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# FCC Certification Test Report
# For the
# MILLER EDGE
# MEL-TX20

## FCC ID: OYE-MEL315

WLL JOB# **13469-01 Rev 0**
**June 6, 2014**

Prepared for:
**Miller Edge**
**300 N Jennersville Road**
**West Grove, PA 19390**

Prepared By:
Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ACCREDITED TESTING

**Testing Certificate AT-1448**

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Prepared by:

Steven Dovell
Compliance Engineer

Reviewed by:

Steven D. Koster
Vice President

 

# Abstract

This report has been prepared on behalf of Miller Edge to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.231 (10/2013) of the FCC Rules and Regulations. This Certification Test Report documents the test configuration and test results for a Miller Edge MEL-TX20.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The Miller Edge MEL-TX20 complies with the limits for an Intentional Radiator device under FCC Part 15.231.

 

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# 1 Introduction

## 1.1 Compliance Statement

The Miller Edge MEL-TX20 complies with the limits for an Intentional Radiator device under FCC Part 15.231 (10/2013).

## 1.2 Test Scope

Tests for radiated were performed. All measurements were performed in accordance with FCC part 15.231 and the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

## 1.3 Contract Information

| | |
|---|---|
| Customer: | Miller Edge<br>300 N Jennersville Road<br>West Grove, PA 19390 |
| Quotation Number: | 68102 |

## 1.4 Test Dates

| | |
|---|---|
| Testing was performed on the following date(s): | 5/27/14 -5/28/14 |

## 1.5 Test and Support Personnel

| | |
|---|---|
| Washington Laboratories, LTD | Steven Dovell |
| Customer Representative(s) | William Kalin |

## 1.6 Abbreviations

| | |
|---|---|
| **A** | **A**mpere |
| **ac** | **a**lternating **c**urrent |
| **AM** | Amplitude Modulation |
| **Amps** | **Amp**ere**s** |
| **b/s** | **b**its per **s**econd |
| **BW** | **B**and**W**idth |
| **CE** | **C**onducted **E**mission |
| **cm** | **c**enti**m**eter |
| **CW** | **C**ontinuous **W**ave |
| **dB** | **d**eci**B**el |
| **dc** | **d**irect **c**urrent |
| **EMI** | **E**lectro**m**agnetic **I**nterference |
| **EUT** | **E**quipment **U**nder **T**est |
| **FM** | **F**requency **M**odulation |
| **G** | **g**iga - prefix for $10^9$ multiplier |
| **Hz** | **H**ertz |
| **IF** | **I**ntermediate **F**requency |
| **k** | **k**ilo - prefix for $10^3$ multiplier |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **M** | **M**ega - prefix for $10^6$ multiplier |
| **m** | **m**eter |
| **µ** | **m**icro - prefix for $10^{-6}$ multiplier |
| **NB** | **N**arrow**b**and |
| **QP** | **Q**uasi-**P**eak |
| **RE** | **R**adiated **E**missions |
| **RF** | **R**adio **F**requency |
| **rms** | **r**oot-**m**ean-**s**quare |
| **SN** | **S**erial **N**umber |
| **S/A** | **S**pectrum **A**nalyzer |
| **V** | **V**olt |

 

# 2 Equipment Under Test

## 2.1 EUT Identification & Description

The Safety Edge transmitter is directly powered by two AA cells, providing a nominal 3 volts. The printed circuit board has a microcontroller whose input circuits are connected to sensors on the industrial door to which it is mounted. These sensors activate when a door edge contacts a person or obstacle in its path, activating the microcontroller's output circuits to the RF board. The transmitter then notifies the receiver at the electromechanical door operator to reverse the motion of the automated, unattended door.

**Table 1: Device Summary**

| ITEM | DESCRIPTION |
|---|---|
| Manufacturer: | MILLER EDGE |
| FCC ID: | OYE-MEL315 |
| Model: | MEL-TX20 |
| FCC Rule Parts: | §15.231 |
| Emission Designator: | 12K7F1D |
| Frequency of Operation | 315 MHz |
| Maximum Field Strength | 1984.1µV/m at 3m |
| Modulation: | OOK |
| Occupied Bandwidth: | 12.7 kHz |
| Keying: | Automatic |
| Type of Information: | data |
| Number of Channels: | 1 (315MHz) |
| Power Output Level | Fixed |
| Antenna Connector | integral |
| Antenna Type | ¼ wave helical antenna |
| Interface Cables: | Remote Switch |
| Power Source & Voltage: | 3.0Vdc Li-ion battery |

## 2.2 Test Configuration

The EUT has two modes of operation. During the idle state, the EUT transmits a "ping" signal to the receiver every 200ms. The second mode of operation is when the external switch is activated and the EUT transmits the event to the receiver.

## 2.3 Testing Algorithm

The MEL-TX20 was configured with test software that allowed the EUT to transmit constantly at 315MHz for radiated measurements and in the normal operating mode depending on internal switch positions.

Worst case emission levels are provided in the test results data.

 

## 2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

## 2.5 Measurements

### 2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

## 2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

**Equation 1: Standard Uncertainty**

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + \ldots\ldots}$$

Where $u_c$ = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

 

**Equation 2: Expanded Uncertainty**

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

k ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)

$u_c$ = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

**Table 2: Expanded Uncertainty List**

| Scope | Standard(s) | Expanded Uncertainty |
|---|---|---|
| Conducted Emissions | CISPR11, CISPR22, CISPR14, FCC Part 15 | ±2.63 dB |
| Radiated Emissions | CISPR11, CISPR22, CISPR14, FCC Part 15 | ±4.55 dB |

.

