



Engineering Test Report No. ETR2302640-01 Rev A		
Report Date	12/15/2023	
Manufacturer Name	Morgan Olson, LLC	
Manufacturer Address	1801 S. Nottawa St Sturgis, MI 49091	
Contract Manufacturer	TouchTronics, Inc.	
Contract Manufacturer Address	57315 Nagy Dr Elkhart, IN 46517	
Model No.	239027252	
Date Received	12/05/2023	
Test Dates	12/06/2023, 12/08/2023 and 12/12/2023	
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231(b) Innovation, Science, and Economic Development Canada, RSS-210	
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515	FCC Reg. Number: 269750 IC Reg. Number: 2987A CAB Identifier: US0107
Signature		
Tested by	Jasen Jonas	
Signature		
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894	
PO Number	NB000048	
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1. Report Revision History

Revision	Date	Description
–	21 DEC 2023	Initial Release of Engineering Test Report No. ETR2302640-01
A	31 JAN 2024 By RK	<ul style="list-style-type: none"> – Throughout report: Added “Rev A” to the report number in the header. – Throughout report: Changed model number from “P1000-TK” to “239027252”. – Cover page: Changed the manufacturer to “Morgan Olson, LLC” with an address of “1801 S. Nottawa St Sturgis, MI 49091”. – Cover page: Added fields to represent “TouchTronics, Inc.” as the contract manufacturer with original address from quote. – Section 2.1: Modified wording to show “Morgan Olson, LLC” as the manufacturer of the key fob and that “TouchTronics, Inc.” submitted the fobs for testing. – Section 2.3: Changed FCC ID from “IVS1000TKTM” to “Not Available” and IC ID from “6265A-1000TKTM” to “Not Available”. – Section 17: Inserted new photographs of EUT without FCC and IC IDs.

2. Introduction

2.1. Scope of Tests

This document presents the results of a series of RF emissions tests that were performed on the Morgan Olson, LLC Key Fob (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was manufactured by Morgan Olson, LLC located in Sturgis, MI and submitted for testing by TouchTronics, Inc. located in Elkhart, IN.

2.2. Purpose

The test series was performed to determine if the EUT meets the RF emission requirements of the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231(b).

The test series was also performed to determine if the EUT meets the RF emission requirements of the Industry Canada Radio Standards Specification RSS-Gen and Industry Canada Radio Standards Specification RSS-210 for Transmitters.

Testing was performed in accordance with ANSI C63.10-2013.

2.3. Identification of the EUT

The EUTs were identified as follows:

EUT Identification	
EUT 1	
Product Description	Key Fob
Model/Part No.	239027252
S/N	X00007 and X00006
Band of Operation	433 MHz
Modulation Type	FSK
20dB Bandwidth	61.9 kHz
99% Bandwidth	55.8 kHz
Size of EUT	6.5 cm x 5 cm x 2 cm
Emission Classification	55K8X3X
FCC ID Number	FCC ID: Not Available
ISED Certification number	IC: Not Available
EUT 2	
Product Description	Key Fob
Model/Part No.	239027252
S/N	X00009 and X00008
Band of Operation	433 MHz
Modulation Type	FSK
20dB Bandwidth	59.9 kHz
99% Bandwidth	55.7 kHz
Size of EUT	6.5 cm x 5 cm x 2 cm
Emission Classification	55K7X3X
FCC ID Number	FCC ID: Not Available
ISED Certification number	IC: Not Available

EUT 3	
Product Description	Key Fob
Model/Part No.	239027252
S/N	X00012 and X00010
Band of Operation	433 MHz
Modulation Type	FSK
20dB Bandwidth	61.9 kHz
99% Bandwidth	55.5 kHz
Size of EUT	6.5 cm x 5 cm x 2 cm
Emission Classification	55K5X3X
FCC ID Number	FCC ID: Not Available
ISED Certification number	IC: Not Available

The EUTs listed above were used throughout the test series.

3. Power Input

The EUTs were powered by 3.3 VDC from internal coin cell battery.

4. Grounding

The EUTs were not connected to ground.

5. Support Equipment

The EUT was submitted for testing along with the following support equipment:

Description	Model #	S/N
Key Fob LF Trigger		X00017

6. Interconnect Leads

No interconnect leads were used during the tests.

7. Modifications Made to the EUT

No modifications were made to the EUTs during the testing.

8. Modes of Operation

Mode	Description
Button Press	The EUTs were powered on and the button was pressed once. (Only used for Periodic Operation Measurements tests.)
LF Trigger	The EUTs were powered on and the trigger button was pressed once. (Only used for Periodic Operation Measurements tests.)
Continuous	The EUTs were powered on and transmitted continuously. (Only used for Field Strength and Spurious Emissions tests.)

9. Test Specifications

The tests were performed to selected portions of, and in accordance with the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231(b) and Innovation, Science, and Economic Development Canada, RSS-210 test specification(s).

- Federal Communications Commission "Code of Federal Regulations," Title 47, Part 15, Subpart C
- ANSI C63.4-2014, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"
- ANSI C63.10-2013, "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
- RSS-210 Issue 10, December 2019, "License-Exempt Radio Apparatus: Category I Equipment"
- RSS-Gen Issue 5, February 2021, Amendment 2, Innovation, Science, and Economic Development Canada, "Spectrum Management and Telecommunications, Radio Standards Specification, General Requirements for Compliance of Radio Apparatus"

10. Test Plan

No test plan was provided. Instructions were provided by personnel from Morgan Olson, LLC and used in conjunction with the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231(b) and Innovation, Science, and Economic Development Canada, RSS-210, and ANSI C63.4-2014 specification(s).

11. Deviation, Additions to, or Exclusions from Test Specification

There were no deviations, additions to, or exclusions from the test specifications during this test series.

12. Laboratory Conditions

Ambient Parameters	Value
Temperature	23.1°C
Relative Humidity	23%
Atmospheric Pressure	1012.75mb.

13. Summary

The following EMC tests were performed and the results are shown below:

Test Description	Requirements	Test Methods	EUT S/N	Results
Periodic Operation Measurements	FCC 15C ISED RSS-210	ANSI C63.10: 2013	X00007, X00009, X00012	Conforms
Duty Cycle Factor Measurements	FCC 15C ISED RSS-210	ANSI C63.10: 2013	X00007, X00009, X00012	Conforms
Spurious Radiated Emissions	FCC 15C ISED RSS-210	ANSI C63.10: 2013	X00006, X00008, X00010	Conforms
Occupied Bandwidth Measurements	FCC 15C ISED RSS-210	ANSI C63.10: 2013	X00007, X00009, X00012	Conforms

14. Sample Calculations

For Powerline Conducted Emissions:

The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF).

$$\text{Formula 1: VL (dBuV) = MTR (dBuV) + CF (dB).}$$

For Radiated Emissions:

The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external preamplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

$$\text{Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)}$$

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

$$\text{Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]}$$

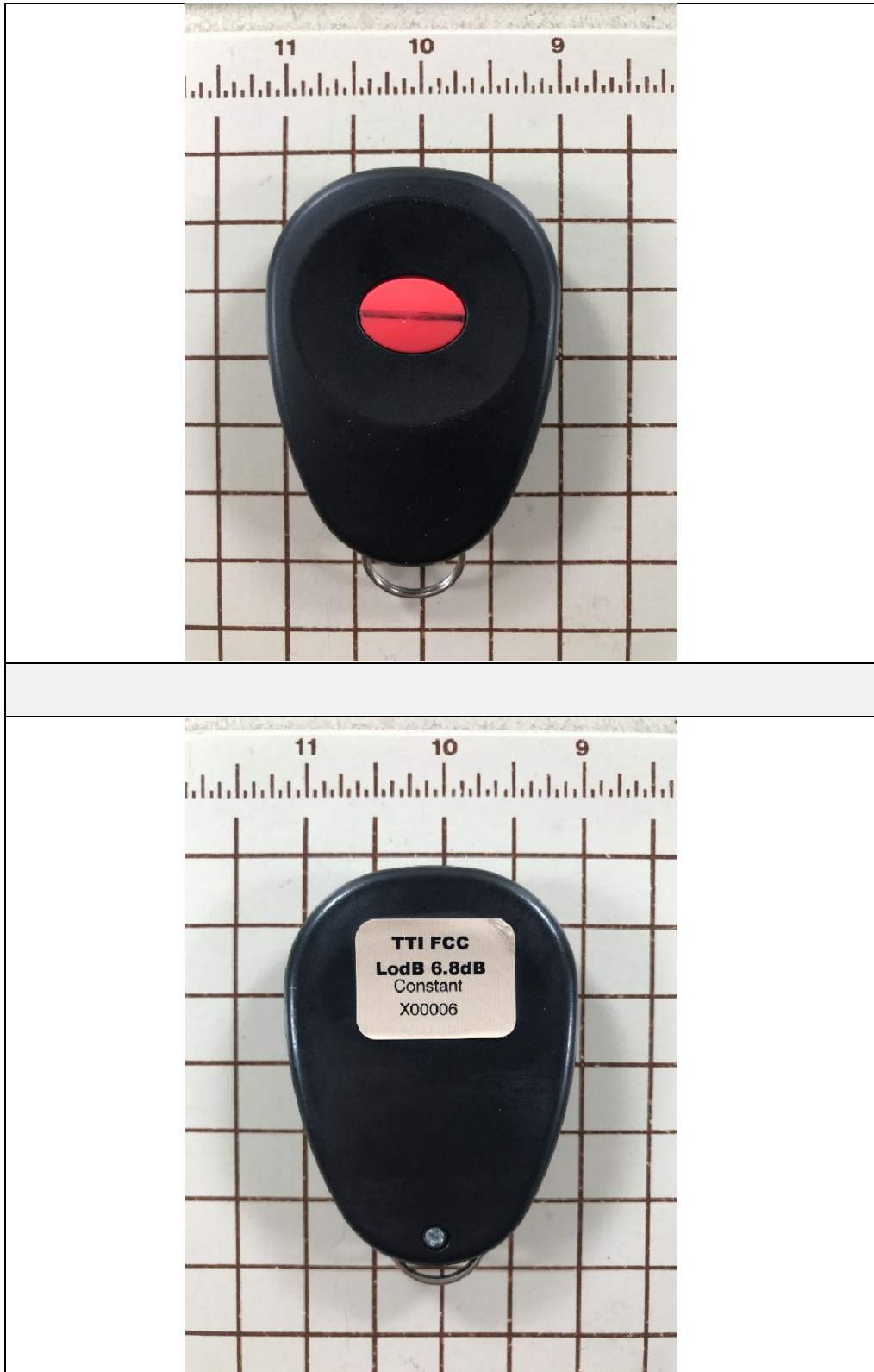
15. Statement of Conformity

The Morgan Olson, LLC Key Fob, Model No. 239027252, Serial Nos. X00007, X00009, X00012, X00006, X00008 and X00010, did fully conform to the selected requirements of FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231(b) and Innovation, Science, and Economic Development Canada, RSS-210.

16. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231(b) and Innovation, Science, and Economic Development Canada, RSS-210 test specifications. The data presented in this test report pertains to the EUT as provided by the customer on the test date specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

17. Photographs of EUT

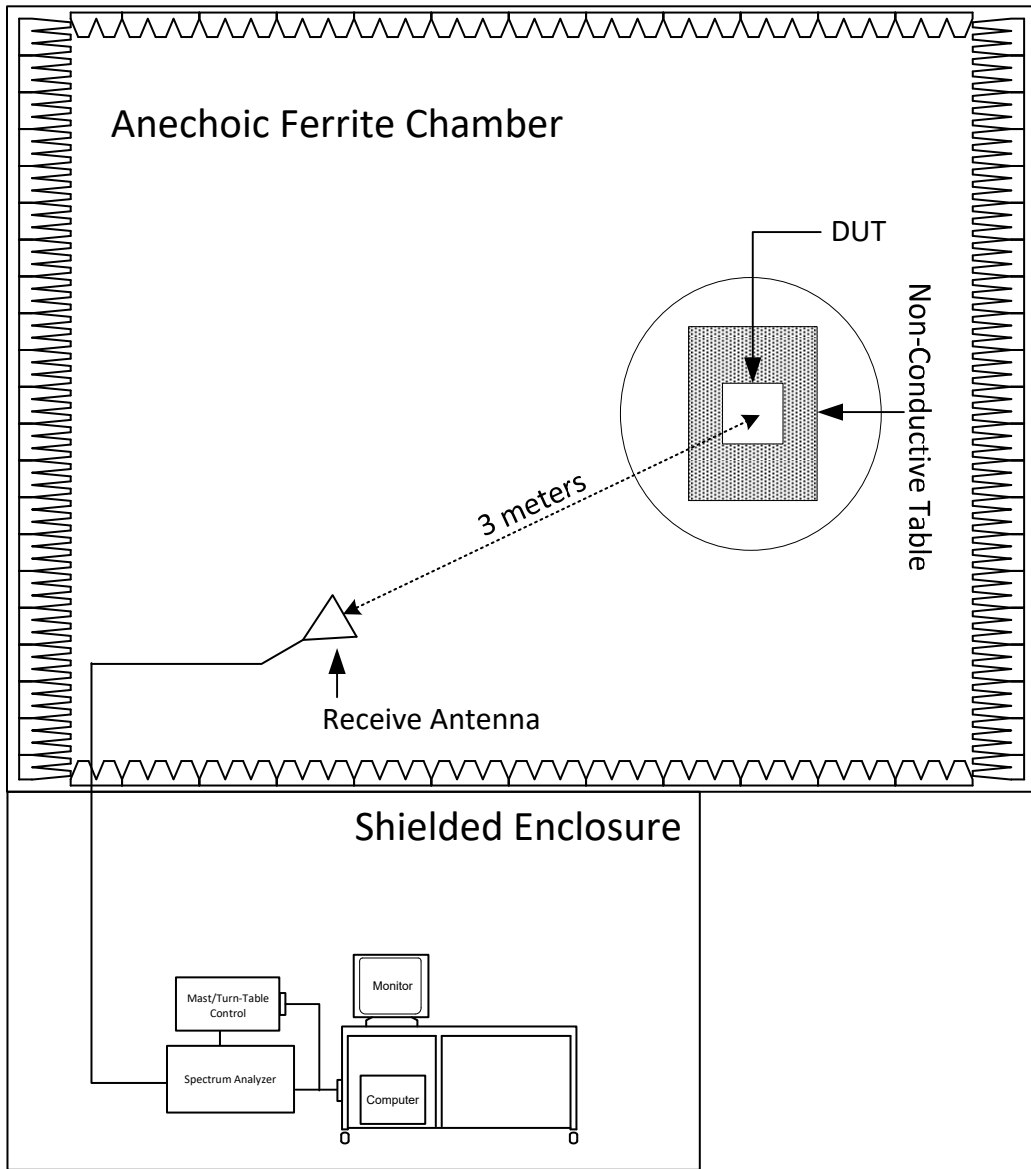








18. Block Diagram of Test Setup



Radiated Measurements Test Setup

19. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW10	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	3/10/2023	3/10/2024
CDZ3	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	11/17/2022	11/17/2024
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	4/27/2022	4/27/2024
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	4/10/2023	4/10/2024
RBG4	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	103007	2HZ-44GHZ	12/8/2022	1/8/2024
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	001	18-27VDC	NOTE 1	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	

