



FCC PART 15.249 & IC RSS-210 900 MHz Test Report

APPLICANT	RENOVIA INC.
ADDRESS	263 SUMMER STREET, 5 TH FLOOR BOSTON, MA 02210
FCC ID	2AT3A-LEVA-02B
MODEL NUMBER	leva-02
PRODUCT DESCRIPTION	915 ISM RADIO
DATE SAMPLE RECEIVED	11/19/2019
FINAL TEST DATE	11/19/2019
TESTED BY	Tim Royer
Approved By	Franklin Rose
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Report Version	Description	Issue Date
811UT20_TestReport_	Rev1	Initial Issue	11/19/2019

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

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GENERAL REMARKS

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- ☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669



Sr. EMC Engineer
EMC-003838-NE



Tested by:

Name and Title: Tim Royer, Project Manager/Testing Engineer

Date: 11/21/2019

Reviewed and approved by:



Name and Title: Franklin Rose, Project Manager/EMC Specialist

Date: 11/21/2019

GENERAL INFORMATION

EUT Information

EUT Description	915 ISM RADIO Relay: 510-00006 RevH Device: Low = 0002-0031 mid = 0002-0030 High = 0002-032		
FCC ID	2AT3A-LEVA-02B		
Model Number	leva-02		
EUT Power Source	☐ 110-120Vac, 50-60Hz	☐ DC Power	☒ Battery Operated
Test Item	☐ Prototype	☒ Pre-Production	☐ Production
Type of Equipment	☐ Fixed	☐ Mobile	☒ Portable
Antenna Connector	SMA		
Test Conditions	The temperature was 26°C Relative humidity of 50%.		
Test Configuration	Operational		
Modification to the EUT	No Modification to EUT.		
Applicable Standards	ANSI C63.10-2013 ANSI C63.4-2014 (Radiated Site Validation)		
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070 ISED Test Site Registration: 2056A		

Peripherals Used in Testing

Description	Type	Connector	Length
n/a	n/a	n/a	n/a

Test Results Summary

FCC Rule Part No.	IC Standard Ref.	Requirement	Test Item	Result
2.1049	RSS-GEN 6.6	Occupied Bandwidth	99% Bandwidth	Pass
15.249(a)(c)	RSS-210 § A2.9(a)	Fundamental and Harmonics	Radiated Spurious Emissions	Pass
15.249(d)(e)	RSS-247 § 5.5	Spurious Emissions	Bandedge	Pass
			Radiated Spurious Emissions	Pass
15.207(a)	RSS-GEN § 8.8	AC Conducted Emissions	AC Powerline Conducted Emissions	N/A

Frequency Range(s) of EUT

Operating Frequency Band 1	902 - 928 MHz
Test Frequency	913.9, 916, 918.1 MHz

Definition of EUT

RULE PART NO.: FCC PART 15.3

(i) *Class B digital device.* A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

NOTE: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

(k) *Digital device.* (Previously defined as a computing device). An unintentional radiator (device or system) that generates and uses timing signals or pulses at a rate in excess of 9,000 pulses (cycles) per second and uses digital techniques; inclusive of telephone equipment that uses digital techniques or any device or system that generates and uses radio frequency energy for the purpose of performing data processing functions, such as electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer. A radio frequency device that is specifically subject to an emanation requirement in any other FCC Rule part or an intentional radiator subject to subpart C of this part that contains a digital device is not subject to the standards for digital devices, provided the digital device is used only to enable operation of the radio frequency device and the digital device does not control additional functions or capabilities.

NOTE: Computer terminals and peripherals that are intended to be connected to a computer are digital devices.

(o) *Intentional radiator.* A device that intentionally generates and emits radio frequency energy by radiation or induction.

MEASUREMENT STANDARDS

RULE PART NO.: FCC PART 15.31

(a) The following measurement procedures are used by the Commission to determine compliance with the technical requirements in this part. Except where noted, copies of these procedures are available from the Commission's current duplicating contractor whose name and address are available from the Commission's Consumer and Governmental Affairs Bureau at 1-888-CALL-FCC (1-888-225-5322).

(2) Unlicensed Personal Communications Service (UPCS) devices are to be measured for compliance using ANSI C63.17-2013: "American National Standard Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communications Services (UPCS) Devices" (incorporated by reference, see §15.38).

(3) Other intentional radiators are to be measured for compliance using the following procedure: ANSI C63.10-2013 (incorporated by reference, see §15.38).

(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

(l) Measurements of radio frequency emissions conducted to the public utility power lines shall be performed using a 50 ohm/50 uH line-impedance stabilization network (LISN).

(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle.
1 to 10 MHz	2	1 near top and 1 near bottom.
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom.

(o) The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

FREQUENCY RANGE OF RADIATED MEASUREMENTS

RULE PART NO.: FCC PART 15.33

§15.33 Frequency range of radiated measurements.

(a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1) through (a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

METHOD OF MEASUREMENT

RULE PART NO.: FCC PART 15.35

§15.35 Measurement detector functions and bandwidths.

The conducted and radiated emission limits shown in this part are based on the following, unless otherwise specified in this part:

(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrumentation using the CISPR quasi-peak detector can be found in ANSI C63.4-2014, clause 4 (incorporated by reference, see §15.38). As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long as the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, *e.g.*, see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, *e.g.*, the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

(c) Unless otherwise specified, *e.g.*, §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to Supplier's Declaration of Conformity.

OCCUPIED BANDWIDTH

Rules Part No.: FCC 2.1049, FCC 15.215(c), IC RSS GEN § 6.6

Requirements:

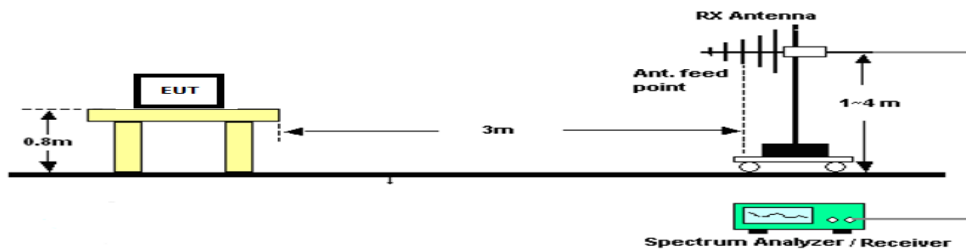
§15.215 Additional provisions to the general radiated emission limitations.

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

IC Requirements: Reporting Only

Test Method: ANSI C63.10 § 6.9 Occupied Bandwidth
ANSI C63.10 § 6.3 Radiated Emissions testing- Common

Test Setup:



Test Data: Device Occupied Bandwidth Measurement Table

Tuned Frequency (MHz)	99% BW (kHz)	20dB BW (kHz)
913.9	91.80	92.74
916	92.27	92.27
918.1	90.87	91.81

Note: The receiver's automatic 99% Occupied Bandwidth function was used. The function is identical in operation to ANSI C63.26, 5.4.4, Step e).

RESULTS: Meets Requirements

Applicant: RENOVIA INC.
FCC ID: 2AT3A-LEVA-02B
Report: 811UT20_TestReport_Rev1

OCCUPIED BANDWIDTH

Test Data: Relay Occupied Bandwidth Measurement Table

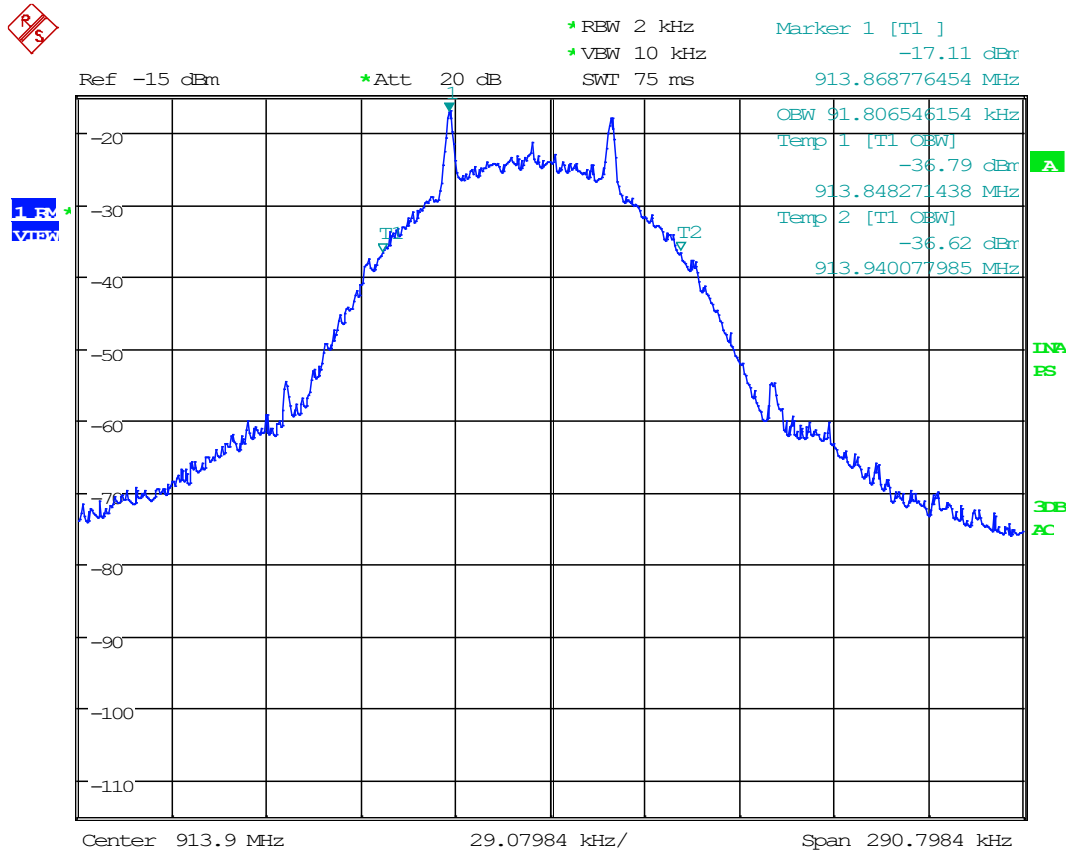
Tuned Frequency (MHz)	99% BW (kHz)	20dB BW (kHz)
913.9	93	91.67
916	91.34	93
918.1	92.27	91.34

Note: The receiver's automatic 99% Occupied Bandwidth function was used. The function is identical in operation to ANSI C63.26, 5.4.4, Step e).