 

# 3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

**Table 3: Test Equipment List**

| Test Name: **Radiated Emissions** | | Test Date: **05/27/2014** | |
|---|---|---|---|
| **Asset #** | **Manufacturer/Model** | **Description** | **Cal. Due** |
| 69 | HP - 85650A | ADAPTER QP | 1/9/2015 |
| 802 | HP - 8568B | SPECTRUM ANALYZER | 1/9/2015 |
| 71 | HP - 85685A | PRESELECTOR RF | 1/9/2015 |
| 644 | SUNOL SCIENCES CORPORATION - JB1 925-833-9936 | BICONALOG ANTENNA | 1/17/2016 |
| 626 | ARA - DRG-118/A | ANTENNA HORN | 1/6/2016 |
| 66 | B&Z - BZ-01002650-401545-282525 | PRE-AMPLIFIER RF. 1-26.5GHZ | 10/2/2014 |
| 528 | AGILENT - E4446A | ANALYZER SPECTRUM | 4/23/2016 |

 

# 4 Test Results

## 4.1 Duty Cycle Correction

Measurements may be adjusted where pulsed RF is utilized to find the average level associated with a quantity. This calculation is applied to limits for unlicensed devices.

- For Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements are compared to a 100 millisecond period

The duty cycle correction factor is calculated by:

20 x LOG (on time/100 ms)

The following Figures show the plots of the modulated carrier. The spectrum analyzer was set to Zero Span and the video triggered to collect the pulse train of the modulation. Calculations of the duty cycle correction factor were obtained from the worst case calculated number of active bits.

The character bits are each of 52 microseconds duration, and each byte then consists of 10 bits. The 'status' change transmission consists of 4 bytes: address, address, status, status. This 4 byte control signal is sent nine times as three groups of three, with each group separated by 33.4 ms and each adjacent control signal separated by 3.5 ms. This series of signals is only transmitted when the Safety Edge transmitter's inputs change. Software limitations only allow at most 8bits per byte. One start bit, seven data bits. The parity bit should always be 0 and the stop bit is always 0. In the 100ms test time used to determine duty cycle there are 7 groups + 1 single bit. Worst case TX on time would be if all bits were set to one. This would result in:

52µsec * 8bits * 4 bytes * 7 groups + 52µsec = 11.7ms.

Duty Cycle correction = 20 * Log (11.7ms/100ms) = -18.6dB

 

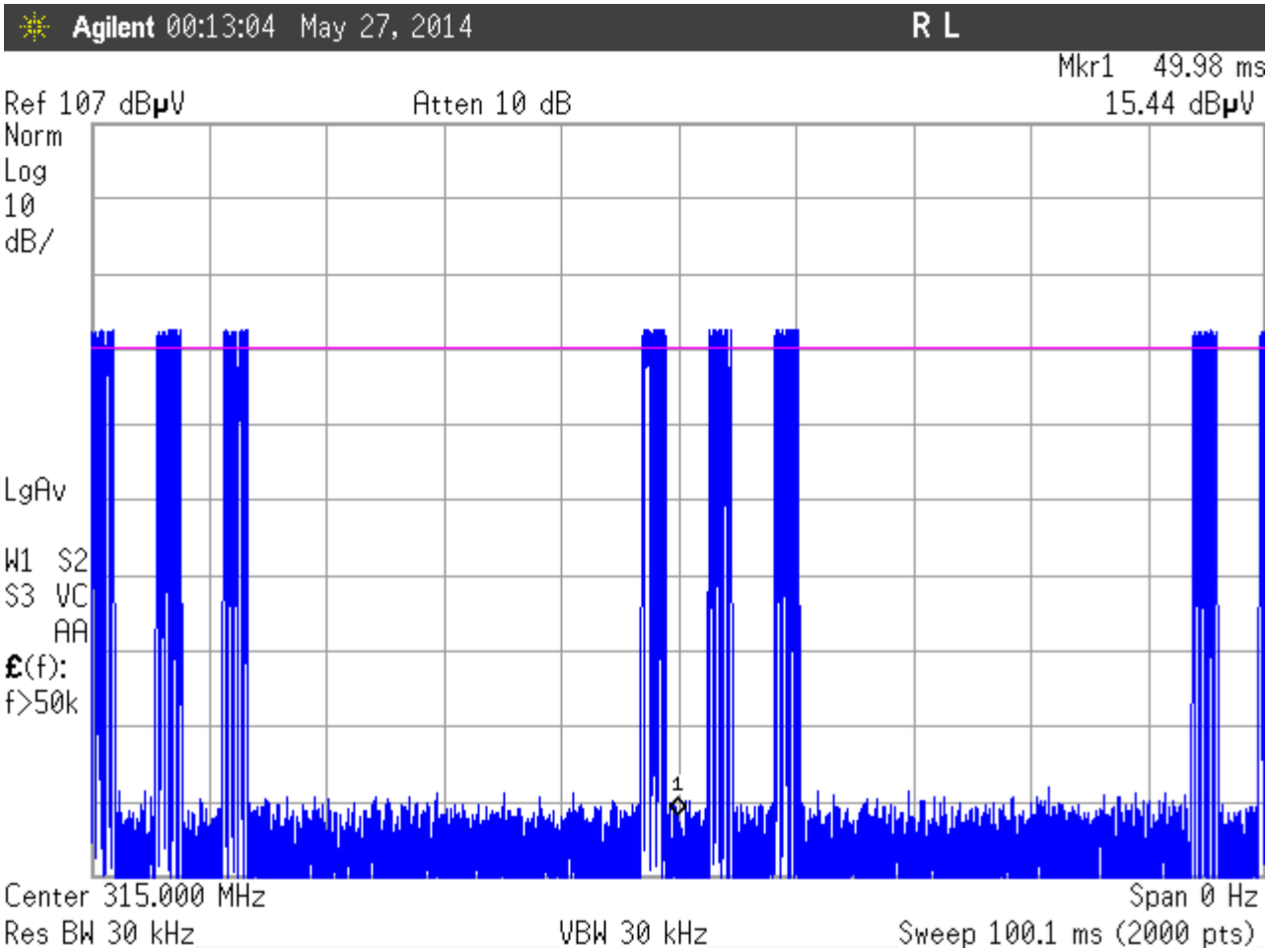


**Figure 1: Duty Cycle Plot – Worst Case 100ms and Pulse Train**

 

