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FCC Certification Test Report

FCCID: OYE-MEL916

MILLER EDGE

MEL-TX70

WLL REPORT# **13470-01 Rev 2**
June 2, 2014
Revised August 27, 2014

Prepared for:

Miller Edge
300 N Jennersville Road
West Grove, PA 19390

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

Testing Certificate AT-1448

FCC Certification Test Report

For the
MILLER EDGE
MEL-TX70

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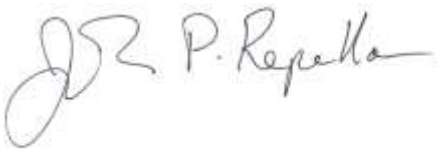
Prepared by:

Steven Dovell
Compliance Engineer

Reviewed by:



John P. Repella
EMC & Wireless Manager

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 15.249 (10/2013) of the FCC Rules. This Certification Test Report documents the test configuration and test results for Miller Edge MEL-TX70.

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. 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-TX70 complies with the limits for an Intentional Radiator device under FCC Part 15.249.

Revision History	Reason	Date
Rev 0	Initial Release	June 2, 2014
Rev 1	Corrected references to 916 MHz to 916.5MHz for fundamental. Corrected miss spellings	August 7, 2014 JR
Rev 2	Band edge compliance section added to end of report	August 27, 2014 JR

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1 Introduction

1.1 Compliance Statement

The Miller Edge MEL-TX70 complies with the limits for an Intentional Radiator device under FCC Part 15.249 (10/2013).

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed in accordance with FCC Public Notice DA 00-705 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 300 N Jennersville Road West Grove, PA 19390
Purchase Order Number:	Signed quotation serves as the PO
Quotation Number:	68102

1.4 Test Dates

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

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell
Customer Representative	Bill 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 MEL transmitter is a safety device that is normally mounted on an unattended, automated door and is connected to a sensing edge mounted on the lower edge of the door to detect inadvertent contact with any obstacle (person, vehicll, etc.) while the door is closing. Upon contact, the MEL transmitter immediately transmits a signal to the MEL receiver, which is mounted near and connected to the door's operator/motor, to stop and reverse the door's motion. A failure of the RF link is sensed by the receiever (no "pings" receieved) which then also prevents the automated door from automatically closing.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Miller Edge
FCC ID:	OYE-MEL916
Model(s):	MEL-TX70
FCC Rule Parts:	§15.249
Frequency Range:	916.5MHz
Maximum Output Power:	19792.60 µV/m @ 3 meters)
Modulation:	OOK
Occupied Bandwidth:	12.5kHz
Keying:	Automatic, manual
Type of Information:	Control, alarm
Number of Channels:	1
Power Output Level	Fixed
Antenna Connector	none
Antenna Type	Internal ¼ wave
Interface Cables:	(4) wires: 2-safety edge N/O sensing, 2-knockout N/O sensing
Power Source & Voltage:	(2) 1.5V AA Lithium Cells
TX Spurious	1212.9µV/m Peak @ 3 meters (2749.5 MHz) 141.9µV/m Average @ 3 meters (2749.5 MHz)

2.2 Test Configuration

The Miller Edge MEL-TX70 was configured with the 916.5MHz transmitter constantly on. A sample operating normally was used to determine the EUT duty cycle.

2.3 Testing Algorithm

The Miller Edge MEL-TX70 was programmed for continuous operation by switch settings and test code.

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

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-C)

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 (R2012) 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 Equation1 and Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

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

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

$k \leq 2$ 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

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

2.7 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: **05/28/2014**	
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

