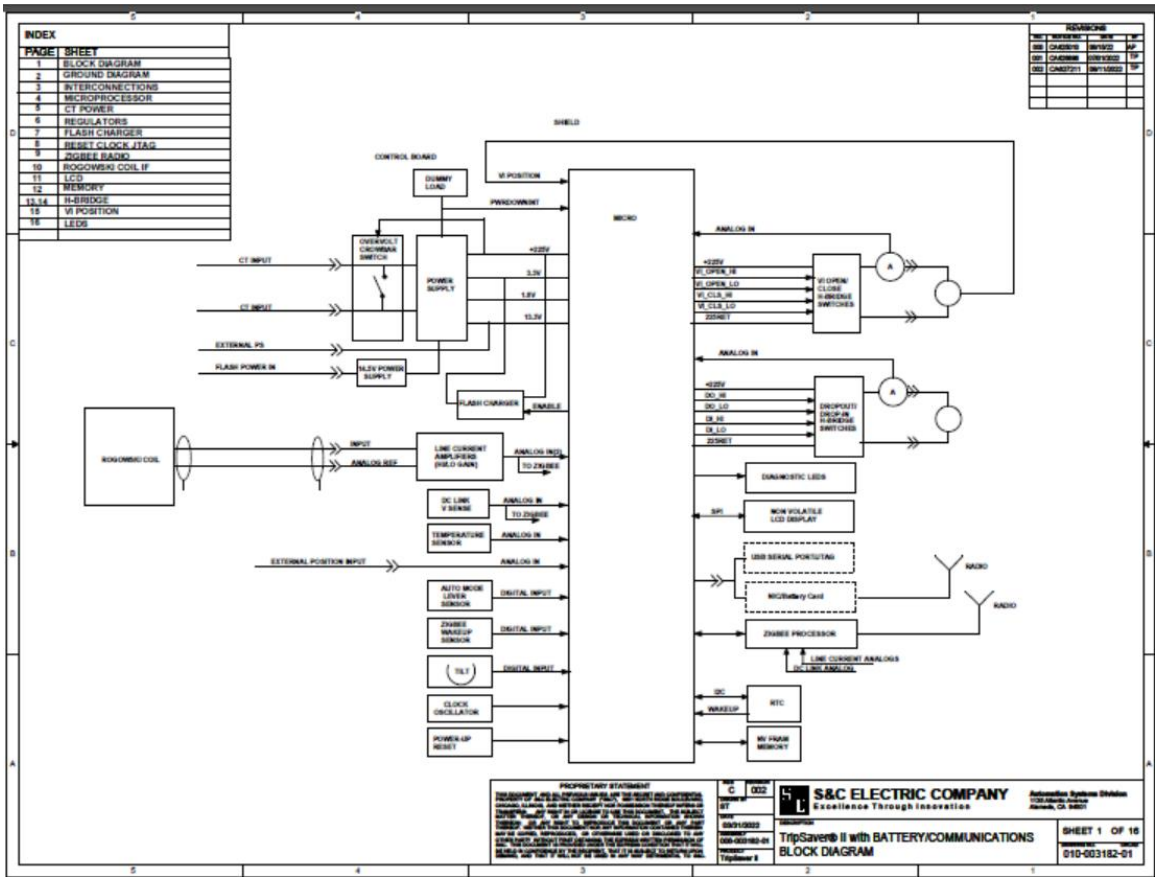

Figure 1. Block Diagram

F. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

G. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to S&C Electric Company upon completion of testing.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is **compliant** the criteria of §15.203. EUT uses a built-in antenna. 3.3dBi Gain.

Test Engineer(s): Donald Salguero

Test Date(s): September 21, 2022

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBµV)	
	Quasi-Peak	Average
* 0.15- 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Table 6. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 µH LISN as the input transducer to an EMC/field intensity meter.

