



FCC PART 15.231 & IC RSS-210 Momentary Transmitter Test Report

APPLICANT	ENERNET CORPORATION
ADDRESS	307 DEWITTSHIRE ROAD SYRACUSE NEW YORK 13214 USA
FCC ID	TGD15700
IC	6120A-15700
MODEL NUMBER	15700
PRODUCT DESCRIPTION	ACCESSORY BOARD
DATE SAMPLE RECEIVED	08/23/2018
FINAL TEST DATE	08/27/2018
TESTED BY	Tim Royer
APPROVED BY	Franklin Rose
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Report Version	Description	Issue Date
1332AUT18TestReport_	Rev1	Initial Issue	08/27/2018

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
Designation #: US1070

Tested by:



Name and Title	Tim Royer, Project Manager / EMC Testing Engineer
Date	08/27/2018

Reviewed and Approved by:



Name and Title	Franklin Rose, Project Manager / EMC Testing Technician
Date	08/30/2018

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GENERAL INFORMATION

EUT Information

EUT Description	ACCESSORY BOARD		
FCC ID	TGD15700		
IC	6120A-15700		
Model Number	15700		
EUT Power Source	☐ 110–120Vac, 50–60Hz	☒ DC Power (12V)	☐ Battery Operated
Test Item	☐ Prototype	☒ Pre-Production	☐ Production
Type of Equipment	☐ Fixed	☒ Mobile	☐ Portable
Antenna Connector	No Antenna Connector		
Test Conditions	The temperature was 26°C Relative humidity of 50%.		
Modification to the EUT	EUT was modified to include a BNC antenna connector.		
Applicable Standards	FCC CFR 47 Part 2, Part 15, RSS-GEN Issue 5, RSS-210, Issue 9 August 2016 Referring to ANSI C63.10-2013 for Test Procedures		
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070 IC Test Site: 2056A		

Peripherals Used in Testing

Description	Type	Connector	Length
Test Fixture	Manufacturer	n/a	n/a

Frequency Range(s) of EUT

Operating Frequency 1	902.875 MHz
Test Frequencies	902.875 MHz

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Definition of EUT

FCC RULE PART NO.: FCC PART 15.3

§15.3 Definitions.

(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.

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

IC RULE PART NO.: RSS-GEN, Section 2.6.1

2.6.1 Category I equipment

Category I equipment consists of radio apparatus that require a technical acceptance certificate (TAC), issued by the Certification and Engineering Bureau of ISED, or a certificate issued by a recognized CB, pursuant to subsections 4(2) of the *Radiocommunication Act* and 21(1) of the *Radiocommunication Regulations*, respectively.

Certified Category I equipment shall be listed in ISED's [radio equipment list](#) (REL).

No person shall import, distribute, lease, offer for sale, or sell Category I radio apparatus in Canada unless they are listed on ISED's REL. [3](#)

Note: The device is a momentarily operated transmitter.

MEASUREMENT STANDARDS

FCC RULE PART NO.: FCC PART 15.31

§15.31 Measurement standards.

(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.

IC RULE PART NO.: RSS-GEN 3.2

3.2 Measurement methods, measurement instrumentation and test site validation

The requirements stated in RSS-Gen and in the applicable RSS shall take precedence if there are discrepancies between the requirements stated in these standards and those stated in the publications referenced in this section. The [adopted editions of the ANSI standards](#) listed below will be posted on the Certification and Engineering Bureau's (CEB) website.

The methods in ANSI C63.26, *American National Standard of Procedures for Compliance Testing of Licensed Transmitters*, and ANSI C63.10, *American National Standard for Testing Unlicensed Wireless Devices*, shall be used for measurement methods applicable to licensed and licence-exempt radio apparatus, respectively.

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METHOD OF MEASUREMENT

FCC 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.

IC RULE PART NO.: RSS-GEN Section 8.1

8.1 Measurement bandwidths and detector functions

Unless otherwise specified, for all frequencies equal to or less than 1 GHz, the emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a CISPR quasi-peak detector function, with the exception of the frequency ranges 9-90 kHz and 110-490 kHz, where the emission limits are based on measurements employing a linear average detector. The measurement bandwidth to be used depends on the measured frequency and shall be as specified in CAN/CSA-CISPR 16-1-1:15 for the required type of detector to be used for measurements.

If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for factors such as pulse desensitization to ensure that the peak emission is less than 20 dB above the average limit.

If an average measurement is specified for wanted emissions, a linear average detector having a bandwidth equal to or greater than the occupied bandwidth shall be used to make the measurement.

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SUMMARY OF TESTING

Requirement	FCC Rule Part No.	IC Rule Part No.	Test Item	Result
FCC PT 15.231(a), RSS-210 Annex 1, 1.1	15.231(a)	RSS-210 Annex 1, 1.1	Periodic Operation	Pass
-	-	-	Duty Cycle*	-
FCC PT 2.1046, RSS-GEN 6.12	15.231(b)	RSS-210 4.4, RSS-210 Annex 1, 1.2	Radiated Field Strength of the Fundamental	Pass
FCC PT 2.1053, RSS-GEN 6.7	15.231(b), 15.209(a), 15.205(a), (b)	RSS-GEN 8.9, 8.10, RSS-210 4.1, RSS-210 Annex 1, 1.2	Radiated Field Strength of Spurious Emissions	Pass
FCC PT 2.1049, RSS-GEN 6.7	15.231(c)	RSS-GEN 6.6	Occupied Bandwidth	Pass
15.207(a), RSS-GEN 8.8	15.207(a), (c)	RSS-GEN 8.8	AC Powerline Conducted Emissions	n / a

***Note:** Duty Cycle Measurements are necessary for Duty Cycle correction, used in conjunction with Peak Measurements to show compliance with the Average Limits. The test data has been included for informational purposes only.

PERIODIC OPERATION

Requirements:

FCC RULE PART NO.: 15.231(a), RSS-210 Annex 1, Section A.1.1

§15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) 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.

(4) 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

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, 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.