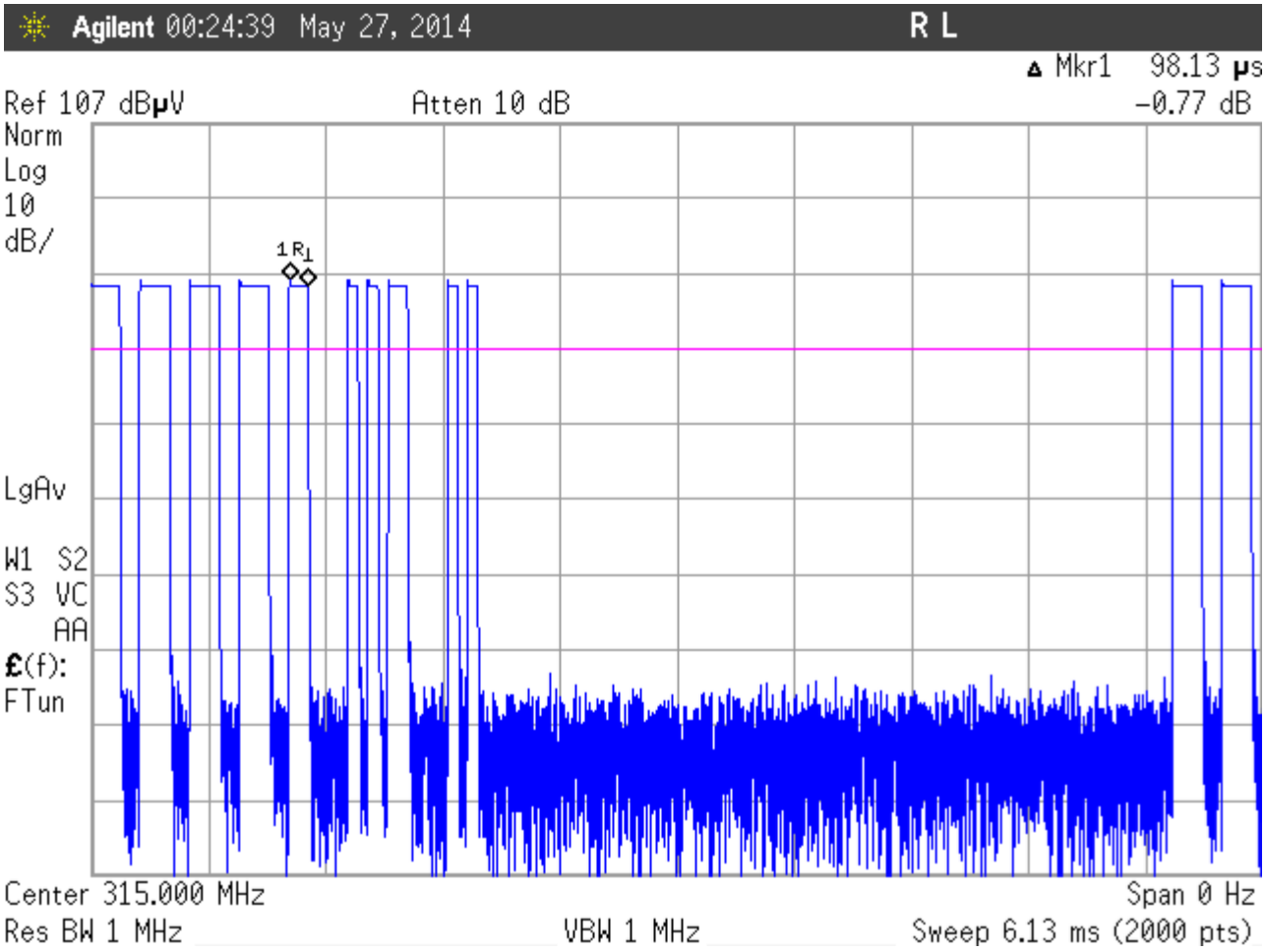


**Figure 2: Duty Cycle Plot – Typical Single Byte**

 