3 Test Results

3.1 Duty Cycle Correction

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

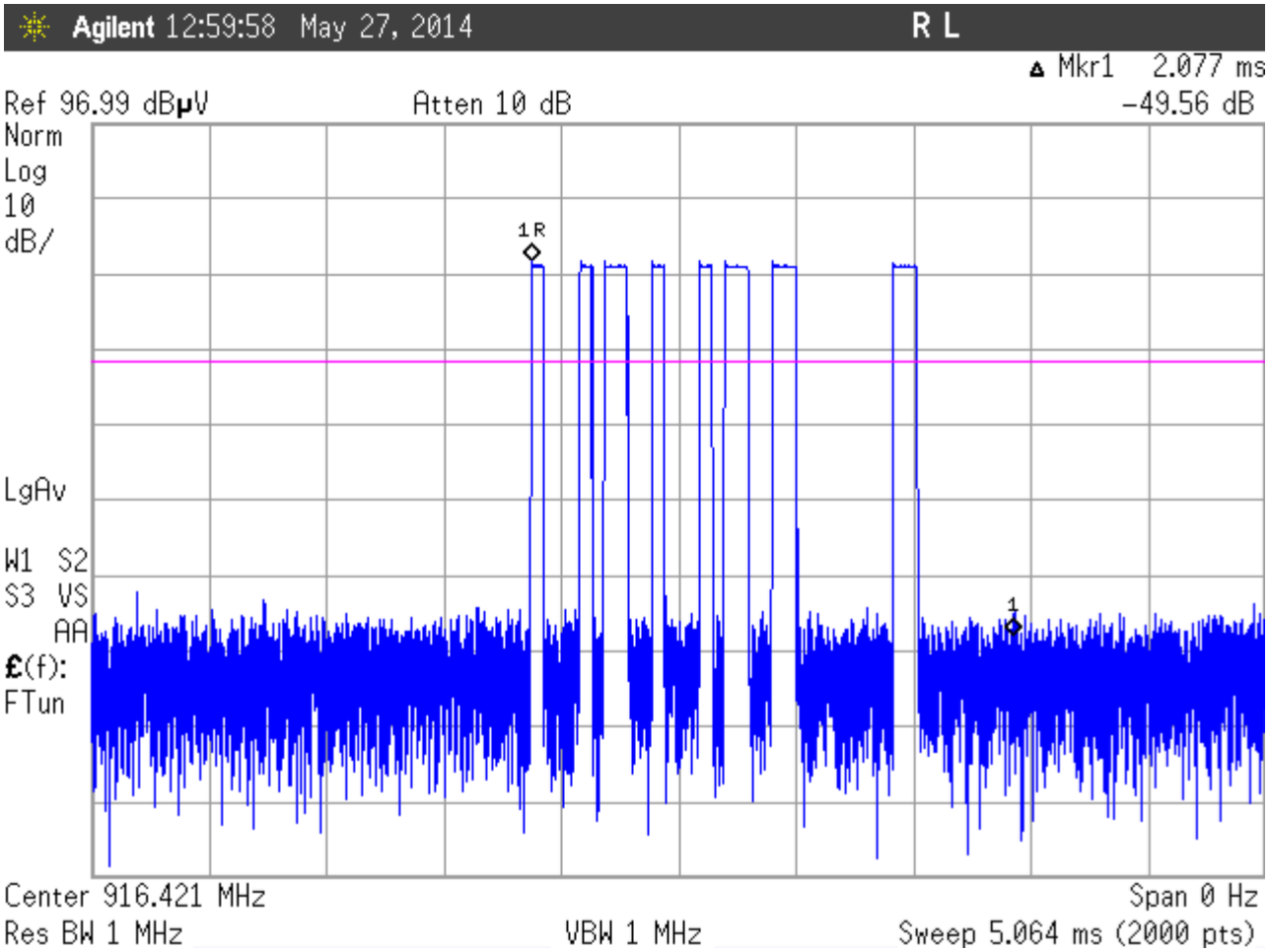

Figure 1: Duty Cycle (Typical Single Byte)