IC RULE PART NO.: RSS-210 Annex 1, Section A.1.1

A.1.1 Types of Momentarily Operated Devices

Devices shall comply with the following for momentary operation:

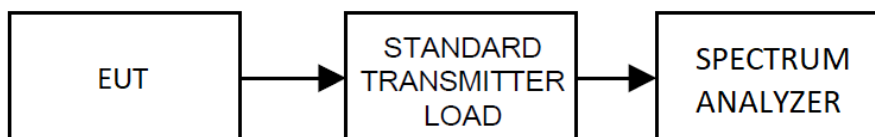
- a. A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all times during transmission. When released, the transmitter shall cease transmission within no more than 5 seconds of being released.
- b. A transmitter that has been activated automatically shall cease transmission within 5 seconds of activation.
- c. Periodic transmissions at regular, predetermined intervals are not permitted, except as specified in [Section A.1.4](#). However, polling or supervision transmissions that determine system integrity of transmitters used in security or safety applications are permitted, provided the total duration of transmission does not exceed 2 seconds per hour for each transmitter.
- d. Intentional radiators used for radio control during emergencies involving fire, security of goods (e.g. burglar alarms), and safety-of-life, when activated to signal an alarm, may operate during the interval of the alarm condition.

Test Procedure: ANSI C63.10 § 7.4

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PERIODIC OPERATION

Test Setup:



Declaration Provided by Applicant

Item	Description	Yes	No
1	Does this device transmit a signal that is only used to control another device?		X
2	Does this device send data with this control signal?		X
3	Does this device send data? Data is, things like: temperature, wind direction, fluid amount, rate of flow, etc.	X	
4	Does this device transmit: continuously or <u>automatically</u>	X	
5	If manually operated does this device stop transmitting within 5 seconds of releasing the button?		
6	If automatically operated does it deactivate 5 seconds after activation?	X	
7	Does it transmit at regular predetermined intervals?		X
8	Does it poll or send supervisory information?		X
	If yes does it do a system integrity check?		
	If yes, How often?		
9	Is this a fire, security or safety of life device?		X
	If Yes, does the device stop transmitting after the alarm condition is satisfied?		
10	The device's Duty cycle:	2.58 %	
	Maximum Pulse On-time (in 100 ms Period):	0.86 ms	
	On-time Period (if other than 100 ms):		
11	Modulation technique: Please specify the modulation of the test sample, FM, or AFSK, or FSK, On-Off Keying, etc.	FSK	

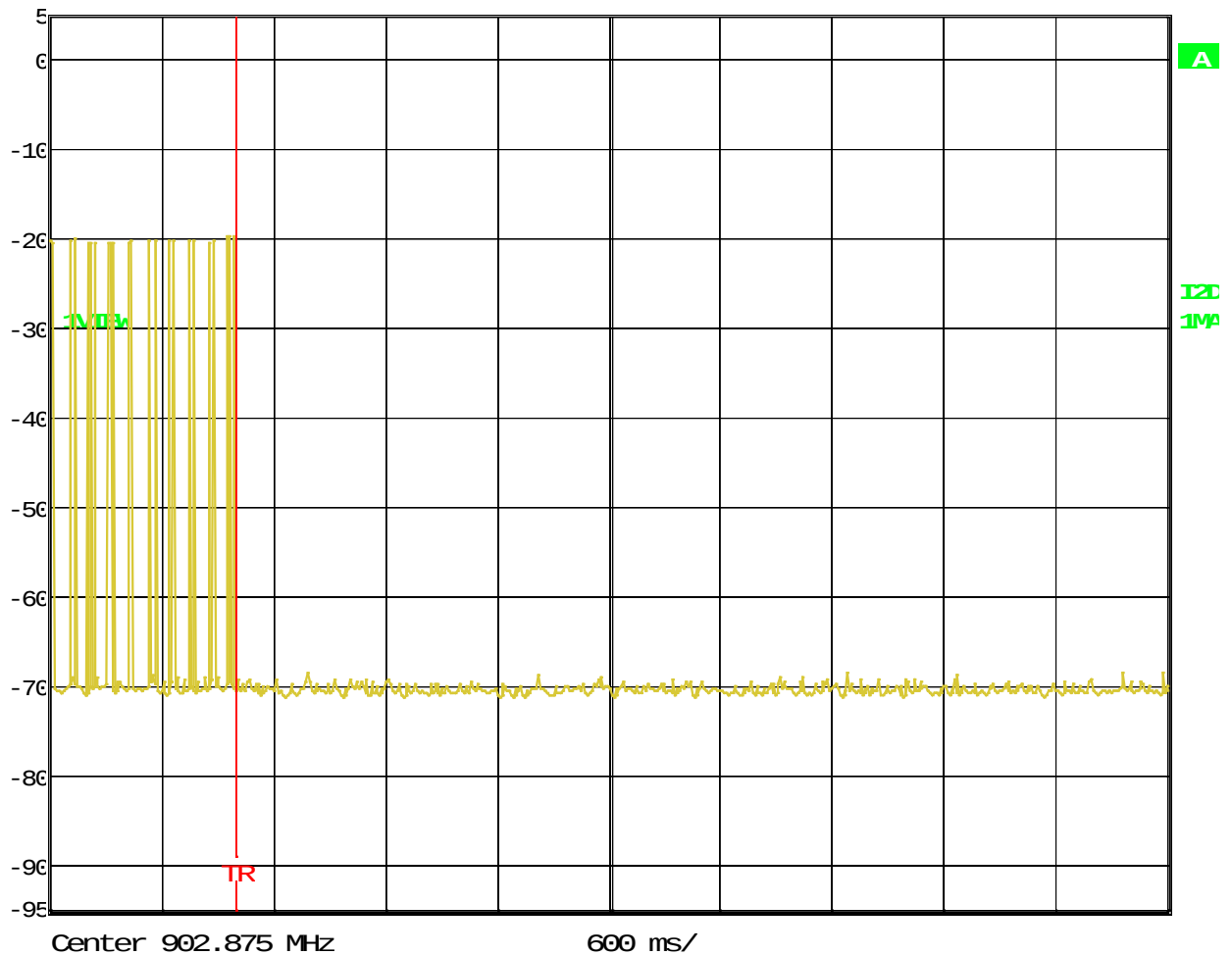
PERIODIC OPERATION

Test Data: 5 Second Turn-Off Period Plot



Ref Lvl
5 dBm

RBW 100 kHz RF Att 15 dB
VBW 300 kHz
SWT 6 s Unit dBm



Date: 1.JAN.1997 03:11:06

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DUTY CYCLE

Requirements:

RULE PART NO.: ANSI C63.10 Section 4.1.4.2.4, Section 7.5

4.1.4.2.4 Average value of pulsed emissions

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall be determined from the peak field strength after correcting for the worst-case duty cycle as described in 7.5. The exact method of calculating the average field strength shall be included in the test report.