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **Device 99% OBW (913.9MHz)**

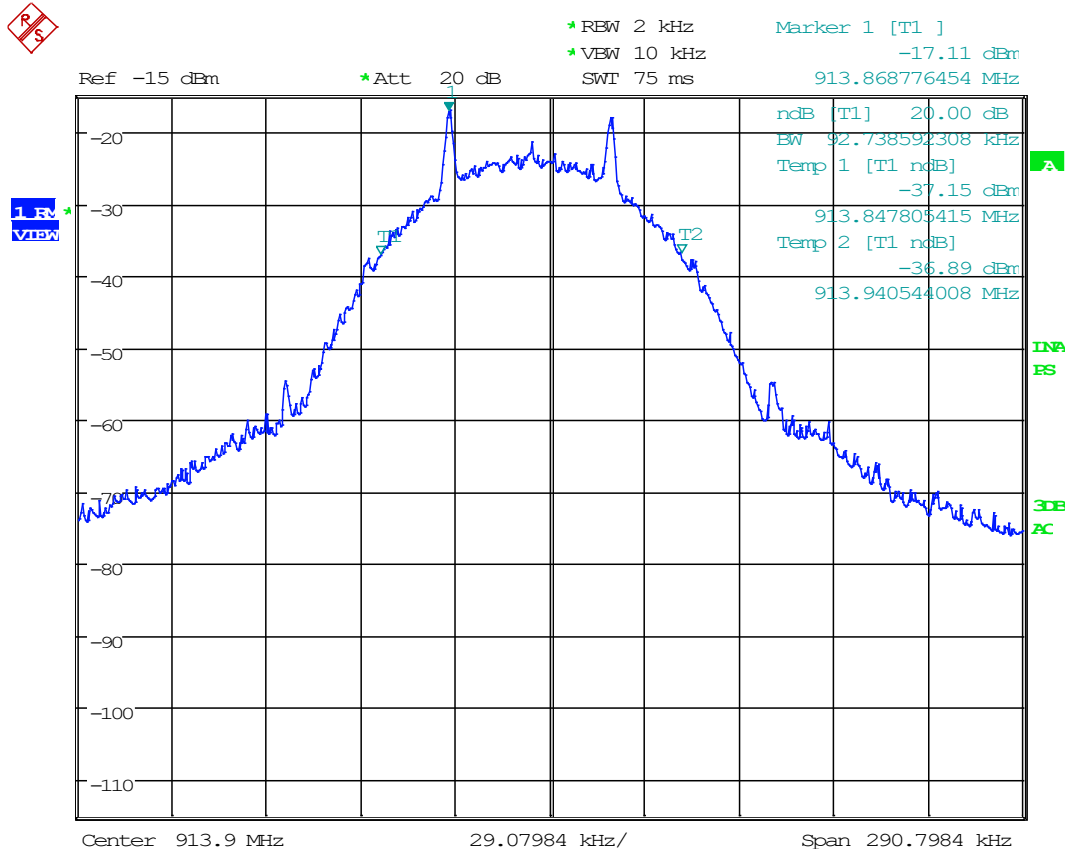


Date: 21.NOV.2019 10:58:48

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: Device 20dB OBW (913.9MHz)

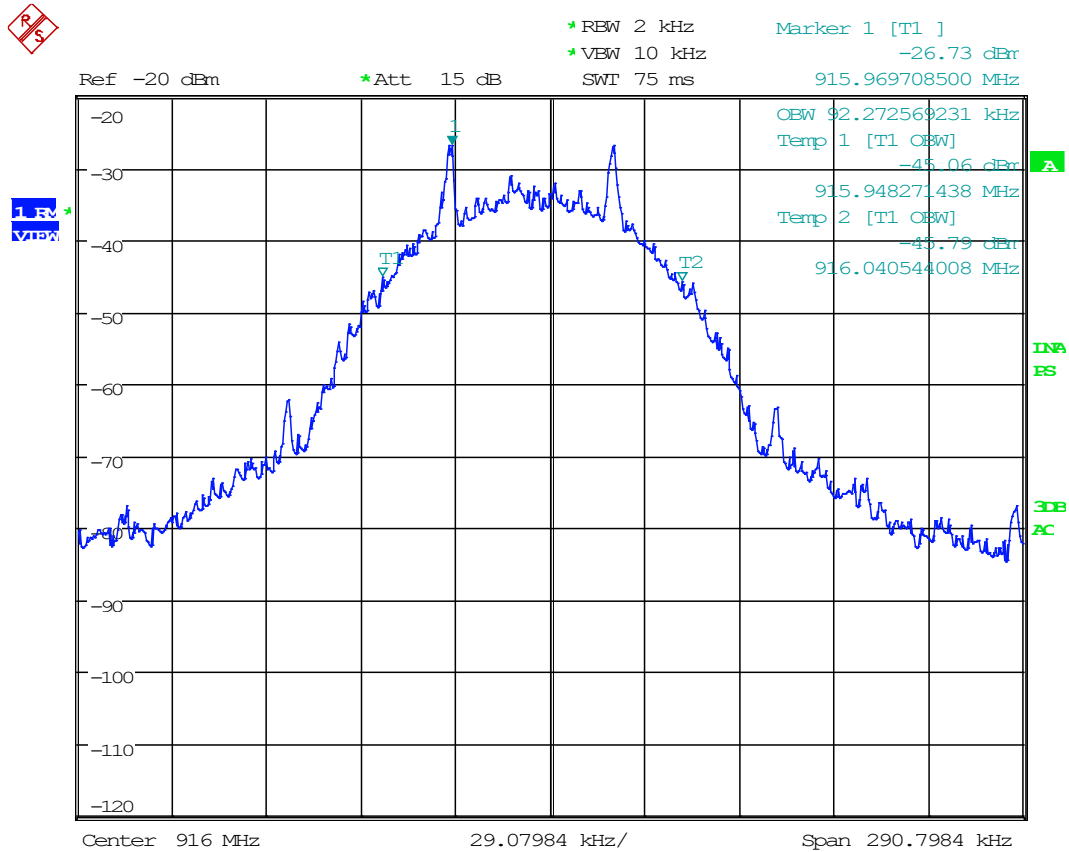


Date: 21.NOV.2019 10:59:11

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **Device 99% OBW (916MHz)**

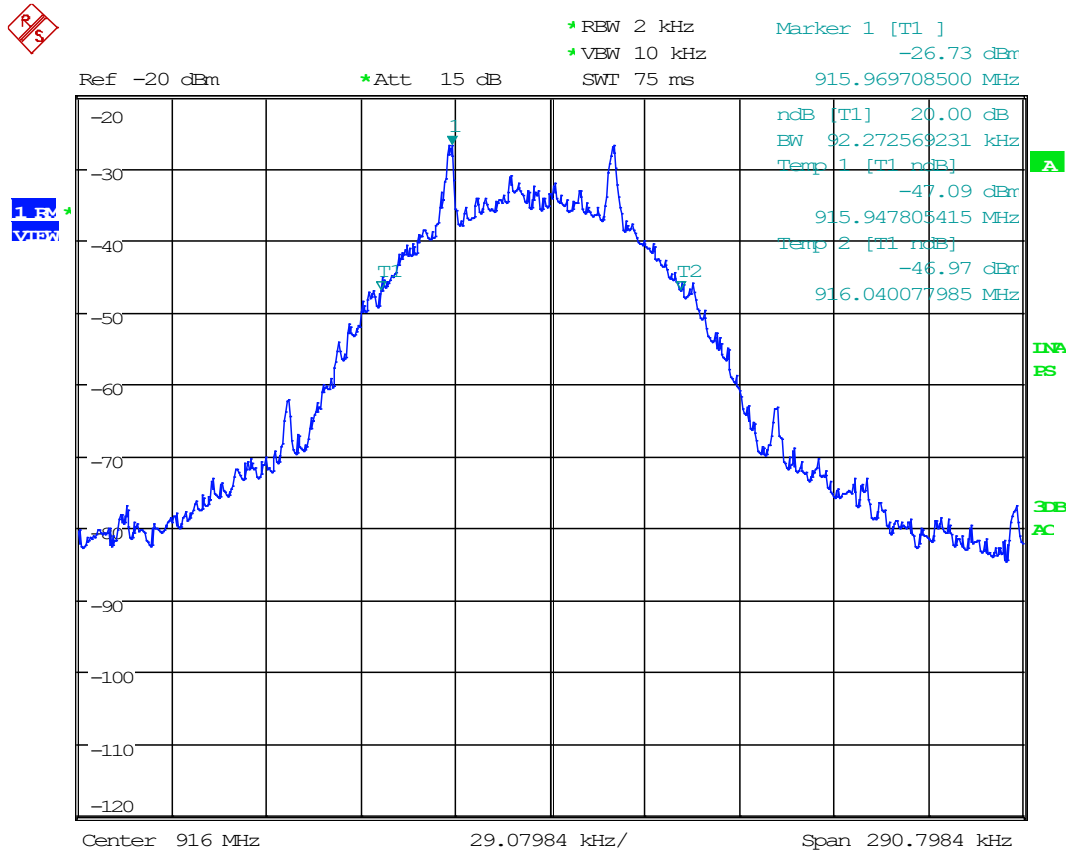


Date: 21.NOV.2019 10:53:38

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **Device 20dB OBW (916MHz)**