RSS-GEN (8.8) AC Power-Line Conducted Emissions Limits

Test Requirement(s):

RSS-GEN (8.8): Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in Table 7, as measured using a 50 μH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in Table 7 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Frequency (MHz)	Conducted Limit (dBμV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56[1]	56 to 46[1]
0.5-5	56	46
5-30	60	50

Table 7. AC Power Line Conducted Emissions Limits

Test Procedure:

The EUT was placed on a non-metallic table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013 "Procedures for Compliance Testing of Unlicensed Wireless Devices"*. Scans were performed with the transmitter on at full power.

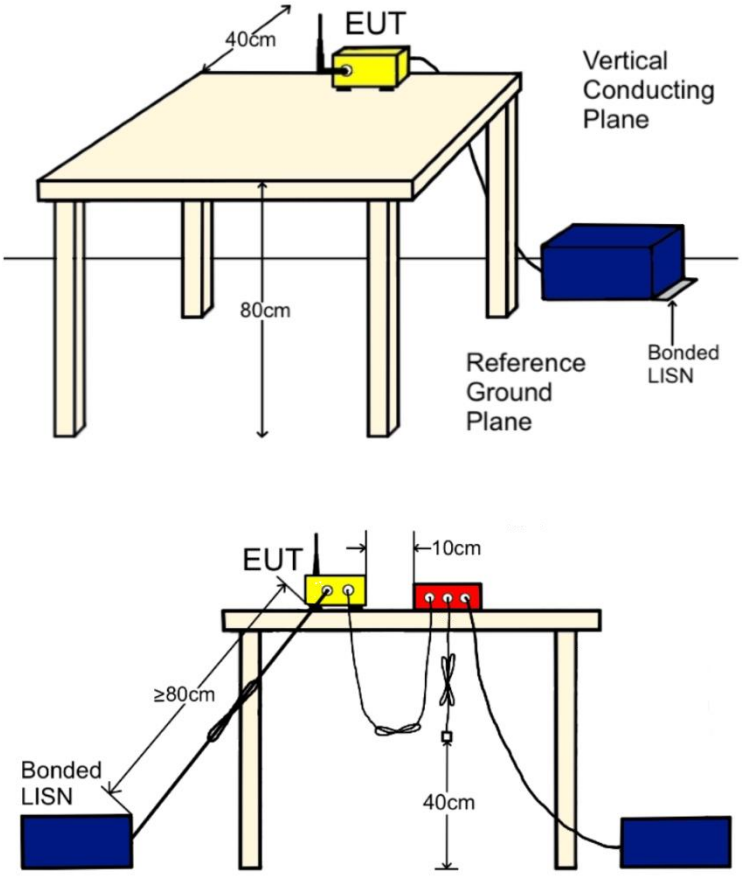

Figure 2. CEV Test Setup

Test Results: The EUT was **compliant** with the requirements **of § 15.207(a) and RSS-GEN (8.8)**. Measured emissions were below applicable limits. Plots are found on Appendix B - WIR121392-FCC247_RSS247 page(s) 2-3.