7.5 Procedure for determining the average value of pulsed emissions

Unless otherwise specified, 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 s (100 ms). In cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined during a 0.1 s interval.⁶⁴ The following procedure is an example of how the average value may be determined. The average field strength may be found by measuring the peak pulse amplitude (in log equivalent units) and determining the duty cycle correction factor (in dB) associated with the pulse modulation as shown in Equation (10):

Duty Cycle Formula: ANSI C63.10 Section 7.5, Equation 10:

$$\delta \text{ (dB)} = 20 \log [\sum (n_1 t_1 + n_2 t_2 \dots) / T]$$

Where:

δ is the duty cycle correction factor (dB)

T is the pulse is the period that the pulses are averaged over, (≤ 100 ms).

t_1 is the pulse width of subpulse 1

t_2 is the pulse width of subpulse 2 (and so on)

n_1 is the number of t_1 pulses

n_2 is the number of t_2 pulses (and so on)

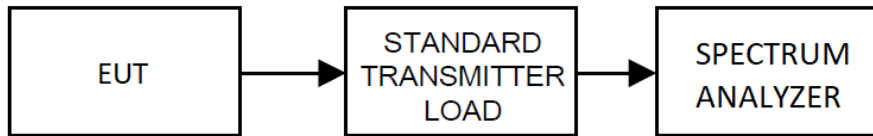
Test Data: Duty Cycle Calculation Table

Sub Pulse	Duration (ms)	Occurrences	On-Time (ms)
1	0.8610	3	2.5830
Total On Time (ms)			2.583
Period (ms)			100.00
Duty Cycle (%)			2.58%
Cor Factor (dB)			-31.76

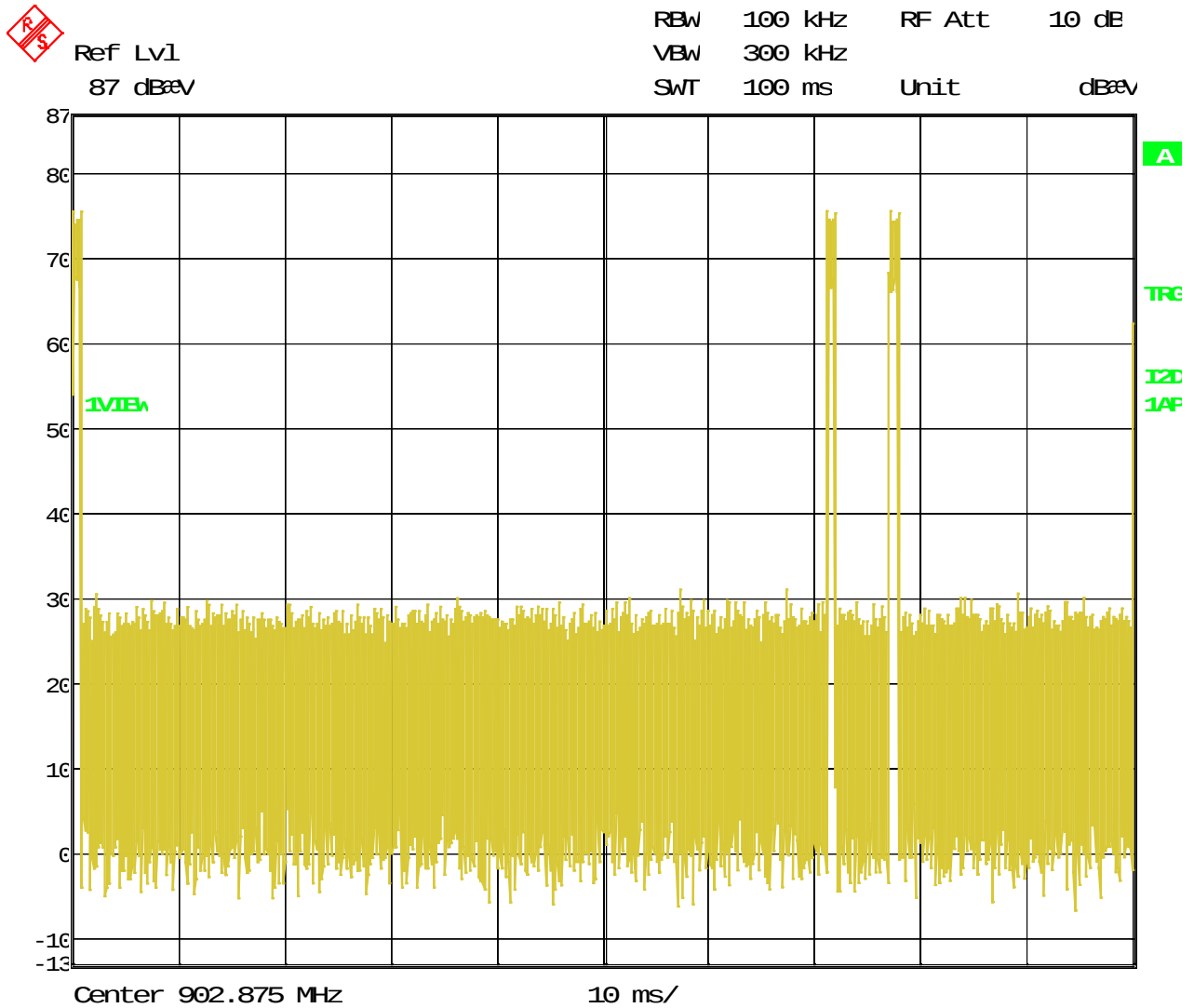
Applicant: ENERNET CORPORATION
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DUTY CYCLE