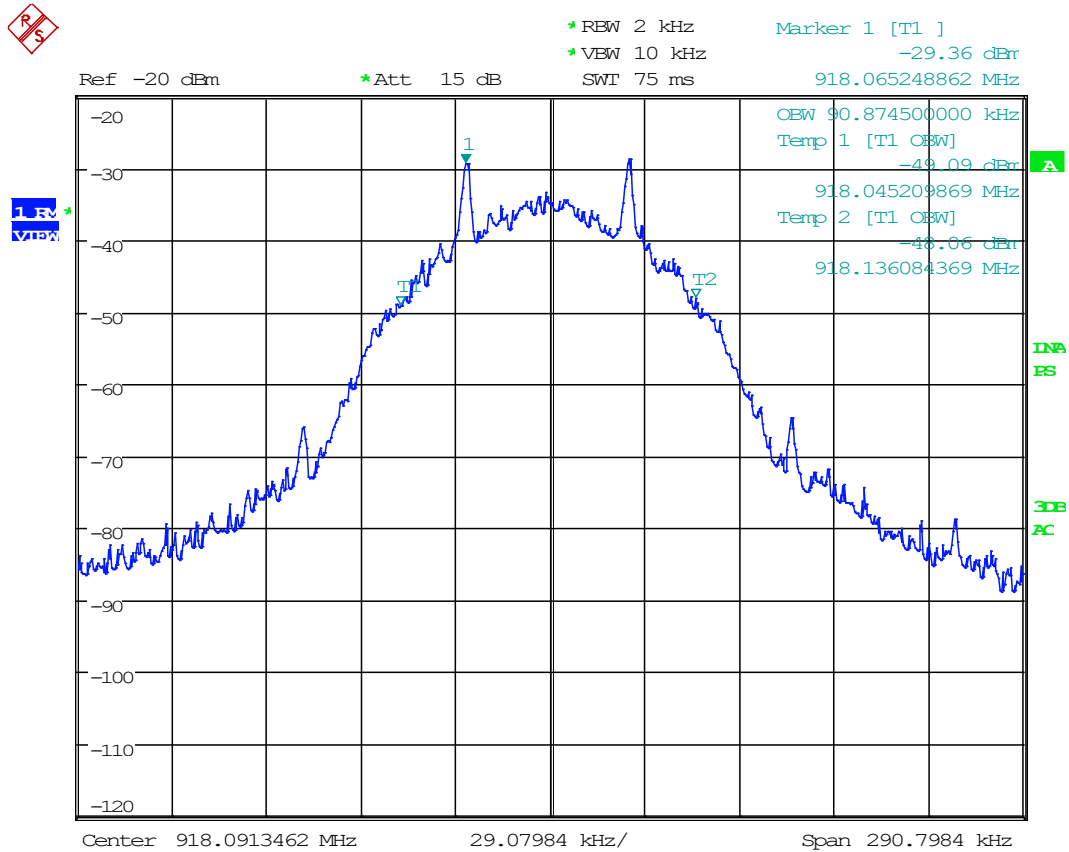


Date: 21.NOV.2019 10:53:19

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: Device 99% OBW (918.1MHz)

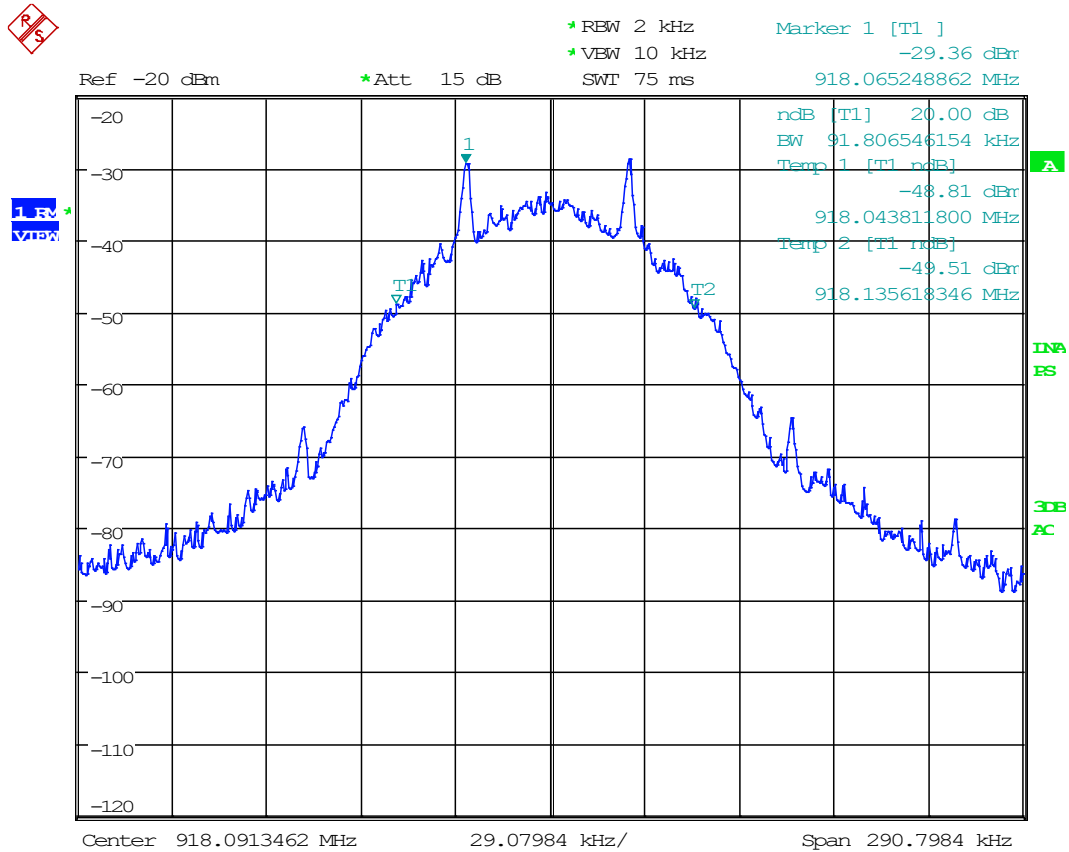


Date: 21.NOV.2019 10:51:47

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **Device 20dB OBW (918.1Hz)**

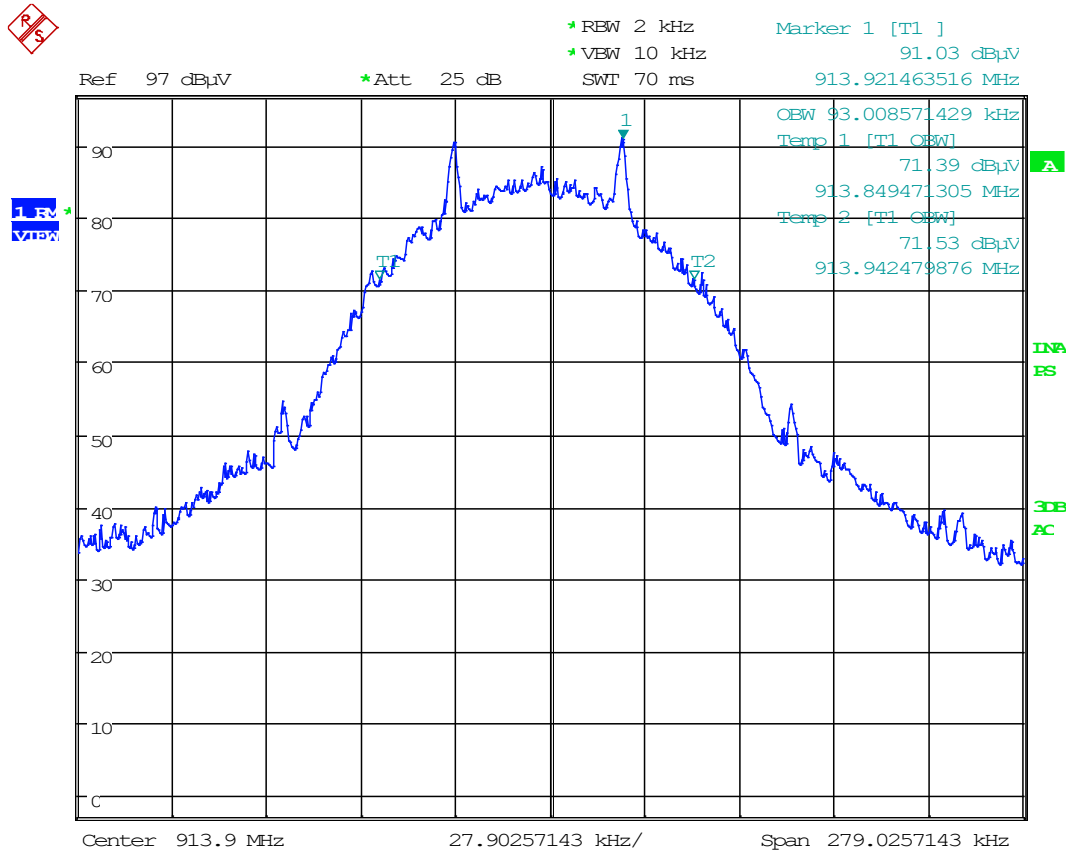


Date: 21.NOV.2019 10:52:04

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: Relay 99% OBW (913.9MHz)

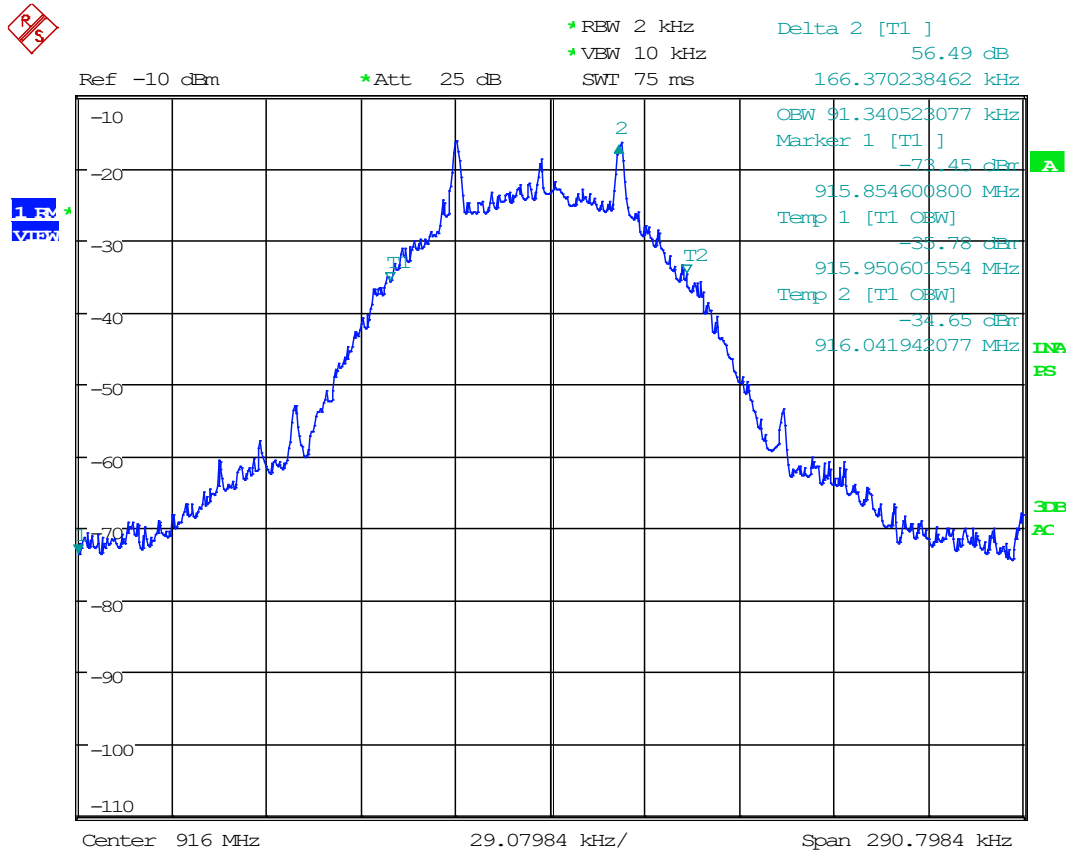


Date: 21.NOV.2019 10:13:29

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: Relay 99% OBW (916MHz)