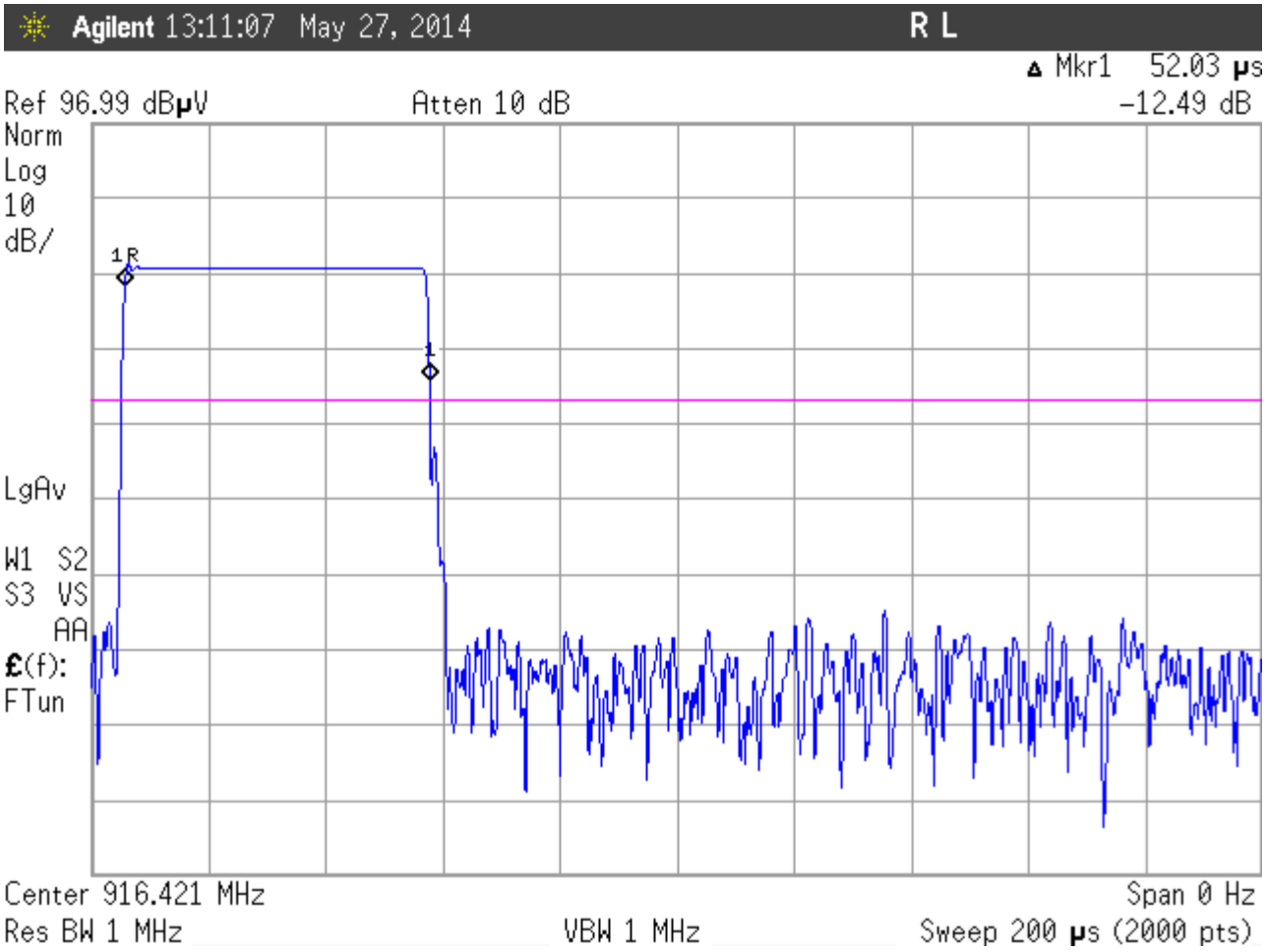

Figure 2: Duty Cycle (Typical Single Bit)