Test Setup:



Test Data: Pulse Activity in 100 ms Plot



Date: 1.JAN.1997 04:20:02

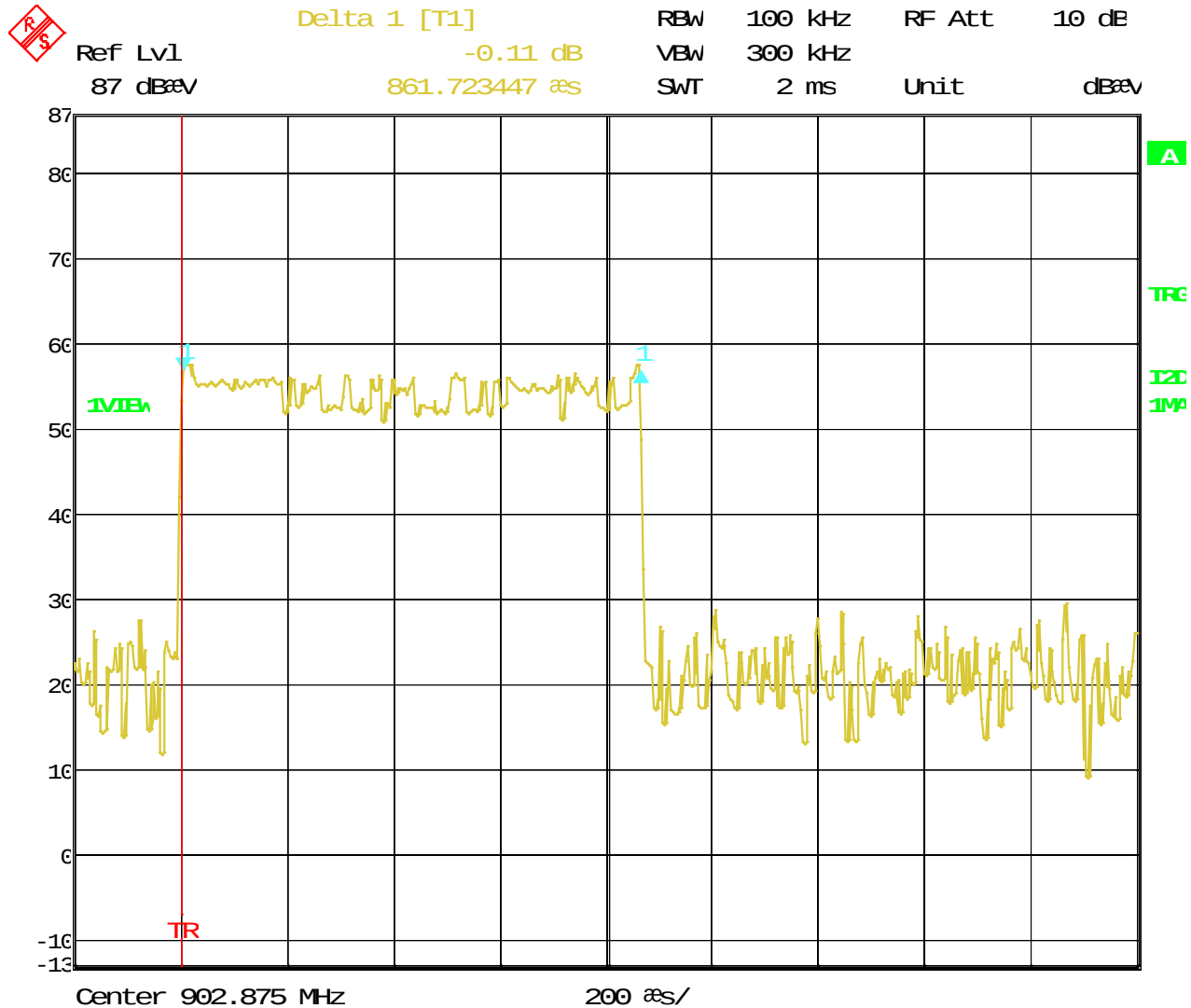
Pulse Trains = 0

Subpulse 1 Occurances = 3

Applicant: ENERNET CORPORATION
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DUTY CYCLE

Test Data: Subpulse 1 Duration



Date: 1.JAN.1997 02:10:57

Subpulse 1 Duration = 861 μ s

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FIELD STRENGTH OF EMISSIONS

Requirements: FCC PT 2.1046, 2.1053, RSS-GEN 6.12, 6.7

FCC RULE PART NO.: 15.231(b), 15.35(c), 15.205(a)(b), 15.209 (a)

§15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	¹ 1,250 to 3,750	¹ 125 to 375
174-260	3,750	375
260-470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

¹Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

FIELD STRENGTH OF EMISSIONS

§15.205 Restricted bands of operation.

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

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

¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

§15.209 Radiated emission limits; general requirements.

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

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

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FIELD STRENGTH OF EMISSIONS

IC RULE PART NO.: , RSS-210 Annex 1, A.1.2, RSS-GEN Section 8.2, 8.9, 8.10

A.1.2 Field Strengths

Following are the requirements for field strength of emissions:

- a. The field strength of emissions from momentarily operated intentional radiators shall not exceed the limits outlined in [Table A1](#), based on the average value of the measured emissions. The requirements of the Pulsed Operation section of RSS-Gen apply for averaging pulsed emissions and limiting peak emissions.

Alternatively, compliance with the limits in Table A1 may be demonstrated using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

- b. Unwanted emissions shall be 10 times below the fundamental emissions field strength limits in Table A1 or comply with the limits specified in RSS-Gen, whichever is less stringent.