N/A: Not Applicable

I/O: Initial Only

CNR: Calibration Not Required

NOTE 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

20. Periodic Operation Measurements

Test Information	
Manufacturer	Morgan Olson, LLC
Product	Key Fob
Model	239027252
Serial Nos	X00007, X00009 and X00012
Mode	Button Press and LF Trigger
Test Date	12/06/2023 and 12/12/2023

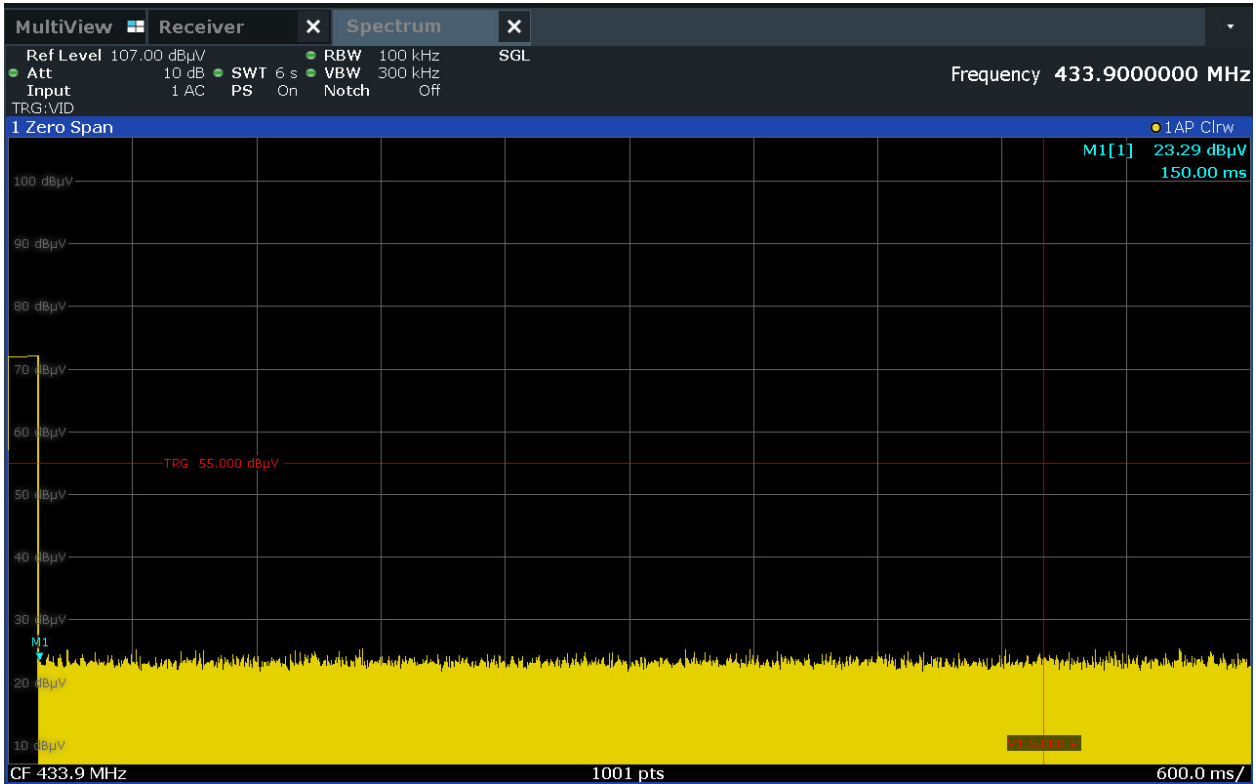
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Workbench
Test site used	N/A
Note	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements
<p>A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released. A transmitter activated automatically shall cease transmission within 5 seconds after activation. Transmission of set-up information for security systems may exceed said transmission duration limits, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.</p> <p>Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.</p> <p>Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.</p>

Procedures
<p>The spectrum analyzer was setup to display the time domain trace. The EUT was set to transmit normally. The spectrum analyzer was used to record the amount of time that the EUT remained active following activation.</p>

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00007
Mode	Button Press and LF Trigger
Carrier Frequency	433.9 MHz
Parameters	Button Press Operation Time = 150 ms Trigger Operation Time = 156 ms
Notes	None

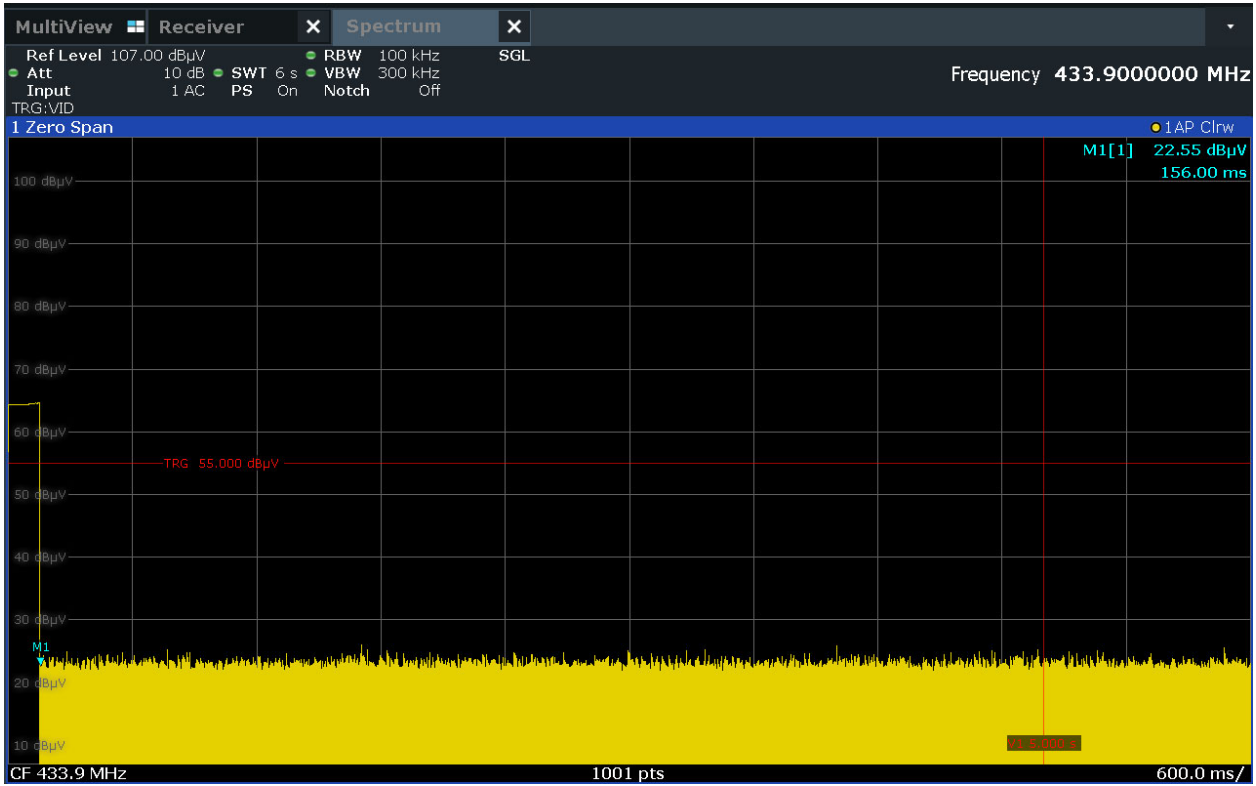


Tx Time

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00007
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/12/2023 10:39:09 AM
 Notes : LodB 6.8 dB

TRACE1 : Normal Peak (dBµV) Trace

EUT Compliant



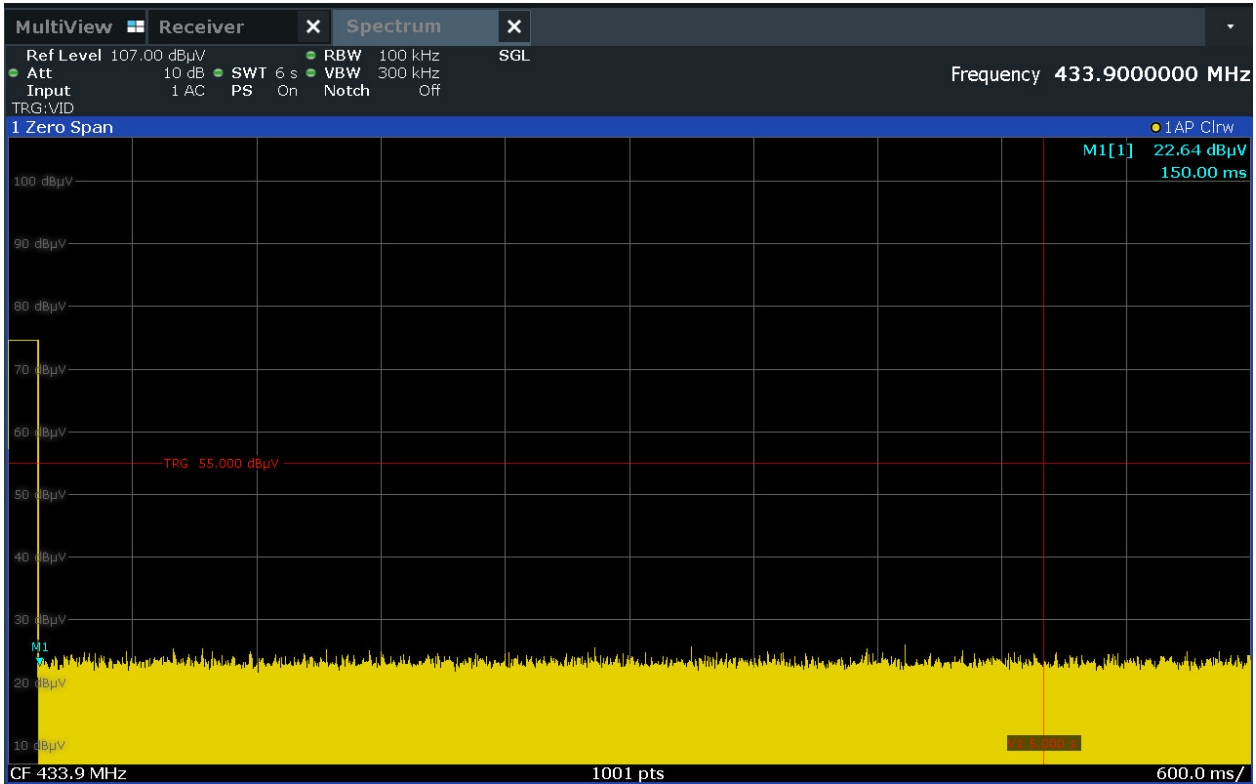
Tx Time

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00007
 Mode : Tx - 433 MHz
 Line Tested : Trigger
 Parameters :
 Date : 12/12/2023 10:39:42 AM
 Notes : LodB 6.8 dB

TRACE1 : Normal Peak (dBµV) Trace

EUT Compliant

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00009
Mode	Button Press and LF Trigger
Carrier Frequency	433.9 MHz
Parameters	Button Press Operation Time = 150 ms Trigger Operation Time = 156 ms
Notes	None

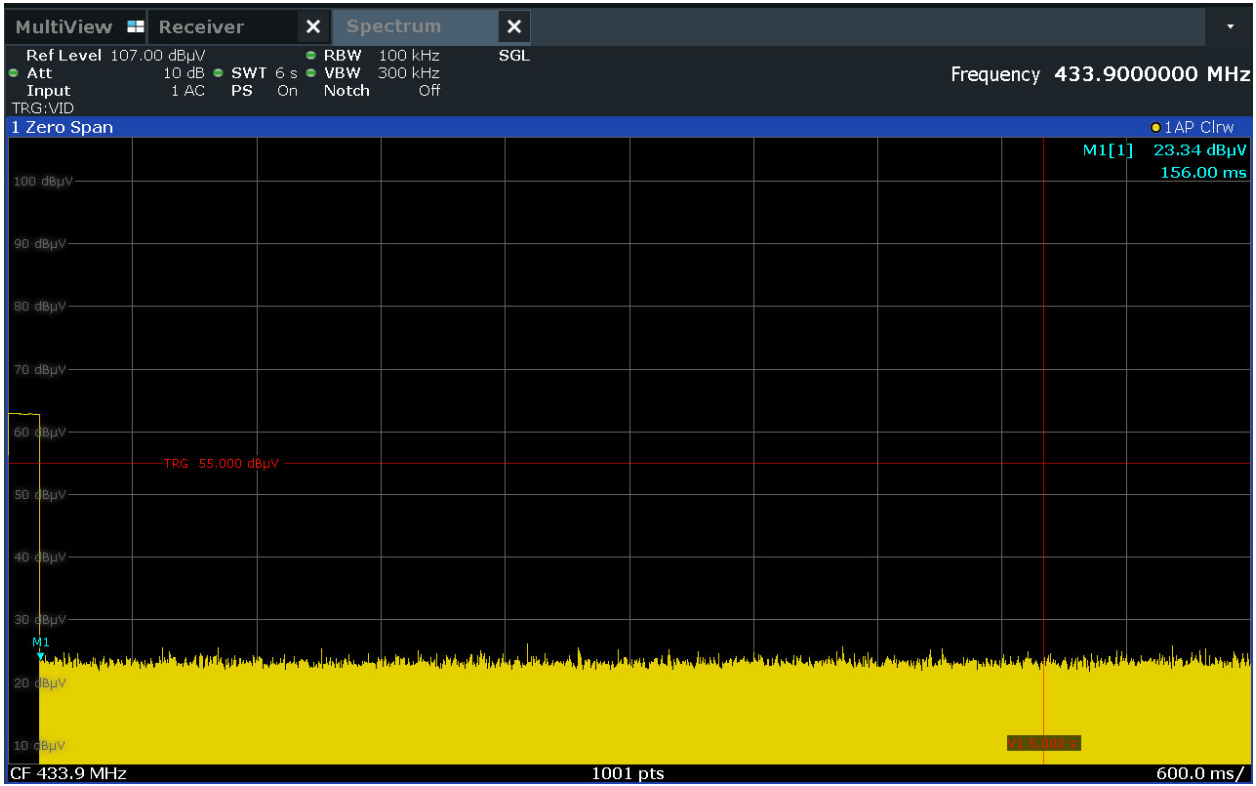


Tx Time

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00009
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/12/2023 10:40:56 AM
 Notes : NormdB 8.5 dB