Test Engineer(s): William Yip

Test Date(s): September 20, 2022

§ 15.207(a) Conducted Emissions Limits

RSS-GEN (8.8) AC Power-Line Conducted Emissions Limits

Conducted Emissions Datasheet						
METrak Number	121392			**Test Specification**	FCC Part 15, Subpart C	
Customer	S & C Company			**Equipment Class**	15.207	
EUT Name	TSII-CONTRL5 and TSII-CONTRL6			**Engineer**	William Yip	
Model/Part Number	TSII-CONTRL6			**Test Date(s)**	9/20/2022	
Serial Number	N/A			**Temperature**	20.5 C	
Mode of Operation	230VAC 50Hz			**Relative Humidity**	56%	
Notes:						
Start Frequency	150kHz				30MHz	
Line Under Test	Line					
Frequency	**Quasi-Peak Measurement**	**Correction Factor**	**Corrected Measurement**	**Quasi-Peak Limit**	**Margin**	**Result**
MHz	**dBµV**	**dB**	**dBµV**	**dBµV**	**dB**	**Pass/Fail**
0.154687	33.41	10.34	43.75	65.87	-22.11	PASS
0.514912	28.07	10	38.07	56	-17.93	PASS
1.520375	15.88	9.98	25.85	56	-30.15	PASS
7.576748	12.1	10.02	22.13	60	-37.87	PASS
13.86583	20.57	10.1	30.67	60	-29.33	PASS
14.12611	20.83	10.1	30.94	60	-29.06	PASS
Frequency	**Average Measurement**	**Correction Factor**	**Corrected Measurement**	**Average Limit**	**Margin**	**Result**
MHz	**dBµV**	**dB**	**dBµV**	**dBµV**	**dB**	**Pass/Fail**
0.154687	13.05	10.34	23.4	55.87	-32.47	PASS
0.514912	13.89	10	23.89	46	-22.11	PASS
1.520375	11.98	9.98	21.96	46	-24.04	PASS
7.576748	8.89	10.02	18.91	50	-31.09	PASS
13.86583	8.37	10.1	18.47	50	-31.53	PASS
14.12611	8.32	10.1	18.43	50	-31.57	PASS

Table 8. CEV Line datasheet

Conducted Emissions Datasheet						
METrak Number	121392			**Test Specification**	FCC Part 15, Subpart C	
Customer	S & C Company			**Equipment Class**	15.207	
EUT Name	TSII-CONTRL5 and TSII-CONTRL6			**Engineer**	William Yip	
Model/Part Number	TSII-CONTRL6			**Test Date(s)**	9/20/2022	
Serial Number	N/A			**Temperature**	20.5 C	
Mode of Operation	230VAC 50Hz			**Relative Humidity**	56%	
Notes:						
Start Frequency	150kHz				30MHz	
Line Under Test	Line					
Frequency	**Quasi-Peak Measurement**	**Correction Factor**	**Corrected Measurement**	**Quasi-Peak Limit**	**Margin**	**Result**
MHz	**dBµV**	**dB**	**dBµV**	**dBµV**	**dB**	**Pass/Fail**
0.154687	33.41	10.34	43.75	65.87	-22.11	PASS
0.514912	28.07	10	38.07	56	-17.93	PASS
1.520375	15.88	9.98	25.85	56	-30.15	PASS
7.576748	12.1	10.02	22.13	60	-37.87	PASS
13.86583	20.57	10.1	30.67	60	-29.33	PASS
14.12611	20.83	10.1	30.94	60	-29.06	PASS
Frequency	**Average Measurement**	**Correction Factor**	**Corrected Measurement**	**Average Limit**	**Margin**	**Result**
MHz	**dBµV**	**dB**	**dBµV**	**dBµV**	**dB**	**Pass/Fail**
0.154687	13.05	10.34	23.4	55.87	-32.47	PASS
0.514912	13.89	10	23.89	46	-22.11	PASS
1.520375	11.98	9.98	21.96	46	-24.04	PASS
7.576748	8.89	10.02	18.91	50	-31.09	PASS
13.86583	8.37	10.1	18.47	50	-31.53	PASS
14.12611	8.32	10.1	18.43	50	-31.57	PASS

Table 9. CEV Neutral datasheet

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) -6dB Bandwidth

Test Requirements: **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths. The 6dB bandwidth was measured according to measurement method 11.8.2 Option 2 of ANSI C63.10-2013.

RSS-247 (5.2) -6dB Bandwidth

Test Requirements: **RSS-247 (5.2):** The minimum 6dB bandwidth shall be 500 kHz.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths. The 6dB bandwidth was measured according to measurement method 11.8.2 Option 2 of ANSI C63.10-2013.