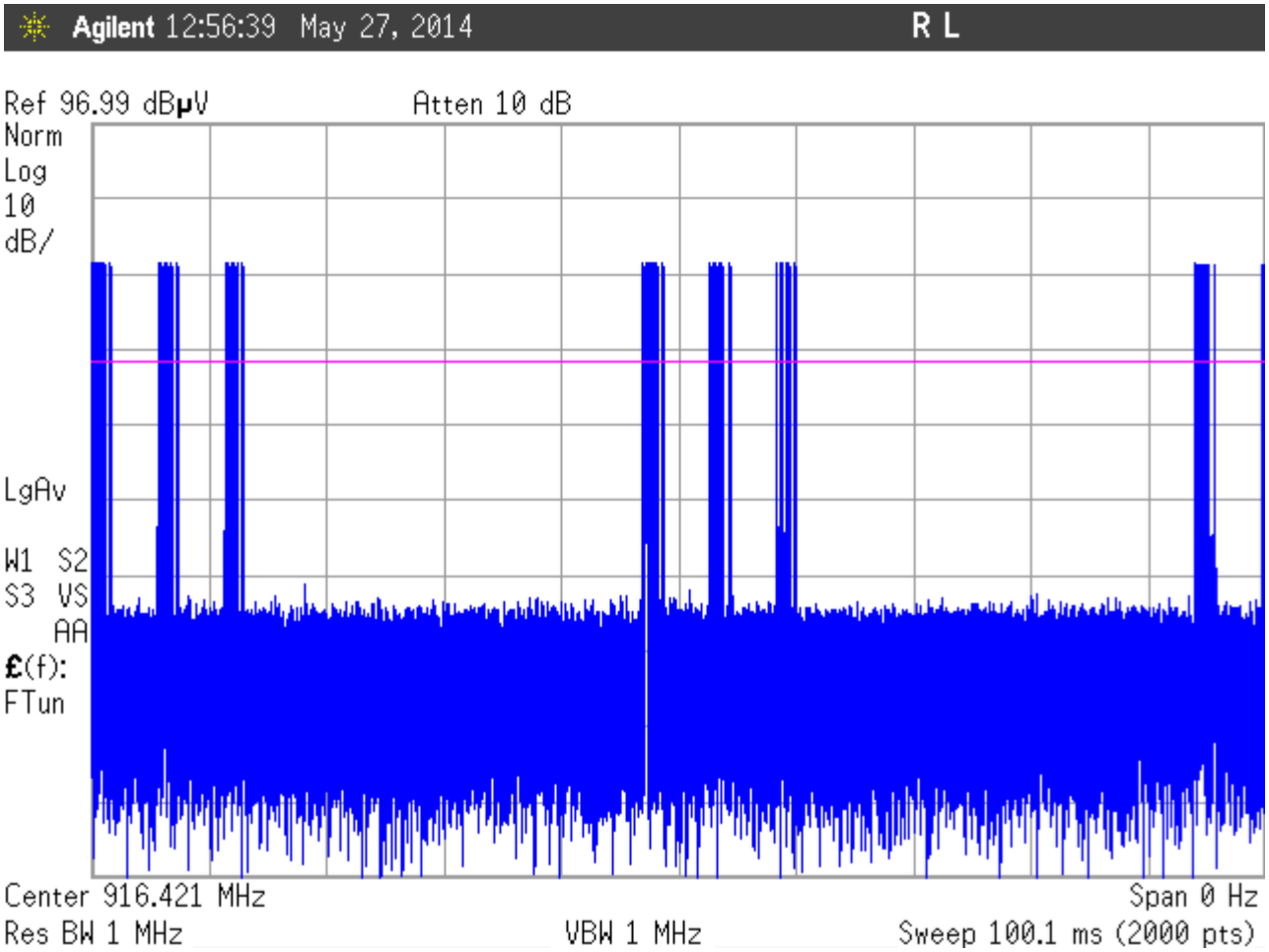

Figure 3: Duty Cycle (TX on time in 100ms)

3.2 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer. Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
916.5MHz	12.5kHz	N/A	Pass

At full modulation, the occupied bandwidth was measured as shown:

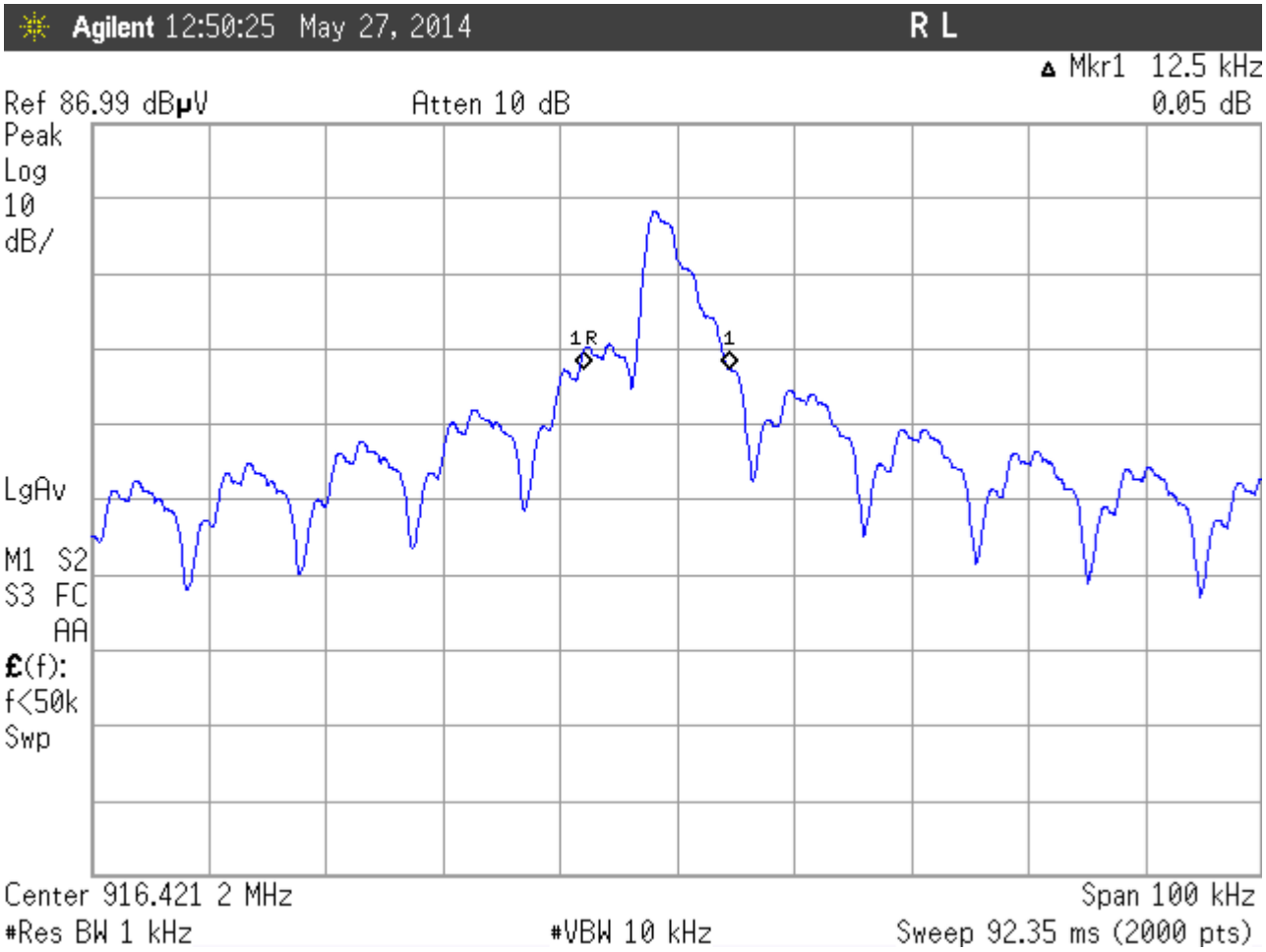

Figure 4: Occupied Bandwidth

3.3 Radiated Emissions: (FCC Part §2.10539)

The EUT must comply with the radiated emission limits of 15.249(a). The limits are as shown in the following table.

Table 5: Radiated Emissions Limits

Fundamental Frequency	Field Strength of Fundamental (µV/m)	Field Strength of Harmonics (µV/m)
902 – 928 MHz	50,000	500
2400 – 2483.5 MHz	50,000	500
5725 – 5875 MHz	50,000	500
24.00 – 24.25 GHz	250,000	2500

3.3.1 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. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. Readings under 1000MHz were performed using a Quasi-Peak Detector function. Average readings were calculated based on the peak reading minus the Duty Cycle correction.

The unit was examined in three orthogonals.

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 10^{th} 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 6: Radiated Emission Test Data (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
Z										
916.50	V	0.00	1.33	53.70	26.0	0.0	9694.0	50000.0	-14.2	Peak
X										
916.50	V	270.00	1.00	45.30	26.0	0.0	3685.6	50000.0	-22.6	Peak
Y										
916.50	V	180.00	1.00	41.10	26.0	0.0	2272.5	50000.0	-26.8	Peak
Z										
916.50	H	355.00	1.00	59.90	26.0	0.0	19792.6	50000.0	-8.0	Peak
X										
916.50	H	355.00	1.00	51.50	26.0	0.0	7524.9	50000.0	-16.4	Peak
Y										
916.50	H	355.00	1.00	51.50	26.0	0.0	7524.9	50000.0	-16.4	Peak