Table A1— Permissible Field Strength Limits for Momentarily Operated Devices

Fundamental Frequency (MHz), Excluding Restricted Frequency Bands Specified in RSS-Gen	Field Strength of the Fundamental Emissions (μV/m at 3 m)
70-130	1,250
130-174	1,250 to 3,750*
174-260 ^(Note 1)	3,750
260-470 ^(Note 1)	3,750 to 12,500*
Above 470	12,500

* Linear interpolation with frequency, f, in MHz:

For 130-174 MHz: Field Strength (μV/m) = $(56.82 \times f) - 6136$

For 260-470 MHz: Field Strength (μV/m) = $(41.67 \times f) - 7083$

8.2 Pulsed operation

When the field strength or envelope power is not constant or it is in pulses, and an average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train during which the field strength or power is at its maximum value, including blanking intervals within the pulse train, provided that the pulse train does not exceed 0.1 seconds. In cases where the pulse train exceeds 0.1 seconds, the average value of field strength or output power shall be determined during a 0.1 seconds interval during which the field strength or power is at its maximum value.

The exact method of calculating the average field strength shall be described in the test report.

For pulse modulated devices with a pulse-repetition frequency of 20 Hz or less and for which CISPR quasi-peak measurements are specified, compliance shall be demonstrated using measuring instrumentation employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements.

FIELD STRENGTH OF EMISSIONS

8.10 Restricted frequency bands

Restricted frequency bands, identified in [table 7](#), are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:

- The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in [table 7](#) except for apparatus compliant with RSS-287, *Emergency Position Indicating Radio Beacons (EPIRB)*, *Emergency Locator Transmitters (ELT)*, *Personal Locator Beacons (PLB)*, and *Maritime Survivor Locator Devices (MSLD)*.
- Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in [table 5](#) and [table 6](#).
- Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

MHz	MHz	GHz
0.090 - 0.110	149.9 - 150.05	9.0 - 9.2
0.495 - 0.505	156.52475 - 156.52525	9.3 - 9.5
2.1735 - 2.1905	156.7 - 156.9	10.6 - 12.7
3.020 - 3.026	162.0125 - 167.17	13.25 - 13.4
4.125 - 4.128	167.72 - 173.2	14.47 - 14.5
4.17725 - 4.17775	240 – 285	15.35 - 16.2
4.20725 - 4.20775	322 - 335.4	17.7 - 21.4
5.677 - 5.683	399.9 - 410	22.01 - 23.12
6.215 - 6.218	608 - 614	23.6 - 24.0
6.26775 - 6.26825	960 - 1427	31.2 - 31.8
6.31175 - 6.31225	1435 - 1626.5	36.43 - 36.5
8.291 - 8.294	1645.5 - 1646.5	Above 38.6
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	
8.41425 - 8.41475	2200 - 2300	
12.29 - 12.293	2310 - 2390	
12.51975 - 12.52025	2483.5 - 2500	
12.57675 - 12.57725	2655 - 2900	
13.36 - 13.41	3260 – 3267	
16.42 - 16.423	3332 - 3339	
16.69475 - 16.69525	3345.8 - 3358	
16.80425 - 16.80475	3500 - 4400	
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 – 8500	
108 – 138		

Note 1: Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

FIELD STRENGTH OF EMISSIONS

8.9 Transmitter emission limits

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 – General field strength limits at frequencies above 30 MHz

Frequency (MHz)	Field strength ($\mu\text{V/m}$ at 3 m)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Table 6 – General field strength limits at frequencies below 30 MHz

Frequency	Magnetic field strength (H-Field) ($\mu\text{A/m}$)	Measurement distance (m)
9 - 490 kHz ^{Note 1}	$6.37/F$ (F in kHz)	300
490 - 1705 kHz	$63.7/F$ (F in kHz)	30
1.705 - 30 MHz	0.08	30

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

FIELD STRENGTH OF EMISSIONS

Measurement Range

Requirements: Part 15.33(b)(1), RSS-GEN Section 6.13.2

§15.33 Frequency range of radiated measurements.

(b) For unintentional radiators:

(1) Except as otherwise indicated in paragraphs (b)(2) or (b)(3) of this section, for an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30.
1.705-108	1000.
108-500	2000.
500-1000	5000.
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower.

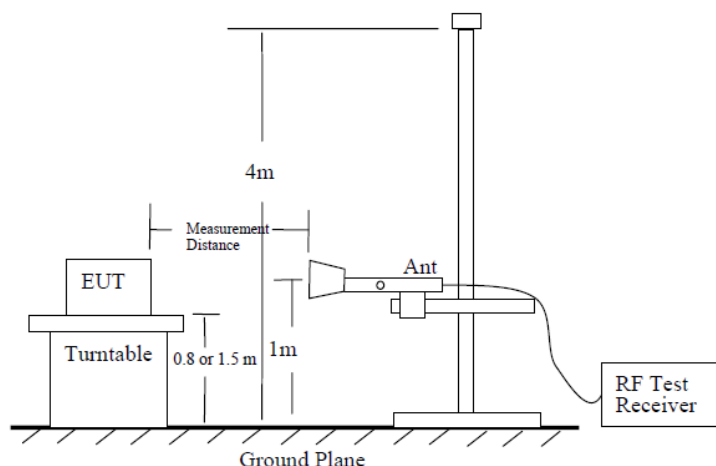
RSS-GEN Section 6.13.2:

Table 2 – Frequency range for radiated measurement for equipment with a digital device	
Highest frequency generated, operated or used in the equipment (MHz)	Upper frequency limit of measurement range (MHz)
< 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
> 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