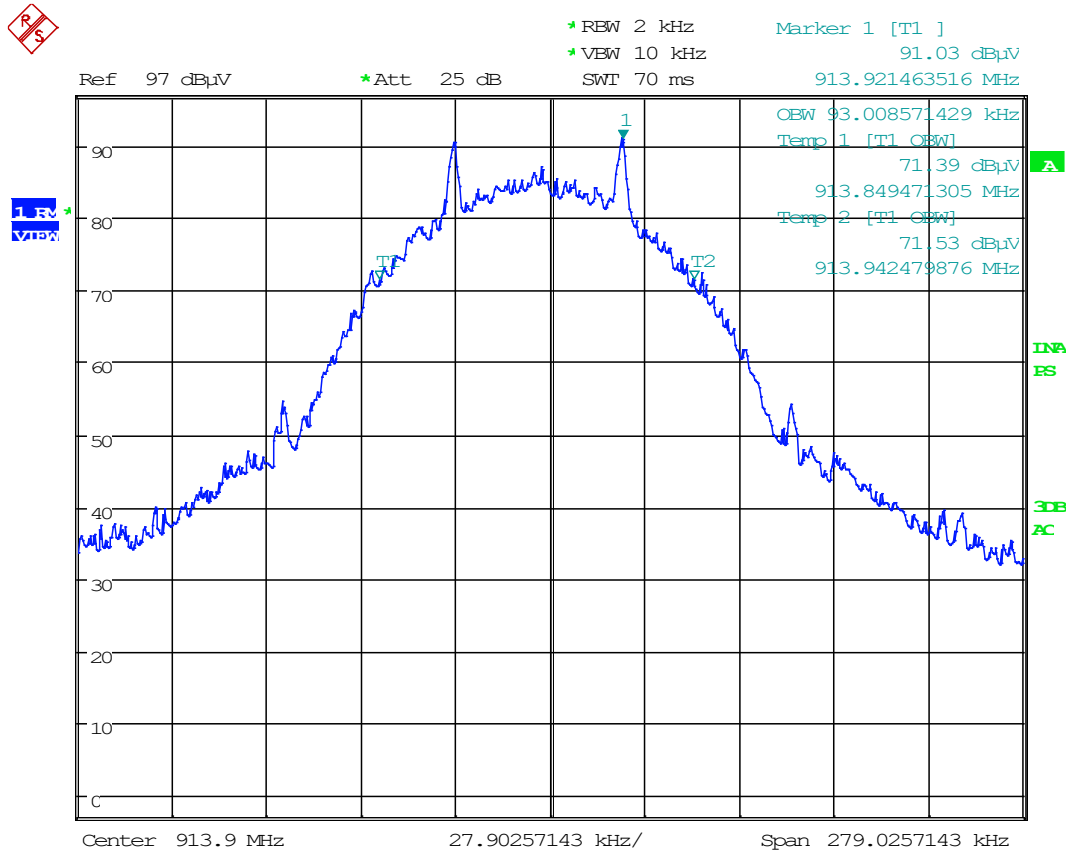


Date: 21.NOV.2019 10:18:49

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: Relay 20dB OBW (916MHz)

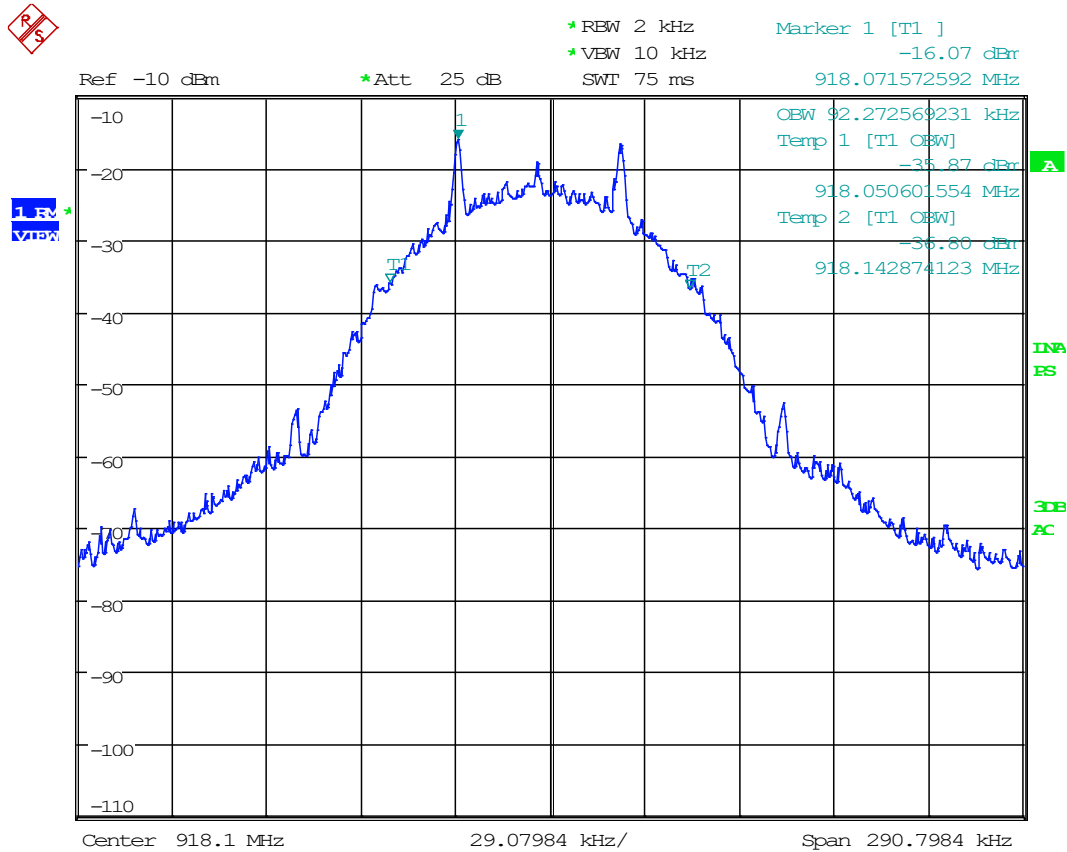


Date: 21.NOV.2019 10:13:29

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: Relay 99% OBW (918.1MHz)

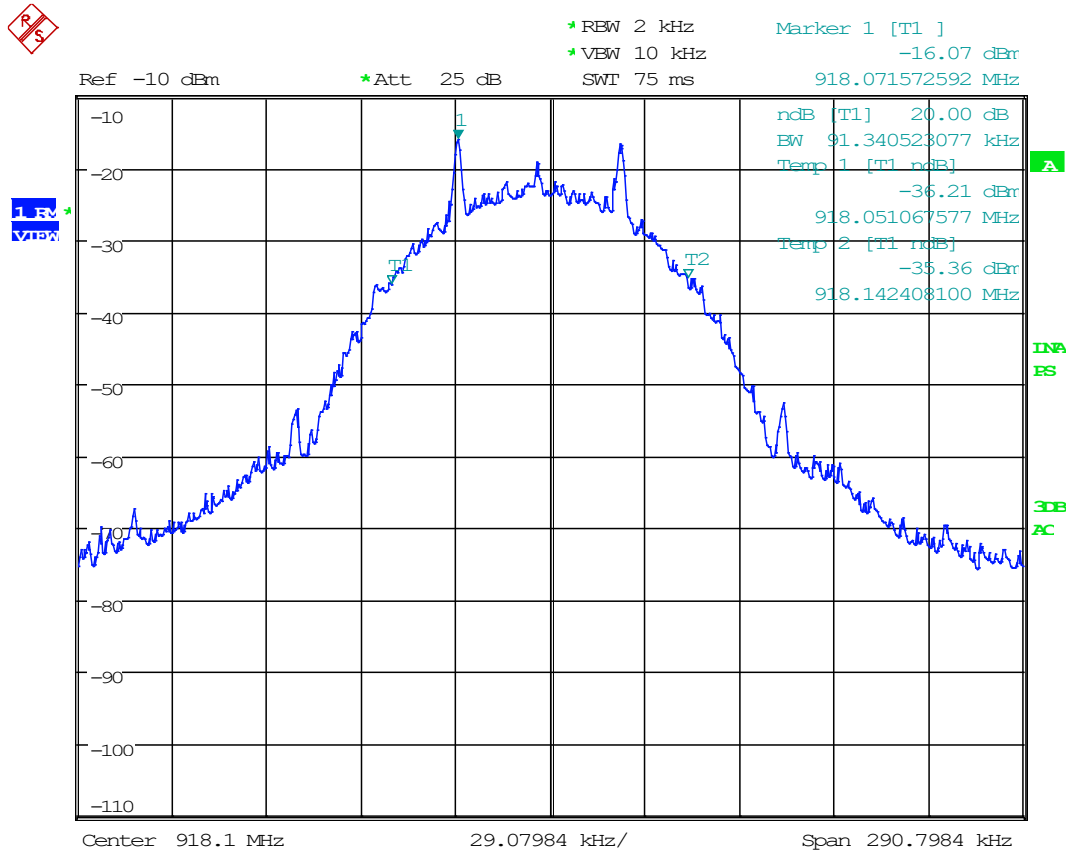


Date: 21.NOV.2019 10:20:16

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: Relay 20dB OBW (918.1Hz)