RSS-GEN (6.7) 99% Occupied Bandwidth

Test Requirements: **RSS-GEN (6.7):** The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 99% Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results The EUT was **compliant** with **§ 15.247 (a)(2), RSS-GEN (6.7), and RSS-247(5.2).** Plots are found on Appendix B - WIR121392-FCC247_RSS247 page(s) 4-7

Test Engineer(s): Donald Salguero

Test Date(s): September 21, 2022

§ 15.247(a)(2) **-6dB Bandwidth**

RSS-247 (5.2) **-6dB Bandwidth**

RSS-GEN (6.7) **99% Occupied Bandwidth**

Frequency (MHz)	-6dB Occupied Bandwidth (kHz)	99% Occupied Bandwidth (kHz)	6dB BW Limit (kHz)
2405	1691.0	2137.1	>500
2440	1680.0	2138.4	>500
2480	1677.0	2141.7	>500

Table 10. OBW, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-247 (6.2.4.1) Duty Cycle

Test Procedure: The EUT was connected to a spectrum analyzer and was ran at the maximum achievable duty cycle for all modes. The duty cycle was measured in accordance with section 11.6 of ANSI C63.10-2013.

Test Results The EUT was **compliant** with **RSS-247 (6.2.4.1)** Duty Cycle. EUT was programmed to exhibit 100% Duty Cycle for testing purposes. Plots are found on Appendix B - WIR121392-FCC247_RSS247 page(s) 8-9

Test Engineer(s): Donald Salguero

Test Date(s): September 21, 2022

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Conducted Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

§15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

§15.247(c)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power was measured according to measurement method RBW≥DTS bandwidth, as described in ANSI C63.10-2013, section 11.9.1.1. Attenuator, cable loss, and duty factor were programmed into the spectrum analyzer.

RSS-247 (5.4) Transmitter Output Power

Test Requirements:

RSS-247 (5.4)(4): For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

RSS-247 (5.4)(5): Fixed point-to-point systems in the bands 2400-2483.5 MHz and 5725-5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems[1], omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

RSS-247 (5.4)(6): Transmitters may operate in the band 2400–2483.5 MHz, employing antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

i. Different information must be transmitted to each receiver.
ii. If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4 (2) and (4).
iii. If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4 (2) and (4). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4 (2) and (4). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4 (2) and (4) by more than 8 dB.
iv. Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4 (2), (4) and (5).

Test Procedure:

The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power was measured according to measurement method RBW≥ DTS bandwidth, as described in ANSI C63.10-2013, section 11.9.1.1. Attenuator, cable loss, and duty factor were programmed into the spectrum analyzer.

[1] However, remote stations of point-to-multipoint systems shall be permitted to operate at an e.i.r.p. greater than 4 W under the same conditions as for point-to-point systems.

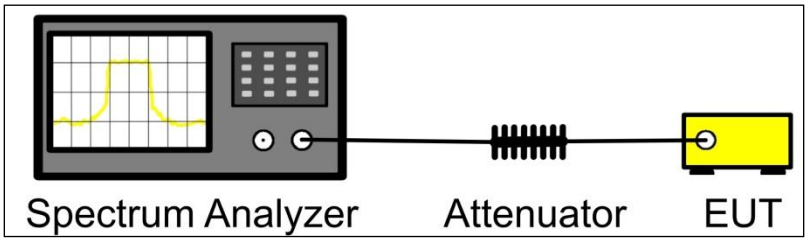

Figure 3. Power Output Test Setup

Test Results: The EUT was **compliant** with the Peak Power Output limits of **§15.247(b) and RSS-247 (5.4)**. No anomalies noted. Plot are found on Appendix B - WIR121392-FCC247_RSS247 page(s) 10-11.

Test Engineer(s): Donald Salguero

Test Date(s): September 21, 2022

§ 15.247(b) Conducted Power Output
RSS-247 (5.4) Transmitter Output Power

Frequency (MHz)	Peak Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2405	8.9	30	-21.1	3.3	12.2	36	-23.8
2440	8.95	30	-21.05	3.3	12.25	36	-23.75
2480	8.98	30	-21.02	3.3	12.28	36	-23.72

Table 11. Output Power, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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	2655–2900	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			

Table 12. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 13.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 13. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

RSS-GEN (6.13), (8.9), & (8.10) Radiated Spurious Emissions and Restricted Band

Test Requirements:

RSS-GEN (6.13): In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:

(a) If the equipment operates below 10 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits below 1000 MHz shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.

Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

RSS-GEN (8.9): Except when the requirements applicable to a given device state otherwise, emissions from license−exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits for License-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	**Field Strength (µV/m at 3 meters)**
30 – 88	100
88 – 216	150
216 – 960	200
Above 960*	500
*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.	

RSS-GEN (8.10): Restricted bands are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

1. Fundamental components of modulation of license-exempt radio apparatus shall not fall within the restricted bands except for apparatus complying under RSS-287;
2. Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and
3. Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. For wide span prescan, a notch filter was used to remove the fundamental to not saturate the pre-amp. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz. Emissions were investigated up to 25GHz.

Test Results: The EUT was **compliant** with the Radiated Spurious Emission limits of **§ 15.247(d), § 15.209, and RSS-GEN (6.13), (8.9), & (8.10)**. Measured emissions were below applicable limits. Plots are found on Appendix B - WIR121392-FCC247_RSS247 page(s) 12-30.

Test Engineer(s): Donald Salguero

Test Date(s): September 20, 2022

§ 15.209 Radiated Spurious Emissions Requirements and Band Edge
RSS- GEN (6.13), (8.9), & (8.10) Radiated Spurious Emissions and Restricted Band

Start Frequency			30 MHz			Stop Frequency			1 GHz	
Measurement Distance			3 Meters			Detector			Quasi-Peak	
TX Channel	Frequency	Polarity	Antenna Height	Turtable Position	Measured	Correction Factor	Corrected Reading	Limit	Margin	Results
(MHz)	MHz	Horizontal/ Vertical	cm	Degrees	dBµV	dB	dBµV/m	dBµV/m	dB	Pass/Fail
2405	30.54	H	227.73	196.9	-1.22	26.35	25.14	40	-14.86	PASS
	31.8	H	217.6	201	-2.52	25.44	22.92	40	-17.08	PASS
	157.568	H	179.82	253.5	12.55	18.39	30.94	43.5	-12.56	PASS
	246.063	H	142.04	107.5	1.32	17.84	19.16	46	-26.84	PASS
	299.98	H	129.56	249.9	2.5	19.84	22.33	46	-23.67	PASS
	599.997	H	117.95	262.2	2.04	26.46	28.5	46	-17.5	PASS
	31.02	V	140	0.3	5.65	24.67	30.32	40	-9.68	PASS
	59.985	V	381.78	158.2	10.54	11.97	22.51	40	-17.49	PASS
	158.312	V	107.86	95.6	13.83	18.69	32.52	43.5	-10.98	PASS
	298.24	V	113.52	203.8	4.94	19.43	24.37	46	-21.63	PASS
	599.997	V	118.73	89	7.54	25.66	33.2	46	-12.8	PASS
	967.871	V	200.86	77.9	6.44	30.52	36.97	56	-19.03	PASS
2440	30.3	H	233	172.1	-0.41	26.54	26.13	40	-13.87	PASS
	45.631	H	208	291.1	7.2	15.46	22.66	40	-17.34	PASS
	151.794	H	169.26	264.8	17.31	18.49	35.8	43.5	-7.7	PASS
	250.008	H	129.69	258.2	9.78	17.84	27.62	46	-18.38	PASS
	285.951	H	142	68.2	2.46	19.61	22.08	46	-23.92	PASS
	300.04	H	108.34	263.5	7.95	19.84	27.79	46	-18.21	PASS
	30.3	V	397.17	67.4	6.37	25.17	31.54	40	-8.46	PASS
	62.622	V	383.95	175.5	10.41	12.39	22.81	40	-17.19	PASS
	159.572	V	107.82	104.2	11.56	18.64	30.19	43.5	-13.31	PASS
	600.02	V	107.95	108.3	8.41	25.66	34.07	46	-11.93	PASS
	777.901	V	229.13	92.2	6.16	28.21	34.37	46	-11.63	PASS
	780.488	V	357.52	17.1	6.3	28.32	34.62	46	-11.38	PASS
2480	30.18	H	219.3	65.8	-0.18	26.64	26.46	40	-13.54	PASS
	30.24	H	203.3	82.4	-0.41	26.59	26.18	40	-13.82	PASS
	150.685	H	175.26	250	17.24	18.49	35.73	43.5	-7.77	PASS
	248.631	H	141.08	97.7	8.22	17.84	26.06	46	-19.94	PASS
	300.012	H	107	108.1	9.95	19.84	29.79	46	-16.21	PASS
	944.482	H	277.39	-0.3	-3.42	31.06	27.64	46	-18.36	PASS
	30.9	V	360.13	24.5	5.95	24.76	30.7	40	-9.3	PASS
	158.998	V	105.43	112.7	13.62	18.69	32.32	43.5	-11.18	PASS
	246.96	V	218.73	15.3	5.95	18.04	23.99	46	-22.01	PASS
	600.357	V	368.04	112	5.87	25.66	31.54	46	-14.46	PASS
	787.181	V	219.17	108.6	6.16	28.53	34.69	46	-11.31	PASS
	945.142	V	330.82	95.2	6.58	30.26	36.84	46	-9.16	PASS