TRACE1 : Normal Peak (dBµV) Trace

EUT Compliant



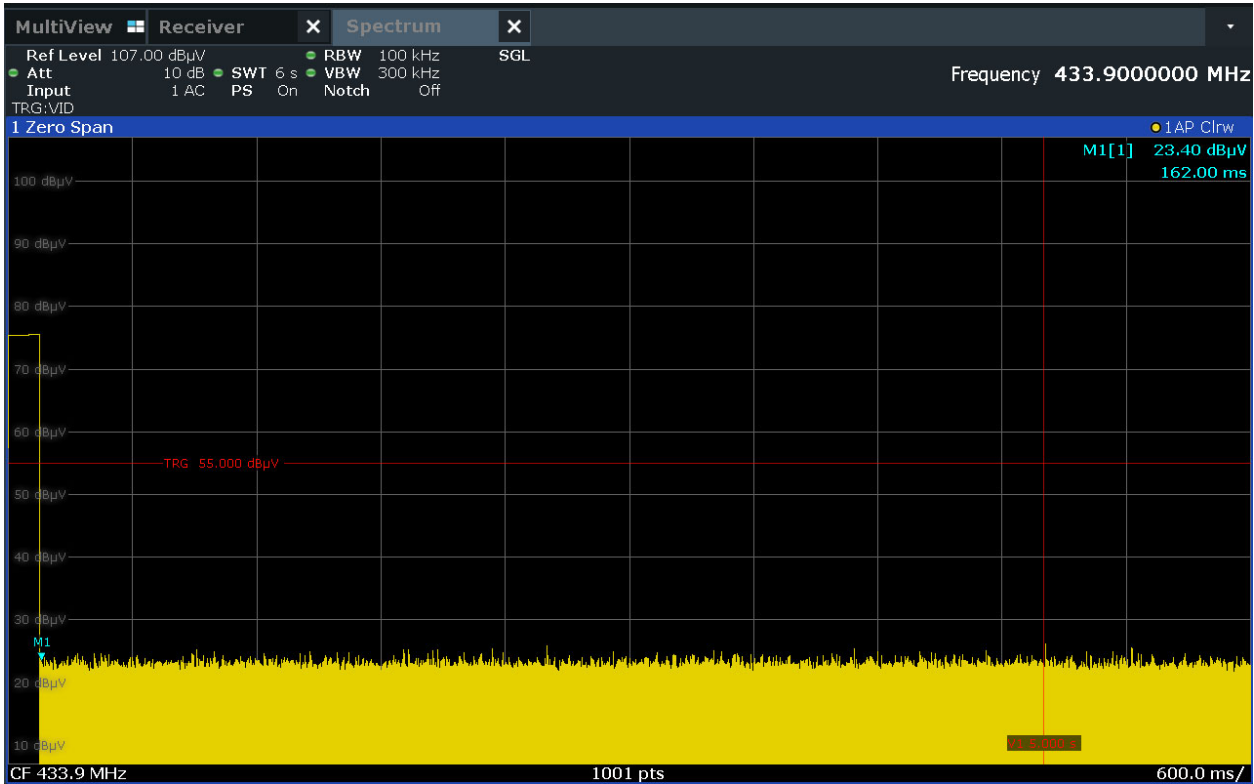
Tx Time

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00009
 Mode : Tx - 433 MHz
 Line Tested : Trigger
 Parameters :
 Date : 12/12/2023 10:40:26 AM
 Notes : NormdB 8.5 dB

TRACE1 : Normal Peak (dBµV) Trace

EUT Compliant

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00012
Mode	Button Press and LF Trigger
Carrier Frequency	433.9 MHz
Parameters	Button Press Operation Time = 162 ms Trigger Operation Time = 156 ms
Notes	None

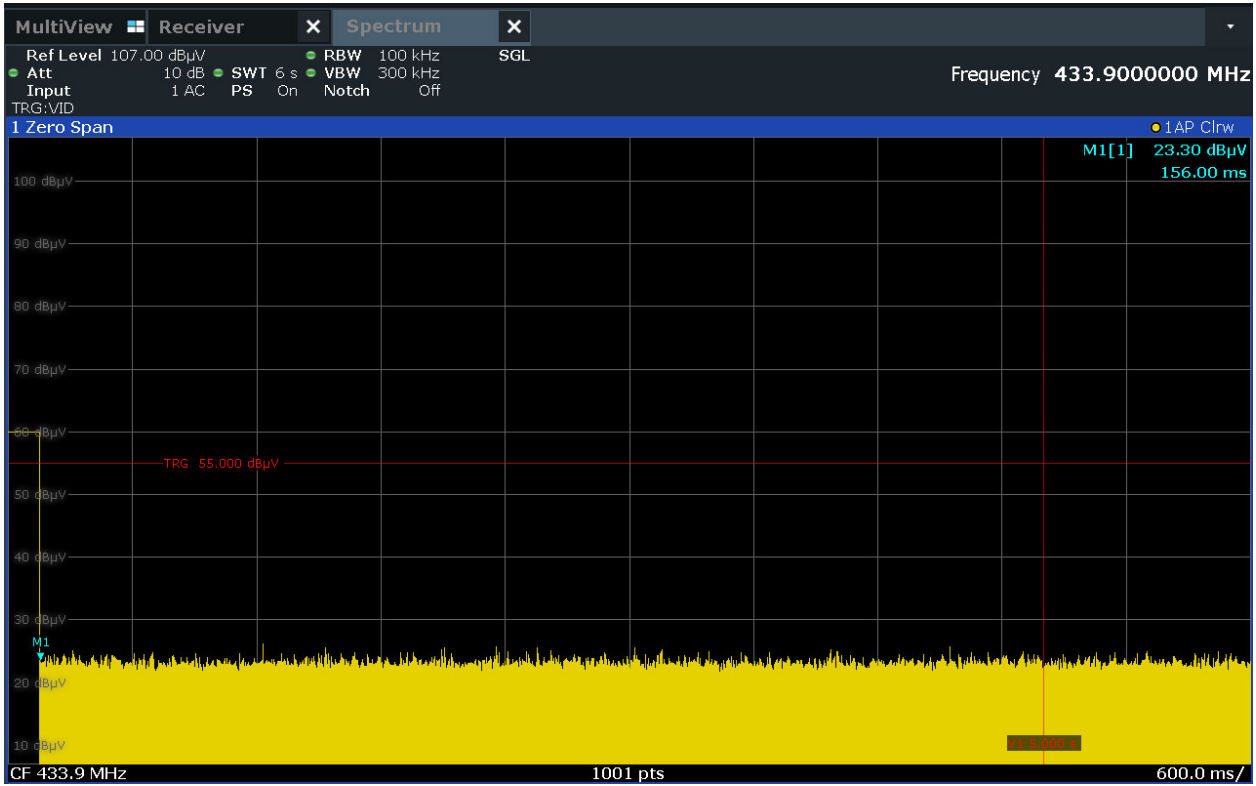


Tx Time

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00012
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/12/2023 10:41:48 AM
 Notes : HidB 9.9 dB

TRACE1 : Normal Peak (dBµV) Trace

EUT Compliant



Tx Time

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00012
 Mode : Tx - 433 MHz
 Line Tested : Trigger
 Parameters :
 Date : 12/12/2023 10:42:28 AM
 Notes : HidB 9.9 dB

TRACE1 : Normal Peak (dBµV) Trace

EUT Compliant

21. Duty Cycle Factor Measurements

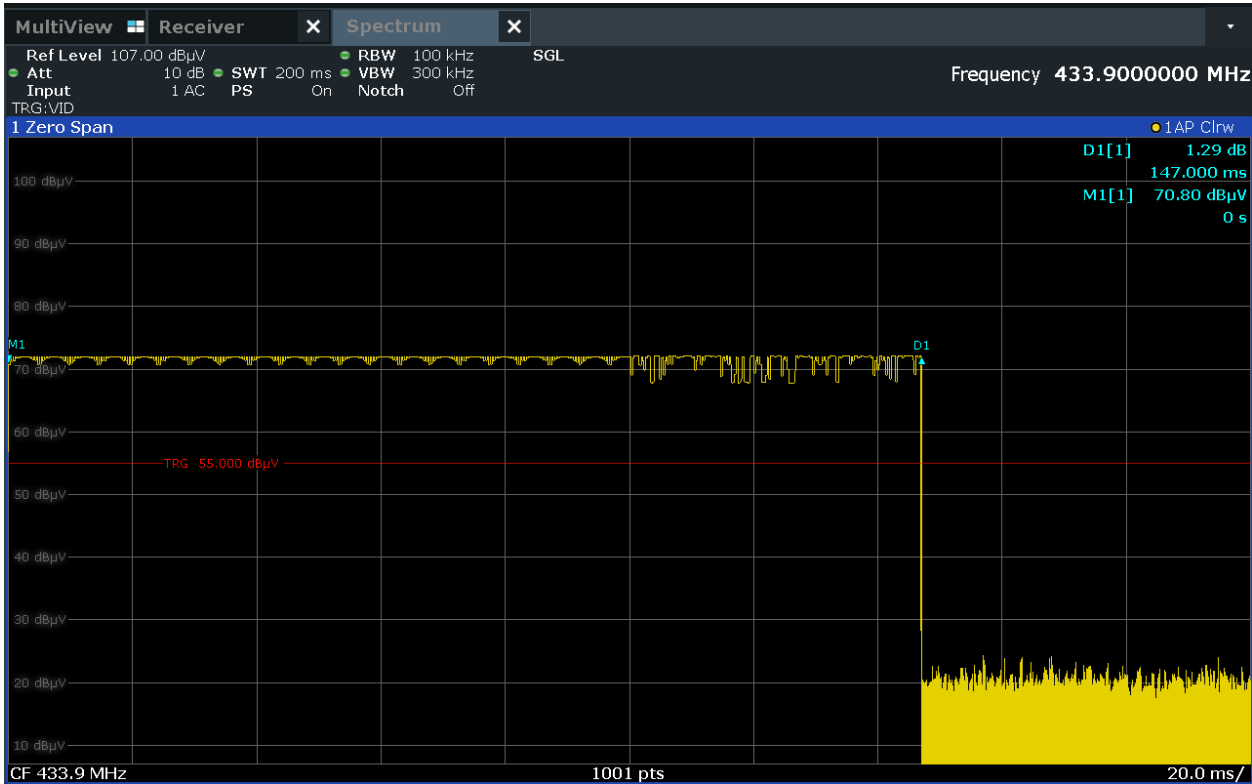
Test Information	
Manufacturer	Morgan Olson, LLC
Product	Key Fob
Model	239027252
Serial No	X00007, X00009 and X00012
Mode	Button Press and LF Trigger
Test Date	12/07/2023 and 12/12/2023

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Workbench
Test site used	N/A
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Procedures
<p>The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal. The following procedure was used to measure a representative sample:</p> <ol style="list-style-type: none"> 1) With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. 2) The pulse width is measured and a plot of this measurement is recorded. 3) Next the number of pulses in the word period is measured and a plot is recorded. 4) Finally the length of the word period is measured and a third plot is recorded. If the word period exceeds 100msec, the word period is limited to 100msec. 5) The pulse width and number of pulses for the word period are used to compute the on-time. The duty cycle is then computed as the (on-time/ word period). 6) The duty cycle factor is computed from the duty cycle.

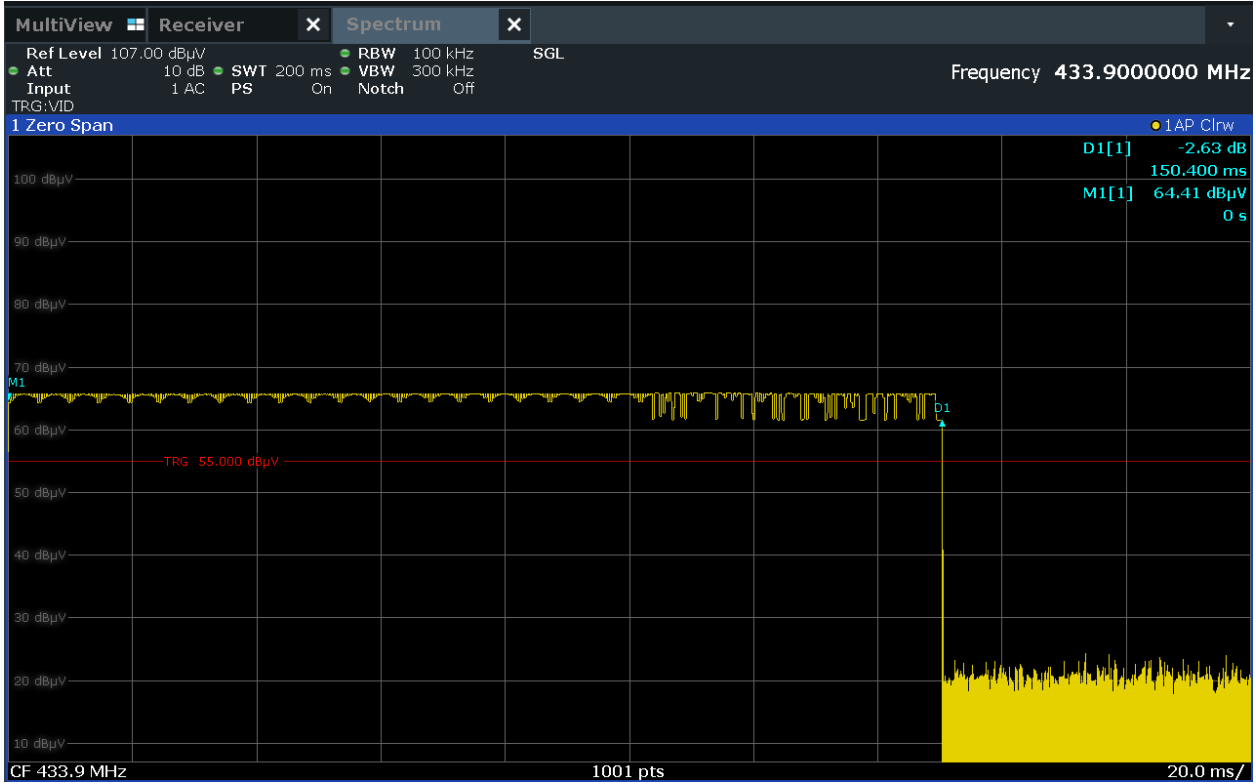
Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00007
Mode	Button Press and LF Trigger
Carrier Frequency	433.9 MHz
Parameters	Button Press On time = 147 ms Trigger On time = 150.4 ms
Notes	None



Duty Cyle

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00007
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/12/2023 10:31:23 AM
 Notes : LodB 6.8 dB