Date: 21.NOV.2019 10:19:55

RESULTS: Meets Requirements

BANDEDGE

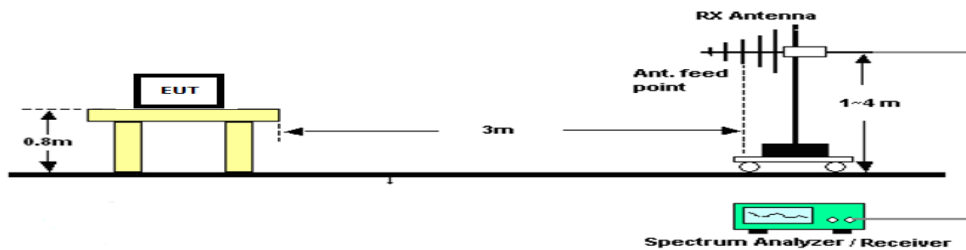
Rule Part No.: FCC 15.249(d), IC RSS 210 § A2.9(b)

Requirements:

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Test Method: ANSI C63.10 § 6.10.4 Authorized band-edge relative method

Setup:



Test Data: Device Bandedge Measurement Table

Bandedge	Tuned Frequency (MHz)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
Lower	913.9	66.63	50	16.63
Upper	918.1	55.38	50	5.38

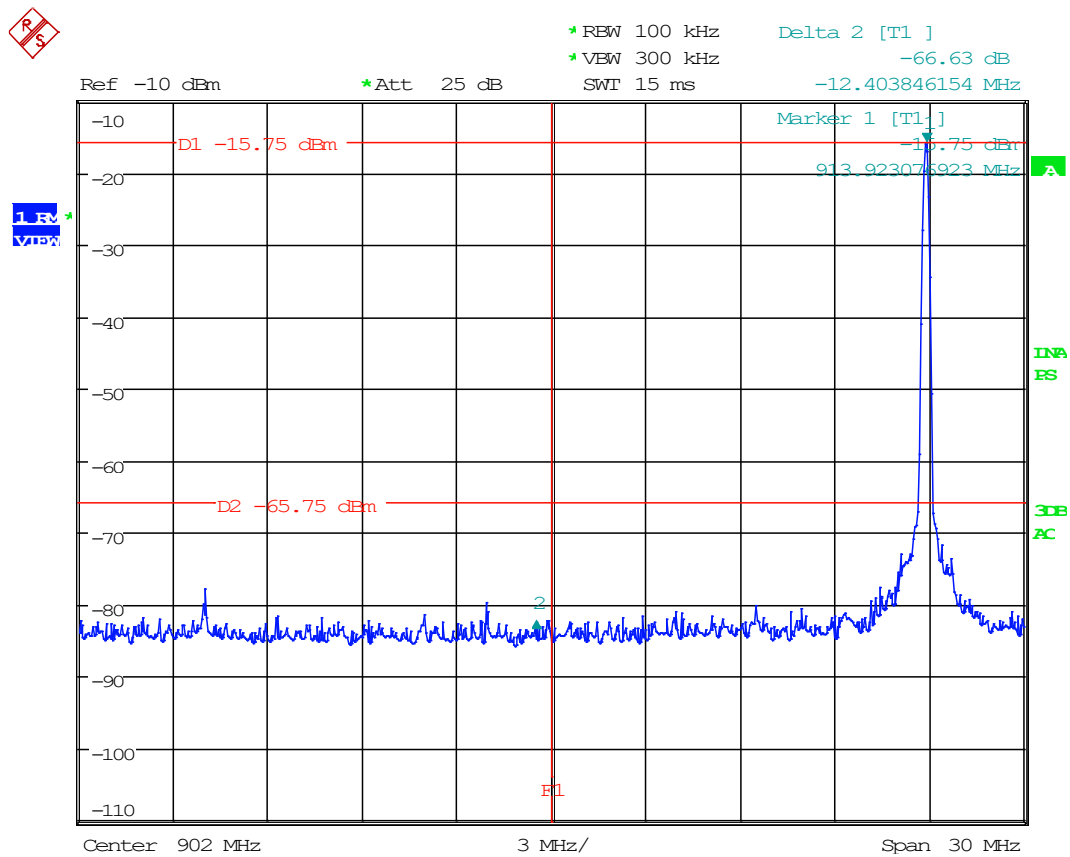
Test Data: Relay Bandedge Measurement Table

Bandedge	Tuned Frequency (MHz)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
Lower	913.9	71.02	50	21.02
Upper	918.1	71.21	50	21.21