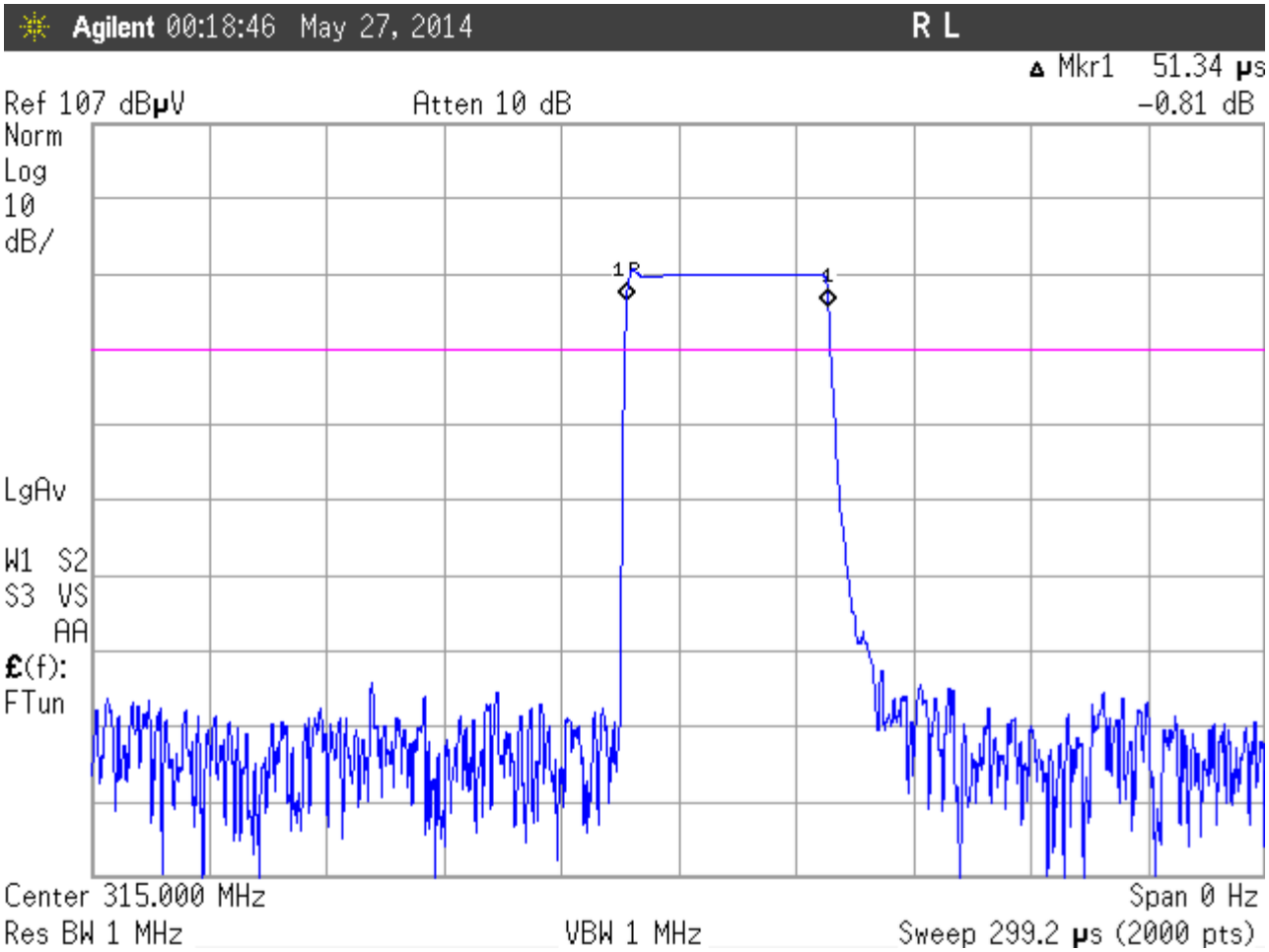


**Figure 3: Duty Cycle Plot – Single Bit**

 

## 4.2 Transmit Turnoff Time (FCC Part §15.231(a) (2))

Per FCC part 15.231 Paragraph (a)(2) *'A transmitter activated automatically shall cease transmission within 5 seconds after activation.'*

The below figure shows that the turnoff time after activation is less than 5 seconds (see marker delta on plot) complying with the requirements of part 15.231(a)(2).

The EUT was measured by a spectrum analyzer through a near field antenna. The sweep was activated at the start of the EUT transmit signal.

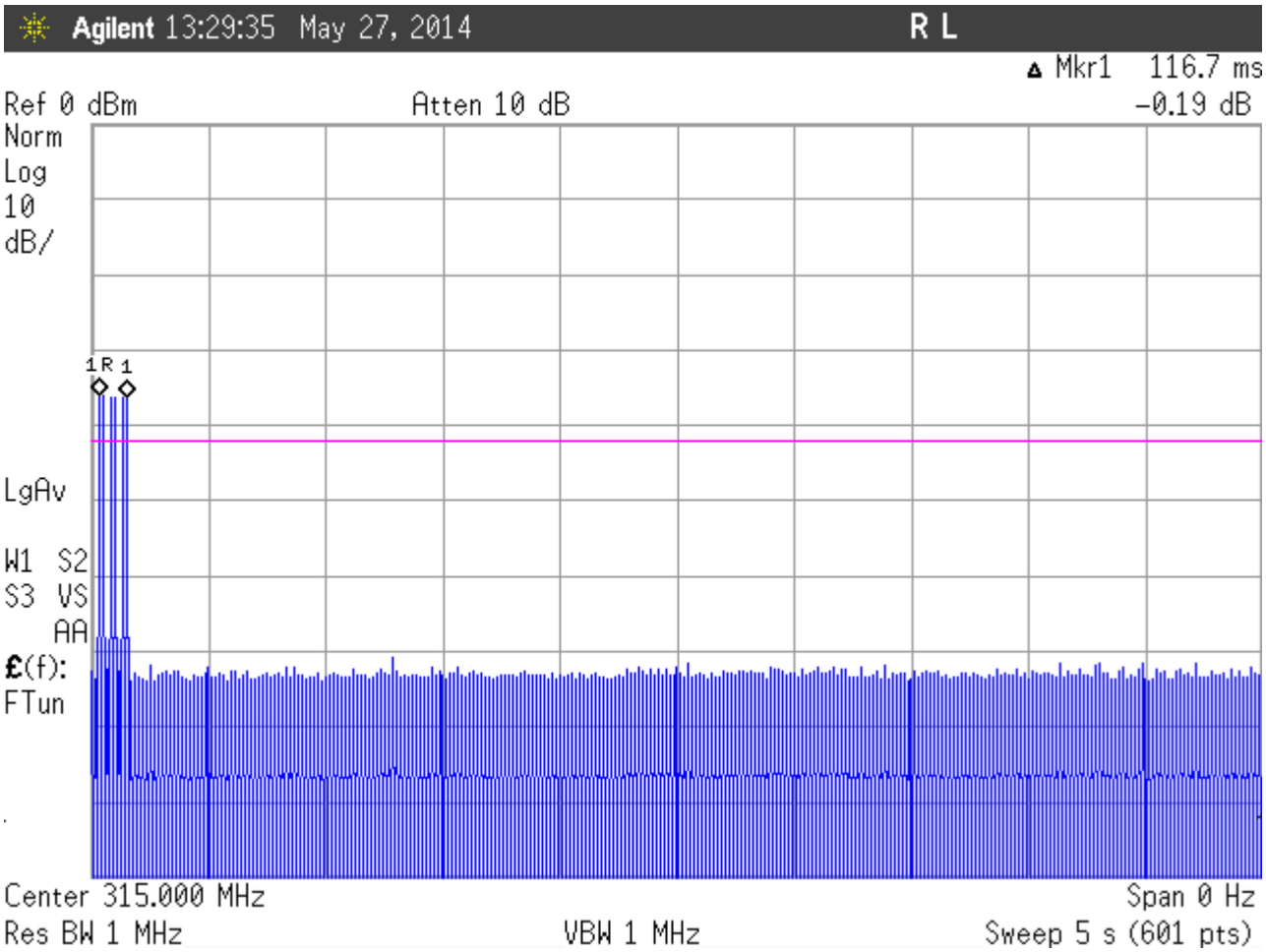


**Figure 4: EUT Turnoff Time**

 

## 4.3 FCC Part §15.231(a) (3) Compliance

Per FCC part 15.231 Paragraph (a)(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'*

The EUT transmits periodic data consisting of a two bit ping. The below figures show that the periodic signal on time equals 104µs per 201.4ms or 1.858 seconds per hour. As this is used in a personnel safety application this complies with this section.