TRACE1 : Normal Peak (dBµV) Trace



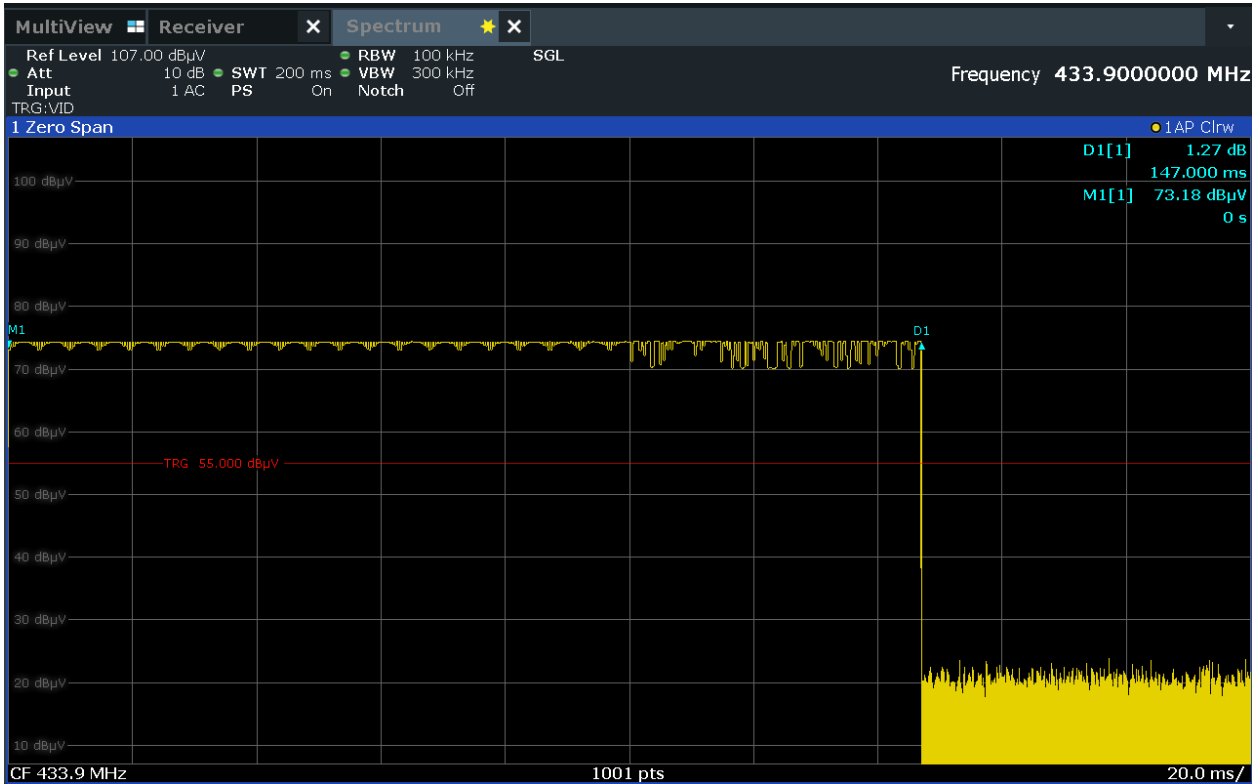
Duty Cyle

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00007
 Mode : Tx - 433 MHz
 Line Tested : Trigger
 Parameters :
 Date : 12/12/2023 10:32:11 AM
 Notes : LodB 6.8 dB

TRACE1 : Normal Peak (dBµV) Trace

Since on time = 146.6 ms, $146.6 > 100$ then Duty Cycle Factor = $20 \log\left(\frac{100 \text{ ms}}{146.6 \text{ ms}}\right) = 0 \text{ dB}$

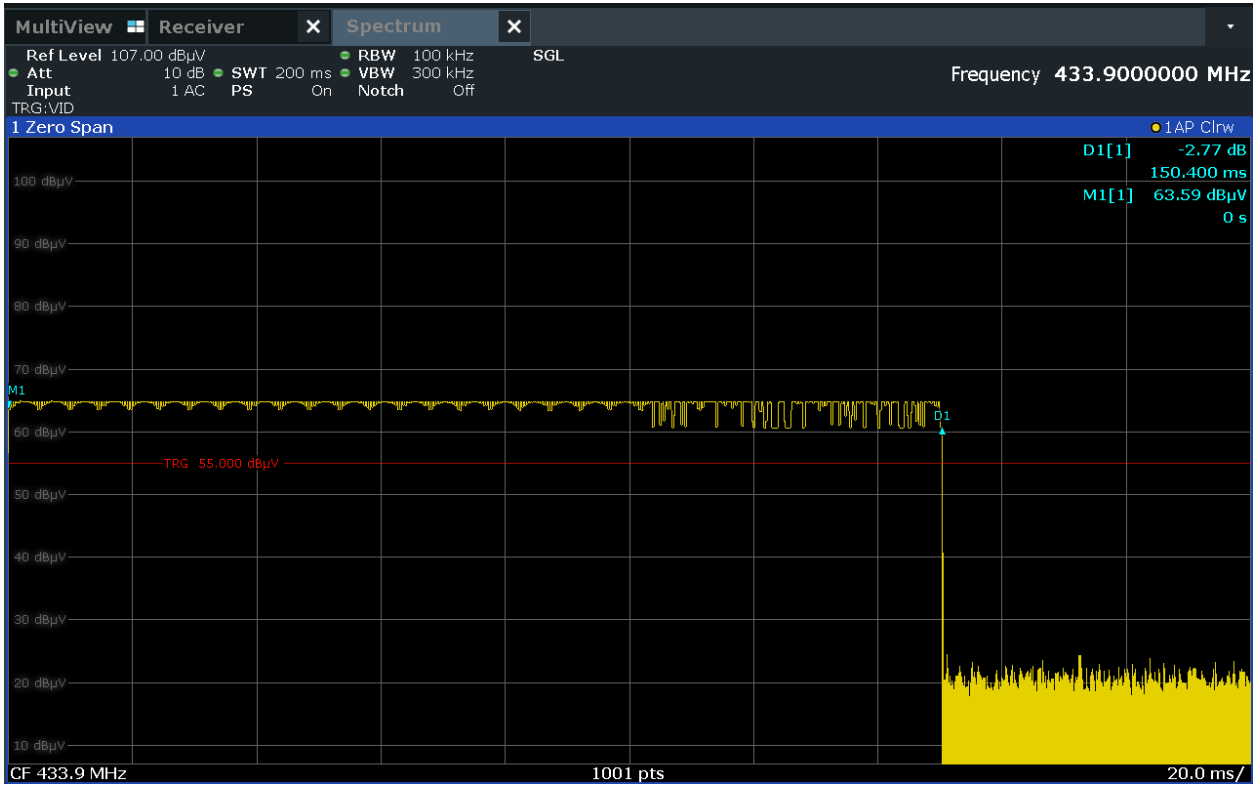
Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00009
Mode	Button Press and LF Trigger
Carrier Frequency	433.9 MHz
Parameters	Button Press On time = 147 ms Trigger On time = 150.4 ms
Notes	None



Duty Cyle

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00009
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/12/2023 10:33:36 AM
 Notes : NormdB 8.5 dB

TRACE1 : Normal Peak (dBµV) Trace



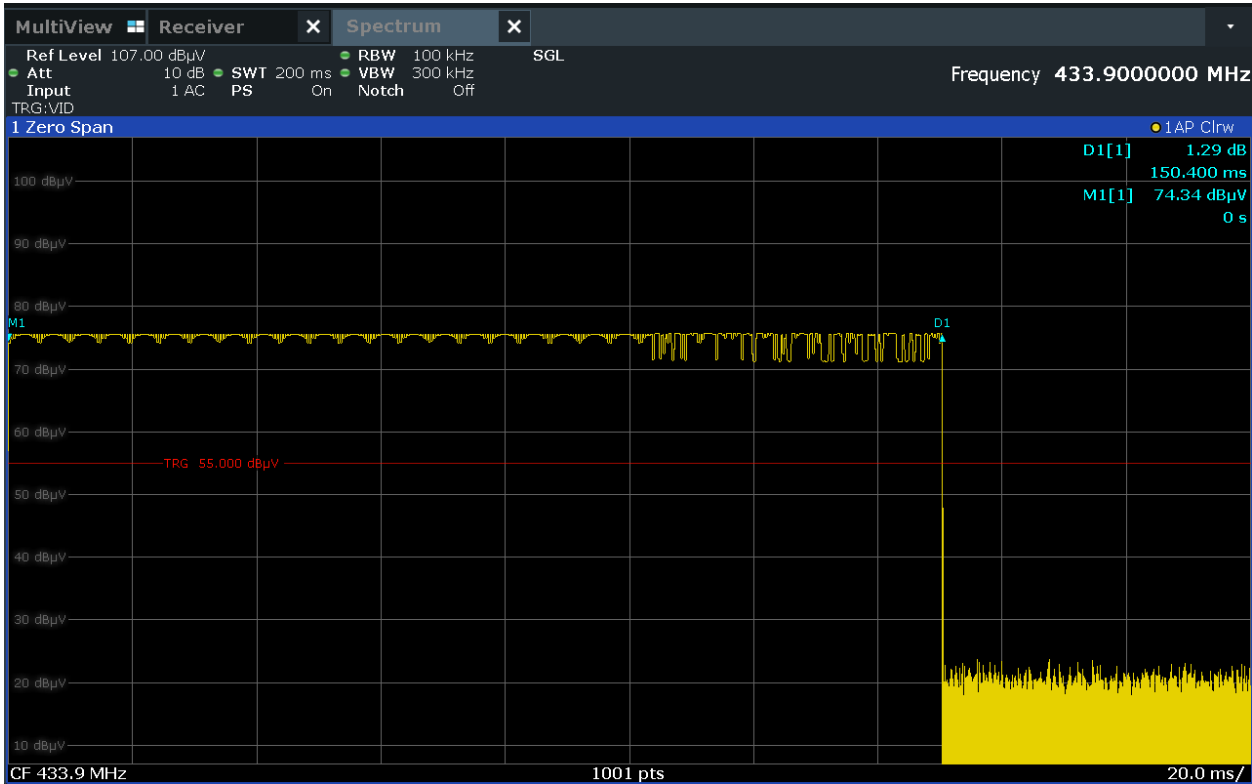
Duty Cycle

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00009
 Mode : Tx - 433 MHz
 Line Tested : Trigger
 Parameters :
 Date : 12/12/2023 10:33:02 AM
 Notes : NormdB 8.5 dB

TRACE1 : Normal Peak (dBµV) Trace

Since on time = 150.4 ms, $150.4 > 100$ then Duty Cycle Factor = $20 \log\left(\frac{100 \text{ ms}}{150.4 \text{ ms}}\right) = 0 \text{ dB}$

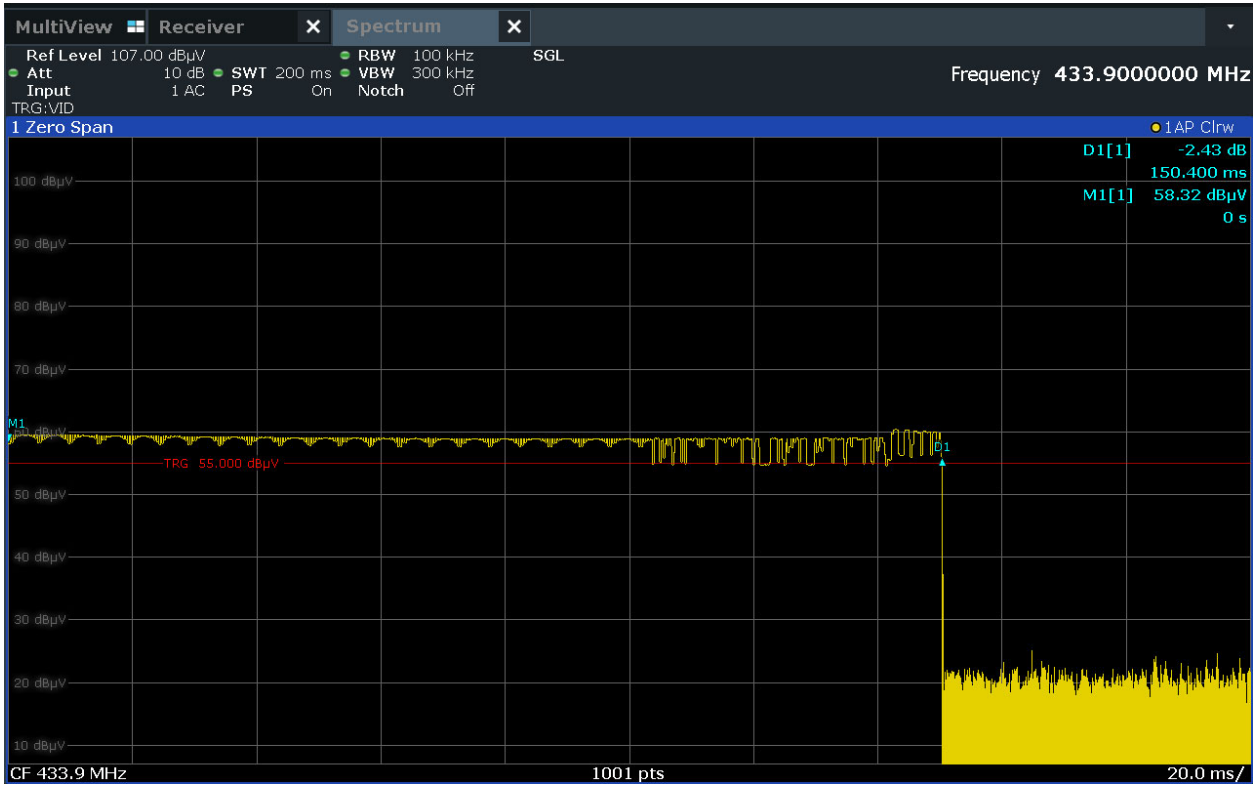
Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00012
Mode	Button Press and LF Trigger
Carrier Frequency	433.9 MHz
Parameters	Button Press On time = 150.4 ms Trigger On time = 150.4 ms
Notes	None



Duty Cyle

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00012
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/12/2023 10:34:27 AM
 Notes : HidB 9.9 dB

TRACE1 : Normal Peak (dBµV) Trace



Duty Cyle

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00012
 Mode : Tx - 433 MHz
 Line Tested : Trigger
 Parameters :
 Date : 12/12/2023 10:34:59 AM
 Notes : HidB 9.9 dB

TRACE1 : Normal Peak (dBµV) Trace

Since on time = 150.4 ms, $150.4 > 100$ then Duty Cycle Factor = $20 \log\left(\frac{100 \text{ ms}}{150.4 \text{ ms}}\right) = 0 \text{ dB}$