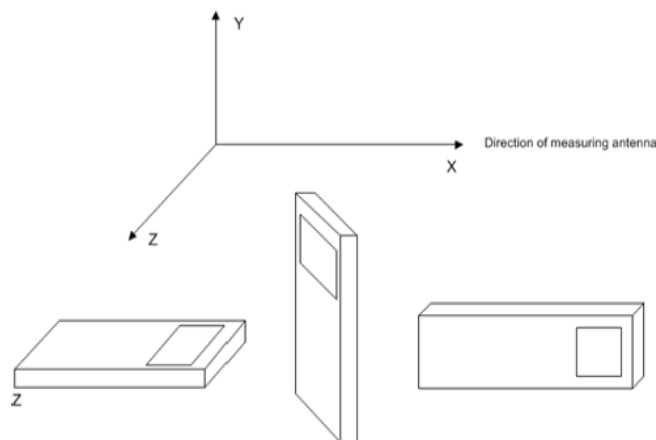
FIELD STRENGTH OF EMISSIONS

Method of Measurement: ANSI C63.10, 6.3 – 6.6 “Radiated Emissions”

Test Site Setup:



EUT Orientation(s):



Note: The measurements below represent the worst case of all the frequencies tested. The six (6) highest emissions or more of each worst-case operational modes of the EUT are represented below. Emissions 20 dB below the limit are not required to be reported, but may be shown for informational purposes.

Formula of Conversion Factors:

The field strength at 3m was established by adding the meter reading of the spectrum analyzer to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB/m. The gain of the preselector was accounted for internally in the spectrum analyzer reading. An example is given below:

Freq. MHz	Meter Reading dB μ V	ACF dB / m	Cable Loss dB	Field Strength dB μ V/m @ 3 m
33	20	+10.36	+1.2	= 31.56

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FIELD STRENGTH OF EMISSIONS

Limit Calculations

Method of Calculation: ANSI C63.10, 7.6.2

Step 1: Limit Interpolation Formula:

$$\text{Limit } (\mu\text{V/m}) = L_l + (f - f_l) * ((L_h - L_l) / (f_h - f_l))$$

Where:

f = fundamental emission frequency (MHz)

f_l = Low-End frequency of the linear interpolation band (MHz)

f_h = High-End frequency of the linear interpolation band (MHz)

L_l = Low-End Limit of the linear interpolation band ($\mu\text{V/m}$)

L_h = High-End Limit of the linear interpolation band ($\mu\text{V/m}$)

Step 2: Limit Conversion Formula:

$$\text{Limit (dB}\mu\text{V/m)} = 20 \log (\mu\text{V/m})$$

15.231(b), RSS-210 A.1.2 - Limit Lookup Chart		
Fundamental Frequency (MHz)	902.875	
Limit Frequency (MHz)	Fundamental Field Strength (dBuV/m)	Spurious Field Strength (dBuV/m)
≥ 470	81.94	61.94

FIELD STRENGTH OF EMISSIONS

Test Data: Radiated Field Strength of the Fundamental

Emission Frequency (MHz)	Meter Reading (dBμV)	Antenna Polarity	Measurement Detector	Coax Loss (dB)	Correction Factor (dB / m)	Duty Cycle Correction (dB)	Field Strength (dBμV / m)	Limit Source	Limit (dBμV / m)	Margin (dB)
902.88	44.26	H	PK	3.543	21.900	31.760	37.943	15.231	81.940	43.997
902.88	45.82	V	PK	3.543	21.900	31.760	39.503	15.231	81.940	42.437

Test Data: Radiated Field Strength of Spurious Emissions

Emission Frequency (MHz)	Meter Reading (dBμV)	Antenna Polarity	Measurement Detector	Coax Loss (dB)	Correction Factor (dB / m)	Duty Cycle Correction (dB)	Field Strength (dBμV / m)	Limit Source	Limit (dBμV / m)	Margin (dB)
53.50	-1.02	V	PK	0.852	10.100	31.760	-21.829	15.231	61.940	83.769
71.22	2.05	H	PK	1.001	6.440	31.760	-22.269	15.231	61.940	84.209
175.81	2.55	V	PK	1.543	14.740	31.760	-12.927	15.231	61.940	74.867
196.59	8.31	V	PK	1.610	16.140	31.760	-5.700	15.231	61.940	67.640
196.59	12.86	H	PK	1.610	16.140	31.760	-1.150	15.231	61.940	63.090
339.47	6.75	V	PK	2.118	13.900	31.760	-8.992	15.231	61.940	70.932
339.47	7.62	H	PK	2.118	13.900	31.760	-8.122	15.231	61.940	70.062
1805.80	16.25	H	PK	5.110	30.840	31.760	20.437	15.231	61.940	41.503
1805.80	13.68	V	PK	5.110	30.840	31.760	17.870	15.231	61.940	44.070
2708.60	15.70	V	PK	6.200	32.600	31.760	22.740	15.209	53.980	31.240
2708.60	15.28	H	PK	6.200	32.600	31.760	22.320	15.209	53.980	31.660
3611.50	14.34	H	PK	7.149	33.520	31.760	23.249	15.209	53.980	30.731
3611.50	15.99	V	PK	7.149	33.520	31.760	24.899	15.209	53.980	29.081
4514.40	15.59	V	PK	8.060	33.850	31.760	25.740	15.209	53.980	28.240
4514.40	14.13	H	PK	8.060	33.850	31.760	24.280	15.209	53.980	29.700
5417.30	16.39	H	PK	8.814	34.440	31.760	27.884	15.209	53.980	26.096
5417.30	16.26	V	PK	8.814	34.440	31.760	27.754	15.209	53.980	26.226
6320.10	20.36	V	PK	9.588	35.610	31.760	33.798	15.231	61.940	28.142
6320.10	20.44	H	PK	9.588	35.610	31.760	33.878	15.231	61.940	28.062
7223.02	29.60	H	PK	10.124	35.680	31.760	43.644	15.231	61.940	18.296
7223.02	28.23	V	PK	10.124	35.680	31.760	42.274	15.231	61.940	19.666
8125.90	27.43	V	PK	10.813	35.820	31.760	42.303	15.209	53.980	11.677
8125.90	29.48	H	PK	10.813	35.820	31.760	44.353	15.209	53.980	9.627
9028.80	28.42	H	PK	11.260	36.100	31.760	44.020	15.209	53.980	9.960
9028.80	27.34	V	PK	11.260	36.100	31.760	42.940	15.209	53.980	11.040

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OCCUPIED BANDWIDTH

Requirements: FCC PT 2.1049, RSS-GEN 6.7

FCC RULE PART NO.: 15.231(c), 15.215(c)

§15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

(c) 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.