Table 14. REE Datasheet, Test Results Below 1GHz

Start Frequency			1 GHz			Stop Frequency			25 GHz	
Measurement Distance			3 Meters			Detector			Average/Peak	
TX Channel	Frequency	Polarity	Antenna Height	Turtable Position	Measured	Correction Factor	Corrected Reading	Limit	Margin	Results
(MHz)	GHz	Horizontal/ Vertical	cm	Degrees	dBµV	dB	dBµV/m	dBµV/m	dB	Pass/Fail
2480	12.291	H	197.52	290.7	36.77	-1.164	35.61	54	-18.39	PASS
	17.69	H	108.08	113.4	36.92	-2	34.92	54	-19.08	PASS
	12.291	H	197.52	290.7	47.584	-1.164	46.42	74	-27.581	PASS
	17.69	H	108.08	113.4	49.615	-2	47.615	74	-26.386	PASS
	14.91	V	291.43	24.7	35.16	0.34	35.5	54	-18.5	PASS
	17.828	V	295.78	64.2	36.26	-0.011	36.24	54	-17.76	PASS
	14.91	V	291.43	24.7	46.657	0.34	46.997	74	-27.003	PASS
	17.828	V	295.78	64.2	47.353	-0.011	47.342	74	-26.658	PASS
2405	14.914	H	286	292.3	34.99	0.306	35.3	54	-18.7	PASS
	17.95	H	291	112.9	35.26	1.126	36.38	54	-17.62	PASS
	14.914	H	286	292.3	45.88	0.306	46.185	74	-27.815	PASS
	17.95	H	291	112.9	45.587	1.126	46.712	74	-27.288	PASS
	14.261	V	104.13	292.3	36.22	-1.593	34.63	54	-19.37	PASS
	14.871	V	155.39	113.1	35.73	0.161	35.89	54	-18.11	PASS
	17.806	V	205.13	22.7	36.2	-0.164	36.03	54	-17.97	PASS
	14.261	V	104.13	292.3	46.901	-1.593	45.308	74	-28.692	PASS
	14.871	V	155.39	113.1	45.954	0.161	46.115	74	-27.885	PASS
	17.806	V	205.13	22.7	47.974	-0.164	47.809	74	-26.191	PASS
2440	14.171	H	289.26	202	35.83	-0.731	35.1	54	-18.9	PASS
	14.887	H	272.78	244.1	35.53	0.364	35.9	54	-18.1	PASS
	17.823	H	106.73	243.5	36.21	0.179	36.38	54	-17.62	PASS
	14.171	H	289.26	202	47.108	-0.731	46.377	74	-27.623	PASS
	14.887	H	272.78	244.1	47.299	0.364	47.663	74	-26.337	PASS
	17.823	H	106.73	243.5	47.385	0.179	47.564	74	-26.436	PASS
	14.899	V	152.6	114.1	35.51	0.429	35.94	54	-18.06	PASS
	17.963	V	107.13	24.8	35.36	0.789	36.14	54	-17.86	PASS
	14.899	V	152.6	114.1	46.104	0.429	46.533	74	-27.467	PASS
	17.963	V	107.13	24.8	46.131	0.789	46.92	74	-27.08	PASS