22. Spurious Radiated Emissions

Test Information	
Manufacturer	Morgan Olson, LLC
Product	Key Fob
Model	239027252
Serial No	X00006, X00008 and X00010
Mode	Continuous
Test Date	12/08/2023

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Semi-Anechoic Chamber
Test site used	Room 29
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements		
The EUT must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.205 et seq. as well as the requirements of the RSS-GEN specification Section 8.10.		
Carrier Frequency (MHz)	Field Strength of Carrier ($\mu\text{V}/\text{m}$)	Field Strength of Spurious Emissions ($\mu\text{V}/\text{m}$)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750*	375
174-260	3750	375
260-470	3750 to 12500*	375 to 1250*
Above 470	12500	1250

*Linear interpolations

Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

A preliminary radiated emissions test was performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 5GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final emission tests were then manually performed over the frequency range of 30MHz to 5GHz. Between 30MHz and 1000MHz, a bi-log antenna was used as the pick-up device. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

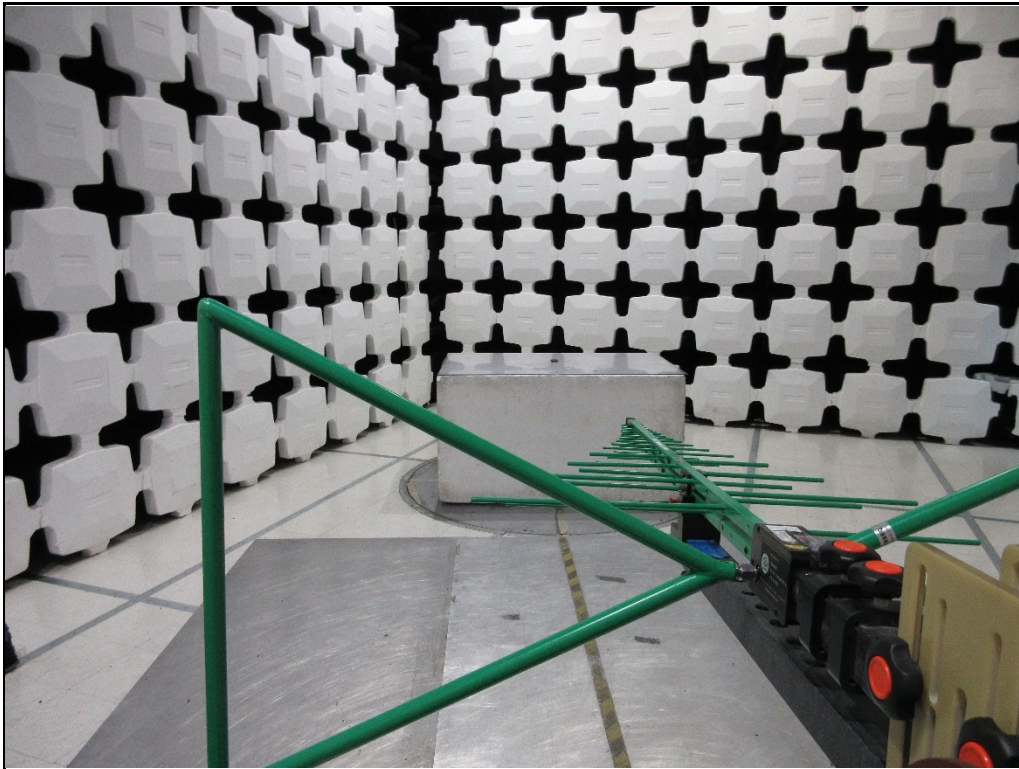
Above 1GHz, a broadband double ridged waveguide antenna was used as the pick-up device. The EUT was placed on an 150cm high non-conductive stand. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.

The peak detected levels were converted to average levels using a duty cycle factor which was computed from the pulse train.

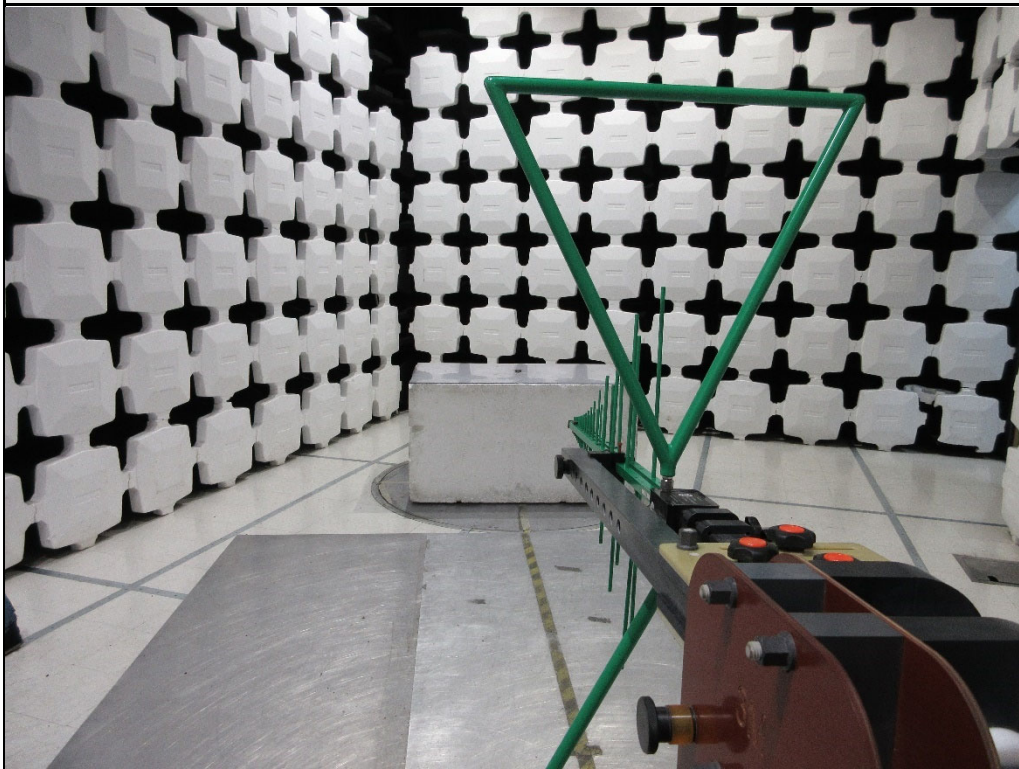
To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

- 1) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
- 2) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
- 3) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
- 4) For hand-held or body-worn devices, the EUT was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.

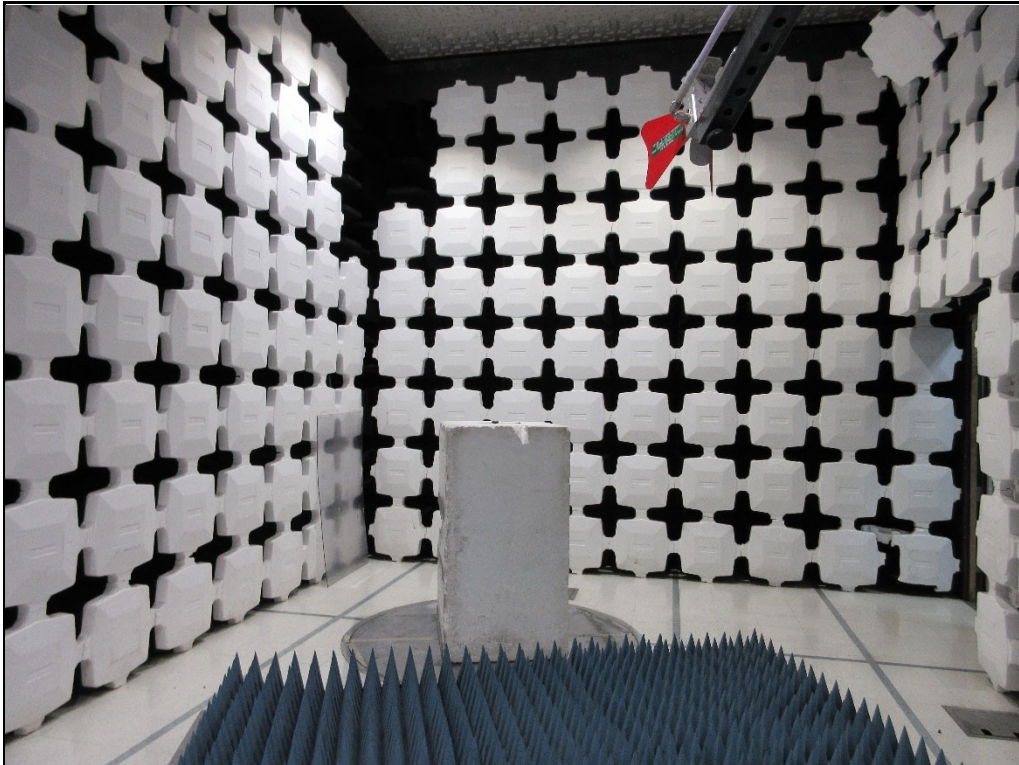
In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer and the antenna cannot be raised to 4 meters. The measuring antenna is raised or lowered as much as the cable will allow and the EUT is rotated through all axis to ensure the maximum readings are recorded.



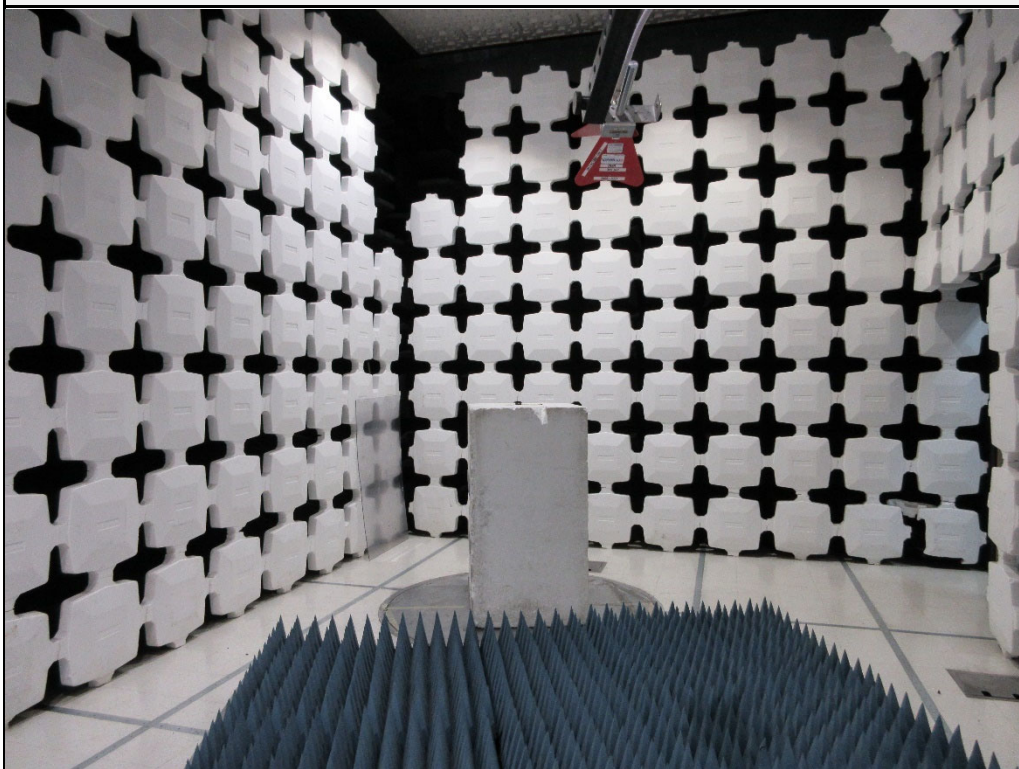
Test Setup for Spurious Radiated Emissions, 30-1000MHz – Antenna Polarization Horizontal



Test Setup for Spurious Radiated Emissions, 30-1000MHz – Antenna Polarization Vertical



Test Setup for Spurious Radiated Emissions, Above 1GHz – Antenna Polarization Horizontal



Test Setup for Spurious Radiated Emissions, Above 1GHz – Antenna Polarization Vertical

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00006
Mode	Continuous
Carrier Frequency	433 MHz
Requirements	Field Strength of Carrier Limit = 6402.5µV/m
Notes	None

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
433.000	H	45.6		1.1	22.2	0.0	0.0	68.9	2788.4	10958.3	-11.9
433.000	V	52.9		1.1	22.2	0.0	0.0	76.1	6402.5	10958.3	-4.7
866.000	H	5.0	*	1.5	26.3	0.0	0.0	32.9	43.9	1095.8	-27.9
866.000	V	6.9	*	1.5	26.3	0.0	0.0	34.7	54.6	1095.8	-26.1
1299.000	H	51.8	*	1.9	28.8	-40.6	0.0	42.0	125.3	1095.8	-18.8
1299.000	V	52.1	*	1.9	28.8	-40.6	0.0	42.2	129.5	1095.8	-18.6
1732.000	H	50.3	*	2.2	29.9	-40.1	0.0	42.3	129.9	1095.8	-18.5
1732.000	V	50.2	*	2.2	29.9	-40.1	0.0	42.2	128.9	1095.8	-18.6
2165.000	H	51.1	*	2.5	31.9	-39.9	0.0	45.6	191.0	1095.8	-15.2
2165.000	V	50.3	*	2.5	31.9	-39.9	0.0	44.8	174.6	1095.8	-16.0
2598.000	H	49.6	*	2.7	32.7	-39.8	0.0	45.2	181.2	1095.8	-15.6
2598.000	V	50.1	*	2.7	32.7	-39.8	0.0	45.7	192.0	1095.8	-15.1
3031.000	H	53.7	*	3.0	33.0	-39.6	0.0	50.1	320.3	1095.8	-10.7
3031.000	V	49.4	*	3.0	33.0	-39.6	0.0	45.8	195.7	1095.8	-15.0
3464.000	H	50.8	*	3.2	33.2	-39.2	0.0	48.0	249.9	1095.8	-12.8
3464.000	V	49.3	*	3.2	33.2	-39.2	0.0	46.4	210.0	1095.8	-14.4
3897.000	H	49.8	*	3.4	33.5	-39.2	0.0	47.5	236.0	500.0	-6.5
3897.000	V	49.0	*	3.4	33.5	-39.2	0.0	46.7	215.5	500.0	-7.3
4330.000	H	51.4	*	3.5	33.9	-39.2	0.0	49.7	304.3	500.0	-4.3
4330.000	V	49.9	*	3.5	33.9	-39.2	0.0	48.1	253.4	500.0	-5.9

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00008
Mode	Continuous
Carrier Frequency	433 MHz
Requirements	Field Strength of Carrier Limit = 8362.7µV/m
Notes	None