Results Meet Requirements

BANDEDGE

Test Data: Device Lower Band Edge Plot



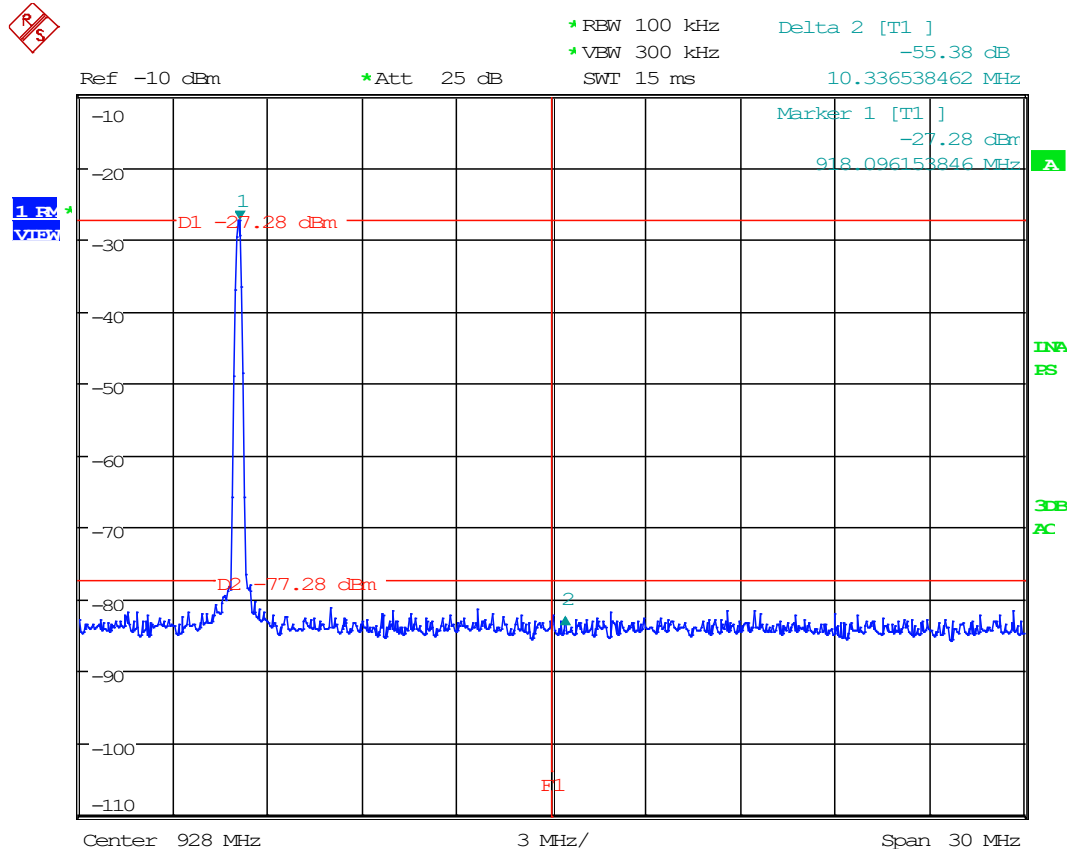
Date: 21.NOV.2019 11:07:02

RESULTS: Meets Requirements

Applicant: RENOVIA INC.
 FCC ID: 2AT3A-LEVA-02B
 Report: 811UT20_TestReport_Rev1

BANDEDGE

Test Data: Device Upper Band Edge Plot



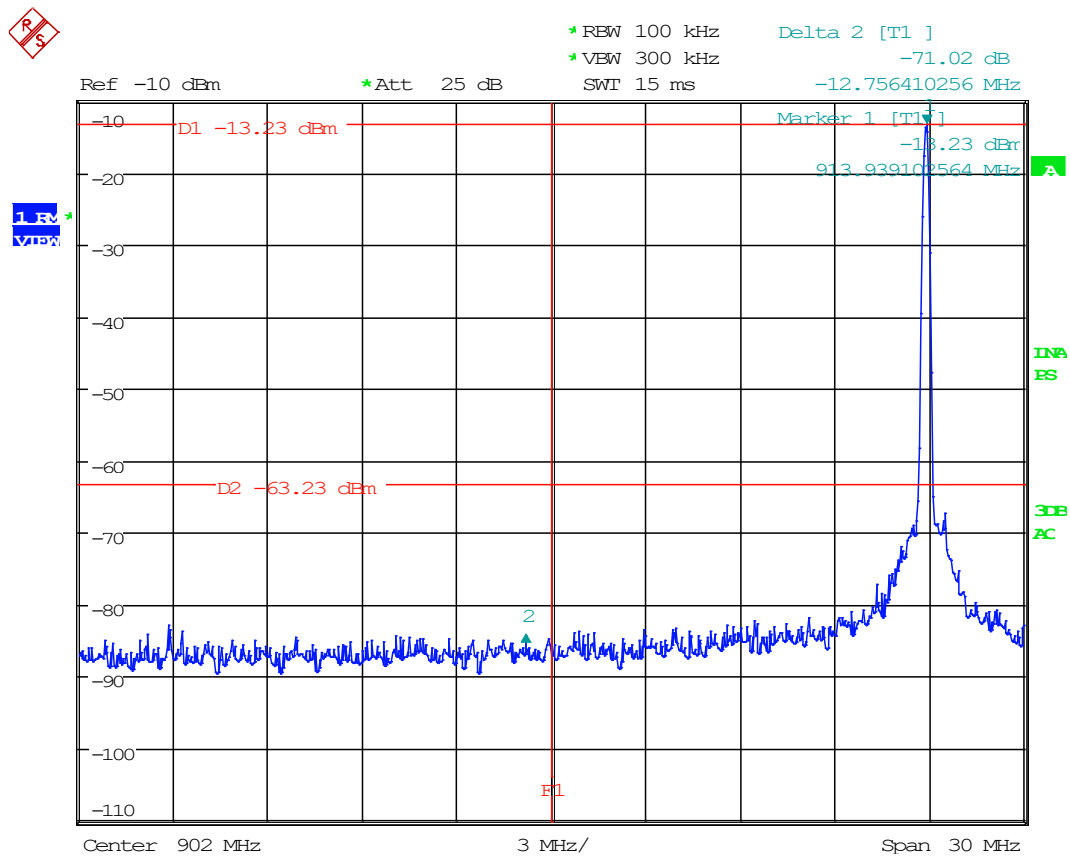
Date: 21.NOV.2019 10:50:33

RESULTS: Meets Requirements

Applicant: RENOVIA INC.
 FCC ID: 2AT3A-LEVA-02B
 Report: 811UT20_TestReport_Rev1

BANDEDGE

Test Data: Relay Lower Band Edge Plot



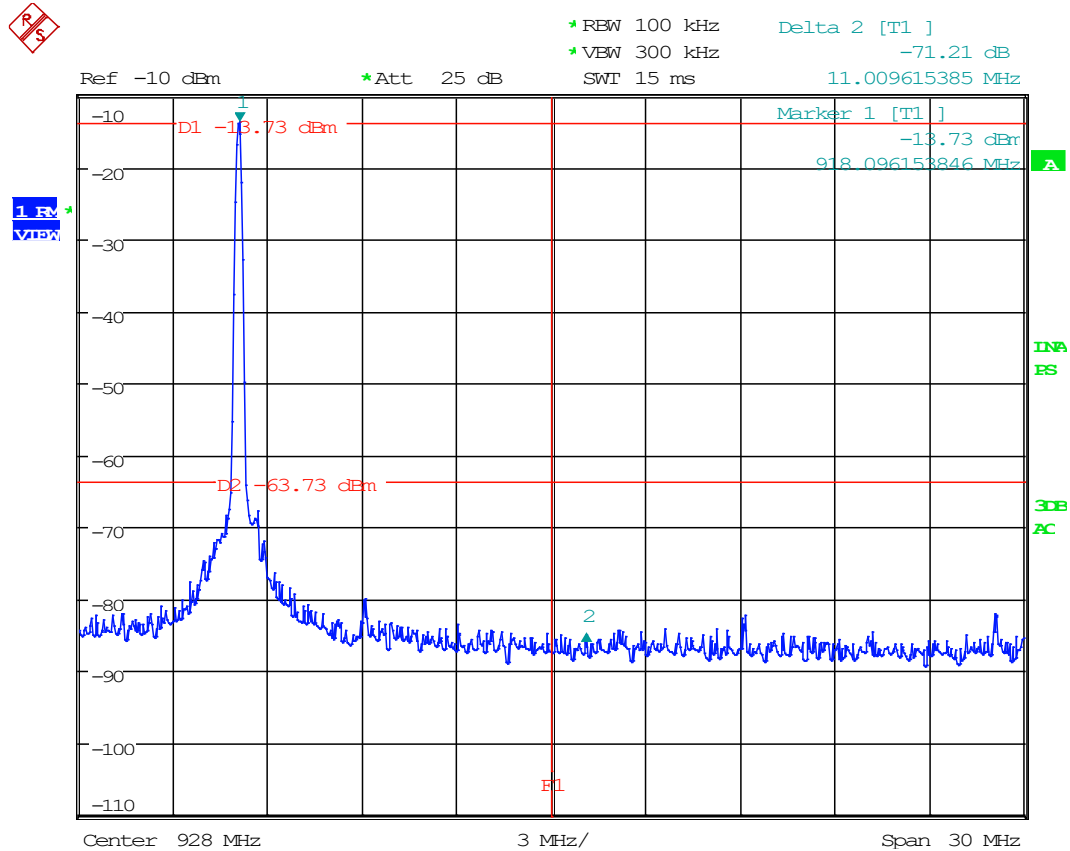
Date: 21.NOV.2019 10:15:58

RESULTS: Meets Requirements

Applicant: RENOVIA INC.
 FCC ID: 2AT3A-LEVA-02B
 Report: 811UT20_TestReport_Rev1

BANDEDGE

Test Data: Relay Upper Band Edge Plot



Date: 21.NOV.2019 10:44:20

RESULTS: Meets Requirements

Applicant: RENOVIA INC.
 FCC ID: 2AT3A-LEVA-02B
 Report: 811UT20_TestReport_Rev1

RADIATED SPURIOUS EMISSIONS

RULE PART NO.: FCC part 15.249 (a)(c)(d)(e)

Requirements:

§15.249 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

§15.209 Radiated emission limits; general requirements.

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Limit (μV/m)	Limit (dBμV/m)
0.009 – 0.490	2400/F(in kHz) @ 300m	-
0.490 – 1.705	24000/F(in kHz) @ 30m	-
1.705 kHz – 30	30.0 @ 30 m	29.54 @ 30m
30 – 88	100.0	40.0
88 – 216	150.0	43.5
216 – 960	200.0	46.0
Above 960	500.0	54.0

§15.35 Measurement detector functions and bandwidths.

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

Test Procedure: ANSI C63.4 § Annex D Validation of radiated emissions standard test sites
 ANSI C63.10 § 6.3 Common requirements radiated emissions
 ANSI C63.10 § 6.4 Emissions below 30 MHz
 ANSI C63.10 § 6.5 Emissions between 30 & 1000 MHz
 ANSI C63.10 § 6.6 Emissions above 1 GHz

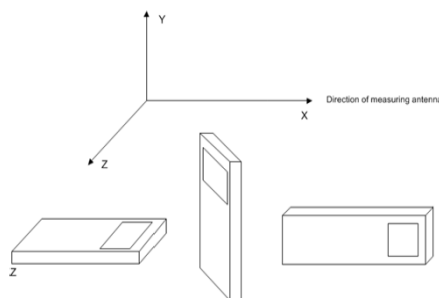
Radiated Emissions Test Setup:

EUT setup and arrangement was completed as described in ANSI C63.4. Exploratory measurements were taken following different peripheral placement and cable manipulations as described in ANSI C63.4. A photo is provided of the Test setup to record the exact peripheral equipment and cable manipulation arrangement found to produce the highest possible level of radiated emissions.

The test procedure used for radiated emissions is described ANSI C63.4 using a spectrum analyzer. The resolution bandwidth used was 100 kHz with an appropriate sweep speed. The analyzer was calibrated in dB above a microvolt at the output of the antenna. All cable loss and antenna factors were calibrated to provide plots with correction factors applied to results using the formula and example described below. The video bandwidth of the analyzer was always greater than or equal to the resolution bandwidth, and a peak detector with max hold was used.

The unit under test was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The table used for radiated measurements is capable of continuous rotation. When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. The frequency was scanned from 30 MHz to 1.0 GHz. The EUT was measured in three parts of the tunable band of EUT and (3) orthogonal planes when necessary.

EUT Orientation(s):



Applicant: RENOVIA INC.
 FCC ID: 2AT3A-LEVA-02B
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RADIATED SPURIOUS EMISSIONS

Formula of Conversion Factors:

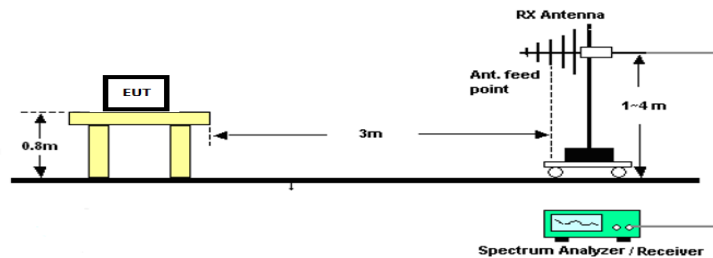
The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dB μ V) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Field Strength Correction Factor Conversion Example:

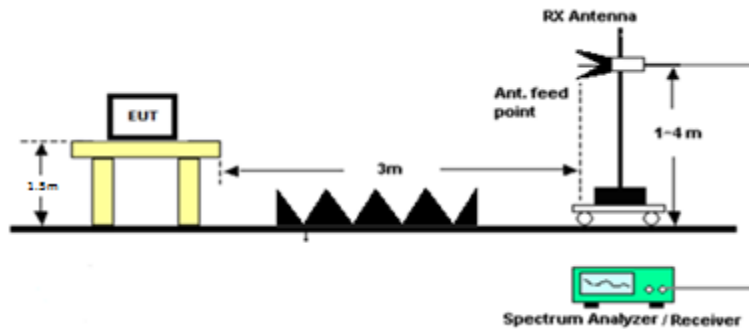
Freq (MHz)	Meter Reading	+ ACF	+CL	= FS
33	20 dB μ V	+ 10.36 dB/m	+0.40 dB	=30.76 dB μ V/m @ 3m

Test Setup:

Emissions 30 – 1000 MHz



Emissions above 1 GHz



RADIATED SPURIOUS EMISSIONS

Notes: The spectrum was measured from 9 KHz to 25 GHz. Six or more of the Spurious Emissions equal to or less than 20 dB from the limits are required to be reported, therefore the worst case data rate and output power which produced emissions within 30 dB of the limit are reported below.

Yellow Highlighted Emission Frequencies indicate Restricted Bands, per 15.209(a). The measurement of restricted bands were taken in Peak Hold, and shown to comply with the average limit of 15.209. In cases where the Peak measurement does not meet or exceed the Average limit of 15.209, the Average detector was used, and the peak is to then meet the level of 15.35(b), 20 dB higher than the limit of 15.209.

For all other emissions (in non-restricted bands) they are shown to comply with the limit of 15.247(d). The Radiated Fundamental Power Output is taken below, using a Peak detector.