Table 15. REE Datasheet, Test Results Above 1GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Spurious Emissions in Non-restricted Bands

Test Requirement: **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.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Conducted spurious emissions were measured according to sections 11.11.2 and 11.11.3 of ANSI C63.10-2013.

RSS-247 (5.5) RF Conducted Spurious Emissions

Test Requirements: **RSS-247 (5.5):** Out-of-Band Emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per section 5.5 of ANSI C63.10-2013; i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Conducted spurious emissions were measured according to sections 11.11.2 and 11.11.3 of ANSI C63.10-2013.

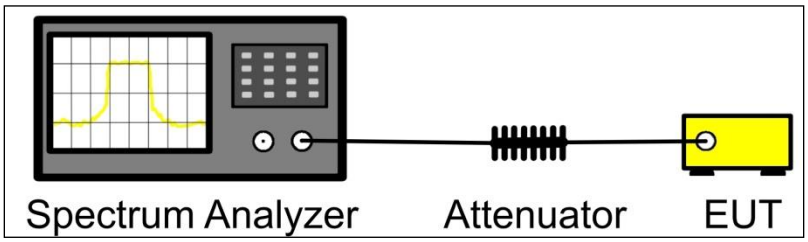

Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup

Test Results: The EUT was **compliant** with the Spurious Emission limits of **§15.247(d) and RSS-247 (5.5)**. Measured emissions were below applicable limits.

Compliance was determined from plots on Appendix B - WIR121392-FCC247_RSS247 page(s) 33-37.

Test Engineer(s): Donald Salguero

Test Date(s): September 21, 2022

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power spectral density was measured according to measurement method PKPSD, as described in ANSI C63.10-2013, section 11.10.2. Attenuator, cable loss, and duty factor were programmed into the spectrum analyzer.

RSS-247 (5.2) Power Spectral Density

Test Requirements: **RSS-247 (5.2):** The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4 (d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power spectral density was measured according to measurement method PKPSD, as described in ANSI C63.10-2013, section 11.10.2. Attenuator, cable loss, and duty factor were programmed into the spectrum analyzer.

Test Results: The EUT was **compliant** with the peak power spectral density limits of **§ 15.247 (e) and RSS-247 (5.2)**. No anomalies noted.

The peak power spectral density was determined from plots on Appendix B - WIR121392-FCC247_RSS247 page(s) 38-39.

Test Engineer(s): Donald Salguero

Test Date(s): September 21, 2022

§ 15.247(e) **Power Spectral Density**
RSS-247 (5.2) **Power Spectral Density**

Frequency (MHz)	Conducted PSD (dBm)	Limit (dBm)	Margin (dB)
2405	-1.04	8	-9.04
2440	-1.04	8	-9.04
2480	-1.00	8	-9.00

Table 16. PSD, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

RSS-102(3.2) RF Exposure Evaluation of Devices

RF Exposure Requirements: **RSS-102(3.2):**A device requiring an RF exposure evaluation shall be made in accordance with the latest version of IEEE C95.3.

If the device is designed such that more than one antenna can functionally transmit at the same time, the RF exposure evaluation shall be conducted while all antennas are transmitting. The individual exposure level ratios shall be totaled and used for compliance purposes.