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
433.000	H	50.5		1.1	22.2	0.0	0.0	73.7	4856.8	10958.3	-7.1
433.000	V	55.2		1.1	22.2	0.0	0.0	78.4	8362.7	10958.3	-2.3
866.000	H	4.6	*	1.5	26.3	0.0	0.0	32.5	42.0	1095.8	-28.3
866.000	V	9.8	*	1.5	26.3	0.0	0.0	37.7	76.5	1095.8	-23.1
1299.000	H	51.5	*	1.9	28.8	-40.6	0.0	41.6	120.4	1095.8	-19.2
1299.000	V	53.0	*	1.9	28.8	-40.6	0.0	43.1	142.8	1095.8	-17.7
1732.000	H	50.5	*	2.2	29.9	-40.1	0.0	42.5	132.9	1095.8	-18.3
1732.000	V	50.4	*	2.2	29.9	-40.1	0.0	42.4	131.9	1095.8	-18.4
2165.000	H	49.9	*	2.5	31.9	-39.9	0.0	44.4	166.7	1095.8	-16.4
2165.000	V	50.7	*	2.5	31.9	-39.9	0.0	45.2	182.2	1095.8	-15.6
2598.000	H	52.2	*	2.7	32.7	-39.8	0.0	47.8	246.1	1095.8	-13.0
2598.000	V	49.9	*	2.7	32.7	-39.8	0.0	45.5	188.4	1095.8	-15.3
3031.000	H	51.3	*	3.0	33.0	-39.6	0.0	47.7	242.4	1095.8	-13.1
3031.000	V	49.3	*	3.0	33.0	-39.6	0.0	45.7	192.8	1095.8	-15.1
3464.000	H	51.4	*	3.2	33.2	-39.2	0.0	48.5	267.4	1095.8	-12.3
3464.000	V	49.6	*	3.2	33.2	-39.2	0.0	46.8	218.1	1095.8	-14.0
3897.000	H	49.6	*	3.4	33.5	-39.2	0.0	47.3	231.7	500.0	-6.7
3897.000	V	49.4	*	3.4	33.5	-39.2	0.0	47.1	225.9	500.0	-6.9
4330.000	H	49.0	*	3.5	33.9	-39.2	0.0	47.2	228.7	500.0	-6.8
4330.000	V	49.4	*	3.5	33.9	-39.2	0.0	47.6	241.1	500.0	-6.3

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00010
Mode	Continuous
Carrier Frequency	433 MHz
Requirements	Field Strength of Carrier Limit = 9791.5µV/m
Notes	None

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
433.000	H	46.0		1.1	22.2	0.0	0.0	69.2	2896.3	10958.3	-11.6
433.000	V	56.5		1.1	22.2	0.0	0.0	79.8	9791.5	10958.3	-1.0
866.000	H	9.3		1.5	26.3	0.0	0.0	37.2	72.3	1095.8	-23.6
866.000	V	11.1		1.5	26.3	0.0	0.0	39.0	88.8	1095.8	-21.8
1299.000	H	51.2	*	1.9	28.8	-40.6	0.0	41.3	116.6	1095.8	-19.5
1299.000	V	50.8	*	1.9	28.8	-40.6	0.0	40.9	111.1	1095.8	-19.9
1732.000	H	50.7	*	2.2	29.9	-40.1	0.0	42.7	136.5	1095.8	-18.1
1732.000	V	50.6	*	2.2	29.9	-40.1	0.0	42.5	134.0	1095.8	-18.3
2165.000	H	55.5	*	2.5	31.9	-39.9	0.0	50.0	317.7	1095.8	-10.8
2165.000	V	51.5	*	2.5	31.9	-39.9	0.0	45.9	198.4	1095.8	-14.8
2598.000	H	52.3	*	2.7	32.7	-39.8	0.0	47.9	247.9	1095.8	-12.9
2598.000	V	50.0	*	2.7	32.7	-39.8	0.0	45.5	189.1	1095.8	-15.3
3031.000	H	51.7	*	3.0	33.0	-39.6	0.0	48.1	253.8	1095.8	-12.7
3031.000	V	50.4	*	3.0	33.0	-39.6	0.0	46.7	217.3	1095.8	-14.1
3464.000	H	52.6	*	3.2	33.2	-39.2	0.0	49.7	306.0	1095.8	-11.1
3464.000	V	49.5	*	3.2	33.2	-39.2	0.0	46.6	214.9	1095.8	-14.2
3897.000	H	52.4	*	3.4	33.5	-39.2	0.0	50.1	319.1	500.0	-3.9
3897.000	V	48.7	*	3.4	33.5	-39.2	0.0	46.4	209.4	500.0	-7.6
4330.000	H	50.0	*	3.5	33.9	-39.2	0.0	48.3	259.0	500.0	-5.7
4330.000	V	49.9	*	3.5	33.9	-39.2	0.0	48.1	255.1	500.0	-5.8

23. Occupied Bandwidth Measurements

Test Information	
Manufacturer	Morgan Olson, LLC
Product	Key Fob
Model	239027252
Serial No	X00007, X00009 and X00012
Mode	Button Press
Test Date	12/06/2023

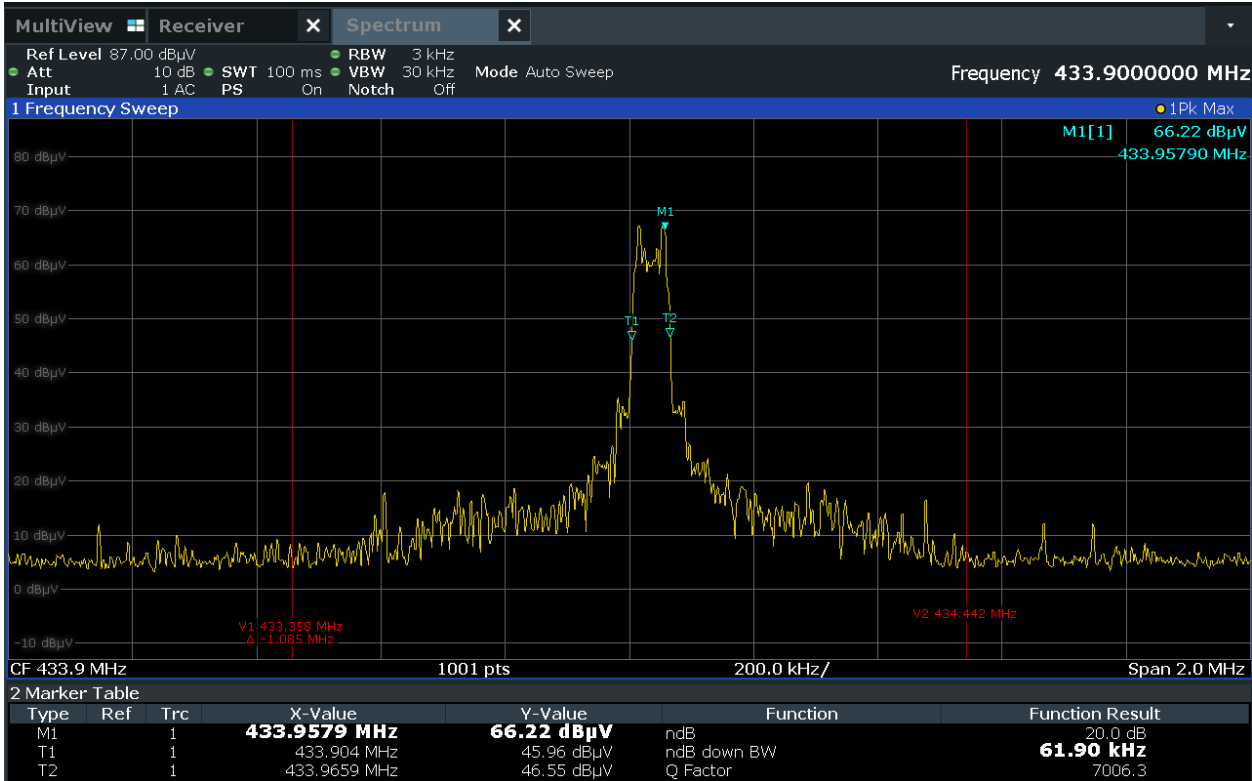
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Workbench
Test site used	N/A
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Requirements
<p>FCC 15.231(c):</p> <p>The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.</p> <p><u>RSS-210, Annex A, Section A.1.3:</u></p> <p>The occupied bandwidth (99% Bandwidth) of momentarily operated devices shall be less than or equal to 0.25% of the center frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the occupied bandwidth shall be less than or equal to 0.5% of the center frequency.</p>

Procedures
<p>A near-field antenna was placed near the EUT. The unit was set to transmit continuously. With an antenna positioned nearby, occupied bandwidth emissions were displayed on the spectrum analyzer. The resolution bandwidth was set to 3kHz and span was set to 2MHz. A screen capture was taken of the frequency spectrum near the carrier using a screen dump function on the spectrum analyzer.</p>
Test Details

Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00007
Mode	Button Press
Carrier Frequency	433.9 MHz
Parameters	20dB BW = 61.9 kHz
Notes	None



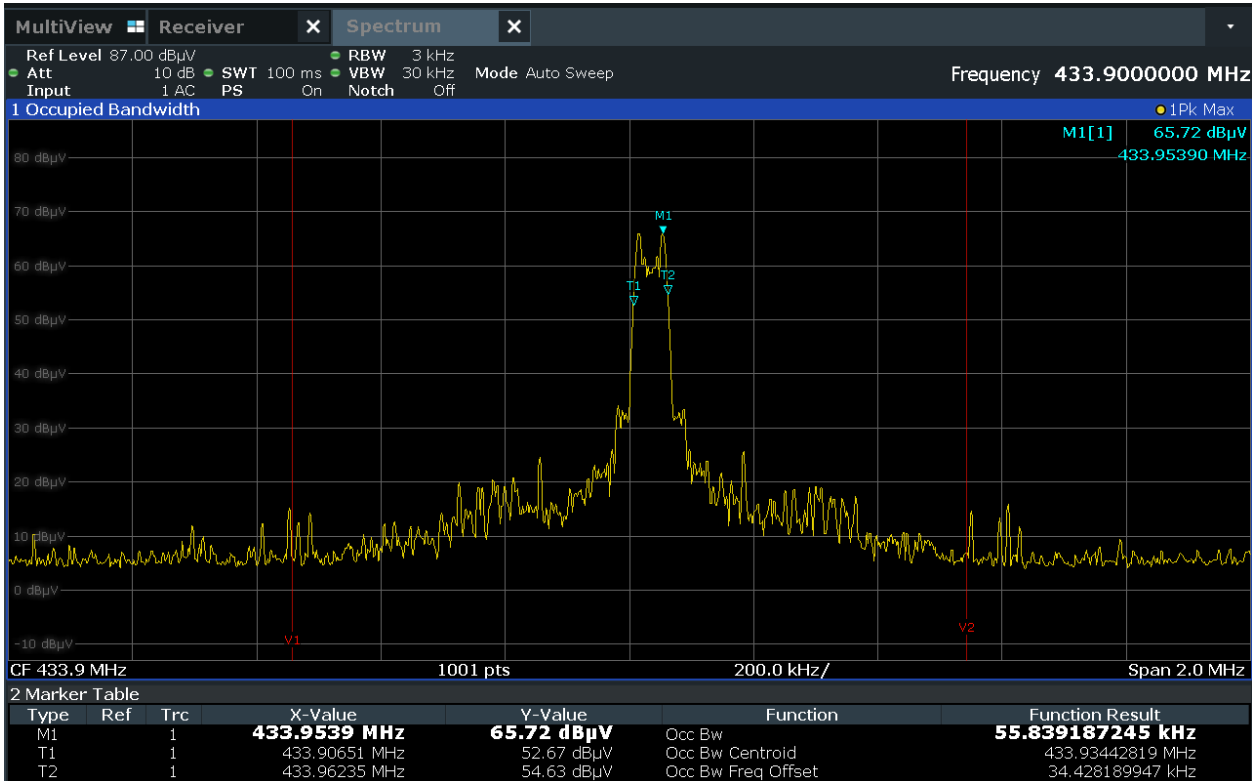
OBW 20 dB

Manufacturer : TouchTronics, Inc.
Model Number : 239027252
Serial Number : X00007
Mode : Tx - 433 MHz
Line Tested : Button Press
Parameters :
Date : 12/6/2023 11:29:56 AM
Notes : LodB 6.8 dB

TRACE1 : Function plot of Max Hold Peak

EUT meets requirement.

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00007
Mode	Button Press
Carrier Frequency	433.9 MHz
Parameters	99% BW = 55.84 kHz
Notes	None

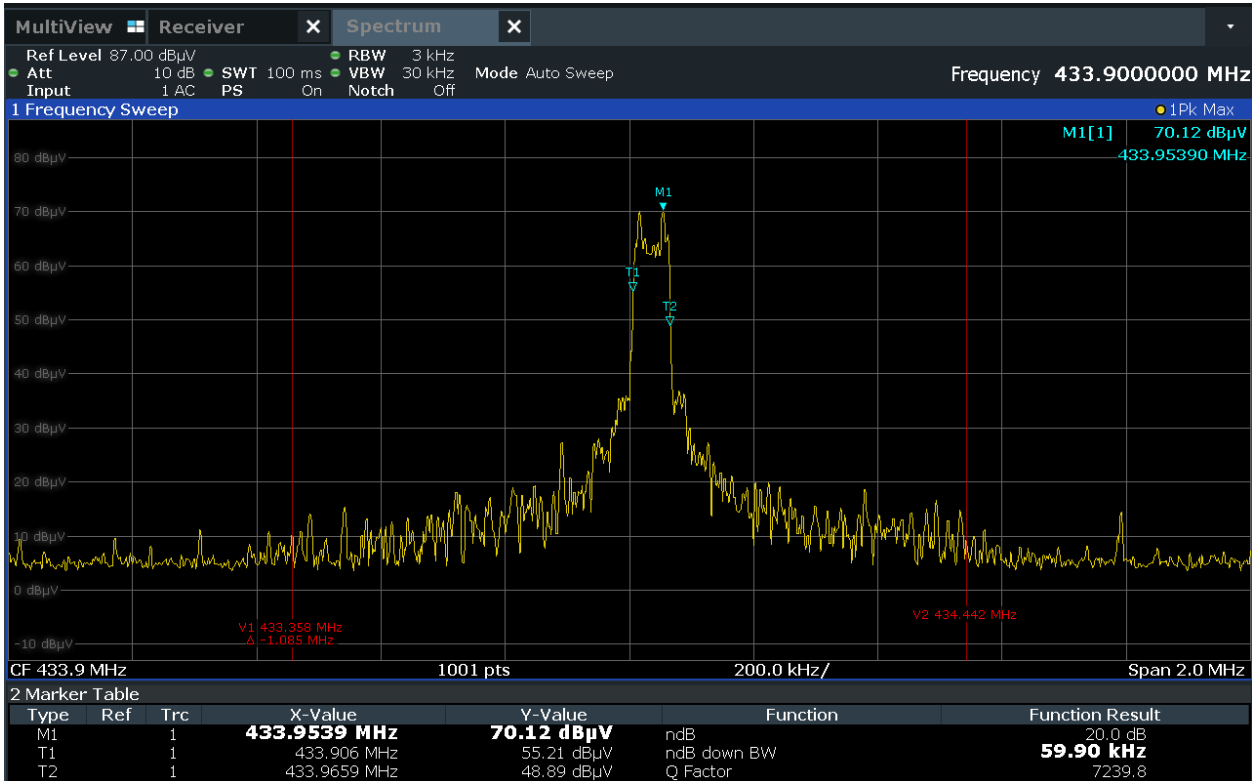


99% BW

Manufacturer : TouchTronics, Inc.
Model Number : 239027252
Serial Number : X00007
Mode : Tx - 433 MHz
Line Tested : Button Press
Parameters :
Date : 12/6/2023 12:48:27 PM
Notes : LodB 6.8 dB