Test Data: Relay Field Strength of the Fundamental

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
913.90	913.90	64.14	PK	H	3.56	22.60	90.30	23.70
913.90	913.90	63.30	QP	H	3.56	22.60	89.46	4.54
913.90	913.90	68.05	PK	V	3.56	22.60	94.21	19.79
913.90	913.90	67.70	QP	V	3.56	22.60	93.86	0.14
913.90	916.00	67.88	PK	V	3.56	22.60	94.04	19.96
913.90	916.00	67.50	QP	V	3.56	22.60	93.66	0.34
913.90	916.00	65.27	PK	H	3.56	22.60	91.43	22.57
913.90	916.00	64.90	QP	H	3.56	22.60	91.06	2.94
918.00	918.00	65.65	PK	H	3.57	22.42	91.64	22.36
918.00	918.00	64.90	QP	H	3.57	22.42	90.89	3.11
918.00	918.00	67.33	PK	V	3.57	22.42	93.32	20.68
918.00	918.00	66.90	QP	V	3.57	22.42	92.89	1.11

RADIATED SPURIOUS EMISSIONS

Test Data: Relay 913.9 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
913.90	1827.80	12.26	PK	V	4.95	30.62	47.83	26.17
913.90	1827.80	10.96	PK	H	4.95	30.62	46.53	27.47
913.90	2741.70	10.38	PK	H	6.07	32.40	48.85	25.15
913.90	2741.70	10.29	PK	V	6.07	32.40	48.76	25.24
913.90	3655.60	14.70	PK	V	6.57	33.20	54.47	19.53
913.90	3655.60	-0.40	AV	V	6.57	33.20	39.37	14.63
913.90	3655.60	-6.80	AV	H	6.57	33.20	32.97	21.03
913.90	3655.60	10.63	PK	H	6.57	33.20	50.40	23.60
913.90	4569.50	17.82	PK	V	7.45	34.02	59.29	14.71
913.90	4569.50	16.81	PK	H	7.45	34.02	58.28	15.72
913.90	4569.50	4.90	AV	H	7.45	34.02	46.37	7.63
913.90	4569.50	5.20	AV	V	7.45	34.02	46.67	7.33
913.90	5483.40	11.42	PK	V	8.07	34.47	53.96	20.04
913.90	5483.40	-11.40	AV	V	8.07	34.47	31.14	22.86
913.90	5483.40	10.13	PK	H	8.07	34.47	52.67	21.33
913.90	6397.30	10.59	PK	H	8.87	35.45	54.91	19.09
913.90	6397.30	-11.80	AV	H	8.87	35.45	32.52	21.48
913.90	6397.30	8.36	PK	V	8.87	35.45	52.68	21.32
913.90	7311.20	10.16	PK	V	9.47	36.26	55.89	18.11
913.90	7311.20	9.69	PK	H	9.47	36.26	55.42	18.58
913.90	7311.20	-11.60	AV	H	9.47	36.26	34.13	19.87
913.90	7311.20	-11.60	AV	V	9.47	36.26	34.13	19.87
913.90	8225.10	8.30	PK	V	10.03	35.80	54.13	19.87
913.90	8225.10	9.22	PK	H	10.03	35.80	55.05	18.95
913.90	8225.10	-12.90	AV	H	10.03	35.80	32.93	21.07
913.90	8225.10	-12.90	AV	V	10.03	35.80	32.93	21.07
913.90	9139.00	10.02	PK	V	10.73	36.17	56.92	17.08
913.90	9139.00	9.92	PK	H	10.73	36.17	56.82	17.18
913.90	9139.00	-11.80	AV	H	10.73	36.17	35.10	18.90
913.90	9139.00	-11.80	AV	V	10.73	36.17	35.10	18.90

Result: Meets Requirements

RADIATED SPURIOUS EMISSIONS

Test Data: Relay 916 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
916.00	1832.00	12.40	PK	H	4.96	30.67	48.03	25.97
916.00	1832.00	10.89	PK	V	4.96	30.67	46.52	27.48
916.00	2748.00	9.85	PK	V	6.09	32.39	48.33	25.67
916.00	2748.00	11.57	PK	H	6.09	32.39	50.05	23.95
916.00	3664.00	13.86	PK	H	6.56	33.20	53.62	20.38
916.00	3664.00	11.81	PK	V	6.56	33.20	51.57	22.43
916.00	4580.00	15.35	PK	V	7.47	34.03	56.85	17.15
916.00	4580.00	-0.40	AV	V	7.47	34.03	41.10	12.90
916.00	4580.00	11.23	PK	H	7.47	34.03	52.73	21.27
916.00	5496.00	10.52	PK	H	8.06	34.47	53.05	20.95
916.00	5496.00	9.89	PK	V	8.06	34.47	52.42	21.58
916.00	6412.00	9.66	PK	V	8.90	35.47	54.03	19.97
916.00	6412.00	-11.80	AV	V	8.90	35.47	32.57	21.43
916.00	6412.00	8.47	PK	H	8.90	35.47	52.84	21.16
916.00	7328.00	9.65	PK	H	9.46	36.22	55.33	18.67
916.00	7328.00	-11.60	AV	H	9.46	36.22	34.08	19.92
916.00	7328.00	9.66	PK	V	9.46	36.22	55.34	18.66
916.00	7328.00	-11.60	AV	V	9.46	36.22	34.08	19.92
916.00	8244.00	10.65	PK	V	10.05	35.80	56.50	17.50
916.00	8244.00	-12.60	AV	V	10.05	35.80	33.25	20.75
916.00	8244.00	8.72	PK	H	10.05	35.80	54.57	19.43
916.00	8244.00	-12.63	AV	H	10.05	35.80	33.22	20.78
916.00	9160.00	9.55	PK	H	10.75	36.20	56.50	17.50
916.00	9160.00	-11.80	AV	H	10.75	36.20	35.15	18.85
916.00	9160.00	9.25	PK	V	10.75	36.20	56.20	17.80
916.00	9160.00	-11.80	AV	V	10.75	36.20	35.15	18.85

Result: Meets Requirements

RADIATED SPURIOUS EMISSIONS

Test Data: Relay 918.1 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
918.10	1836.20	11.11	PK	V	4.96	30.72	46.75	27.25
918.10	1836.20	9.36	PK	H	4.96	30.72	45.04	28.96
918.10	2754.30	19.85	PK	H	6.09	32.39	58.33	-4.33
918.10	2754.30	9.30	AV	H	6.09	32.39	47.78	26.22
918.10	2754.30	16.76	PK	V	6.09	32.39	55.24	-1.24
918.10	2754.30	2.00	AV	V	6.09	32.39	40.48	13.52
918.10	3672.40	15.74	PK	V	6.55	33.19	55.48	18.52
918.10	3672.40	-0.60	AV	V	6.55	33.19	39.14	14.86
918.10	3672.40	18.26	PK	H	6.55	33.19	58.00	16.00
918.10	3672.40	4.70	AV	H	6.55	33.19	44.44	9.56
918.10	4590.50	10.40	PK	H	7.49	34.05	51.54	22.46
918.10	4590.50	10.71	PK	V	7.49	34.05	52.25	21.75
918.10	5508.60	10.61	PK	V	8.07	34.46	53.14	20.86
918.10	5508.60	11.50	PK	H	8.07	34.46	54.03	19.97
918.10	5508.60	-11.50	AV	H	8.07	34.46	31.03	22.97
918.10	6426.70	10.04	PK	H	8.93	35.49	54.46	19.54
918.10	6426.70	9.87	PK	V	8.93	35.49	54.29	19.71
918.10	6426.70	-11.80	AV	H	8.93	35.49	32.62	21.38
918.10	6426.70	-11.60	AV	V	8.93	35.49	32.82	21.18
918.10	7344.80	9.37	PK	H	9.45	36.18	55.00	19.00
918.10	7344.80	-11.80	AV	H	9.45	36.18	33.83	20.17
918.10	7344.80	-11.80	AV	V	9.45	36.18	33.83	20.17
918.10	7344.80	9.96	PK	V	9.45	36.18	55.55	18.45
918.10	8262.90	9.22	PK	V	10.06	35.81	55.05	18.95
918.10	8262.90	8.65	PK	H	10.06	35.81	54.52	19.48
918.10	8262.90	-12.60	AV	H	10.06	35.81	33.27	20.73
918.10	8262.90	-12.63	AV	V	10.06	35.81	33.24	20.76
918.10	9181.00	11.89	PK	V	10.78	36.23	58.90	15.10
918.10	9181.00	10.84	PK	H	10.78	36.23	57.85	16.15
918.10	9181.00	-11.90	AV	H	10.78	36.23	35.11	18.89
918.10	9181.00	-12.00	AV	V	10.78	36.23	35.01	18.99

Result: Meets Requirements

RADIATED SPURIOUS EMISSIONS

Test Data: Device Field Strength of the Fundamental

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
913.90	913.90	67.53	Pk	H	3.56	22.60	93.69	20.31
913.90	913.90	67.20	QP	H	3.56	22.60	93.36	0.64
913.90	913.90	60.56	Pk	V	3.56	22.60	86.72	27.28
913.90	913.90	60.20	QP	V	3.56	22.60	86.36	7.64
916.00	916.00	61.93	Pk	V	3.57	22.54	88.04	25.96
916.00	916.00	61.70	QP	V	3.57	22.54	87.81	6.19
916.00	916.00	67.86	Pk	H	3.57	22.54	93.97	20.03
916.00	916.00	67.00	QP	H	3.57	22.54	93.11	0.89
918.10	918.10	67.85	Pk	H	3.57	22.41	93.83	20.17
918.10	918.10	67.80	QP	H	3.57	22.41	93.78	0.22
918.10	918.10	60.94	Pk	V	3.57	22.41	86.92	27.08
918.10	918.10	59.06	QP	V	3.57	22.41	85.04	8.96