Table 7: Radiated Spurious Emission Test Data

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
1833.00	V	270.00	1.56	80.14	-20.3	0.0	982.2	5000.0	-14.1	Peak
1833.00	V	270.00	1.56	80.14	-20.3	-18.6	114.9	500.0	-12.8	Average
2749.50	V	270.00	1.56	76.00	-15.6	0.0	1041.9	5000.0	-13.6	Peak
2749.50	V	270.00	1.56	76.00	-15.6	-18.6	121.8	500.0	-12.3	Average
3666.00	V	95.00	1.80	58.55	-13.0	0.0	190.5	5000.0	-28.4	Peak
3666.00	V	95.00	1.80	58.55	-13.0	-18.6	22.3	500.0	-27.0	Average
4582.50	V	0.00	1.80	55.60	-9.7	0.0	197.8	5000.0	-28.1	Peak
4582.50	V	0.00	1.80	55.60	-9.7	-18.6	23.1	500.0	-26.7	Average
5499.00	V	180.00	1.55	54.90	-6.5	0.0	263.0	5000.0	-25.6	Peak
5499.00	V	180.00	1.55	54.90	-6.5	-18.6	30.8	500.0	-24.2	Average
6415.50	V	350.00	1.50	54.90	-4.3	0.0	340.1	5000.0	-23.3	Peak
6415.50	V	350.00	1.50	54.90	-4.3	-18.6	39.8	500.0	-22.0	Average
7332.00	V	85.00	1.50	53.10	0.7	0.0	487.7	5000.0	-20.2	Peak
7332.00	V	85.00	1.50	53.10	0.7	-18.6	57.0	500.0	-18.9	Average
8248.50	V	0.00	1.50	48.00	1.9	0.0	313.7	5000.0	-24.0	Peak
8248.50	V	0.00	1.50	48.00	1.9	-18.6	36.7	500.0	-22.7	Average
9165.00	V	0.00	1.50	48.00	3.3	0.0	367.4	5000.0	-22.7	Peak
9165.00	V	0.00	1.50	48.00	3.3	-18.6	43.0	500.0	-21.3	Average
1833.00	H	250.00	1.56	74.18	-20.3	0.0	494.5	5000.0	-20.1	Peak
1833.00	H	250.00	1.56	74.18	-20.3	-18.6	57.8	500.0	-18.7	Average
2749.50	H	90.00	1.56	77.32	-15.6	0.0	1212.9	5000.0	-12.3	Peak
2749.50	H	90.00	1.56	77.32	-15.6	-18.6	141.8	500.0	-10.9	Average
3666.00	H	125.00	1.60	56.00	-13.0	0.0	142.0	5000.0	-30.9	Peak
3666.00	H	125.00	1.60	56.00	-13.0	-18.6	16.6	500.0	-29.6	Average
4582.50	H	45.00	1.38	52.00	-9.7	0.0	130.7	5000.0	-31.7	Peak
4582.50	H	45.00	1.38	52.00	-9.7	-18.6	15.3	500.0	-30.3	Average
5499.00	H	270.00	1.40	50.86	-6.5	0.0	165.2	5000.0	-29.6	Peak
5499.00	H	270.00	1.40	50.86	-6.5	-18.6	19.3	500.0	-28.3	Average
6415.50	H	180.00	1.40	50.00	-4.3	0.0	193.4	5000.0	-28.2	Peak
6415.50	H	180.00	1.40	50.00	-4.3	-18.6	22.6	500.0	-26.9	Average
7332.00	H	175.00	1.30	49.64	0.7	0.0	327.4	5000.0	-23.7	Peak
7332.00	H	175.00	1.30	49.64	0.7	-18.6	38.3	500.0	-22.3	Average
8248.50	H	45.00	1.30	48.00	1.9	0.0	313.7	5000.0	-24.0	Peak
8248.50	H	45.00	1.30	48.00	1.9	-18.6	36.7	500.0	-22.7	Average
9165.00	H	270.00	1.35	49.30	3.3	0.0	426.7	5000.0	-21.4	Peak
9165.00	H	270.00	1.35	49.30	3.3	-18.6	49.9	500.0	-20.0	Average

Note: No spurious emissions were noted below 1 GHz.

3.4 Radiated Band Edge Compliance

FCC Pt 15.249 (d) states "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."