TRACE1 : Function plot of Max Hold Peak

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00009
Mode	Button Press
Carrier Frequency	433.9 MHz
Parameters	20dB BW = 59.9 kHz
Notes	None



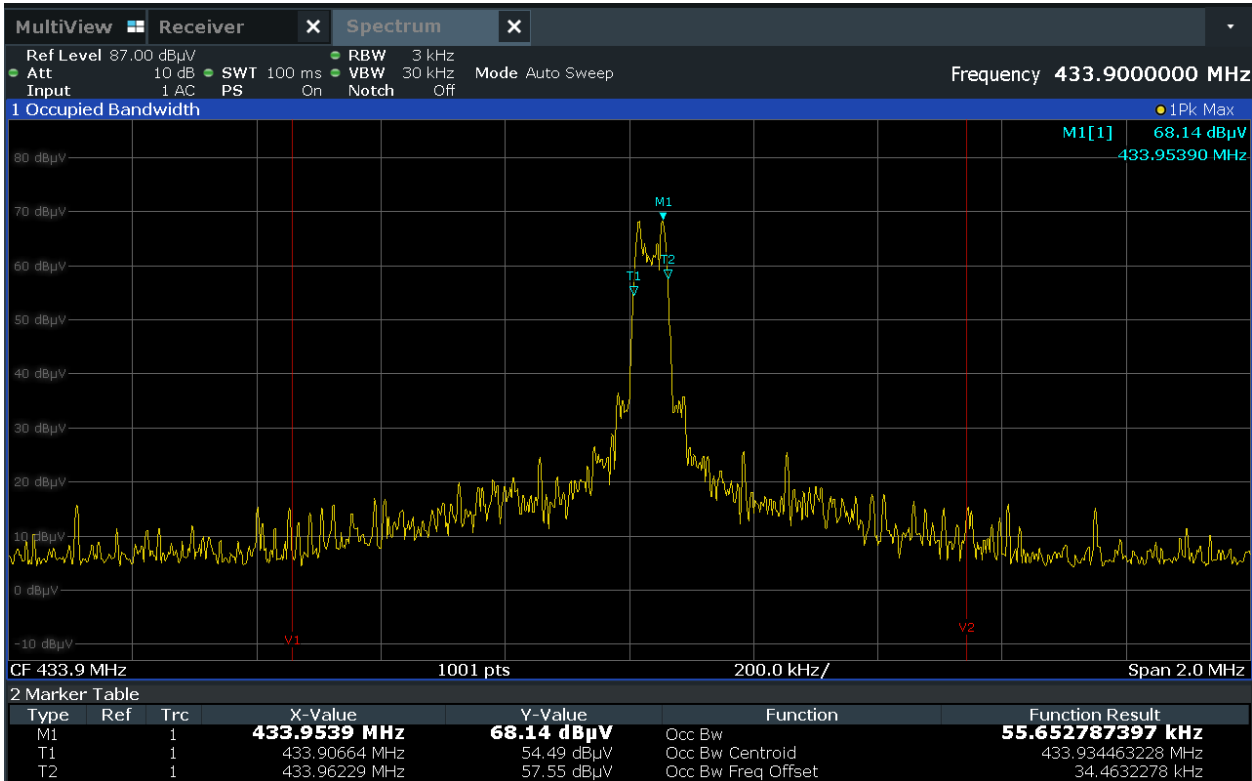
OBW 20 dB

Manufacturer : TouchTronics, Inc.
Model Number : 239027252
Serial Number : X00009
Mode : Tx - 433 MHz
Line Tested : Button Press
Parameters :
Date : 12/6/2023 11:32:32 AM
Notes : NormdB 8.5 dB

TRACE1 : Function plot of Max Hold Peak

EUT meets requirement.

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00009
Mode	Button Press
Carrier Frequency	433.9 MHz
Parameters	99% BW = 55.65
Notes	None

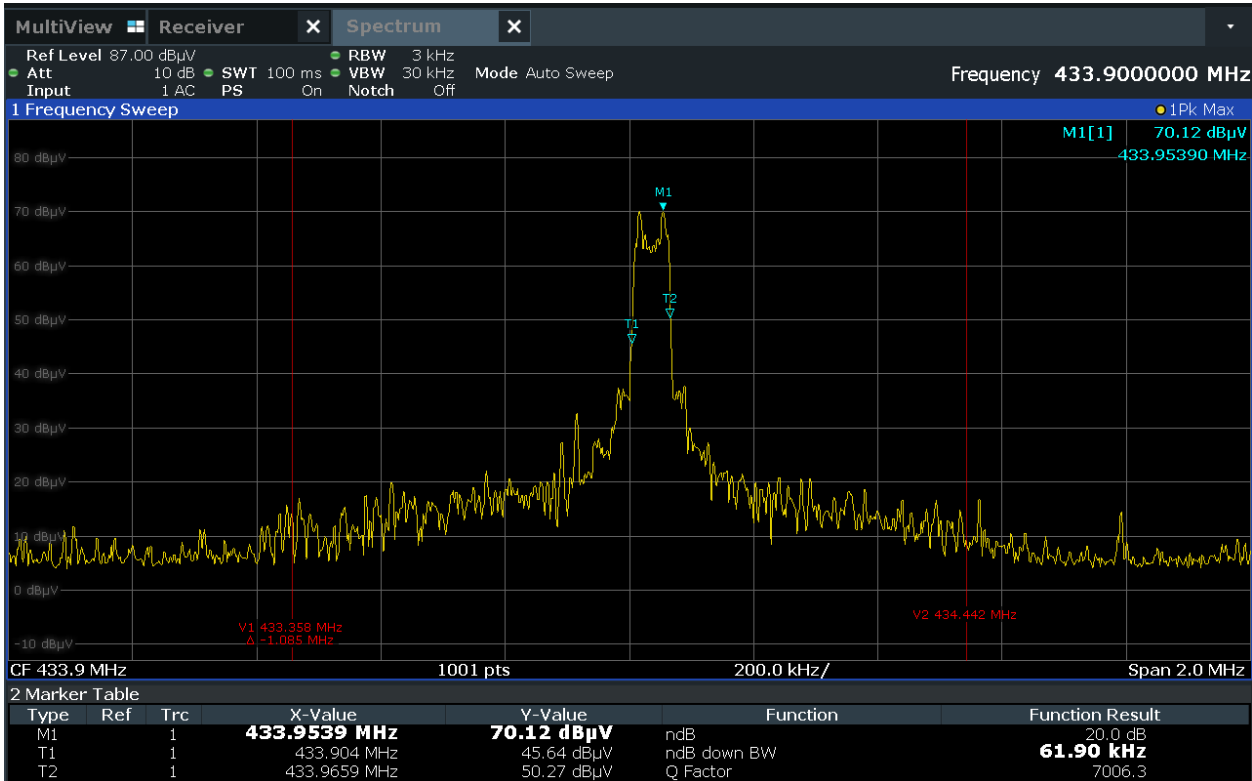


99% BW

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00009
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/6/2023 12:48:51 PM
 Notes : NormdB 8.5 dB

TRACE1 : Function plot of Max Hold Peak

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00012
Mode	Button Press
Carrier Frequency	433.9 MHz
Parameters	20dB BW = 61.9 kHz
Notes	None



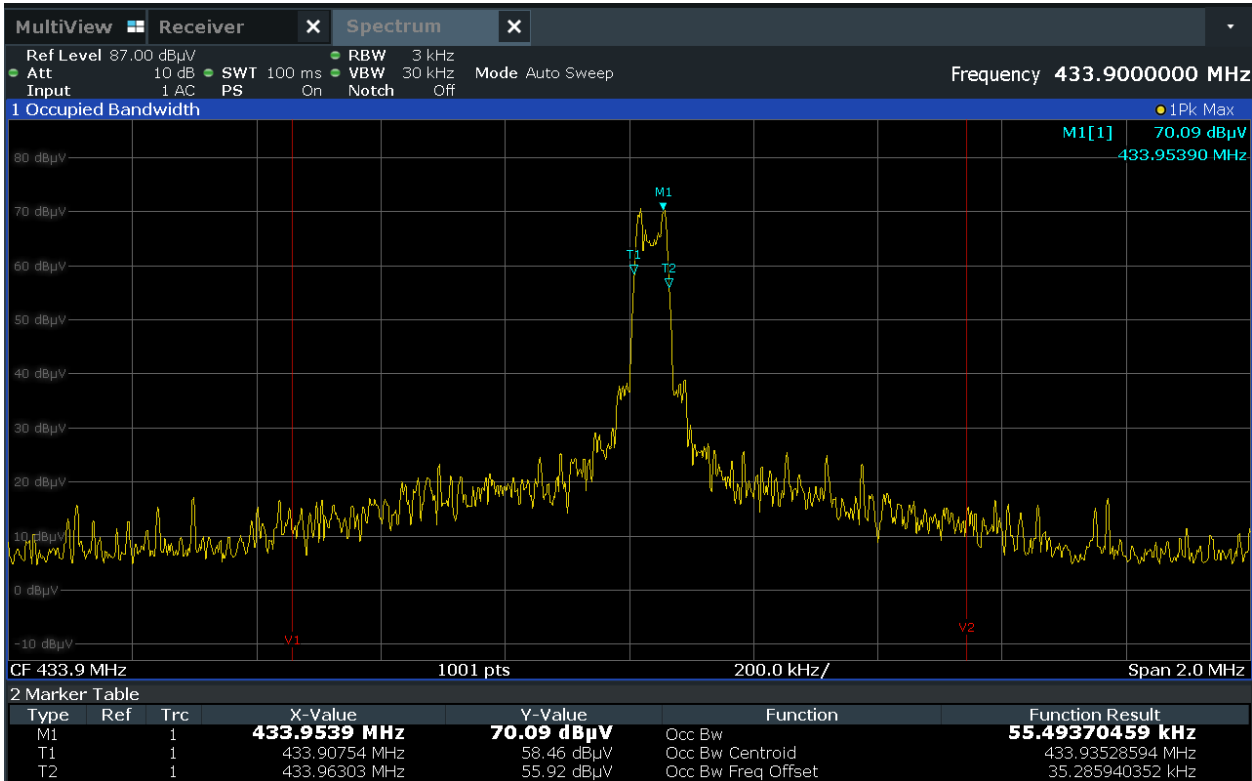
OBW 20 dB

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00012
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/6/2023 11:33:02 AM
 Notes : HidB 9.9 dB

TRACE1 : Function plot of Max Hold Peak

EUT meets requirement.

Test Details	
Manufacturer	Morgan Olson, LLC
Model	239027252
S/N	X00012
Mode	Button Press
Carrier Frequency	433.9 MHz
Parameters	99% BW = 55.49 kHz
Notes	None



99% BW

Manufacturer : TouchTronics, Inc.
 Model Number : 239027252
 Serial Number : X00012
 Mode : Tx - 433 MHz
 Line Tested : Button Press
 Parameters :
 Date : 12/6/2023 12:49:26 PM
 Notes : HidB 9.9 dB

TRACE1 : Function plot of Max Hold Peak

24. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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ELECTRICAL

Valid To: June 30, 2025

Certificate Number: 1786.01

In recognition of the successful completion of the A2LA Accreditation Program evaluation process, accreditation is granted to this laboratory to perform the following automotive electromagnetic compatibility and other electrical tests:

Test Technology:**Test Method(s)¹:**

Transient Immunity
(Max Voltage 60V/Max current 100A)

ISO 7637-2 (including emissions); ISO 7637-3;
ISO 16750-2:2012, Sections 4.6.3 and 4.6.4;
CS-11979, Section 6.4; CS.00054, Section 5.9;
EMC-CS-2009.1 (CI220); FMC1278 (CI220, CI221, CI222);
GMW 3097, Section 3.5; SAE J1113-11; SAE J1113-12;
ECE Regulation 10.06 Annex 10

Electrostatic Discharge (ESD)
(Up to +/-25kV)

ISO 10605 (2001, 2008);
CS-11979 Section 7.0; CS.00054, Section 5.10;
EMC-CS-2009.1 (CI 280); FMC1278 (CI280); SAE J1113-13;
GMW 3097 Section 3.6

Conducted Emissions

CISPR 25 (2002, 2008), Sections 6.2 and 6.3;
CISPR 25 (2016), Sections 6.3 and 6.4;
CS-11979, Section 5.1; CS.00054, Sections 5.6.1 and 5.6.2;
GMW 3097, Section 3.3.2;
EMC-CS-2009.1 (CE 420); FMC1278 (CE420, CE421,
CE 430, CE440)

Test Technology:

Test Method(s)¹:

*Radiated Emissions Anechoic
(Up to 6GHz)*

CISPR 25 (2002, 2008), Section 6.4;
CISPR 25 (2016), Section 6.5;
CS-11979, Section 5.3; CS.00054, Section 5.6.3;
GMW 3097, Section 3.3.1;
EMC-CS-2009.1 (RE 310); FMC1278 (RE310, RE320);

Vehicle Radiated Emissions

CISPR 12; CISPR 36; ICES-002;
ECE Regulation 10.06 Annex 5

*Bulk Current Injection (BCI)
(1 to 400MHz 500mA)*

ISO 11452-4; CS-11979, Section 6.1; CS.00054, Section 5.8.1;
GMW 3097, Section 3.4.1; SAE J1113-4;
EMC-CS-2009.1 (RI112); FMC1278 (RI112);
ECE Regulation 10.06 Annex 9

*Radiated Immunity Anechoic
(Up to 6GHz and 200V/m)
(Including Radar Pulse 600V/m)*