§15.215 Additional provisions to the general radiated emission limitations.

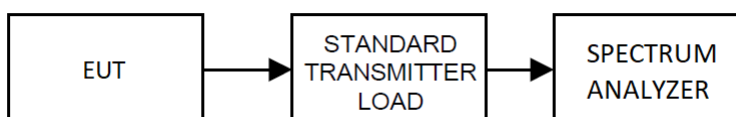
(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific 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 RULE PART NO.: RSS-210 Annex 1, A.1.3

A.1.3 Bandwidth of Momentary Signals

The 99% bandwidth of momentarily operated devices shall be less or equal to 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the 99% bandwidth shall be less or equal to 0.5% of the centre frequency.

Test Setup:



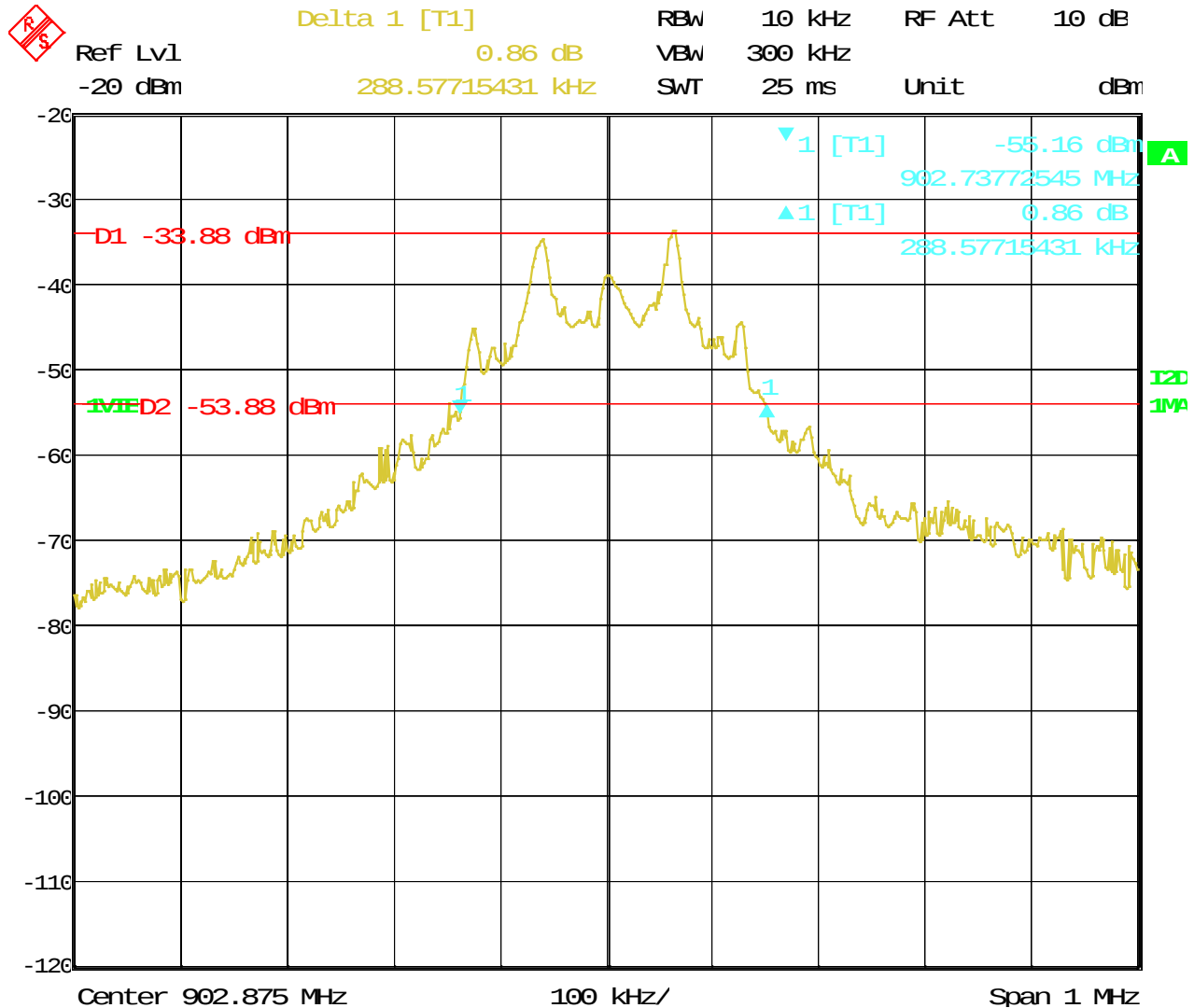
Test Data: Occupied Bandwidth Measurement Table

Tuned Frequency (MHz)	Occupied Bandwidth Limit (KHz)
902.875	2257.1875
Measured 20 dB BW (KHz)	288.57
Margin (KHz)	1968.6175
Measured 99% BW (KHz)	322.64
Margin (KHz)	1934.5475