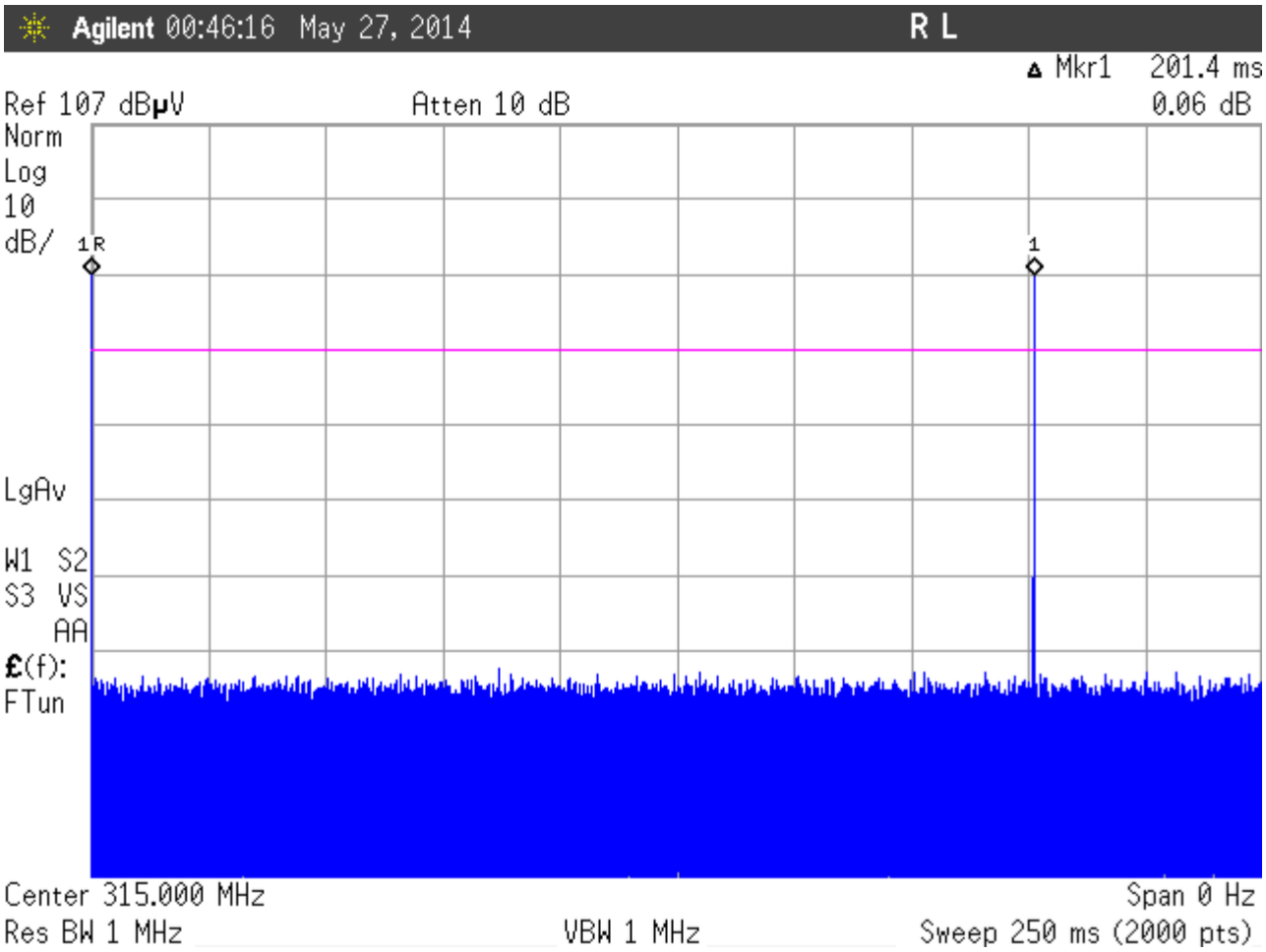


**Figure 5: Periodic Transmission Timing**

 