RADIATED SPURIOUS EMISSIONS

Test Data: Device 913.9 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
913.90	1827.80	9.70	PK	V	4.95	30.62	45.27	28.73
913.90	1827.80	10.91	PK	H	4.95	30.62	46.48	27.52
913.90	2741.70	11.23	PK	H	6.07	32.40	49.70	24.30
913.90	2741.70	-9.20	AV	H	6.07	32.40	29.27	24.73
913.90	2741.70	-9.20	AV	H	6.07	32.40	29.27	24.73
913.90	2741.70	10.31	PK	H	6.07	32.40	48.78	25.22
913.90	3655.60	11.30	PK	V	6.57	33.20	51.07	22.93
913.90	3655.60	-11.60	AV	V	6.57	33.20	28.17	25.83
913.90	3655.60	-11.60	AV	H	6.57	33.20	28.17	25.83
913.90	3655.60	9.96	PK	H	6.57	33.20	49.73	24.27
913.90	4569.50	10.70	PK	H	7.45	34.02	52.17	21.83
913.90	4569.50	-11.00	AV	H	7.45	34.02	30.47	23.53
913.90	4569.50	-11.00	AV	V	7.45	34.02	30.47	23.53
913.90	4569.50	11.84	PK	V	7.45	34.02	53.31	20.69
913.90	5483.40	11.58	PK	V	8.07	34.47	54.12	19.88
913.90	5483.40	10.34	AV	H	8.07	34.47	52.88	1.12
913.90	6397.30	10.55	PK	V	8.87	35.45	54.87	19.13
913.90	6397.30	-11.60	AV	V	8.87	35.45	32.72	21.28
913.90	6397.30	-11.60	AV	H	8.87	35.45	32.72	21.28
913.90	6397.30	9.86	PK	H	8.87	35.45	54.18	19.82
913.90	7311.20	12.20	PK	H	9.47	36.26	57.93	16.07
913.90	7311.20	-11.60	AV	H	9.47	36.26	34.13	19.87
913.90	7311.20	-11.60	AV	V	9.47	36.26	34.13	19.87
913.90	7311.20	10.08	PK	V	9.47	36.26	55.81	18.19
913.90	8225.10	9.57	PK	V	10.03	35.80	55.40	18.60
913.90	8225.10	-12.90	AV	V	10.03	35.80	32.93	21.07
913.90	8225.10	-13.00	AV	H	10.03	35.80	32.83	21.17
913.90	8225.10	8.57	PK	H	10.03	35.80	54.40	19.60
913.90	9139.00	8.83	PK	H	10.73	36.17	55.73	18.27
913.90	9139.00	-11.90	AV	H	10.73	36.17	35.00	19.00
913.90	9139.00	-11.90	AV	V	10.73	36.17	35.00	19.00
913.90	9139.00	8.90	PK	V	10.73	36.17	55.80	18.20

Result: Meets Requirements

RADIATED SPURIOUS EMISSIONS

Test Data: Device 916 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
916.00	1832.00	21.89	PK	V	4.96	30.67	57.52	16.48
916.00	1832.00	0.10	AV	V	4.96	30.67	35.73	18.27
916.00	2748.00	22.44	PK	V	6.09	32.39	60.92	13.08
916.00	2748.00	0.70	AV	V	6.09	32.39	39.18	14.82
916.00	3664.00	19.77	PK	V	6.56	33.20	59.53	14.47
916.00	3664.00	-1.50	AV	V	6.56	33.20	38.26	15.74
916.00	4580.00	20.14	PK	V	7.47	34.03	61.64	12.36
916.00	4580.00	-1.10	AV	V	7.47	34.03	40.40	13.60
916.00	5496.00	20.89	PK	V	8.06	34.47	63.42	10.58
916.00	5496.00	-1.50	AV	V	8.06	34.47	41.03	12.97
916.00	6412.00	21.51	PK	V	8.90	35.47	65.88	8.12
916.00	6412.00	-1.60	AV	V	8.90	35.47	42.77	11.23
916.00	7328.00	20.44	PK	V	9.46	36.22	66.12	7.88
916.00	7328.00	-1.80	AV	V	9.46	36.22	43.88	10.12
916.00	8244.00	19.84	PK	V	10.05	35.80	65.69	8.31
916.00	8244.00	-2.40	AV	V	10.05	35.80	43.45	10.55
916.00	9160.00	19.31	PK	V	10.75	36.20	66.26	7.74
916.00	9160.00	-2.30	AV	V	10.75	36.20	44.65	9.35
916.00	2748.00	22.43	PK	H	10.75	36.20	66.92	7.08
916.00	2748.00	0.70	AV	H	10.75	36.20	44.65	9.35
916.00	3664.00	20.16	PK	H	10.05	35.80	65.26	8.74
916.00	3664.00	-1.50	AV	H	10.05	35.80	43.35	10.65
916.00	4580.00	20.42	PK	H	9.46	36.22	65.26	8.74
916.00	4580.00	-1.10	AV	H	9.46	36.22	43.88	10.12
916.00	5496.00	20.49	PK	H	8.90	35.47	65.46	8.54
916.00	5496.00	-1.50	AV	H	8.90	35.47	42.77	11.23
916.00	6412.00	21.09	PK	H	8.06	34.47	63.02	10.98
916.00	6412.00	-1.60	AV	H	8.06	34.47	41.03	12.97
916.00	7328.00	19.58	PK	H	7.47	34.03	61.92	12.08
916.00	7328.00	-1.80	AV	H	7.47	34.03	40.40	13.60
916.00	8244.00	19.41	PK	H	6.56	33.20	59.92	14.08
916.00	8244.00	-2.50	AV	H	6.56	33.20	38.26	15.74
916.00	9160.00	19.97	PK	H	6.09	32.39	60.91	13.09
916.00	9160.00	-2.30	AV	H	6.09	32.39	39.18	14.82

Result: Meets Requirements

RADIATED SPURIOUS EMISSIONS

Test Data: Device 918.1 MHz Field Strength table

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Detector	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Field Strength dBu V/M	Margin
918.10	1836.20	12.78	PK	V	4.96	30.72	48.46	25.54
918.10	1836.20	11.59	PK	H	4.96	30.72	47.27	26.73
918.10	2754.30	10.04	PK	V	6.09	32.39	48.52	25.48
918.10	2754.30	-9.30	AV	V	6.09	32.39	29.18	24.82
918.10	2754.30	-9.30	AV	H	6.09	32.39	29.18	24.82
918.10	2754.30	11.49	PK	H	6.09	32.39	49.97	24.03
918.10	3672.40	10.62	PK	V	6.55	33.19	50.36	23.64
918.10	3672.40	-11.60	AV	V	6.55	33.19	28.14	25.86
918.10	3672.40	-11.50	AV	H	6.55	33.19	28.24	27.52
918.10	3672.40	10.76	PK	H	6.55	33.19	50.50	23.50
918.10	4590.50	10.28	PK	H	7.49	34.05	51.82	22.18
918.10	4590.50	-11.20	AV	H	7.49	34.05	30.34	23.66
918.10	4590.50	-11.20	AV	V	7.49	34.05	30.34	23.66
918.10	4590.50	9.98	PK	V	7.49	34.05	51.52	22.48
918.10	5508.60	9.24	PK	V	8.07	34.46	51.77	22.23
918.10	5508.60	10.22	PK	H	8.07	34.46	52.75	21.25
918.10	6426.70	9.00	PK	H	8.93	35.49	53.42	20.58
918.10	6426.70	10.17	PK	V	8.93	35.49	54.59	19.41
918.10	6426.70	-11.70	AV	V	8.93	35.49	32.72	21.28
918.10	7344.80	9.22	PK	V	9.45	36.18	54.85	19.15
918.10	7344.80	10.50	PK	H	9.45	36.18	56.13	17.87
918.10	7344.80	-11.70	AV	H	9.45	36.18	33.93	20.07
918.10	7344.80	-11.70	AV	V	9.45	36.18	33.93	20.07
918.10	8262.90	9.82	PK	V	10.06	35.81	55.65	18.35
918.10	8262.90	10.33	PK	H	10.06	35.81	56.20	17.80
918.10	8262.90	-12.80	AV	H	10.06	35.81	33.07	20.93
918.10	8262.90	-12.90	AV	V	10.06	35.81	32.97	21.03
918.10	9181.00	9.04	PK	V	10.78	36.23	56.05	17.95
918.10	9181.00	10.17	PK	H	10.78	36.23	57.18	19.87
918.10	9181.00	-12.20	AV	H	10.78	36.23	34.81	19.19
918.10	9181.00	-12.20	AV	V	10.78	36.23	34.81	19.19

Result: Meets Requirements

POWER LINE CONDUCTED INTERFERENCE

Rule Part No.: FCC Part 15.107 & ICES-003 § 6.1

Requirements:

§15.107 Conducted limits.

(a) Except for Class A digital devices, for equipment 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 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms 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 band edges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

(d) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

Method of Measurement:

The procedure used was ANSI C63.4 using a 50 μ H LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

The following plots represent the emissions for power line conducted. Both lines were observed.

Test Data: n/a

NOTE: This device is battery operated only.

TEST EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Active Loop	ETS-Lindgren	6502	62529	12/11/2017	12/11/2019
Antenna: Biconical 1057	Eaton	94455-1	1057	12/13/2017	12/13/2019
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	7/26/2017	7/26/2020
CHAMBER	Panashield	3M	N/A	3/15/2019	3/15/2021
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	08/28/18	08/28/2021
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	41534	3/1/2017	3/1/2020
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A
Coaxial Cable #103 - KMKM-0180-01 Aqua	Micro-Coax	UFB142A-0-0720-200200	225363-002 (#103)	4/12/2019	4/12/2021
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244-01 KMKM-0670-00 KFKF-0198-01	4/12/2019	4/12/2021
Band Reject Filter 2.4 GHz	Micro-Tronics	BRM50702-02	0	4/12/2019	4/12/2021
Pre-amp	RF-LAMBDA	RLNA00M45GA	N/A	2/27/2019	2/27/2021
Antenna: Double-Ridged Horn 18-40 GHz	EMCO	3116	9011-2145	12/8/2017	12/8/2019

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

STATE OF THE MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16-4 or ENTR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: “Uncertainty in EMC Measurements” and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device. Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

Test Items	Measurement Uncertainty	Notes
RF Frequency Accuracy	± 49.5 Hz	(1)
RF Conducted Power	± 0.93 dB	(1)
Conducted spurious emission of transmitter valid up to 40GHz	± 1.86 dB	
Occupied Bandwidth	$\pm 2.65\%$	
Audio Frequency Response	± 1.86 dB	
Modulation limiting	$\pm 1.88\%$	
Radiated RF Power	± 1.4 dB	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq.	$\pm 1.88\%$	
Within 6kHz and 25kHz of audio Freq.	$\pm 2.04\%$	
Rad Emissions Sub Meth up to 26.5GHz	± 2.14 dB	
Adjacent channel power	± 1.47 dB	(1)
Transient Frequency Response	$\pm 1.88\%$	
Temperature	$\pm 1.0^{\circ}\text{C}$	(1)
Humidity	$\pm 5.0\%$	

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=1.96$.

END OF REPORT