If the device has more than one antenna, but is not designed to have more than one antenna functionally transmit at the same time, the RF exposure evaluation of the device shall be performed for each of the individually transmitting antennas. The maximum RF field strength value shall be recorded and used for compliance purposes.

If the device combines groups of simultaneous and non-simultaneous transmitting antennas, the worst-case of the above scenarios applies.

Exposure Limit: For a device operating between 300 – 6000 MHz the power density limit for RF Evaluation can be determined from the equation $0.02619 \times f^{0.6834}$ W/m^2, where f is the frequency in MHz.

The Time-Averaged Maximum e.i.r.p. RF Evaluation Exemption limit for devices operating between 300 – 6000 MHz can be found from the equation $0.0131 \times f^{0.6834}$ W, where f is the frequency in MHz.

Test Results: The EUT was **compliant** with the RF Exposure Requirements and RF Radiation Exposure Limit limits of **§ 15.247(i) and RSS-102(3.2).** Measured emissions were below applicable limits.

§ 15.247(i) Maximum Permissible Exposure
RSS-102(3.2) RF Exposure Evaluation of Devices

FCC									
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Margin**	**Distance (cm)**	**Result**
2480	10	10	3.3	2.138	0.00425	1	0.99575	20	Pass

IC											
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (W/m^2)**	**MPE Limit (W/m^2)**	**Margin**	**Distance (cm)**	**e.i.r.p. (W)**	**e.i.r.p. Exempt Limit (W)**	**Result**
2480	10	10	3.3	2.138	N/A	N/A	N/A	20	0.02138	2.7355	Exempt

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Conducted Emissions Equipment List						
Asset Number	Description	Manufacturer	Model Number	Serial Number	Calibration Date	Calibration Due Date
1T9987	Thermometer/Hygrometer/Barometer	Fisher Scientific	14-650-118, 15557603	200659491	10/26/2020	10/26/2022
1T6658	Spectrum Analyzer	Agilent Technologies	E4407B	US41443517	9/7/2021	3/7/2023
1T8909	LISN	Com-Power	LI-150C	201222	4/12/2021	10/12/2022
1T8908	LISN	Com-Power	LI-150C	201229	4/12/2021	10/12/2022
1T7450	Transient Limiter	Com-Power	LIT-153A	22010020	FVR	FVR
1T8834	Conducted Comb Generator	Com-Power	CGC-255E	311358	9/10/2021	3/10/2023
1T4606	ISN for Unshielded Balanced Pairs	Teseq	ISN T8	25190	3/26/2022	9/26/2023

Table 17. CEV Test Equipment List

Asset Number	Description	Manufacturer	Model Number	Serial Number	Calibration Date	Calibration Due Date
1T4751	Antenna - Bilog	Sunol Sciences	JB6	A101910	6/1/2022	12/1/2023
1T4483	Antenna; Horn	ETS-Lindgren	3117	56658	1/31/2022	7/31/2023
1T8743	Preamplifier	A.H. Systems, Inc.	PAM-0118P	419	Func. Verify	Func. Verify
1T4744	Antenna, Horn	ETS-Lindgren	3116	126519	3/4/2021	10/4/2022
1T4752	Pre-Amplifier	Miteq	JS44-18004000-35-8P	1594792	Func. Verify	Func. Verify
1T4300	SEMI-ANECHOIC CHAMBER (NSA)	EMC TEST SYSTEMS	NONE	NONE	8/19/2021	8/31/2023
1T4300B	Semi-Anechoic 3m Chamber sVSWR	EMC TEST SYSTEMS	NONE	NONE	9/30/2021	9/30/2023
1T4409	EMI Receiver	Rohde & Schwarz	ESIB7	100207	2/16/2022	8/31/2023
1T4681	Spectrum Analyzer (PSA)	Agilent Technologies	E4448A	MY46180897	10/15/2021	4/15/2023
1T4576	Antenna, Active Horn	Com-Power	AHA-118	711065	7/8/2022	1/31/2024

Table 18. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

End of Report