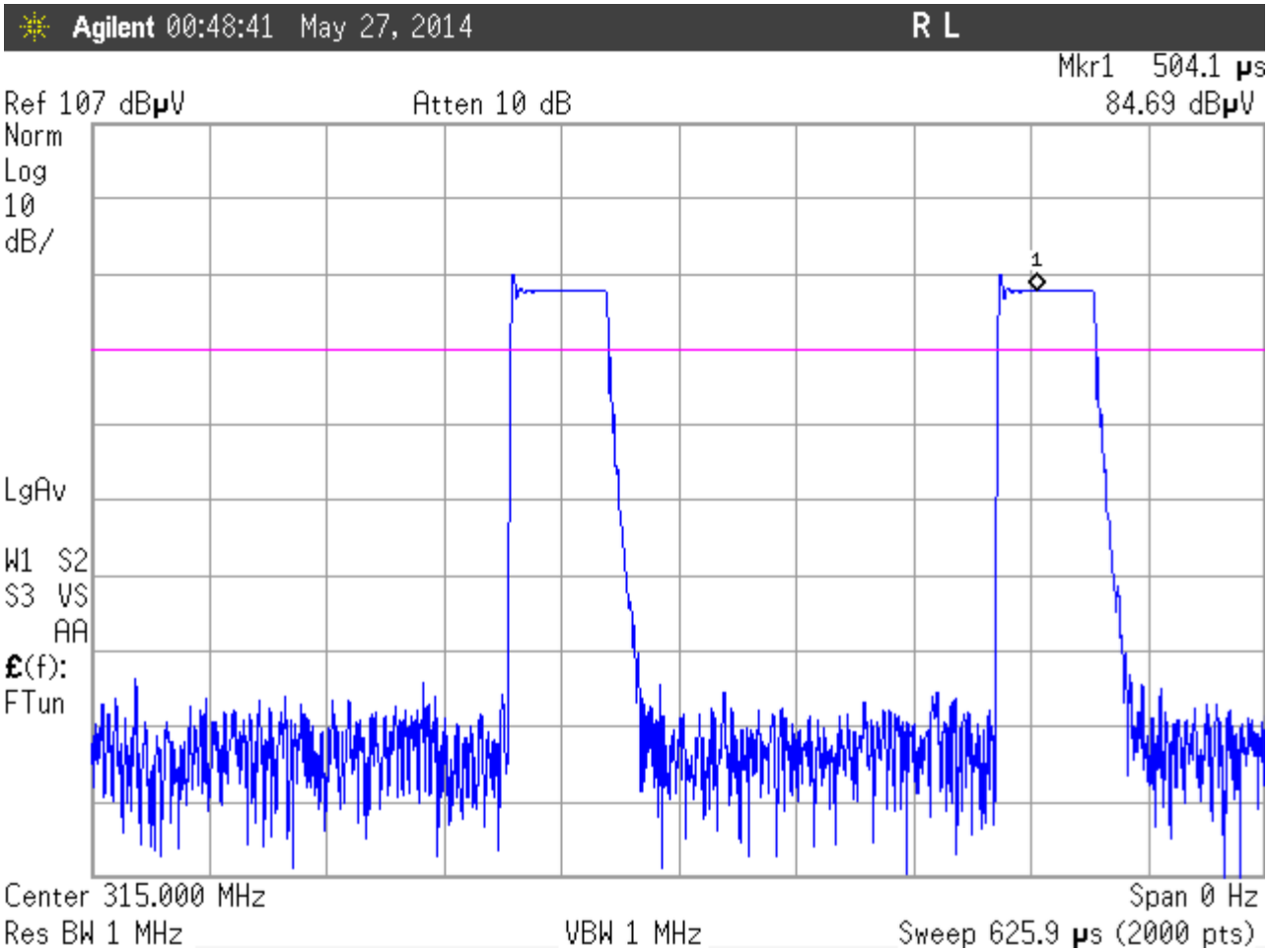


**Figure 6: Ping Pulse Time**

 

## 4.4 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

According to FCC Part 15.231 the Occupied bandwidth (20dB) shall be:

> *(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 a system operating at 315MHz the maximum 20dB bandwidth is 787.5kHz.

At full modulation, the occupied bandwidth was measured at 12.7kHz (as shown below):