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OCCUPIED BANDWIDTH

Test Data: 20 dB Occupied Bandwidth Measurement Plot



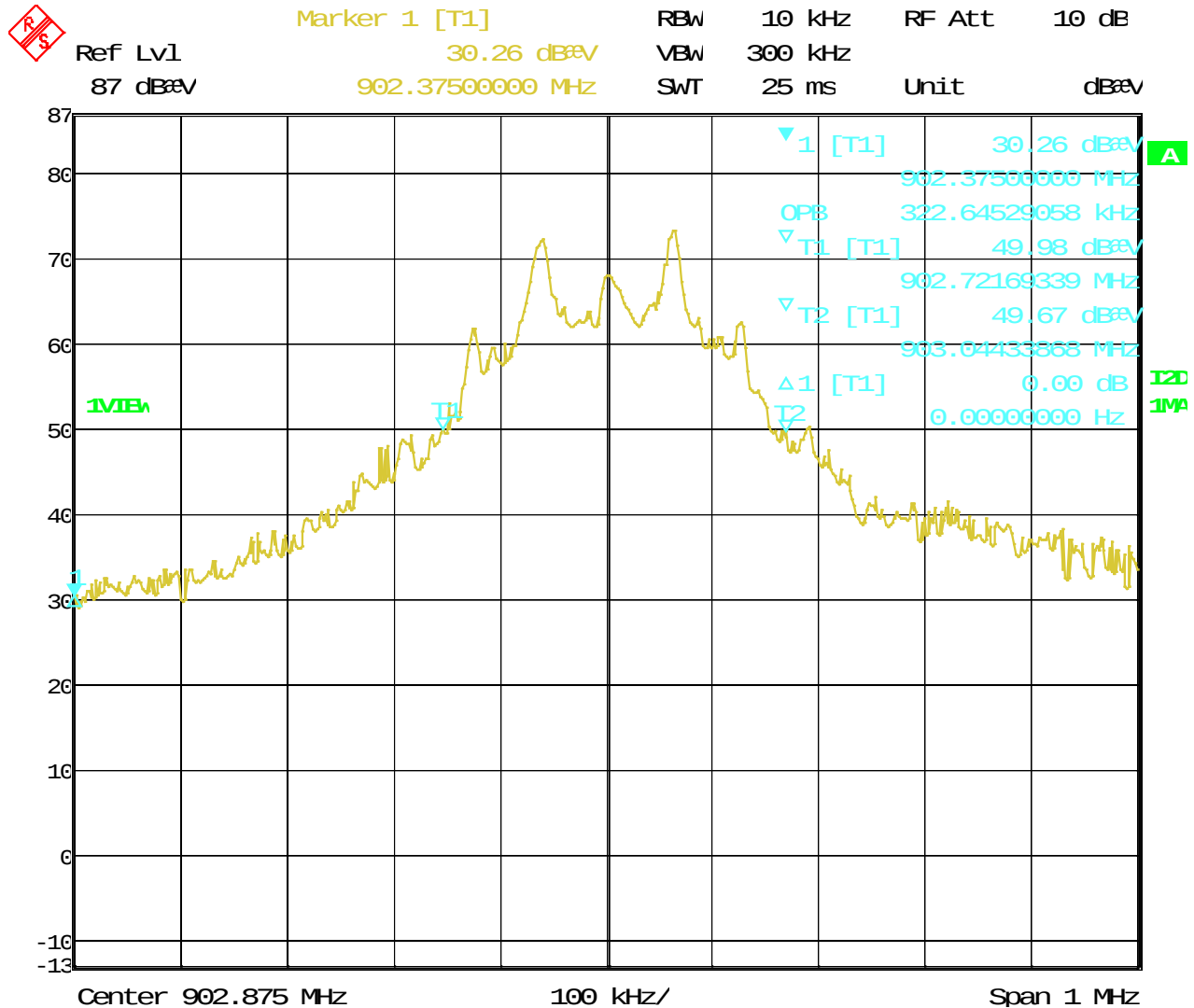
Date: 1.JAN.1997 02:51:46

20 dB Occupied Bandwidth = 288.57 kHz

Applicant: ENERNET CORPORATION
 FCC ID: TGD15700
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OCCUPIED BANDWIDTH

Test Data: 99% Occupied Bandwidth Measurement Plot



Date: 1.JAN.1997 02:50:39

99 % Occupied Bandwidth = 322.64 kHz

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POWER LINE CONDUCTED INTERFERENCE

Requirements: FCC Part 15.207(a), (c), RSS-GEN 8.8

FCC Rule Part No.: FCC Part 15.207(a), (c), RSS-GEN 8.8

§15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 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 boundary between the frequency ranges.

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.

(c) 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 provisions for, the use of battery chargers which permit operating while charging, AC adapters 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.

POWERLINE CONDUCTED INTERFERENCE

IC Rule Part No.: RSS-GEN 8.8, ICES-003 § 6.1

8.8 AC power-line conducted emissions limits

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μ H / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 4 – AC power-line conducted emissions limits

Frequency (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 ^{Note 1}	56 to 46 ^{Note 1}
0.5 – 5	56	46
5 – 30	60	50

Note 1: The level decreases linearly with the logarithm of the frequency.

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

The EUT does not connect to an AC external powerline.

TEST EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Attenuator BNC 30dB 50OHM DC- 2G	Mini-Circuits	HAT-30+	#58	7/14/2017	7/14/2019
Coaxial Cable - BMBM-0061-01 RG400	Pasternack	PE3582LF-24	BMBM-0061-01	1/31/2017	1/31/2019
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	7/26/2019
CHAMBER	Panashield	3M	N/A	5/5/2017	5/5/2019
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/16/16	08/16/19
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	3/1/2019
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244-01 KMKM-0670-00 KFKF-0198-01	8/9/2016	8/9/2019
LISN (Primary)	Electro-Metrics	ANS-25/2	225363	08/26/17	08/26/19

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

MEASUREMENT UNCERTAINTY

TEI Tab Lic Devices Uc 170428

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	$\pm 49.5 \text{ Hz}$	(1)
RF Conducted Power	$\pm 0.93 \text{ dB}$	(1)
Conducted spurious emission of transmitter valid up to 40GHz	$\pm 1.86 \text{ dB}$	
Occupied Bandwidth	$\pm 2.65 \%$	
Radiated RF Power	$\pm 1.4 \text{ dB}$	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq. Within 6kHz and 25kHz of audio Freq.	$\pm 1.88 \%$ $\pm 2.04 \%$	
Transient Frequency Response	$\pm 1.88 \%$	
Temperature	$\pm 1.0^\circ \text{C}$	(1)
Humidity	$\pm 5.0 \%$	

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

END OF REPORT

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