The below plot shows that the emissions at the band edges are attenuated by > 55dB down from the peak fundamental reading. The display line in the plot shows the part 15.209 limit of 46dBuV/m (200uV/m). Readings were taken in a 100kHz RBW.

The EUT complies with this requirement at the band edges.

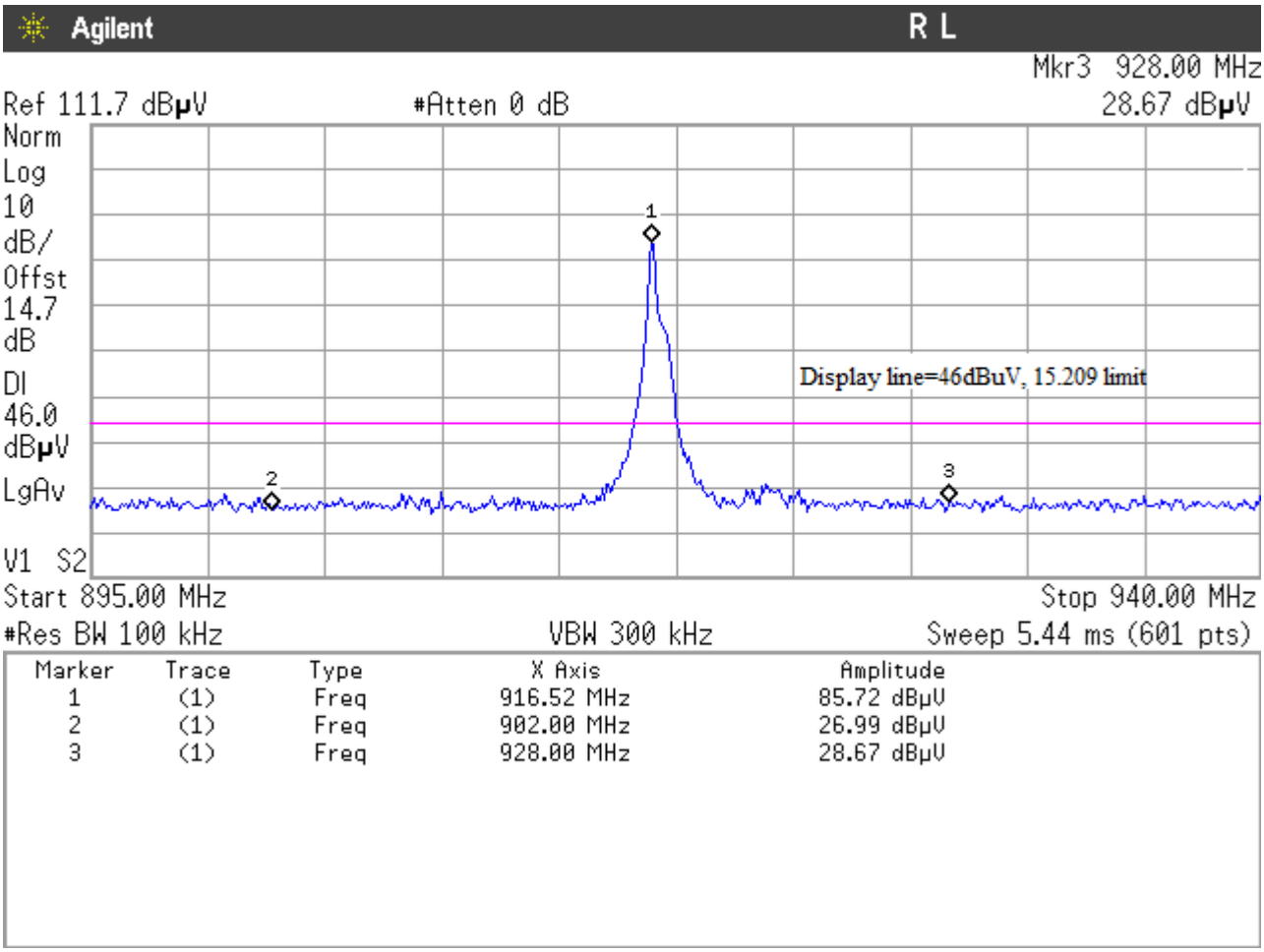

Figure 5: Radiated Band Edge Compliance