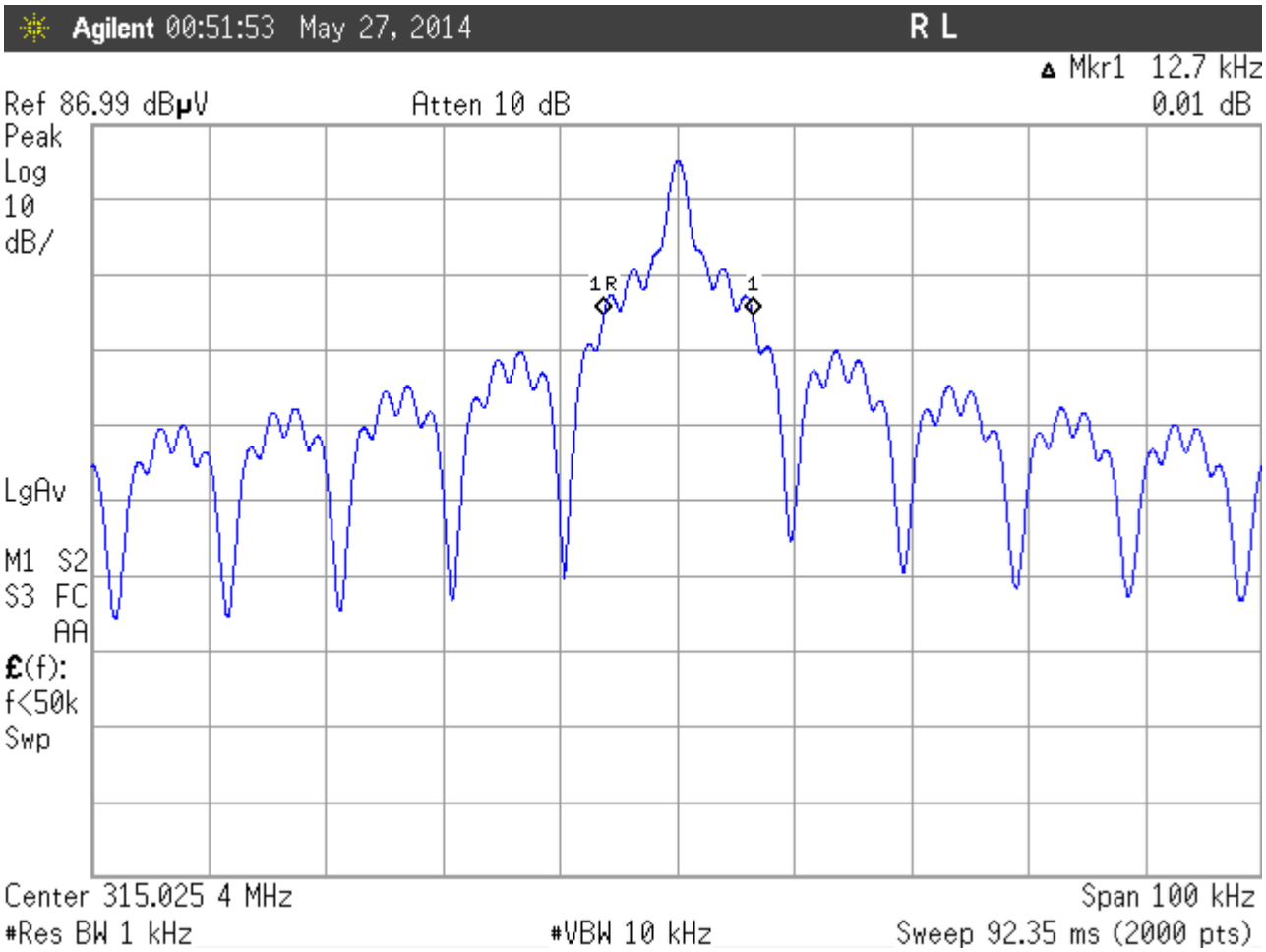


**Figure 7: Occupied Bandwidth**

 

## 4.5 Radiated Emissions: (FCC Part §2.1053)

The EUT must comply with the radiated emission limits of 15.231(a). The limits are as shown in the following table.

**Table 4: Radiated Emissions Limits**

| Fundamental Frequency (MHz) | Field Strength of Fundamental (µV/m) | Field Strength of Field strength of spurious emission (µV/m) |
|---|---|---|
| 40.66-40.70 | 2250 | 225 |
| 70-130 | 1250 | 125 |
| 130-174 | 1250 to 3750 | 125 to 375 |
| 174-260 | 3750 | 375 |
| 260-470 | 3750 to 12500 | 375 to 1250 |
| Above 470 | 12500 | 1250 |

Frequencies that fall in FCC part 15.205 restricted bands must be below part 15.209 limits within these bands.

In accordance with FCC part 15.35 when averaging is used the peak limit shall be 20 dB above the average limits.

### 4.5.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters.

In accordance with FCC part 15.35 averaging was performed by using a duty cycle correction subtracted from the peak reading. For this EUT a duty cycle correction of -18.6dB was calculated. The EUT was scanned from 30MHz to 3150MHz in both Vertical and horizontal antenna polarities.

The EUT was tested in 3 orthogonals with the worst case reported (fundamental frequency is reported in all orthogonals).

Non harmonic spurious emissions peaks were tested against the average limits for compliance (no duty cycle correction was used).

The emissions were measured using the following resolution bandwidths:

| Frequency Range | Resolution Bandwidth | Video Bandwidth |
|---|---|---|
| 30MHz-1000 MHz | 120kHz | >100 kHz |
| >1000 MHz | 1 MHz | 1MHz (Peak) |

Emissions were measured to the 10th harmonic of the transmit frequency. Worst case emission levels are reported.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.Sample Calculation:

Spectrum Analyzer Voltage (SA Level): V dBμV

Antenna Factor (Ant Corr): AFdB/m

Cable Loss Correction (Cable Corr): CCdB

Duty Cycle Correction (Average) DCCdB

Amplifier Gain: GdB

Electric Field (Corr Level): EdBμV/m = VdBμV + AFdB/m + CCdB + DCCdB - GdB

 

## Table 5: Radiated Emission Test Data, 315MHz (Fundamental)

| Frequency (MHz) | Polarity H/V | Azimuth (Degree) | Ant. Height (m) | SA Level (dBuV) | Corr Factors (dB) | Duty Cycle Correction | Corr. Level (uV/m) | Limit (uV/m) | Margin (dB) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **X Orthogonal** | | | | | | | | | | |
| 315.01 | V | 270.00 | 1.42 | 55.20 | 15.9 | 0.0 | 3569.1 | 60417.0 | -24.6 | Peak |
| 315.01 | V | 270.00 | 1.42 | 55.20 | 15.9 | -18.6 | 419.3 | 6041.7 | -23.2 | Average |
| 315.01 | H | 180.00 | 1.00 | 68.70 | 15.9 | 0.0 | 16887.1 | 60417.0 | -11.1 | Peak |
| 315.01 | H | 180.00 | 1.00 | 68.70 | 15.9 | -18.6 | 1984.1 | 6041.7 | -9.7 | Average |
| **Y Orthogonal** | | | | | | | | | | |
| 315.01 | V | 300.00 | 1.65 | 65.40 | 15.9 | 0.0 | 11549.3 | 60417.0 | -14.4 | Peak |
| 315.01 | V | 300.00 | 1.65 | 65.40 | 15.9 | -18.6 | 1356.9 | 6041.7 | -13.0 | Average |
| 315.00 | H | 45.00 | 1.26 | 65.90 | 15.9 | 0.0 | 12233.3 | 60417.0 | -13.9 | Peak |
| 315.00 | H | 45.00 | 1.26 | 65.90 | 15.9 | -18.6 | 1437.3 | 6041.7 | -12.5 | Average |
| **Z Orthogonal** | | | | | | | | | | |
| 315.01 | V | 270.00 | 1.45 | 58.45 | 15.9 | 0.0 | 5188.7 | 60417.0 | -21.3 | Peak |
| 315.01 | V | 270.00 | 1.45 | 58.45 | 15.9 | -18.6 | 609.6 | 6041.7 | -19.9 | Average |
| 315.00 | H | 180.00 | 1.00 | 66.10 | 15.9 | 0.0 | 12518.3 | 60417.0 | -13.7 | Peak |
| 315.00 | H | 180.00 | 1.00 | 66.10 | 15.9 | -18.6 | 1470.8 | 6041.7 | -12.3 | Average |

 