ISO 11452-2;
CS-11979, Section 6.2; CS.00054, Section 5.8.2;
GMW 3097, Section 3.4.2;
EMC-CS-2009.1 (RI114); FMC1278 (RI114); SAE J1113-21;
ECE Regulation 10.06 Annex 9

Radiated Immunity Magnetic Field

ISO 11452-8; FMC 1278 (RI140)

*Radiated Immunity Reverb
(360MHz to 6GHz and 100V/m)*

ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3;
EMC-CS-2009.1 (RI114); FMC1278 (RI114);
ISO 11452-11

*Radiated Immunity
(Portable Transmitters)
(Up to 6GHz and 20W)*

ISO 11452-9;
EMC-CS-2009.1 (RI115); FMC1278 (RI115);
GMW 3097, Sec 3.4.4

Vehicle Radiated Immunity (ALSE)

ISO 11451-2; ECE Regulation 10.06 Annex 6

*Vehicle Product Specific EMC
Standards*

EN 14982; EN ISO 13309; ISO 13766; EN 50498;
EC Regulation No. 2015/208; EN 55012

Electrical Loads

ISO 16750-2

Stripline

ISO 11452-5

*Transverse Electromagnetic (TEM)
Cell*

ISO 11452-3

Test Technology:

Test Method(s)¹:

Emissions

Radiated and Conducted
(3m Semi-anechoic chamber,
up to 40 GHz)

47 CFR, FCC Part 15 B (using ANSI C63.4:2014);
47 CFR, FCC Part 18 (using FCC MP-5:1986);
ICES-001; ICES-003; ICES-005;
IEC/CISPR 11, Ed. 4.1 (2004-06); AS/NZS CISPR 11 (2004);
IEC/CISPR 11 Ed 5 (2009-05) + A1 (2010);
KN 11 (2008-5) with RRL Notice No. 2008-3 (May 20, 2008);
CISPR 11; EN 55011; KS C 9811; CNS 13803 (1997, 2003);
CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1;
CISPR 16-2-1 (2008); CISPR 16-2-1; KS C 9814-1; KN 14-1;
IEC/CISPR 22 (1997);
EN 55022 (1998) + A1(2000);
EN 55022 (1998) + A1(2000) + A2(2003); EN 55022 (2006);
IEC/CISPR 22 (2008-09); AS/NZS CISPR 22 (2004);
AS/NZS CISPR 22, 3rd Edition (2006); KN 22 (up to 6 GHz);
CNS 13438 (up to 6 GHz); VCCI V-3 (up to 6 GHz);
CISPR 32; EN 55032; KS C 9832; KN 32;
ECE Regulation 10.06 Annex 7 (Broadband);
ECE Regulation 10.06 Annex 8 (Narrowband);
ECE Regulation 10.06 Annex 14 (Conducted)

Cellular Radiated Spurious Emissions

ETSI TS 151 010-1 GSM; 3GPP TS 51.010-1, Sec 12;
ETSI TS 134 124 UMTS; 3GPP TS 34.124;
ETSI TS 136 124 LTE; E-UTRA; 3GPP TS 36.124

Current Harmonics

IEC 61000-3-2; IEC 61000-3-12;
EN 61000-3-2; KN 61000-3-2;
KS C 9610-3-2; ECE Regulation 10.06 Annex 11

Flicker and Fluctuations

IEC 61000-3-3; IEC 61000-3-11;
EN 61000-3-3; KN 61000-3-3;
KS C 9610-3-3; ECE Regulation 10.06 Annex 12

Immunity

Electrostatic Discharge

IEC 61000-4-2, Ed. 1.2 (2001);
IEC 61000-4-2 (1995) + A1(1998) + A2(2000);
EN 61000-4-2 (1995); EN 61000-4-2 (2009-05);
KN 61000-4-2 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-2; EN 61000-4-2; KN 61000-4-2;
KS C 9610-4-2; IEEE C37.90.3 2001

Radiated Immunity

IEC 61000-4-3 (1995) + A1(1998) + A2(2000);
IEC 61000-4-3, Ed. 3.0 (2006-02);
IEC 61000-4-3, Ed. 3.2 (2010);
KN 61000-4-3 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-3; EN 61000-4-3; KN 61000-4-3;
KS C 9610-4-3; IEEE C37.90.2 2004

Test Technology:

Test Method(s)¹:

Immunity (cont'd)

Electrical Fast Transient/Burst

IEC 61000-4-4, Ed. 2.0 (2004-07);
 IEC 61000-4-4, Ed. 2.1 (2011);
 IEC 61000-4-4 (1995) + A1(2000) + A2(2001);
 KN 61000-4-4 (2008-5);
 RRL Notice No. 2008-5 (May 20, 2008);
 IEC 61000-4-4; EN 61000-4-4; KN 61000-4-4;
 KS C 9610-4-4; ECE Regulation 10.06 Annex 15

Surge

IEC 61000-4-5 (1995) + A1(2000);
 IEC 61000-4-5, Ed 1.1 (2005-11);
 EN 61000-4-5 (1995) + A1(2001);
 KN 61000-4-5 (2008-5);
 RRL Notice No. 2008-4 (May 20, 2008);
 IEC 61000-4-5; EN 61000-4-5; KN 61000-4-5;
 KS C 9610-4-5;
 IEEE C37.90.1 2012; IEEE STD C62.41.2 2002;
 ECE Regulation 10.06 Annex 16

Conducted Immunity

IEC 61000-4-6 (1996) + A1(2000);
 IEC 61000-4-6, Ed 2.0 (2006-05);
 IEC 61000-4-6 Ed. 3.0 (2008);
 KN 61000-4-6 (2008-5);
 RRL Notice No. 2008-4 (May 20, 2008);
 EN 61000-4-6 (1996) + A1(2001); IEC 61000-4-6;
 EN 61000-4-6; KN 61000-4-6; KS C 9610-4-6

Power Frequency Magnetic Field
 Immunity (Down to 3 A/m)

IEC 61000-4-8 (1993) + A1(2000); IEC 61000-4-8 (2009);
 EN 61000-4-8 (1994) + A1(2000);
 KN 61000-4-8 (2008-5);
 RRL Notice No. 2008-4 (May 20, 2008);
 IEC 61000-4-8; EN 61000-4-8; KN 61000-4-8; KS C 9610-4-8

Voltage Dips, Short Interrupts, and Line
 Voltage Variations

IEC 61000-4-11, Ed. 2 (2004-03);
 KN 61000-4-11 (2008-5);
 RRL Notice No. 2008-4 (May 20, 2008);
 IEC 61000-4-11; EN 61000-4-11; KN 61000-4-11;
 KS C 9610-4-11

Ring Wave

IEC 61000-4-12, Ed. 2 (2006-09);
 EN 61000-4-12:2006;
 IEC 61000-4-12; EN 61000-4-12; KN 61000-4-12;
 IEEE STD C62.41.2 2002



Test Technology:

Test Method(s):

Generic and Product Specific EMC Standards

IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1; KS C 9610-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2; KN 61000-6-2; KS C 9610-6-2; IEC/EN 61000-6-3; AS/NZS 61000-6-3; KN 61000-6-3; KS C 9610-6-3; IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4; KS C 9610-6-4; EN 50130-4; EN 61326-1; EN 50121-3-2; EN 12895; EN 50270; EN 50491-1; EN 50491-2; EN 50491-3; EN 55015; EN 60730-1; EN 60945; IEC 60533; EN 61326-2-6; EN 61800-3; IEC/CISPR 14-2; EN 55014-2; AS/NZS CISPR 14.2; KN 14-2; KS C 9814-2; IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24; IEC/CISPR 35; AS/NZS CISPR 35; EN 55035; KN 35; KS C 9835; IEC 60601-1-2; JIS T0601-1-2

TxRx EMC Requirements

EN 301 489-1; EN 301 489-3; EN 301 489-9; EN 301 489-17; EN 301 489-19; EN 301 489-20

European Radio Test Standards

ETSI EN 300 086-1; ETSI EN 300 086-2; ETSI EN 300 113-1; ETSI EN 300 113-2; ETSI EN 300 220-1; ETSI EN 300 220-2; ETSI EN 300 220-3-1; ETSI EN 300 220-3-2; ETSI EN 300 330-1; ETSI EN 300 330-2; ETSI EN 300 440-1; ETSI EN 300 440-2; ETSI EN 300 422-1; ETSI EN 300 422-2; ETSI EN 300 328; ETSI EN 301 893; ETSI EN 301 511; ETSI EN 301 908-1; ETSI EN 908-2; ETSI EN 908-13; ETSI EN 303 413; ETSI EN 302 502; EN 303 340; EN 303 345-2; EN 303 345-3; EN 303 345-4

Canadian Radio Tests

RSS-102 measurement (RF Exposure Evaluation); RSS-102 measurement (Nerve Stimulation); SPR-002; RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125; RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194; RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211; RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236; RSS-238; RSS-243; RSS-244; RSS-247; RSS-248; RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN

Mexico Radio Tests

IFT-008-2015; NOM-208-SCFI-2016

Japan Radio Tests

Radio Law No. 131, Ordinance of MPT No. 37, 1981, MIC Notification No. 88:2004, Table No. 22-11; ARIB STD-T66, Regulation 18

Taiwan Radio Tests

LP-0002 (July 15, 2020)



<u>Test Technology:</u>	<u>Test Method(s)¹:</u>
<i>Australia/New Zealand Radio Tests</i>	AS/NZS 4268; Radiocommunications (Short Range Devices) Standard (2014)
<i>Hong Kong Radio Tests</i>	HKCA 1039 Issue 6; HKCA 1042; HKCA 1033 Issue 7; HKCA 1061; HKCA 1008; HKCA 1043; HKCA 1057; HKCA 1073
<i>Korean Radio Test Standards</i>	KN 301 489-1; KN 301 489-3; KN 301 489-9; KN 301 489-17; KN 301 489-52; KS X 3124; KS X 3125; KS X 3130; KS X 3126; KS X 3129
<i>Vietnam Radio Test Standards</i>	QCVN 47:2015/BTTTT; QCVN 54:2020/BTTTT; QCVN 55:2011/BTTTT; QCVN 65:2013/BTTTT; QCVN 73:2013/BTTTT; QCVN 74:2020/BTTTT; QCVN 112:2017/BTTTT; QCVN 117:2020/BTTTT
<i>Vietnam EMC Test Standards</i>	QCVN 18:2014/BTTTT; QCVN 86:2019/BTTTT; QCVN 96:2015/BTTTT; QCVN 118:2018/BTTTT
<i>Unlicensed Radio Frequency Devices (3 Meter Semi-Anechoic Room)</i>	47 CFR FCC Part 15C, 15D, 15E, 15F, 15G, 15H (using ANSI C63.10:2013, ANSI C63.17:2013 and FCC KDB 905462 D02 (v02))
<i>Licensed Radio Service Equipment</i>	47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95, 96, 97, 101 (using ANSI/TIA-603-E, TIA-102.CAAA-E, ANSI C63.26:2015)
<i>OIA (Over the Air) Performance</i> GSM, GPRS, EGPRS UMTS (W-CDMA) LTE including CAT M1 A-GPS for UMTS/GSM LTS A-GPS, A-GLONASS, SIB8/SIB16 Large Device/Laptop/Tablet Testing Integrated Device Testing WiFi 802.11 a/b/g/n/a	CTIA Test Plan for Wireless Device Over-the-Air Performance (Method for Measurement for Radiated Power and Receiver Performance) V3.8.2; CTIA Test Plan for RF Performance Evaluation of WiFi Mobile Converged Devices V2.1.0

Test Technology:

Test Method(s)¹:

Electrical Measurements and Simulation

AC Voltage / Current

(1mV to 5kV) 60 Hz
(0.1V to 250V) up to 500 MHz
(1µA to 150A) 60 Hz

FAA AC 150/5345-10H;
FAA AC 150/5345-43J;
FAA AC 150/5345-44K;
FAA AC 150/5345-46E;
FAA AC 150/5345-47C;
FAA EB 67D

DC Voltage / Current

(1mV to 15 kV) / (1µA to 10A)

Power Factor / Efficiency / Crest Factor

(Power to 30kW)

Resistance

(1mΩ to 4000MΩ)

Surge

(Up to 10 kV / 5 kA) (Combination Wave and Ring Wave)

On the following products and materials:

Telecommunications Terminal Equipment (TTE), Radio Equipment, Network Equipment, Information Technology Equipment (ITE), Automotive Electronic Equipment, Automotive Hybrid Electronic Devices, Maritime Navigation and Radio Communication Equipment and Systems, Vehicles, Boats and Internal Combustion Engine Driven Devices, Automotive, Aviation, and General Lighting Products, Medical Electrical Equipment, Motors, Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment, Household Appliances, Electric Tools, Low-voltage Switchgear and Control gear, Programmable Controllers, Electrical Equipment for Measurement, Control and Laboratory Use, Base Materials, Power and Data Transmission Cables and Connectors

¹ When the date, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA R101 - General Requirements - Accreditation of ISO-IEC 17025 Laboratories.

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Unintentional Radiators</u> Part 15B	ANSI C63.4:2014	40000
<u>Industrial, Scientific, and Medical Equipment</u> Part 18	FCC MP-5 (February 1986)	40000
<u>Intentional Radiators</u> Part 15C	ANSI C63.10:2013	40000



Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Unlicensed Personal Communication Systems Devices</u> Part 15D	ANSI C63.17:2013	40000
<u>U-NII without DFS Intentional Radiators</u> Part 15E	ANSI C63.10:2013	40000
<u>U-NII with DFS Intentional Radiators</u> Part 15E	FCC KDB 905462 D02 (v02)	40000
<u>UWB Intentional Radiators</u> Part 15F	ANSI C63.10:2013	40000
<u>BPL Intentional Radiators</u> Part 15G	ANSI C63.10:2013	40000
<u>White Space Device Intentional Radiators</u> Part 15H	ANSI C63.10:2013	40000
<u>Commercial Mobile Services (FCC Licensed Radio Service Equipment)</u> Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>General Mobile Radio Services (FCC Licensed Radio Service Equipment)</u> Parts 22 (non-cellular), 90 (below 3 GHz), 95, 97, and 101 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment)</u> Part 96	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Maritime and Aviation Radio Services</u> Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	40000
<u>Microwave and Millimeter Bands Radio Services</u> Parts 25, 30, 74, 90 (above 3 GHz), 97 (above 3 GHz), and 101	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000

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Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Broadcast Radio Services</u> Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Signal Boosters</u> Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	40000

² Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (<https://apps.fcc.gov/oetcf/eas/>) for a listing of FCC approved laboratories.





Accredited Laboratory

A2LA has accredited

ELITE ELECTRONIC ENGINEERING INC.

Downers Grove, IL

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 15th day of August 2023.



Mr. Trace McInturf, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1786.01
Valid to June 30, 2025

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