## Table 6: Radiated Emission Test Data, Spurious Emissions

| Frequency (MHz) | Polarity H/V | Azimuth (Degree) | Ant. Height (m) | SA Level (dBuV) | Corr Factors (dB) | Duty Cycle Correction | Corr. Level (uV/m) | Limit (uV/m) | Margin (dB) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 630.00 | V | 250.00 | 1.30 | 27.80 | 22.2 | 0.0 | 316.9 | 6041.7 | -25.6 | Peak |
| 630.00 | V | 250.00 | 1.30 | 27.80 | 22.2 | -18.6 | 37.2 | 604.2 | -24.2 | Average |
| 945.00 | V | 90.00 | 1.00 | 2.10 | 26.0 | 0.0 | 25.4 | 6041.7 | -47.5 | Peak |
| 945.00 | V | 90.00 | 1.00 | 2.10 | 26.0 | -18.6 | 3.0 | 604.2 | -46.1 | Average |
| 1260.00 | V | 270.00 | 2.70 | 56.10 | -21.5 | 0.0 | 53.6 | 6041.7 | -41.0 | Peak |
| 1260.00 | V | 270.00 | 2.70 | 56.10 | -21.5 | -18.6 | 6.3 | 604.2 | -39.6 | Average |
| 1575.00 | V | 265.00 | 2.04 | 59.90 | -21.5 | 0.0 | 83.5 | 6041.7 | -37.2 | Peak |
| 1575.00 | V | 265.00 | 2.04 | 59.90 | -21.5 | -18.6 | 9.8 | 604.2 | -35.8 | Average |
| 1890.00 | V | 180.00 | 2.00 | 55.00 | -19.8 | 0.0 | 57.6 | 6041.7 | -40.4 | Peak |
| 1890.00 | V | 180.00 | 2.00 | 55.00 | -19.8 | -18.6 | 6.8 | 604.2 | -39.0 | Average |
| 2205.00 | V | 180.00 | 2.00 | 55.70 | -17.5 | 0.0 | 81.5 | 6041.7 | -37.4 | Peak |
| 2205.00 | V | 180.00 | 2.00 | 55.70 | -17.5 | -18.6 | 9.6 | 604.2 | -36.0 | Average |
| 2520.00 | V | 180.00 | 2.00 | 46.45 | -16.3 | 0.0 | 32.1 | 6041.7 | -45.5 | Peak |
| 2520.00 | V | 180.00 | 2.00 | 46.45 | -16.3 | -18.6 | 3.8 | 604.2 | -44.1 | Average |
| 2835.00 | V | 275.00 | 1.80 | 56.75 | -15.5 | 0.0 | 116.0 | 6041.7 | -34.3 | Peak |
| 2835.00 | V | 275.00 | 1.80 | 56.75 | -15.5 | -18.6 | 13.6 | 604.2 | -32.9 | Average |
| 3150.00 | V | 0.00 | 1.80 | 55.00 | -13.4 | 0.0 | 120.0 | 6041.7 | -34.0 | Peak |
| 3150.00 | V | 0.00 | 1.80 | 55.00 | -13.4 | -18.6 | 14.1 | 604.2 | -32.6 | Average |
| | | | | | | | | | | |
| 630.00 | H | 250.00 | 2.00 | 30.00 | 22.2 | 0.0 | 408.2 | 6041.7 | -23.4 | Peak |
| 630.00 | H | 250.00 | 2.00 | 30.00 | 22.2 | -18.6 | 48.0 | 604.2 | -22.0 | Average |
| 945.00 | H | 270.00 | 1.00 | 4.10 | 26.0 | 0.0 | 32.0 | 6041.7 | -45.5 | Peak |
| 945.00 | H | 270.00 | 1.00 | 4.10 | 26.0 | -18.6 | 3.8 | 604.2 | -44.1 | Average |
| 1260.00 | H | 260.00 | 1.66 | 58.56 | -21.5 | 0.0 | 71.2 | 6041.7 | -38.6 | Peak |
| 1260.00 | H | 260.00 | 1.66 | 58.56 | -21.5 | -18.6 | 8.4 | 604.2 | -37.2 | Average |
| 1575.00 | H | 0.00 | 1.88 | 53.88 | -21.5 | 0.0 | 41.7 | 6041.7 | -43.2 | Peak |
| 1575.00 | H | 0.00 | 1.88 | 53.88 | -21.5 | -18.6 | 4.9 | 604.2 | -41.8 | Average |
| 1890.00 | H | 10.00 | 1.80 | 53.77 | -19.8 | 0.0 | 50.0 | 6041.7 | -41.6 | Peak |
| 1890.00 | H | 10.00 | 1.80 | 53.77 | -19.8 | -18.6 | 5.9 | 604.2 | -40.2 | Average |
| 2205.00 | H | 15.00 | 1.80 | 54.00 | -17.5 | 0.0 | 67.0 | 6041.7 | -39.1 | Peak |
| 2205.00 | H | 15.00 | 1.80 | 54.00 | -17.5 | -18.6 | 7.9 | 604.2 | -37.7 | Average |
| 2520.00 | H | 45.00 | 1.70 | 52.53 | -16.3 | 0.0 | 64.6 | 6041.7 | -39.4 | Peak |
| 2520.00 | H | 45.00 | 1.70 | 52.53 | -16.3 | -18.6 | 7.6 | 604.2 | -38.0 | Average |
| 2835.00 | H | 90.00 | 1.88 | 57.00 | -15.5 | 0.0 | 119.4 | 6041.7 | -34.1 | Peak |
| 2835.00 | H | 90.00 | 1.88 | 57.00 | -15.5 | -18.6 | 14.0 | 604.2 | -32.7 | Average |
| 3150.00 | H | 355.00 | 1.80 | 54.20 | -13.4 | 0.0 | 109.5 | 6041.7 | -34.8 | Peak |
| 3150.00 | H | 355.00 | 1.80 | 54.20 | -13.4 | -18.6 | 12.9 | 604.2 | -33.4 | Average |

 

## 4.6 Conducted Emissions (AC Power Line)

As this unit is only powered from in internal battery, Power mains testing is not required.

## 4.7 Receiver Emissions

As the receiver associated with this transmitter is a separate unit and is filed under a separate report.